M0012314B

SANMOTION

AC SERVO SYSTEMS

R

3E Model

TYPE S

Built-in Positioning Function Model

For Rotary Motor, Linear Motor

Instruction Manual

SANYO DENKI

Safety Precautions

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

■ Warning Symbol

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

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

■ Prohibited, Mandatory Symbols

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

Safety Precautions

■ Attention in use

⚠ Warning

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

⚠ Caution

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

■ Storage

Prohibited

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

Safety Precautions

Mandatory

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

■ Transportation

Caution

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

Mandatory

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

■ Installation

⚠ Caution

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

Safety Precautions

■ Wiring

⚠ Caution

- ◆ Wiring connections must be secure.
  Bodily injury could otherwise result.
- ◆ Wiring should be completed based on the Wiring Diagram or the User Manual.
  Electric shock or fire could otherwise result.
- ◆ Wiring should follow electric equipment technical standards and indoor wiring regulations.
  An electrical short or fire could otherwise result.
- ◆ Do not connect a commercial power supply to the U, V or W terminals of the servo motor.
  Fire or damage to the device could otherwise result.
- ◆ Install a safety device such as a breaker to prevent external wiring short-circuits.
  Fire could otherwise result.
- ◆ Do not bind or band the power cable, input/output signal cable and/or encoder cable together or pass through the same duct or conduit.
  This action will cause faulty operation.
- ◆ Must add the surge absorbing diode if inductive load as relay connect to the control signal output of the amplifier. Please take care of polarity of the diode that will be cause of failure.
- ◆ Do not connect 90 VDC or AC power to the 24 VDC Brake of the servo motor. Also, do not connect 400 VAC to the 200 VAC Fan of the servo motor.
  An electrical short or fire could otherwise result.
- ◆ Please design a sequence that included braking delay time because the surge-absorbing component for the relay of holding brake of the servo motor gives braking delay time.
  Injury or load falling could otherwise result.

Mandatory

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

■ Operation

⚠ Caution

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

Safety Precautions

Prohibited

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

Mandatory

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

■ Maintenance・Inspection

Caution

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

Prohibited

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

■ Disposal

Mandatory

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

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7. Digital Operator

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8. Maintenance

Refer the instruction manual for functions, M0012315.

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1 Preface

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

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1. Preface

1.1 Introduction

1.1.1 Product overview

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

The AC Servo amplifier “SANMOTION R” 3E Model has lineup of eight (8) models of consolidated power supply single-axis type and two (2) models of separated power supply model, ten (10) types capacity totally.

This product is corresponded the Rotary Motor R series, and allows using an absolute encoder and incremental encoder as motor encoder. It is also allows using an incremental encoder and Heidenhain-made absolute encoder (Endat 2.2) as external encoder of full-closed system. Battery for the motor encoder is able to mount by battery holder (provided optionally). Battery holder is two types such as attaching to the amplifier and attaching to the encoder cable.

Outer shape and mounting dimensions and each connector is compatible with "SANMOTION R" ADVANCED MODEL. And, communication with setup software (in PC) is corresponding USB (Full speed).

1.1.2 Features of "SANMOTION R" 3E Model

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

(1) Evolved

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

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

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

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

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

(2) Eco-Efficient

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

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

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

(3) Easy to use

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

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

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

1. Preface

1.1.3 Cautions for replacement from "SANMOTION R" ADVANCED MODEL

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

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

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

1.2 Instruction manual

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

Descriptions against servo amplifier are applied to power unit/amplifier unit also, when there is no specification.

1.2.1 Contents

- Chapter 1 Preface
  Product outline, model number, names of components

- Chapter 2 Specifications
  Detailed specifications for Servo Motor, Servo Amplifier and Motor Encoder

- Chapter 3 Installation
  Explanation of installation procedure

- Chapter 4 Wiring
  Illustrations and explanations of wiring

- Chapter 5 Linear motor
  Explanation of how to use with linear motor combination
  For explanation of how to use with rotary motor combination, refer the instruction manual for functions, M0012315.

- Chapter 6 Servo Tuning
  Explanation of servo adjustment as auto-tuning, manual tuning

- Chapter 7 Digital Operator
  For LED display and how to use the digital operator, refer the instruction manual for functions, M0012315.

- Chapter 8 Maintenance
  For the corrective action for alarm, and the inspection, refer the instruction manual for functions, M0012315.

- Chapter 9 Dedicated function
  Explanation of full-closed control and its how to use

- Chapter 10 Safe Torque Off function
  Explanation of Safe Torque Off function and its how to use

- Chapter 11 Selection
  Explanation of selection method for the servo motor and regenerative resistor capacity

- Chapter 12 Appendix
  Explanation of international standards, servo motor data sheets, dimensions and options

1. Preface

1.2.2 Precautions related to these instructions

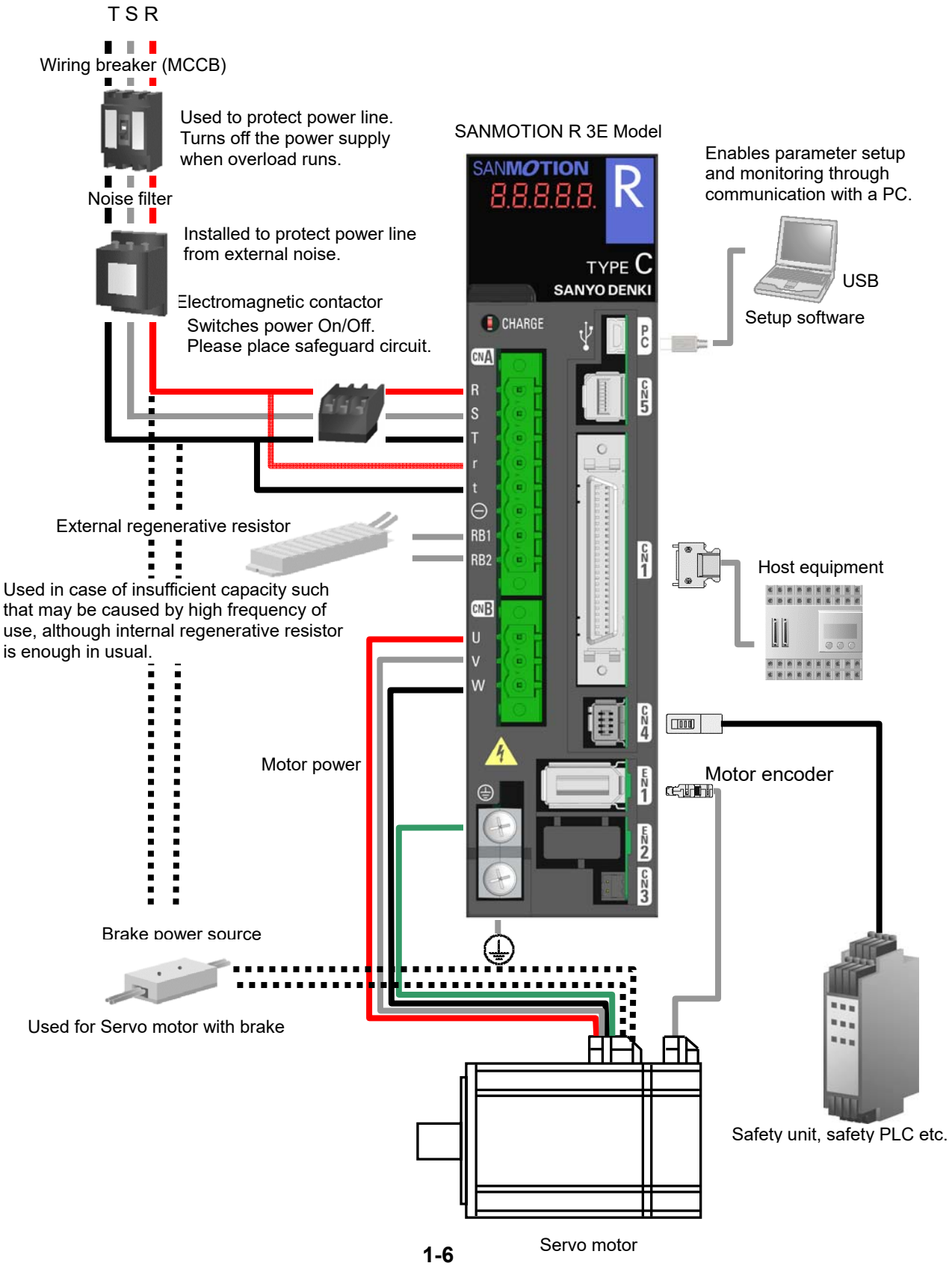
In order to fully understand the functions of this product, please read this instruction manual thoroughly before using the product. After thoroughly reading the manual, keep it handy for reference.
Carefully and completely follow the safety instructions outlined in this manual.
Note that safety is not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

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

1.3 Illustration of system components

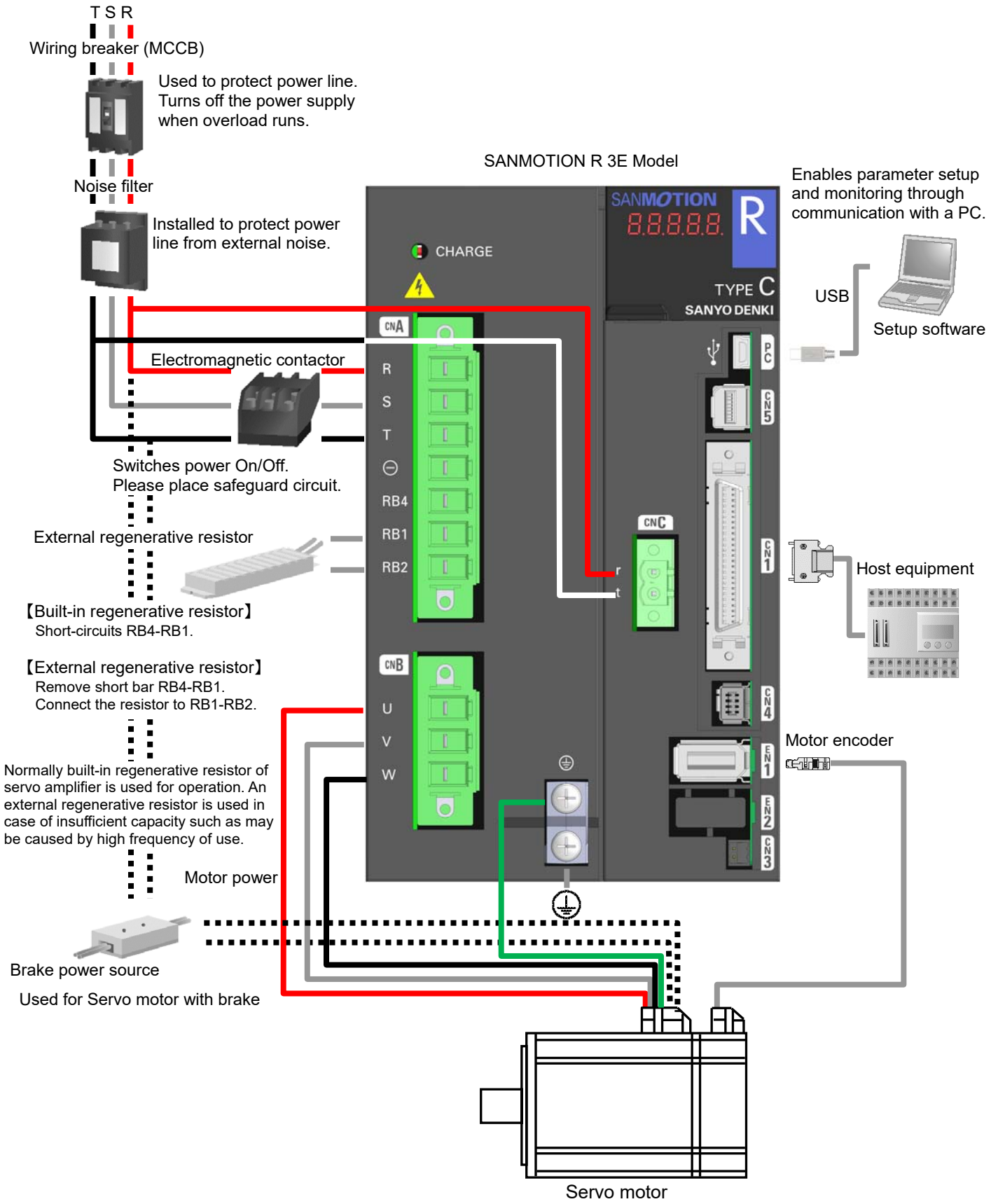
1.3.1 Illustration of system components [C: I/O]

■ RS3☐01/02/03/05



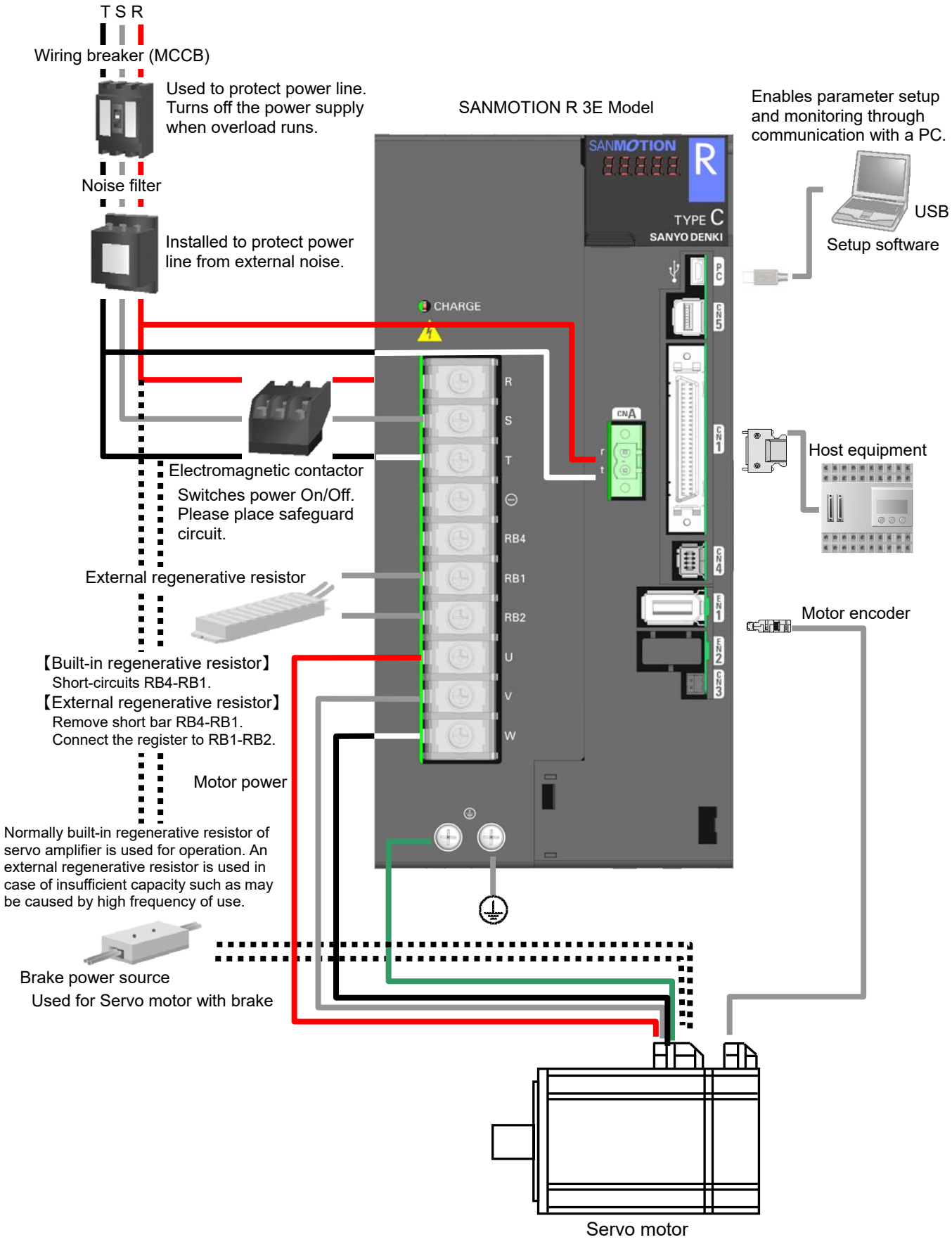
1. Preface

■ RS3A07

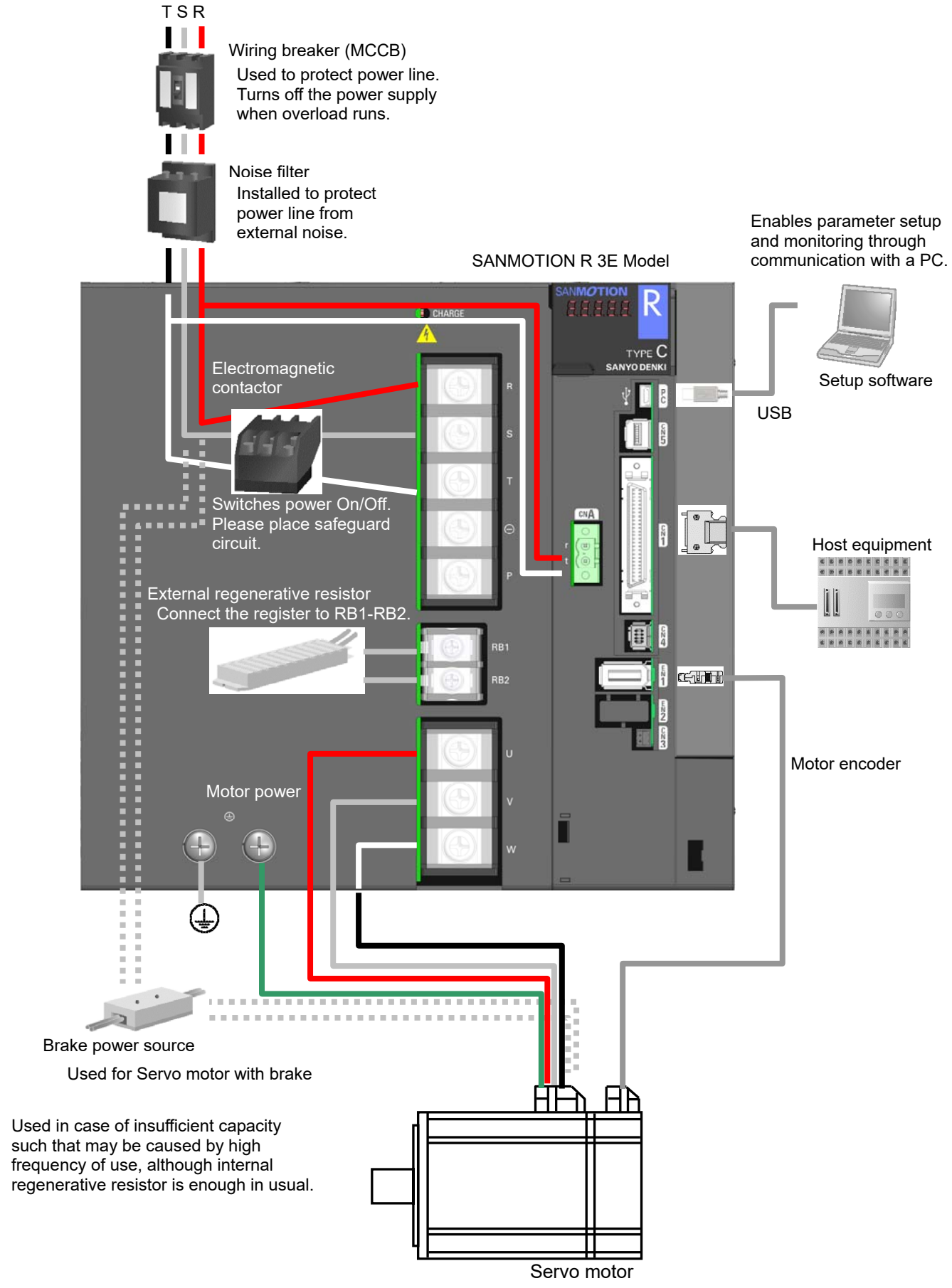


1.3 Illustration of system components

■ RS3A10/15

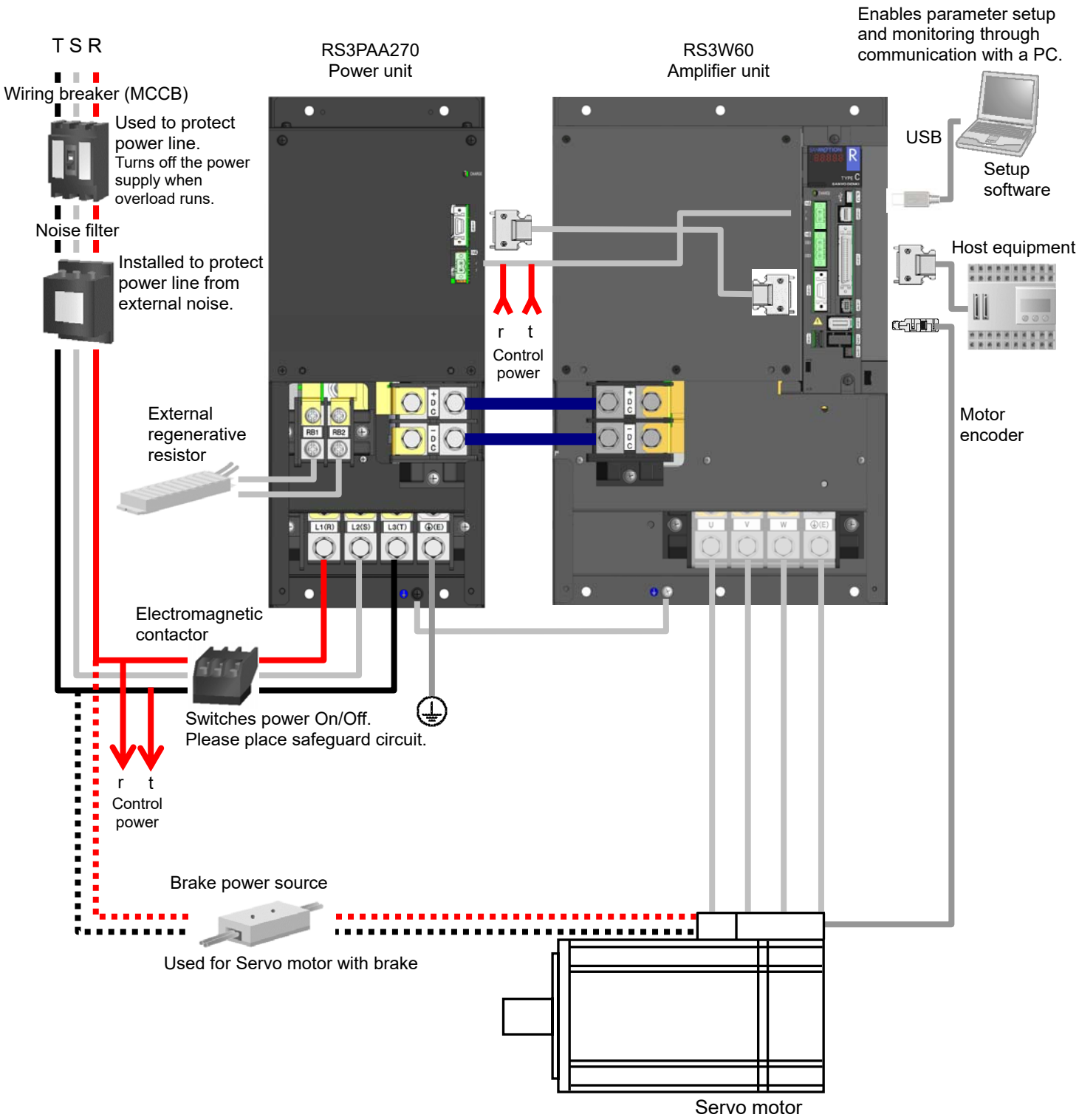


■ RS3A30

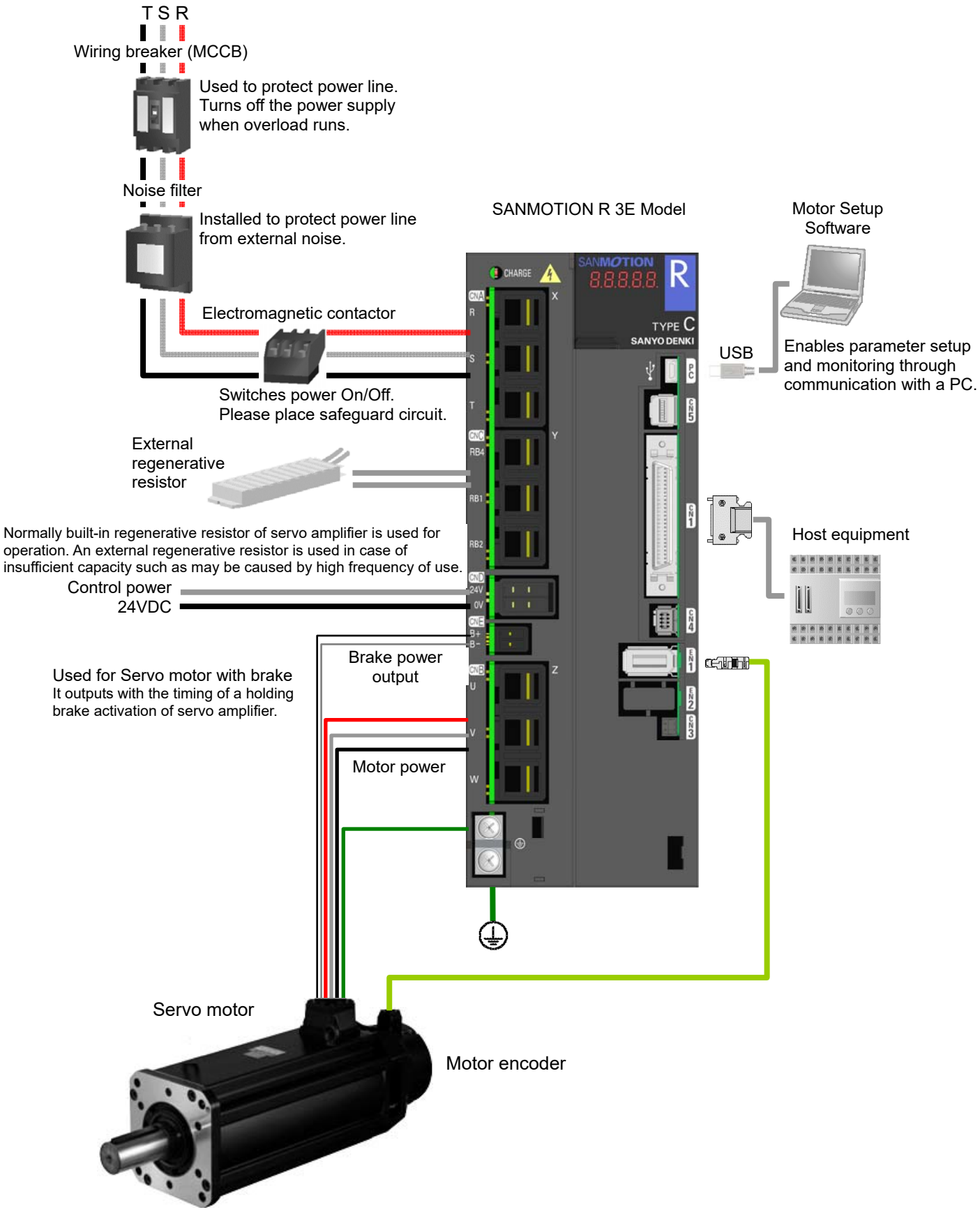

T S R
Wiring breaker (MCCB)
Used to protect power line.
Turns off the power supply
when overload runs.
Noise filter
Installed to protect
power line from
external noise.
SANMOTION R 3E Model
Enables parameter setup
and monitoring through
communication with a PC.
Setup software
USB
CHARGE
SANMOTION
TYPE C
SANYO DENKI
Electromagnetic
contactor
Switches power On/Off.
Please place safeguard
circuit.
External regenerative resistor
Connect the register to RB1-RB2.
Host equipment
Motor encoder
Motor power
Brake power source
Used for Servo motor with brake
Used in case of insufficient capacity
such that may be caused by high
frequency of use, although internal
regenerative resistor is enough in usual.
Servo motor

1.3 Illustration of system components

■ RS3W60

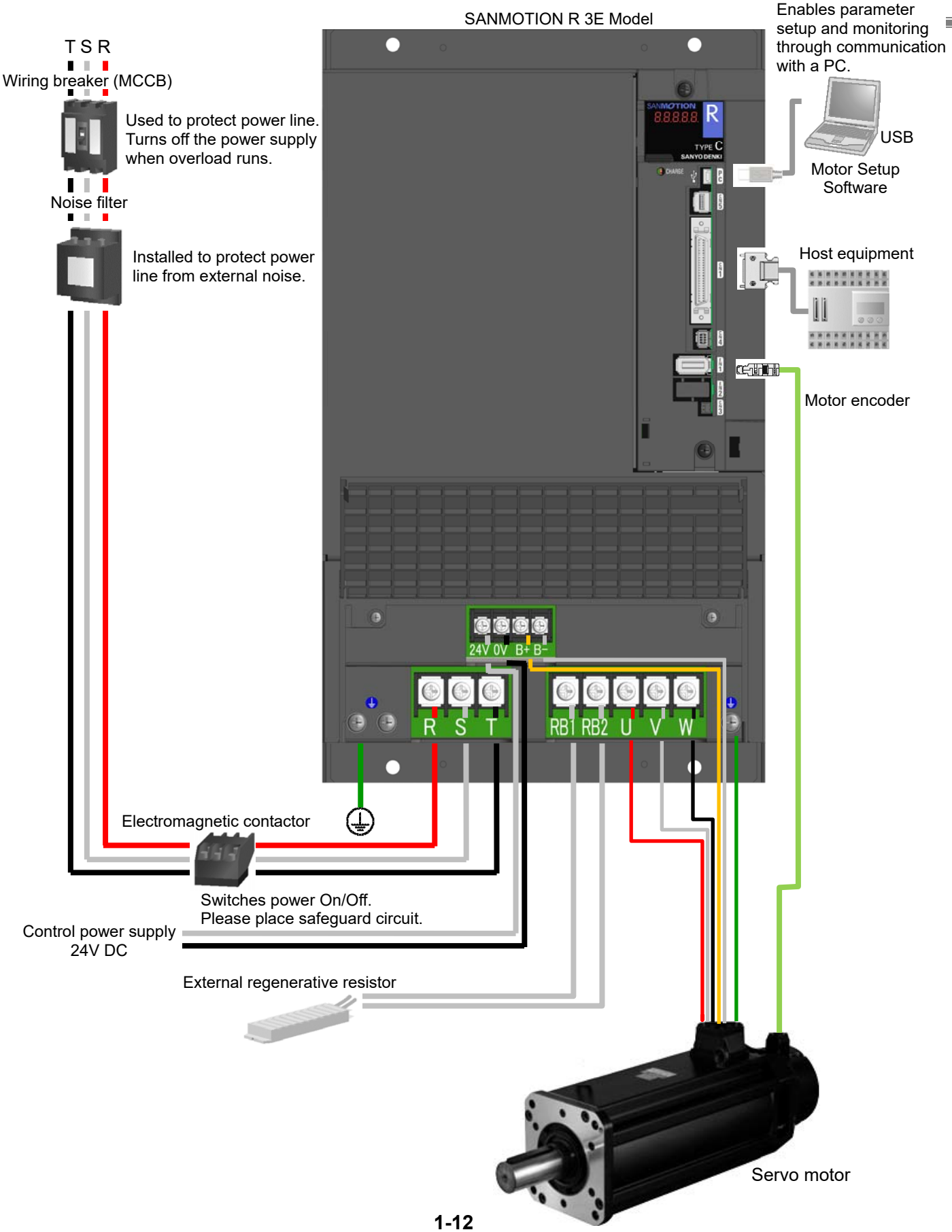


■ RS3C02/05/10


T S R
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
Normally built-in regenerative resistor of servo amplifier is used for operation. An external regenerative resistor is used in case of insufficient capacity such as may be caused by high frequency of use.
Control power
24VDC
Used for Servo motor with brake
It outputs with the timing of a holding brake activation of servo amplifier.
Brake power
output
Motor power
Servo motor
Motor encoder
SANMOTION R 3E Model
CHARGE
SANMOTION
TYPE C
SANYO DENKI
Motor Setup
Software
USB
Enables parameter setup
and monitoring through
communication with a PC.
Host equipment

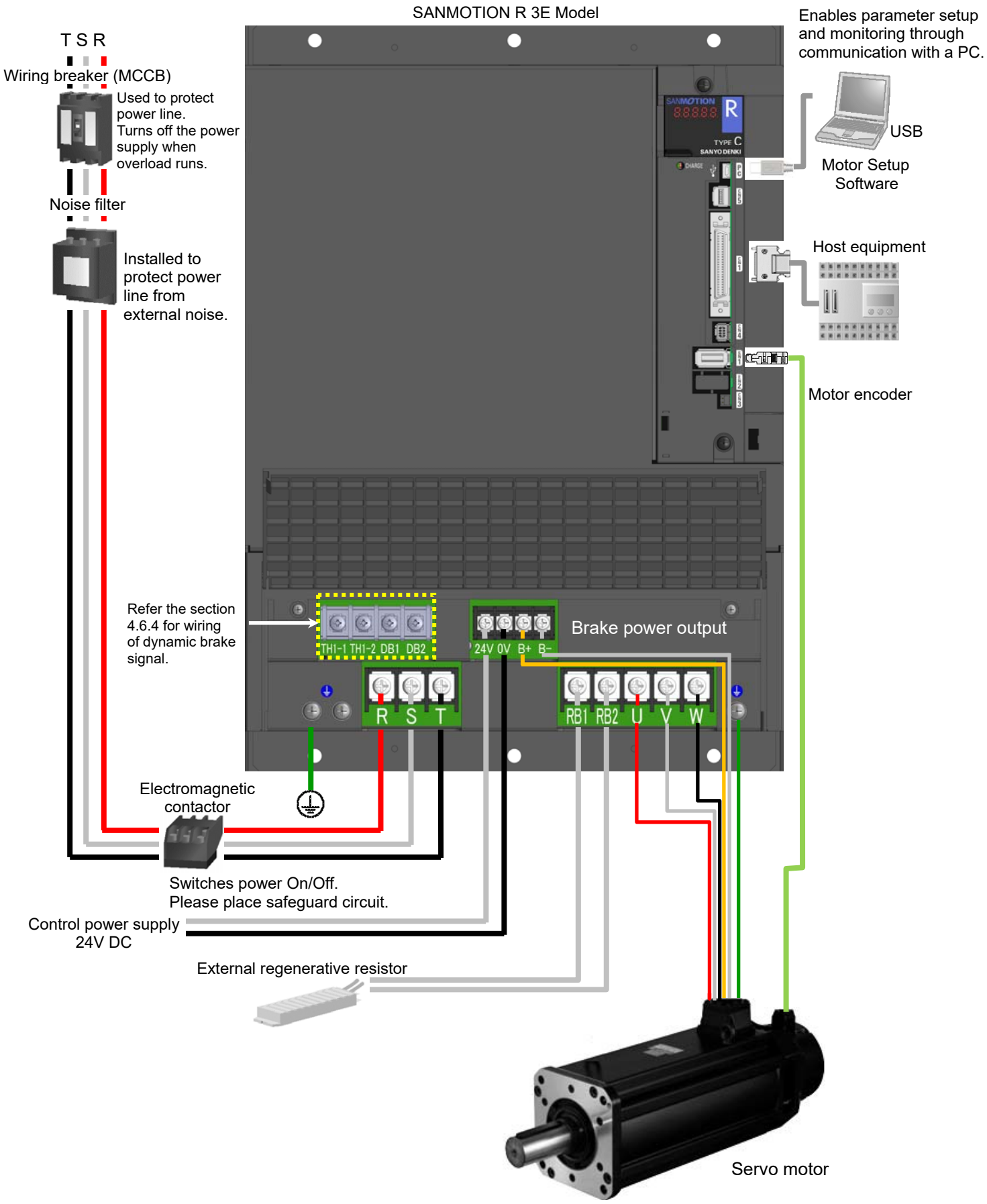
1.3 Illustration of system components

■ RS3C15



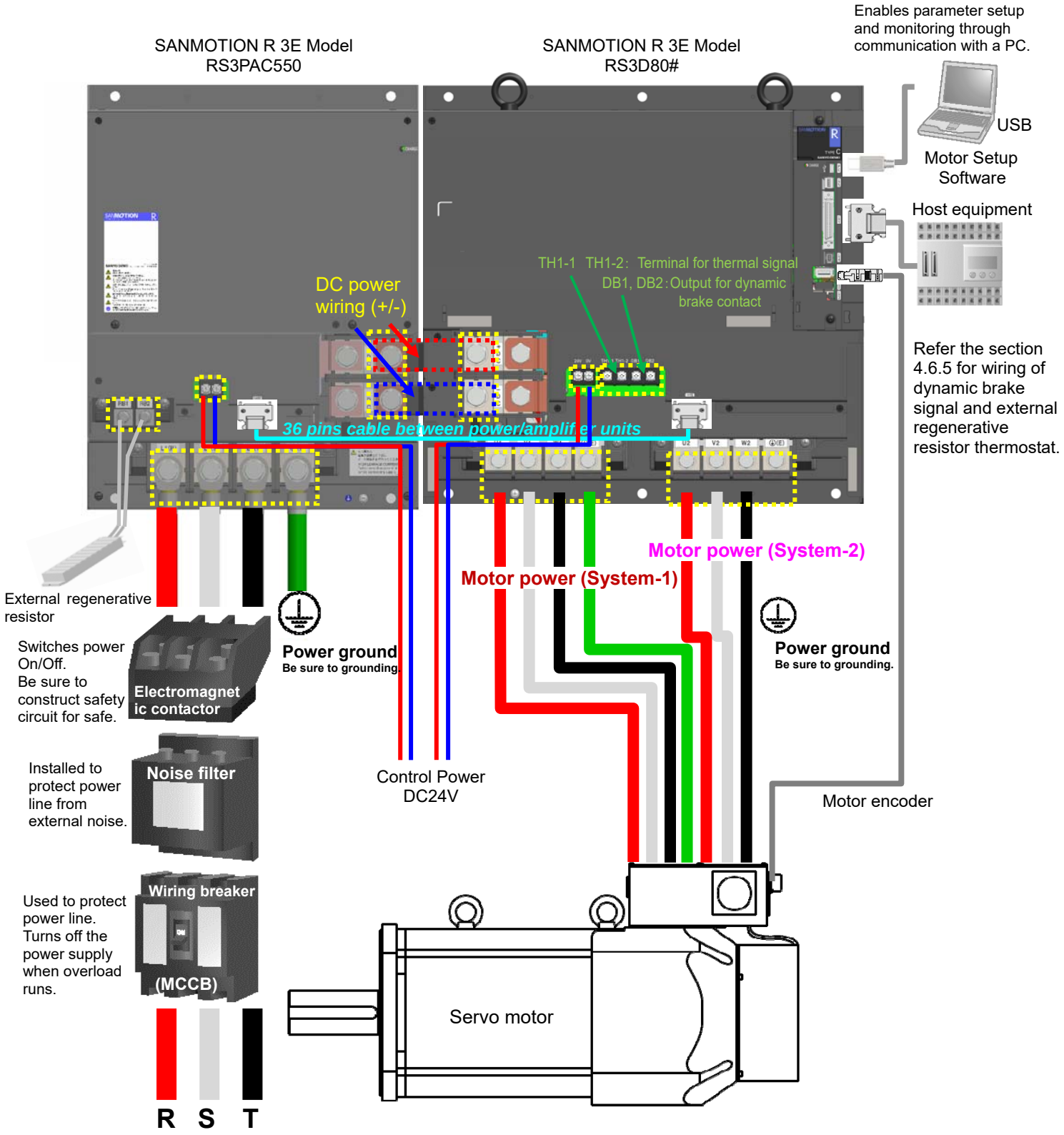
1. Preface

■ RS3C30



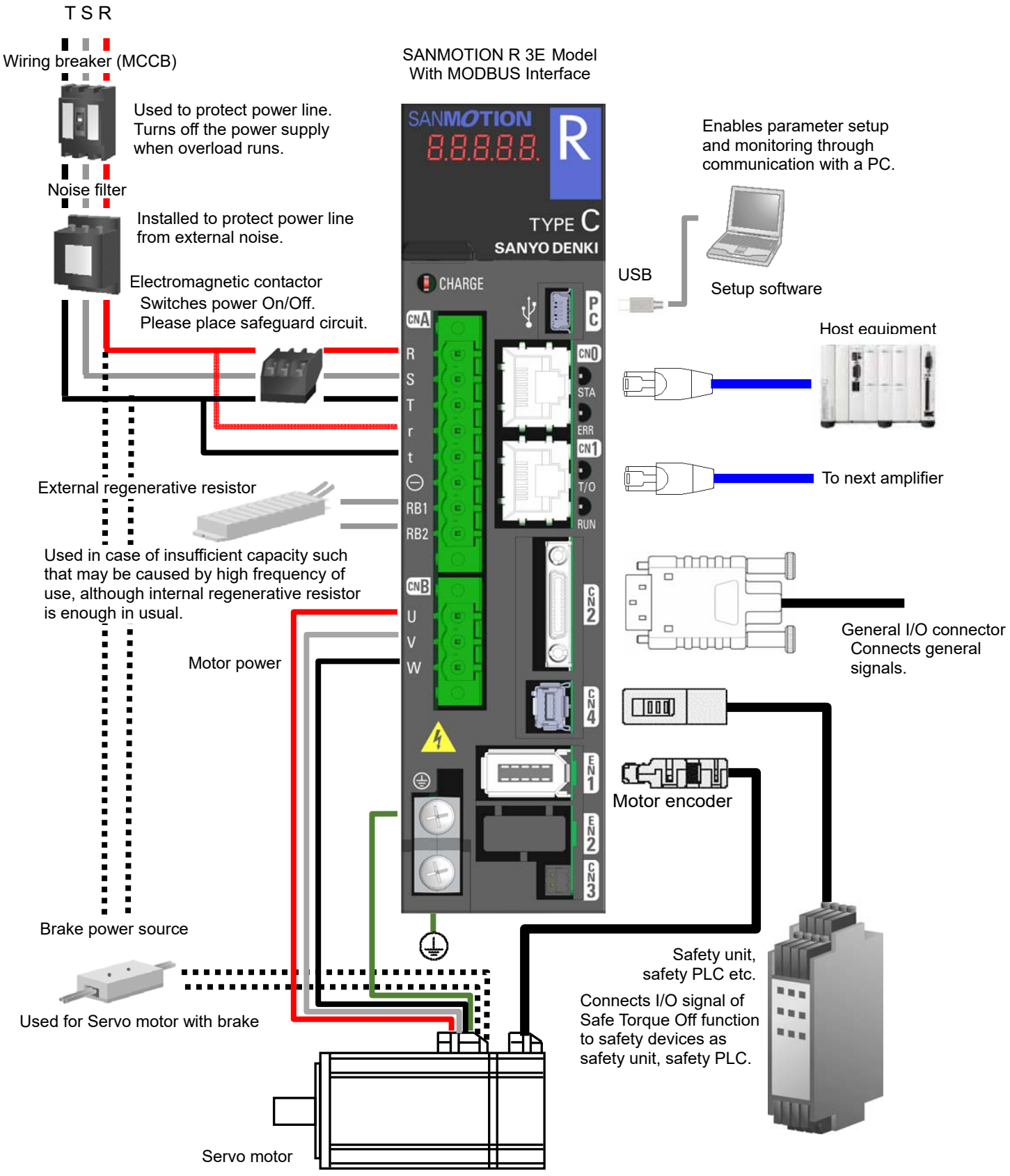
1.3 Illustration of system components

■ Power unit: RS3PAC550, Amplifier unit: RS3D80



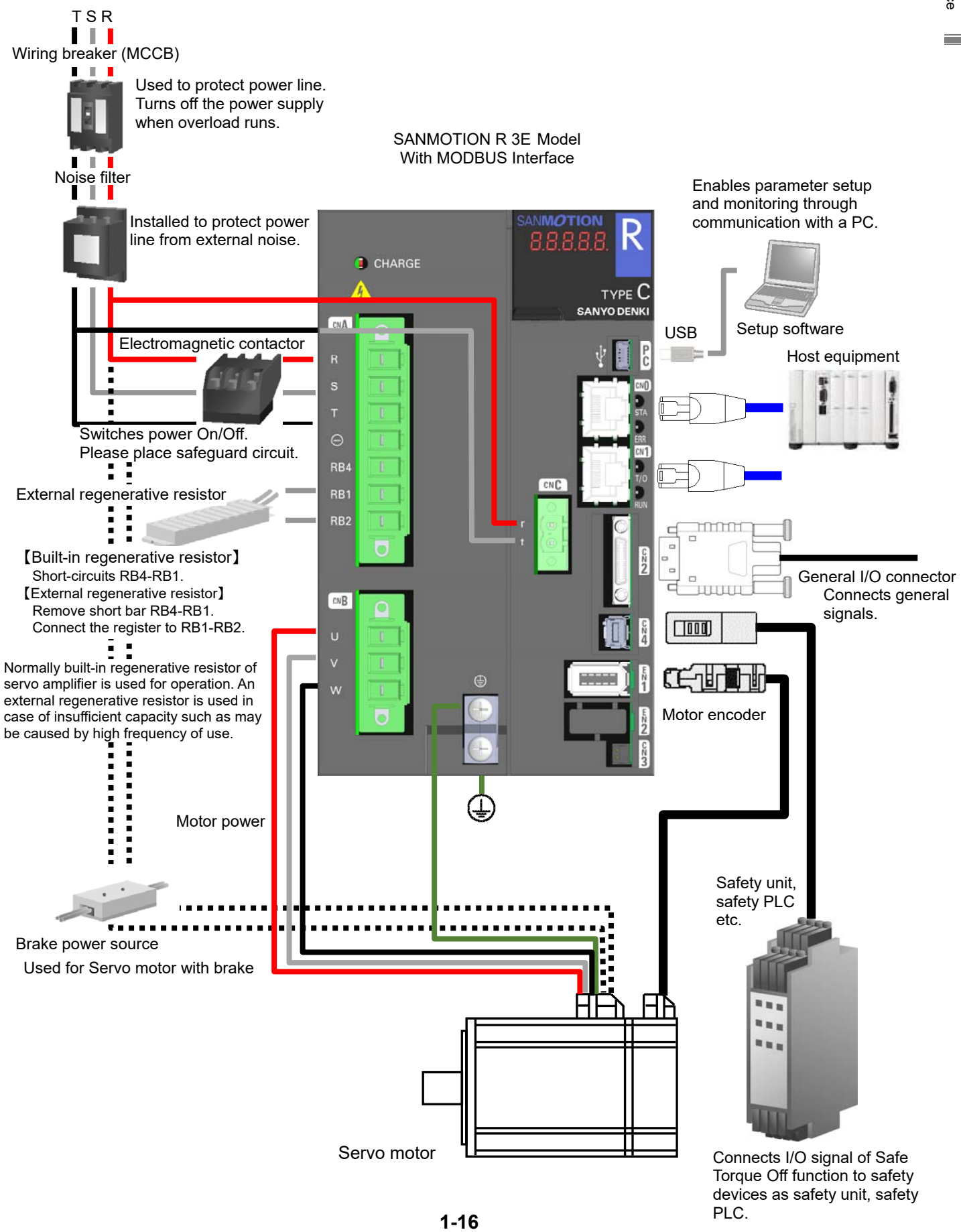
1.3.2 Illustration of system components [F: MODBUS]

■ RS3☐01/02/03/05



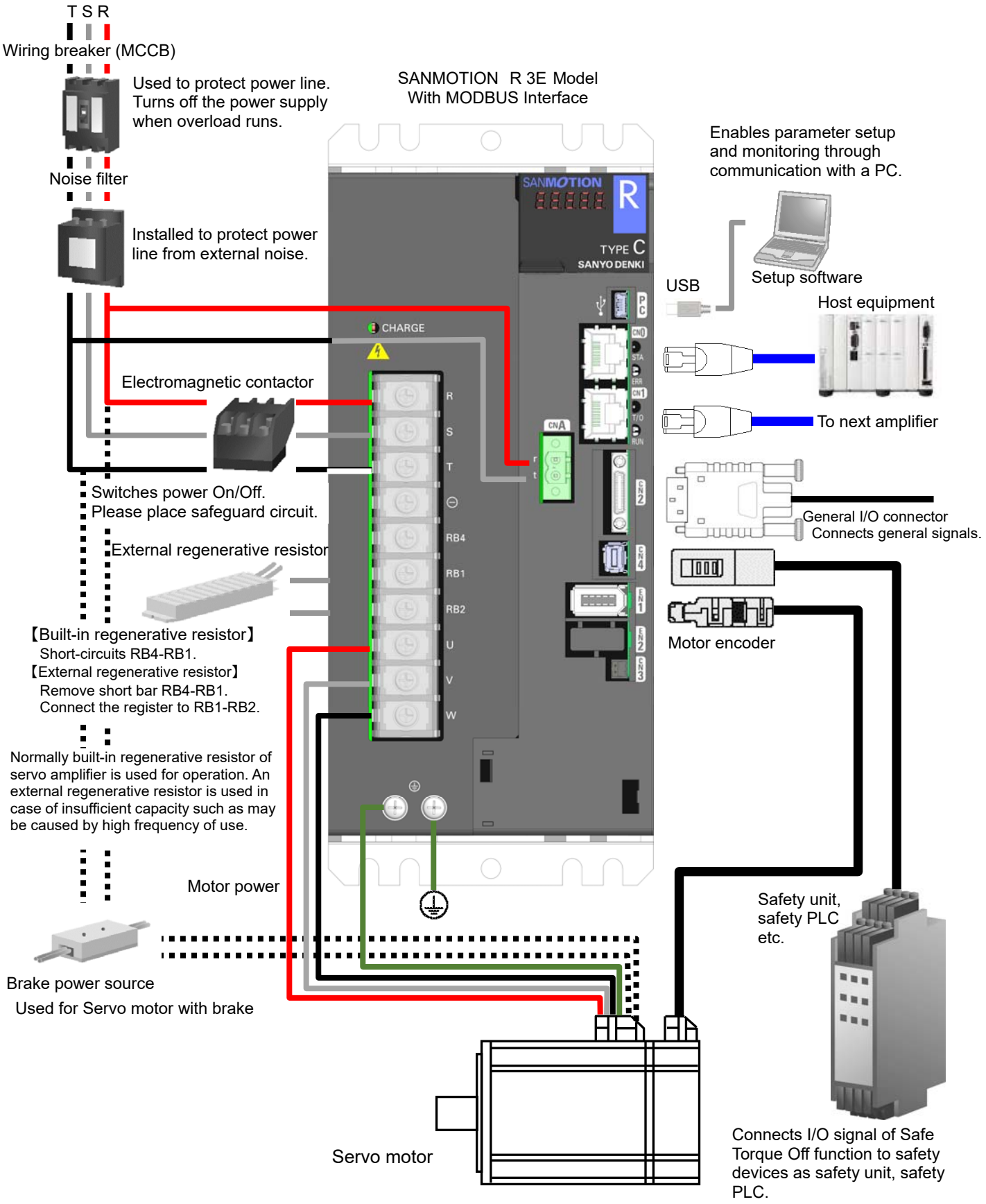
1.3 Illustration of system components

■ RS3☐07



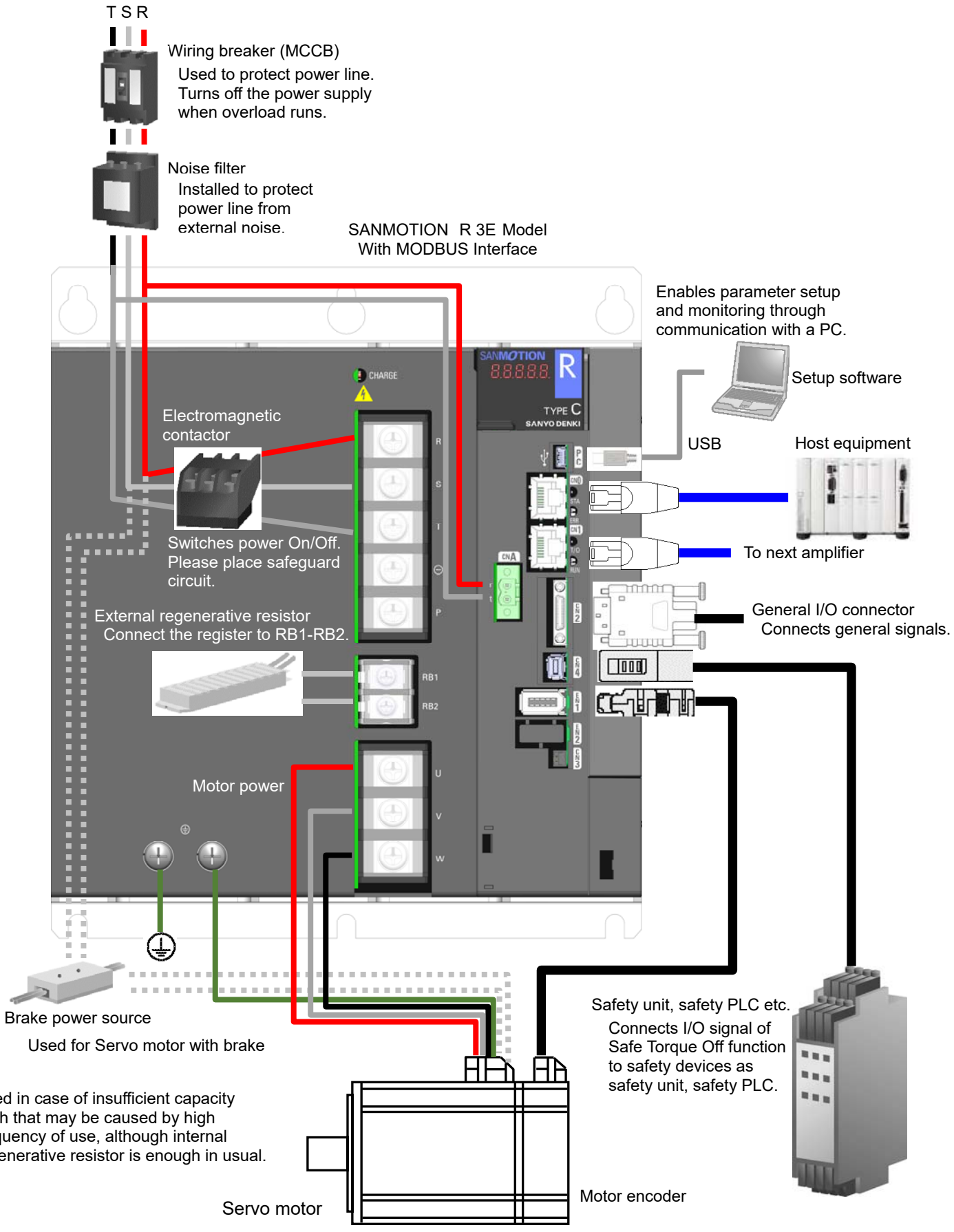
1. Preface

■ RS3☐10/15



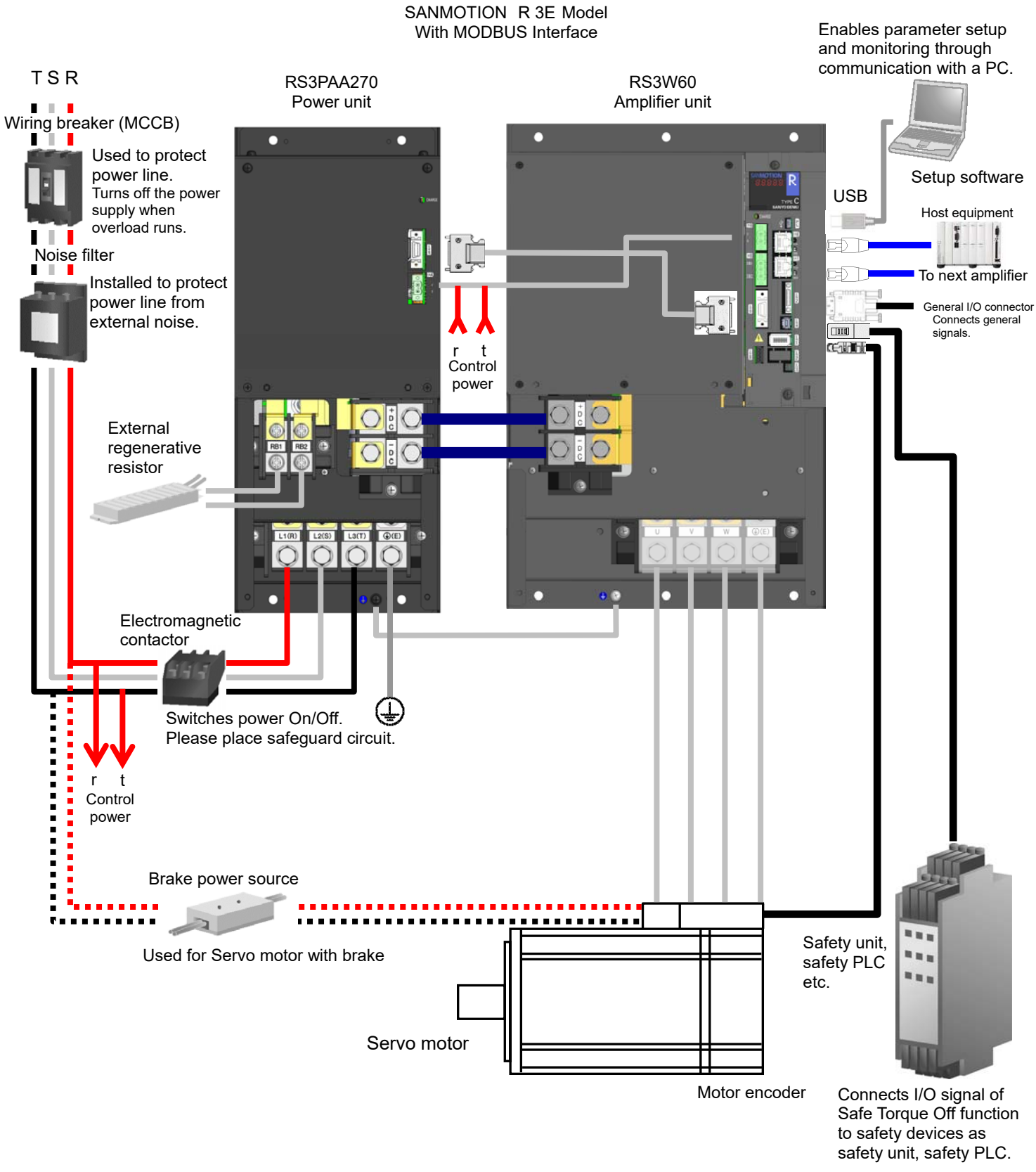
1.3 Illustration of system components

■ RS3□30



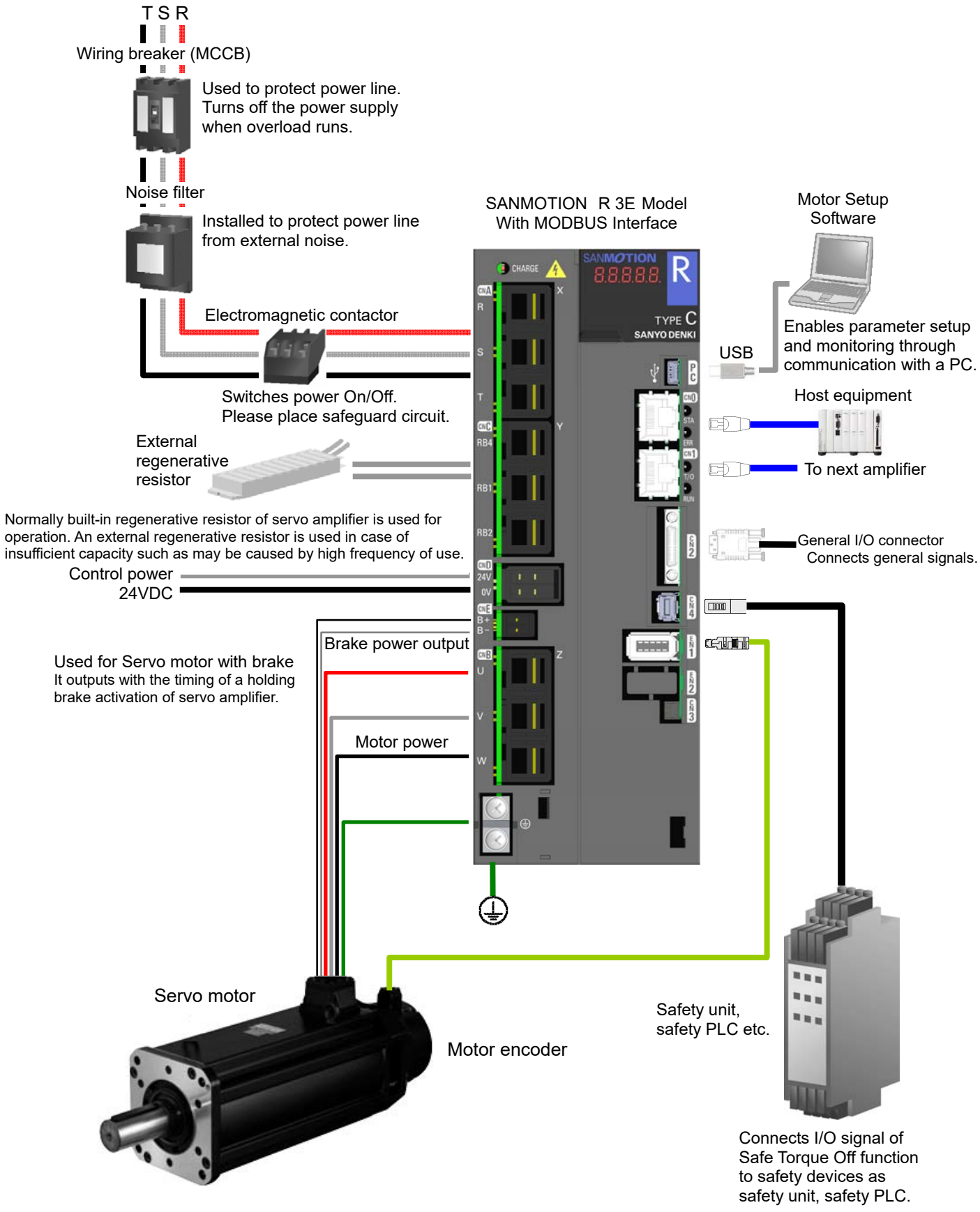
1. Preface

■ RS3W60

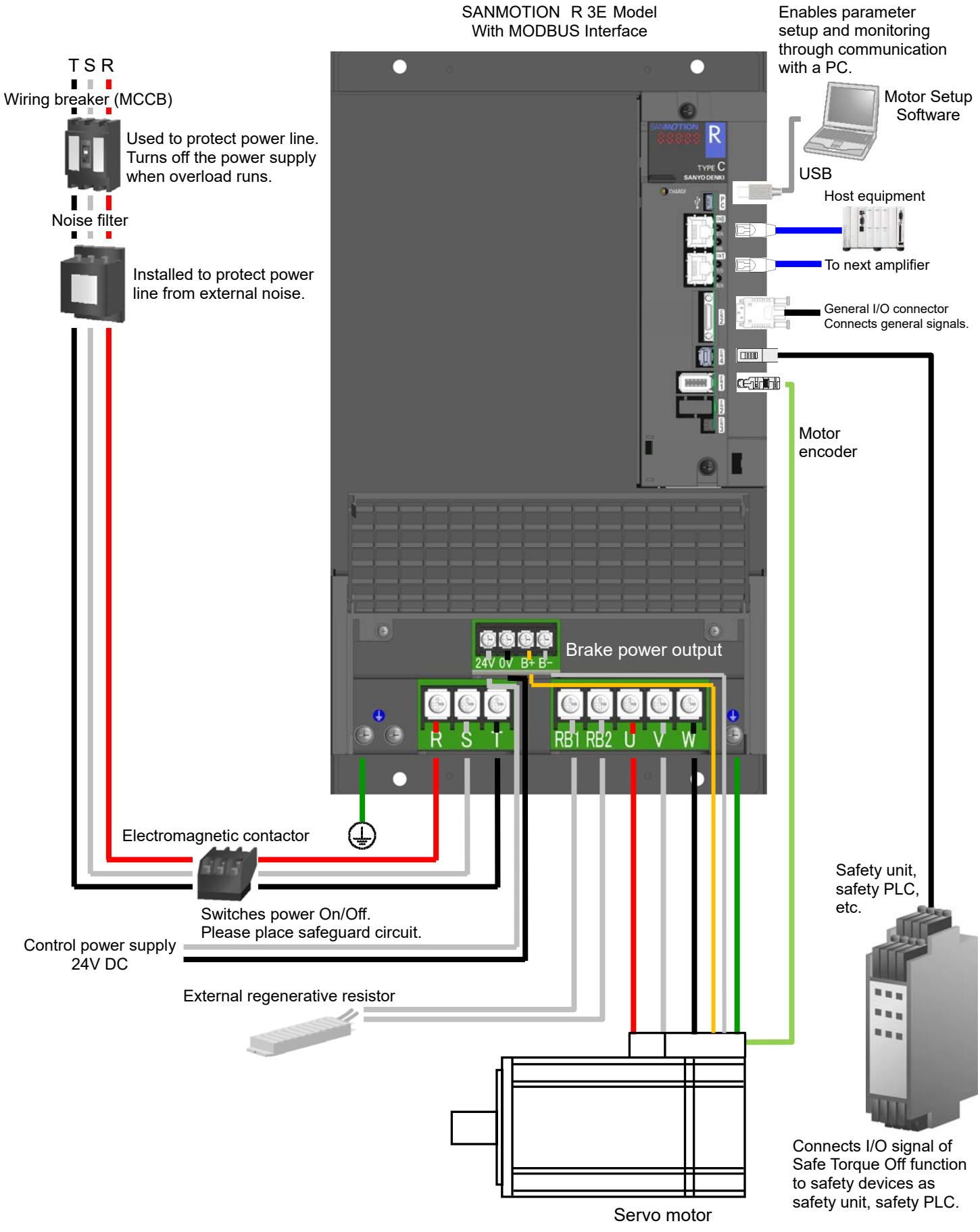


1.3 Illustration of system components

■ RS3C02/05/10

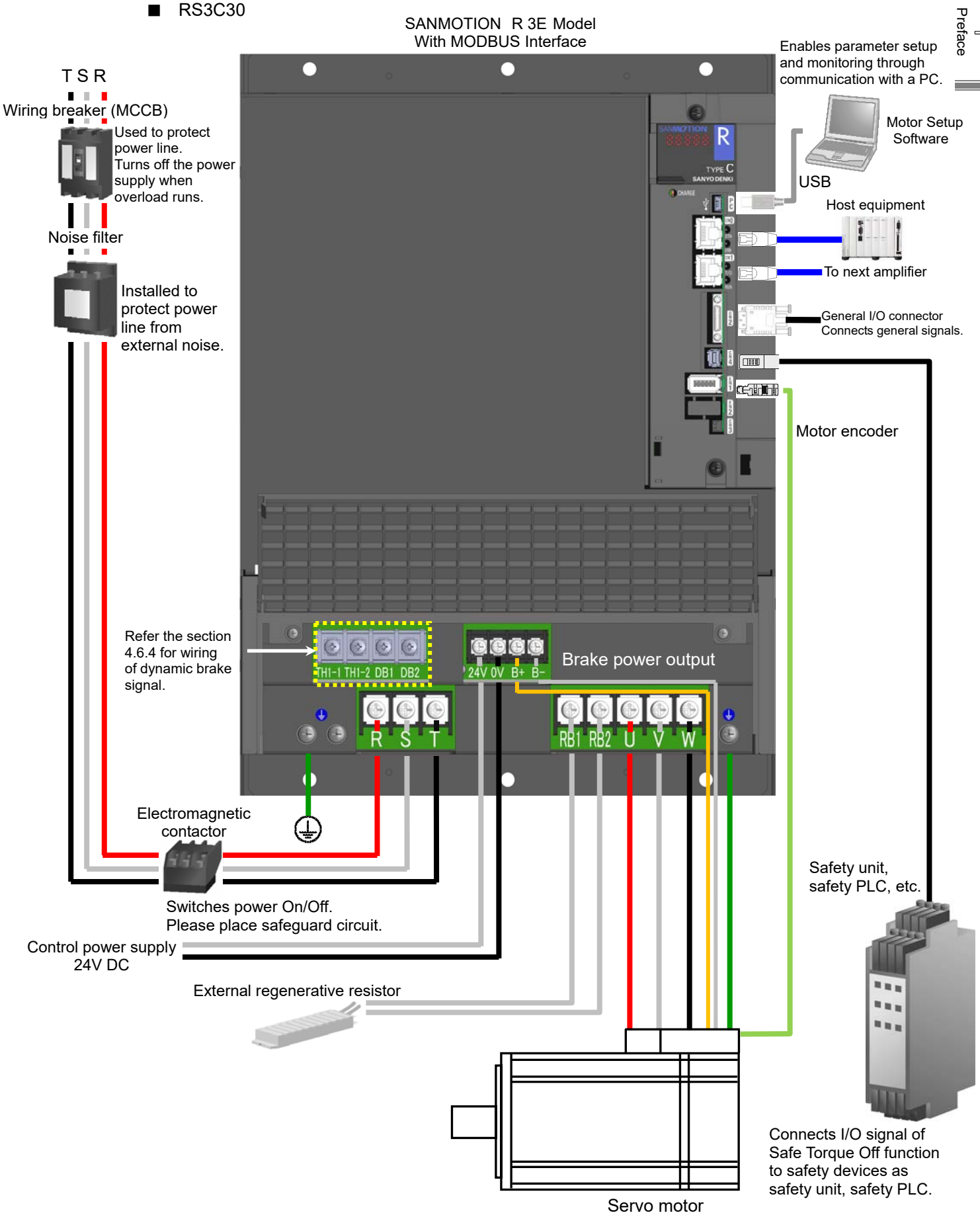


■ RS3C15


SANMOTION R 3E Model
With MODBUS Interface
Enables parameter setup and monitoring through communication with a PC.
Motor Setup Software
USB
Host equipment
To next amplifier
General I/O connector
Connects general signals.
Motor encoder
T S R
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.
Brake power output
24V 0V B+ B-
R S T
RB1 RB2 U V W
Electromagnetic contactor
Switches power On/Off.
Please place safeguard circuit.
Control power supply
24V DC
External regenerative resistor
Safety unit, safety PLC, etc.
Connects I/O signal of Safe Torque Off function to safety devices as safety unit, safety PLC.
Servo motor

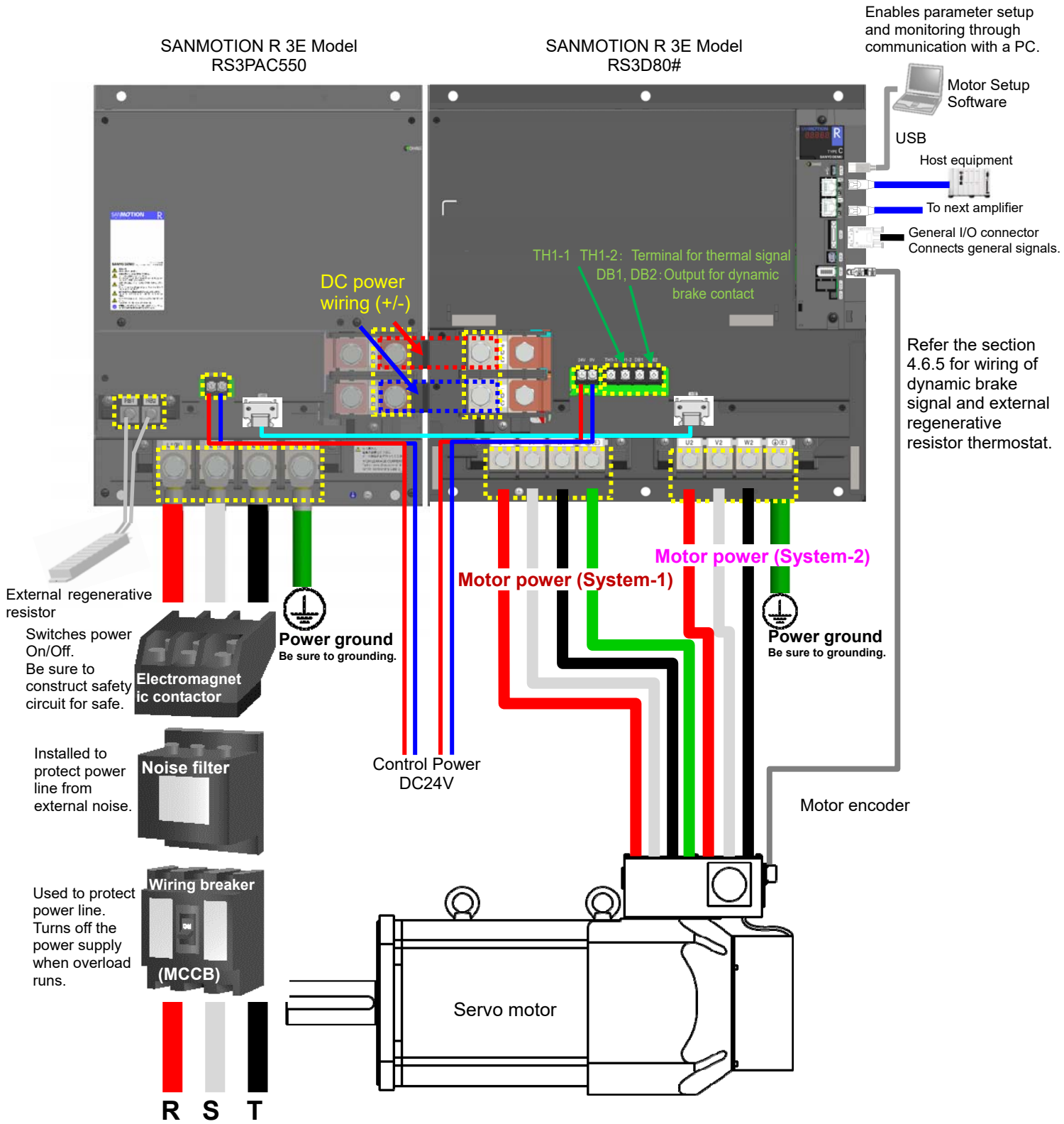
1.3 Illustration of system components

■ RS3C30



1. Preface

■ Power unit: RS3PAC550, Amplifier unit: RS3D80



1.4 Model number structure

1.4.1 Servo Motor Model Number

■ R motor

R 2 AA ○○ ○○○ △ □ ◇ ○○ △ □

Servo motor series
R･･･R series

Servo motor type
1･･･R1 motor, 2･･･R2 motor, 5･･･R5 motor

Voltage
AA･･･200 VAC, EA･･･100 VAC, CA･･･400 VAC

Flange dimensions
04･･･40 mm, 06･･･60 mm, 08･･･80 mm,
B8･･･86 mm, 10･･･100 mm, 13･･･130 mm,
18･･･180 mm, 22･･･220 mm, 32･･･320 mm

Rated output

003･･･30 W,	005･･･50 W,	008･･･80 W,	010･･･100 W,
020･･･200 W,	040･･･400 W,	050･･･500/550 W,	075･･･750 W,
100･･･1.0 kW,	120･･･1.2 kW,	150･･･1.5 kW,	180･･･1.8 kW,
200･･･2.0 kW,	250･･･2.5 kW,	300･･･3.0 kW,	350･･･3.5 kW,
400･･･4.0 kW,	450･･･4.5 kW,	500･･･5.0 kW,	550･･･5.5 kW,
700･･･7.0 kW,	750･･･7.5 kW,	11K･･･11 kW,	15K･･･15 kW,
20K･･･20 k/21 kW,	30K･･･30 kW,	55K･･･55 kW	

Maximum rotation speed

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

Existence and spec for securing brake
X･･･No brake, B･･･With brake (90V DC), C･･･With brake (24V DC)

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

* See page 1-15, for kind of applicable motor encoder.

Specification identification
00･･･Standard

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

Additional specification
for the motor with gear

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

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

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

◆ Absolute encoder (Standard)

Name (Code)	Motor model number Encoder code	Resolution per rotation	Multi turn amount	Transfer method
Single-turn absolute encoder (PA035S)	H	131072(17bit)	—	Half-duplex asynchronous 2.5Mbps
Battery backup absolute encoder (PA035C)	P	131072(17bit)	65536(16bit)	Half-duplex asynchronous 2.5Mbps
Battery-less absolute encoder (HA035)	R	131072(17bit)	65536(16bit)	Half-duplex asynchronous 2.5Mbps
Resolver type battery-less absolute encoder (RA035C)	W	131072(17bit)	65536(16bit)	Half-duplex asynchronous 2.5Mbps

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

◆ Incremental encoder (Standard)

Name (Code)	Motor model number Encoder code	Division number (Number of pulse)
Wire-saving incremental encoder (PP031H, PP031T, PP062)	S	8000 (2000P/R) Note 1)

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

Note 1) Pay attention to R2CA3255KB motor encoder because that resolution (pulse number) is 20,000 (5,000 P/R).

1.4.2 Linear Motor Model Number (DS, DD series)

■ Coil model number

DS 030 C 1 N2 E C 1 00

Linear motor series
DS···Flat type, with core, DD···Twin type, with core

Magnet width
030···30 mm, 050···50 mm, 075···75 mm,
100···100 mm, 150···150 mm

Type
C···Coil

Coil length

	Flat type, with core (DS)	Twin type, with core (DD)
1	200 mm	226 mm
2	376 mm	402 mm
3	552 mm	578 mm
4	-	754 mm (DD075 only)

Cooling options
N2···Standard winding, Y2···Standard winding (DD050, DD075),
Y4···Standard winding (DD030)

Hall effect sensor specification
E···Line drive (Standard), B···Open-collector, A···None

Thermal protection
A···None, C···With thermal protector

Cable length
1···300 mm, 2···600 mm

Specification identification
00···DS standard, 02···DD standard

■ Magnet rail model number

DS 030 M 512 A 00

Linear motor series
DS···Flat type, with core, DD···Twin type, with core

Magnet width
030···30 mm, 050···50 mm, 075···75 mm,
100···100 mm, 150···150 mm

Type
M··Magnet rail

Magnet rail length
064···64 mm, 128···128 mm, 256···256 mm, 512···512 mm

Cover
A···Without cover, B···With cover

Hall effect sensor specification
00···DS standard, 02···DD standard

1.4.3 Linear Motor Model Number (DS/DD series, Small type)

■ Coil Model Number

DS 045 C C1 A N E A 1 00

Linear motor series
DS･･･Flat type, with core, DD･･･Twin type, with core

Magnet width
045･･･45 mm (for DS type, and DD type (coil length B4 only)),
035･･･35 mm (for DD type (coil length C2 only))

Type
C･･･Coil

Coil length

	Flat type, with core (DS)	Twin type, with core (DD)
C1	130mm	-
B4	-	349mm
C2	-	253mm

Power supply voltage
A･･200 VAC

Winding specification
N･･Standard winding

Hall effect sensor specification
E･･･Line driver (Standard), A･･･None

Thermal specification
A･･･No thermal

Cable length
1･･･300 mm, 2･･･600 mm

Specification identification
00･･･Standard

■ Magnet rail model number

DS 045 M C512 A 00

Linear motor series
DS･･･Flat type, with core, DD･･･Twin type, with core

Magnet width
045･･･45 mm, 035･･･35mm

Type
M･･Magnet rail

Magnet rail length
DS type C064･･･64 mm, C128･･･128 mm, C256･･･256 mm, C288･･･288 mm, C512･･･512 mm
DD type B064･･･64 mm, B128･･･128 mm, B256･･･256 mm, B512･･･512 mm

Cover
A･･･Without cover, B･･･With cover

Specification identification
00･･･Standard

1.4.4 Linear Motor Model Number (DT series)

■ Coil Model Number

DT 030 C D1 A N E A 1 00

Linear motor series
DT···Center magnet type

Magnet width
030···30 mm

Type
C···Coil

Coil length
D1···145 mm

Power supply voltage
A··200 VAC

Winding specification
N··Standard winding

Hall effect sensor specification
E···Line driver (Standard), A···None

Thermal specification
A···No thermal

Cable length
1···300 mm, 2···600 mm

Specification identification
00···Standard

■ Magnet rail model number

DT 030 M 512 B 00

Linear motor series
DT···Center magnet type

Magnet width
030···30 mm

Type
M··Magnet rail

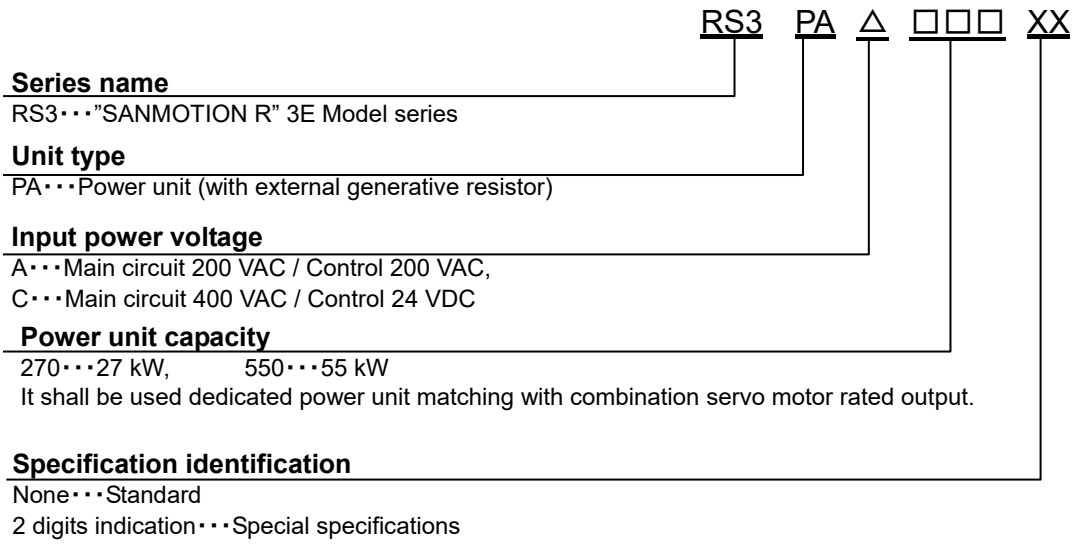
Magnet rail length
128···128 mm, 256···256 mm, 288···288 mm, 512···512 mm

Cover
A···Without cover, B···With cover

Individual specification
00···Standard

1. Preface

1.4.5 Power Unit Model Number



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

* Refer Section 10 for detail of Safe-Torque-Off function.

1.4.6 Servo Amplifier Model Number

RS3 △ ○○ A □ ◇ △ 0

Servo amplifier series

RS3･･･"SANMOTION R" 3E Model series

Input voltage

A･･･Main 200 VAC / Control 200 VAC, E･･･Main 100 VAC / Control 100 VAC,
C･･･Main 400 VAC / Control 24 VDC, D･･･Main 560 VDC / Control 24 VDC,
W･･･Main 280 VDC / Control 200 VAC

Servo Amplifier capacity

01･･･10 A, 02･･･20 A(100,200V AC), 25A(400V AC) 03･･･30 A, 05･･･50 A,
07･･･75 A, 10･･･100 A, 15･･･150 A, 30･･･300 A, 60･･･600 A, 80･･･800 A

✓ See page 1-20 for servo amplifier capacity and combination motor.

Servo Motor type

A･･･Rotary motor/Linear motor

Motor Encoder Type (for rotary motor)

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

Motor Encoder Type (for linear motor)

	EN1 (for Linear encoder)	EN2 (for Hall sensor)
A	Incremental encoder	Line driver
B	Incremental encoder	Open collector

Interface type

C･･･Built-in positioning function, I/O type (Parallel interface)
F･･･Built-in positioning function, MODBUS communication type (Serial interface)

Option 1

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

Option 2

	Safe Torque Off function	Functional safety module
4	Available (with delay circuit)	None
E	Available (with delay circuit)	Available

* See "Instruction manual of SANMOTION R3E Model Safety: M0011778" for detail of Functional safety module.
* Model numbers above are standard spec. Model number which is not listed spec in this manual will differ. Please contact us for the detail.
* Setup values of servo amplifier are "default values" at the time of shipment from our factory. Adjustments for System Parameters and General Parameters according to your equipment specifications, etc., as well as for Combination of Servo amplifier and Servo motor are necessary. Make sure to perform setup fit to the system to be used by referring another document M0012315 (Instruction manual for positioning function).
* Servo amplifier for the “Full-closed” system can be used for the “Semi-closed” system.
* Motor encoder type “2” is able to use for both of absolute encoder and incremental encoder, as motor encoder. Connect absolute encoder to EN1, and connect incremental encoder to EN2.
* See "10. Safe Torque Off function" for detail of Safe Torque Off function.

1. Preface

■ Servo amplifier capacity and combination servo motor (200V AC)

Input voltage	Servo amplifier model number	Servo motor model number
200V AC	RS3A01#	R1AA04005F
		R1AA04010F
		R2AA04003F
		R2AA04005F
		R2AA04010F
		R2AA06010F
		R5AA06020H
	RS3A02#	R1AA06020F
		R1AA06040F
		R2AA06020F
		R2AA06040F
		R2AA06040H
		R2AA08020F
		R2AA08040F
		R5AA06020F
		R5AA06040F
		R5AA06040H
	RS3A03#	R1AA08075V
		R1AA10100H
		R1AA10150H
		R2AA08075F
		R2AAB8100H
		R2AA10075F
		R2AA13050D
		R2AA13050H
		R2AA13120B
		R5AA08075D
		R5AA08075F
	RS3A05#	R1AA08075F
		R1AA10100F
		R1AA10150F
		R1AA10200H
		R1AA10250H
		R2AAB8075F
		R2AAB8100F
		R2AA10100F
		R2AA13120D
		R2AA13120L
		R2AA13180H
		R2AA13200L

Input voltage	Servo amplifier model number	Servo motor model number
200V AC	RS3A07#	R1AA10200F
		R1AA10250F
		R1AA13300H
		R2AA13180D
		R2AA13200D
		R2AA18350V
	RS3A10#	R1AA13300F
		R1AA13400H
		R1AA13500H
		R2AA13180D
		R2AA13200D
		R2AA18350L
	RS3A15#	R1AA13400F
		R1AA13500F
		R2AA18350D
		R2AA18450H
		R2AA18550R
		R2AA22500L
		R2AA22700S
	RS3A30#	R1AA18550H
		R1AA18750L
		R1AA1811KR
		R1AA1815KB
		R2AA18550H
		R2AA18750H
		R2AA1811KR
		R2AA2211KB
		R2AA2215KB
	RS3W60#	R1AA2220KV
		R2AA2220KB
		R2AA2225KB
		R2AA2830KV

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

■ Servo amplifier capacity and combination servo motor (100V AC)

Input voltage	Servo amplifier model number	Servo motor model number
100V AC	RS3E01#	R2EA04003F
	RS3E02#	R1EA04005F
		R1EA04010F
		R2EA04005F
		R2EA04008F
		R2EA06010F
	RS3E03#	R1EA06020F
		R2EA06020F

1.4 Model number structure

■ Servo amplifier capacity and combination servo motor (400V AC)

Input voltage	Servo amplifier model number	Servo motor model number
400V AC	RS3C02#	R1CA10150V
		R2CA10075F
		R2CA13050D
		R2CA13120R
		R2CA13180H
		R2CA13200L
	RS3C05#	R1CA10200V
		R1CA13300V
		R2CA10100F
		R2CA13120F
		R2CA13180D
		R2CA13200H
		R2CA18350L
	RS3C10#	R2CA18350D
		R2CA18450H
		R2CA18550R
	RS3C15#	R1CA18550H
		R1CA18750L
		R1CA1811KR
		R1CA1815KB
		R2CA18550H
		R2CA18750H
		R2CA2211KB
		R2CA2215KV
	RS3C30#	R1CA2220KV
		R2CA2220KV
		R2CA2830KV

■ Amplifier unit capacity and combination servo motor (400V AC)
* : Factory setting value of shortened model number

Input voltage	Power unit model number	Amplifier unit model number	Servo motor model number
400 VAC	RS3PAC550	RS3D80#	R2CA3255KB

■ Servo amplifier capacity and combination linear motor (200V AC)

Input voltage	Servo amplifier model number	Linear motor model number
200V	RS3A03#	DS030C1N2*
		DS050C1N2
		DS075C1N2
		DS045CC1AN
		DT030CD1AN
	RS3A05#	DS030C2N2*
		DS050C2N2
		DS075C2N2
		DS100C1N2
		DS150C1N2
		DD030C1Y4
	RS3A07#	DS030C3N2*
		DS050C3N2
		DS075C3N2
		DD030C2Y4
		DD050C1Y2
		DD075C1Y2
		DD045CB4AN
		DD035CC2AN

Input voltage	Servo amplifier model number	Linear motor model number
200V	RS3A10#	DS030C3N2
		DS050C3N2
		DS075C3N2
		DS100C2N2
		DS150C2N2
		DD030C2Y4
		DD030C3Y4
		DD050C1Y2
		DD075C1Y2
		DD045CB4AN
	RS3A15#	DS100C3N2*
		DS150C3N2
		DD050C2Y2
		DD075C2Y2
	RS3A30#	DD050C3Y2
		DD075C3Y2
		DD075C4Y2

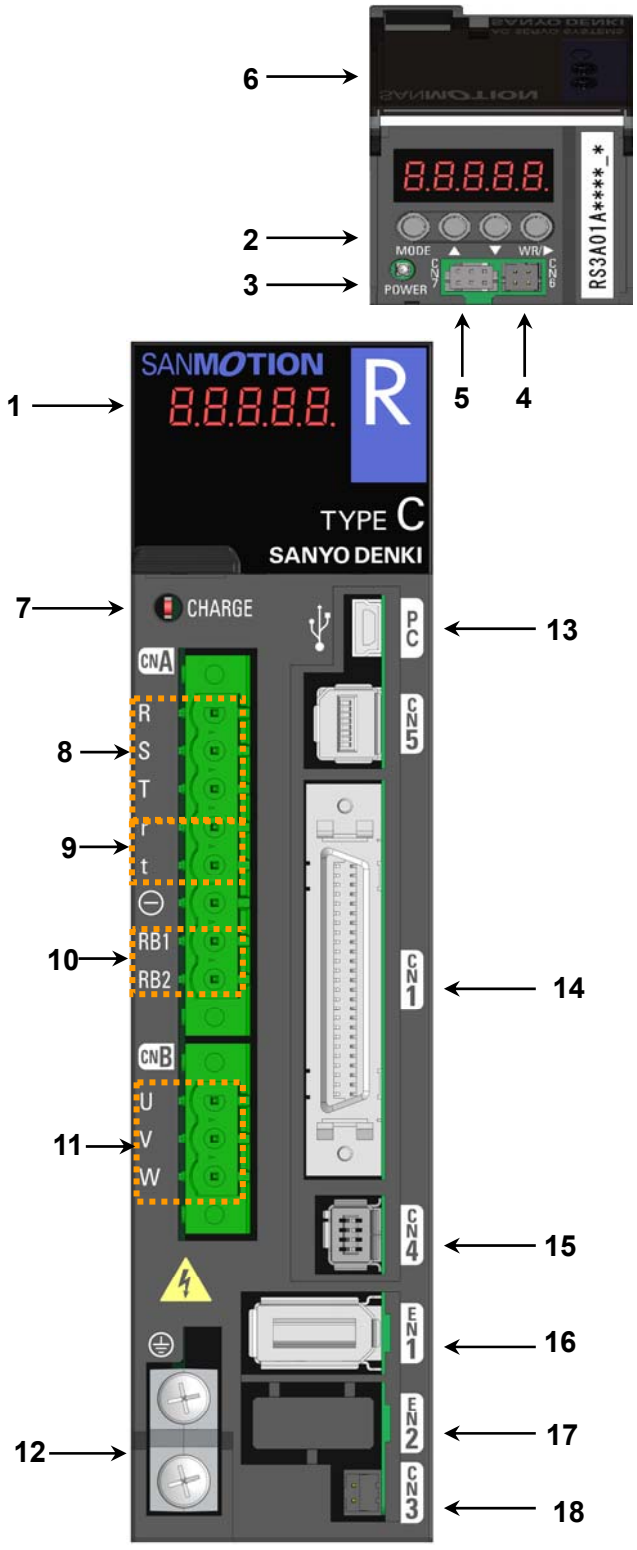
* DS030C3N2, DS050C3N2, DS075C3N2, DD030C2Y4, DD050C1Y2, DD075C1Y2 and DD045CB4AN are able to combine with either RS3A07 or RS3A10.

1. Preface

1.5 Part names

1.5.1 Servo amplifier [C: I/O]

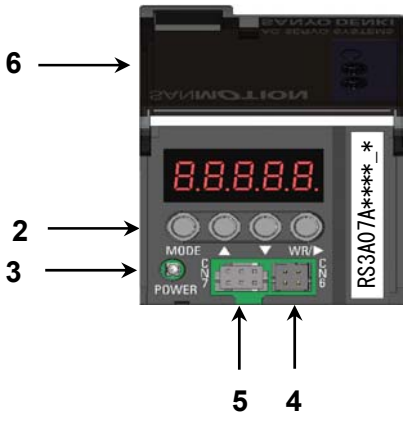
■ RS3☐01/ RS3☐02/ RS3☐03/ RS3☐05

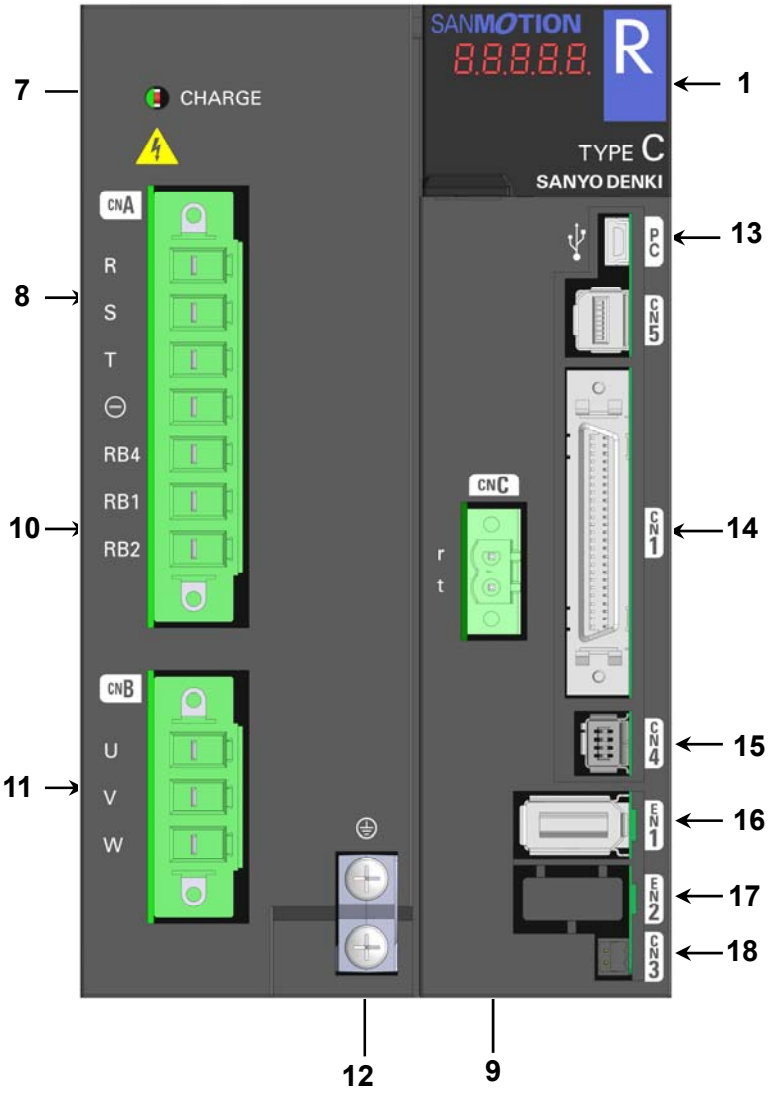


No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog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

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

■ RS3A07



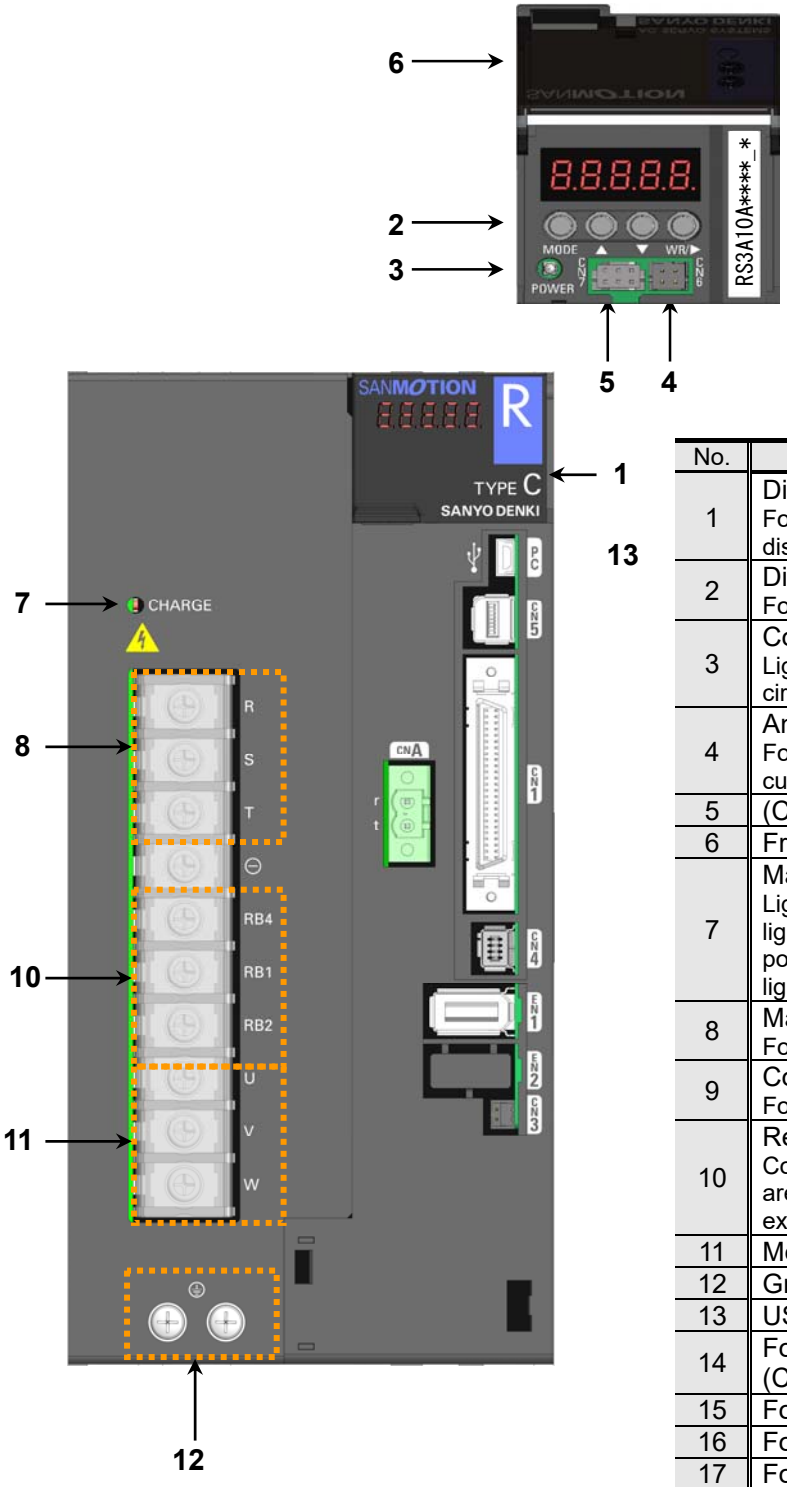


No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog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

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

1. Preface

■ RS3A10/ RS3A15

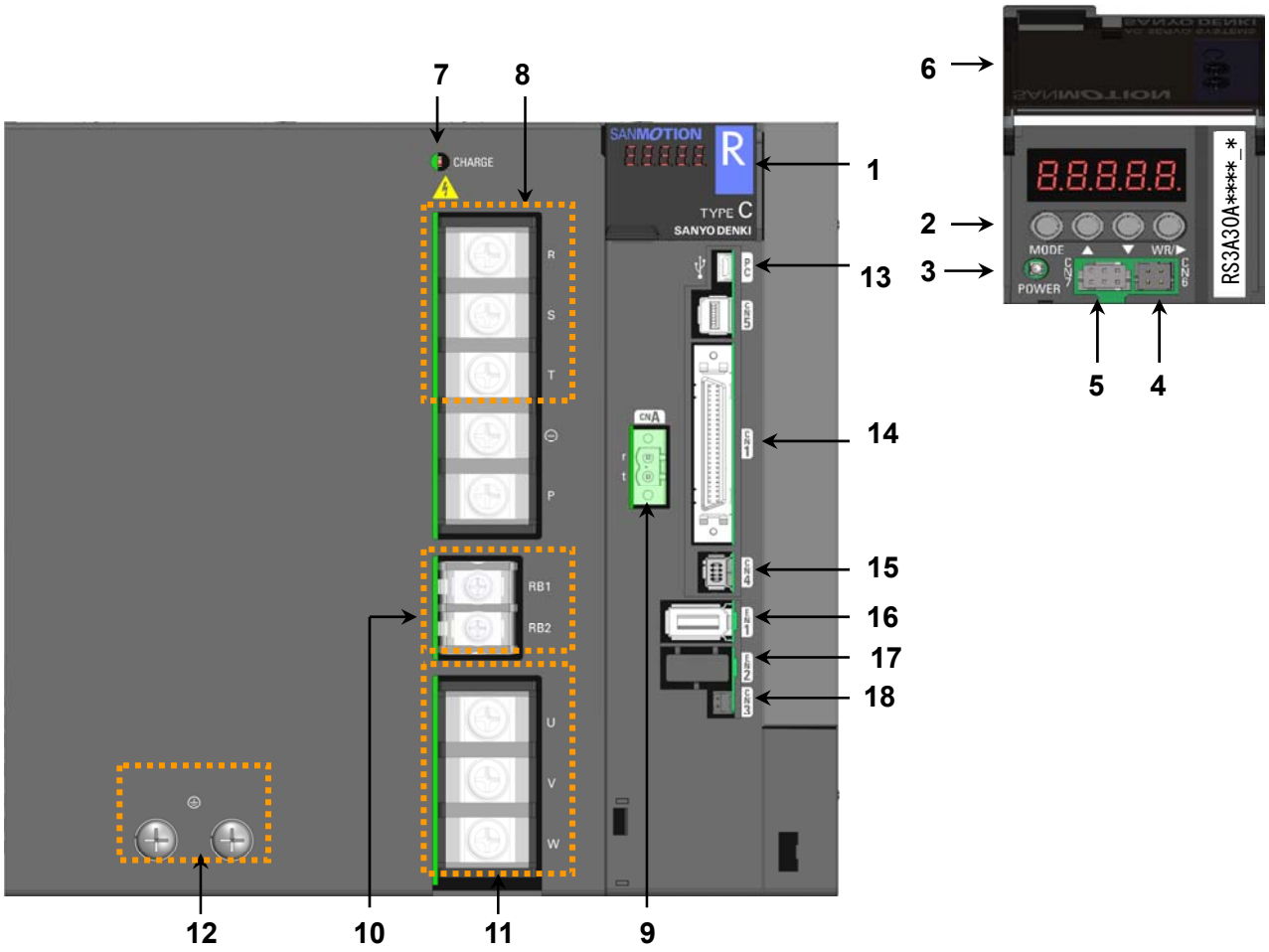


No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog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

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

1.5 Part names

■ RS3A30



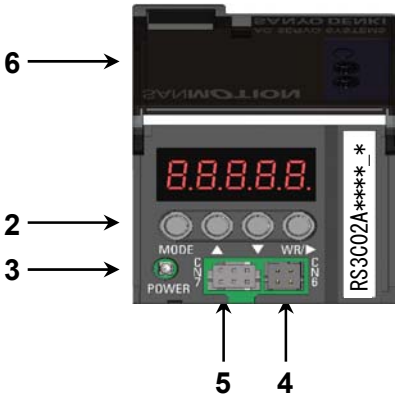
No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog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

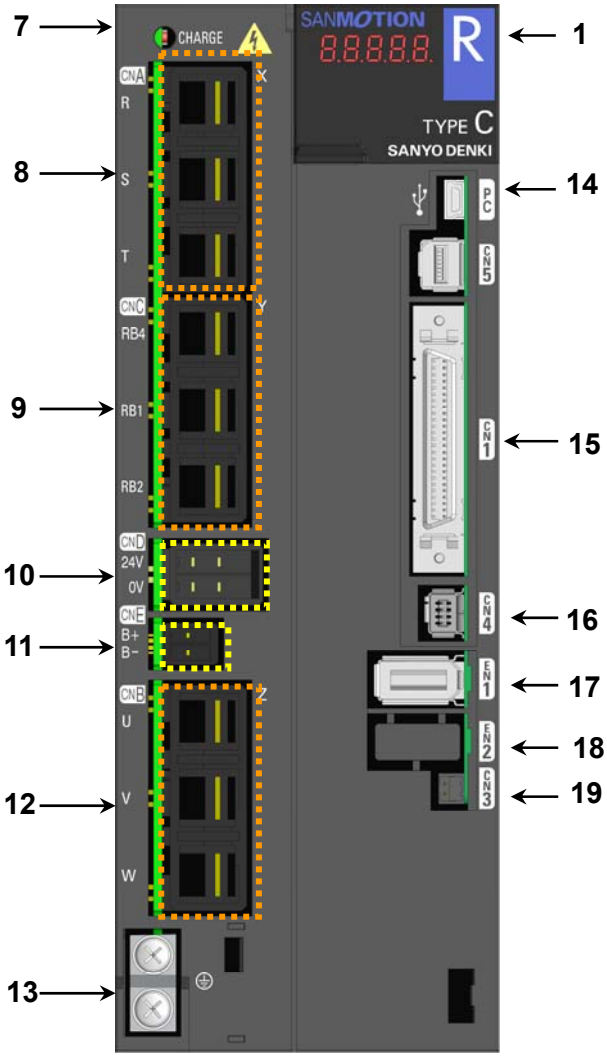
No.	Name/ Use
8	Main circuit power input terminal/ For input terminal of main circuit power
9	Control power input (CNA)/ For input terminal of control power
10	Regenerative resistor terminal/ Connect the external regenerative resistor between RB1 and RB2.
11	Motor power terminal/
12	Grounding terminal/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

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

1. Preface

■ RS3C02/05/10



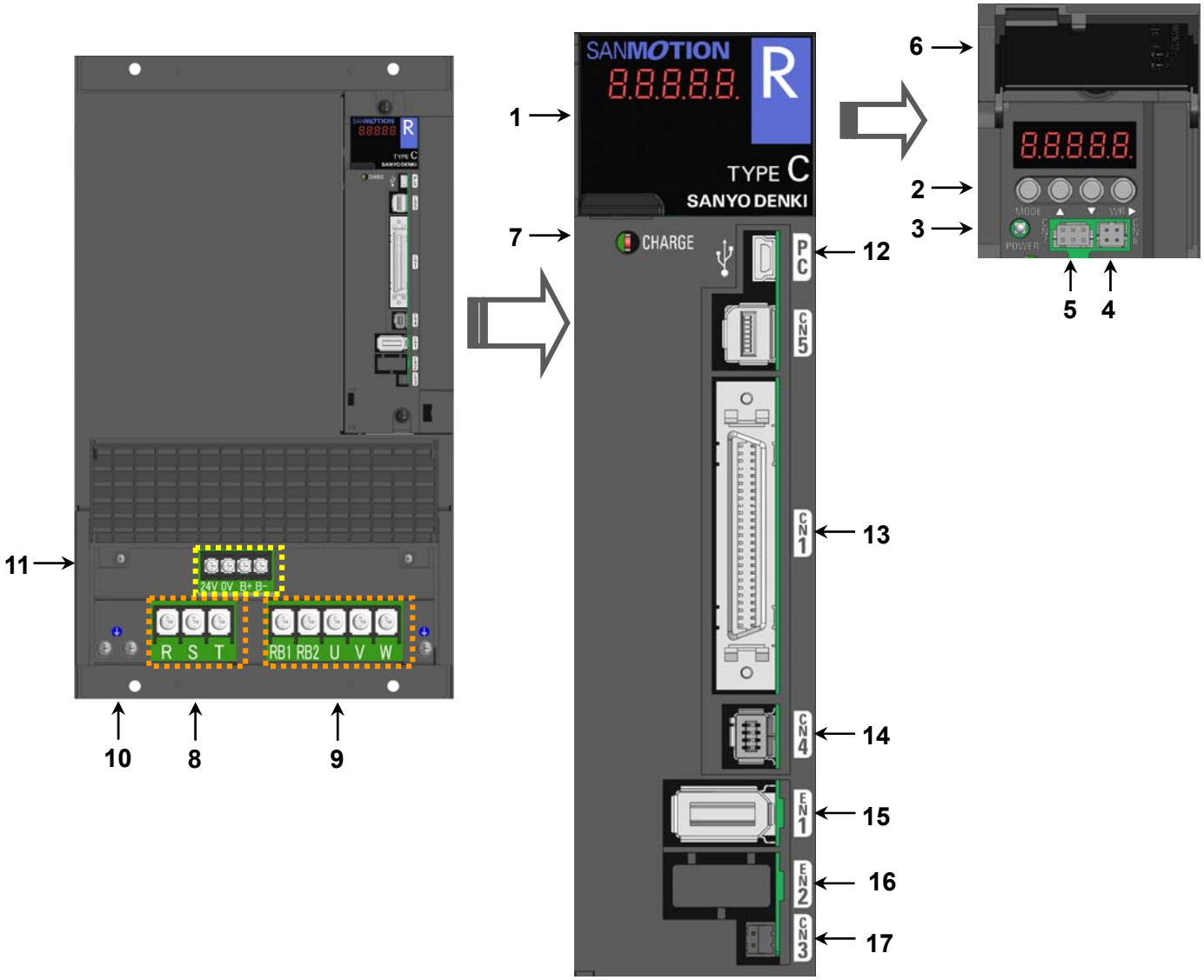


No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (CN6)/ For measuring analog signal such as velocity or current with dedicated cable.
5	(CN7)/ For maintenance
6	Front panel cover/
7	Main circuit power LED (Red)/ Lighting on when main circuit power is ON. Continue lighting during internal capacitor has charge, even if power is OFF. Do not touch power terminal during lighting. There is a risk of electric shock.
8	Main circuit power input (CNA)/ For input terminal of main circuit power
9	Regenerative resistor terminal (CNC)/ For internal regenerative resistor use, connect a shorting-wire between RB4 and RB1. For external regenerative resistor use, remove a shorting-wire and connect a resistor cable between RB1 and RB2. Note) Do not connect the shorting-wire between RB1 and RB2.
10	Control power input (CND)/ For input terminal of control power
11	Holding brake output (CNE)/ Terminal for output of holding brake power.
12	(CNB)/ For motor power cable
13	Grounding terminal/
14	USB connector for PC communication (PC)/
15	For I/O signal connector with host equipment (CN1)/
16	For safety device connecting connector (CN4)/ *
17	For motor encoder (EN1)/
18	For motor encoder or external encoder (EN2)/ *
19	For battery connection (CN3)/ *

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

1.5 Part names

■ RS3C15



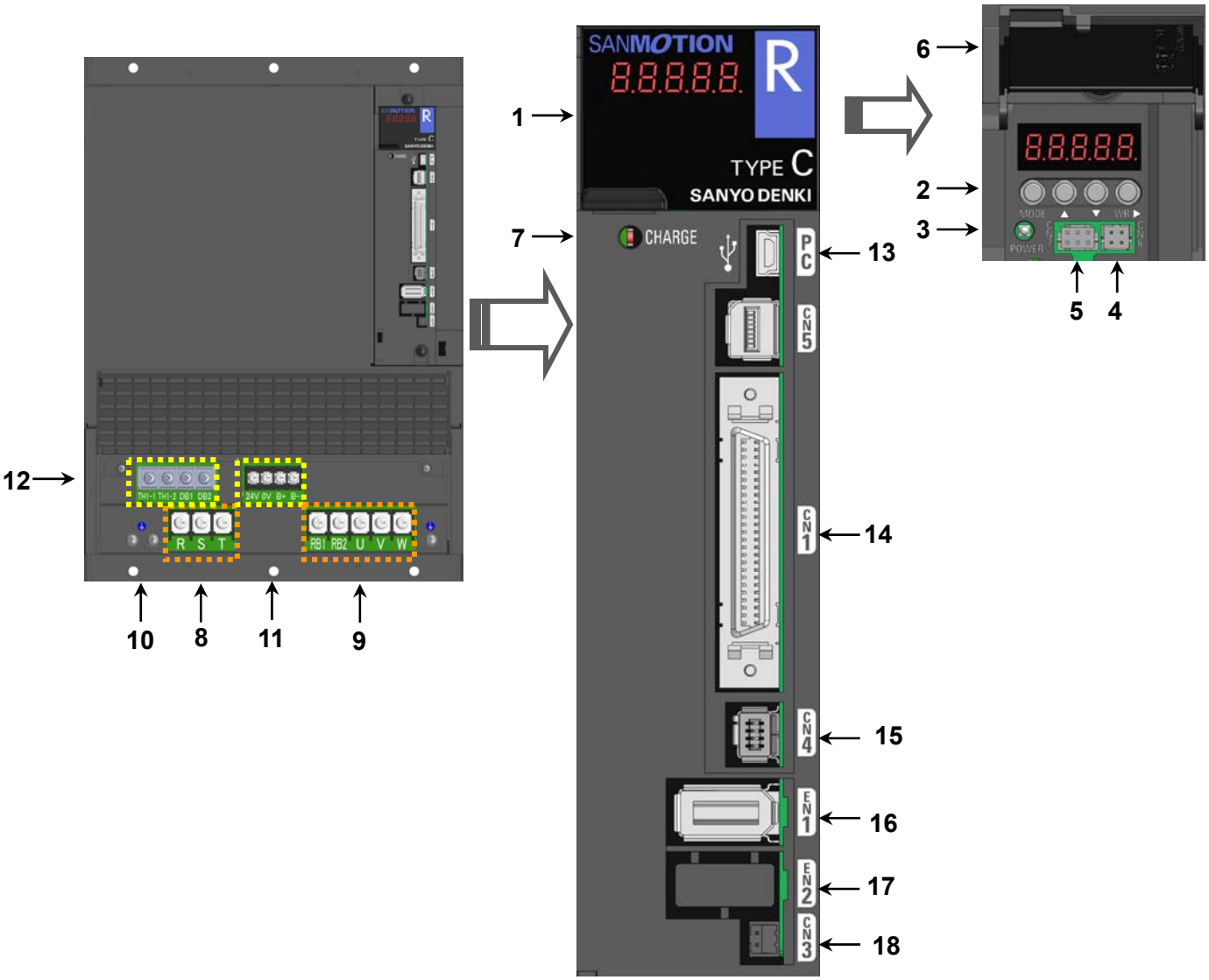
No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog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

No.	Name/ Use
8	Main circuit power input terminal/ For input terminal of main circuit power
9	Terminal block for external regenerative resistor and motor power
10	Grounding terminal/
11	Control power input･Holding brake output/ For control power input terminal and holding brake power output terminal
12	USB connector for PC communication (PC)/
13	For I/O signal connector with host equipment (CN1)/
14	For safety device connecting connector (CN4)/ *
15	For motor encoder (EN1)/
16	For motor encoder or external encoder (EN2)/ *
17	For battery connection (CN3)/ *

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

1. Preface

■ RS3C30



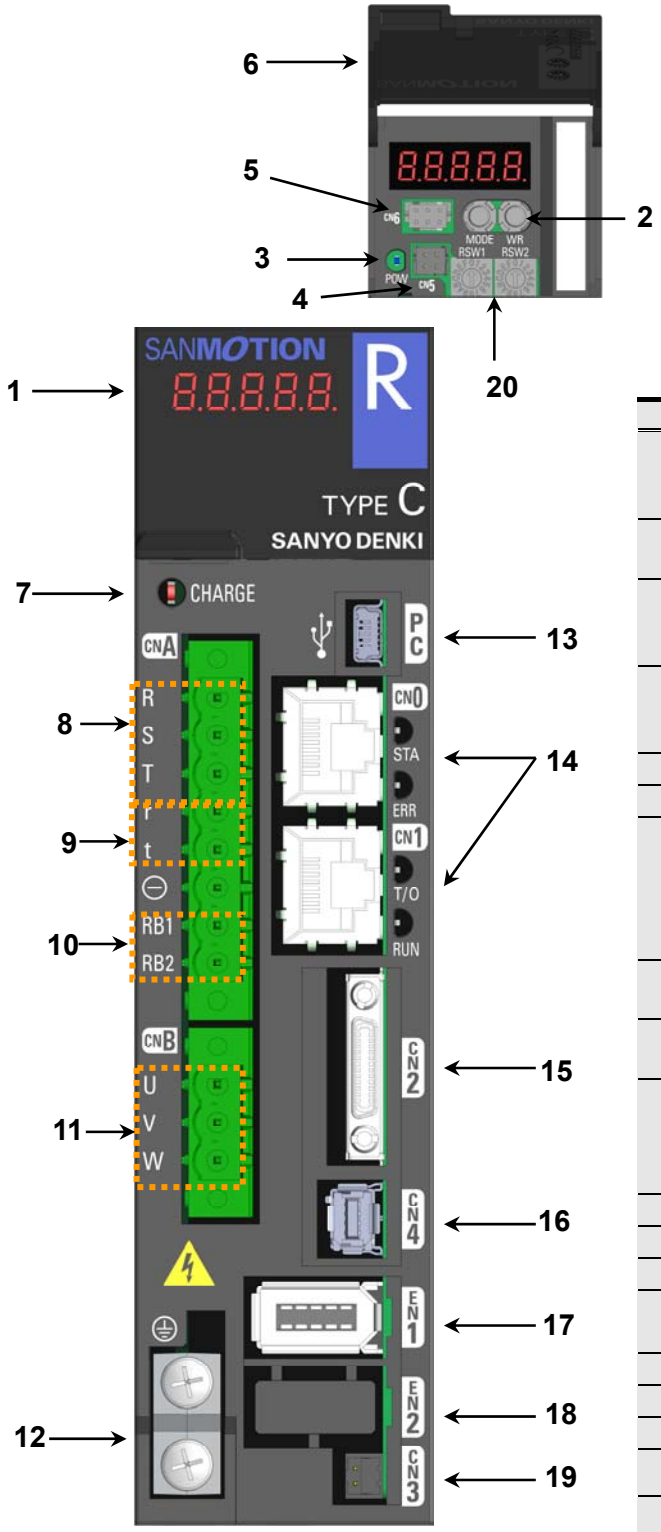
No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog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

No.	Name/ Use
8	Main circuit power input terminal/ For input terminal of main circuit power
9	Terminal block for external regenerative resistor and motor power
10	Grounding terminal/
11	Control power input･Holding brake output/ For control power input terminal and holding brake power output terminal
12	Terminal block for dynamic brake signal and thermal signal
13	USB connector for PC communication (PC)/
14	For I/O signal connector with host equipment (CN1)/
15	For safety device connecting connector (CN4)/ *
16	For motor encoder (EN1)/
17	For motor encoder or external encoder (EN2)/ *
18	For battery connection (CN3)/ *

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

1.5.2 Servo amplifier [F: MODBUS]

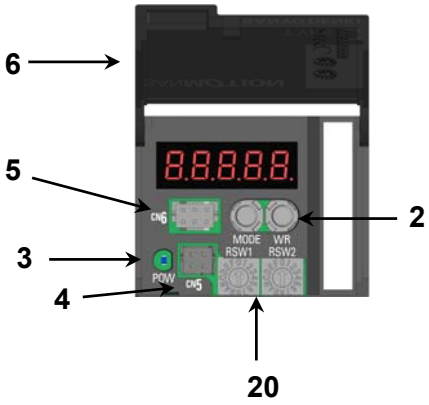
■ RS3☐01/ RS3☐02/ RS3☐03/ RS3☐05

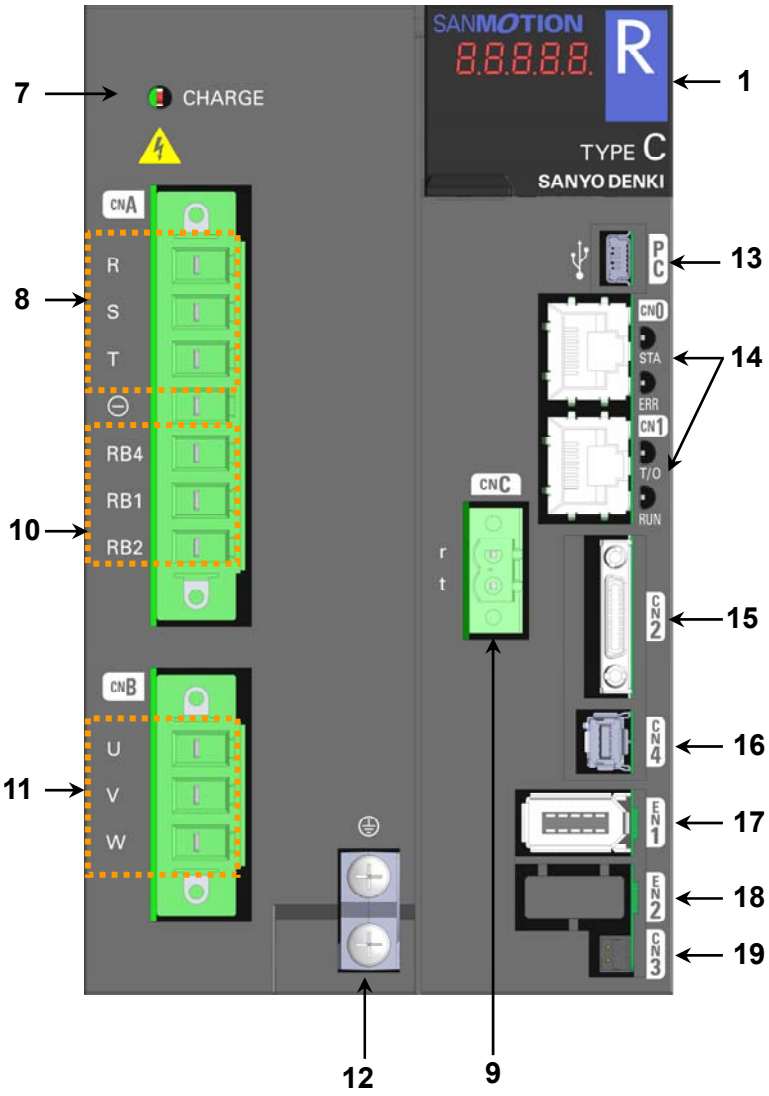


No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (CN5)/ For measuring analog signal such as velocity or current with dedicated cable.
5	(CN6)/ For maintenance
6	Front panel cover/
7	Main circuit power LED (Red)/ Lighting on when main circuit power is ON. Continue lighting during internal capacitor has charge, even if power is OFF. Do not touch power terminal during lighting. There is a risk of electric shock.
8	Main circuit power input (CNA)/ For input terminal of main circuit power
9	Control power input (CNA)/ For input terminal of control power
10	Regenerative resistor terminal (CNA)/ Connect the resistor between RB1 and RB2. There are two kind of regenerative resistor, internal and external.
11	Motor power terminal (CNB)/
12	Grounding terminal/
13	USB connector for PC communication (PC)/
14	For MODBUS communication connector (CN0/CN1)/
15	For general I/O signal connector (CN2)/
16	For safety device connecting connector (CN4)/
17	For motor encoder (EN1)/
18	For motor encoder or external encoder (EN2)/
19	For battery connection (CN3)/
20	Rotary switch for communication baud rate and slave address setting (RSW1/RSW2)/

1. Preface

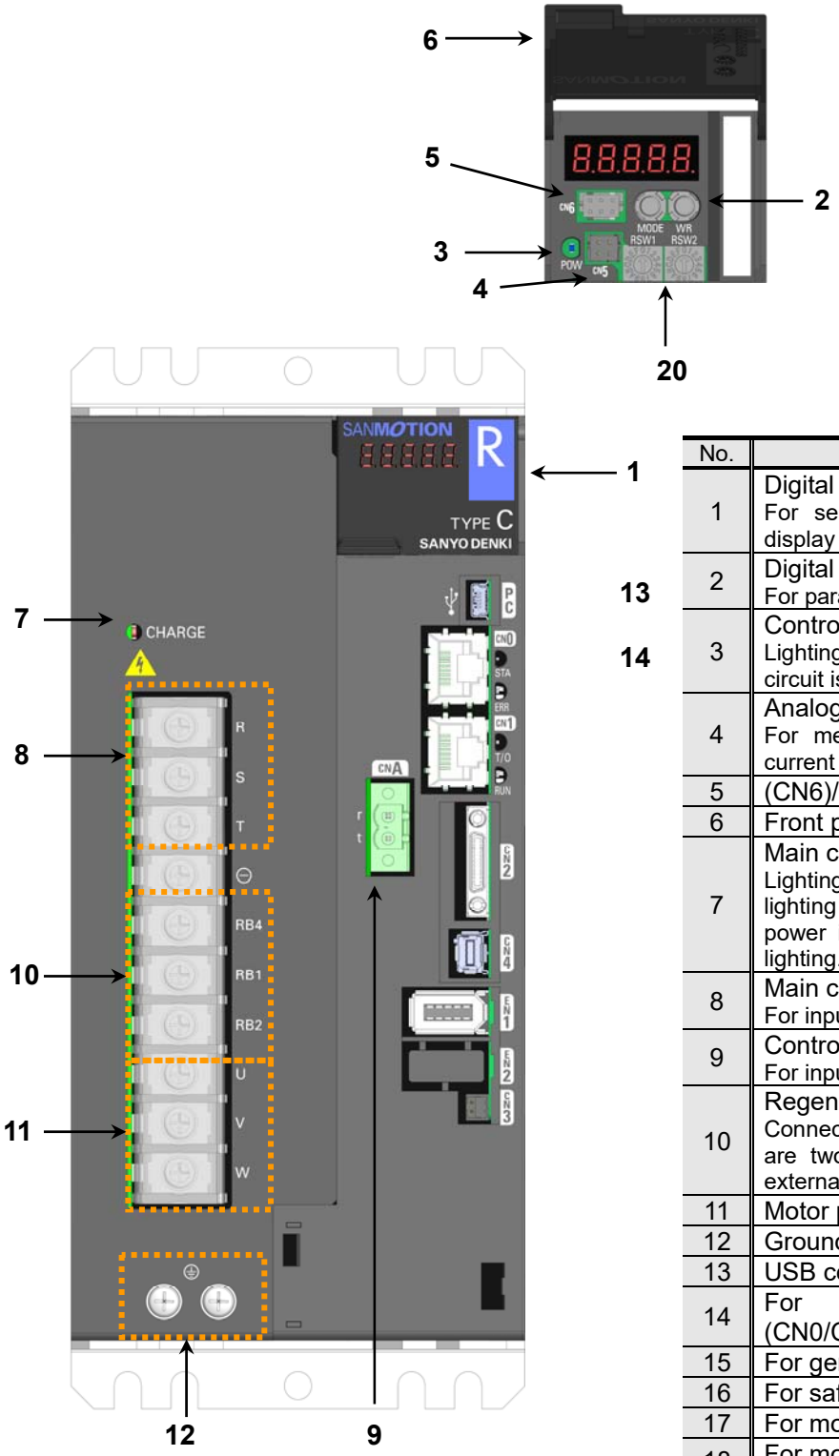
■ RS3A07





No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (CN5)/ For measuring analog signal such as velocity or current with dedicated cable.
5	(CN6)/ For maintenance
6	Front panel cover/
7	Main circuit power LED (Red)/ Lighting on when main circuit power is ON. Continue lighting during internal capacitor has charge, even if power is OFF. Do not touch power terminal during lighting. There is a risk of electric shock.
8	Main circuit power input (CNA)/ For input terminal of main circuit power
9	Control power input (CNA)/ For input terminal of control power
10	Regenerative resistor terminal (CNA)/ Connect the resistor between RB1 and RB2. There are two kind of regenerative resistor, internal and external.
11	Motor power terminal (CNB)/
12	Grounding terminal/
13	USB connector for PC communication (PC)/
14	For MODBUS communication connector (CN0/CN1)/
15	For general I/O signal connector (CN2)/
16	For safety device connecting connector (CN4)/
17	For motor encoder (EN1)/
18	For motor encoder or external encoder (EN2)/
19	For battery connection (CN3)/
20	Rotary switch for communication baud rate and slave address setting (RSW1/RSW2)/

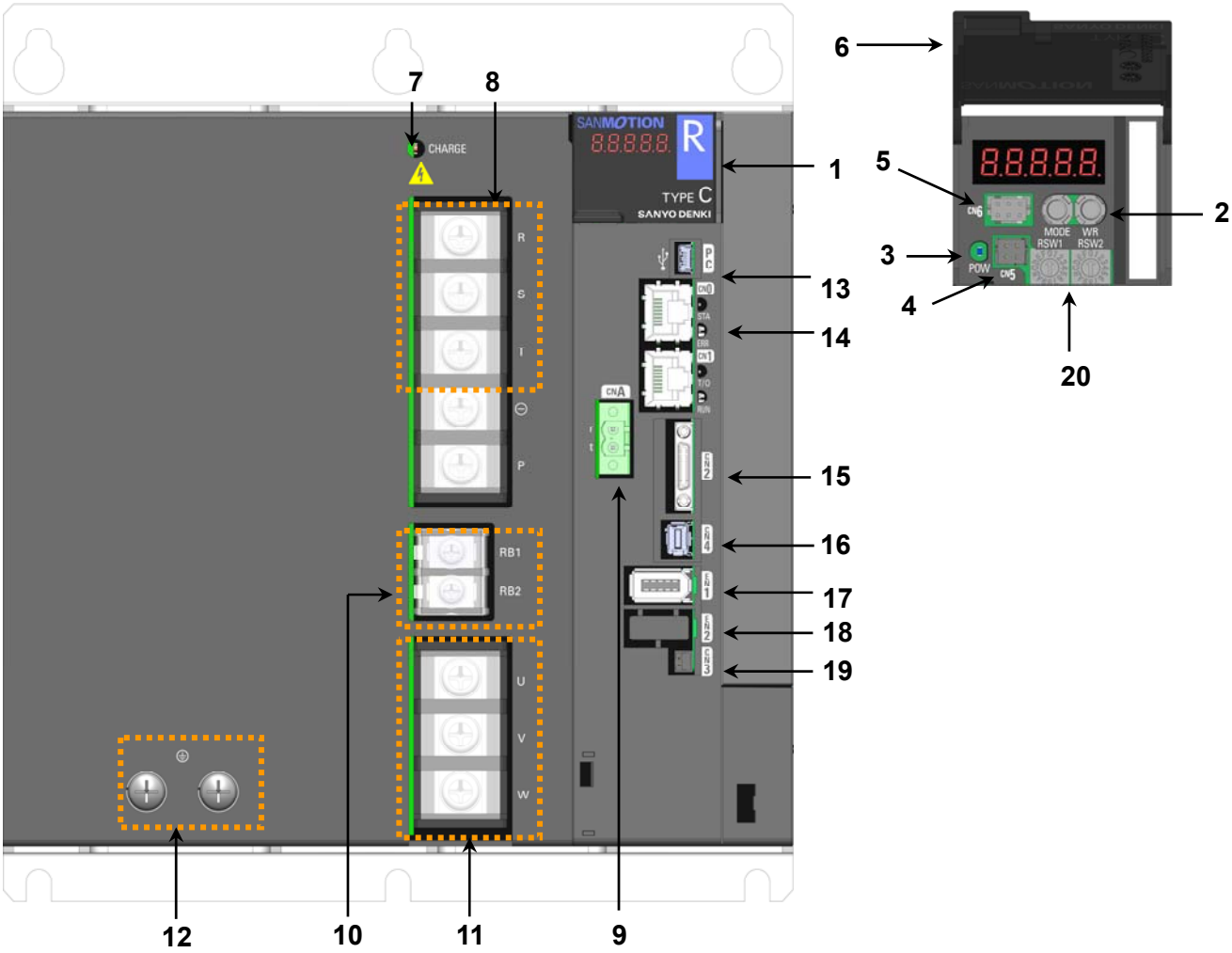
■ RS3A10/ RS3A15



No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (CN5)/ For measuring analog signal such as velocity or current with dedicated cable.
5	(CN6)/ For maintenance
6	Front panel cover/
7	Main circuit power LED (Red)/ Lighting on when main circuit power is ON. Continue lighting during internal capacitor has charge, even if power is OFF. Do not touch power terminal during lighting. There is a risk of electric shock.
8	Main circuit power input terminal/ For input terminal of main circuit power
9	Control power input (CNA)/ For input terminal of control power
10	Regenerative resistor terminal/ Connect the resistor between RB1 and RB2. There are two kind of regenerative resistor, internal and external.
11	Motor power terminal/
12	Grounding terminal/
13	USB connector for PC communication (PC)/
14	For MODBUS communication connector (CN0/CN1)/
15	For general I/O signal connector (CN2)/
16	For safety device connecting connector (CN4)/
17	For motor encoder (EN1)/
18	For motor encoder or external encoder (EN2)/
19	For battery connection (CN3)/
20	Rotary switch for communication baud rate and slave address setting (RSW1/RSW2)/

1. Preface

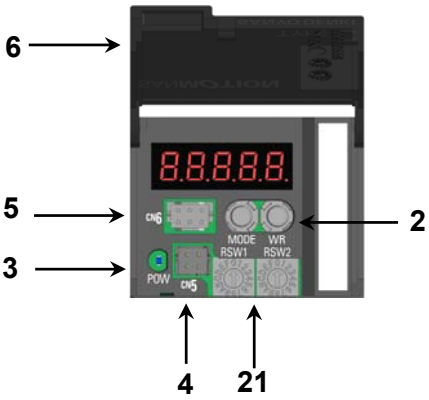
■ RS3A30

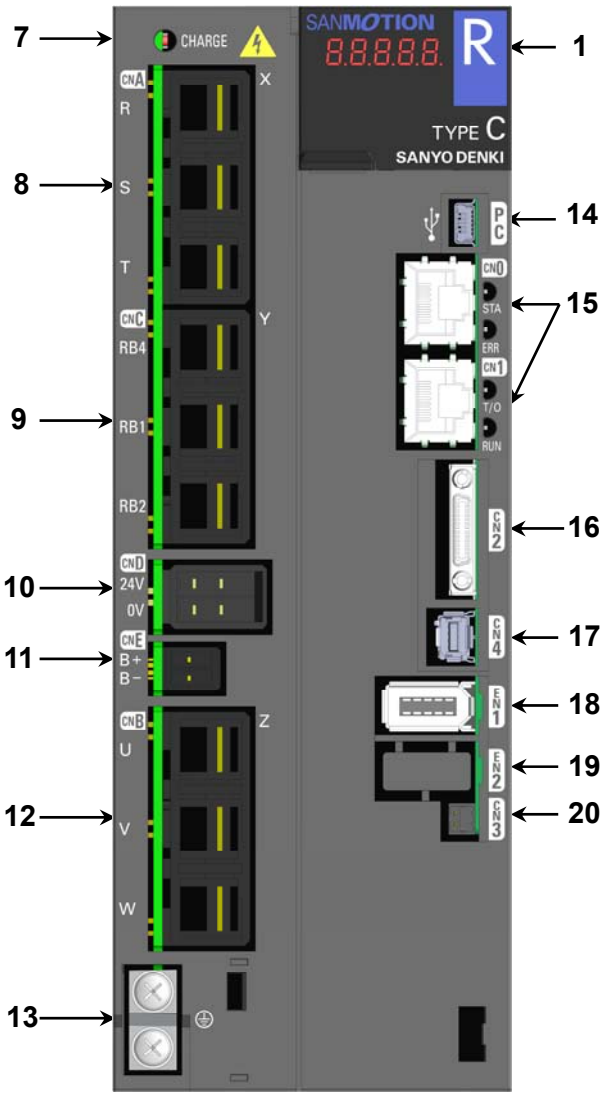


No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (CN5)/ For measuring analog signal such as velocity or current with dedicated cable.
5	(CN6)/ For maintenance
6	Front panel cover/
7	Main circuit power LED (Red)/ Lighting on when main circuit power is ON. Continue lighting during internal capacitor has charge, even if power is OFF. Do not touch power terminal during lighting. There is a risk of electric shock.

