

SANMOTION

AC SERVO SYSTEMS

R

3E Model

TYPE S

Analog / Pulse Input Type

For Linear Motor

Instruction Manual

The third edition (C)

- Overall
 - Unify encoder names and add encoder code information.
Single-turn absolute encoder (Encoder code: H)
Battery backup absolute encoder (Encoder code: P)
Battery-less absolute encoder (Encoder code: R)
Wire-saving incremental encoder (Encoder code: S)
 - ACC10060 is deleted from motor lineup.
- p. 1-3
 - Wiring drawing for RS3is corrected.
- p. 4-25
 - Below note is added.
* For Molded Case Circuit Breaker (MCCB)/Noise filter/Magnetic contact, the model required to single axis is shown.
 - MCCB and Magnetic contact model numbers are updated from discontinued products.
- p. 5-32, 5-39, 5-41
 - ID4C, 70, 71 and 73 are added.
- p. 5-50, 5-113
 - Setting range of MON1 and MON2 is changed to "00 to 36".
- p. 5-51
 - Setting range of ID25, GroupD is corrected as follows:
-9223372036854775808 to 9223372036854775807
 - Setting range of ID11 is corrected as follows: 00 to 66 → 00 to 73.
 - Setting ranges of ID31 to 36 are corrected as follows: 00 to 19, FF → 00 to 22, FF.
- p. 5-80
 - A part of description in ID12 is corrected as follows: becomes → may become.
- p. 5-105, 10-2, 10-5, 10-6
 - Symbols in drawing are changed to comply with JIS standards.
- p. 5-114
 - List number 34 to 36 are added as Load Mass Ratio monitor.
- p. 5-128
 - Setting range/description of ID11 are corrected as follows:
00 to 66 → 00 to 73, WARNING1 to SYNERR → WARNING1 to MOTE-ERRAT.
- p. 5-129
 - Setting range of ID25 is corrected as follows:
-9223372036854775808 to 9223372036854775807
- p. 5-130
 - Items in ID31 to 36 are corrected as below.
00 to 19, FF → 00 to 23, FF
 - ID21 and 22 are added to the table.
- p. 7-5
 - Regenerative power monitor display (monitor ID: 4C) is added.

Details of revision history

- p. 8-32
 - Section "8.3.3 Correspondence table of EnDat Error message/alarm code" is added.
- p. 8-34
 - Descriptions are corrected as follows:

Some parts have aging degradation. Perform periodic inspection for preventive maintenance.

↓

Some parts have aging degradation. Please request us an overhaul by referring to the periods below for preventive maintenance.
- p. 10-8
 - Below note is added.

* Torque may turn off for a moment if the pulse of 1ms over to less than 8ms is input.
- p. 10-17
 - Period of confirmation of function operation is changed to "every 3 month" from "annually".
- p. 12-1
 - Model number in the table of conformity verification test is corrected.
- p. 12-3
 - Test standard number in the table of Standards Conformity is corrected.
- p. 12-4
 - Surge-absorber model number/manufacturer in the table of EMC Installation Requirements is corrected.
- p. 12-34
 - Front view of RS3A30 is divided.

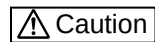
Safety Precautions

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 and confirm extinction of CHARGE-LED for main circuit power 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 linear motor should always be connected to the protective ground terminal (⊕) of the amplifier. Be sure to confirm that the grounding cable is D class or more.
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 linear motor during operation.
Bodily injury could otherwise result.

Safety Precautions



Caution

- ◆ Use the servo amplifier and linear 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 servo amplifier/ linear motor and the peripherals.
Burn could otherwise result.
- ◆ Do not touch the radiation fin of the servo amplifier, the regenerative resistor, or the linear 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 servo amplifier or the linear motor outside their specifications.
Electric shock, injury or damage to the device could otherwise result.
- ◆ Attached lead wire of 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.
- ◆ Magnetic rails have been magnetized. Keep away from the magnets anyone who has electronic medical device such as a pace maker. Otherwise, the medical device will not work appropriately, leading to a serious danger to the person who has the medical device.
- ◆ Magnetic rails have been magnetized. A strong magnetic attraction (or repulsion between magnets) arises between the magnets themselves or the magnets and any other objects made of iron such as jigs. Treat them carefully.
Bodily injury could otherwise result.
- ◆ Magnetic rails and coil have metal edges. Handle them with care.
Bodily injury could otherwise result.



Prohibited

- ◆ Do not perform additional machining to magnet part.
Rust occurring or ignition could otherwise result.

Safety Precautions

■ Storage



Caution

- ◆ When a work must be done with the protective cover removed, start working carefully and safely paying attention to an electric shock or runaway.
Electric shock or injury could otherwise result.



Prohibited

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



Mandatory

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

Safety Precautions

■ Transportation



Caution

- ◆ When handling or moving this equipment, do not hold the device by the cables
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.
- ◆ Linear motor and its stage may be too heavy. Keep in mind of falling.
Bodily injury could otherwise result.
- ◆ Transport magnet rail in the state of packing. Do not use magnet rail to carry equipments.
Magnet rail transportation with unpacked can cause injuries, as the magnet rail is magnetized.



Mandatory

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

Safety Precautions

■ Installation



Danger

- ◆ Voltage is generated at the motor power line when the coil is moved after having been installed.
Electric shock could otherwise result.



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.
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.
- ◆ Install sufficient protective cover in movable part of linear motor.
Bodily injury could otherwise result.
- ◆ The magnetic attraction force which is 5 times or more of maximum force of linear motor works between coil and magnet rail. (Type with core) Make sure to hold them by adequate strength.
Bodily injury could otherwise result.
- ◆ Be sure to place limit switch and collision safety device to linear motor stroke end.
Bodily injury could otherwise result.

Safety Precautions

■ Wiring



Caution

- ◆ Wiring connections must be secure. Will be cause of linear motor runaway.
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 linear 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.



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.

Safety Precautions

■ Operation

Caution

- ◆ Do not perform extensive adjustments to the device as they may result in unstable operation.
Bodily injury could otherwise result.
- ◆ Be sure to perform a test operation depending on steps of "5.2 Test operation" in instruction manual.
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 linear motor or servo 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.
- ◆ Keep away dust, water or others from the coil moving area and the magnetic rails.
Electric shock, injury or damage to the device could otherwise result.

Safety Precautions

Prohibited

- ◆ Keep the linear motor's encoder cables and terminals 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 move the linear 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 linear 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).
Linear Motor
Temperature 0°C to 40°C
Humidity below 90% RH (non-condensing).}
Burnout or damage to the device could otherwise result.

Safety Precautions

■ 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. Replace them to new ones for pre protection according to standard replacement term. Please contact our offices.
Damage to the device could otherwise result.
- ◆ Absolutely, 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.

Safety Precautions

■ Disposal



Danger

- ◆ Strong permanent magnet is installed to a magnet rail of linear motor.
For disassembling and disposing of linear motor, remind enough attention to the worker and around.
- ◆ For disassembling and discarding of linear motor, keep anyone who has electronic medical device as a pace maker away from the magnets. Otherwise, the medical device will not work appropriately, leading to a serious danger to the person who has the medical device.
- ◆ Keep anyone who has magnetic metal at inside of the body away from the magnets.
A strong magnetic attraction will arise between the magnets and magnetic metal, and it will be cause of bodily injury.
- ◆ A strong magnetic attraction (or repulsion between magnets) arises between the magnet rails themselves or the magnet rails and any other objects made of iron such as jigs.
At disassembling, treat them carefully to avoid pinch a hand or something.
- ◆ For linear motor disassembling, do not leave the magnet rails without control to around a work place. Magnet surface must cover by 20mm or more thick non-magnetic protection board (aluminum, wood etc) and avoid exposure.



Caution

- ◆ For the worker of linear motor disassembling/discarding and around the work place, magnetic record products like as magnetic card, watch, ticket, floppy disk etc should not be equipped.
They might be magnetized and will be unusable.
- ◆ Coils of linear motor should be discarded as industrial waste.
- ◆ For discarding, magnet rails of linear motor should be heated to 300°C, 10 minutes or more for demagnetizing. then discard as industrial waste.
- ◆ Demagnetized magnet rails which is heated to 300°C or more should be confirmed that temperature is decreased enough, before touching.
Burn could otherwise result.



Mandatory

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

Table of contents

1. Preface

1.1 Introduction	1-1
1.1.1 Product overview	1-1
1.1.2 Features of "SANMOTION R" 3E Model	1-2
1.1.3 Cautions for replacement from "SANMOTION R" ADVANCED MODEL	1-3
1.2 Instruction manual	1-5
1.2.1 Contents	1-5
1.2.2 Precautions related to these instructions	1-6
1.3 Illustration of system components	1-7
1.4 Model number structure	1-11
1.4.1 Linear Motor Model Number (DS, DD series)	1-11
1.4.2 Linear Motor Model Number (DS/DD series, Small type)	1-12
1.4.3 Linear Motor Model Number (DT series)	1-13
1.4.4 Servo Amplifier Model Number	1-14
1.5 Part names	1-16
1.5.1 Servo amplifier	1-16
1.5.2 Linear motor	1-20

2. Specifications

2.1 Linear motor	2-1
2.1.1 Common specifications	2-1
2.1.2 Exterior dimensions/ specifications/ mass	2-1
2.1.3 Mechanical specifications	2-1
2.1.4 Moving direction of linear motor (DD/DS/DT series)	2-2
2.2 Linear encoder	2-4
2.2.1 Applicable linear encoder	2-4
2.3 Servo amplifier	2-5
2.3.1 Common specifications	2-5
2.3.2 Input command, position signal output, general input/output	2-6
2.3.3 Force limit input	2-7
2.4 Power supply, calorific value	2-8
2.4.1 Main circuit power supply capacity, control power supply capacity	2-8
2.4.2 Inrush current, leakage current	2-9
2.4.3 Calorific value	2-10
2.5 Operation pattern	2-11
2.5.1 Time of acceleration and deceleration, permitted repetition, loading precaution	2-11
2.6 Position signal output	2-14
2.6.1 Position signal output by serial signal	2-14
2.6.2 Binary code output format and transfer period	2-15
2.6.3 Position signal output by pulse signal	2-16

Table of contents

2.7 Specifications for analog monitor	2-17
2.7.1 Monitor output	2-17
2.7.2 Monitor for velocity, force, and position deviation	2-18
2.8 Specifications for dynamic brake	2-19
2.8.1 Allowable frequency, instantaneous tolerance, coasting distance of the dynamic brake	2-19
2.9 Regeneration process	2-21
2.9.1 Minimum values of Built-in/ external regenerative resistor	2-21
2.9.2 Allowable regenerative power	2-21
3. Installation	
3.1 Servo amplifier	3-1
3.1.1 Precautions	3-1
3.1.2 Unpacking	3-2
3.1.3 Mounting direction and location	3-3
3.1.4 Arrangement within the cabinet	3-3
3.2 Linear motor	3-4
3.2.1 Precautions on linear motor installation	3-4
3.2.2 Unpacking	3-7
3.2.3 Installation of flat-type linear motor with core	3-8
3.2.4 Installation of twin-type linear motor with core	3-12
3.2.5 Installation of center magnet type linear motor with core	3-17
3.2.6 Installation of cylinder-type motor	3-20
3.2.7 Cable installation and its considerations	3-21
4. Wiring	
4.1 Wiring for the terminal of high voltage and grounding	4-1
4.1.1 Part name and function	4-1
4.1.2 Wire	4-1
4.1.3 Wire size - allowable current	4-2
4.1.4 Recommended wire size	4-2
4.1.5 Example of wiring	4-4
4.1.6 Crimping of wires	4-6
4.1.7 High voltage circuit terminal; tightening torque	4-6
4.2 Wiring with Host Unit	4-7
4.2.1 CN1 signal name and pin number (wiring with host unit)	4-7
4.2.2 CN1 pin assignment	4-9
4.2.3 Signal name and its function	4-9
4.2.4 Terminal connection circuit	4-10
4.3 Wiring for linear encoder	4-21
4.3.1 EN1, EN2 signal names and its pin numbers	4-21
4.3.2 EN1, EN2 pin assignment	4-23

Table of contents

4.3.3 Recommended encoder cable specification	4-24
4.3.4 Encoder cable length	4-24
4.4 Peripheral equipments.....	4-25
4.4.1 Power supply capacity and peripherals list.....	4-25

5. Operation

5.1 Basic setting of the system	5-1
5.1.1 Specification check.....	5-1
5.1.2 System parameters	5-5
5.1.3 Linear motor setting.....	5-8
5.1.4 Linear encoder setting	5-10
5.1.5 Main circuit power setting	5-14
5.1.6 Regenerative resistor setting	5-14
5.1.7 Control method selection	5-15
5.2 Test operation.....	5-17
5.2.1 Check of installation and wiring	5-17
5.2.2 Preparation before operation	5-18
5.2.3 Magnetic pole position estimation	5-19
5.2.4 Check of operation	5-20
5.2.5 Setting of I/O signal	5-21
5.2.6 Check of device operation.....	5-23
5.3 Servo amplifier status display.....	5-24
5.3.1 Normal display	5-24
5.3.2 Alarm display	5-24
5.4 Operation sequence.....	5-25
5.4.1 The operation sequence with factory setting from "turn power on" to "turn power off"	5-25
5.4.2 The operation sequence from "turn power on", at the magnetic pole position estimation valid.....	5-27
5.4.3 Stop sequence at alarm.....	5-28
5.4.4 Sequence of alarm reset	5-30
5.4.5 Sequence when power is turned OFF during operation (During servo ON)	5-31
5.5 Monitor function	5-32
5.5.1 Monitor list.....	5-32
5.5.2 Descriptions of each monitor	5-33
5.6 Analog monitor and digital monitor	5-42
5.7 Setting parameters	5-43
5.7.1 Parameters list	5-43
5.8 Parameter functions	5-53
5.9 Control block diagram	5-132
5.10 SEMI F47 supporting function	5-135
5.10.1 Parameter setting.....	5-135
5.10.2 Operational sequence	5-135
5.10.3 Notes	5-136

Table of contents

5.11 Virtual motor operation function.....	5-137
5.11.1 Setting	5-137
5.11.2 Restrictions	5-138
5.11.3 Digital operator display	5-139
5.11.4 Operating precautions	5-139
6. Servo Tuning	
6.1 Servo tuning functions and basic adjustment procedure.....	6-1
6.1.1 Servo tuning functions	6-1
6.1.2 Tuning method selection procedure	6-3
6.2 Adaptive notch filter function	6-4
6.3 Auto-tuning function	6-5
6.3.1 Selection of tuning method.....	6-5
6.3.2 Automatically adjusted parameters in auto-tuning.....	6-10
6.3.3 Adjustable main parameters during auto-tuning	6-12
6.3.4 Unavailable functions during auto-tuning.....	6-13
6.3.5 Auto-tuning characteristic selection	6-14
6.3.6 Adjustment method for auto-tuning	6-15
6.3.7 Monitoring servo gain adjustment parameters	6-15
6.3.8 Manual tuning method using auto-tuning results	6-16
6.4 Manual tuning function	6-17
6.4.1 Servo system configuration and servo adjustment parameters	6-17
6.4.2 Basic manual tuning method for velocity control.....	6-19
6.4.3 Basic manual tuning method for position control	6-19
6.5 The function of making servo gain higher.....	6-20
6.5.1 Velocity loop phase lead compensation	6-20
6.5.2 Position loop phase lead compensation	6-21
6.5.3 Force feed forward compensation.....	6-22
6.6 Model following control function	6-23
6.6.1 Manual tuning method for model following control	6-24
6.6.2 Switching of the Feedback control and the Model-following (vibration suppression) control.....	6-25
6.6.3 Model velocity feed forward differential compensation.....	6-26
6.7 Auto notch filter tuning function.....	6-27
6.8 Vibration suppression function.....	6-29
6.8.1 Model following vibration suppression control.....	6-29
6.8.2 Auto FF Vibration Suppression Frequency Tuning	6-32
6.8.3 FF vibration suppression control.....	6-33
6.8.4 CP vibration suppression control	6-35
6.8.5 Minor vibration suppression.....	6-36
6.9 Disturbance impact suppression function	6-37
6.9.1 High order integral control	6-37
6.9.2 Disturbance Observer Function	6-38
6.10 Stick-slip behavior compensation function	6-39

Table of contents

7. Digital Operator

7.1 Digital Operator names and functions	7-1
7.2 Modes	7-1
7.2.1 Changing modes	7-1
7.2.2 Mode contents	7-2
7.3 Setting and display range	7-3
7.4 Status display mode	7-6
7.4.1 Status display mode	7-6
7.4.2 Over-travel status display	7-6
7.4.3 Status display of warning	7-7
7.4.4 Alarm code and servo amplifier status code when alarm occurs	7-8
7.4.5 Alarm reset when alarm activated	7-8
7.4.6 How to check the software version of servo amplifier	7-8
7.4.7 How to check the servo amplifier information 1 to 3	7-9
7.4.8 How to set pass ward	7-10
7.4.9 How to cancel password	7-11
7.5 Editing parameters	7-12
7.5.1 Basic parameters, editing system parameters	7-12
7.5.2 Editing general parameters	7-13
7.6 How to tune automatic notch frequency	7-15
7.7 Auto FF vibration suppression frequency tuning	7-16
7.8 Offset adjustment of velocity/ force command	7-17
7.9 Offset adjustment of analog force compensation command	7-18
7.10 Magnetic pole position estimation	7-19
7.11 Velocity-controlled JOG Operation	7-20
7.12 Automatic tuning result writing	7-21
7.13 Alarm history display	7-22
7.14 How to clear alarm history	7-23
7.15 Monitor display	7-23
7.16 Fixed monitor display	7-24
7.17 Motor code-setting of linear motor used	7-24

8. Maintenance

8.1 Trouble shooting	8-1
8.2 List of warning and alarm	8-4
8.2.1 Warning List	8-4
8.2.2 Alarm list	8-5
8.3 Trouble shooting when alarm activated	8-8
8.3.1 Alarm display	8-8
8.3.2 Corrective action for alarm	8-8
8.3.3 Correspondence table for EnDat Error message and alarm code	8-32

Table of contents

8.4 Inspection	8-33
8.5 Service parts	8-34
8.5.1 The parts requiring Inspection	8-34
9. Dedicated function	
9.1 Tandem operation	9-1
9.1.1 Illustration of system components	9-1
9.1.2 Internal block diagram	9-3
9.1.3 Wiring	9-4
9.1.4 Setting for the tandem operation function	9-4
9.1.5 How to use	9-6
9.1.6 Error detection	9-7
9.1.7 Precaution	9-8
10. Safe-Torque-Off (STO) function	
10.1 Illustration of system configuration	10-1
10.2 Safe-Torque-Off function	10-2
10.2.1 Outline	10-2
10.2.2 Standards conformity	10-3
10.2.3 Risk assessment	10-3
10.2.4 Residual risk	10-3
10.2.5 Delay circuit	10-4
10.3 Wiring	10-5
10.3.1 CN4 connector layout	10-5
10.3.2 Connection diagram of CN4-terminals	10-5
10.3.3 Example of wiring	10-6
10.3.4 Safety input-off shot pulse for safety device self-diagnosis	10-8
10.4 Safe-Torque-Off operation	10-9
10.4.1 Safe-torque-off state	10-9
10.4.2 Restoration from safe-torque-off state	10-10
10.4.3 Safe-Torque-Off during linear motor running	10-11
10.4.4 Safe-Torque-Off during linear motor stoppage	10-14
10.4.5 Deviation clear	10-15
10.4.6 Safety input signal failure detection	10-15
10.5 Error Detection Monitor (EDM)	10-16
10.5.1 Specifications	10-16
10.5.2 Connection example	10-16
10.5.3 Error detection method	10-16

Table of contents

10.6 Verification test	10-17
10.6.1 Preparation	10-17
10.6.2 Confirmation procedure	10-17
10.6.3 Acceptance criteria	10-17
10.7 Safety precautions	10-18

11. Selection

11.1 Linear motor sizing	11-1
11.1.1 Flowchart of linear motor sizing	11-1
11.1.2 Maximum necessary force and necessary effective force	11-2
11.1.3 Select magnet rail	11-3
11.1.4 Cautions on load conditions	11-4
11.2 Regenerative resistor sizing	11-5
11.2.1 Calculate "regenerative effective power (PM)" of driving in a horizontal axis.	11-5
11.2.2 Selection of regenerative resistor	11-6
11.2.3 Selection of external regenerative resistor	11-7
11.2.4 Specification of external regenerative resistor	11-8
11.2.5 Connection of regenerative resistor	11-9
11.2.6 Thermostat connection of external regenerative resistor	11-10
11.2.7 Protection function of regenerative resistor	11-10
11.2.8 Confirmation method of regeneration power PM in actual operation	11-11
11.2.9 Precautions for external regenerative resistor use	11-12

12. Appendix

12.1 Standards Conformity	12-1
12.1.1 Standards Conformity	12-1
12.1.2 Over-voltage Category, Protection Grade, Pollution Level	12-2
12.1.3 Connection and installation	12-2
12.1.4 UL File Number	12-2
12.2 Compliance with EN Directives	12-3
12.2.1 Conformity verification test	12-3
12.2.2 EMC Installation Requirements	12-4
12.3 Linear motor dimensions	12-5
12.3.1 Linear motor with core, flat-type	12-5
12.3.2 Linear motor with core, twin-type	12-8
12.3.3 Linear motor, twin-type	12-11
12.3.4 Linear motor, center magnet-type	12-12
12.3.5 Linear motor, cylinder-type	12-13

Table of contents

12.4 Linear motor data sheet	12-14
12.4.1 Characteristics table	12-14
12.4.2 Velocity-force characteristics.....	12-17
12.4.3 Overload characteristics	12-21
12.5 Servo amplifier dimensions	12-25
12.5.1 RS3A01L□□L□	12-25
12.5.2 RS3A02L□□L□	12-25
12.5.3 RS3A03L□□L□	12-26
12.5.4 RS3A05L□□L□	12-26
12.5.5 RS3A07L□□L□	12-27
12.5.6 RS3A10L□□A□	12-27
12.5.7 RS3A15L□□A□	12-28
12.5.8 RS3A30L□□L□	12-28
12.6 Optional parts	12-29
12.6.1 Connectors of servo amplifier.....	12-29
12.6.2 Fixing bracket.....	12-35
12.6.3 Analog monitor related item	12-37
12.6.4 Communication cable of tandem operation between amplifiers.....	12-37
12.6.5 External regenerative resistor	12-38
12.7 Optional parts dimensions	12-39
12.7.1 Monitor box outline drawing	12-39
12.7.2 Dedicated Cable outline drawing	12-39
12.7.3 Outline drawing of USB communication cable.....	12-40
12.7.4 Outline drawing of communication cable of tandem operation between amplifiers.....	12-40
12.7.5 Outline drawing of regenerative resistor	12-41

Preface	1
Specifications	2
Installation	3
Wiring	4
Operation	5
Servo Tuning	6
Digital Operator	7
Maintenance	8
Dedicated function	9
Safe-Torque-Off function	10
Selection	11
Appendix	12

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Preface

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

1.1 Introduction	1-1
1.1.1 Product overview	1-1
1.1.2 Features of "SANMOTION R" 3E Model	1-2
1.1.3 Cautions for replacement from "SANMOTION R" ADVANCED MODEL	1-3
1.2 Instruction manual	1-5
1.2.1 Contents	1-5
1.2.2 Precautions related to these instructions	1-6
1.3 Illustration of system components	1-7
1.4 Model number structure	1-11
1.4.1 Linear Motor Model Number (DS, DD series)	1-11
1.4.2 Linear Motor Model Number (DS/DD series, Small type)	1-12
1.4.3 Linear Motor Model Number (DT series)	1-13
1.4.4 Servo Amplifier Model Number	1-14
1.5 Part names	1-16
1.5.1 Servo amplifier	1-16
1.5.2 Linear motor	1-20

1. Preface

1.1 Introduction

1.1.1 Product overview

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

The AC Servo amplifier "SANMOTION R" 3E Model is a consolidated power supply, single-axis type servo amplifier consisting of eight (8) models according to capacity.

This product is corresponded the Linear Motor DS/DD/DT series, and allows using an A/B/Z-phase differential output type incremental encoder and a EnDat2.2 absolute encoder which is made in Heidenhain, as a linear encoder.

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.

(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

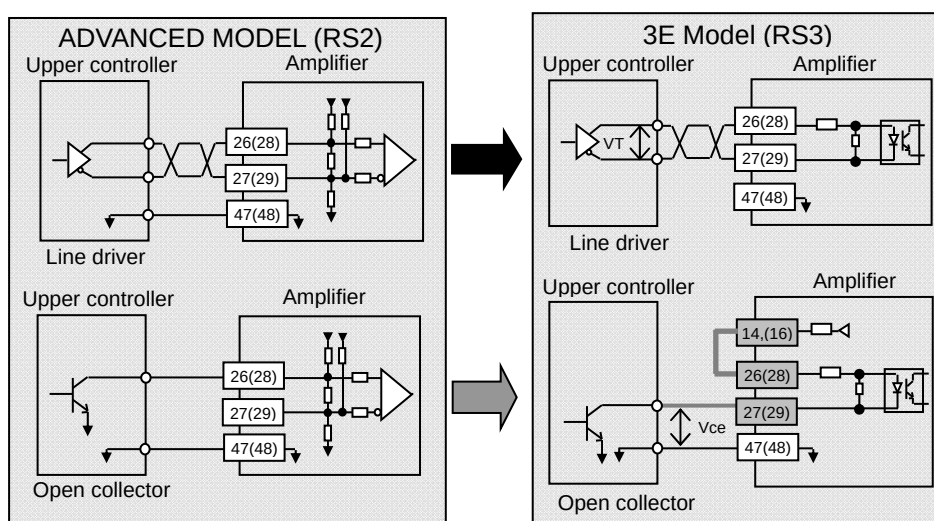
1.1.3 Cautions for replacement from "SANMOTION R" ADVANCED MODEL

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

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

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



1.1 Introduction

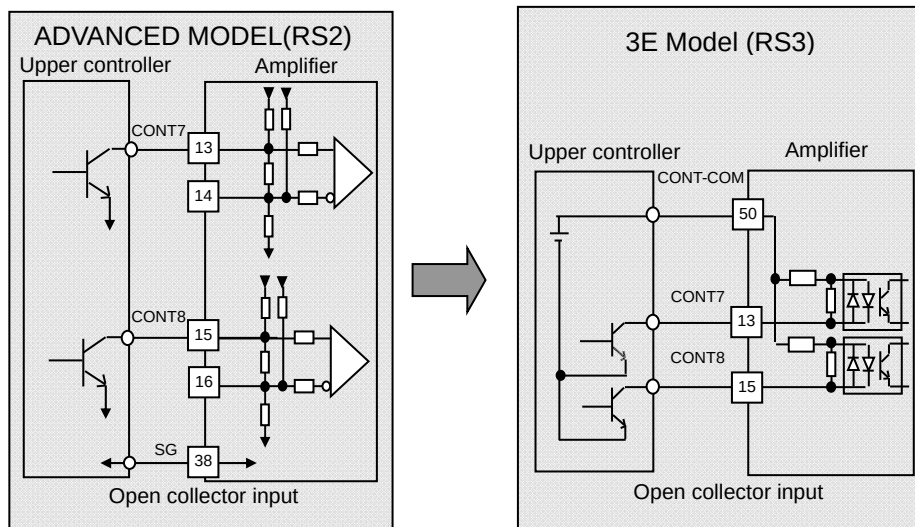
■ General input 7,8 (CONT 7,8)

General input 7,8 have changed to photo coupler from line receiver because all the circuit of general input (CONT 1 to 8) unifies to insulation type.

Therefore line driver output can not use to upper controller.

And, when open collector output is used, wiring change is needed.

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



■ The setup software

The setup software for AC servo amplifier “SANMOTION R” 3E Model is “SANMOTION MOTOR SETUP SOFTWARE”. “SANMOTION R ADVANCED MODEL SETUP SOFTWARE” is not able to use.

Please download “SANMOTION MOTOR SETUP SOFTWARE” from our Website.

And prepare commercial USB cable (Amplifier side is mini USB) as communication cable between the setup software and amplifier.

1. Preface

1.2 Instruction manual

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

1.2.1 Contents

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

1.2.2 Precautions related to these instructions

In order to fully understand the functions of this product, please read this instruction manual thoroughly before using the product. After thoroughly reading the manual, keep it handy for reference.

Carefully and completely follow the safety instructions outlined in this manual.

Note that safety is not guaranteed for usage methods other than those specified in this manual or those methods intended for the original product.

Permission is granted to reproduce or omit a portion of the attached figures (as abstracts) for use.

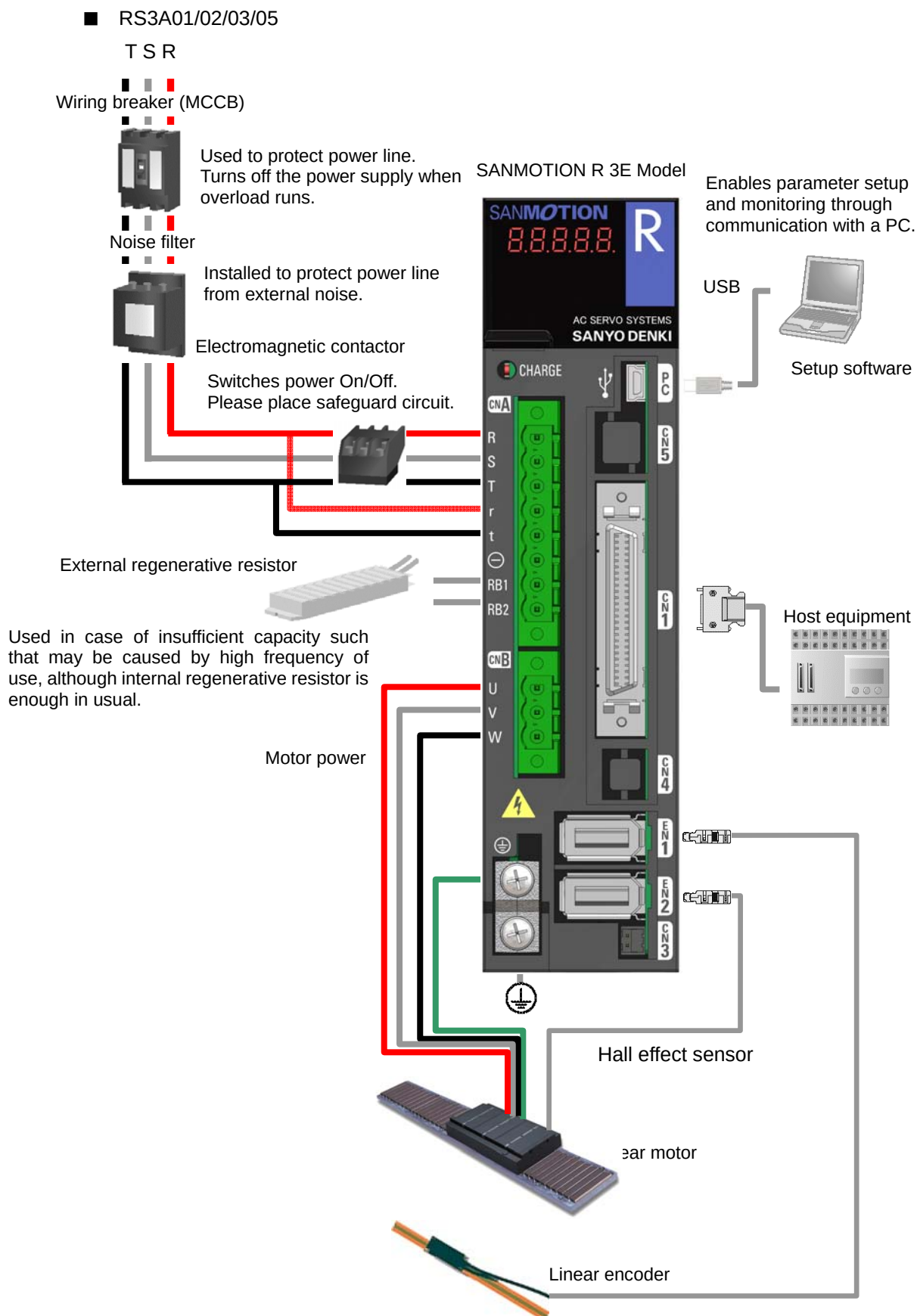
The contents of this manual may be modified without prior notice as revisions or additions are created regarding the usage method of the product. Modifications are performed as per the revisions of this manual.

Although the manufacturer has taken all possible measures to ensure the veracity of the contents of this manual, should you notice any error or omission, please notify the nearest branch office or head office written in back cover.

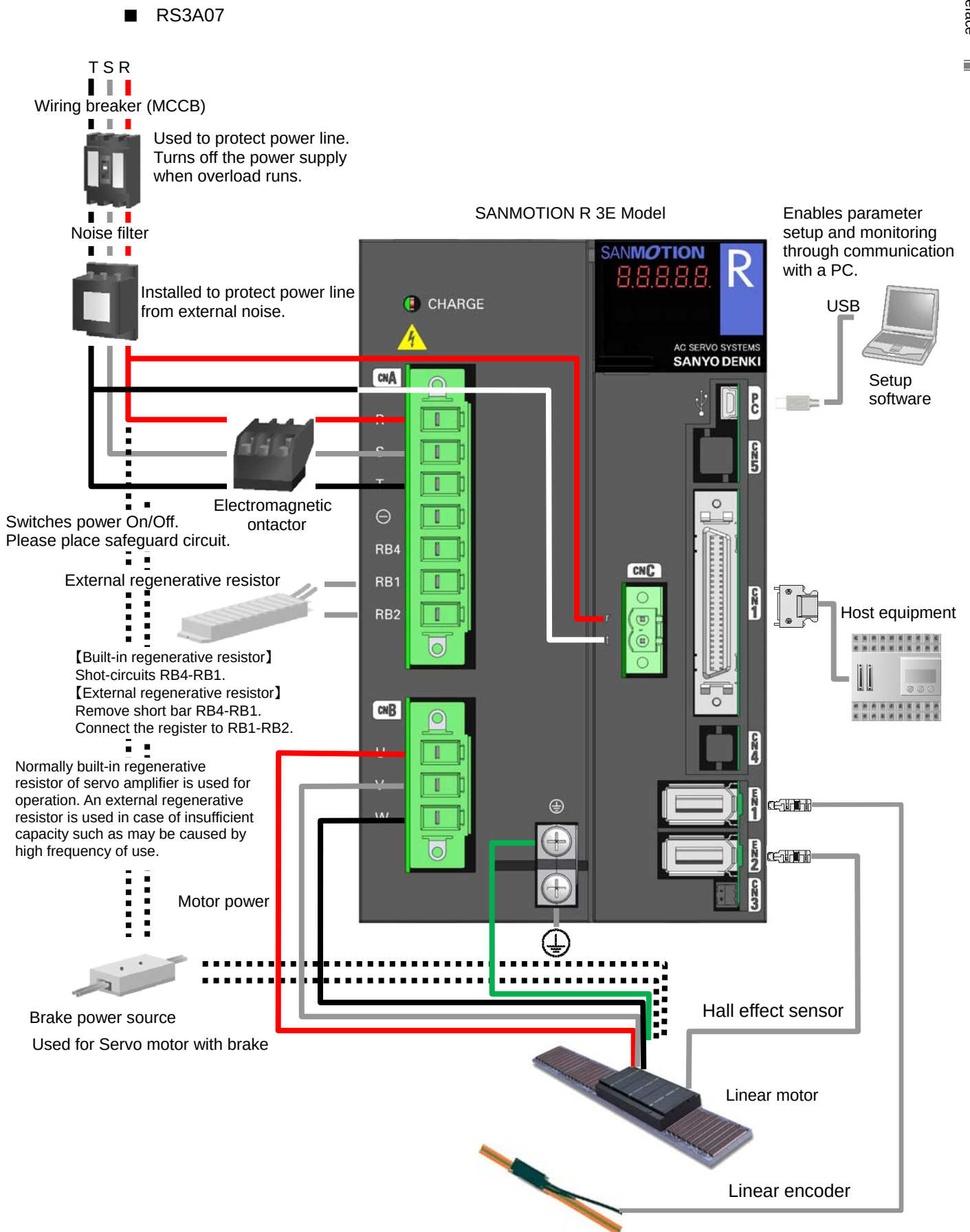
Moreover, original text of this instruction manual is Japanese. Original text writing has priority if there is difference between original text and the other language writing.