No.	Name/ Use
8	Main circuit power input terminal/ For input terminal of main circuit power
9	Control power input (CNA)/ For input terminal of control power
10	Regenerative resistor terminal/ Connect the external regenerative resistor between RB1 and RB2.
11	Motor power terminal/
12	Grounding terminal/
13	USB connector for PC communication (PC)/
14	For MODBUS communication connector (CN0/CN1)/
15	For general I/O signal connector (CN2)/
16	For safety device connecting connector (CN4)/
17	For motor encoder (EN1)/
18	For motor encoder or external encoder (EN2)/
19	For battery connection (CN3)/
20	Rotary switch for communication baud rate and slave address setting (RSW1/RSW2)/

■ RS3C02/05/10

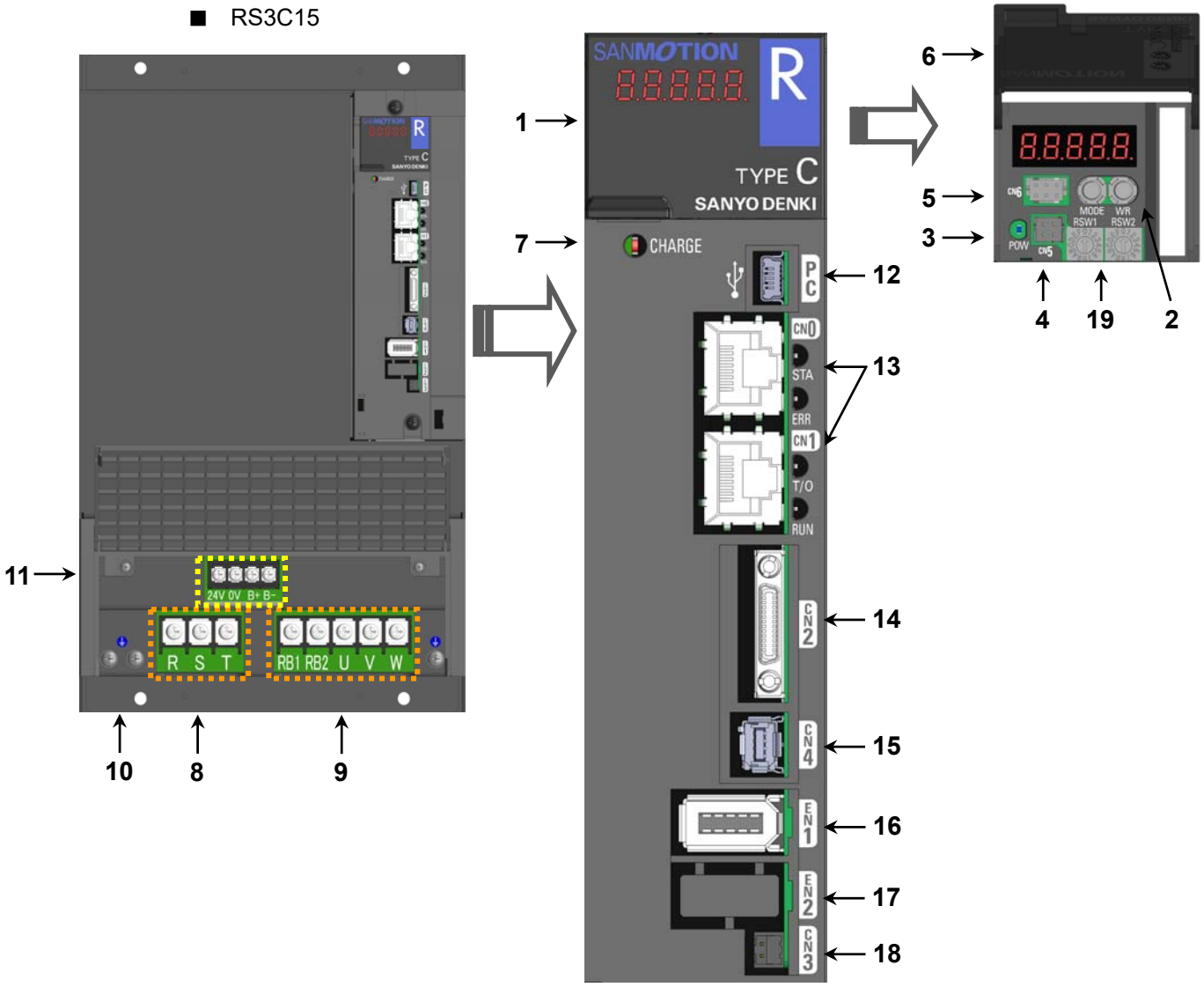




No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (CN5)/ For measuring analog signal such as velocity or current with dedicated cable.
5	(CN6)/ For maintenance
6	Front panel cover/
7	Main circuit power LED (Red)/ Lighting on when main circuit power is ON. Continue lighting during internal capacitor has charge, even if power is OFF. Do not touch power terminal during lighting. There is a risk of electric shock.
8	Main circuit power input (CNA)/ For input terminal of main circuit power
9	Regenerative resistor terminal (CNC)/ For internal regenerative resistor use, connect a shorting-wire between RB4 and RB1. For external regenerative resistor use, remove a shorting-wire and connect a resistor cable between RB1 and RB2. Note) Do not connect the shorting-wire between RB1 and RB2.
10	Control power input (CND)/ For input terminal of control power
11	Holding brake output (CNE)/ Terminal for output of holding brake power.
12	(CNB)/ For motor power cable
13	Grounding terminal/
14	USB connector for PC communication (PC)/
15	For MODBUS communication connector (CN0/CN1)/
16	For general I/O signal connector (CN2)/
17	For safety device connecting connector (CN4)/
18	For motor encoder (EN1)/
19	For motor encoder or external encoder (EN2)/
20	For battery connection (CN3)/
21	Rotary switch for communication baud rate and slave address setting (RSW1/RSW2)/

1. Preface

■ RS3C15

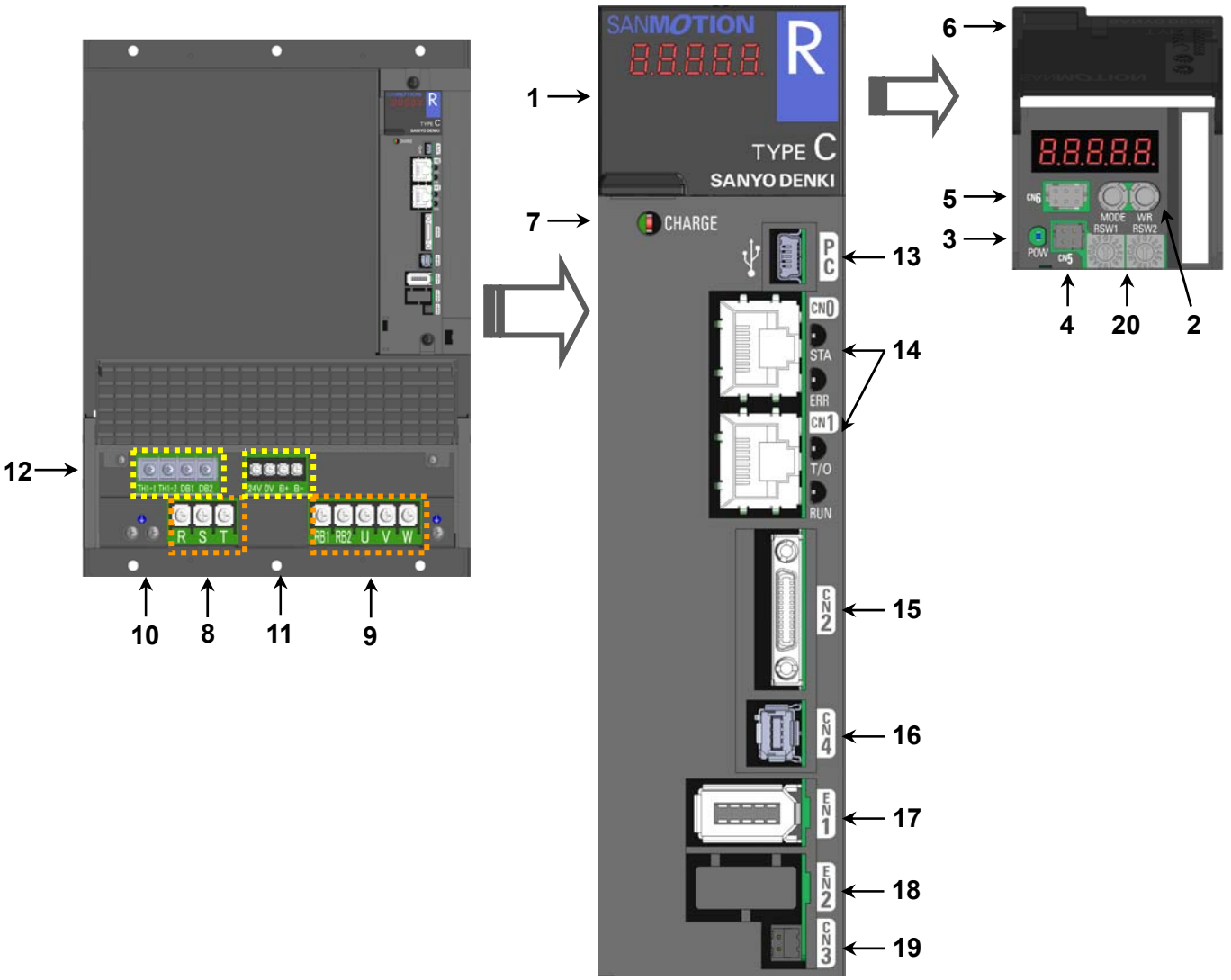


No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (CN5)/ For measuring analog signal such as velocity or current with dedicated cable.
5	(CN6)/ For maintenance
6	Front panel cover/
7	Main circuit power LED (Red)/ Lighting on when main circuit power is ON. Continue lighting during internal capacitor has charge, even if power is OFF. Do not touch power terminal during lighting. There is a risk of electric shock.

No.	Name/ Use
8	Main circuit power input terminal/ For input terminal of main circuit power
9	Terminal block for external regenerative resistor and motor power
10	Grounding terminal/
11	Control power input･Holding brake output/ For control power input terminal and holding brake power output terminal
12	USB connector for PC communication (PC)/
13	For MODBUS communication connector (CN0/CN1)/
14	For general I/O signal connector (CN2)/
15	For safety device connecting connector (CN4)/
16	For motor encoder (EN1)/
17	For motor encoder or external encoder (EN2)/
18	For battery connection (CN3)/
19	Rotary switch for communication baud rate and slave address setting (RSW1/RSW2)/

1.5 Part names

■ RS3C30

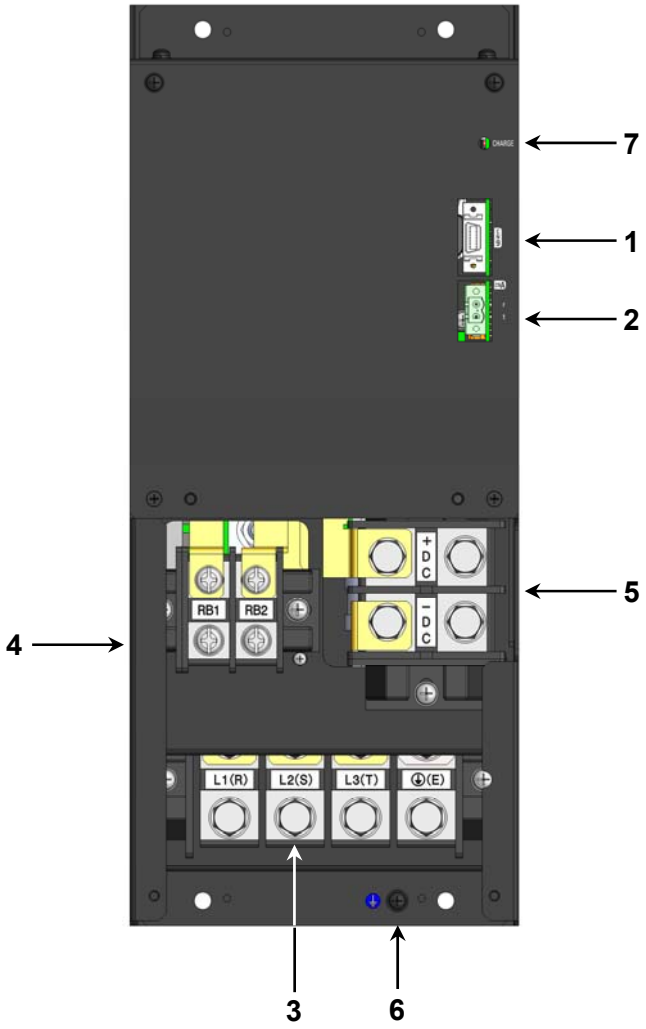


No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (CN5)/ For measuring analog signal such as velocity or current with dedicated cable.
5	(CN6)/ For maintenance
6	Front panel cover/
7	Main circuit power LED (Red)/ Lighting on when main circuit power is ON. Continue lighting during internal capacitor has charge, even if power is OFF. Do not touch power terminal during lighting. There is a risk of electric shock.

No.	Name/ Use
8	Main circuit power input terminal/ For input terminal of main circuit power
9	Terminal block for external regenerative resistor and motor power
10	Grounding terminal/
11	Control power input･Holding brake output/ For control power input terminal and holding brake power output terminal
12	Terminal block for dynamic brake signal and thermal signal
13	USB connector for PC communication (PC)/
14	For MODBUS communication connector (CN0/CN1)/
15	For general I/O signal connector (CN2)/
16	For safety device connecting connector (CN4)/
17	For motor encoder (EN1)/
18	For motor encoder or external encoder (EN2)/
19	For battery connection (CN3)/
20	Rotary switch for communication baud rate and slave address setting (RSW1/RSW2)/

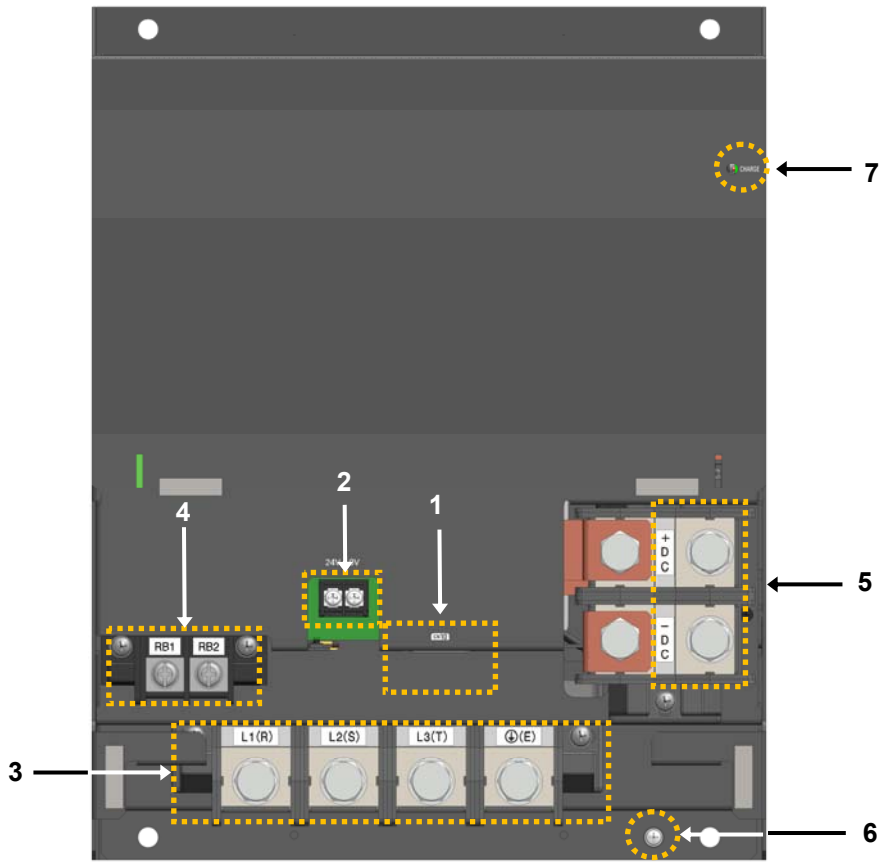
1.5.3 Power unit

■ RS3PAA270



No.	Name/ Use
1	Amplifier unit connection connector Connect to CN9 of the amplifier unit.
2	Control power input (CNA)/ For input terminal of control power
3	Main circuit power input For input terminal of main circuit power Also, grounding a power unit.
4	Regenerative resistor terminal Connect the resistor between RB1 and RB2.
5	DC output terminal for main circuit Connect to +DC/-DC of the amplifier unit.
6	Frame ground Connect to the frame ground of amplifier unit and upper controller.
7	Main circuit power LED (Red)/ Lighting on when main circuit power is ON. Continue lighting during internal capacitor has charge, even if power is OFF. Do not touch power terminal during lighting. There is a risk of electric shock.

■ RS3PAC550

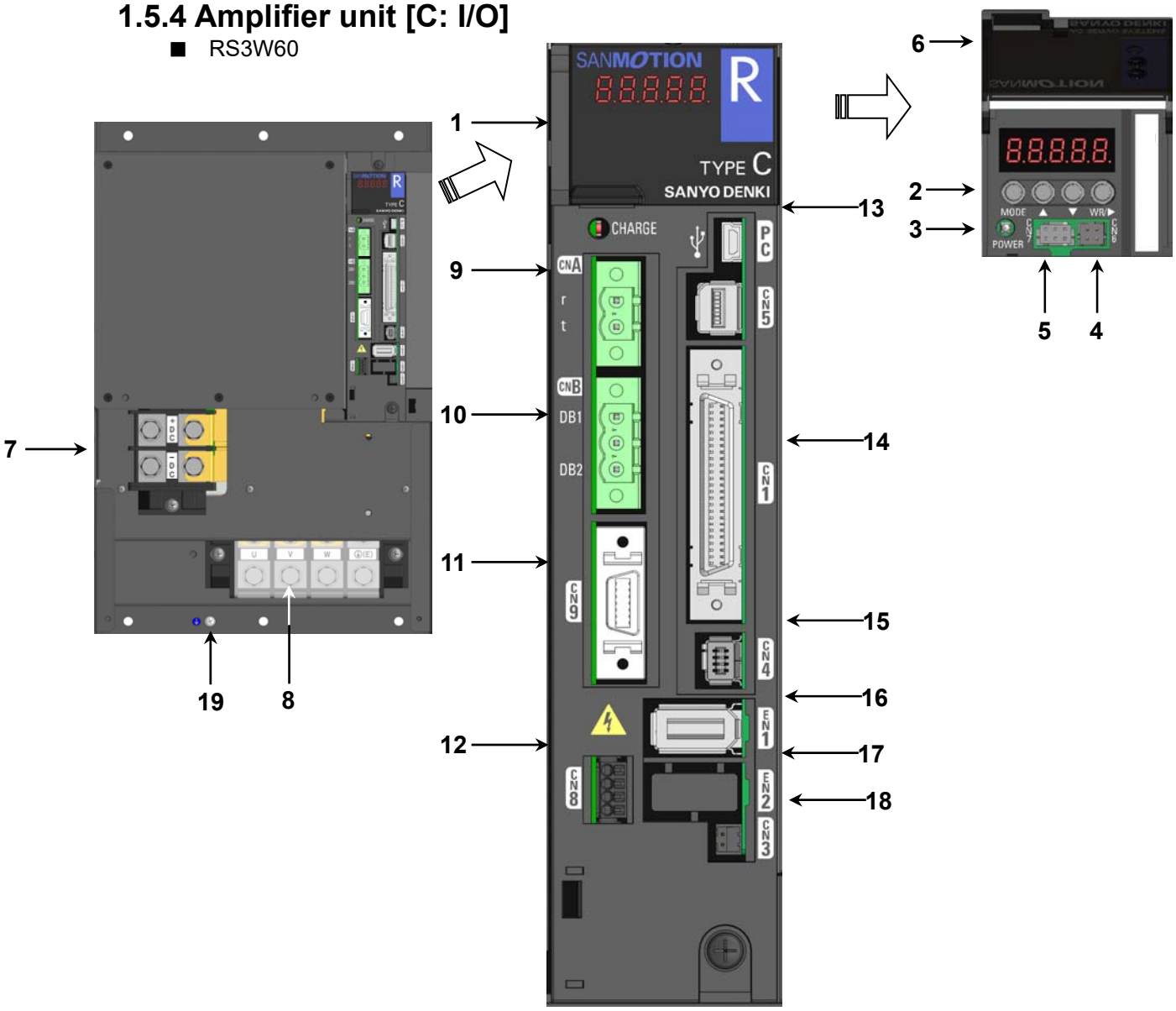


No.	Name/ Use
1	Amplifier unit connection connector (CN10)/ Connect to CN10 of the amplifier unit with optional cable which connects units each other.
2	Control power input (24V・0V)/ For input terminal of control power
3	Main circuit power input(R・S・T・E)/ For input terminal of main circuit power Make sure to connect power grounding cable to terminal E.
4	Regenerative resistor terminal(RB1・RB2)/ Connect the resistor between RB1 and RB2.
5	DC output terminal for main circuit (+DC・-DC) Connect to +DC/-DC of the amplifier unit.
6	Frame ground Connect to the frame ground of amplifier unit.
7	Main circuit power LED (Red)/ Lighting on when main circuit power is ON. Continue lighting during internal capacitor has charge, even if power is OFF. Do not touch power terminal during lighting. There is a risk of electric shock.

1. Preface

1.5.4 Amplifier unit [C: I/O]

■ RS3W60

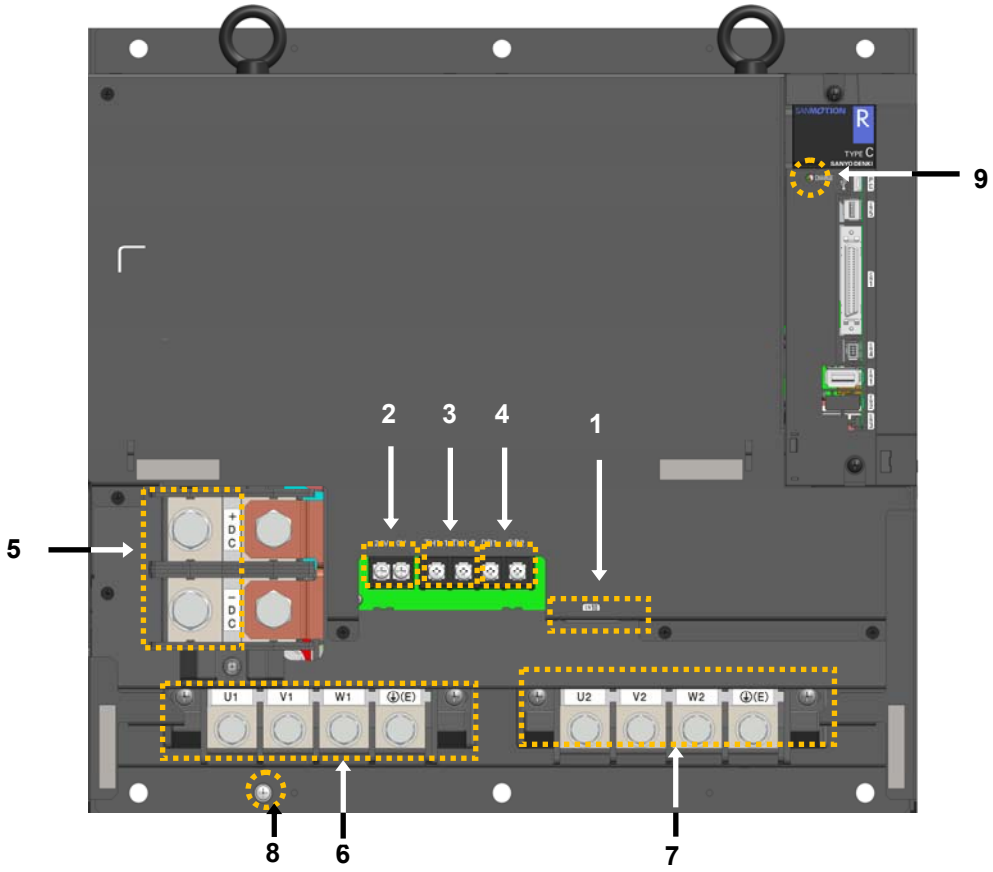


No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For performing a parameter setting.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (CN6)/ For measuring analog signal such as velocity or current with dedicated cable.
5	(CN7)/ For maintenance
6	Front panel cover/
7	Main circuit power DC input/ For connection with +DC/-DC of power unit.
8	Motor power line/

No.	Name/ Use
9	Control power input (CNA)/ For input terminal of control power
10	For dynamic brake signal connector (CNB)/
11	For power unit signal connector (CN9)/ Connect to CN9 of power unit with optional cable which connects units each other (AL-00917284).
12	For external alarm input (CN8)/
13	USB connector for PC communication (PC)/
14	For I/O signal connector with host equipment (CN1)/
15	For safety device connecting connector (CN4)/ *
16	For motor encoder (EN1)/
17	For motor encoder or external encoder (EN2)/ *
18	For battery connection (CN3)/ *
19	Frame grounding/ Connect to frame grounding of power unit.

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

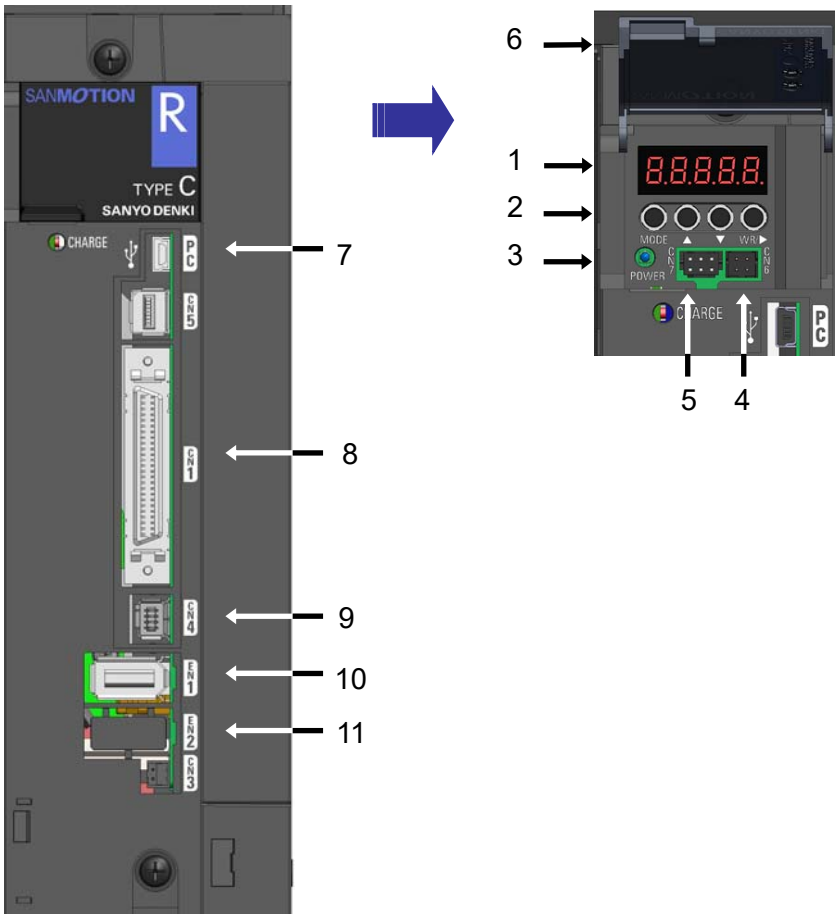
■ RS3D80# terminal block, connector



No.	Name/ Use
1	Power unit connection connector (CN10)/ Connect to CN10 of the power unit with optional cable which connects units each other.
2	Control power input (24V・0V)/ For input terminal of control power
3	Terminal for thermal signal connection of dynamic brake (TH1-1・TH1-2)/ Use as dynamic brake overheat detection. Note) If not used, be sure to make short circuit between terminals.
4	Terminal for dynamic brake signal (DB1・DB2)/ Terminal for dynamic brake signal timing output contact (24 VDC output). Use for construction of dynamic brake circuit externally.
5	DC input terminal for main circuit（+DC・-DC） Connect to +DC/-DC of the power unit.
6	Motor power line (U1・V1・W1・E) Connect to motor terminal block (U1・V1・W1). Be sure to connect motor grounding cable to terminal E.
7	Motor power line (U2・V2・W2・E) Connect to motor terminal block (U2・V2・W2). Be sure to connect motor grounding cable to terminal E.
8	Frame ground Connect to the frame ground of power unit.
9	Main circuit power LED (Red)/ Lighting on when main circuit power is ON. Continue lighting during internal capacitor has charge, even if power is OFF. Do not touch power terminal during lighting. There is a risk of electric shock.

1. Preface

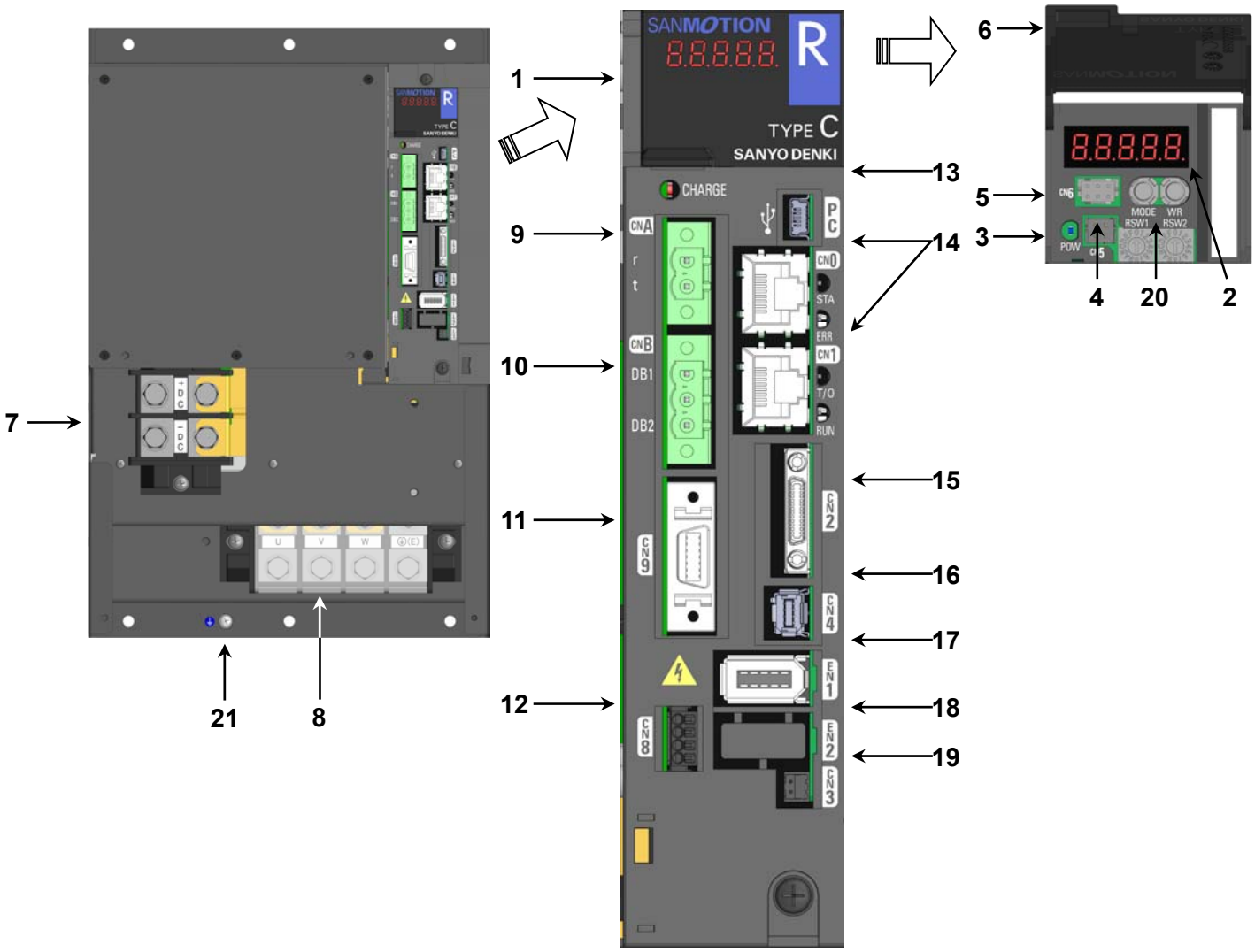
■ RS3D80# interface part with upper device



No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For performing a parameter setting.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (CN6)/ For measuring analog signal such as velocity or current with dedicated cable.
5	(CN7)/ For maintenance
6	Front panel cover/
7	USB connector for PC communication (PC)/
8	For I/O signal connector with host equipment (CN1)/
9	For safety device connecting connector (CN4)/ Note) It may not have the connecter depending on the servo amplifier spec.
10	For motor encoder (EN1)/
11	For motor encoder or external encoder (EN2)/ Note) It may not have the connecter depending on the servo amplifier spec.

1.5.5 Amplifier unit [F: MODBUS]

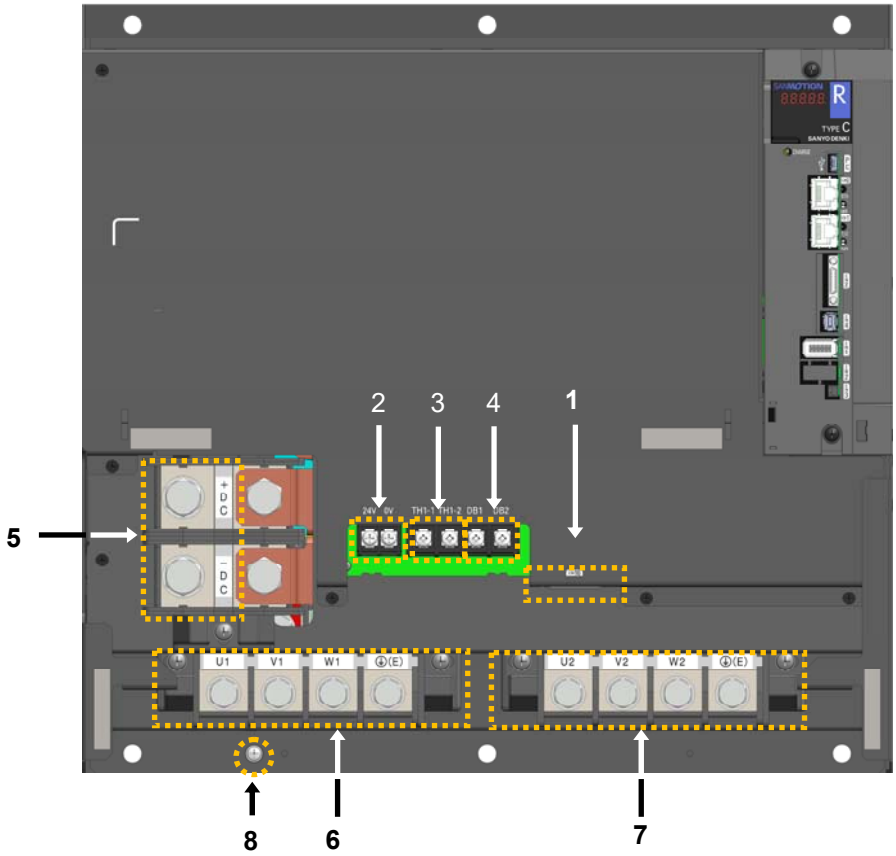
■ RS3W60



No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For performing a parameter setting.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (CN5)/ For measuring analog signal such as velocity or current with dedicated cable.
5	(CN6)/ For maintenance
6	Front panel cover/
7	Main circuit power DC input/ For connection with +DC/-DC of power unit.
8	Motor power line/

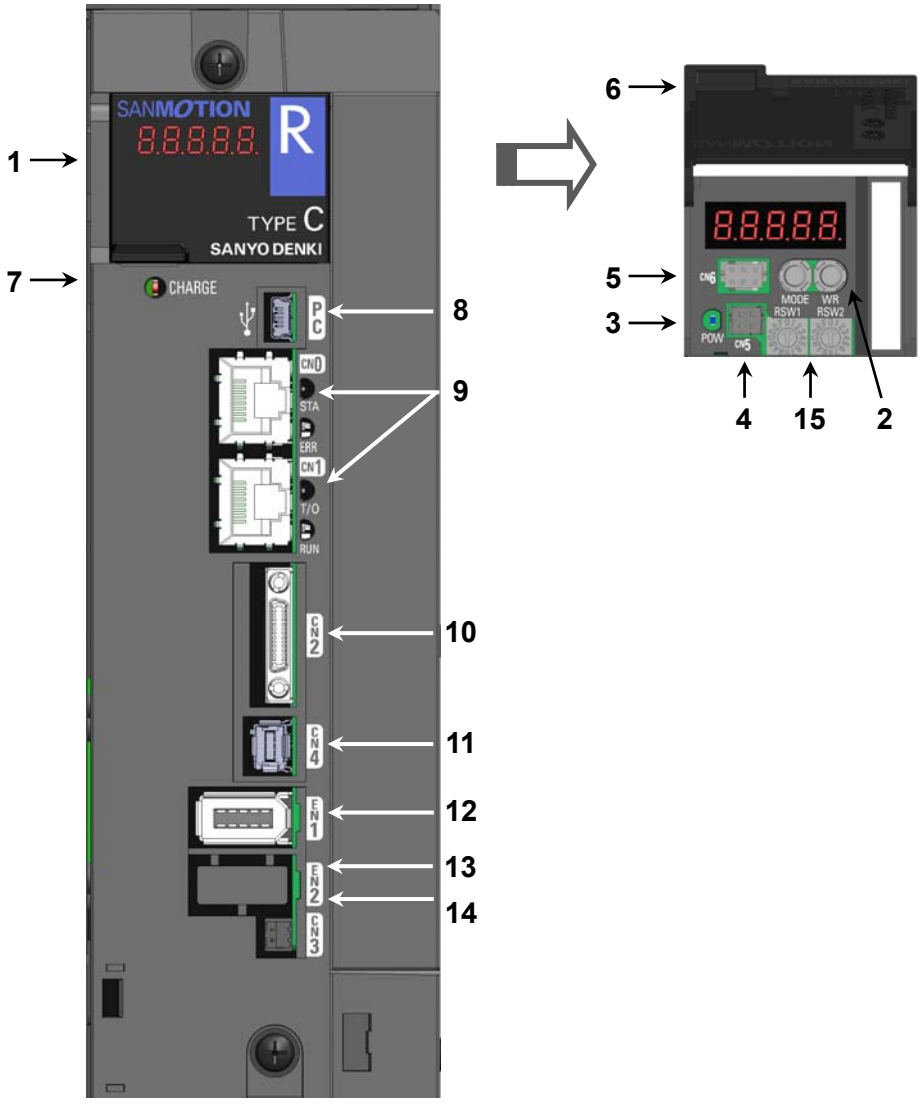
No.	Name/ Use
9	Control power input (CNA)/ For input terminal of control power
10	For dynamic brake signal connector (CNB)/
11	For power unit signal connector (CN9)/ Connect to CN9 of power unit.
12	For external alarm input (CN8)/
13	USB connector for PC communication (PC)/
14	For MODBUS communication connector (CN0/CN1)/
15	For general I/O signal connector (CN2)/
16	For safety device connecting connector (CN4)/
17	For motor encoder (EN1)/
18	For motor encoder or external encoder (EN2)/
19	For battery connection (CN3)/
20	Rotary switch for communication baud rate and slave address setting (RSW1/RSW2)/
21	Frame grounding/ Connect to frame grounding of power unit.

■ RS3D80# terminal block, connector



No.	Name/ Use
1	Power unit connection connector (CN10)/ Connect to CN10 of the power unit with optional cable which connects units each other.
2	Control power input (24V・0V)/ For input terminal of control power
3	Terminal for thermal signal connection of dynamic brake (TH1-1・TH1-2)/ Use as dynamic brake overheat detection. Note) If not used, be sure to make short circuit between terminals.
4	Terminal for dynamic brake signal (DB1・DB2)/ Terminal for dynamic brake signal timing output contact (24 VDC output). Use for construction of dynamic brake circuit externally.
5	DC input terminal for main circuit（+DC・-DC） Connect to +DC/-DC of the power unit.
6	Motor power line (U1・V1・W1・E) Connect to motor terminal block (U1・V1・W1). Be sure to connect motor grounding cable to terminal E.
7	Motor power line (U2・V2・W2・E) Connect to motor terminal block (U2・V2・W2). Be sure to connect motor grounding cable to terminal E.
8	Frame ground Connect to the frame ground of power unit.

■ RS3D80# interface part with upper device



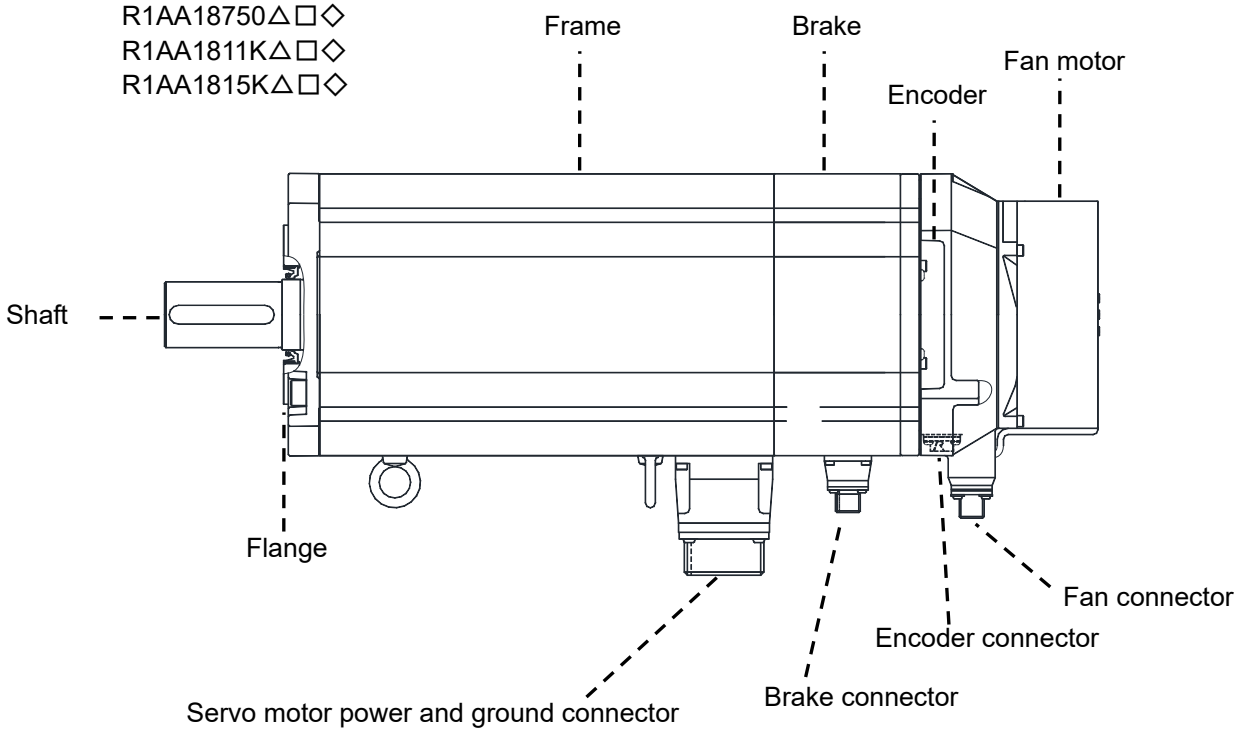
No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (CN5)/ For measuring analog signal such as velocity or current with dedicated cable.
5	(CN6)/ For maintenance
6	Front panel cover/
7	Main circuit power LED (Red)/ Lighting on when main circuit power is ON. Continue lighting during internal capacitor has charge, even if power is OFF. Do not touch power terminal during lighting. There is a risk of electric shock.

No.	Name/ Use
8	USB connector for PC communication (PC)/
9	For MODBUS communication connector (CN0/CN1)/
10	For general I/O signal connector (CN2)/
11	For safety device connecting connector (CN4)/
12	For motor encoder (EN1)/
13	For motor encoder or external encoder (EN2)/
14	For battery connection (CN3)/
15	Rotary switch for communication baud rate and slave address setting (RSW1/RSW2)/

1.5.6 Servo motor

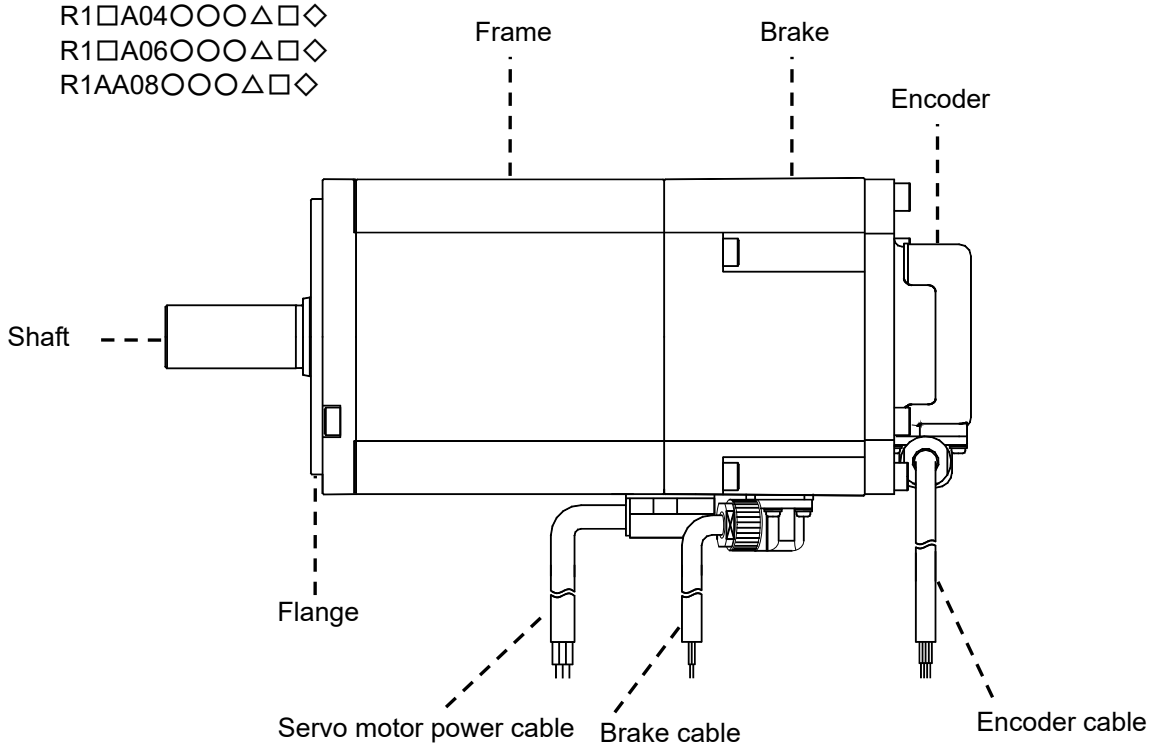
■ R1 servo motor, 180 mm sq./5.5 to 15 kW

R1AA18550△□◇
R1AA18750△□◇
R1AA1811K△□◇
R1AA1815K△□◇



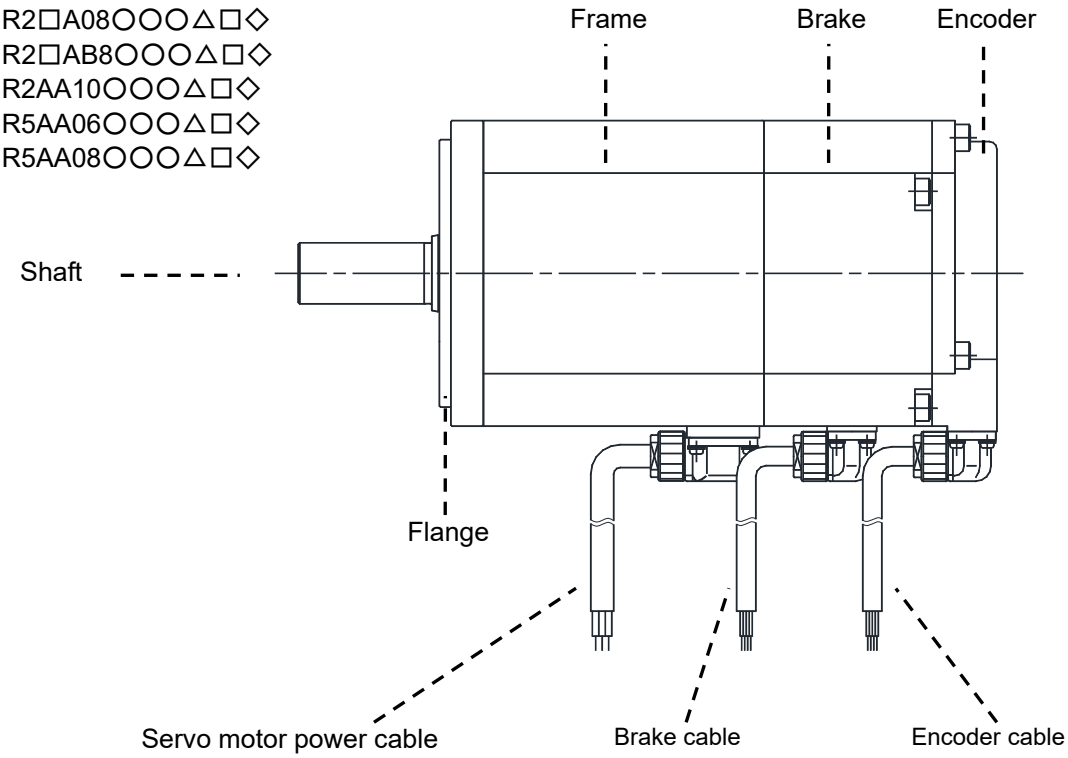
■ R1 servo motor, 40 to 80 mm sq.

R1□A04○○○△□◇
R1□A06○○○△□◇
R1AA08○○○△□◇



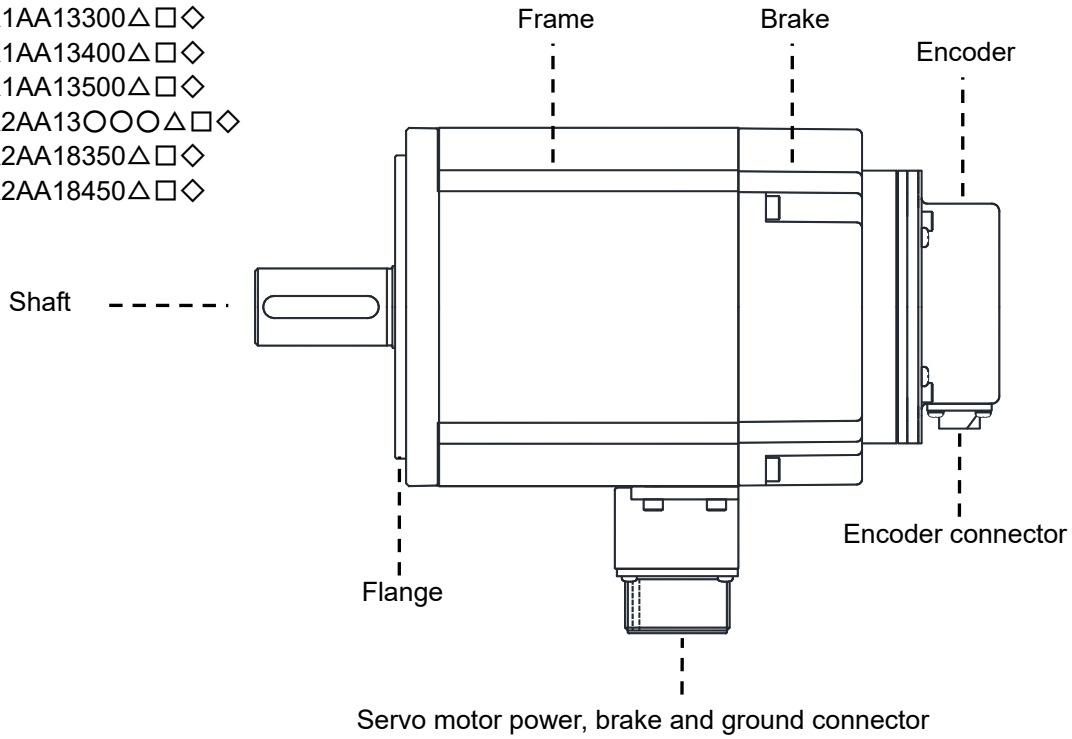
■ R2,R5 servo motor, 40 to 100 mm sq./30 W to 1.0 kW

R2□A04○○○△□◇
R2□A06○○○△□◇
R2□A08○○○△□◇
R2□AB8○○○△□◇
R2AA10○○○△□◇
R5AA06○○○△□◇
R5AA08○○○△□◇

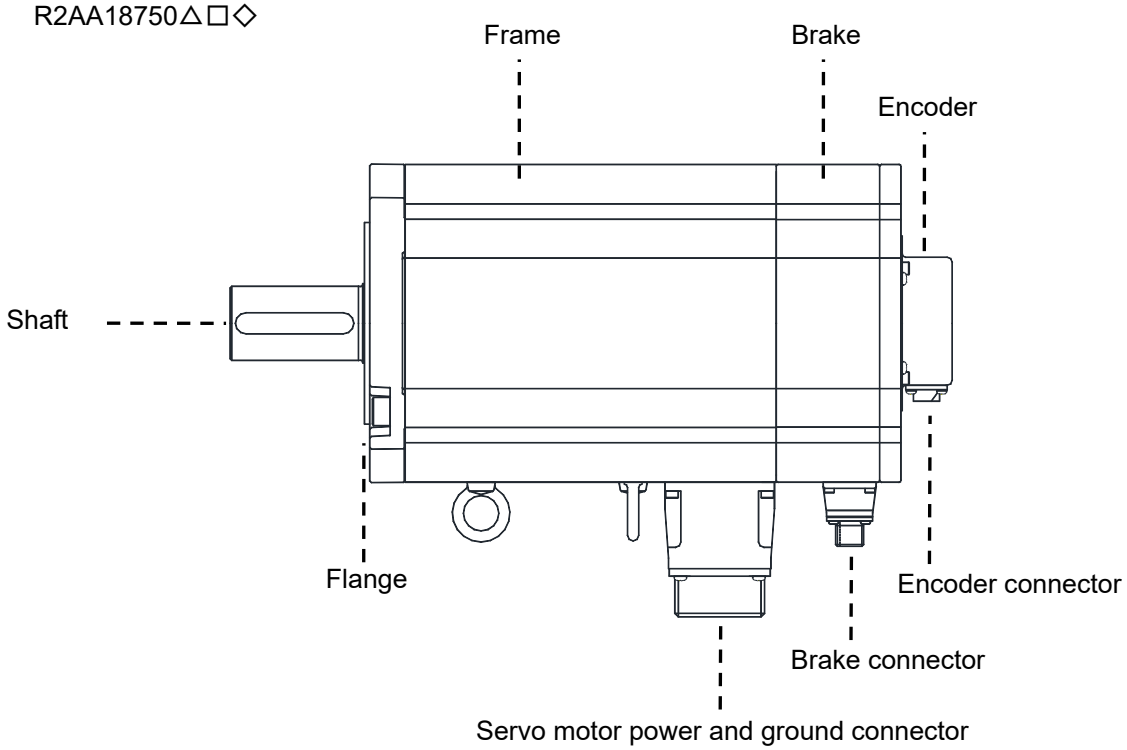


■ R1 servo motor, 100 mm sq./1.0 to 2.5 kW, 130 mm sq./3 to 5 kW
R2 servo motor, 130 mm sq./0.5 to 2 kW, 180 mm sq./3.5 to 4.5 kW

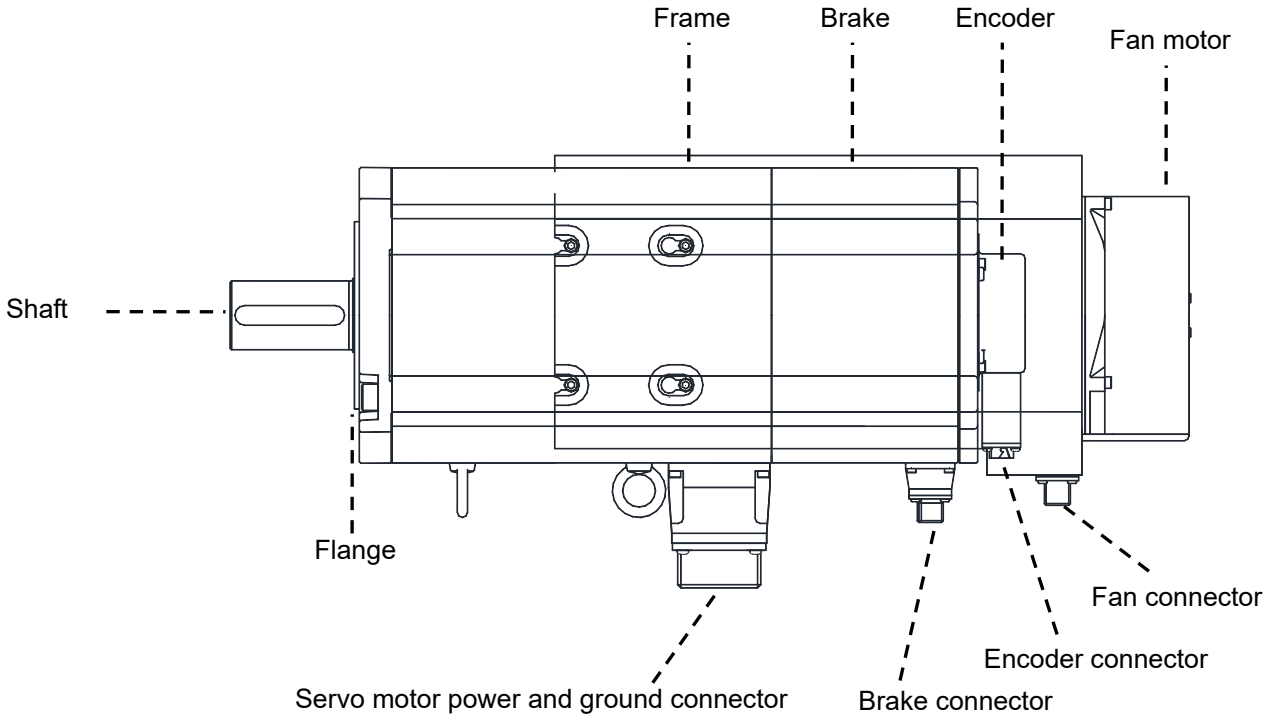
R1AA10100△□◇
R1AA10150△□◇
R1AA10200△□◇
R1AA10250△□◇
R1AA13300△□◇
R1AA13400△□◇
R1AA13500△□◇
R2AA13○○○△□◇
R2AA18350△□◇
R2AA18450△□◇



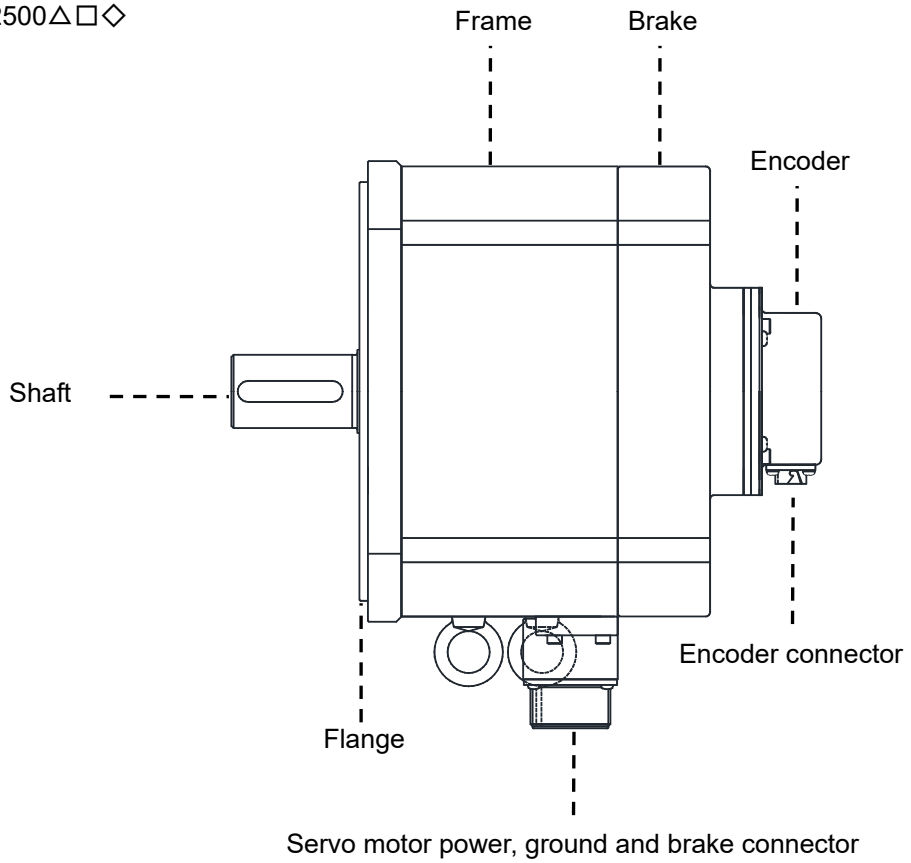
■ R2 servo motor, 180 mm sq./5.5 to 7.5 kW
R2AA18550△□◇
R2AA18750△□◇



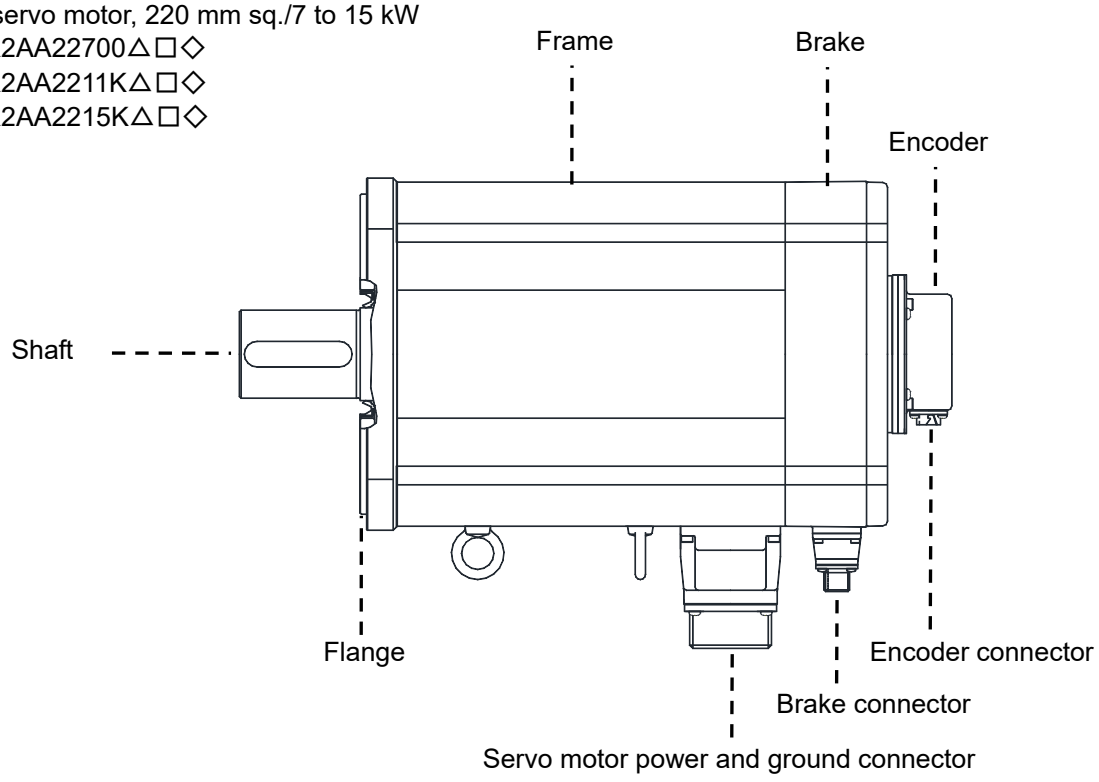
■ R2 servo motor, 180 mm sq./11 kW
R2AA1811K△□◇



■ R2 servo motor, 220 mm sq./5 kW
R2AA22500△□◇



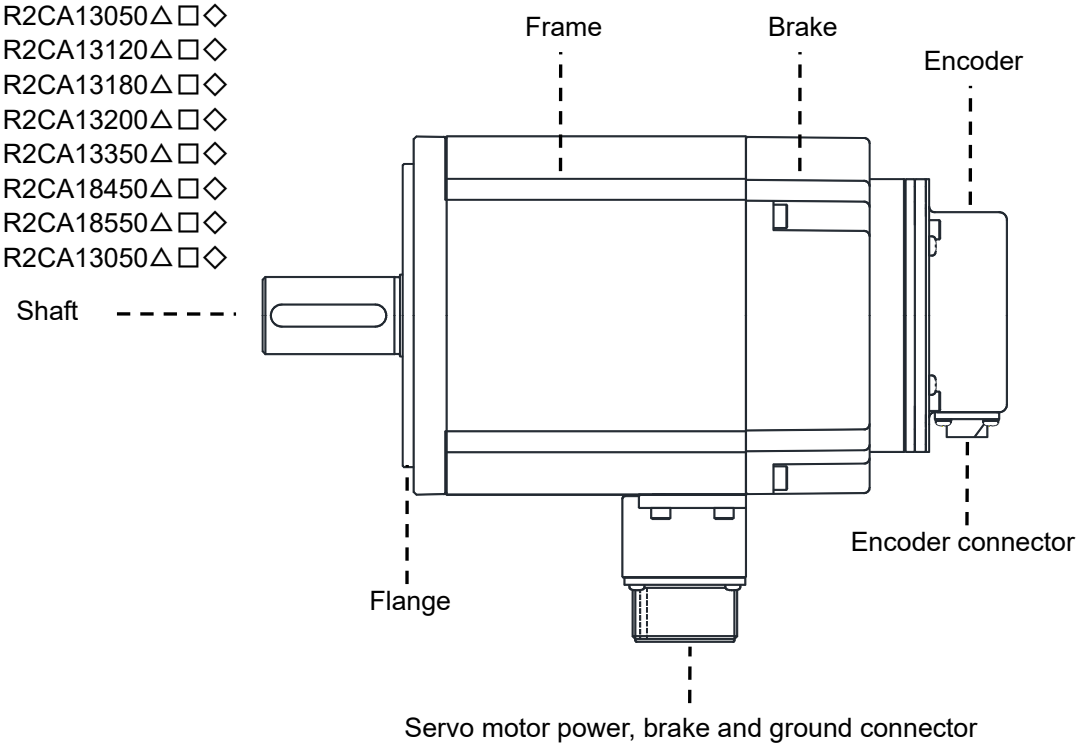
■ R2 servo motor, 220 mm sq./7 to 15 kW
R2AA22700△□◇
R2AA2211K△□◇
R2AA2215K△□◇



1. Preface

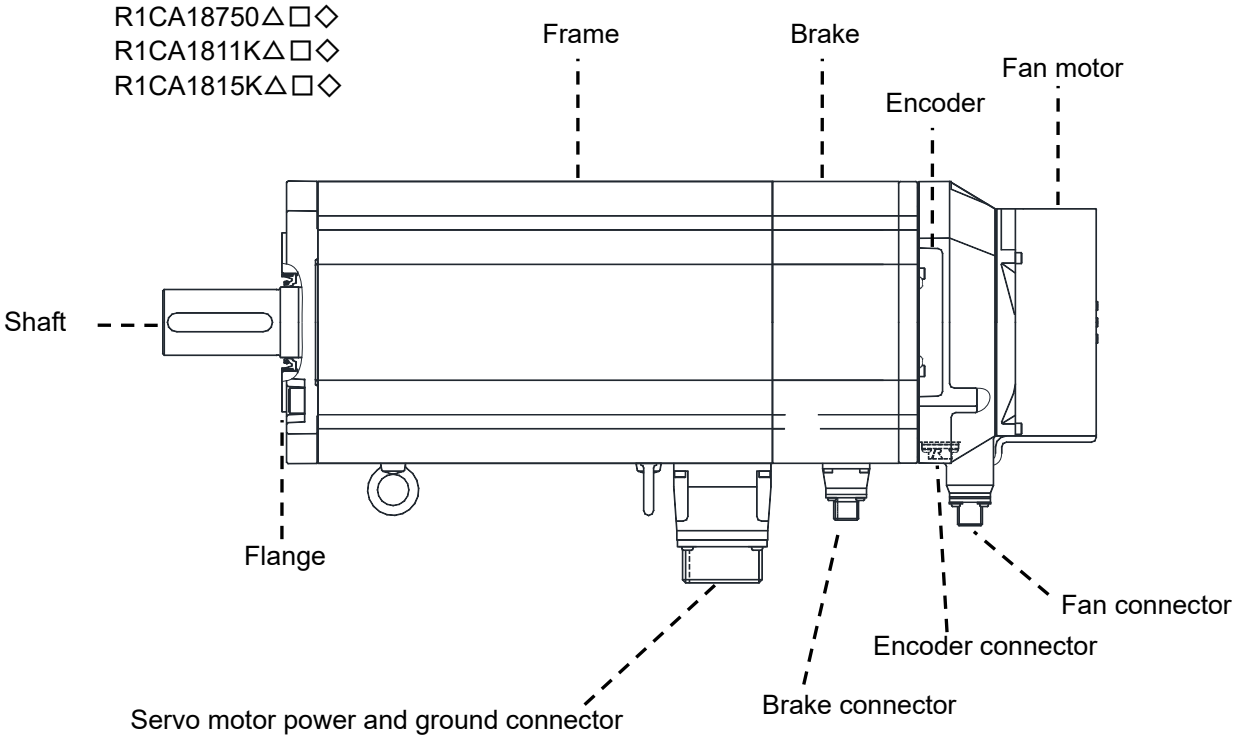
■ R1 servo motor, 100 mm sq./1.5 to 2.0 kW, 130 mm sq./3.0kW
R2 servo motor, 100 mm sq./0.75 to 1.0 kW, 130 mm sq./0.5 to 2.0kW, 180mm sq./5.5kW

R1CA10150△□◇
R1CA10200△□◇
R1CA13300△□◇
R2CA10075△□◇
R2CA10100△□◇
R2CA13050△□◇
R2CA13120△□◇
R2CA13180△□◇
R2CA13200△□◇
R2CA13350△□◇
R2CA18450△□◇
R2CA18550△□◇
R2CA13050△□◇

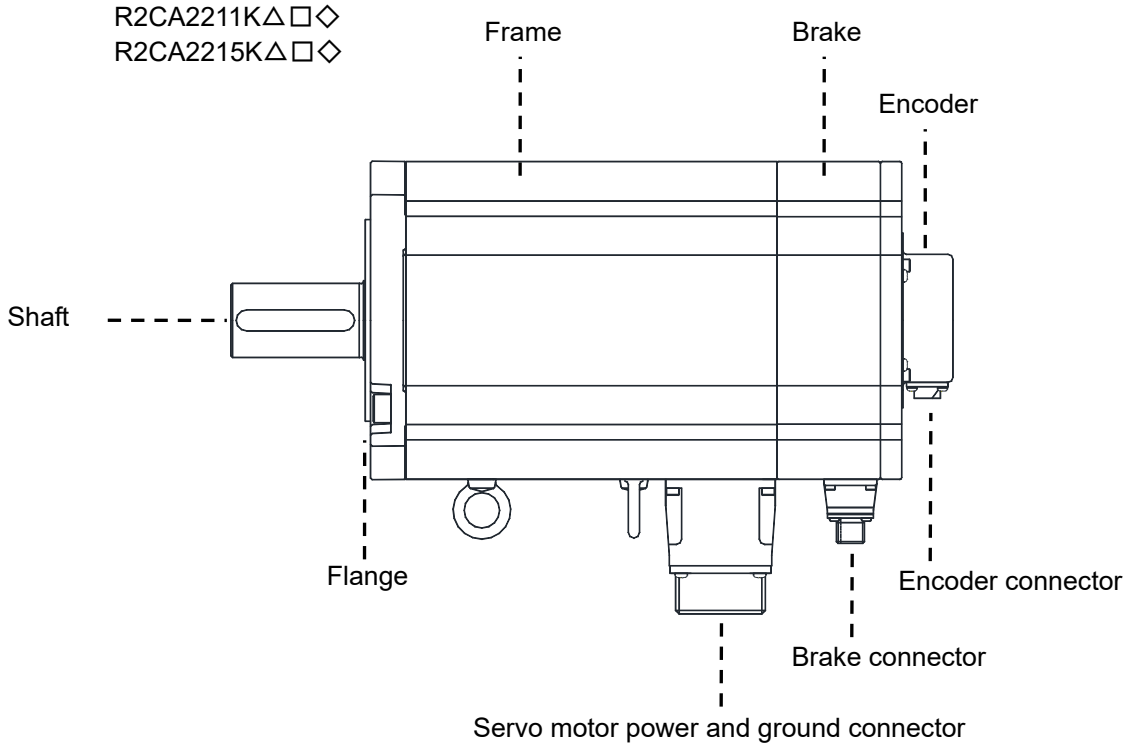


■ R1 servo motor 180mm sq./5.5 to 15kW

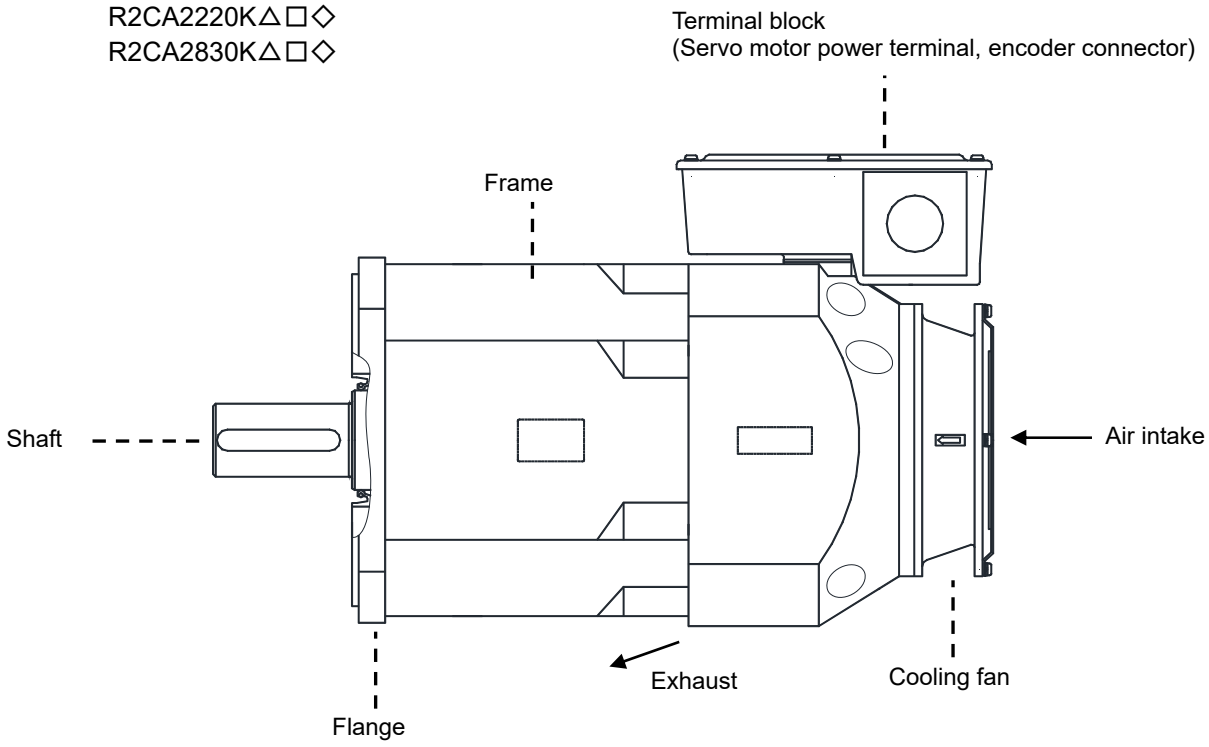
R1CA18550△□◇
R1CA18750△□◇
R1CA1811K△□◇
R1CA1815K△□◇



■ R2 servo motor 180mm sq./7.5kW, 220mm sq./11 to 15kW
R2CA18750△□◇
R2CA2211K△□◇
R2CA2215K△□◇

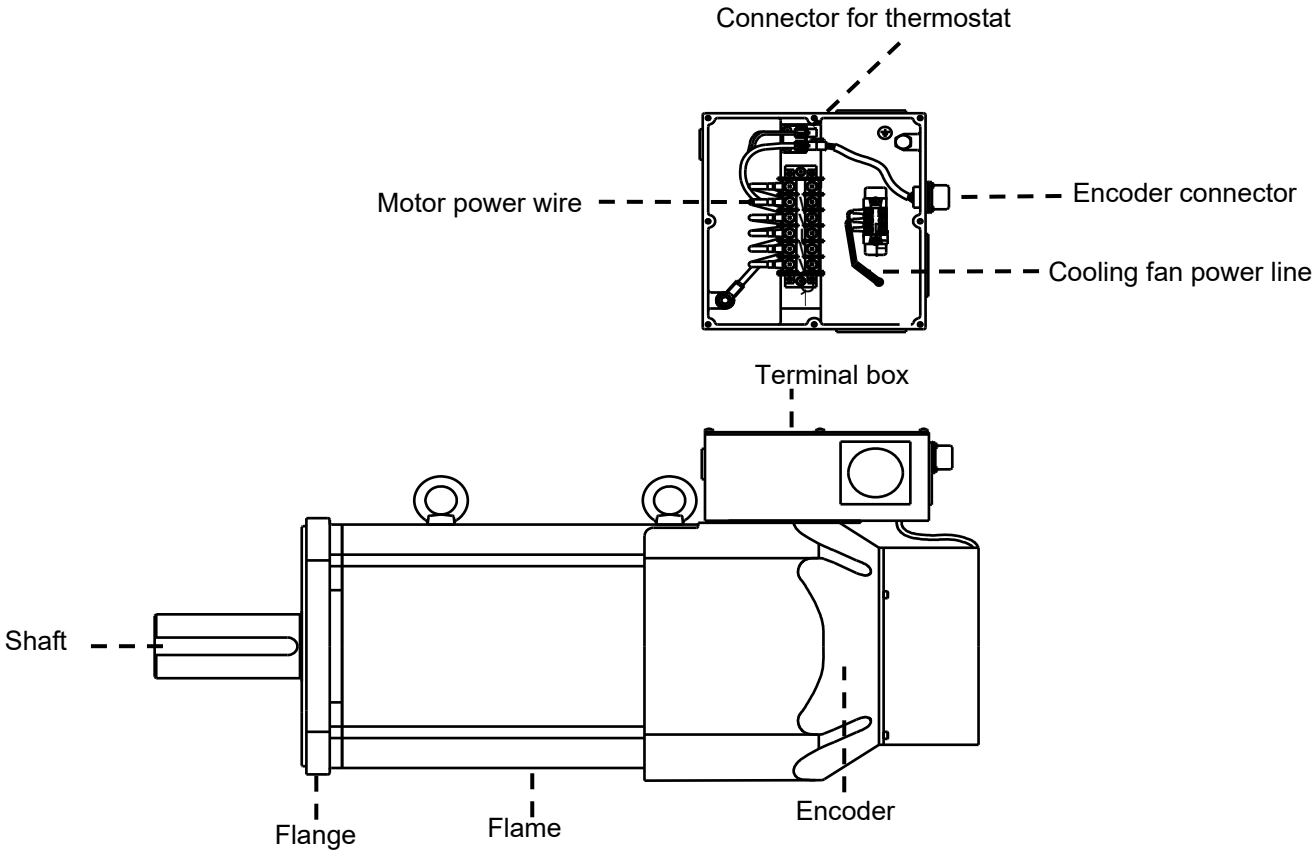


■ R1 servo motor 220mm sq./21kW
R2 servo motor 220mm sq./20kW, 275mm sq./30kW
R1CA2220K△□◇
R2CA2220K△□◇
R2CA2830K△□◇



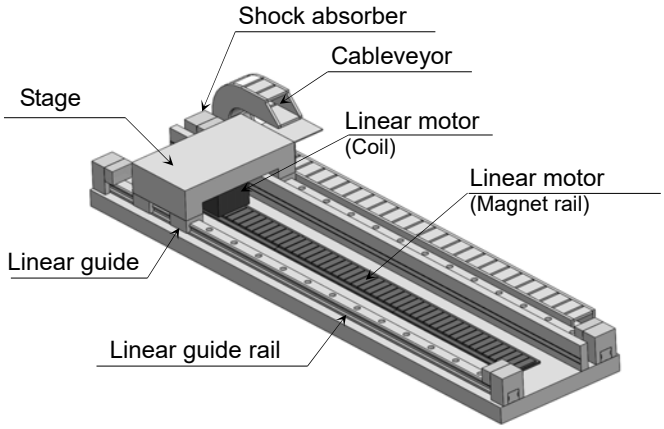
1. Preface

■ R2 sevo motor, 320 mm sq./55 kW
R2CA3255K△□◇

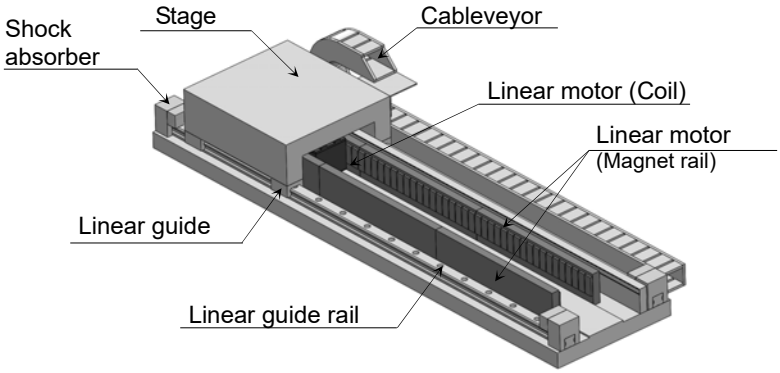


1.5.5 Linear motor

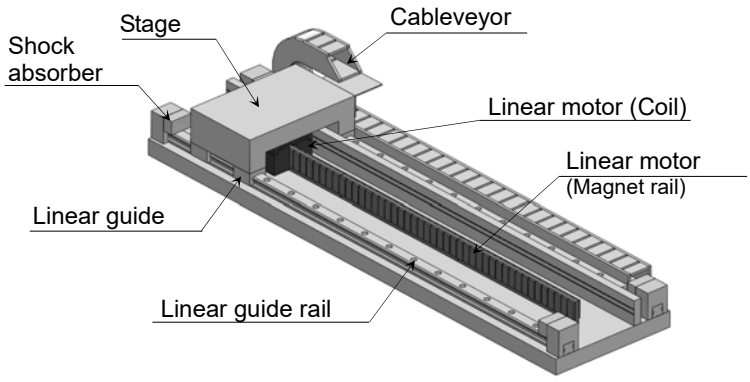
■ Flat type with core
DS030□△○○
DS045□△△○◇
DS050□△○○
DS075□△○○
DS100□△○○
DS150□△○○



■ Twin type with core
DD030□△○○
DD035□△△○◇
DD045□△△○◇
DD050□△○○
DD075□△○○



■ Center magnet type with core
DT030□△○○



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2

Specifications

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

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2. Specifications

2.1 Servo motor

2.1.1 General specifications

Series name	R1, R2, R5	R2CA3255KB
Time rating	Continuous	
Insulation classification	Type F	
Voltage/Dielectric strength	1500V AC (2000V AC), 1 minute. Note) Value in parentheses is for 400V AC R2 motor.	
Insulation resistance	500V DC, greater than 10MΩ	
Protection method	Totally Enclosed, Non-Ventilated	Totally Enclosed Air Over
	Motor flange size 100 or less: IP65, 67 Motor flange size 130 or over: IP65 However, except for axial penetration part and cable tip part	IP55 However except terminal box working part by customer, and fan motor.
Oil Sealing	Motor flange size 100 or less: No oil seal (but optionally available. Exceptionally, motor flange size 100 of R1 motor: With oil seal.) Motor flange size 130 or over: With oil seal	
Ambient temperature	0 to +40°C	
Storage temperature	-20 to +65°C	
Ambient humidity	20 to 90% (without condensation)	
Vibration classification	V15	
Excitation method	Permanent magnet type	
Installation method	Flange mount	

2.1.2 Exterior dimensions/ specifications/ mass

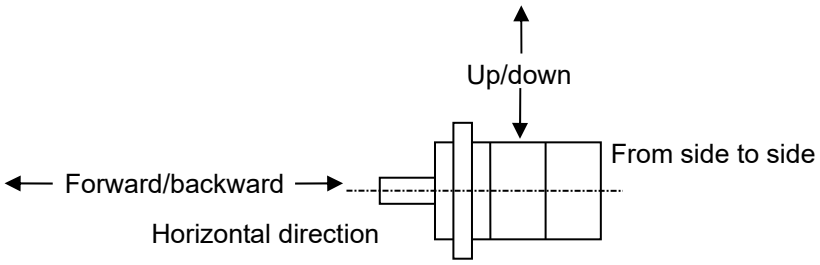
Described on another document: M0011792.

2.1.3 Cooling fan specifications

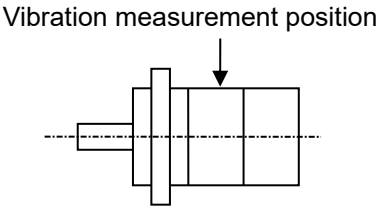
Item	Unit	Constant value
Power supply voltage	V	200 VAC±10 % (180 to 220 VAC)
Frequency	Hz	50/60 (Nominal)
Phase number	-	3-phase
Input	W	150/195 (Nominal)
Current	A	0.9/0.9 (Nominal)

2.1.4 Mechanical specifications/ mechanical strength/ working accuracy

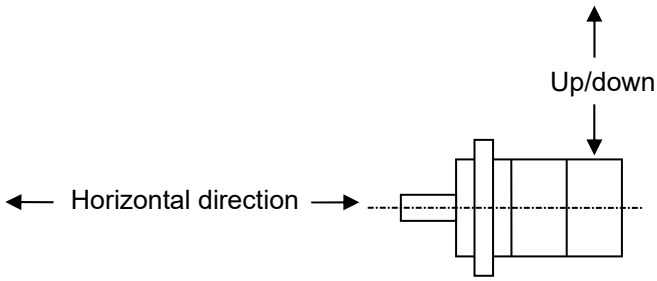
■ Vibration resistance
Install the servo motor horizontally (shown in the figure below), so when vibration occurs in any of three (3) directions (up/down, backward/forward, left/right) the motor will withstand vibration acceleration up to 24.5m/s^2.
Exceptionally for 100 and 130mm flange size R1 motor, 49m/s2 in rotating and 24.5m/s^2 at stop.



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



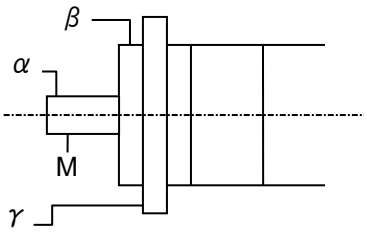
■ Shock resistance
Install the shaft of servo motor in a horizontal direction (shown in the figure below). This shaft should withstand shock acceleration up to 98m/s2 (when shock is applied in an upward/downward direction) for two (2) times. However, since a precision motor encoder is fixed to the counter-load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



2. Specifications

■ 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) 0.04 (280, 320)	
Eccentricity of external diameter of flange on output shaft M: β	0.06 (80 or less)	
	0.08 (100 or over) 0.10 (280, 320)	
Perpendicularity of flange face to output shaft M: γ	0.07 (80 or less)	
	0.08 (100 or over) 0.10 (220 or over)	

* Figures in parentheses indicate square flange dimensions in millimeters.

2.1.5 Oil seal type

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

Servo motor model number	Oil seal type
R1□A04○○○□	Standard: N/A, Optional: G-Type
R1□A06○○○□	Standard: N/A, Optional: S-Type
R1□A08○○○□	Standard: N/A, Optional: S-Type
R1AA10○○○□	Standard: Double Lip seal type
R1AA13○○○□	Standard: S-Type
R1AA18○○○□	Standard: S-Type
R2□A04○○○□	Standard: N/A, Optional: S-Type
R2□A06○○○□/R2□A□8○○○□	Standard: N/A, Optional: S-Type
R2□A10○○○□	Standard: N/A, Optional: S-Type
R2AA13○○○□/R2AA22500L	Standard: Double Lip seal type
R2AA18○○○□/R2AA22○○○□	Standard: S-Type
R5AA06○○○□	Standard: N/A, Optional: S-Type
R5AA08○○○□	Standard: N/A, Optional: S-Type

Servo motor model number	Oil seal type
R1AA2220KV	Standard: With oil seal, S-Type
R2AA2220KB	Standard: With oil seal, S-Type
R2AA2225KB	Standard: With oil seal, S-Type
R2AA2830KV	Standard: With oil seal, S-Type
R1CA10○○○□	Standard: Double Lip seal type
R1CA13○○○□	Standard: S-Type
R1CA18○○○□	Standard: S-Type
R1CA22○○○□	Standard: With oil seal, S-Type
R2CA10○○○□	Standard: N/A, Optional: S-Type
R2CA13○○○□	Standard: Double Lip seal type
R2CA18○○○□	Standard: S-Type
R2CA22○○○□	Standard: S-Type
R2CA28○○○□	Standard: With oil seal, S-Type
R2CA3255KB	Standard: With oil seal, S-Type

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

2. Specifications

2.1.6 Holding brake

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

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

■ Holding brake control
Please control by using holding brake excitation signal from servo amplifier. In use of this signal, set suitable value to "Index 0x2025 Delay Time of Releasing Holding Brake [BOFFDLY]" and "Index 0x2024 Delay Time of Engaging Holding Brake [BONDLY]" by seeing the time in the table below as reference.
In use of the signal from other device for holding brake excitation control, also refer the time in the table below.

Release delay time is same for varistor and diode.

Servo motor model number		Static friction torque N・m	Release delay time ms	Braking delay time ms	
				Varistor	Diode
R1	R1AA04005☐	0.32	25	15	100
	R1AA04010☐				
	R1AA06020☐	1.37	30	20	120
	R1AA06040☐				
	R1AA08075☐	2.55	40	20	200
	R1AA10100☐	9.3	100	30	140
	R1AA10150☐				
	R1AA10200☐				
	R1AA10250☐				
	R1AA13300☐	12	100	30	140
	R1AA13400☐	16	150	50	300
	R1AA13500☐				
	R1AA18550H	54.9	300	140	400
	R1AA18750L				
	R1AA1811KR	75			
	R1AA1815KB	120		60	600
	R1AA2220KV	170	250	-	350
	R1EA04005☐	0.32	25	15	100
	R1EA04010☐				
	R1EA06020☐	1.37	30	20	120

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

Servo motor model number		Static friction torque N·m	Release delay time ms	Braking delay time ms	
				Varistor	Diode
R2	R2AA04003F	0.32	25	15	100
	R2AA04005F				
	R2AA04010F				
	R2AA06010F	0.36	30	20	120
	R2AA06020F	1.37			
	R2AA06040☐	1.37			
	R2AA08020F	2.55	40		200
	R2AA08040F				
	R2AA08075F				
	R2AAB8075F	3.92			
	R2AAB8100☐				
	R2AA10075F				
	R2AA10100F				
	R2AA13050☐	3.50		30	120
	R2AA13120☐	9.0	100		130
	R2AA13180☐				
	R2AA13200☐	12.0			140
	R2AA18350☐	22.0	120	50	150
	R2AA18450H	32.0	150	60	250
	R2AA18550☐	42.0	150	60	250
	R2AA18750H	54.9	300	140	400
	R2AA1811KR	100	300	140	400
	R2AA22500L	42	150	60	250
	R2AA22700S	90	300	140	400
	R2AA2211KB				
	R2AA2215KB				
	R2AA2220KB	170	250	-	350
	R2AA2225KB	-	-	-	-
	R2AA2830KV	-	-	-	-
	R2EA04003F	0.32	25	15	100
	R2EA04005F				
	R2EA04008F				
	R2EA06010F	0.36	30	20	120
	R2EA06020F	1.37			
R5	R5AA06020☐				
	R5AA06040☐				
	R5AA08075☐	2.55	40		200

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

2. Specifications

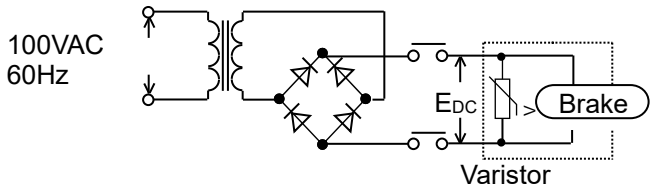
Delay times below are not including the delay time by acting relay etc.
The value in parentheses shows the time including delay of internal action when using CNE brake output of servo amplifier.
Release delay time is same even if using either of varistor or diode.

Servo motor model number		Static friction torque N·m	Release delay time ms	Braking delay time ms	
				Varistor	Diode
R1	R1CA10150V	9.3	100 (125)	30 (55)	140 (165)
	R1CA10200V				
	R1CA13300V	12			
	R1CA18550H	54.9	300 (325)	140 (165)	400 (425)
	R1CA18750L				
	R1CA1811KR	75			
	R1CA1815KB	120		60 (85)	600 (625)
	R1CA2220KV	There is no model with brake.			
R2	R2CA10075F	3.92	40 (65)	20 (45)	200 (225)
	R2CA10100F				
	R2CA13050☐	3.50		30 (55)	120 (145)
	R2CA13120☐	9.0	100 (125)		130 (155)
	R2CA13180☐				
	R2CA13200☐	12.0			140 (165)
	R2CA18350☐	22.0	120 (145)	50 (75)	150 (175)
	R2CA18450H	32.0	150 (175)	60 (85)	250 (275)
	R2CA18550☐	42.0	150 (175)	60 (85)	250 (275)
	R2CA18750☐	54.9	300 (325)	140 (165)	400 (425)
	R2CA2211K☐	90	300 (325)	140 (165)	400 (425)
	R2CA2215K☐				
	R2CA2220K☐	170	250 (275)	-	350 (375)
	R2CA2830K☐	191.2	600 (625)	-	600 (625)

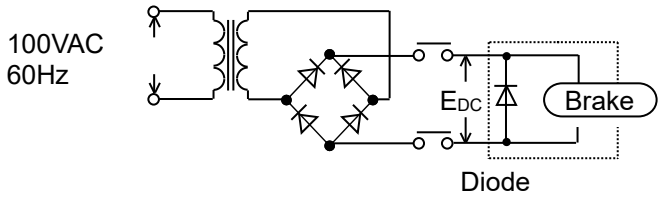
* Please contact us for specifications of the other model number above.
* For servo motor R2CA3255KB, there is no specification with brake.

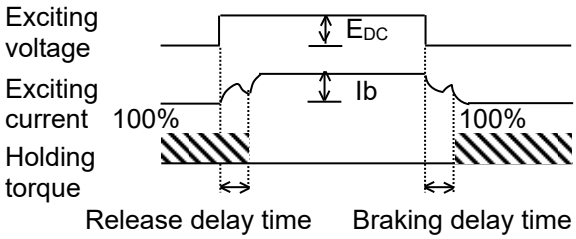
■ Measurement of release delay time and braking delay time
The value of release delay time and braking delay time are measured by the circuit below.

◆ Varistor used circuit

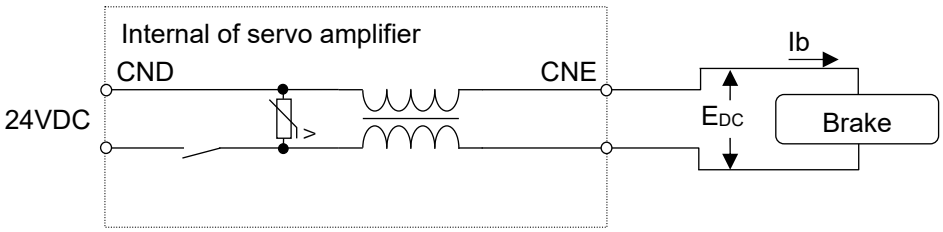


◆ Diode used circuit





◆ When using CNE holding brake output which is built in servo amplifier (400VAC)



* For use of holding brake power supply built in servo amplifier, brake power voltage may drop by influence of cable impedance. Make sure the voltage at power plug of motor is 21.6 VDC or more. If it is less than 21.6 VDC, adjust control power voltage up to 26.4 VDC and check the voltage again.

2.1.7 Degree of decrease rating for R1□A / R2□A 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.

Brake \ Oil seal	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

	R1AA06040F	R1AA08075□	R1EA04005F	R1EA04010F	R1EA06020F
Degree of decrease rating 1	90%	-	-	80%	-
Degree of decrease rating 2	80%	90%	90%	80%	90%

	R2AA04005F	R2AA04010F	R2AA06040□	R2AA08075F	R2EA04005F
Degree of decrease rating 1	-	90%	90%	-	-
Degree of decrease rating 2	90%	85%	80%	90%	90%

2. Specifications

2.2 Linear motor

2.2.1 General specifications

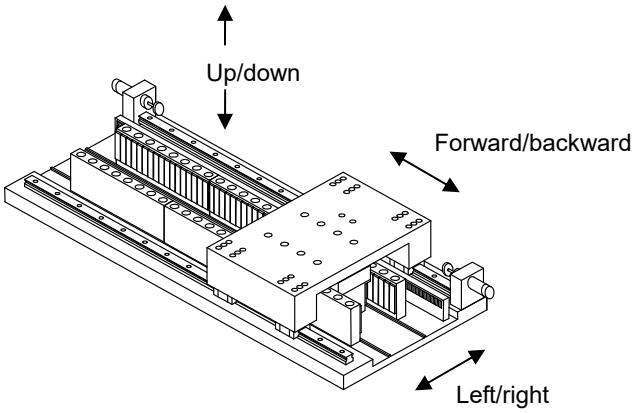
Series name	DS, DD, DT
Time rating	Continuous
Insulation classification	Type F
Voltage/Dielectric strength	1500V AC, 1 minute.
Insulation resistance	500V DC, greater than 10MΩ
Protection method	Self-cooling type or Water cooling type (IP00)
Ambient temperature	0 to +40°C
Storage temperature	-20 to +65°C
Ambient humidity	20 to 90% (without condensation)
Excitation method	Permanent magnet type
Elevation	Less than 1000m

2.2.2 Exterior dimensions/ specifications/ mass

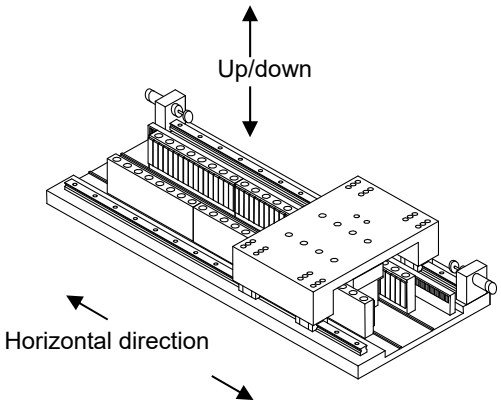
Described on another document: M0011791.

2.2.3 Mechanical specifications

■ Vibration resistance
Install the linear 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.

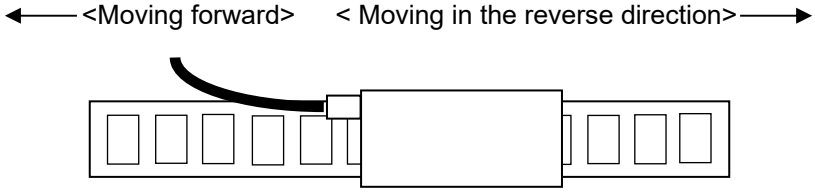


■ Shock resistance
Install the linear motor in a horizontal direction (shown in the figure below) and add shock to vertical direction. The motor should withstand shock acceleration up to 98m/s^2 (when shock is applied in an upward/downward direction) for two (2) times.

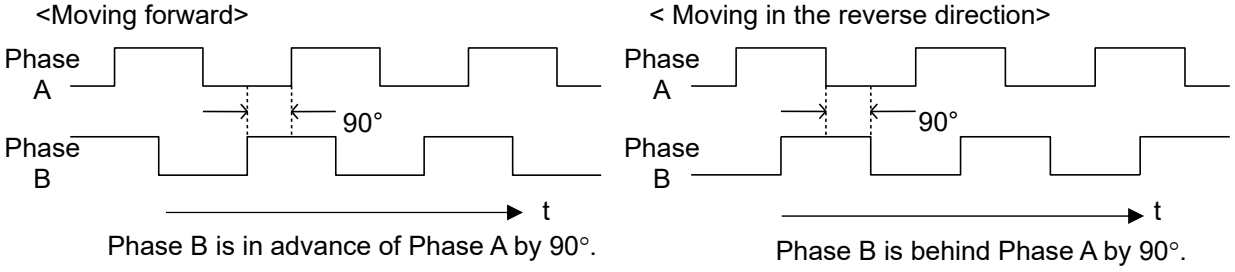


2.2.4 Moving direction of linear motor (DD/DS/DT series)

■ Forward moving direction of linear motor is defined as the direction to where power line lead pulled out when position command inputs a command to increase.

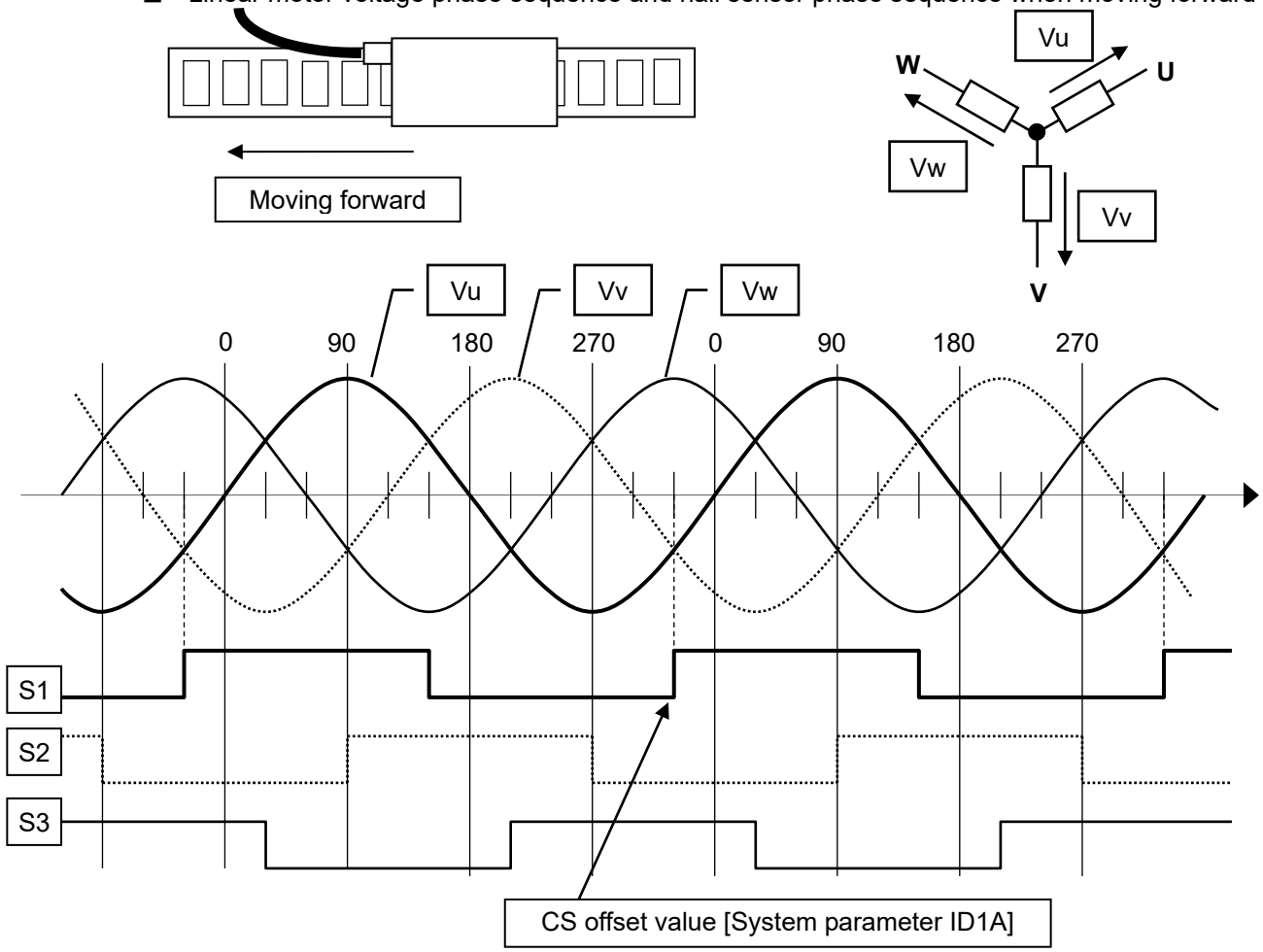


■ Linear encoder signal phase



2. Specifications

■ Linear motor voltage phase sequence and hall sensor phase sequence when moving forward



* CS offset value of each linear motor is shown in table below.
In case of using our recommendation Hall effect sensor, CS-offset value shall be set depending on table below, before operation.

Combination amplifier	Linear motor model number	CS offset value
RS3A03	DS030C1N2	330
	DS050C1N2	330
	DS075C1N2	330
	DS045CC1AN	155
	DT030C01AN	240
RS3A05	DS030C2N2	330
	DS050C2N2	330
	DS075C2N2	330
	DS100C1N2	330
	DS150C1N2	330
	DD030C1Y4	330
RS3A07	DS030C3N2	330
	DS050C3N2	330
	DS075C3N2	330
	DD030C2Y4	330
	DD050C1Y2	330
	DD075C1Y2	330
	DD045CB4AN	290
	DD035CC2AN	230

Combination amplifier	Linear motor model number	CS offset value
RS3A10	DS030C3N2	330
	DS050C3N2	330
	DS075C3N2	330
	DS100C2N2	330
	DS150C2N2	330
	DD030C2Y4	330
	DD030C3Y4	330
	DD050C1Y2	330
	DD075C1Y2	330
	DD045CB4AN	290
RS3A15	DS100C3N2	330
	DS150C3N2	330
	DD050C2Y2	330
	DD075C2Y2	330
RS3A30	DD050C3Y2	330
	DD075C3Y2	330
	DD075C4Y2	330

2.3 Motor encoder

2.3.1 Absolute encoder

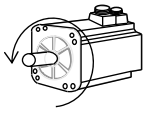
■ Absolute encoder specifications

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

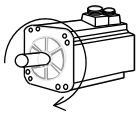
* For a positioning function built-in servo amplifier, use the absolute encoder of system division number (131,072) in GroupA ID3B.
* Please contact us for applicable or not of motor model number, equipping absolute encoder except above.

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

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



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



* Positive rotation is the direction of CCW seeing from load side to servo motor.
* PS data can be confirmed by ID33,34 ABSPS in “5.5 Monitor display mode”.

2. Specifications

2.3.2 Incremental encoder specifications

■ Wire-saving incremental encoder

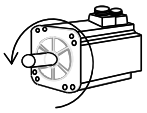
Model	Motor model number encoder code	Resolution	Applicable motor flange size
PP031H PP031T	S	1000/2000/2048/4096/5000/6000/8192/10000 P/R	40 mm sq. or more
PP062	S	1000/2000/2048/4096/5000/6000/8192/10000 P/R	80 mm sq. or more
PP062H	S	5,000P/R Note 1)	320 mm sq. or more

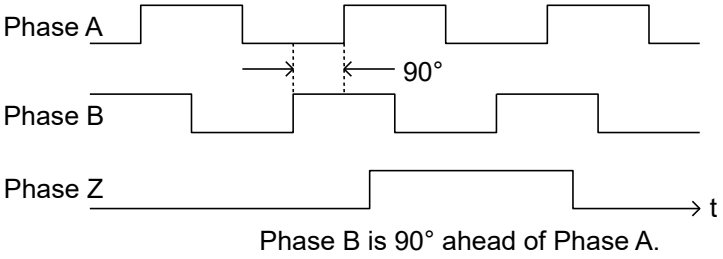
Model number example: R2-series, 60mm sq., 200W-model
R2AA06020FCS00

Note 1) Please contact us for the motor model number with the other incremental encoder except above.

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

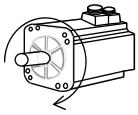
Servo motor rotation direction-Positive

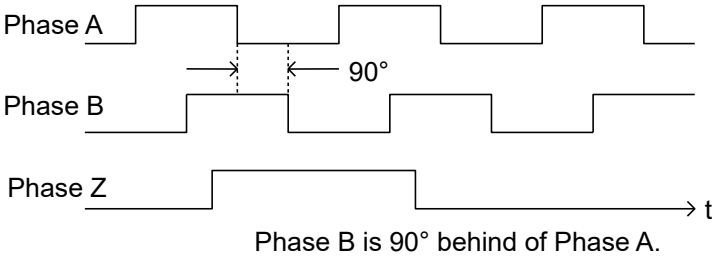




Phase B is 90° ahead of Phase A.

Servo motor rotation direction- Negative





Phase B is 90° behind of Phase A.

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

2.3.3 Battery specification

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

2.4 Linear encoder

2.4.1 Applicable linear encoder

The products below are applicable as combination linear encoder.

■ Incremental encoder

Manufacturer	Series name	Output signal	Power supply voltage	Minimum resolution
Renishaw Inc	RGH22	RS422-compliant, 90 degree phase shift pulse train	5V±5%	0.1 to 5μm
Heidenhain Corporation	LIDA400			0.05 to 1μm
	LIDA200			0.5 to 5μm

* Output signal is applicable to only RS422-compliant 90 degree phase shift pulse train (LIDA47 and LIDA27). Analog sinusoidal output (LIDA47 and LIDA27) or serial signal output is not available.
* Please contact each linear encoder manufacturer for the details of performance, specification, warranty, and installation.
* For a positioning function built-in servo amplifier, select applicable incremental encoder with conditions below:
  - System division number (131,072 or less) in GroupA ID3B.
  - User division number (131,072 or less) in GroupA ID3C.
  - Velocity/position data decimal point (0 to 5) in GroupA ID3E.

■ Absolute encoder

EnDAT2.2 interface is only applicable.

Manufacturer	Series name	Power supply voltage	Resolution	Maximum speed	Effective measurement distance (Maximum)
Heidenhain Corporation	LIC4100	5V±5%	0.01μm 0.005μm 0.001μm	6m/s	28,440mm
	LIC2100		0.1μm 0.05μm	6m/s	6,020mm
	LC400		0.01μm 0.001μm	3m/s	2,040mm

* Above table spec is depending on our servo amplifier combination.
  Something may differ from manufacturer spec.
* Effective measurement distance is manufacturer spec.
* Please contact each linear encoder manufacturer for the details of performance, specification, warranty, and installation.
* It is not applicable except EnDat2.2 interface (Ordering designation: EnDat22).
* Please contact us if combined with the other of above recommendation encoder.
* For a positioning function built-in servo amplifier, select applicable incremental encoder with conditions below:
  - System division number (131,072 or less) in GroupA ID3B.
  - User division number (131,072 or less) in GroupA ID3C.
  - Velocity/position data decimal point (0 to 5) in GroupA ID3E.
* Maximum command value of point data is -2,147,483,648 to +2,147,483,647.
  Check an effective stroke length at the command unit decided by positioning function parameter.

2. Specifications

2.5 Servo amplifier

2.5.1 General specifications

■ General specifications (100/200 VAC)

Control function		Speed control/Torque control/Position control (Parameter changeover)							
Control system		IGBT: PWM control Sinusoidal drive							
Main Circuit Power Note 1)		Three-phase: 200 to 240 VAC +10,-15 %, 50/60 Hz±3 Hz Single-phrase: 200 to 240 VAC +10,-15 %, 50/60 Hz±3 Hz Note 2) Single-phrase: 100 to 120 VAC +10,-15 %, 50/60 Hz±3 Hz Note 3)							
Control power Note 1)		Single-phrase: 200 to 240 VAC +10,-15 %, 50/60 Hz±3 Hz Single-phrase: 100 to 120 VAC +10,-15 %, 50/60 Hz±3 Hz Note 3)							
Environment		Ambient temperature	0 to 55 ℃						
		Storage temperature	-20 to +65 ℃						
		Operation/ Storage humidity	Below 90 %RH (no condensation)						
		Elevation	Below 1,000 m						
		Vibration	4.9 m/s^2						
		Shock	19.6 m/s^2						
Structure		Built-in tray type power supply							
Servo amplifier model number		RS3#01A#HA# RS3#01A#HL#	RS3#02A#HA# RS3#02A#HL#	RS3#03A#HA# RS3#03A#HL#	RS3A05A#HA# RS3A05A#HL#	RS3A07A#HA# RS3A07A#HL#	RS3A10A#HA# RS3A10A#HL#	RS3A15A#HA# RS3A15A#HL#	RS3A30A#HL#
External dimensions (H×W×D) (mm)		160×40×130	160×40×130	160×50×130	160×85×130	160×95×190	205(235) ×100 × 220	205(235) ×120×220	205(235) ×220×220
Weight (kg)	Without internal regenerative resistor	0.7	0.7	0.8	1.5	2.3	4.2	4.8	9.8
	With internal regenerative resistor	0.8	0.8	0.9	1.6	2.5	4.2	5.0	None

Note 1) Power source voltage should be within the specified range.
200 VAC Power input type: Specified power supply range = 170 to 264 VAC
100 VAC Power input type: Specified power supply range = 85 to 132 VAC
Note 2) 200 VAC -single-phase input type corresponds only to RS3□01/RS3□02/RS3□03/ RS3□05.
Note 3) 100 VAC -single-phase input type corresponds only to RS3□01/ RS3□02/RS3□03.

■ General specifications (100 VAC, 600 A power unit and amplifier unit combination)

Control function		Position control/ Velocity control/ Force control/ (Parameter changeover)
Control system		IGBT: PWM control Sinusoidal drive
Main Circuit Power Note 1)		Three-phase: 200 to 240 VAC +10,-15 %, 50/60 Hz±3 Hz
Control power Note 1)		Single-phase: 200 to 240 VAC +10,-15 %, 50/60 Hz±3 Hz
Environment	Ambient temperature	0 to 55 ℃
	Storage temperature	-20 to +65 ℃
	Operation/ Storage humidity	Below 90 %RH (no condensation)
	Elevation	Below 1,000 m
	Vibration	4.9 m/s^2
	Shock	19.6 m/s^2
Structure		Wall-mounted type, Power supply part is separating
Power unit model number/ Amplifier unit model number		RS3PAA270# / RS3W60#
External dimensions (H×W×D) (mm)		380x160x292 / 380x250x292
Mass (kg)		12 / 18

Note 1) Power source voltage should be within the specified range.
Specified power supply range for 200V AC power input type: 170 to 264 V AC

■ General specifications (400V AC)

Control function		Position control/ Velocity control/ Force control/ (Parameter changeover)				
Control system		IGBT: PWM control Sinusoidal drive				
Main Circuit Power Note 1)		Three-phase: 380 to 480V AC +10,-15 %, 50/60 Hz±3 Hz				
Control power Note 1)		24V DC ±10 %				
Environment	Ambient temperature	0 to 55 ℃				
	Storage temperature	-20 to +65 ℃				
	Operation/ Storage humidity	Below 90 %RH (no condensation)				
	Elevation	Below 1,000 m				
	Vibration	4.9 m/s^2				
	Shock	19.6 m/s^2				
Structure		Built-in tray type power supply			Built-in wall mount type power supply	
Servo amplifier model number		RS3C02A##A#	RS3C05A##A#	RS3C10A##A#	RS3C15A##L#	RS3C30A##M#
External dimensions: H		205mm	205mm	205mm	375mm	375mm
W		75mm	100mm	175mm	220mm	270mm
D		235mm	235mm	235mm	230mm	235mm
Mass		2.5 kg	4.7 kg	8.5 kg	11.0 kg	18.0 kg

Note 1) Power source voltage should be within the specified range.
Spec of power supply range: 323 to 528V AC for main power,
21.6 to 26.4V DC for control power
Moreover, the "over-voltage category" of servo amplifier is "III" (EN61800-5-1). For a control power 24V DC and interface DC power, use a DC power supply with reinforced insulation of input/output.

■ General specifications (Power unit/Amplifier unit combination of 400 VAC-800 A)

Control function		Speed control/Torque control/Position control (Changed by parameter)	
Control method		IGBT: PWM control Sinusoidal drive	
Main Circuit Power Note 1)		Three-phase: 380 to 480 VAC+10,-15 % , 50/60 Hz±3 Hz	
Control power Note 1)		24 VDC±10 %	
Protection level		IP00	
Environment	Ambient temperature	0 to 55 ℃	
	Storage temperature	-20 to +65 ℃	
	Operation/ Storage humidity	Below 90 %RH (no condensation)	
	Elevation	Below 1,000 m	
	Vibration	4.9 m/s^2	
	Shock	19.6 m/s^2	
Structure		Wall-mounted type power unit	Wall-mounted type amplifier unit
Unit model number		RS3PAC550	RS3D80#
External dimensions (H×W×D) (mm)		380	380
		300	400
		315	315
Mass (kg)		22.4	32.5

Note 1) Power source voltage should be within the specified range.
Specified power supply range Main circuit power: 323 to 528 VAC
Control power: 20.4 to 27.6 VDC
Moreover, Overvoltage Category of Power unit and Amplifier unit are III (EN61800-5-1). So, use a DC power supply with reinforced insulation, for 24VDC control power and DC power of interface.

2. Specifications

■ Specifications

Speed control range	1: 5,000 Note 2)
Frequency characteristics	2,200 Hz Note 3)
Allowable load inertia moment	10 times motor rotor inertia moment Note 4)

Note 2) Internal speed command
Note 3) In case of high-velocity sampling mode
Note 4) When the value exceeds the above allowable load inertia moment, please contact us.

■ Built-in functions (100/200 VAC, 400 VAC)

Protection functions	Over current, Current detection error, Overload, Regeneration error, Overheat error, External overheating, Over voltage, Main circuit power low voltage, Main circuit power supply open phase, Control power supply low voltage, Encoder error, Over speed, Speed control error, Speed feedback error, Excessive position deviation, Position command pulse error, Built-in memory error, Parameter error, Cooling fan error	
Digital operator	Status display, Monitor display, Alarm display, Test operation	
Dynamic brake circuit	Built-in Note 5)	
Regeneration process circuit	Built-in Note 6)	
Monitor	Speed monitor (VMON)	2.0 V±10 % (at 1,000 min^{-1})
	Torque (Thrust) (TCMON)	2.0 V±10 % (at 100 %)

Note 5) For RS3C30, just DB signal output circuit is built in.
Note 6) For RS3C15/30, regenerative resistor is external type only.

■ Built-in functions (Power unit/Amplifier unit combination of 200 VAC-600 A, 400 VAC-800 A)

Protection functions	Over current, Current detection error, Overload, Regeneration error, Overheat error, External overheating, Over voltage, Main circuit power low voltage, Main circuit power supply open phase, Control power supply low voltage, Encoder error, Over speed, Speed control error, Speed feedback error, Excessive position deviation, Position command pulse error, Built-in memory error, Parameter error, Cooling fan error	
Digital operator	Status display, Monitor display, Alarm display, Parameter setting, Test operation, Adjustment mode	
Dynamic brake circuit	Not included Note 7)	
Regeneration process circuit	Included Note 8)	
Monitor	Speed monitor (VMON)	2.0 V±10 % (at 1,000 min^{-1})
	Torque (Thrust) (TCMON)	2.0 V±10 % (at 100 %)

Note 7) Only dynamic brake timing signal output circuit is included.
Note 8) Regenerative resistor is attached external.

■ Positioning function

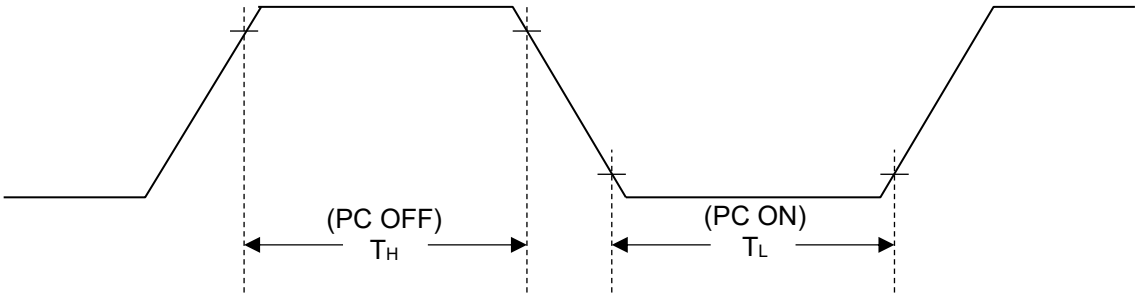
Controllable axis number	1 axis
Registrable point number	254 points maximum (Point 000 to 253 settable)
Maximum command value	-2,147,483,648 to +2,147,483,647
Command unit	Selectable from pulse, mm or deg.
Quick feeding speed	2,147,483.647 mm/s (At 0.001 mm/pulse selection)
Acceleration/deceleration	Linear or S-shaped (select with parameter)
Point data setting	Numerical input via SANMOTION MOTOR Setup
Move point number setting	Parallel 8 bits (Binary code)
Current limit	0 to 799 % (Rated value: 100 %), however equal to peak stall current or less. Note 9)
Software limit	Available
Move mode	Homing/Manual (JOG, 1-step)/Point specification move
Zone signal	8 zone maximum

Note 9) Current limit disabled if 0 % is set. It is limited by motor peak torque.

2.5.2 General Input/Output

■ General input signals (For interface type [F: MODBUS], function selectable for 7 inputs.)

Sequence input signals	Interactive photo coupler (sink, source connection): ×7 inputs
	External power supply: 24V DC±10%,100mA or over (24V DC)
	Positive direction limit switch, Negative direction limit switch, External trip, Forced discharge, Emergency stop. Refer to the section 5.8 in the manual for functions (M0012315) for detail.



* T_H denotes the minimum time that H-level input signal must be held and T_L denotes the minimum time that L-level input signals must be held.

* Generic input signals will be set depending on the selection of each function. Validity conditions and AC characteristics differ depending on set functions.

* Shows AC characteristics in respective functions.

General input functions	Photo coupler ON Hold time (T_L)	Photo coupler OFF Hold time (T_H)
Emergency stop function (Emergency Stop)	Min. 250 µs	Min. 250 µs
Forward direction limit switch Reverse direction limit switch Forced discharge input External trip input	Min. 8 ms	Min. 8 ms

* Generic output is transmitted when the set function has held longer than 125µs inside the servo amplifier.

■ General output signals (For interface type [F: MODBUS], function selectable for 2 outputs.)

Sequence output signals	Photorelay output (SYNC, Source connection) x 2 outputs
	External power supply: 24V DC±10%, 20 mA or over
	Circuit power for output signal: 24V DC±10% / Max. current value 50mA (per 1 output)
	Servo ready, Power ON, Servo ON, Holding brake timing, Torque limiting, Velocity 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/Reverse direction limit, Warning, Alarm code (3bits), etc. Refer to the section 5.8 in the manual for functions (M0012315) for detail.

2. Specifications

2.6 Power supply, calorific value

2.6.1 Main circuit power supply capacity, control power supply capacity

■ 200 VAC input

Input Voltage	Servo amplifier capacity	Servo motor model number	Rated output (W)	Main circuit power supply capacity (kVA)	Control power supply capacity (VA)
200V AC	RS3A01#	R1AA04005F	50	0.2	40
		R1AA04010F	100	0.3	
		R2AA04003F	30	0.2	
		R2AA04005F	50	0.2	
		R2AA04010F	100	0.3	
		R2AA06010F	100	0.3	
		R5AA06020H	200	0.6	
	RS3A02#	R1AA06020F	200	0.6	
		R1AA06040F	400	1.0	
		R2AA06020F	200	0.6	
		R2AA06040F	400	1.0	
		R2AA06040H	400	1.0	
		R2AA08020F	200	0.6	
		R2AA08040F	400	1.0	
		R5AA06020F	200	0.6	
		R5AA06040F	400	1.0	
		R5AA06040H	400	1.0	
	RS3A03#	R1AA08075V	750	1.6	
		R1AA10100H	1,000	2.3	
		R1AA10150H	1,500	3.0	
		R2AA08075F	750	1.6	
		R2AAB8100H	1,000	2.0	
		R2AA10075F	750	1.7	
		R2AA13050D	550	1.2	
		R2AA13050H	550	1.2	
		R2AA13120B	1,200	2.2	
		R5AA08075D	750	1.6	
		R5AA08075F	750	1.6	
	RS3A05#	R1AA08075F	750	1.6	
		R1AA10100F	1,000	2.3	
		R1AA10150F	1,500	3.0	
		R1AA10200H	2,000	4.0	
		R1AA10250H	2,500	5.0	
		R2AAB8075F	750	1.6	
		R2AAB8100F	1,000	2.3	
		R2AA10100F	1,000	2.3	
		R2AA13120D	1,200	2.8	
		R2AA13120L	1,200	2.8	
		R2AA13180H	1,800	3.6	
		R2AA13200L	2,000	4.0	
	RS3A07#	R1AA10200F	2,000	4.0	
		R1AA10250F	2,500	5.0	
		R1AA13300H	3,000	6.0	
		R2AA13180D	1,800	4.0	
		R2AA13200D	2,000	4.0	
		R2AA18350V	3,500	6.0	

* # = Optional alphabetical letter

* Power supply capacity above is the value with motor rated output operation.

2.6 Power supply calorific value

■ 200 VAC input

Input Voltage	Servo amplifier capacity	Servo motor model number	Rated output (W)	Main circuit power supply capacity (kVA)	Control power supply capacity (VA)
200V AC	RS3A10#	R1AA13300F	3,000	6.0	40
		R1AA13400H	4,000	6.7	
		R1AA13500H	5,000	8.3	
		R2AA13180D	1,800	4.0	
		R2AA13200D	2,000	5.0	
		R2AA18350L	3,500	6.0	
	RS3A15#	R1AA10200F	4,000	6.7	
		R1AA10250F	5,000	8.3	
		R2AA18350D	3,500	7.0	
		R2AA18450H	4,500	7.4	
		R2AA18550R	5,500	8.4	
		R2AA22500L	5,000	9.6	
		R2AA22700S	7,000	12.2	
	RS3A30#	R1AA18550H	5,500	9.3	
		R1AA18750L	7,500	11.6	
		R1AA1811KR	11,000	16.0	
		R1AA1815KB	15,000	21.4	
		R2AA18550H	5,500	9.3	
		R2AA18750H	7,500	11.6	
		R2AA1811KR	11,000	16.0	
		R2AA2211KB	11,000	16.0	
		R2AA2215KB	15,000	21.4	
	RS3PAA270 RS3W60#	R1AA2220KV	21K	28	80 Note 1)
		R2AA2220KB	20K	28	
		R2AA2830KV	30K	42	

* # = Optional alphabetical letter
* Power supply capacity above is the value with motor rated output operation.

Note 1) Control power supply capacity is total of power unit (40VA) and amplifier (40VA).

2. Specifications

■ 100 VAC Input

Input Voltage	Servo amplifier capacity	Servo motor model number	Rated output (W)	Main circuit power supply capacity (kVA)	Control power supply capacity (VA)
100V AC	RS3E01#	R2EA04003F	30	0.2	40
	RS3E02#	R1EA04005F	50	0.2	
		R1EA04010F	100	0.4	
		R2EA04005F	50	0.2	
		R2EA04008F	80	0.4	
		R2EA06010F	100	0.5	
	RS3E03#	R1EA06020F	200	0.6	
		R2EA06020F	200	0.6	

* # = Optional alphabetical letter
* Power supply capacity above is the value with motor rated output operation.

■ 400 VAC Input

Input Voltage	Servo amplifier capacity	Servo motor model number	Rated output (W)	Main circuit power supply capacity (kVA)	Control power supply capacity (VA)
400V AC	RS3C02#	R1CA10150V	1,500	2.5	55
		R2CA10075F	750	1.3	45
		R2CA13050D	550	1.0	48
		R2CA13120R	1,200	2.0	50
		R2CA13180H	1,800	2.9	50
		R2CA13200L	2,000	3.3	54
	RS3C05#	R1CA10200V	2,000	3.7	59
		R1CA13300V	3,000	5.2	58
		R2CA10100F	1,000	1.8	49
		R2CA13120F	1,200	2.3	54
		R2CA13180D	1,800	3.3	54
		R2CA13200H	2,000	3.7	58
		R2CA18350L	3,500	6.0	71
	RS3C10#	R2CA18350D	3,500	6.0	77
		R2CA18450H	4,500	7.6	72
		R2CA18550R	5,500	9.5	72
	RS3C15#	R1CA18550H	5,500	7.0	98
		R1CA18750L	7,500	9.5	98
		R1CA1811KR	11,000	13.8	100
		R1CA1815KB	15,000	18.2	110
		R2CA18550H	5,500	7.0	88
		R2CA18750H	7,500	9.4	96
		R2CA2211KB	11,000	13.6	105
		R2CA2215KV	15,000	18.4	105
	RS3C30#	R1CA2220KV	21,000	24.2	120
		R2CA2220KV	20,000	27.5	120
		R2CA2830KV	30,000	36.2	147
	RS3PAC550	R2CA3255KB	55,000	90	61
	RS3D80#				83

* # = Optional alphabetical letter
* Power supply capacity above is the value with motor rated output operation.
* Control power supply capacity is the value with using holding brake output and maximum fan motor rotation.
* For RS3D80#, control power supply capacity is the value with using holding brake output and maximum fan motor rotation. Moreover, Main circuit power capacity is the value with the condition of rated output calculated by power factor 75 %.

2.6.2 Inrush current, leakage current

■ Inrush current (100/200 VAC input)

Input Voltage	Servo amplifier capacity	Control power (Maximum value between1ms after input)	Main circuit power (Maximum value between 1.2 seconds after input)
200V AC	RS3A01#	40A(0-P)	22A(0-P)
	RS3A02#		
	RS3A03#		
	RS3A05#		
	RS3A07#		17A(0-P)
	RS3A10#		
	RS3A15#		
	RS3A30#		
100V AC	RS3E01#	20A(0-P)	11A(0-P)
	RS3E02#		
	RS3E03#		

■ Inrush current for control circuit of RS3W60#

Input voltage	Unit name	Model number	Control power (Maximum value between1ms after input)
200V AC	Power unit	RS3PAA270#	80A(0-P)
	Amplifier unit	RS3W60#	

■ Inrush current for main circuit of RS3W60#

Input voltage	Power unit	Main circuit power (Maximum value between 1.2 seconds after input)
200V AC	RS3PAA270#	80A(0-P)

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

■ Inrush current (400V AC input)

Input Voltage	Servo amplifier capacity	Control power (Maximum value between1ms after input)	Main circuit power (Maximum value between 1.2 seconds after input)
400V AC	RS3C02#	56A(0-P)	22.6A(0-P)
	RS3C05#		
	RS3C10#		45.3A(0-P)
	RS3C15#		
	RS3C30#		

* # = Optional alphabetical letter
* Inrush current values above are at the condition of ordinary temperatures, 480 VAC input.

■ Inrush current for control circuit/main circuit of RS3D80#

Input Voltage	Servo amplifier capacity	Control power (Maximum value between 1ms after input)	Main circuit power (Maximum value between 1.2 seconds after input)
400 VAC	RS3PAC550	56 A(0-P)	135.8 A(0-P)
	RS3D80#		

* # = Optional alphabetical letter
* Inrush current values above are at the condition of ordinary temperature and 480 VAC input voltage.

2. Specifications

■ Leakage current

Servo amplifier capacity	Electric leakage current per motor
RS3#01#	0.8 mA or less
RS3#02#	0.8 mA or less
RS3#03#	0.8 mA or less
RS3#05#	1.5 mA or less
RS3#07#	3.0 mA or less
RS3#10#	3.0 mA or less
RS3#15#	3.0 mA or less
RS3#30#	3.0 mA or less
RS3PAA270+RS3W60A#	3.5 mA or less
RS3C02#	1.0 mA or less
RS3C05#	1.0 mA or less
RS3C10#	3.0 mA or less
RS3C15#	3.0 mA or less
RS3C30#	3.0 mA or less
RS3PAC550+RS3D80#	13.0 mA or less

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

2.6.3 Calorific value

■ 200V AC

Input voltage	Servo amplifier capacity	Servo motor model number	Servo amplifier total calorific value (W)
200V AC	RS3A01#	R1AA04005F	14
		R1AA04010F	15
		R2AA04003F	13
		R2AA04005F	14
		R2AA04010F	15
		R2AA06010F	15
		R5AA06020H	20
	RS3A02#	R1AA06020F	20
		R1AA06040F	32
		R2AA06020F	20
		R2AA06040F	31
		R2AA06040H	22
		R2AA08020F	20
		R2AA08040F	30
		R5AA06020F	20
		R5AA06040F	31
		R5AA06040H	22
	RS3A03#	R1AA08075V	43
		R1AA10100H	45
		R1AA10150H	60
		R2AA08075F	43
		R2AAB8100H	45
		R2AA10075F	43
		R2AA13050D	44
		R2AA13050H	40
		R2AA13120B	50
		R5AA08075D	43
		R5AA08075F	43
	RS3A05#	R1AA08075F	45
		R1AA10100F	60
		R1AA10150F	70
		R1AA10200H	70
		R1AA10250H	80
		R2AAB8075F	45
		R2AAB8100F	52
		R2AA10100F	50
		R2AA13120D	68
		R2AA13120L	60
		R2AA13180H	87
		R2AA13200L	87
	RS3A07#	R1AA10200F	100
		R1AA10250F	115
		R1AA13300H	120
		R2AA13180D	110
		R2AA13200D	100
		R2AA18350V	135

* # = Optional alphabetical letter

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

2. Specifications

■ 200V AC (continued)

Input voltage	Servo amplifier capacity	Servo motor model number	Servo amplifier total calorific value (W)
200V AC	RS3A10#	R1AA13300F	135
		R1AA13400H	157
		R1AA13500H	170
		R2AA13180D	110
		R2AA13200D	100
		R2AA18350L	148
	RS3A15#	R1AA13400F	157
		R1AA13500F	180
		R2AA18350D	148
		R2AA18450H	163
		R2AA18550R	213
		R2AA22500L	164
		R2AA22700S	235
	RS3A30#	R1AA18550H	315
		R1AA18750L	365
		R1AA1811KR	430
		R1AA1815KB	450
		R2AA18550H	315
		R2AA18750H	365
		R2AA1811KR	430
		R2AA2211KB	440
		R2AA2215KB	450

■ RS3W60#

Input voltage	Power unit/ Amplifier unit	Servo motor model number	Power unit/Amplifier unit total calorific value (W)
200V AC	RS3PAA270#/ RS3W60#	R1AA2220KV	890
		R2AA2220KB	890
		R2AA2830KV	960

■ 100V AC

Input voltage	Servo amplifier capacity	Servo motor model number	Servo amplifier total calorific value (W)
100V AC	RS3E01#	R2EA04003F	13
	RS3E02#	R1EA04005F	15
		R1EA04010F	17
		R2EA04005F	15
		R2EA04008F	16
		R2EA06010F	17
	RS3E03#	R1EA06020F	26
		R2EA06020F	26

* # = Optional alphabetical letter

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

2.6 Power supply calorific value

■ 400V AC

Input voltage	Servo amplifier capacity	Servo motor model number	Servo amplifier total calorific value (W)
400 VAC	RS3C02#	R1CA10150V	96
		R2CA10075F	78
		R2CA13050D	76
		R2CA13120R	84
		R2CA13180H	102
		R2CA13200L	98
	RS3C05#	R1CA10200V	116
		R1CA13300V	142
		R2CA10100F	102
		R2CA13120F	114
		R2CA13180D	152
		R2CA13200H	134
		R2CA18350L	152
	RS3C10#	R2CA18350D	228
		R2CA18450H	208
		R2CA18550R	280
	RS3C15#	R1CA18550H	288
		R1CA18750L	333
		R1CA1811KR	385
		R1CA1815KB	450
		R2CA18550H	293
		R2CA18750H	344
		R2CA2211KB	423
		R2CA2215KV	475
	RS3C30#	R1CA2220KV	536
		R2CA2220KV	643
		R2CA2830KV	700

* # = Optional alphabetical letter
* Calorific values above are the condition of rated motor output operation. Calorific value of regenerative resistor is not included.

■ RS3D80#

Input voltage	Servo amplifier capacity	Servo motor model number	Power unit/Amplifier unit total calorific value (W)
400 VAC	RS3PAC550 RS3D80#	R2CA3255KB	2,500 or less

* # = Optional alphabetical letter
* Calorific values above are the condition of rated motor output operation. Calorific value of regenerative resistor is not included.