1. Preface

1.3 Illustration of system components

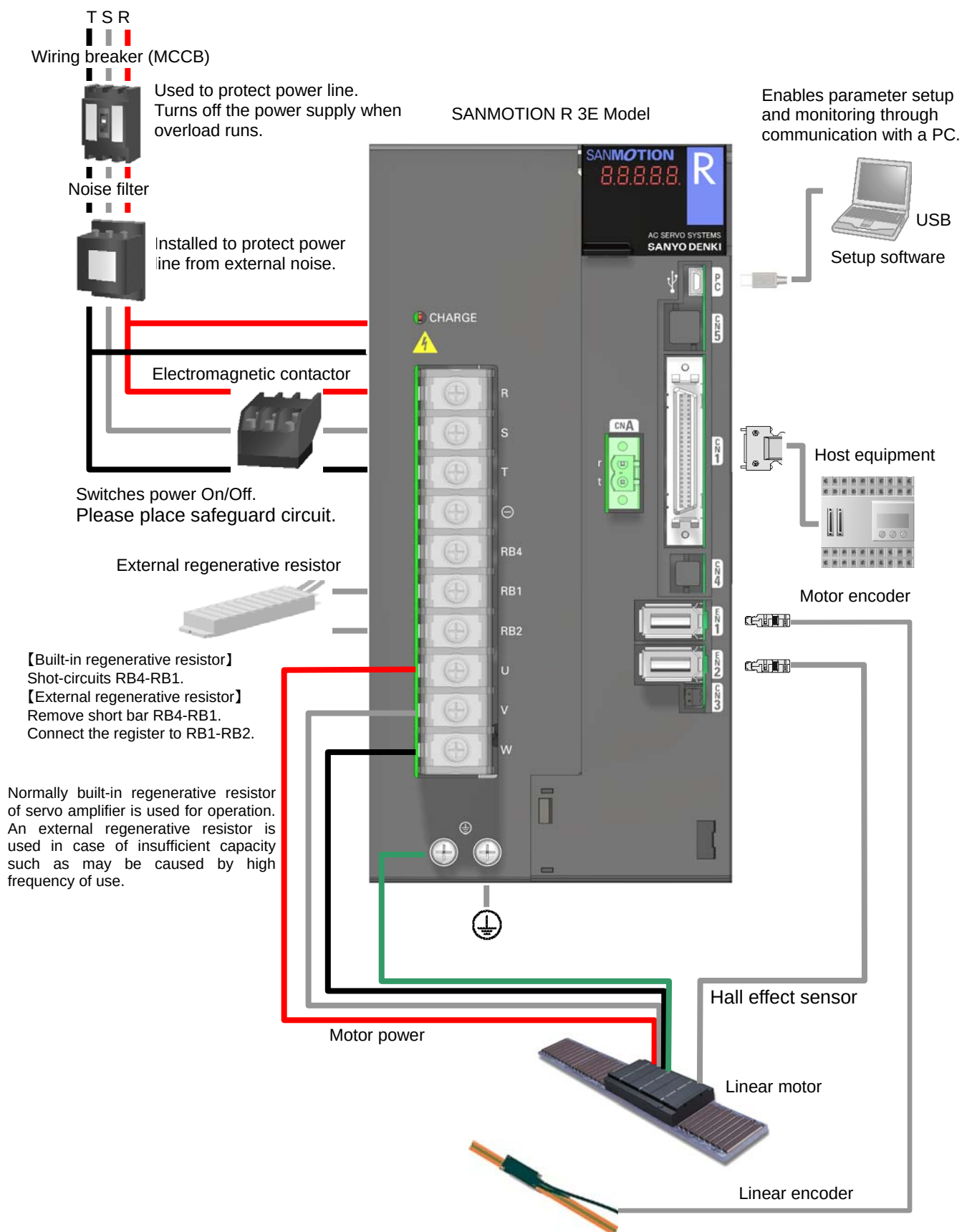


1.3 Illustration of system components



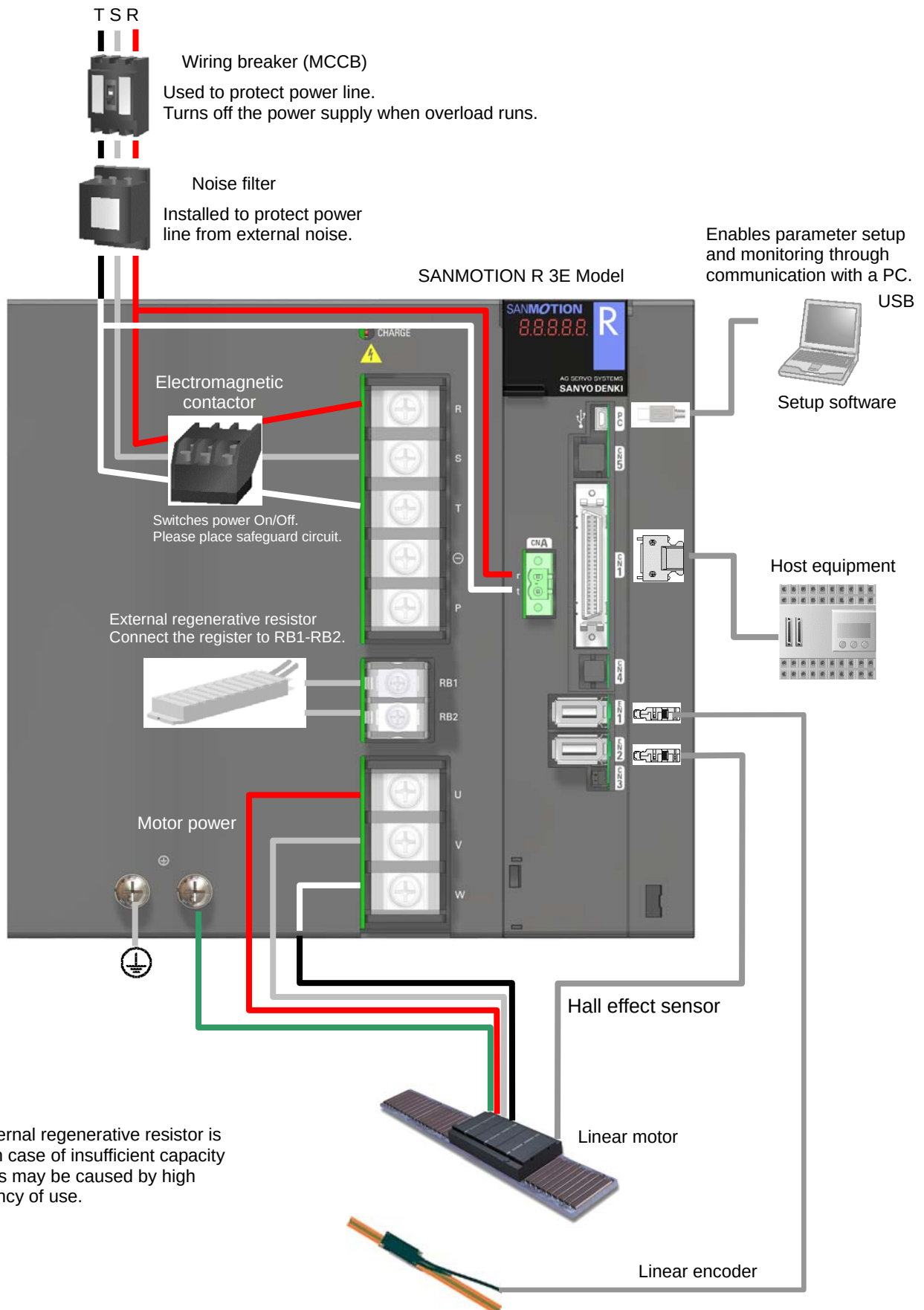
1. Preface

■ RS3A10/15



1.3 Illustration of system components

■ RS3A30

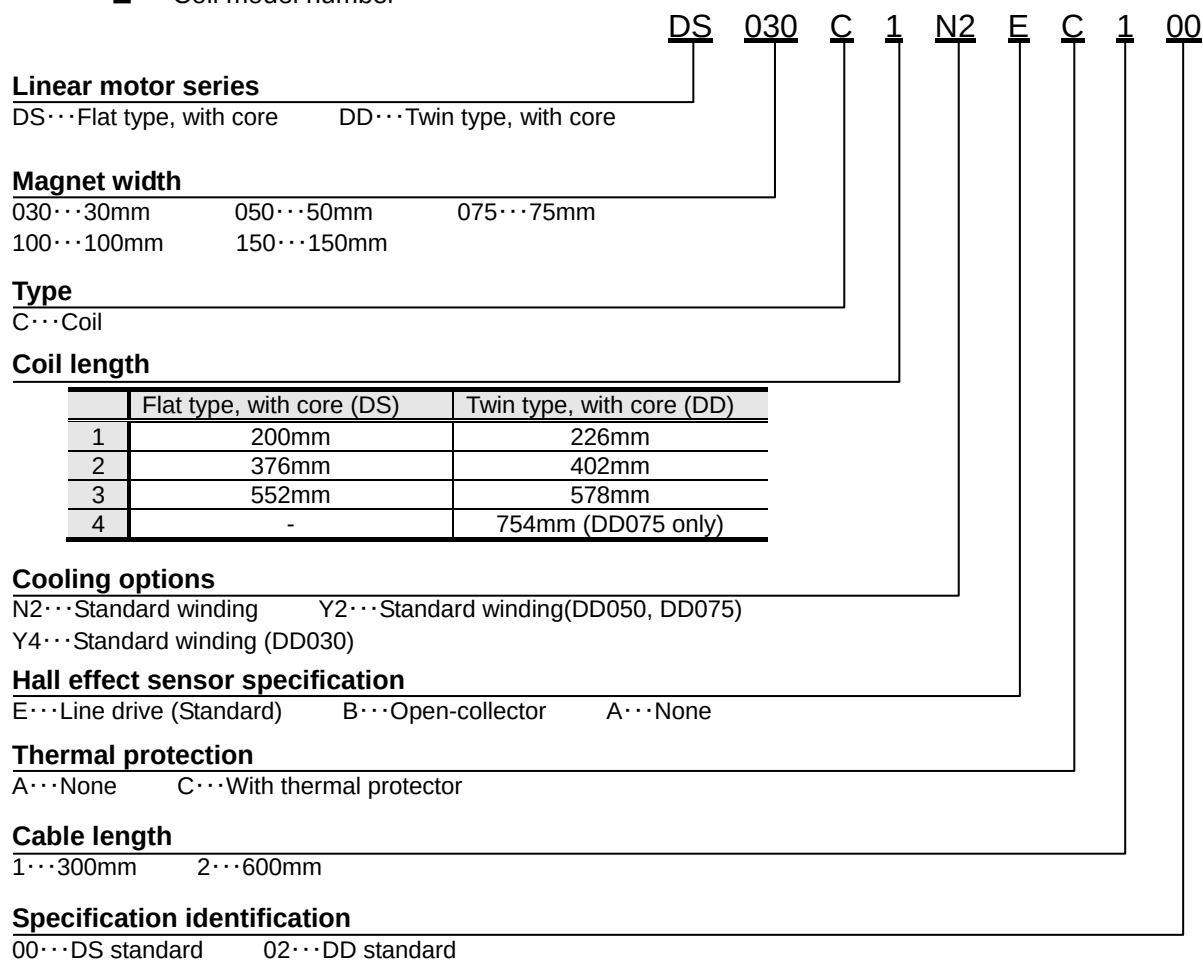


1. Preface

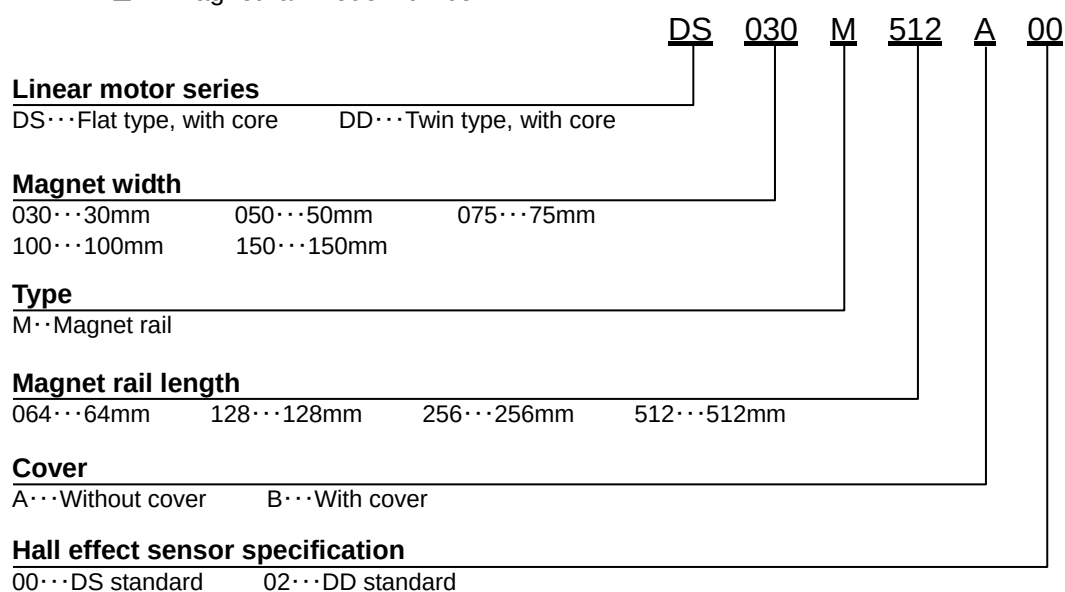
1.4 Model number structure

1.4.1 Linear Motor Model Number (DS, DD series)

■ Coil model number



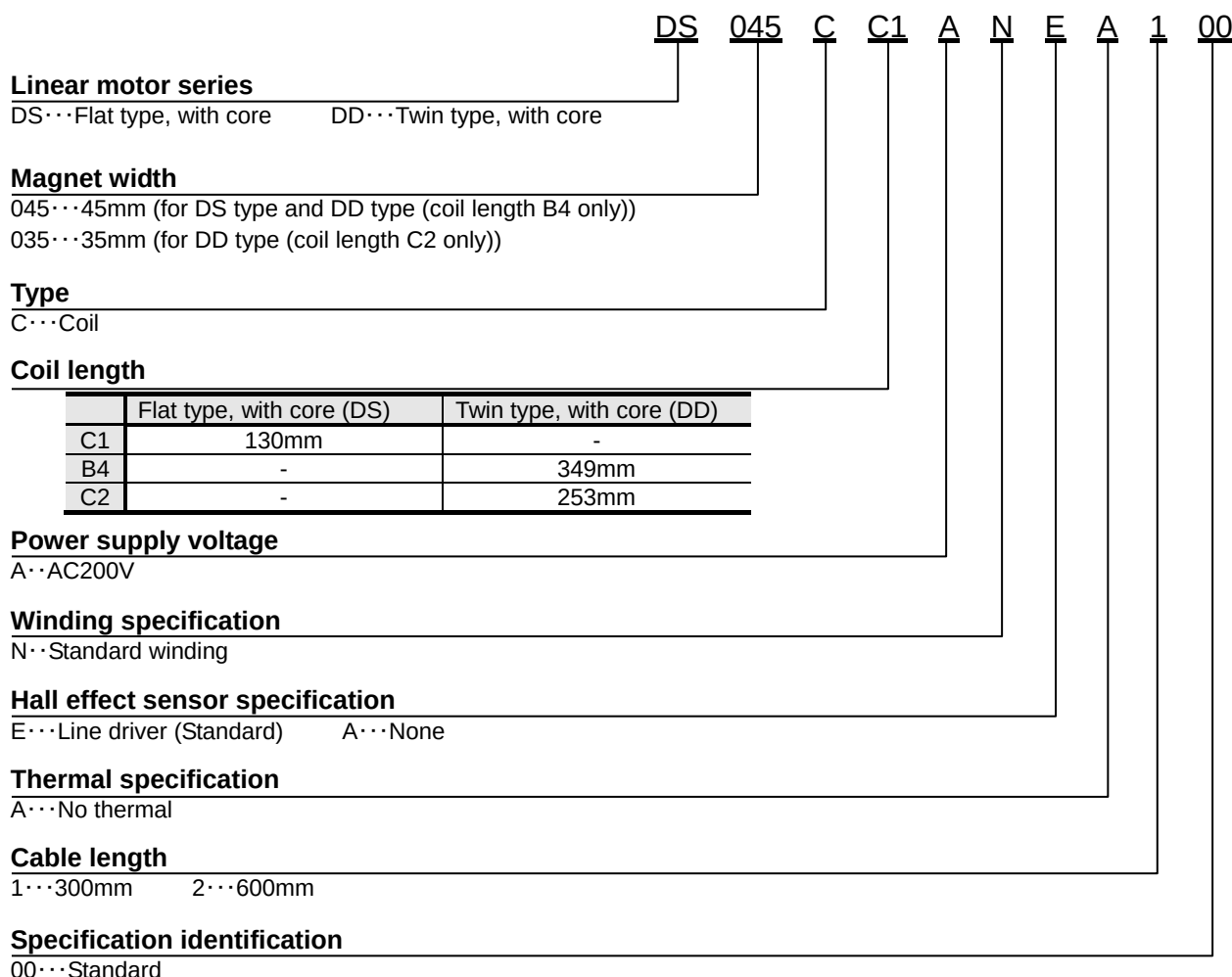
■ Magnet rail model number



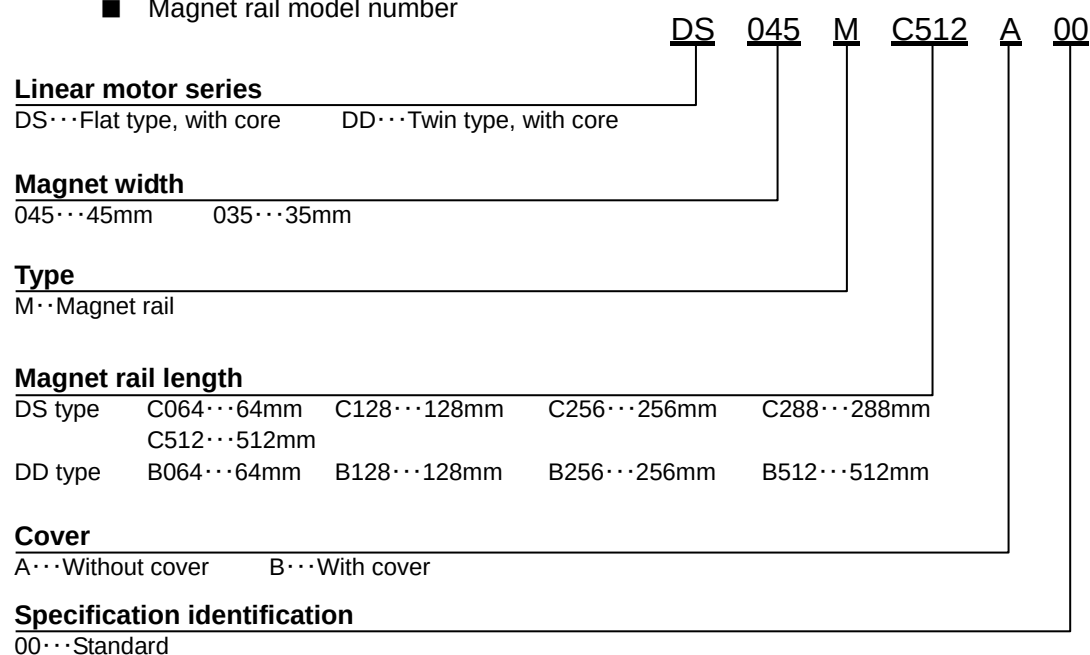
1.4 Model number structure

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

■ Coil Model Number



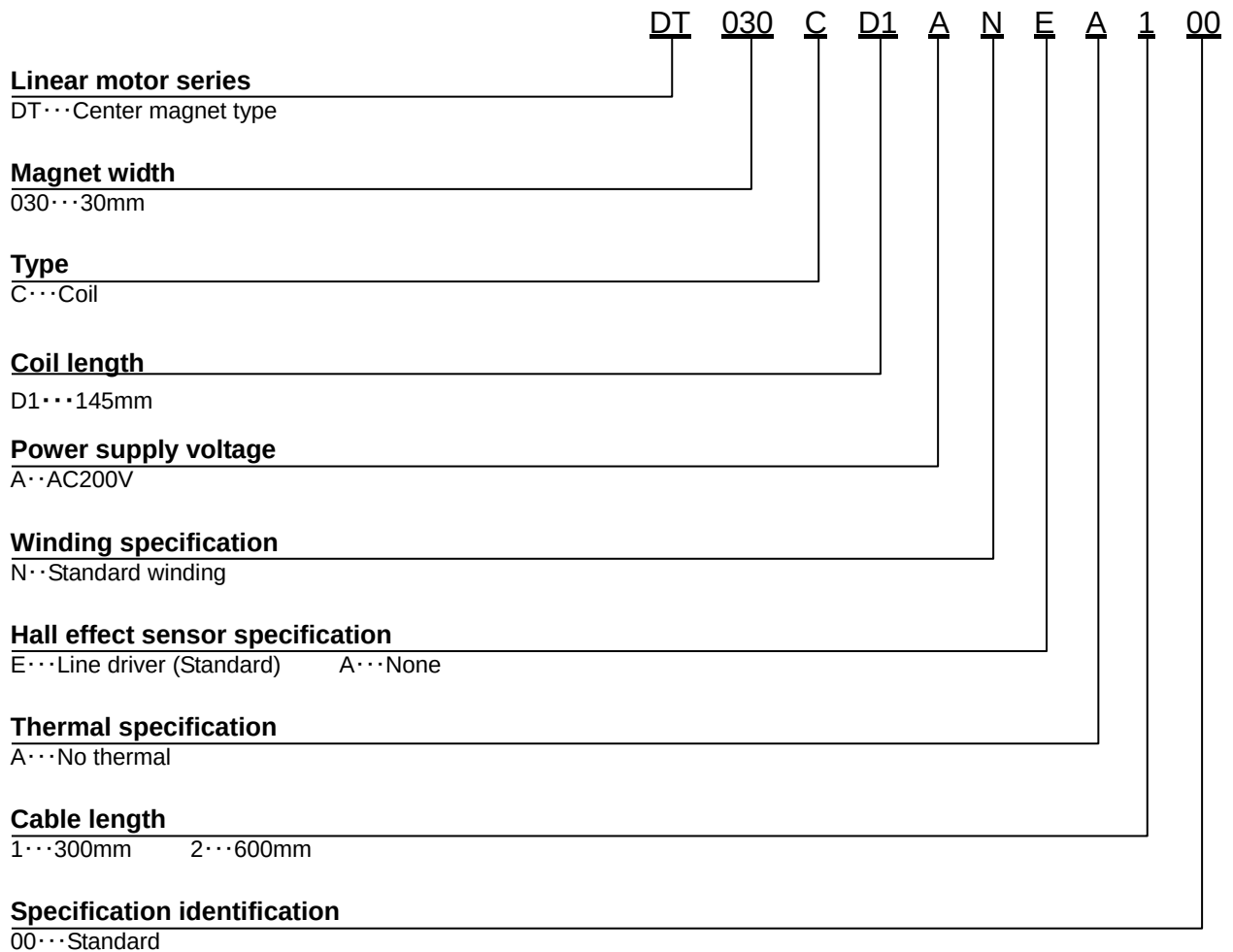
■ Magnet rail model number



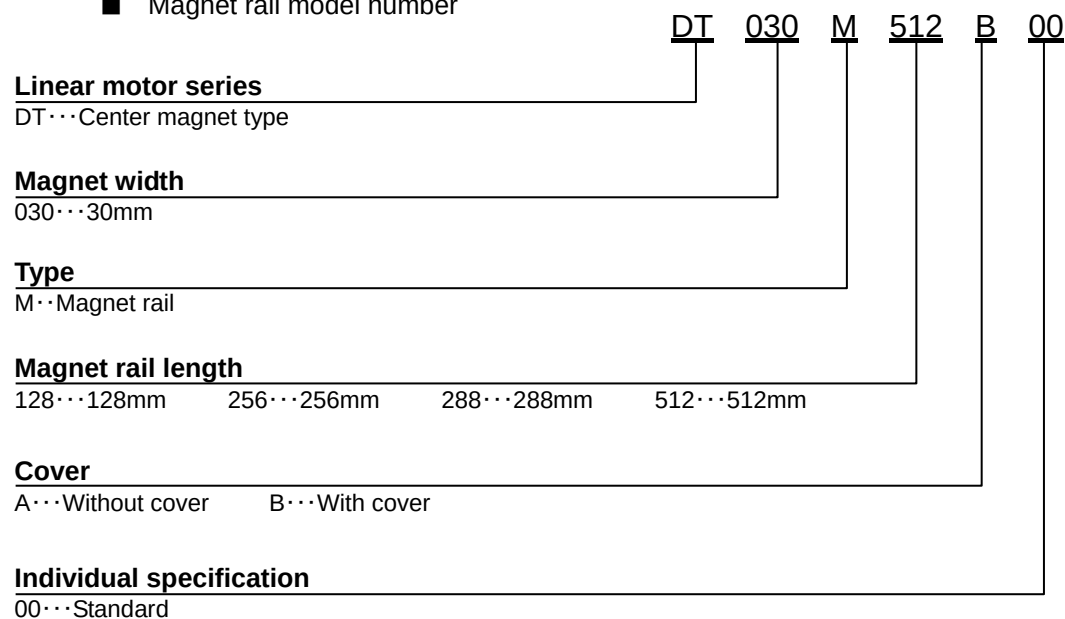
1. Preface

1.4.3 Linear Motor Model Number (DT series)

■ Coil Model Number

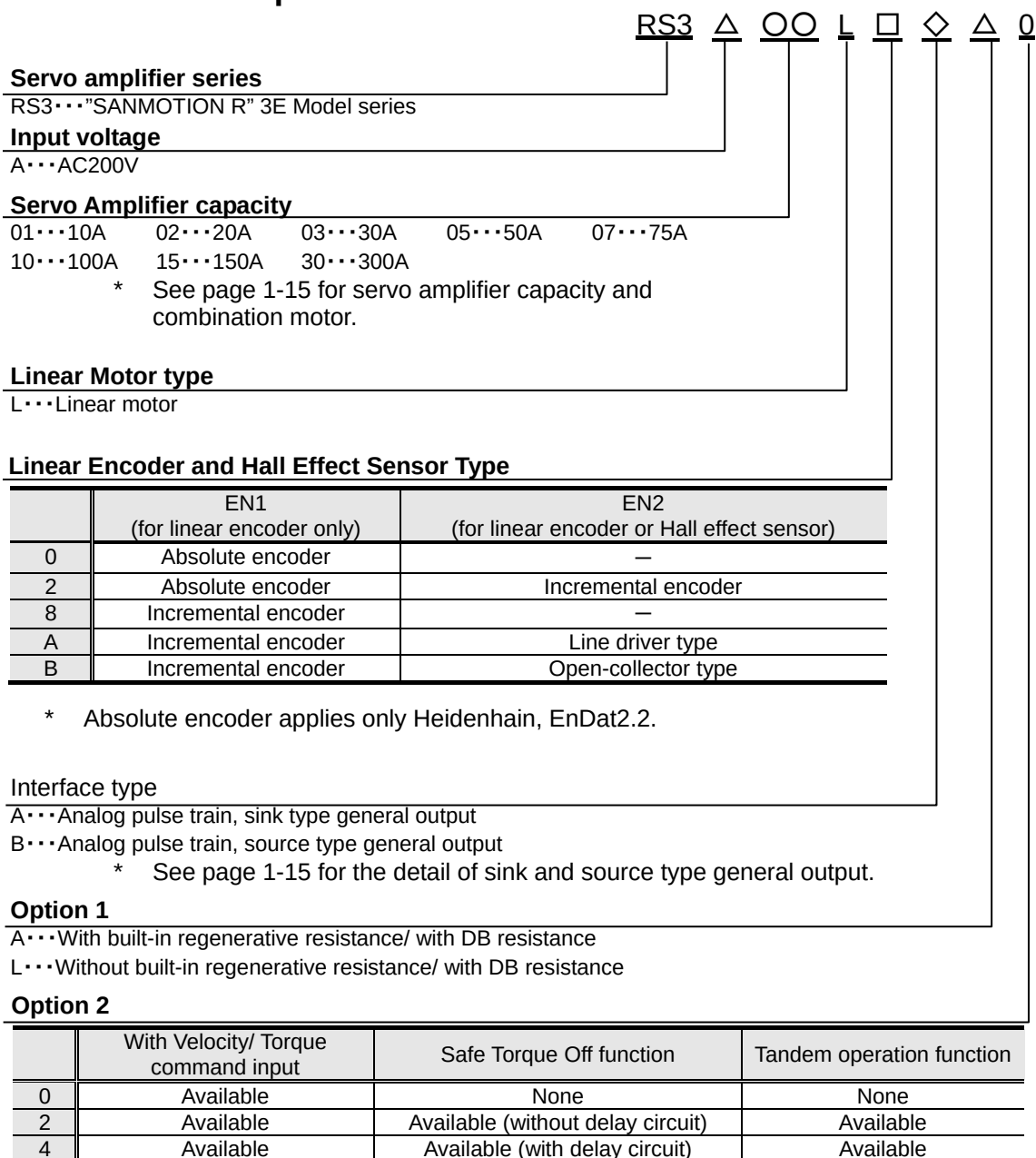


■ Magnet rail model number



1.4 Model number structure

1.4.4 Servo Amplifier 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.
- * 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 Linear motor are necessary. Make certain to follow the appropriate set-up procedure to operate your system by referring to the following chapters:
 - ◆ 5.1 Basic setting of the system
 - ◆ 5.8 Parameter functions
- * Motor encoder type "2" is able to use for both of absolute encoder and incremental 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 linear motor (AC200V)

*: Factory setting value of shortened model number

Input voltage	Servo amplifier capacity	Linear motor model number
200V	RS3A03L	DS030C1N2*
		DS050C1N2
		DS075C1N2
		DS045CC1AN
		DT030CD1AN
	RS3A05L	DS030C2N2*
		DS050C2N2
		DS075C2N2
		DS100C1N2
		DS150C1N2
		DD030C1Y4
		DS030C3N2*
	RS3A07L	DS050C3N2
		DS075C3N2
		DD030C2Y4
		DD050C1Y2
		DD075C1Y2
		DD045CB4AN
		DD035CC2AN
	RS3A10L	DS030C3N2*
		DS050C3N2
		DS075C3N2
		DS100C2N2
		DS150C2N2
		DD030C2Y4
		DD030C3Y4
		DD050C1Y2
		DD075C1Y2
		DD045CB4AN
200V	RS3A15L	DS100C3N2*
		DS150C3N2
		DD050C2Y2
		DD075C2Y2
		DD050C3Y2*
	RS3A30L	DD075C3Y2
		DD075C4Y2

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

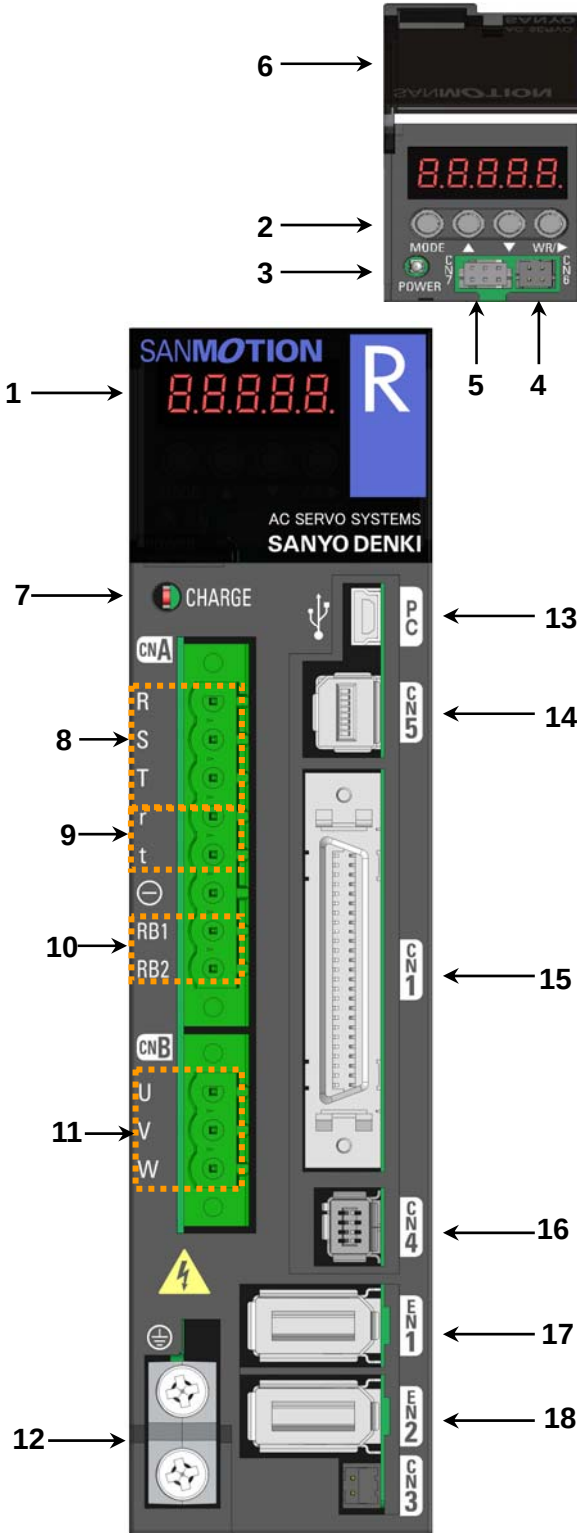
■ Sink type general output, Source type general output

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

1.5 Part names

1.5.1 Servo amplifier

■ RS3A01/ RS3A02/ RS3A03/ RS3A05

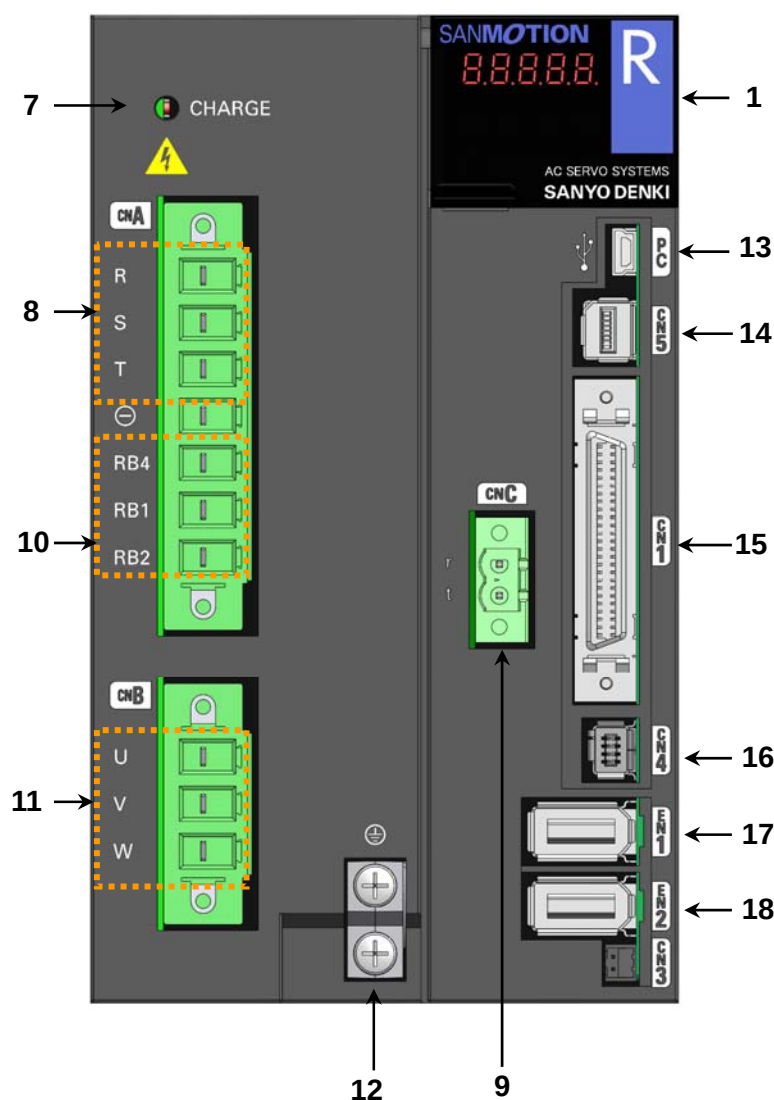
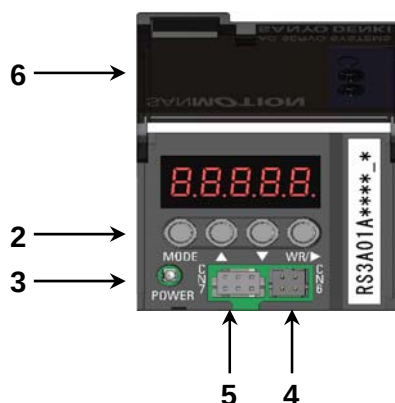


No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog 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	Linear motor power terminal (CNB)/
12	Earth connecting terminal/
13	USB connector for PC communication (PC)/
14	For function expansion connector (CN5) *
15	For I/O signal connector with host equipment (CN1)/
16	For safety features connector (CN4)/ *
17	For linear motor encoder (EN1)/
18	For motor encoder or hall effect sensor (EN2)/ *