2. Specifications

■ Linear motor

Input voltage	Servo amplifier capacity	Linear motor model number	Servo amplifier total calorific value (W)
200V AC	RS3A03#	DS030C1N2	41
		DS050C1N2	41
		DS075C1N2	42
		DS045CC1AN	41
		DT030CD1AN	41
	RS3A05#	DS030C2N2	68
		DS050C2N2	68
		DS075C2N2	69
		DS100C1N2	70
		DS150C1N2	70
		DD030C1Y4	65
	RS3A07#	DS030C3N2	91
		DS050C3N2	91
		DS075C3N2	93
		DD030C2Y4	110
		DD050C1Y2	110
		DD075C1Y2	110
		DD045CB4AN	75
		DD035CC2AN	70
	RS3A10#	DS030C3N2	91
		DS050C3N2	91
		DS075C3N2	93
		DS100C2N2	135
		DS150C2N2	135
		DD030C2Y4	110
		DD030C3Y4	138
		DD050C1Y2	110
		DD075C1Y2	110
		DD045CB4AN	75
	RS3A15#	DS100C3N2	185
		DS150C3N2	185
		DD050C2Y2	210
		DD075C2Y2	210
	RS3A30#	DD050C3Y2	270
		DD075C3Y2	275
		DD075C4Y2	380

* # = Optional alphabetical letter

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

2.7 Operation pattern

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

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

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

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

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

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

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

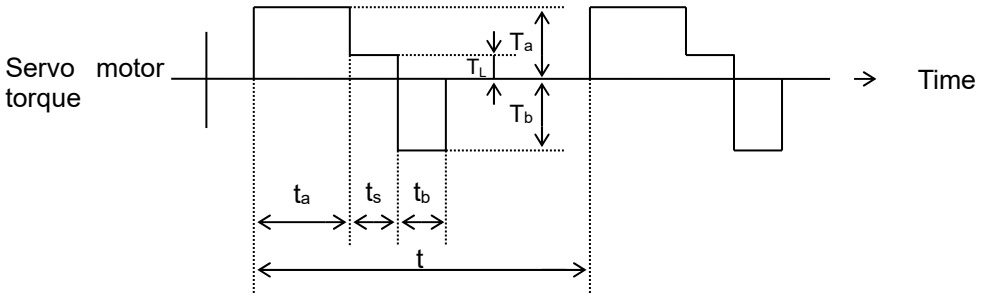
■ Frequency of permitted repetitions for the servo amplifier
When Start/Stop sequences are repeated frequently, confirm in advance that the frequency of repetitions are within tolerance range. Allowed repetitions differ depending on the type, capacity, load inertia moment, accel/decel torque and motor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

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

■ 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.

2. Specifications

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



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

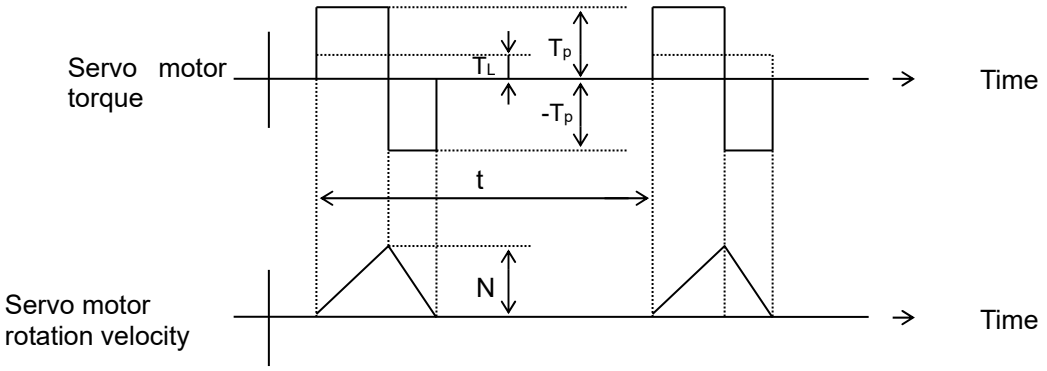
$$t \geqq \frac{T_a^2 t_a + T_L^2 t_s + T_b^2 t_b}{T_R^2} \quad [s]$$

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

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

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

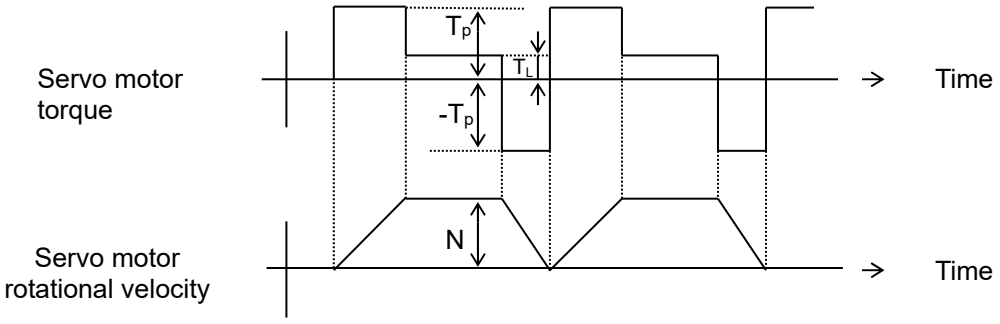
■ When the motor repeats acceleration, deceleration and stop status
In operating status (shown below) the value of permitted repetitions n (times/minutes) is found with the following equation:



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

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

■ 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:



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

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

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

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

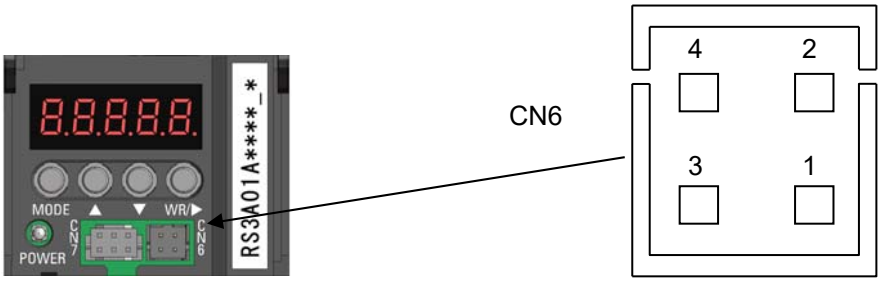
- ◆ Reduce the torque limit
- ◆ Extend the acceleration and deceleration times (slow down)
- ◆ Reduce the maximum rotation speed
- ◆ Re-examine regenerative resistance

2. Specifications

2.8 Specifications for analog monitor

2.8.1 Specifications for analog monitor

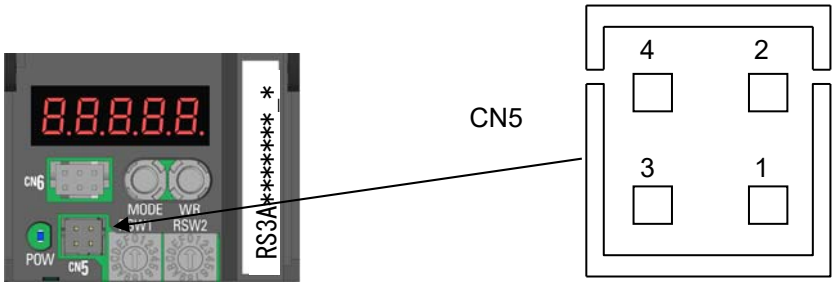
■ Pin number/signal name of monitor output for I/O type



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

	Analog monitor connector CN6
Analog monitor output 1 (MON1)	CN6-3
Analog monitor output 2 (MON2)	CN6-4
Digital monitor output (DMON)	CN6-2
GND	CN6-1

■ Pin number/signal name of monitor output for MODBUS communication type



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

	Analog monitor connector CN5
Analog monitor output 1 (MON1)	CN5-3
Analog monitor output 2 (MON2)	CN5-4
Digital monitor output (DMON)	CN5-2
GND	CN5-1

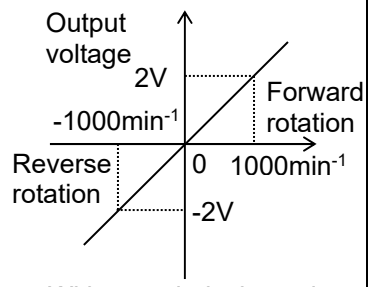
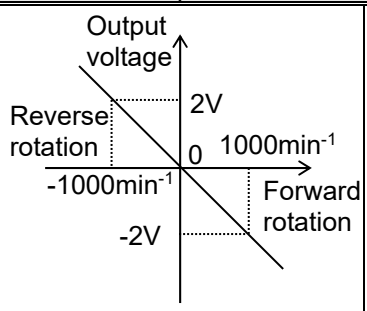
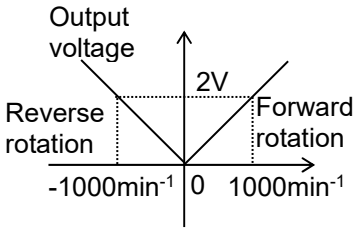
2.8.2 Monitor for velocity, torque, and position deviation

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

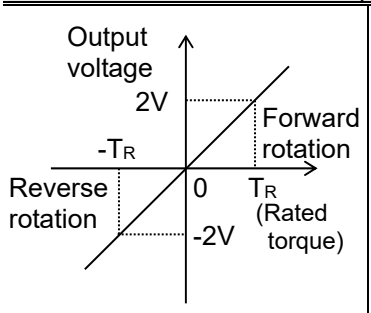
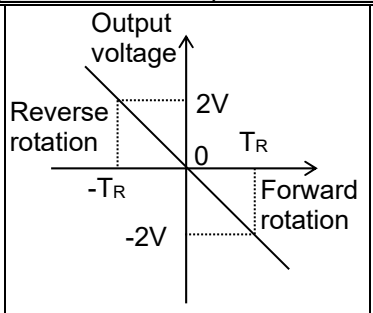
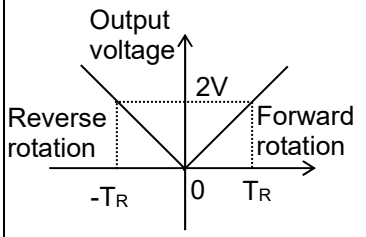
* Monitor output is indefinite at the time of power ON/OFF and may output DC12V+/- around 10%.

* Monitor output polarity can be selected from "+, Without polarity inversion", "-, With polarity inversion", "ABS, Absolute value output". Select from the Group9 ID63: Analog monitor output polarity [MONPOL].

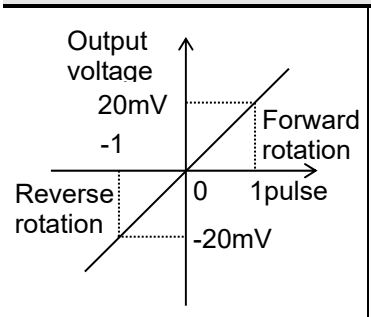
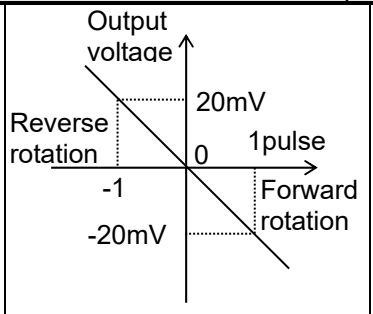
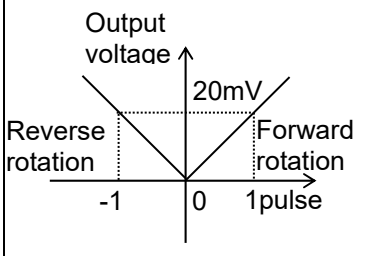
■ Velocity command, velocity monitor

Speed command, speed monitor output		
		
+, Without polarity inversion	-, With polarity inversion	ABS, Absolute value output

■ Torque command, torque monitor

Torque command, torque monitor output		
		
+, Without polarity inversion	-, With polarity inversion	ABS, Absolute value output

■ Position deviation monitor

Position deviation monitor output		
		
+, Without polarity inversion	-, With polarity inversion	ABS, Absolute value output

2. Specifications

2.9 Specifications for dynamic brake

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

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

■ Operation intervals
In basic terms, operation of the dynamic brake in six (6) minutes 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:

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

■ If/When load inertia moment (J_L) substantially exceeds allowable load inertia moment, abnormal heat can generate due to dynamic brake resistance. Take precautions against (Overheat alarm of the dynamic break) or (failure of dynamic brake resistance). Please consult us if such a situation is evident.
Dynamic brake circuit is not included to servo amplifier RS3C30# and amplifier unit RS3D80#. Please contact us for external dynamic brake resistor selection.

■ Instantaneous tolerance of dynamic brake

Servo amplifier model number	E_{RD} (J)
RS3#02A##A#/RS3#02A##L#	218
RS3#03A##A#/RS3#03A##L#	
RS3#05A##A#/RS3#05A##L#	912
RS3#07A##A#/RS3#07A##L#	2,000
RS3#10A##A#/RS3#10A##L#	2,450
RS3#15A##A#/RS3#15A##L#	
RS3#30A##L#	9,384
RS3C02A##A#	1,100
RS3C05A##A#	2,100
RS3C10A##A#	13,000
RS3C15A##L#	13,000

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

2.9 Specifications for dynamic brake

■ Rotary motor

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

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

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

■ Linear motor

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

$$E_{RD}= \frac{2.5}{R\Phi+2.5} \times \frac{1}{2} M \times V^2 \quad [J]$$

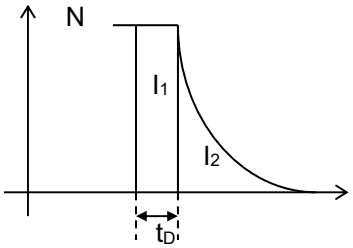
$R\phi$: Linear motor phase winding resistance [Ω]
M: Movable part [kg]
Movable part $M = M_C + M_L$
(M_C: Mover mass [kg], M_L: Load mass [kg])
V: Last-minute velocity before deceleration [m/s]

2. Specifications

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

◆ Rotary motor

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



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

α, β: See below.

◆ 100/200V AC input

Servo amplifier capacity	Servo motor model number	α	β	J_M ($kg\cdot m^2$)
RS3A01	R1AA04005F	111	6.15×10^{-6}	0.0146×10^{-4}
	R1AA04010F	49.4	3.88×10^{-6}	0.0242×10^{-4}
	R2AA04003F	187	5.18×10^{-6}	0.0247×10^{-4}
	R2AA04005F	93.2	3.78×10^{-6}	0.0376×10^{-4}
	R2AA04010F	32.5	1.98×10^{-6}	0.0627×10^{-4}
	R2AA06010F	21.4	7.67×10^{-6}	0.117×10^{-4}
	R5AA06020H	11.7	3.76×10^{-6}	0.2×10^{-4}
RS3A02	R1AA06020F	14.7	3.39×10^{-6}	0.122×10^{-4}
	R1AA06040F	9.25	1.37×10^{-6}	0.203×10^{-4}
	R2AA06020F	14.5	2.46×10^{-6}	0.219×10^{-4}
	R2AA06040F	8.82	1.00×10^{-6}	0.412×10^{-4}
	R2AA06040H	5.47	1.61×10^{-6}	0.412×10^{-4}
	R2AA08020F	11.3	1.13×10^{-6}	0.52×10^{-4}
	R2AA08040F	6.91	4.25×10^{-6}	1.04×10^{-4}
	R5AA06020F	15.36	2.92×10^{-6}	0.2×10^{-4}
	R5AA06040F	10.11	1.55×10^{-6}	0.416×10^{-4}
	R5AA06040H	6.09	2.3×10^{-6}	0.416×10^{-4}
RS3A03	R1AA08075V	4.35	6.57×10^{-7}	0.719×10^{-4}
	R1AA10100H	2.6	1.21×10^{-6}	1.4×10^{-4}
	R1AA10150H	1.31	6.87×10^{-7}	2.0×10^{-4}
	R2AA08075F	5.84	9.10×10^{-8}	1.82×10^{-4}
	R2AAB8100H	3.09	3.83×10^{-7}	2.38×10^{-4}
	R2AA10075F	6.04	1.2×10^{-6}	2.0×10^{-4}
	R2AA13050D	6.46	2.14×10^{-6}	3.1×10^{-4}
	R2AA13050H	4.37	3.55×10^{-6}	3.1×10^{-4}
	R2AA13120B	1.68	1.56×10^{-6}	6×10^{-4}
	R5AA08075D	4.67	1.67×10^{-6}	1.65×10^{-4}
	R5AA08075F	6.45	2.75×10^{-6}	1.65×10^{-4}
RS3A05	R1AA08075F	7.44	3.75×10^{-7}	0.719×10^{-4}
	R1AA10100F	8.39	3.24×10^{-7}	1.4×10^{-4}
	R1AA10150F	4.21	1.82×10^{-7}	2.0×10^{-4}
	R1AA10200H	1.71	3.88×10^{-7}	2.3×10^{-4}
	R1AA10250H	1.26	2.80×10^{-7}	2.8×10^{-4}
	R2AAB8075F	6.55	4.16×10^{-7}	1.64×10^{-4}
	R2AAB8100F	5.46	2.08×10^{-7}	2.38×10^{-4}
	R2AA10100F	5.35	4.86×10^{-7}	3.5×10^{-4}
	R2AA13120D	4.06	6.45×10^{-7}	6.3×10^{-4}
	R2AA13120L	2.99	1.21×10^{-6}	6×10^{-4}
	R2AA13180H	2.17	4.66×10^{-7}	9.0×10^{-4}
	R2AA13200L	1.83	3.1×10^{-7}	12.2×10^{-4}

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

2.9 Specifications for dynamic brake

Servo amplifier capacity	Servo motor model number	α	β	J_M (kg·m^2)
RS3A07	R1AA10200F	3.17	5.00×10^{-8}	2.3×10^{-4}
	R1AA10250F	2.15	4.70×10^{-8}	2.8×10^{-4}
	R1AA13300H	1.00	5.60×10^{-8}	7.0×10^{-4}
	R2AA13180D	2.12	1.23×10^{-7}	9.0×10^{-4}
	R2AA13200D	1.69	0.91×10^{-7}	12.2×10^{-4}
	R2AA18350V	0.56	2.5×10^{-8}	40×10^{-4}
RS3A10	R1AA13300F	3.08	4.20×10^{-8}	7.0×10^{-4}
	R1AA13400H	0.8	3.40×10^{-8}	8.8×10^{-4}
	R1AA13500H	0.57	3.00×10^{-8}	10.6×10^{-4}
	R2AA13180D	2.12	1.23×10^{-7}	9.0×10^{-4}
	R2AA13200D	1.69	0.91×10^{-7}	12.2×10^{-4}
	R2AA18350L	0.82	1.6×10^{-8}	40×10^{-4}
RS3A15	R1AA13400F	2.06	1.40×10^{-8}	8.8×10^{-4}
	R1AA13500F	1.88	9.00×10^{-9}	10.6×10^{-4}
	R2AA18350D	1.05	1.3×10^{-8}	40×10^{-4}
	R2AA18450H	0.67	1.2×10^{-8}	50×10^{-4}
	R2AA18550R	0.53	7×10^{-9}	68×10^{-4}
	R2AA22500L	0.8	0.41×10^{-7}	55×10^{-4}
	R2AA22700S	0.16	7×10^{-9}	136×10^{-4}
RS3A30	R1AA18550H	1.08	4×10^{-9}	33×10^{-4}
	R1AA18750L	0.67	2×10^{-9}	42×10^{-4}
	R1AA1811KR	0.41	2×10^{-9}	64×10^{-4}
	R1AA1815KB	0.26	2×10^{-9}	86×10^{-4}
	R2AA18550H	1.13	4×10^{-9}	68×10^{-4}
	R2AA18750H	0.72	2×10^{-9}	98×10^{-4}
	R2AA1811KR	0.51	3×10^{-9}	110×10^{-4}
	R2AA2211KB	0.42	1×10^{-9}	178×10^{-4}
	R2AA2215KB	0.35	1×10^{-9}	237×10^{-4}
RS3E01	R2EA04003F	187	5.18×10^{-6}	0.0247×10^{-4}
RS3E02	R1EA04005F	166	4.03×10^{-6}	0.0146×10^{-4}
	R1EA04010F	75.1	2.56×10^{-6}	0.0242×10^{-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}
RS3E03	R1EA06020F	47.8	1.3×10^{-6}	0.122×10^{-4}
	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. Specifications

◆ 400V AC input

Servo amplifier capacity	Servo motor model number	α	β	$J_M(kg \cdot m^2)$
RS3C02	R1CA10150V	1.26	8.37×10^{-7}	2.1×10^{-4}
	R2CA10075F	2.54	2.86×10^{-6}	2.5×10^{-4}
	R2CA13050D	2.15	6.23×10^{-6}	3.1×10^{-4}
	R2CA13120R	0.66	2.54×10^{-6}	6.0×10^{-4}
	R2CA13180H	0.41	1.93×10^{-6}	9.0×10^{-4}
	R2CA13200L	0.25	1.38×10^{-6}	12.2×10^{-4}
RS3C05	R1CA10200V	1.17	6.39×10^{-7}	2.4×10^{-4}
	R1CA13300V	0.78	3.12×10^{-7}	6.8×10^{-4}
	R2CA10100F	3.40	7.64×10^{-7}	3.9×10^{-4}
	R2CA13120F	1.97	1.13×10^{-6}	6.0×10^{-4}
	R2CA13180D	1.26	5.88×10^{-7}	9.0×10^{-4}
	R2CA13200H	0.68	1.05×10^{-6}	12.2×10^{-4}
	R2CA18350L	0.30	2.19×10^{-7}	40×10^{-4}
RS3C10	R2CA18350D	0.26	5.20×10^{-8}	40×10^{-4}
	R2CA18450H	0.15	5.30×10^{-8}	50×10^{-4}
	R2CA18550R	0.13	3.10×10^{-8}	68×10^{-4}
RS3C15	R1CA18550H	0.17	2.70×10^{-8}	33×10^{-4}
	R1CA18750L	0.12	2.20×10^{-8}	42×10^{-4}
	R1CA1811KR	0.06	1.50×10^{-8}	64×10^{-4}
	R1CA1815KB	0.05	1.30×10^{-8}	86×10^{-4}
	R2CA18550H	0.18	2.30×10^{-8}	68×10^{-4}
	R2CA18750H	0.13	1.70×10^{-8}	98×10^{-4}
	R2CA2211KB	0.07	8.00×10^{-9}	178×10^{-4}
	R2CA2215KV	0.05	5.00×10^{-9}	288×10^{-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).

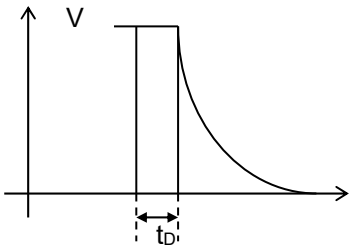
* About the values for α, β of R2CA3255KB, please consult us.

2.9 Specifications for dynamic brake

◆ Linear motor

■ Coasting distance of movable stage is calculated roughly as follows, when dynamic brake is worked at horizontal axis without friction consideration:

Coasting distance = $V \cdot t_D + M \cdot (\alpha V + \beta V^3)$ [m]



V: Linear motor velocity [m/s]
t_D: 10×10^{-3} [s]
M: Movable part [kg]
Movable part $M = M_C + M_L$
(M_C: Mover mass [kg], M_L: Load mass [kg])

α･β: See below.

Servo amplifier capacity	Servo motor model number	α	β	M_C [kg]
RS3A03	DS030C1N2	6.88E-3	1.59E-3	2.8
	DS050C1N2	3.05E-3	1.27E-3	3.8
	DS075C1N2	1.75E-3	1.03E-3	5.2
	DS045CC1AN	4.16E-3	3.62E-3	1.8
	DT030CD1AN	2.85E-3	1.06E-3	2.4
RS3A05	DS030C2N2	5.42E-3	5.04E-4	5.4
	DS050C2N2	2.27E-3	4.26E-4	7.4
	DS075C2N2	1.23E-3	3.64E-4	10
	DS100C1N2	2.65E-3	4.05E-4	6.6
	DS150C1N2	1.30E-3	3.49E-4	9.4
	DD030C1Y4	3.98E-3	1.08E-3	8.3
RS3A07	DS030C3N2	4.46E-3	6.83E-5	7.8
	DS050C3N2	1.74E-3	6.15E-5	10.9
	DS075C3N2	8.91E-4	5.59E-5	14.8
	DD030C2Y4	2.21E-3	1.22E-4	15.0
	DD050C1Y2	3.25E-3	1.09E-4	11.2
	DD075C1Y2	1.63E-3	9.95E-5	14.7
	DD045CB4AN	2.30E-3	1.62E-4	8.6
	DD035CC2AN	2.30E-3	1.62E-4	5.0
RS3A10	DS030C3N2	4.46E-3	6.83E-5	7.8
	DS050C3N2	1.74E-3	6.15E-5	10.9
	DS075C3N2	8.91E-4	5.59E-5	14.8
	DS100C2N2	2.09E-3	3.21E-5	12.6
	DS150C2N2	9.60E-4	2.96E-5	17.8
	DD030C2Y4	2.21E-3	1.22E-4	15.0
	DD030C3Y4	2.02E-3	5.92E-5	21.6
	DD050C1Y2	3.25E-3	1.09E-4	11.2
	DD075C1Y2	1.63E-3	9.95E-5	14.7
	DD045CB4AN	2.30E-3	1.62E-4	8.6
RS3A15	DS100C3N2	2.03E-3	1.47E-5	18.6
	DS150C3N2	9.23E-4	1.37E-5	26.2
	DD050C2Y2	2.93E-3	3.01E-5	21.2
	DD075C2Y2	1.43E-3	2.83E-5	26.5
RS3A30	DD050C3Y2	2.83E-3	1.39E-5	29.0
	DD075C3Y2	1.37E-3	1.32E-5	38.1
	DD075C4Y2	1.33E-3	7.60E-6	49.5

* 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. Specifications

2.10 Regeneration process

Allowable minimum values of Built-in/ external regenerative resistor and allowable regenerative power of regenerative circuit of servo amplifier are shown below. See "11.3 Selection of regenerative resistor" for selection method of regenerative resistor.

2.10.1 Minimum values of Built-in/ external regenerative resistor

Servo amplifier model	Built-in regenerative resistor	External regenerative resistor
RS3#01A##A#	50Ω	35Ω
RS3#02A##A#	50Ω	35Ω
RS3#03A##A#	50Ω	35Ω
RS3#05A##A#	17Ω	17Ω
RS3A07A##A#/RS3A07A##L#	10Ω	10Ω
RS3A10A##A#/RS3A10A##L#	10Ω	10Ω
RS3A15A##A#/RS3A15A##L#	6Ω	6Ω
RS3A30A##L#	Without built-in regenerative resistor	2.5Ω
RS3PAA270#	Without built-in regenerative resistor	2.5Ω

■ Input voltage 400V AC

Servo amplifier model	Built-in regenerative resistor	External regenerative resistor
RS3C02A##A#	80Ω	80Ω
RS3C05A##A#	40Ω	40Ω
RS3C10A##A#	20Ω	20Ω
RS3C15A##L#	Without built-in regenerative resistor	13Ω
RS3C30A##M#	Without built-in regenerative resistor	6.5Ω
RS3PAC550	Without built-in regenerative resistor	2.4Ω

* "#" is optional number or alphabetical letter.

2.10.2 Allowable regenerative power

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

■ Input voltage 400V AC

Servo amplifier model	Built-in regenerative resistor use [PRI]	External regenerative resistor use [PR0]
RS3C02A##A#	15W	125W
RS3C05A##A#	28W	250W
RS3C10A##A#	40W	500W
RS3C15A##L#	Without built-in regenerative resistor	1000W
RS3C30A##M#	Without built-in regenerative resistor	2000W
RS3PAC550	Without built-in regenerative resistor	5000W

* "#" is optional number or alphabetical letter.

3 Installation

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

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3.1.1 Precautions 3-1

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3. Installation

3.1 Servo amplifier

3.1.1 Precautions

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

■ Various precautions

The device should be installed on non-flammable surfaces only. Installation on or near flammable materials can cause fire.
Do not stand on, or put heavy items on the servo amplifier.
Operate the device within the specified environmental conditions.
Do not drop the device or subject it to excessive shock.
Make sure no screws or other conductive or flammable materials get inside the servo amplifier.
Do not obstruct the air intake and exhaust vents. The mounting direction should be observed strictly.
Please contact our office if the amplifier is to be stored for a period of 3 years or longer. The capacity of the electrolytic capacitors decreases during long-term storage.
Any damaged parts or the products which have damaged parts shall be repaired by returning it to our company immediately.

■ If enclosed in a cabinet

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

■ If there is a vibration source nearby

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

■ If there is a heat generator nearby

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

■ If corrosive gas is present

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

■ If explosive or combustible gas is present

Never use the device where explosive or combustible gas is present. The device's relays and contactors, regenerative resistors and other parts can generate arc (spark) and can cause fire or explosion.

■ If dust or oil mist is present

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

■ If a large noise source is present

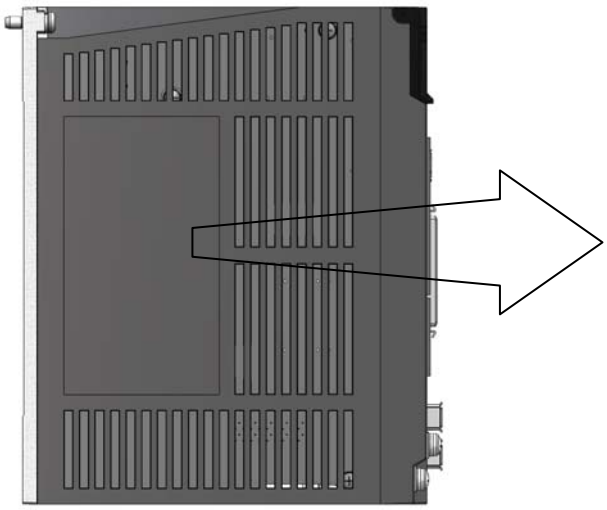
If inductive noise enters the input signals or the power circuit, it can cause a malfunction. If there is a possibility of noise, inspect the line wiring and take appropriate noise prevention measures. A noise filter should be installed before the servo amplifier.

3.1.2 Unpacking

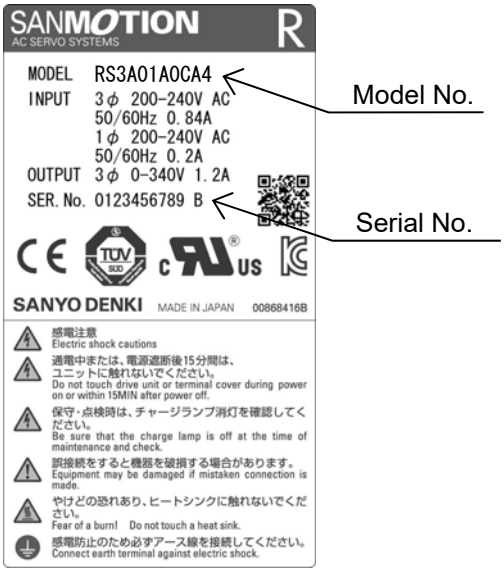
Verify the followings when the product arrives. If you find any discrepancy, contact your distributor or sales office.

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

Servo amplifier



Servo amplifier main nameplate

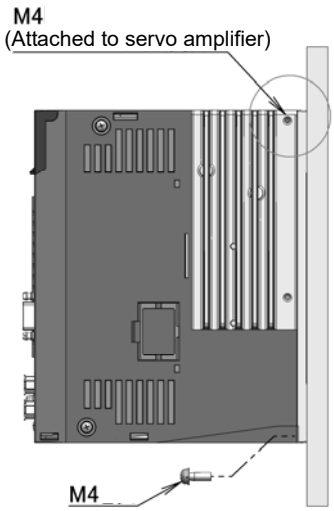


Interpretation of the serial number
Month (2-digit) + Year (2-digit) + Day (2-digit) + Serial number (4-digit) + Revision ("A" abbreviated)

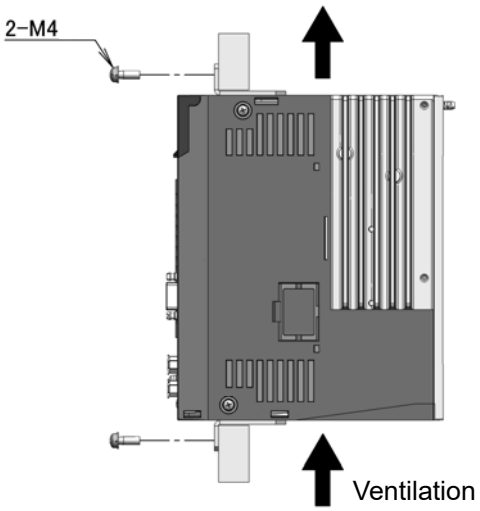
3. Installation

3.1.3 Mounting direction and location

Rear-mounting

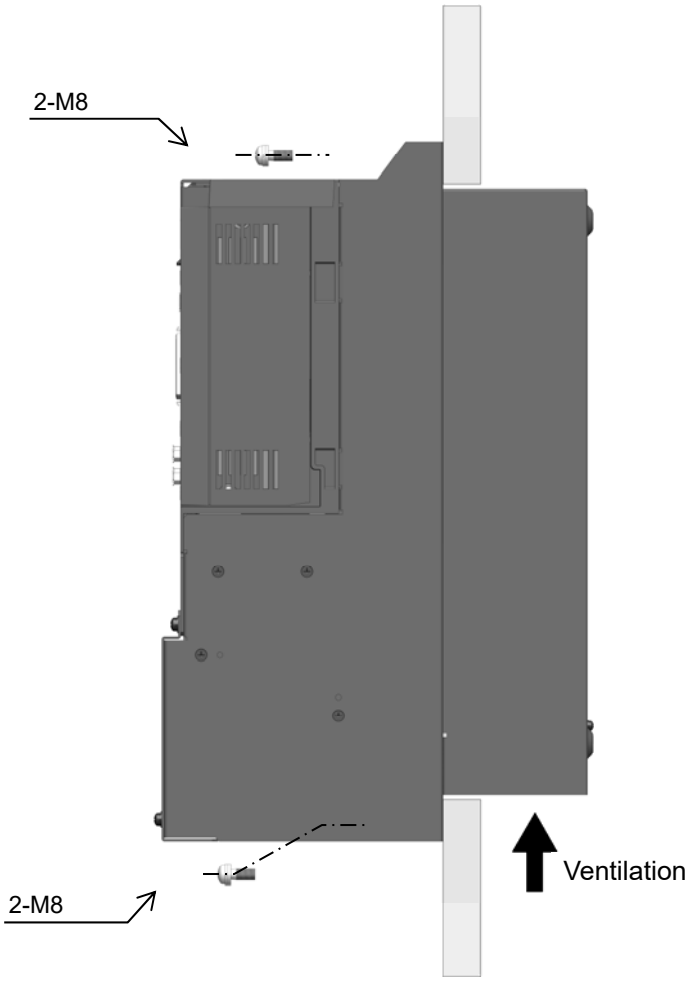


Front-mounting



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

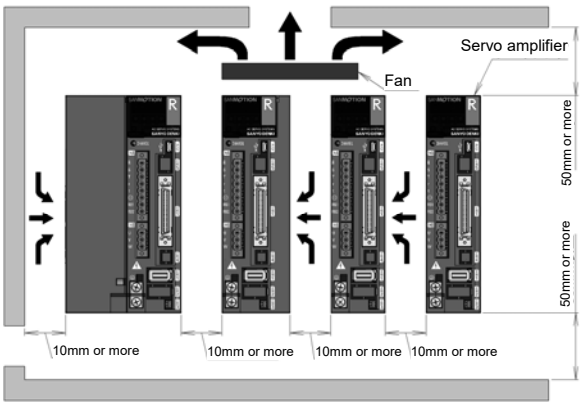
RS3PAC550
RS3D80#



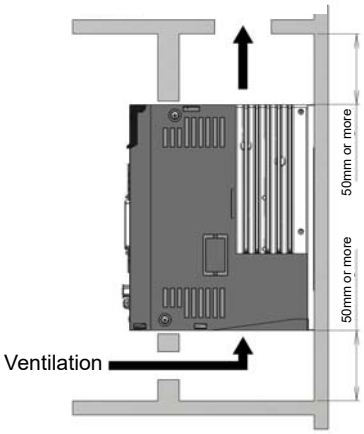
3.1.4 Arrangement within the cabinet

- Leave at least 50 mm (100 mm for RS3D80#) space above and below the servo amplifier to ensure unobstructed airflow from the inside of the servo amplifier and the radiator. If heat gets trapped around the servo amplifier, use a cooling fan to create airflow.
- Make sure the temperature around the servo amplifier does not exceed 55°C. For longevity and reliability purposes it is recommended to keep the temperature below 40°C.
- Leave at least 10 mm space on both sides of the servo amplifier to ensure unobstructed airflow from the heat sinks on the side and from the inside of the servo amplifier.
- For RS3□02·RS3□03·RS3□05, a cooling fan is attached at the side. Therefore, it is recommended that the servo amplifier be mounted in an arrangement as shown below.

Front view

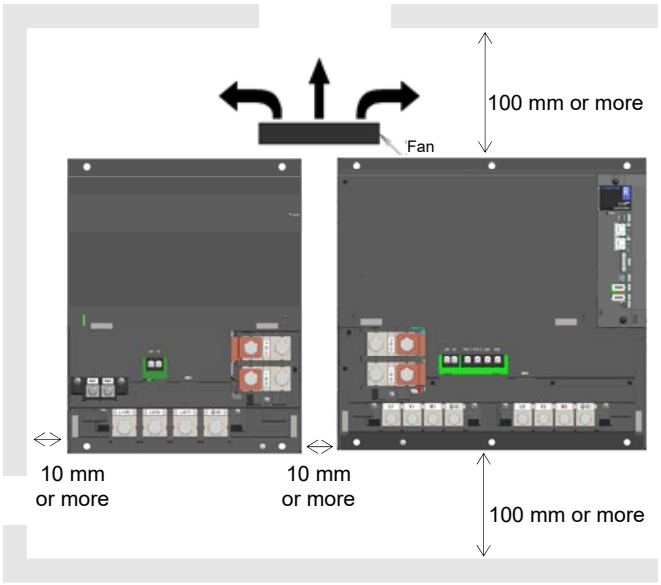


Side view

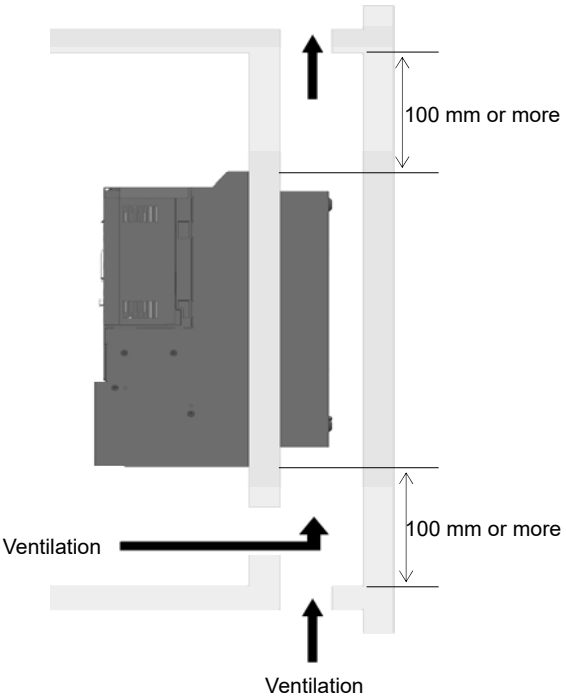


* Arrangement above is order of RS3□05, RS3□03, RS3□02 and RS3□01 from left side.

Front view



Side view



* Arrangement above is order of RS3PAC550 and RS3D80# from left side.

3. Installation

3.2 Rotary motor

3.2.1 Precautions

■ Various precautions

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

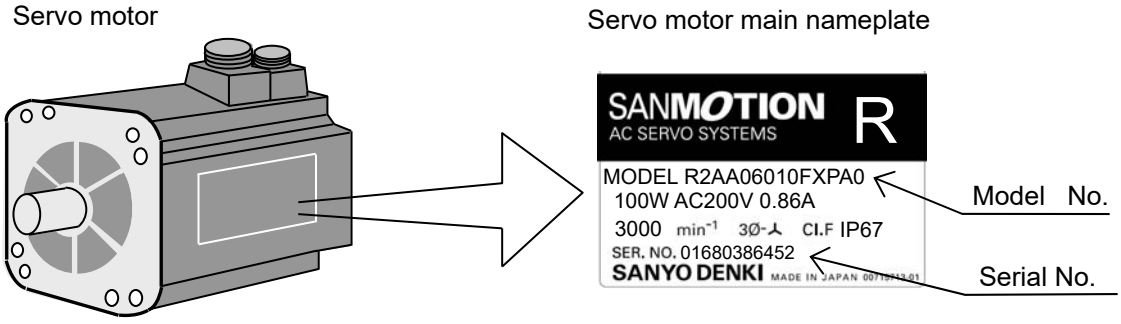
3.2.2 Unpacking

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

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

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

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



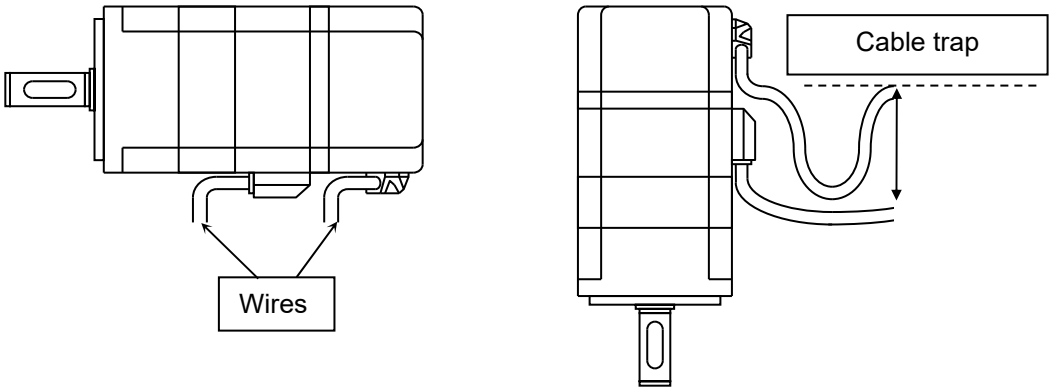
3.2.3 Installation

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

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.

3.2.4 Mounting method

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



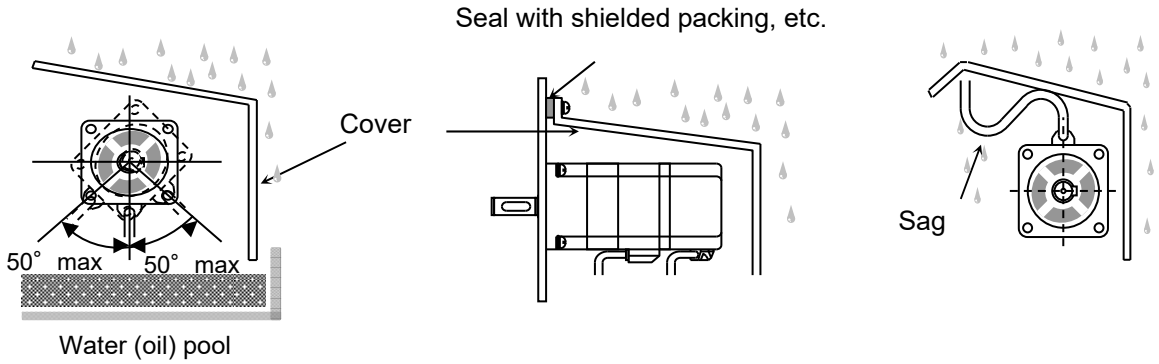
3.2.5 Waterproofing and dust proofing

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

3. Installation

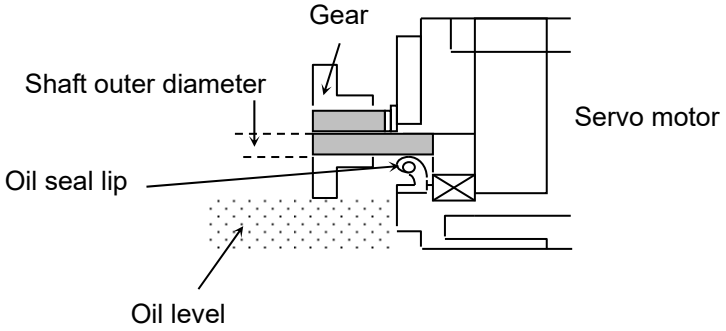
3.2.6 Protective cover installation

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



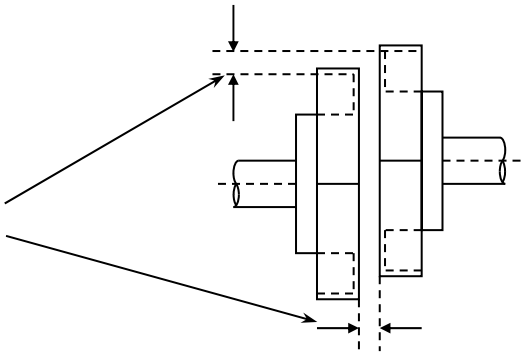
3.2.7 Gear installation and Integration with the target machinery

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

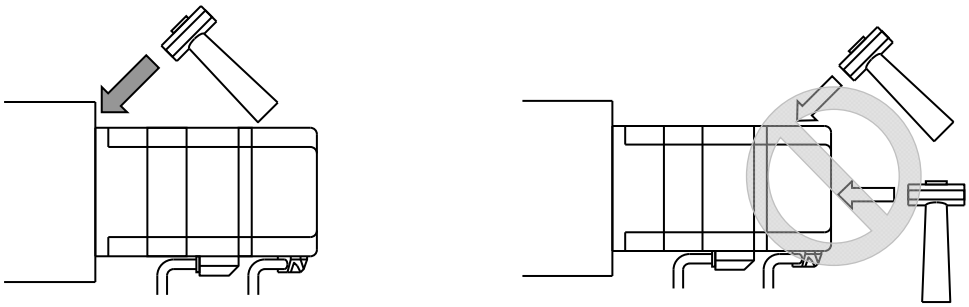


■ Refer to the drawing below for correct centering of the motor shaft and the target machinery. Please note when using a rigid coupling that even a slight mistake in centering can damage the output shaft.

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

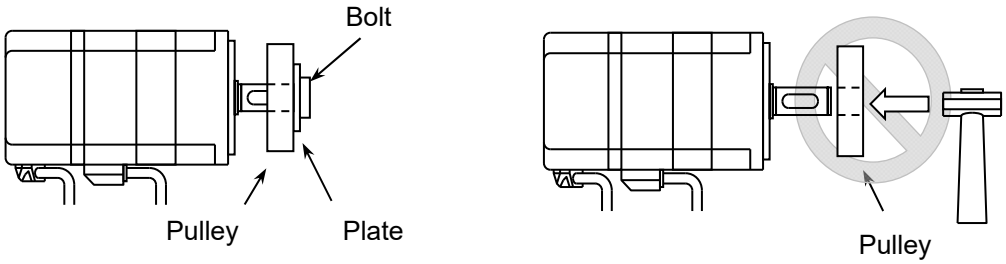


■ Do not apply any shocks on the servo motor shaft because precision equipment, encoder is directly connected to it. If it is absolutely necessary to hit the motor for position adjustment or other reasons, use a rubber or plastic hammer and hit the front flange area.



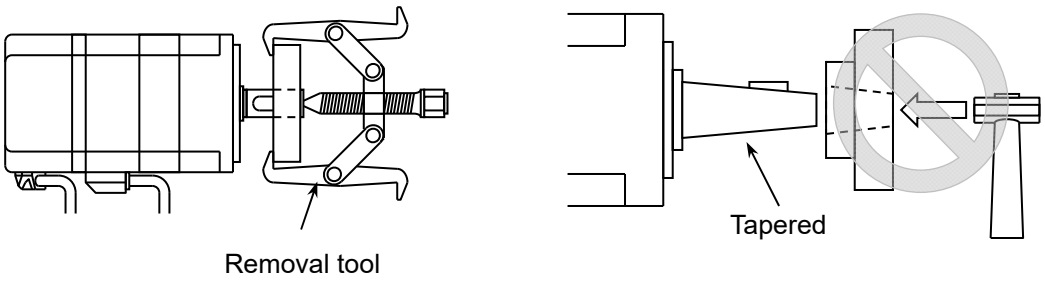
■ For mounting to a machine, create accurate enough mounting holes for smooth coupling of the motor flange rabbet. The mounting surface should be flat, otherwise damage to the shaft or the load may occur.

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



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

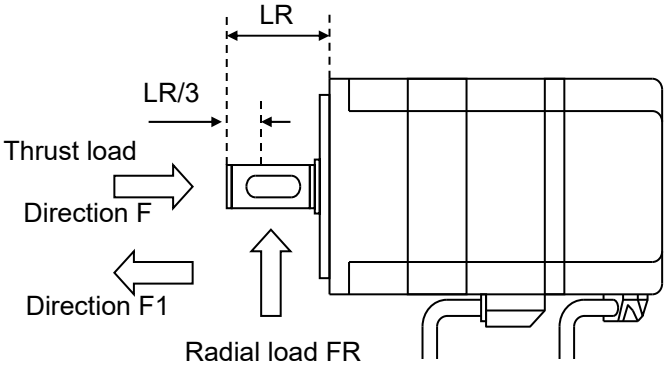
■ Use a special tool for removing the gear, pulley, etc.



3.2.8 Allowable bearing load

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

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



■ Input voltage 100, 200V AC (10 to 300A)

	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	R1□A04005	150	98	98	98	29	29
	R1□A04010	150	98	98	98	29	29
	R1□A06020	390	200	200	200	68	68
	R1AA06040	390	200	200	200	68	68
	R1AA08075	590	390	390	340	200	200
	R1AA10100	980	290	290	690	290	290
	R1AA10150	980	290	290	690	290	290
	R1AA10200	980	290	290	690	290	290
	R1AA10250	980	290	290	690	290	290
	R1AA13300	2,000	390	390	980	390	390
	R1AA13400	2,000	390	390	980	390	390
	R1AA13500	2,000	390	390	1,200	390	390
	R1AA18550	3,900	2,000	2,000	1,800	590	590
	R1AA18750	3,900	2,000	2,000	1,800	590	590
	R1AA1811K	3,900	2,000	2,000	1,800	590	590
	R1AA1815K	3,900	2,000	2,000	2,700	1,500	1,500

■ Input voltage 100, 200V AC (10 to 300A, continued)

	Servo motor model number	Assembly			Operation		
		Radial load (N)	Thrust load (N)		Radial load (N)	Thrust load (N)	
		FR	Direction F	Direction F1	FR	Direction F	Direction F1
R2	R2□A04003	98	78	78	49	29	29
	R2□A04005	150	98	98	98	29	29
	R2EA04008	150	98	98	98	29	29
	R2AA04010	150	98	98	98	29	29
	R2□A06010	150	98	98	98	29	29
	R2□A06020	390	200	200	200	68	68
	R2AA06040	390	200	200	250	68	68
	R2AA08020	390	200	200	200	98	98
	R2AA08040	390	200	200	250	98	98
	R2AA08075	590	390	390	340	200	200
	R2AAB8075	590	780	290	340	200	200
	R2AAB8100	590	780	290	340	200	200
	R2AA10075	590	780	290	340	200	200
	R2AA10100	590	780	290	340	200	200
	R2AA13050	980	1,400	1,400	640	490	490
	R2AA13120	1,700	1,900	1,900	640	490	490
	R2AA13180	1,700	1,900	1,900	640	490	490
	R2AA13200	1,700	1,900	1,900	640	490	490
	R2AA18350	2,300	1,900	1,900	1,500	290	290
	R2AA18450	2,300	1,900	1,900	1,500	290	290
	R2AA18550	3,900	2,000	2,000	1,800	590	590
	R2AA18750	3,900	2,000	2,000	1,800	590	590
	R2AA1811K	3,900	2,000	2,000	1,800	590	590
	R2AA22500	2,300	1,900	1,900	1,500	490	490
	R2AA22700	3,900	2,000	2,000	2,500	1,100	1,100
	R2AA2211K	3,900	2,000	2,000	2,700	1,500	1,500
	R2AA2215K	3,900	2,000	2,000	2,700	1,500	1,500
R5	R5AA06020	390	200	200	200	68	68
	R5AA06040	390	200	200	250	68	68
	R5AA08075	390	390	390	340	200	200

3. Installation

■ Input voltage 100, 200V AC (600A)

	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	R1AA2220KV	3,900	2,000	2,000	2,700	1,500	1,500
R2	R2AA2220KB	3,900	2,000	2,000	2,700	1,500	1,500
	R2AA2225KB						
	R2AA2830KV	4,700	2,000	2,000	3,300	1,500	1,500

■ Input voltage 400V AC

	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	R1CA10150	980	290	290	690	290	290
	R1CA10200	980	290	290	690	290	290
	R1CA13300	2,000	390	390	980	390	390
	R1CA18550	3,900	2,000	2,000	1,800	590	590
	R1CA18750	3,900	2,000	2,000	1,800	590	590
	R1CA1811K	3,900	2,000	2,000	1,800	590	590
	R1CA1815K	3,900	2,000	2,000	2,700	1,500	1,500
	R1CA2220K	3,900	2,000	2,000	2,700	1,500	1,500
R2	R2CA10075	590	780	290	340	200	200
	R2CA10100	590	780	290	340	200	200
	R2CA13050	980	1,400	1,400	640	490	490
	R2CA13120	1,700	1,900	1,900	640	490	490
	R2CA13180	1,700	1,900	1,900	640	490	490
	R2CA13200	1,700	1,900	1,900	640	490	490
	R2CA18350	2,300	1,900	1,900	1,500	290	290
	R2CA18450	2,300	1,900	1,900	1,500	290	290
	R2CA18550	3,900	2,000	2,000	1,800	590	590
	R2CA18750	3,900	2,000	2,000	1,800	590	590
	R2CA2211K	3,900	2,000	2,000	2,700	1,500	1,500
	R2CA2215K	3,900	2,000	2,000	2,700	1,500	1,500
	R2CA2220K	3,900	2,000	2,000	2,700	1,500	1,500
	R2CA2830K	4,700	2,000	2,000	3,300	1,500	1,500
	R2CA3255KB	8,500	3,400	3,400	5,900	2,000	2,000

3.2.9 Cable installation considerations

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

3. Installation

3.3 Linear motor

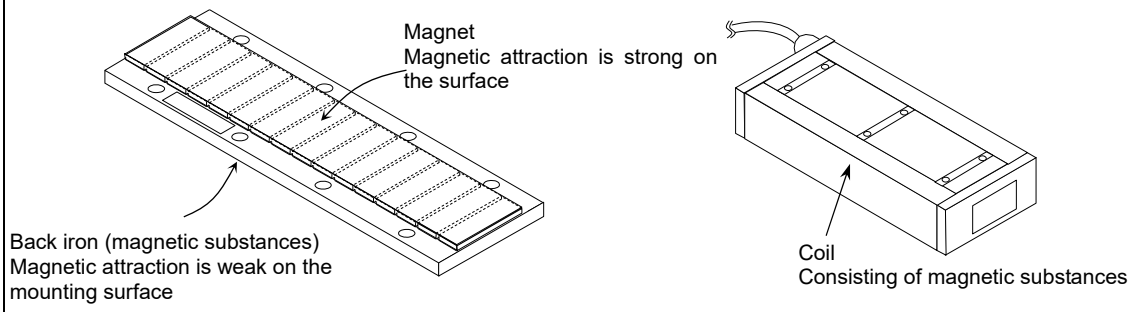
3.3.1 Precautions on linear motor installation

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

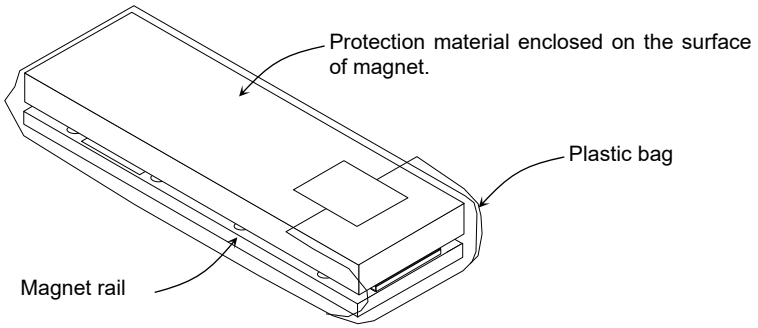
■ Prevention of impairment

Strong magnet is mounted in magnet rail, so those who is wearing medical equipment, such as pacemakers, or being implanted magnetic metal into the body, make sure to keep 0.5m or over away from linear motor, and do not perform unpacking. Severe physical impairment can occur due to equipment failure or strong magnetic attraction of magnetic metal. So pay careful attention to not only operators but also people around work area.

Magnet rail structure is such that magnet is adhered on the surface of back iron which has magnetic body.
There is almost no magnetic field on the mounting surface of back iron, and magnetic attraction is weak. (Less than one tenth the own weight)
However, please also be aware that powerful magnetic field generates on the surface of magnet, and strong magnetic attractive force generates between magnetic bodies. Coil is not mounting magnet in, however, consisting of magnetic substances.



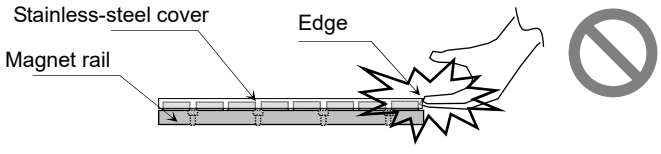
Magnet rail body is wrapped in plastic bag, and protection material (styrene foam) whose thickness is approximately 20mm is enclosed on the surface of magnet to reduce magnetic attraction.
Do not remove the protection material until just before mounting process.



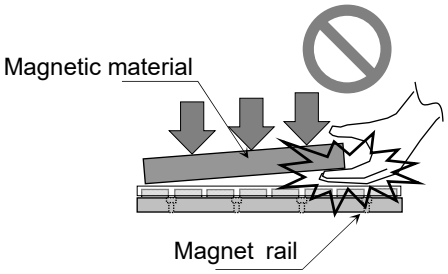
Packing of single magnet rail

Operators shall not wear any rings, watches, or magnetic cards.
Putting magnetic storage media, such as magnetic card or floppy disk, and PC close to magnet rail can result in damages to the data or equipment failures.

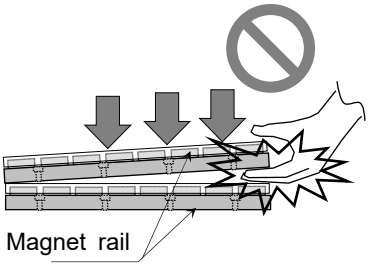
Never touch edge of magnet rail stainless-steel cover or coil with bare hands. Failure to do so can result in injuries. Make sure to protect your hands with gloves to perform installation. However, please also make sure not to use gloves when operating motor to prevent operators being caught in.



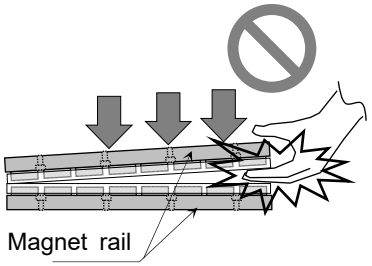
Take care to keep the magnetic substances other than tools needed away from magnet rail.
Strong magnet is mounted in magnet rail, so strong attraction generates between a piece of iron, steel tool, or magnet, and your hand may be gotten stuck in, and this can cause severe physical impairment.
The smaller the gap is, the more sharply-increased the magnetic attraction between magnet surface and magnet body is, and the magnetic attraction is proportional to the opposing area. It is dangerous as extremely great force up to approximately 4000N (400kgf) per 100cm^2 (10cm square) of the opposing area generates.



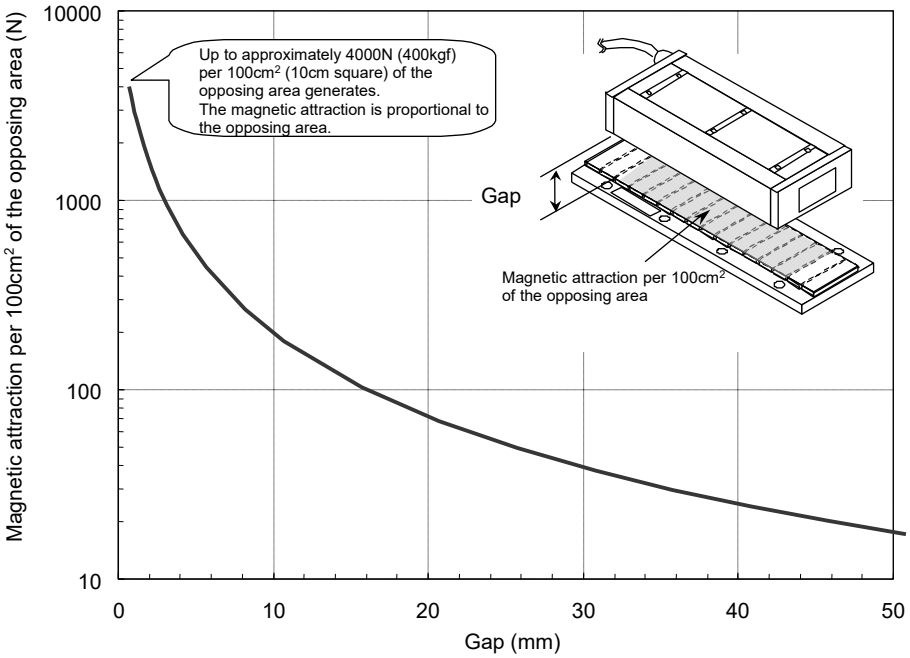
Magnet surface + magnetic body



Magnet surface + back iron surface



Magnet surface + magnet surface

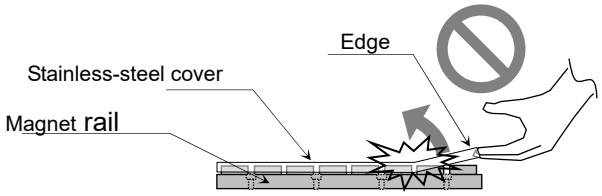


If you suspend unpacking, return the unpacked items to the original packing state.
If you leave the magnet rail as it is, strong attraction generates between magnetic bodies, your hand may be gotten stuck in, and this can cause severe physical impairment.

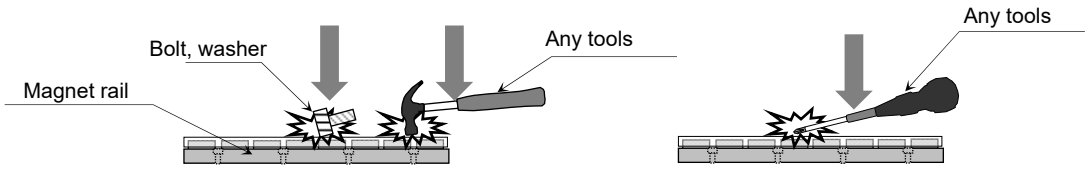
3. Installation

■ Prevention of system damage

Take care not to have a hand on edge of magnet stainless-steel cover. Applying stress to the edge can cause deformation or removal, and then damages to the product.



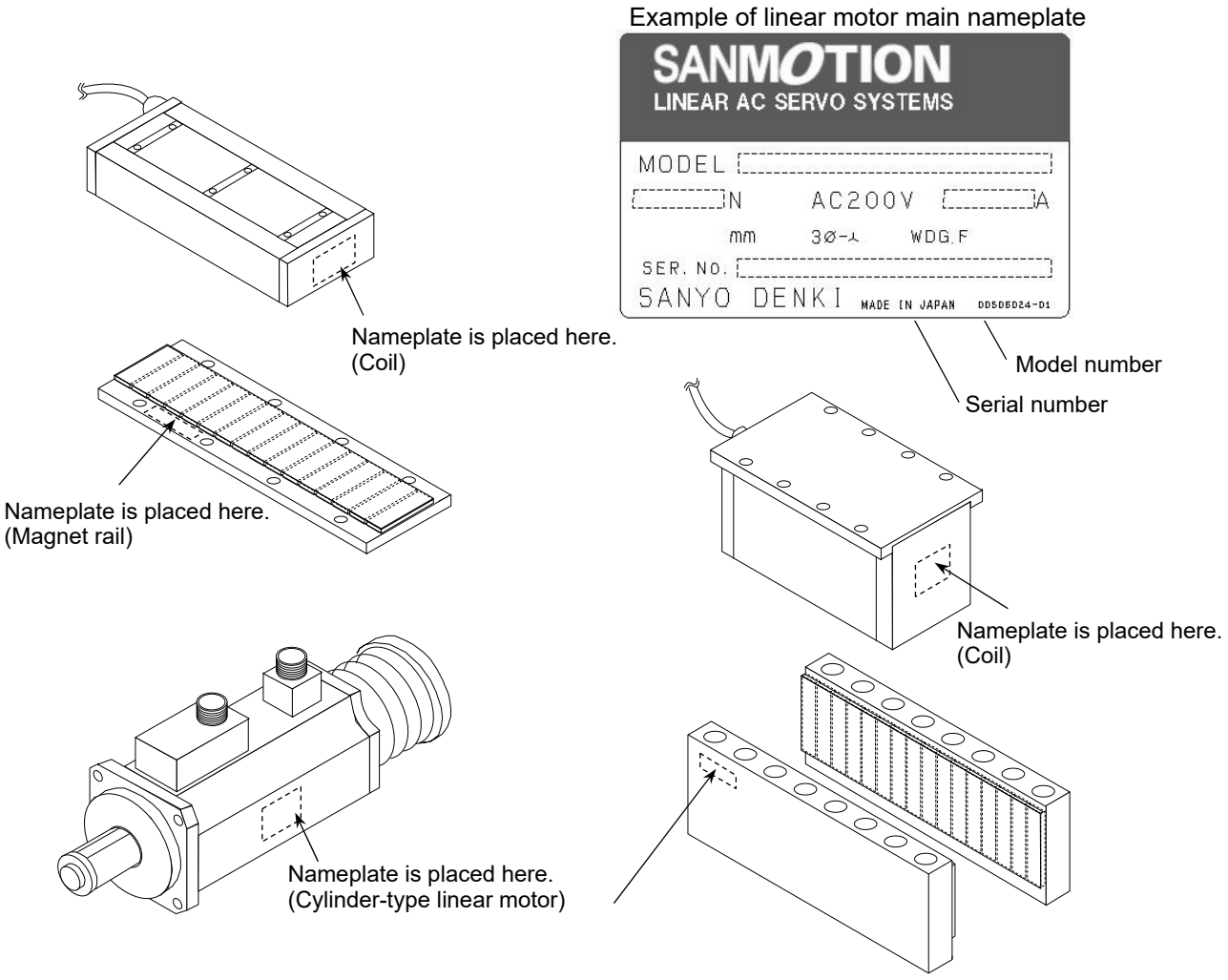
Take care not to drop items such as tools, bolts (especially magnetic materials) onto magnet rail surface. This can cause deformation and damage of cover, crack and chip on magnet, and then damages to the product.



3.3.2 Unpacking

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

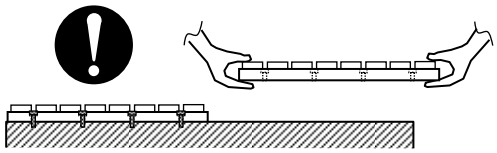
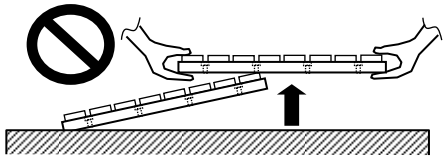
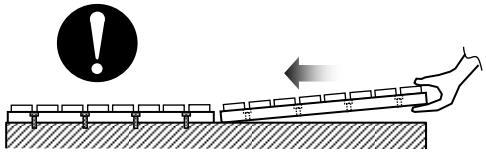
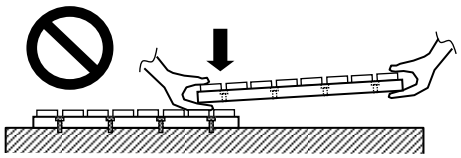
- Unpack after checking upside and downside. Failure to do this can result in injuries.
- Check servo motor model number to see if any discrepancies between ordered item and delivered item. Model number is marked after each product nameplate "MODEL." Nameplate is placed onto coil and magnet rail respectively. Position to which nameplate placed varies depending on linear motor models. Installing incorrect model number product can result in injuries or damages.
- Check servo motor exterior to see if any problems.
- Check servo motor screws to see if any looseness.



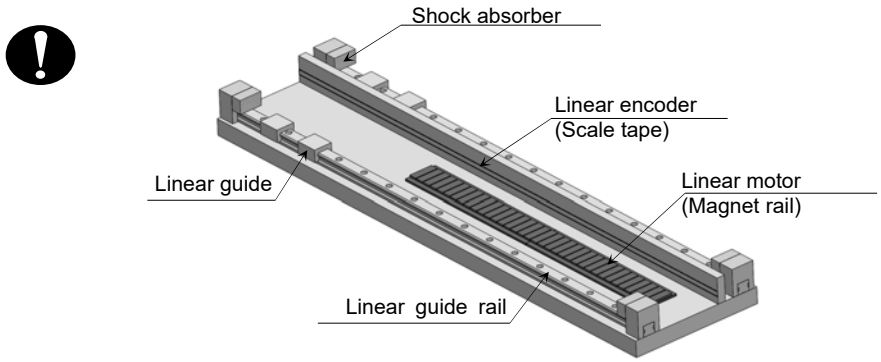
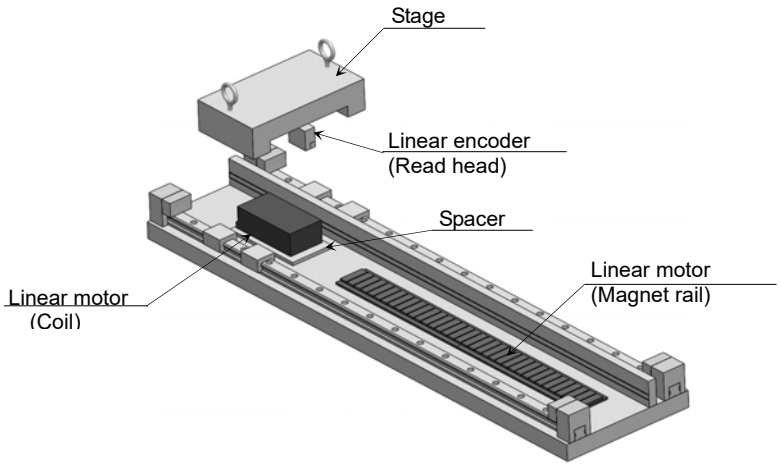
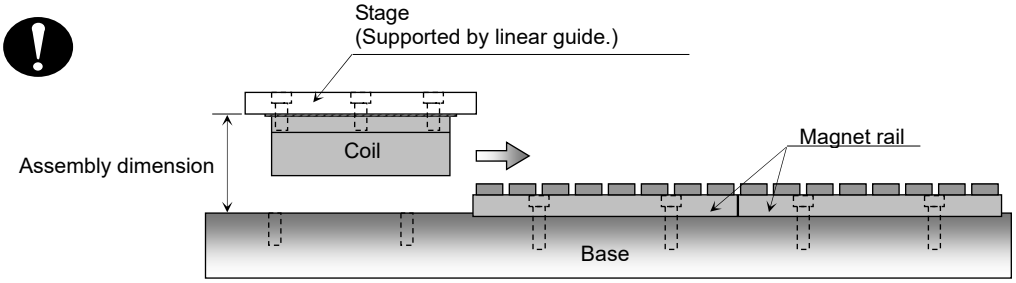
3. Installation

3.3.3 Installation of flat-type linear motor with core

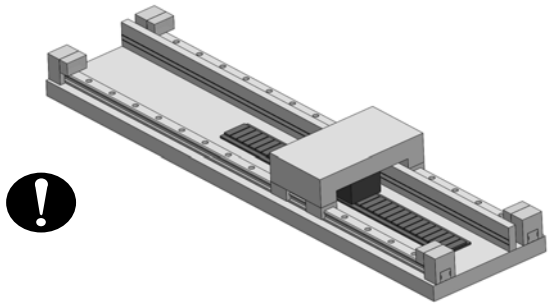
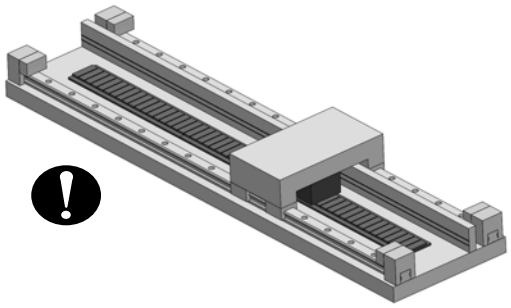
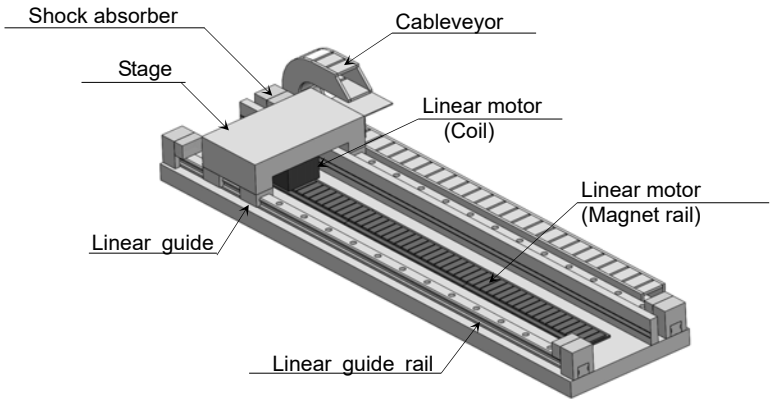
■ Mounting magnet rail

Step	Description
1	Strong magnet is mounted on the surface of magnet rail. Strong magnetic attraction works when putting magnetic substances such as motor coil, steel tools or other magnet rail closer to the magnet rail. Take great care not to get your hand stuck in.
2	Magnetic attraction works between magnet rail and motor coil. This force always stays constant, and works even if motor power supply not tuned on. So the system structure needs to have sufficient rigidity enough to support magnetic attraction and maintain the accuracy.
3	Driving motor with foreign substances, such as magnetic powder, magnetic metal, or dirt, adsorbed onto the surface of magnet rail, the foreign substances can be gotten caught in the moving part, and then this causes failures. Place bellows or sliding cover to prevent adhesion of foreign substances, depending on the operating environments. Always keep magnet rail surface clean.
4	Face all the nameplates on magnet rail in the same direction.
5	Make sure that mounting front surface is the back surface (even surface) to install magnet rail. Closing the front surface to the mounting surface generates magnetic attraction, this can cause injuries or damages.
6	Place magnet rails with all their positioning pin hole placed in the same direction on the same side. Please be aware of that mounting magnet rails with their positioning holes placed upside down makes magnet polarity incorrect, and this can cause going out of control.
7	Secure the magnet rails one by one with all the mounting screws. Tightening torque, mating length and screw strength class of mounting screw depends on the values written in the outline drawing of magnet rail. Also, use a thread locker. Magnet rail not fastened with screw can generate attraction when bringing other magnet rails or magnetic metal close to the magnet rail, this can cause injuries and damages.  
8	Place magnet rails from the end in order. When mounting a magnet rail next to the already fixed magnet rail, put the magnet rail from the side not from the top. Magnetic attraction can generate, and this can cause injuries and damages.  

■ Installation of coil <Mounting coil where magnet rail not mounted. >

Step	Description
1	First mount one-half of the entire length of magnet rail. Make sure that both the magnet rail length and the length magnet rail not yet mounted shall be more than 50mm longer than coil length.
	
2	Place the coil via spacer to the base where magnet rail not yet mounted. Use the material avoiding base or coil being damaged for spacer. Take care not to get your fingers stuck between coil and base. Please use the spacer thinner than magnet rail in some degree.
	
3	Secure the coil with all the mounting screws. Use screw strength class: more than 10.9, and use thread locker. And, tightening torque and mating length of mounting screw depends on the values written in the outline drawing of coil. Assembly dimension between magnet rail and coil depends on the values written in the outline drawing of coil.
	

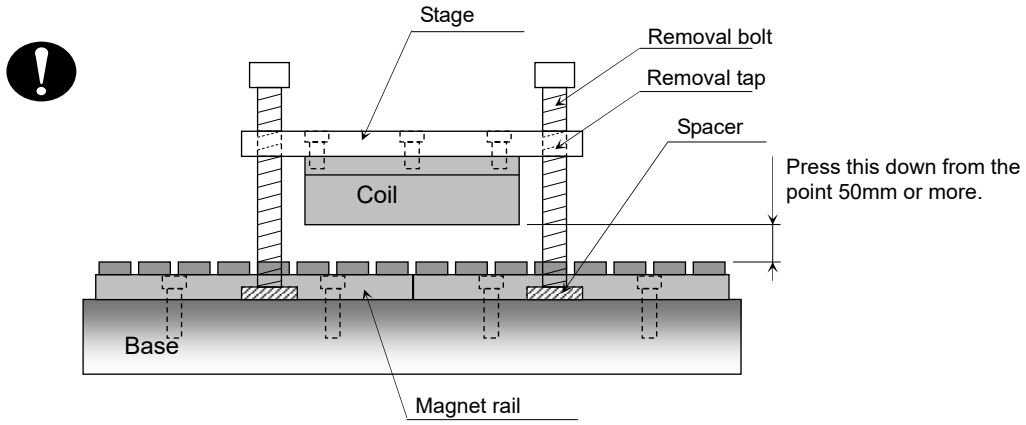
3. Installation

Step	Description
4	Slide the moving stage with coil mounted across the magnet rail fasten with screw. The attraction that coil drawn to the magnet surface at this time is as indicated in the table below. The attraction goes off when the entire coil is over the magnet rail.  The attraction when mounting: generates value ± in cycle of approximately 16mm
5	Mount the last half of the magnet rail. 
6	The installation is completed when motor mounting completed. Perform wirings. 

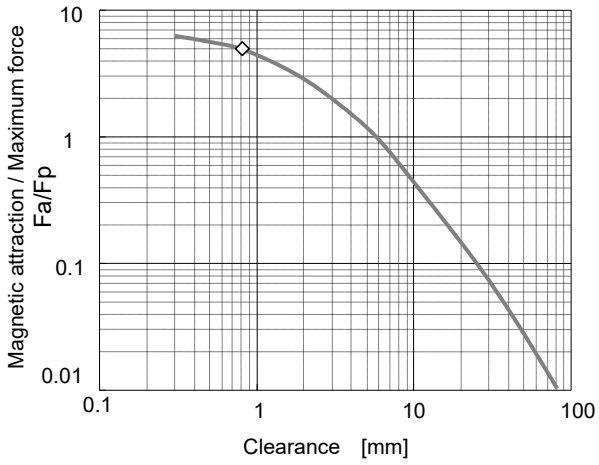
Series	Attraction
DS030C####	Approx. ±60N
DS045C####	Approx. ±100N
DS050C####	Approx. ±100N
DS075C####	Approx. ±150N
DS100C####	Approx. ±200N
DS150C####	Approx. ±300N

■ Installation of coil <Mounting coil where magnet rail mounted. >

Step	Description
1	After installing the entire magnet rail, place coil via nonmagnetic spacer whose thickness is more than 50mm to the magnet rail surface. Use the nonmagnetic spacer whose materials are not being compressed by coil weight.
2	Place removal tap so that stage can be moved up and down in a horizontal direction with bolts. Stage can be lifted up by contacting with the tip of removal bolt. Use resin spacer so as not to scratch base even if removal bolt hits the base. Determine tap shape, the number of tap, and spacer in consideration of magnetic attraction.
3	Place stage onto coil, fasten the coil and stage, lift the coil including stage by using removal bolts with removal taps placed in the stage, separate coil from nonmagnetic spacer, and then remove the nonmagnetic spacer.
4	Move the stage down to be locked with guide block in a parallel fashion by pushing removal screw down in order. After that, remove the removal bolts. Stage positioning shall be performed where the space between coil and magnet is wide and magnetic attraction is small.



Magnetic attraction vs Clearance characteristic

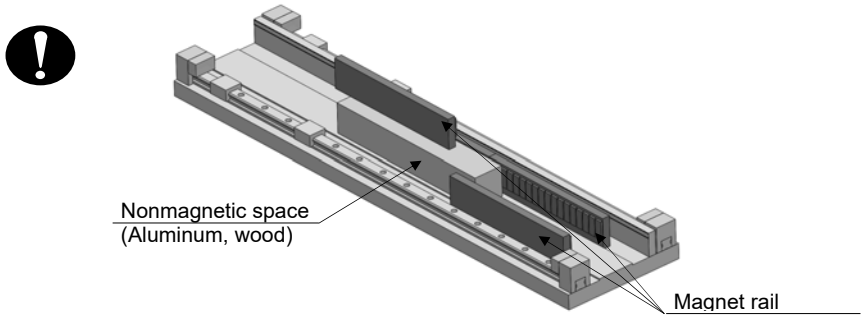
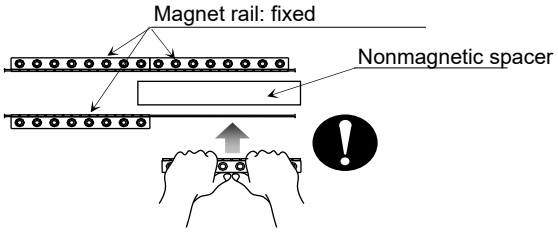
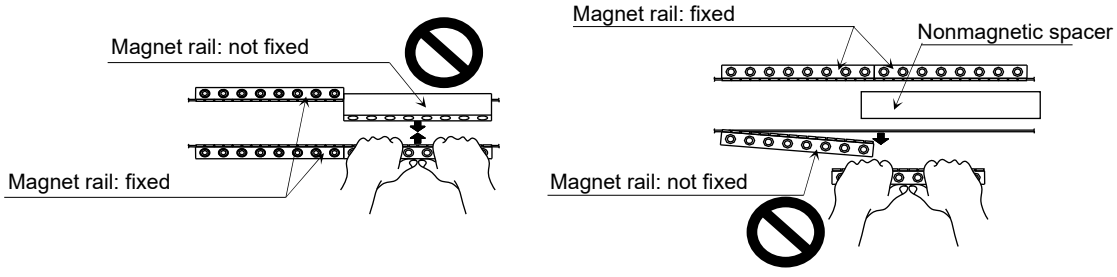


Keep clearance 50mm or more between coil and magnet rail while installing, for the safety.

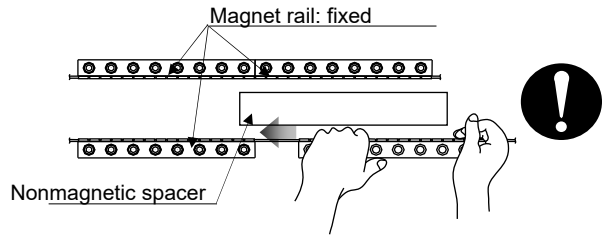
3. Installation

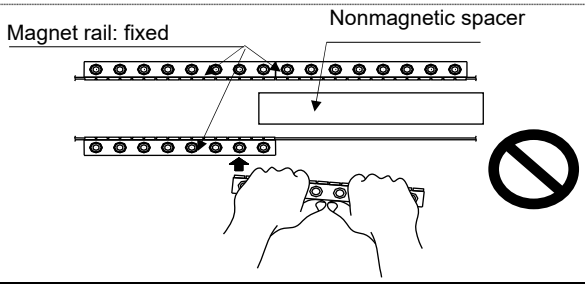
3.3.4 Installation of twin-type linear motor with core

■ Mounting magnet rail and the precautions

Step	Description
1	Strong magnet is mounted on the surface of magnet rail. Strong magnetic attraction works when putting magnetic substances such as motor coil, steel tools, or other magnet rail closer to the magnet rail. Take great care not to get your hand stuck in.
2	Magnetic attraction works between magnet rail and motor coil. This force always stays constant, and works even if motor power supply not tuned on. So the system structure needs to have sufficient rigidity enough to support magnetic attraction and maintain the accuracy.
3	Driving motor with foreign substances, such as magnetic powder, magnetic metal, or dirt, adsorbed onto the surface of magnet rail, the foreign substances can be gotten caught in the moving part, and then this causes failures. Place bellows or sliding cover to prevent adhesion of foreign substances, depending on the operating environments. Always keep magnet rail surface clean.
4	Install magnet rails so that two magnet surfaces (convex side) of both magnet rails face each other. Make sure not to let the both magnet rails being attracted each other by inserting nonmagnetic spacer (Width: 30 to 80mm, height: more than 100mm) between the magnet rails facing each other for your safety. 
5	To place magnet rail, the surface with counterbore in its mounting hole is the upper side. Mounting magnet rail upside down makes mounting bolt head interfere with motor coil, and this can cause damages.
6	Secure the magnet rails one by one with all the mounting screws. Tightening torque, mating length and screw strength class of mounting screw depends on the values written in the outline drawing of magnet rail. Also, use a thread locker. Magnet rail not fastened with screw can generate attraction when bringing other magnet rails or magnetic metal close to the magnet rail, this can cause injuries and damages.  

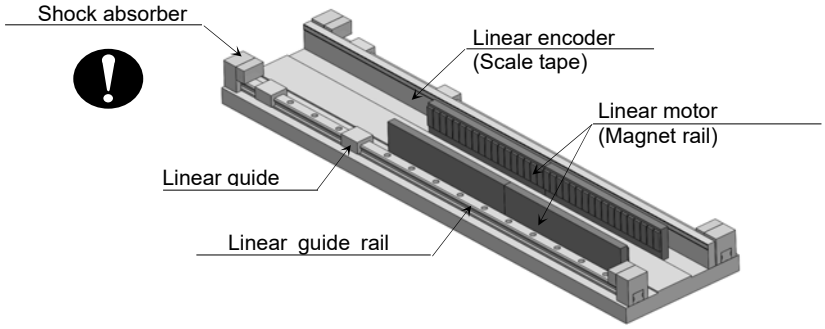
7	Place magnet rails from the end in order. When mounting a magnet rail next to the already fixed magnet rail, put the magnet rail from the stroke direction not from the orthogonal (facing magnet surface). Magnetic attraction can generate, and this can cause injuries and damages.



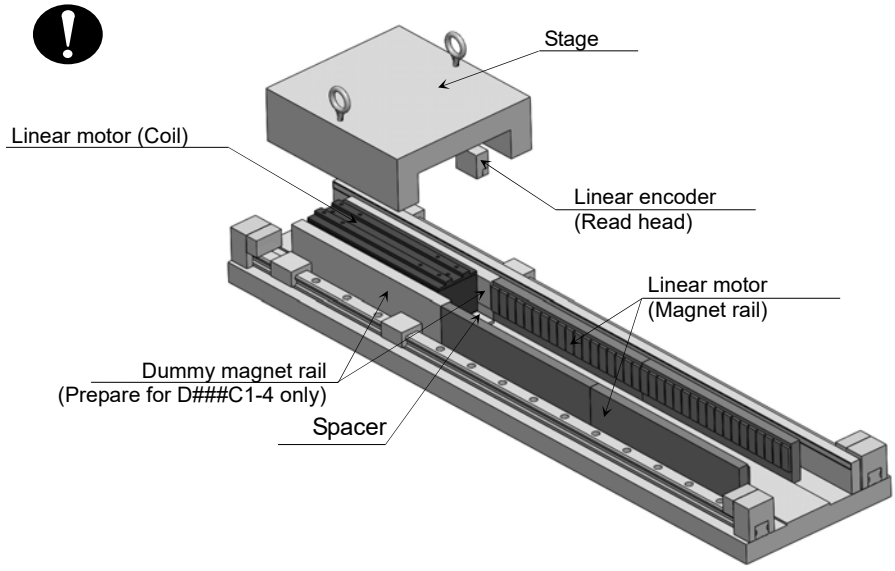


■ Mounting coil

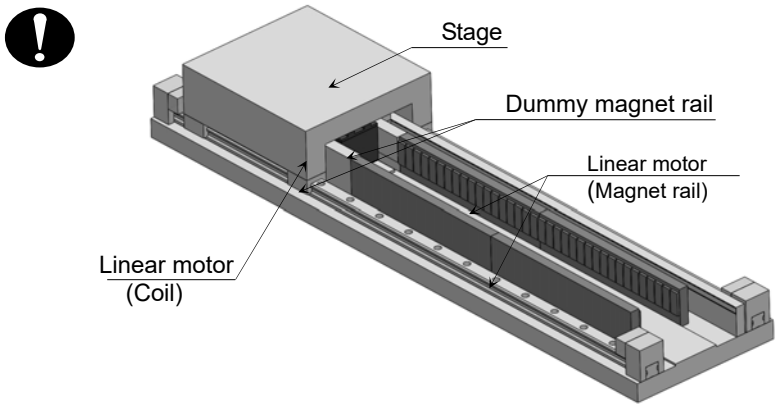
Step	Description
1	First mount one-half of the entire length of magnet rail. Make sure that both the magnet rail length and the length magnet rail not yet mounted shall be more than 50mm longer than coil length.



2	Mount dummy magnet rail on the stroke area magnet rail not mounted, insert motor coil into the area dummy magnet rail mounted. Take care not to get your fingers stuck between motor coil and base. (Prepare the dummy magnet rail for D###C1-4 only. Refer to the outline drawing, for shape.)



Temporary fasten motor coil and stage with bolts, and adjust the gap length between dummy magnet rail and coil so as to be appropriate value (gap length refer the outline drawing of coil). 0.2mm or less is recommended for the difference between two points of the gap between dummy magnet rail and motor coil. After adjusting gap, tighten the bolts for fastening motor coil and stage. Use all the mounting screws for motor coil. Use screw strength class: more than 10.9, and use thread locker. And, tightening torque and mating length of mounting screw depends on the values written in the outline drawing of coil.

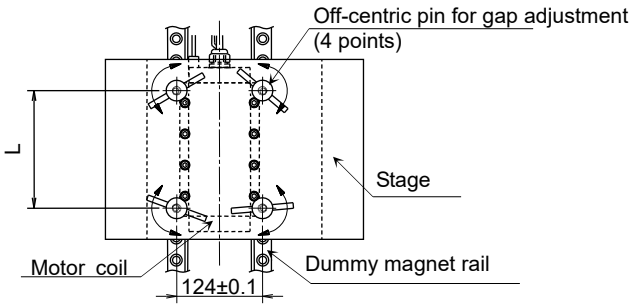


[Adjusting gap]

Make sure to perform gap adjustment only within the area motor coil faces dummy magnet rail. Strong magnetic attraction is acting on motor coil within the area magnet rails face each other, so this can cause injuries and damages. Never perform gap adjustment within the area magnet rails face each other.

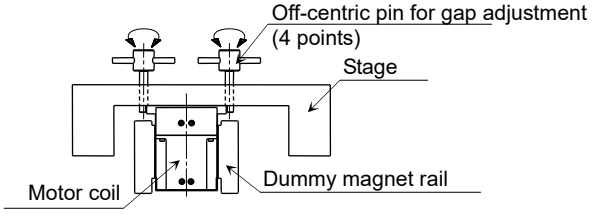
By using off-centric pin (DD###C1-4)

3 When using off-centric pin, perform gap adjustment from the upper side of the stage.
Place more than four off-centric pin holes on the stage. These hole positions shall be located on the points of motor coil top board with which off-centric pin ends contact. If stress of off-centric pin is applied to the area other than top board, motor coil can be damaged. For hole position of off-centric pin, refer to the recommended values indicated below. For recommended shape of off-centric pin, refer to outline drawing. Gap adjustment is performed by inserting off-centric pin into off-centric pin hole on the stage, and then turning this pin side to side. 0.2mm or less is recommended for the difference between two points of the gap between dummy magnet rail and motor coil.



Coil model number	L [mm]
DD###C1	170±5
DD###C2	345±5
DD###C3	520±5
DD###C4	670±5
DD###CB4	300±5

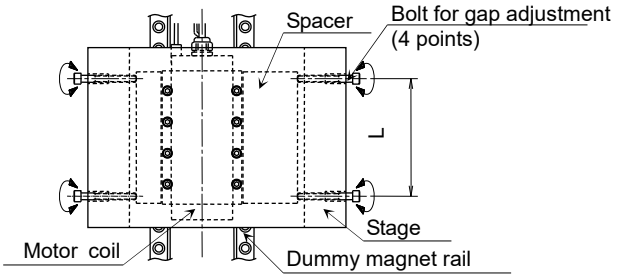
(Position of off-centric pin hole for gap adjustment: dimensions recommended)



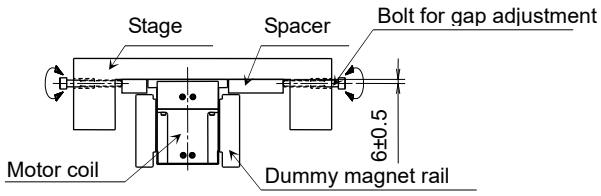
3

By using bolt (DD###C1-4)

When using bolts, gap adjustment shall be performed from the side of stage.
Place 4 taps for gap adjusting bolt on the side of stage.
This hole position shall be the place where gap adjusting bolt end contacts top panel of motor coil.
Applying bolt stress to the area other than the top board can damage the motor coil.
For bolt tap position, refer to the recommended values indicated in the figure below. M8 or M10 is recommended for tap diameter.
Gap adjustment is performed by installing bolts for gap adjustment in the taps on the side of stage, and then turning the bolts side to side. If the bolts are too short to reach the top board of coil, insert spacer between the end of bolt and top board. 0.2 mm or less is recommended for the difference between two points of the gap between dummy magnet rail and motor coil.

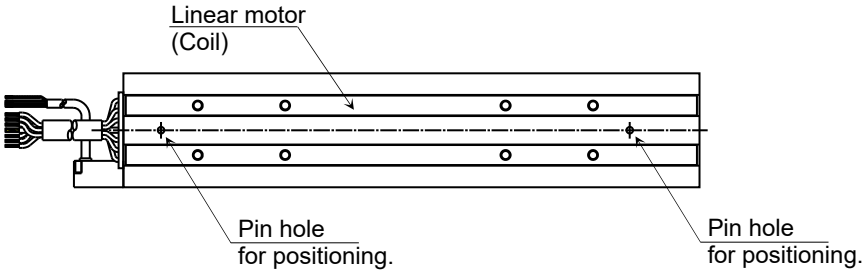


Coil model number	L [mm]
DD###C1	170±5
DD###C2	345±5
DD###C3	520±5
DD###C4	670±5
DD###CB4	300±5



By using positioning pin (DD###CB, DD###CC)

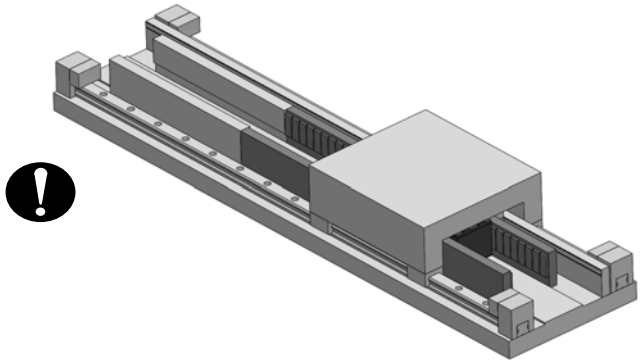
DD###CB and DD###CC have pin holes for positioning on the coil-mounting side.
Prepare the positioning pins to machine side stage, for use. Refer to outline drawing of coil, for diameter, length, position and quantity of positioning pin.



3. Installation

4

Slide the moving stage with coil mounted to the magnet rail fasten with screw.
The attraction that coil drawn to the magnet surface at this time is as indicated in the table below. The attraction goes off when the entire coil is over the magnet rail.

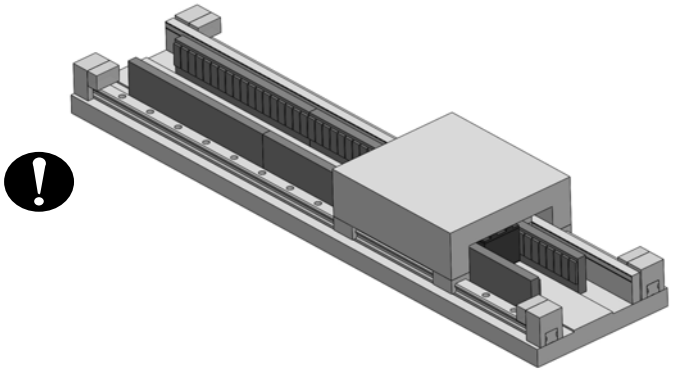


The attraction when mounting: generates value ± in cycle of approximately 16mm

Series	Attraction
DD030C####	Approx.±120N
DD035C####	Approx.±160N
DD045C####	Approx.±200N
DD050C####	Approx.±200N
DD075C####	Approx.±300N

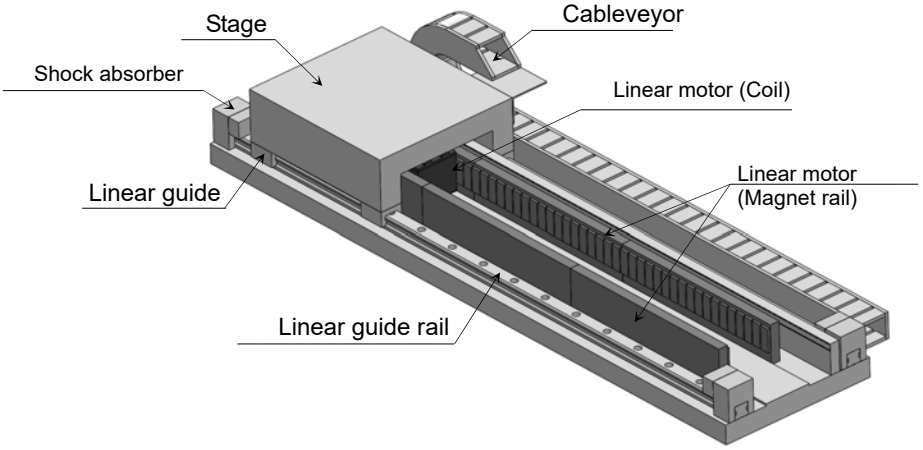
5

Remove dummy magnet rail and mount the last half of the magnet rail.



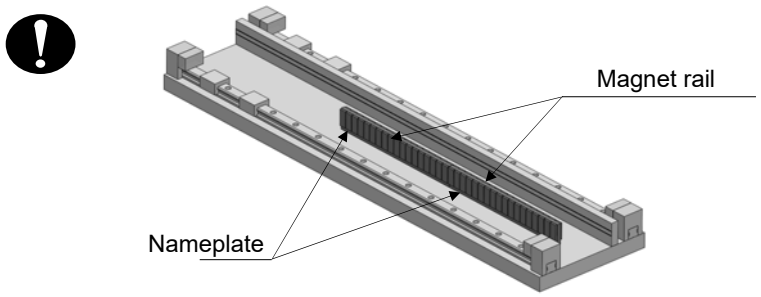
6

Perform wirings after completing motor installation.



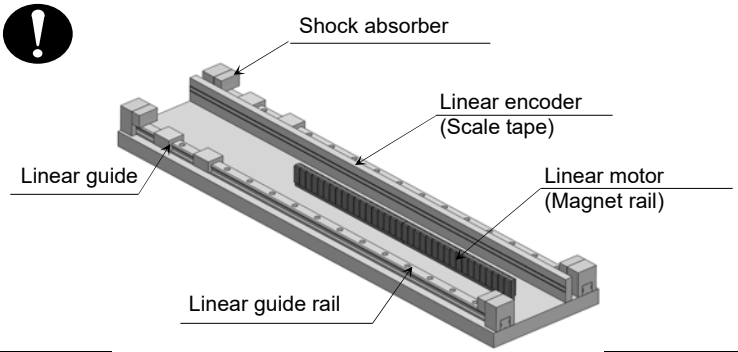
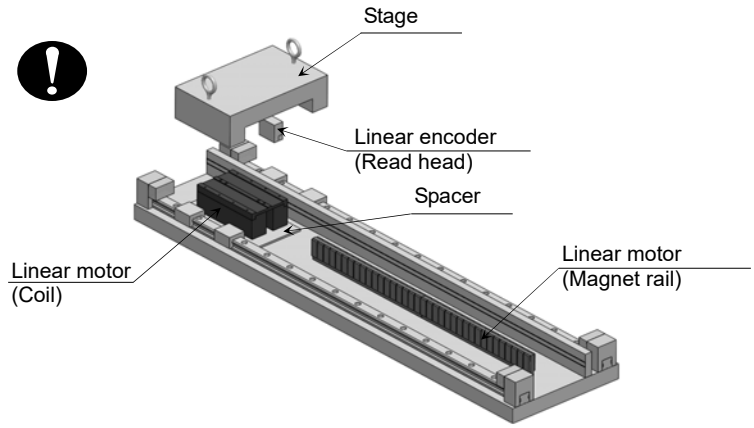
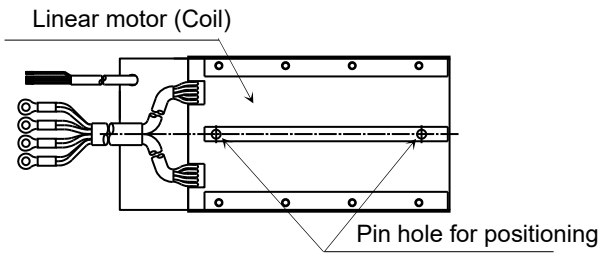
3.3.5 Installation of center magnet type linear motor with core

■ Mounting magnet rail, and caution

Step	Description
1	Strong magnet is mounted on the surface of magnet rail. Strong magnetic attraction works when putting magnetic substances such as motor coil, steel tools or other magnet rail closer to the magnet rail. Take great care not to get your hand stuck in.
2	Magnetic attraction works between magnet rail and motor coil. This force always stays constant, and works even if motor power supply not tuned on. So the system structure needs to have sufficient rigidity enough to support magnetic attraction and maintain the accuracy.
3	Driving motor with foreign substances, such as magnetic powder, magnetic metal, or dirt, adsorbed onto the surface of magnet rail, the foreign substances can be gotten caught in the moving part, and then this causes failures. Place bellows or sliding cover to prevent adhesion of foreign substances, depending on the operating environments. Always keep magnet rail surface clean.
4	Face all the nameplates on magnet rail in the same direction. 
5	Make sure that nameplate is lower side (mounting side) to install magnet rail. If it is to be mounted upside down, strong magnetic attraction is generated and this can cause injuries or damages. Moreover, this can cause a motor force reduction, driving-characteristic reduction and abnormal heat generation.
6	Secure the magnet rails one by one with all the mounting screws. Tightening torque and mating length of mounting screw depends on the values written in the outline drawing of magnet rail. Also, use screw strength class: more than 10.9, and use thread locker. Magnet rail not fastened with screw can generate attraction when bringing other magnet rails or magnetic metal close to the magnet rail, this can cause injuries and damages.
7	Place magnet rails from the end in order. When mounting a magnet rail next to the already fixed magnet rail, put the magnet rail from the side not from the top. Magnetic attraction can generate, and this can cause injuries and damages.

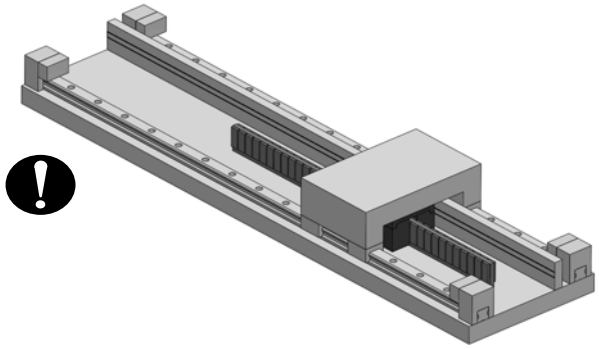
3. Installation

■ Mounting coil

Step	Description
1	First mount one-half of the entire length of magnet rail. Make sure that both the magnet rail length and the length magnet rail not yet mounted shall be more than 50mm longer than coil length.
	
2	Put a coil along with spacer on the stroke area without magnet rail. For spacer, use the material which does not scar a base or coil. Pay attention to avoid pinching fingers, between base and coil.
	
3	Secure the coil with all the mounting screws. Use screw strength class: more than 10.9, and use thread locker. And, tightening torque and mating length of mounting screw depends on the values written in the outline drawing of coil. Assembly dimension between magnet rail and coil depends on the values written in the outline drawing of coil.
	[Adjusting gap]
	Make sure to perform gap adjustment only within the area motor coil faces dummy magnet rail. Strong magnetic attraction is acting on motor coil within the area magnet rails face each other, so this can cause injuries and damages. DT###C has pin holes for positioning on the coil-mounting side. Prepare the positioning pins to machine side stage, for use. Refer to outline drawing of coil, for diameter, length, position and quantity of positioning pin.
	

4

Slide the moving stage with coil mounted across the magnet rail fasten with screw.
The attraction that coil drawn to the magnet surface at this time is as indicated in the table below. The attraction goes off when the entire coil is over the magnet rail.

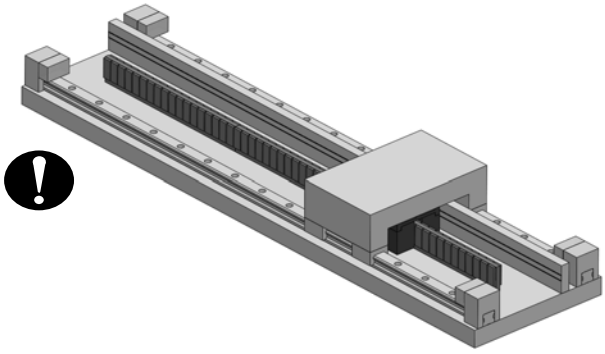


The attraction when mounting: generates value ± in cycle of approximately 16mm

Series	Attraction
DT030CD###	Approx.±250N

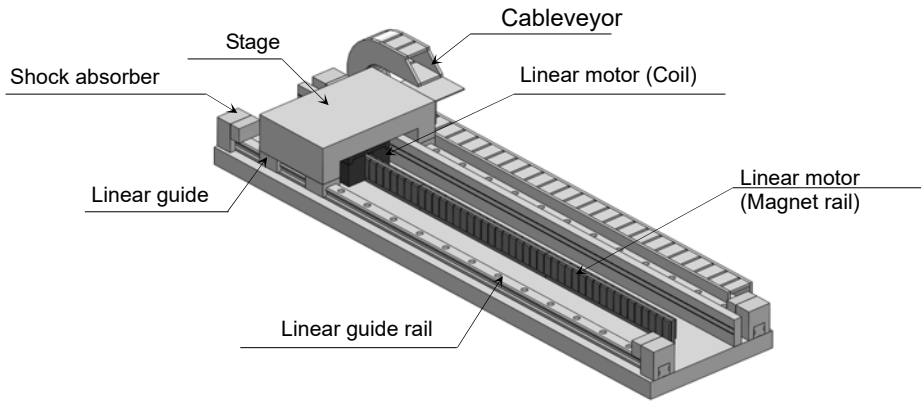
5

Mount the last half of the magnet rail.



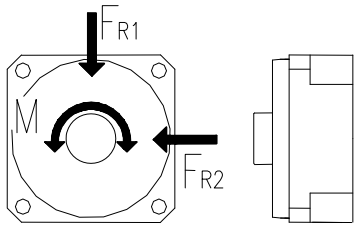
6

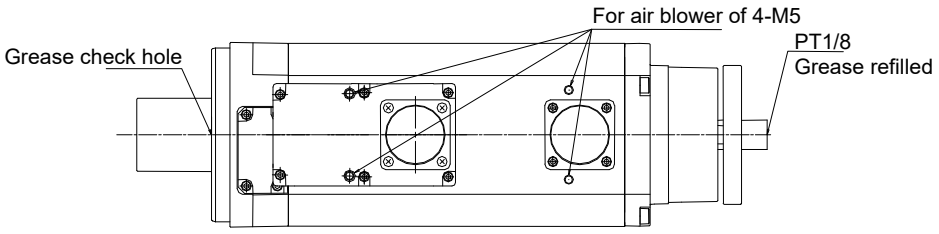
The installation is completed when motor mounting completed. Perform wirings.



3. Installation

3.3.6 Installation of cylinder-type motor

<table>
<tr><th>Step</th><th>Description</th></tr>
<tr><td>1</td><td>The rotational moment acting on load mounting plate on the output shaft is received by the rotation stopper on the counter-output shaft side alone. Therefore if excessive rotational moment load is acting on, this can cause motor damage or reduce the motor lifetime. Fix the mover to install load so as not to apply rotational moment to output shaft, and not to exceed the allowable load indicated in the table below.
<table>
<tr><td rowspan="1">Maximum allowable moment load</td><td>Direction M</td><td>0.8</td><td>(N·m)</td></tr>
<tr><td rowspan="2">Maximum allowable radial load</td><td>Direction F_{R1}</td><td>70</td><td>(N)</td></tr>
<tr><td>Direction F_{R2}</td><td>70</td><td>(N)</td></tr>
</table>


</td></tr>
<tr><td>2</td><td>Four screw taps for M5-screw provided on the top surface to dust prevention.
An opening on the flange surface is passing completely through the interior of the motor. So using in the environment such as exposing to dust needs to perform air blower to prevent dust from entering the inside of the motor and to apply internal pressure.
Perform piping to screw taps in which air is injected, to perform air blower. Plug the screw taps not used with M5-screw. The mating depth shall be 8mm or less.</td></tr>
<tr><td>3</td><td>This motor needs periodical grease refilling to avoid running out of oil film for the bearing.
The recommend interval of grease refilling is either every 1500 to 1700km of mileage or every 8 to 10 months, whichever is shorter. Grease refilling shall be performed as follows:
Refill grease into grease refilling hole of PT 1/8 on counter-output shaft side until grease overflows from grease check hole on output shaft side. Rub the grease overflowed off thoroughly.
Recommended single grease refilling amount is less than the amount of two discharges of grease gun (0.7cc/ time-discharge). For motor mover position when refilling grease, the output shaft shall be moved further than the center of all the movable range.
AFC grease (product of THK Co., Ltd.) is filled in the motor at the factory, so AFC grease is recommended for refilling.


</td></tr>
<tr><td>4</td><td>As return-to-origin operation after control power supply turned on, drive the motor coming across phase Z signal at least 1 time. If use the motor without coming across phase Z signal, the force to be generated can decrease to approximately one-half of the specified value.</td></tr>
<tr><td>5</td><td>If drive stroke is always shorter than 10mm, grease cannot be applied to ball bearing. This cause fretting damage due to lack of oil film. So you need devices to add whole stroke operation during continuous drive pattern when operating with a short stroke. Please contact us for further detailed setting of drive patterns.</td></tr>
</table>

4 Wiring

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

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4.1 Wiring for the terminal of high voltage and grounding

4.1.1 Part name and function

■ Input voltage 200V AC

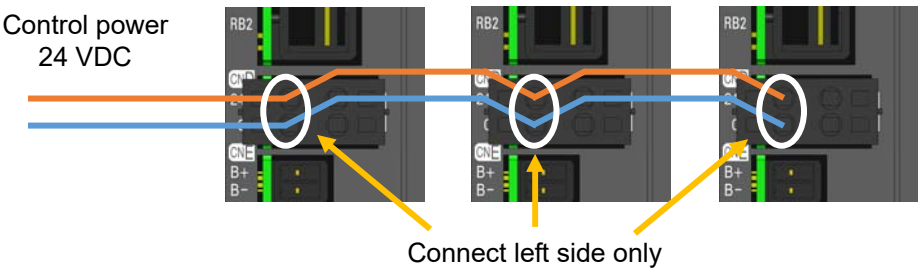
Terminal name	Connector marking	Remarks	
Main circuit power supply	R･T or R･S･T	Single phase 100 to 120 VAC +10%, -15% 50/60Hz±3%	
		Single phase 200 to 240 VAC +10%, -15% 50/60Hz±3%	
		Three-phase 200 to 240 VAC +10%, -15% 50/60Hz±3%	
Control power supply	r･t	Single phase 100 to 120 VAC +10%, -15% 50/60Hz±3%	
		Single phase 200 to 240 VAC +10%, -15% 50/60Hz±3%	
Servo motor connector	U･V･W	Connected with servo motor	
Protective grounding terminal	⏚	Connected with grounding wire of power supply and of servo motor.	
Regeneration resistance connector	RB1･RB2 RB4	RS3□01 RS3□02 RS3□03 RS3A05 RS3A30 RS3W60	Connects regenerative resistance to terminal RB1 and RB2. Built-in regenerative resistor model has already connected at factory setting. Connects external regenerative resistor to terminal RB1 and RB2 when regenerative performance is insufficient. RB4 terminal is not equipped.
		RS3A07 RS3A10 RS3A15	Built-in regenerative resistor model has short-bar between RB1 and RB4 at factory setting. Connects external regenerative resistor to terminal RB1 and RB2 after removing the short-bar when regenerative performance is insufficient.
Maker maintenance	P･⊖	For maker maintenance. Do not connect anything.	

4. Wiring

■ Input voltage 400V AC

Terminal name	Connector marking	Remarks	
Main circuit power supply	R･S･T	Three-phase 380 to 480 VAC +10%, -15% 50/60Hz±3%	
Control power supply	24V･0V	24 VDC ±10%	
Servo motor connector	U･V･W	Connected with servo motor	
Protective grounding terminal	⏚	Connected with grounding wire of power supply and of servo motor.	
Regenerative resistor connector	RB1･RB2 RB4	RS3C02 RS3C05 RS3C10	It has shorting-wire between RB1 and RB4 at factory setting. Connects external regenerative resistor to terminal RB1 and RB2 after removing the shorting-wire, if regenerative performance is insufficient. Note) Do not connect the shorting-wire between RB1 and RB2.
		RS3C15 RS3C30	RB4 is not equipped. Connects external regenerative resistor to terminal RB1 and RB2.
Holding brake output terminal	B+ ･ B-	Connects to a holding brake of servo motor.	

* For 24 VDC control power connector of RS3C02/05/10, left/right pins below are connected. However, do not use them for different side of daisy chain in multi-axis connection. Connector pin of some amplifier may be insufficient of current capacity. If daisy chain is required to multi-axis connection, use left side pins only (in the white line circle below) for avoiding flow of total current into contact point of connector.



For 24 VDC control power of RS3C15/30, connect to terminal block.

* For use of holding brake power supply built in servo amplifier, brake power voltage may drop by influence of cable impedance. Make sure the voltage at power plug of motor is 21.6 VDC or more. If it is less than 21.6 VDC, adjust control power voltage up to 26.4 VDC and check the voltage again.

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

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

4.1 Wiring for the terminal of high voltage and grounding

■ Input voltage 400V AC/800A (Power unit/Amplifier unit combination)

Terminal name	Terminal marking	Equipping unit	Remarks
3-phase main circuit power input terminal	R・S・T	Power unit	3-phase 380 to 480 VAC +10 %, -15 %, 50/60Hz±3 %
Direct current main circuit power terminal	+DC・-DC	Power unit Amplifier unit	457 to 747 VDC Connects a power unit output to amplifier unit.
Servo motor connector	U1・V1・W1 U2・V2・W2	Amplifier unit	Connects 2 systems output to servo motor.
Protective grounding terminal	⏚	Power unit Amplifier unit	Connected with grounding wire of power supply and of servo motor.
Regenerative resistor connector	RB1・RB2	Power unit	Connects an external regenerative resistor to RB1 and RB2 terminals.
Control power terminal	24V・0V	Power unit Amplifier unit	24 VDC ±15%
Thermostat connecting terminal	TH1-1・ TH1-2	Amplifier unit	Connects a thermostat (normally-close, b-contact) of external dynamic brake resistor.
Dynamic brake contact output terminal	DB1・DB2	Amplifier unit	The terminal for outputting a contact of magnet switch for external dynamic brake. Contact rating: 5 A, 250 VAC/ 30 VDC (resistance load) Mechanical life: 2 million times Electrical life: Hundred thousand times (Contact rating load, resistance load)

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

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

4. Wiring

4.1.2 Wire

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

■ Wire type

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

* The information in this table is based on rated armature current running through three bundled lead wires at ambient temperature of 40°C.
  Use the electric wire beyond voltage resistance 600V.
* When wires are bundled or put into a wire-duct, such as a hardening vinyl pipe or a metallic conduit, take the allowable current reduction ratio into account.
* At high ambient temperature, service life of the wires becomes shorter by heat-related deterioration.
  In this case, we recommend using heat-resistant vinyl wires (HIV).

4.1.3 Wire size - allowable current

AWG size	Nominal cross-sectional area [mm^2]	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

Nominal cross-sectional area [mm^2]	AWG size	Allowable current over ambient temperature [A]		
		30°C	40°C	55°C
14.0	AWG6	79.0	70.0	52.5
22.0	AWG4	98.0	86.2	65.7
38.0	AWG1	138.0	121.4	92.5
60.0	AWG2/0	185.0	162.8	124.0

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

4.1 Wiring for the terminal of high voltage and grounding

4.1.4 Recommended wire size (Rotary motor)

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

■ Input voltage 200V AC

Servo motor model No.	Motor power (U・V・W・⏚)		Combination servo amplifier	Main circuit power supply (R・S・T)		Control power supply		Regenerative resistance		⏚	
	mm^2	AWG No.		mm^2	AWG No.	mm^2	AWG No.	mm^2	AWG No.	mm^2	AWG No.
R1AA04005F	0.5	20	RS3#01#	1.25	16	1.25	16	2.0	14	2.0	14
R1AA04010F											
R2AA04003F											
R2AA04005F											
R2AA04010F											
R2AA06010F											
R5AA06020H											
R1AA06020F	0.75	19	RS3#02#	2.0	14						
R1AA06040F											
R2AA06020F											
R2AA06040H											
R5AA06020F											
R5AA06040H											
R2AA08020F											
R2AA06040F											
R2AA08040F											
R5AA06040F											
R1AA08075V	0.75	19	RS3#03#								
R1AA10100H											
R1AA10150H											
R2AA08075F											
R2AAB8100H											
R2AA10075F											
R2AA13050D											
R2AA13050H											
R2AA13120B											
R5AA08075D											
R5AA08075D											
R5AA08075F											
R1AA08075F	2.0	14	RS3A05#								
R1AA10100F											
R1AA10150F											
R1AA10200H											
R1AA10250H											
R2AAB8075F											
R2AAB8100F											
R2AA10100F											
R2AA13120D											
R2AA13120L											
R2AA13180H											
R2AA13200L											

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

■ Input voltage 200V AC, continued

Servo motor model No.	Motor power (U・V・W・⏚)		Combination servo amplifier	Main circuit power supply (R・S・T)		Control power supply		Regenerative resistance		⏚	
	mm²	AWG No.		mm²	AWG No.	mm²	AWG No.	mm²	AWG No	mm²	AWG No.
R1AA10200F	3.5	12	RS3A07#	5.5	10	1.25	16	3.5	12	5.5	10
R1AA10250F											
R1AA13300H	5.5	10									
R2AA13180D											
R2AA13200D											
R2AA18350V											
R1AA13300F			RS3A10#					5.5	10		
R1AA13400H											
R1AA13500H											
R2AA13200D											
R2AA13180D											
R2AA18350L											
R1AA13400F	5.5	10	RS3A15#	8.0	8			8.0	8	8.0	8
R1AA13500F											
R2AA18350D											
R2AA18450H											
R2AA22500L											
R2AA18550R	8.0	8									
R2AA22700S	5.5	10									
R1AA18550H	14.0	6	RS3A30#	14.0	6			8.0	8	14.0	6
R1AA18750L											
R1AA1811KR											
R1AA1815KB											
R2AA18550H											
R2AA18750H											
R2AA1811KR											
R2AA2211KB											
R2AA2215KB											

■ Input voltage 100V AC

Servo motor model No.	Motor power (U・V・W・⏚)		Combination servo amplifier	Main circuit power supply (R・S・T)		Control power supply		Regenerative resistance		⏚	
	mm²	AWG No.		mm²	AWG No.	mm²	AWG No.	mm²	AWG No.	mm²	AWG No.
R2EA04003F	0.5	20	RS3#01#	1.25	16	1.25	16	1.25	16	2.0	14
R2EA04005F			RS3#02#								
R1EA04005F											
R1EA04010F											
R2EA04008F											
R2EA06010F											
R1EA06020F	0.75	19	RS3#03#	2.0	14			2.0	14		
R2EA06020F											

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

4.1 Wiring for the terminal of high voltage and grounding

■ Input voltage 200 VAC (600 A)

Combination power unit	Main circuit power supply (R･S･T･E)		Control power supply		Regenerative resistance		⏚	
	mm^2	AWG No.	mm^2	AWG No.	mm^2	AWG No.	mm^2	AWG No.
RS3PAA270	38	2	1.25	16	8	8	5.5	10

Servo motor model No.	Motor power (U･V･W･E)		Combination amplifier unit	Control power supply		⏚	
	mm^2	AWG No.		mm^2	AWG No.	mm^2	AWG No.
R1AA2220KV	38	2	RS3#60#	1.25	16	5.5	10
R2AA2220KB							
R2AA2225KB							
R2AA2830KV							

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

4. Wiring

■ Input voltage 400 VAC

Servo motor model No.	Motor power (U·V·W·⏚)		Combination servo amplifier	Main circuit power supply (R·S·T)		Control power supply		Regenerative resistance		⏚	
	mm^2	AWG No.		mm^2	AWG No.	mm^2	AWG No.	mm^2	AWG No.	mm^2	AWG No.
R1CA10150V R2CA10075F R2CA13050D R2CA13120R R2CA13180H R2CA13200L	1.25	16	RS3C02#	1.25	16	1.25	16	1.25	16	1.25	16
R1CA10200V R1CA13300V R2CA10100F R2CA13120F R2CA13180D R2CA13200H R2CA18350L	2.0	14	RS3C05#	2.0	14			1.25	16	2.0	14
R2CA18350D R2CA18450H R2CA18550R	3.5	12	RS3C10#	2.0	14					2.0	14
R1CA18550H R1CA18750L R1CA1811KR R1CA1815KB	8	8	RS3C15#	5.5	10			2.0	14	5.5	10
R2CA18550H	5.5	10									
R2CA18750H R2CA2211KB R2CA2215KV	8	8									
R1CA2220KV R2CA2220KV R2CA2830KV	14	5,6	RS3C30#	14	5,6			3.5	12	14	5,6

■ Input voltage 400 VAC (800 A)

Servo motor model No.	Motor power (U·V·W· ⏚)		Combination servo amplifier	Main circuit power supply (R·S·T)		Control power supply		Regenerative resistance		⏚	
	mm^2	AWG No		mm^2	AWG No	mm^2	AWG No	mm^2	AWG No	mm^2	AWG No.
R2CA3255KB	22	4	RS3PAC550 RS3D80#	60	2/0	1.25	16	22	4	50	0

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

4.1 Wiring for the terminal of high voltage and grounding

4.1.5 Recommended wire size (Linear motor)

■ Input-voltage 200V AC (DS-series: flat type linear motor with core)

Linear motor model No.	Motor power (U･V･W･⏚)		Combination servo amplifier	Main circuit power supply (R･S･T)		Control power supply		Regenerative resistor		⏚	
	mm^2	AWG No.		mm^2	AWG No.	mm^2	AWG No.	mm^2	AWG No.	mm^2	AWG No.
DS030C1N2	0.75	19	RS3A03L	2.0	14	1.25	16	2.0	14	2.0	14
DS050C1N2											
DS075C1N2											
DS045CC1AN											
DS030C2N2	2.0	14	RS3A05L								
DS050C2N2											
DS075C2N2											
DS100C1N2											
DS150C1N2											
DS030C3N2	5.5	10	RS3A07L	5.5	10			3.5	12	5.5	10
DS050C3N2											
DS075C3N2											
DS030C3N2	5.5	10	RS3A10L	5.5	10			5.5	10	5.5	10
DS050C3N2											
DS075C3N2											
DS100C2N2											
DS150C2N2											
DS100C3N2	8.0	8	RS3A15L	8.0	8			8.0	8	8.0	8
DS150C3N2											

4. Wiring

■ Input-voltage 200V AC (DD-series: twin type linear motor with core)

Linear motor model No.	Motor power (U・V・W・⏚)		Combination servo amplifier	Main circuit power supply (R・S・T)		Control power supply		Regenerative resistor		⏚	
	mm²	AWG No.		mm²	AWG No.	mm²	AWG No.	mm²	AWG No.	mm²	AWG No.
DD030C1Y4	2.0	14	RS3A05L	2.0	14	1.25	16	2.0	14	2.0	14
DD030C2Y4	5.5	10	RS3A07L	5.5	10			3.5	12	5.5	10
DD050C1Y2											
DD075C1Y2											
DD045CB4AN											
DD030C2Y4	5.5	10	RS3A10L	5.5	10			5.5	10	5.5	10
DD030C3Y4											
DD050C1Y2											
DD075C1Y2											
DD045CB4AN											
DD050C2Y2	8.0	8	RS3A15L	8.0	8			8.0	8	8.0	8
DD075C2Y2											
DD050C3Y2	14.0	6	RS3A30L	14.0	6			8.0	8	14.0	6
DD075C3Y2											
DD075C4Y2											

■ Input-voltage 200V AC (DT-series: center magnet type linear motor)

Linear motor model No.	Motor power (U・V・W・⏚)		Combination servo amplifier	Main circuit power supply (R・S・T)		Control power supply		Regenerative resistor		⏚	
	mm²	AWG No.		mm²	AWG No.	mm²	AWG No.	mm²	AWG No.	mm²	AWG No.
DT030CD1AN	0.75	19	RS3A03L	2.0	14	1.25	16	2.0	14	2.0	14

■ Input-voltage 200V AC (DD-series: twin type linear motor)

Linear motor model No.	Motor power (U・V・W・⏚)		Combination servo amplifier	Main circuit power supply (R・S・T)		Control power supply		Regenerative resistor		⏚	
	mm²	AWG No.		mm²	AWG No.	mm²	AWG No.	mm²	AWG No.	mm²	AWG No.
DD035CC2AN	3.5	12	RS3A07L	3.5	12	1.25	16	3.5	12	3.5	12

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

4.1 Wiring for the terminal of high voltage and grounding

4.1.6 Wiring for servo motor

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

Servo motor model number:
R1#A04***, R1#A06***, R1AA08***, R2#A04***, R2#A06***, R2AA08***, R2AAB8***, R2AA10***, R5AA06***, R5AA08***

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

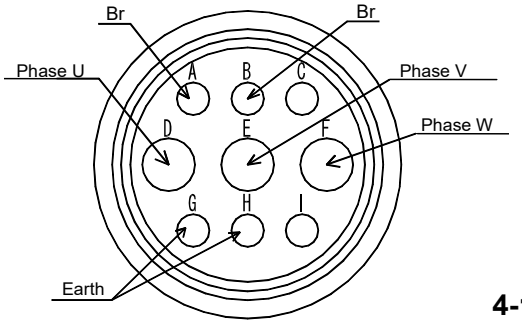
* No polarity on terminal for brake power.
Please contact us for specifications for 90V DC power supply for brake.
* We recommend 1.25mm^2(AWG16)-wiring size of power supply for brake.

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

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

Note1) Plug for braking line is used in common with powering line.
* Please contact us for waterproof type and TÜV-compliant products.
Please place your order by [plug + clamp model number], our exclusive model numbers.

■ Pin assignment of cannon plug



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

4. Wiring

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

<table>
<tr><th rowspan="2">Servo motor model number</th><th colspan="2">Plug for powering and braking line
①Plug (Manufacturer model number)
②Cable clamp (Manufacturer model number)
③Plug and Cable clamp
(SANYO DENKI model number)</th><th colspan="2">Plug for braking line
①Plug (Manufacturer model number)
②Cable clamp (Manufacturer model number)
③Plug and Cable clamp (SANYO DENKI model number)</th></tr>
<tr><th>Straight</th><th>Angle</th><th>Straight</th><th>Angle</th></tr>
<tr><td>R1CA10150V
R1CA10200V
R2CA10075F
R2CA10100F</td><td>①N/MS3106B20-15S
②N/MS3057A-12A
③MS06B20-15S-12</td><td>①N/MS3108B20-15S
②N/MS3057A-12A
③MS08B20-15S-12</td><td rowspan="15">Note 1)</td><td rowspan="15">Note 1)</td></tr>
<tr><td>R1CA13300V
R2CA13050D
R2CA13120R
R2CA13120F
R2CA13180H
R2CA13180D
R2CA13200L
R2CA13200H
R2CA18350L
R2CA18350D
R2CA18450H
R2CA18550R
R2CA18550H</td><td>①N/MS3106B24-11S
②N/MS3057-16A
③MS06B24-11S-16</td><td>①N/MS3108B24-11S
②N/MS3057-16A
③MS08B24-11S-16</td></tr>
<tr><td>R1CA18550H
R1CA18750L
R1CA1811KR
R1CA1815KB
R2CA18750H
R2CA2211KB
R2CA2215KV</td><td>①N/MS3106B32-17S
②N/MS3057-20A
③MS06B32-17S-20</td><td>①N/MS3108B32-17S
②N/MS3057-20A
③MS08B32-17S-20</td><td rowspan="2">①JL04V-6A10SL-3SE-EB-R
②JL04-1012CK(05)-R
③332706X1</td><td rowspan="2">①JL04V-8A10SL-3SE-EB-R
②JL04-1012CK(05)-R
③332707X1</td></tr>
<tr><td>R2CA2220KV</td><td colspan="2" rowspan="3">Terminal block</td></tr>
<tr><td>R1CA2220KV</td><td colspan="2">Note 2)</td></tr>
<tr><td>R2CA2230KV</td><td colspan="2">Terminal block</td></tr>
<tr><td>R2CA3255KB</td><td colspan="2">Note 2)</td></tr>
</table>

Note 1) Plug for braking line is used in common with powering line.
Note 2) There is no model with brake.

* Please contact us for waterproof type and TÜV-compliant products.

4.1 Wiring for the terminal of high voltage and grounding

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

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

* No polarity.
Please place your order by [plug + clamp model number], our exclusive model numbers.
* For wire size of cooling fan, 1.25mm^2 (AWG16) is recommended.

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

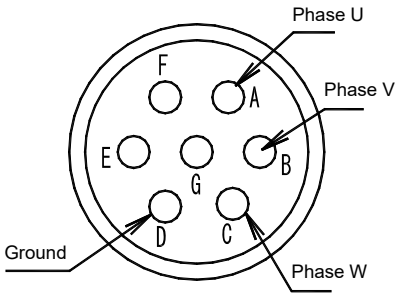
Servo motor model number	Plug model number for cooling fan ①Plug (Manufacturer model number) ②Cable clamp (Manufacturer model number) ③Plug and Cable clamp (SANYO DENKI model number)		Cooling fan specifications
	Straight	Angle	
R1CA18750L R1CA1811KR R1CA1815KB R1CA2220KV	①N/MS3106B10SL-4S ②N/MS3057-4A ③MS06B10SL-4S-4	①N/MS3108B10SL-4S ②N/MS3057-4A ③MS08B10SL-4S-4	Power: Single-phase Thermostat: None
R2CA2220KV	①JL04V-6A18-12SE-EB-R ②JL04-18CK(13)-R ③332706X3	①JL04V-8A18-12SE-EB-R ②JL04-18CK(13)-R ③332707X3	Power: Three-phase Thermostat: Equipped
R2CA3255KB	Terminal block Note 1)		Power: Single-phase Thermostat: None

Note 1) Use 200V AC power supply for cooling fan.
Recommended wire size for cooling fan is 1.25mm^2 (AWG16).
Contact us for fan motor power supply except 200 VAC.

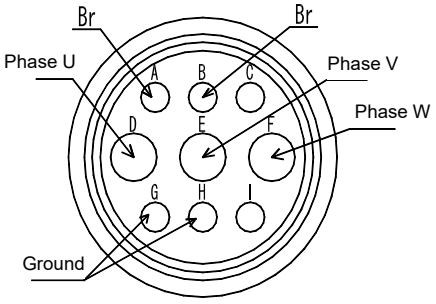
* Use 200V AC power supply for cooling fan.
* Recommended wire size for cooling fan is 1.25mm^2 (AWG16).
* Please contact us for waterproof type and TÜV-compliant products.

4. Wiring

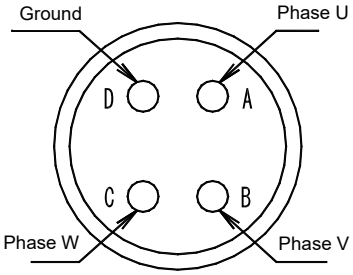
■ Pin assignment of cannon plug
Pin assignments are below, depending on model number for power, brake and cooling fan cable.



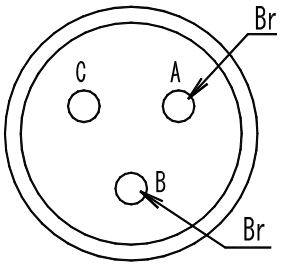
Cannon plug for power line
(for N/MS3106(8)B20-15S)
Pin assignment (Viewed from motor)



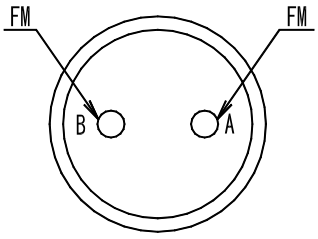
Cannon plug for power line
(for N/MS3106(8)B24-11S)
Pin assignment (Viewed from motor)



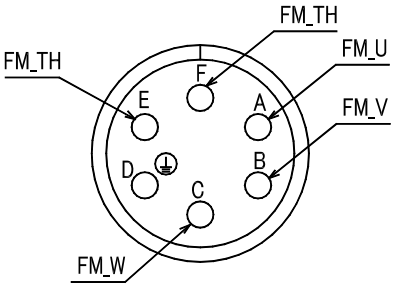
Cannon plug for power line
(for N/MS3106(8)B32-17S)
Pin assignment (Viewed from motor)



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



Cannon plug for cooling fan
(for N/MS3106(8)B10SL-4S)
Pin assignment (Viewed from motor)



Cannon plug for cooling fan
(for L04V-6A(8)18-12SE-EB-R)
Pin assignment (Viewed from motor)

4.1 Wiring for the terminal of high voltage and grounding

4.1.7 Example of wiring

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

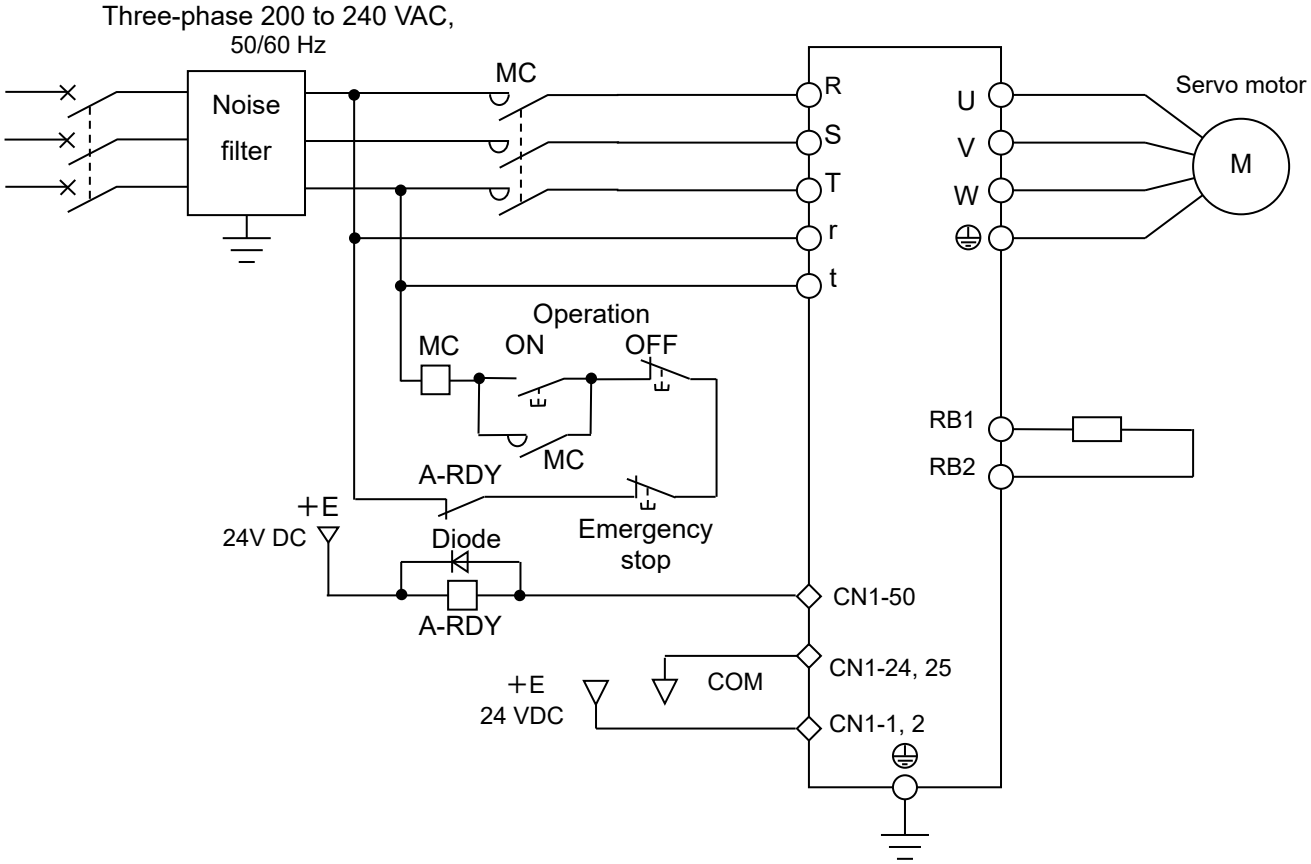
Refer applicable wiring example due to interface type in servo amplifier model number.