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

1. Preface

■ RS3A07

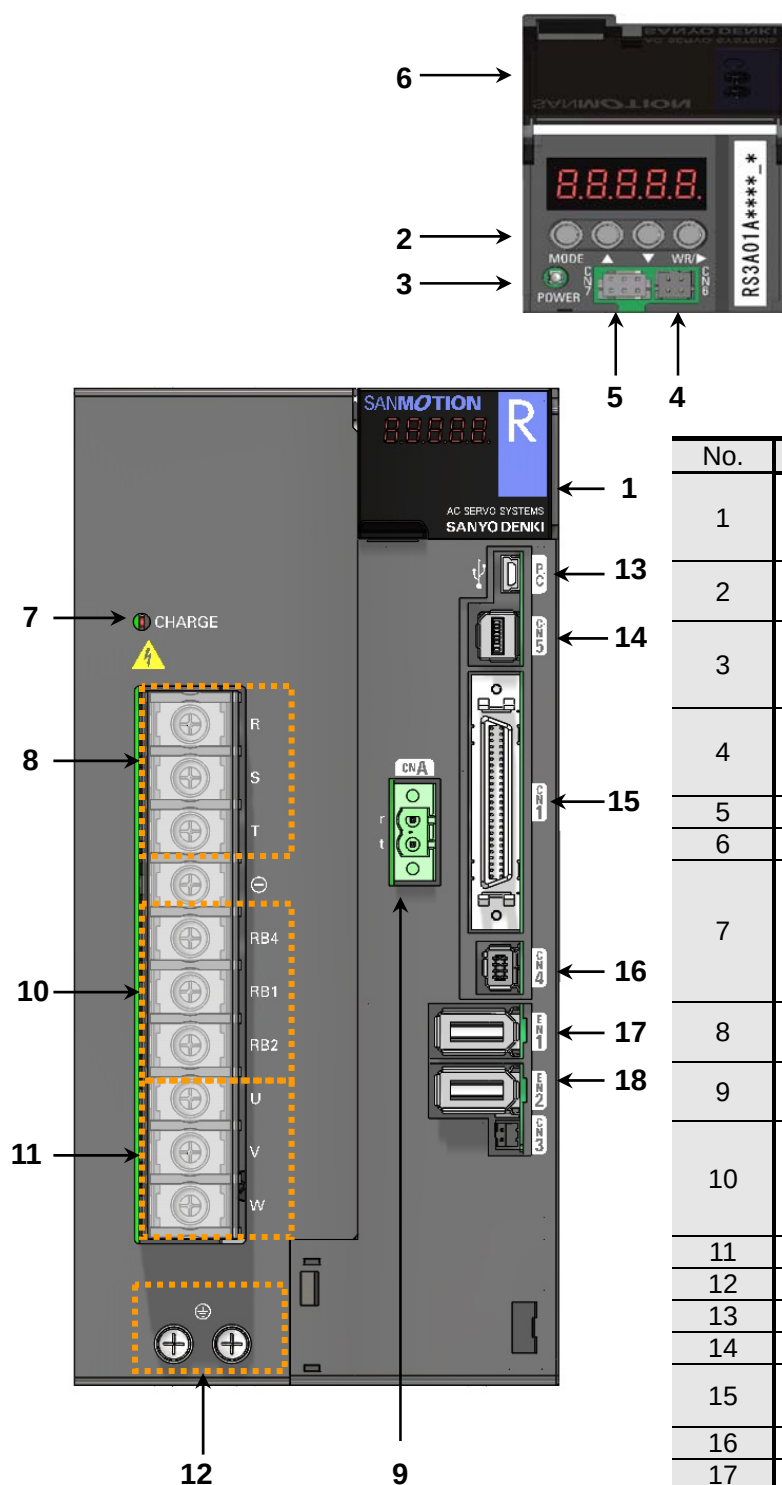


No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (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 (CNC)/ For input terminal of control power
10	Regenerative resistor connection (CNA) Connect the resistor between RB1 and RB2. There are two kind of regenerative resistor, internal and external.
11	Linear motor power (CNB)
12	Earth connecting terminal/
13	USB connector for PC communication (PC)/
14	For function expansion connector (CN5) *
15	or I/O signal connector with host equipment (CN1)/
16	For safety features connector (CN4) *
17	For linear encoder signal (EN1)/
18	For linear encoder or hall effect sensor (EN2)/ *

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

1.5 Part names

■ RS3A10/ RS3A15

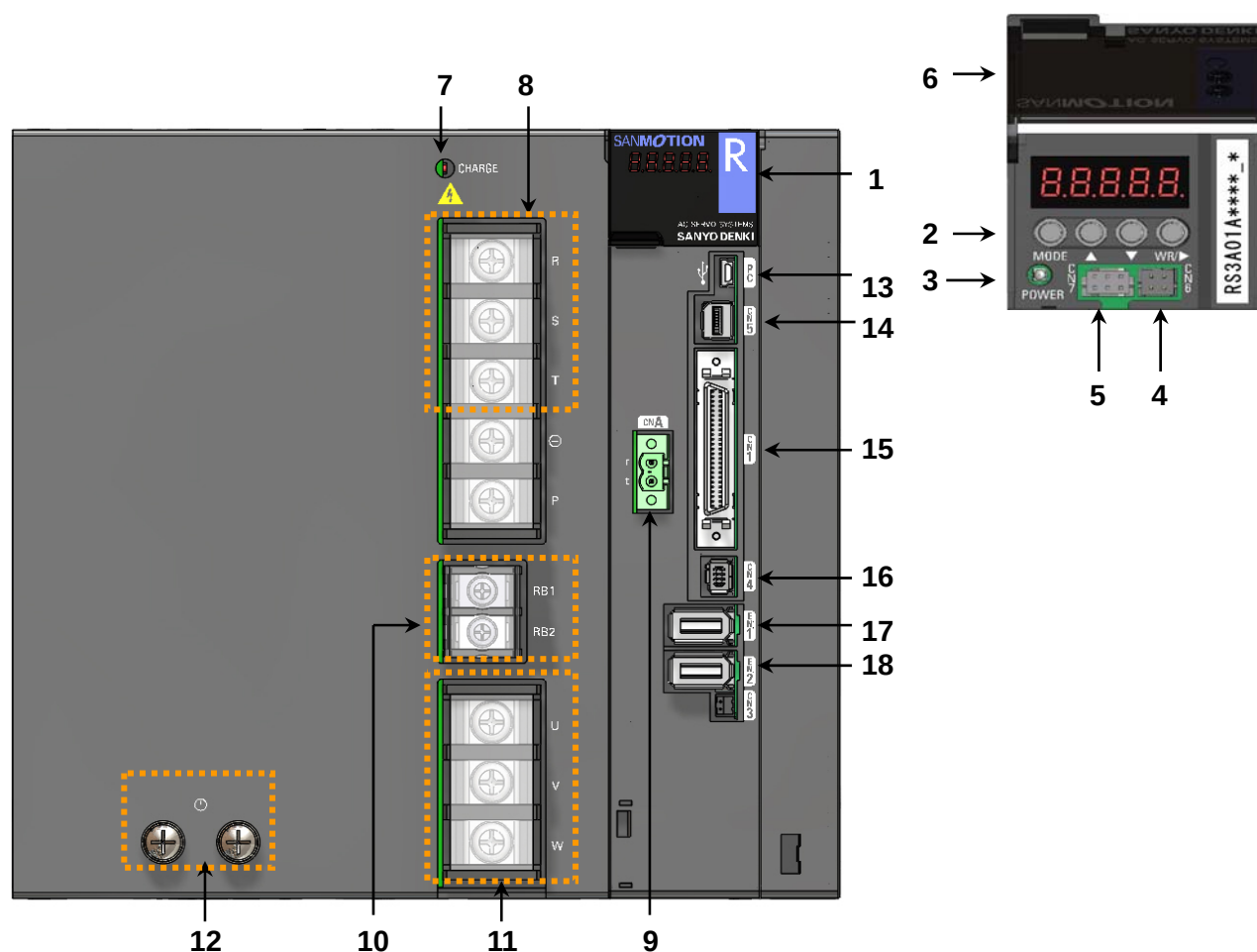


No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog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

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

1. Preface

■ RS3A30



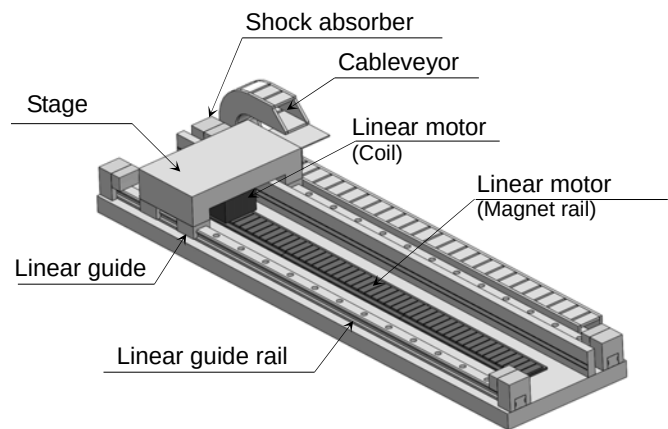
No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (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 resistor between RB1 and RB2.
11	Linear motor power terminal/
12	Earth connecting terminal/
13	USB connector for PC communication (PC)/
14	For function expansion connector (CN5) *
15	For I/O signal connector with host equipment (CN1)/
16	For safety features connector (CN4)/ *
17	For linear motor encoder (EN1)/
18	For motor encoder or hall effect sensor (EN2)/ *

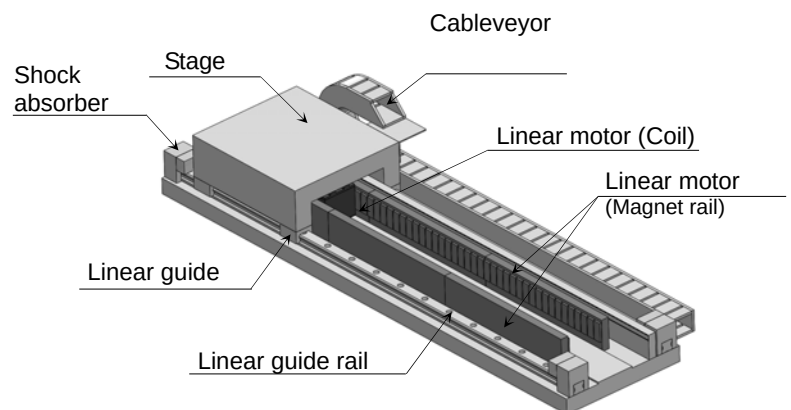
* It may not have the connector depending on the servo amplifier spec.

1.5.2 Linear motor

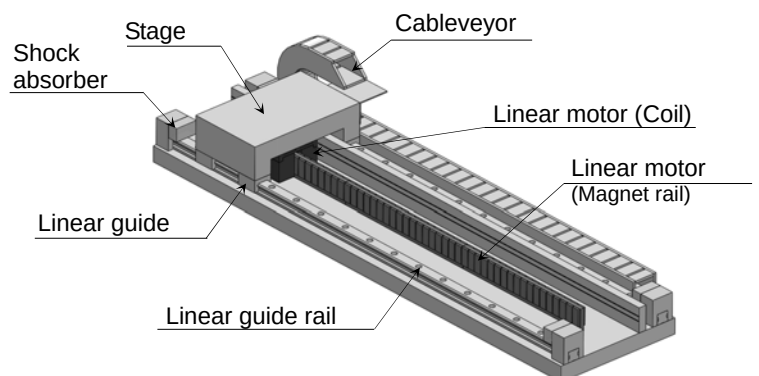
- Flat type with core
 - DS030□△○○
 - DS045□△△○◇
 - DS050□△○○
 - DS075□△○○
 - DS100□△○○
 - DS150□△○○



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



- Center magnet type with core
 - DT030□△○○



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Specifications

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

2.1 Linear motor	2-1
2.1.1 Common specifications.....	2-1
2.1.2 Exterior dimensions/ specifications/ mass.....	2-1
2.1.3 Mechanical specifications	2-1
2.1.4 Moving direction of linear motor (DD/DS/DT series)	2-2
2.2 Linear encoder	2-4
2.2.1 Applicable linear encoder.....	2-4
2.3 Servo amplifier	2-5
2.3.1 Common specifications.....	2-5
2.3.2 Input command, position signal output, general input/output	2-6
2.3.3 Force limit input	2-7
2.4 Power supply, calorific value	2-8
2.4.1 Main circuit power supply capacity, control power supply capacity	2-8
2.4.2 Inrush current, leakage current.....	2-9
2.4.3 Calorific value	2-10
2.5 Operation pattern	2-11
2.5.1 Time of acceleration and deceleration, permitted repetition, loading precaution	2-11
2.6 Position signal output	2-14
2.6.1 Position signal output by serial signal.....	2-14
2.6.2 Binary code output format and transfer period	2-15
2.6.3 Position signal output by pulse signal.....	2-16
2.7 Specifications for analog monitor	2-17
2.7.1 Monitor output.....	2-17
2.7.2 Monitor for velocity, force, and position deviation.....	2-18
2.8 Specifications for dynamic brake	2-19
2.8.1 Allowable frequency, instantaneous tolerance, coasting distance of the dynamic brake	2-19
2.9 Regeneration process	2-21
2.9.1 Minimum values of Built-in/ external regenerative resistor.....	2-21
2.9.2 Allowable regenerative power.....	2-21

2. Specifications

2.1 Linear motor

2.1.1 Common specifications

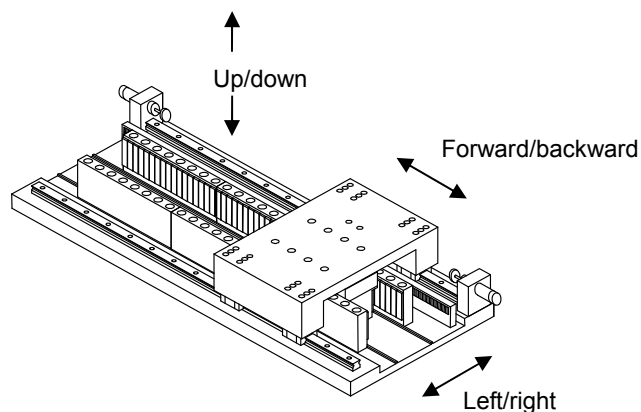
Series name	DS, DD, DT
Time rating	Continuous
Insulation classification	Class F
Voltage/Dielectric strength	AC1500V 1 minute
Insulation resistance	DC500V, greater than 10MΩ
Protection method	Self cooling type or Water cooling type (IP00)
Ambient temperature	0 to +40°C
Storage temperature	-20 to +65°C
Ambient humidity	20 to 90% (without condensation)
Excitation method	Permanent magnet type
Elevation	Below 1000m

2.1.2 Exterior dimensions/ specifications/ mass

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

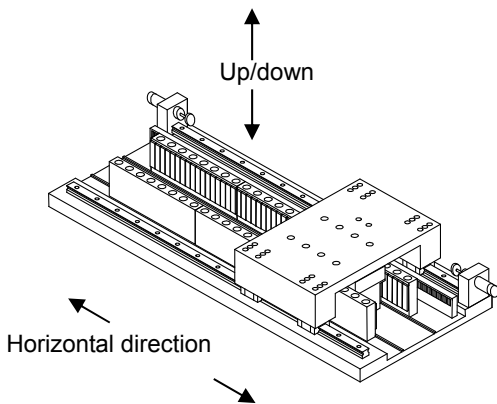
2.1.3 Mechanical specifications

- 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 .



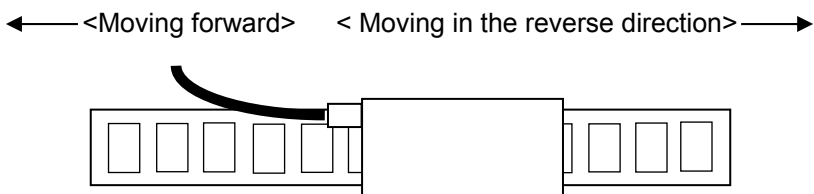
2.1 Linear motor

- 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.

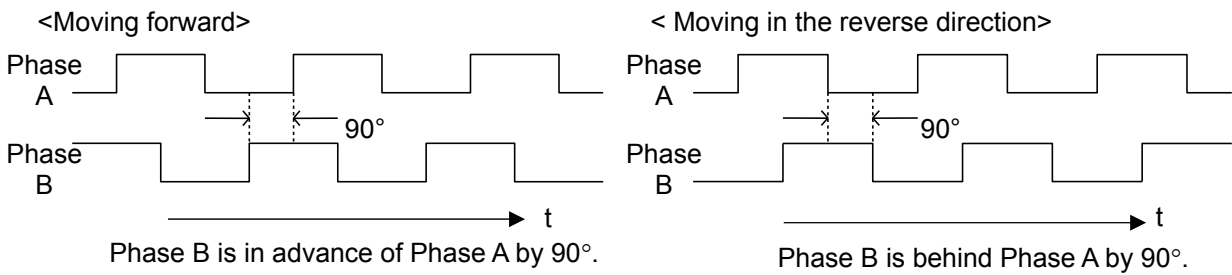


2.1.4 Moving direction of linear motor (DD/DS/DT series)

- 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.

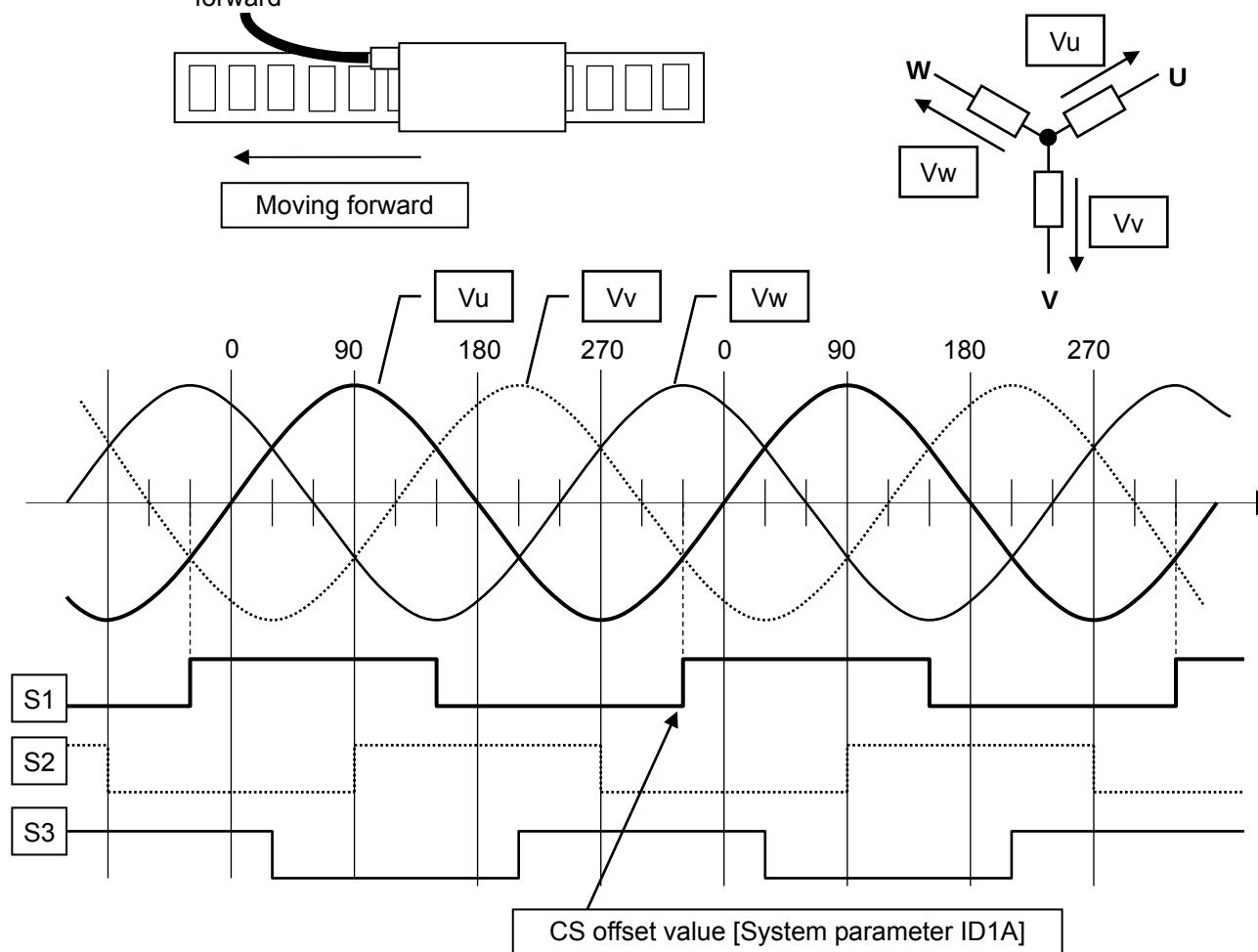


- Linear encoder signal phase



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
	DD030C3Y4	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

2.2 Linear encoder

2.2.1 Applicable linear encoder

The products below are applicable as combination linear encoder.

■ Pulse 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.

■ Serial 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.

2. Specifications

2.3 Servo amplifier

2.3.1 Common specifications

■ General specifications

General specifications

Control function	Position control/ Velocity control/ Force control/ (Parameter changeover)									
Control system	IGBT: PWM control Sinusoidal drive									
Main Circuit Power Note 1)	Three-phase: AC200 to 240V+10,-15% , 50/60Hz±3Hz Single-pharse: AC200 to 240V+10,-15% , 50/60Hz±3Hz Note 2)									
Control power Note 1)	Single-pharse: AC200 to 240V+10,-15% , 50/60Hz±3Hz									
Environment	Ambient temperature			0 to 55℃						
	Storage temperature			-20 to +65℃						
	Operation/ Storage humidity			Below 90%RH (no condensation)						
	Elevation			Below 1000m						
	Vibration			4.9m/s ²						
	Shock			19.6m/s ²						
Structure		Built-in tray type power supply								
Servo amplifier model number		RS3A01L##A# RS3A01L##L#	RS3A02L##A# RS3A02L##L#	RS3A03L##A# RS3A03L##L#	RS3A05L##A# RS3A05L##L#	RS3A07L##A# RS3A07L##L#	RS3A10L##A# RS3A10L##L#	RS3A15L##A# RS3A15L##L#	RS3A30L##L#	
External dimensions (H×W×D)		160×40×130	160×40×130	160×50×130	160×85×130	160×95×190	205(235) ×100×220	205(235) ×120×220	205(235) ×220×220	
Weight (kg)	Without internal regenerative resistor	0.68	0.70	0.80	1.5	2.3	4.0	4.7	9.8	
	With internal regenerative resistor	0.73	0.75	0.85	1.55	2.5	4.2	4.9	None	

Note 1) Power source voltage should be within the specified range

AC200V Power input type: Specified power supply range = AC170V to AC264V

Note 2) AC200V-single-phase input type corresponds only to RS3A01/RS3A02/RS3A03/RS3A05.

■ Performance

Speed control range	1: 5000 Note 3)
Frequency characteristics	2200Hz Note 4)
Allowable load mass	10 times linear motor mover mass Note 5)

Note 3) Internal speed command

Note 4) In case of high-velocity sampling mode

Note 5) When the value exceeds the above allowable load mass, please contact us.

■ Built-in functions

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

2.3 Servo amplifier

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

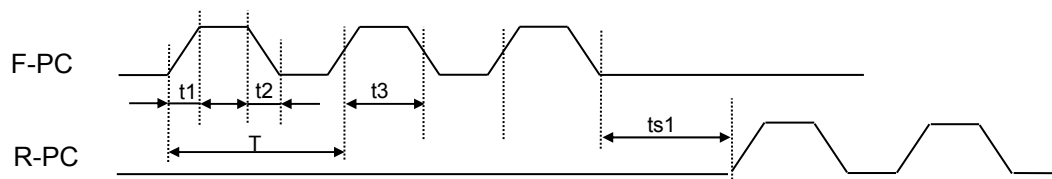
■ Input command

◆ Position command

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

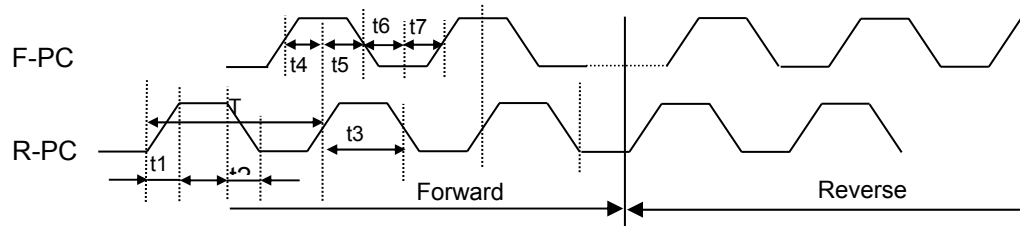
● Position command timing

Positive move pulse train + Negative move pulse train



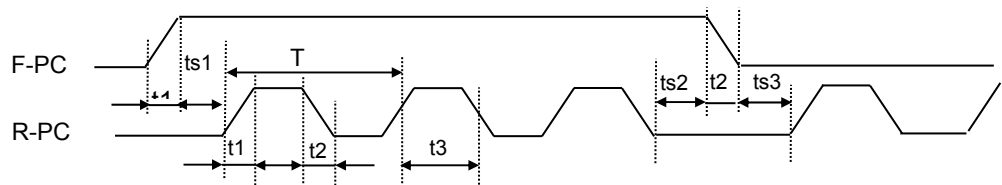
Stage up time (t1): $\leq 0.1\mu\text{s}$	Stage down time (t2): $\leq 0.1\mu\text{s}$
Duty[(t3/T)x100]: 50%	Change of pulse time: $ts1 > 2\mu\text{s}$

Pulse trains with 90° phase difference



Stage up time (t1): $\leq 0.1\mu\text{s}$	Stage down time (t2): $\leq 0.1\mu\text{s}$
Duty[(t3/T)x100]: 50%	
Minimum phase difference between pulse edges (t4, t5, t6, t7): $>250\text{nsec}$	

Code + Pulse train



Stage up time (t1): $\leq 0.1\mu\text{s}$	Stage down time (t2): $\leq 0.1\mu\text{s}$
Duty[(t3/T)x100]: 50%	Change of pulse time: $ts1, ts2, ts3 > 2\mu\text{s}$

◆ Speed command

Speed command	Voltage command	DC $\pm 2.0\text{V}$ at 1000mm/s command, Positive move by Plus command, Maximum input voltage $\pm 10\text{V}$
	Input impedance	Approximately $10\text{k}\Omega$

2. Specifications

◆ Force command

Force command	Voltage command	DC $\pm$ 2.0V at rated force (100%), Positive move by Plus command, Maximum input voltage $\pm$ 10k Ω
	Input impedance	Approximately 10k Ω

■ Position signal output

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

■ General input

Sequence input	Interactive photo coupler (sink, source connection): $\times$ 8 input
	Input power voltage range: DC5V $\pm$ 5% / DC12 V to DC 24V $\pm$ 10%, 100mA or over (DC24V)
	Servo ON, Alarm reset, Force limit, Encoder clear, Positive move prohibit, Negative move prohibit, Command prohibit, Command prohibit, External trip, Forced discharge, Emergency stop, Gain switching, Internal velocity setting, etc. Refer to "Group9 Condition settings for enabling function (5-100)" for details.

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

Sequence output	Open collector output: $\times$ 8 outputs
	Power supply for general output circuit (CN1-49,OUT-PWR): DC5V $\pm$ 5% / DC12V to DC24V $\pm$ 10%, 20mA or over
	Specification of Power supply for general output circuit ·DC5V $\pm$ 5% , Maximum current value 10mA (per 1 output) ·DC12V to DC15V $\pm$ 10% , Maximum current value 30mA (per 1 output) ·DC24V $\pm$ 10% , Maximum current value 50mA (per 1 output)
	Servo ready, Power ON, Servo ON, Holding brake timing, Force limiting, Low speed, Velocity attainment, Matching speed, Zero speed, Command acceptable, Status of gain switch, Velocity loop proportional control status, Control mode switchover status, Forward OT, Reverse OT, Reverse OT, Warning, Alarm code (3bits), etc. Refer to "GroupA Settings for Generic Output Outputting Condition/Monitor Output selection/ Serial Communications (5-111)" for details.

2.3.3 Force limit input

Force limit input	DC $\pm$ 2.0V $\pm$ 15% (at rated force (100%)) Input impedance: approximately 10k Ω

2.4 Power supply calorific value

2.4 Power supply, calorific value

2.4.1 Main circuit power supply capacity, control power supply capacity

■ AC200V Input

Input Voltage	Servo amplifier capacity	Servo motor model number	Rated output (W)	Main circuit power supply capacity (kVA)	Control power supply capacity (VA)
AC200V	RS3A03#	DS030C1N2	640	1.4	40
		DS050C1N2	620	1.4	
		DS075C1N2	640	1.5	
		DS045CC1AN	470	1.4	
		DT030CD1AN	670	1.4	
	RS3A05#	DS030C2N2	1280	2.7	
		DS050C2N2	1250	2.7	
		DS075C2N2	1280	3.0	
		DS100C1N2	1510	3.2	
		DS150C1N2	1440	3.2	
		DD030C1Y4	950	2.7	
	RS3A07#	DS030C3N2	1920	3.5	
		DS050C3N2	1870	3.5	
		DS075C3N2	1920	3.8	
		DD030C2Y4	1890	4.5	
		DD050C1Y2	1750	4.4	
		DD075C1Y2	2100	4.8	
		DD045CB4AN	1520	3.2	
		DD035CC2AN	1200	3.0	
		DS030C3N2	1920	3.5	
	RS3A10#	DS050C3N2	1870	3.5	
		DS075C3N2	1920	3.8	
		DS100C2N2	3020	5.5	
		DS150C2N2	2880	5.5	
		DD030C2Y4	1890	4.5	
		DD030C3Y4	2840	6.8	
		DD050C1Y2	1750	4.4	
		DD075C1Y2	2100	4.8	
		DD045CB4AN	1520	3.2	
		DS100C3N2	4540	8.2	
	RS3A15#	DS150C3N2	4320	8.2	
		DD050C2Y2	3500	8.8	
		DD075C2Y2	4200	9.5	
		DD050C3Y2	5250	12.2	
	RS3A30#	DD075C3Y2	6200	13.2	
		DD075C4Y2	8300	17.5	

* # = Optional alphabetical letter

* Values are of rated velocity, force ratings.

2. Specifications

2.4.2 Inrush current, leakage current

■ Inrush current

Input Voltage	Servo amplifier capacity	Control power (Maximum value between 1ms after input)	Main circuit power (Maximum value between 1.2 seconds after input)
AC200V	RS3A01#	40A(0-P)	22A(0-P)
	RS3A02#		
	RS3A03#		
	RS3A05#		
	RS3A07#		17A(0-P)
	RS3A10#		
	RS3A15#		
	RS3A30#		

* # = Optional alphabetical letter

* Inrush current values above are at the condition of ordinary temperatures, 120VAC or 240VAC input.

* Using thermistor for inrush prevention circuit of control power supply. Inrush current which exceed value above might flow if power-cycled frequently in short time or ambient temperature is higher.

■ Leakage current

Servo amplifier capacity	Electric leakage current per motor
RS3A01#	0.8 mA
RS3A02#	0.8 mA
RS3A03#	0.8 mA
RS3A05#	1.5 mA
RS3A07#	3.0 mA
RS3A10#	3.0 mA
RS3A15#	3.0 mA
RS3A30#	3.0 mA

* # = Optional alphabetical letter

* Leakage current value above is measured by leak checker which has set 700 Hz filter.

* While using two (2) or more motors, leakage current from each motor should be added.

* These values are applicable when a tough rubber sheath cable of 2M is used as a power line. In the case of a shorter or longer cable length, values of the above table should be selected as closely as possible.

* The machine should be grounded so that dangerous voltage does not occur at the main part of the machine, such as the operation panel, etc., during a period of emergency leakage current.

* Please use an earth leakage circuit breaker which is allowing high harmonics because normal earth leakage circuit breaker or earth leakage protection relay might malfunction by flow of a high harmonics leakage current of ground floating capacitance of linear motor winding, power cable or servo amplifier.

2.4 Power supply calorific value

2.4.3 Calorific value

Input voltage	Servo amplifier capacity	Servo motor model number	Servo amplifier total calorific value (W)
AC200V	RS3A03#	DS030C1N2	41
		DS050C1N2	41
		DS075C1N2	42
		DS045CC1AN	41
		DT030CD1AN	41
	RS3A05#	DS030C2N2	68
		DS050C2N2	68
		DS075C2N2	69
		DS100C1N2	70
		DS150C1N2	70
	RS3A07#	DD030C1Y4	65
		DS030C3N2	91
		DS050C3N2	91
		DS075C3N2	93
		DD030C2Y4	110
		DD050C1Y2	110
		DD075C1Y2	110
		DD045CB4AN	75
	RS3A10#	DD035CC2AN	70
		DS030C3N2	91
		DS050C3N2	91
		DS075C3N2	93
		DS100C2N2	135
		DS150C2N2	135
		DD030C2Y4	110
		DD030C3Y4	138
		DD050C1Y2	110
		DD075C1Y2	110
	RS3A15#	DD045CB4AN	75
		DS100C3N2	185
		DS150C3N2	185
		DD050C2Y2	210
	RS3A30#	DD075C2Y2	210
		DD050C3Y2	270
		DD075C3Y2	275
		DD075C4Y2	380

* # = Optional alphabetical letter

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

2. Specifications

2.5 Operation pattern

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

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

■ Acceleration time: $t_a = (M_C + M_L) \cdot \{(V_2 - V_1) / (0.8 \times F_P - F_L)\}$ [s]

■ Deceleration time: $t_b = (M_C + M_L) \cdot \{(V_2 - V_1) / (0.8 \times F_P + F_L)\}$ [s]

- ◆ t_a : Acceleration time [s]
- ◆ t_b : Deceleration time [s]
- ◆ M_C : Linear motor mover mass [kg]
- ◆ M_L : Load mass [kg]
- ◆ V_1, V_2 : Linear motor velocity [m/s]
- ◆ F_P : Maximum force [N]
- ◆ F_L : Load force [N]

* This formula is in condition of ignoring a friction force and a gravity for mover, and within a rated velocity range.

■ Notes on load

There are separate limitations on repetitive operations for both the linear 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 mass, accel/decel current value and motor velocity of the motor in use. If the load mass = linear motor mover mass x m-times, and when the permitted Start/Stop repetitions (up to the maximum rotation speed) exceed the following value, please contact us for assistance, as precise calculation of effective torque and regenerating power is critical.

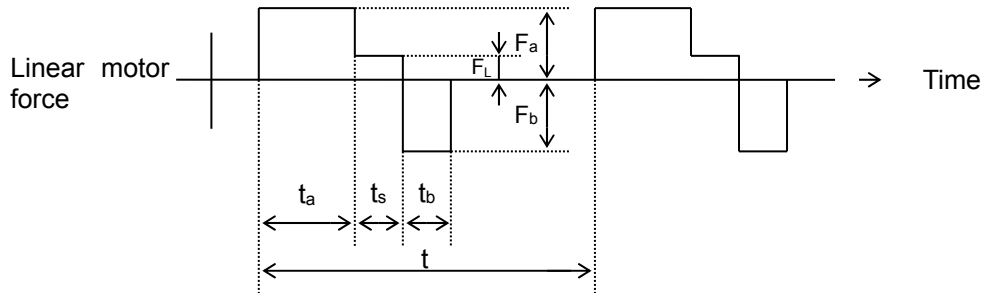
$$\text{Frequency of repetitions} = \frac{20}{m+1} \text{ times / min}$$

■ Frequency of permitted repetitions for the linear motor.

Permitted Start/Stop repetitions differ according to the linear motor usage conditions, such as load condition and operating time.

2.5 Operation pattern

- When the linear 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 force is less than the rated force F_R .



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

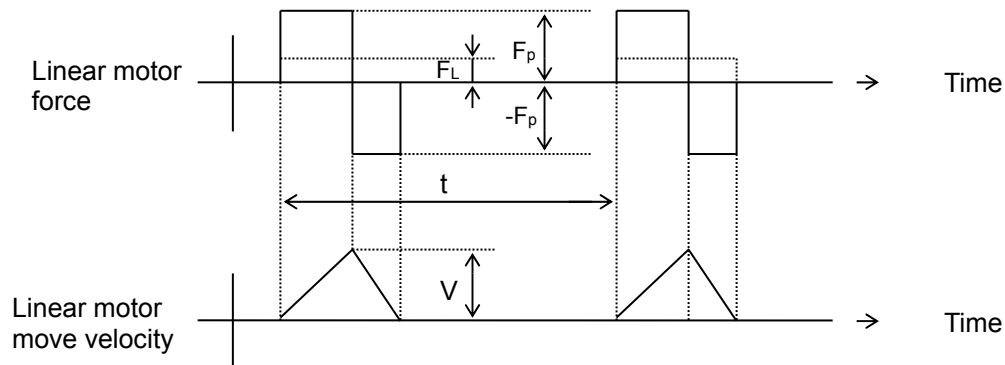
$$t \geq \frac{F_a^2 t_a + F_L^2 t_s + F_b^2 t_b}{F_R^2} \quad [\text{s}]$$

F_a : Acceleration force [N]
 F_b : Deceleration force [N]
 F_L : Load force [N]
 F_{rms} : Effective force [N]
 F_R : Rated force [N]
 t_s : constant speed time [s]

- ◆ When the cycle time (t) is predetermined F_a , F_b , t_a , and t_b 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 $F_{rms} < 0.8F_R$.

- 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:

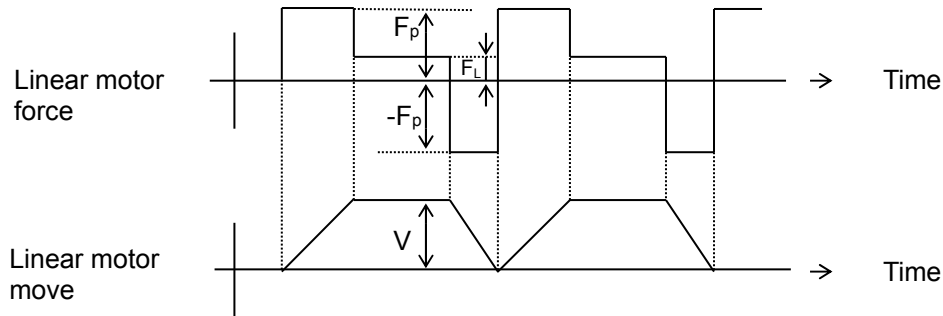


$$n = 30 \times \frac{1}{V(M_C + M_L)} \times \frac{F_P^2 - F_L^2}{F_P^3} \times F_R^2 \quad [\text{times/ min}]$$

F_P : Peak force [N]
 F_R : Rated force [N]
 V : Linear motor velocity [m/s]
 M_C : Linear motor mover mass [kg]
 M_L : Load mass [kg]

2. Specifications

- 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:



$$n = 30 \times \frac{1}{V(M_C + M_L)} \times \frac{F_R^2 - F_L^2}{F_P} \quad [\text{times/ min}]$$

- Negative load
Servo amplifier cannot perform continuous operation with a negative load.
Please contact us when using the amplifier with a negative load.