	Interface type	
	[C: I/O]	[F: MODBUS]
Three-phase 200 VAC	4.1.7.1	4.1.7.2
Single phase 200 VAC, Single phase 100 VAC	4.1.7.3	4.1.7.4
RS3C02/05/10/15	4.1.7.5	4.1.7.6
Three-phase 200 VAC, 600 A	4.1.7.7	4.1.7.8
RS3C30	4.1.7.9	4.1.7.10
RS3PAC550, RS3D80#	4.1.7.11	4.1.7.12
	4.1.7.13	4.1.7.14

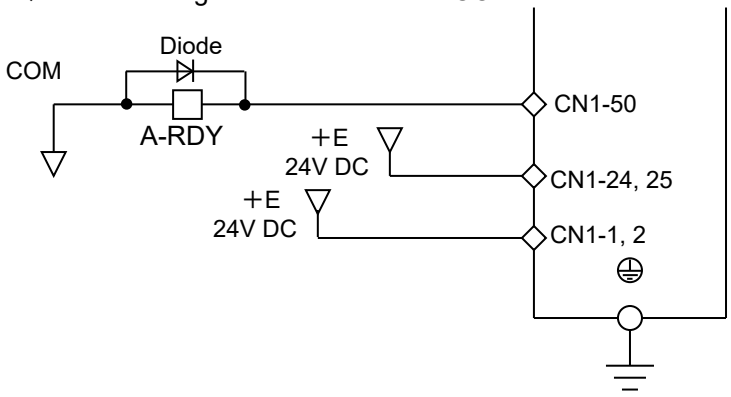
4.1.7.1 Interface type [C: I/O] wiring example

■ Three-phase 200 VAC

◆ When using A-RDY side for power supply



◆ When using + side of A-RDY for COM



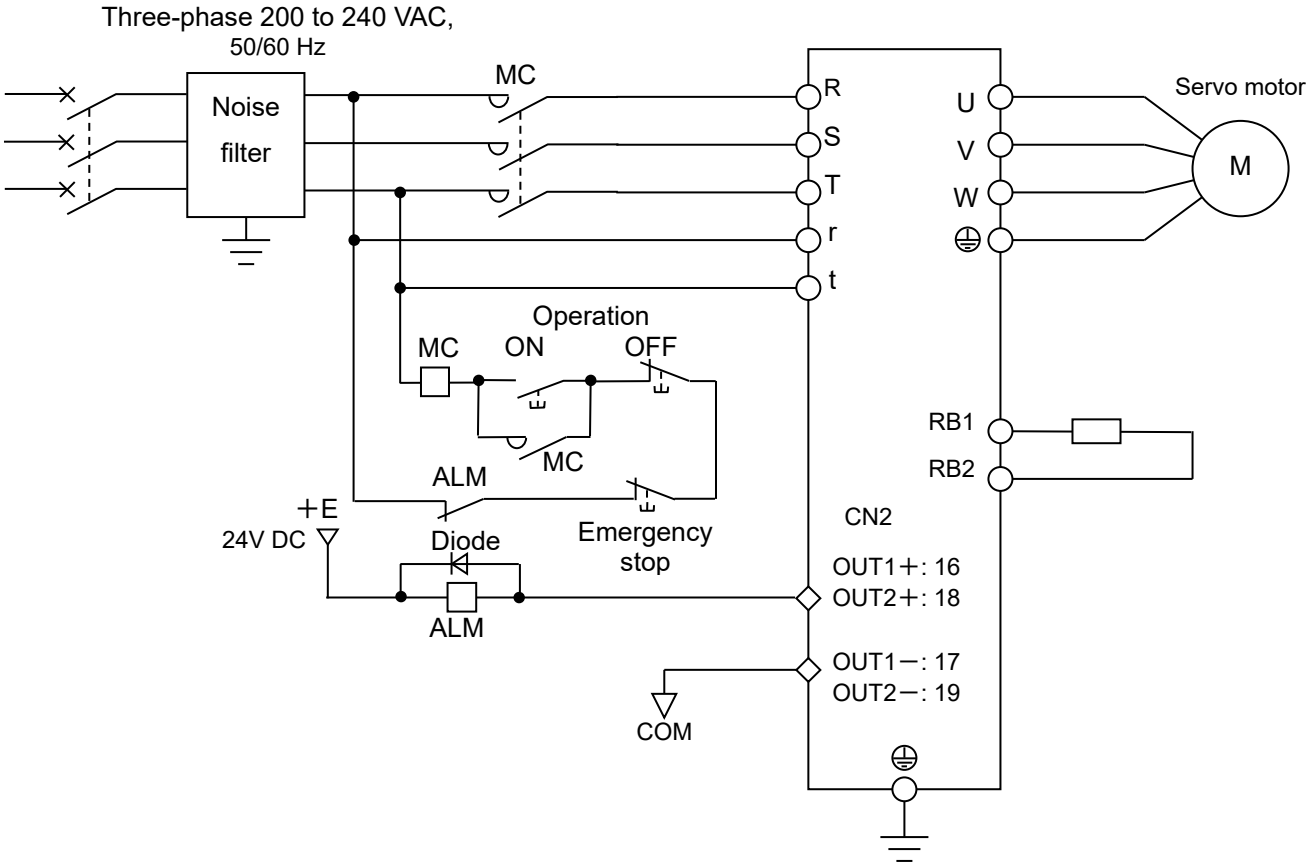
* Use the CN1- 50 (A-RDY) output. Turns OFF when it becomes main circuit power ON permission condition after control power ON. Turns OFF when alarm condition.

* When relay or induction coil load connect to CN1-50 (A-RDY) output, need to connect surge absorbing diode. In order to avoid the failure of the amplifier, please make sure of polarity of the diode.

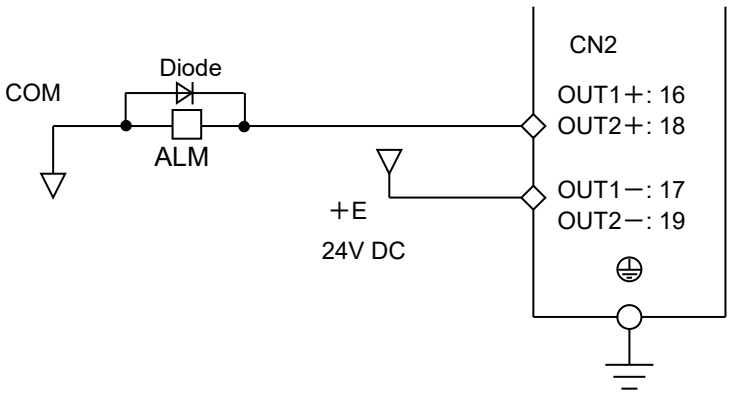
4.1.7.2 Interface type [F: MODBUS] wiring example

■ Three-phase 200 VAC

◆ When using + side of OUT1 or OUT2 for power supply



◆ When using - side of OUT1 or OUT2 for power supply



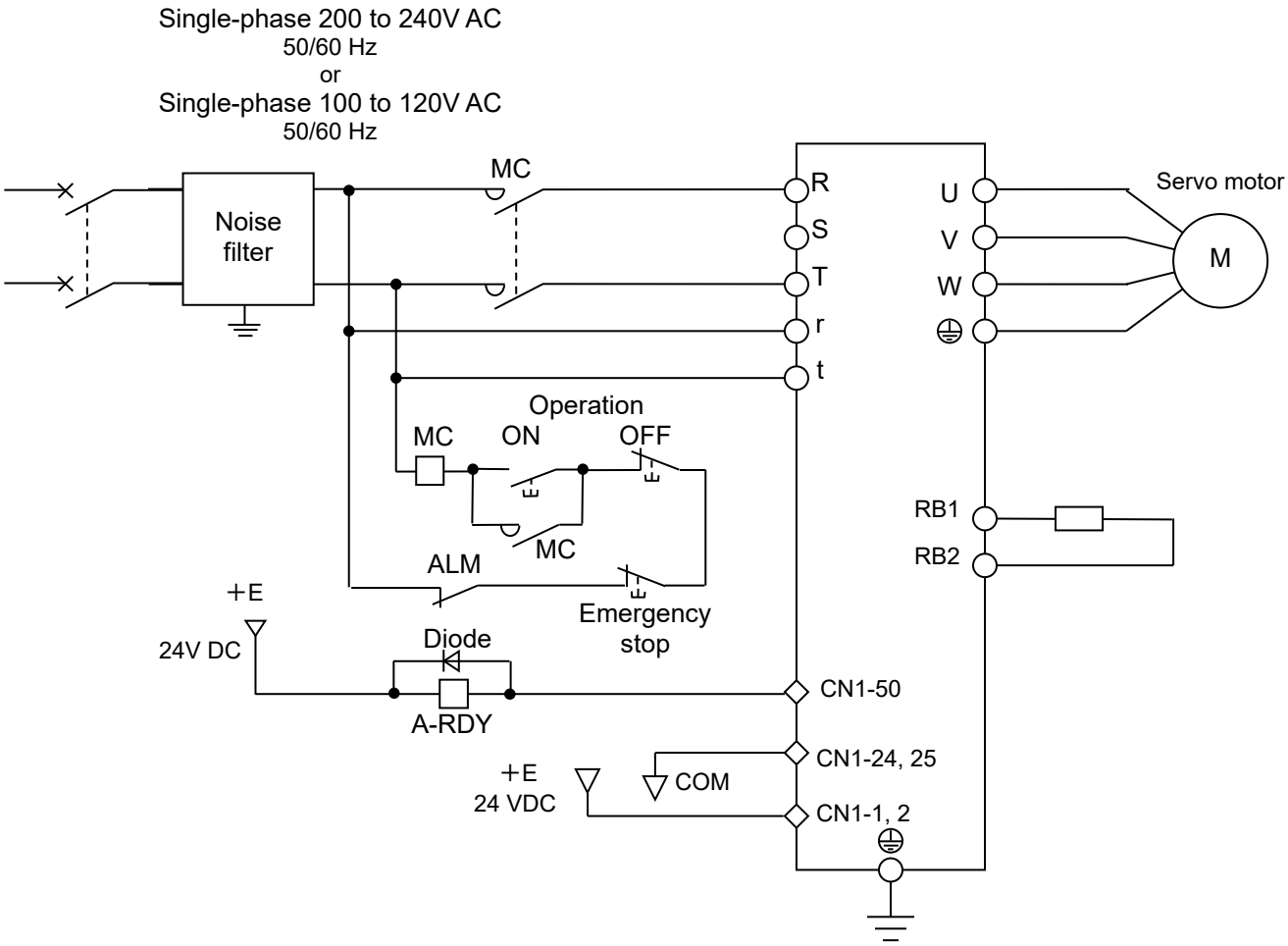
* Use one of the CN2 - 16 to 19 (OUT1, OUT2) outputs, and set either during ALM status output ON or during ALM status output OFF with the selection setting of “Group9 ID50, ID51 General output function selection”.

* When relay or induction coil load connect to CN2 - 16 to 19 (OUT1, OUT2) outputs, need to connect surge absorbing diode. In order to avoid the failure of the amplifier, please make sure of polarity of the diode.

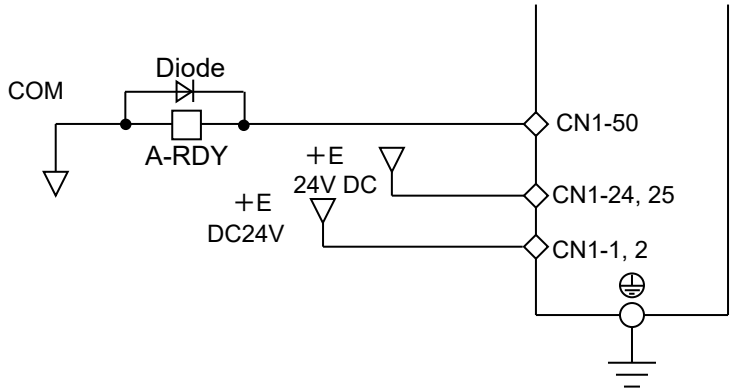
4.1.7.3 Interface type [C: I/O] wiring example

■ Single-phase 200V AC, single-phase 100V AC

◆ When using A-RDY side for power supply



◆ When using A-RDY side for COM



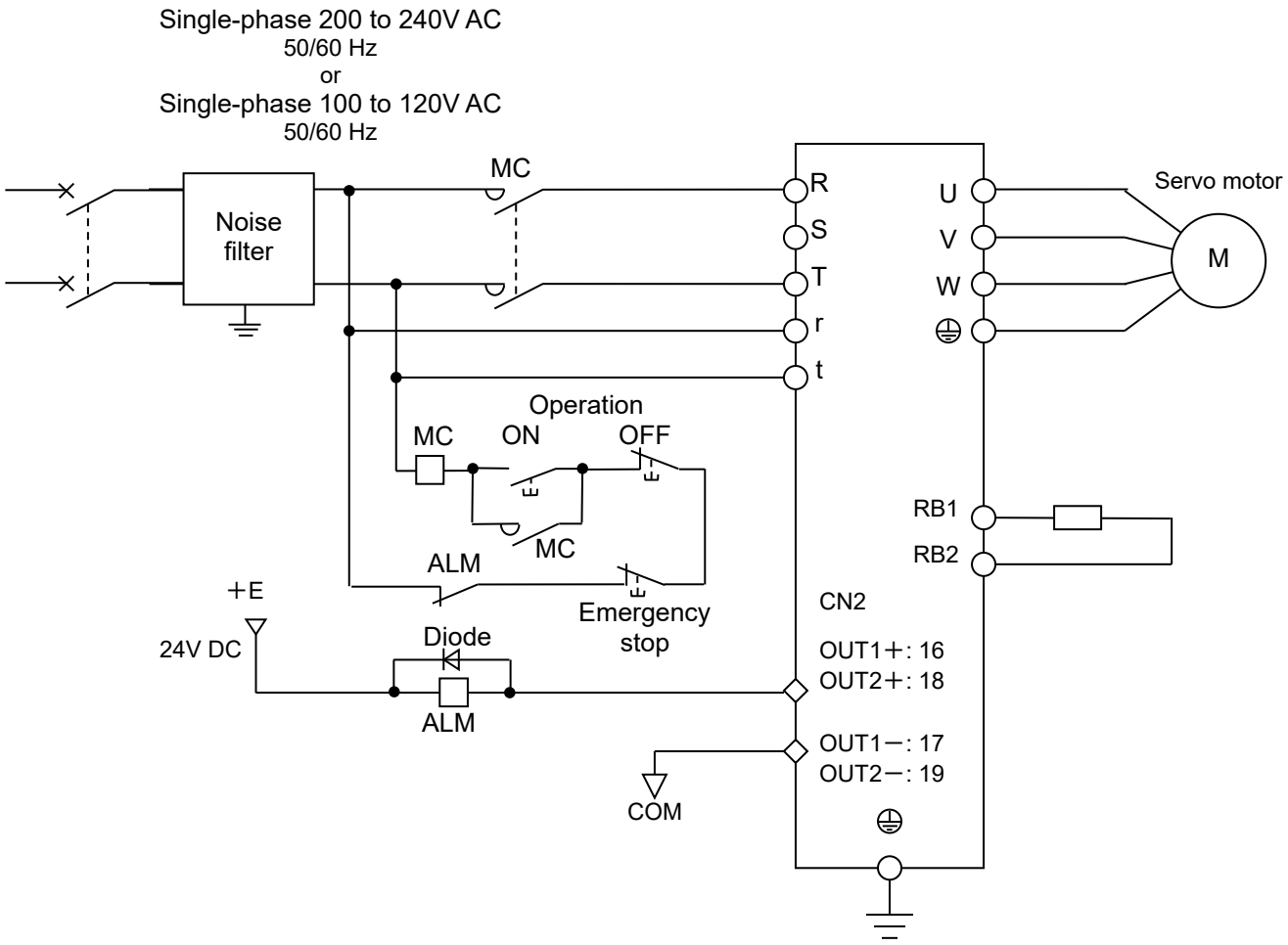
* Use the CN1- 50 (A-RDY) output. Turns OFF when it becomes main circuit power ON permission condition after control power ON. Turns OFF when alarm condition.

* When relay or induction coil load connect to CN1-50 (A-RDY) output, need to connect surge absorbing diode. In order to avoid the failure of the amplifier, please make sure of polarity of the diode.

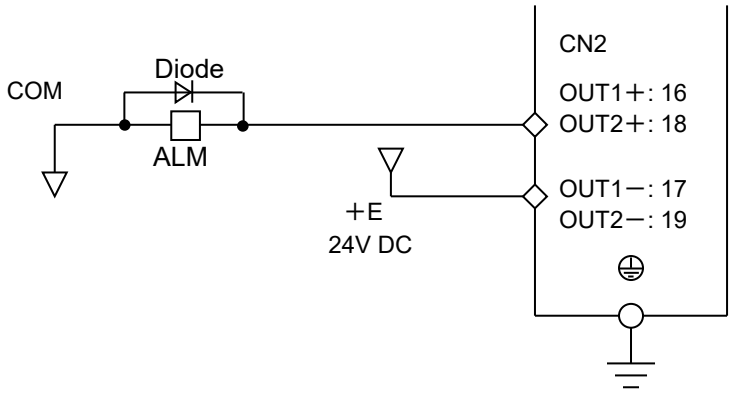
4.1.7.4 Interface type [F: MODBUS] wiring example

■ Single-phase 200V AC, single-phase 100V AC

◆ When using + side of OUT1 or OUT2 for power supply



◆ When using - side of OUT1 or OUT2 for power supply



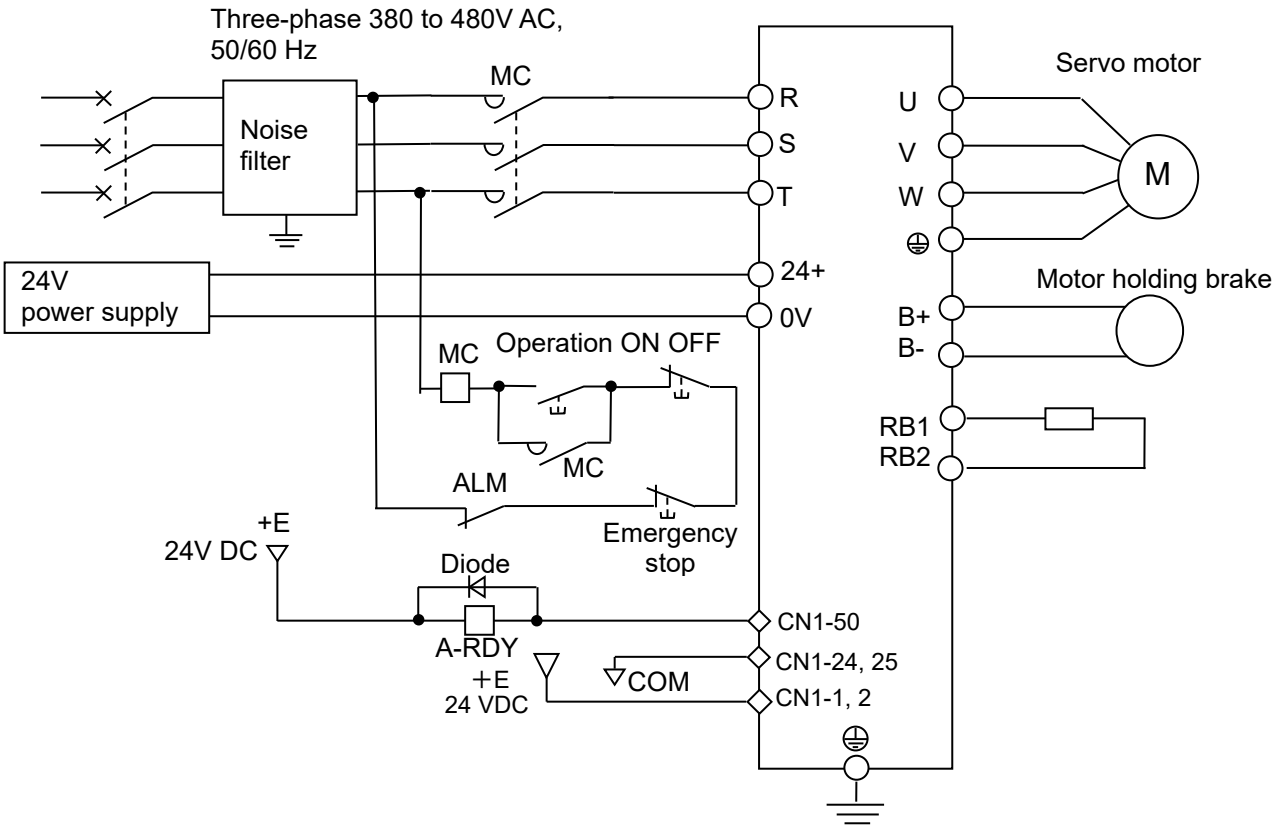
* Use one of the CN2 - 16 to 19 (OUT1, OUT2) outputs, and set either during ALM status output ON or during ALM status output OFF with the selection setting of “Group9 ID50, ID51 General output function selection”.

* When relay or induction coil load connect to CN2 - 16 to 19 (OUT1, OUT2) outputs, need to connect surge absorbing diode. In order to avoid the failure of the amplifier, please make sure of polarity of the diode.

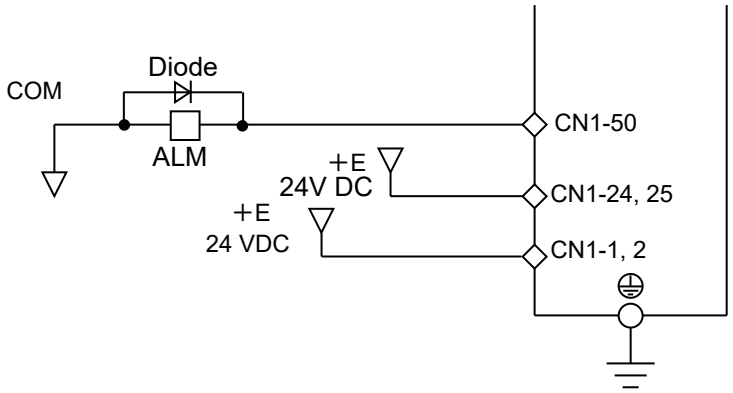
4.1.7.5 Interface type [C: I/O] wiring example

■ RS3C02/05/10/15

◆ When using + side of OUT1 or OUT2 for power supply



◆ When using - side of OUT1 or OUT2 for power supply



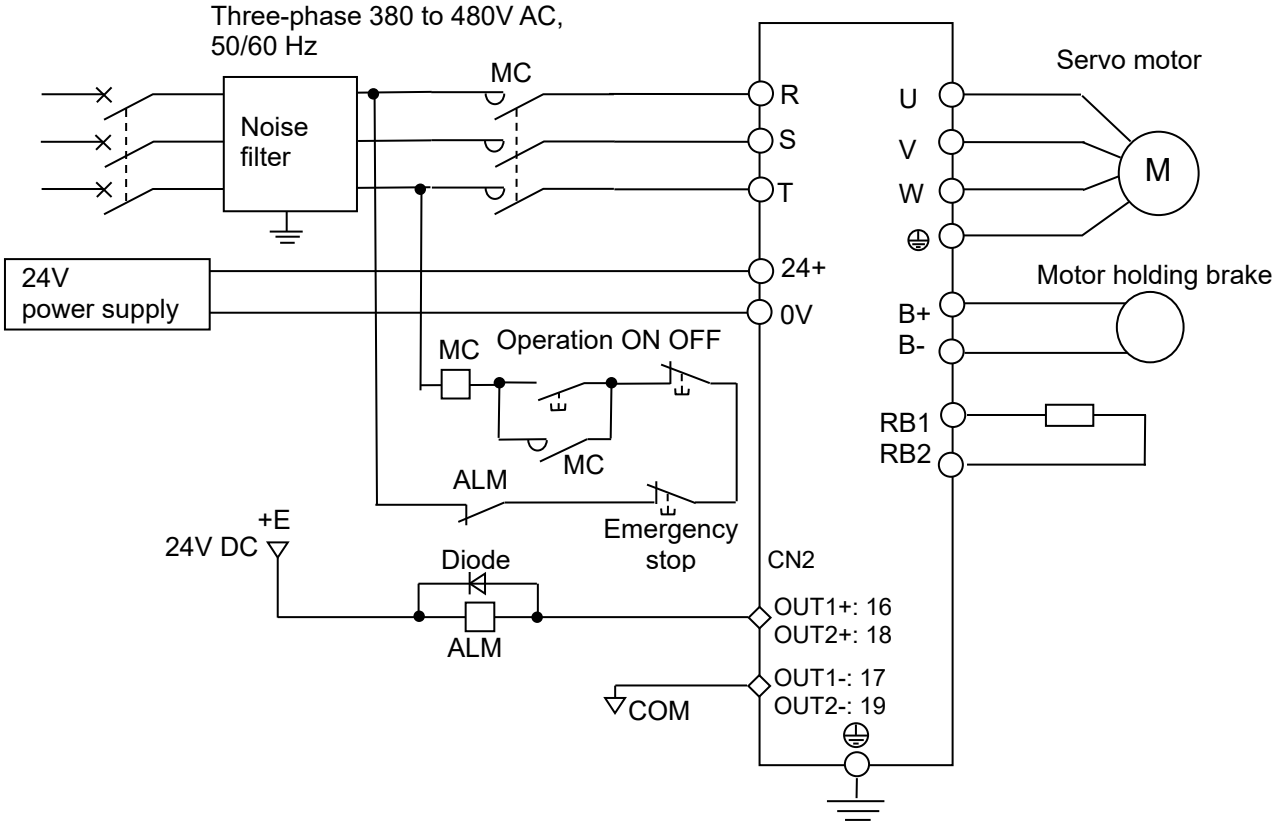
* Use the CN1- 50 (A-RDY) output. Turns OFF when it becomes main circuit power ON permission condition after control power ON. Turns OFF when alarm condition.

* When relay or induction coil load connect to CN1-50 (A-RDY) output, need to connect surge absorbing diode. In order to avoid the failure of the amplifier, please make sure of polarity of the diode.

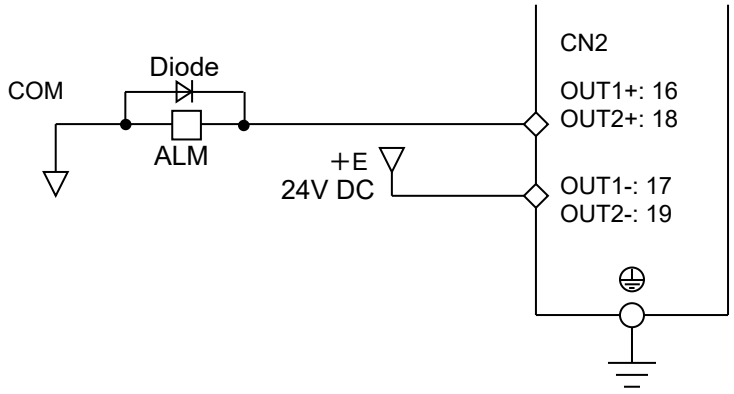
4.1.7.6 Interface type [F: MODBUS] wiring example

■ RS3C02/05/10/15

◆ When using + side of OUT1 or OUT2 for power supply



◆ When using - side of OUT1 or OUT2 for power supply



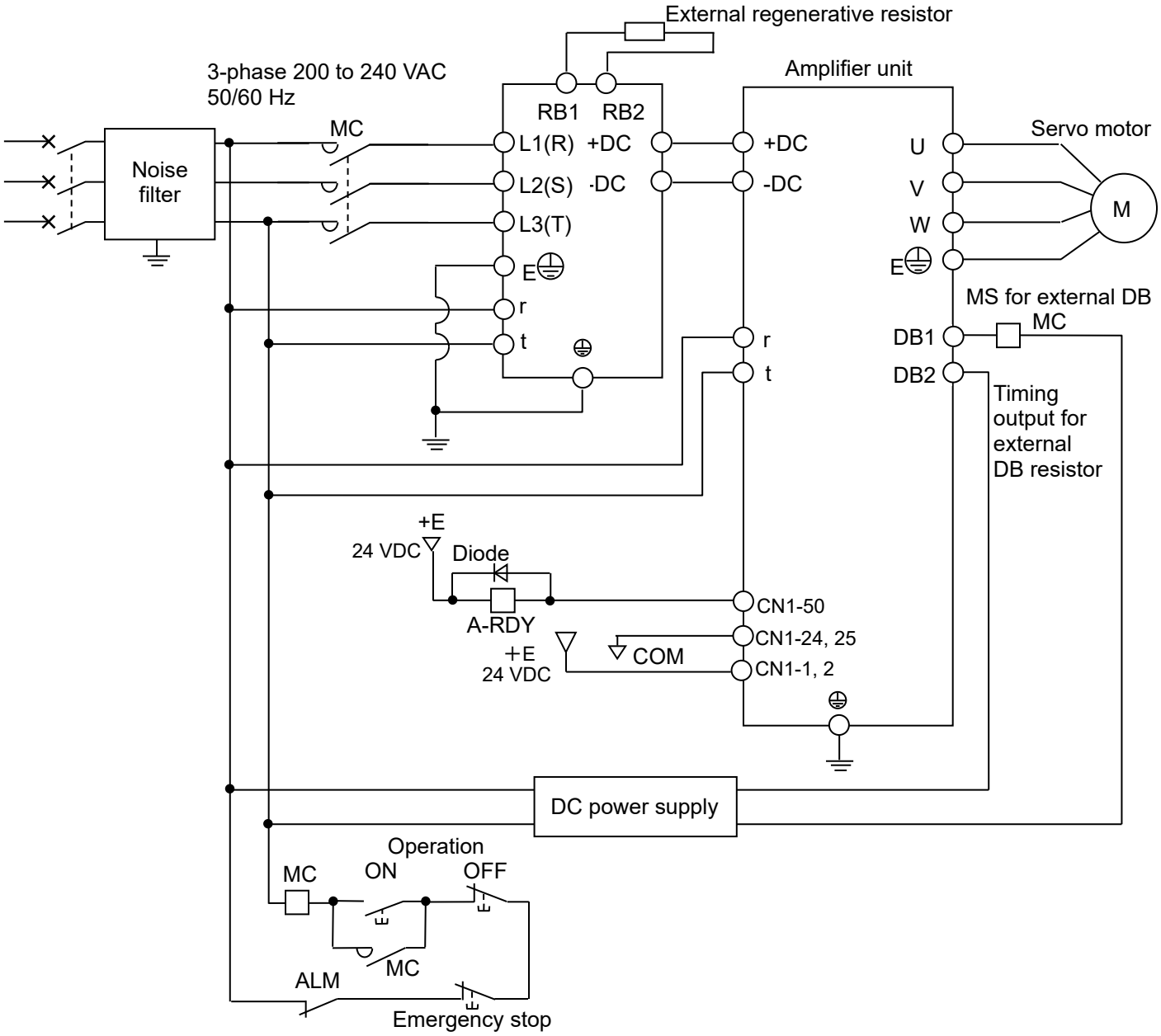
* Use one of the CN2 - 16 to 19 (OUT1, OUT2) outputs, and set either during ALM status output ON or during ALM status output OFF with the selection setting of “Group9 ID50, ID51 General output function selection”.

* When relay or induction coil load connect to CN2 - 16 to 19 (OUT1, OUT2) outputs, need to connect surge absorbing diode. In order to avoid the failure of the amplifier, please make sure of polarity of the diode.

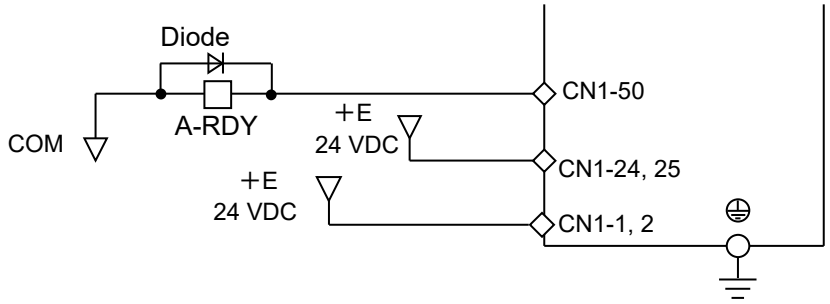
4.1.7.7 Interface type [C: I/O] wiring example

■ 3-phase 200 to 240 VAC, 600 A

◆ When using A-RDY side for power supply



◆ When using A-RDY side for COM



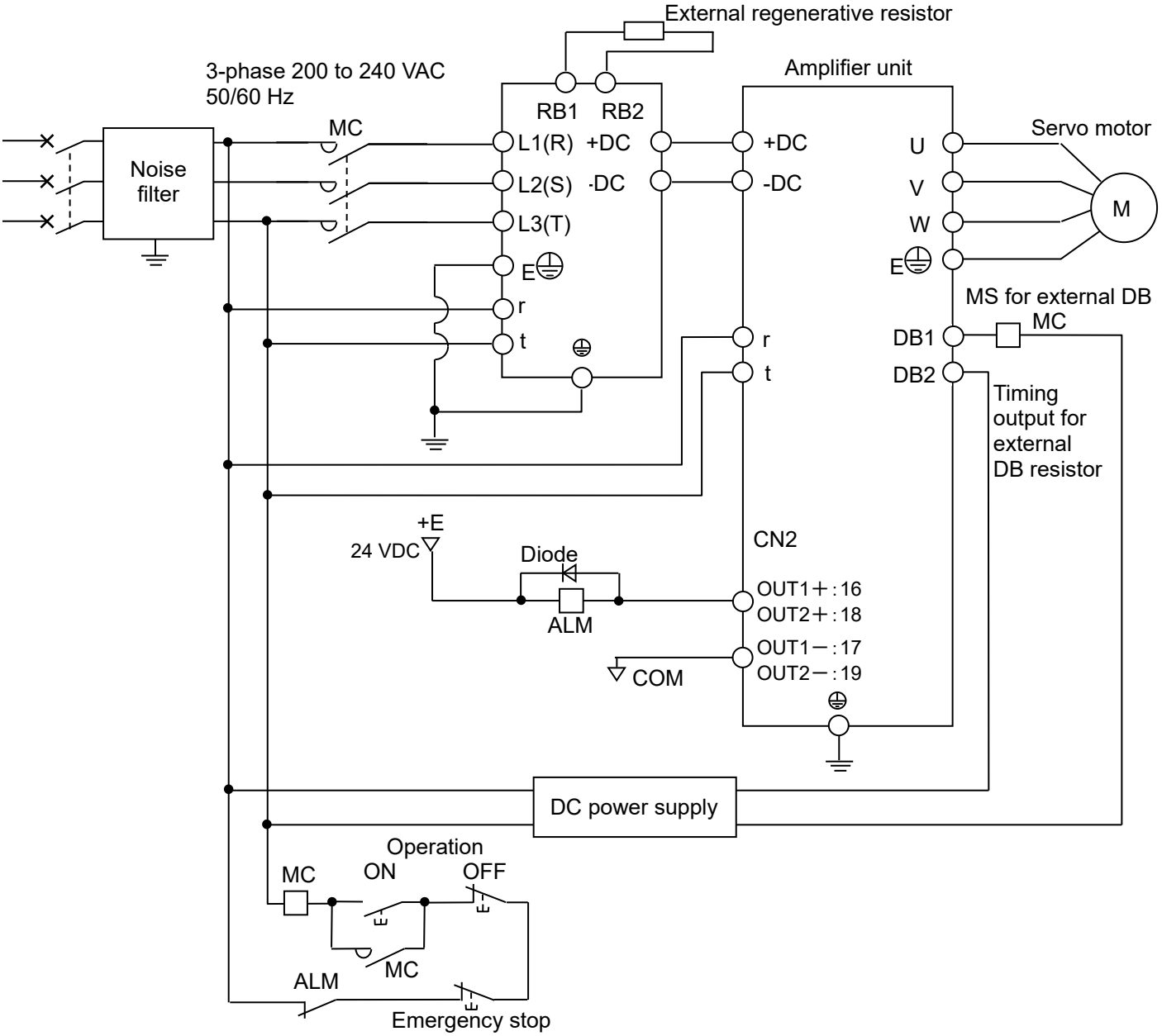
* Use the CN1- 50 (A-RDY) output. Turns OFF when it becomes main circuit power ON permission condition after control power ON. Turns OFF when alarm condition.

* When relay or induction coil load connect to CN1-50 (A-RDY) output, need to connect surge absorbing diode. In order to avoid the failure of the amplifier, please make sure of polarity of the diode.

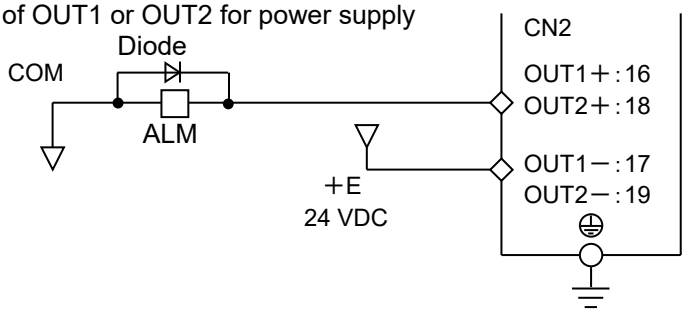
4.1.7.8 Interface type [F: MODBUS] wiring example

■ 3-phase 200 to 240 VAC, 600 A

◆ When using + side of OUT1 or OUT2 for power supply



◆ When using - side of OUT1 or OUT2 for power supply



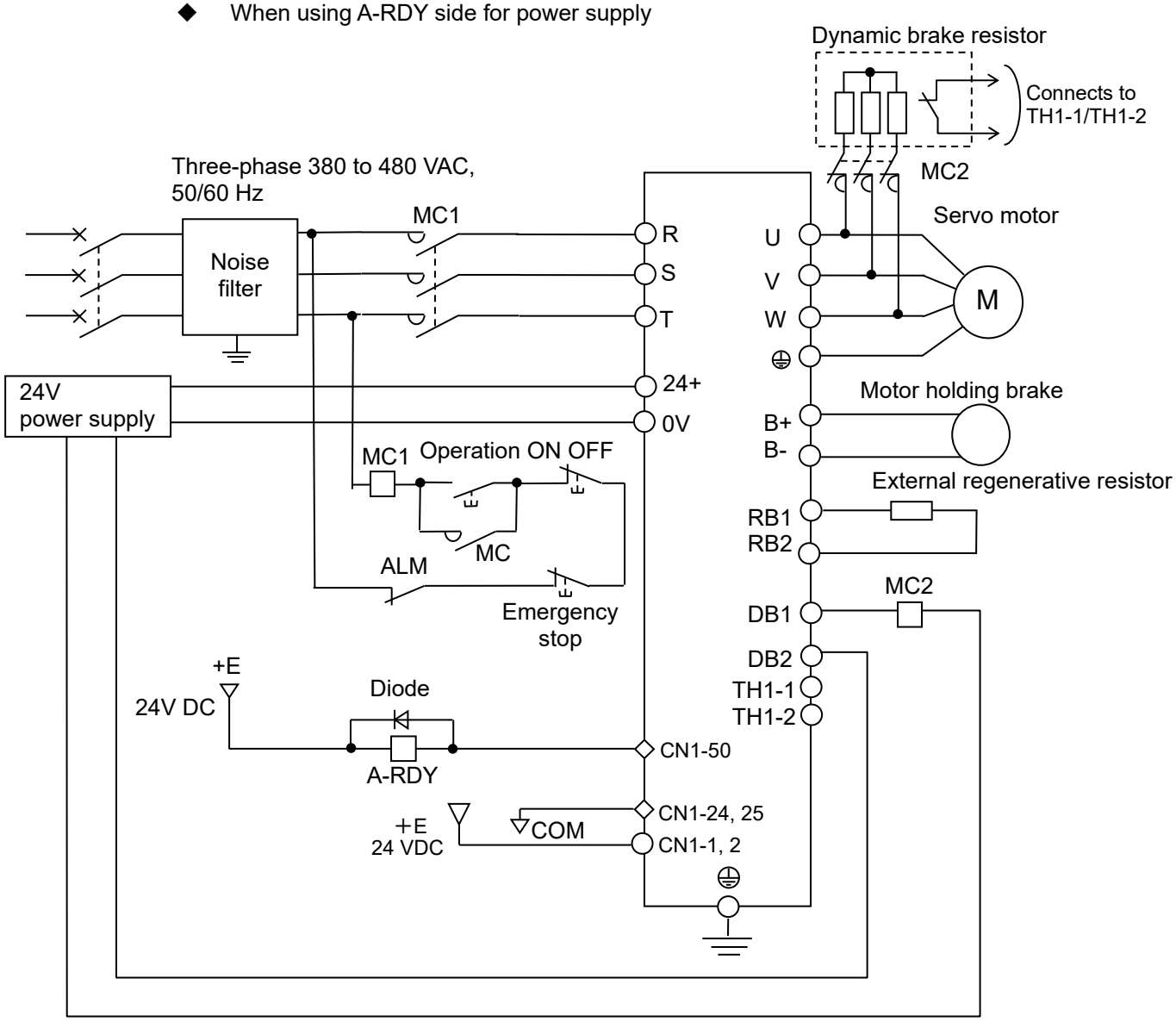
* Use one of the CN2 - 16 to 19 (OUT1, OUT2) outputs, and set either during ALM status output ON or during ALM status output OFF with the selection setting of “Group9 ID50, ID51 General output function selection”.

* When relay or induction coil load connect to CN2 - 16 to 19 (OUT1, OUT2) outputs, need to connect surge absorbing diode. In order to avoid the failure of the amplifier, please make sure of polarity of the diode.

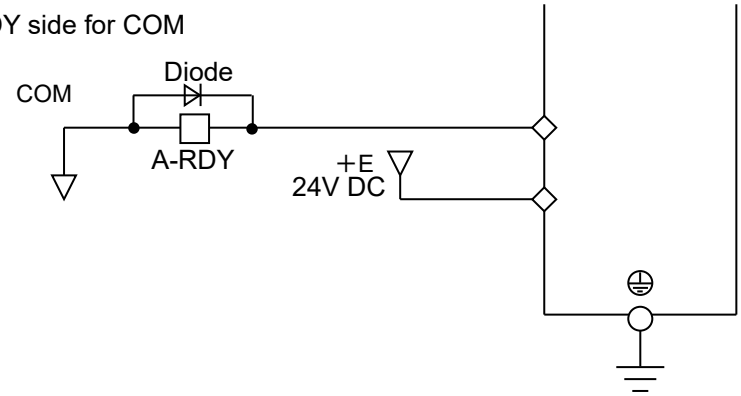
4.1.7.9 Interface type [C: I/O] wiring example

■ RS3C30

◆ When using A-RDY side for power supply



◆ When using A-RDY side for COM



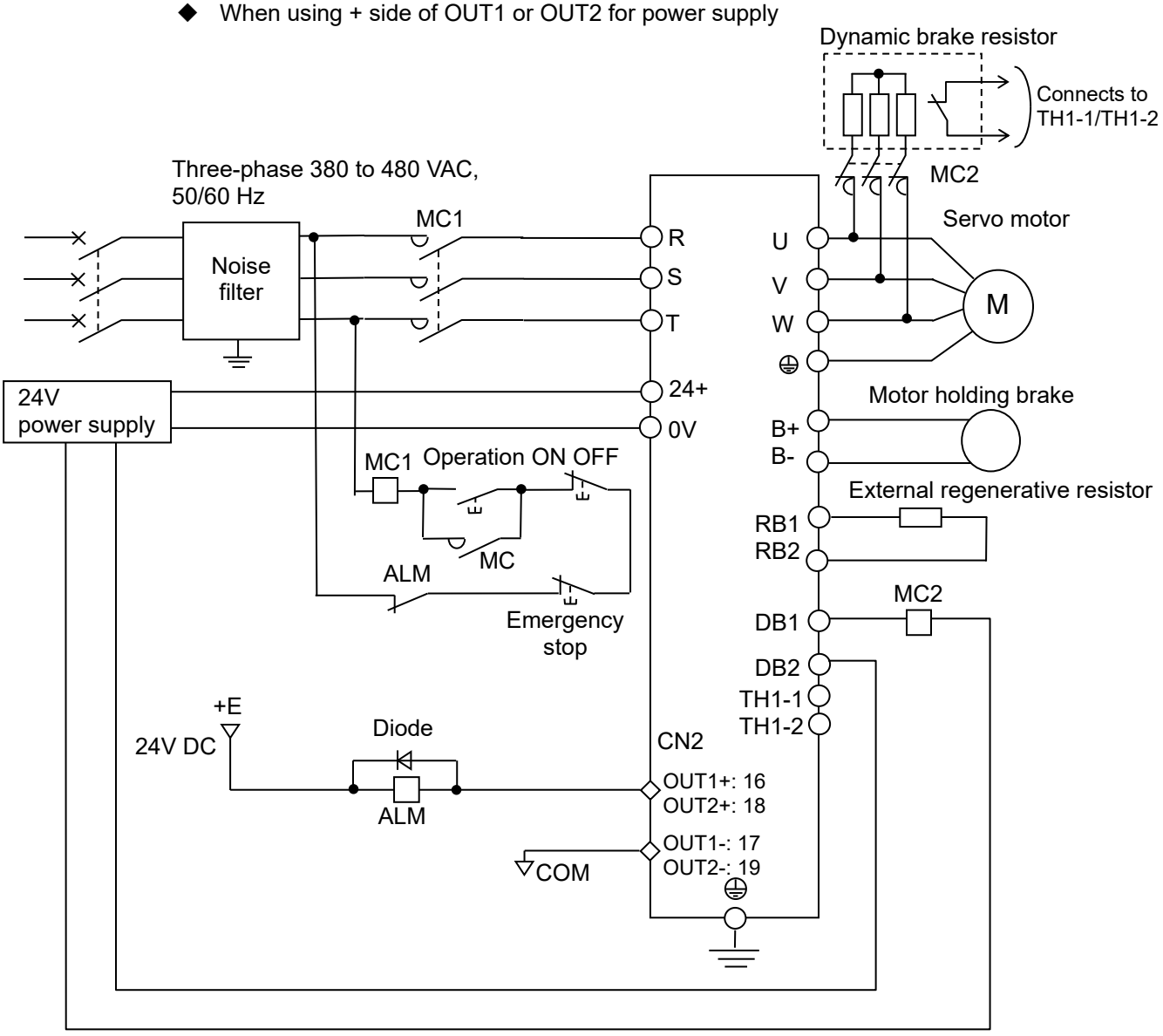
* Use the CN1- 50 (A-RDY) output. Turns OFF when it becomes main circuit power ON permission condition after control power ON. Turns OFF when alarm condition.

* When relay or induction coil load connect to CN1-50 (A-RDY) output, need to connect surge absorbing diode. In order to avoid the failure of the amplifier, please make sure of polarity of the diode.

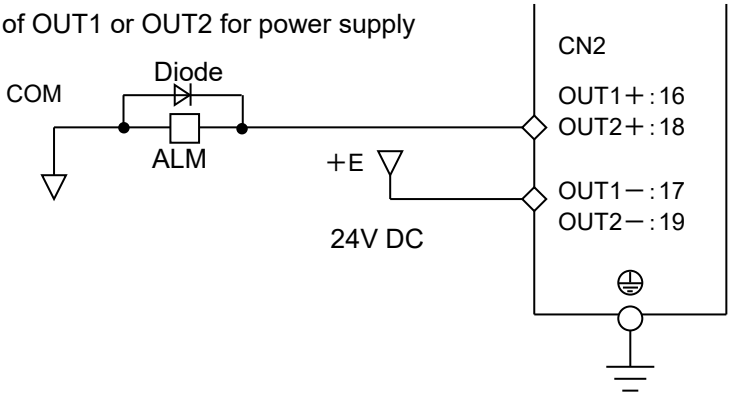
4.1.7.10 Interface type [F: MODBUS] wiring example

■ RS3C30

◆ When using + side of OUT1 or OUT2 for power supply



◆ When using - side of OUT1 or OUT2 for power supply

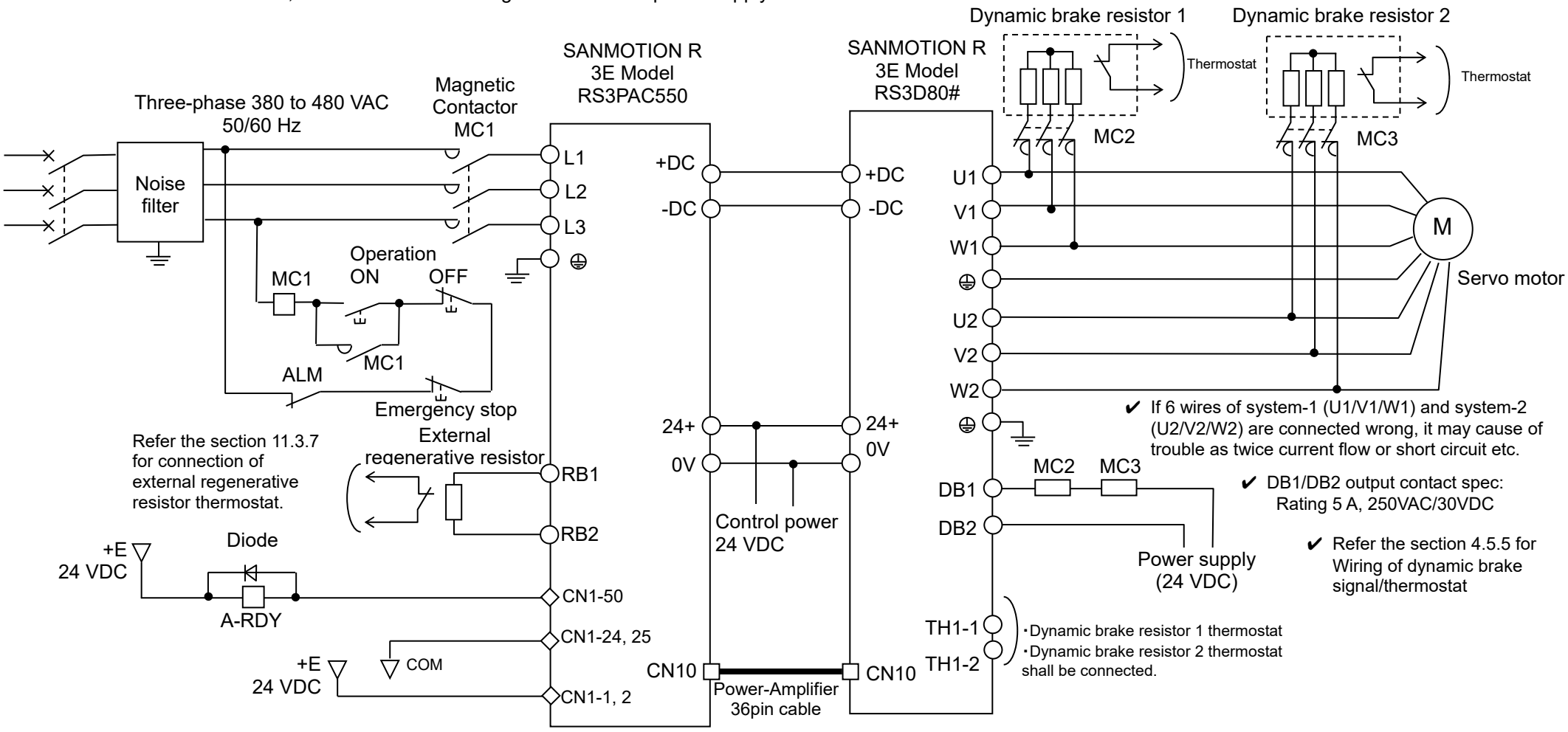


* Use one of the CN2 - 16 to 19 (OUT1, OUT2) outputs, and set either during ALM status output ON or during ALM status output OFF with the selection setting of “Group9 ID50, ID51 General output function selection”.

* When relay or induction coil load connect to CN2 - 16 to 19 (OUT1, OUT2) outputs, need to connect surge absorbing diode. In order to avoid the failure of the amplifier, please make sure of polarity of the diode.

4.1.7.11 Interface type [C: I/O] wiring example

■ RS3PAC550,RS3D80# When using A-RDY side for power supply

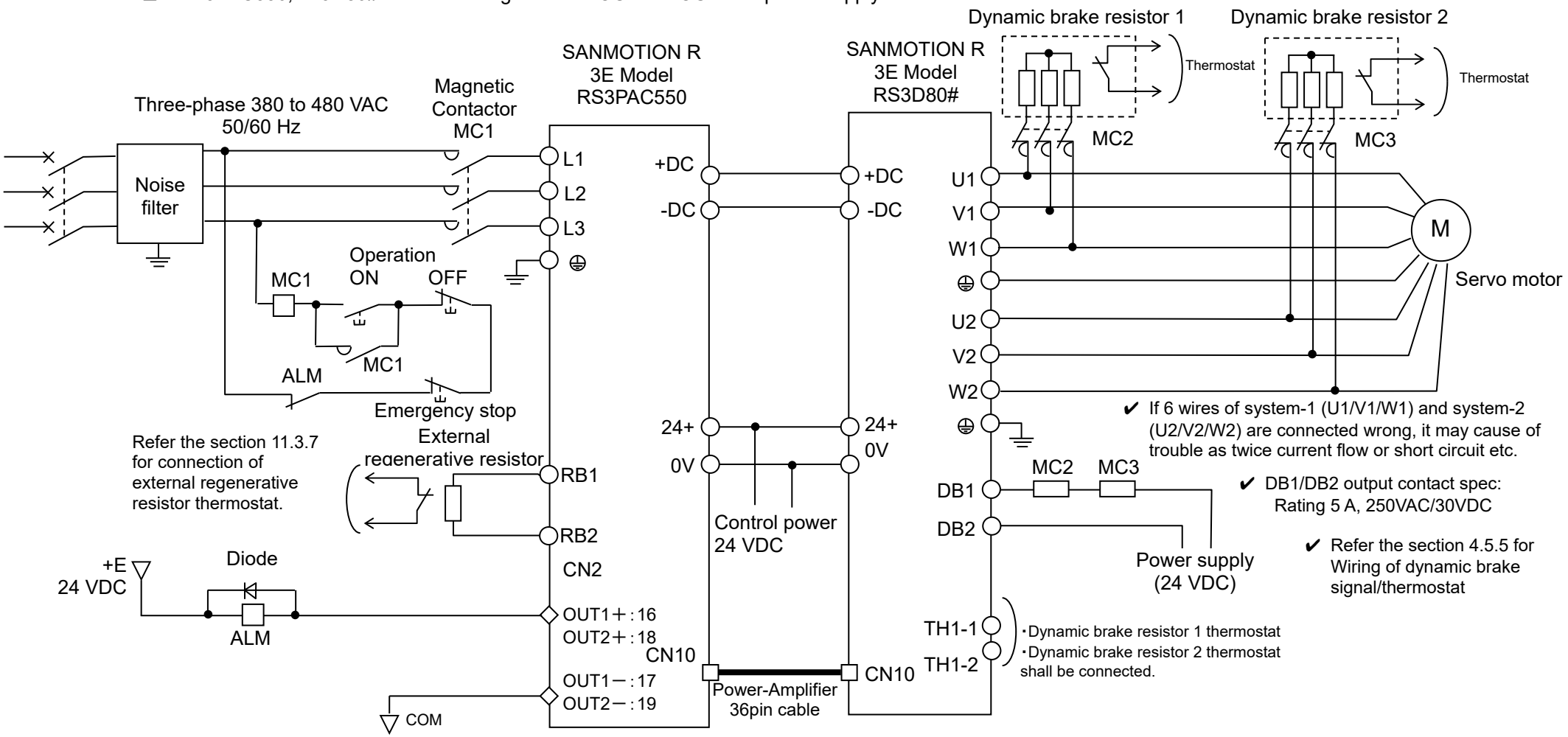


* Use the CN1- 50 (A-RDY) output. Turns OFF when it becomes main circuit power ON permission condition after control power ON. Turns OFF when alarm condition.

* When relay or induction coil load connect to CN1-50 (A-RDY) output, need to connect surge absorbing diode. In order to avoid the failure of the amplifier, please make sure of polarity of the diode.

4.1.7.12 Interface type [F: MODBUS] wiring example

■ RS3PAC550,RS3D80# When using + side of OUT1 or OUT2 for power supply

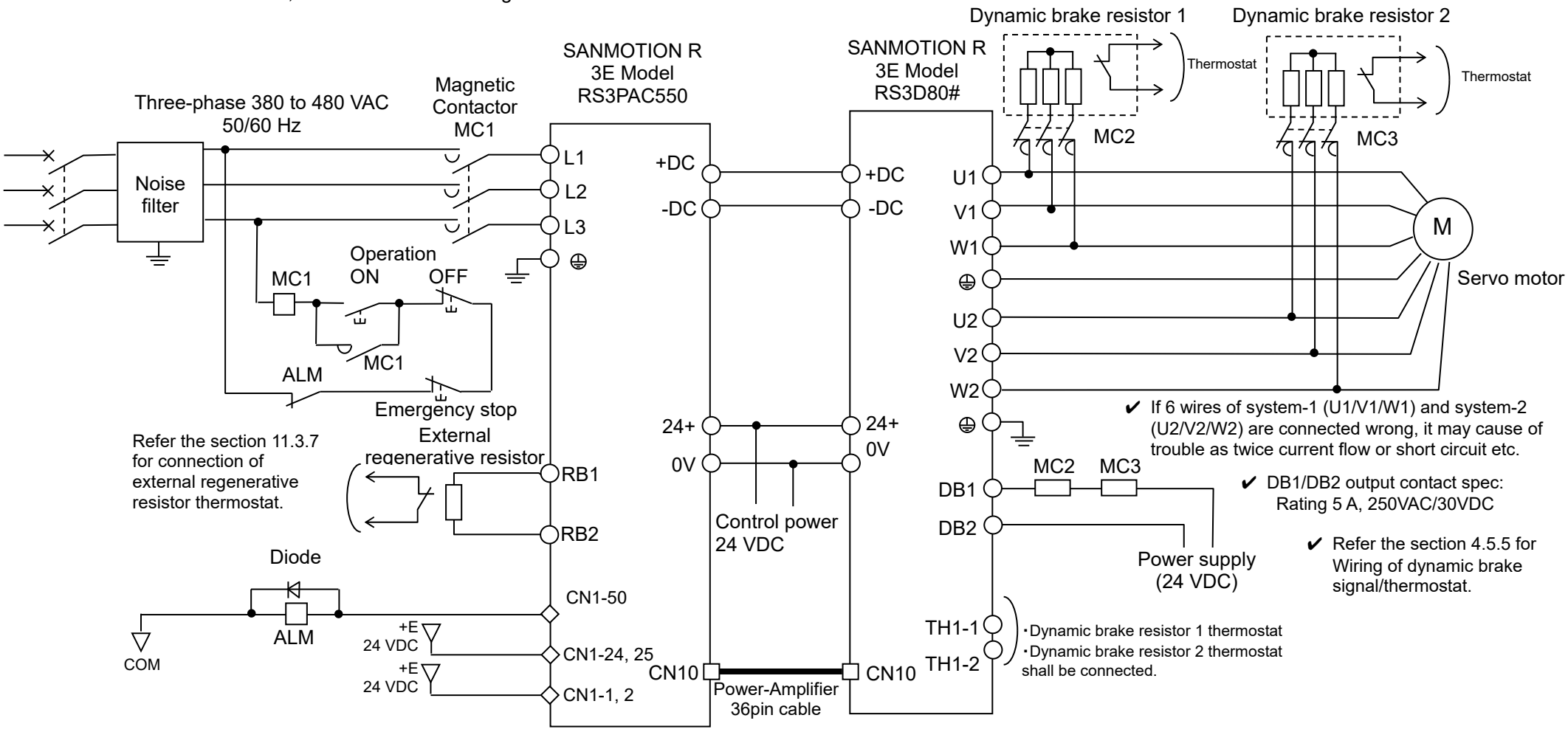


* Use one of the CN2 - 16 to 19 (OUT1, OUT2) outputs, and set either during ALM status output ON or during ALM status output OFF with the selection setting of “Group9 ID50, ID51 General output function selection”.

* When relay or induction coil load connect to CN2 - 16 to 19 (OUT1, OUT2) outputs, need to connect surge absorbing diode. In order to avoid the failure of the amplifier, please make sure of polarity of the diode.

4.1.7.13 Interface type [C: I/O] wiring example

■ RS3PAC550,RS3D80# When using A-RDY side for COM

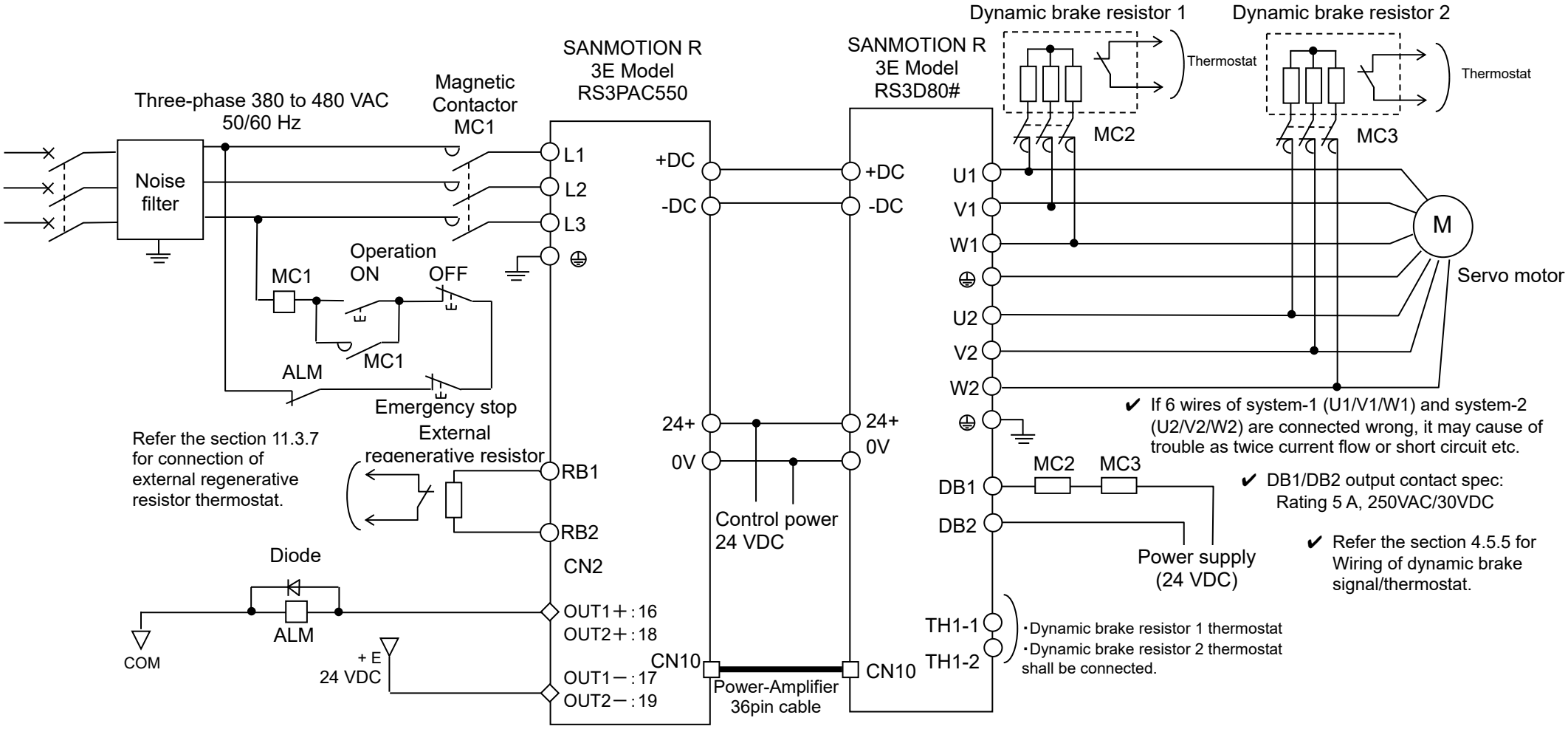


* Use the CN1- 50 (A-RDY) output. Turns OFF when it becomes main circuit power ON permission condition after control power ON. Turns OFF when alarm condition.

* When relay or induction coil load connect to CN1-50 (A-RDY) output, need to connect surge absorbing diode. In order to avoid the failure of the amplifier, please make sure of polarity of the diode.

4.1.7.14 Interface type [F: MODBUS] wiring example

■ RS3PAC550,RS3D80# When using - side of OUT1 or OUT2 for power supply

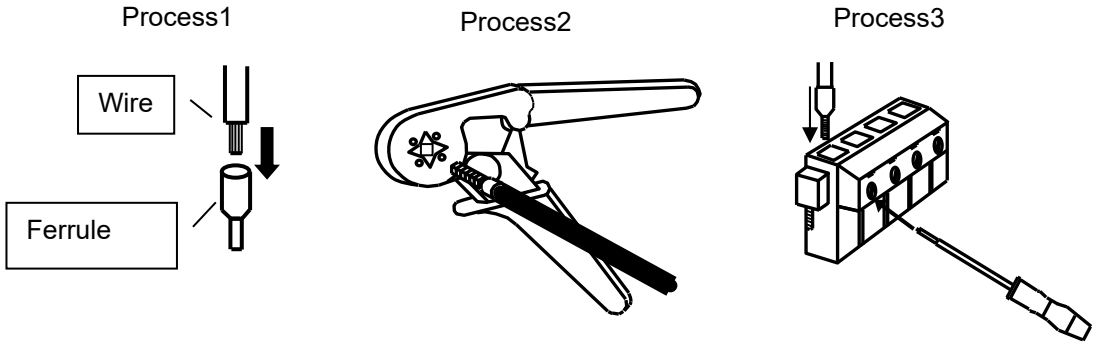


* Use one of the CN2 - 16 to 19 (OUT1, OUT2) outputs, and set either during ALM status output ON or during ALM status output OFF with the selection setting of “Group9 ID50, ID51 General output function selection”.

* When relay or induction coil load connect to CN2 - 16 to 19 (OUT1, OUT2) outputs, need to connect surge absorbing diode. In order to avoid the failure of the amplifier, please make sure of polarity of the diode.

4.1.8 Crimping of wires

Insert the wire into ferrule, and use a special tool to crimp it in.
Insert the ferrule deep into the connector, and tighten it with a special minus screwdriver or something. The recommended torque is shown in the section 4.1.9.



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

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

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

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

4.1 Wiring for the terminal of high voltage and grounding

4.1.9 High voltage circuit terminal; tightening torque

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

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

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

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

* "#" will be any number or alphabet.

■ RS3W60#

Unit model number	Terminal marking		
	CNA	CNB	⏚
RS3PAA270	[0.5 to 0.6 N·m]		[1.18 N·m] M4 (screw size)
RS3W60A			

4. Wiring

■ 400V AC input

Servo amplifier model number	Terminal marking ⏚
RS3C02#	[1.18 N·m] M4 (screw size)
RS3C05#	
RS3C10#	

Servo amplifier model number	Terminal marking R	S	T	RB1	RB2	U	V	W	24V	0V	B+	B-	⏚
RS3C15#	[2.0 N·m] M5 (screw size)								[1.2 N·m] M4 (screw size)				[2.45 N·m] M5 (screw size)

Servo amplifier model number	Terminal marking R	S	T	RB1	RB2	U	V	W	24V	0V	B+	B-	⏚
RS3C30#	[2.0 N·m] M5 (screw size)								[1.2 N·m] M4 (screw size)				[2.45 N·m] M5 (screw size)

Servo amplifier model number	Terminal marking TH1-1	TH1-2	DB1	DB2
RS3C30#	[1.2 N·m] M4 (screw size)			

Unit model number	端子記号 R	S	T	⏚	RB1	RB2	24V	0V
RS3PAC550	[12.0 N·m] M10 (screw size)				[3.0 N·m] M6 (screw size)		[1.2 N·m] M4 (screw size)	

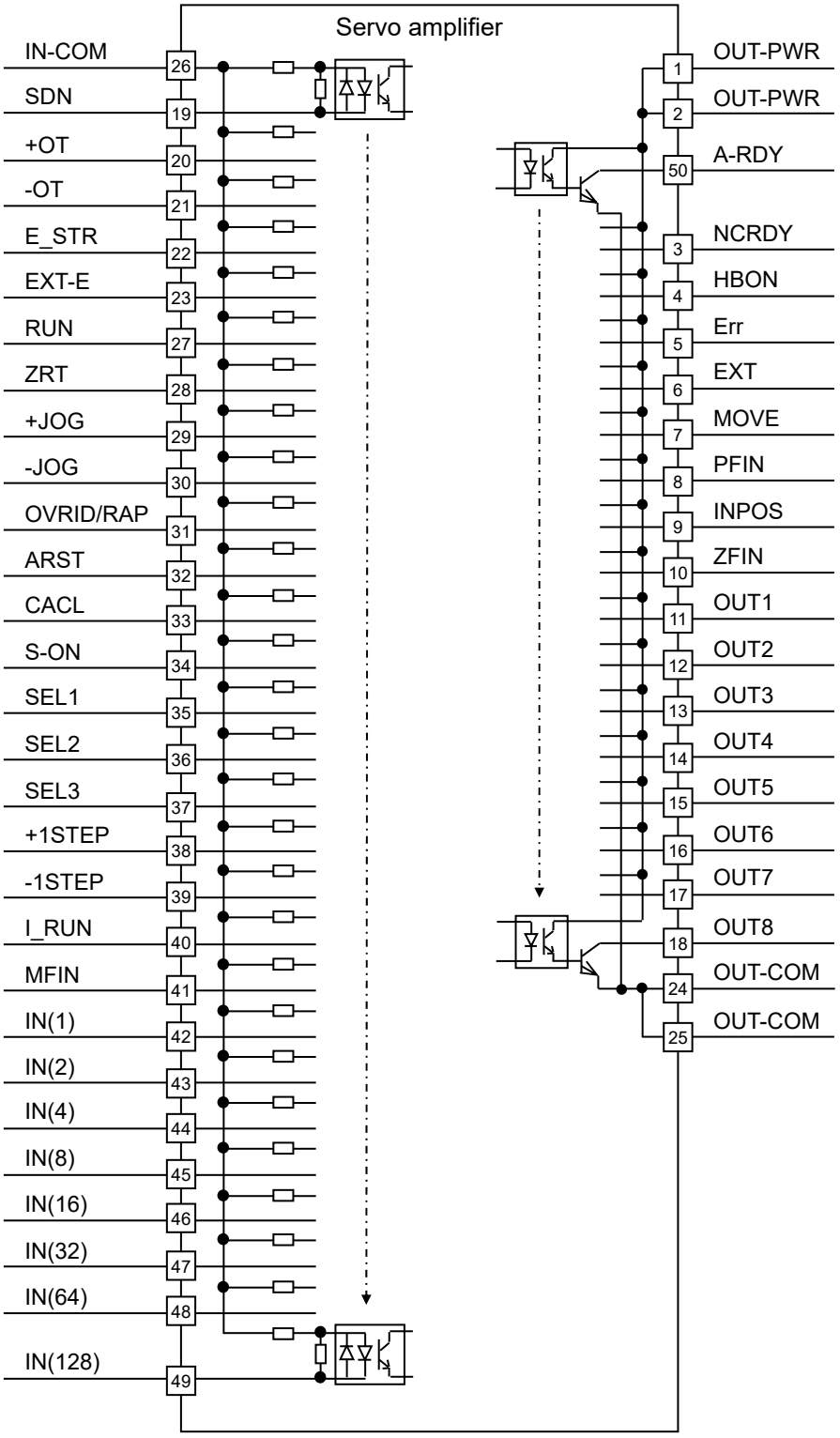
Unit model number	端子記号 U1	V1	W1	⏚	U2	V2	W2	⏚	24V	0V	TH1-1	TH1-2	DB1	DB2
RS3D80#	[9.0 N·m] M8 (screw size)							[1.2 N·m] M4 (screw size)						

* " # " will be any number or alphabet.

4.2 Wiring with Host Unit [C: I/O]

4.2.1 CN1 signals and pin numbers (wiring with host unit)

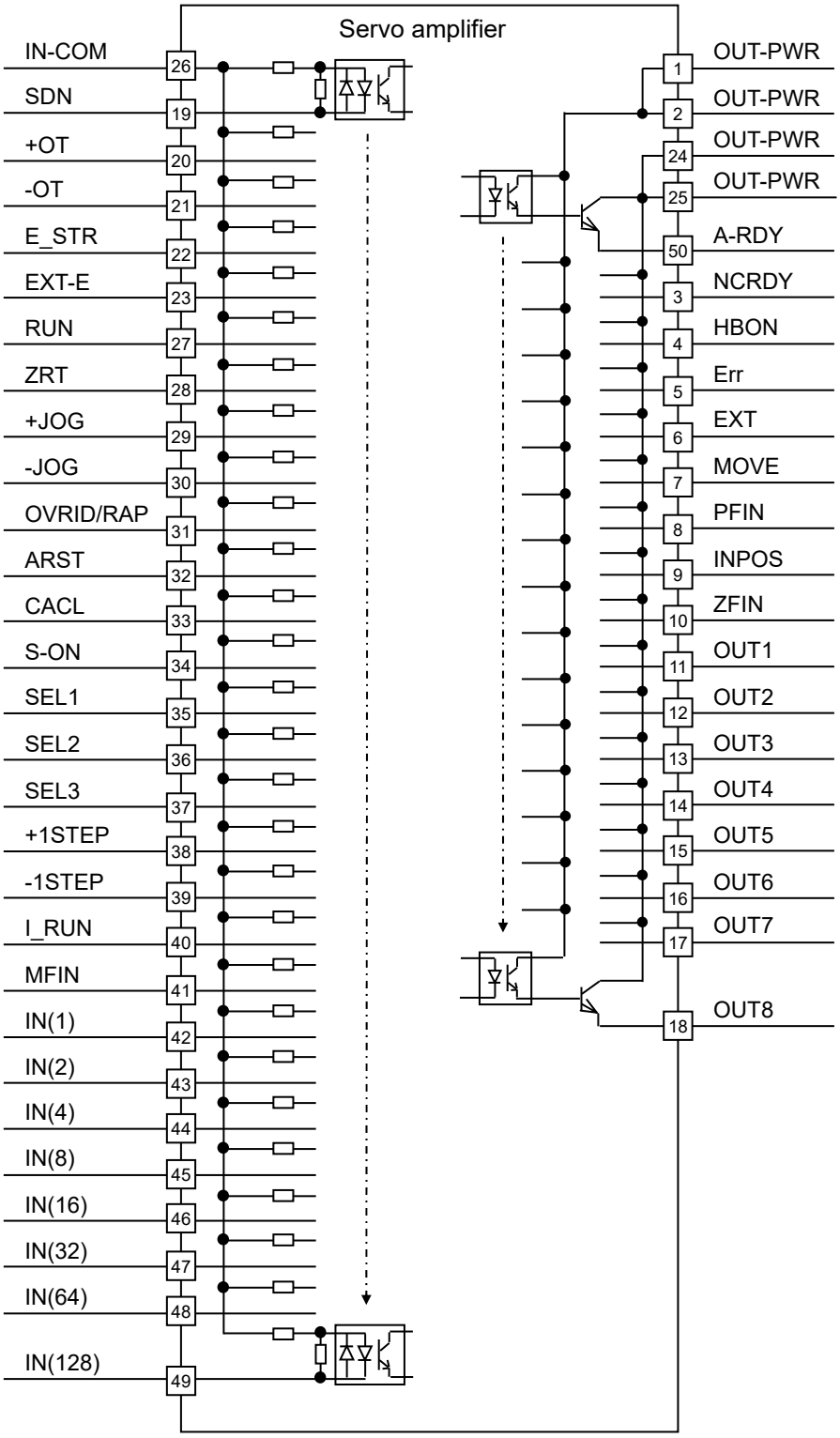
■ CN1 terminal sequence [General output: Sink type output]



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

* The wiring of CN1 should be used a twisted pair shield cable.

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

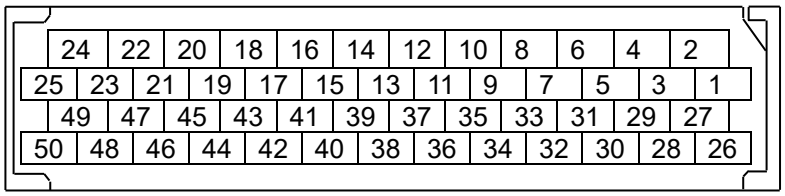


* Please check "1.1.3 Notes for replacement from SANMOTION R ADVANCED MODEL" for replacement from previous product (RS1).

* The wiring of CN1 should be used a twisted pair shield cable.

4.2.2 CN1 pin assignment

■ CN1 10150-3000PE (Soldered side)



4.2.3 Signal name and its function

Terminal number	Signal name	Description
1	OUT-PWR	Output circuit power
2	OUT-PWR	Output circuit power
3	NCRDY	NC ready
4	HBON	Holding brake output timing
5	Err	Error output
6	EXT	External operation valid output
7	MOVE	While-move output
8	PFIN	Positioning completion output
9	INPOS	In-position output
10	ZFIN	Homing completion output
11	OUT1	General output 1
12	OUT2	General output 2
13	OUT3	General output 3
14	OUT4	General output 4
15	OUT5	General output 5
16	OUT6	General output 6
17	OUT7	General output 7
18	OUT8	General output 8
19	SDN	Slowdown before home signal
20	+OT	Positive overtravel
21	-OT	Negative overtravel
22	E_STR	External data setting input
23	EXT-E	External error
24 Note 1)	OUT-COM	Common for output circuit power
25 Note 1)	OUT-COM	Common for output circuit power

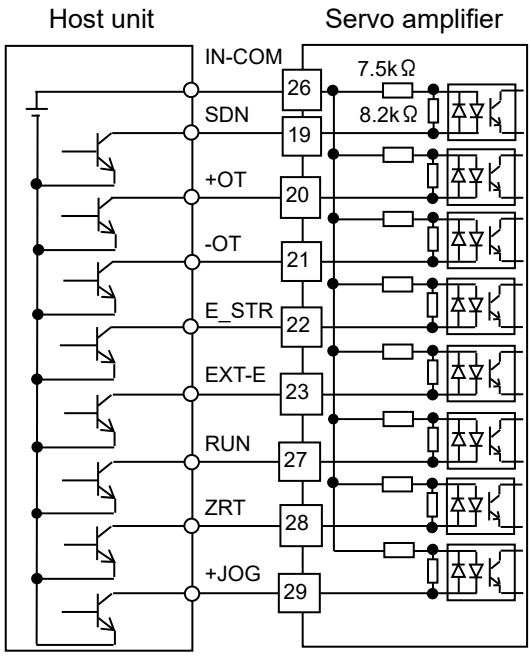
Terminal number	Signal name	Description
26	IN-COM	Input circuit power
27	RUN	Startup
28	ZRT	Homing
29	+JOG	Manual feed (positive)
30	-JOG	Manual feed (negative)
31	OVRID/RAP	Override/ Manual high speed
32	ARST	Alarm reset
33	CACL	Cancel
34	S-ON	Servo on
35	SEL1	Output selection 1
36	SEL2	Output selection 2
37	SEL3	Output selection 3
38	+1STEP	1-step feed (positive)
39	-1STEP	1-step feed (negative)
40	I_RUN	Interrupt startup
41	MFIN	MFIN
42	IN(1)	Point specification input 1
43	IN(2)	Point specification input 2
44	IN(4)	Point specification input 4
45	IN(8)	Point specification input 8
46	IN(16)	Point specification input 16
47	IN(32)	Point specification input 32
48	IN(64)	Point specification input 64
49	IN(128)	Point specification input 128
50	A-RDY	Power on permission

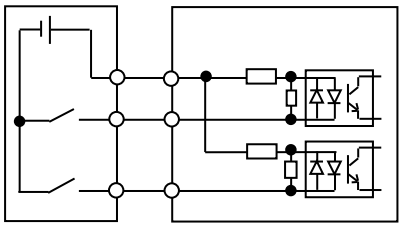
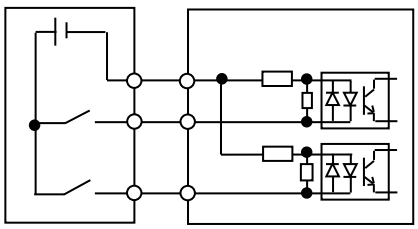
Note 1) 24 and 25 (OUT-COM) will be common terminals in case of sink type output, and power terminals in case of source type output.

4.2.4 Connection circuit for terminals

■ Input circuit
Inputting signals from relay switch, open collector type transistor (sink type, source type) output, etc.

Terminal No.	Symbol	Name	Connection circuit example
26	IN-COM	Power for input circuit	[External power supply spec.] - Power supply voltage range: 24 VDC±10 % - Current capacity: 100 mA or more (at 24 VDC) [Sink type circuit example]
19	SDN	Slowdown before home signal	
20	+OT	Positive overtravel	
21	-OT	Negative overtravel	
22	E_STR	External data setting input	
23	EXT-E	External error	
27	RUN	Startup	
28	ZRT	Homing	
29	+JOG	Manual feed (Positive dir.)	
30	-JOG	Manual feed (Negative dir.)	
31	OVRID/RAP	Override/Manual high speed	
32	ARST	Alarm reset	
33	CACL	Cancel	
34	S-ON	Servo on	
35	SEL1	Output selection 1	
36	SEL2	Output selection 2	
37	SEL3	Output selection 3	
38	+1STEP	1-step deed (Positive dir.)	
39	-1STEP	1-step deed (Negative dir.)	
40	I_RUN	Interruption startup	
41	MFIN	MFIN	
42	IN(1)	Point specification input 1	
43	IN(2)	Point specification input 2	
44	IN(4)	Point specification input 4	
45	IN(8)	Point specification input 8	
46	IN(16)	Point specification input 16	
47	IN(32)	Point specification input 32	
48	IN(64)	Point specification input 64	
49	IN(128)	Point specification input 128	



Sink type circuit	Source type circuit
	

■ Output circuit
Driving electric loads like relay switch or photo-coupler.

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

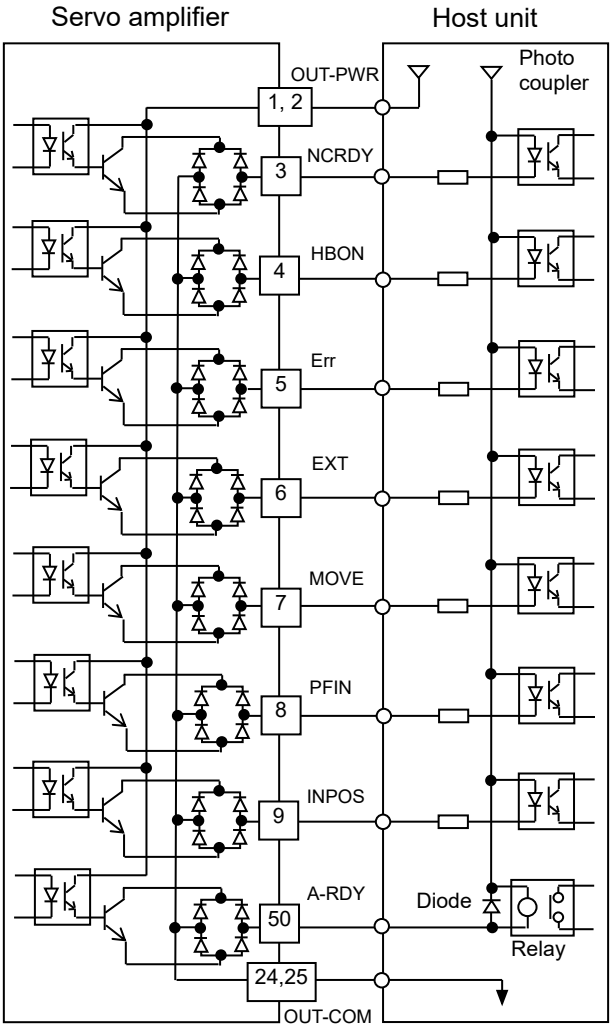
Terminal No.	Symbol	Name
3	NCRDY	NC ready
4	HBON	Holding brake output timing
5	Err	Error output
6	EXT	External operation valid output
7	MOVE	While operation output
8	PFIN	Positioning completion output
9	INPOS	In-position output
10	ZFIN	Homing completion output
11	OUT1	General output 1
12	OUT2	General output 2
13	OUT3	General output 3
14	OUT4	General output 4
15	OUT5	General output 5
16	OUT6	General output 6
17	OUT7	General output 7
18	OUT8	General output 8
50	A-RDY	Power ON ready
1	OUT-PWR	Power for output circuit
2	OUT-PWR	Power for output circuit
24	OUT-COM	Common for output circuit
25	OUT-COM	Common for output circuit

Connection circuit example

[Power source spec for general output circuit (OUT-PWR)]
- Power supply voltage range: 24 VDC±10 %
- Current capacity: 80 mA or more

[General output (OUT-1 to OUT-8) spec.]

Power supply voltage range	Maximum output current (per 1 output terminal)
24 VDC ±10 %	50 mA



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

4. Wiring

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

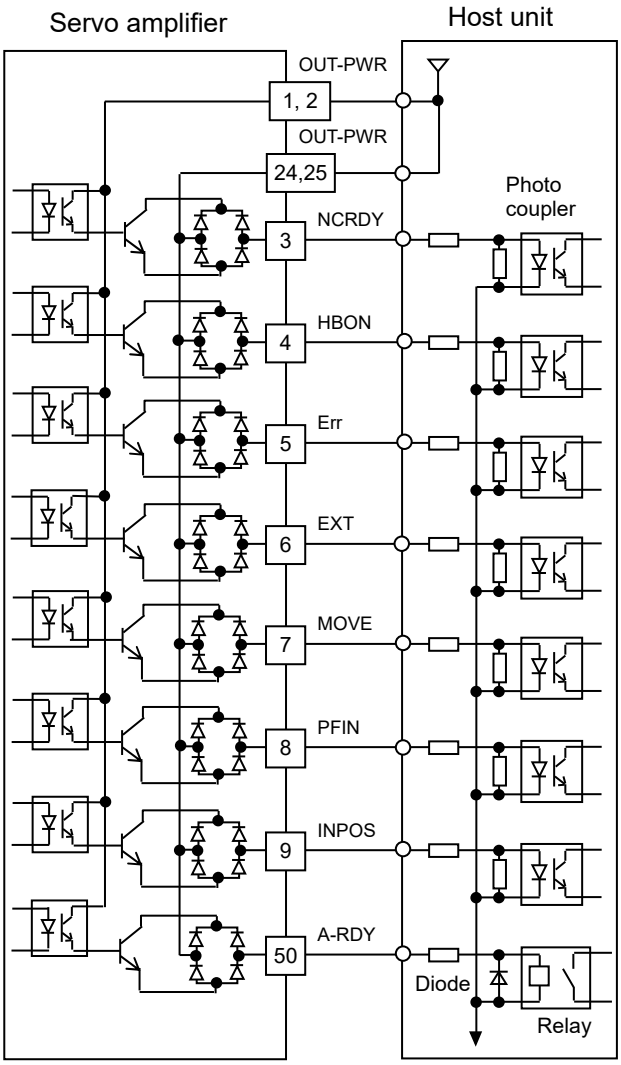
Terminal No.	Symbol	Name
3	NCRDY	NC ready
4	HBON	Holding brake output timing
5	Err	Error output
6	EXT	External operation valid output
7	MOVE	While operation output
8	PFIN	Positioning completion output
9	INPOS	In-position output
10	ZFIN	Homing completion output
11	OUT1	General output 1
12	OUT2	General output 2
13	OUT3	General output 3
14	OUT4	General output 4
15	OUT5	General output 5
16	OUT6	General output 6
17	OUT7	General output 7
18	OUT8	General output 8
50	A-RDY	Power ON ready
1	OUT-PWR	Power for output circuit
2	OUT-PWR	Power for output circuit
24	OUT-PWR	Power for output circuit
25	OUT-PWR	Power for output circuit

Connection circuit example

[Power source spec for general output circuit (OUT-PWR)]
- Power supply voltage range: 24 VDC±10 %
- Current capacity: 80 mA or more
- Maximum voltage drop at ON: Max. 5.6 V (with 50 mA)

[General output (OUT-1 to OUT-8) spec.]

Power supply voltage range	Maximum output current (per 1 output terminal)
24 VDC ±10 %	50 mA

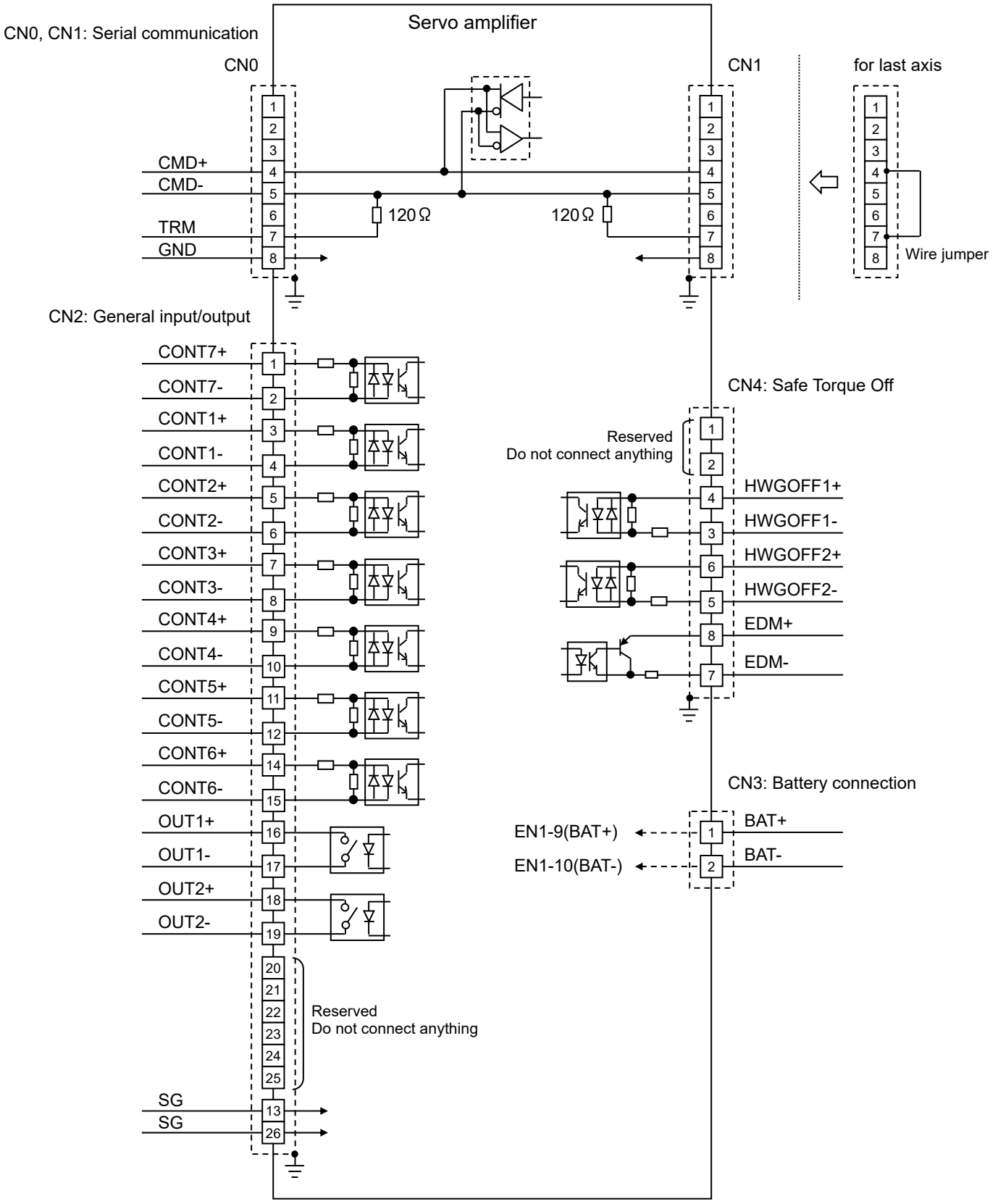


* Must add the surge absorbing diode if inductive load such as relay connect to the control signal output of the amplifier. Please take care of polarity of the diode that will be cause of failure.

4.3 Wiring with Host Unit [F: MODBUS communication]

4.3.1 Control signals and pin numbers (wiring with host unit)

■ Control signals terminal sequence



4.3.2 CN0, CN1 connectors pin assignment

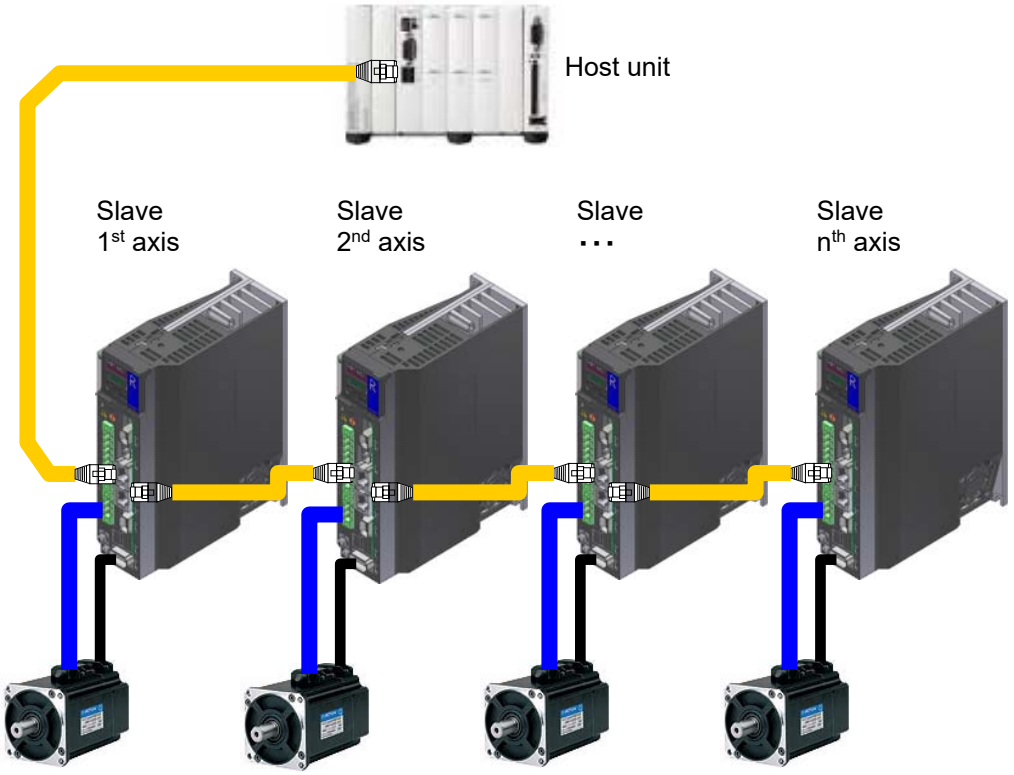
■ Pin assignment

For serial communication amplifier, two RJ-45 modular connectors are provided as CN0 and CN1 for the communication with host device. Use twisted-pair cables with pin 4, 5 and 8 connection between CN0/CN1 that satisfy at least "Category 5e".
When you make cables using exclusive tools, use STP (Shielded twisted pair cable) and RJ-45 modular plug with shield.

CN0, CN1	Terminal number	Signal	Description
	1	-	No connection
	2	-	No connection
	3	-	No connection
	4	CMD+	Communication signal +
	5	CMD-	Communication signal -
	6	-	No connection
	7	TRM	No connection (For termination connection)
	8	GND	Communication ground

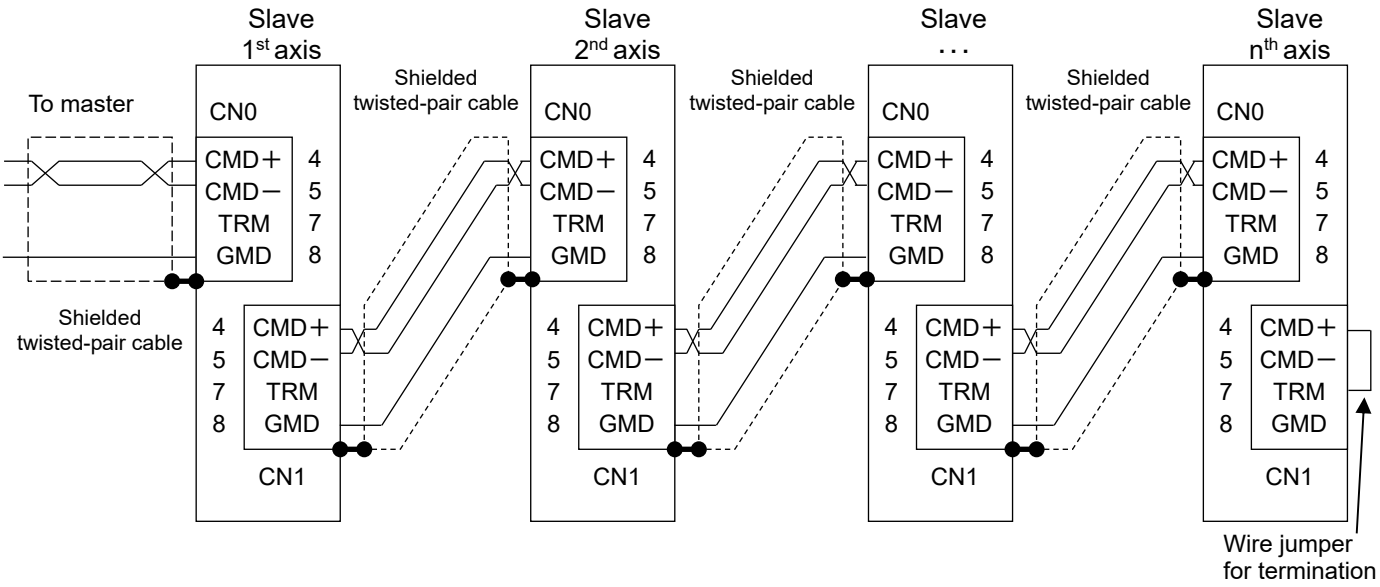
* Refer to "Control signals and pin numbers (wiring with host unit)" on the previous page for electrical connection of CN0 and CN1.

■ Connection diagram



4.3 Wiring with Host Unit [F: MODBUS communication]

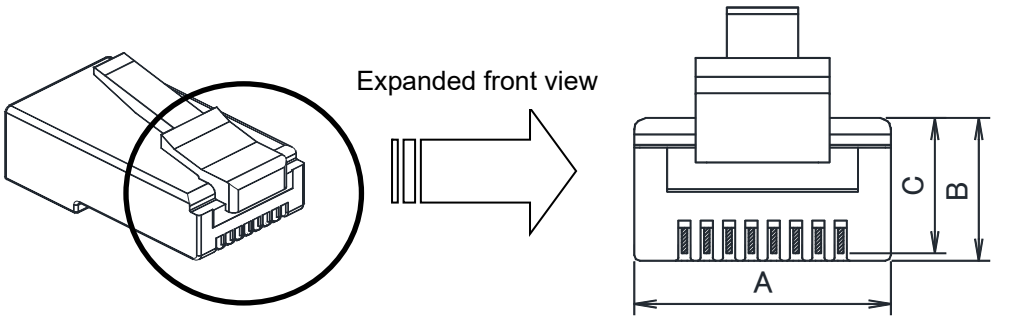
■ Wiring diagram



■ Termination resistor
This servo amplifier has termination resistor internal.
120Ω termination resistor will be connected between CMD+ and CMD- by connection of the modular connector short circuited of pin 4 and 7 to opened port of series end servo amplifier.

■ Caution for RJ-45 modular connector selection

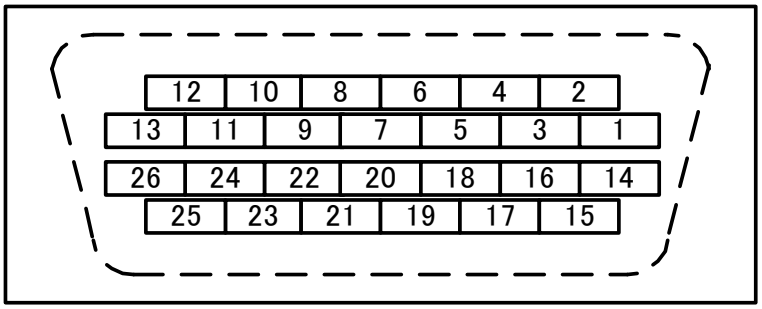
- For the modular connector selection and modification, please confirm the standards dimension below (Standards: TIA-968-A).
- Especially, when the connector (ready-made/ modified product) which has out-of-range dimension at C (from top end of connector housing to lower side of terminal) is used, it gives excessive stress to mating connector and may cause a damage of terminal or connector, and a communication error by contact failure.



Standards dimension:
A: 11.58 to 11.78 mm
B: 6.49 to 6.70 mm
C: 5.89 to 6.15 mm

4.3.3 CN2 general I/O connector pin assignment

■ HDR-E26MSG1+ (*The figure below is viewed from connector's soldered side.)

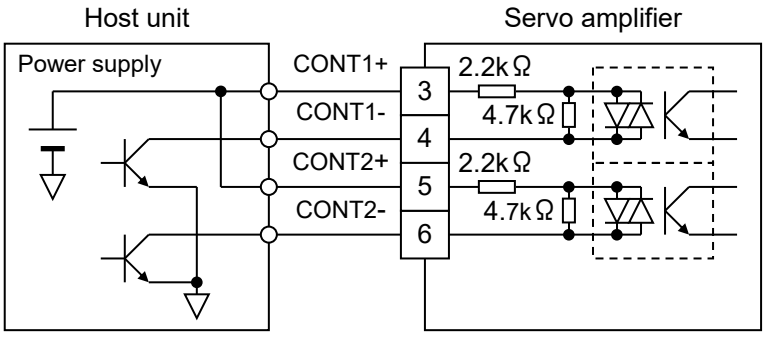
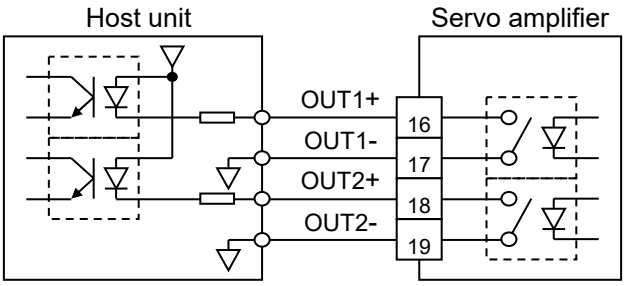


◆ Signal names and functions

Terminal No.	Signal name	Description
1	CONT7+	General input 7 (+)
2	CONT7-	General input 7 (-)
3	CONT1+	General input 1 (+)
4	CONT1-	General input 1 (-)
5	CONT2+	General input 2 (+)
6	CONT2-	General input 2 (-)
7	CONT3+	General input 3 (+)
8	CONT3-	General input 3 (-)
9	CONT4+	General input 4 (+)
10	CONT4-	General input 4 (-)
11	CONT5+	General input 5 (+)
12	CONT5-	General input 5 (-)
13	SG	Signal ground
14	CONT6+	General input 6 (+)
15	CONT6-	General input 6 (-)
16	OUT1+	General output 1 (+)
17	OUT1-	General output 1 (-)
18	OUT2+	General output 2 (+)
19	OUT2-	General output 2 (-)
20	Reserved	Do not connect anything.
21	Reserved	Do not connect anything.
22	Reserved	Do not connect anything.
23	Reserved	Do not connect anything.
24	Reserved	Do not connect anything.
25	Reserved	Do not connect anything.
26	SG	Signal ground

4.3 Wiring with Host Unit [F: MODBUS communication]

4.3.4 Connection circuit for terminals

<table>
<tr><th>Terminal No.</th><th>Symbol</th><th>Name</th><th>Description</th></tr>
<tr><td>1</td><td>CONT7+</td><td>General input 7 (+)</td><td rowspan="12">■ Connect the general input circuit to a relay or open-collector transistor circuit.
Power supply voltage range: 24 VDC±10 %
Current capacity of host unit: 100 mA or more (24 VDC)
 
</td></tr>
<tr><td>2</td><td>CONT7-</td><td>General input 7 (-)</td></tr>
<tr><td>3</td><td>CONT1+</td><td>General input 1 (+)</td></tr>
<tr><td>4</td><td>CONT1-</td><td>General input 1 (-)</td></tr>
<tr><td>5</td><td>CONT2+</td><td>General input 2 (+)</td></tr>
<tr><td>6</td><td>CONT2-</td><td>General input 2 (-)</td></tr>
<tr><td>7</td><td>CONT3+</td><td>General input 3 (+)</td></tr>
<tr><td>8</td><td>CONT3-</td><td>General input 3 (-)</td></tr>
<tr><td>9</td><td>CONT4+</td><td>General input 4 (+)</td></tr>
<tr><td>10</td><td>CONT4-</td><td>General input 4 (-)</td></tr>
<tr><td>11</td><td>CONT5+</td><td>General input 5 (+)</td></tr>
<tr><td>12</td><td>CONT5-</td><td>General input 5 (-)</td></tr>
<tr><td>14</td><td>CONT6+</td><td>General input 6 (+)</td></tr>
<tr><td>15</td><td>CONT6-</td><td>General input 6 (-)</td></tr>
<tr><td>16</td><td>OUT1+</td><td>General output 1 (+)</td><td rowspan="4">■ Connect the general output circuit to a photo coupler or relay circuit.
Power supply voltage range: 24 VDC±10 %, Max. current value: 50 mA.
* When host unit input circuit is a TTL or CMOS-input, the maximum current value shall be 20 mA or less.
 
</td></tr>
<tr><td>17</td><td>OUT1-</td><td>General output 1 (-)</td></tr>
<tr><td>18</td><td>OUT2+</td><td>General output 2 (+)</td></tr>
<tr><td>19</td><td>OUT2-</td><td>General output 2 (-)</td></tr>
<tr><td>20 to 25</td><td>-</td><td>Reserved</td><td>Do not connect anything.</td></tr>
<tr><td>13, 26</td><td>SG</td><td>Signal ground</td><td>Connected to the signal ground of servo amplifier.</td></tr>
</table>

4.4 Wiring of motor encoder

4.4.1 EN1, EN2 signal names and pin numbers

■ Battery backup absolute encoder (Encoder code: P)

Servo Amplifier EN1 Terminal No.	Signal name	Flange size 220mm or less Servo motor plug pin number (For lead wire type)	Flange size 275mm Servo motor plug pin number	Description	Remarks Note 1)
1	5V	9 (Red)	7	Power supply	Twisted pair (Recommended)
2	SG	10 (Black)	8	Power supply common	
3	5V	-	-	NC Note 3)	-
4	SG	-	-	NC Note 3)	-
5	(NC)	-	-	NC Note 3)	-
6	(NC)	-	-	NC Note 3)	-
7	ES+	1 (Brown)	1	Serial data signal	Twisted pair
8	ES-	2 (Blue)	2		
9	BAT+	8 (Pink)	5	Battery	Twisted pair
10	BAT-	4 (Purple)	9		
Note 2)	Ground	7 (shielded)	10	Shield	-

Note 1) Use shielded cable and perform twisted-pair wiring.
Note 2) Connect outer-shielded wires of servo amplifier to metal case (ground) of servo amplifier (EN1). For the servo motor with leads, the outer shielded wire of the servo motor shall be connected to shielded wires of leads, and for the cannon plug-type servo motor, perform wiring very close to servo motor. Encoder and outer shields are not connected inside the servo motor equipped with this encoder.
Note 3) Do not connect anything to 3 to 6 pins.

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

Servo Amplifier EN1 Terminal No.	Signal name	Flange size 220mm or less Servo motor plug pin number (For lead wire type)	Flange size 275mm Servo motor plug pin number	Description	Remarks Note 1)
1	5V	9 (Red)	7	Power supply	Twisted pair (Recommended)
2	SG	10 (Black)	8	Power supply common	
3	5V	-	-	NC Note 3)	-
4	SG	-	-	NC Note 3)	-
5	(NC)	-	-	NC Note 3)	-
6	(NC)	-	-	NC Note 3)	-
7	ES+	1 (Brown)	1	Serial data signal	Twisted pair
8	ES-	2 (Blue)	2		
9	(NC)	-	-	NC Note 3)	-
10	(NC)	-	-	NC Note 3)	-
Note 2)	Ground	7 (shielded)	10	Shield	-

Note 1) Use shielded cable and perform twisted-pair wiring.
Note 2) Connect outer-shielded wires of servo amplifier to metal case (ground) of servo amplifier (EN1). For the servo motor with leads, the outer shielded wire of the servo motor shall be connected to shielded wires of leads, and for the cannon plug-type servo motor, perform wiring very close to servo motor. Encoder and outer shields are not connected inside the servo motor equipped with this encoder.
Note 3) Do not connect anything to 3 to 6, 9 and 10 pins.

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

Servo Amplifier EN1 Terminal No.	Signal name	Flange size 220mm or less Servo motor plug pin number (For lead wire type)	Flange size 275mm Servo motor plug pin number	Description	Remarks Note 1)
1	5V	9 (Red)	7	Power supply	Twisted pair (Recommended)
2	SG	10 (Black)	8	Power supply common	
3	5V	-	-	NC Note 3)	-
4	SG	-	-	NC Note 3)	-
5	(NC)	-	-	NC Note 3)	-
6	(NC)	-	-	NC Note 3)	-
7	ES+	1 (Brown)	1	Serial data signal	Twisted pair
8	ES-	2 (Blue)	2		
9	(NC)	-	-	NC Note 3)	-
10	(NC)	-	-	NC Note 3)	-
Note 2)	Earth	7 (shielded)	10	Shield	-

Note 1) Use an exterior covering shielded cable and perform twisted-pair wiring.
Note 2) Connect outer-shielded wires of encoder cable to metallic case (ground) of encoder connector (EN1) for servo amplifier and a ground of motor encoder.
Note 3) Do not connect anything to 3 to 6, 9 and 10 pins.

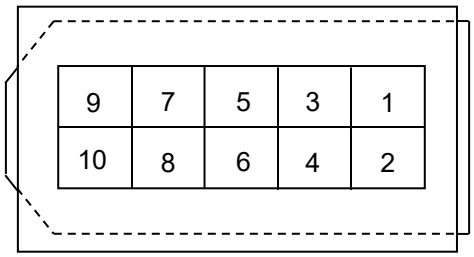
■ Wire-saving incremental encoder (Encoder code: S)

Servo Amplifier EN1, EN2 Terminal No.	Signal name	Flange size 220mm or less Servo motor plug pin number (For lead wire type)	Flange size 275mm Servo motor plug pin number	Description	Remarks Note 1)
1	5V	9 (Red)	7	Power supply	Twisted pair (Recommended)
2	SG	10 (Black)	8	Power supply common	
3	5V	-	-	NC Note 4)	-
4	SG	-	-	NC Note 4)	-
5	B	2 (Green)	3	Phase B pulse output	Twisted pair
6	/B	5 (Purple)	4		
7	A	1 (Blue)	1	Phase A pulse output	Twisted pair
8	/A	4 (Brown)	2		
9	Z	3 (White)	5	Phase Z pulse output	Twisted pair
10	/Z	6 (Yellow)	6		
Note 2)	Earth	7 (shielded)	10	Shield	-

Note 1) For amplifier model number "RS3****2***", EN2 is able to use as motor encoder input.
Note 2) Use an exterior covering shielded cable and perform twisted-pair wiring.
Note 3) Connect outer-shielded wires of encoder cable to metallic case (ground) of encoder connector (EN1 or EN2) and a ground of motor encoder.
Note 4) Do not connect anything to 3 and 4 pins.

4.4.2 EN1, EN2 pin assignment

■ EN1, EN2 54593-1016 (soldered side)



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

■ Connector model number (Molex Japan LLC)

	Model Number	Applicable wire size	Applicable cable diameter
Plug connector	54593-1016	AWG30 to AWG18	—
Plug cable cover set	54599-1016	—	ϕ7 to ϕ9

4.4.3 Connector model number for motor encoder

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

Motor model number	Motor encoder plug model number	Connector type	Applicable cable diameter
R1#A04005 R1#A04010 R1#A06020 R1AA06040 R1AA08075 R2#A04003 R2#A04005 R2EA04008 R2#A04010 R2#A06010 R2#A06020 R2AA08020 R2AA06040 R2AA08040 R2AA08075 R2AAB8075 R2AAB8100 R2AA10075 R2AA10100 R5AA06020 R5AA06040 R5AA08075	(Lead wire type)	—	—
R1AA10100 R1AA10150 R1AA10200 R1AA10250	JN2DS10SL1-R	Straight	φ5.7 to φ7.3
R1AA13300 R1AA13400 R1AA13500 R1AA18550	JN2FS10SL1-R	Angle	
R1AA18750 R1AA1811K R1AA1815K R2AA13050	JN2DS10SL2-R	Straight	φ6.5 to φ8.0
R2AA13120 R2AA13180 R2AA13200 R2AA18350	JN2FS10SL2-R	Angle	
R2AA18450 R2AA18550 R2AA18750 R2AA1811K	JN2DS10SL3-R	Straight	φ3.5 to φ5.0
R2AA22500 R2AA22700 R2AA2211K R2AA2215K	JN2FS10SL3-R	Angle	

* "#" will be any number or alphabet.

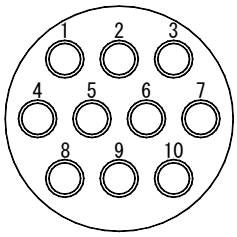
■ R-series servo motor encoder
Connector model numbers (Products of Japan Aviation Electronics Industry, Ltd.) (Continued)

Motor model number	Motor encoder plug model number	Connector type	Applicable cable diameter
R1CA10150 R1CA10200 R1CA13300 R1CA18550 R1CA18750 R1CA1811K R1CA1815K	JN2DS10SL1-R	Straight	φ5.7 to φ7.3
	JN2FS10SL1-R	Angle	
R1CA2220K R2CA10075 R2CA10100 R2CA13050 R2CA13120 R2CA13180 R2CA13200	JN2DS10SL2-R	Straight	φ6.5 to φ8.0
	JN2FS10SL2-R	Angle	
R2CA18350 R2CA18450 R2CA18550 R2CA18750 R2CA2211K R2CA2215K R2CA2220K	JN2DS10SL3-R	Straight	φ3.5 to φ5.0
	JN2FS10SL3-R	Angle	
R2CA2830K	5557-10R	—	—

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

Motor model number	Type	Model number	Qty.	Applicable wire size
Except R2CA2830K	Manual crimping type	JN1-22-20S-R-PKG100	Note 1)	AWG20
		JN1-22-22S-PKG100	Note 1)	AWG21 to AWG25
		JN1-22-26S-PKG100	Note 1)	AWG26 to AWG28
	Soldering type	JN1-22-22F-PKG100	Note 1)	AWG20 max.

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

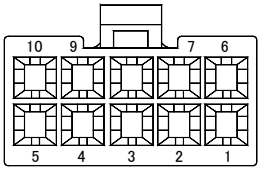


R-series servo motor encoder cannon plug pin assignment (Viewed from motor)

■ Contact model numbers (Molex Japan LLC)

Motor model number	Type	Model number	Applicable wire size
R2CA2830K	Manual crimping type	5556T2L	AWG22 to AWG28
		5556GS2 Note 1)	

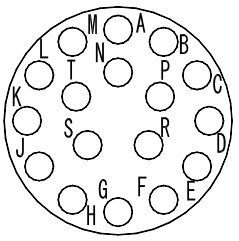
Note 1) Gold plating. Use with battery backup absolute encoder (encoder code: P).



Flange size 280mm Servo motor encoder connector pin assignment (Viewed from motor)

■ Encoder of R2CA3255KBXS00 (for wire-saving incremental system)
Connector model numbers (Products of Japan Aviation Electronics Industry, Ltd.)

Motor model number	Motor encoder plug model number	Connector type	Applicable cable diameter
R2CA3255KB	N/MS3106B20-29S	Straight	—



Encoder cannon plug
pin assignment
(Viewed from motor)

4.4.4 Recommended encoder cable specification

Shielded cables with multiple twisted pairs

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

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

4.4.5 Encoder cable length

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

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

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

4.5 Wiring for thermostat of servo motor FAN (for 400V AC)

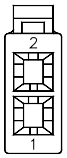
4.5.1 Connector model number for thermostat of servo motor FAN

■ Connector model number (Molex Japan LLC)
for thermostat of flange size 280 and 320 mm servo motor FAN

Motor model number	Model number	Applicable wire size
R2CA2830K R2CA3255K	5557-02R	AWG22 to AWG28

■ Contact model number (Molex Japan LLC)

Type	Model number	Applicable wire size
Manual crimping type	5556T2L	AWG22 to AWG28



Flange size 280/320 mm
thermostat connector
of servo motor FAN
pin assignment
(Viewed from motor)

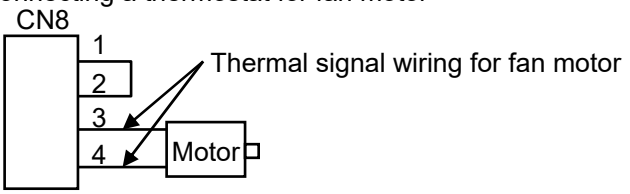
4.6 External alarm input, dynamic brake signal and thermostat

4.6.1 Pin assignment of external alarm input (CN8) (RS3W60#)

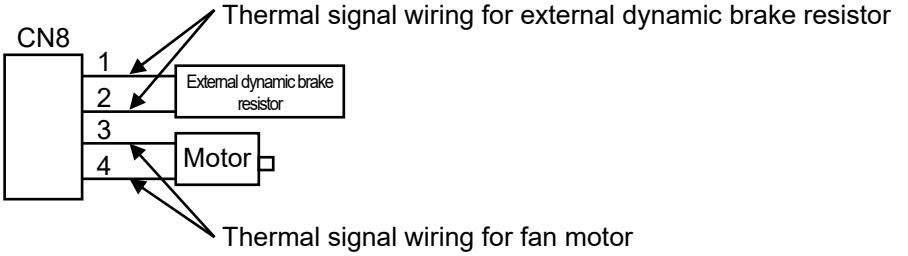
Pin number	Signal name
1	Thermal signal wiring for external dynamic brake resistor
2	
3	Thermal signal wiring for servo motor or fan motor
4	

4.6.2 Wiring of external alarm input (CN8) (RS3W60#)

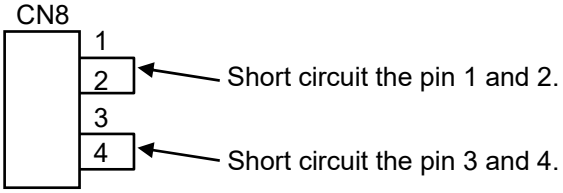
■ In case of connecting a thermostat for fan motor



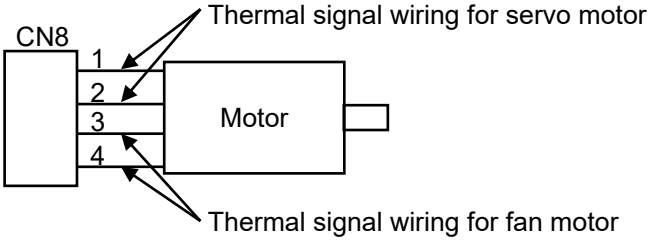
■ In case of connecting thermostats for a fan motor and for an external dynamic brake resistor



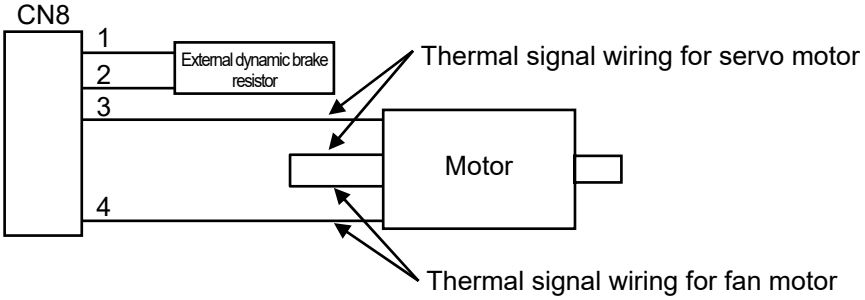
■ In case of no connection to CN8



■ In case of connecting thermostats for a fan motor and for a servo motor



■ In case of connecting thermostats for an external dynamic brake resistor, servo motor and fan motor.



4.6.3 Terminal block pin assignment for dynamic brake signal/thermostat (400 VAC)

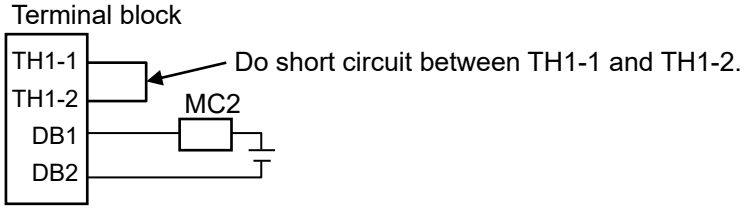
Terminal name	Signal name
TH1-1	Thermal signal of external dynamic brake resistor
TH1-2	
DB1	Control terminal (+) for contact of external dynamic brake resistor
DB2	Control terminal (-) for contact of external dynamic brake resistor

* RS3C02/05/10/15 equips dynamic brake circuit internally so no terminal block.

4.6.4 Wiring of dynamic brake signal/thermostat (RS3C30#)

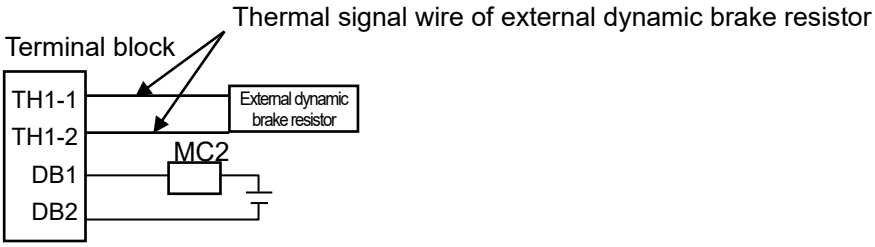
Below shows a wiring example.
Consult us for the other usage.

■ Wiring of dynamic brake signal only



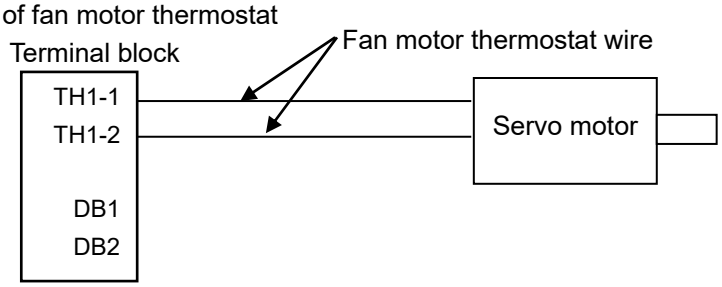
* Use Form b-contact (Normally Close) to magnetic contact (MC) of external dynamic brake circuit.

■ Wiring of dynamic brake signal and dynamic brake resistor thermostat



* Use Form b-contact (Normally Close) to magnetic contact (MC) of external dynamic brake circuit.

■ Wiring of fan motor thermostat



■ In case of using nothing

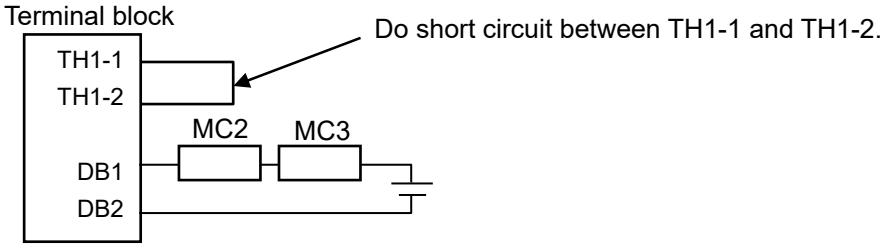
* Do short circuit between TH1-1 and TH1-2.

4.6 External alarm input, dynamic brake signal and thermostat

4.6.5 Wiring of dynamic brake signal/thermostat (RS3D80#)

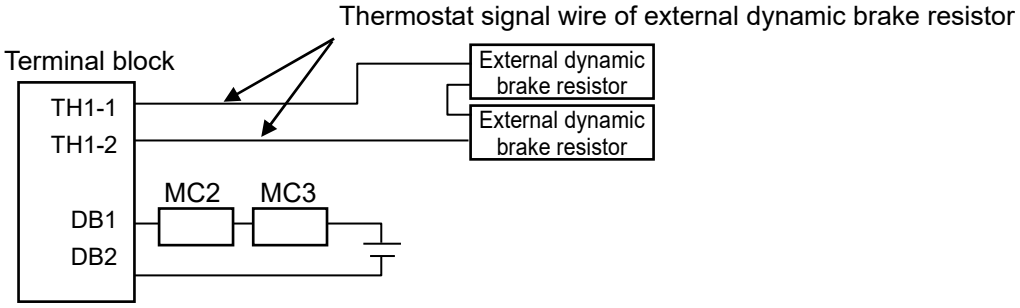
Below shows a wiring example.
Consult us for the other usage.

■ Wiring of dynamic brake signal only



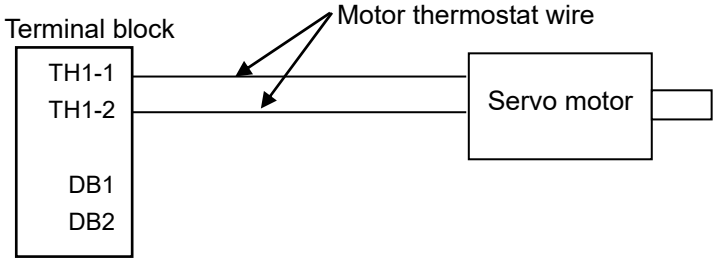
* Use Form b-contact (Normally Close) to magnetic contact (MC) of external dynamic brake circuit.

■ Wiring of dynamic brake signal and dynamic brake resistor thermostat.



* Use Form b-contact (Normally Close) to magnetic contact (MC) of external dynamic brake circuit.

■ Wiring of servo motor thermostat.



■ In case of using nothing

* Do short circuit between TH1-1 and TH1-2.

4.7 Peripheral equipments

4.7.1 Power supply capacity and peripherals list (Rotary motor)

■ 200V AC input

Input voltage	Servo amplifier model number	Servo motor model No.	Main circuit power supply rating (kVA)	Molded Case Circuit Breaker (MCCB)	Noise filter	Magnetic contact	Surge absorber
200V AC	RS3#01#	R1AA04005F	0.2	Model NF32 10A MITSUBISHI ELECTRIC	HF3030C-SZA SOSHIN ELECTRIC Co., Ltd.	S-T10 MITSUBISHI ELECTRIC	LV275DI-U4 OKAYA ELECTRIC INDUSTRIES CO.,LTD.
		R1AA04010F	0.3				
		R2AA04003F	0.2				
		R2AA04005F	0.2				
		R2AA04010F	0.3				
		R2AA06010F	0.3				
		R5AA06020H	0.6				
	RS3#02#	R1AA06020F	0.6				
		R1AA06040F	1.0				
		R2AA06020F	0.6				
		R2AA06040F	1.0				
		R2AA06040H	1.0				
		R2AA08020F	0.6				
		R2AA08040F	1.0				
		R5AA06020F	0.6				
		R5AA06040F	1.0				
		R5AA06040H	1.0				
	RS3#03#	R1AA08075V	1.6				
		R1AA10100H	2.3				
		R1AA10150H	3.0				
		R2AA08075F	1.6				
		R2AAB8100H	2.0				
		R2AA10075F	1.7				
		R2AA13050D	1.2				
		R2AA13050H	1.2				
		R2AA13120B	2.2				
		R5AA08075D	1.6				
		R5AA08075F	1.6				
	RS3A05#	R1AA08075F	1.6	Model NF32 15A MITSUBISHI ELECTRIC			
		R1AA10100F	2.3				
		R1AA10150F	3.0				
		R1AA10200H	4.0				
		R1AA10250H	5.0				
		R2AAB8075F	1.6				
		R2AAB8100F	2.3				
		R2AA10100F	2.3				
		R2AA13120D	2.8				
		R2AA13120L	2.8				
		R2AA13180H	3.6				
		R2AA13200L	4.0				
	RS3A07#	R1AA10200F	4.0	Model NF63 30A MITSUBISHI ELECTRIC		S-T21 MITSUBISHI ELECTRIC	
		R1AA10250F	5.0				
		R1AA13300H	6.0				
		R2AA13180D	4.0				
		R2AA13200D	4.0				
		R2AA18350V	6.0				

* "#" will be any number or alphabet.

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

* For Molded Case Circuit Breaker (MCCB)/Noise filter/Magnetic contact, the model required to single axis is shown.

■ 200V AC input

Input voltage	Servo amplifier model number	Servo motor model No.	Main circuit power supply rating (kVA)	Molded Case Circuit Breaker (MCCB)	Noise filter	Magnetic contact	Surge absorber
200V AC	RS3A10#	R1AA13300F	6.0	Model NF63 30A MITSUBISHI ELECTRIC	3SUPF-CH 40M-F OKAYA ELECTRIC INDUSTRIES CO.,LTD.	S-T21 MITSUBISHI ELECTRIC	LV275DI-U4 OKAYA ELECTRIC INDUSTRIES CO.,LTD.
		R1AA13400H	6.7				
		R1AA13500H	8.3				
		R2AA13180D	4.0				
		R2AA13200D	5.0				
		R2AA18350L	6.0				
	RS3A15#	R1AA13400F	6.7	Model NF63 50A MITSUBISHI ELECTRIC		S-T35 MITSUBISHI ELECTRIC	
		R1AA13500F	8.3				
		R2AA18350D	7.0				
		R2AA18450H	7.4				
		R2AA18550R	8.4				
		R2AA22500L	9.6				
		R2AA22700S	12.2	Model NF125 75A MITSUBISHI ELECTRIC		S-T50 MITSUBISHI ELECTRIC	
	RS3A30#	R1AA18550H	9.3	Model NF100 100A MITSUBISHI ELECTRIC	3SUPF-CH 80M-F OKAYA ELECTRIC INDUSTRIES CO.,LTD.	S-T65 MITSUBISHI ELECTRIC	
		R1AA18750L	11.6				
		R1AA1811KR	16.0				
		R1AA1815KB	21.4				
		R2AA18550H	9.3				
		R2AA18750H	11.6				
		R2AA1811KR	16.0				
		R2AA2211KB	16.0				
		R2AA2215KB	21.4				

■ RS3W60#/ 200V AC input

Input voltage	Power unit Amplifier unit	Servo motor model No.	Main circuit power supply rating (kVA)	Molded Case Circuit Breaker (MCCB)	Noise filter	Magnetic contact	Surge absorber
200V AC	RS3PAA270# RS3W60#	R1AA2220KV	28	Model NF125 100A MITSUBISHI ELECTRIC	3SUPF-CH 150MF-F OKAYA ELECTRIC INDUSTRIES CO.,LTD.	S-T65 MITSUBISHI ELECTRIC	LV275DI-U4 OKAYA ELECTRIC INDUSTRIES CO.,LTD.
		R2AA2220KB	28				
		R2AA2225KB	35				
		R2AA2830KV	42	Model NF225 150A MITSUBISHI ELECTRIC		S-T80 MITSUBISHI ELECTRIC	

■ 100V AC input

Input voltage	Servo amplifier model number	Servo motor model No.	Main circuit power supply rating (kVA)	Molded case circuit breaker (MCCB)	Noise filter	Magnetic contact	Surge absorber
100V AC	RS3#01#	R2EA04003F	0.2	Model NF32 10A MITSUBISHI ELECTRIC	HF3030C-SZA SOSHIN ELECTRIC Co., Ltd.	S-T10 MITSUBISHI ELECTRIC	LV275DI-U4 OKAYA ELECTRIC INDUSTRIES CO.,LTD.
	RS3#02#	R1EA04005F	0.2				
		R1EA04010F	0.4				
		R2EA04005F	0.2				
		R2EA04008F	0.4				
		R2EA06010F	0.5				
	RS3#03#	R1EA06020F	0.6				
		R2EA06020F	0.6				

* "#" will be any number or alphabet.

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

* For Molded Case Circuit Breaker (MCCB)/Noise filter/Magnetic contact, the model required to single axis is shown.

4. Wiring

■ 400V AC input

Input voltage	Servo amplifier model number	Servo motor model No.	Main circuit power supply rating (kVA)	Molded Case Circuit Breaker (MCCB)	Noise filter	Magnetic contact	Surge absorber
400 VAC	RS3C02#	R1CA10150V	2.5	BW125JAGU-3P020 Fuji Electric Co., Ltd.	HF3010C-SZA SOSHIN ELECTRIC Co., Ltd.	HS10 Hitachi Industrial Equipment Systems Co., Ltd.	LV480DI-U4 OKAYA ELECTRIC INDUSTRIES CO.,LTD.
		R2CA10075F	1.3				
		R2CA13050D	1.0				
		R2CA13120R	2.0				
		R2CA13180H	2.9				
		R2CA13200L	3.3				
	RS3C05#	R1CA10200V	3.7		HF3020C-SZA SOSHIN ELECTRIC Co., Ltd.	HS20 Hitachi Industrial Equipment Systems Co., Ltd.	
		R1CA13300V	5.2				
		R2CA10100F	1.8				
		R2CA13120F	2.3				
		R2CA13180D	3.3				
		R2CA13200D	3.7				
		R2CA18350L	6.0				
	RS3C10#	R2CA18350D	6.0	BW125JAGU-3P030 Fuji Electric Co., Ltd.	HF3030C-SZA SOSHIN ELECTRIC Co., Ltd.		
		R2CA18450H	7.6				
		R2CA18550R	9.5				
	RS3C15#	R1CA18550H	7.0	BW125JAGU-3P050 Fuji Electric Co., Ltd.	HF3100C-SZC SOSHIN ELECTRIC Co., Ltd.	HS50 Hitachi Industrial Equipment Systems Co., Ltd.	
		R1CA18750L	9.5				
		R1CA1811KR	13.8				
		R1CA1815KB	18.2				
		R2CA18550H	7.0				
		R2CA18750H	9.4				
		R2CA2211KB	13.6				
		R2CA2215KV	18.4				
	RS3C30#	R1CA2220KV	24.2	BW125JAGU-3P100 Fuji Electric Co., Ltd.		H100C Hitachi Industrial Equipment Systems Co., Ltd.	
		R2CA2220KV	27.5				
		R2CA2230KV	36.2				

Input voltage	Power unit/Amplifier unit model number	Servo motor model number	Main circuit power supply rating (kVA)	Molded Case Circuit Breaker (MCCB)	Noise filter	Magnetic contact	Surge absorber
400 VAC	RS3PAC550 RS3D80#	R2CA3255KB	90	EW400EAG-3P250 30mA Fuji Electric Co., Ltd. NV400-CW 3P 250A 30mA Mitsubishi Electric	HF3200C-SZB-4DEDE SOSHIN ELECTRIC Co., Ltd.	H400C Hitachi Industrial Equipment Systems Co., Ltd.	LV480DI-U4 OKAYA ELECTRIC INDUSTRIES CO.,LTD.

* "#" will be any number or alphabet.

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

* For Molded Case Circuit Breaker (MCCB)/Noise filter/Magnetic contact, the model required to single axis is shown.

4.7.2 Power supply capacity and peripherals list (Linear motor)

■ 200V AC input

Input voltage	Servo amplifier model number	Linear motor model number	Main circuit power supply rating (kVA)	Molded Case Circuit Breaker (MCCB)	Noise filter	Magnetic contact	Surge absorber
200V AC	RS3A03L	DS030C1N2	1.4	Model NF32 10A MITSUBISHI ELECTRIC	HF3030C-SZA SOSHIN ELECTRIC	S-T10 MITSUBISHI ELECTRIC	LV275DI-U4 OKAYA ELECTRIC INDUSTRIES CO.,LTD.
		DS050C1N2	1.4				
		DS075C1N2	1.5				
		DS045CC1AN	1.4				
	RS3A05L	DS030C2N2	2.7	Model NF32 15A MITSUBISHI ELECTRIC			
		DS050C2N2	2.7				
		DS075C2N2	3.0				
		DD030C1Y4	2.7				
		DS100C1N2	3.2				
		DS150C1N2	3.2				
	RS3A07L	DS030C3N2	3.5	Model NF63 30A MITSUBISHI ELECTRIC	3SUPF-CH 40M-F OKAYA ELECTRIC INDUSTRIES CO.,LTD.	S-T21 MITSUBISHI ELECTRIC	
		DS050C3N2	3.5				
		DS075C3N2	3.8				
		DD030C2Y4	4.5				
		DD050C1Y2	4.4				
		DD075C1Y2	4.8				
		DD045CB4AN	3.2				
		DD035CC2AN	3.0				
	RS3A10L	DS030C3N2	3.5				
		DS050C3N2	3.5				
		DS075C3N2	3.8				
		DS100C2N2	5.5				
		DS150C2N2	5.5				
		DD030C2Y4	4.5				
		DD030C3Y4	6.8	Model NF63 50A MITSUBISHI ELECTRIC		S-T35 MITSUBISHI ELECTRIC	
		DD050C1Y2	4.4	Model NF63 30A MITSUBISHI ELECTRIC		S-T21 MITSUBISHI ELECTRIC	
		DD075C1Y2	4.8				
		DD045CB4AN	3.2	Model NF63 50A MITSUBISHI ELECTRIC		S-T35 MITSUBISHI ELECTRIC	
	RS3A15L	DS100C3N2	8.2				
		DS150C3N2	8.2				
		DD050C2Y2	8.8				
		DD075C2Y2	9.5				
	RS3A30L	DD075C3Y2	12.2	Model NF125 75A MITSUBISHI ELECTRIC	3SUPF-CH 80M-F OKAYA ELECTRIC INDUSTRIES CO.,LTD.	S-T65 MITSUBISHI ELECTRIC	
		DD075C4Y2	13.2	Model NF125 100A MITSUBISHI ELECTRIC			
		DD030C2Y4	17.5				

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

* For Molded Case Circuit Breaker (MCCB)/Noise filter/Magnetic contact, the model required to single axis is shown.

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5

Linear motor

In this chapter, each items for linear motor operations are explained.
For explanation of how to use with rotary motor combination,
refer the instruction manual for functions, M0012315.