Example

- Motor drive downward (when there is no counter weight).

- Load mass (M_L)
When the servo amplifier is used with a load mass exceeding the allowable load mass, "Over voltage" or "regeneration overload" may be issued at the time of the operation.
In such a case, the following processes are required. Please contact us for the details.

- ◆ Reduce the force limit
- ◆ Extend the acceleration and deceleration times (slow down)
- ◆ Reduce the maximum velocity
- ◆ Re-examine regenerative resistor

2.6 Position signal output

2.6 Position signal output

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

2.6.1 Position signal output by serial signal

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

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

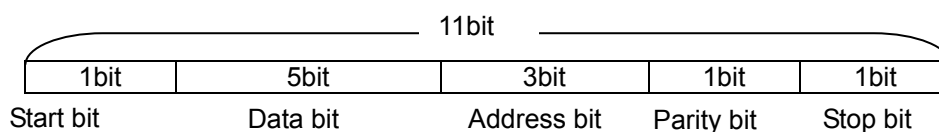
- * "Encoder signal output (PS)" outputs from "CN1-9,10pin".
- * "Forward moving direction" means that a linear motor moves to the direction where power line lead is pulling out. Absolute value will change to minimum value (zero) when exceeding maximum value.
- * Incremental encoder outputs "Actual position monitor value" through binary code.

2. Specifications

2.6.2 Binary code output format and transfer period

■ Format

◆ Data format

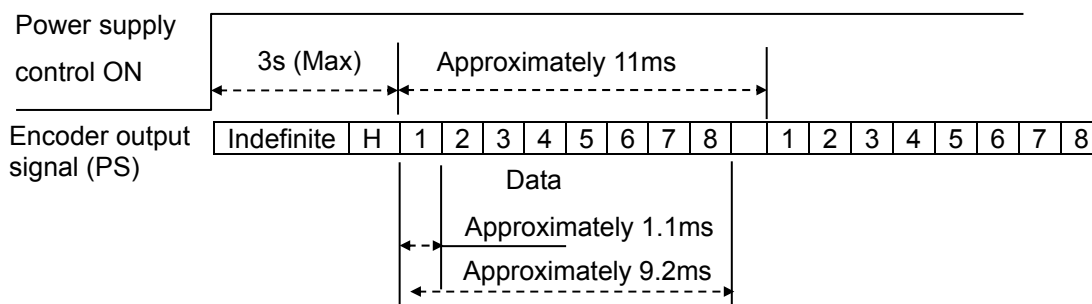


◆ Transfer format

Data number	Start bit	Data bit					Address bit			Parity bit	Stop bit
· Data 1	0	D0	D1	D2	D3	D4	0	0	0	0/1	1
		(LSB)									
· Data 2	0	D5	D6	D7	D8	D9	1	0	0	0/1	1
· Data 3	0	D10	D11	D12	D13	D14	0	1	0	0/1	1
· Data 4	0	D15	D16	D17	D18	D19	1	1	0	0/1	1
· Data 5	0	0/D20	0/D21	0/D22	0/D23	0/D24	0	0	1	0/1	1
· Data 6	0	0/D25	0/D26	0/D27	0/D28	0/D29	1	0	1	0/1	1
· Data 7	0	0/D30	0/D31	0/D32	0/D33	0/D34	0	1	1	0/1	1
		(MSB)									
· Data 8	0	0/D35	0/D36	0/D37	0/D38	0/D39	1	1	1	0/1	1

* Effective bit length differs depending on the encoder resolution.

■ Transfer period



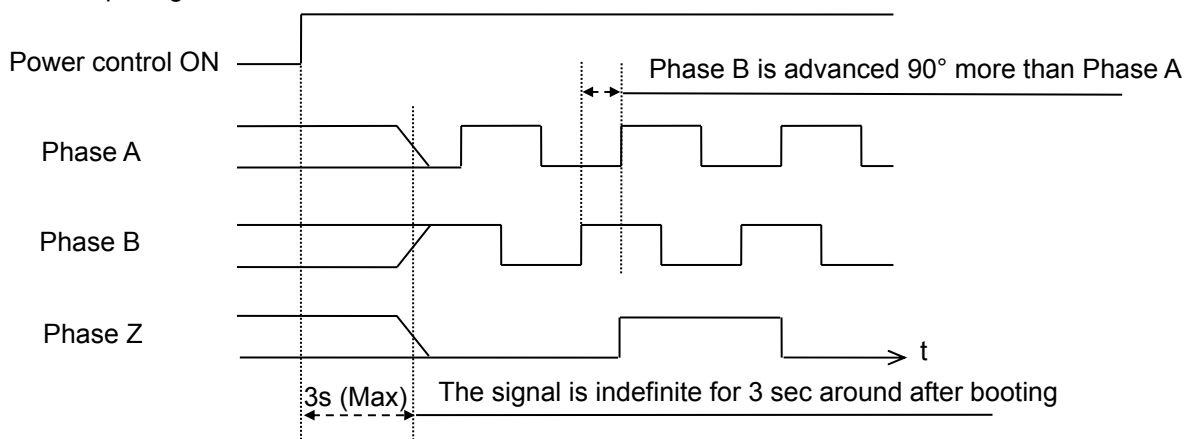
* The signal is indefinite for about 3 seconds after booting power and communication may not always begin from the first frame, even after 3 sec.

2.6 Position signal output

2.6.3 Position signal output by pulse signal

- Servo amplifier outputs "90 degree phase shift two-phase pulse (phase A, B) and origin pulse (phase Z)". Pulse output can change the division ratio by parameter.
Set the general parameter "GroupC ID04 Encoder Output Pulse Division [ENRAT]".
- * Output signal "phase A output (A0/ $\overline{A0}$)" outputs from "CN1-3 pin, 4 pin."
- * Output signal "phase B output (B0/ $\overline{B0}$)" outputs from "CN1-5 pin, 6 pin."
- * Output signal "phase Z output (Z0/ $\overline{Z0}$)" outputs from "CN1-7 pin, 8 pin." Also output from CN1-11 pin with open-collector.

■ Output signal at forward move



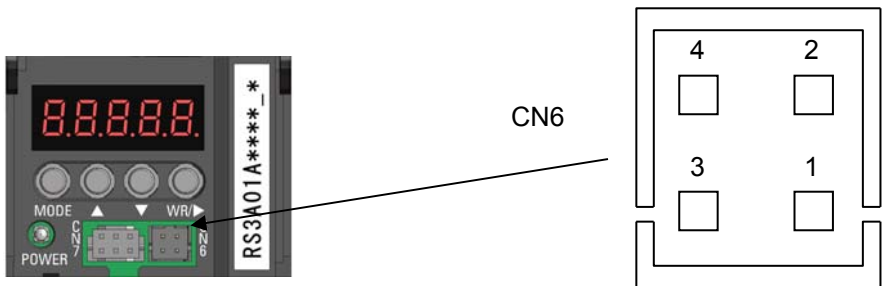
- * Absolute encoder "positions signal output" delays about 224 μ s.
- * For absolute encoder, phase Z is output by 131072 x 0.5 μ m period based on absolute position zero.
- * When other than 1/1 is set as division ratio, Phase A and Phase B are divided but Phase Z is output with original pulse width. In this case, the phase relation between phase Z and phase A/B pulse is not decided.

2. Specifications

2.7 Specifications for analog monitor

2.7.1 Monitor output

- Pin number and signal name of the monitor output



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

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

2.7 Specifications for analog monitor

2.7.2 Monitor for velocity, force, and position deviation

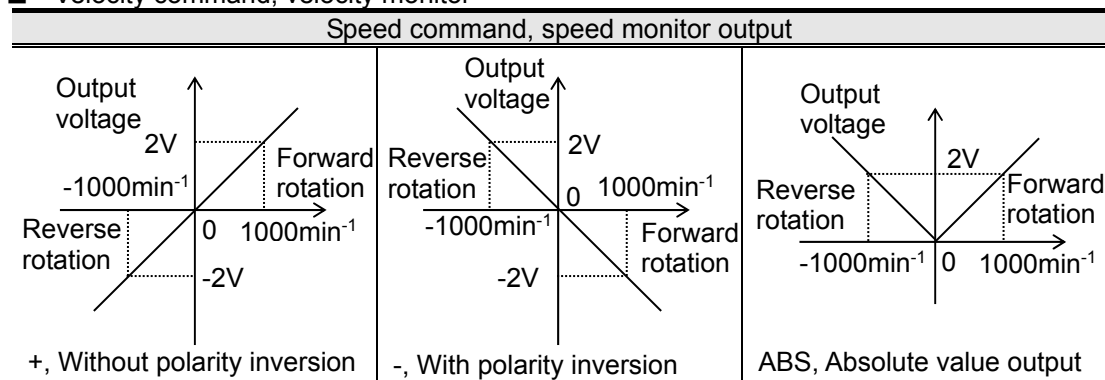
■ Electrical specifications

- ◆ Output voltage range: DC $\pm$ 8V
- ◆ Output resistance: 1k Ω
- ◆ Load: less than 2mA

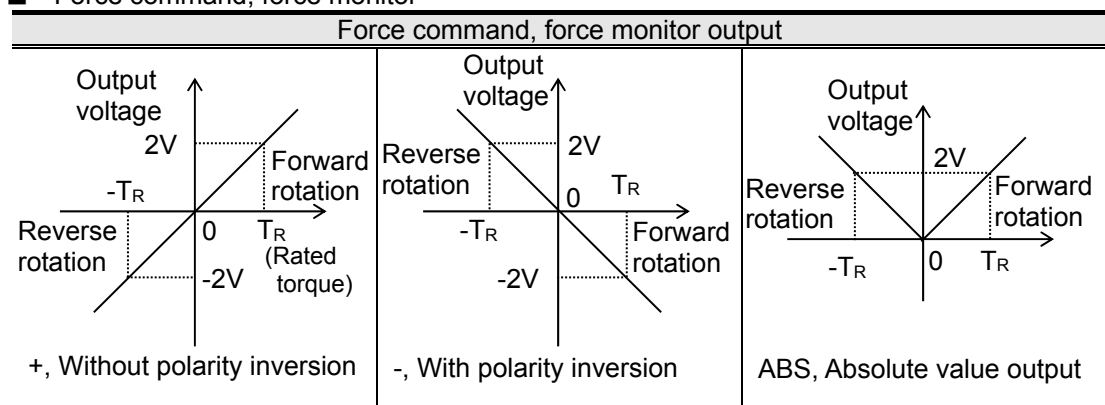
* Monitor output is indefinite at the time of power ON/OFF and may output DC12V $\pm$ around 10%.

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

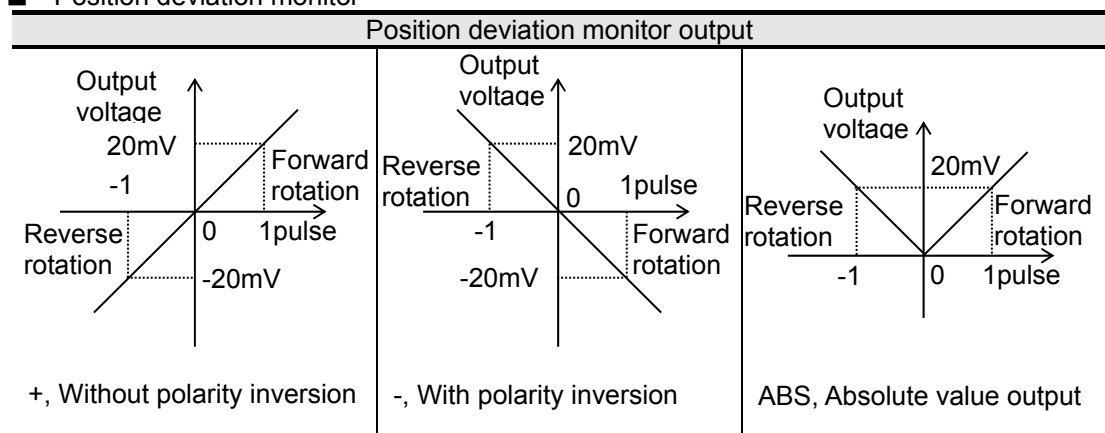
■ Velocity command, velocity monitor



■ Force command, force monitor



■ Position deviation monitor



2. Specifications

2.8 Specifications for dynamic brake

2.8.1 Allowable frequency, instantaneous tolerance, coasting distance 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 mass.
- Operation intervals
In basic terms, operation of the dynamic brake in six (6) minute intervals is acceptable. If the brake is to be operated more frequently, the move speed must be reduced sufficiently. Refer to the following expression to find a standard of operation:

6 minutes

(Rated speed/maximum speed in use)²

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

- Instantaneous tolerance of dynamic brake

Servo amplifier model number	E _{RD} (J)
RS3A02L##A# / RS3A02L##L#	218
RS3A03L##A# / RS3A03L##L#	
RS3A05L##A# / RS3A05L##L#	912
RS3A07L##A# / RS3A07L##L#	2000
RS3A10L##A# / RS3A10L##L#	2450
RS3A15L##A# / RS3A15L##L#	
RS3A30L##L#	9384

* # = Optional number or alphabetical letter.

* RS3A01L does not have dynamic brake resistor. Shorting between motor phases as dynamic brake.

- ◆ The consumption of energy E_{RD} by dynamic brake resistance in one dynamic brake operation is as follows:
Must keep the value smaller than the value in the table above.

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

R ϕ : 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]

2.8 Specifications for dynamic brake

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

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

V: Linear motor velocity [m/s]

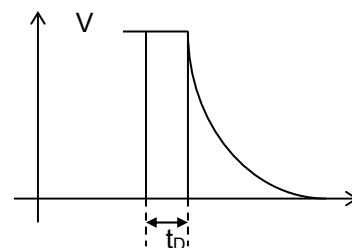
t_D : 10×10^{-3} [s]

M: Movable part [kg]

Movable part $M = M_C + M_L$

(M_C : Mover mass [kg], M_L : Load mass [kg])

$\alpha \cdot \beta$: See below.



Specifications

Servo amplifier capacity	Linear 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
	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

2.9 Regeneration process

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

2.9.1 Minimum values of Built-in/ external regenerative resistor

Servo amplifier model	Built-in regenerative resistor	External regenerative resistor
RS3A01L##A#/RS3A01L##L#	50Ω	35Ω
RS3A02L##A#/RS3A02L##L#	50Ω	35Ω
RS3A03L##A#/RS3A03L##L#	50Ω	35Ω
RS3A05L##A#/RS3A05L##L#	17Ω	17Ω
RS3A07L##A#/RS3A07L##L#	10Ω	10Ω
RS3A10L##A#/RS3A10L##L#	10Ω	10Ω
RS3A15L##A#/RS3A15L##L#	6Ω	6Ω
RS3A30L##L#	without built-in regenerative resistor	2.5Ω

* “#” is optional number or alphabetical letter.

2.9.2 Allowable regenerative power

Servo amplifier model	Built-in regenerative resistor use [PRI]	External regenerative resistor use [PR0]
RS3A01L##A#/RS3A01L##L#	5W	125W
RS3A02L##A#/RS3A02L##L#	5W	125W
RS3A03L##A#/RS3A03L##L#	5W	125W
RS3A05L##A#/RS3A05L##L#	20W	250W
RS3A07L##A#/RS3A07L##L#	60W	500W
RS3A10L##A#/RS3A10L##L#	90W	500W
RS3A15L##A#/RS3A15L##L#	120W	500W
RS3A30L##L#	---	500W

* “#” is optional number or alphabetical letter.

Installation

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

3.1 Servo amplifier	3-1
3.1.1 Precautions	3-1
3.1.2 Unpacking	3-2
3.1.3 Mounting direction and location	3-3
3.1.4 Arrangement within the cabinet	3-3
3.2 Linear motor	3-4
3.2.1 Precautions on linear motor installation	3-4
3.2.2 Unpacking	3-7
3.2.3 Installation of flat-type linear motor with core	3-8
3.2.4 Installation of twin-type linear motor with core	3-12
3.2.5 Installation of center magnet type linear motor with core	3-17
3.2.6 Installation of cylinder-type motor	3-20
3.2.7 Cable installation and its considerations	3-21

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.

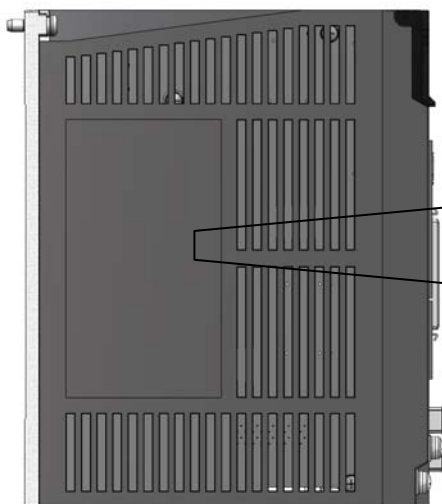
3.1 Servo amplifier

3.1.2 Unpacking

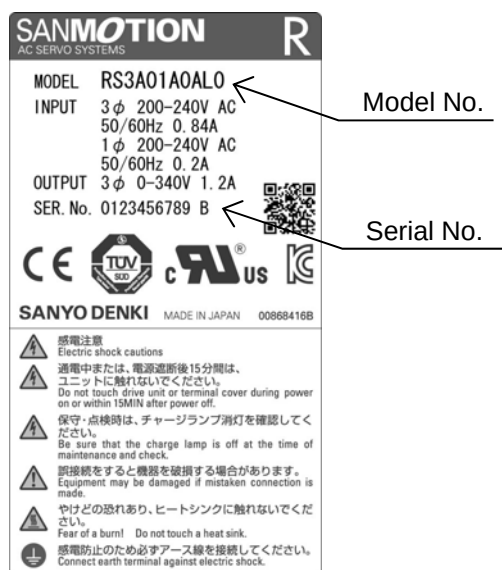
Verify the followings when the product arrives. If you find any discrepancy, contact your distributor or sales office.