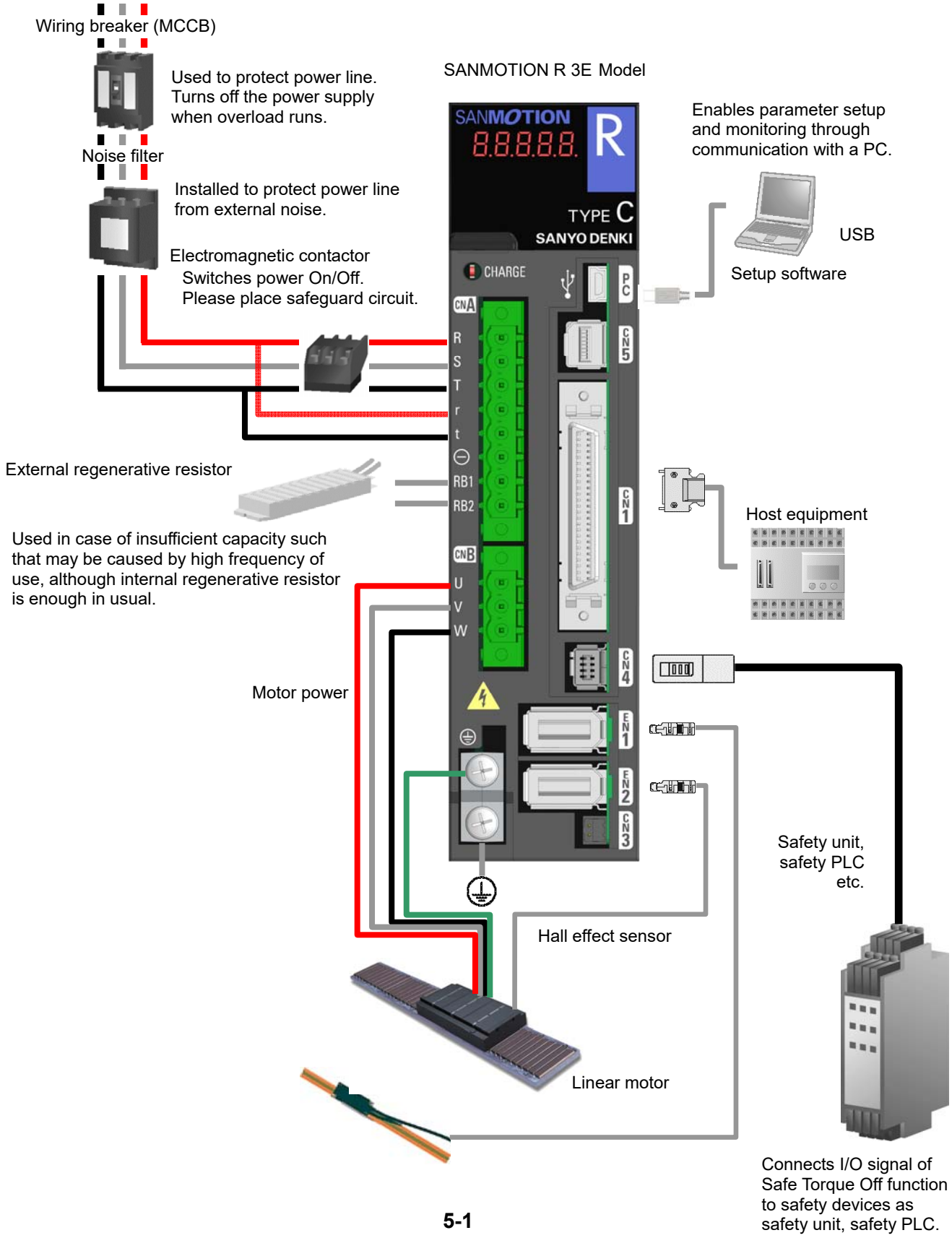
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5. Linear motor

5.1 Illustration of system components

■ RS3A01/02/03/05

T S R



5.2 Wiring of linear encoder

5.2.1 EN1, EN2 signal names and pin numbers

■ EN1 linear encoder (Incremental differential output)

Servo Amplifier EN1 Terminal No.	Signal name	DS/DD series linear motor	Description	Remarks Note 1)
1	5V	Wiring depending on linear encoder specification. As note, please prepare linear encoder at user side.	Power supply Note 3)	Twisted pair
2	SG		Power supply common Note 4)	
3	5V		Power supply Note 3)	Twisted pair
4	SG		Power supply common Note 4)	
5	B		B-phase signal output	Twisted pair
6	/B			
7	A		A-phase signal output	Twisted pair
8	/A			
9	Z		Z-phase signal output	Twisted pair
10	/Z			
Note 2)	Ground		Shield	-

Note 1) Use an exterior covering shielded cable and perform twisted-pair wiring.
Note 2) Connect jacketed and shielded wire to metallic case (ground) on EN1 and ground on linear encoder.
Note 3) Power supply for linear encoder of servo amplifier can supply 5.1 to 5.5 VDC, 300mA. Please prepare external power supply if the specifications for power supply needed for linear encoder you use are different.
Note 4) Make sure to connect power supply common.
Note 5) For amplifier model number "RS3****2***", EN2 is able to use as linear encoder.
Hall effect sensor cannot use. CS decision method selection shall be "Magnetic pole position estimation" or "Forced setting".

■ EN1 absolute encoder (EnDat2.2)

Servo Amplifier EN1 Terminal No.	Signal name	DS/DD series linear motor	Description	Remarks Note 1)
1	5V	Wiring depending on linear encoder specification. As note, please prepare linear encoder at user side.	Power supply Note 3)	Twisted pair
2	SG		Power supply common Note 4)	
3	5V		Power supply Note 3)	Twisted pair
4	SG		Power supply common Note 4)	
5	CLOCK+		Serial clock signal	Twisted pair
6	CLOCK-			
7	DATA+		Serial data signal	Twisted pair
8	DATA-			
9	-		-	-
10	-			
Note 2)	Ground		Shield	-

Note 1) Use an exterior covering shielded cable and perform twisted-pair wiring.
Note 2) Connect jacketed and shielded wire to metallic case (ground) on EN1 and ground on linear encoder.
Note 3) Power supply for linear encoder of servo amplifier can supply 5.1 to 5.5 VDC, 300mA. Please prepare external power supply if the specifications for power supply needed for linear encoder you use are different.
Note 4) Make sure to connect power supply common.

5. Linear motor

■ EN2 hall effect sensor (Line driver output)

Servo Amplifier EN2 Terminal No.	Signal name	DS/DD series linear motor Lead wire spec	Description	Remarks Note 1)
1	5V	Red	Power supply	Twisted pair
2	SG	Black	Power supply common Note 3)	
3	5V	—	Power supply	Twisted pair
4	SG	—	Power supply common Note 3)	
5	S2	Green	V-phase signal output	Twisted pair
6	/S2	Purple		
7	S1	Blue	U-phase signal output	Twisted pair
8	/S1	Brown		
9	S3	White	W-phase signal output	Twisted pair
10	/S3	Yellow		
Note 2)	Ground	Ground	Shield	—

Note 1) Use an exterior covering shielded cable and perform twisted-pair wiring.
Note 2) Connect jacketed and shielded wire to metallic case (ground) on EN1 and ground on linear encoder.
Note 3) Make sure to connect power supply common.

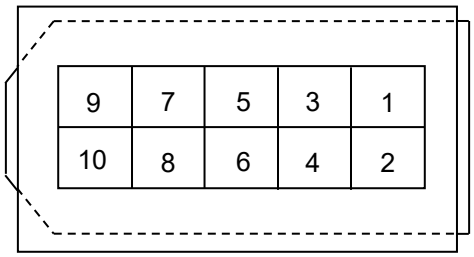
■ EN2 Hall effect sensor (Open-collector output)

Servo Amplifier EN2 Terminal No.	Signal name	DS/DD series linear motor Lead wire spec	Description	Remarks Note 1)
1	5V	Grey	Power supply Note 3)	Twisted pair
2	SG	White	Power supply common Note 4)	
3	5V	—	Power supply Note 3)	Twisted pair
4	SG	—	Power supply common Note 4)	
5	S2	Yellow	V-phase signal output	—
6	—	—	—	NC
7	S1	Green	U-phase signal output	—
8	—	—	—	NC
9	S3	Brown	W-phase signal output	—
10	—	—	—	NC
Note 2)	Ground	Ground	Shield	—

Note 1) Use an exterior covering shielded cable and perform twisted-pair wiring.
Note 2) Connect jacketed and shielded wire to metallic case (ground) on EN1 and ground on linear encoder.
Note 3) Make sure to connect power supply common.

5.2.2 EN1, EN2 pin assignment

■ EN1, EN2 54593-1016 (soldered side)



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

■ Connector model number (Molex Japan LLC)

	Model Number	Applicable wire size	Applicable cable outer diameter
Plug connector	54593-1016	Up to AWG18 (for terminal No.: 1, 2, 9, 10) Up to AWG22 (for terminal No.: 3 to 8)	Up to ϕ1.6 mm (for terminal No.: 1, 2, 9, 10) Up to ϕ1.2 mm (for terminal No.: 3 to 8)
Plug cable cover set	54599-1016	—	ϕ7 to ϕ9

5.2.3 Recommended encoder cable specification

Shielded cables with multiple twisted pairs

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

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

5.2.4 Encoder cable length

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

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

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

5. Linear motor

5.3 Linear motor control-related parameters

Positioning function built-in servo amplifier is set as rotary motor application at factory setting.
Please check that the servo amplifier you bought is applicable with the linear motor/encoder to be used, by SANMOTION MOTOR Setup.
After checking main circuit power voltage/amplifier capacity/encoder type etc, set as linear motor application.

* Refer another document M0010842 for operation detail of the setup software "SANMOTION MOTOR Setup".

[Check 1: Check for main power supply voltage]

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

Main circuit power supply voltage code	Main circuit power supply voltage
00	200 V
01	100 V

[Check 2: Check for amplifier capacity]

It shows the output current capacity of this servo amplifier.
Please confirm that the amplifier capacity code is match to combined motor.
Amplifier capacity code is shown in the system information.

Amplifier capacity code	Amplifier capacity	Servo amplifier model number
0D	10A	RS3A01A####
0B	20A	RS3A02A####
0A	30A	RS3A03A####
09	50A	RS3A05A####
08	75A	RS3A07A####
07	100A	RS3A10A####
06	150A	RS3A15A####
04	300A	RS3A30A####

[Check 3: Check for encoder type]

It shows the type of this servo amplifier applicable encoder. Please confirm that the linear encoder to be used is applicable with this servo amplifier. Encoder type code is shown in the system information.

Servo amplifier model number	Encoder type code	Linear encoder connectable with EN1	Linear encoder or Hall effect sensor connectable with EN2
RS3###A0###	00	Absolute encoder	Not applicable
RS3###A2###	02	Absolute encoder	Incremental encoder
RS3###A8###	08	Incremental encoder	Not applicable
RS3###AA###	0A	Incremental encoder	Hall effect sensor (Differential signal output type)
RS3###AB###	0B	Incremental encoder	Hall effect sensor (Open-collector output type)

* In case of the encoder type code 02, linear encoder is able to connect and use at EN2 even if incremental type.

5.3 Linear motor control-related parameters

5.3.1 Setting of system parameters

Below shows basic setting for use of linear motor.

[Step 1: Motor structure selection setting]

Set 01 (linear motor) to motor structure code.

Group	ID	Motor structure code	Motor structure
System	0E	01	Linear

* Perform control power cycle. It changes to linear motor application after power cycle.

* For the project of SANMOTION MOTOR Setup connected to servo amplifier set as rotary motor application, it cannot connect the servo amplifier as linear motor application. Please make new project for linear motor application.

[Step 2: Linear motor setting]

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

[Check 4: Rechecking the linear motor setting]

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

[Step 3: Linear encoder setting]

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

Target linear encoder	Applicable encoder type by servo amplifier model number				Reference
	RS3xxxx0xxx	RS3xxxx2xxx	RS3xxxx8xxx	RS3xxxxAxxx RS3xxxxBxxx	
Absolute encoder	○	○	×	×	1)
Incremental encoder	×	○	○	○	2)

* ○: Combination available, ×: Combination not available

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

■ Motor encoder input selection

Select the connector for connecting linear encoder. Must set "00: EN1".

Group	ID	Selection		Description
System	10	00	EN1	Uses EN1 as motor encoder input connector.
		01	EN2	Uses EN2 as motor encoder input connector.

* RS3xxxx0xxx allows "00:EN1" only.

■ EN1 encoder type

Select the encoder type that will be connected to EN1.

Group	ID	Selection		Description
System	11	22	EnDat_ABS	Battery-less absolute encoder (EnDat)

5. Linear motor

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

Group	ID	Selection		Description
System	13	01	2Mbps	2Mbps
		03	4Mbps	4Mbps

* Normally, please use with default setting (01:2Mbps).

■ Absolute encoder resolution
Select the encoder resolution.

Group	ID	Selection		Description	
System	15	80	10000_P/mm	10000P/mm	(100 nm)
		81	20000_P/mm	20000P/mm	(50 nm)
		82	100000_P/mm	100000P/mm	(10 nm)
		83	200000_P/mm	200000P/mm	(5 nm)
		84	1000000_P/mm	1000000P/mm	(1 nm)

* For a positioning function built-in servo amplifier, there are restrictions of GroupA ID3B System division (131,072 or less) and GroupA ID3C User division (131,072 or less).
Please use the absolute encoder settable as 131,072 or less.
* To use high resolution absolute encoder, the procedure such as lower a command resolution will be required. Please contact us for use high resolution absolute encoder.

■ CS decision method selection
Selects the decision method for CS position of linear motor.

Group	ID	Selection		Description
System	18	00	Type1	Hall effect sensor (Incremental encoder) or Encoder absolute position (Absolute encoder)
		01	Type2	Magnetic pole position estimation
		02	Type3	Forced setting

* Alarm (AL.E6) will be detected if "02:Type3" is selected.

■ CS offset
Sets an offset value between magnetic pole position and absolute position of serial encoder, by electric angle conversion.

Group	ID	Setting range	Unit
System	1A	0 to 359	degree

* Set an offset value which is estimated by the magnetic pole position estimation.
Setting is required in case below.
- At a system setup (Initial startup)
- At a servo amplifier replacement
- At a linear motor replacement
- At a linear encoder (scale or head) replacement or mounting change
- In case of occurring shift of position relation between linear motor and encoder

2) Incremental encoder
(Applicable amplifier model number: RS3xxxx2xxx,RS3xxxx8xxx, RS3xxxxAxxx, RS3xxxx Bxxx)

■ Motor encoder input selection
Select the connector for connecting linear encoder.
- ◆ Select "01:EN2" if "RS3xxxx2xxx" is used.
- ◆ Select "00:EN1" if "RS3xxxx8xxx, RS3xxxxAxxx or RS3xxxxBxxx" is used.

Group	ID	Selection		Description
System	10	00	EN1	Uses EN1 as motor encoder input connector.
		01	EN2	Uses EN2 as motor encoder input connector.

* RS3xxxx8xxx, RS3xxxxAxxx and RS3xxxxBxxx allow "00:EN1" only.

■ EN1 encoder type
Select the encoder type that will be connected to EN1.
Please select incremental encoder type that will be used.
- ◆ For RS3xxxx2xxx, select encoder type at "EN2 encoder type".
- ◆ For RS3xxxx8xxx, RS3xxxxAxxx and RS3xxxxBxxx select encoder type at this parameter.

Group	ID	Selection		Description
System	11	80	Pulse	Wire-saving incremental encoder
		81	Pulse_with_CS	Incremental encoder with CS
		82	Pulse_without_CS	Incremental encoder

* "81:Pulse_with_CS" is not able to select if RS3xxxx8xxx is used.

■ EN2 encoder type
Select the encoder type that will be connected to EN2.
Please select incremental encoder type that will be used.
- ◆ For RS3xxxx2xxx, select encoder type at this parameter.
- ◆ For RS3xxxx8xxx, RS3xxxxAxxx and RS3xxxxBxxx, this parameter is not shown because its setting is not necessary.

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

■ CS decision method selection
Selects the decision method for CS position of linear motor.
- ◆ Selects just when "82:Pulse_without_CS" is set to the encoder type.

Group	ID	Selection		Description
System	18	00	Type1	Hall effect sensor (Incremental encoder) or Encoder absolute position (Absolute encoder)
		01	Type2	Magnetic pole position estimation
		02	Type3	Forced setting

* Select "01:Type1" if "80:Pulse" or "81:Pulse_with_CS" is set to the encoder type. Alarm (AL.E6) will be detected if except of "01:Type1" is selected.

■ CS normalization method selection
Selects the normalization method for CS position of linear motor.

Group	ID	Selection		Description
System	19	01	U_phase	Hall effect sensor S1-phase (U-phase)
		02	none	Without normalization
		03	Z_phase_Type2	Z-phase

* Select "02:none" or "03:Z_phase_Type2" if "80:Pulse" or "82:Pulse_without_CS" is set to the encoder type. Alarm (AL.E6) will be detected if "01:U_phase" is selected.
* Do not select "03:Z_phase_Type2" if Z-phase is detected periodically but that cycle is not fit to magnetic pole pitch of linear motor.

■ CS offset
Sets an offset value between U-phase electric angle 0 (deg) and S1-phase hall effect sensor output signal edge, by electric angle conversion.
◆ Set just when "81:Pulse_with_CS" is set to the encoder type.
◆ For the CS offset value of each motors, please refer the CS offset value list in "2.1.4 Linear motor move direction (DD, DS, DT series)".

Group	ID	Setting range	Unit
System	1A	0 to 359	degree

* Set an U-phase electric angle at power on if "02:Type3" is set to the CS decision method selection.

■ Z-phase CS normalization offset
Sets an offset value between U-phase electric angle 0 (deg) and Z-phase signal output position, by electric angle conversion.
◆ Sets just when "03:Z_phase_Type2" is set to the CS normalization method selection.

Group	ID	Setting range	Unit
System	1B	0 to 359	degree

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

Group	ID	Setting range	Unit
System	17	20 to 50,000 (4-multiplied)	P/mm

* For a positioning function built-in servo amplifier, there are restrictions of GroupA ID3B System division (131,072 or less) and GroupA ID3C User division (131,072 or less).
Please use the incremental encoder settable as 131,072 or less with 4-multiplied value.

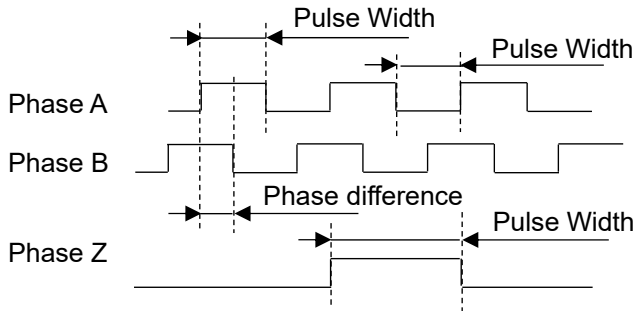
[Check 5: Check for position loop control/position loop encoder selection**]**
Selects a control method of position loop and an encoder used to position control.
Confirm the set value is below.

Group	ID	Selection		Description
System	20	00	Motor_Enc	Semi closed control/Motor encoder

5.3 Linear motor control-related parameters

5.3.2 Setting of linear encoder

■ GroupC “Encoder related setting”

<table>
<tr><th>ID</th><th colspan="4">Description</th></tr>
<tr><td rowspan="2">00</td><td>Motor Incremental Encoder Digital Filter
[ENFIL]</td><td>Setting range
00 to 07</td><td>Unit
—</td><td>Default
01:220ns</td></tr>
<tr><td colspan="4">This parameter is settable only when using incremental encoder.
Sets Digital filter to motor Incremental encoder.
Pulse lower than the set value is eliminated as noise when noise superposition occurs in encoder signals. Consider Encoder resolution and Maximum velocity of the linear motor in operation when selecting value. Set the value roughly less than 1/4 of the Encoder pulse width at Maximum rotation velocity.
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>110ns</td><td>Minimum pulse width = 110 ns (Minimum phase difference = 37.5 ns)</td></tr>
<tr><td>01</td><td>220ns</td><td>Minimum pulse width = 220 ns</td></tr>
<tr><td>02</td><td>440ns</td><td>Minimum pulse width = 440 ns</td></tr>
<tr><td>03</td><td>880ns</td><td>Minimum pulse width = 880 ns</td></tr>
<tr><td>04</td><td>75ns</td><td>Minimum pulse width = 75 ns (Minimum phase difference = 37.5 ns)</td></tr>
<tr><td>05</td><td>150ns</td><td>Minimum pulse width = 150 ns</td></tr>
<tr><td>06</td><td>300ns</td><td>Minimum pulse width = 300 ns</td></tr>
<tr><td>07</td><td>600ns</td><td>Minimum pulse width = 600 ns</td></tr>
</table>


</td></tr>
<tr><td rowspan="2">09</td><td>Linear Encoder Polarity Selection
[ENCDIR] "Perform a control power cycle after setting"</td><td>Setting range
00 to 01</td><td>Unit
—</td><td>Default
00:Standard</td></tr>
<tr><td colspan="4">Selects a count polarity of linear encoder against linear motor move direction.
When mover is moved to motor power line connection side (positive direction), set "00: Standard" if monitor ID10 increments or set "01:Reversed" if monitor ID10 decrements.
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>Standard</td><td>Not reverse encoder operating direction</td></tr>
<tr><td>01</td><td>Reversed</td><td>Reverse encoder operating direction</td></tr>
</table>
</td></tr>
</table>

5. Linear motor

5.3.3 Setting of magnetic pole position parameters

■ GroupC “Encoder related settings”

<table>
<tr><th>ID</th><th>Description</th></tr>
<tr><td>01</td><td>
Hall effect sensor digital filter
[EX-ENFIL]
<table>
<tr><th>Setting range</th><th>Unit</th><th>Default</th></tr>
<tr><td>00 to 07</td><td>—</td><td>01:220ns</td></tr>
</table>
The parameter settable when just using Hall effect sensor.
Sets digital filter of Hall effect sensor input signal.
When noises are superimposed on Hall effect sensor signal, pulse under the set value will be removed as noise. Normally, please use with default setting.
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>110ns</td><td>Minimum pulse width = 110 ns (Minimum phase difference = 37.5 ns)</td></tr>
<tr><td>01</td><td>220ns</td><td>Minimum pulse width = 220 ns</td></tr>
<tr><td>02</td><td>440ns</td><td>Minimum pulse width = 440 ns</td></tr>
<tr><td>03</td><td>880ns</td><td>Minimum pulse width = 880 ns</td></tr>
<tr><td>04</td><td>75ns</td><td>Minimum pulse width = 75 ns (Minimum phase difference = 37.5 ns)</td></tr>
<tr><td>05</td><td>150ns</td><td>Minimum pulse width = 150 ns</td></tr>
<tr><td>06</td><td>300ns</td><td>Minimum pulse width = 300 ns</td></tr>
<tr><td>07</td><td>600ns</td><td>Minimum pulse width = 600 ns</td></tr>
</table>
</td></tr>
<tr><td>02</td><td>
Hall effect sensor polarity selection
[EX-ENPOL] "Perform a control power cycle after setting"
<table>
<tr><th>Setting range</th><th>Unit</th><th>Default</th></tr>
<tr><td>00 to 07</td><td>—</td><td>00:Type1</td></tr>
</table>
The parameter settable when just using Hall effect sensor.

Sets polarity of Hall effect sensor signal.
<table>
<tr><th colspan="2">Selection</th><th colspan="3">Description</th></tr>
<tr><td>00</td><td>Type1</td><td>EX-Z/ not reversed</td><td>EX-B/ not reversed</td><td>EX-A/ not reversed</td></tr>
<tr><td>01</td><td>Type2</td><td>EX-Z/ not reversed</td><td>EX-B/ not reversed</td><td>EX-A/ reversed</td></tr>
<tr><td>02</td><td>Type3</td><td>EX-Z/ not reversed</td><td>EX-B/ reversed</td><td>EX-A/ not reversed</td></tr>
<tr><td>03</td><td>Type4</td><td>EX-Z/ not reversed</td><td>EX-B/ reversed</td><td>EX-A/ reversed</td></tr>
<tr><td>04</td><td>Type5</td><td>EX-Z/ reversed</td><td>EX-B/ not reversed</td><td>EX-A/ not reversed</td></tr>
<tr><td>05</td><td>Type6</td><td>EX-Z/ reversed</td><td>EX-B/ not reversed</td><td>EX-A/ reversed</td></tr>
<tr><td>06</td><td>Type7</td><td>EX-Z/ reversed</td><td>EX-B/ reversed</td><td>EX-A/ not reversed</td></tr>
<tr><td>07</td><td>Type8</td><td>EX-Z/ reversed</td><td>EX-B/ reversed</td><td>EX-A/ reversed</td></tr>
</table>
</td></tr>
</table>

5.3 Linear motor control-related parameters

－GroupC－

ID	Description			
0A	Magnetic pole position estimation mode selection [CSETMD] "Perform a control power cycle after setting"	Setting range	Unit	Default
		00 to 01	—	00:Normal

Sets the condition performing magnetic pole position estimation.

Selection		Description
00	Normal	Performs when valid condition of magnetic pole position estimation function (Group9 ID1D) established.
01	Auto_Pon	Performs once automatically only after turning on the main circuit power.

Caution for "00：Normal" selection

* Performs when valid condition of magnetic pole position estimation function (Group9 ID1D) established.
  However for interface type [F: MODBUS], it can assign the function to general input CONT1 to CONT7. For interface type [C: I/O], it cannot assign the function to general input.

Caution for "01：Auto_Pon" selection

* Automatic performing does not start if alarm/emergency stop etc is detected at main circuit power turning on, or magnetic pole position estimation valid condition is established. Automatic performing will start soon after eliminating those conditions.
* Alarm 44 or DF will be issued if magnetic pole position estimation cannot complete normal.
* Even if after automatic performing completion, magnetic pole position estimation performs again if the effective condition is satisfied or performed via the digital operator / the setup software.

■ GroupD "Supporting function related settings"

ID	Description			
01	Excitation command frequency set value [EMPFREQ]	Setting range	Unit	Default
		30 to 70	Hz	50
	Sets the frequency of force command for detecting magnetic pole position.			

■ Group9 "Function enabling condition settings"

ID	Name	Setting range	Default	Functions-enabled maximum input time
1D	Magnetic pole position estimation function [CSET]	00 to 29	00:Always_Disable	20 ms

ID	Description
1D	Magnetic pole position estimation function [CSET]
	■ Magnetic pole position estimation is able to perform by enabling the magnetic pole position estimation function [CSET].

5.3.4 Setting of broken-wire mask level at encoder connector

■ GroupC “Encoder related settings”

<table>
<tr><th>ID</th><th>Description</th></tr>
<tr><td rowspan="2">10</td><td>
<table>
<tr><td>Broken-wire mask level at Encoder connector 1
[DE1MSKLVL]</td><td>Setting range
0 to 65535</td><td>Unit
kHz</td><td>Default
0</td></tr>
</table>
Sets the encoder pulse frequency (1-multiplied) which masks the detection of "Encoder Connector Disconnection 1 (AL.81)" if the linear encoder is incremental type and connect to encoder connector 1 (EN1).
For high resolution incremental encoder, "Encoder Connector Disconnection 1 (AL.81)" might detect at high frequency range depending on its specs. In that case, please change this setting value.
"Encoder Connector Disconnection 1 (AL.81)" does not detect while encoder frequency exceeds this setting value.
"Encoder Connector Disconnection 1 (AL.81)" is detected at all frequency if 0 [kHz] is set.
</td></tr>
<tr><td>11</td><td>
<table>
<tr><td>Broken-wire mask level at Encoder connector 2
[DE3MSKLVL]</td><td>Setting range
0 to 65535</td><td>Unit
kHz</td><td>Default
0</td></tr>
</table>
Sets the encoder pulse frequency (1-multiplied) which masks the detection of "Encoder Connector Disconnection 2 (AL.83)" if the linear encoder is incremental type or Hall effect sensor and connect to encoder connector 2 (EN2).
For high resolution incremental encoder, "Encoder Connector Disconnection 2 (AL.83)" might detected at high frequency range depending on its specs. In that case, please change this setting value.
"Encoder Connector Disconnection 2 (AL.83)" does not detect while encoder frequency exceeds this setting value.
"Encoder Connector Disconnection 2 (AL.83)" is detected at all frequency if 0 [kHz] is set.
</td></tr>
</table>

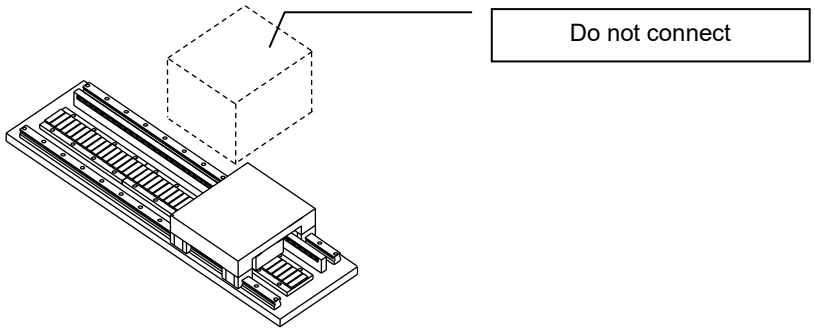
5.4 Test operation

5.4.1 Check of installation and wiring

Check the installation / wiring of servo amplifier and linear motor.

[Step 1: installation]

- Set the servo amplifier and linear motor by following "3. Installation".
- Remove a load on the stage, and keep free from a load.



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

- Please wire the servo amplifier, linear motor and host unit by following "4. Wiring".
  As note, do not connect I/O signals to the amplifier after wiring.
  For interface type [C: I/O], do not connect CN1.
  For interface type [F: MODBUS], do not connect CN2.
- Supply power. Check that the display of upper of servo amplifier front face does not show alarm code. If alarm code is shown, please take corrective action by following "8.3 Trouble shooting when alarm activated".
- If "≡" is not shown at 7-segment LED even if main power turns on, please take corrective action by following " 8.1 Trouble shooting".

5.4.2 Preparation before operation

Before operation, adjusting a relation between move direction and encoder polarity, and a magnetic pole position.

1) For absolute encoder

[Step 1: Move direction check]

■ Move linear motor to the direction where power line lead pulled out (positive direction), through monitoring the monitor function ID33 "Absolute encoder PS data monitor".
When the monitoring data decreased, please set "01: Reversed" to GroupC ID09 "Linear encoder polarity selection".

[Step 2: CS offset value setting]

■ Set "01:Type2 (Magnetic pole position estimation)" to System parameter ID18 "CS decision method". And make control power cycle.

■ Supply main circuit power, and perform the magnetic pole position estimation.

* Refer the section "5.4.3 Magnetic pole position estimation method" for detail.

■ Confirm the monitor function ID37 "CS offset monitor", and then set the indicated data to System parameter ID1A "CS offset value".

* For the "CS offset value", please set the average of "CS offset value" which are picked up from 3 points (center and both end of linear motor stroke) or more through the magnetic pole position estimation.

■ Set "00:Type1 (Encoder absolute position)" to System parameter ID18 "CS decision method". And make control power cycle.

2) For incremental encoder

[Step 1: Move direction check]

■ Move linear motor to the direction where power line lead pulled out, through monitoring the monitor function ID10 "Present position monitor".
When the monitoring data decreased, please set "01: Reversed" to GroupC ID09 "Linear encoder polarity selection".

[Step 2: Magnetic pole position estimation]

■ Supply main circuit power, and perform the magnetic pole position estimation.

* Perform only when "01:Type2 (Magnetic pole position estimation)" is set to System parameter ID18 "CS decision method".

* Refer the section "5.4.3 Magnetic pole position estimation method" for detail.

5.4.3 Magnetic pole position estimation

Magnetic pole position estimation is able to perform by methods below.

1) Perform through general input operation (Available with interface type [F: MODBUS] only)
   - ◆ Set "0x00: Normal" to GroupC ID0A "Magnetic pole position estimation mode".
   - ◆ Set the condition for enabling the function to Group9 ID1D "Magnetic pole position estimation function".
   - ◆ Supply main circuit power, and make valid the selected condition.

2) Perform automatically when main circuit power is supplied
   - ◆ Set "01: Auto" to GroupC ID0A "Magnetic pole position estimation mode".
   - ◆ Supply main circuit power.
     Performs the magnetic pole position estimation automatically.

* Pay attention that the linear motor moves automatically after supplying main circuit power.
* Even if after automatic performing completion, magnetic pole position estimation is able to perform again if the effective condition is satisfied or the digital operator / the setup software perform the function.

3) Perform through the setup software
   Select the magnetic pole position estimation from the menu in the test operation. See "7.4 Magnetic pole position estimation" in another document: M0010842, for operation method of the setup software.

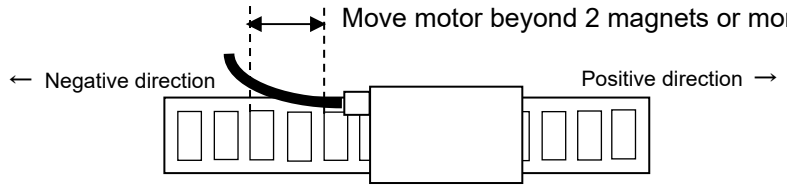
* For the magnetic pole position estimation, forward/reverse force command is performed and pole position is estimated by detecting the acceleration. Force command will be larger automatically if the acceleration is small.
* Pay attention to motor movement because motor moves slightly during the function operation.
* Maximum 5 seconds will be required for the magnetic pole position detection.
* Please stop the magnetic pole position estimation immediately if problem occurred on the motion.
* Magnetic pole position is not able to detect correct if GroupD ID01 "Excitation command frequency set value" is near to a resonance frequency of mechanical system. In this case, lower the excitation command frequency set value.
* This function is not able to use to the machine which is vertical axis or getting a large external force.
* For the machine which is combined multi axes as tandem structure, magnetic pole position may not detect correct if magnetic pole position estimations are performed at multi axes at the same time. Must perform magnetic pole position estimation singly. Also, the other axes which are not performed magnetic pole position estimation make servo off.

5.4.4 Check of operation

[Step 1: JOG operation]

■ Run the JOG operation without a load on the stage.

■ Check whether the linear motor is able to move to positive and negative direction full stroke.



* The positive direction means the direction where motor power line lead pulled out.
* Please perform operation with safety speed.

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

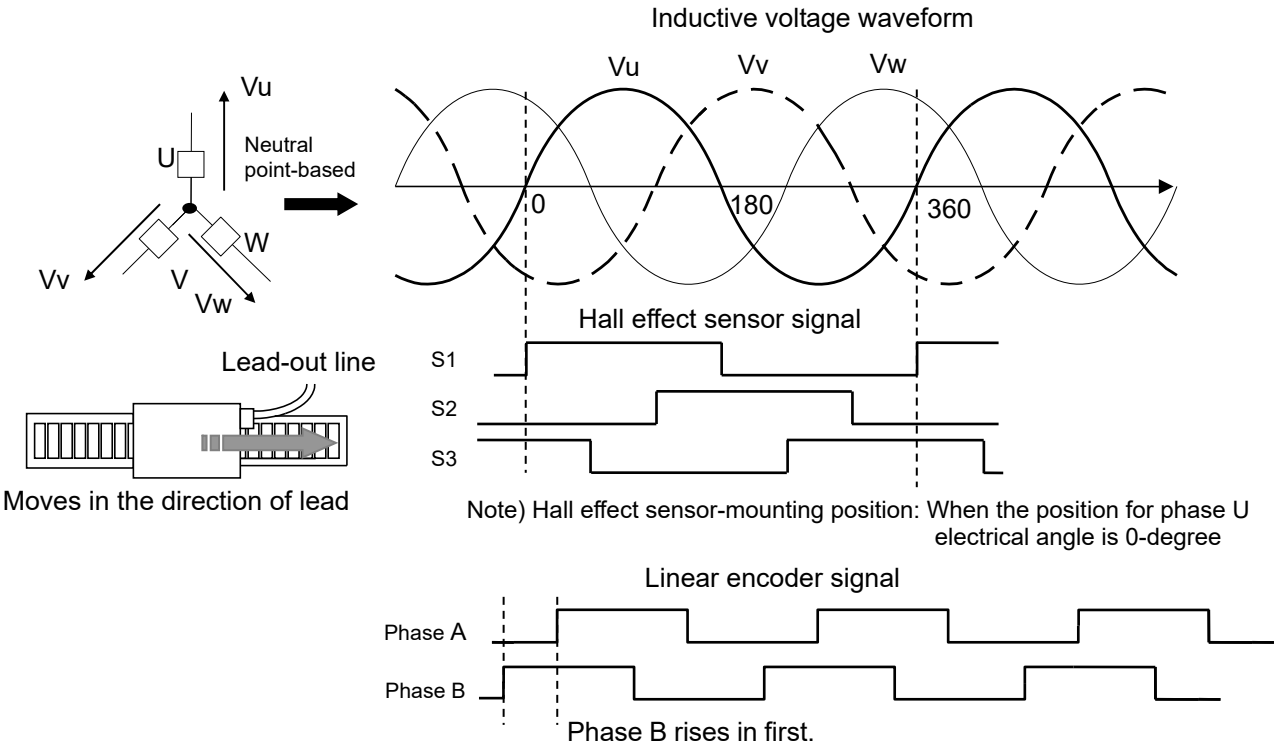
5.5 Precautions

5.5.1 When you use SANYO DENKI servo amplifier with other manufacturer linear motor combined.

■ When you use our servo amplifier with other manufacturer linear motor combined, we provide “servo amplifier parameter (motor parameter file)” needed to drive the motor based on motor constants you provide to us. In this case, we do not conduct any combination tests of servo amplifier and the linear motor, so we assume no responsibility whatsoever for any combination operations and characteristics of the motor. In addition, we assume no responsibility whatsoever for any failures caused by the linear motor.

5.5.2 Setting of parameters to combine amplifier and motor

■ Set "motor parameter" for the liner motor you use.
■ Maximum moving rate shall be limited by resolution of the linear encoder you use. When using linear motor at maximum moving rate, set the value of minimum pulse width or less to GroupC ID00 "Motor incremental encoder digital filter setting value: [ENFIL]". (factory setting is default set value [minimum pulse width =220ns])
■ When connection of phase sequence or polarity of motor power line, linear encoder signal line, and hall sensor signal line (when you use) is not correct, there may be at a risk of loss of control. Perform wiring so that the relation between each phase of voltage induced by motor and each signal shall be as indicated in the figure below when moving linear motor in the direction of leading out a power line from linear motor core.



- "Linear encoder resolution" is set to 1μm (multiplier ratio 1:4) 1000P/mm at factory setting. So select and set the linear encoder resolution you use from "System parameter ID17".
- When using "motor thermal", connect motor thermal wire to any of CONT1 to CONT7, and then setting condition "Group 9, ID40 or Index 0x20F8-3 EXT-E" of the connected "CONT*" to "external trip function".
- When using Hall effect sensor, set the mounting position of Hall effect sensor to phase U electrical angle to System parameter ID1A “CS offset".

5.5.3 Automatic Magnetic Pole Position Estimation Function

- After power on, if moving to preparation status of magnetic pole position estimation (3 seven-segment LEDs blink) because of an alarm/emergency stop etc., start running automatic execution after deactivating alarm/emergency stop.
- At the time of moving to preparation status of magnetic pole position estimation, when the function of magnetic pole position estimation is set in any other mode than automatic mode, the automatic execution does not start running. To start running automatic execution, temporarily clear off the requests from other than automatic mode.
- When the magnetic pole position estimation does not shut down normally, alarm 44 or DF will be issued.
- After completion of automatic execution, the magnetic pole position estimation is possible by either the valid condition of pointing function of magnetic pole position, or magnetic pole position estimation of assistance function.

6

Servo Tuning

In this chapter, tuning of servo amplifier are explained.

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6. Servo Tuning

6.1 Servo tuning functions and basic adjustment procedure

To operate the servo motor (and machine) using the servo amplifier, adjustments of the servo gain and its control system is necessary. Generally, the higher setting value of the servo gain increases the machine response. However, if the servo gain is too high, in a lower rigidity machine, vibration may result and the machine response will not increase. The servo gain and its control system need to be appropriately adjusted according to the operating servo motor and the mechanical system, and this adjustment method is called Servo tuning.
Following is an explanation of the Servo tuning procedure:

6.1.1 Servo tuning functions

■ Adaptive notch filter function
Realizing vibration suppression operation of machine vibration by estimating resonant frequency of machine system during servo motor operation and making feedback it to the control system.

■ Automatic Tuning function
- ◆ Automatic Tuning
  Servo amplifier estimates load inertia moment ratio during operation, and then automatically adjusts servo gain and filter frequency on a real-time basis. This is the most basic tuning method.

- ◆ Automatic Tuning [JRAT Manual Setting]
  The servo amplifier does not estimate the Load inertia moment ratio. Servo gain and filter frequency are adjusted automatically corresponding to the load inertia moment ratio and the responses that are already set. This method is used when the Load inertia moment ratio could not be estimated correctly with auto-tuning.

■ Manual Tuning
Set all parameters, such as Load inertia moment ratio, servo gain, filter frequency, etc. manually. This method is used when characteristics during auto-tuning are insufficient.

■ The function of making servo gain higher
- ◆ Velocity loop phase lead compensation
  This is the function which compensate phase delay of velocity control system, to get higher velocity loop proportional gain.

- ◆ Position loop phase lead compensation
  This is the function which compensate phase delay of position control system, to get higher position loop proportional gain.

- ◆ Torque feed forward compensation
  This is the function which improve response for the command of control system by applying feed forward compensation to torque control system.

■ Model following control
Model following control is a control method that ensures a higher response by composing a model control system including the mechanical system in a servo amplifier to operate the actual servo motor in order to follow the model control system.

■ Auto notch filter tuning function
Notch filter is able to suppress high frequency resonance depends on a mechanical system coupling or stiffness. "Auto notch filter tuning" is able to search mechanical system resonant frequency easily by rotating servo motor in a short time.

6.1 Servo tuning functions and basic adjustment procedure

■ Vibration suppression function

◆ Model-following vibration suppression
Positioning settle time and response of machine are able to improve by using model control system to suppress machine stand vibration.

◆ Auto FF Vibration Suppression Frequency Tuning, FF vibration suppression control
FF Vibration Suppression control is able to suppress low frequency resonance like machine end vibration. "Auto FF Vibration Suppression Frequency Tuning" is able to set FF Vibration Suppression Frequency easily by rotating servo motor in a short time.

◆ CP vibration suppression control
This function is suppressing machine stand vibration though at the CP (Continuous Path) control like cutting work of machine tool.

◆ Minor vibration suppression
This function is suppressing minor vibration against velocity feedback during servo motor stop.

■ Disturbance impact suppression function

◆ High order integral control
Uses when desired to suppress disturbance impact into control system, by decreasing the velocity loop integral time constant. This function compensates phase delay against feedback of velocity integral control system.

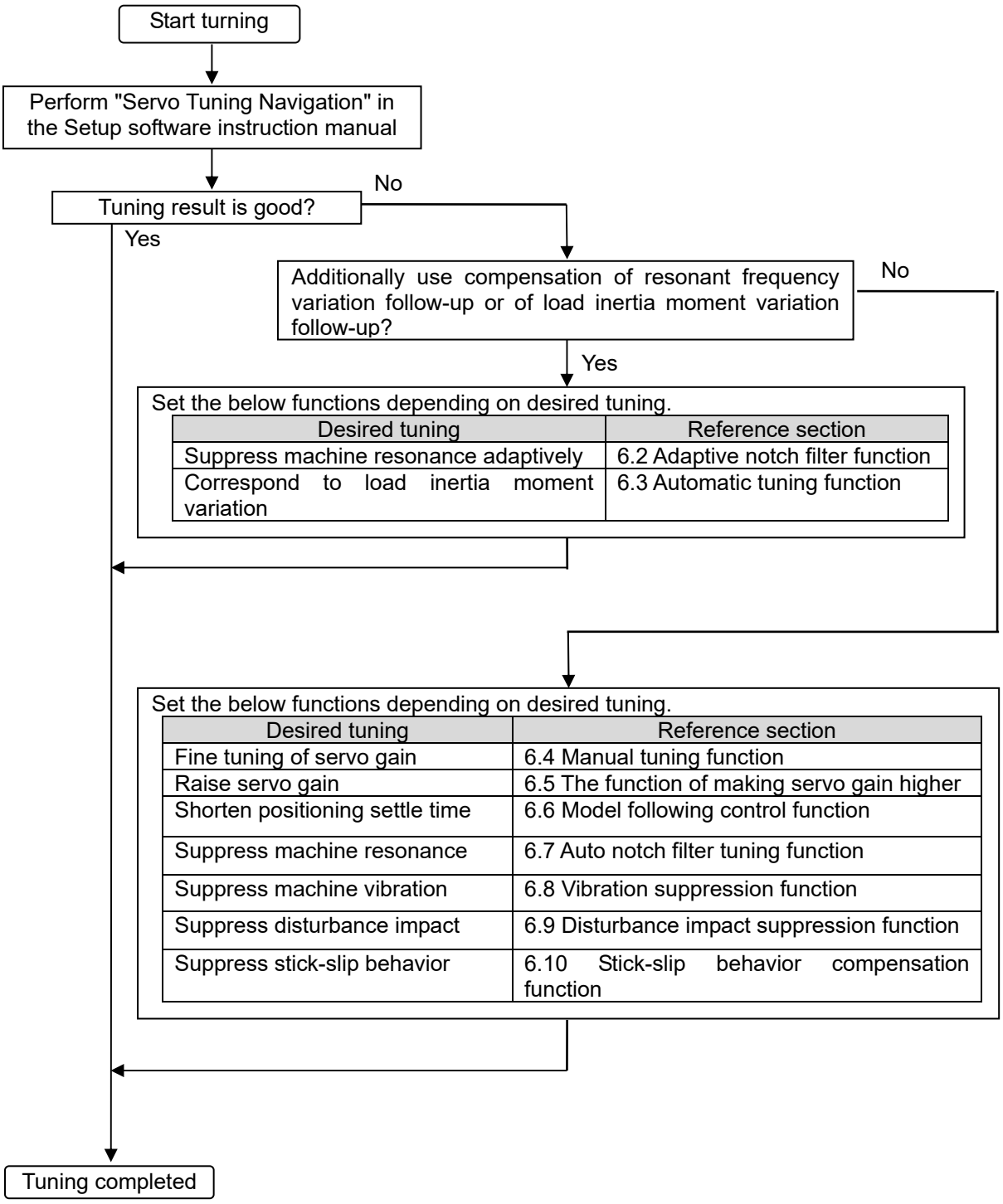
◆ Disturbance observer function
This function is suppressing impact of load torque by estimating the load torque internally and adding compensation against load torque to a torque command, if external load torque is applied to a servo motor.

■ Stick-slip behavior compensation function
This function is suppressing stick-slip behavior occurring by machine system friction etc.

6. Servo Tuning

6.1.2 Tuning method selection procedure

The selection procedure is displayed in the following chart:



* Combinations of some functions are not allowed.

6.2 Adaptive notch filter function

Vibration suppression operation which adapt to frequency variation of mechanical vibration is realized by estimating mechanical resonant frequency in motor operation and reflecting to the control system.
It can suppress dispersion and variation of mechanical resonance frequency.

■ How to use

- ◆ Check a resonant frequency of mechanical system. (For use of the system analysis, see "10.3 System analysis" in setup software instruction manual: M0010842.)
- ◆ Set the value which have margin and consider dispersion and variation of mechanical resonance frequency from system analysis result, into "Adaptive notch filter frequency upper limit E", "Adaptive notch filter frequency lower limit E", Group0 ID35, 36. Adaptive notch filter will work between upper/lower limit which set.
- ◆ This function will be valid when "01_Adp_Filter_Enable" is set to "Group0 ID34: Adaptive notch filter function E [ADNFE]".
- ◆ Adaptive notch filter starts an operation with getting the value of "Group2 ID28: Torque Command Notch Filter E [TCNFILE]" as the initial value.
- ◆ Tuning result of Adaptive notch filter is saved to "Torque Command Notch Filter E [TCNFILE]" every 30 minutes automatically.
- ◆ Set "01_No_Saving" to "Group0 ID37: Adaptive notch filter E auto saving [ADNSVE]" if auto-save is not desired.

* This function is not able to estimate resonant frequency at below conditions.
(Corrective action: Adaptive notch filter is not able to use, so use notch filter with fixed value.)

- ◆ Resonance frequency is 3 times or less of “velocity loop proportional gain [KVP]".
- ◆ Resonance amplitude is small, or there is no impact of resonance to motor speed caused by low “velocity loop proportional gain [KVP]".
- ◆ Mechanical system has multiple resonance frequency.
- ◆ Position command resolution is low.
(Corrective action: Set "Group1 ID00: Position Command Smoothing Constant [PCSMT]".)

* This function cannot use with the tandem operation.

6. Servo Tuning

6.3 Auto-tuning function

6.3.1 Selection of tuning method

■ Parameter list
Using parameters below for auto-tuning mode.

◆ Tuning mode

Group	ID	Selection		Contents
0	00	00	AutoTun	Auto-tuning
		01	AutoTun_JRAT-Fix	Auto-tuning [JRAT manual setting]
		02	ManualTun	Manual Tuning

◆ Auto-Tuning characteristic

Group	ID	Selection		Contents
0	01	00	Positioning1	Positioning Control 1 (General Purpose)
		01	Positioning2	Positioning Control 2 (High Response)
		02	Positioning3	Positioning Control 3 (High Response, FFGN Manual Setting)
		03	Positioning4	Positioning Control 4 (High Response, Horizontal Axis Limited)
		04	Positioning5	Positioning Control 5 (High Response, Horizontal Axis Limited, FFGN Manual Setting)
		05	Trajectory1	Trajectory Control 1
		06	Trajectory2	Trajectory Control 2 (KP, FFGN Manual Setting)

◆ Auto-Tuning Response

Group	ID	Setting range	Unit
0	02	1 to 40	–

◆ Auto-Tuning Automatic Parameter Saving

Group	ID	Selection		Contents
0	03	00	Auto_Saving	Automatically Saves in JRAT1
		01	No_Saving	Automatic Saving is Invalid

◆ Auto-Tuning characteristic compatible mode

Group	ID	Selection		Contents
0	04	00	Disable	Invalid
		01	Enable	Valid (RS2 Compatible)

■ Explanation for each parameter
Details of each parameter are shown below.

◆ General Parameter Group0 Auto-Tuning

ID	Contents
00	Tuning Mode [TUNMODE]

Selection	Contents
00: AutoTun	Auto-Tuning

- ◆ Servo amplifier estimates Load inertia moment ratio of the machine or equipment during real time and automatically tunes the servo gain.
- ◆ Parameters which is tuned automatically by servo amplifier, is vary depends on selection of Group0 ID00 "Auto-Tuning Characteristic [ATCHA]".
- ◆ Servo amplifier estimates the Load inertia moment ratio at the time of acceleration/deceleration. Therefore, for operations only with excessively long acceleration/deceleration time constants or with only low torque in low velocity, this mode cannot be used. Also, for operations with high disturbance torque or with major mechanical clearance, this mode cannot be used. Use in [01:_AutoTun_JRAT-Fix Automatic Tuning [JRAT Manual Setting].

Selection	Contents
01: AutoTun_JRAT-Fix	Auto-Tuning [JRAT manual setting]

- ◆ Based on Group1 ID14 "Load inertia moment ratio 1 [JRAT1], which has to be set, the servo amplifier automatically tunes to the best servo gain.
- ◆ Parameters for the servo amplifier to automatically tune will vary depending on "Auto-Tuning characteristic [ATCHA]".

Selection	Contents
02: ManualTun	Manual Tuning

- ◆ 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.

ID	Contents
01	Auto-Tuning Characteristic [ATCHA]

■ Auto-Tuning Characteristic to fit the mechanical requirements and movements are provided. Parameters that can be adjusted vary depending on each auto-tuning characteristic. Select the parameters based on the situation.

■ [Positioning control (Positioning)]
Positioning control is a control method used to reach the servo motor quickly to target a position from the present position by disregarding the trajectory between the positions. Select this mode when positioning PTP (point to point) is necessary.

■ [Trajectory control (Trajectory)]
Trajectory control is a method used to move the servo motor to the target position from the present position while considering the trajectory between the positions. Select this mode when the Position command corresponding trajectory control is needed such as in processing work.

Selection		Contents
00	Positioning1	Positioning Control 1 (General Purpose)

◆ Select for general positioning purposes.
◆ Parameters shown in table at section 6.3.2 cannot be adjusted manually.

Selection		Contents
01	Positioning2	Positioning Control 2 (High Response)

◆ Select for high response positioning.
◆ Parameters shown in table at section 6.3.2 cannot be adjusted manually.

Selection		Contents
02	Positioning3	Positioning control 3 (High Response, FFGN Manual Setting)

◆ Select this mode to adjust Group1 ID06 "Velocity Feed Forward Gain [FFGN]" manually.
◆ The following parameter is able to adjust manually, if not use model following (vibration suppression) control:

Group	ID	Symbol	Contents
1	06	FFGN	Velocity Feed Forward Gain

◆ The following parameter is able to adjust manually, if using model following (vibration suppression) control:

Group	ID	Symbol	Contents
3	02	MFFGN	Model velocity feed forward gain

Selection		Contents
03	Positioning4	Positioning control 4 (High Response, Horizontal Axis Limited)

◆ Select this mode when the machine movement is on a horizontal axis and receives no disturbing influence from external sources.
◆ Positioning time may be shortened compared to “Positioning Control 2”.
◆ Parameters shown in table at section 6.3.2 cannot be adjusted manually.

ID	Contents
01	Auto-Tuning Characteristic [ATCHA]

Selection		Contents
04	Positioning5	Positioning control 5 (for high response, horizontal axis only, FFGN manual setting)

- ◆ Select this mode when the machine movement is on a horizontal axis and receives no disturbing influence from external sources and when you want to adjust Group1 id06 "Velocity Feed Forward Gain [FFGN]" manually.
- ◆ Positioning time may be shortened compared to “Positioning control 3”.
- ◆ The following parameter is able to adjust manually, if not use model following (vibration suppression) control:

Group	ID	Symbol	Contents
1	06	FFGN	Velocity Feed Forward Gain

- ◆ The following parameter is able to adjust manually, if using model following (vibration suppression) control:

Group	ID	Symbol	Contents
3	02	MFFGN	Model velocity feed forward gain

Selection		Contents
05	Trajectory1	Trajectory Control 1

- ◆ Select this mode for single axis use. The response of each axis can be different.
- ◆ Parameters shown in table 6.3.2 cannot be adjusted manually.

Selection		Contents
06	Trajectory2	Trajectory Control 2 (KP, FFGN Manual Setting)

- ◆ Select this mode when you need equal responses from multiple axes, respectively. Adjust Group1 ID02 "Position Loop Proportional Gain 1 [KP1]”, Group1 ID06 “Velocity Feed Forward Gain [FFGN]".
- ◆ The following parameter is able to adjust manually, if not use model following (vibration suppression) control:

Group	ID	Symbol	Contents
1	02	KP1	Position Loop Proportional Gain 1
1	06	FFGN	Velocity Feed Forward Gain

- ◆ The following parameter is able to adjust manually, if using model following (vibration suppression) control:

Group	ID	Symbol	Contents
1	02	KP1	Position Loop Proportional Gain 1
3	02	MFFGN	Model velocity feed forward gain

ID	Contents
02	Auto-Tuning Response [ATRES] ■ Set this parameter when "00: Auto Tun" or "01: AutoTun_JRAT-Fix" in Group0 ID00 are used. ■ As the setting value rises, the response increases. Set the value suitable for equipment rigidity. ■ This does not function when "02: ManualTun" of the Tuning mode is selected.
03	Auto-Tuning Automatic Parameter Saving [ATSAVE] ■ "Load inertia moment ratio" obtained from the result of auto-tuning is automatically saved in Group1 ID14 "Load Inertia Moment Ratio 1 [JRAT1]" every 30 minutes. ■ The select value is effective when auto-tuning is used. This does not function when "01: AutoTun_JRAT-Fix" of the Tuning mode is selected.

6.3.2 Automatically adjusted parameters in auto-tuning

These parameters will not reflect on servo motor movements by changing or overriding those values.
However, some of them can be adjusted manually depending on selected Group0 ID00 "Tuning mode [TUNMODE]" and Group0 ID01 "Auto-Tuning Characteristic [ATCHA].

■ At the standard position control, below parameters are adjusted automatically.

◆ General parameters Group1 “Basic control parameter settings”

ID	Symbol	Name	Remarks
02	KP1	Position Loop Proportional Gain 1	Note 1)
06	FFGN	Velocity Feed Forward Gain	Note 1), Note 2)
08	TRCPGN	Higher Tracking Control Position Compensation Gain	
12	KVP1	Velocity Loop Proportional Gain 1	
13	TVI1	Velocity Loop Integral Time Constant 1	
14	JRAT1	Load Inertia Moment Ratio 1	Note 3)
1C	AFBK	Acceleration Feedback Gain	
1E	TRCVGN	Higher Tracking Control Velocity Compensation Gain	
20	TCFIL1	Torque Command Filter 1	

◆ General parameters Group8 "Control system settings"

ID	Symbol	Name	Remarks
43	LOWV	Low Speed Range	Note 4)

◆ General parameters Group9 "Function enabling condition settings"

ID	Symbol	Name
19	PLPCON	Position Loop Proportional Control Switching Function
27	VLPCON	Velocity Loop Proportional Control Switching Function

Note 1) Manual setting is available on "06: Trajectory Control 2 (KP,FFGN Manual Setting)" is selected at the Auto-Tuning Characteristic [ATCHA].
Note 2) Manual setting is available on "02: Positioning Control 3 (High Response, FFGN Manual Setting)" or "04: Positioning Control 5 (High Response, Horizontal Axis Limited, FFGN Manual Setting)" are selected at the Auto-Tuning Characteristic [ATCHA].
Note 3) Manual setting is available on "01: Positioning Control 2 (High Response)" is selected at the Auto-Tuning Characteristic [ATCHA].
Note 4) Manual setting is available on "00: Positioning Control 1 (General Purpose)", "01: Positioning Control 2 (High Response)", "02: Positioning Control 3 (High Response, FFGN Manual Setting)", "05: Trajectory Control 1" or "06: Trajectory Control 2 (KP,FFGN Manual Setting)" are selected at the Auto-Tuning Characteristic [ATCHA].

6. Servo Tuning

■ At the model following control, below parameters are adjusted automatically.

◆ General parameters Group1 “Basic control parameter settings”

ID	Symbol	Name	Remarks
02	KP1	Position Loop Proportional Gain 1	Note 1)
08	TRCPGN	Higher Tracking Control Position Compensation Gain	
12	KVP1	Velocity Loop Proportional Gain 1	
13	TVI1	Velocity Loop Integral Time Constant 1	
14	JRAT1	Load Inertia Moment Ratio 1	Note 3)
1C	AFBK	Acceleration Feedback Gain	
1E	TRCVGN	Higher Tracking Control Velocity Compensation Gain	
20	TCFIL1	Torque Command Filter 1	

◆ General parameters Group3 "Model following control settings"

ID	Symbol	Name	Remarks
00	KM1	Model Control Gain 1	
02	MFFGN	Model velocity feed forward gain	Note 1), Note 2)

◆ General parameters Group8 "Control system settings"

ID	Symbol	Name	Remarks
43	LOWV	Low Speed Range	Note 4)

◆ General parameters Group9 "Function enabling condition settings"

ID	Symbol	Name
19	PLPCON	Position Loop Proportional Control Switching Function
27	VLPCON	Velocity Loop Proportional Control Switching Function

Note 1) Manual setting is available on "06: Trajectory2 (KP,FFGN Manual Setting)" is selected at the Auto-Tuning Characteristic [ATCHA].

Note 2) Manual setting is available on "00: Positioning1 (General Purpose)", "02: Positioning3 (High Response, FFGN Manual Setting)" or "04: Positioning5 (High Response, Horizontal Axis Limited, FFGN Manual Setting)" are selected at the Auto-Tuning Characteristic [ATCHA].

Note 3) Manual setting is available on "01: Positioning2 (High Response)" is selected at the Auto-Tuning Characteristic [ATCHA].

Note 4) Manual setting is available on "00: Positioning1 (General Purpose)", "01: Positioning2 (High Response)", "02: Positioning3 (High Response, FFGN Manual Setting)", "05: Trajectory1" or "06: Trajectory2 (KP,FFGN Manual Setting)" are selected at the Auto-Tuning Characteristic [ATCHA].

6.3.3 Adjustable main parameters during auto-tuning

■ The following main parameters are adjustable during auto-tuning:

◆ General parameters Group1 “Basic control parameter settings”

ID	Symbol	Name
00	PCSMT	Position Command Smoothing Constant
01	PCFIL	Position Command Filter
07	FFFIL	Velocity Feed Forward Filter
10	VCFIL	Velocity Command Filter
11	VDFIL	Velocity Feedback Filter
19	TFFK	Torque Feed Forward Gain
1A	TFFAVE	Torque feed forward averaging
1B	TFFOUT	Torque Feed Forward output selection
21	TCFILOR	Torque Command Filter Order
30	DFBCG	Dual position feedback gain
31	DFBFIL	Dual position feedback filter

◆ General parameters Group2 "FF vibration suppression control/ Notch filter/ Disturbance observer settings"

ID	Symbol	Name
00	SUPFRQA1	FF Vibration Suppression Frequency A1
01	SUPLVA	FF Vibration Suppression Level Selection A
02	SUPFRQB1	FF Vibration Suppression Frequency B1
03	SUPCRB	FF Vibration Suppression Level Selection B
10	VCNFIL	Velocity Command Notch Filter
20	TCNFILA	Torque Command Notch Filter A
21	TCNFPA	TCNFILA, Low Frequency Phase Delay Improvement
22	TCNFILB	Torque Command Notch Filter B
23	TCNFDB	TCNFILB, Depth Selection
24	TCNFILC	Torque Command Notch Filter C
25	TCNFDC	TCNFILC, Depth Selection
26	TCNFILD	Torque Command Notch Filter D
27	TCNFDD	TCNFILD, Depth Selection
28	TCNFILE	Torque Command Notch Filter E
29	TCNFDE	TCNFILE, Depth Selection
50	CPVSFQ	CP vibration suppression control frequency
51	CPVSLV	CP vibration suppression control level
52	CPVSSH	CP vibration suppression control characteristics selection
60	FBHPLS	Minor vibration suppression pulse compensation value
61	FBHTIM	Minor vibration suppression pulse compensation frequency

◆ General parameters Group4 “Gain switching control/Vibration suppression frequency switching settings”

ID	Symbol	Name
40	SUPFRQA2	FF Vibration Suppression Frequency A2
41	SUPFRQA3	FF Vibration Suppression Frequency A3
42	SUPFRQA4	FF Vibration Suppression Frequency A4
43	SUPFRQB2	FF Vibration Suppression Frequency B2
44	SUPFRQB3	FF Vibration Suppression Frequency B3
45	SUPFRQB4	FF Vibration Suppression Frequency B4

◆ General parameters Group5 “High setting control setting”

ID	Symbol	Name
00	CVFIL	Command Velocity Low-pass Filter
01	CVTH	Command Velocity Threshold
02	ACCCO	Acceleration Compensation
03	DECCO	Deceleration Compensation

6.3.4 Unavailable functions during auto-tuning

■ The following functions CANNOT be used during auto-tuning:

◆ General parameters Group9 “Function enabling condition settings”

ID	Symbol	Name
13	GC1	Gain Switching Condition 1
14	GC2	Gain Switching Condition 2
19	PLPCON	Position Loop Proportional Control Switching Function
27	VLPCON	Velocity Loop Proportional Control Switching Function
33	OBS	Disturbance Observer Function

* "Disturbance Observer" is not able to use together with Auto-Tuning. If desired to use Auto-Tuning, make Group9 ID33 "Disturbance Observer Function [OBS]" invalid.

◆ General parameters Group1 “Basic control parameter settings”

ID	Symbol	Name
08	TRCPGN	Higher Tracking Control Position Compensation Gain
1C	AFBK	Acceleration Feedback Gain
1E	TRCVGN	Higher Tracking Control Velocity Compensation Gain

◆ General parameters Group8 "Control system settings"

ID	Symbol	Name
43	LOWV	Low Speed Range

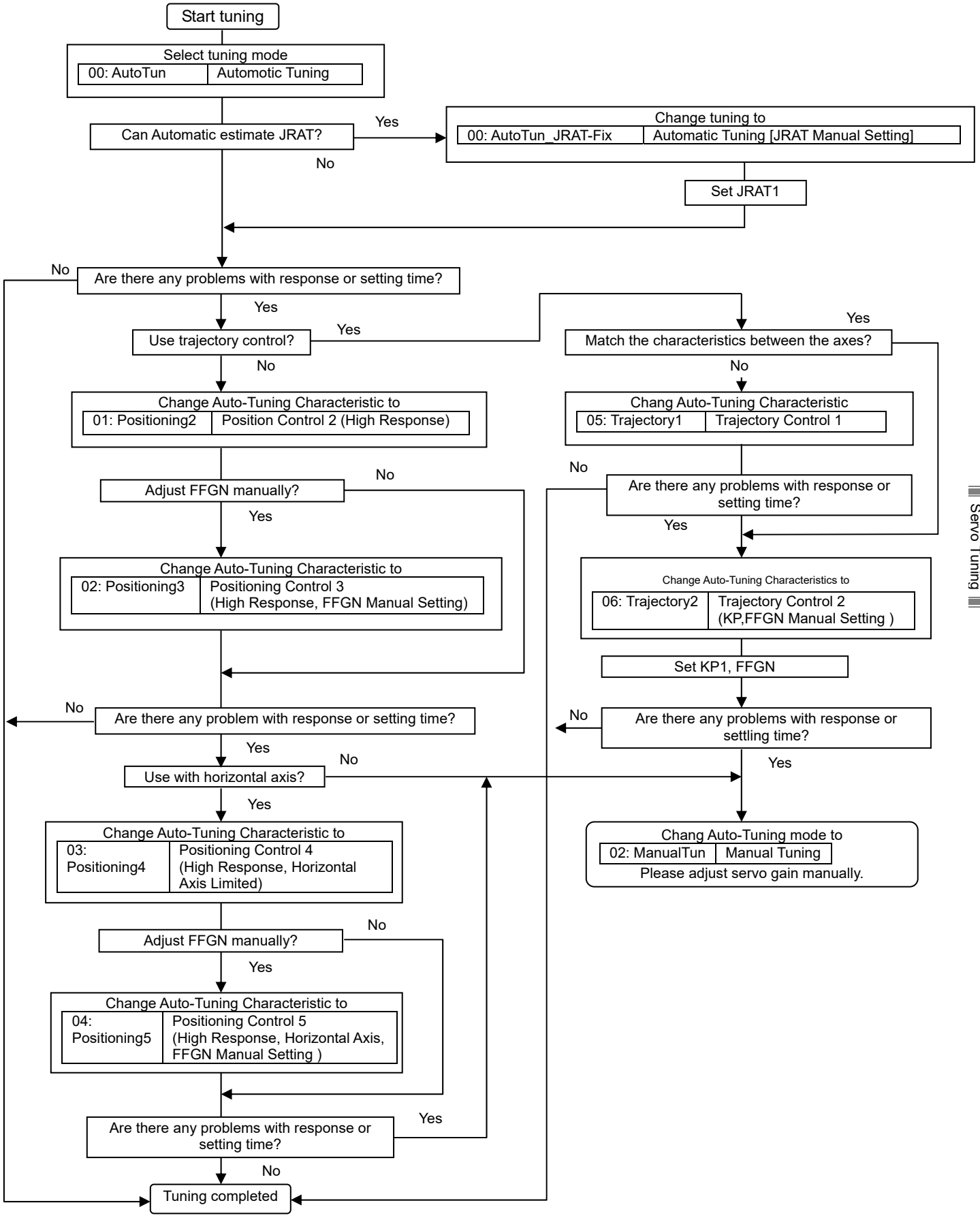
* "Low Speed Range [LOWV]" is able to use when "00: Positioning Control 1 (General Purpose)", "01: Positioning Control 2 (High Response)", "02: Positioning Control 3 (High Response, FFGN Manual Setting)", "05: Trajectory Control 1" or "06: Trajectory Control 2 (KP,FFGN Manual Setting)" are selected at the Auto-Tuning Characteristic [ATCHA].

◆ General parameters Group3 “Model following control settings”

ID	Symbol	Name
06	ANRFRQ1	Model Control Anti-resonance Frequency 1
07	RESFRQ1	Model Control Resonance Frequency 1

* “Model following control” is able to use when "01: AutoTun_JRAT-Fix" is set to Group0 ID00 "Tuning mode". If "00: AutoTun" is set, select"00: Standard" or "01: Model1" to sytem parameter ID07 "Position control selection".

6.3.5 Auto-tuning characteristic selection



6. Servo Tuning

6.3.6 Adjustment method for auto-tuning

Auto-tuning is a function where the servo amplifier automatically tunes to the best servo gain in real time.

Procedure 1	■ Select "00: AutoTun Auto-Tuning" at Group0 ID00 "Tuning mode [TUNMODE]" to estimate load inertia moment ratio by servo amplifier on a real-time basis, and then automatically adjust servo gain. Select "01:AutoTun_JRAT-Fix Automatic Tuning (JRAT Manual Setting)" to automatically adjust optimum servo gain based on manually set value of Group1 ID14 "Load Inertia Moment Ratio 1 [JRAT1]".
Procedure 2	■ After setting "Tuning mode [TUNMODE]", select Group0 ID00 "Auto-Tuning Characteristic [ATCHA]" for the machine or equipment.
Procedure 3	■ Next, boot the servo motor and adjust Group0 ID02 "Auto-Tuning Response [ATRES]" according to equipment rigidity. ◆ Set "Auto-Tuning Response [ATRES]" at a low value initially and allow the machine to work about 10 times or more by commanding from upper controller. ◆ When response is low and the positioning settling time is slow, after machine movement, try to improve the response and settling times by increasing "Auto-Tuning Response [ATRES]" gradually. ◆ If increasing the response has caused the machine to get vibration, lower the value of the "Auto-Tuning Response [ATRES]" slightly. * If the machine has not developed vibration, enable the Vibration suppression by setting the Notch filter and /or FF Vibration suppression frequency. Set the filter frequency to suppress mechanical vibration by using "6.7 Auto notch filter tuning function" and/or "6.8.2 Auto FF Vibration Suppression Frequency Tuning". * Tuning methods are the same in "01:AutoTun_JRAT-Fix Automatic Tuning (JRAT Manual Setting)".

6.3.7 Monitoring servo gain adjustment parameters

Parameters automatically adjusted when using auto-tuning can be monitored with the Digital Operator and the Setup software. Refer to "7. Digital operator" for use of the Digital Operator.

ID	Symbol	Name	Unit
50	JRAT MON	Load Inertia Moment Ratio monitor	%
51	MKP MON	Model Control Gain monitor	1/s
52	KP MON	Position Loop Proportional Gain monitor	1/s
54	KVP MON	Velocity Loop Proportional Gain monitor	Hz
55	TVI MON	Velocity Loop Integral Time Constant monitor	ms
56	TCFIL MON	Torque Command Filter monitor	Hz

6.3.8 Manual tuning method using auto-tuning results

Result of auto-tuning can be stored in block and used to perform auto-tuning.
Refer to "7. Digital operator" for use of the Digital Operator.
For the Setup software, perform "Auto-tuning >> Auto-tuning result saving".

■ Saving parameters

◆ General parameters Group1 “Basic control parameter setting”

ID	Symbol	Name	Unit
02	KP1	Position Loop Proportional Gain 1	1/s
06	FFGN	Velocity Feed Forward Gain	%
08	TRCPGN	Higher Tracking Control Position Compensation Gain	%
12	KVP1	Velocity Loop Proportional Gain 1	Hz
13	TVI1	Velocity Loop Integral Time Constant 1	ms
14	JRAT1	Load Inertia Moment Ratio 1	%
1C	AFBK	Acceleration Feedback Gain	%
1E	TRCVGN	Higher Tracking Control Velocity Compensation Gain	%
20	TCFIL1	Torque Command Filter 1	Hz

◆ General parameters Group3 “Model following control settings”

ID	Symbol	Name	Unit
00	KM1	Model Control Gain 1	1/s
02	MFFGN	Model velocity feed forward gain	%

◆ General parameters Group8 "Control system settings"

ID	Symbol	Name	Unit
43	LOWV	Low Speed Range	min^{-1}

◆ General parameters Group9 "Function enabling condition settings"

ID	Symbol	Name	Unit
19	PLPCON	Position Loop Proportional Control Switching Function	—
27	VLPCON	Velocity Loop Proportional Control Switching Function	—

6. Servo Tuning

6.4 Manual tuning function

All gain is adjustable manually using manual tuning mode when characteristics in auto-tuning are insufficient. Select "02: ManualTun Manual Tuning" at Group0 ID00 "Tuning mode [TUNMODE]".

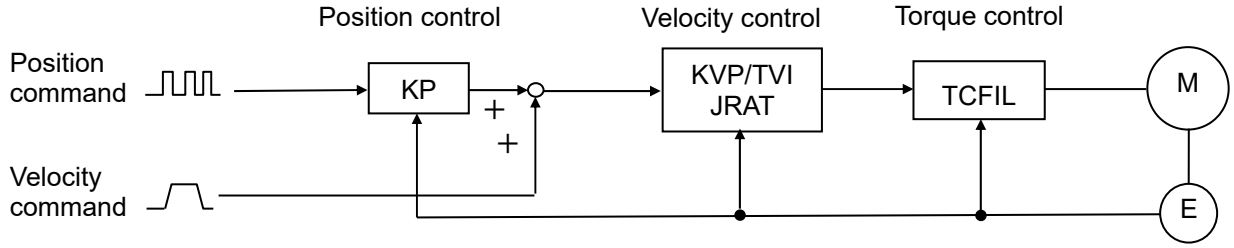
■ Setting parameters

◆ General parameters Group0 ID00 “Tuning Mode [TUNMODE]”

Selection		Contents
02	ManualTun	Manual Tuning

6.4.1 Servo system configuration and servo adjustment parameters

The servo system is consist from "Position, Velocity and Torque control", and the control system response should be "Position control < Velocity control < Torque control". If this structure is compromised, the system will be unstable and it might result in low response, vibration or oscillation.



See below explanation for each servo parameter

■ Group1 ID00 "Position Command Smoothing Constant [PCSMT]"
This moving low-pass filter smoothes the position command pulse. Sets time constants. The position command pulse will become smoother by setting this parameter when the electronic gear ratio is high or position command pulse is coarse.

■ Group1 ID01 "Position Command Filter [PCFIL]"
When the position command resolution is low, set this parameter to suppress the ripples contained in the position command. A larger value of this parameter will cause a greater ripple suppressing effect; however, delay will be increased.

◆ When Group1 ID1E "Higher Tracking Control Position Compensation Gain [TRCPGN]" is set to other than 0%, this parameter is automatically set.

■ Group1 ID02 "Position Loop Proportional Gain 1 [KP1]"
Sets the response of Position control. Set this to: KP1 [1/S]=KVP1 [Hz]/4・2π, as a rough indication.

■ Group1 ID06 "Velocity Feed Forward Gain [FFGN]"
The tracking effect of position command can be improved by increasing this gain. Under positioning control, set this to approximately 30-40% as the standard.

◆ When Group1 ID1E "Higher Tracking Control Position Compensation Gain [TRCPGN]" is set to other than 0%, this parameter is automatically set.

■ Group1 ID07 "Velocity Feed Forward Filter [FFFIL]"
When position command resolution is low, set this parameter to suppress ripples.

■ Group1 ID08 "Higher Tracking Control Position Compensation Gain [TRCPGN]"
When the tracking effect needs to be improved under high resolution of position command, increase this parameter after adjustment of Higher Tracking Control Velocity Compensation Gain.

■ Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]"
Set the value as high as possible in stable range that machine system does not vibrate and oscillate. If Group1 ID14 "Load Inertia Moment Ratio 1 [JRAT1]" is properly set, the set value as "Velocity Loop Proportional Gain 1 [KVP1]" becomes velocity control responsive band.

■ Group1 ID13 "Velocity Loop Integral Time Constant 1 [TVI1]"
Set this to: TVI1 [ms] = 1000/(KVP1 [Hz]), as a rough indication.

■ Group1 ID14 "Load inertia moment ratio 1 [JRAT1]"
Set this value to the calculation shown below:

$$JRAT = \frac{\text{Motor axis converted load inertia moment (JL)}}{\text{Servo motor rotor inertia moment (JM)}} \times 100\%$$

■ Group1 ID1E "Higher Tracking Control Velocity Compensation Gain [TRCVGN]"
Tracking effect can be improved by increasing compensation gain.
Adjust this to shorten the position setting time.

◆ Set the value of "Load Inertia Moment Ratio 1 [JRAT1]" properly to use this function.

◆ Set 0% when you use Group9 ID27 "Velocity Loop Proportional Control Switching Function [VLPCON]" during operation.

◆ Set at 100% to equal Q-series servo amplifier.

■ Group1 ID20 "Torque Command Filter 1 [TCFIL1]"
When rigidity of the mechanical device is high, set this value high and the "Velocity Loop Proportional Gain1 [KVP1]" can also be set higher. When the rigidity of the mechanical device is low, set this value low and resonance in the high frequency zone as well as abnormal sound can be suppressed. For normal usage, set this below 1200Hz.

6.4.2 Basic manual tuning method for velocity control

- Set value of Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]" as high as possible within the range that mechanical system can stably work without any vibration or oscillation. If vibration increases, lower the value.

- Set value of Group 1 ID13 "Velocity Loop Integral Time Constant 1[TVI1]" by referring to "TVI1 [ms] = 1000/ KVP1 [Hz]", as a rough indication.

  - When you cannot increase the gain because of mechanical resonance, etc., and the response is insufficient, (after using the Torque notch filter and/or FF vibration suppression frequency to suppress resonance) try the procedure again.

6.4.3 Basic manual tuning method for position control

- Set value of Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]" as high as possible within the range that mechanical system can stably work without any vibration or oscillation. If vibration increases, lower the value.

- Set value of Group1 ID13 "Velocity Loop Integral Time Constant 1 [TVI1]" by referring to "TVI1 [ms] = 1000/ KVP1 [Hz]", as a rough indication.

- Set value of Group1 ID02 "Position Loop Proportional Gain 1 [KP1]" by referring to "KP1 [1/s] = KVP1 [Hz]/ 4･2π", as a rough indication. When vibration occurs, lower the value.

  - When you cannot increase the gain because of mechanical resonance, etc., and the response is insufficient (after using the Torque notch filter and/or FF vibration suppression frequency to suppress resonance) try the procedure again.

6.5 The function of making servo gain higher

There are explanations of the function for improving response, for position/ velocity/ torque control system each.

6.5.1 Velocity loop phase lead compensation

This is the function to compensate phase delay of Velocity control system, and helps Group1 ID12 "Velocity loop proportional gain 1 [KVP1]" change higher.
Use this when "Velocity loop proportional gain 1 [KVP1]" is not able to increase because there is no gain margin, phase margin.

■ How to use

◆ Please get a frequency characteristic of machine. (In case use of the System Analysis, see "10.3 System Analysis" in M0010842.)

◆ Set 3 times of "Velocity Loop Proportional Gain 1 [KVP1]" to Group1 ID16 "Velocity loop phase lead compensation frequency [VLPHLF]", and set near 30% to Group1 ID15 "Velocity loop phase lead compensation gain [VLPHLK]", and then confirm increase of phase margin at higher frequency.

◆ Group1 ID15 "Velocity loop phase lead compensation gain [VLPHLK]" is able to increase up to the value of allowed phase margin at higher frequency.

◆ "Velocity Loop Proportional Gain 1 [KVP1]" is able to increase up to the value of allowed phase margin at around of "Velocity Loop Proportional Gain 1 [KVP1]".

■ Velocity loop phase lead compensation gain
Sets the compensation value of Velocity loop phase lead compensation.

◆ General parameters Group1 “Basic Control parameter settings”

ID	Symbol	Name	Unit	Setting range
15	VLPHLK	Velocity loop phase lead compensation gain	%	0 to 100

* This function will be disabled when 0% is set.

■ Velocity loop phase lead compensation frequency
Sets the frequency of Velocity loop phase lead compensation.

◆ General parameters Group1 “Basic Control parameter settings”

ID	Symbol	Name	Unit	Setting range
16	VLPHLF	Velocity loop phase lead compensation frequency	Hz	10 to 4000

* Up to 1000Hz setting is valid at normal sampling mode.

6.5.2 Position loop phase lead compensation

This is the function to compensate phase delay of Position control system, and helps Group1 ID02 “Position Loop Proportional Gain 1 [KP1]" change higher.
Use when "Position Loop Proportional Gain 1 [KP1]" is not able to change higher by overshoot occurring.

■ How to use

◆ Set 4 times of "Position Loop Proportional Gain 1 [KP1]" (KP1 [1/s]/2π×4 [Hz]) to Group1 ID05 "Position loop phase lead compensation frequency [PLPHLF]", and set near 30% to Group1 ID04 "Position loop phase lead compensation gain [PLPHLK]", and operate a servo motor.

◆ Increase "Position loop phase lead compensation gain [PLPHLK]" up to eliminating overshoot.

◆ Able to increase "Position Loop Proportional Gain 1 [KP1]" up to the value that allowed overshoot.

■ Position loop phase lead compensation gain
Sets the compensation value of Position loop phase lead compensation.

◆ General parameters Group1 “Basic Control parameter settings”

ID	Symbol	Name	Unit	Setting range
04	PLPHLK	Position loop phase lead compensation gain	%	0 to 100

* This function will be disabled when 0% is set.

■ Position loop phase lead compensation frequency
Sets the compensation frequency of Position loop phase lead compensation.

◆ General parameters Group1 “Basic Control parameter settings”

ID	Symbol	Name	Unit	Setting range
05	PLPHLF	Position loop phase lead compensation frequency	Hz	10 to 4000

* Up to 1000Hz setting is valid at normal sampling mode.

6.5 The function of making servo gain higher

6.5.3 Torque feed forward compensation

There is explanation of function which improving response against a command of control system and applying feed forward compensation to the torque control system. Use when response is not good against command during circular machining etc.

■ How to use

◆ Improve response by increasing Group1 ID19 "Torque feed forward gain [TFFK]", at condition of setting value except 0% to Group1 ID06 "Feed Forward Gain [FFGN]".

◆ When there is no Improvement even if increasing "Torque feed forward gain [TFFK]", please change value of Group1 ID1A "Torque feed forward averaging [TFFAVE]" or Group1 ID1B "Torque feed forward output selection [TFFOUT]", and then confirm impact.

■ Torque Feed Forward Gain
Sets the compensation value of Torque-Feed Forward.

◆ General parameters Group1 “Basic Control parameter settings”

ID	Symbol	Name	Unit	Setting range
19	TFFK	Torque feed forward gain	%	0 to 100

* This function will be disabled when 0% is set.
* Able to use at the position control type and velocity control type.
* At the position control type, this function will be disabled when 0% is set to Group1 ID06 "Feed Forward Gain [FFGN]".
* This function will be disabled at torque control type.
* This function will be disabled at model following (vibration suppression) control.
* Able to use the function along with the auto-tuning, except when "00: Positioning1 Positioning Control 1 (General Purpose)" is set to Gropu0 ID01 "Auto-Tuning Characteristic [ATCHA]".

■ Torque feed forward gain averaging
Selects the average count of torque feed forward compensation.

◆ General parameters Group1 “Basic Control parameter settings”

ID	Symbol	Name	Unit	Setting range
1A	TFFAVE	Torque feed forward gain averaging	-	00 to 01

Selection		Contents
00	2timesAverage	2 times
01	4timesAverage	4 times

■ Torque feed forward output selection
Select the point that is to be added torque feed forward compensation.

◆ General parameters Group1 “Basic Control parameter settings”

ID	Symbol	Name	Unit	Setting range
1B	TFFOUT	Torque feed forward output selection	-	00 to 01

Selection		Contents
00	Before_Filter	Before torque command filter
01	After_Filter	After torque command filter

6. Servo Tuning

6.6 Model following control function

Model following control is a method used to obtain a higher response. Model control systems include mechanical devices in a servo amplifier and drive a servo motor in order to track the Model control system.
System parameter ID06 "Control mode selection" is fixed to "02: Position Position control type". Select "01: Model1 Model-following control" at the system parameter ID07 "Position control selection".

■ How to use

- ◆ See "6.3.6 Adjustment method for auto-tuning" when using this function together with the auto-tuning.
- ◆ See "6.6.1 Manual tuning method for model following control" when setting the parameter manually without the auto-tuning.
- ◆ See "6.6.3 Model velocity feed forward differential compensation", for command-following improvement after the auto-tuning or the manual tuning.

■ Setting parameters

◆ System parameters

<table>
<tr><th>ID</th><th>Content</th></tr>
<tr><td>06</td><td>Control Mode Selection
<table><tr><th colspan="2">Select value</th><th>Content</th></tr><tr><td>02</td><td>Position</td><td>Position control type</td></tr></table></td></tr>
<tr><td>07</td><td>Position Control Selection
<table><tr><th colspan="2">Select value</th><th>Content</th></tr><tr><td>01</td><td>Model1</td><td>Model following control</td></tr></table></td></tr>
</table>

* Model following control can be used with auto-tuning at the same time.

* Model following control can be used with full-closed control at the same time.

6.6 Model following control function

6.6.1 Manual tuning method for model following control

■ Set value of Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]" as high a value as possible within the range that mechanical system stably works without any oscillation. If vibration occurs, lower the value.

■ Set value of Group1 ID13 "Velocity Loop Integral Time Constant 1 [TVI1]" by referring “TVI1 [ms] = 1000/ KVP1 [Hz]”, as a rough indication.

■ Set value of Group1 ID12 "Position Loop Proportional Gain 1 [KP1]" by referring to “KP1 [1/s] = KVP1 [Hz]/ 4･2π”, as a rough indication.

■ Set value of Group3 ID03 "Model control gain 1 [KM1]" by referring to “KM1 ≒KP1”, as a rough indication. When vibration occurs, lower the set value.

■ When responsiveness is low, change the value of "Model control gain 1 [KM1]" to the value approximately 1.1 to 1.2 times the value.

◆ When the gain cannot rise because of mechanical vibration, etc., and the response time is insufficient, use Torque notch filter and/or FF Vibration suppression frequency to suppress resonance and attempt it again.

■ Adjustable parameters in Model following control
In addition to the parameters in Standard position control, the following parameters are also adjustable:

◆ General Parameters Group3 “Model following control settings”

ID	Symbol	Name
00	KM1	Model Control Gain 1
01	MZETA	Model control damping coefficient
05	OSSFIL	Overshoot Suppression Filter

◆ Model Control Gain 1 [KM1]
Proportional gain of Model following control position controller.
Adjust this to: KM1 ≒ KP1, as a rough indication.

◆ Model control damping coefficient [MZETR]
This is parameter which changes velocity proportional gain of Model following control.
The parameter value will be ζ=0.866 by 0% and ζ=1.0 by 100%.

◆ Overshoot Suppression Filter [OSSFIL]
Set cutoff frequency of overshoot suppression filter in Model following control.
If overshoot occurs, lower the setting value. When overshoot occurs on position deviation, lower the set value.

6.6.2 Switching of the Feedback control and the Model-following (vibration suppression) control

Explains the function which switches standard position control, model-following control and model-following vibration suppression control, on real-time.
System parameter ID06 "Control mode selection" is fixed to "02: Position Position control type", Select "03: Model3 Model-following / standard position control switching" or "04: Model4 Model-following vibration suppression / standard position control switching" at the system parameter ID07 "Position control selection".

■ How to use

- ◆ The function is valid when condition that is selected in Group9 ID1A "Model following (vibration suppression) control/ standard position control switching function" is satisfied.
- ◆ "Model following (vibration suppression) control/ standard position control switching function" supports "00: Always_Disable", "01: Always_Enable" and "General input signal (CONT1 to CONT7)".

* For interface type [F: MODBUS], it can switch by general I/O signals.

■ Setting parameters

◆ System parameters

<table>
<tr><th>ID</th><th>Content</th></tr>
<tr><td>06</td><td>Control Mode Selection
<table><tr><th colspan="2">Select value</th><th>Content</th></tr><tr><td>02</td><td>Position</td><td>Position control type</td></tr></table></td></tr>
<tr><td>07</td><td>Position Control Selection
<table><tr><th colspan="2">Select value</th><th>Content</th></tr><tr><td>03</td><td>Model3</td><td>Model-following / standard position control switching</td></tr><tr><td>04</td><td>Model4</td><td>Model-following vibration suppression / standard position control switching</td></tr></table></td></tr>
</table>

* Model following control can be used with auto-tuning at the same time.
* Model following control / Model-following vibration suppression control can be used with full-closed control at the same time.

■ Model following (vibration suppression) control/ standard position control switching function
Sets the valid condition for Model-following (vibration suppression) control.

◆ General parameters Group9 "Function enabling condition settings"

ID	Symbol	Name	Unit	Setting range
1A	MODEL	Model following (vibration suppression) control/ standard position control switching function	-	00 to 11

* Control mode will be Model-following (vibration suppression) control when this function is valid.
* This setting value is valid only when Control mode selection is "03: Model3 Model-following / standard position control switching" or "04: Model4 Model-following vibration suppression / standard position control switching".
* Do not perform switching of the model following (vibration suppression) control and the standard position control, during servo motor operation. Alarm (Model Following Vibration Suppression Control Error (AL.C5)) may occur.

6.6.3 Model velocity feed forward differential compensation

This is the function to improve command response of model control system by differential compensation for feed forward of model control system.

■ How to use

◆ Able to improve a command-following by increasing Group3 ID02 "Model velocity feed forward gain [MFFGN]", at the model following control mode and the model following vibration suppression control mode.

◆ Able to improve more a command-following by increasing Group3 ID03 "Model velocity feed forward differential time constant [MTFFD]".

■ Model velocity feed forward gain
Sets the compensation value of Model velocity feed forward.

◆ General parameters Group3 “Model following control”

ID	Symbol	Name	Unit	Setting range
02	MFFGN	Model velocity feed forward gain	%	0 to 100

* This function will be disabled when 0% is set.

■ Model velocity feed forward differential time constant
Sets the time constant of Model velocity feed forward differential compensation.

◆ General parameters Group3 “Model following control”

ID	Symbol	Name	Unit	Setting range
03	MTFFD	Model velocity feed forward differential time constant	ms	0.00 to 10.00

* This function will be disabled when 0.00ms is set.
* This function will be enabled when the value except 0% is set to "Model velocity feed forward gain [MFFGN]".

■ Model velocity feed forward filter
Sets the cutoff frequency of Model velocity feed forward filter.

◆ General parameters Group3 “Model following control”

ID	Symbol	Name	Unit	Setting range
04	MFFFIL	Model velocity feed forward filter	Hz	1 to 4000

* The function is Invalid at 1,000Hz or more.

6. Servo Tuning

6.7 Auto notch filter tuning function

Notch filter is able to suppress high frequency resonance depends on a mechanical system coupling or stiffness. "Auto notch filter tuning" is able to search mechanical system resonant frequency easily by rotating servo motor in a short time.

■ How to use

◆ Able to operate from "Auto-tuning mode" in the Setup Software or the Digital Operator.

◆ The tuning results are saved automatically in Group2 ID20 “Torque Command Notch Filter A [TCNFILA]”.

◆ When resonance of the device does not stop even after using Automatic Tuning of notch filter, there may be two or more resonance points. In this case, inquire about the resonance frequency using the system analysis function and insert Notch filter B, C, D (Manual setting) to suppress each resonance. If resonance is still not suppressed, there is a possibility that Group0 ID02 "Auto-tuning response [ATRES]" or Group1 ID12 "Velocity loop proportional gain 1 [KVP1]" is too high. Lower the "Auto-tuning response [ATRES]" or "Velocity loop proportional gain 1 [KVP1]".

* Torque command notch filter function can be used together with Auto-tuning at the same time.

* Holding torque falls while auto notch filter is running. Do not use as a gravity axis.

■ Torque command value for auto notch filter tuning
Setting the Torque command value to the servo motor at the time of auto notch filter tuning.

◆ General parameters Group0 “Auto-Tuning settings”

ID	Symbol	Name	Unit	Setting range
10	ANFILTC	Auto-Notch Filter Tuning Torque Command	%	10.0 to 100.0

* As the value increases so does tuning accuracy. However, machine movement will increase as well. Please monitor it closely.

■ Automatically saving parameters with Automatic tuning of notch filter

◆ General parameters Group2
“FF vibration suppression control / Notch filter Disturbance observer settings”

ID	Symbol	Name	Unit	Setting range
20	TCNFILA	Torque Command Notch Filter A	Hz	100 to 4000

* The above parameter is saved automatically with auto notch filter tuning.

■ Adaptive notch filter function E
Selects the valid/invalid of the Adaptive notch filter.

◆ General parameters Group0 “Auto-Tuning”

ID	Symbol	Name	Unit	Setting range
34	ADNFE	Adaptive notch filter function E	-	00 to 01

Select value		Content
00	Adp_Filter Disable	Adaptation invalid (TCNFILE manual setting)
01	Adp_Filter Enable	Adaptation at all times

* When adaptive notch filter function is valid, Group2 ID29 "TCNFILE, Depth Selection" will be fixed to 0.

■ Adaptive notch filter frequency upper limit E
Sets the upper limit value of adaptive notch filter frequency.

◆ General parameters Group0 “Auto-Tuning”

ID	Symbol	Name	Unit	Setting range
35	ADNFUE	Adaptive notch filter frequency upper limit E	Hz	100 to 1000

* Sets the upper limit value of adaptive notch filter frequency for mechanical dispersion.
* Please set higher value than ADNFLE.

■ Adaptive notch filter frequency lower limit E
Sets the lower limit value of adaptive notch filter frequency.

◆ General parameters Group0 “Auto-Tuning”

ID	Symbol	Name	Unit	Setting range
36	ADNFLE	Adaptive notch filter frequency lower limit E	Hz	100 to 1000

* Sets the lower limit value of adaptive notch filter frequency for mechanical dispersion.
* Please set lower value than ADNFLE.

■ Adaptive notch filter E auto saving
Selects valid/invalid of the function that saves mechanical resonant frequency automatically.

◆ General parameters Group0 “Auto-Tuning”

ID	Symbol	Name	Unit	Setting range
37	ADNSVE	Adaptive notch filter E auto saving	-	00 to 01

Select value		Content
00	Auto_Saving	Automatically Saves
01	No_Saving	Automatic Saving is Invalid

6. Servo Tuning

6.8 Vibration suppression function

6.8.1 Model following vibration suppression control

When you use the servo motor to drive tables on a machine stand, the stand itself may vibrate as a reciprocal reactor of the motor.
When the machine stand vibrates, the vibration may cause a reaction with the Positioning stabilizing time of the table working on the stand.
Model following vibration suppression control suppresses this type of machine stand vibration and improves Position stabilization time and response.

■ How to use

◆ First, select “01: Model1 model following control” at the system parameter ID07 "Position control selection”, and then perform auto-tuning to adjust the machine to optimum servo gain. Refer to "6.3.6 Adjustment method for auto-tuning" for instructions on tuning.

◆ When servo gain tuning is completed, switch Group0 ID00 “Tuning mode” to “02: ManualTun manual tuning“ after performing auto tuning result saving function.

◆ Set “02: Model2 model following vibration suppression control” at the "Position control selection”, and then set mechanical anti-resonance frequency and resonance frequency. When anti-resonance frequency and resonance frequency are already known, set the values. If anti-resonance frequency and resonance frequency are not known, you can set by measuring anti-resonance frequency and resonance frequency by system analysis.

- When you measure the anti-resonance and resonance frequencies using System analysis, set the "Frequency range selection" in the low range. If you set the range in a high range, the ant-resonance and resonance frequencies in suppressible ranges created by the Model following vibration suppression control may not be measured.
  1 - 125Hz for "Frequency range selection" is recommended.
  (For use of the system analysis, see "10.3 System analysis" in another document: M0010842.)

- When the mass of the servo motor is smaller than the machine stand mass, the anti-resonance and resonance frequencies may not be measured in system analysis. And, system analysis cannot use during tandem operation. In this case, obtain the vibration frequency (Model anti-resonance frequency) by calculating the machine vibration period of the vibrating point at positioning and its reciprocal and set the model resonance frequency 1.05-1.2 times the anti-resonance frequency.

◆ Set value of Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]" as high as possible within the range that mechanical system can stably work without any oscillation. If vibration occurs, lower the set value.

◆ Set value of Group1 ID13 "Velocity Loop Integral Time Constant 1 [TVI1]" by referring to “TVI1 [ms] = 1000/KVP1 [Hz]”, as a rough indication.

◆ Set value of Group1 ID02 "Position Loop Proportional Gain 1 [KP1] by referring to “KP1 [1/s] = KVP1 [Hz]/ 4・2π”, as a rough indication.

◆ Set value of Group3 ID00 "Model Control Gain 1 [KM1]" by referring to “KM1 ≒KP1”, as a rough indication.
If vibration increases, lower the value.

◆ When responsiveness is low, change the value of "Model control gain 1 [KM1]" to the value approximately 1.1 to 1.2 times the value.

◆ Depending on the mechanical system, there may be two or more frequency vibrations aside from anti-resonance and resonance frequencies that have already been set. In this case, the vibration can be suppressed using FF vibration suppression controls together. Set the vibration frequency to Group02 ID00 "FF vibration suppression frequency A1 [SUPFRQA1]" by calculating the frequency from the vibration period.

◆ In case you cannot increase the gain because of mechanical resonance, etc., and response is insufficient, use Torque command notch filter and FF vibration suppression frequency to suppress the resonance, and then try again.

* Auto-tuning function is able to use only "Auto-tuning [JRAT manual setting]".

* Full-closed control is able to use in Model-following vibration suppression control, also.

* Model following (vibration suppression) control cannot be used when in Velocity control type or Torque control type.

■ Setting parameters

◆ General parameters Group3 “Model following control settings”

ID	Symbol	Name	Unit	Setting range
00	KM1	Model Control Gain 1	1/s	15 to 315
01	MZETA	Model control damping coefficient	%	0 to 100
05	OSSFIL	Overshoot Suppression Filter	Hz	1 to 4000
06	ANRFRQ1	Model Control Anti-resonance Frequency 1	Hz	10.0 to 80.0
07	RESFRQ1	Model Control Resonance Frequency 1	Hz	10.0 to 80.0

* Do not change the setting value when the servo motor is running.

■ Model Control Gain 1 [KM1]
This is the proportional gain of the Model following controlling position controller and set response for Model control system. Adjust by referring to “KM1 ≒KP1”, as a rough indication.

■ Model control damping coefficient [MZETA]
This is parameter which changes velocity proportional gain of Model following control.
The parameter value will be ζ=0.866 by 0% and ζ=1.0 by 100%.

■ Overshoot Suppression Filter [OSSFIL]
This parameter is to set the cutoff frequency of the Overshoot suppression filter in Model following vibration suppression control. When overshoot occurs on position deviation, lower the set value.

■ Model Control Anti-resonance Frequency 1 [ANRFRQ1]
This is to set the Anti-resonance frequency of the machine using Model following vibration suppression control.
When the value is set higher than Model Control Resonance Frequency, vibration suppression control will be invalid.

■ Model Control Resonance Frequency 1 [RESFRQ1]
This is to set the Resonance frequency of the machine model using Model following vibration suppression control.
Vibration suppression control will be invalid at 80.0Hz.

■ Parameter setting range for model following vibration suppression control
Setting ranges for the following parameters are restricted:

◆ General parameters Group1 “Basic control parameter settings”

ID	Symbol	Name	Unit	Setting range
14	JRAT1	Load Inertia Moment Ratio 1	%	100 to 3000
20	TCFIL1	Torque Command Filter 1	Hz	100 to 1000

◆ General parameters Group3 “Model following control settings”

ID	Symbol	Name	Unit	Setting range
00	KM1	Model Control Gain 1	1/s	15 to 315

6.8.2 Auto FF Vibration Suppression Frequency Tuning

FF Vibration Suppression control is able to suppress low frequency resonance like machine end vibration. "Auto FF Vibration Suppression Frequency Tuning" is able to set FF Vibration Suppression Frequency easily by rotating servo motor in a short time.

■ How to use

◆ Able to operate from "Auto-tuning mode" in the Setup Software or the Digital Operator. For use of the setup software, see "9.2 Auto FF Vibration Suppression Frequency Tuning" in another document: M0010842. For use of the digital operator, see "7.7 Auto FF vibration suppression frequency tuning".

◆ The tuning result is automatically saved in Group2 ID00 "FF vibration suppression frequency A1 [SUPFREQA1]".

◆ FF vibration suppression frequency is obtained by executing auto-tuning of vibration suppression frequency or by calculating vibration frequency from the mechanical vibration period at the time of positioning, and it is able to set.

* When the vibration is not able to suppress by setting of FF vibration suppression frequency, there is a possibility that Group1 ID02 "Position Loop Proportional Gain 1 [KP1]" or Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]" may be too high. In this case, lower "Position Loop Proportional Gain 1 [KP1]" or "Velocity Loop Proportional Gain 1 [KVP1]".

* When used together with Group1 ID1E "Higher Tracking Control Velocity Compensation Gain [TRCVGN]", vibration suppression effect may be improved.

* FF vibration suppression control function can be used with auto-tuning at the same time.

* Holding torque falls while Auto FF Vibration Suppression Frequency tuning is executing. Do not use as gravity axis.

■ Torque command value of Auto FF vibration suppression frequency tuning
Sets torque command value giving to servo motor at the time of performing the Auto FF vibration suppression frequency tuning

◆ General parameters Group0 “Auto-Tuning”

ID	Symbol	Name	Unit	Setting range
20	ASUPTC	Auto-FF Vibration Suppression Frequency Tuning Torque Command	%	10.0 to 100.0

* As the value increases so does tuning accuracy. However, machine movement will increase as well. Please monitor it closely.

■ Auto-FF Vibration Suppression Frequency Tuning Friction Compensation Value
Sets additional frictional torque compensation amount when Auto FF Vibration Suppression Frequency Tuning is executed. By setting the value close to the actual friction torque, the accuracy of Auto FF Vibration Suppression Frequency Tuning can be improved.

◆ General parameters Group0 “Auto-Tuning”

ID	Symbol	Name	Unit	Setting range
21	ASUPFC	Auto-FF Vibration Suppression Frequency Tuning Friction Compensation Value	%	0.0 to 50.0

■ The parameter saved automatically by the Auto FF Vibration Suppression Frequency Tuning

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

ID	Symbol	Name	Unit	Setting range
00	SUPFRQA1	FF Vibration Suppression Frequency A1	Hz	1.0 to 500.0

6.8.3 FF vibration suppression control

FF vibration suppression control can be used as a method of suppressing the vibration of the mechanical tip.
There are two kinds of FF vibration suppression controls which have different characteristics.

Name	Adjustable characteristics
FF vibration suppression control A	Vibration suppression effect
FF vibration suppression control B	Responsiveness of position control

■ How to use

◆ Find out vibration frequencies of machine. (For use of the system analysis, see "10.3 System analysis" in another document: M0010842.)

◆ In case of having a single vibration frequency, use either FF vibration suppression control A or B. (The vibration frequency will be set to FF vibration suppression control A (Group2 ID00 "FF vibration suppression frequency A1 [SUPFRQA1]") by performing "Auto FF vibration suppression frequency tuning".)

◆ In case of having 2 vibration frequencies, use FF vibration suppression control A ("FF vibration suppression frequency A1 [SUPFRQA1]") with lower frequency, and use B (Group2 ID00 "FF vibration suppression frequency B1 [SUPFRQB1]") with higher frequency.

* When the vibration is not able to suppress the vibration of the mechanical tip by procedure above, there is a possibility that Group1 ID02 "Position Loop Proportional Gain 1 [KP1]" or Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]" may be too high. In this case, lower "Position Loop Proportional Gain 1 [KP1]" or "Velocity Loop Proportional Gain 1 [KVP1]".

■ Setting parameter

◆ General parameters Group2
"FF vibration suppression control / Notch filter Disturbance observer settings"

ID	Symbol	Name	Unit	Setting range
00	SUPFRQA1	FF Vibration Suppression Frequency A1	Hz	1.0 to 500.0
01	SUPLVA	FF Vibration Suppression Level Selection A	—	00 to 03
02	SUPFRQB1	FF Vibration Suppression Frequency B1	Hz	1.0 to 500.0
03	SUPCRB	FF Vibration Suppression Level Selection B	—	00 to 01

* Do not change the setting value when the servo motor is running.

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

ID	Symbol	Name
40	SUPFRQA2	FF Vibration Suppression Frequency A2
41	SUPFRQA3	FF Vibration Suppression Frequency A3
42	SUPFRQA4	FF Vibration Suppression Frequency A4
43	SUPFRQB2	FF Vibration Suppression Frequency B2
44	SUPFRQB3	FF Vibration Suppression Frequency B3
45	SUPFRQB4	FF Vibration Suppression Frequency B4

◆ General parameters Group9 "Function enabling condition settings"

ID	Symbol	Name	Unit	Setting range
15	SUPFSELA1	FF Vibration Suppression Frequency Select Input A1	-	00 to 29
16	SUPFSELA2	FF Vibration Suppression Frequency Select Input A2	-	00 to 29
17	SUPFSELB1	FF Vibration Suppression Frequency Select Input B1	-	00 to 29
18	SUPFSELB2	FF Vibration Suppression Frequency Select Input B2	-	00 to 29

* When the vibration suppression frequency is changed, FF vibration suppression control will be invalid and servo motor will rotate till outputting a rest of position command pulse in the FF vibration suppression function.

* Do not change the vibration suppression frequency when the servo motor is running.

6.8.4 CP vibration suppression control

This is the function which suppress a vibration of machine stand, even if perform CP control like as during machine cutting.

■ How to use

◆ If a vibration occur by low rigidity of machine, calculate and find out vibration frequency from position deviation monitor, and set it to Group2 ID50 "CP vibration suppression control frequency [CPVSFQ]".

◆ If effect of CP vibration suppression is weak, it is able to make strong by increasing value of Group2 ID51 "CP vibration suppression control level [CPVSLV]".

■ CP vibration suppression control frequency
Sets the vibration frequency of Machine stand.

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

ID	Symbol	Name	Unit	Setting range
50	CPVSFQ	CP vibration suppression control frequency	Hz	10.0 to 100.0

* Please stop servo motor when setting this value.
* This function will be valid when performing at standard position control mode.

■ CP vibration suppression control level
This is the parameter which sets impact of CP vibration suppression control.

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

ID	Symbol	Name	Unit	Setting range
51	CPVSLV	CP vibration suppression control level	-	00 to 03

* Effect of CP vibration control will be larger when increasing this value.
* Please stop servo motor when selecting this value.

■ CP vibration suppression control characteristics selection
Sets the effective frequency range of CP vibration suppression control.

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

ID	Symbol	Name	Unit	Setting range
52	CPVSSH	CP vibration suppression control characteristics selection	-	00 to 03

* Frequency range of CP vibration control will be narrow when increasing this value.
* Please stop servo motor when selecting this value.

6.8.5 Minor vibration suppression

Explains the function which suppresses a minor vibration against velocity feedback during servo motor stop.

■ How to use

- ◆ The function is valid when condition that is selected in Group9 ID35 "Minor vibration suppression function" is filled.
  Example: Always valid when "01: Always_Enable" is selected.
- ◆ If minor vibration is there in velocity feedback at conditions of servo ON and servo motor stopping, activate FBHYST and set FBHPLS, FBHTIM.
- ◆ Set FBHPLS as multiple of FBHTIM as follows. If not multiple of FBHTIM, the actual Minor vibration suppression pulse compensation frequency will have deviation with FBHTIM.
- ◆ Sample combinations of Minor vibration suppression pulse compensation value and Minor vibration suppression pulse compensation frequency

Minor vibration suppression pulse compensation value	Minor vibration suppression pulse compensation frequency
10	1
10	10
50	1
50	10
50	50

■ Minor vibration suppression function
Select the condition which will be valid/invalid of this function.

- ◆ General parameters Group9 "Function enabling condition settings"

ID	Symbol	Name	Unit	Setting range
35	FBHYST	Minor vibration suppression function	-	00 to 29

■ Minor vibration suppression pulse compensation value
Sets the compensation amount of Minor vibration suppression function for velocity feedback.

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

ID	Symbol	Name	Unit	Setting range
60	FBHPLS	Minor vibration suppression pulse compensation value	pulse	1 to 100

* Sets by multiple of FBHTIM.

■ Minor vibration suppression pulse compensation frequency
Sets the number of Minor vibration suppression.

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

ID	Symbol	Name	Unit	Setting range
61	FBHTIM	Minor vibration suppression pulse compensation frequency	times	1 to 100

* The larger the set value, longer the minor vibration suppression period.
* Set the value which is smaller than FBHPLS.

6. Servo Tuning

6.9 Disturbance impact suppression function

When a force is given to a servo motor externally, bad impact might be given to the control system. Follows are explaining the function of suppressing disturbance impact.

6.9.1 High order integral control

Use for suppression of disturbance impact for control system by decreasing Group1 ID13 "Velocity Loop Integral Time Constant 1 [TVI1]" more. This is the function to compensate phase delay of Velocity integral control system feedback. Use when oscillation or overshoot occurs by decreasing "Velocity Loop Integral Time Constant 1 [TVI1]".

■ How to use

◆ Set 1 or 2 times of Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]" to Group1 ID18 "High order integral control frequency [HKVIF]".

◆ Set 30% to Group1 ID17 "High order integral control gain [HKVIK]", and then confirm the things that phase margin near to "Velocity Loop Proportional Gain 1 [KVP1]" became large.

◆ "High order integral control gain [HKVIK]" is able to increase up to phase margin will be allowed value at high frequency range.

◆ "Velocity Loop Integral Time Constant 1 [TVI1]" is able to decrease till phase margin will be allowed value at near of "Velocity Loop Proportional Gain 1 [KVP1]".

* High order integral control cannot use along with higher tracking control. For use of High order integral control, set 0% to Group1 ID1E "Higher Tracking Control Velocity Compensation Gain [TRCVGN]".

■ High order integral control gain

◆ General parameters Group1 "Basic control parameter settings"

ID	Symbol	Name	Unit	Setting range
17	HKVIK	High order integral control gain	%	0 to 100

* This function will be disabled when 0% is set.

■ High order integral control frequency

◆ General parameters Group1 "Basic control parameter settings"

ID	Symbol	Name	Unit	Setting range
18	HKVIF	High order integral control frequency	Hz	10 to 4000

* Up to 1000Hz setting is valid at normal sampling mode.

6.9 Disturbance impact suppression function

6.9.2 Disturbance Observer Function

The Disturbance Observer is a function to suppress the influence of external load torque by estimating the load torque inside the servo amplifier and adding the load torque compensation to the torque command.

■ How to use

◆ The function will be valid when the condition which is selected at Group9 ID33 "Disturbance Observer Function" is filled.
Example: The function will be always valid when "01: Always_Enable" is selected.

◆ Select appropriate observer characteristic depending on disturbance frequency which is desired to suppress.

◆ Increase the value of Group2 ID31 "Observer Compensation Gain [OBG]" by little, and do not start from large value. Disturbance suppression characteristic will improve by increasing "Observer Compensation Gain [OBG]". However, oscillation might occur by too large of set value. Please use in range of no oscillation.

◆ Group2 ID32 "Observer Output Low-pass Filter [OBLPF]" is able to improve observer characteristic by setting frequency higher at high encoder resolution or low load inertia moment ratio etc.

◆ Use "Observer Output Notch Filter" to suppress vibration when resonance is changed at high frequency range.

■ Parameters for using the Disturbance Observer

◆ Group9 “Functions enabling conditions settings”

ID	Symbol	Name	Setting range
33	OBS	Disturbance Observer Function	00 to 29

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

ID	Symbol	Name	Unit	Setting range
30	OBCHA	Observer Characteristic	—	00 to 02
31	OBG	Observer Compensation Gain	%	0 to 100
32	OBLPF	Observer Output Low-pass Filter	Hz	1 to 4000
33	OBNFIL	Observer Output Notch Filter	Hz	100 to 4000

◆ Disturbance observer characteristics are prepared as "00_Low: Low frequency disturbance suppression", "01_Middle: Mid-frequency disturbance suppression" and "02_High: High frequency disturbance suppression".

Frequency	Selection		Description
10 to 40 Hz	00	Low	Low frequency disturbance suppression
40 to 80 Hz	01	Middle	Mid-frequency disturbance suppression
80 to 200 Hz	02	High	High frequency disturbance suppression

* Disturbance Observer cannot be used with Auto-tuning at the same time.

* Use “02_High for High frequency disturbance suppression” when encoder resolution is above 1048576 division.

* Torque command might have variation if switches a valid/ invalid of Group9 ID33 "Disturbance Observer Function [OBS]" when cutoff frequency of OBLPF is set higher.

6. Servo Tuning

6.10 Stick-slip behavior compensation function

Explains the compensation function of stick-slip behavior which occurs by machine system friction etc.

■ How to use

◆ The function will be valid when the condition which is selected at Group9 ID34 "Stick-slip behavior compensation function" is filled.
Example: The function will be always valid when "01: Always_Enable" is selected.

◆ Set 70% of Group1 ID13 "Velocity Loop Integral Time Constant 1 [TVI1]" to Group1 ID42 "Velocity loop integral time constant for stick-slip behavior compensation [STTVI]", and then confirm the things that stick-slip behavior has reduced.

◆ "Velocity loop integral time constant for stick-slip behavior compensation [STTVI]" is able to decrease when oscillation does not occur. Increase "Velocity loop integral time constant for stick-slip behavior compensation [STTVI]" up to the value which has margin against oscillation, when oscillation occurs.

■ Parameters for using the stick-slip behavior compensation function.

◆ Group9 “Functions enabling conditions settings”

ID	Symbol	Name	Unit	Setting range
34	STC	Stick-slip behavior compensation function	-	00 to 29

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

ID	Symbol	Name	Unit	Setting range
40	STV	Effective velocity for compensating stick-slip behavior	min^{-1}	0.1 to 128.0
41	STHLD	Retention time for compensating stick-slip behavior	ms	1 to 500
42	STTVI	Velocity loop integral time constant for stick-slip behavior compensation	ms	0.3 to 1000.0

◆ Effective velocity for compensating stick-slip behavior [STV]
Stick-slip behavior compensation will work when internal velocity command of servo amplifier is below of this value.

◆ Retention time for compensating stick-slip behavior [STHLD]
Stick-slip behavior compensation will be kept till over the set time, when internal velocity command of servo amplifier exceeds STV. Increase this value when response of velocity control is low.

◆ Velocity loop integral time constant for stick-slip behavior compensation [STTVI]
This set value will apply to velocity integral control system while stick-slip behavior compensation is performing.

7

Digital Operator

For LED display and how to use the digital operator, refer the instruction manual for functions, M0012315.

No Text on This Page.

8 Maintenance

For the corrective action for alarm, and the inspection, refer the instruction manual for functions, M0012315.

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9

Dedicated function

In this chapter, the things concerning dedicated function are explained.

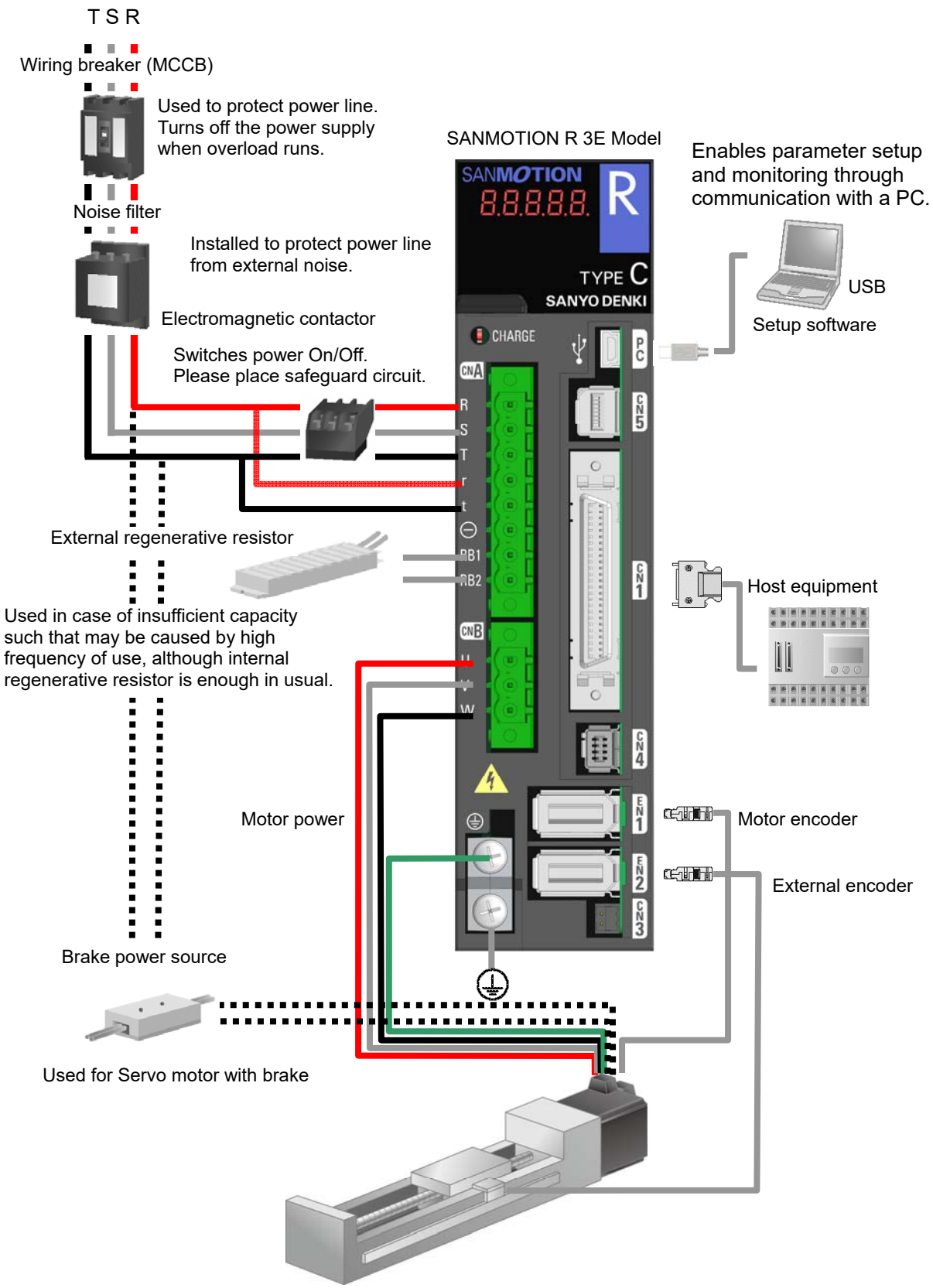
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9. Dedicated function

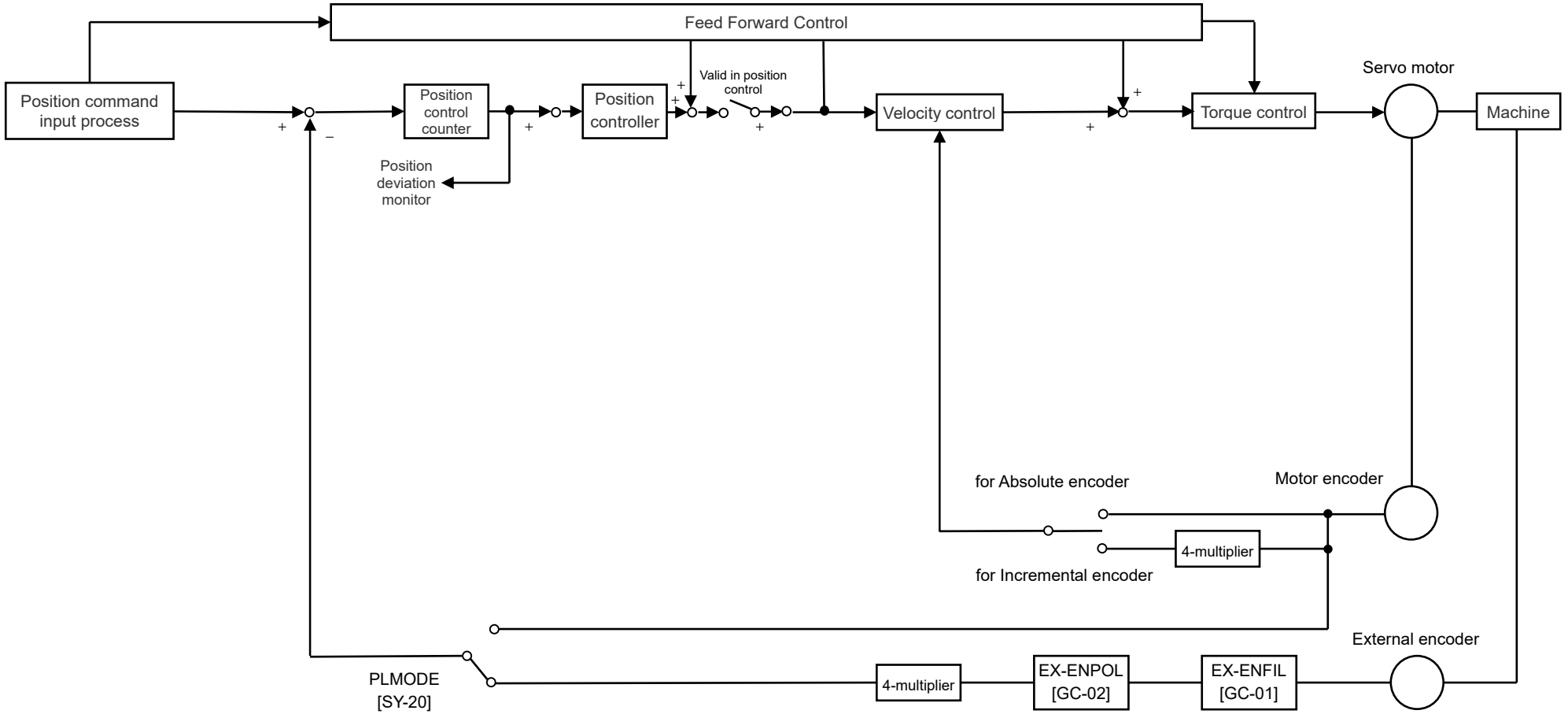
9.1 Full-closed system

9.1.1 Illustration of system components

■ RS3☐01/02/03/05



9.1.2 Internal block diagram



9. Dedicated function

9.1.3 Combination encoder

Apply to the product below as external combination encoder.

■ Incremental encoder

Manufacturer	Series name	Output signal	Power supply	Minimum resolution
Renishaw K.K.	RGH22	RS422 compliant, 90 degree phase shift pulse train	5 V±5 %	0.1 to 5 μm
HEIDENHAIN K.K.	LIDA400			0.05 to 1 μm
	LIDA200			0.5 to 5 μm

* Applicable output signal is RS422 compliant 90 degree phase shift pulse train only. (LIDA47, LIDA27)
  Analog sine wave output (LIDA48, LIDA28) and serial signal output are not applicable.
* For detail of linear encoder performance/spec/guarantee/mounting/etc, inquire to manufacturer of each linear encoder.
* Contact us if combine with the encoder except recommendation encoder above.
* For a positioning function built-in servo amplifier, there are restrictions of GroupA ID3B System division (131,072 or less) and GroupA ID3C User division (131,072 or less). Please use the incremental encoder settable as 131,072 or less with 4-multiplied value.

■ Absolute encoder

EnDAT2.2 interface is only applicable.

Manufacturer	Type	Series name	Power supply	Resolution
HEIDENHAIN K.K.	Linear encoder	LIC4100	5V±5%	0.01 μm 0.005 μm 0.001 μm
		LIC2100		0.1 μm 0.05 μm
		LC400		0.01 μm 0.001 μm
	Angle encoder	RCN2000		26,28 bit
		RCN5000		26,28 bit
		RCN8000		29 bit
	Rotary encoder	ECN/ENQ1100		Single-turn resolution: 23 bit, Multi-turn total count: 12 bit
		ECN/ENQ1300		Single-turn resolution: 25 bit, Multi-turn total count: 12 bit

* Above table spec is depending on our servo amplifier combination.
  Something may differ from manufacturer spec.
* Please contact each linear encoder manufacturer for the details of performance, specification, warranty, and installation.
* It is not applicable except EnDat2.2 interface classified to EnDat22.
* Contact us if combine with the encoder except recommendation encoder above.
* It is not able to use if the resolution converted to single-turn of motor axis exceeds 17 bit (131,072).
* For a positioning function built-in servo amplifier, there are restrictions of GroupA ID3B System division (131,072 or less) and GroupA ID3C User division (131,072 or less). Please use the incremental encoder settable as 131,072 or less with 4-multiplied value.
* To use high resolution absolute encoder, the procedure such as lower a command resolution will be required. Please contact us for use high resolution absolute encoder.

9.1.4 Wiring

Connect external encoder to EN2 when using as full-closed system. See "4.3 Wiring for motor encoder" for motor encoder wiring (EN1 connector).

9.1.4.1 Signal names and its pin numbers for external encoder (EN2)

■ Incremental encoder

EN2 Terminal No.	Signal name	Description	Remarks Note 1)
1	-	Note 3)	—
2	SG	Power supply common Note 4)	
3	-	Note 3)	—
4	SG	Power supply common Note 4)	
5	B	Phase B pulse output	Twisted pair
6	/B		
7	A	Phase A pulse output	Twisted pair
8	/A		
9	Z	Phase Z pulse output	Twisted pair
10	/Z		
Note 2)	Ground	Shield	—

Note 1) Use an exterior covering shielded cable and perform twisted-pair wiring.
Note 2) Connect exterior covering shielded cable to metal case of EN2 side, and to earth of external encoder side.
Note 3) Please prepare power supply for external encoder by yourself.
Do not connect power supply for external encoder to 1 and 3 pins.
Note 4) Power supply common shall be connected.

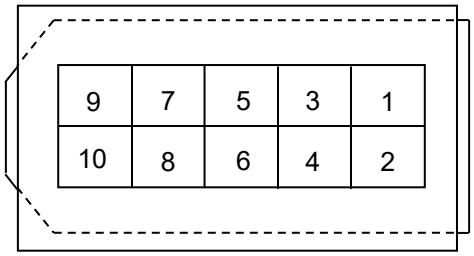
■ Absolute encoder (EnDat2.2)

EN2 Terminal No.	Signal name	Description	Remarks Note 1)
1	-	Note 3)	—
2	SG	Power supply common Note 4)	
3	-	Note 3)	—
4	SG	Power supply common Note 4)	
5	CLOCK+	Serial clock signal	Twisted pair
6	CLOCK-		
7	DATA+	Serial data signal	Twisted pair
8	DATA-		
9	—	—	—
10	—		
Note 2)	Ground	Shield	—

Note 1) Use an exterior covering shielded cable and perform twisted-pair wiring.
Note 2) Connect exterior covering shielded cable to metal case of EN2 side, and to earth of external encoder side.
Note 3) Please prepare power supply for external encoder by yourself.
Do not connect power supply for external encoder to 1 and 3 pins.
Note 4) Power supply common shall be connected.

9.1.4.2 EN2 pin assignment

■ EN2: 54593-1016 (soldered side)



■ Connector model number (Molex Japan LLC)

	Model Number	Applicable wire size	Applicable cable diameter
Plug connector	54593-1016	Up to AWG18 (for terminal No.: 1, 2, 9, 10) Up to AWG22 (for terminal No.: 3 to 8)	Up to ϕ1.6 mm (for terminal No.: 1, 2, 9, 10) Up to ϕ1.2 mm (for terminal No.: 3 to 8)
Plug cable/ cover set	54599-1016	—	ϕ7 to ϕ9

9.1.5 Basic setting of full-closed system

Explains basic setting of the system for full-closed system operation.

9.1.5.1 Specification confirmation

Confirm specifications of servo amplifier through the setup software.

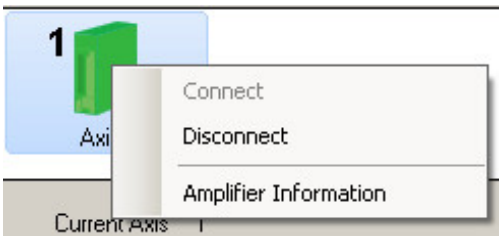
[Step 1: How to confirm specifications of servo amplifier]

Confirm that your servo amplifier is fit to full-closed system or not by the information below.

- ◆ Encoder type

1) Confirmation through the setup software

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



[Step 2: Encoder type confirmation]

See below for allowable encoder of this servo amplifier. Please confirm that your external encoder is allowed.

Servo amplifier model number	Encoder type code	Motor encoder allowed by EN1	External encoder allowed by EN2
RS3###A1##	01	Absolute encoder	Absolute encoder
RS3###A2##	02	Absolute encoder	Incremental encoder
RS3###AA##	0A	Incremental encoder	Incremental encoder

* Full-closed system is not allowed when encoder type code is the other of 01, 02 or 0A.

* For a positioning function built-in servo amplifier, there are restrictions of GroupA ID3B System division (131,072 or less) and GroupA ID3C User division (131,072 or less). Please use the incremental encoder settable as 131,072 or less with 4-multiplied value.

* To use high resolution absolute encoder, the procedure such as lower a command resolution will be required. Please contact us for use high resolution absolute encoder.

1) Through the setup software

Encoder type code is shown in Encoder Type of System information.

9.1.5.2 System parameter setting

Set the parameters as follows for use of full-closed control.

■ Motor encoder connector selection
Selects the connector used as motor encoder. "00: EN1" shall be selected for use of full-closed control.

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

■ Position loop control, position loop encoder selection
Select the encoder for use of control method of position loop and position control. "0x01: External_Enc" shall be selected for use of full-closed control.

Group	ID	Selection		Description
System	20	01	External_Enc	Full-closed control/ External encoder

9.1.5.3 Full-closed encoder selection

■ EN2 encoder type code
Selects the external encoder type connected to EN2. Select depending on encoder type as below:
8th digit of servo amplifier model number is 1 (Absolute encoder): "22: EnDat_ABS"
8th digit of servo amplifier model number is 2 or A (Incremental encoder): "82: Pulse_without_CS"

Group	ID	Selection		Selection
System	12	22	EnDat_ABS	EnDat2.2
		80	Pulse	Wire-saving incremental encoder
		82	Pulse_without_CS	Incremental encoder

■ EN2 absolute encoder baud rate selection
It sets if 22:EnDat_ABS is selected to EN2.

Group	ID	Selection		Selection
System	21	01	2Mbps	2Mbps
		03	4Mbps	4Mbps

* Normally, please use with default setting (01:2Mbps).

9.1.5 Basic setting of full-closed system

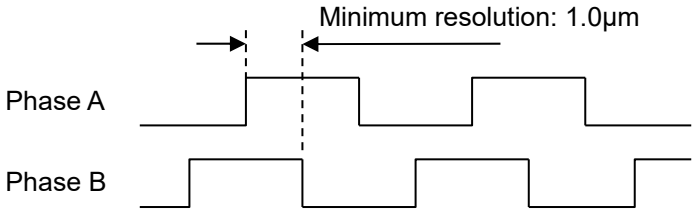
9.1.5.4 Feedback pulse setting

■ External encoder division (for incremental encoder)
Sets pulse amount (multiply 1) of external encoder per 1 turn of motor axis.
Be valid after control power cycle.

Index	Sub-Idx	Setting range	Unit
System	22	500 to 500,000 (multiplied 1)	P/R

* For a positioning function built-in servo amplifier, there are restrictions of GroupA ID3B System division (131,072 or less) and GroupA ID3C User division (131,072 or less). Please use the incremental encoder settable as 131,072 or less with 4-multiplied value.

◆ Setting sample
[Use condition]
- Move distance of work per 1 turn of motor axis: 10mm
- Minimum resolution of external encoder (multiplied 4): 1.0×10^{-3} mm (=1.0μm)



[Setting value]
Move distance of work per 1 turn of motor axis is 10mm, and Minimum resolution of external encoder is 1.0μm, so,

Pulse amount of external encoder per 1 turn of motor axis

$$= \frac{\text{Move distance of work per 1 turn of motor axis [mm]}}{\text{Minimum resolution of external encoder [mm]}}$$

$= 10\text{mm} / (1.0 \times 10^{-3}\text{ mm})$
= 10,000 P/R (multiplied 4)

ID22 "External encoder resolution" is "multiplied 1" value (amount of phase-A or phase-B), so the value below is set.

External encoder resolution = 10,000/4 = 2,500 P/R

* Round off the value to the whole number.

■ External absolute encoder resolution (for absolute encoder)
Sets an external encoder resolution per single rotation of motor axis.
Be valid after control power cycle.

Group	ID	Setting range	Unit
System	26	2,048 to 8,388,608	P/R

* For a positioning function built-in servo amplifier, there are restrictions of GroupA ID3B System division (131,072 or less) and GroupA ID3C User division (131,072 or less). Please use the incremental encoder settable as 131,072 or less with 4-multiplied value.

* To use high resolution absolute encoder, the procedure such as lower a command resolution will be required. Please contact us for use high resolution absolute encoder.

◆ Setting sample
[Use condition]
- Move distance of work per 1 turn of motor axis: 10mm
- Minimum resolution of external encoder (linear encoder): 0.01×10^{-3} mm (=0.01μm)

[Setting value]
Move distance of work per 1 turn of motor axis is 10mm, and Minimum resolution of external encoder is 0.01μm, so,

Pulse amount of external encoder per 1 turn of motor axis

$$= \frac{\text{Move distance of work per 1 turn of motor axis [mm]}}{\text{Minimum resolution of external encoder [mm]}}$$

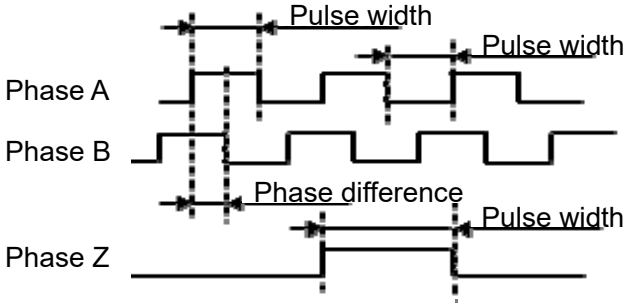
$= 10\text{mm} / (0.01 \times 10^{-3}\text{ mm})$
$= 1{,}000{,}000$ P/R

* Round off the value to the whole number.

9.1.5 Basic setting of full-closed system

■ External Encoder Digital Filter
Sets the digital filter for external encoder.
Even if noise is given to external incremental encoder, eliminate pulses below set value, as noise. Considering encoder resolution and maximum operation speed of servo motor, and set a quarter of maximum speed pulse width as a rough indication.

Group	ID	Selection		Description
C	01	00	110 ns	Minimum Pulse Width =110nsec (Minimum pulse Phase Difference = 37.5nsec)
		01	220 ns	Minimum Pulse Width = 220nsec
		02	440 ns	Minimum Pulse Width = 440nsec
		03	880 ns	Minimum Pulse Width = 880nsec
		04	75 ns	Minimum Pulse Width = 75nsec (Minimum pulse Phase Difference = 37.5nsec)
		05	150 ns	Minimum Pulse Width = 150nsec
		06	300 ns	Minimum Pulse Width = 300nsec
		07	600 ns	Minimum Pulse Width = 600nsec

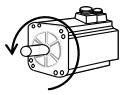
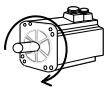
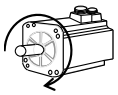
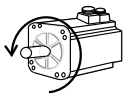


* Be valid when external incremental encoder is used.

9.1.5.5 Rotation direction setting for servo motor

At full-closed control, servo motor rotation direction is decided by command polarity and external incremental encoder polarity.

■ Move direction (M_dir)
For a positioning function built-in servo amplifier, selects a move direction.
Rotation direction of servo motor is able to invert.
Be valid after control power cycle.

Group	ID	Selection		Coordinate increment	Coordinate decrement
A	0A	00	Positive_Dir	CCW rotation 	CW rotation 
		01	Negative_Dir	CW rotation 	CCW rotation 

■ External Encoder Polarity Selection
Selects signal polarity of external incremental encoder.
Select polarity to get matching with increase/decrease of "ID61/62 Present position monitor (External encoder) [EX-APMON]" and "ID10/11 Present position monitor (Motor encoder) [APMON]".
Be valid after control power cycle.

Group	ID	Selection		Description		
C	02	00	Type1	EX-Z /without inversion	EX-B /without inversion	EX-A /without inversion
		01	Type2	EX-Z /without inversion	EX-B /without inversion	EX-A /with inversion

* When count direction (increase/decrease) of external incremental encoder and motor encoder are not match, it might get runaway.

■ External Absolute Encoder Polarity Selection
Selects counting polarity of external absolute encoder.
Select polarity to get matching with increase/decrease of "ID61/62 Present position monitor (External encoder) [EX-APMON]" and "ID10/11 Present position monitor (Motor encoder) [APMON]".
Be valid after control power cycle.

Group	ID	Selection		Description
C	0B	00	Standard	Inverts not an encoder operation direction.
		01	Reversed	Inverts an encoder operation direction.

* It may become out of control if a counting direction (increase/decrease) of motor encoder and external absolute encoder are not matched.

9.1.5.6 External encoder signal output waiting function setting

If there is delay from supplying power to outputting encoder signal depending on external encoder specification, this function is able to delay boot time of servo amplifier along with encoder signal start time.

■ Initial timeout waiting time
Set the time of "from Supplying power to external encoder to Starting encoder signal output + α".

Group	ID	Selection	Description
B	0B	0	Invalid
		1	1,000 ms
		2	1,400 ms
		3	1,800 ms
		4	2,000 ms
		5	3,000 ms
		6	5,000 ms
		7	10,000 ms

* Supply power to external encoder at same timing for control power of servo amplifier or earlier.
* "Encoder Connector 2 Disconnection (AL.83)" will be output when setting value is shorter than the time from supplying power to outputting encoder signal.
* When EnDat is used to external encoder, it takes 1.3sec to start serial communication access from power establishment of external encoder. Therefore, 1.3 seconds or more is required to a booting time also when set value is 0 or 1.

9.1.6 Precautions

9.1.6.1 Power supply for external encoder

■ Please prepare power supply for external encoder by yourself.

* Power supply to external encoder shall be start at before or same timing of servo amplifier control power.

9.1.6.2 External encoder operation

■ Please check that external encoder has no problem before servo ON (exciting servomotor).

◆ When count directions (increase/decrease) of "ID10/11 Present position monitor (Motor encoder) [APMON]" and "ID61/62 Present position monitor (External encoder) [EX-APMON]" are opposite, change the GroupC ID02 "External Incremental Encoder Polarity Selection" for external incremental encoder or change the GroupC ID0B "External Absolute Encoder Polarity Selection" for external absolute encoder, and adjust count directions (increase/decrease).

◆ When external pulse encoder operation is removed
Use at the condition that external pulse encoder is connecting mechanically.

10

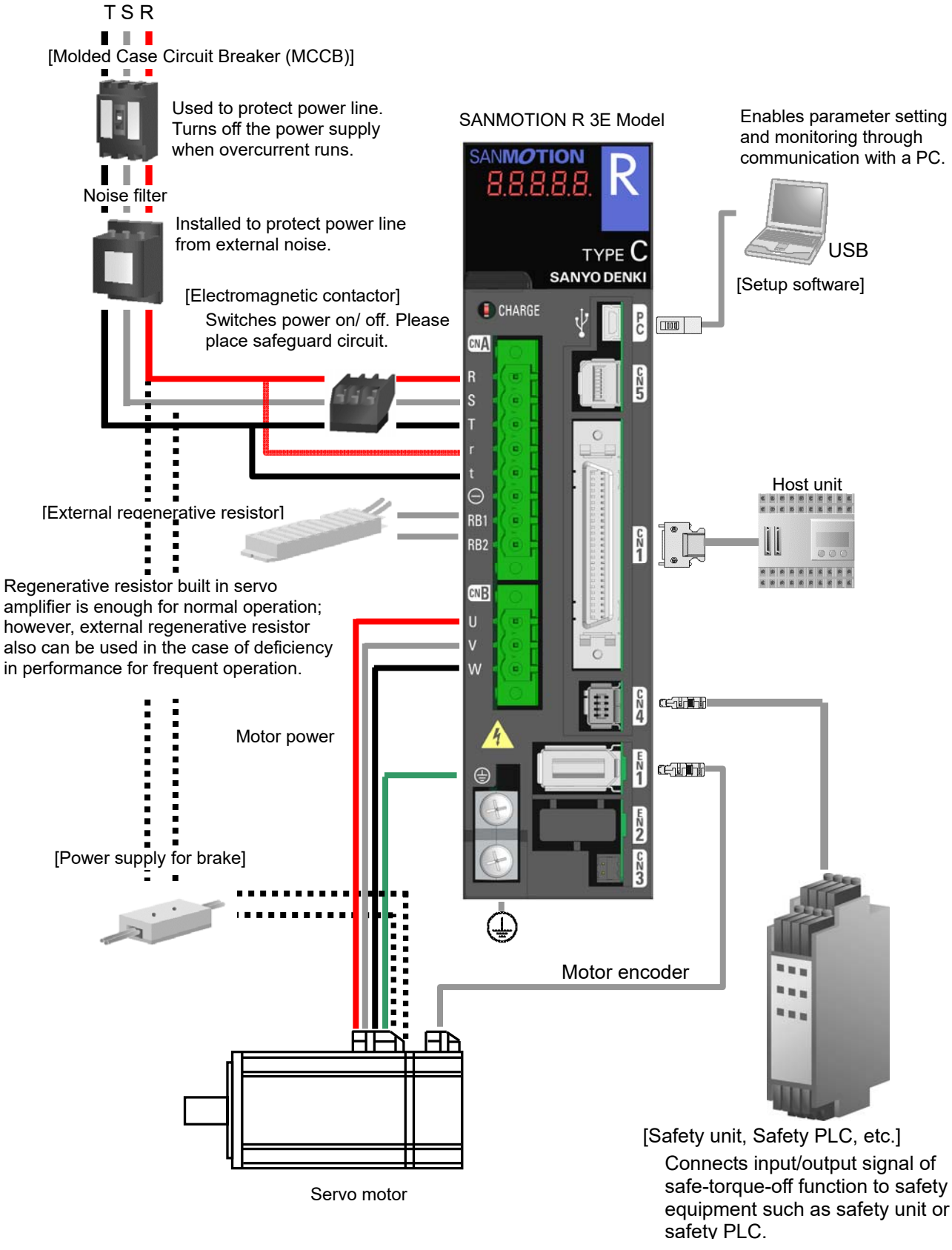
Safe-Torque-Off (STO) function

In this chapter, details of Safe-Torque-Off (STO) function are explained.

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10. Safe Torque Off function

10.1 Illustration of system configuration

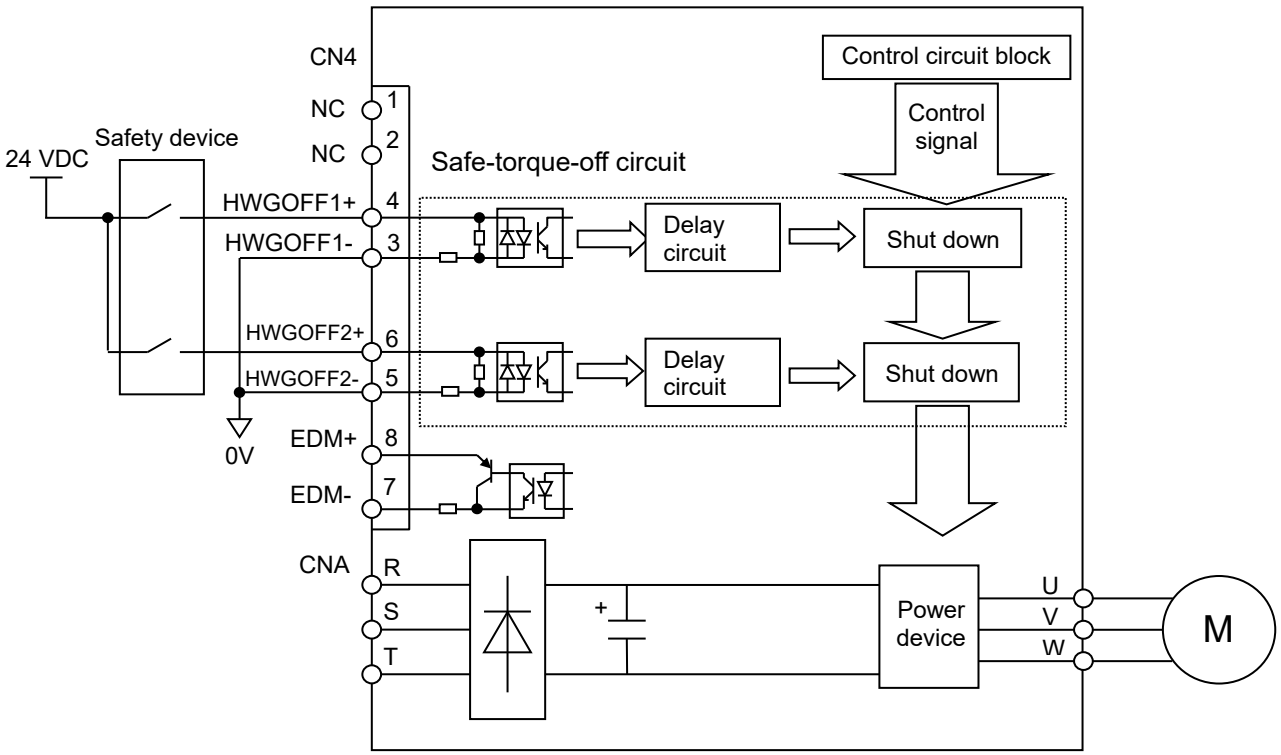


10.2 Safe-Torque-Off function

Safe-torque-off function reduces injury risks and ensures the safety for those who work near moving parts of equipment. This function employs 2-channel input signal to block current to servo motor. Previously we ensure machine safety by blocking current to servo amplifier with use of electromagnetic contactor. This safe-torque-off function allows keeping machine safety without shutting down power supply even when you need to perform tasks such as machine maintenance in dangerous areas. Maintenance without shutting down power supply can help you improve your work efficiency.

10.2.1 Outline

This function stops current control signal of servo motor, which is generated control circuit, by any of each path connected to 2-channel safety input signals (HWGOFF1 and HWGOFF2), and then blocks current from power device to servo motor.



10. Safe Torque Off function

10.2.2 Standards conformity

This function meets the following safety functions, safety standards, and safety parameters.

Item	Standard
Safety functions	■ IEC61800-5-2, safe-torque-off (STO) / EN61800-5-2
Safety Standards	■ IEC61508(2nd), SIL3, HFT=1, type B / EN61508 ■ IEC62061, SILCL3, HFT=1, type B / EN62061 ■ ISO13849-1:2015, Cat3, PL = e (When error detection performed by using EDM) / EN ISO 13849-1:2015 ■ ISO13849-1:2015, PL = c (When error detection not performed.) / EN ISO 13849-1:2015

* Probability of a dangerous Failure per Hour (PFH) of this function (Safe Torque Off circuit) achieves less than 25% of required level of SIL3 and 2% of required level of SIL2.
* To suffice ISO13849-1:2015, Cat3, PL=d, you need to design machine safety system so as to detect failure of STO circuit by surely using Error Detection Monitor (EDM).
* The Mean Time to Dangerous Failure (MTTFd) for this function is a hundred year. The Diagnostic Coverage (DC) for this function with use of Error Detection Monitor (EDM) is 92%.
* For another standards conformity of Safety Function and Safety Standard, refer to Chapter 12.
* Please contact us if error detection by EDM is not used.

10.2.3 Risk assessment

This servo amplifier unit meets the requirements of the above functional safety standards. However, before activating this safety function, make sure to assess the risks associated with the overall equipment to ensure safety.

10.2.4 Residual risk

Even if this function activated, the following risks remain. Please ensure the safety is maintained even if these risks occur, by performing risk assessments.

■ When this function is activated while servo motor is running, the power supply to the motor is shut down, however, the motor continues to run a while because of inertia. Please make sure to design the safety system to prevent any danger until the motor stops completely.

■ When servo motor used in vertical axes, the motor rotates by gravity. Please be advised that preparing means for stopping such as mechanical brake at your end is needed. Moreover, please note that servo brake circuit of servo amplifier, dynamic brake circuit, holding brake excitation signal, and servo motor holding brake are not safety related devices.

■ If the power device malfunctions and causes inter-phase shorting, the servo motor may move within a range of up to 180 degrees in electrical angle and remain in the excited state. For your information, the travel distance of R motor in this occasion is as follows;
R-motor travel distance: 1/10 turns (rotation angle at the motor shaft).

■ Be sure to check if this function works properly when the machine is operated for the first time or servo amplifier is replaced. If the servo amplifier is incorrectly used due to miswiring of input / output signals, this function will not work properly, which may incur danger.

■ Even when this function is working, power supply to servo amplifier is not shut down. Be sure to shut down power supply before you perform maintenance or checkup of servo amplifier, in which you may be exposed to electric shock.

10.2.5 Delay circuit

We offer two paths, with or without delay circuit between safety input 1(HGWOFF1)/safety input 2 (HWGOFF2) input circuit and servo motor current control signal blocking circuit. When using in vertical axis, please use path with delay circuit to prevent motor shaft falling due to holding brake operation delay during safe torque off function operation.

Servo amplifier model number	Delay circuit (Max. delay time)
RS3########4	With delay circuit (Max.700 ms)

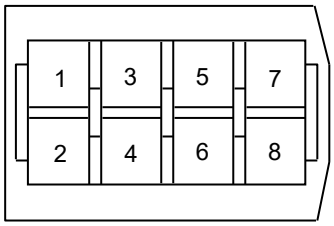
* Holding brake excitation signal and servo motor holding brake are not safety related parts.

10. Safe Torque Off function

10.3 Wiring

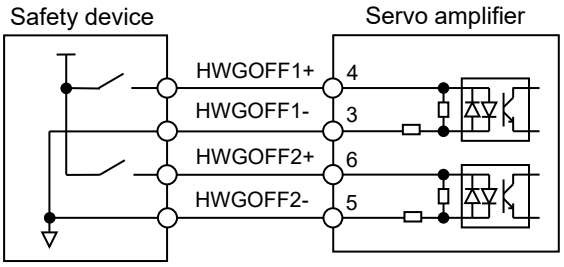
10.3.1 CN4 connector layout

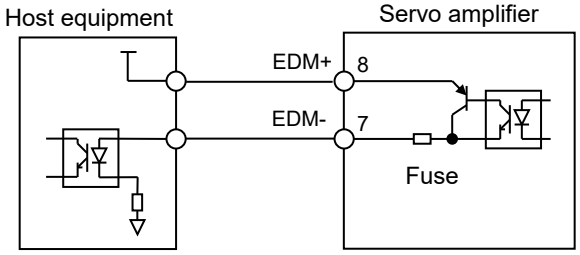
■ CN4 2013595-3 (soldered side)



10.3.2 Connection diagram of CN4-terminals

Functions and connection circuit of each CN4-teminal are as shown below.

Signal	Terminal No.	Code	Description
	1		These are connecting terminals when the function is not used. Do not use these terminals.
	2		
Safety input 1	3	HWGOFF1-	This is an input signal to control safe-torque-off state. Connection circuit Connects to relay or transistor circuit of open collector. Power supply voltage range: 24 VDC±10% Internal impedance: 2.2kΩ 
	4	HWGOFF1+	
Safety input 2	5	HWGOFF2-	
	6	HWGOFF2+	

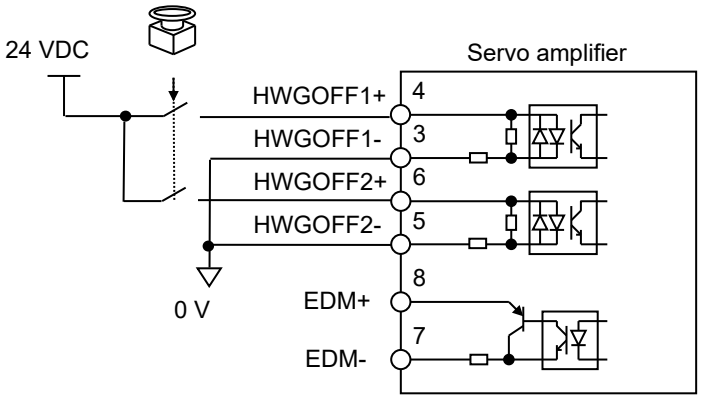
Signal	Terminal No.	Code	Description
Error detection monitor	7	EDM-	This is a signal to monitor safe-torque-off functions faults. Connection circuit: Connects to photo coupler or relay circuit. Power supply voltage range (Uext): 24 VDC±10% Maximum current value: 50mA Output voltage: Uext-0.5 -Uext 
	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.

* Short-circuit connector AL-00718251-01 will be attached to the product equipping STO delay circuit of RS3#####C#4, RS3#####C#E, RS3#####F#4 and RS3#####F#E. Connect the attached connector to CN4 if this function is not used.

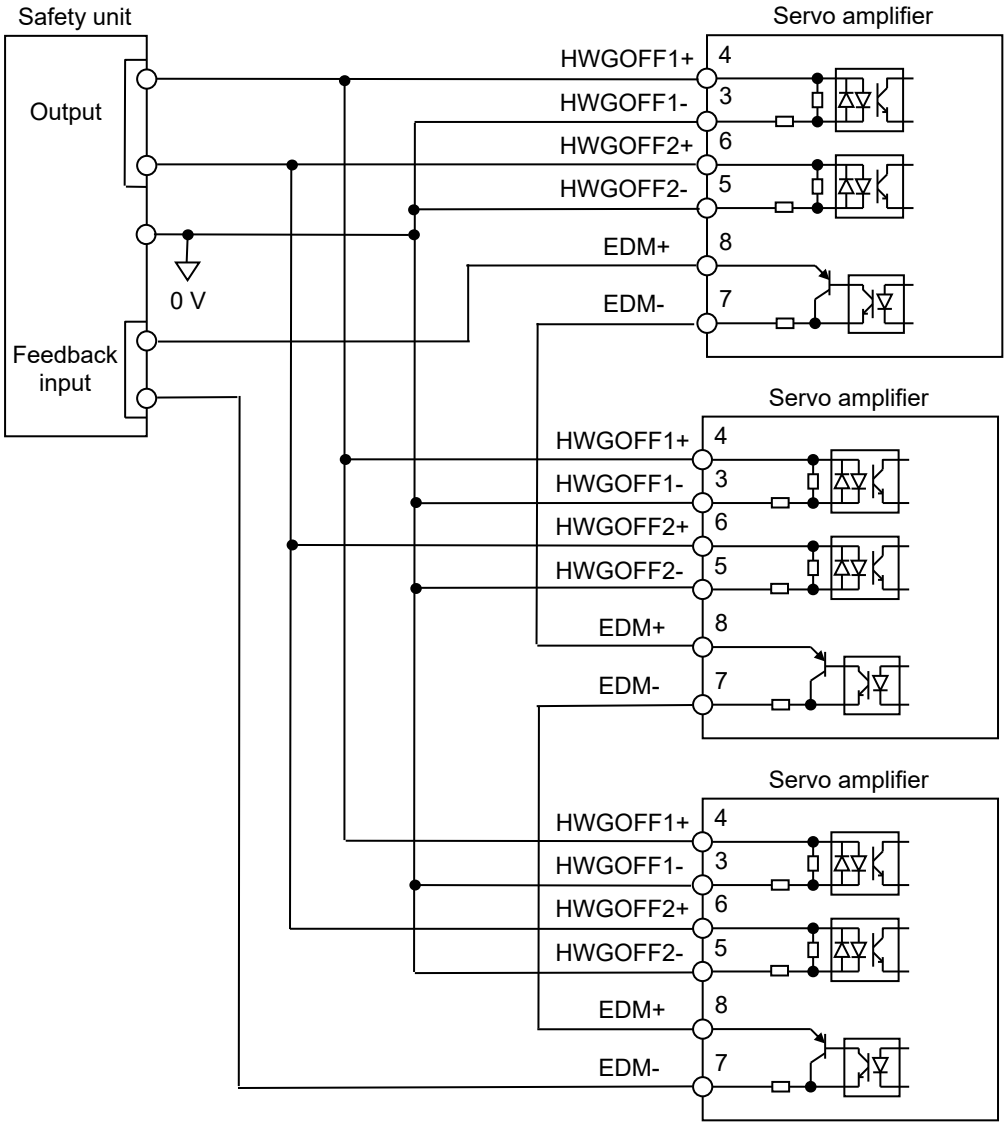
10.3.3 Example of wiring

Example of wiring to safety switch (single servo amplifier connected)



10. Safe Torque Off function

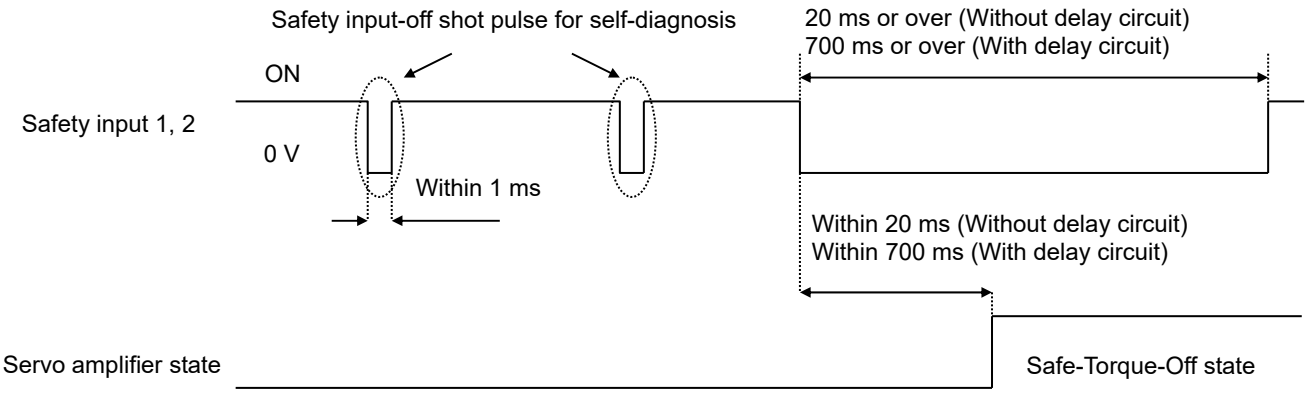
Example of wiring to safety unit (multiple-servo amplifier connected)



* Maximum voltage drop at turn on when 50 mA flows to error detection monitor circuit is 1.2 V. In case that multiple axis outputs are connected series and connected to the feedback input of safety unit, design wiring with consideration of voltage drop through multiple axis.

10.3.4 Safety input-off shot pulse for safety device self-diagnosis

When you connect safety device supplied with safety input-off shot pulse signal for self-diagnosis added to safety output signal, such as safety unit or safety sensor, use safety device whose safety input-off shot pulse signal is 1 ms or less. Safe-torque-off function is not activated when the period of safety input signal (HWGOFF1, HWGOFF2)-OFF is 1 ms or less. In order to surely fulfill safe-torque-off function, turn off safety input signal for 20 ms or more (without delay circuit) or 700 ms or more (with delay circuit).



* Torque may turn off for a moment if the pulse of 1 ms over to less than 8 ms is input.

10. Safe Torque Off function

10.4 Safe-Torque-Off operation

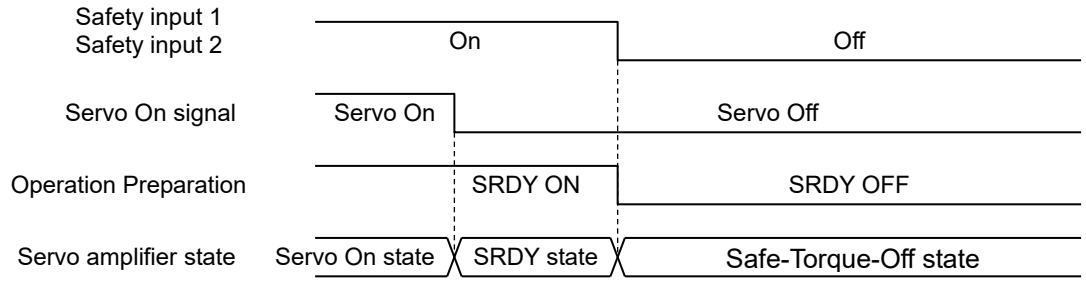
10.4.1 Safe-torque-off state

When safety input 1(HWGOFF1) or safety input 2 (HWGOFF2) signal is off (as shown the table below), the state becomes safe-torque-off state.
In this state, servo-ready signal is turned off, and servo-on signal reception is prohibited.

Signal	Input condition	Servo amplifier condition
Safety input 1 (HWGOFF1)	On	Normal state
	Off	Safe-torque-off state
Safety input 2 (HWGOFF2)	On	Normal state
	Off	Safe-torque-off state

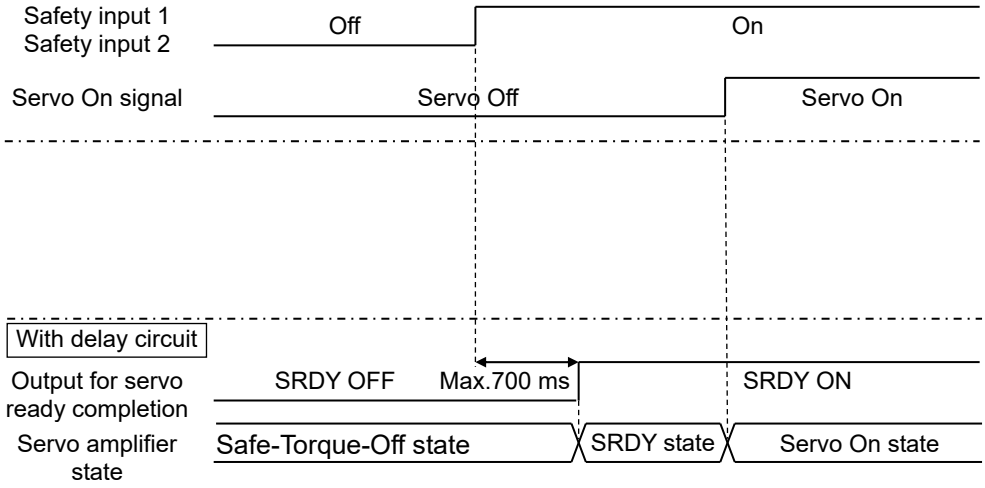
* Off: Electric current will not flow (contact open).

* On: Electric current will flow (contact closed).

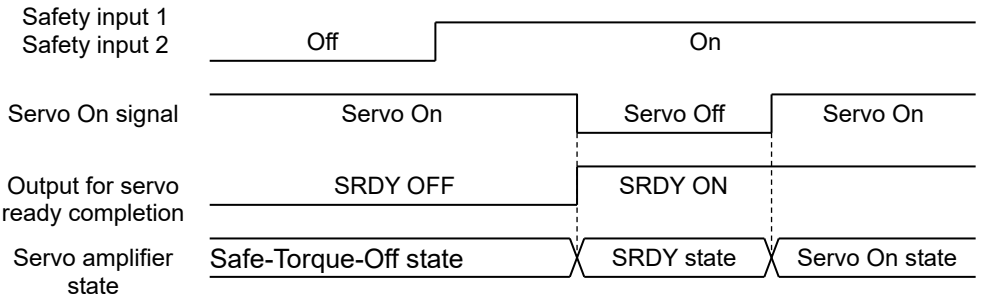


10.4.2 Restoration from safe-torque-off state

In the state servo-on signal is not input as described in 10.4.1, turning on safety input 1 or 2 activates SRDY state. Operation is restarted on inputting servo-on signal. (For delay circuit equipped hardware, it takes maximum 700 ms 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.



* For interface type [C: I/O]:
In case that servo on (S-ON) input of CN1-34 is always on, it cannot return from the Safe Torque Off state. To return from the Safe Torque Off state, turn a servo on signal off once and transit to SRDY state, and then turn on a servo on signal again.

* For interface type [F: MODBUS]:
In case that servo on (S-ON) command via MODBUS communication is always on, it cannot return from the Safe Torque Off state. To return from the Safe Torque Off state, turn a servo on command off once and transit to SRDY state, and then turn on a servo on command again.

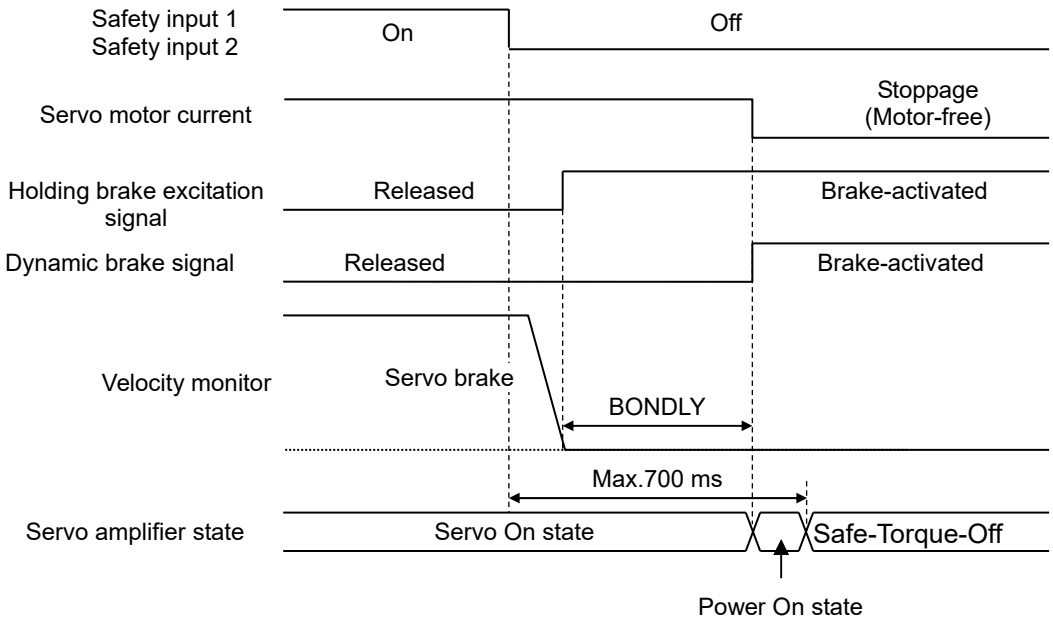
* For interface type [F: MODBUS]:
In case that "01: Always On" is set to Group9 ID05 Servo-ON Function, it cannot return from the Safe Torque Off state. Do not use this setting when using the safe torque off function.

10.4.3 Safe-Torque-Off during servo motor running

Stoppage behavior varies depending on forced outage operation settings (GroupB ID02 [ACTEMR]).

■ In case of setting "00: SERVO-BRAKE" at GroupB ID02 "Emergency Stop Operation [ACTEMR]".

◆ RS3########4 (with safe-torque-off delay circuit)
Motor stops with servo brake when safety input 1 or 2 is turned off.



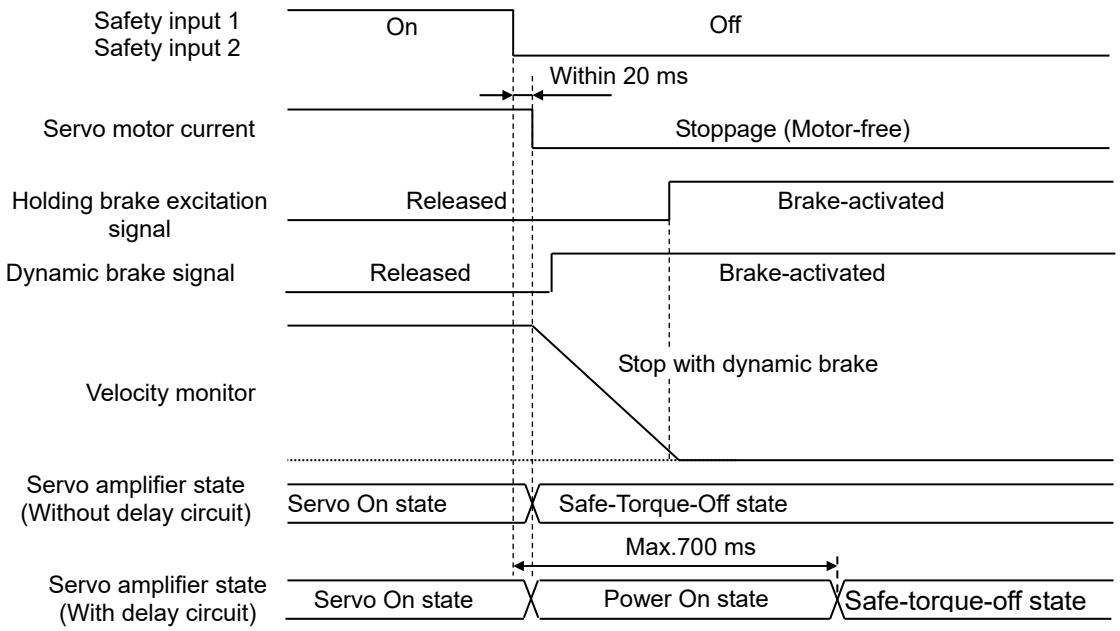
* When set value of GroupB ID03 “Holding brake activation delay time [BONDLY]” is more than safe-torque-off delay time (700 ms max.), the state becomes motor-free after period of safe-torque-off delay time. Please note that recommended set value for BONDLY is less than 300 ms.

* Servo brake circuit, dynamic brake circuit, and holding brake excitation signal are not safety-related sections.

■ In case of setting "01: DYNAMIC-BRAKE" at GroupB ID02 "Emergency Stop Operation [ACTEMR]".

When safety input 1 or 2 is turned off, this setting blocks servo motor current, and then stops servo motor with dynamic brake after. Transition behavior to safe-torque-off state varies depending on amplifier model numbers.

◆ RS3#######4 (with safe-torque-off delay circuit)
The state moves to safe-torque-off state after period of delay time (500 ms max.) from turning off safety input.
Dynamic brake is activated on turning off safety input.

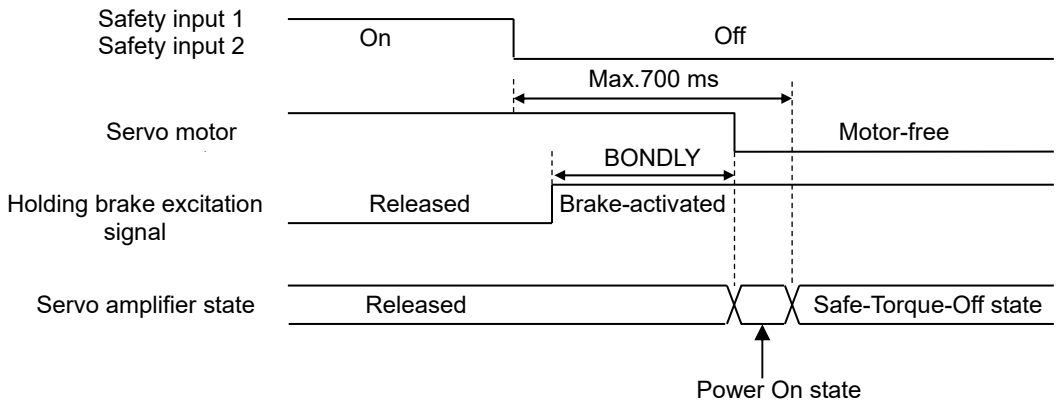


* Dynamic brake circuit and holding brake excitation signal are not safety-related sections.

10. Safe Torque Off function

10.4.4 Safe-Torque-Off during servo motor stoppage

For RS3#######4 (with safe-torque-off delay circuit), you can ensure the time to activate holding brake because of maximum 700ms of delay time by the time safe-torque-off function activated after safety input 1 or 2 is input.
Select RS3#######4 for use with gravity influenced axis.



* Set GroupB ID03 “Holding brake activation delay time [BONDLY]” to the value less than 700 ms.

* Set GroupB ID02 “Emergency Stop Operation [Emergency Stop Operation]” to "00: SERVO-BRAKE".

10.4.5 Deviation clear

When selecting 02:Type3 or 03:Type4 (not to clear deviations at servo-off state) on Group8 ID19 "Deviation Clear Selection [CLR]", please pay careful attention to the followings.
When safe-torque-off function activated under the condition that position command is input at the time of position control, position deviation accumulates and this causes alarm (excess position deviation: alarm D1) activated. Furthermore, when servo-on re-performed before alarm activated, servo motor moves by the accumulated partial position deviation. When you activated safe-torque-off function to avoid this state, stop position command and clear position deviation at the same time.
When selecting 00:Type1 or 01:Type2 (to clear deviation at servo-off state) on Group8 ID19 "Deviation Clear Selection [CLR]", position deviation is automatically cleared at servo-off.

10.4.6 Safety input signal failure detection

■ Safe-Torque-Off malfunction 1 (Alarm 25)
This alarm is activated when either safety input 1 or safety input 2 turned off, and after that the other is not turned off within 10 seconds. This allows detecting errors such as safety input signal disconnection.
If internal circuits fail, the alarm is detected after 10 seconds. However it doesn’t affect the safety circuit.

■ Safe-Torque-Off malfunction 2 (Alarm 26)
This alarm is activated when detecting internal circuit errors by judging from safety input and internal status. This allows detecting errors occurred in the circuit that stops control signal from safety input to power module.

10.5 Error Detection Monitor (EDM)

10.5.1 Specifications

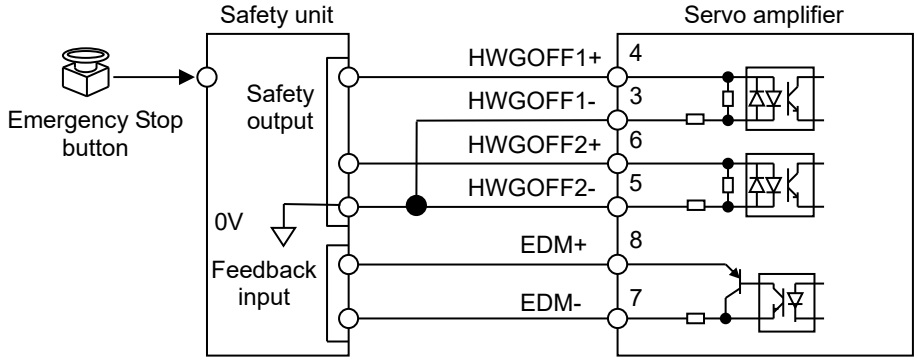
Error detection monitor (EDM) output is a signal to monitor wiring errors in safe-torque-off circuit or between safety equipment and safety input. The following table shows connections between safety input (HWGOFF1 and HWGOFF2) and error detection monitor (EDM) output.

Signal	State			
Safety input 1 (HWGOFF1)	On	On	Off	Off
Safety input 2 (HWGOFF2)	On	Off	On	Off
Error detection monitor (EDM)	Off	Off	Off	On

* If the above connections are not satisfied, the safe-torque-off circuit or EDM output circuit is malfunctioning.

10.5.2 Connection example

The following is connection example that allows activating safe-torque-off function on pressing emergency button by using safety unit.



Connect safety output signals of safety unit to safety input 1 (HWGOFF1) and safety input 2 (HWGOFF2) respectively, and then failure detection monitor output signal (EDM) from servo amplifier to feedback input of safety unit. Under normal conditions, pressing emergency stop button turns off both of safety inputs and on EDM output. Once emergency stop button is cancelled, feedback circuit of safety unit is reset and 2 safety inputs are turned on at the same time because EDM output is on. This allows restarting operation.

* In case such a malfunction occurs that EDM will not be turned on despite both the /HWGOFF1 and /HWGOFF2 being off, even if the emergency stop button is cancelled, the operation will not resume as the feedback circuit has not been reset yet. (The amplifier keeps safe-torque-off state).

10.5.3 Error detection method

EDM output will not on and EDM-signal remains off even if emergency stop button is pressed, in the case of an error such as either of safety input remains on inside of servo amplifier. In line with this, errors like this can be detected by developing system with use of safety unit enabling to detect any failures in the connections in the above table.

* In case you need to suffice requirement of ISO13849-1, PL=e, be sure to do testing of failure detection using EDM output once a month or more frequently.

* For discussions on connecting and operating the safety unit, please refer to the manual provided with your safety unit.

* The EDM signal is not a safety output. Do not use the EDM signal for any purpose other than malfunction monitoring.

10.6 Verification test

For use of the Safe Torque Off function, you must confirm that the safe torque off operations correctly during machine startup, servo amplifier replacement and test operation.
Even if it is not fit to the case above, strongly recommended that confirmation of function operation at least once every three months.

10.6.1 Preparation

Please perform test operation prior to performing verification test to verify no problems with servo amplifier and motor installation and wiring, and with servo amplifier and motor properly operate. Refer to "3. Installation", "4. Wiring" and another document M0012315 "6. Supporting function and test operation" for installation, wiring, and test operation.

10.6.2 Confirmation procedure

Perform verification test for safe-torque-off in accordance with the follow the procedures:

Procedure 1. Supply control power and main circuit power.
Procedure 2. Turn on both safety input 1and 2.
Procedure 3. Input servo-on signal to excite servo motor.
Procedure 4. Turn off both safety input 1and 2.

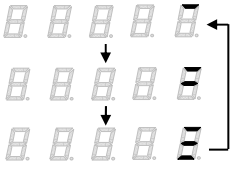
10.6.3 Acceptance criteria

In steps 2 to 4, verify the states listed below.

Procedure 1. In step 2, make sure that EDM output and LED indication are as follows:

Confirmation item	State
EDM output	Off
LED indication	

Procedure 2. In step 3, verify that servo motor is excited.
Procedure 3. In step 4, verify that EDM output and LED indication are as follows:
Also, verify that servo motor excitation is cancelled.

Confirmation item	State
EDM output	On
LED indication	

10. Safe Torque Off function

10.7 Safety precautions

Please thoroughly observe the following safety precautions to use safe-torque-off functions. Incorrect use of the functions can lead to personal injury or death.

* Safety system with safe-torque-off function shall be designed by the person with expertise of related safety standards and through understanding of the descriptions specified in this manual.

* Surely perform system risk assessment when you design safety system by using this function.

* When safe-torque-off function activated during servo motor running, power supply to servo motor is blocked but servo motor remains running through inertia. Please design your safety system so that no risks occur until servo motor comes to a complete stop.

* When used in vertical axes, servo motor runs by gravity. So please prepare means for stopping such as mechanical brake. Servo amplifier servo brake circuit, dynamic brake circuit, holding brake excitation signal, and servo motor holding brake are not safety-related sections.

* There is a possibility that servo motor runs in the range of maximum 180 electrical degree and servo motor-excited state continues, due to servo motor inter-phase short-circuit caused by power device failure. Please use this function only for usage you can judge that this behavior causes no risk conditions.

* Please perform verification test for this function at every machine start-up and servo amplifier replacement. Incorrect usage such as faulty wiring of input-output signals can lead to improper functioning and a risk condition.

* For the time of Safe Torque Off function working and the cause concerning information, recommended that recording as error log at user device.

* At inspection and maintenance for servo amplifier, strongly recommended that recording and storing a detail of inspection and maintenance.

11 Selection

In this chapter, each kind of selections are explained.

11.1 Servo motor sizing 11-1

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11.1.2 Make an operation pattern 11-2

11.1.3 Calculate motor shaft conversion load moment of inertia (J_L) 11-2

11.1.4 Calculate motor shaft conversion load torque (T_L) 11-3

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11.2.2 Maximum necessary force and necessary effective force 11-7

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11.3 Selection of regenerative resistor 11-10

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11.3.7 Thermostat connection of external regenerative resistor 11-21

11.3.8 Protection function of regenerative resistor 11-21

11.3.9 Confirmation method of regeneration power PM in actual operation 11-22

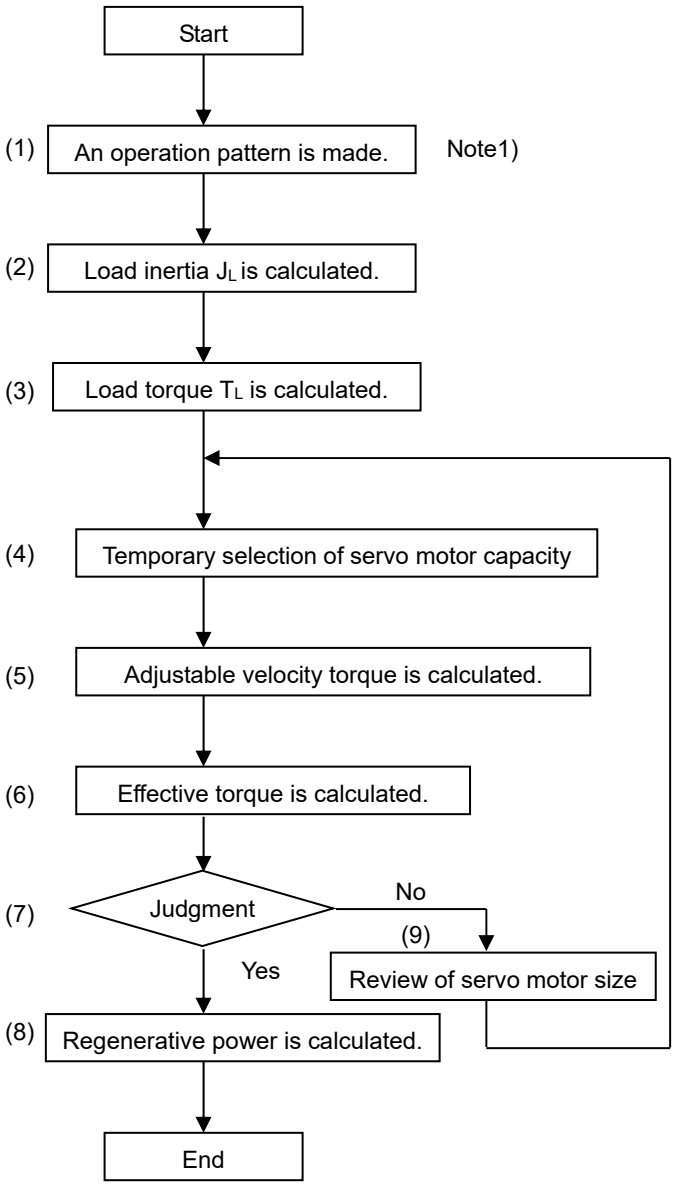
11.3.10 Precautions for external regenerative resistor use 11-23

11. Selection

11.1 Servo motor sizing

It is estimated that selection of servo motor capacity computes required servo motor capacity from machine specification (composition). In addition, since the capacity selection of a servo motor can download "the capacity selection software of a servo motor" for free from our company "website", please use it here. Here, the fundamental formula is described.

11.1.1 Flowchart of servo motor sizing



(1) Create operation pattern.
(2) Calculate load moment of inertia from a machine configuration.
(3) Calculate load torque from a machine configuration.
(4) 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.

$J_L \leqq J_M \times 10$
$T_L \leqq T_R \times 0.8$

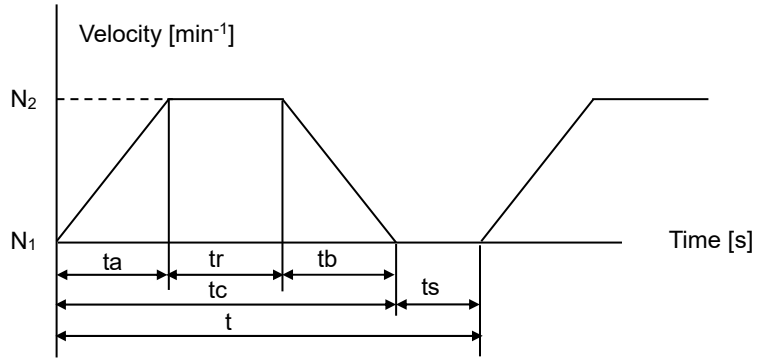
(5) Calculate the required adjustable velocity torque from an operation pattern.
(6) Calculate the effective torque from a torque pattern.
(7) Judge whether the followings have been established. Adjustable velocity torque (T_a, T_b) is 80% (T_p×0.8) or less of the peak torque at stall (T_p) of servo motor
The effective torque (Trms) is 80% (T_R×0.8) or less of the rated torque (T_R) of servo motor

$T_a \leqq T_p \times 0.8$
$T_b \leqq T_p \times 0.8$
$Trms \leqq T_R \times 0.8$

(8) Calculate regeneration electric power, and if required, select an external regeneration resistor.
(9) Improve servo motor capacity, such as raising the capacity of a servo motor.

Note1) For making operation pattern, must not exceed continuous maximum rotation speed by average rotation speed of motor.

11.1.2 Make an operation pattern



ta=Acceleration time
tb=Deceleration time
tr=Constant velocity time
ts=Stop time
t=1cycle

11.1.3 Calculate motor shaft conversion load moment of inertia (J_L)

■ The inertia moment of a moving part.

$$J_L = \left(\frac{1}{G}\right)^2 \times \frac{\pi \times \rho \times D^4 \times L}{32} \quad [kg \cdot m^2]$$

G: Reduction ratio
ρ : Moving part specific gravity [kg/m^3]
D: Moving part diameter [m]
L: Moving part length [m]

■ Work inertia moment

$$J_L = \left(\frac{1}{G}\right)^2 \times W \times \left(\frac{P}{2\pi}\right)^2 \quad [kg \cdot m^2]$$

G: Reduction ratio
W: Moving part mass [kg]
P: In the case of a ball screw, is the lead of a ball screw [m]
In the case of a belt pulley, is an outside diameter of a pulley. [m]
($P = \pi D$)

11.1.4 Calculate motor shaft conversion load torque (T_L)

■ Ball screw (in horizontal axis)

$$T_L = \frac{(F + \mu W)}{\eta} \times \frac{P}{2\pi} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

■ Ball screw (in vertical axis)

When motor drives upward

$$T_L = \frac{(F + (\mu + 1)W)}{\eta} \times \frac{P}{2\pi} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

When motor drives downward

$$T_L = \frac{(F + (\mu - 1)W)}{\eta} \times \frac{P}{2\pi} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

■ When ball screw stops (in horizontal axis)

$$T_L = \frac{F}{\eta} \times \frac{P}{2\pi} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

■ When ball screw stops (in vertical axis)

$$T_L = \frac{(F+W)}{\eta} \times \frac{P}{2\pi} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

F: External force [kg]
η : Transmission efficiency
μ: Coefficient of friction
W: Moving part mass [kg]
P: Ball screw lead [m]
G: Reduction ratio

■ Belt pulley (in vertical axis)

$$T_L = \frac{(F+\mu W)}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

■ Belt pulley (in vertical axis)

Belt pulley (in vertical axis)

$$T_L = \frac{(F+(\mu+1)W)}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

When motor drives downward

$$T_L = \frac{(F+(\mu-1)W)}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

■ When belt pulley stops (in horizontal axis)

$$T_L = \frac{F}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

■ When belt pulley stops (in vertical axis)

$$T_L = \frac{(F+W)}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

F: External force [kg]
η : Transmission efficiency
μ: Coefficient of friction
W: Moving part mass [kg]
P: Diameter of a pulley [m]
G: Reduction ratio

11.1.5 Calculate acceleration torque (T_a)

$$T_a = \frac{2\pi\ (N_2-N_1) \times (J_L+J_M)}{60 \times ta} + T_L \quad [N\cdot m]$$

N_2: Servo motor rotation velocity after acceleration [min^{-1}]
N_1: Servo motor rotation velocity before acceleration [min^{-1}]
J_L: Load inertia moment [$kg\cdot m^2$]
J_M: Rotor inertia moment of servo motor [$kg\cdot m^2$]

11.1.6 Calculate deceleration torque (T_b)

$$T_b = \frac{2\pi\ (N_2-N_1) \times (J_L+J_M)}{60 \times tb} - T_L \quad [N\cdot m]$$

N_2: Servo motor rotation velocity before deceleration [min^{-1}]
N_1: Servo motor rotation velocity after deceleration [min^{-1}]
J_L: Load inertia moment [$kg\cdot m^2$]
J_M: Rotor inertia moment of servo motor [$kg\cdot m^2$]

11.1.7 Calculate effective torque (Trms)

$$Trms = \sqrt{\frac{(T_a^2 \times ta) + (T_L^2 \times tr) + (T_b^2 \times tb)}{t}} \quad [N\cdot m]$$

11.1.8 Judgment condition

■ We consider the followings as the standard of the judgment.

◆ Load torque load ratio $T_L \leqq T_R \times 0.8$ (Load torque is 80% or less of rated torque)

◆ Acceleration torque load ratio $T_a \leqq T_P \times 0.8$ (Acceleration torque is 80% or less of peak torque at stall)
* T_P: peak torque at stall

◆ Deceleration torque load ratio $T_b \leqq T_P \times 0.8$ (Deceleration torque is 80% or less of peak torque at stall)
* T_P: peak torque at stall

◆ Effective torque load ratio $Trms \leqq T_R \times 0.8$ (The effective torque is 80% or less of rated torque)

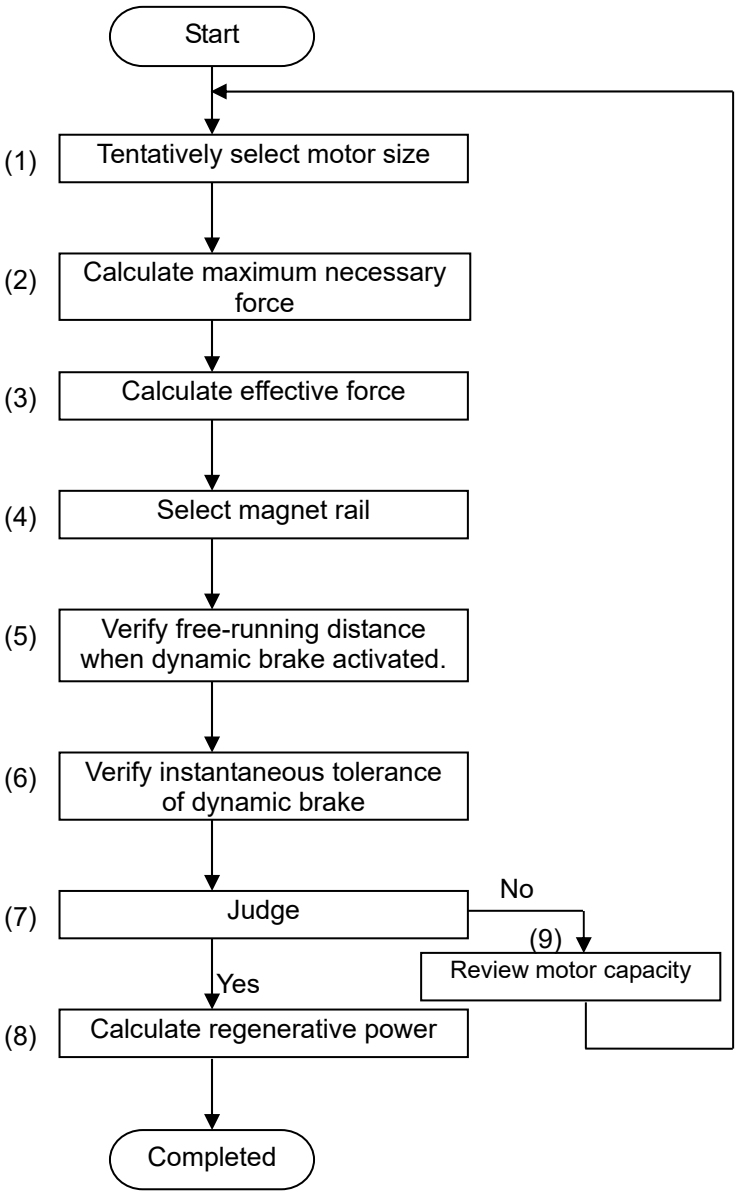
◆ Inertia moment ratio $J_L \leqq J_M \times 10$(Load moment of inertia is 10 times or less of the motor rotor moment of inertia)

In addition, the rise in heat of motor can be suppressed by taking the large degree of margin at torque load ratio. Moreover, when rotating a table mechanism slowly depending on inertia moment ratio, it may be able to control 10 or more times. We recommend you the check by the real machine.

11.2 Linear motor sizing

It is estimated that selection of linear motor capacity computes required linear motor capacity from machine specification (composition). Here, the fundamental formula is described.

11.2.1 Flowchart of linear motor sizing



(1) Tentatively select motor size
Tentatively select coil whose maximum force satisfies the necessary force for use.
(At least "load mass × maximum acceleration+α" or more is needed.)

(2) Calculate maximum necessary force
Calculate necessary maximum force in consideration of motor mass, friction, and gravity. Confirm that the maximum force of tentatively selected motor is necessary maximum force or over. Having a margin of 10% or more is recommended in consideration of load fluctuation.

(3) Calculate effective force
Confirm that the continuous rated force of tentatively selected motor is necessary effective force or over.
Having a margin of 10% or more is recommended in consideration of load fluctuation.

(4) Select magnet rail
Select magnet rail to satisfy the necessary stroke for tentatively selected motor.

(5) Verify free-running distance when dynamic brake activated.
Calculate free-running distance of dynamic brake on tentatively selected motor, and confirm that no problems with operation.

(6) Verify instantaneous tolerance of dynamic brake.
Calculate energy for single activation of dynamic brake of selected motor consumed by dynamic brake resistor, and then confirm the energy is amplifier allowable value or less.

(8) Calculate regenerative power
Calculate regenerative power of selected motor, and then confirm that the power is regenerative resistor allowable power or less.

(9) Review motor capacity

11. Selection

11.2.2 Maximum necessary force and necessary effective force

■ Calculate frictional force: Ff

$Ff = (M \cdot g \cdot \cos\theta + Fatt) \cdot \mu + Fadd$ [N]

Mc	: Mover mass	[kg]	
ML	: Load mass	[kg]	
M	: Moving part mass = Mc + ML	[kg]	
g	: Gravity acceleration= 9.8	[m/s^2]	
cosθ	: Angle to horizontal driving surface	[rad]	(For horizontal surface, cosθ=1)
Fatt	: magnetic attractive force	[N]	
μ	: Frictional coefficient		
Fadd	: Sealing resistance	[N]	(including kinetic friction, cover friction, and cable routing resistance)

■ Calculate gravity applied to moving parts.

$Fw = M \cdot g \cdot \sin\theta$ [N]

M	: Mover mass = Mc + ML	[kg]	
g	: Gravity acceleration= 9.8	[m/s^2]	
θ	: Angle to horizontal driving surface	[rad]	(For horizontal surface, sinθ=0)

■ Calculate maximum necessary force: Fmax,
and then confirm that "maximum motor force Fp > maximum necessary force: Fmax".

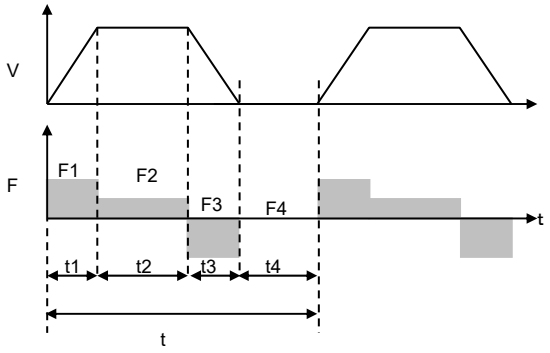
$Fmax = M \cdot amax + Ff + Fw + Fwork$ [N]

M	: Mover mass=Mc + ML	[kg]
amax	: Maximum acceleration	[m/s^2]
Ff	: Frictional force	[N]
Fw	: Gravity	[N]
Fwork	: Process reaction force	[N]

* Having a margin of “$0.9 \cdot Fp \geqq Fmax$” or more is recommended in consideration of load fluctuation.

■ Confirm that "motor continuous rated force: Fr > effective force: Frms".

$$Frms = \sqrt{\frac{(F1^2 \cdot t1 + F2^2 \cdot t2 + F3^2 \cdot t3 + \cdots)}{t}} \quad [N]$$



* Having a margin of “0.9 · Fr ≧ Frms” or more is recommended in consideration of load fluctuation.

11.2.3 Select magnet rail

5 types of magnet rail (with core or core-less) length are offered as follows:
64, 128, 256, 512 [mm]
Decide the length so as to be “magnet rail length ≧ coil length + stroke + margin”.
Provided that mounting magnet rail to the remaining half part from the end of the stage and mounting coil to moving stage where magnet rail not mounted are recommended to facilitate installation of coil into machine.

11.2.4 Cautions on load conditions

■ Negative load

Servo amplifier cannot operate with negative load such that motor is continuously driven by load for more than several seconds.

[e.g.]
・Downward driving force of motor (No counterweight)
Please contact us to apply this system to negative load.

■ Load mass (ML)

When using this system in the situation that load mass (ML) is too large compared to mover mass, main circuit power supply overvoltage detection or regenerative error can be activated when decelerating.

In this case, the following processes are needed. Please contact us for the details.
(1) Decrease force limit.
(2) Lengthen acceleration time (slow down)
(3) Decrease maximum velocity in use.
(4) Install external regenerative resistor (optional).

11.3 Selection of regenerative resistor

Calculate "regeneration effective power (PM)," and determine the capacity of the regeneration resistance to be used. Judge whether usage of an internal regenerative register machine is possible by this calculation result.

11.3.1 How to find "regeneration effective power (PM)" of the horizontal axis drive by a formula

■ Calculate regeneration energy.

$$EM = Ehb = \frac{1}{2} \times N \times 3 \times Ke\phi \times \frac{Tb}{KT} \times tb - \left[\frac{Tb}{KT}\right]^2 \times 3 \times R\phi \times tb$$

EM : EM: Regeneration energy during operations along horizontal axis [J]
Ehb : Regeneration energy during deceleration [J]
Keϕ : Voltage constant per 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]

11.3.2 How to find "regeneration effective power (PM)" of the vertical axis drive by a formula

■ Calculate regeneration energy.

$$EM = EVUb + EVD + EVDb$$

$$= \frac{1}{2} \times N \times 3 \cdot Ke\phi \times \frac{TUb}{KT} \times tUb - \left[\frac{TUb}{KT}\right]^2 \times 3 \cdot R\phi \times tUb$$

$$+ N \times 3 \cdot Ke\phi \times \frac{TD}{KT} \times tD - \left[\frac{TD}{KT}\right]^2 \times 3 \cdot R\phi \times tD$$

$$+ \frac{1}{2} \times N \times 3 \cdot Ke\phi \times \frac{TDb}{KT} \times tDb - \left[\frac{TDb}{KT}\right]^2 \times 3 \cdot R\phi \times tDb$$

EM : Regeneration energy during operation in horizontal axis [J]
EVUb : Regeneration energy while motor drives upward during deceleration [J]
EVD : Regeneration energy while motor drives downward [J]
EVDb : Regeneration energy while motor drives downward during deceleration [J]
$Ke\phi$: Voltage constant per phase [$Vrms/min^{-1}$] (Motor constant)
KT : Torque constant [N・m/Arms] (Motor constant)
N : Motor rotational velocity [min^{-1}]
$R\phi$: Phase resistance [Ω] (Motor constant)
Tub : Torque while motor drives upward during deceleration [N・m]
tUb : Period of time motor drives upward during deceleration [s]
TD : Torque while motor drives downward [N・m]
tD : Period of time motor drives downward [s]
TDb : Torque while motor drives downward during deceleration [N・m]
tDb : Period of time motor drives downward during deceleration [s]

* When the calculation result of either of EVUb, EVD, or EVDb is negative, calculate EM by considering the value of those variabkes as 0.

■ Calculate "regeneration effective power" from regeneration energy.

$$PM = \frac{EM}{to}$$

PM : Effective regeneration power [W]
EM : Regeneration energy during deceleration [J]
to : Cycle time [s]

11.3.3 Selection of regenerative resistor

Judge whether an internal regenerative resistor can be used from the calculation result. Moreover, when you cannot use it, determine the capacity of an external regeneration resistor.

■ Allowable power of an internal regenerative resistor
If the value of the regeneration effective power "PM" by the calculation result is below the value of [PRI] of the following table, an internal regenerative resistor can be used. Please use an external regenerative resistor at excepting conditions below.

Servo amplifier model number	Allowable regeneration resistance power to be used with an internal regenerative resistor [PRI]	Instantaneous capacity	Internal resistance value
RS3#01A##A#	5 W or less	408 J	50 Ω
RS3#02A##A#	5 W or less	408 J	50 Ω
RS3#03A##A#	5 W or less	408 J	50 Ω
RS3A05A##A#	20 W or less	743 J	17 Ω
RS3A07A##A#	60 W or less	2,300 J	10 Ω
RS3A10A##A#	90 W or less	4,400 J	10 Ω
RS3A15A##A#	120 W or less	6,400 J	6 Ω

◆ 400 VAC input

Servo amplifier model number	Allowable regeneration resistance power to be used with an internal regenerative resistor [PRI]	Instantaneous capacity	Internal resistance value
RS3#02A##A#	15 W or less	500 J	80 Ω
RS3A05A##A#	28 W or less	2,100 J	40 Ω
RS3A10A##A#	40 W or less	10,100 J	20 Ω

11. Selection

■ Allowable power of an external regenerative resistor
When regeneration effective power "PM" becomes more than the allowable power of the amplifier internal regenerative resistor, the optional external regenerative resistor which is shown at "11.2.4" can be connected and operated. Allowable regenerative power and minimum resistance value of regenerative resistor are shown in below table.

Servo amplifier/ power unit model number	Allowable regeneration resistance power to be used by an external regenerative resistor [PR0]	Allowable minimum resistance value of external regenerative resistor
RS3#01A##L#	125 W or less	35 Ω
RS3#02A##L#	125 W or less	35 Ω
RS3#03A##L#	125 W or less	35 Ω
RS3A05A##L#	250 W or less	17 Ω
RS3A07A##L#	500 W or less	10 Ω
RS3A10A##L#	500 W or less	10 Ω
RS3A15A##L#	500 W or less	6 Ω
RS3A30A##L#	500 W or less	2.5 Ω
RS3PAA270##	500 W or less	2.5 Ω

◆ 400 VAC input

Servo amplifier/ power unit model number	Allowable regeneration resistance power to be used by an external regenerative resistor [PR0]	Allowable minimum resistance value of external regenerative resistor
RS3#02A##L#	125 W or less	80 Ω
RS3A05A##L#	220 W or less	40 Ω
RS3A10A##L#	500 W or less	20 Ω
RS3C15A##L#	1,000 W or less	13 Ω
RS3C30A##M#	2,000 W or less	6.5 Ω
RS3PAC550##	5,000 W or less	2.4 Ω

* When regeneration effective power PM exceeds the maximum permitted power (PRO) of the external regeneration resistor, reconsider the acceleration constant, load inertia, etc.
* RS3PAA270 and RS3PAC550 power unit have no built-in regenerative resistor so external regenerative resistor shall be connected for use.
* For use of external regenerative resistor, "02: External_R" shall be selected into regenerative resistor selection and resistance value shall be set correct. Refer the section 11.3.8 for detail. Average power monitor doesn't show accurate if resistance value is not set correct.

1.3.4 Selection of external regenerative resistor

With the regeneration effective power "PM" found from calculation, choose the external regeneration resistor to be used from the following table.

Servo amplifier model number	[PM]	20W or less	30W or less	55W or less	60W or less	110W or less	125W or less
RS3#01A##L# RS3#02A##L# RS3#03A##L#	Resistor Sign	B×1	D×1	F×1	C×2	E×2	D×4
	Connection Number	Ⅲ	Ⅲ	Ⅲ	Ⅴ	Ⅴ	Ⅵ

Servo amplifier model number	[PM]	55W or less	125W or less	250W or less
RS3A05A##L#	Resistor Sign	G×1	H×1	I×2
	Connection Number	Ⅲ	Ⅲ	Ⅳ

Servo amplifier model number	[PM]	125W or less	250W or less	500W or less
RS3A07A##L#	Resistor Sign	I×1	H×2	I×4
	Connection Number	Ⅲ	Ⅴ	Ⅵ

Servo amplifier model number	[PM]	125W or less	250W or less	500W or less
RS3A10A##L#	Resistor Sign	I × 1	H × 2	I × 4
	Connection Number	Ⅲ	Ⅴ	Ⅵ

Servo amplifier model number	[PM]	125W or less	250W or less	500W or less
RS3A15A##L#	Resistor Sign	J × 1	K × 2	J × 4
	Connection Number	Ⅲ	Ⅴ	Ⅵ

Servo amplifier model number	[PM]	125W or less	250W or less	500W or less
RS3A30A##L#	Resistor Sign	J × 1	M × 1	M × 2
	Connection Number	Ⅲ	Ⅲ	Ⅴ

Power unit model number	[PM]	250W or less	500W or less
RS3PAA270##	Resistor Sign	L × 2	I × 4
	Connection Number	Ⅴ	Ⅹ

* The resistor sign of an external regeneration resistor and the connection number correspond with the following page.

* The permissible effective power of external regenerative resistor is maximum 25% of the rated power under natural air cooling.

* The permissible effective power of external regenerative resistor is maximum 50% of the rated power under forced air cooling by fan.

11. Selection

◆ 400 VAC input

Servo amplifier model number	[PM]	125W or less		
RS3C02A##A#	Resistor Sign	A' × 1		
	Connection Number	III		

Servo amplifier model number	[PM]	125W or less	250W or less	
RS3C05A##A#	Resistor Sign	B' × 1	A' × 2	
	Connection Number	III	V	

Servo amplifier model number	[PM]	125W or less	250W or less	500W or less
RS3C10A##A#	Resistor Sign	C' × 1	B' × 2	C' × 4
	Connection Number	III	V	VI

Servo amplifier model number	[PM]	125W or less	250W or less	500W or less	1kW or less
RS3C15A##L#	Resistor Sign	D' × 1	E' × 2	D' × 4	E' × 8
	Connection Number	III	IV	VI	VII

Servo amplifier model number	[PM]	125W or less	250W or less	500W or less	1kW or less	2kW or less
RS3C30A##M#	Resistor Sign	E' × 1	D' × 2	E' × 4	D' × 8	E' × 16
	Connection Number	III	V	VI	VIII	IX

Power unit model number	[PM]	250W or less	500W or less	1kW or less	2kW or less	4kW or less
RS3PAC550##	Resistor Sign	G' × 2	F' × 4	C' × 8	B' × 16	A' × 32
	Connection Number	V	X	XI	IX	XII

* The resistor sign of an external regeneration resistor and the connection number correspond with the following page.

* The permissible effective power of external regenerative resistor is maximum 25% of the rated power under natural air cooling.

* The permissible effective power of external regenerative resistor is maximum 50% of the rated power under forced air cooling by fan.

11.3 Selection of regenerative resistor

11.3.5 Specification of external regenerative resistor

The resistor model name corresponds with the sign of the external regeneration resistor selected for the preceding clause.

◆ 200 VAC input

Resistor Sign	Resistor Model Number	Rated power [PR]	Resistance Value	Thermostat Detection temperature (Contact specification)	Permissible Effective Power [PM]	Allowable instantaneous capacity [JI]	Mass
A	REGIST-080W100B	80W	100Ω	135°C±7°C (Switching contact b)	20W	35J	0.19kg
B	REGIST-080W50B	80W	50Ω		20W	35J	
C	REGIST-120W100B	120W	100Ω		30W	50J	0.24kg
D	REGIST-120W50B	120W	50Ω		30W	80J	
E	REGIST-220W100B	220W	100Ω		55W	90J	0.44kg
F	REGIST-220W50B	220W	50Ω		55W	125J	
G	REGIST-220W20B	220W	20Ω		55W	210J	
H	REGIST-500CW20B	500W	20Ω	100°C±5°C (Switching contact b)	125W	9,300J	1.4kg
I	REGIST-500CW10B	500W	10Ω		125W	9,300J	
J	REGIST-500CW7B	500W	7Ω		125W	7,500J	
K	REGIST-500CW14B	500W	14Ω		125W	13,000J	
L	REGIST-500CW5B	500W	5Ω		125W	8,000J	
M	REGIST-1000W6R7B	1000W	6.7Ω	140°C±5°C (Switching contact b)	250W	26,000J	3.0kg

◆ 400 VAC input

Resistor Sign	Resistor Model Number	Rated power [PR]	Resistance Value	Thermostat Detection temperature (Contact specification)	Permissible Effective Power [PM]	Allowable instantaneous capacity [JI]	Mass
A’	REGIST-500CW80B	500W	80Ω	100°C±5°C (Switching contact b)	125W	4,200J	1.4kg
B’	REGIST-500CW40B	500W	40Ω		125W	6,400J	
C’	REGIST-500CW20B	500W	20Ω		125W	9,300J	
D'	REGIST-500CW14B	500W	14Ω		125W	13,000J	
E'	REGIST-500CW7B	500W	7Ω		125W	7,500J	
F’	REGIST-500CW10B	500W	10Ω		125W	9,300J	
G’	REGIST-500CW5B	500W	5Ω		125W	8,000J	

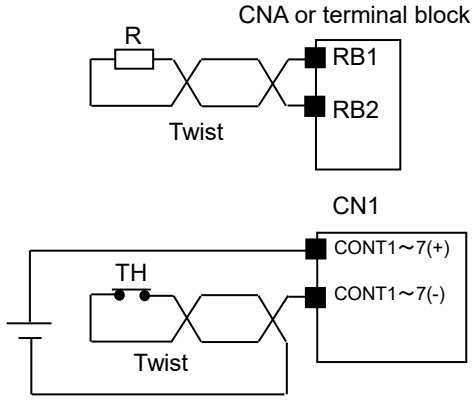
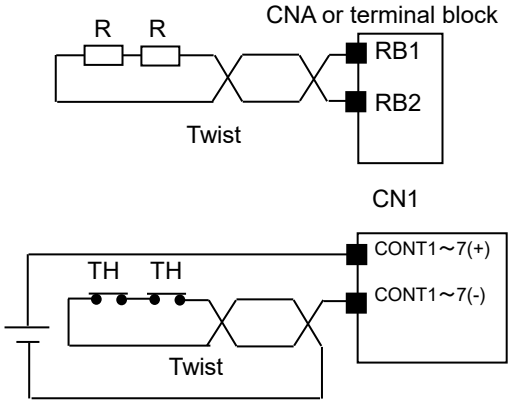
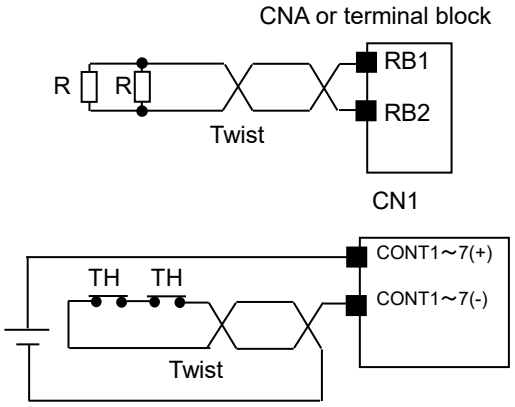
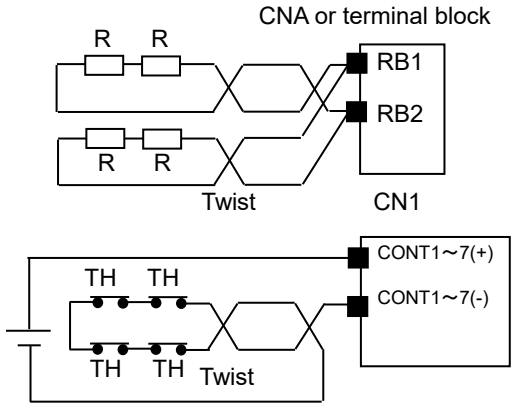
* Refer the section 12.9.10 for external dimension of regenerative resistor.
* Permissible Effective Power value is at condition of natural air cooling.

11. Selection

11.3.6 Connection of regenerative resistor

The connection method of a resistor corresponds with the connection number of the external regeneration resistor selected by the 4) clause.

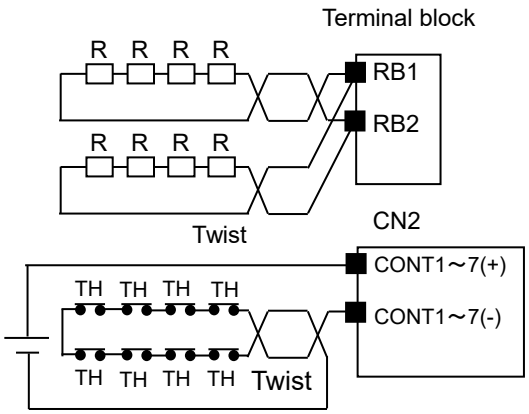
■ Connection of regenerative resistor

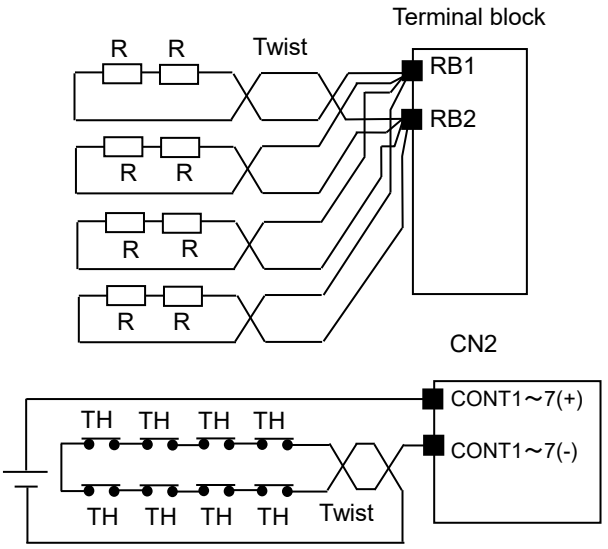
Connection Number Ⅲ	Connection Number Ⅳ
One resistance is connected.	Series connection about two resistances.
	
Connection Number Ⅴ	**Connection Number Ⅵ**
Parallel connection about two resistances.	Series/ parallel connection about four resistances.
	

* Thermostat shall be connected to general input in CN2.
* For amplifier: capacity 75A/100A/150A (200VAC input type), mount an external regenerative resistor to terminals of RB1 and RB2 after removing short-bar between RB1 and RB4.
* For RS3C02/05/10, mount an external regenerative resistor to terminals of RB1 and RB2 after removing short-wire between RB1 and RB4.
* Do not connect short-wire between terminals of RB1 and RB2.

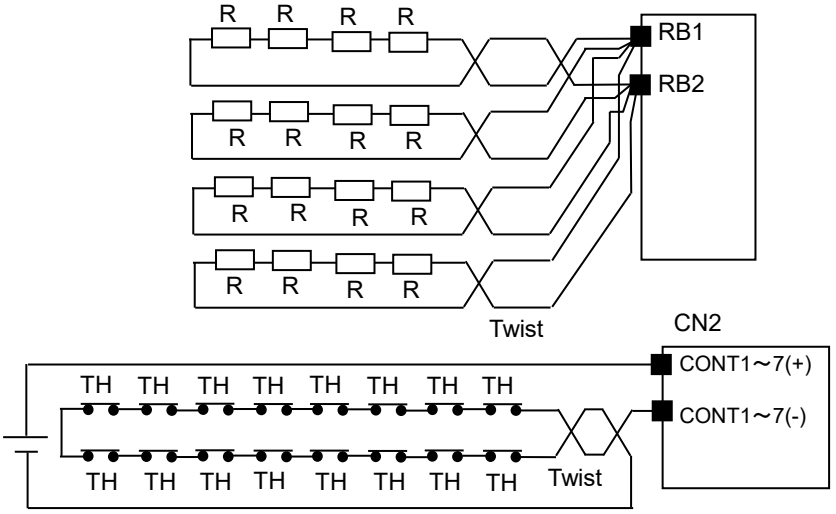
11.3 Selection of regenerative resistor

Connection Number Ⅶ	Connection Number Ⅷ
■ 8 resistors connected serial/parallel.	■ 8 resistors connected serial/parallel.





Connection Number Ⅸ
■ 16 resistors connected serial/parallel.

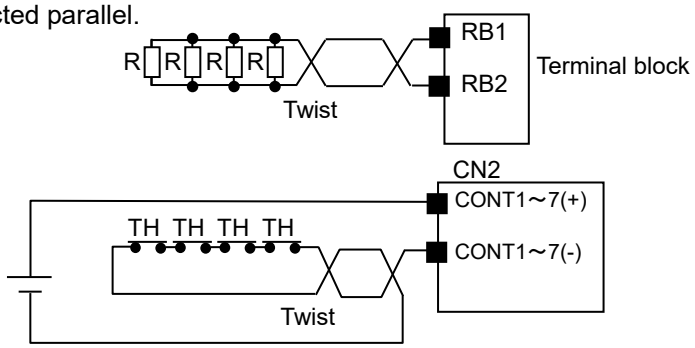


* Thermostat shall be connected to general input in CN2.
* For RS3C02/05/10, mount an external regenerative resistor to terminals of RB1 and RB2 after removing short-wire between RB1 and RB4.
* Do not connect short-wire between terminals of RB1 and RB2.

11. Selection

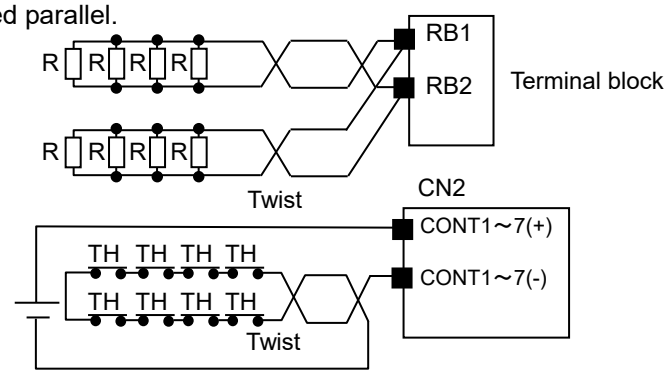
Connection Number Ⅹ

■ 4 resistors connected parallel.



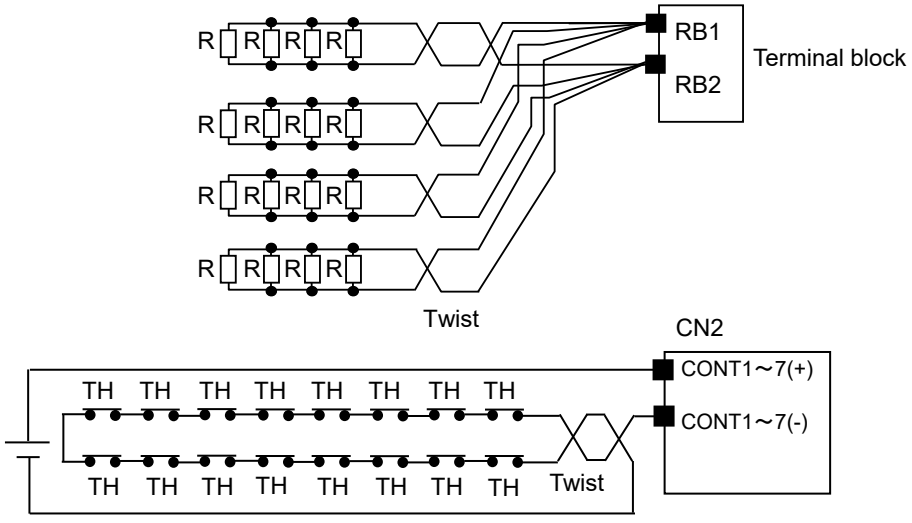
Connection Number ⅩⅠ

■ 8 resistors connected parallel.



Connection Number ⅩⅡ

■ 16 resistors connected parallel.

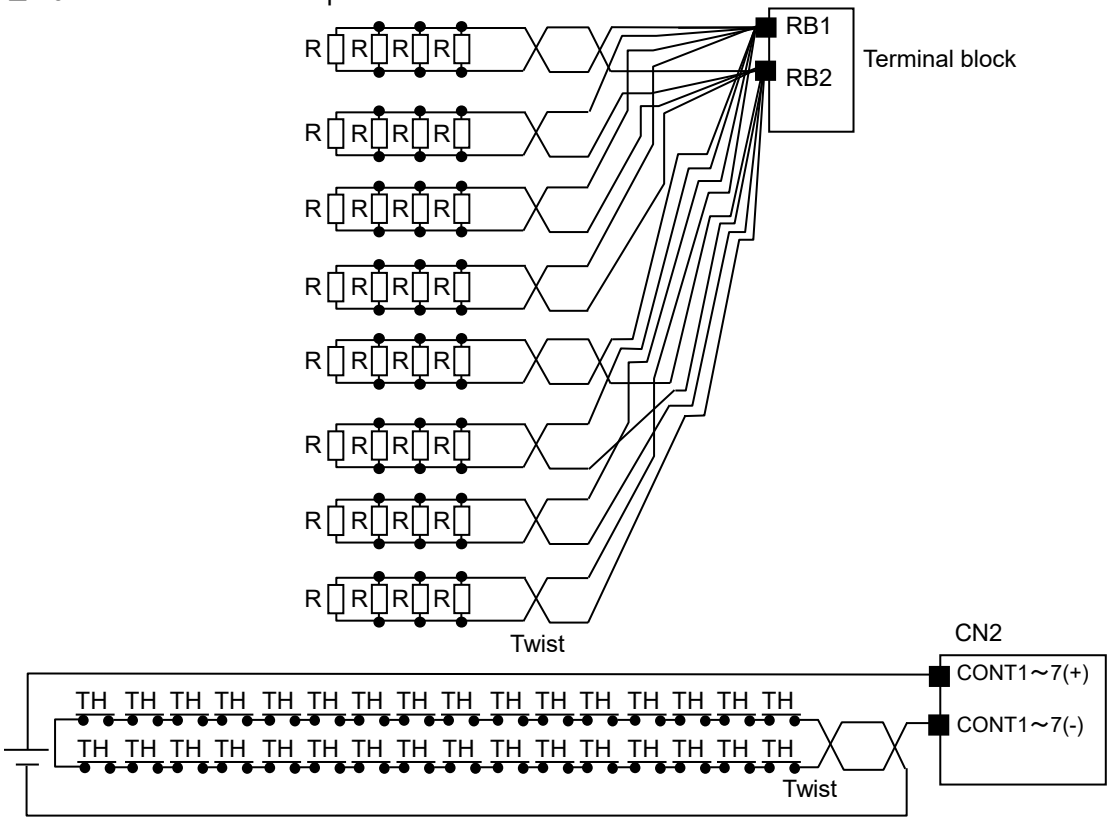


* Thermostat shall be connected to general input in CN2.
* Do not connect short-wire between terminals of RB1 and RB2.

11.3 Selection of regenerative resistor

Connection Number XIII

■ 32 resistors connected parallel.



* Thermostat shall be connected to general input in CN2.

* Do not connect short-wire between terminals of RB1 and RB2.

11.3.7 Thermostat connection of external regenerative resistor

Connect a thermostat to either of "the general-purpose inputs CONT1-CONT7". Depending on the connected general-purpose input signal terminal, please set the Index 0x20F8-3 "External Trip Input Function [EXT-E]".

■ Example: when connecting the thermostat to CONT6
The external trip function will be valid when "0DH:CONT6_OFF" is set to the Index 0x20F8-3 "External Trip Input Function [EXT-E]" and CONT6 is turned off. Alarm AL.55 will be output from the servo amplifier when the thermostat of a generative resistor trips (the contact point comes off) because of heating. Refer to "4.2 Wiring with host unit for the wiring method".

11.3.8 Protection function of regenerative resistor

The regenerative resistor protection function is specified by parameter selections. Appropriate protection for regenerative resistor is applied by setting parameters according to the type of regenerative resistor to be connected. Set the appropriate parameters by following the instructions given below.

■ The two parameters requiring settings are given below.

◆ Index 0x20FD-2 “Regenerative resistor selection”
- Must set "01: Built-in_R" when internal regenerative resistor is used.
- Must set "02: External_R" when external regenerative resistor is used.

◆ Index 0x20F8-3 “External Trip Input Function [EXT-E]”
- When thermostat is connected to the servo amplifier, please set the Index 0x20F8-3 "External Trip Input Function [EXT-E]" depending on the connected general-purpose input signal terminal.

■ The protection functions are divided into three main types:

◆ Protection for a short-time, high load factor (using built-in or external regenerative resistor):
An error is detected when the power absorption of regenerative resistor is extremely high over a short time period (100msec to 10 seconds). A ‘Regenerative Error’ alarm “AL.43” is issued when this error is detected.

◆ Protection when allowable power absorption is exceeded for long time (using built-in regenerative resistor):
An error is detected when the power absorption of the built-in regenerative resistor exceeds the allowable power absorption over a long time period (from a few seconds to a few minutes). An ’Internal Overheat’ alarm “AL.54” is issued when this error is detected.

◆ Protection during thermostat operation of the external regenerative resistor:
An error will be detected when External Trip Function works. An ’External Error’ alarm “AL.55” is issued when this error is detected.

11.3.9 Confirmation method of regeneration power PM in actual operation

Regeneration power PM can be easily confirmed in the digital operator or by the setup software.

■ Digital operator: Monitor mode ID40 "Regenerative Resistor Operation Percentage monitor"

■ Setup software: Monitor display ID40 "Regenerative Resistor Operation Percentage monitor"

* The monitor value of the regenerative resistor operation percentage shows the operating rate of regeneration circuit.

* The display range is 0.00% - 99.9%.

■ The actual regeneration effective power PM can be calculated from this monitor value by following equation.

◆ Input Supply Voltage: In case of 200 VAC 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 100 VAC specification

$$\text{Regeneration effective power [PM](W)} = \frac{200(\text{V}) \times 200(\text{V})}{\text{Regeneration resistance}(\Omega)} \times \frac{\text{Regenerative Resistor Operation Percentage (\%)}}{100(\%)}$$

◆ Input Supply Voltage: In case of 400 VAC specification

$$\text{Regeneration effective power [PM](W)} = \frac{800(\text{V}) \times 800(\text{V})}{\text{Regeneration resistance}(\Omega)} \times \frac{\text{Regenerative Resistor Operation Percentage (\%)}}{100(\%)}$$

■ Calculation Example
Input Supply Voltage: [200 VAC Specification]
Regeneration resistance value: 50Ω [Built-in Regenerative Resistor]
Monitor Value (RegP): 0.12%

$$\text{Regeneration effective power [PM](W)} = \frac{400(\text{V}) \times 400(\text{V})}{\text{Regeneration resistance}(\Omega)} \times \frac{0.12(\%)}{100(\%)} = 3.84\ (\text{W})$$

* The regeneration power calculated from this monitor value continues to be the target until the end of operations. Regeneration power varies with the voltage fluctuation of the input power supply and changes across the ages of the servo amplifier and the loading device.

* Be sure to opt for selection of regeneration resistance based on the regeneration effective power "PM" found from calculation of a pattern of operation and regeneration power.

* Install the external regeneration resistor on equipment, and measure the temperature of the external regeneration resistor by the operating condition that the regeneration effective power “PM” becomes the maximum. Then do sufficient mounting check of alarm not being generated. In addition, it takes 1 to 2 hours until the temperature of the external regeneration resistor is saturated.

* Monitor display ID4C "Regenerative power monitor" can use substitute of above calculation.

11. Selection

11.3.10 Precautions for external regenerative resistor use

- The place where corrosive gas has occurred, and when there is much dust, insulated degradation, corrosion, etc. may arise. Therefore be careful of an attachment place.
- External regeneration resistor should be placed by keeping enough distance from the other parts so as not to be affected by the other parts-generated heat.
- Must wiring by twisted lines to external regenerative resistor. Wiring length keeps 5 m or less, and aims as short as it can.
- Wiring should keep no contact with regenerative resister, and using flame-retardant cable or giving flame-retardant by silicon tube.

12 Appendix

In this chapter, standards conformity, servo amplifier outline drawing and option parts are explained.

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12.1.1 Standards Conformity 12-1

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12.1 Standards Conformity

In our company, compatibility examinations of overseas standards are carried out in certificate authorities, and attestation markings are done based on the published certificate of attestation.

12.1.1 Standards Conformity

■ Servo amplifier/power unit/amplifier unit implement the standards examinations below.

Product model NO.	Applicable laws and Regulations		Standard code	Certificate authorities
	Class	Detailed class		
RS3###A### **#**	UL/c-UL standards		UL61800-5-1	UL (Underwriters Laboratories inc.)
RS3###A### **0** (Safe Torque Off function Unequipped model)	Electrical safety	Electrical safety under Low Voltage Directive (2014/35/EU)	IEC61800-5-1 EN61800-5-1	TÜV (TÜV SÜD Japan, Ltd.)
	EMC	EMC under EMC Directive (2014/30/EU)	EN61000-6-2 IEC61800-3 (Note 1) EN61800-3 (Note 1)	TÜV (TÜV SÜD Japan, Ltd.)
RS3###A### **2** RS3###A### **4** (Safe Torque Off function equipped model)	Electrical safety	Electrical safety under Low Voltage Directive (2014/35/EU)	IEC61800-5-1 EN61800-5-1	TÜV (TÜV SÜD Japan, Ltd.)
	Functional Safety	Generic Functional safety	IEC61508 EN61508 (SIL3)	(Blue octagon)
		Functional safety under Machinery Directive (2006/42/EC)	IEC62061 EN62061(SILCL3)	
		Functional safety under Machinery Directive (2006/42/EC)	EN ISO13849-1/ 2015(Cat.3, PL=e)	
		Functional safety for PDS under Machinery Directive (2006/42/EC)	IEC61800-5-2 EN61800-5-2	
	EMC	EMC under EMC Directive(2014/30/EU)	IEC61800-3 (Note 1) EN61800-3 (Note 1)	
		Functional safety EMC for machine, factory automation application	IEC61326-3-1 EN61326-3-1	
RS3###A### **#**	KC Mark		KN61000-6-2 KN61000-6-4	Ministry of Science, ICT & Future Planning

Note 1) Category of this standard is C2.
Warning: In a domestic environment, this product may cause radio interference, in which case supplementary mitigation measures may be required.

12. Appendix

■ The servo motor implements the attestation examination to the following standards.

Standards	Standards code	Certificate authorities
UL standards	UL1004-1 UL1004-5	UL (Underwriters Laboratories inc.)
EN Directive	EN60034-1 EN60034-5	TÜV (TÜV SÜD Japan, Ltd.)

* For products conforming to conformity standards, some specifications may differ from the standard product due to prerequisites necessary for obtaining approval. Contact us for more details.

12.1.2 Over-voltage Category, Protection Grade, Pollution Level

■ The "over-voltage category" of servo amplifier is "III" (EN61800-5-1). For 24VDC of control power and the interface, please use a DC power supply with reinforced and insulated input and outputs.

■ Make sure to install the servo amplifier in your control panel in an environment where the pollution level specified in EN61800-5-1 and IEC664 is no less than 2 (pollution level 1, 2). The protection grade of 100/200V AC input type servo amplifiers are IP2X for 50A or less, IP1X for 100 to 300A and IP0X for 600A, and 400V AC input type servo amplifiers are IP2X for 100A or less, IP1X for 150 to 300A and IP0X for 800A. The control panel installation configuration (under IP54) must exclude exposure to water, oil, carbon, dust, etc.

12.1.3 Connection and installation

Be careful of connection and installation as follows.

* Always ground the protective ground terminals of the servo amplifier/power unit/amplifier unit to the power supply ground.

* 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 grounding wire to servo amplifier/power unit/amplifier unit 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 servo amplifier/power unit.

* Use an EN/ IEC-standard compatible no-fuse Circuit breaker and electromagnetic contactor.

* Wiring for main circuit power shall be done as with the circuit shown in the section "4.1.6 Example of wiring", to break power at alarm.

12.1.4 UL File Number

The UL file number of servo amplifier and servo motor is as follows.
Can check from the website of UL. 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

We implement the conformity verification test of "Low Voltage Directive" and "an EMC command" in a certificate authority so that a user's CE Marking acquisition can be performed easily, and servo amplifier CE Marking is done based on the published certificate of attestation.

12.2.1 Conformity verification test

The following conformity verification tests are implemented.

Directive classification	Classification	Test	Test standard
Low voltage Directive (Servo amplifier)	—	—	EN61800-5-1
Low voltage Directive (Servo motor)	—	Rotating electrical machines-Part1: Rating and performance	EN60034-1
		Rotating electrical machines-Part5: Classification of degrees of protection provided by enclosures of rotating electrical machines (IP code)	EN60034-5
EMC Directive (Servo amplifier / servo motor)	Emission	Conducted emission	EN61800-3
		Radiated emission	EN61800-3
	Immunity	Electrostatic discharge immunity	EN61000-4-2
		Radiated electromagnetic field immunity	EN61000-4-3
		Electrical first transient/ burst immunity	EN61000-4-4
		Conducted disturbance immunity	EN61000-4-6
		Surge immunity	EN61000-4-5
		Voltage Dips & Interruptions immunity	EN61000-4-11
		Adjustable speed electrical power drive system	EN61800-3
		Safety of machinery	EN62061 (Annex E) Note 1)

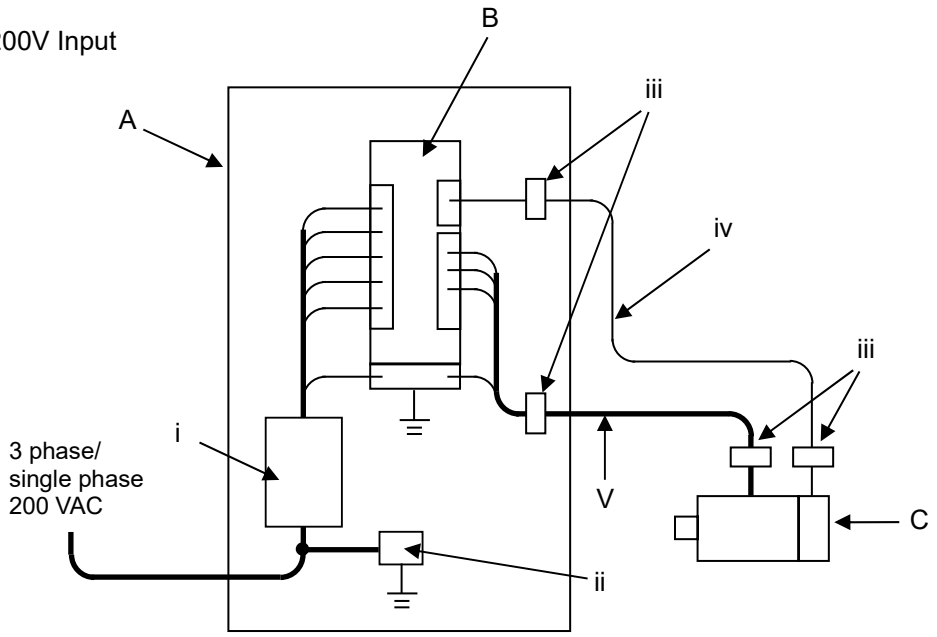
Note 1) Standards applicable only to Safe Torque Off function equipped models.

12. Appendix

12.2.2 EMC Installation Requirements

For the installation requirements, in our company the verification test is implemented by the following installations and measures methods, as machines and configurations differ depending on customers' needs. This servo amplifier has been authorized to display CE marking based on the recognition certificate issued by a certifying authority. Customers are instructed to perform the final conformity tests for all instruments and devices in use.

■ 200V Input

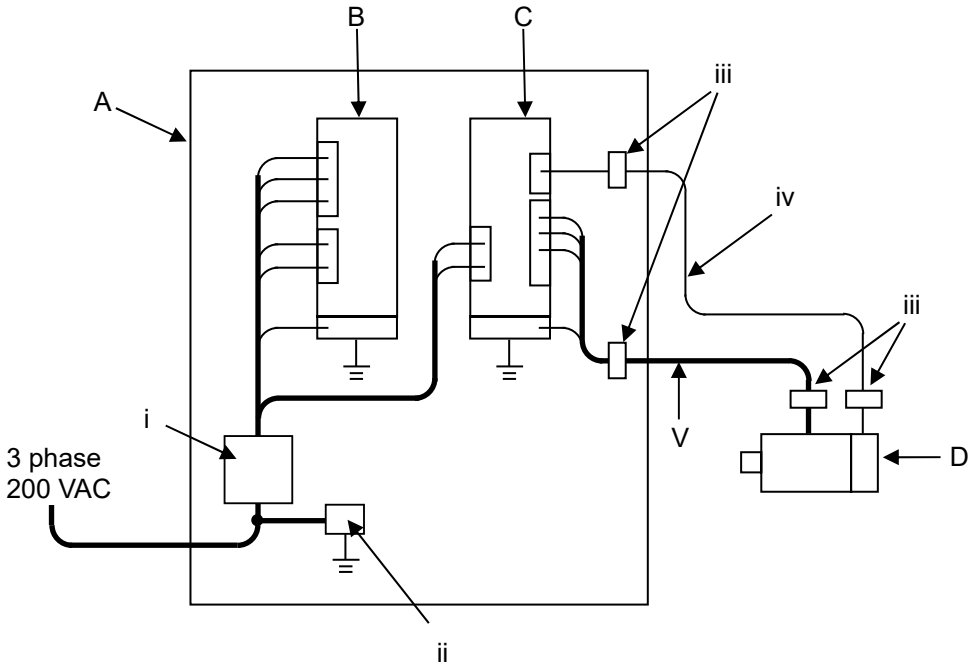


No.	Name	Remarks
A	Control panel	-
B	Servo amplifier	-
C	Servo motor	-
i	Noise filter (Recommended prevention components)	RS3A01 to RS3A07: HF3030C-SZA: SOSHIN ELECTRIC Co. Ltd. Rated voltage/rated current: Line-Line 480V AC / 30A RS3A10 to RS3A15: 3SUPF-CH40M-F: OKAYA ELECTRIC INDUSTRIES CO., LTD. Rated voltage/rated current: Line-Line 500V AC / 40A RS3A30: 3SUPF-CH80M-F: OKAYA ELECTRIC INDUSTRIES CO., LTD. Rated voltage/rated current: Line-Line 500V AC / 40A
ii	Surge-absorber (Recommended prevention components)	LV275DI-U4: OKAYA ELECTRIC INDUSTRIES CO.,LTD.
iii	Clamp grounding	-
iv	Encoder cable	Shield cable
v	Servo motor power cable	Shield cable

* Use metallic materials for the door and main body of control panel.
* Use EMI gasket so that there is zero clearance between the door and control panel. Install EMI gasket uniformly to the contact points between door and main body of control panel to confirm their conductivity.
* Ground the noise filter frame to the control panel.
* Use shield cables for motor power line and encoder cable. Clamp grounding of shield at the frame of control panel and equipment.
* Use conducting metal P-clip or U-clip to ground and clamp shielded wire, and fix it directly with metal screws. Do not ground by soldering electric wire to shielded wire.
* Wire servo amplifier at a short distance from the secondary side of noise filter, and wire the primary side and secondary side of noise filter separately.

12.2 Compliance with EN Directives

■ 200V Input (600A)

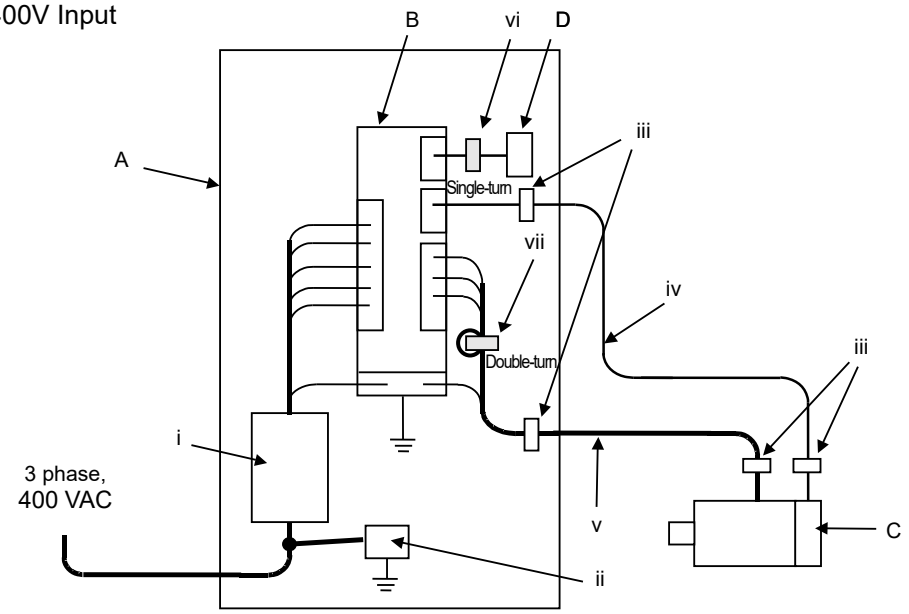


No.	Name	Remarks
A	Control panel	-
B	Power unit	-
C	Amplifier unit	-
D	Servo motor	-
i	Noise filter (Recommended prevention components)	3SUPF-CH150M-F: OKAYA ELECTRIC INDUSTRIES CO., LTD. Rated voltage/rated current : Line-Line 500V AC / 150A
ii	Surge-absorber (Recommended prevention components)	LV275DI-U4: OKAYA ELECTRIC INDUSTRIES CO.,LTD.
iii	Clamp grounding	-
iv	Encoder cable	Shield cable
v	Servo motor power cable	Shield cable

* Use metallic materials for the door and main body of control panel.
* Use EMI gasket so that there is zero clearance between the door and control panel. Install EMI gasket uniformly to the contact points between door and main body of control panel to confirm their conductivity.
* Ground the noise filter frame to the control panel.
* Use shield cables for motor power line and encoder cable. Clamp grounding of shield at the frame of control panel and equipment.
* Use conducting metal P-clip or U-clip to ground and clamp shielded wire, and fix it directly with metal screws. Do not ground by soldering electric wire to shielded wire.
* Wire servo amplifier at a short distance from the secondary side of noise filter, and wire the primary side and secondary side of noise filter separately.

12. Appendix

■ 400V Input

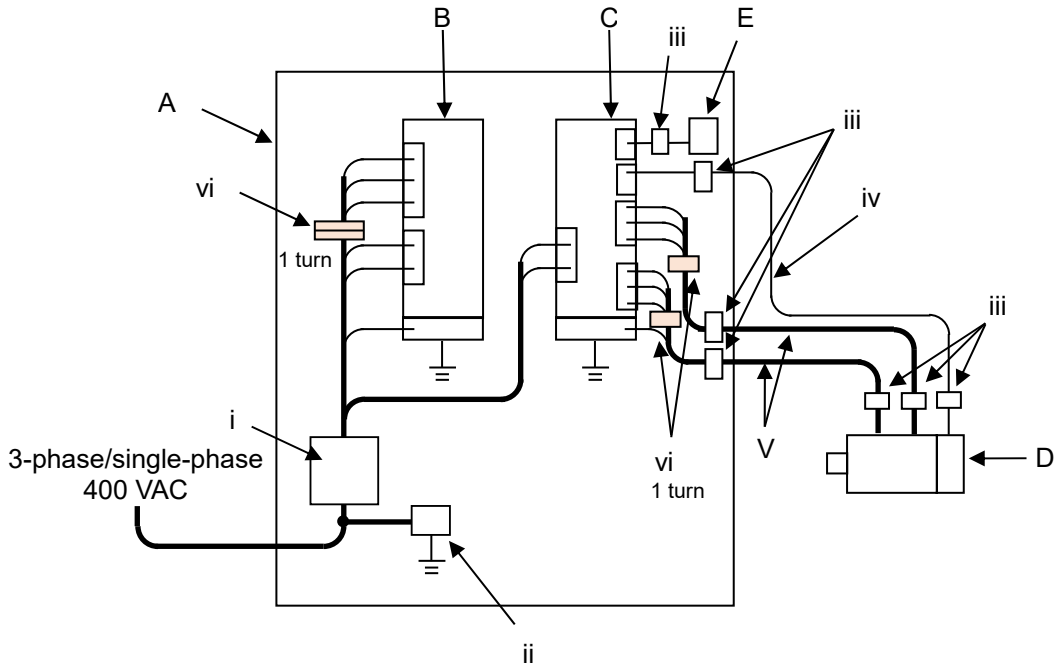


No.	Name	Remarks
A	Control panel	-
B	Servo amplifier	-
C	Servo motor	-
D	Host device	-
i	Noise filter (Recommended prevention components)	RS3C02: HF3010C-SZA: SOSHIN ELECTRIC Co. Ltd. Rated voltage/rated current: Line-Line 500V AC / 10A RS3C05: HF3020C-SZA: SOSHIN ELECTRIC Co. Ltd. Rated voltage/rated current: Line-Line 500V AC / 20A RS3C10: HF3030C-SZA: SOSHIN ELECTRIC Co. Ltd. Rated voltage/rated current: Line-Line 500V AC / 30A RS3C15/30: HF3100C-SZC: SOSHIN ELECTRIC Co. Ltd. Rated voltage/rated current: Line-Line 500V AC / 100A
ii	Surge-absorber (Recommended prevention components)	LV480DI-U4: OKAYA ELECTRIC INDUSTRIES CO.,LTD.
iii	Clamp grounding	-
iv	Encoder cable	Shield cable
v	Servo motor power cable	Shield cable
vi	Sleeve Ferrite Clamp	RS3C02/05/10: GRFC-13 (KITAGAWA INDUSTRIES CO., LTD.)
vii	Split Ferrite Core	RS3C02: E04SR401938 (SEIWA ELECTRIC MFG CO., Ltd.)
viii	Ring core	RS3C15/30: RC5075Y (SOSHIN ELECTRIC Co. Ltd.)

* Use metallic materials for the door and main body of control panel.
* Use EMI gasket so that there is zero clearance between the door and control panel. Install EMI gasket uniformly to the contact points between door and main body of control panel to confirm their conductivity.
* Ground the noise filter frame to the control panel.
* Use shield cables for motor power line and encoder cable. Clamp grounding of shield at the frame of control panel and equipment.
* Use conducting metal P-clip or U-clip to ground and clamp shielded wire, and fix it directly with metal screws. Do not ground by soldering electric wire to shielded wire.
* Wire servo amplifier at a short distance from the secondary side of noise filter, and wire the primary side and secondary side of noise filter separately.
* Avoid putting each cables redundant at cabinet inside.

12.2 Compliance with EN Directives

■ 400V Input (800A)



No.	Name	Remarks
A	Control panel	—
B	Power unit	—
C	Amplifier unit	—
D	Servo motor	—
E	Upper device	—
i	Noise filter (Recommended prevention components)	HF3200C-SZB-4DEDE: SOSHIN ELECTRIC Co. Ltd. Rated voltage/rated current: Line-Line 500V AC / 200A
ii	Surge-absorber (Recommended prevention components)	LV480DI-U4: OKAYA ELECTRIC INDUSTRIES CO.,LTD.
iii	Clamp grounding	—
iv	Encoder cable	Shield cable
v	Servo motor power cable	Shield cable
vi	Sleeve Ferrite Clamp	RC1100Y: SOSHIN ELECTRIC Co. Ltd.
vii	Split Ferrite Core	E04SR401938: SEIWA ELECTRIC MFG CO. Ltd.

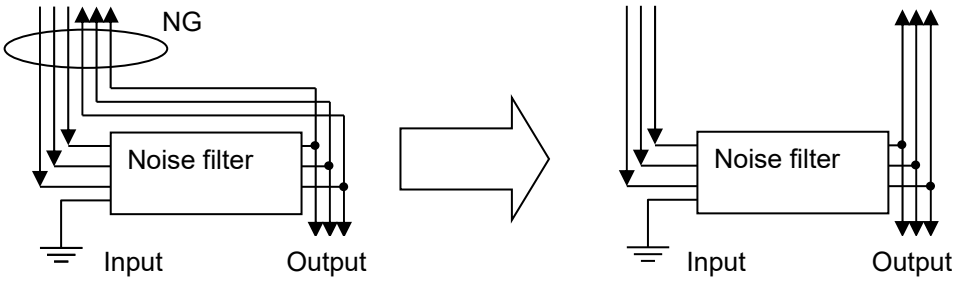
* Use metallic materials for the door and main body of control panel.
* Use EMI gasket so that there is zero clearance between the door and control panel. Install EMI gasket uniformly to the contact points between door and main body of control panel to confirm their conductivity.
* Ground the noise filter frame to the control panel.
* Use shield cables for motor power line and encoder cable. Clamp grounding of shield at the frame of control panel and equipment.
* Use conducting metal P-clip or U-clip to ground and clamp shielded wire, and fix it directly with metal screws. Do not ground by soldering electric wire to shielded wire.
* Wire a power unit at a short distance from the secondary side of noise filter, and wire the primary side and secondary side of noise filter separately.
* Avoid putting each cables redundant at cabinet inside.

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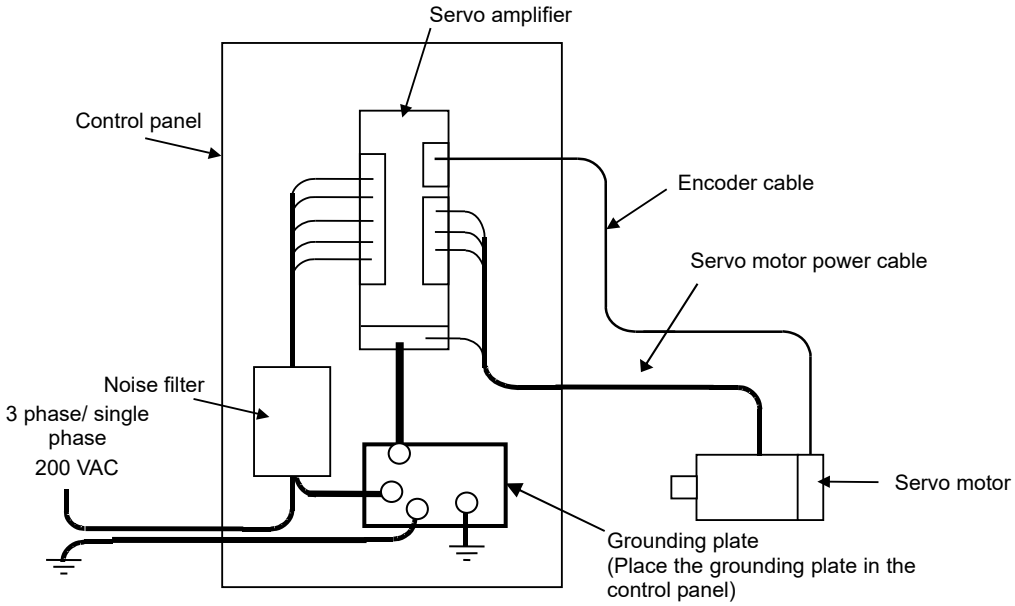
12.2.3 Precautions for noise filter connection

Precautions for noise filter mounting and wiring
See below precautions for mounting and wiring when noise filter is used.

■ Do not bundle with input line and output line of noise filter. (Earth line also.)
Avoid that go through a same duct. (It might reduce effect of filter, and noise might come around through that point.)



■ Each of earth line shall be connected to grounding plate in a control panel by single-point.
Also in case of multi axes construction in same control panel, grounding by single-point.



12.3 Servo motor dimensions

Refer another document [M0011792].

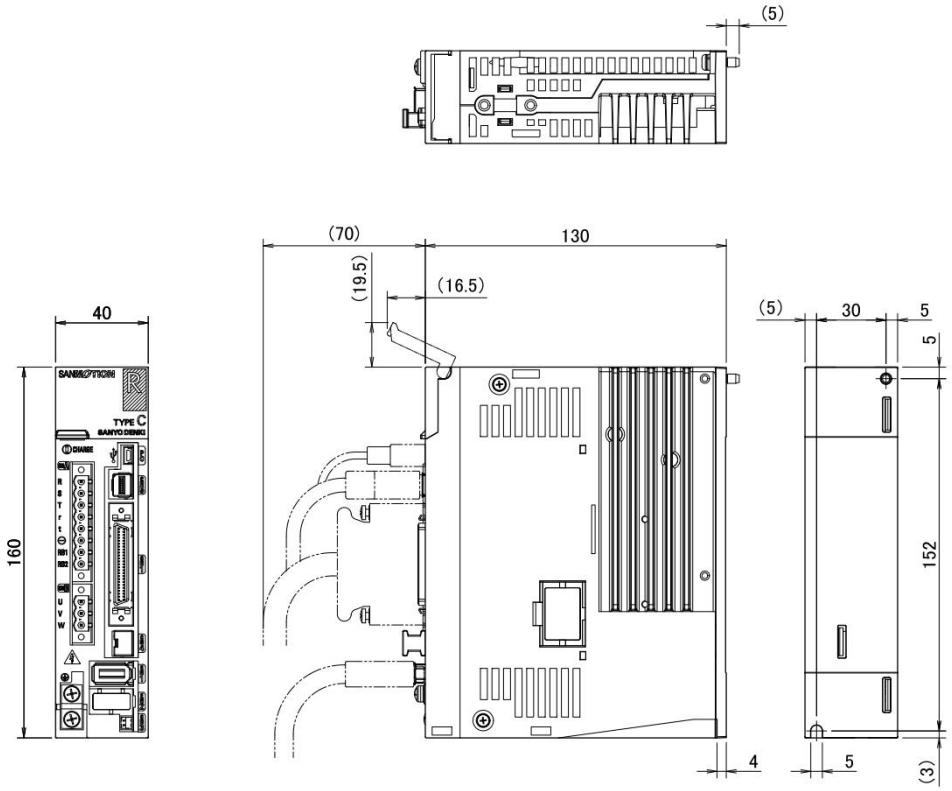
12. Appendix

12.4 Servo motor data sheet

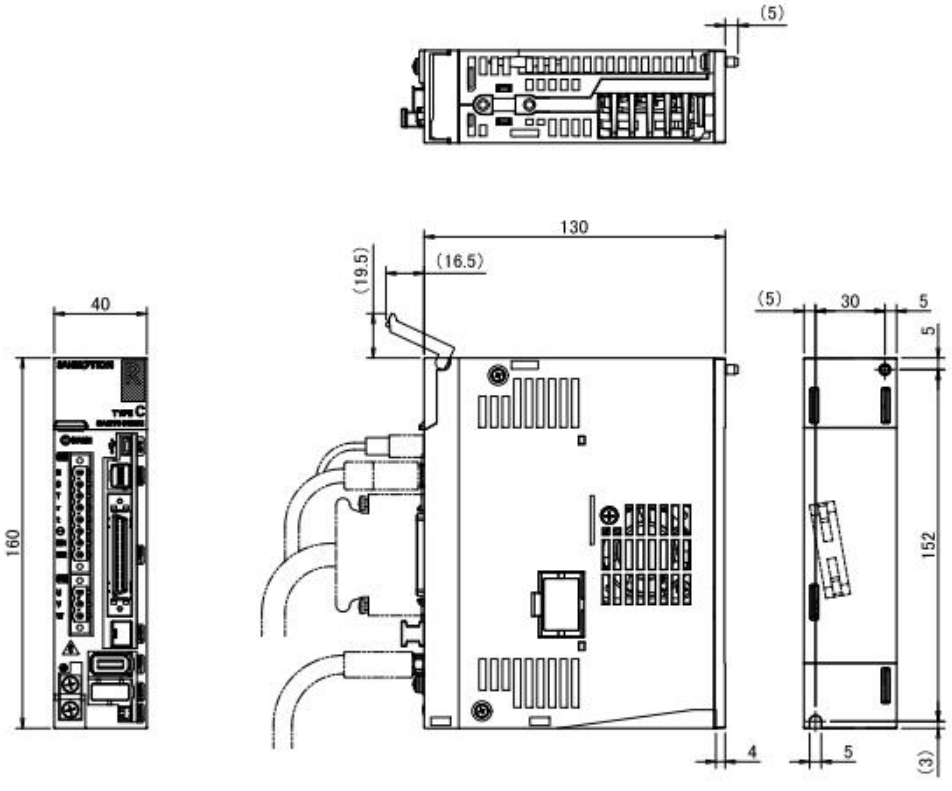
Refer another document [M0011792].

12.5 Servo amplifier dimensions

12.5.1 RS3□01A□CL□

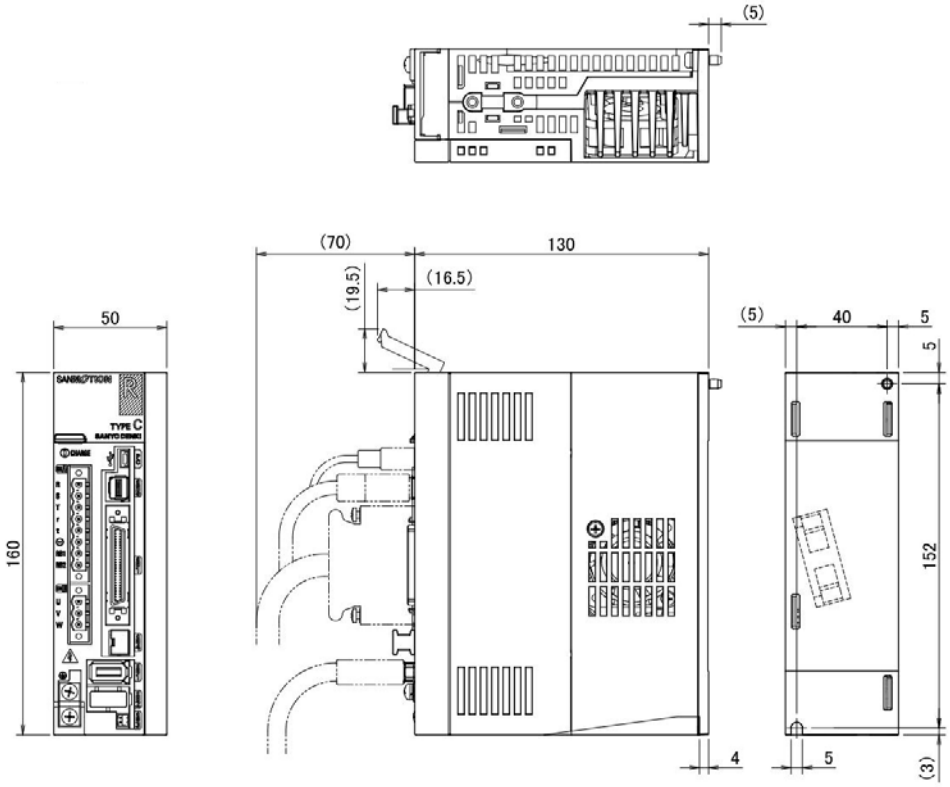


12.5.2 RS3□02A□CL□

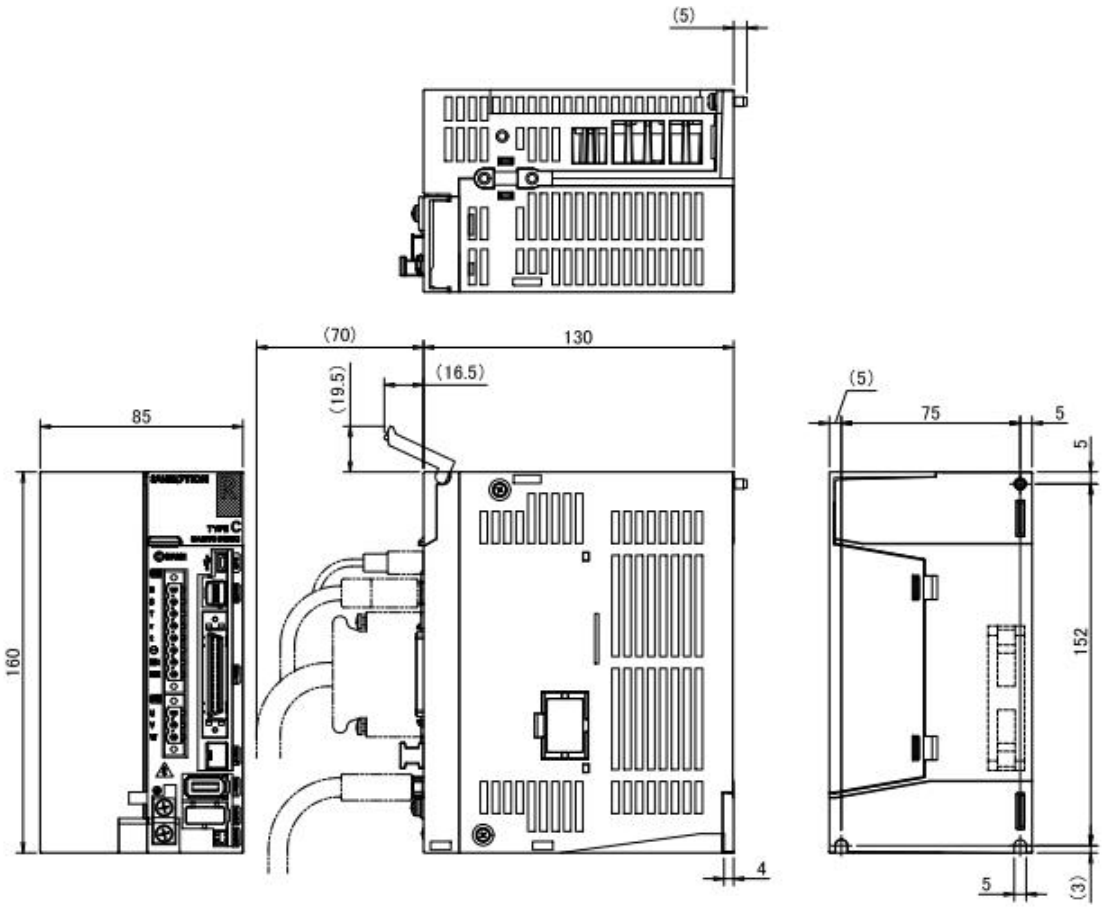


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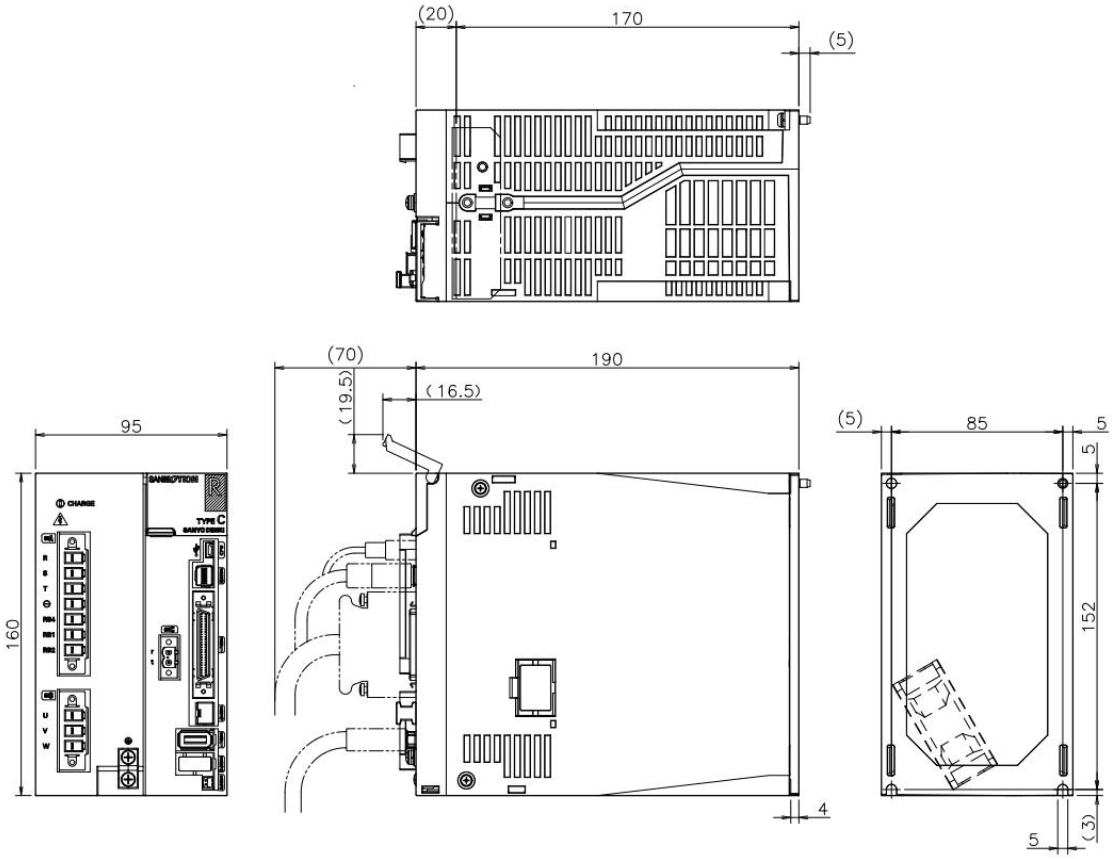
12.5.3 RS3□03A□CL□



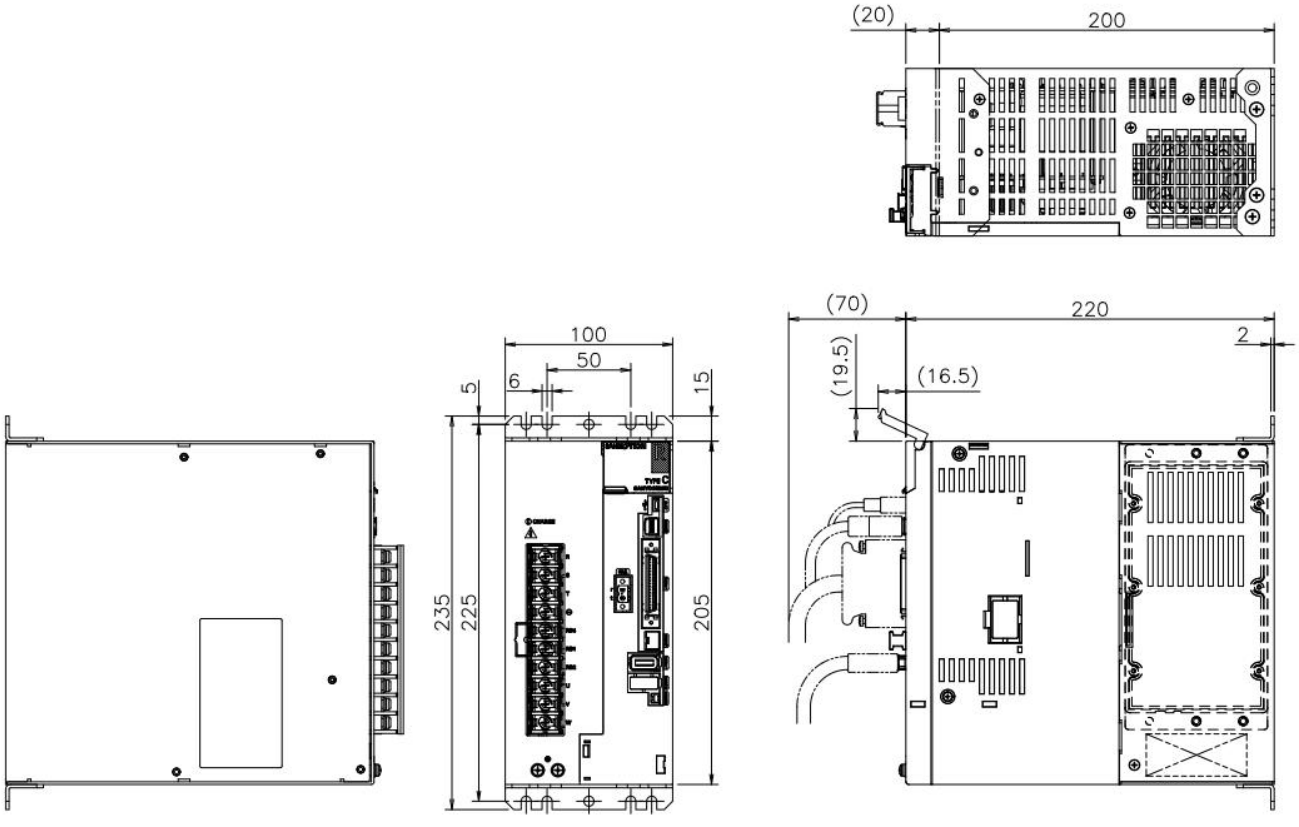
12.5.4 RS3A05A□CL□



12.5.5 RS3A07A□CL□

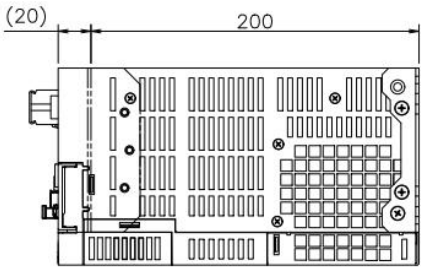


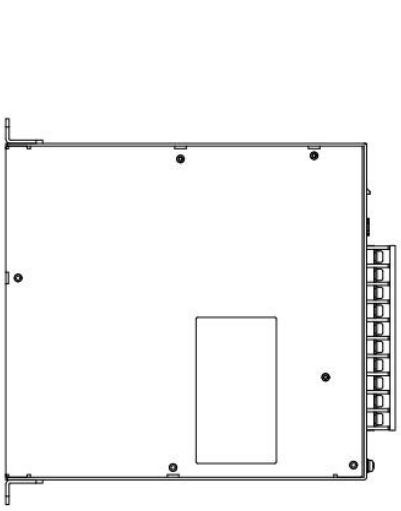
12.5.6 RS3A10A□CA□

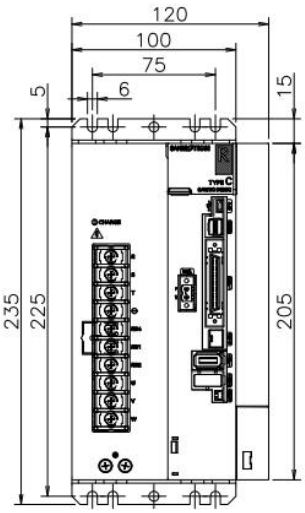


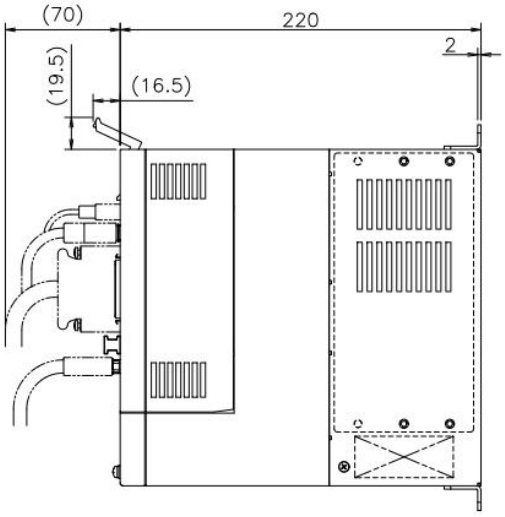
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12.5.7 RS3A15A□CA□

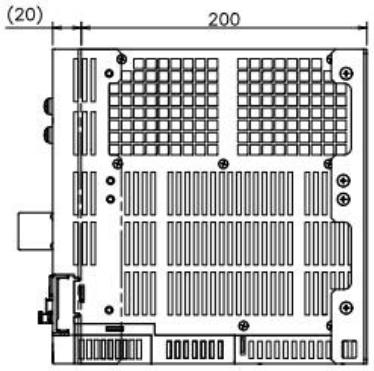


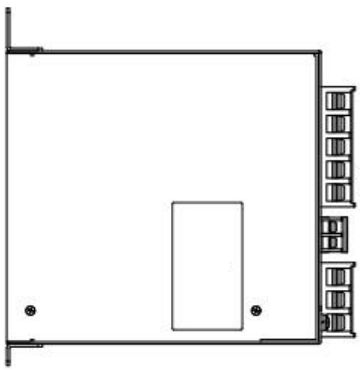


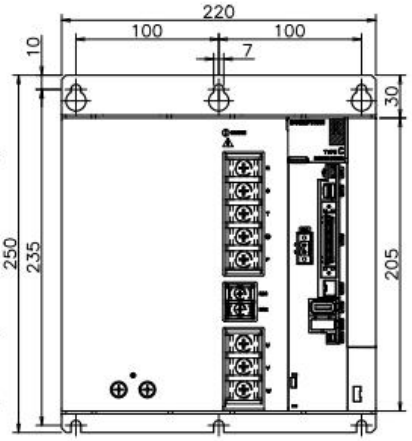


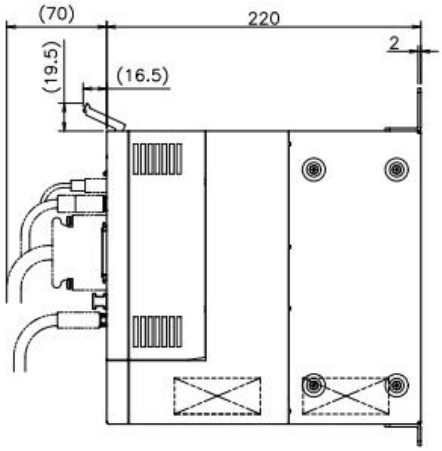


12.5.8 RS3A30A□CL□

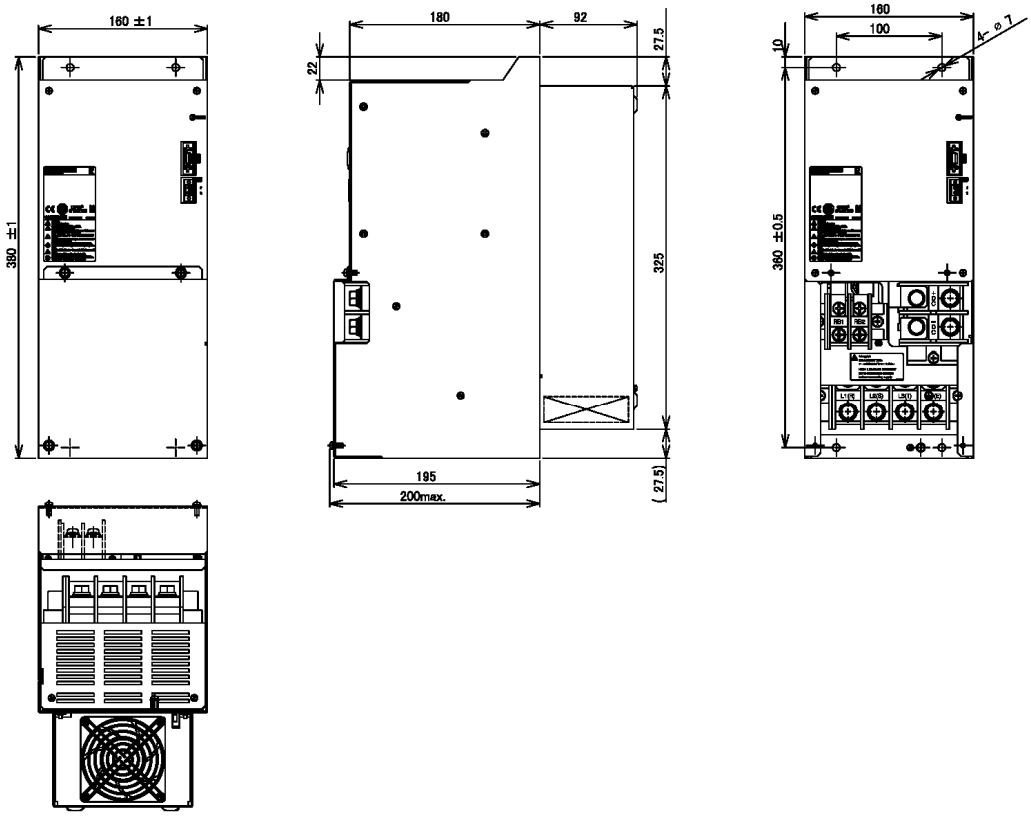




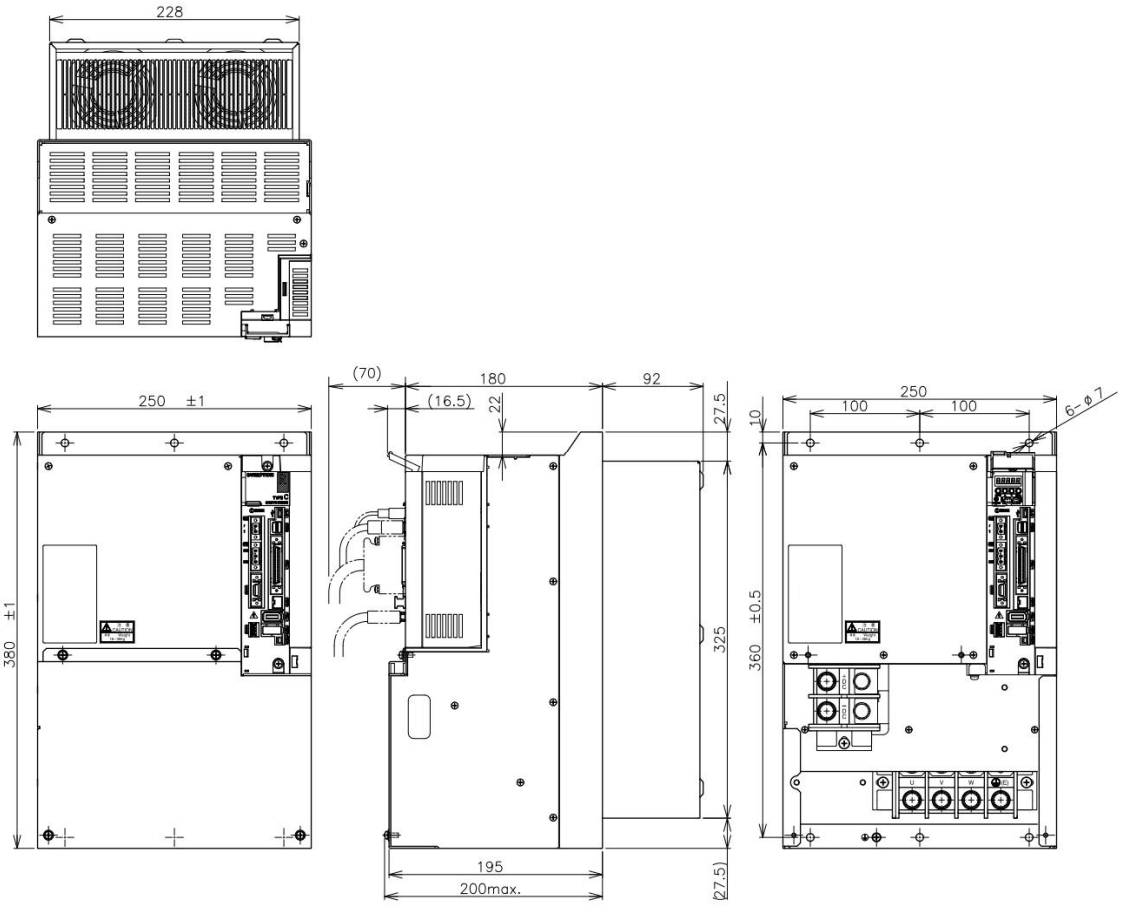




12.5.9 Power unit: RS3PAA270

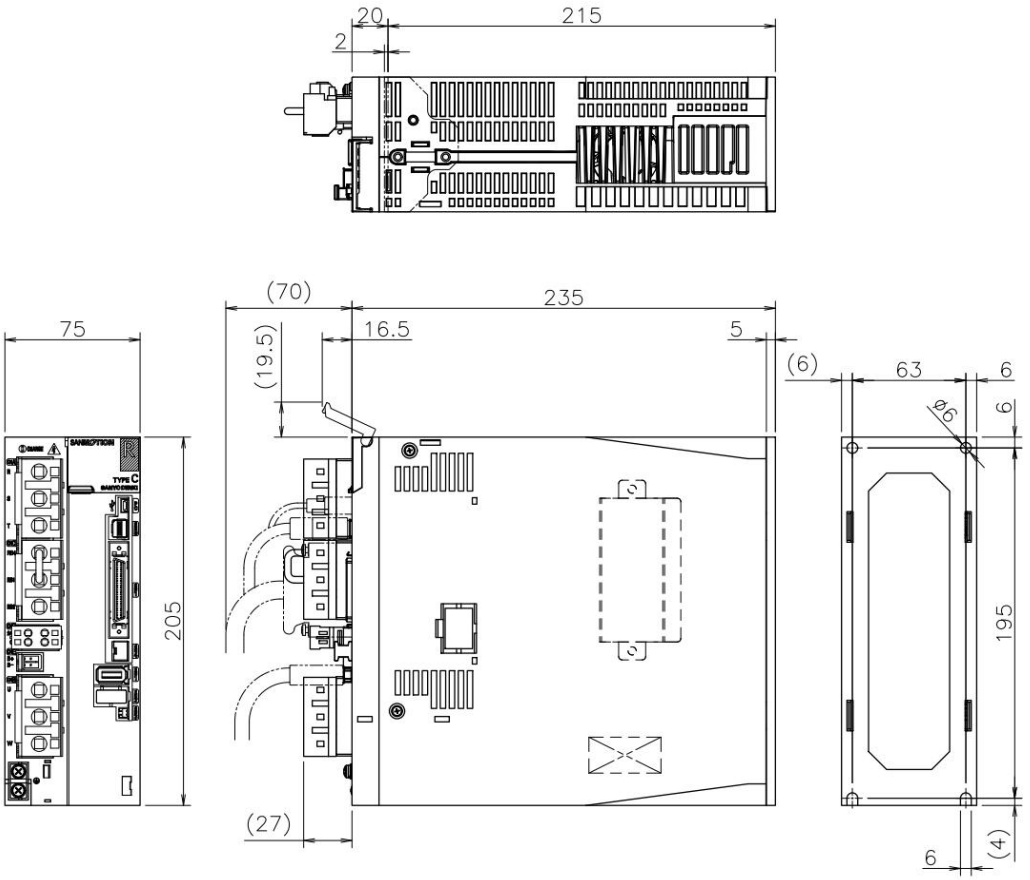


12.5.10 Amplifier unit: RS3W60A□CM□

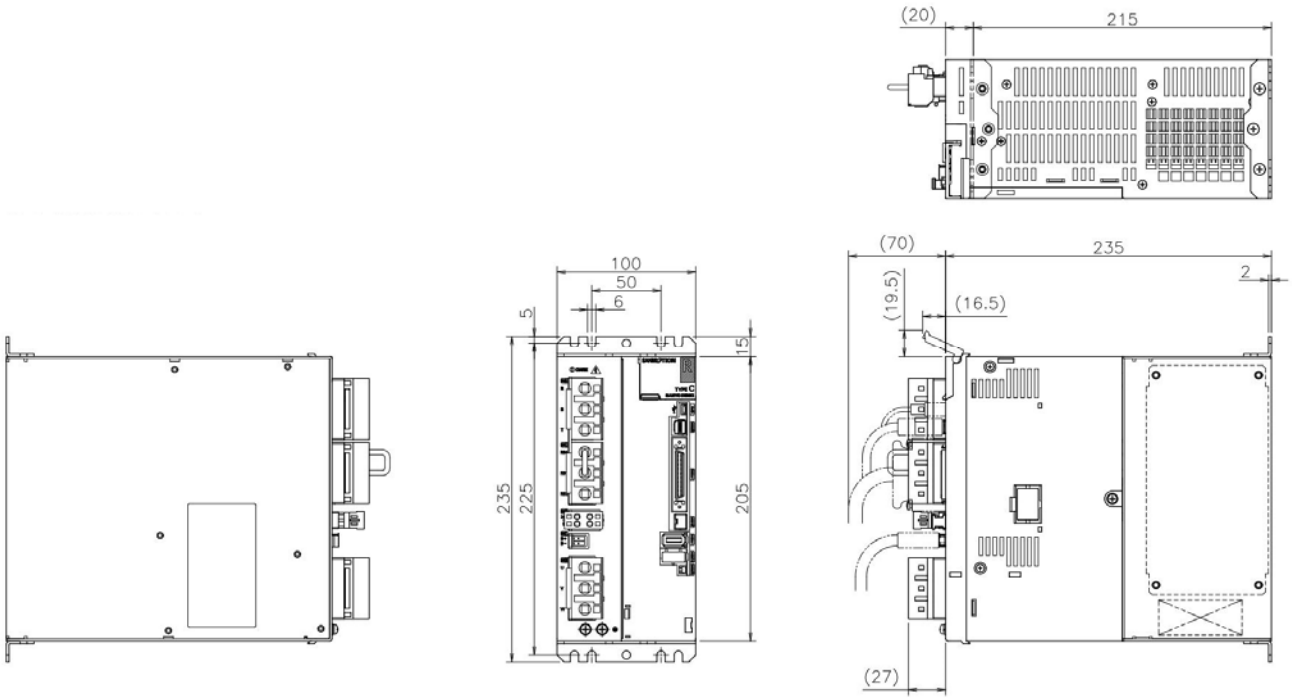


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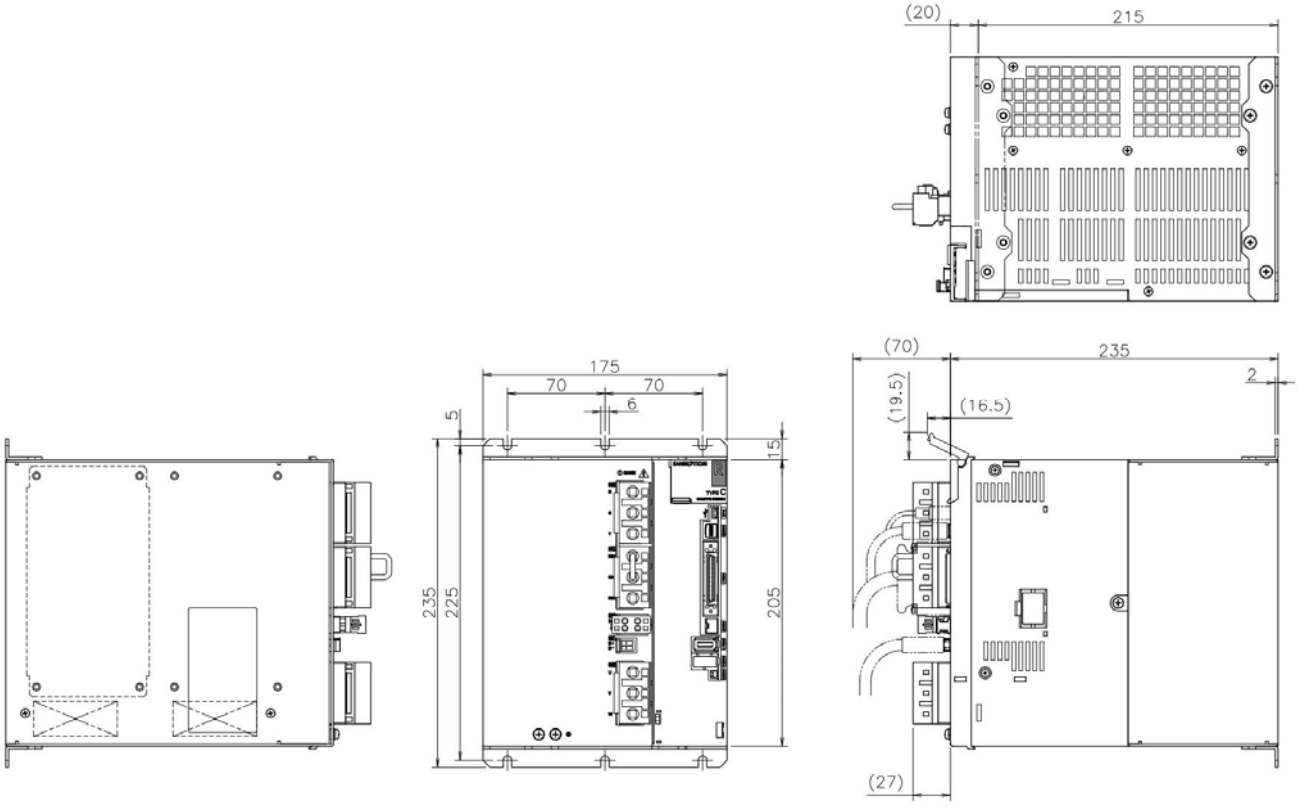
12.5.11 RS3C02A□CA□



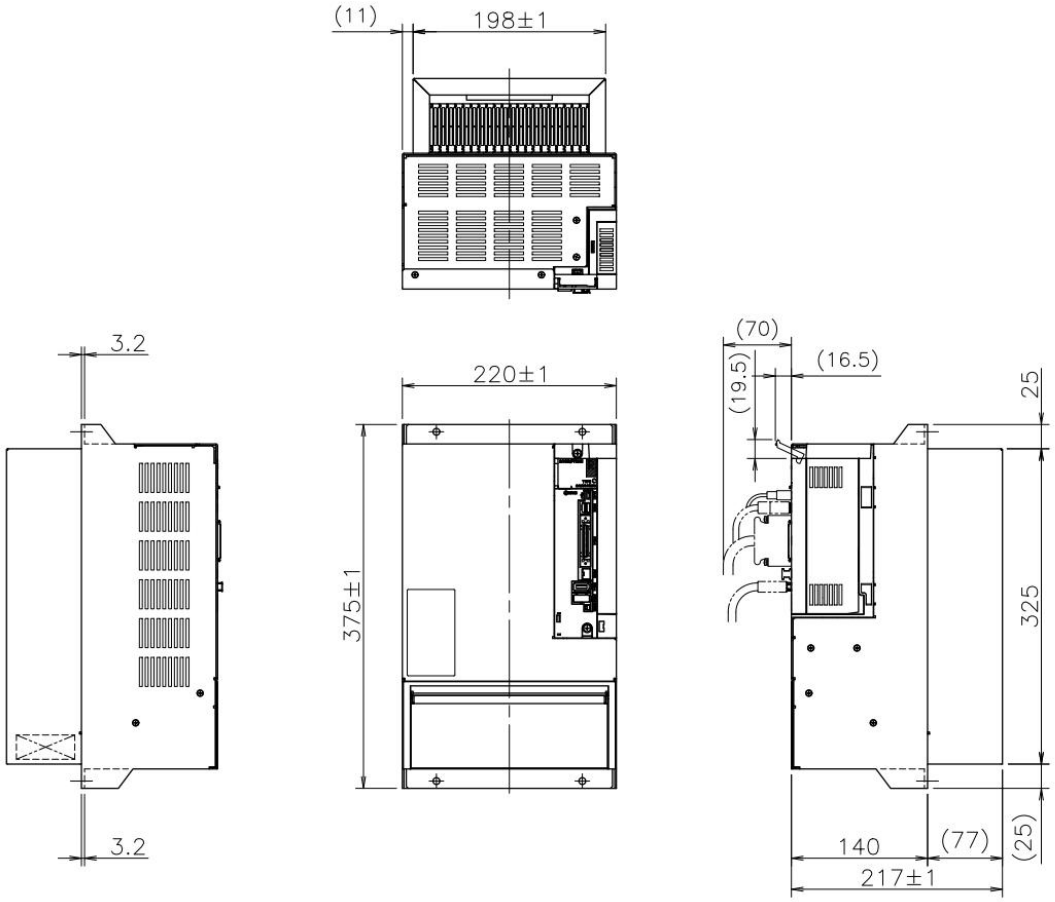
12.5.12 RS3C05A□CA□



12.5.13 RS3C10A□CA□

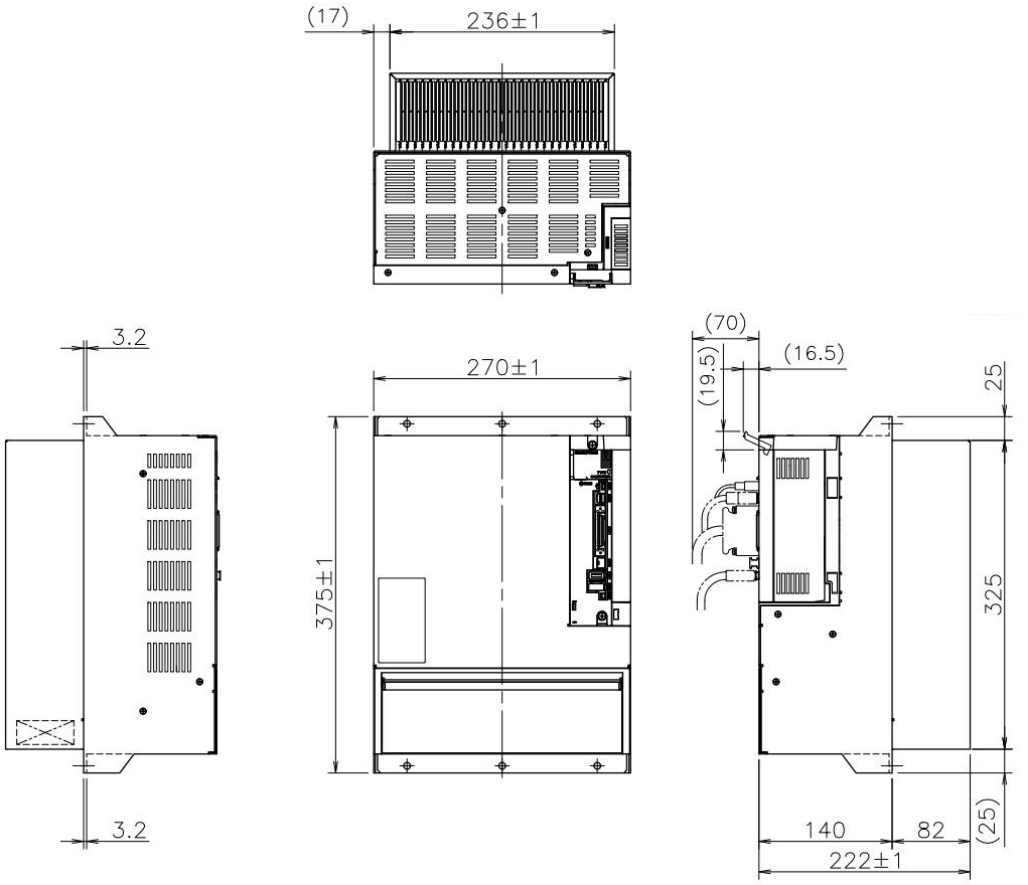


12.5.14 RS3C15A□CL□

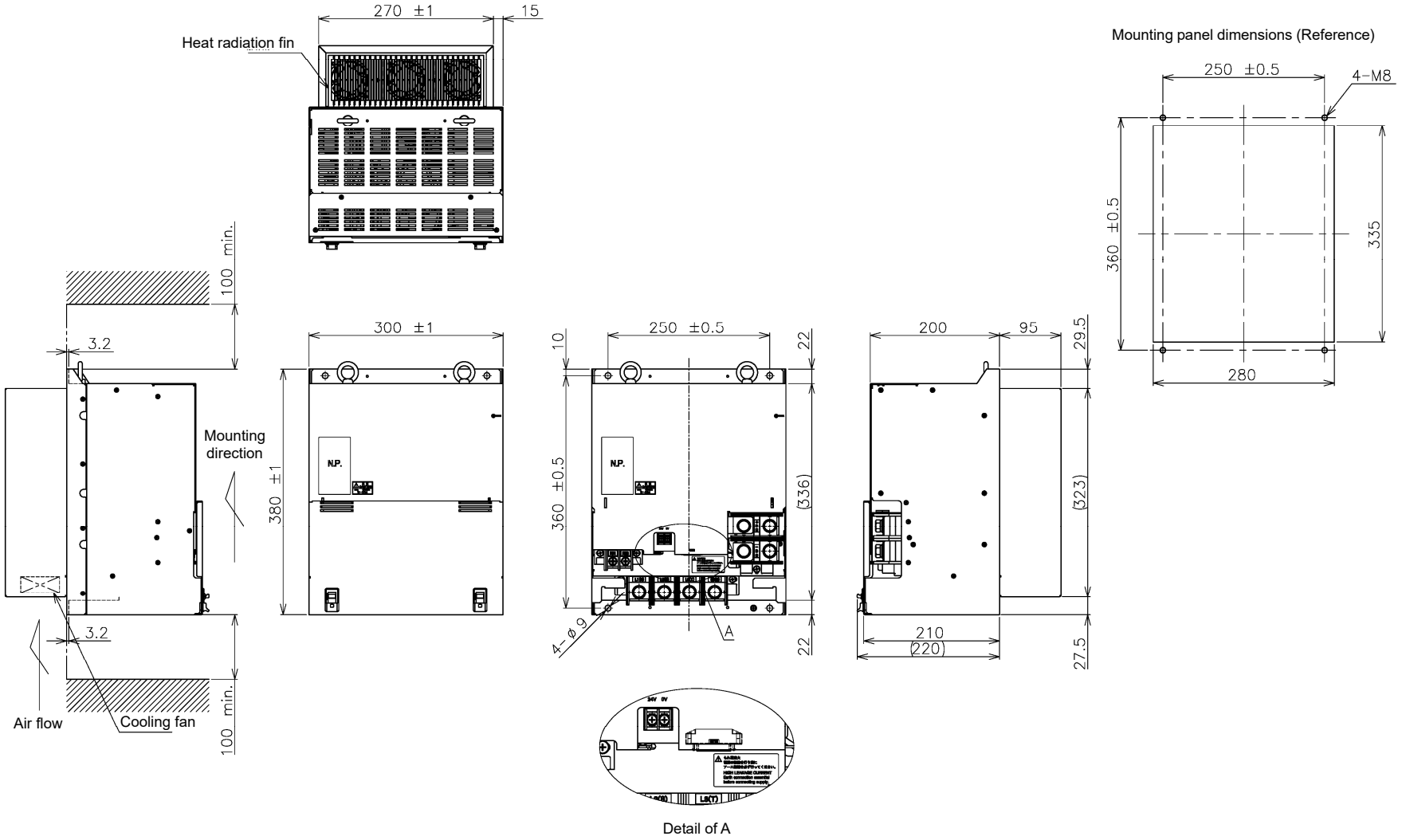


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12.5.15 RS3C30A□CM□

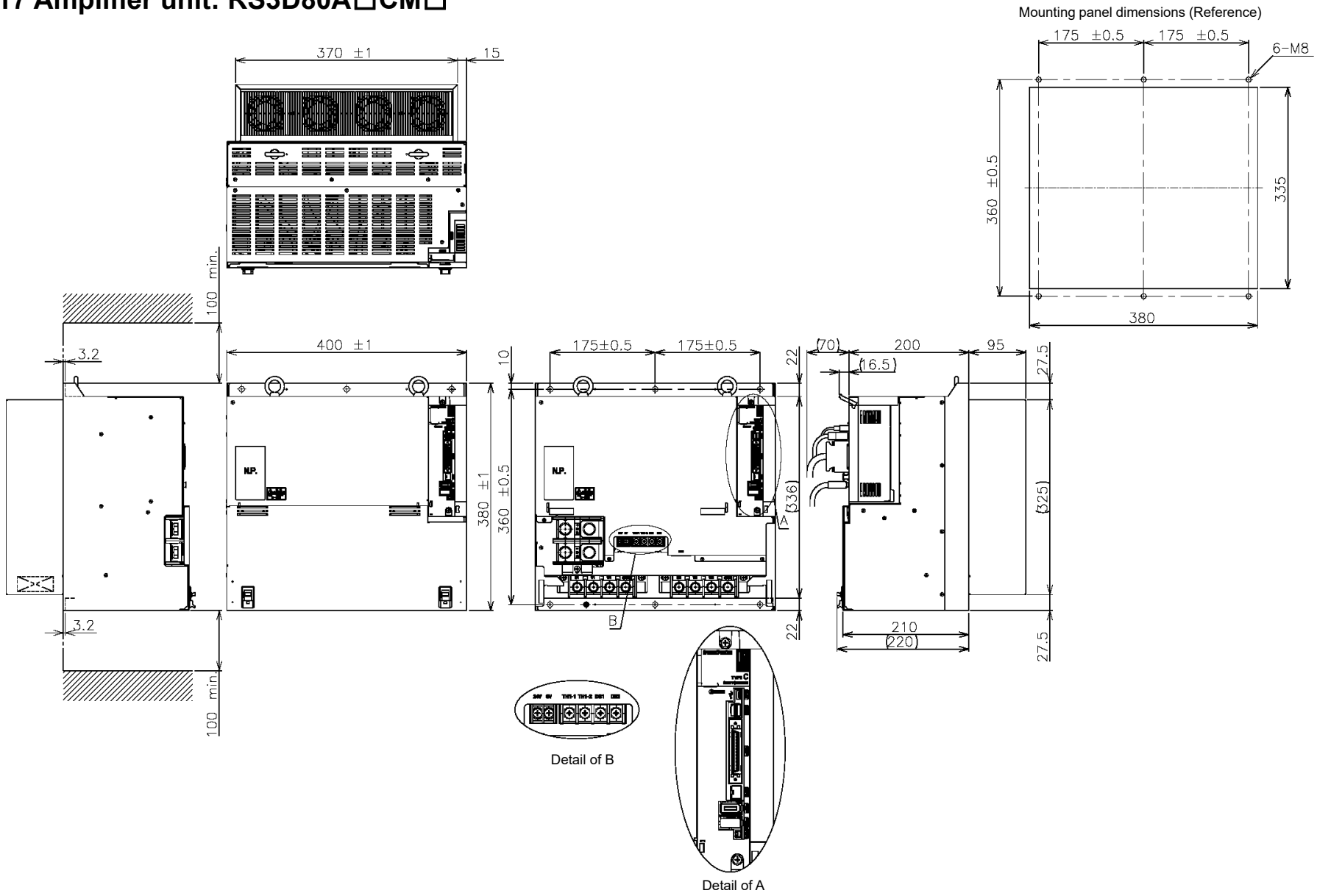


12.5.6 Power unit: RS3PAC550

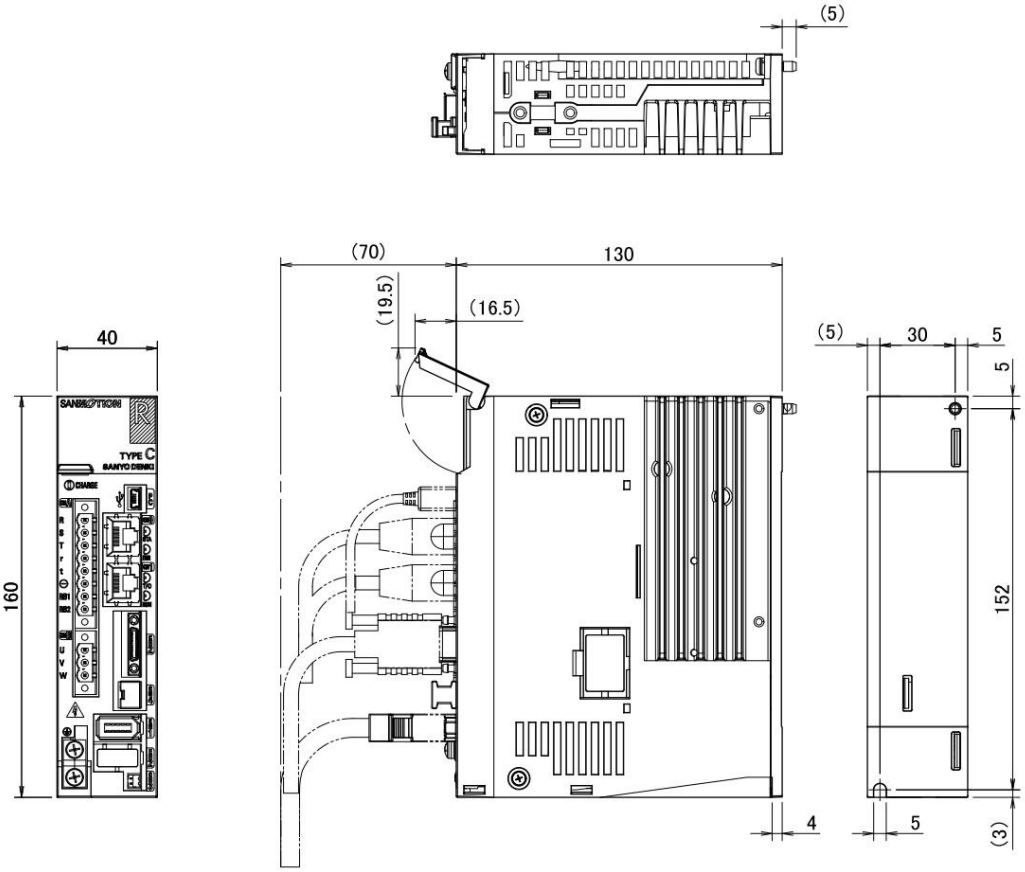


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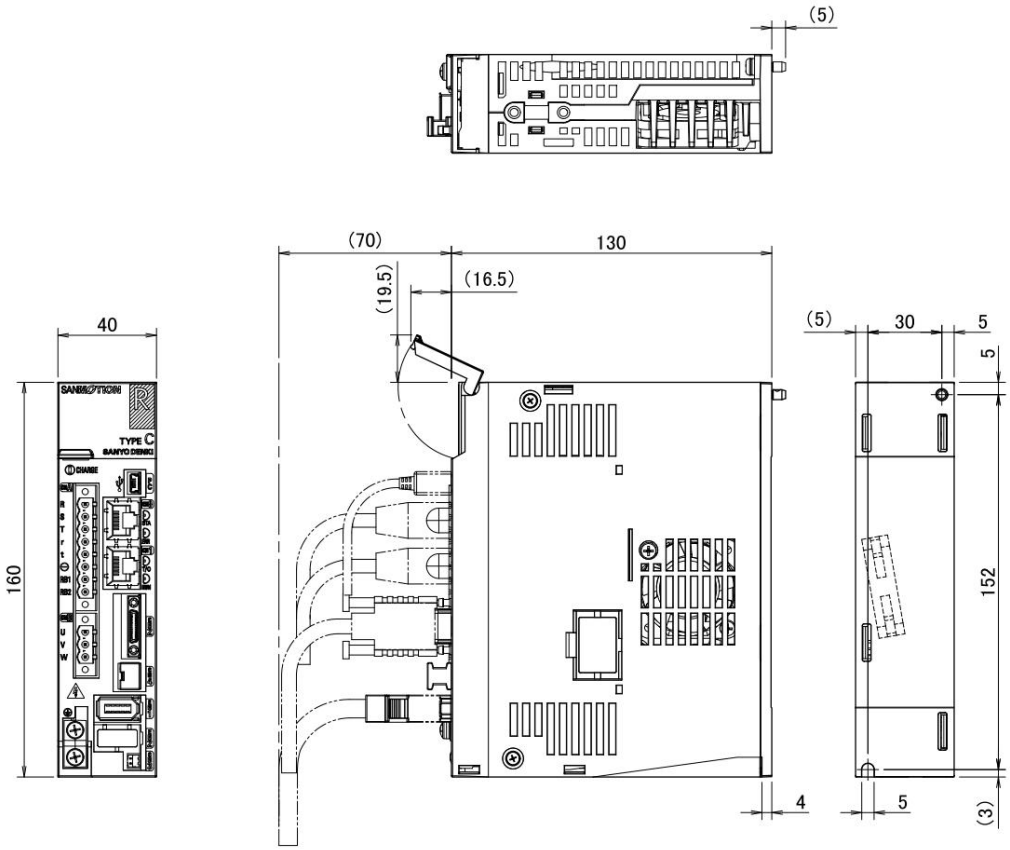
12.5.17 Amplifier unit: RS3D80A□CM□



12.5.18 RS3□01A□FL□

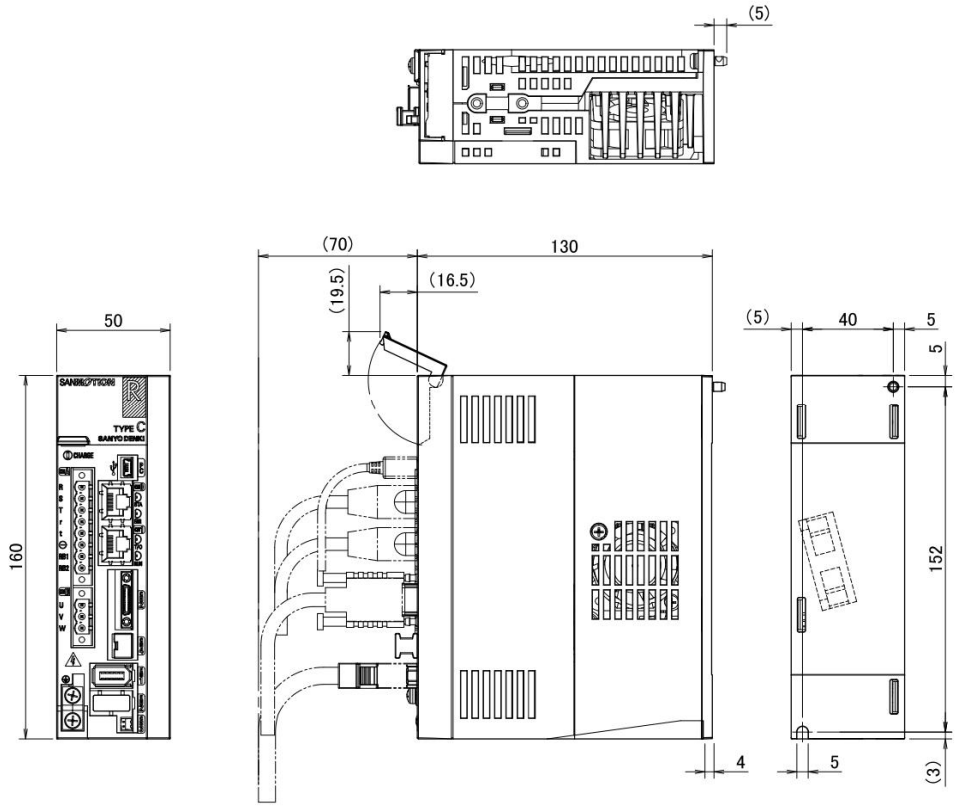


12.5.19 RS3□02A□FL□

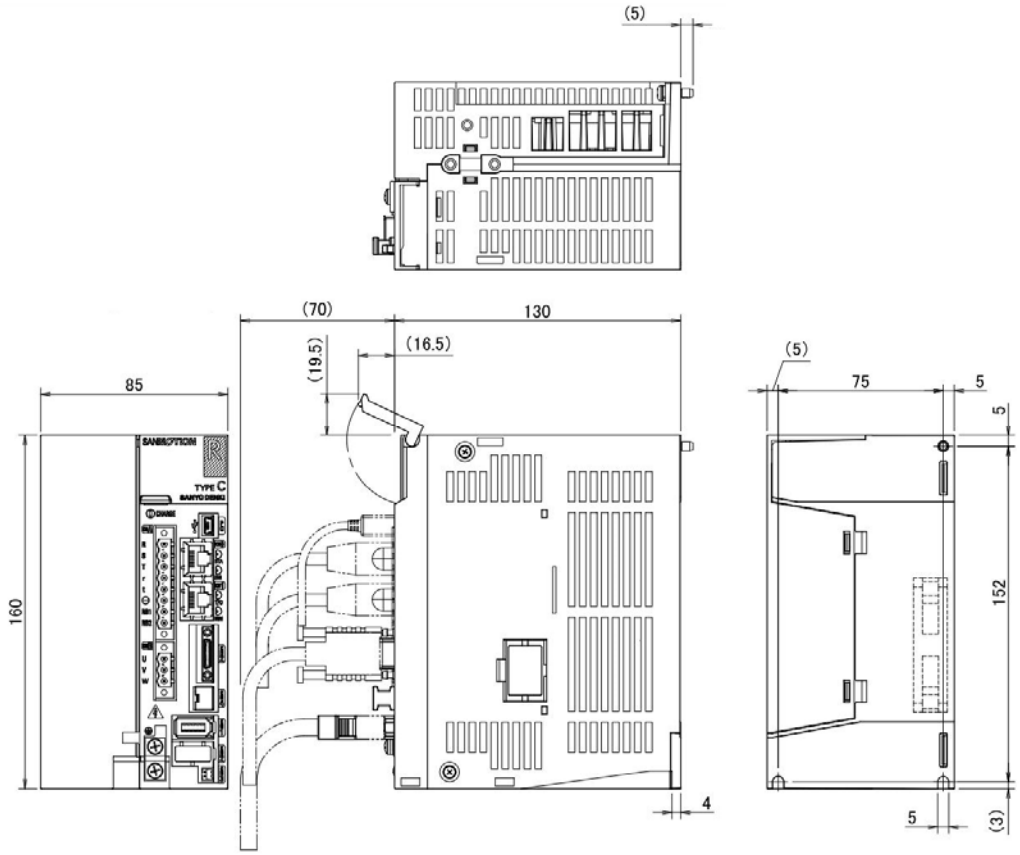


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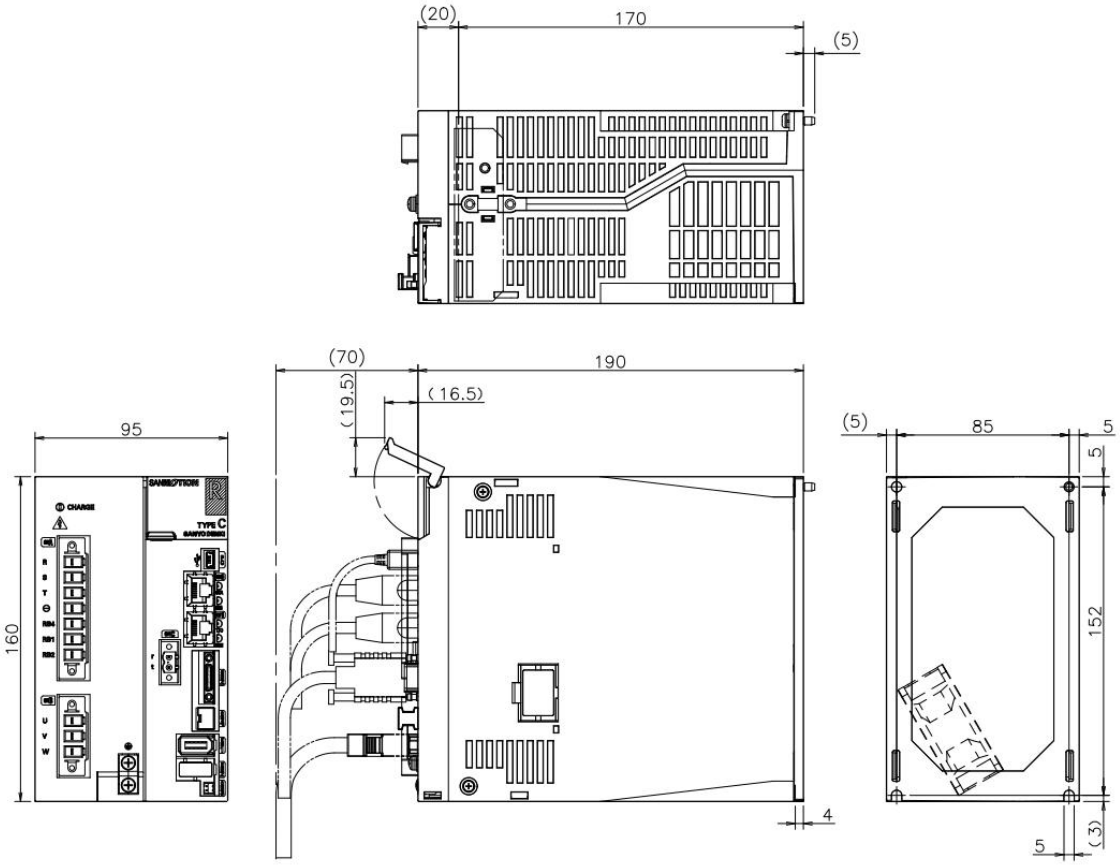
12.5.20 RS3□03A□FL□



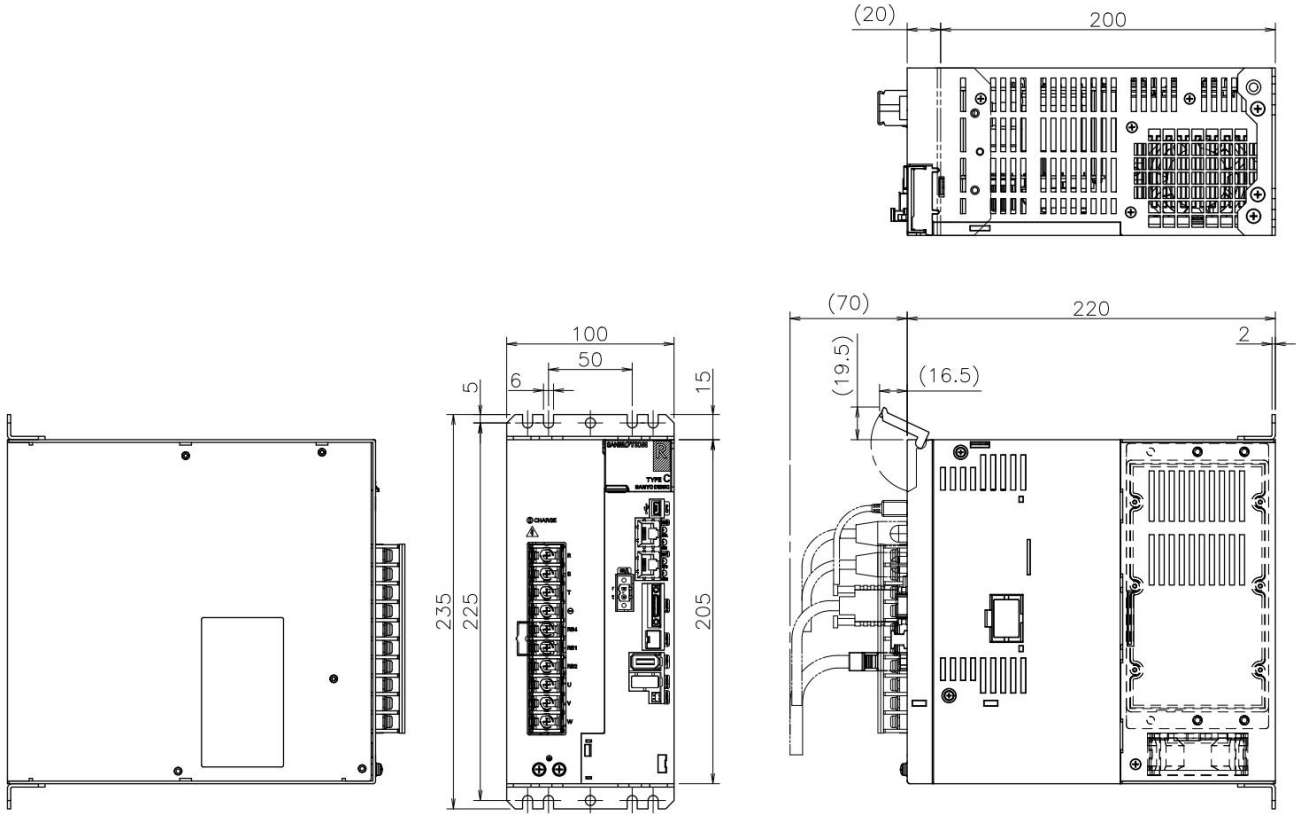
12.5.21 RS3A05A□FL□



12.5.22 RS3A07A□FL□

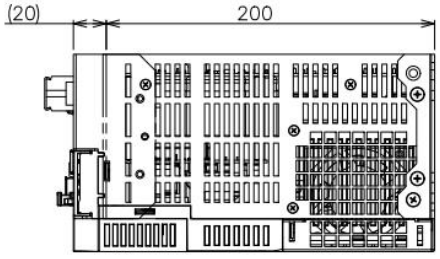


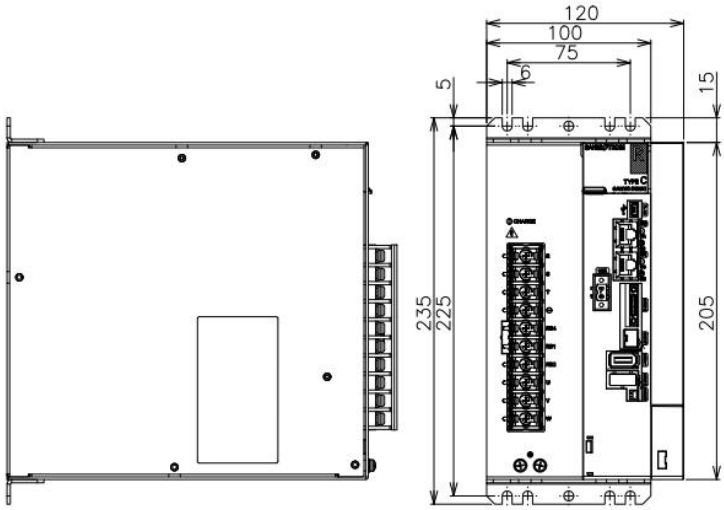
12.5.23 RS3A10A□FA□

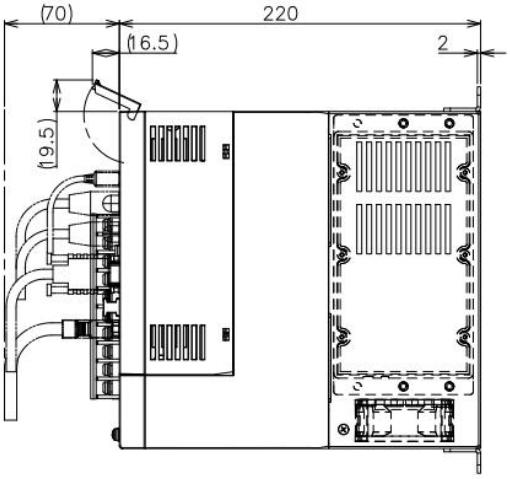


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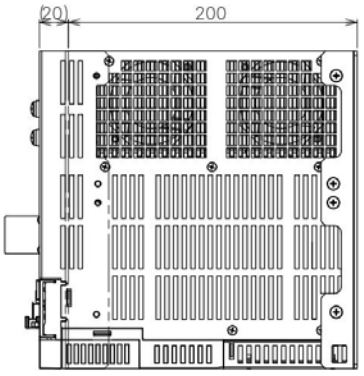
12.5.24 RS3A15A□FA□

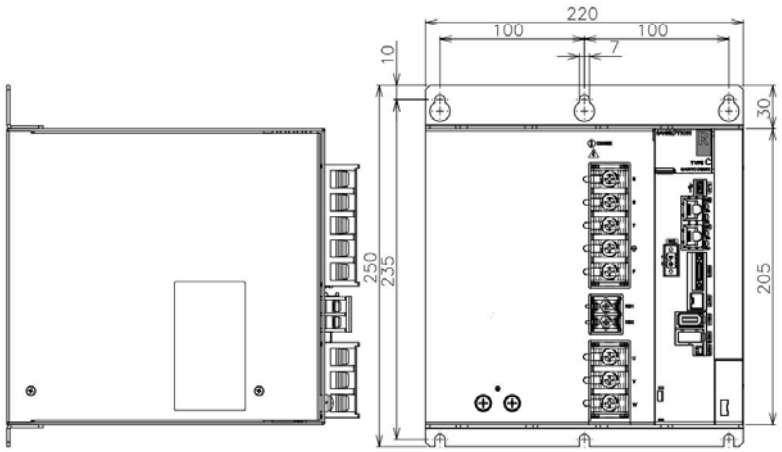


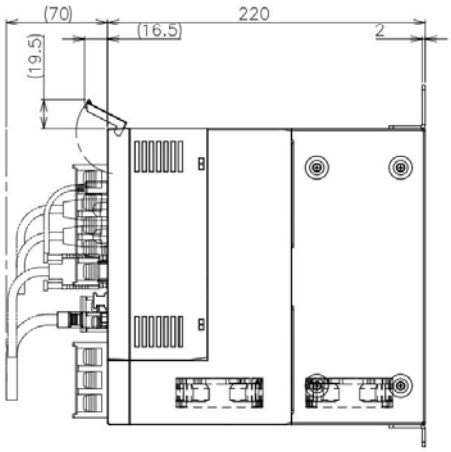




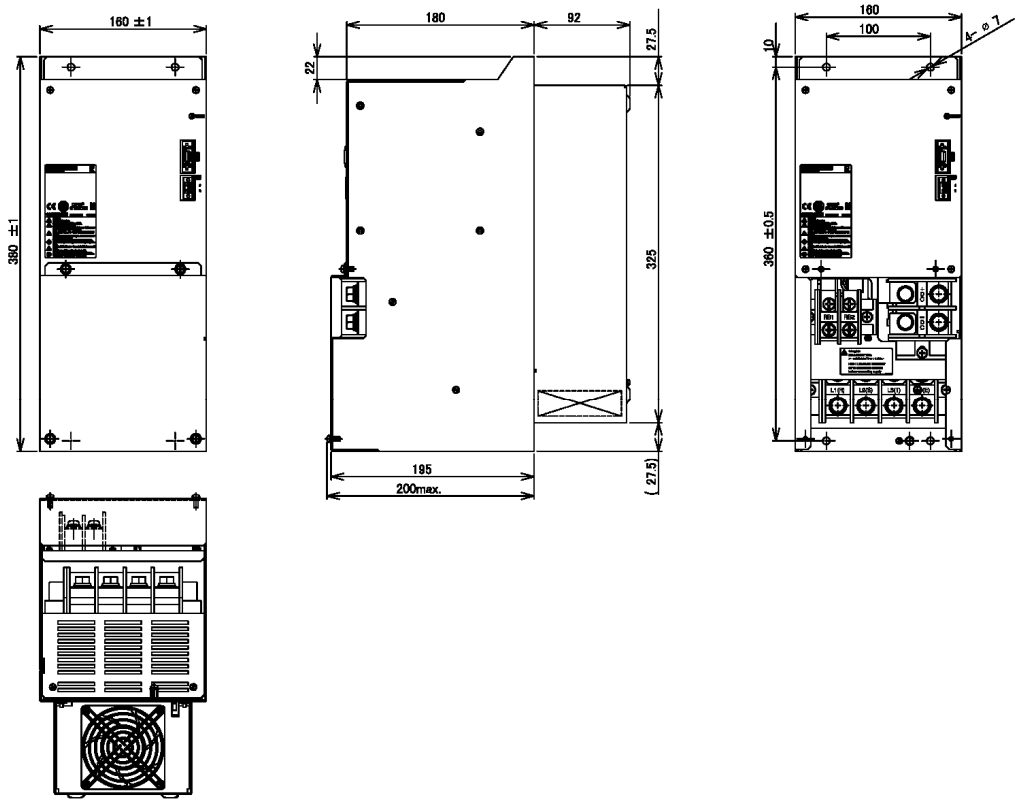
12.5.25 RS3A30A□FL□



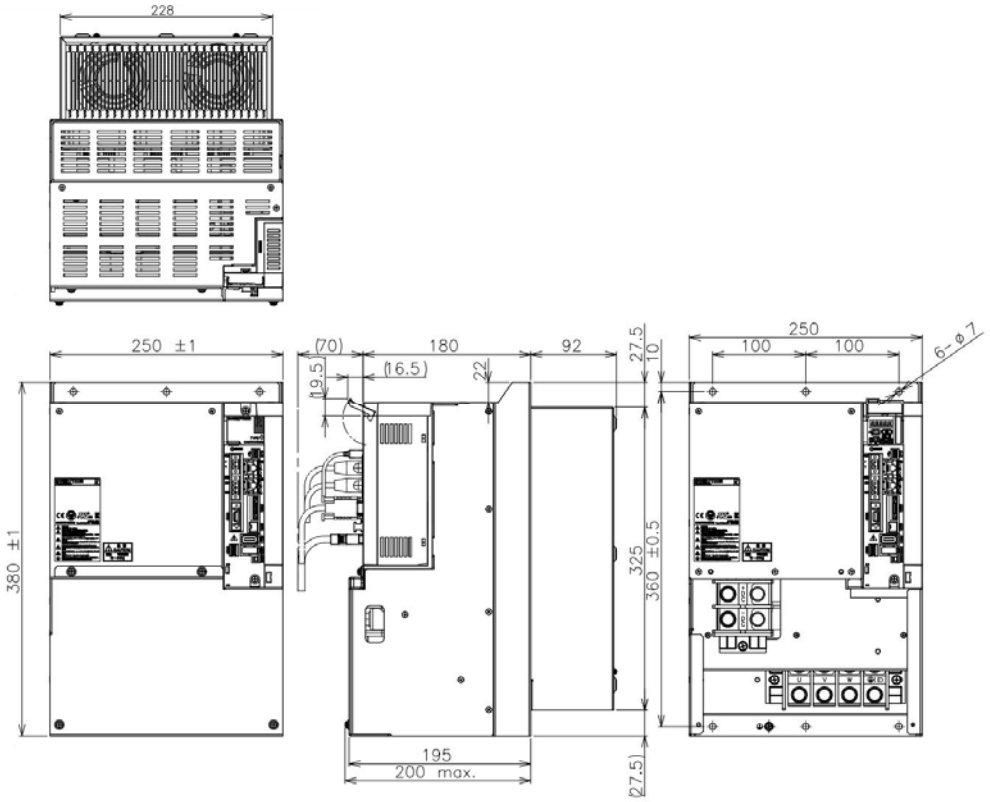




12.5.26 Power unit: RS3PAA270

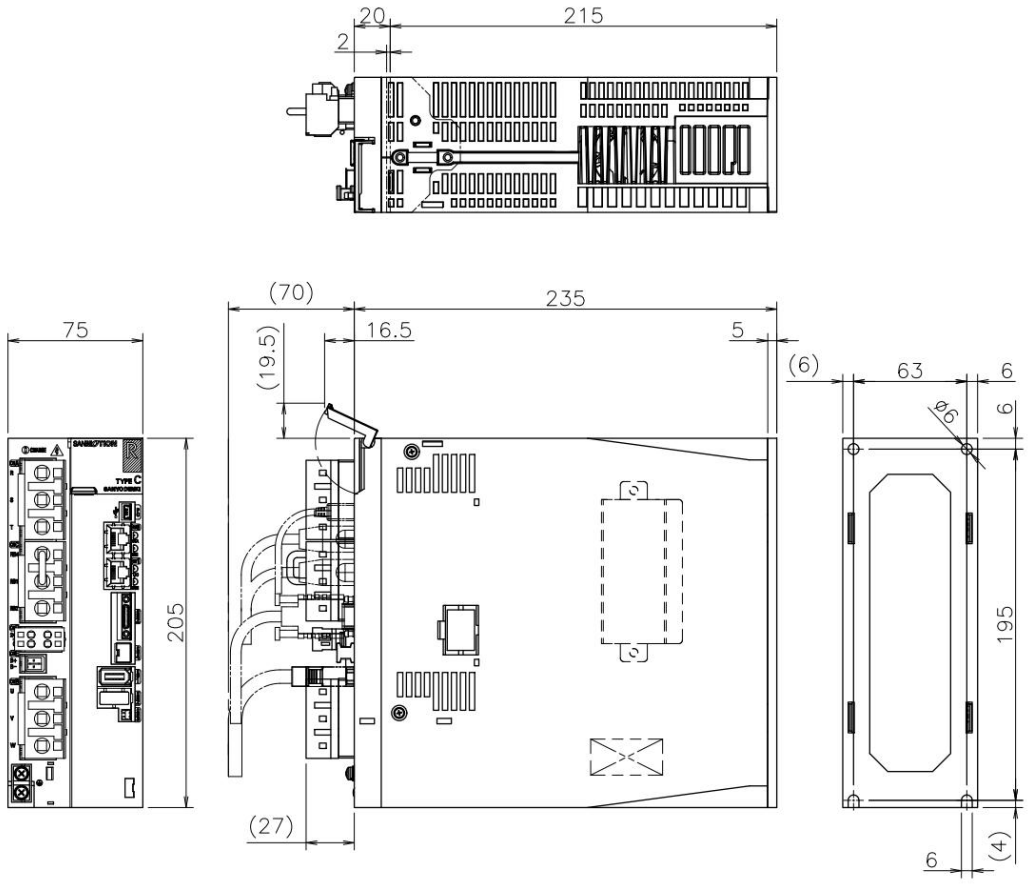


12.5.27 Amplifier unit: RS3W60A□FM□

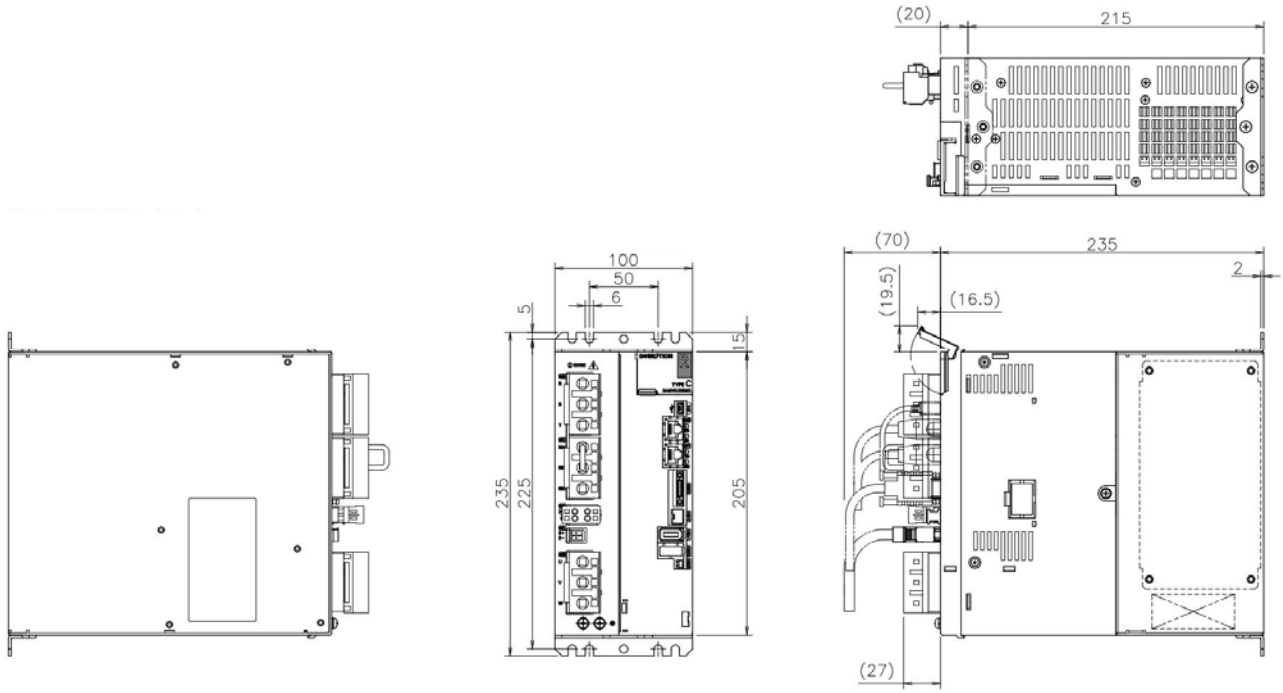


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12.5.28 RS3C02A□FA□

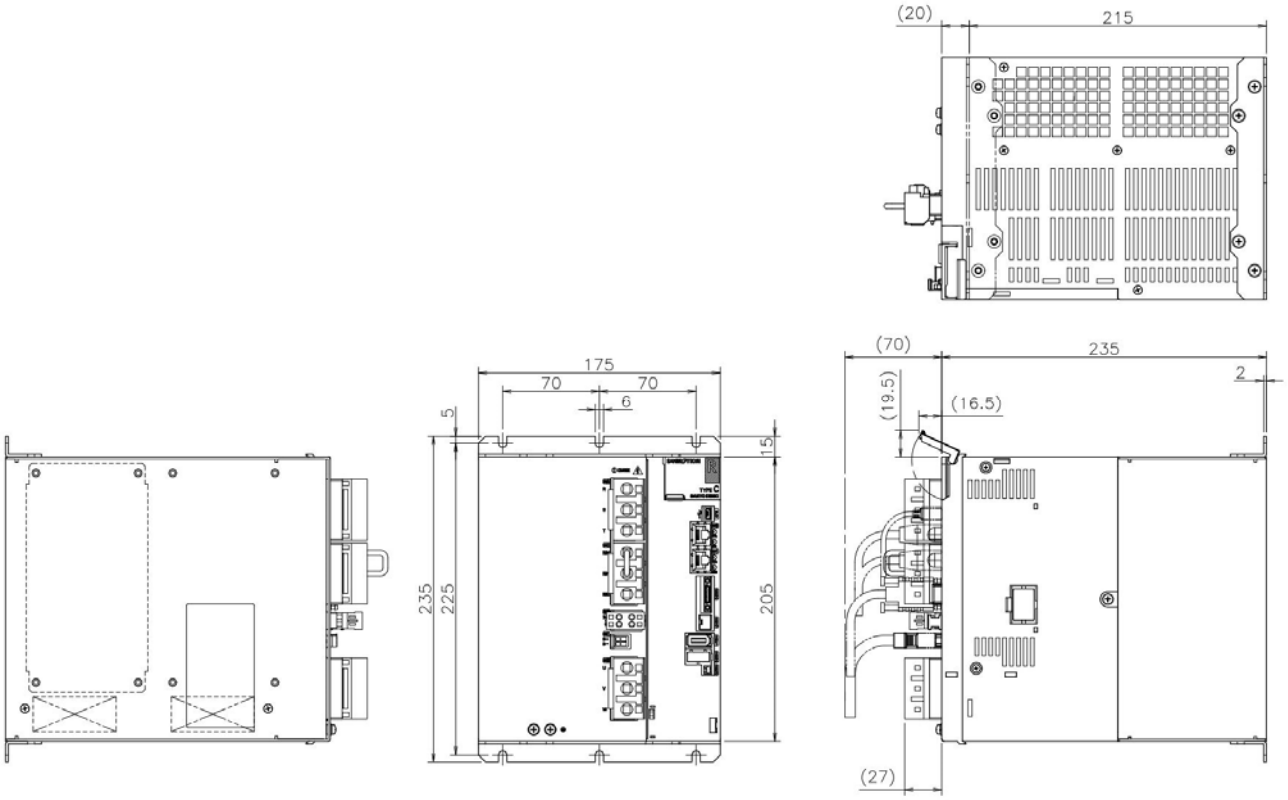


12.5.29 RS3C05A□FA□

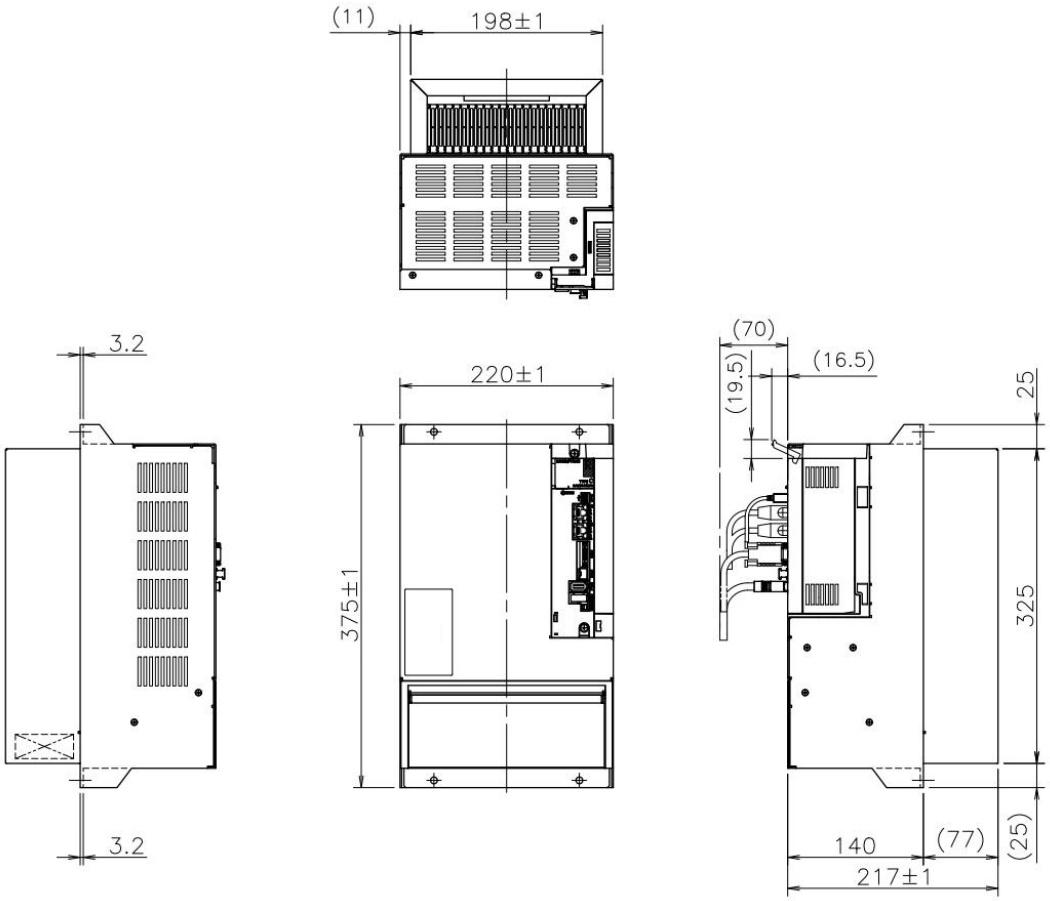


12.5 Servo amplifier dimensions

12.5.30 RS3C10A□FA□

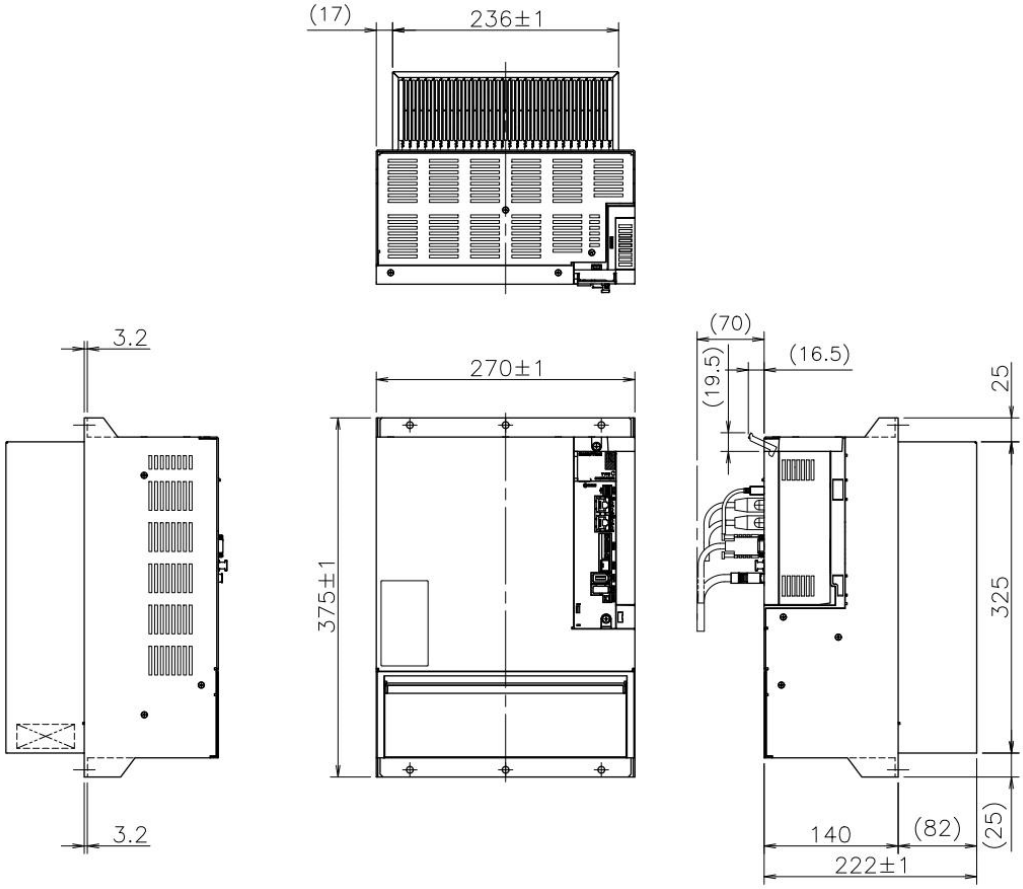


12.5.31 RS3C15A□FL□

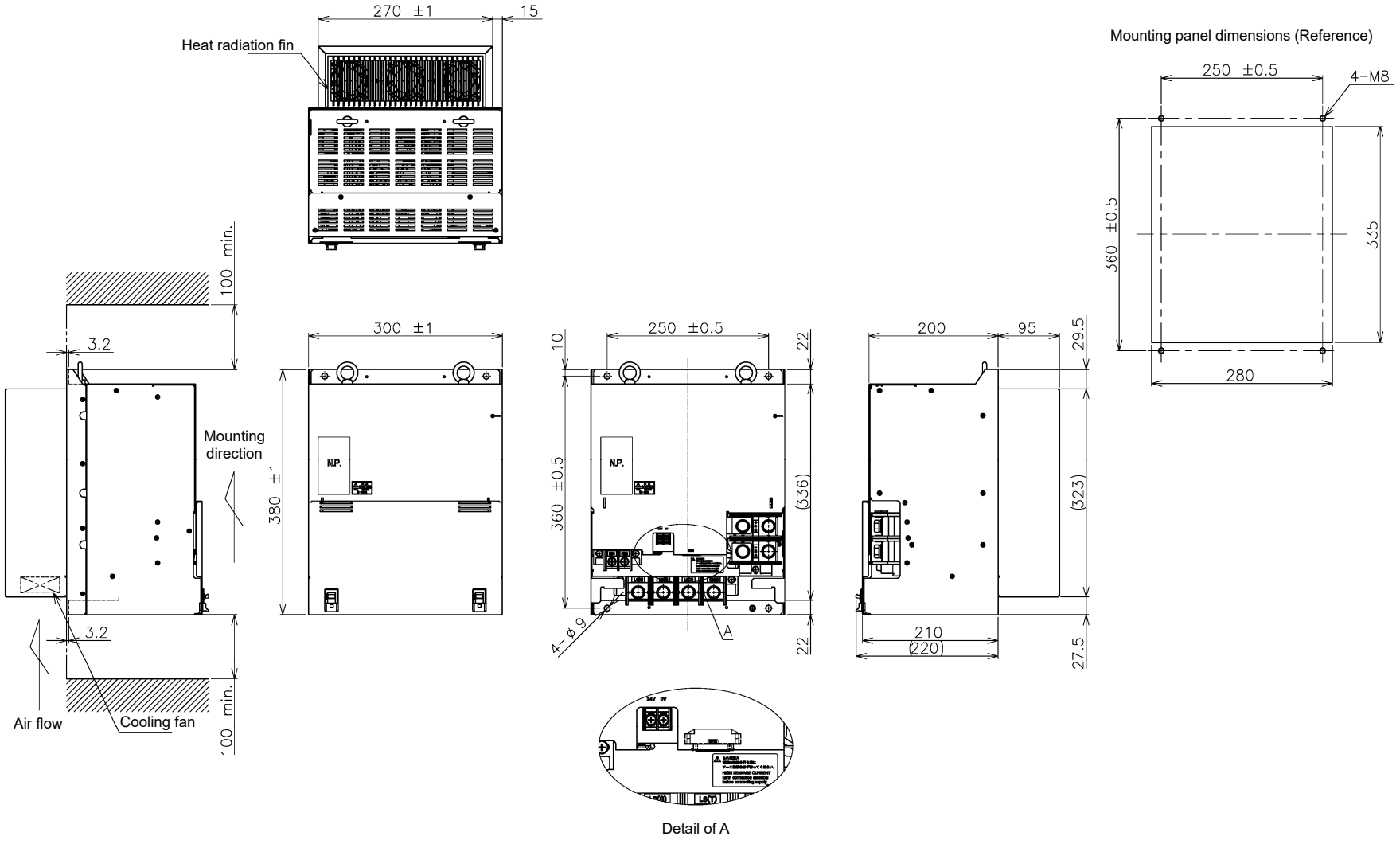


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12.5.32 RS3C30A□FM□

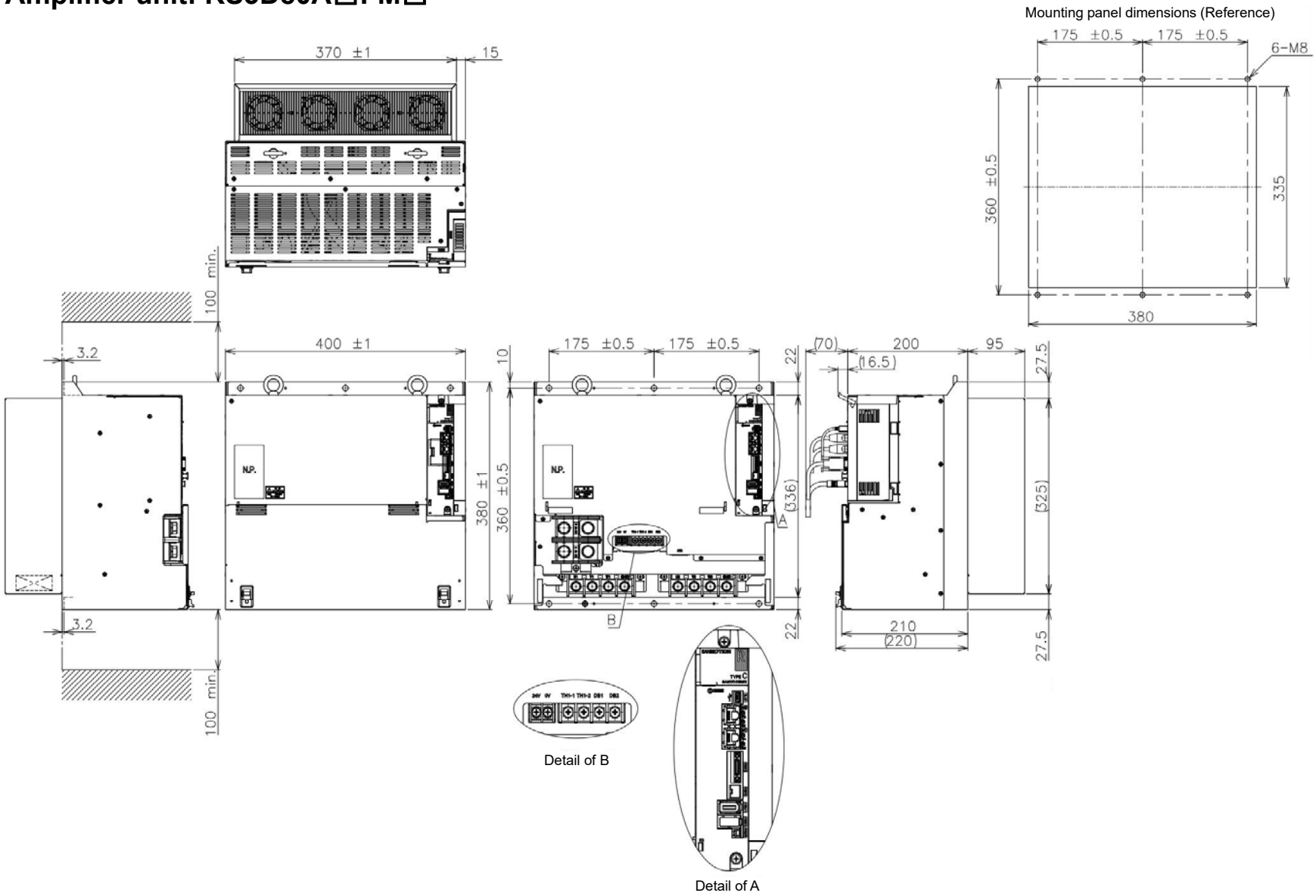


12.5.33 Power unit: RS3PAC550

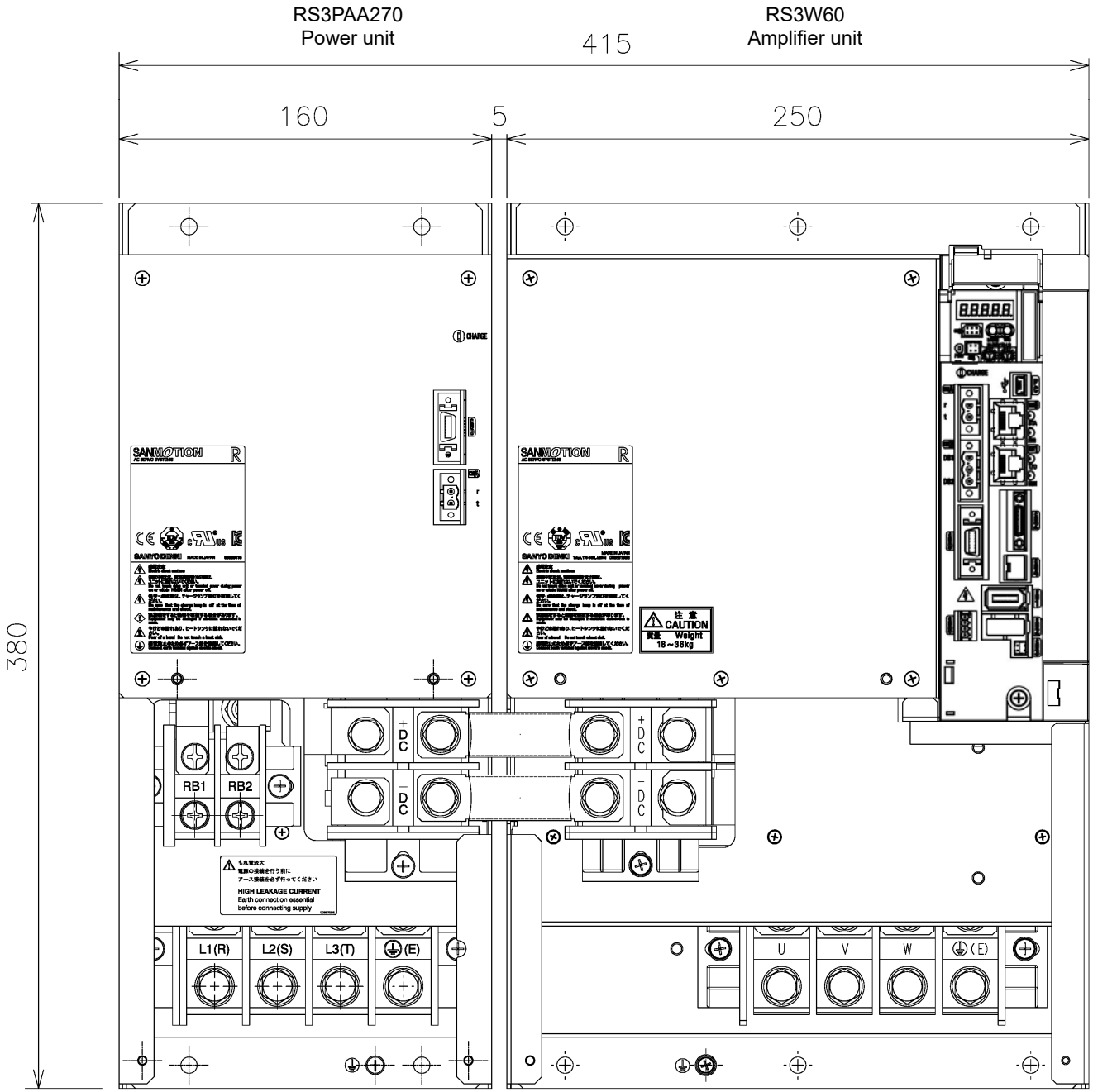


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12.5.34 Amplifier unit: RS3D80A□FM□

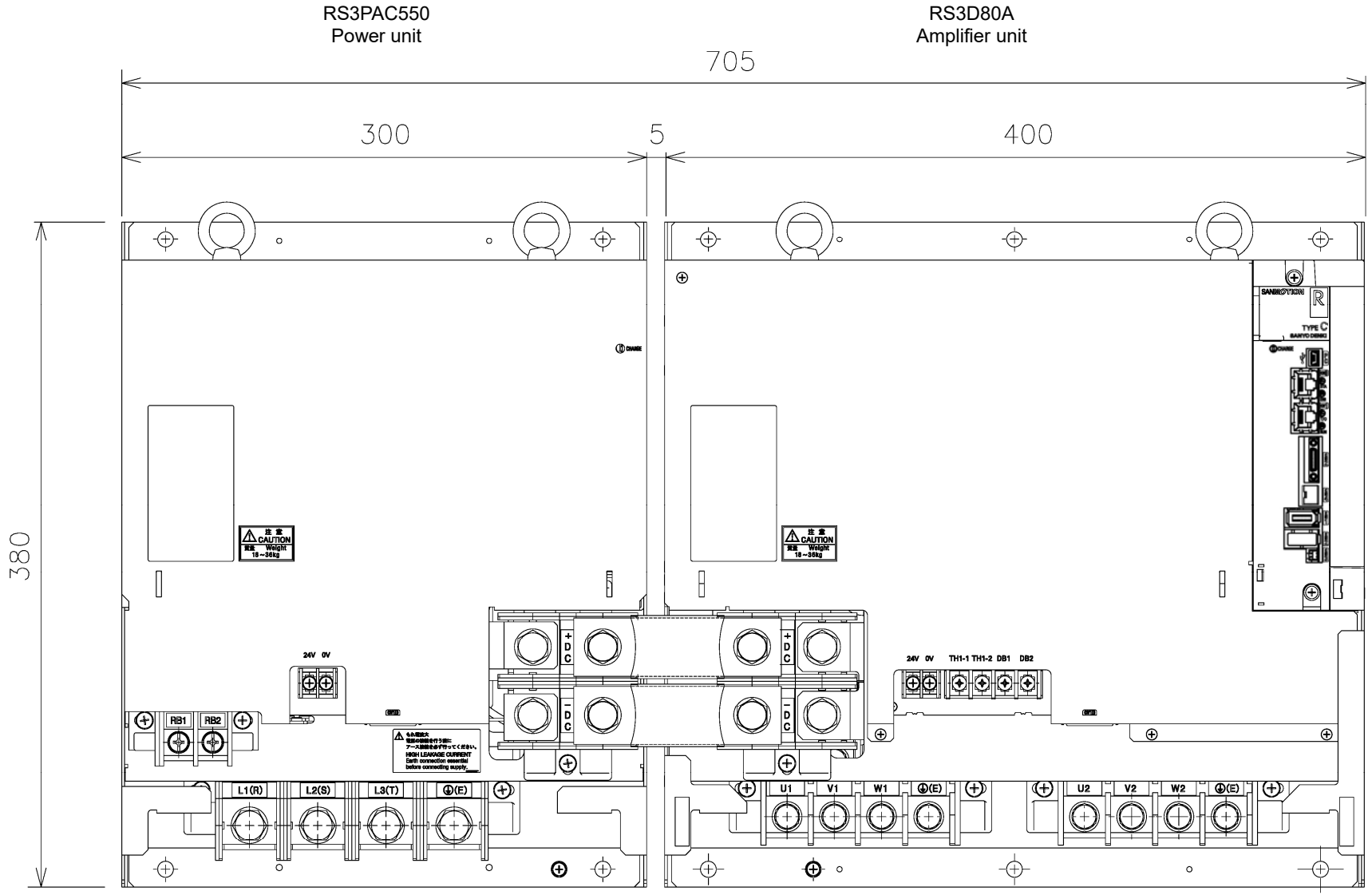


12.5.35 Unit installation drawing (600 A)



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12.5.36 Unit installation drawing (800 A)



12.6 Optional parts

SANYO DENKI offers the following optional parts.

12.6.1 Connectors of servo amplifier [C: I/O]

■ Model numbers of single connectors for RS3□01, RS3□02, RS3□03 and RS3A05

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN1	For host unt connection	AL-00385594	10150-3000PE, 10350-52A0-008	3M Japan Limited
EN1, EN2	For encoder connection	AL-Y0012504-01	54599-1016	Molex Japan LLC
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 Note1)	For safety device connection (For short circuit)	AL-00718251-01	2040978-1	Tyco Electronics Japan G.K.
CN4	For safety device connection (For wiring)	AL-00718252-01	2013595-3	

Note1) If CN4 is unused (open), be sure to insert connecter for safety device (for short circuit) to CN4 of servo amplifier.

■ Model numbers of connector-kits for RS3□01, RS3□02, RS3□03, and RS3A05 (Without safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
CN1, EN1, CNA, CNB	Standard	AL-01108210	RS3###A0CL4/RS3###A8CL4	No regenerative resistance
CN1, EN1, CNB	Standard	AL-01108211	RS3###A0CA4/RS3###A8CA4	With regenerative resistance
CN1,EN1,EN2,CNA, CNB	For full-closed control system	AL-01108212	RS3###A2CL4/RS3###AACL4	No regenerative resistance
CN1, EN1, EN2, CNB		AL-01108213	RS3###A2CA4/RS3###AACA4	With regenerative resistance
CN1, EN1	Low voltage set	AL-01108214	RS3###A0C#4/RS3###A8C#4	-
CAN, CNB	High voltage set	AL-00696037	RS3###A##L#	No regenerative resistance

* Mark "#" shows arbitrary numerical values or alphabets.
* For amplifier with regenerative resistor, the wire of the regenerative resistor is to be connected to CNA, so CNA is equipped with amplifier. So no optional provisions are offered.

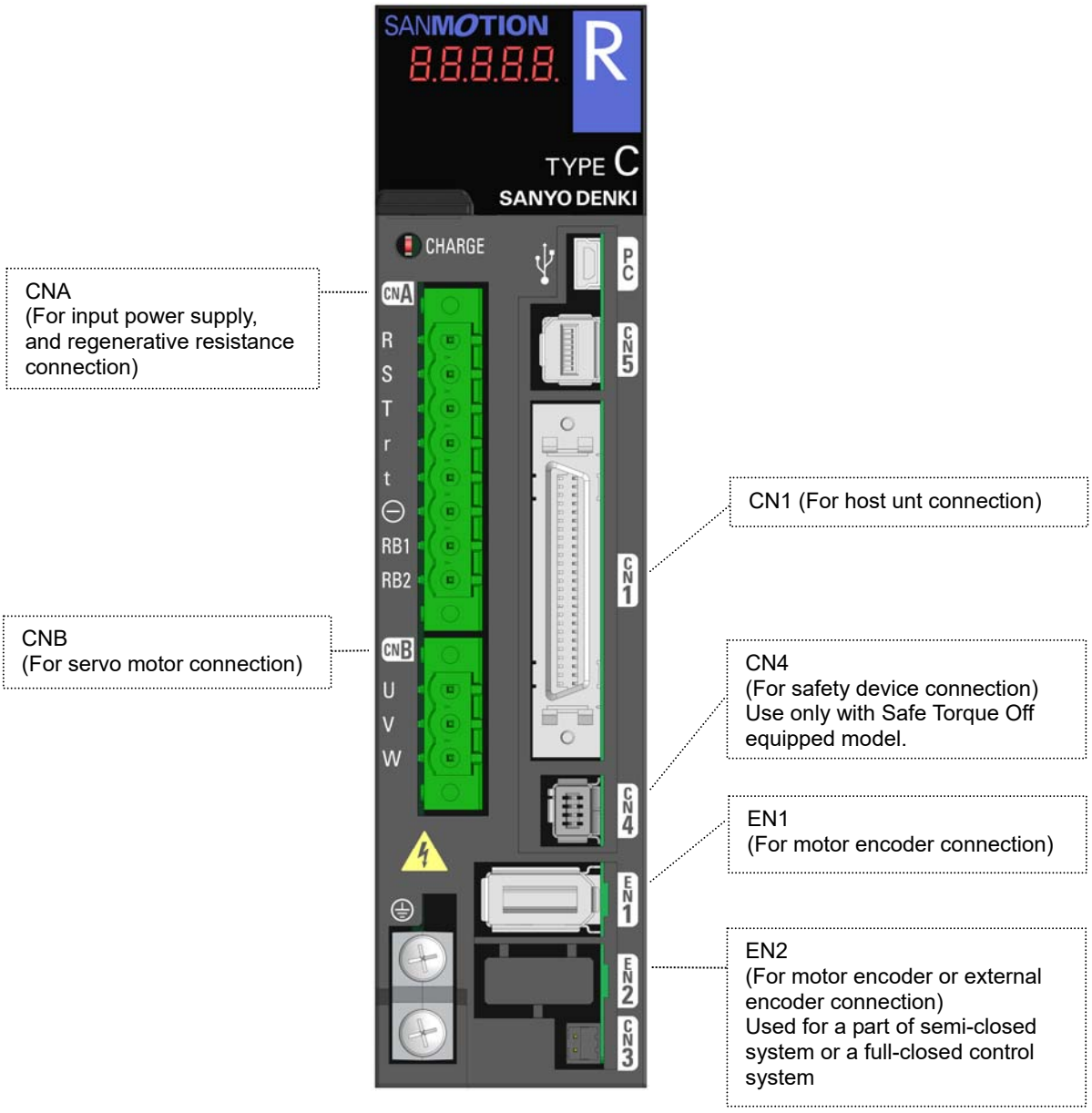
■ Model numbers of connector-kits for RS3□01, RS3□02, RS3□03, and RS3A05 (With safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
EN1, CNA, CNB, CN2, CN4	Standard	AL-00977724	RS3###A2HL4/RS3###AAHL4	No regenerative resistance
EN1, CNB, CN2, CN4	Standard	AL-00977726	RS3###A2HA4/RS3###AAHA4	With regenerative resistance
EN1, EN2, CNA, CNB, CN2, CN4	For full-closed control system	AL-00977728	RS3###A2HL4/RS3###AAHL4	No regenerative resistance
EN1, EN2, CNB, CN2, CN4		AL-00977730	RS3###A2HA4/RS3###AAHA4	With regenerative resistance
EN1, CN2, CN4	Low voltage set	AL-00977732	RS3###A2H#4/RS3###AAH#4	-

* Mark "#" shows arbitrary numerical values or alphabets.
* CN4 in connector-kits is for safety device connection (wiring available). Our model number is 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.

12. Appendix

RS3□01, RS3□02, RS3□03, RS3A05



■ Model numbers of single connector for RS3□07

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN1	For host unt connection	AL-00385594	10150-3000PE, 10350-52A0-008	3M Japan Limited
EN1, EN2	For encoder connection	AL-Y0012504-01	54599-1016	Molex Japan LLC
CNA	For main circuit power supply, and regenerative resistance connection	AL-Y0011766-01	PC5/7-STF1-7.62	Phoenix Contact Co. Ltd.
CNB	For servo motor connection	AL-Y0011768-01	PC5/3-STF1-7.62	
CNC	For control power supply connection	AL-Y0005159-01	MSTBT2.5/2-STF-5.08	
CN4 Note1)	For safety device connection (For short circuit)	AL-00718251-01	2040978-1	Tyco Electronics Japan G.K.
CN4	For safety device connection (For wiring)	AL-00718252-01	2013595-3	

Note1) If CN4 is unused (open), be sure to insert connecter for safety device (for short circuit) to CN4 of servo amplifier.

■ Model numbers of connector-kits for RS3□07 (Without safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
CN1, EN1, CNA, CNB, CNC	Standard	AL-01108221	RS3A07A0CL4/RS3A07A8CL4	No regenerative resistance
CN1, EN1, CNB, CNC	Standard	AL-01108222	RS3A07A0CA4/RS3A07A8CA4	With regenerative resistance
CN1, EN1, EN2, CNA, CNB, CNC	For full-closed control system	AL-01108223	RS3A07A2CL4/RS3A07AACL4	No regenerative resistance
CN1, EN1, EN2, CNB, CNC		AL-01108224	RS3A07A2CA4/RS3A07AACA4	With regenerative resistance
CN1, EN1	Low voltage set	AL-01108214	RS3A07A0C#4/RS3A07A8C#4	-
CAN, CNB, CNC	High voltage set	AL-00946092	RS3A07A##L#	No regenerative resistance
CNB, CNC	High voltage set	AL-00946094	RS3A07A##A#	With regenerative resistance

* Mark "#" shows arbitrary numerical values or alphabets.
* For amplifier with regenerative resistor, the wire of the regenerative resistor is to be connected to CNA, so CNA is equipped with amplifier. So no optional provisions are offered.

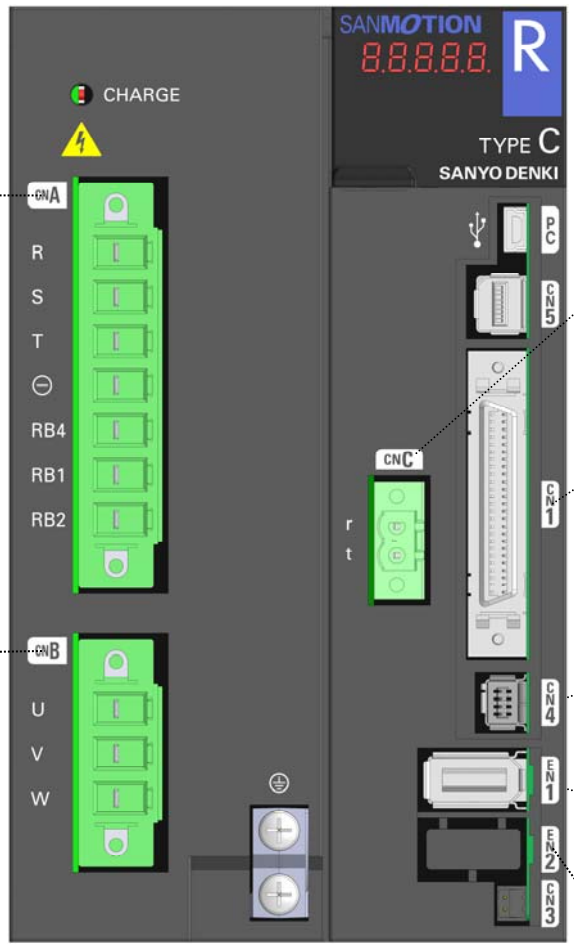
■ Model numbers of connector-kits for RS3□07 (With safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
EN1, CNA, CNB, CNC, CN2, CN4	Standard	AL-00977734	RS3A07A2HL4/RS3A07AAHL4	No regenerative resistance
EN1, CNB, CNC, CN2, CN4	Standard	AL-00977736	RS3A07A2HA4/RS3A07AAHA4	With regenerative resistance
EN1, EN2, CNA, CNB, CNC, CN2, CN4	For full-closed control system	AL-00977738	RS3A07A2HL4/RS3A07AAHL4	No regenerative resistance
EN1, EN2, CNB, CNC, CN2, CN4		AL-00977740	RS3A07A2HA4/RS3A07AAHA4	With regenerative resistance
EN1, CN2, CN4	Low voltage set	AL-00977732	RS3###A2H#4/RS3###AAH#4	-

* Mark "#" shows arbitrary numerical values or alphabets.
* CN4 in connector-kits is for safety device connection (wiring available). Our model number is 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.

12. Appendix

RS3A07



CNA
(For main circuit power supply, and regenerative resistance connection)

CNB
(For servo motor connection)

CNC
(For control power supply connection)

CN1 (For host unt connection)

CN4
(For safety device connection)
Use only with Safe Torque Off equipped model.

EN1
(For motor encoder connection)

EN2
(For motor encoder or external encoder connection)
Used for a part of semi-closed system or a full-closed control system

■ Model numbers of single connectors for RS3A10, RS3A15, and RS3A30

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN1	For host unt connection	AL-00385594	10150-3000PE and 10350-52A0-008	3M Japan Limited
EN1, EN2	To connect encoder	AL-Y0012504-01	54599-1016	Molex Japan LLC
CNA	To input control power	AL-Y0005159-01	MSTBT2.5/2-STF-5.08	Phoenix Contact Co. Ltd.
CN4 Note1)	To connect safety device (For short-circuiting)	AL-00718251-01	2040978-1	Tyco Electronics Japan G.K.
CN4	To connect safety devices (For wiring)	AL-00718252-01	2013595-3	

Note1) If CN4 is unused (open), be sure to insert connecter for safety device (for short circuit) to CN4 of servo amplifier.

■ Model numbers of connector-kits for RS3A10, RS3A15 and RS3A30 (Without safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number
CN1, EN1, CNA	Standard	AL-01108229	RS3###A0C#4/RS3###A8#A4
CN1, EN1, EN2, CNA	For full-closed system	AL-01108230	RS3###A2C#4/RS3###AAC#4
CN1, EN1	Low voltage set	AL-01108214	RS3###A0C#4/RS3###A8C#4

* Mark "#" shows arbitrary numerical values or alphabets.

■ Model numbers of connector-kits for RS3A10, RS3A15 and RS3A30 (With safe-torque-off function)

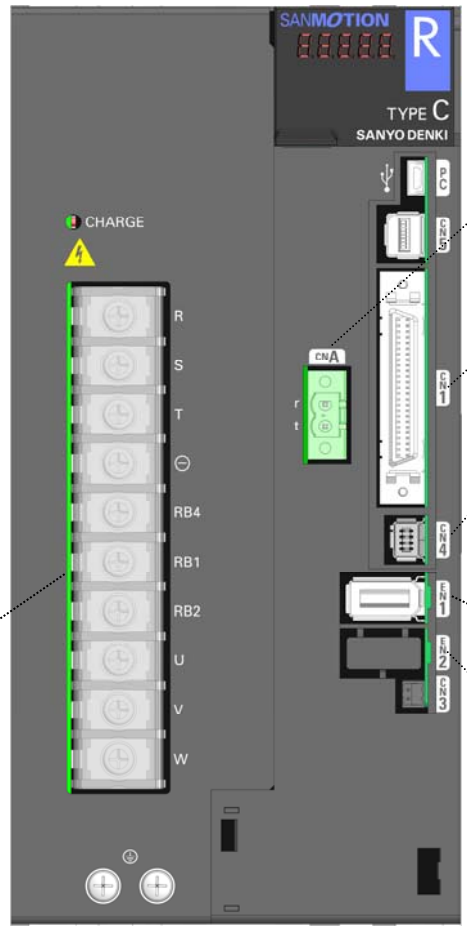
Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number
CN1, EN1, CNA, CN4	Standard	AL-01108231	RS3###A0C#4/RS3###A8C#4
CN1, EN1, EN2, CNA, CN4	For full-closed system	AL-01108232	RS3###A2C#4/RS3###AAC#4
CN1, EN1, CN4	Low voltage set	AL-01108220	RS3###A0C#4/RS3###A8C#4

* Mark "#" shows arbitrary numerical values or alphabets.

* CN4 in connector-kits is for safety device connection (wiring available). Our model number is AL-00718252-01.

12. Appendix

■ RS3A10, RS3A15



Terminal block
(For main circuit power,
regenerative resistance
and servo motor connection)

CNA
(For control power supply input)

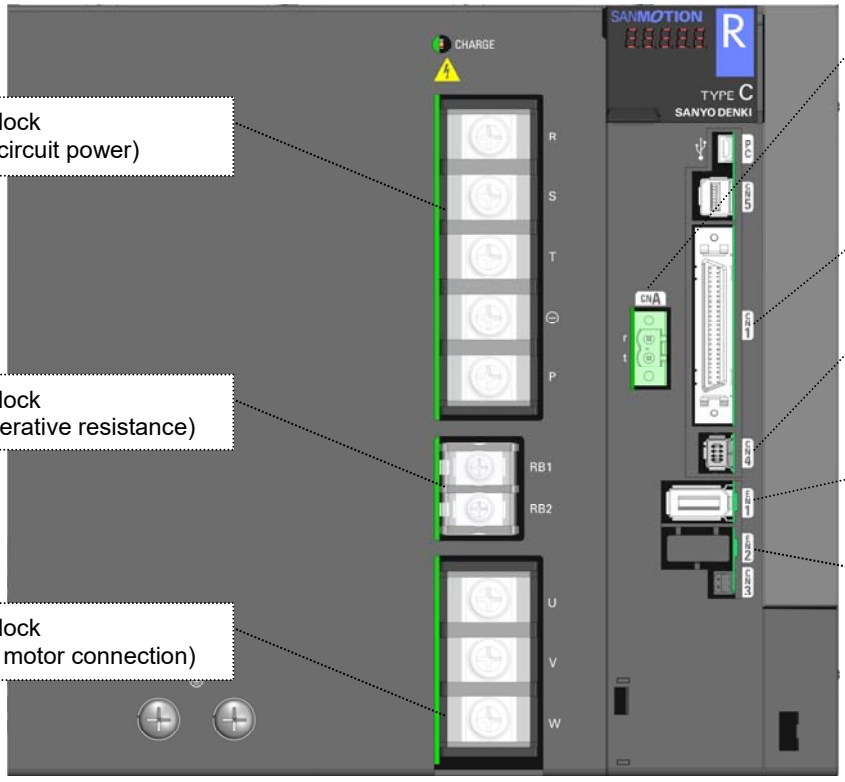
CN1 (For host unt connection)

CN4
(For safety device connection)
Use only with Safe-Torque-Off
equipped model.

EN1
(For motor encoder connection)

EN2
(For motor encoder or external
encoder connection)
Used for a part of semi-closed
system or a full-closed control
system

■ RS3A30



Terminal block
(For main circuit power)

Terminal block
(For regenerative resistance)

Terminal block
(For servo motor connection)

CNA
(For control power supply input)

CN1 (For host unt connection)

CN4
(For safety device connection)
Use only with Safe-Torque-Off
equipped model.

EN1
(For motor encoder connection)

EN2
(For motor encoder or external
encoder connection)
Used for a part of semi-closed
system or a full-closed control

■ Model numbers of single connectors for RS3W60

Connector No.	Item	SANYO DENKI Model No.	Manufacturer's model No.	Manufacturer
CN9 Note 2)	For unit connection (single)	AL-00608710	10114-3000PE, 10314-52A0-008	3M Japan Limited
CN1	For host unt connection	AL-00385594	10150-3000PE, 10350-52A0-008	
EN1, EN2	To connect encoder	AL-Y0012504-01	54599-1016	Molex Japan LLC
CNA Note 2)	For control power input	AL-Y0005159-01	MSTBT2.5/2-STF-5.08	Phoenix Contact Co. Ltd.
CNB	For dynamic brake signal	AL-Y0004079-01	MSTBT2.5/3-STF-5.08	
CN8	For external alarm signal	AL-Y0011185-01	FMC0,5/4-ST-2.54	
CN4 Note 1)	For safety device connection (For short-circuit)	AL-00718251-01	2040978-1	Tyco Electronics Japan G.K.
CN4	For safety device connection (For wiring)	AL-00718252-01	2013595-3	

Note1) If CN4 is unused (open), be sure to insert connecter for safety device (for short-circuit) to CN4 of servo amplifier.

Note 2) For CN9 and CNA, connector is used 1 piece each for power unit and amplifier unit.

■ Model numbers of connector-kits for RS3W60 (Without Safe-torque-off function)

Connector No.	Item	SANYO DENKI Model No.
CN1, EN1, CNA, CN8	Standard	AL-01108233
CN1, EN1, EN2, CNA, CN8	For full-closed control system	AL-01108234
CN1, EN1	Low voltage set	AL-01108214
CNA, CNB	High voltage set	AL-00892854

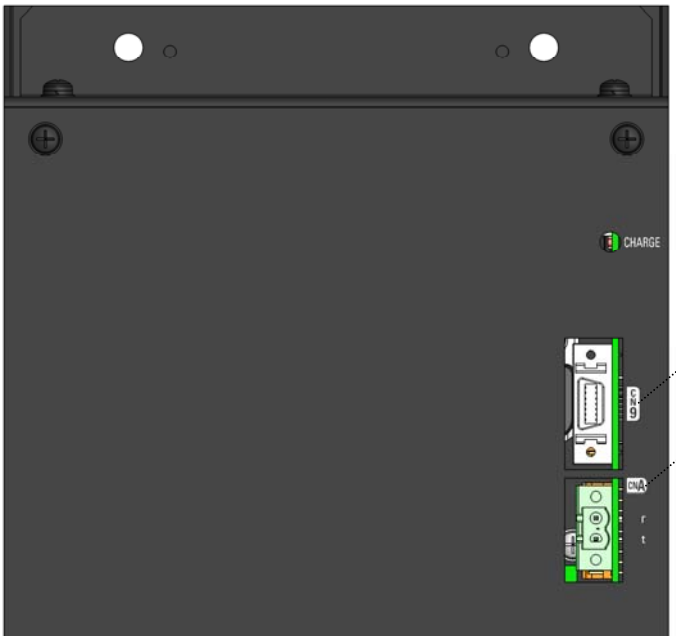
■ Model numbers of connector-kits for RS3W60 (With Safe-torque-off function)

Connector No.	Item	SANYO DENKI Model No.
CN1, EN1, CNA, CN8, CN4	Standard	AL-01108235
CN1, EN1, EN2, CNA, CN8, CN4	For full-closed control system	AL-01108236
CN1, EN1, CN4	Low voltage set	AL-01108220

* CN4 of the connecter kit is for connection with safety devices (for wiring), part number: AL-00718252-01.
* The connector set above is dedicated to amplifier unit. Connecter for power unit shall be bought individually. Especially for CNA, it includes just 1 piece (for amplifier unit side) to connector set so 1 more piece for power unit side should be bought.
* In case of using unit connection cable (AL-00917284), it is not necessary to buy CN9 individually.

12. Appendix

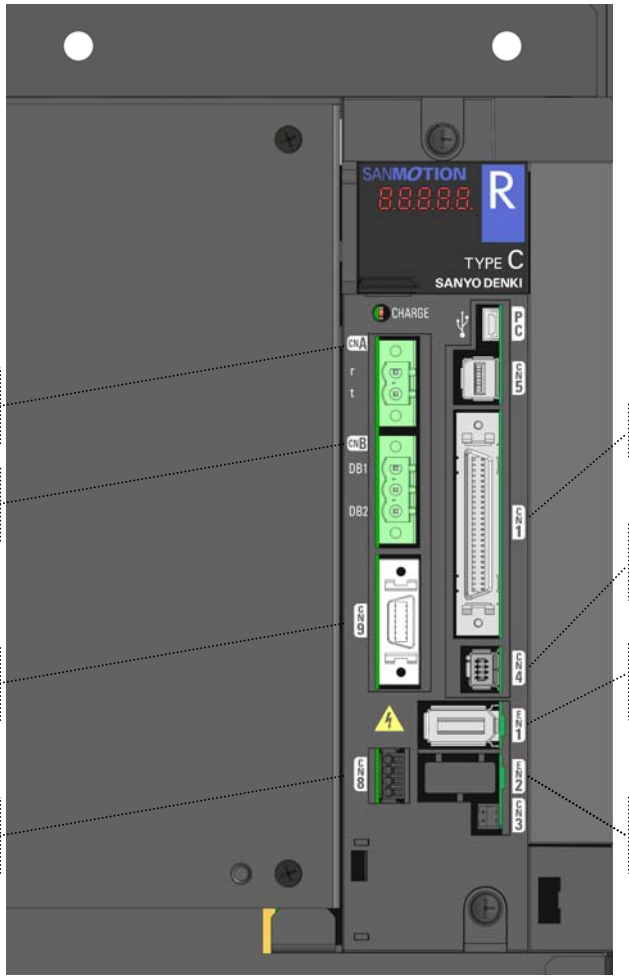
■ Power unit: RS3PAA270



CN9
(For amplifier unit connection)

CNA
(For control power input)

■ Amplifier unit: RS3W60



CNA
(For control power input)

CNB
(For dynamic brake signal)

CN9
(For power unit connection)

CN8
(External alarm)

CN1 (For host unt connection)

CN4
(For safety device connection)

EN1
(For encoder connection)

EN2
(For encoder connection)

■ Model numbers of single connectors for RS3C02, RS3C05 and RS3C10

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN1	For host unt connection	AL-00385594	10150-3000PE, 10350-52A0-008	3M Japan Limited
EN1, EN2	To connect encoder	AL-Y0012504-01	54599-1016	Molex Japan LLC
CN4 Note1)	For safety device connection (For short circuit)	AL-00718251-01	2040978-1	Tyco Electronics Japan G.K.
CN4	For safety device connection (For wiring)	AL-00718252-01	2013595-3	
CNA	For main circuit power supply	AL-00953863-01	03JFAT-SAXGDK-P15	J.S.T. Mfg. Co., Ltd.
CNB	For servo motor connection	AL-00953865-01	03JFAT-SAZGDK-P15	
CNC	For regenerative resistor	AL-00953864-01	03JFAT-SAYGDK-P15	
Open tool	For CAN/CNB/CNC	AL-00953866-01	J-FAT-OT-P	
CND	For control power supply	AL-00961843-01	04JFAT-SAGG-G-KK	
Open tool	For CND	AL-00961844-01	J-FAT-OT(N)	
CNE	For holding brake	AL-00953867-01	02MJFAT-SAGF	
Open tool	For CNE	AL-00953868-01	MJFAT-OT	

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 RS3C02, RS3C05, and RS3C10 (Without Safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
CN1, EN1	Standard	AL-01108214	RS3C##A0CA4 RS3C##A8CA4	For holding brake Without connector
CN1, EN1, CNE and open tool		AL-01108238		For holding brake With connector
CN1, EN1, EN2	For full-closed control system	AL-01108239	RS3C##A2CA4 RS3C##AACA4	For holding brake Without connector
CN1, EN1, EN2, CNE and open tool		AL-01108240		For holding brake With connector

* Mark "#" shows arbitrary numerical values or alphabets.

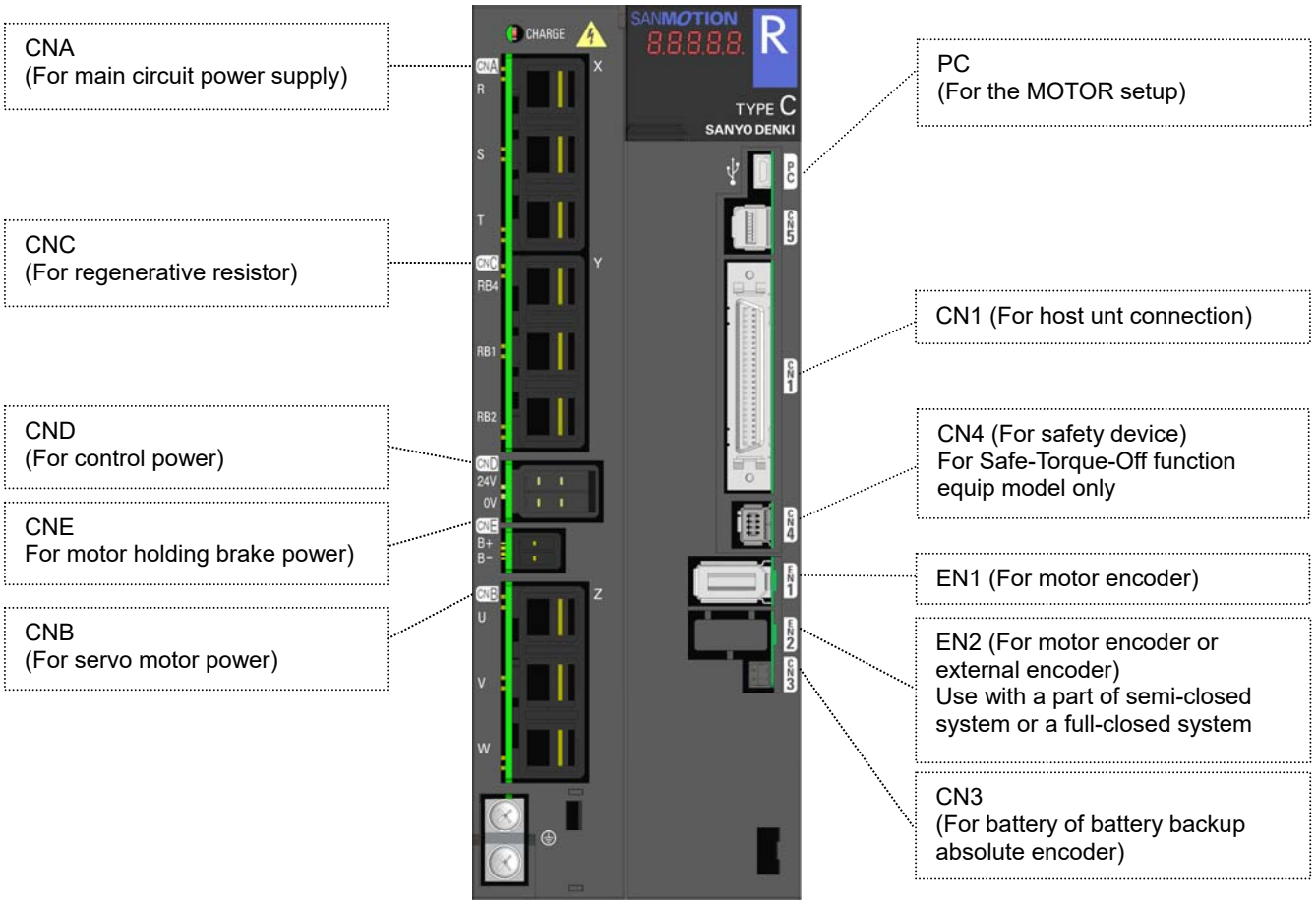
■ Model numbers of connector-kits for RS3C02, RS3C05, and RS3C10 (With Safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
CN1, EN1, CN4	Standard	AL-01108220	RS3C##A0CA4 RS3C##A8CA4	For holding brake Without connector
CN1, EN1, CN4, CNE and open tool		AL-01108242		For holding brake With connector
CN1, EN1, EN2, CN4	For full-closed control system	AL-01108244	RS3C##A2CA4 RS3C##AACA4	For holding brake Without connector
CN1, EN1, EN2, CN4, CNE and open tool		AL-01108245		For holding brake With connector

* 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.

12. Appendix

■ RS3C02/05/10



■ Model numbers of single connectors for RS3C15 and RS3C30

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN1	For host unt connection	AL-00385594	10150-3000PE, 10350-52A0-008	3M Japan Limited
EN1, EN2	To connect encoder	AL-Y0012504-01	54599-1016	Molex Japan LLC
CN4 Note1)	For safety device connection (For short circuit)	AL-00718251-01	2040978-1	Tyco Electronics Japan G.K.
CN4	For safety device connection (For wiring)	AL-00718252-01	2013595-3	

Note1) If CN4 is unused (open), be sure to insert connecter for safety device (for short circuit) to CN4 of servo amplifier.

■ Model numbers of connector-kits for RS3C15 and RS3C30
(Without Safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number
CN1, EN1	Standard	AL-01108214	RS3C##A0C#4 RS3C##A8C#4
CN1, EN1, EN2	For full-closed control system	AL-01108239	RS3C##A2C#4 RS3C##AA##0

* Mark "#" shows arbitrary numerical values or alphabets.

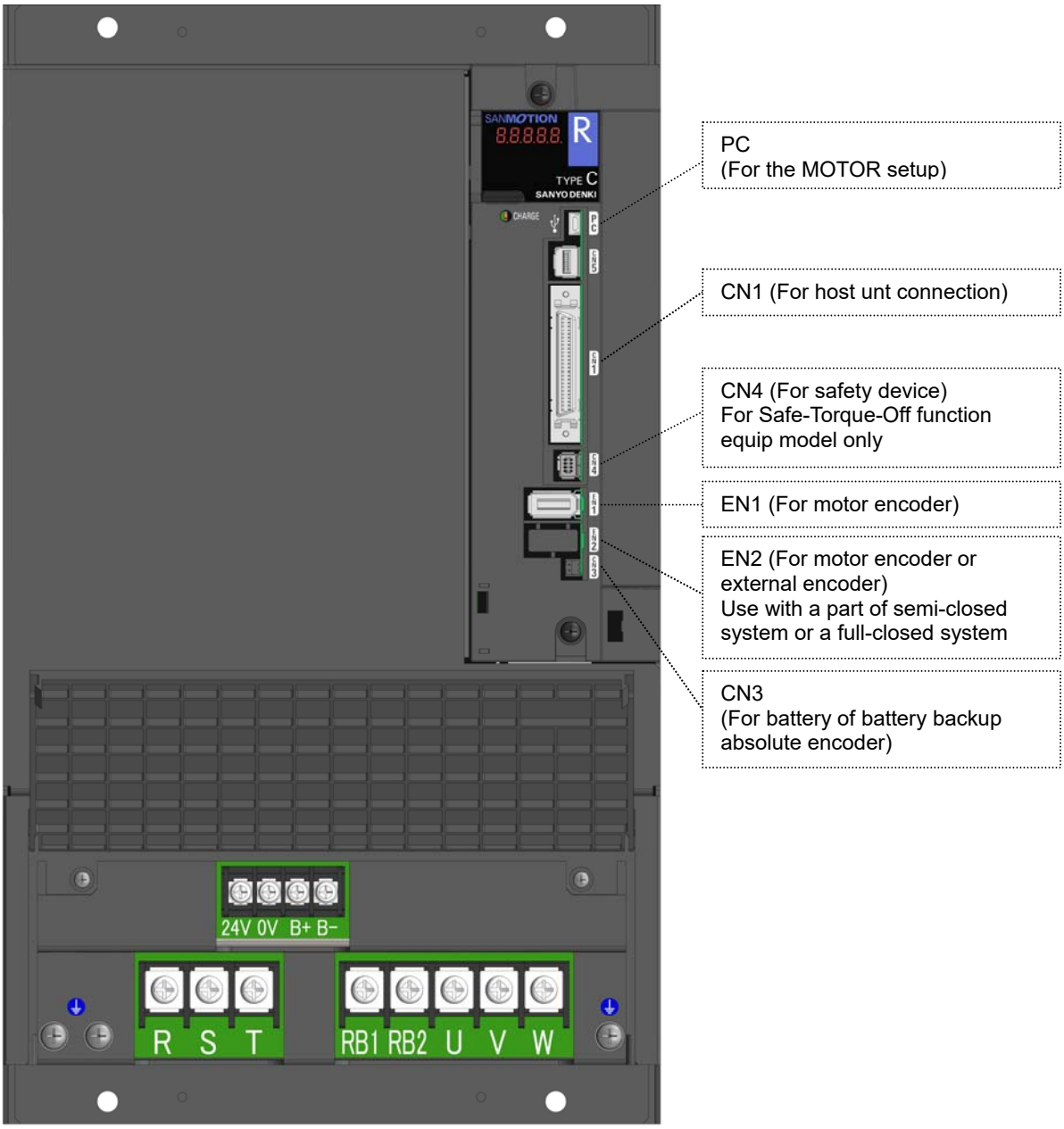
■ Model numbers of connector-kits for RS3C15 and RS3C30
(With Safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number
CN1, EN1, CN4	Standard	AL-01108220	RS3C##A0C#4 RS3C##A8C#4
CN1, EN1, EN2, CN4	For full-closed control system	AL-01108244	RS3C##A2C#4 RS3C##AA##0

* 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.

12. Appendix

■ RS3C15/30



■ Our model numbers of single connectors for RS3D80

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN1	For host unt connection	AL-00385594	10150-3000PE, 10350-52A0-008	3M Japan Limited
EN1, EN2	For encoder connection	AL-Y0012504-01	54599-1016	Molex Japan LLC
CN4 Note 1)	For safety device connection (For short circuit)	AL-00718251-01	2040978-1	Tyco Electronics Japan G.K.
CN4	For safety device connection (For wiring)	AL-00718252-01	2013595-3	
CN10	For power unit connection Note 2)	AL-01017659	DF02P036F22A1, DF02D036A22	Japan Aviation Electronics Industry, Ltd.

Note 1) If CN4 is unused (open), be sure to insert connecter for safety device (for short circuit) to CN4 of amplifier unit.
Note 2) CN10 connector includes 2 pieces: for power unit side and for amplifier unit side.

■ Our model numbers of connector-kits for RS3D80 (Without Safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number
CN1, EN1, CN4	Standard	AL-01108214	RS3D80A8#M4
CN1, EN1, EN2, CN4	For full-closed control system	AL-01108239	RS3D80AA#M4

* Mark "#" shows arbitrary numerical values or alphabets.

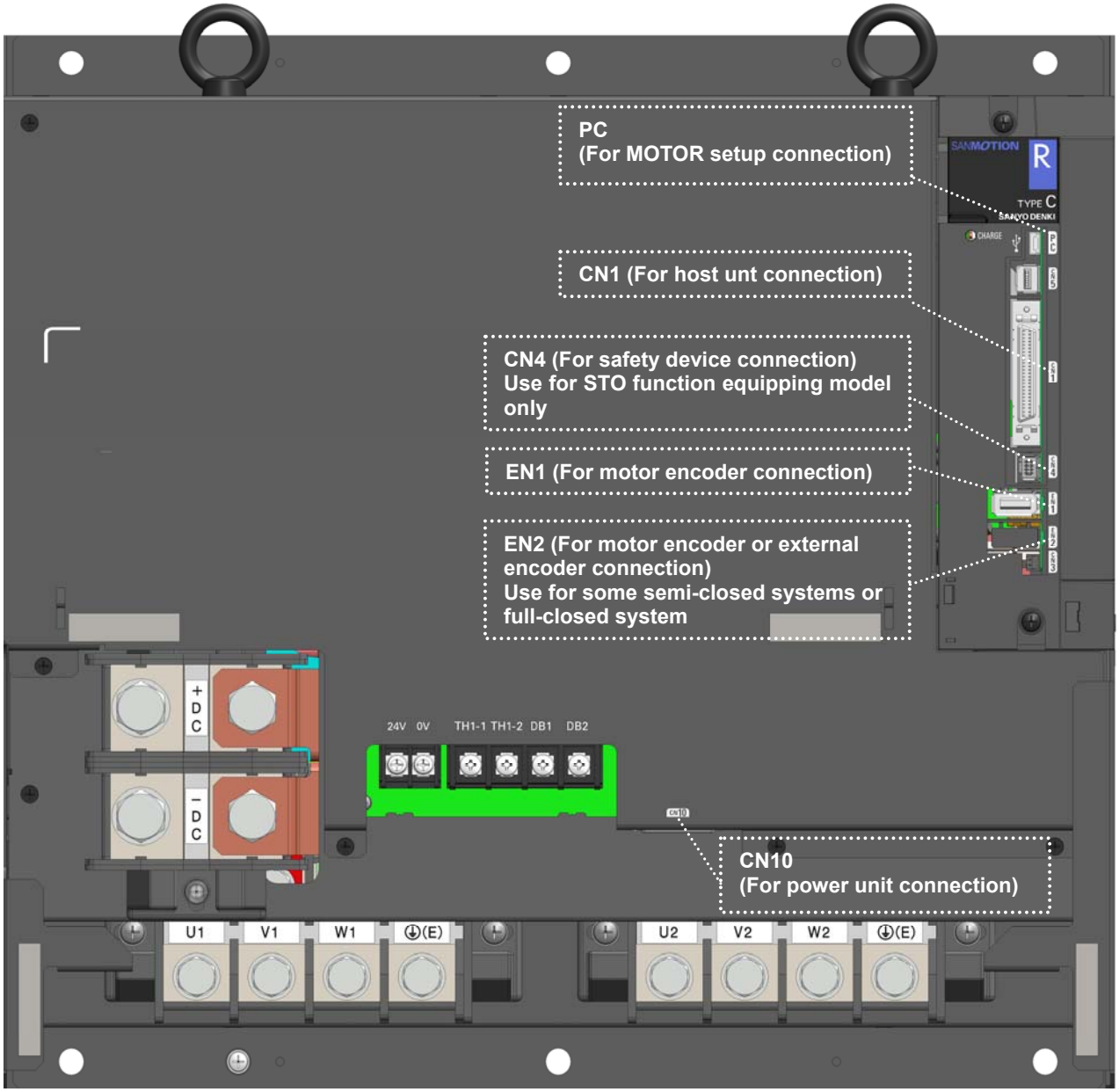
■ Our model numbers of connector-kits for RS3D80A (With Safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
CN1, EN1, CN4	Standard	AL-01108220	RS3D80A8#M4	For holding brake Without connector
CN1, EN1, EN2, CN4	For full-closed control system	AL-01108244	RS3D80AA#M4	For holding brake Without connector

* 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.

12. Appendix

■ RS3D80



12.6.2 Connectors of servo amplifier [F: MODBUS]

■ Model numbers of single connectors for RS3□01, RS3□02, RS3□03 and RS3A05

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN0, CN1	For serial communication connection	Not provided by our company. Please use shielded type modular plug (RJ-45).		
EN1, EN2	For encoder connection	AL-Y0012504-01	54599-1016	Molex Japan LLC
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	
CN2	For general I/O signal	AL-00842383	HDR-E26MSG1+ and HDR-E26LPH	Honda Tsushin Kogyo Co., Ltd.
CN4 Note 1)	For safety device connection (For short circuit)	AL-00849548-02	1971153-2	Tyco Electronics Japan G.K.
CN4	For safety device connection (For wiring)	AL-00718252-01	2013595-3	

Note1) If CN4 is unused (open), be sure to insert connecter for safety device (for short circuit) to CN4 of servo amplifier.

■ Model numbers of connector-kits for RS3□01, RS3□02, RS3□03, and RS3A05 (Without safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
EN1, CNA, CNB, CN2	Standard	AL-01108246	RS3###A0FL4/RS3###A8FL4	No regenerative resistance
EN1, CNB, CN2	Standard	AL-01108247	RS3###A0FA4/RS3###A8FA4	With regenerative resistance
EN1, EN2, CNA, CNB, CN2	For full-closed control system	AL-01108248	RS3###A2FL4/RS3###AAFL4	No regenerative resistance
EN1, EN2, CNB, CN2		AL-01108249	RS3###A2FA4/RS3###AAFA4	With regenerative resistance
EN1, CN2	Low voltage set	AL-01108250	RS3###A0F#4/RS3###A8F#4	—

* Mark "#" shows arbitrary numerical values or alphabets.
* For amplifier with regenerative resistor, the wire of the regenerative resistor is to be connected to CNA, so CNA is equipped with amplifier. So no optional provisions are offered.

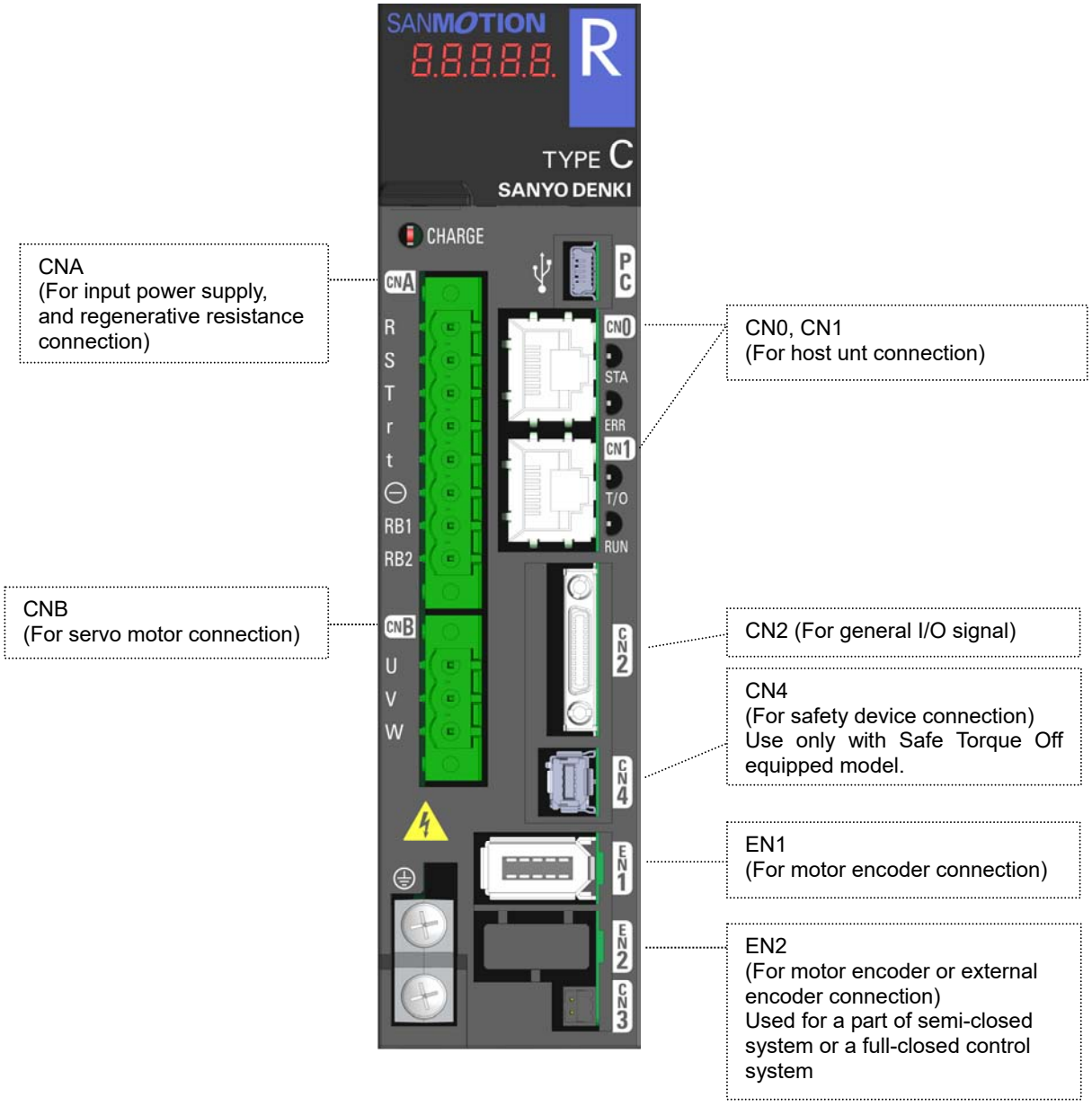
■ Model numbers of connector-kits for RS3□01, RS3□02, RS3□03, and RS3A05 (With safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
EN1, CNA, CNB, CN2, CN4	Standard	AL-00977724	RS3###A0FL4/RS3###A8FL4	No regenerative resistance
EN1, CNB, CN2, CN4	Standard	AL-00977726	RS3###A0FA4/RS3###A8FA4	With regenerative resistance
EN1, EN2, CNA, CNB, CN2, CN4	For full-closed control system	AL-00977728	RS3###A2FL4/RS3###AAFL4	No regenerative resistance
EN1, EN2, CNB, N2, CN4		AL-00977730	RS3###A2FA4/RS3###AAFA4	With regenerative resistance
EN1, CN2, CN4	Low voltage set	AL-00977732	RS3###A0F#4/RS3###A8F#4	—

* Mark "#" shows arbitrary numerical values or alphabets.
* CN4 in connector-kits is for safety device connection (wiring available). Our model number is 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.

12. Appendix

■ RS3□01, RS3□02, RS3□03, RS3A05



■ Model numbers of single connectors for RS3□07

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN0, CN1	For serial communication connection	Not provided by our company. Please use shielded type modular plug (RJ-45).		
EN1, EN2	For encoder connection	AL-Y0012504-01	54599-1016	Molex Japan LLC
CNA	For input power supply, and regenerative resistance connection	AL-Y0011766-01	PC5/7-STF1-7.62	Phoenix Contact Co., Ltd.
CNB	For servo motor connection	AL-Y0011768-01	PC5/3-STF1-7.62	
CNC	For control power supply connection	AL-Y0005159-01	MSTBT2.5/2-STF-5.08	
CN2	For general I/O signal	AL-00842383	HDR-E26MSG1+ and HDR-E26LPH	Honda Tsushin Kogyo Co., Ltd.
CN4 Note 1)	For safety device connection (For short circuit)	AL-00849548-02	1971153-2	Tyco Electronics Japan G.K.
CN4	For safety device connection (For wiring)	AL-00718252-01	2013595-3	

Note1) If CN4 is unused (open), be sure to insert connecter for safety device (for short circuit) to CN4 of servo amplifier.

■ Model numbers of connector-kits for RS3□07 (Without safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
EN1, CNA, CNB, CNC, CN2	Standard	AL-01108251	RS3A07A0FL4/RS3A07A8FL4	No regenerative resistance
EN1, CNB, CNC, CN2	Standard	AL-01108252	RS3A07A0FA4/RS3A07A8FA4	With regenerative resistance
EN1, EN2, CNA, CNB, CNC, CN2	For full-closed control system	AL-01108253	RS3A07A2FL4/RS3A07AAFL4	No regenerative resistance
EN1, EN2, CNB, CNC, CN2		AL-01108254	RS3A07A2FA4/RS3A07AAFA4	With regenerative resistance
EN1, CN2	Low voltage set	AL-01108250	RS3###A0F#4/RS3###A8F#4	—

* Mark "#" shows arbitrary numerical values or alphabets.
* For amplifier with regenerative resistor, the wire of the regenerative resistor is to be connected to CNA, so CNA is equipped with amplifier. So no optional provisions are offered.

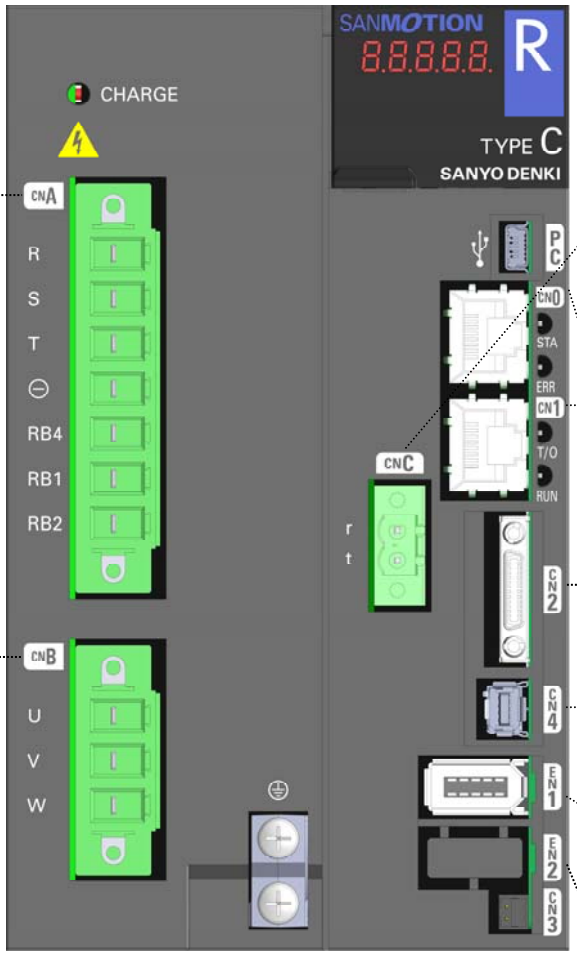
■ Model numbers of connector-kits for RS3□07 (With safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
EN1, CNA, CNB, CNC, CN2, CN4	Standard	AL-00977734	RS3A07A0FL4/RS3A07A8FL4	No regenerative resistance
EN1, CNB, CNC, CN2, CN4	Standard	AL-00977736	RS3A07A0FA4/RS3A07A8FA4	With regenerative resistance
EN1, EN2, CNA, CNB, CNC, CN2, CN4	For full-closed control system	AL-00977738	RS3A07A2FL4/RS3A07AAFL4	No regenerative resistance
EN1, EN2, CNC, CNB, CN2, CN4		AL-00977740	RS3A07A2FA4/RS3A07AAFA4	With regenerative resistance
EN1, CN2, CN4	Low voltage set	AL-00977732	RS3###A0F#4/RS3###A8F#4	—

* Mark "#" shows arbitrary numerical values or alphabets.
* CN4 in connector-kits is for safety device connection (wiring available). Our model number is 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.

12. Appendix

■ RS3A07



CNA
(For main circuit power supply, and regenerative resistance connection)

CNB
(For servo motor connection)

CNC
(For control power supply connection)

CN0, CN1
(For host unt connection)

CN2 (For general I/O signal)

CN4
(For safety device connection)
Use only with Safe Torque Off equipped model.

EN1
(For motor encoder connection)

EN2
(For motor encoder or external encoder connection)
Used for a part of semi-closed system or a full-closed control system

■ Model numbers of single connectors for RS3A10, RS3A15, and RS3A30

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN0, CN1	For serial communication connection	Not provided by our company. Please use shielded type modular plug (RJ-45).		
EN1, EN2	To connect encoder	AL-Y0012504-01	54599-1016	Molex Japan LLC
CNA	To input control power	AL-Y0005159-01	MSTBT2.5/2-STF-5.08	Phoenix Contact Co. Ltd.
CN2	For general I/O signal	AL-00842383	HDR-E26MSG1+ and HDR-E26LPH	Honda Tsushin Kogyo Co., Ltd.
CN4 Note1)	To connect safety device (For short-circuiting)	AL-00849548-02	1971153-2	Tyco Electronics Japan G.K.
CN4	To connect safety devices (For wiring)	AL-00718252-01	2013595-3	

Note1) If CN4 is unused (open), be sure to insert connecter for safety device (for short circuit) to CN4 of servo amplifier.

■ Model numbers of connector-kits for RS3A10, RS3A15 and RS3A30 (Without safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number
EN1, CNA, CN2	Standard	AL-01108255	RS3###A0F#4/RS3###A0F#4
EN1, EN2, CAN, CN2	For full-closed system	AL-01108256	RS3###A2F#4/RS3###AAF#4
EN1, CN2	Low voltage set	AL-01108250	RS3###A0F#4/RS3###A8F#4

* Mark "#" shows arbitrary numerical values or alphabets.

■ Model numbers of connector-kits for RS3A10, RS3A15 and RS3A30 (With safe-torque-off function)

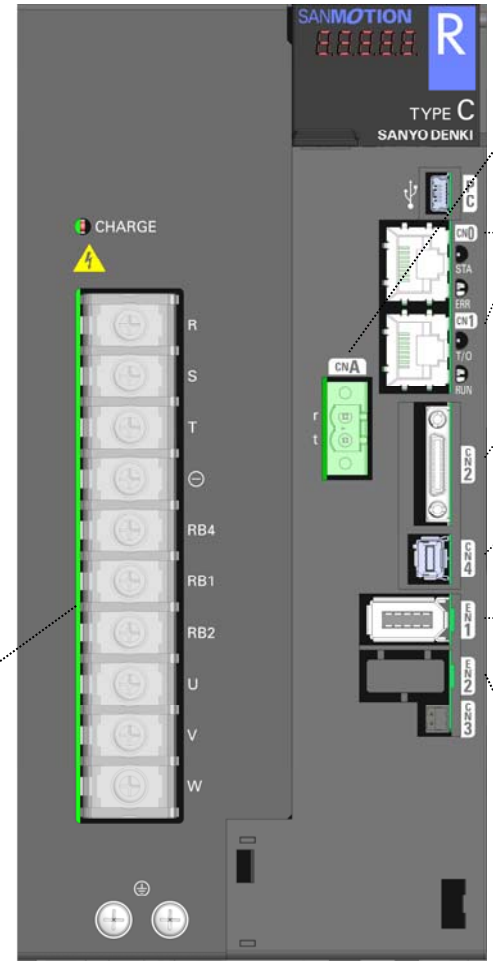
Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number
EN1, CNA, CN2, CN4	Standard	AL-00977742	RS3###A0F#4/RS3###A0F#4
EN1, EN2, CNA, CN2, CN4	For full-closed system	AL-00977744	RS3###A2F#4/RS3###AAF#4
EN1, CN2, CN4	Low voltage set	AL-00977732	RS3###A0F#4/RS3###A8F#4

* Mark "#" shows arbitrary numerical values or alphabets.

* CN4 in connector-kits is for safety device connection (wiring available). Our model number is AL-00718252-01.

12. Appendix

■ RS3A10, RS3A15



Terminal block
(For main circuit power,
regenerative resistance
and servo motor connection)

CNA
(For control power supply input)

CN0, CN1
(For host unt connection)

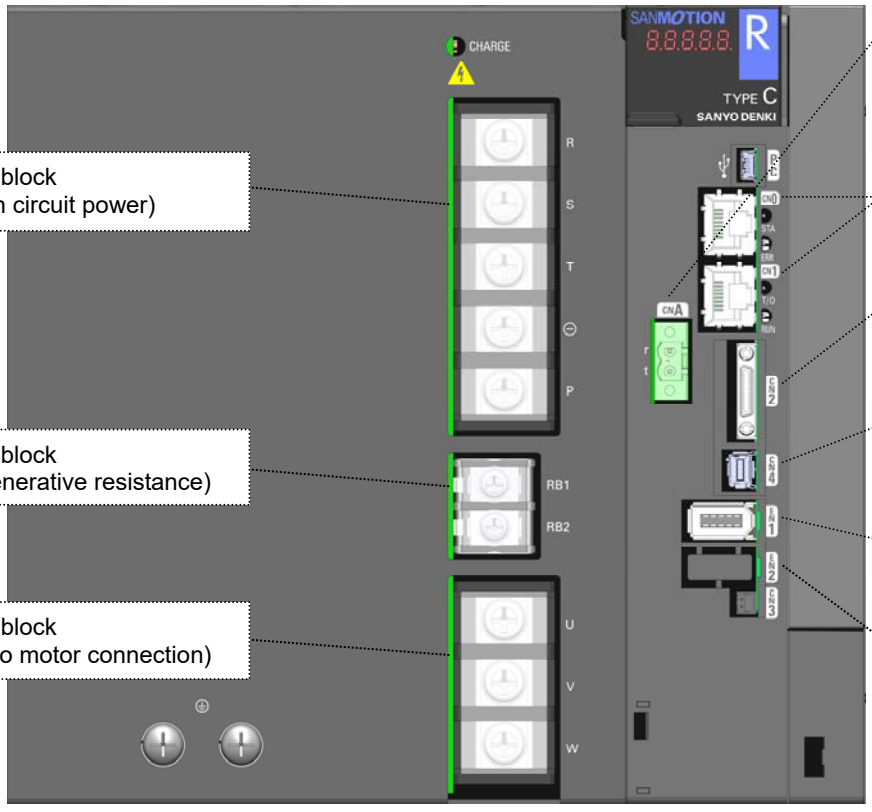
CN2 (For general I/O signal)

CN4
(For safety device connection)
Use only with Safe-Torque-Off
equipped model.

EN1
(For motor encoder connection)

EN2
(For motor encoder or external
encoder connection)
Used for a part of semi-closed
system or a full-closed control
system

■ RS3A30



Terminal block
(For main circuit power)

Terminal block
(For regenerative resistance)

Terminal block
(For servo motor connection)

CNA
(For control power supply input)

CN0, CN1
(For host unt connection)

CN2 (For general I/O signal)

CN4
(For safety device connection)
Use only with Safe-Torque-Off
equipped model.

EN1
(For motor encoder connection)

EN2
(For motor encoder or external
encoder connection)
Used for a part of semi-closed
system or a full-closed control

■ Model numbers of single connectors for RS3W60

Connector No.	Item	SANYO DENKI Model No.	Manufacturer's model No.	Manufacturer
CN0, CN1	For serial communication connection	Not provided by our company. Please use shielded type modular plug (RJ-45).		
EN1, EN2	To connect encoder	AL-Y0012504-01	54599-1016	Molex Japan LLC
CNA	To input control power	AL-Y0005159-01	MSTBT2.5/2-STF-5.08	Phoenix Contact Co., Ltd.
CNB	For dynamic brake signal	AL-Y0004079-01	MSTBT2.5/3-STF-5.08	
CN8	For external alarm signal	AL-Y0011185-01	FMC0,5/4-ST-2.54	
CN2	For general I/O signal	AL-00842383	HDR-E26MSG1+ and HDR-E26LPH	Honda Tsushin Kogyo Co., Ltd.
CN4 Note 1)	To connect safety device (For short-circuiting)	AL-00849548-02	1971153-2	Tyco Electronics Japan G.K.
CN4	To connect safety devices (For wiring)	AL-00718252-01	2013595-3	

Note1) If CN4 is unused (open), be sure to insert connecter for safety device (for short circuit) to CN4 of servo amplifier.

■ Model numbers of connector-kits for RS3W60 (Without Safe-torque-off function)

Connector No.	Item	SANYO DENKI Model No.
EN1, CNA, CN8, CN2	Standard	AL-01108257
EN1, EN2, CNA, CN8, CN2	For full-closed control system	AL-01108258
EN1, CN2	Low voltage set	AL-01108250
CNA, CNB	High voltage set	AL-01108259

* Mark "#" shows arbitrary numerical values or alphabets.

■ Model numbers of connector-kits for RS3W60 (With Safe-torque-off function)

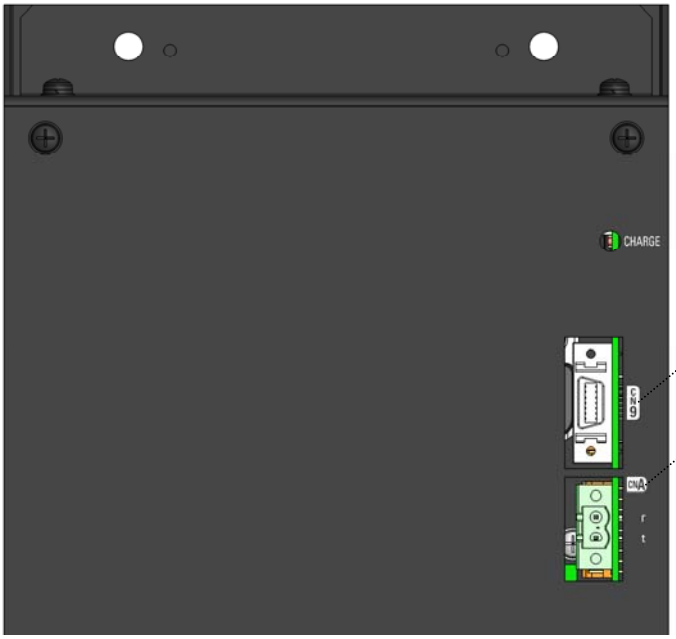
Connector No.	Item	SANYO DENKI Model No.
EN1, CNA, CN8, CN2, CN4	Standard	AL-00977746
EN1, EN2, CNA, CN8, CN2, CN4	For full-closed control system	AL-00977748
EN1, CN2, CN4	Low voltage set	AL-00977732
CNA, CNB, CN4	High voltage set	AL-00892852

* Mark "#" shows arbitrary numerical values or alphabets.

* CN4 in connector-kits is for safety device connection (wiring available). Our model number is AL-00718252-01.

12. Appendix

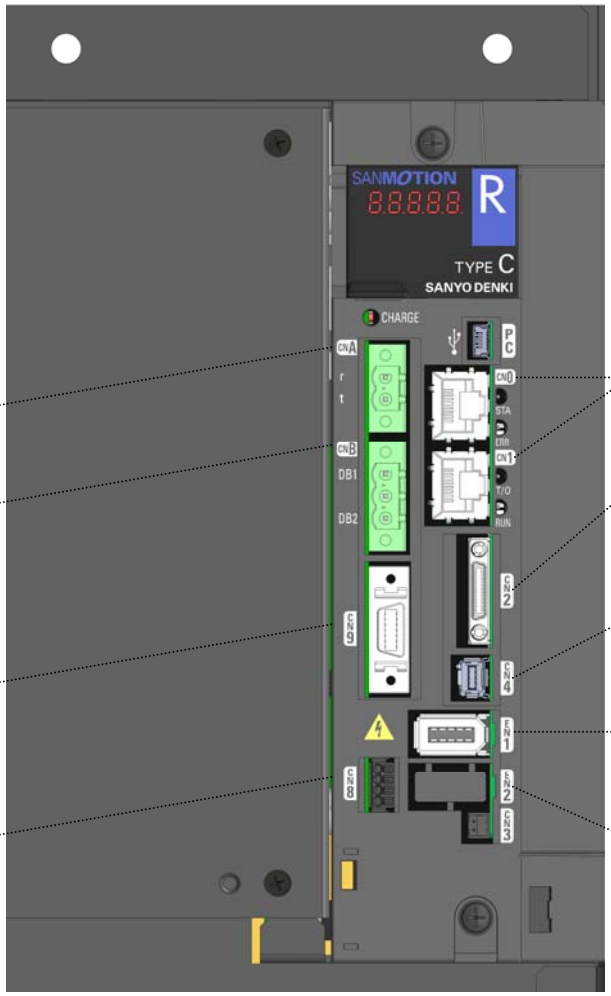
■ Power unit: RS3PAA270



CN9
(For amplifier unit connection)

CNA
(For control power input)

■ Amplifier unit: RS3W60



CNA
(For control power input)

CNB
(For dynamic brake signal)

CN9
(For power unit connection)

CN8
(External alarm)

CN0, CN1
(For host unt connection)

CN2 (For general I/O signal)

CN4
(For safety device connection)

EN1
(For encoder connection)

EN2
(For encoder connection)

■ Model numbers of single connectors for RS3C02, RS3C05 and RS3C10

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN0, CN1	For serial communication connection	Not provided by our company. Please use shielded type modular plug (RJ-45).		
EN1, EN2	For encoder connection	AL-Y0012504-01	54599-1016	Molex Japan LLC
CN2	For general I/O signal	AL-00842383	HDR-E26MSG1+ and HDR-E26LPH	Honda Tsushin Kogyo Co., Ltd.
CN4 Note 1)	For safety device connection (for short-circuiting)	AL-00849548-02	1971153-2	Tyco Electronics Japan G.K.
CN4	For safety device connection (for wiring)	AL-00718252-01	2013595-3	
CNA	For main circuit power connection	AL-00953863-01	03JFAT-SAXGDK-P15	J.S.T. Mfg. Co., Ltd.
CNB	For servo motor connection	AL-00953865-01	03JFAT-SAZGDK-P15	
CNC	For regenerative resistor connection	AL-00953864-01	03JFAT-SAYGDK-P15	
Open tool	For CAN to CNC	AL-00953866-01	J-FAT-OT-P	
CND	For control power connection	AL-00961843-01	04JFAT-SAGG-G-KK	
Open tool	For CND	AL-00961844-01	J-FAT-OT(N)	
CNE	For holding brake output	AL-00953867-01	02MJFAT-SAGF	
Open tool	For CNE	AL-00953868-01	MJFAT-OT	

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 RS3C02, RS3C05, and RS3C10

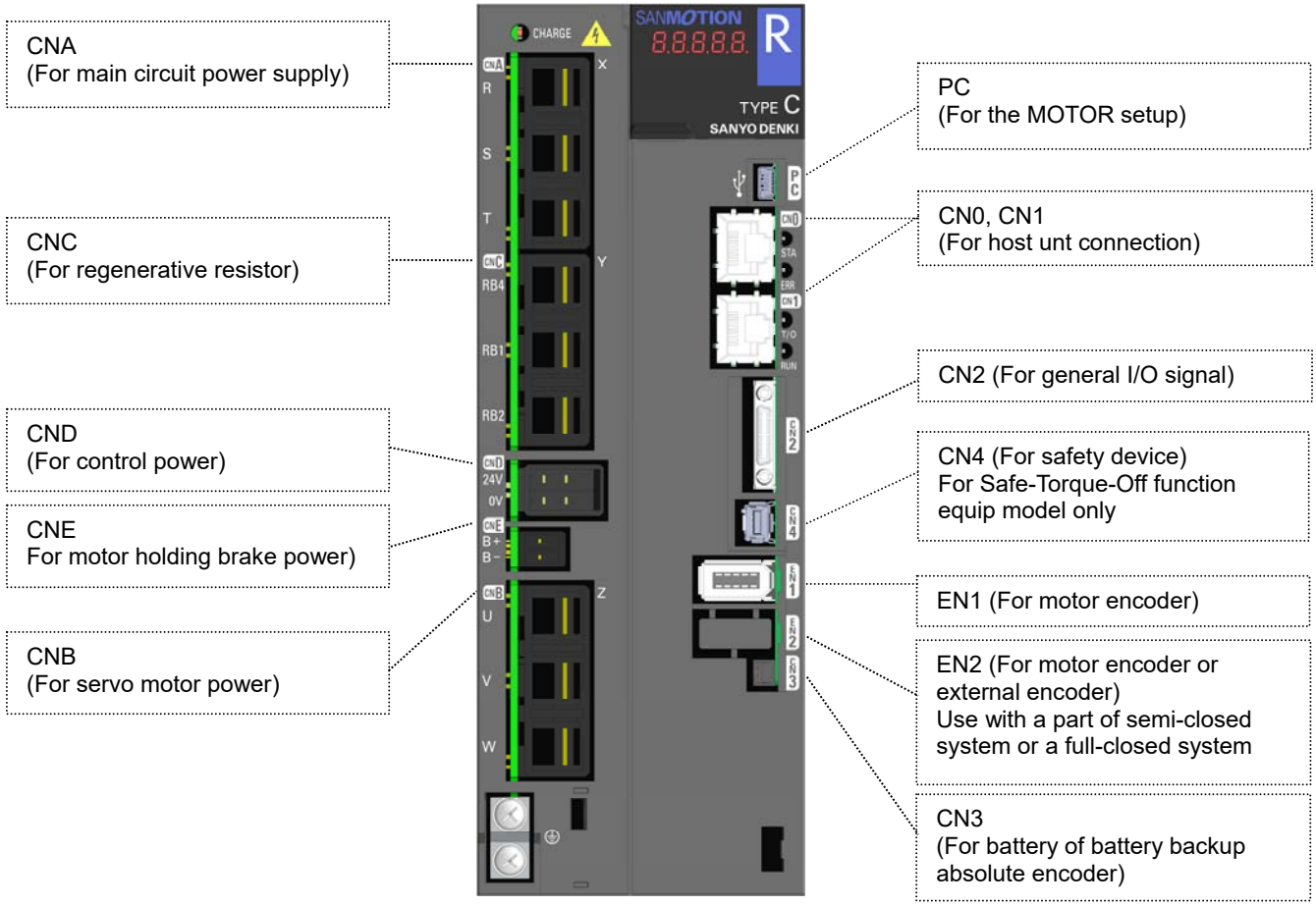
Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
EN1, CN2, CN4	Standard	AL-00977732	RS3C##A0FA4, RS3C##A8FA4	Without connector for holding brake
EN1, CN2		AL-01002534		Without connector for safety device connection
EN1, CN2, CN4, CNE and open tool		AL-00977750		With connector for holding brake
EN1, EN2, CN2, CN4	For full-closed control system	AL-00977752	RS3C##A2FA4, RS3C##AAFA4	Without connector for holding brake
EN1, EN2, CN2		AL-01002536		Without connector for safety device connection
EN1, EN2, CN2, CN4, CNE and open tool		AL-00977754		With connector for holding brake

* Mark "#" shows arbitrary numerical values or alphabets.

* CN4 in connector-kits is for safety device connection (wiring available). Our model number is AL-00718252-01.

12. Appendix

■ RS3C02/05/10



■ Model numbers of single connectors for RS3C15 and RS3C30

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN0, CN1	For serial communication connection	Not provided by our company. Please use shielded type modular plug (RJ-45).		
EN1, EN2	For encoder connection	AL-Y0012504-01	54599-1016	Molex Japan LLC
CN2	For general I/O signal	AL-00842383	HDR-E26MSG1+ and HDR-E26LPH	Honda Tsushin Kogyo Co., Ltd.
CN4 注 1)	For safety device connection (For short circuit)	AL-00849548-02	1971153-2	Tyco Electronics Japan G.K.
CN4	For safety device connection (For wiring)	AL-00718252-01	2013595-3	

Note1) If CN4 is unused (open), be sure to insert connecter for safety device (for short circuit) to CN4 of servo amplifier.

■ Model numbers of connector-kits for RS3C15 and RS3C30

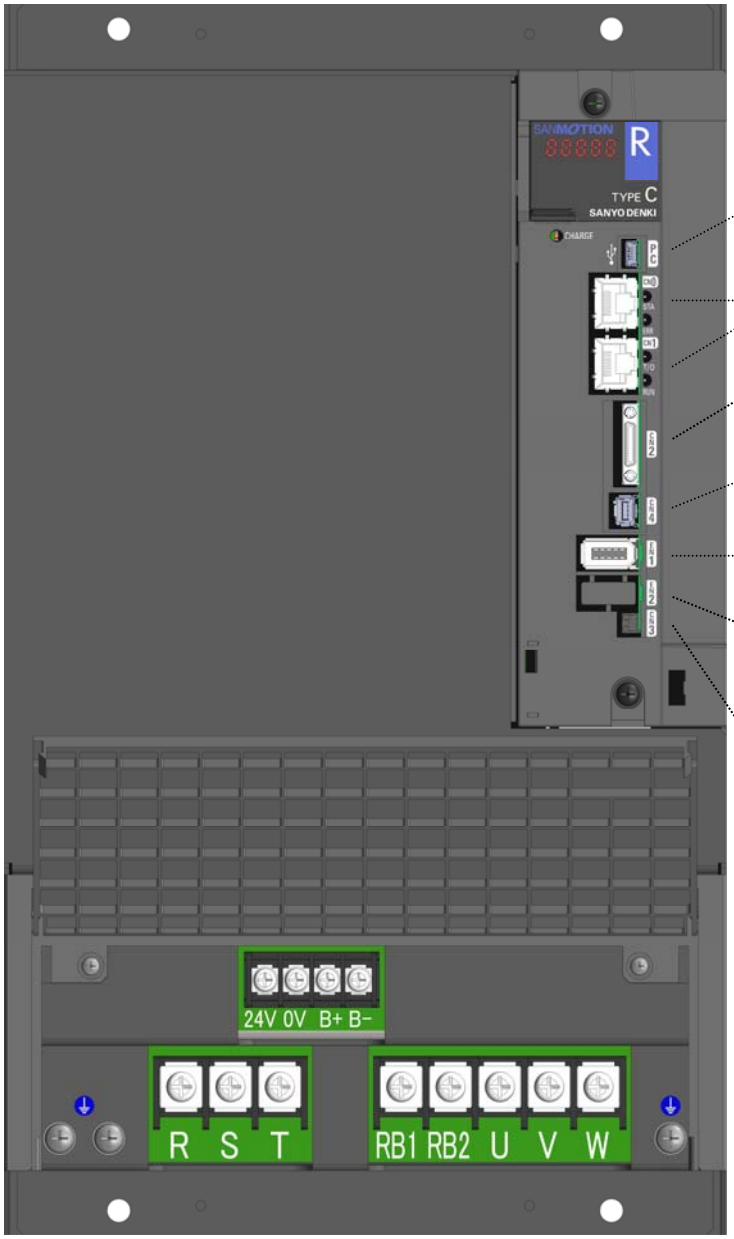
Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
EN1, CN2, CN4	Standard	AL-00977732	RS3C##A0FA4, RS3C##A8FA4	Without connector for holding brake
EN1, CN2		AL-01002534		Without connector for safety device connection
EN1, EN2, CN2, CN4	For full-closed control system	AL-00977752	RS3C##A2FA4, RS3C##AAFA4	Without connector for holding brake
EN1, EN2, CN2		AL-01002536		Without connector for safety device connection

* Mark "#" shows arbitrary numerical values or alphabets.

* CN4 in connector-kits is for safety device connection (wiring available). Our model number is AL-00718252-01.

12. Appendix

■ RS3C15/30



PC
(For the MOTOR setup)

CN0, CN1
(For host unt connection)

CN2 (For general I/O signal)

CN4 (For safety device)
For Safe-Torque-Off function
equip model only

EN1 (For motor encoder)

EN2 (For motor encoder or
external encoder)
Use with a part of semi-closed
system or a full-closed system

CN3
(For battery of battery backup
absolute encoder)

■ Our model numbers of single connectors for RS3D80

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN0, CN1	For serial communication connection	Not provided by our company. Please use shielded type modular plug (RJ-45).		
EN1, EN2	For encoder connection	AL-Y0012504-01	54599-1016	Molex Japan LLC
CN2	For general I/O signal	AL-00842383	HDR-E26MSG1+ and HDR-E26LPH	Honda Tsushin Kogyo Co., Ltd.
CN4 注 1)	For safety device connection (For short circuit)	AL-00849548-02	1971153-2	Tyco Electronics Japan G.K.
CN4	For safety device connection (For wiring)	AL-00718252-01	2013595-3	
CN10	For power unit connection Note 2)	AL-01017659	DF02P036F22A1 and DF02D036A22	Japan Aviation Electronics Industry, Ltd.

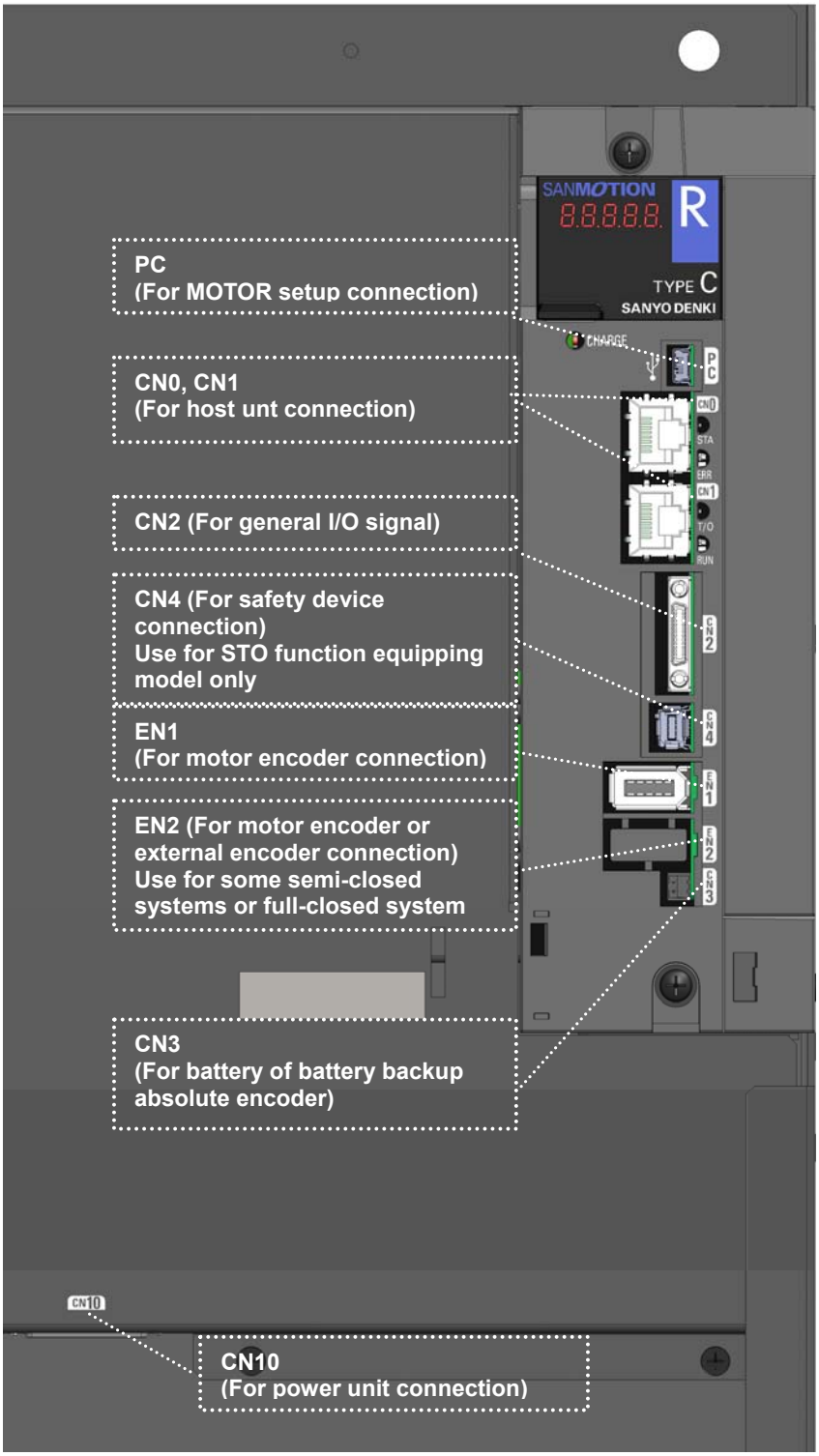
Note 1) If CN4 is unused (open), be sure to insert connecter for safety device (for short circuit) to CN4 of amplifier unit.
Note 2) CN10 connector includes 2 pieces: for power unit side and for amplifier unit side.

■ Our model numbers of connector-kits for RS3D80

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
EN1, CN2, CN4	Standard	AL-00977732	RS3D80A8FM4	Without connector for holding brake
EN1, CN2		AL-01002534		Without connector for safety device connection
EN1, EN2, CN2, CN4	For full-closed control system	AL-00977752	RS3D80AAFM4	Without connector for holding brake
EN1, EN2, CN2		AL-01002536		Without connector for safety device connection

12. Appendix

■ RS3D80A8AM0



12.6.3 Fixing bracket

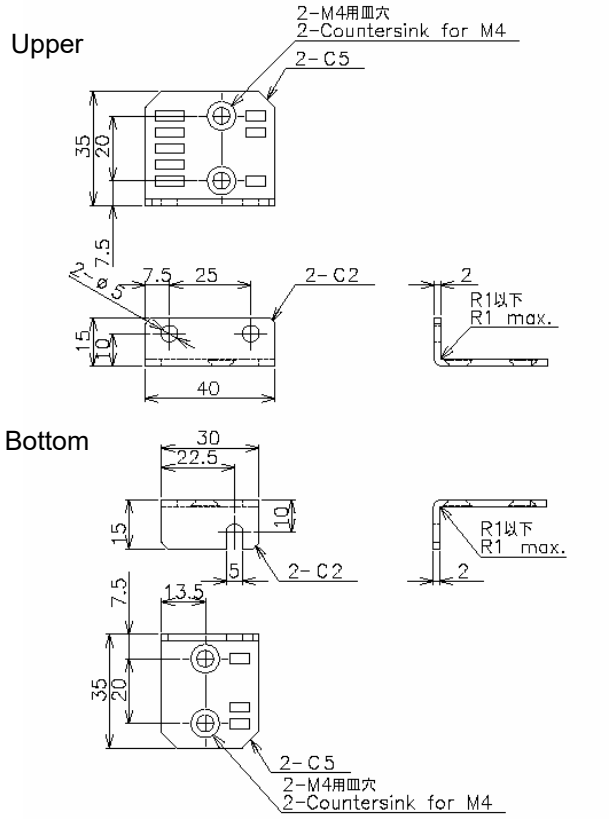
Fixing brackets for mounting servo amplifier front side are prepared.

■ List of fixing brackets for RS3□01 to 30

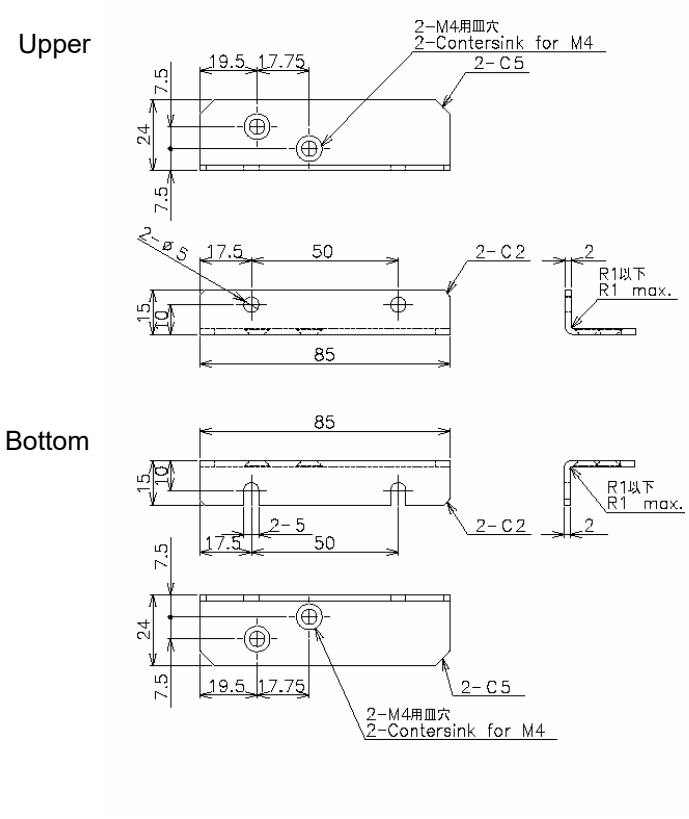
Servo amplifier model number	Bracket fixing position	Model number	Contents
RS3□01,02,03	Front	AL-00880390-01	Fixing bracket (upper/bottom): 1 ea, respectively Tightening screw: 4 ea
RS3A05,07	Front	AL-00880391-01	Fixing bracket (upper/bottom): 1 ea, respectively Tightening screw: 4 ea
RS3A10,15 (Common)	Front	AL-00907039-01	Fixing bracket (upper/bottom): 1 ea, respectively Tightening screw: 6 ea
RS3A30	Front	AL-00907040-01	Fixing bracket (upper/bottom): 1 ea, respectively Tightening screw: 8 ea

These optional fixing brackets are processed trivalent chromium plating.
(Surface color: blue-silver/ different from body color.)

For RS3□01, RS3□02, RS3□03
AL-00880390-01



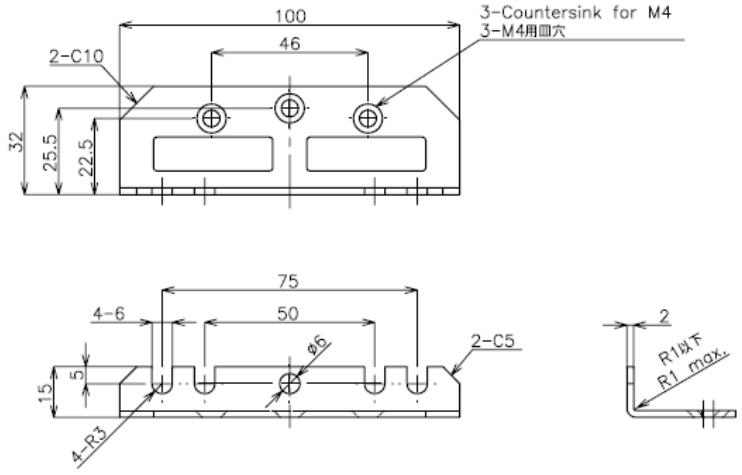
For RS3A05, 07
AL-00880391-01



12. Appendix

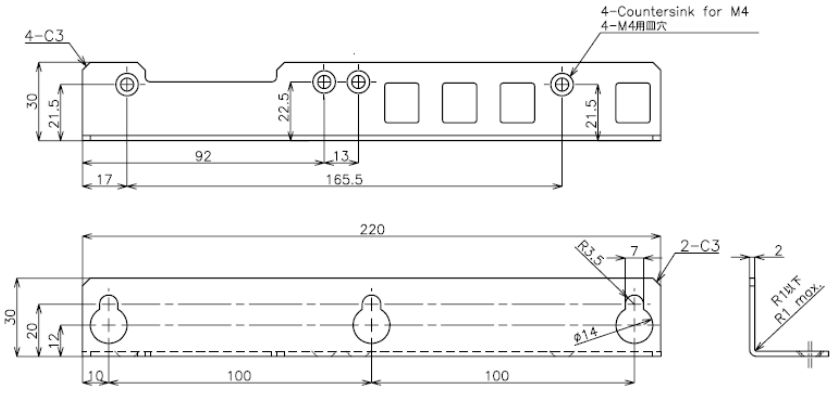
For RS3A10, RS3A15
AL-00907039-01

Common parts (Upper / Bottom)

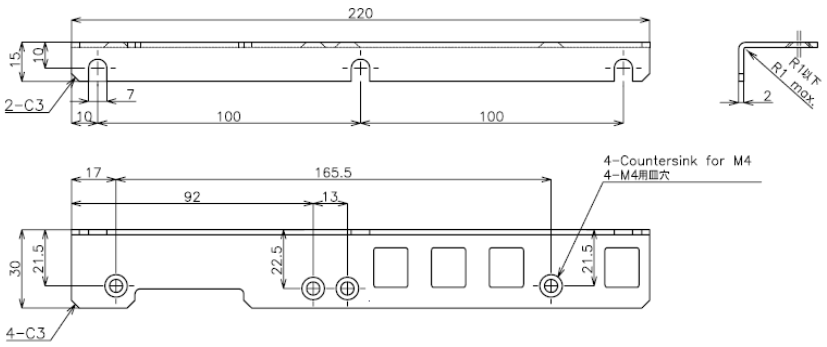


For RS3A30
AL-00907040-01

Upper



Bottom



■ List of fixing brackets for RS3C02

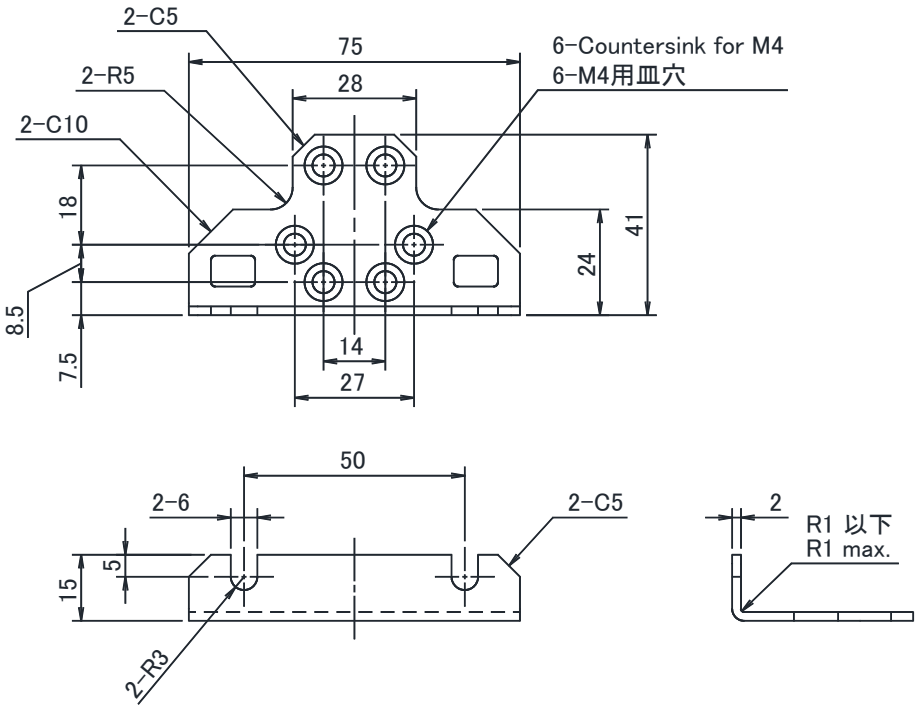
Servo amplifier model number	Bracket fixing position	Model number	Contents
RS3C02	Front	AL-00962547-01	Fixing bracket (upper/bottom): 1 ea, respectively Tightening screw: 6 ea

These optional fixing brackets are processed trivalent chromium plating.
(Surface color: blue-silver/ different from body color.)

For RS3C05/10, back side fixing brackets are able to replace to front side of amplifier.

For RS3C02
AL-00962547-01

Common parts（Upper / Bottom）



12. Appendix

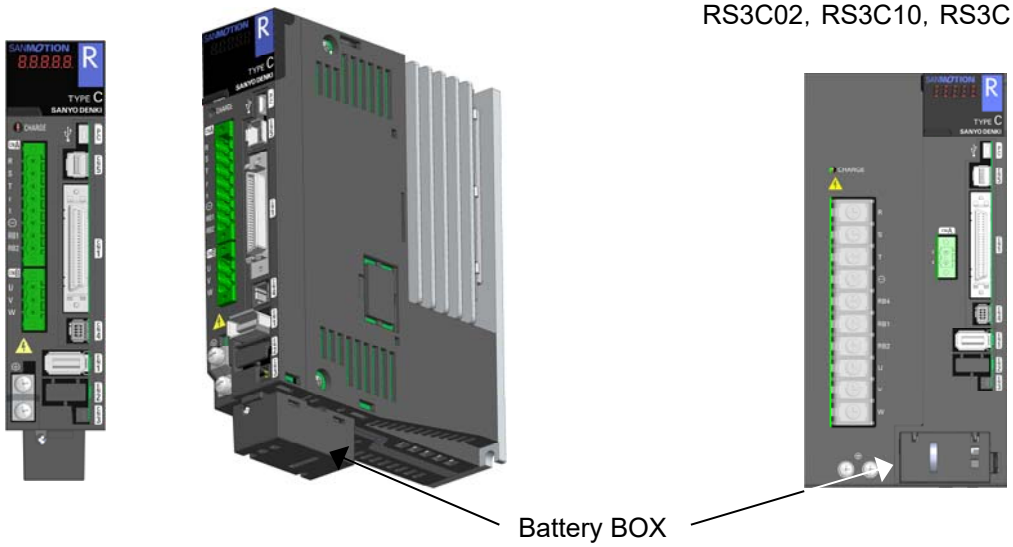
12.6.4 Battery backup absolute encoder (encoder code: P) related items

Name	Details	SANYO DENKI model No.
Battery body for battery box (Lithium battery)	Lithium battery: ER3VLY Toshiba Lifestyle Products & Services Corporation	AL-00879511-01
Battery BOX	Lithium battery: ER3VLY Toshiba Lifestyle Products & Services Corporation With battery BOX	AL-00880402-01
Battery body for junction cable (Lithium battery)	Lithium battery: ER3VLY Toshiba Lifestyle Products & Services Corporation	AL-00697958-01
Battery trunk cable	—	AL-00697960-01 to -06
Battery trunk cable	—	AL-00731792-01

■ Battery BOX mounting position

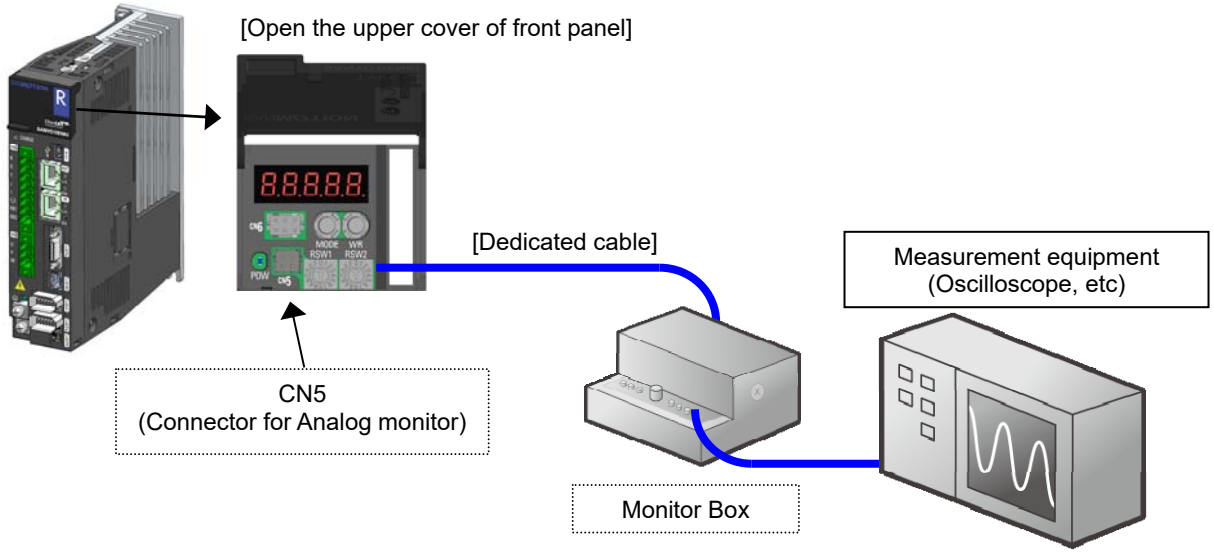
RS3☐01, RS3☐02, RS3☐03, RS3☐05, RS3A07

RS3A10, RS3A15, RS3A30
RS3C02, RS3C10, RS3C15



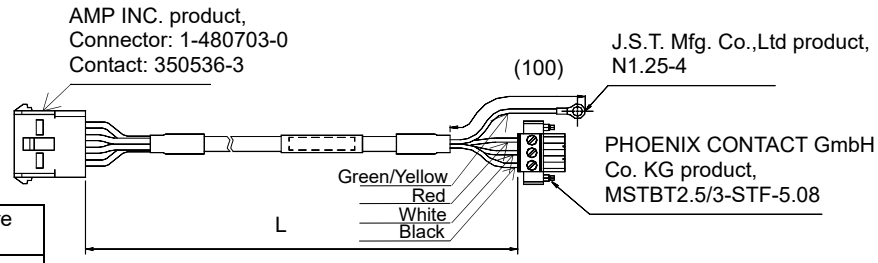
12.6.5 Analog monitor related item

Name	Details	SANYO DENKI model No.
Monitor Box	Monitor box body 2 dedicated cables	Q-MON-3
Dedicated cable	1 dedicated cable	AL-00690525-01



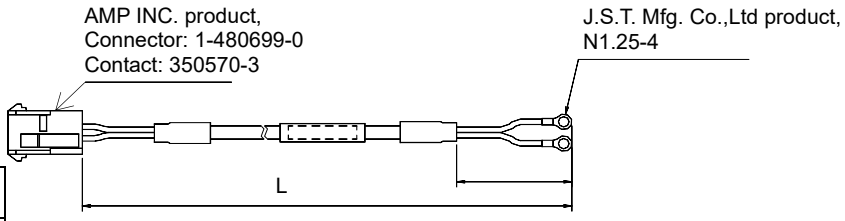
12.6.6 Junction cable for servo motor

Power cable



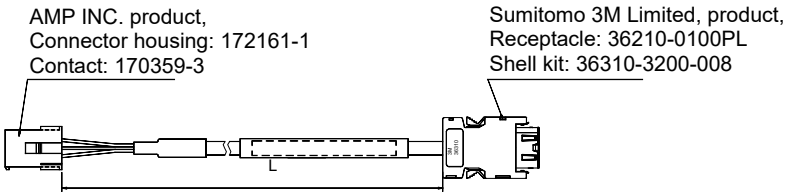
NO.	Lead wire color
1	Red
2	White
3	Black
4	Green/ Yellow

Brake cable



NO.	Lead wire color
1	White
2	Black

Encoder cable



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)	Ground

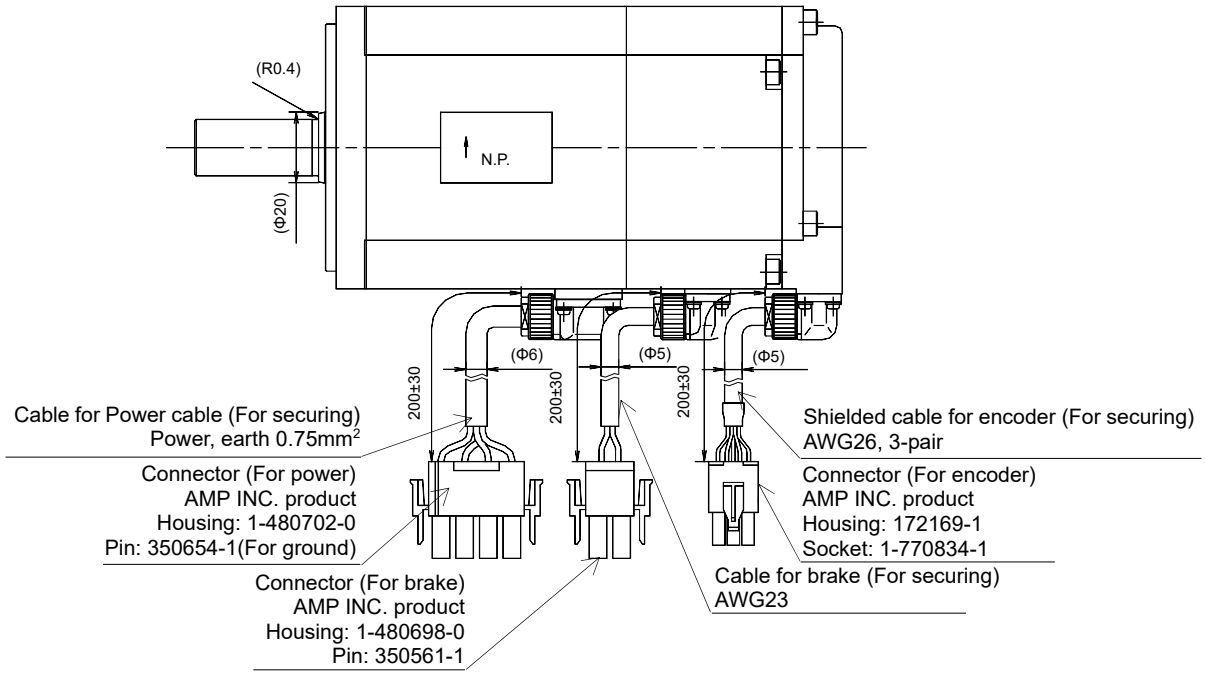
NO.	Lead wire color	Signal name
1	Red	5V
2	Black	0V
7	Blown	ES+
8	Blue	ES-
9	Green	EBAT+
10	Purple	EBAT-

Model Number			Cable length:
Power cable	For brake	For encoder	L (mm)
RS-CM4-01-R	RS-CB3-01-R	RS-CA4-01-R	1,000
RS-CM4-02-R	RS-CB3-02-R	RS-CA4-02-R	2,000
RS-CM4-03-R	RS-CB3-03-R	RS-CA4-03-R	3,000
RS-CM4-05-R	RS-CB3-05-R	RS-CA4-05-R	5,000
RS-CM4-10-R	RS-CB3-10-R	RS-CA4-10-R	10,000

12. Appendix

Servo motor with connectors for junction cables, for 200 V system

Rated output	Motor flange size	Holding brake	Model number	Remarks
30W	40 mm sq.	–	R2AA04003FXPA0	
30W	40 mm sq.	With holding brake (24 VDC)	R2AA04003FCPA0	
50W	40 mm sq.	–	R2AA04005FXPA0	
50W	40 mm sq.	With holding brake (24 VDC)	R2AA04005FCPA0	
100W	40 mm sq.	–	R2AA04010FXPA0	
90W	40 mm sq.	With holding brake (24 VDC)	R2AA04010FCPA0	The rating decreases to 90%
100W	60 mm sq.	–	R2AA06010FXPA0	
100W	60 mm sq.	With holding brake (24 VDC)	R2AA06010FCPA0	
200W	60 mm sq.	–	R2AA06020FXPA0	
200W	60 mm sq.	With holding brake (24 VDC)	R2AA06020FCPA0	
400W	60 mm sq.	–	R2AA06040FXPA0	
360W	60 mm sq.	With holding brake (24 VDC)	R2AA06040FCPA0	The rating decreases to 90%
750W	80 mm sq.	–	R2AA08075FXPA0	
750W	80 mm sq.	With holding brake (24 VDC)	R2AA08075FCPA0	



12.6.7 Servo motor power cable

■ Amplifier model number: RS3□02A and RS3□03A

Motor/amplifier option For power, AWG#19	Cable length: L (mm)	Applicable motor
RS-CM4-01-R	1,000	R2AA04003F R2AA04005F R2AA04010F R2AA06010F R2AA06020F R2AA06040F R2AA08075F
RS-CM4-02-R	2,000	
RS-CM4-03-R	3,000	
RS-CM4-05-R	5,000	
RS-CM4-10-R	10,000	

Item	Connector model number	Remarks
Motor side connector	Connector: 1-480703-0 Contact: 350536-3	Tyco Electronics Japan G.K.

Motor/amplifier option For brake, AWG#23	Cable length: L (mm)	Applicable motor
RS-CB3-01-R	1,000	R2AA04003F R2AA04005F R2AA04010F R2AA06010F R2AA06020F R2AA06040F R2AA08075F
RS-CB3-02-R	2,000	
RS-CB3-03-R	3,000	
RS-CB3-05-R	5,000	
RS-CB3-10-R	10,000	

Item	Connector model number	Remarks
Motor side connector	Connector: 1-480699-0 Contact: 350570-3	Tyco Electronics Japan G.K.

Model number For power, AWG#16	Model number For power and brake, AWG#16・AWG#20	Cable length: L (mm)	Applicable motor
AL-00996451-01	AL-00996452-01	1,000	R1AA10100H R1AA10150H
AL-00996451-02	AL-00996452-02	2,000	
AL-00996451-03	AL-00996452-03	3,000	
AL-00996451-05	AL-00996452-05	5,000	
AL-00996451-10	AL-00996452-10	10,000	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A24-11SE-EB-R Cable clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

Model number For power, AWG#19	Model number For power and brake, AWG#18	Cable length: L (mm)	Applicable motor
AL-00937696-01	AL-00937697-01	1,000	R2AA13120B
AL-00937696-02	AL-00937697-02	2,000	
AL-00937696-03	AL-00937697-03	3,000	
AL-00937696-05	AL-00937697-05	5,000	
AL-00937696-10	AL-00937697-10	10,000	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A24-11SE-EB-R Cable clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

12. Appendix

■ Amplifier model number: RS3□05A

Model number		Cable length: L (mm)	Applicable motor
For power, AWG#14	For power and brake, AWG#14・AWG#20		
AL-00937698-01	AL-00937699-01	1,000	R2AA13050H R2AA13050D R2AA13120D R2AA13120L R2AA13180H R2AA13200L
AL-00937698-02	AL-00937699-02	2,000	
AL-00937698-03	AL-00937699-03	3,000	
AL-00937698-05	AL-00937699-05	5,000	
AL-00937698-10	AL-00937699-10	10,000	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A24-11SE-EB-R Cable clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

Model number		Cable length: L (mm)	Applicable motor
For power, AWG#12	For power and brake, AWG#12・AWG#20		
AL-00996453-01	AL-00996454-01	1,000	R1AA10100F R1AA10200H R1AA10250H
AL-00996453-02	AL-00996454-02	2,000	
AL-00996453-03	AL-00996454-03	3,000	
AL-00996453-05	AL-00996454-05	5,000	
AL-00996453-10	AL-00996454-10	10,000	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A20-15SE-EB-R Cable clamp: JL04-2022CK(14)-R	Japan Aviation Electronics Industry, Ltd.

■ Amplifier model number: RS3□07A

Model number		Cable length: L (mm)	Applicable motor
For power, AWG#12	For power and brake, AWG#12・AWG#20		
AL-00962887-01	AL-00962895-01	1,000	R1AA10200F R1AA10250F
AL-00962887-02	AL-00962895-02	2,000	
AL-00962887-03	AL-00962895-03	3,000	
AL-00962887-05	AL-00962895-05	5,000	
AL-00962887-10	AL-00962895-10	10,000	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A20-15SE-EB-R Cable clamp: JL04-2022CK(14)-R	Japan Aviation Electronics Industry, Ltd.

Model number		Cable length: L (mm)	Applicable motor
For power, AWG#10	For power and brake, AWG#10・AWG#20		
AL-00996455-01	AL-00996456-01	1,000	R1AA13300H R2AA13180D R2AA13200D R2AA18350V
AL-00996455-02	AL-00996456-02	2,000	
AL-00996455-03	AL-00996456-03	3,000	
AL-00996455-05	AL-00996456-05	5,000	
AL-00996455-10	AL-00996456-10	10,000	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A24-11SE-EB-R Cable clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

■ Amplifier model number: RS3□10A

Model number		Cable length: L (mm)	Applicable motor
For power, AWG#10	For power and brake, AWG#10・AWG#20		
AL-00918635-01	AL-00918636-01	1,000	R1AA13300F R1AA13400H R1AA13500H R2AA13180D R2AA13200D R2AA18350L
AL-00918635-02	AL-00918636-02	2,000	
AL-00918635-03	AL-00918636-03	3,000	
AL-00918635-05	AL-00918636-05	5,000	
AL-00918635-10	AL-00918636-10	10,000	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A24-11SE-EB-R Cable clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

12. Appendix

■ Amplifier model number: RS3□15A

Model number		Cable length: L (mm)	Applicable motor
For power, AWG#10	For power and brake, AWG#10・AWG#20		
AL-00918635-01	AL-00918636-01	1,000	R1AA13400F R1AA13500F R2AA18350D R2AA18450H R2AA22500L
AL-00918635-02	AL-00918636-02	2,000	
AL-00918635-03	AL-00918636-03	3,000	
AL-00918635-05	AL-00918636-05	5,000	
AL-00918635-10	AL-00918636-10	10,000	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A24-11SE-EB-R Cable clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

Model number		Cable length: L (mm)	Applicable motor
For power, AWG#8	For brake, AWG#19		
AL-00965259-01	AL-00918630-01	1,000	R2AA22700S
AL-00965259-02	AL-00918630-02	2,000	
AL-00965259-03	AL-00918630-03	3,000	
AL-00965259-05	AL-00918630-05	5,000	
AL-00965259-10	AL-00918630-10	10,000	

Item	Connector model number	Remarks
Motor side connector	■ For power Straight plug: JL04V-6A24-11SE-EB-R Cable clamp: JL04-2428CK(17)-R ■ For brake Straight plug: JL04V-6A10SL-3SE-EB-R Cable clamp: JL04-1012CK(05)-R	Japan Aviation Electronics Industry, Ltd.

■ Amplifier model number: RS3□15A (continued)

Model number		Cable length: L(mm)	Applicable motor
For power, AWG#6	For brake, AWG#19		
AL-00968911-01	AL-00918630-01	1,000	R2AA18550R
AL-00968911-02	AL-00918630-02	2,000	
AL-00968911-03	AL-00918630-03	3,000	
AL-00968911-05	AL-00918630-05	5,000	
AL-00968911-10	AL-00918630-10	10,000	

Item	Connector model number		Remarks
Motor side connector	■ For power		
	Straight plug:	JL04V-6A32-17SE-EB-R	Japan Aviation Electronics Industry, Ltd.
	Socket:	N2KM2532	SANKEI MANUFACTURING CO. LTD.
	■ For brake Straight plug: JL04V-6A10SL-3SE-EB-R Cable clamp: JL04-1012CK(05)-R		Japan Aviation Electronics Industry, Ltd.

■ Amplifier model number: RS3□30A

Model number		Cable length: L(mm)	Applicable motor
For power, AWG#6	For brake, AWG#19		
AL-00965260-01	AL-00918630-01	1,000	R1AA18550H R1AA18750L R1AA1811KR R1AA1815KB R2AA18550H R2AA18750H R2AA1811KR R2AA2211KB R2AA2215KB
AL-00965260-02	AL-00918630-02	2,000	
AL-00965260-03	AL-00918630-03	3,000	
AL-00965260-05	AL-00918630-05	5,000	
AL-00965260-10	AL-00918630-10	10,000	

Item	Connector model number		Remarks
Motor side connector	■ For power		
	Straight plug:	JL04V-6A32-17SE-EB-R	Japan Aviation Electronics Industry, Ltd.
	Socket:	N2KM2532	SANKEI MANUFACTURING CO. LTD.
	■ For brake Straight plug: JL04V-6A10SL-3SE-EB-R Cable clamp: JL04-1012CK(05)-R		Japan Aviation Electronics Industry, Ltd.

12. Appendix

■ For encoder

Model number	Cable length: L(mm)	Applicable motor
RS-CA7-01-R	1,000	R2AA04003F R2AA04005F R2AA04010F R2AA06010F R2AA06020F R2AA06040F R2AA08075F
RS-CA7-02-R	2,000	
RS-CA7-03-R	3,000	
RS-CA7-05-R	5,000	
RS-CA7-10-R	10,000	

Item	Connector model number	Remarks
Motor side connector	Housing: 172161-1 Contact: 170359-3	Tyco Electronics Japan G.K.
Amplifier side connector	Plug cable/cover kit: 54599-1016	Molex Japan LLC

Model number	Cable length: L(mm)
AL-01108490-01	1,000
AL-01108490-02	2,000
AL-01108490-03	3,000
AL-01108490-05	5,000
AL-01108490-10	10,000

Item	Connector model number	Remarks
Motor side connector	Straight plug: JN2DS10SL2-R Contact: JN1-22-22F-PKG100	Japan Aviation Electronics Industry, Ltd.
Amplifier side connector	Plug cable/cover kit: 54599-1016	Molex Japan LLC

■ 400 VAC Input

For R2, 100mm sq.

Model number		Cable length: L (mm)	Applicable motor
For power AWG#16 (1.25mm^2)	For power and holding brake #16 (1.25mm^2)・#20 (0.5mm^2)		
AL-00964811-01	AL-00964812-01	1,000	R2CA10075F, R2CA10100F, R1CA10150V, R1CA10200V
AL-00964811-02	AL-00964812-02	2,000	
AL-00964811-03	AL-00964812-03	3,000	
AL-00964811-05	AL-00964812-05	5,000	
AL-00964811-10	AL-00964812-10	10,000	

Item	Connector model number	Remarks
Motor side connector Common to with or without brake	Straight plug: JL04V-6A20-15SE-EB-R Clamp: JL04-2022CK(14)-R	Japan Aviation Electronics Industry, Ltd.

For R2, 130mm sq.

Model number		Cable length: L (mm)	Applicable motor
For power AWG#16 (1.25mm^2)	For power and holding brake #16 (1.25mm^2)・#20 (0.5mm^2)		
AL-00965739-01	AL-00965740-01	1,000	R2CA13050D, R2CA13120R, R2CA13120F, R2CA13180H, R2CA13200L, R2CA13200H, R1CA13300V
AL-00965739-02	AL-00965740-02	2,000	
AL-00965739-03	AL-00965740-03	3,000	
AL-00965739-05	AL-00965740-05	5,000	
AL-00965739-10	AL-00965740-10	10,000	

Item	Connector model number	Remarks
Motor side connector Common to with or without brake	Straight plug: JL04V-6A24-11SE-EB-R Clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

For R2, 130/180mm sq.

Model number		Cable length: L (mm)	Applicable motor
For power AWG#14 (2.0mm^2)	For power and holding brake #14 (2.0mm^2)・#20 (0.5mm^2)		
AL-00965741-01	AL-00965742-01	1,000	R2CA13180D, R2CA18350L
AL-00965741-02	AL-00965742-02	2,000	
AL-00965741-03	AL-00965742-03	3,000	
AL-00965741-05	AL-00965742-05	5,000	
AL-00965741-10	AL-00965742-10	10,000	

Item	Connector model number	Remarks
Motor side connector Common to with or without brake	Straight plug: JL04V-6A24-11SE-EB-R Clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

12. Appendix

For R2, 180mm sq.

Model number		Cable length: L (mm)	Applicable motor
For power AWG#12 (3.5mm^2)	For power and holding brake #12 (3.5mm^2)・#20 (0.5mm^2)		
AL-00965743-01	AL-00965744-01	1,000	R2CA18350D, R2CA18450H, R2CA18550R
AL-00965743-02	AL-00965744-02	2,000	
AL-00965743-03	AL-00965744-03	3,000	
AL-00965743-05	AL-00965744-05	5,000	
AL-00965743-10	AL-00965744-10	10,000	

Item	Connector model number	Remarks
Motor side connector Common to with or without brake	Straight plug: JL04V-6A24-11SE-EB-R Clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

For R2, 180mm sq.

Model number		Cable length: L (mm)	Applicable motor
For power AWG#10 (5.5mm^2)	For power and holding brake #10 (5.5mm^2)・#20 (0.5mm^2)		
AL-00997919-01	AL-00997920-01	1,000	R2CA18550H
AL-00997919-02	AL-00997920-02	2,000	
AL-00997919-03	AL-00997920-03	3,000	
AL-00997919-05	AL-00997920-05	5,000	
AL-00997919-10	AL-00997920-10	10,000	

Item	Connector model number	Remarks
Motor side connector Common to with or without brake	Straight plug: JL04V-6A24-11SE-EB-R Clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

For R2, 180/220mm sq.

Model number	Cable length: L (mm)	Applicable motor
For power AWG#8 (8mm^2)		
AL-00997921-01	1,000	R2CA18750H, R2CA2211KB, R2CA2215KV, R1CA18550H, R1CA18750L, R1CA1811KR, R1CA1815KB
AL-00997921-02	2,000	
AL-00997921-03	3,000	
AL-00997921-05	5,000	
AL-00997921-10	10,000	

Item	Connector model number	Remarks
Motor side connector	Plug: JL04V-6A32-17SE-EB-R Socket: N2KM2532 Conduit: NS25 Bush: N2HBI2519	Japan Aviation Electronics Industry, Ltd. SANKEI MANUFACTURING CO. LTD.

For R2, 180mm sq.

Model number	Cable length: L (mm)	Applicable motor
For power AWG#5, 6 equivalent (14mm^2 equivalent)		
AL-00999240-01	1,000	R2CA2220KV, R2CA2830KV, R1CA2220KV
AL-00999240-02	2,000	
AL-00999240-03	3,000	
AL-00999240-05	5,000	
AL-00999240-10	10,000	

Item	Crimp terminal model number	Remarks
Motor side crimp terminal	-	No work with motor side crimp terminal.

For encoder

Model number For encoder	Cable length: L (mm)	Applicable motor
AL-01108490-01	1,000	Except R2CA2830KV
AL-01108490-02	2,000	
AL-01108490-03	3,000	
AL-01108490-05	5,000	
AL-01108490-10	10,000	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JN2DS10SL2-R Contact: JN1-22-22F-PKG100	Japan Aviation Electronics Industry, Ltd.
Amplifier side connector	Plug cable/cover kit: 54599-1016	Molex Japan LLC

Model number For encoder	Cable length: L (mm)	Applicable motor
AL-01108491-01	1,000	R2CA2830KV
AL-01108491-02	2,000	
AL-01108491-03	3,000	
AL-01108491-05	5,000	
AL-01108491-10	10,000	

Item	Connector model number	Remarks
Motor side connector	-	No work with motor side connector. Refer the section 4.3, for connector model number and wiring.
Amplifier side connector	Plug cable/cover kit: 54599-1016	Molex Japan LLC

12. Appendix

■ Cable specifications

For servo motor power

(TOTOKU ELECTRIC CO., LTD.) (Operating temperature range: -20 to 105℃)		
V-8C-MP_NO.2	V-8C-MP_NO.1	V-8C-MP_NO.3
AL-00964811-01 to -10; 1 to 10m AL-00964812-01 to -10; 1 to 10m AL-00965739-01 to -10; 1 to 10m AL-00965740-01 to -10; 1 to 10m	AL-00965741-01 to -10; 1 to 10m AL-00965742-01 to -10; 1 to 10m	AL-00965743-01 to -10; 1 to 10m AL-00965744-01 to -10; 1 to 10m
1.25sq. × 4C + 0.5sq. × 4C Sheath thickness: 1.4mm Cable diameter: Around 11.6mm	2sq. × 4C + 0.5sq. × 4C Sheath thickness: 1.3mm Cable diameter: Around 12.5mm	3.5sq. × 4C + 0.5sq. × 4C Sheath thickness: 1.5mm Cable diameter: Around 14mm
Individual wire specification 3.5 sq. Conductor diameter: 2.47mm, Insulator thickness: 0.8 mm, Overall diameter: 4.07 mm 2.0 sq. Conductor diameter: 1.8 mm, Insulator thickness: 0.7 mm, Overall diameter: 3.2 mm 1.25 sq. Conductor diameter: 1.47mm, Insulator thickness: 0.7 mm, Overall diameter: 2.87 mm 0.5 sq. Conductor diameter: 1.0 mm, Insulator thickness: 0.5 mm, Overall diameter: 2.0 mm		

(BANDO DENSEN Co., ltd.) (Operating temperature range: Up to 105℃)
2586 6C
AL-00997919-01 to 10; 1 to 10m specifications AL-00997920-01 to10; 1 to 10m specifications
5.5sq. x 4C + 0.5sq. x 2C Sheath thickness: 1.35mm Cable diameter: Around 15mm
Individual wire specification 5.5 sq. Conductor diameter: 3.1mm, Insulator thickness: 0.85mm, Overall diameter: 4.8mm 0.5 sq. Conductor diameter: 0.95mm, Insulator thickness: 0.59mm, Overall diameter: 2.13mm

(SUMIDEN HITACHI CABLE Ltd.) (Operating temperature range: Up to 90℃)	
600V_CV_4_8SQ	600V_CV_4_14SQ
AL-00997921-01 to 10; 1 to 10m specifications	AL-00999240-01 to 10; 1 to 10m specifications
8sq. x 4C Sheath thickness: 1.5mm Cable diameter: Around 17mm	14sq. x 4C Sheath thickness: 1.5mm Cable diameter: Around 19mm
Individual wire specification 8 sq. Conductor diameter: 3.6mm, Insulator thickness: 1.0mm, Overall diameter: 5.6mm 14 sq. Conductor diameter: 4.4mm, Insulator thickness: 1.0mm, Overall diameter: 6.4mm	

For encoder

Robot Cable for high speed motion; UL-OREV30-SB, composite wire spec. (OKANO CABLE Co., Ltd.) With ETFE (fluoroplastic) insulation, vinyl sheath, braided shield
UL STYLE NO.20276 (Rating: 80℃, 30V)
AL-00937694-01 to 10; 1 to 10m specifications AL-00999243-01 to 10; 1 to 10m specifications
22 AWG × 2C + 24 AWG × 2P Sheath thickness: 1.0mm Overall diameter: φ6.7±0.5mm
Individual wire specification 22 AWG Conductor diameter: φ0.77mm, Insulator thickness: 0.25mm, Overall diameter: φ1.27mm 24 AWG Conductor diameter: φ0.65mm, Insulator thickness: 0.20mm, Overall diameter: φ1.05mm

12.6.8 Power cable for servo motor FAN

Model number FAN for motor	Cable length: L (mm)	Applicable motor
AL-00997923-01	1,000	R1CA18750L, R1CA1811KR, R1CA1815KB, R1CA2220KV
AL-00997923-02	2,000	
AL-00997923-03	3,000	
AL-00997923-05	5,000	
AL-00997923-10	10,000	

Item	Connector model number	Remarks
Motor side connector	Plug: N/MS3106B10SL-4S Clamp: N/MS3057-4A	Japan Aviation Electronics Industry, Ltd.

Model number FAN for motor	Cable length: L (mm)	Applicable motor
AL-00999241-01	1,000	R2CA2830KV
AL-00999241-02	2,000	
AL-00999241-03	3,000	
AL-00999241-05	5,000	
AL-00999241-10	10,000	

Item	Connector model number	Remarks
Motor side crimp terminal	—	No work with both side crimp terminal.

Cable specifications

(KURABE Industrial Co., Ltd.) (Operating temperature range: None)
FFR2C
AL-00997923-01 to 10; 1 to 10m specifications
20AWG x 2C Sheath thickness: 1.0mm Cable diameter: Around 4.8mm
Individual wire specification 20 AWG Conductor diameter: Around 0.9mm, Insulator thickness: 0.25mm, Overall diameter: 1.4mm

(NISSEI ELECTRIC CO., LTD.) (Operating temperature range: Up to 105℃)
2103_PVC_AWG#19X4C
AL-00999241 -01 to 10; 1 to 10m specifications
19AWG x 4C Sheath thickness: 0.5mm Cable diameter: Around 6.1mm
Individual wire specification 19 AWG Conductor diameter: Around 1.24mm, Insulator thickness: 0.23mm, Overall diameter: 1.7mm

12. Appendix

12.6.9 Servo motor brake cable

Model number For brake	Cable length: L(mm)	Applicable motor
AL-00999239-01	1,000	R2CA2830KV
AL-00999239-02	2,000	
AL-00999239-03	3,000	
AL-00999239-05	5,000	
AL-00999239-10	10,000	

Item	Connector model number	Remarks
Motor side crimp terminal	—	No work with motor side crimp terminal.

Cable specifications

(KURABE Industrial Co., Ltd.) (Operating temperature range: None)
FFR2C
AL-00999239-01 to 10; 1 to 10m specifications
20AWG x 2C Sheath thickness: 1.0mm Cable diameter: Around 4.8mm
Individual wire specification 20 AWG Conductor diameter: Around 0.9mm, Insulator thickness: 0.25mm, Overall diameter: 1.4mm

12.6.10 Thermostat cable for servo motor FAN

Model number For thermostat	Cable length: L(mm)	Applicable motor
AL-00999242-01	1,000	R2CA2830KV
AL-00999242-02	2,000	
AL-00999242-03	3,000	
AL-00999242-05	5,000	
AL-00999242-10	10,000	

Item	Connector model number	Remarks
Motor side connector	—	No work with motor side connector. Refer the section 4.4, for connector model number and wiring.

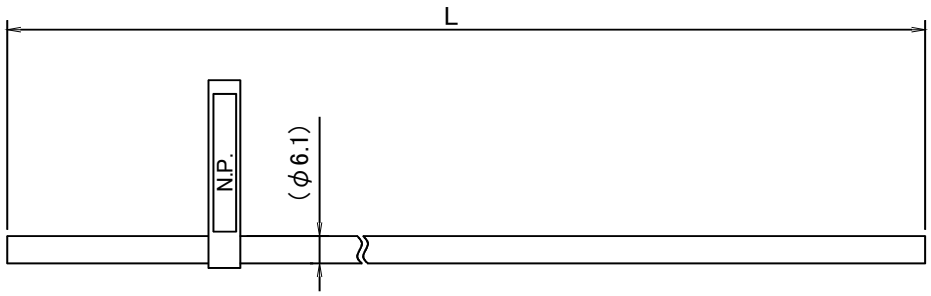
Cable specifications

(KURABE Industrial Co., Ltd.) (Operating temperature range: Up to 150℃)
2C FRW-ST sheath cable
AL-00999242-01 to 10; 1 to 10m specifications
22 equivalent AWG x 2C Sheath thickness: 1.2mm Cable diameter: Around 5.0mm
Individual wire specification 20,21 equivalent AWG Conductor diameter: Around 0.75mm, Insulator thickness: 0.275mm, Overall diameter: 1.3mm

12.6.11 Servo motor FAN power cable

Model number For FAN power	Cable length: L (mm)	Applicable motor
AL-00999241-01	1,000	R2CA3255KB
AL-00999241-02	2,000	
AL-00999241-03	3,000	
AL-00999241-05	5,000	
AL-00999241-10	10,000	

Item	Connector model number	Remarks
Motor side crimp terminal	—	No work with both side crimp terminal.



L (mm): 1,000/2,000/3,000/5,000/10,000

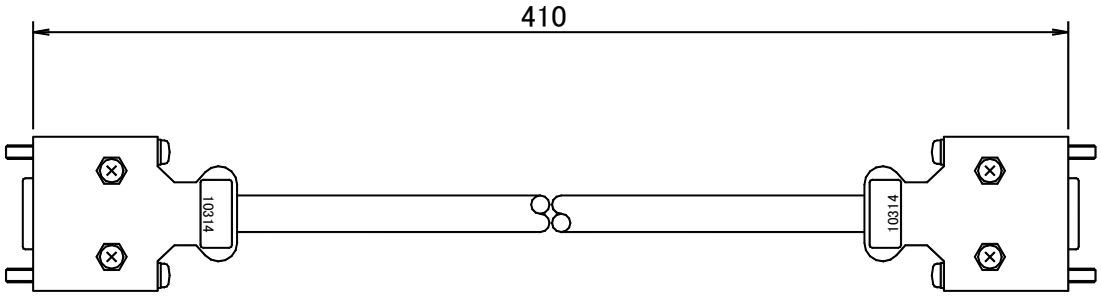
12. Appendix

12.6.12 External regenerative resistor

Resistor Model Number	Rated power [PR]	Resistance value	Thermostat Detection temperature (Contact specification)	Mass
REGIST-080W100B	80 W	100 Ω	135 °C±7 °C (Switching contact b)	0.19 kg
REGIST-080W50B	80 W	50 Ω		
REGIST-120W100B	120 W	100 Ω		0.24 kg
REGIST-120W50B	120 W	50 Ω		
REGIST-220W100B	220 W	100 Ω		0.44 kg
REGIST-220W50B	220 W	50 Ω		
REGIST-220W20B	220 W	20 Ω		
REGIST-500CW80B	500 W	80 Ω	100 °C±5 °C (Switching contact b)	1.4 kg
REGIST-500CW40B	500 W	40 Ω		
REGIST-500CW20B	500 W	20 Ω		
REGIST-500CW10B	500 W	10 Ω		
REGIST-500CW14B	500 W	14 Ω		
REGIST-500CW7B	500 W	7 Ω		
REGIST-500CW5B	500 W	5 Ω		
REGIST-1000W6R7B	1,000 W	6.7 Ω	140 ℃±5 ℃ (Switching contact b)	3.0 kg

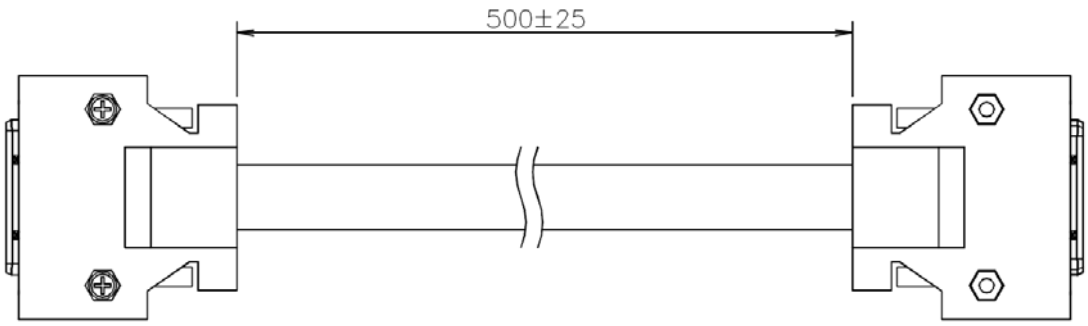
12.6.13 Connection cable between units

■ For 200V AC, 600A



Apply	Model number
Connecting each CN9 of power unit and amplifier unit	AL-00917284

■ For 400V AC, 800A



Apply	Model number
Connecting each CN9 of power unit and amplifier unit	AL-01018354-01

12.6.14 Copper bus bar

■ For 200V AC, 600A

Apply	Description	Model number
+DC, -DC connection	2 pieces include	AL-00918125-01

■ For 400V AC, 800A

Apply	Description	Model number
+DC, -DC connection	2 pieces include	AL-01020858-01

12.6.15 MODBUS communication connection cables and termination connector

■ Model numbers of optional items for MODBUS communication

Name	Description	SANYO DENKI model No.	Cable length: [m]
Communication cable of host device and amplifier	For host device connection (between SANMOTION C and amplifier)	AL-01101867-01	1
		AL-01101867-03	3
		AL-01101867-05	5
		AL-01101867-07	7
		AL-01101867-10	10
Communication cable between amplifiers	For between amplifiers connection	AL-01101866-01	0.2
		AL-01101866-02	0.5
		AL-01101866-03	1
		AL-01101866-04	3
		AL-01101866-05	5
		AL-01101866-06	7
		AL-01101866-07	10
Termination connector	For termination resistance connection	AL-01101864	—

■ Cable specifications

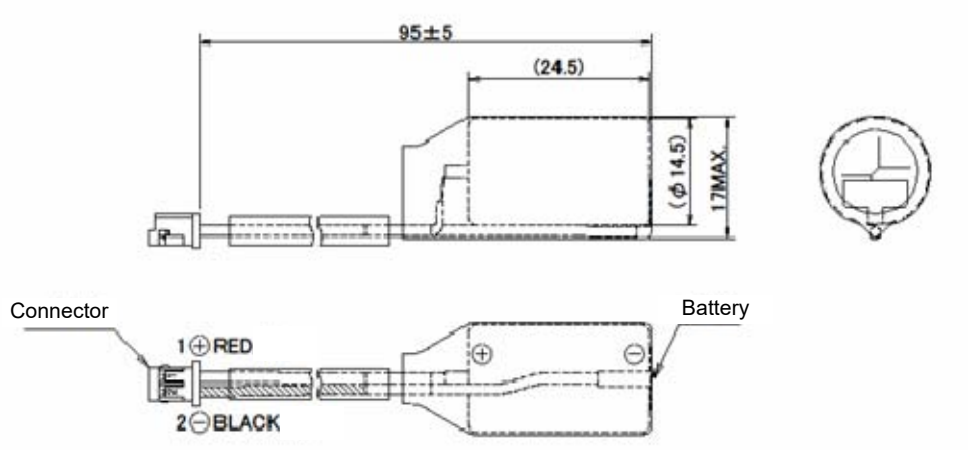
(BANDO DENSEN Co., ltd.)
20276 ESVP AWG#24×2P (Rating: 80 ℃, 30 V)
AL-01101867-01 to -10; 1 to 10m specifications AL-01101866-01 to -07; 0.2 to 10m specifications
24 AWG × 2P Sheath thickness: 0.9mm Cable diameter: Around 6.5mm
Individual wire specification 24 AWG Conductor diameter: 0.53mm, Insulator thickness: 0.225mm, Overall diameter: 0.98mm

12. Appendix

12.7 Optional parts dimensions

12.7.1 Battery peripherals dimensions

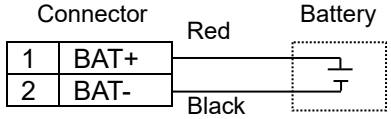
■ Battery body for battery box (Model No.: AL-00879511-01)



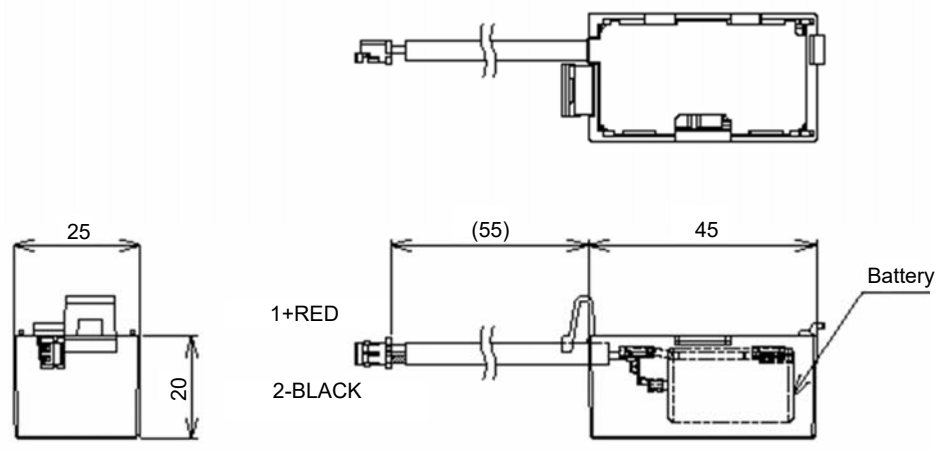
1. Battery and connector specifications

Lithium battery	Thionyl Chloride Lithium Battery ER3VLY (Toshiba Lifestyle Products & Services Corporation) Nominal Voltage: 3.6V Nominal Capacity: 1000mAh Lithium metal mass as standard: 0.31g
Connector	DF3-2S-2C; Socket Housing (HIROSE) DF3-2428SCFC; Contact (HIROSE)

2. Wiring diagram



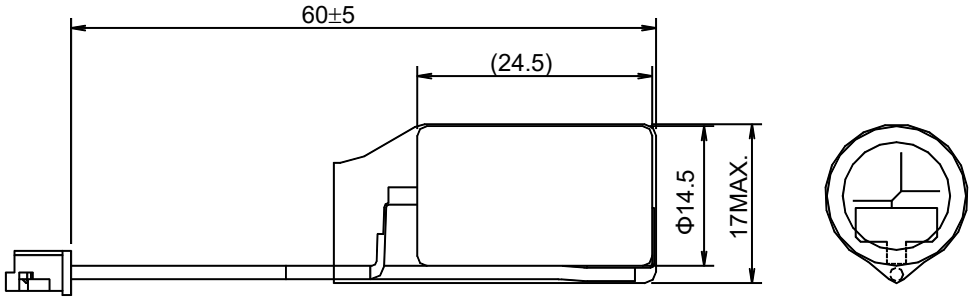
■ Battery BOX (Model No.:AL-00880402-01)

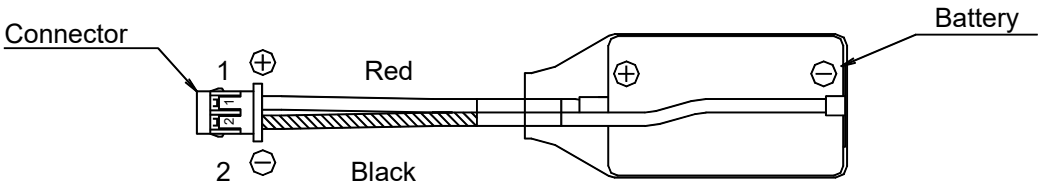


See "8.6.2 Replacing battery for motor encoder" for how to replace battery box.

12.7 Optional parts dimensions

■ Battery body for junction cable (Model No.: AL-00697958-01)

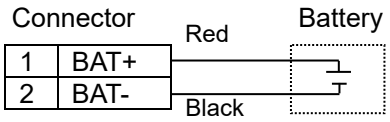




1. Battery and connector specifications

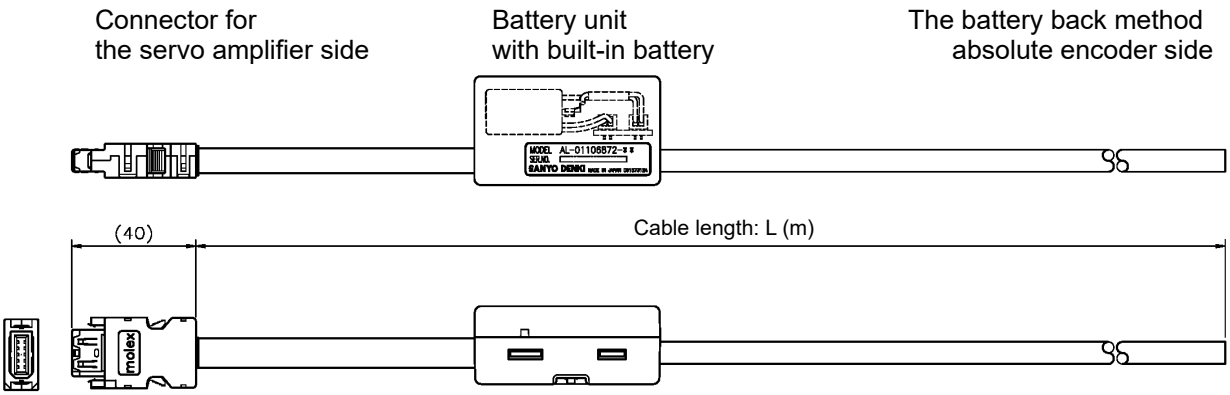
Lithium battery	Thionyl Chloride Lithium Battery ER3VLY (Toshiba Lifestyle Products & Services Corporation) Nominal Voltage: 3.6V Nominal Capacity: 1000mAh Lithium metal mass as standard: 0.31g
Connector	DF3-2S-2C; Socket Housing (HIROSE) DF3-2428SCFC; Contact (HIROSE)

2. Wiring diagram



12. Appendix

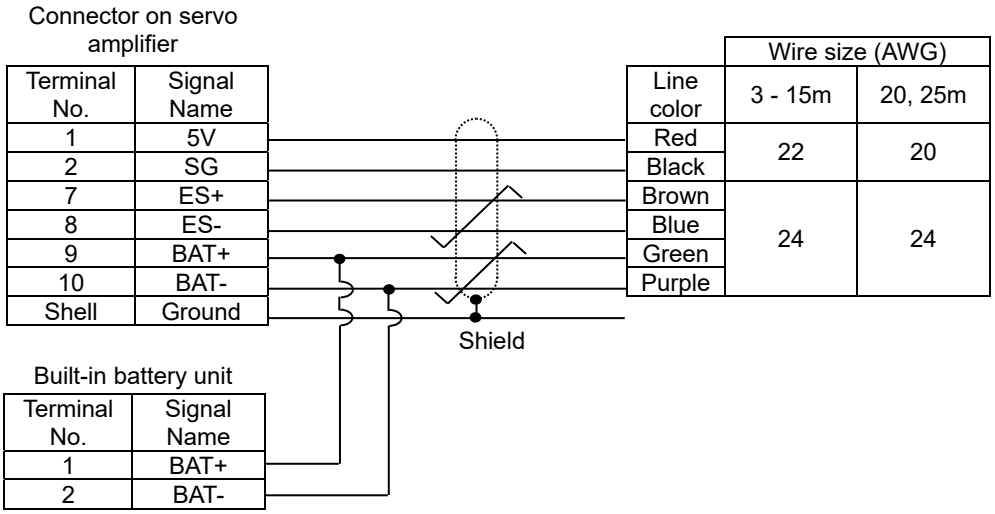
■ Battery trunk cable (Model No.: AL-01106872-☐☐)



Model Number	L [m]
AL-00697960-01	3
AL-00697960-02	5
AL-00697960-03	10
AL-00697960-04	15
AL-00697960-05	20
AL-00697960-06	25

1. Spec: Trunk cable for encoder with the connector in one end and the battery unit for moving part at mid-low speed *This shall not be designed for moving part at high speed.

2. Wiring specifications



3. Specification for the connector and the battery unit

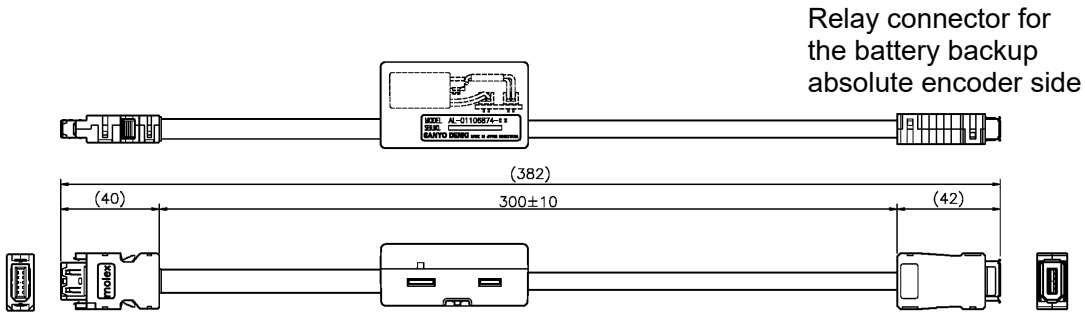
Connector for servo amplifier	54599-1016; Plug Set (Molex)
Battery unit	Built-in battery; ER3VLY (Toshiba Lifestyle Products & Services Corporation) Nominal Voltage: 3.6V Nominal Capacity: 1000mAh Lithium-metal mass: 0.31g

4. Outline specification for cable

Robot cable for moving part at mid-low speed; UL-ORHV30-SB, Composite wire specification (Manufactured by OKANO ELECTRIC WIRE Co., Ltd.) High-density polyethylene insulated wire, Vinyl sheath, Braided shield addition.	
UL STYLE NO. 20276 (Ratings: 80°C, 30V)	
AL-00697960-01 - 04; 3 - 15m	AL-00697960-05, 06; 20,25m
22 AWG x 2C + 24 AWG x 2P Sheath thickness: 1.0mm Cable outer diameter: Φ7.1±0.5mm	20 AWG x 2C + 24 AWG x 2P Sheath thickness 1.0mm Cable outer diameter: Φ7.1±0.5mm
Respective wire specifications 24 AWG Conductor diameter: Φ0.65mm, Insulator thickness: 0.25mm, Insulator coat outer diameter:Φ1.15mm 22 AWG Conductor diameter: Φ0.77mm, Insulator thickness: 0.25mm, Insulator coat outer diameter: Φ1.27mm 20 AWG Conductor diameter: Φ0.95mm, Insulator thickness: 0.25mm, Insulator coat outer diameter: Φ1.45mm	

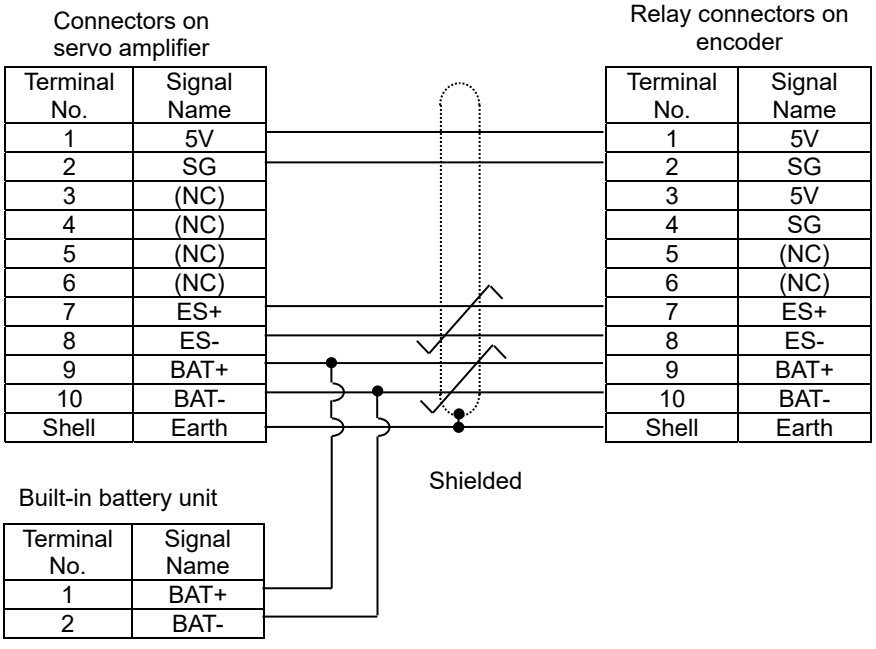
5. Battery model number for replacement: AL-00697958-01

■ Battery trunk cable (Model No.: AL-01106874-01)



1. Specification: Relay cable for encoder with the connector at both ends and the battery unit

2. Wiring spec



12. Appendix

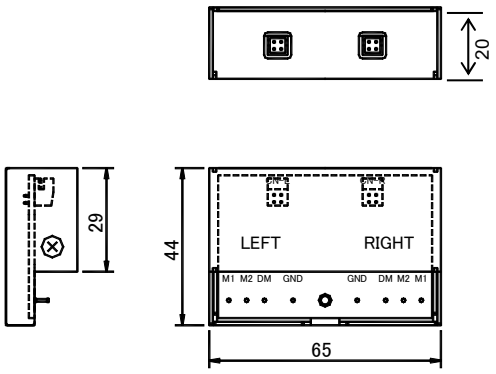
3. Specification for the connector and the battery unit

Connectors for servo amplifier	54599-1016; Plug Set (Molex)
Trunk connectors for encoder	36110-3000FD; Wiremount Plug (3M) 36310-F200-008; Shell Kit (3M)
Battery unit	Built-in battery; ER3VLY (Toshiba Lifestyle Products & Services Corporation) Nominal Voltage: 3.6V Nominal Capacity: 1000mAh Lithium-metal mass:0.31g

4. Battery model number or replacement: AL-00697958-01

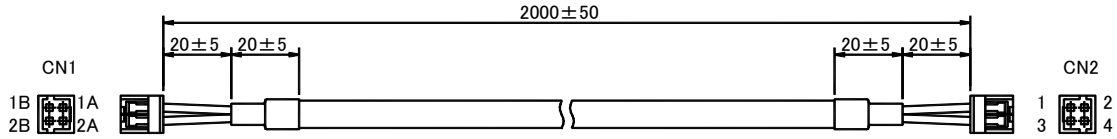
12.7.2 Monitor box outline drawing

■ Monitor Box (Model No.: Q-MON-3



12.7.3 Dedicated Cable outline drawing

■ Dedicated Cable (Model No.: AL-00690525-01)



Note 1) A pair of the dedicated cable shown above (model number: AL-00690525-01) are supplied with the Monitor Box (model number: Q-MON-3).
Note 2) CN1 connects to monitor box, CN2 connects to CN6 for RS3#####C##, and to CN5 for RS3#####F##.

Terminal No. on CN1	Signal name	Terminal No. on CN2
1A	Analog monitor 1	3
1B	Analog monitor 2	4
2A	GND	1
2B	-	2

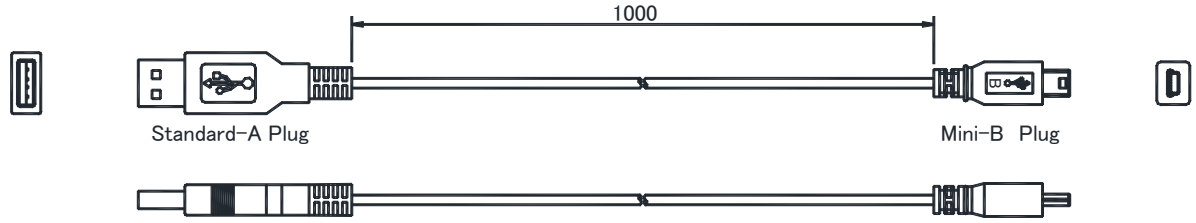
CN1	Manufacturer model No.	Manufacturer
Connector	LY10-DC4BR	Japan Aviation Electronics Industry, Limited
Contact	LY10-C1-A1-1000	Japan Aviation Electronics Industry, Limited

CN2	Manufacturer model No.	Manufacturer
Connector	DF11-4DS-2C	HIROSE ELECTRIC CO., LTD.
Contact	DF11-2428SCA	HIROSE ELECTRIC CO., LTD.

12. Appendix

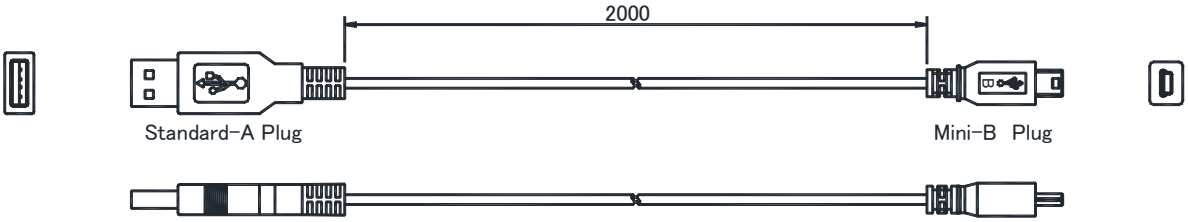
12.7.4 Outline drawing of USB communication cable

■ USB communication cable (1.0m) (Model number: AL-00896515-01)



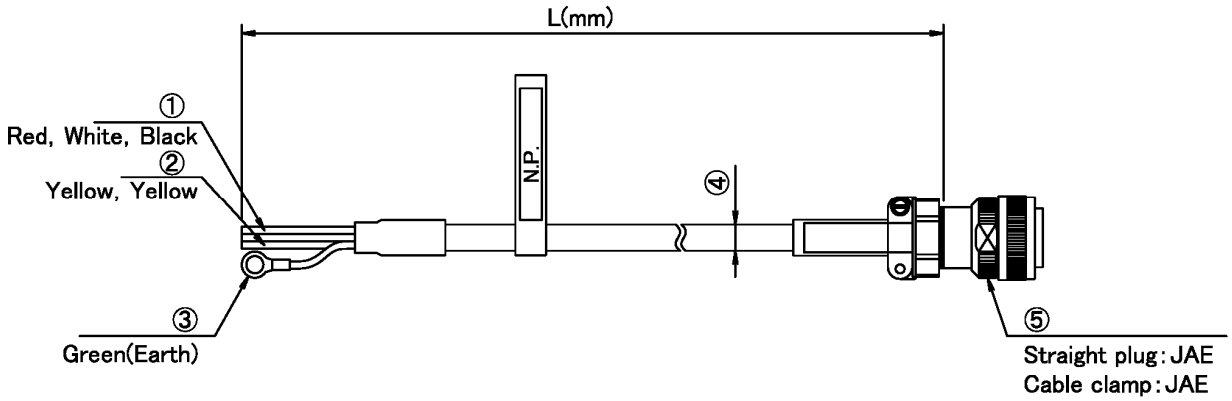
* Appearance and spec may change without prior notice.

■ USB communication cable (2.0m) (Model number: AL-00896515-02)



* Appearance and spec may change without prior notice.

12.7.5 Servo Motor Power Cable outline drawing

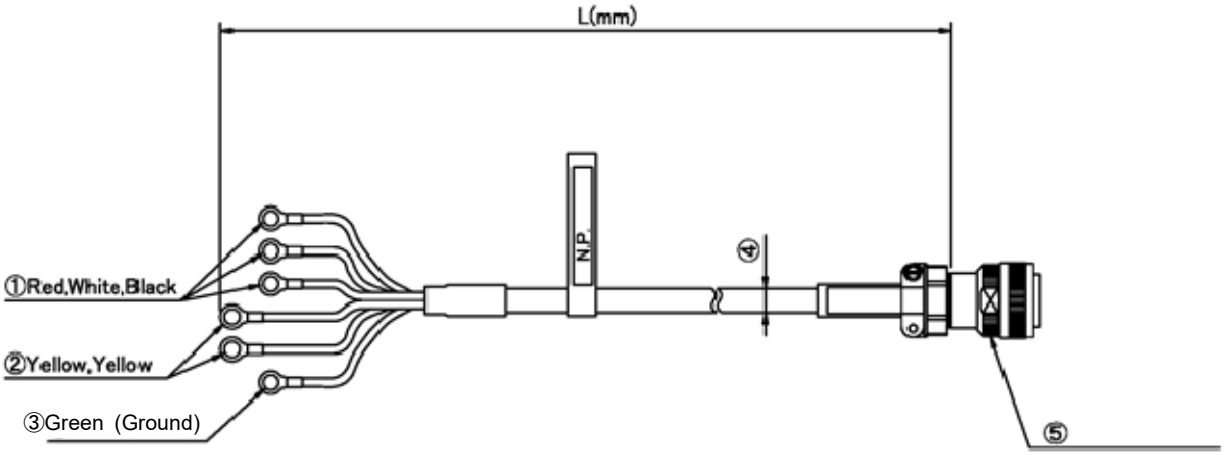


L (mm): Means 1,000, 2,000, 3,000 5,000 or 10,000

Model number		AL-00964811-□□	AL-00964812-□□	AL-00965739-□□	AL-00965740-□□
①Power	Wire	AWG16	AWG16	AWG16	AWG16
	Terminal	—	—	—	—
②Brake	Wire	—	AWG20	—	AWG20
	Terminal	—	—	—	—
③Ground	Wire	AWG16	AWG16	AWG16	AWG16
	Terminal	N2-M4	N2-M4	N2-M4	N2-M4
④Cable diameter		φ11.6	φ11.6	φ11.6	φ11.6
⑤Plug /Clamp		JL04V-6A20-15SE-EB-R / JL04-2022CK(14)-R	JL04V-6A20-15SE-EB-R / JL04-2022CK(14)-R	JL04V-6A24-11SE-EB-R / JL04-2428CK(17)-R	JL04V-6A24-11SE-EB-R / JL04-2428CK(17)-R
Connection		Lead wire: Red — Motor side name: U — Connector pin number: A Lead wire: White — V — B Lead wire: Black — W — C Lead wire: Green — Ground — D	Lead wire: Red — Motor side name: U — Connector pin number: A Lead wire: White — V — B Lead wire: Black — W — C Lead wire: Green — Ground — D Lead wire: Yellow — Brake — E Lead wire: Yellow — Brake — F	Lead wire: Red — Motor side name: U — Connector pin number: D Lead wire: White — V — E Lead wire: Black — W — F Lead wire: Green — Ground — G	Lead wire: Red — Motor side name: U — Connector pin number: D Lead wire: White — V — E Lead wire: Black — W — F Lead wire: Green — Ground — G Lead wire: Yellow — Brake — A Lead wire: Yellow — Brake — B

Model number		AL-00965741-□□	AL-00965742-□□	AL-00965743-□□	AL-00965744-□□
①Power	Wire	AWG14	AWG14	AWG12	AWG12
	Terminal	—	—	—	—
②Brake	Wire	—	AWG20	-	AWG20
	Terminal	—	—	—	—
③Ground	Wire	AWG14	AWG14	AWG12	AWG12
	Terminal	N2-M4	N2-M4	N2-M4	N2-M4
④Cable diameter		φ12.5	φ12.5	φ14.0	φ14.0
⑤Plug /Clamp		JL04V-6A24-11SE-EB-R / JL04-2428CK(17)-R	JL04V-6A24-11SE-EB-R / JL04-2428CK(17)-R	JL04V-6A24-11SE-EB-R / JL04-2428CK(17)-R	JL04V-6A24-11SE-EB-R / JL04-2428CK(17)-R
Connection		Lead wire: Red — Motor side name: U — Connector pin number: D Lead wire: White — V — E Lead wire: Black — W — F Lead wire: Green — Ground — G	Lead wire: Red — Motor side name: U — Connector pin number: D Lead wire: White — V — E Lead wire: Black — W — F Lead wire: Green — Ground — G Lead wire: Yellow — Brake — A Lead wire: Yellow — Brake — B	Lead wire: Red — Motor side name: U — Connector pin number: D Lead wire: White — V — E Lead wire: Black — W — F Lead wire: Green — Ground — G	Lead wire: Red — Motor side name: U — Connector pin number: D Lead wire: White — V — E Lead wire: Black — W — F Lead wire: Green — Ground — G Lead wire: Yellow — Brake — A Lead wire: Yellow — Brake — B

12. Appendix

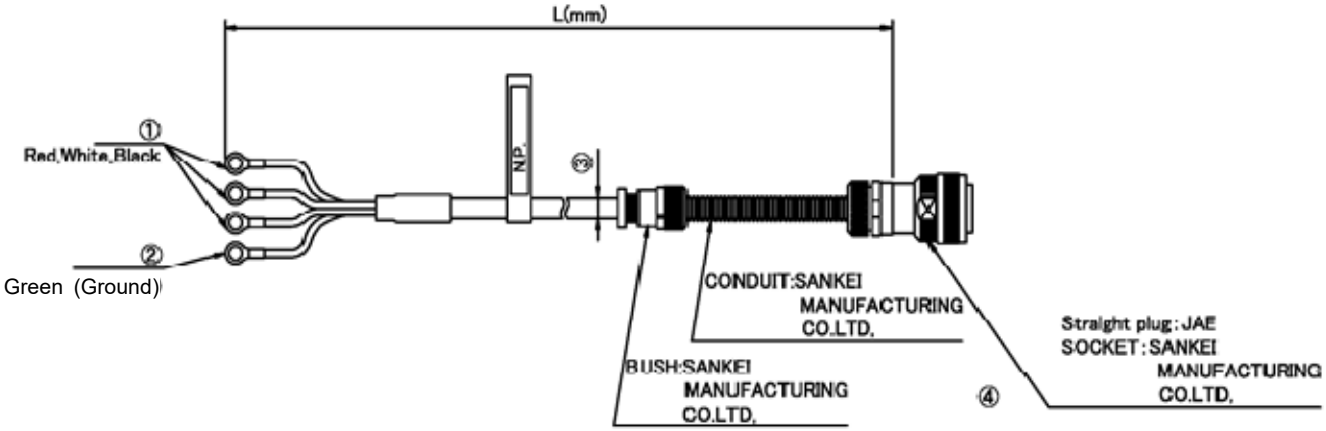


Straight plug: Product of JAE
Cable clamp: Product of JAE

L (mm): Means 1,000, 2,000, 3,000 5,000 or 10,000

Model number		AL-00997919-☐☐	AL-00997920-☐☐
①Power	Wire	AWG10	AWG10
	Terminal	N5.5-5	N5.5-5
②Brake	Wire	—	AWG20
	Terminal		N1.25-4
③Ground	Wire	AWG10	AWG10
	Terminal	N5.5-5	N5.5-5
④Cable diameter		ϕ15	ϕ15
⑤Plug /Clamp		JL04V-6A24-11SE-EB-R / JL04-2428CK(17)-R	JL04V-6A24-11SE-EB-R / JL04-2428CK(17)-R
Connection		Lead wire Red — U — D Lead wire White — V — E Lead wire Black — W — F Lead wire Green — Earth — G	Lead wire Red — U — D Lead wire White — V — E Lead wire Black — W — F Lead wire Green — Earth — G Lead wire Yellow — Brake — A Lead wire Yellow — Brake — B

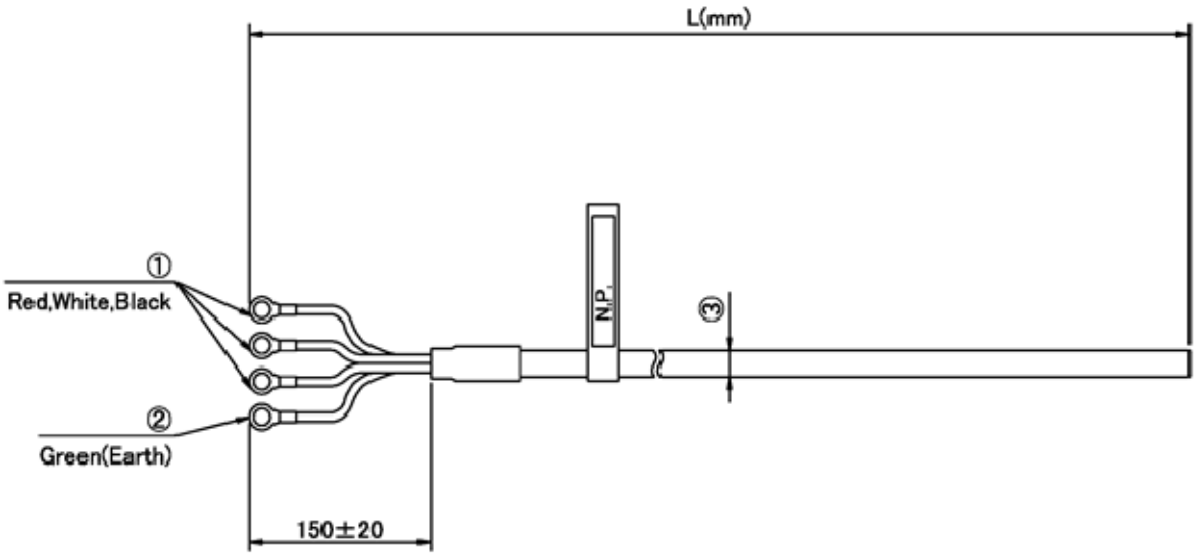
12.7 Optional parts dimensions



L (mm): Means 1,000, 2,000, 3,000 5,000 or 10,000

Model number		AL-00997921-☐☐	AL-00997922-☐☐
①Power	Wire	AWG8	AWG5,6 equivalent
	Terminal	R8-5	R14-5
②Ground	Wire	AWG8	AWG5,6 equivalent
	Terminal	R8-5	R14-5
③Cable diameter		ϕ17	ϕ19
④Plug/ Socket/ Conduit/ Bush		JL04V-6A32-17SE-EB-R / N2KM2532 / NS25 / N2HBI2519	JL04V-6A32-17SE-EB-R / N2KM2532 / NS25 / N2HBI2519
Connection		Lead wire Red – U – A Lead wire White – V – B Lead wire Black – W – C Lead wire Green – Earth – D	Lead wire Red – U – A Lead wire White – V – B Lead wire Black – W – C Lead wire Green – Earth – D

12. Appendix

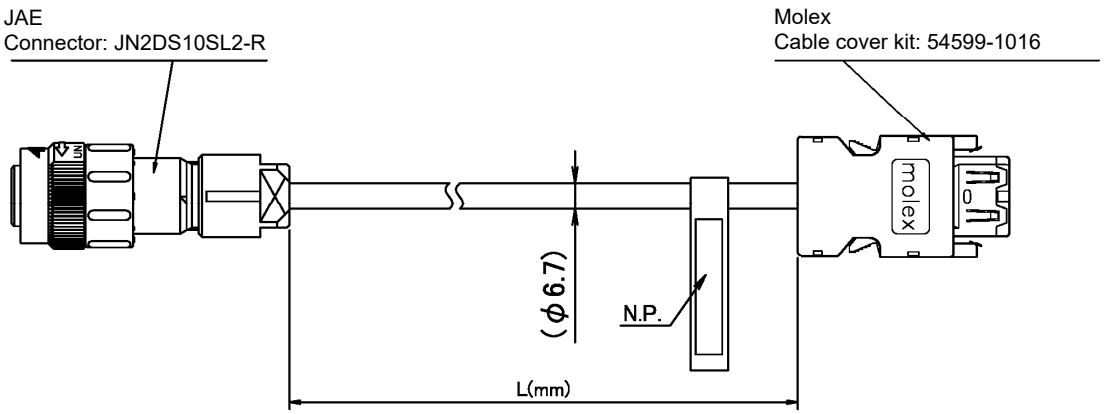


L (mm): Means 1,000, 2,000, 3,000 5,000 or 10,000

Model number		AL-00999240-☐☐
①Power	Wire	AWG5.6 equivalent
	Terminal	R14-5
②Ground	Wire	AWG5.6 equivalent
	Terminal	R14-5
③Cable diameter		ϕ19
Connection		Lead wire Red – Motor side signal name: U Lead wire White – V Lead wire Black – W Lead wire Green – Earth

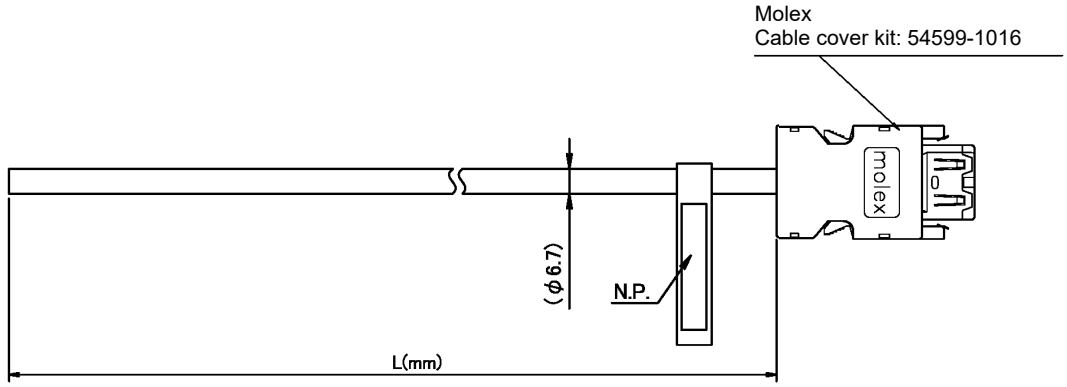
12.7.6 Servo motor encoder cable dimensions

AL-01108490-☐☐



L (mm): Means 1,000, 2,000, 3,000 5,000 or 10,000

AL-01108491-☐☐

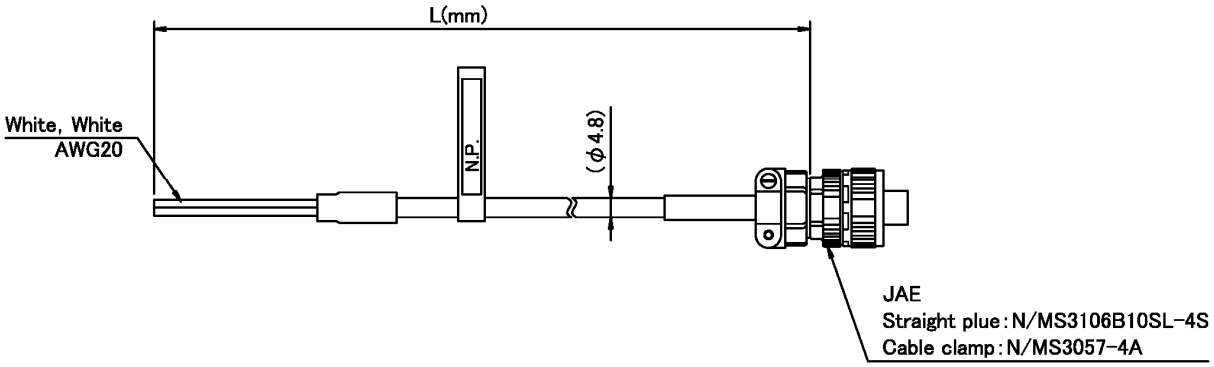


L (mm): Means 1,000, 2,000, 3,000 5,000 or 10,000

12. Appendix

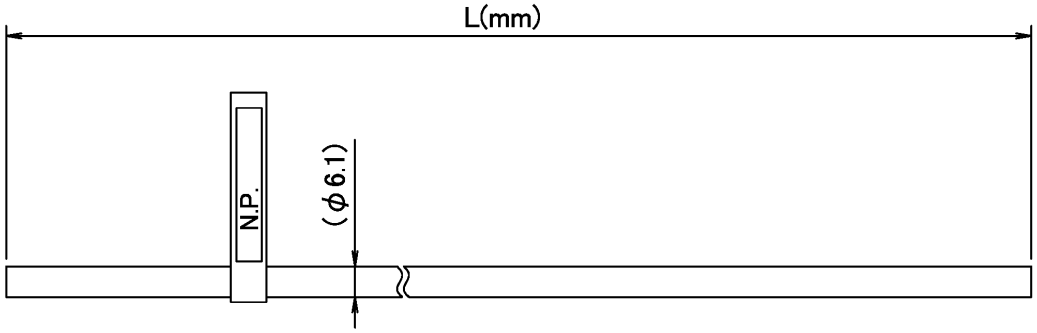
12.7.7 Power cable dimensions for servo motor FAN

AL-00997923-☐☐



L (mm): Means 1,000, 2,000, 3,000 5,000 or 10,000

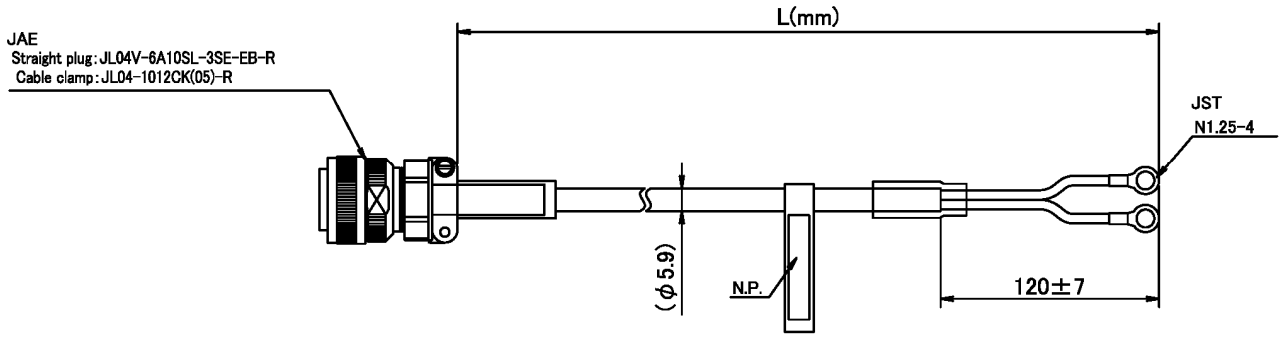
AL-00999241-☐☐



L (mm): Means 1,000, 2,000, 3,000 5,000 or 10,000

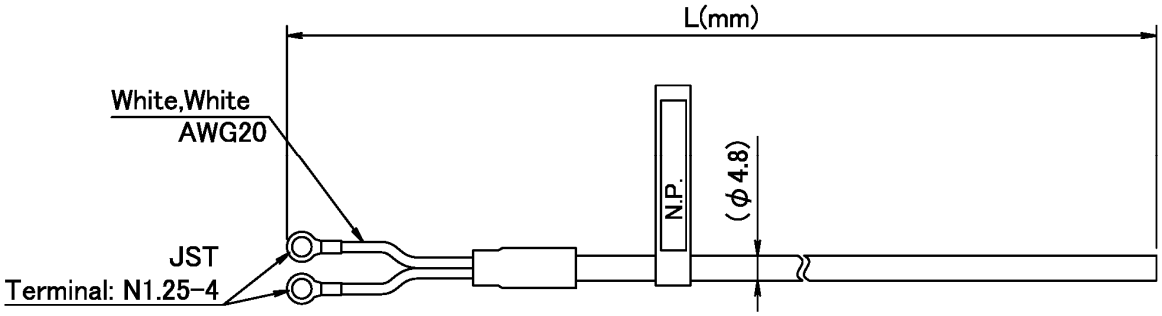
12.7.8 Servo motor brake cable dimensions

AL-00918630-☐☐



L (mm): Means 1000, 2000, 3000, 5000 or 10000

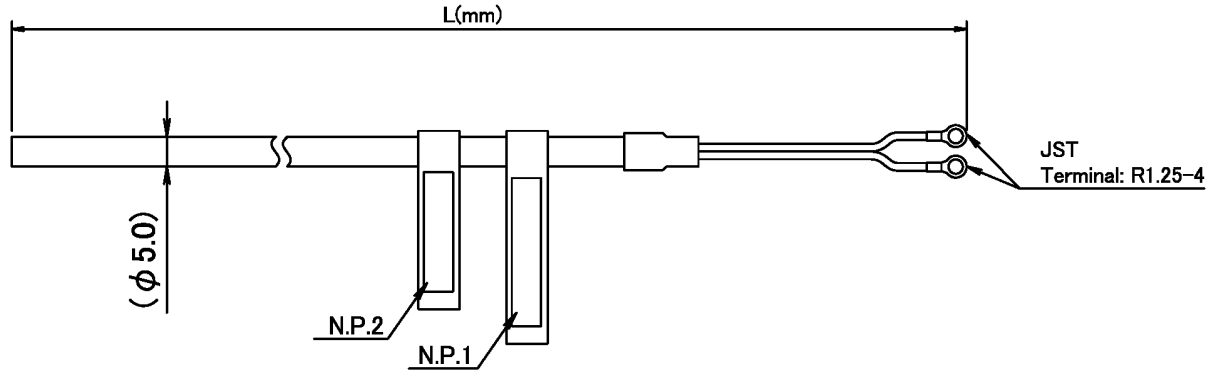
AL-00999239-☐☐



L (mm): Means 1000, 2000, 3000, 5000 or 10000

12.7.9 Thermostat cable dimensions for servo motor FAN

AL-00999242-☐☐

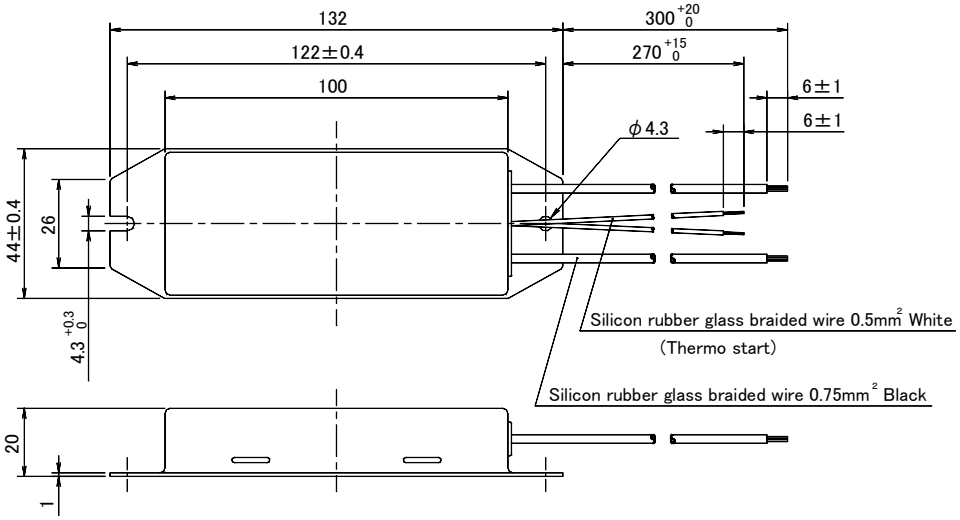


L (mm): Means 1000, 2000, 3000, 5000 or 10000

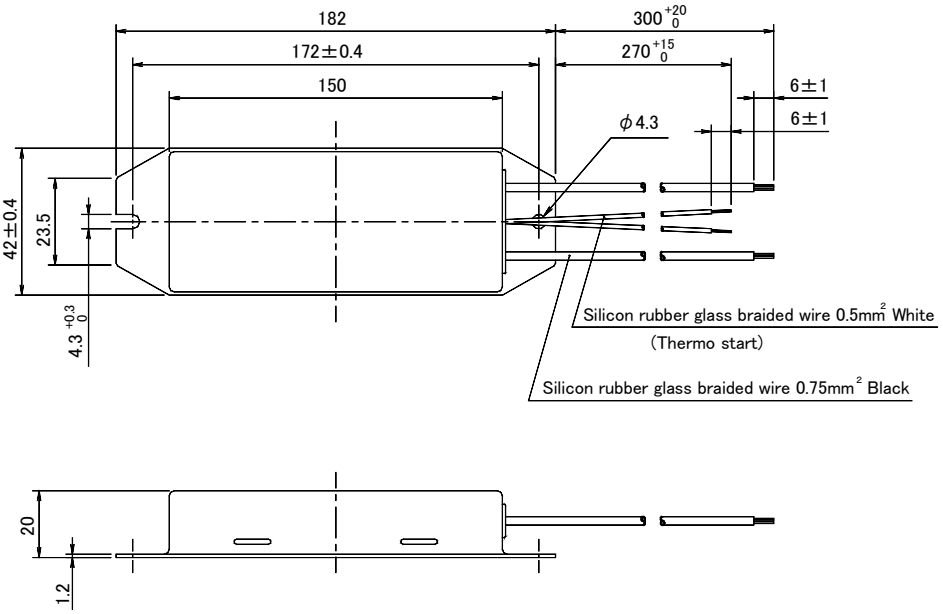
12. Appendix

12.7.10 Outline drawing of regenerative resistor

■ REGIST-080W

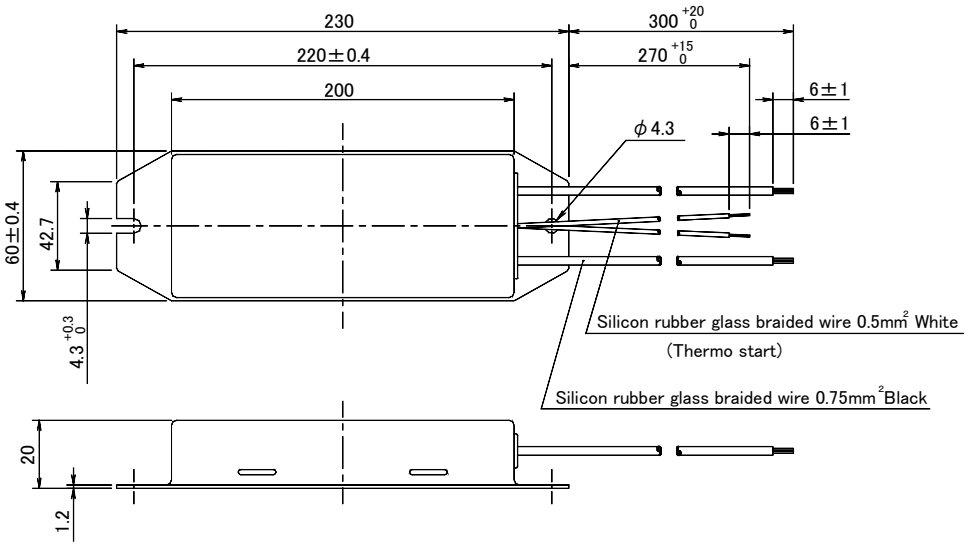


■ REGIST-120W

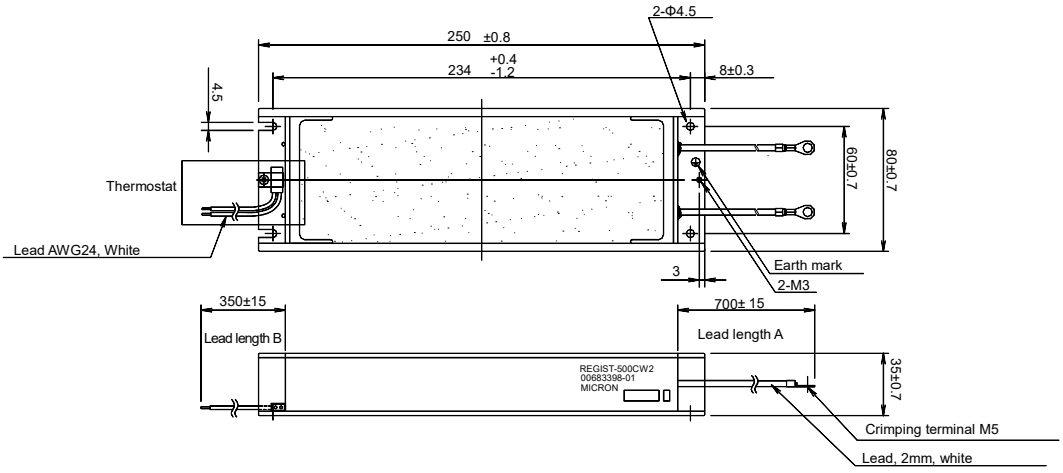


12.7 Optional parts dimensions

■ REGIST-220W

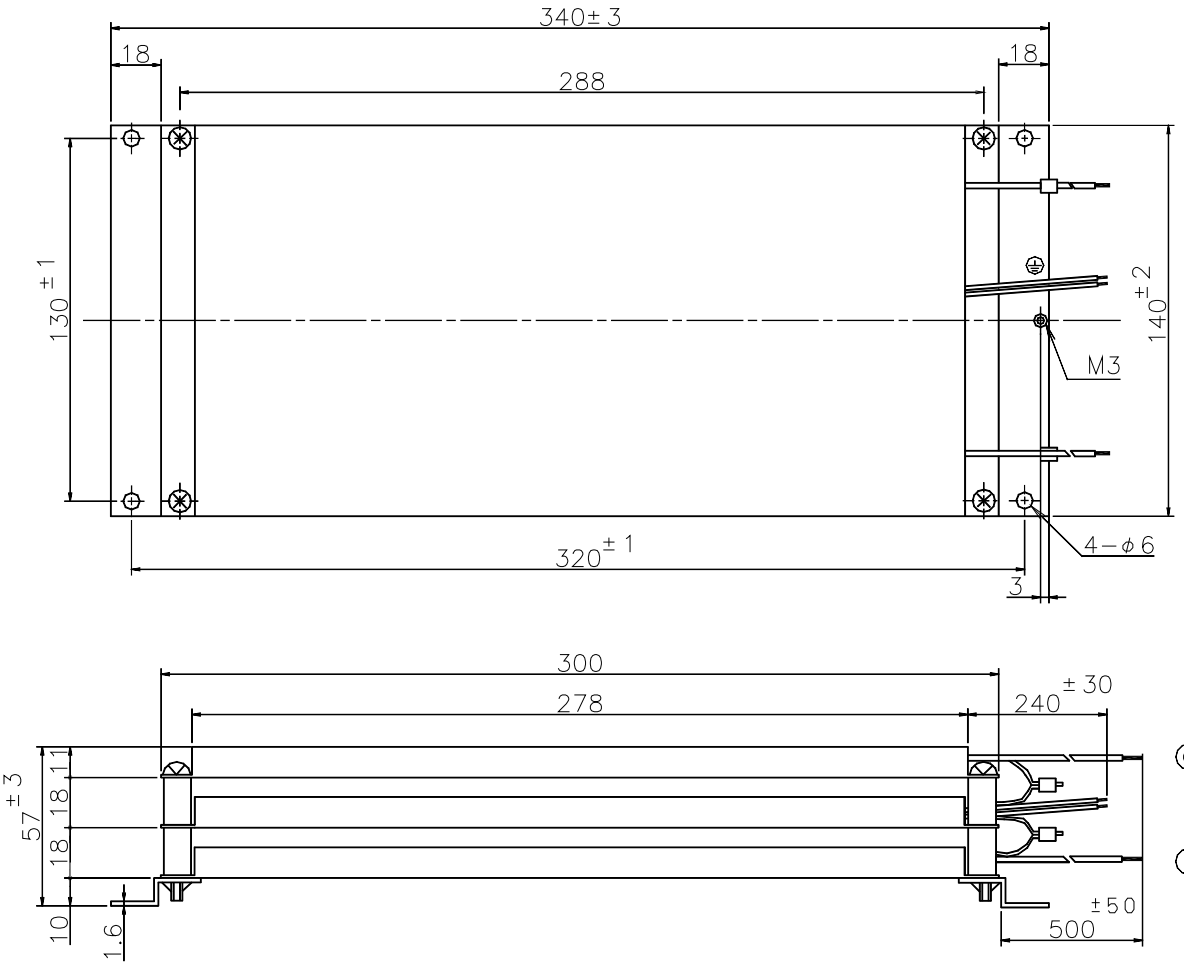


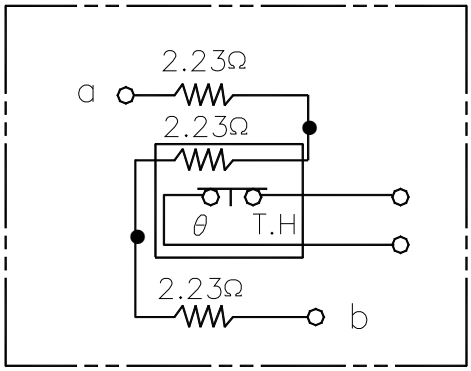
■ REGIST-500CW



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■ REGIST-1000W

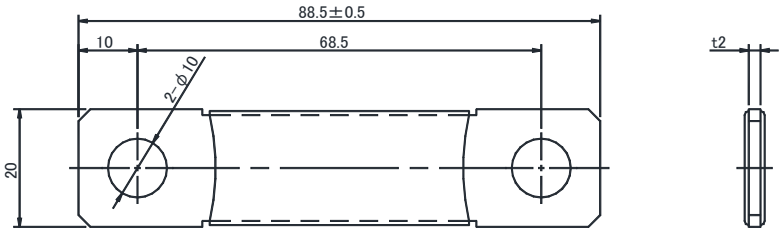




Wiring diagram

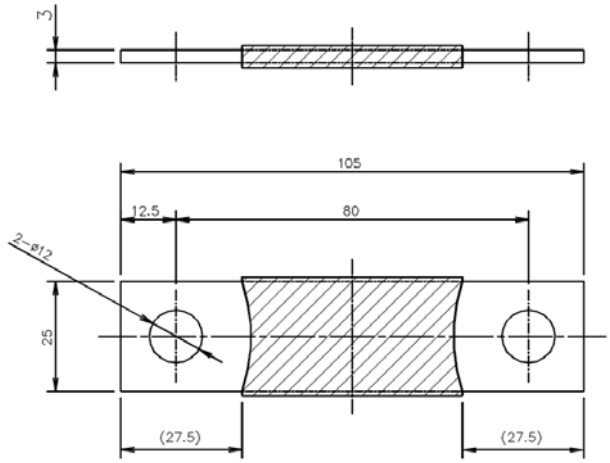
12.7.11 Copper bus bar

■ +DC, -DC (Model number: AL-00918125-01)



* 2 pieces include

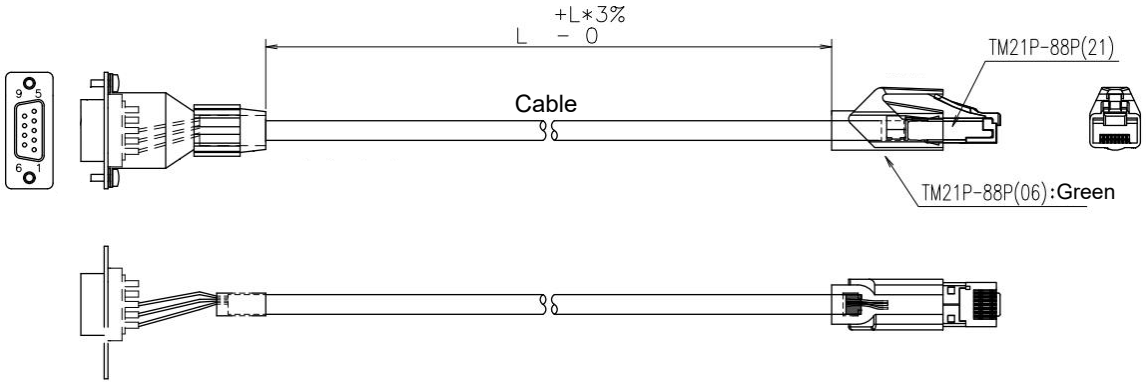
■ +DC, -DC (Model number: AL-01020858-01)



12. Appendix

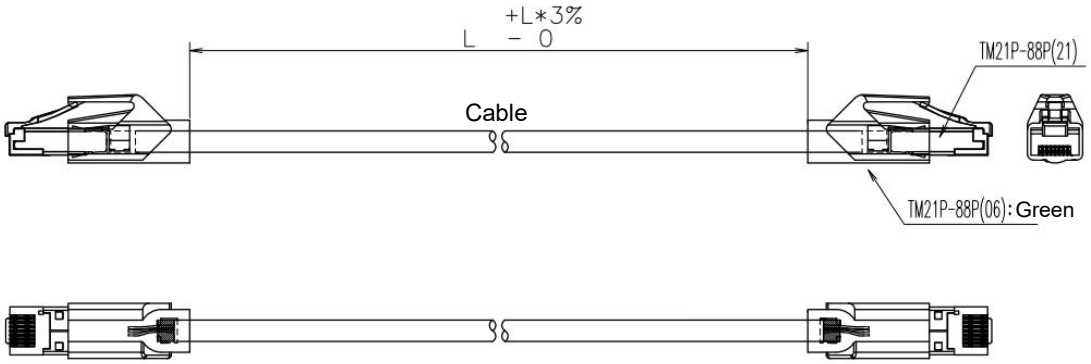
12.7.12 MODBUS communication connection cables dimensions

■ For host device connection (between SANMOTION C and amplifier)
AL-01101867-☐☐



L (mm): Means 1,000, 3,000, 5,000 7,000 or 10,000

■ For between amplifiers connection
AL-01101866-☐☐



L (mm): Means 200, 500, 1,000, 3,000, 5,000 7,000 or 10,000

Release
Revision B Jul. 2020

ECO PRODUCTS

■ECO PRODUCTS

Sanyo Denki's ECO PRODUCTS are designed with the concept of lessening impact on the environment in the process from product development to waste. The product units and packaging materials are designed for reduced environmental impact.
We have established our own assessment criteria on the environmental impacts applicable to all processes, ranging from design to manufacture.

■Precautions For Adoption

Failure to follow the precautions on the right may cause moderate injury and property damage, or in some circumstances, could lead to a serious accident.
Always follow all listed precautions.

⚠ Cautions

- Read the accompanying Instruction Manual carefully prior to using the product.
- If applying to medical devices and other equipment affecting people's lives please contact us beforehand and take appropriate safety measures.
- If applying to equipment that can have significant effects on society and the general public, please contact us beforehand.
- Do not use this product in an environment where vibration is present, such as in a moving vehicle or shipping vessel.
- Do not perform any retrofitting, re-engineering, or modification to this equipment.
- The Products presented in this Instruction Manual are meant to be used for general industrial applications. If using for special applications related to aviation and space, nuclear power, electric power, submarine repeaters, etc., please contact us beforehand.

* For any question or inquiry regarding the above, contact our Sales Department.

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*Specifications are subject to change without notice.

Translated version of the original instructions