- 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



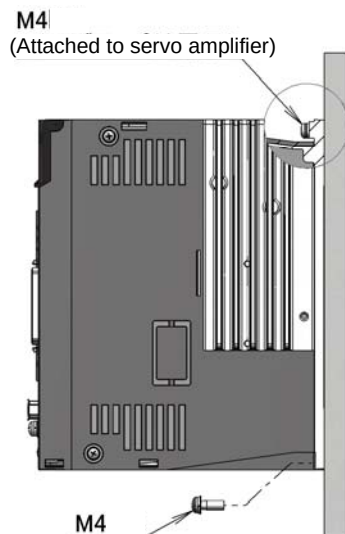
Interpretation of the serial number

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

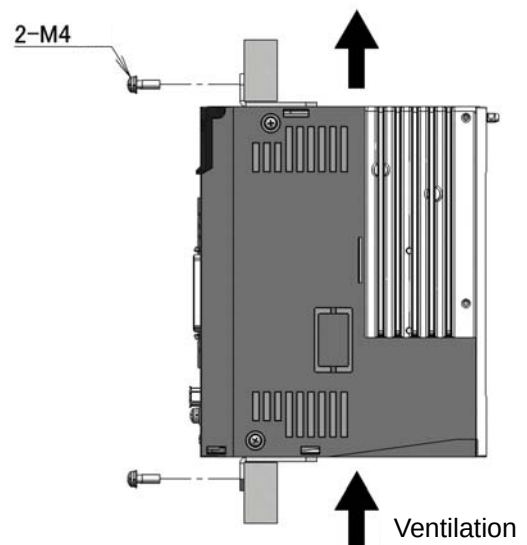
3. Installation

3.1.3 Mounting direction and location

Rear-mounting



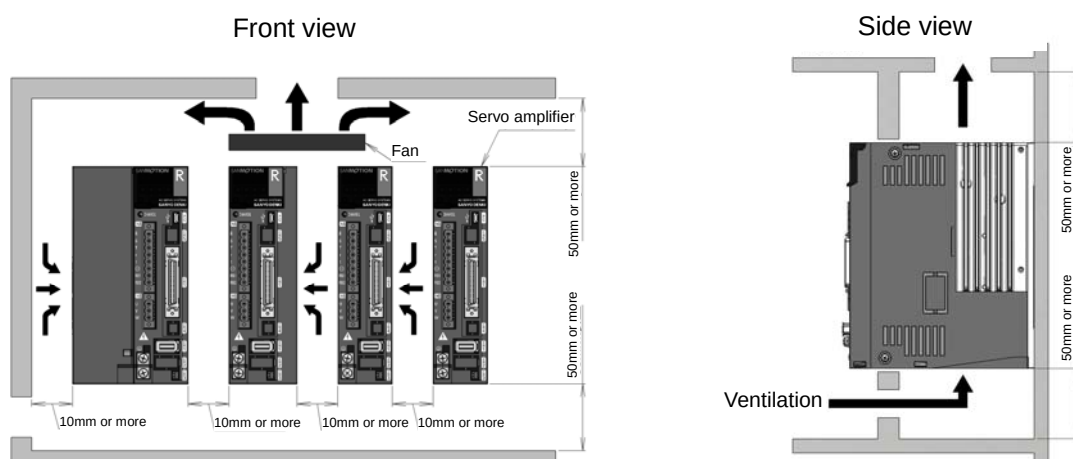
Front-mounting



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

3.1.4 Arrangement within the cabinet

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



* Arrangement above is order of RS3A05, RS3A03, RS3A02 and RS3A01 from left side.

3.2 Linear motor

3.2.1 Precautions on linear motor installation

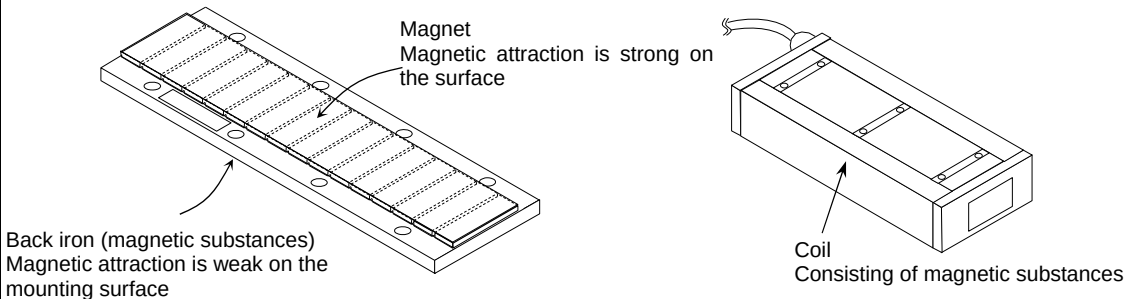
When installing, please be sure to protect the following precautions.

■ Prevention of impairment

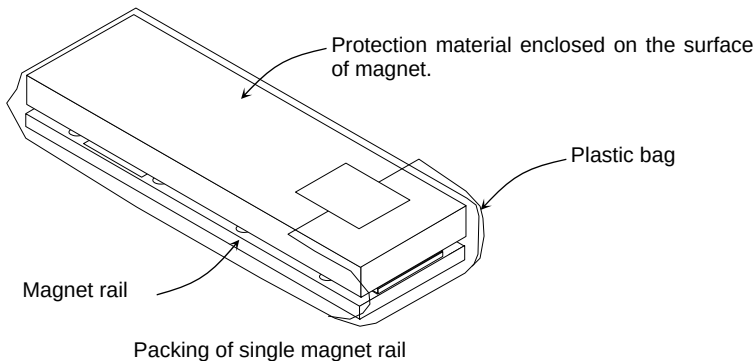
Strong magnet is mounted in magnet rail, so those who is wearing medical equipment, such as pacemakers, or being implanted magnetic metal into the body, make sure to keep 0.5m or over away from linear motor, and do not perform unpacking. Severe physical impairment can occur due to equipment failure or 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.

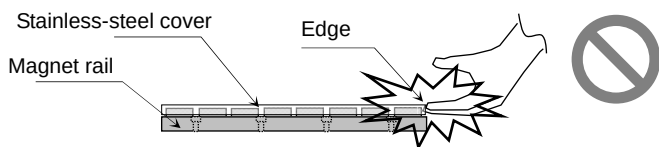


Magnet rail body is wrapped in plastic bag, and protection material (styrene foam) whose thickness is approximately 20mm is enclosed on the surface of magnet to reduce magnetic attraction. Do not remove the protection material until just before mounting process.



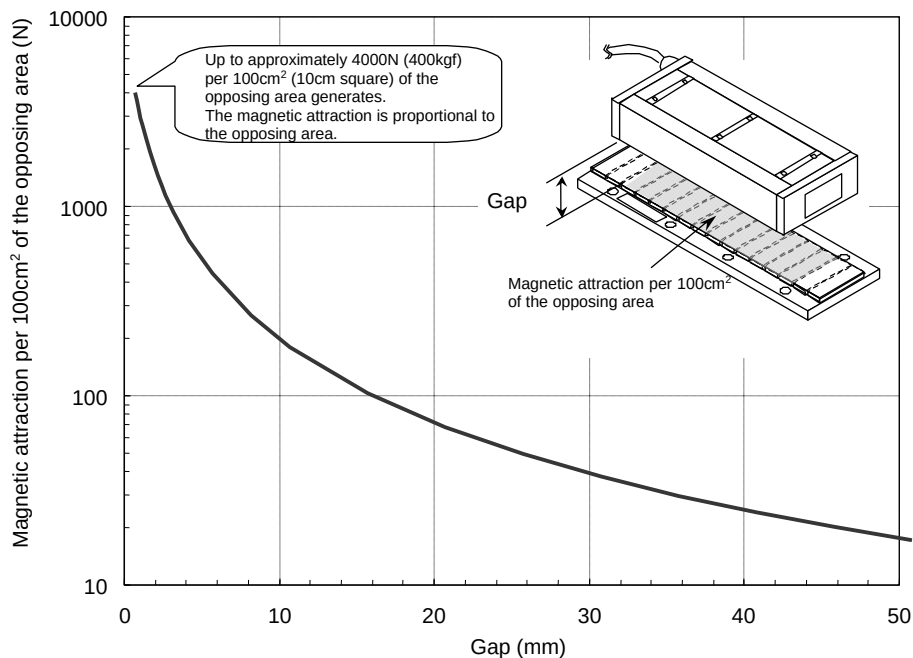
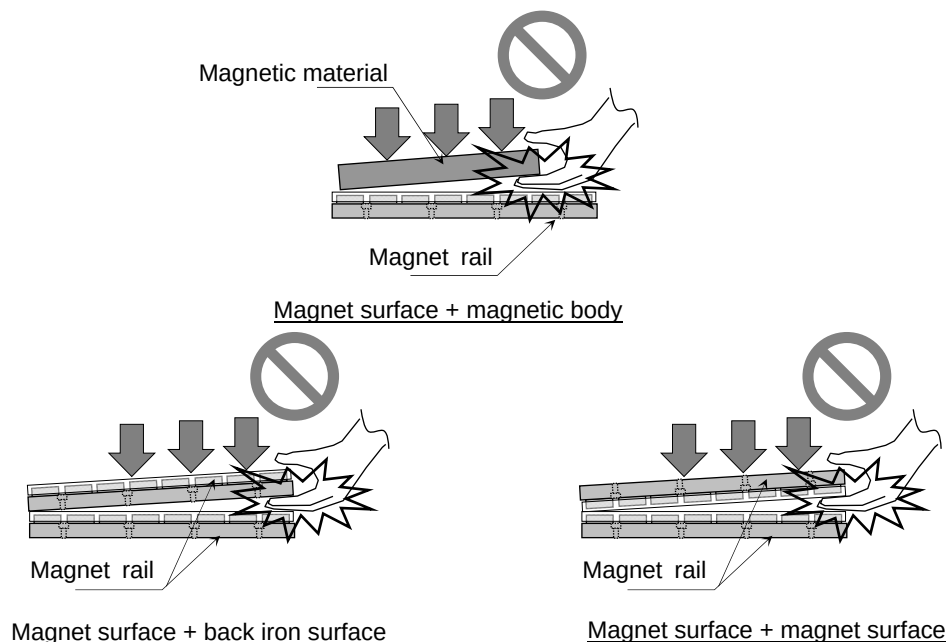
Operators shall not wear any rings, watches, or magnetic cards. Putting magnetic storage media, such as magnetic card or floppy disk, and PC close to magnet rail can result in damages to the data or equipment failures.

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.



3. Installation

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 100cm² (10cm square) of the opposing area generates.

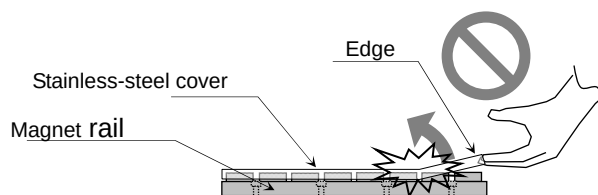


If you suspend unpacking, return the unpacked items to the original packing state. If you leave the magnet rail as it is, strong attraction generates between magnetic bodies, your hand may be gotten stuck in, and this can cause severe physical impairment.

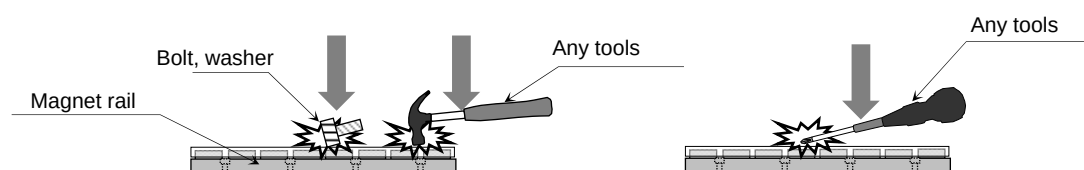
3.2 Linear motor

■ 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.

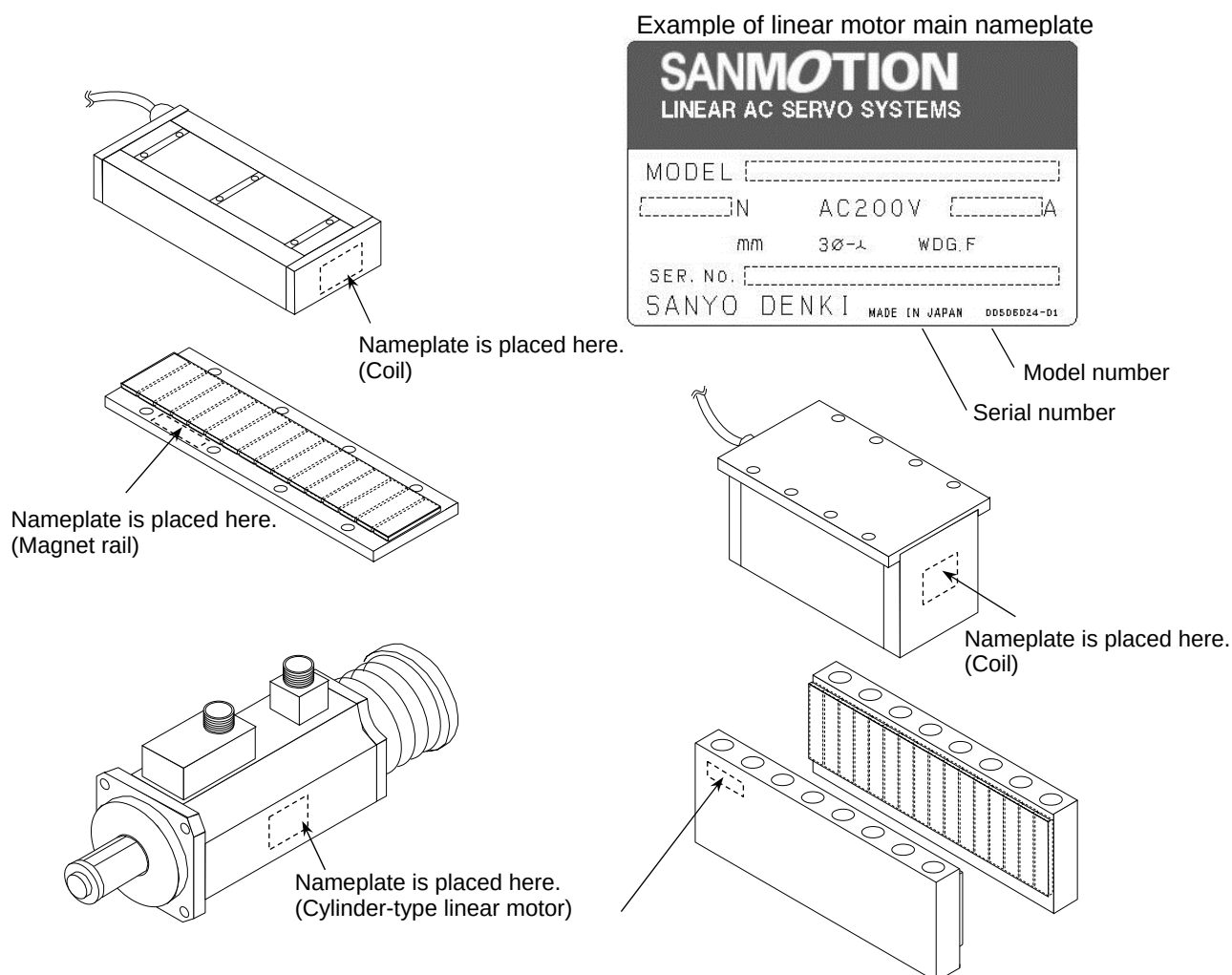


3. Installation

3.2.2 Unpacking

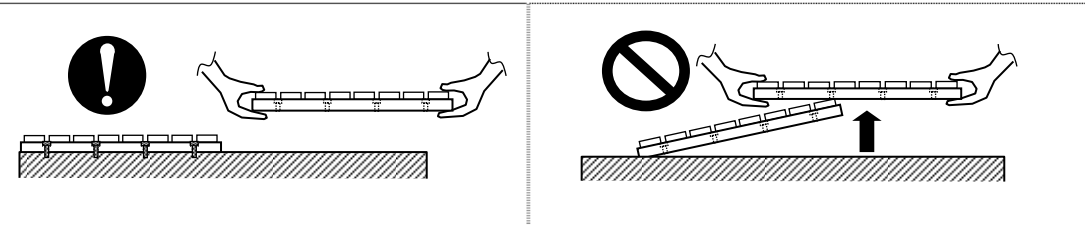
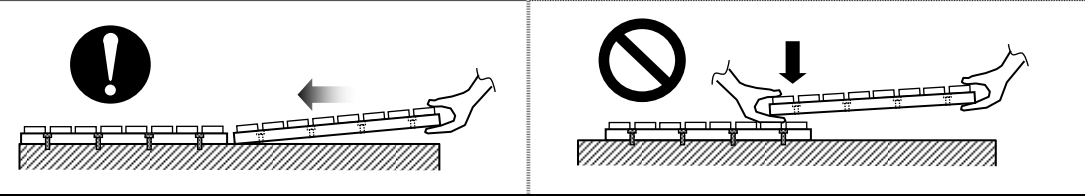
Verify the followings when the product arrives. If you find any discrepancy, contact your distributor or sales office.

- 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.



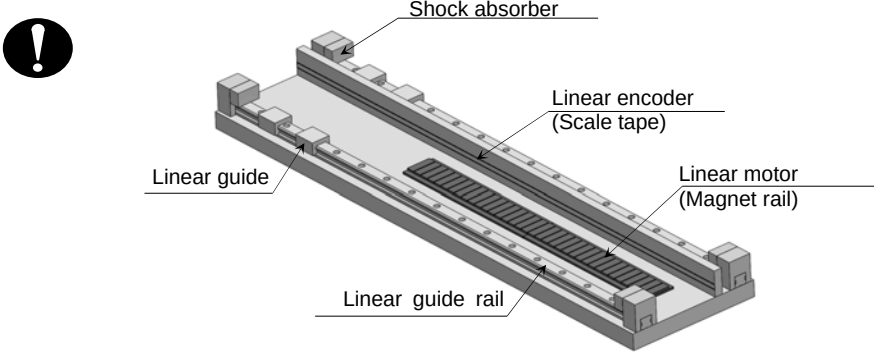
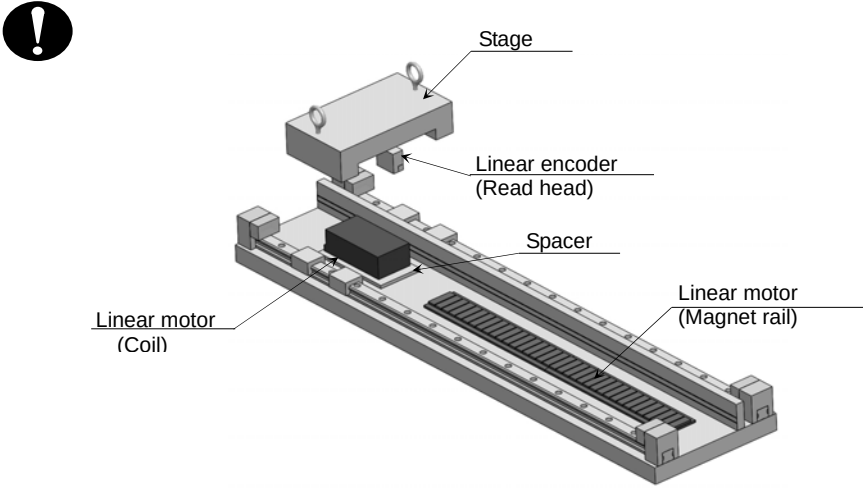
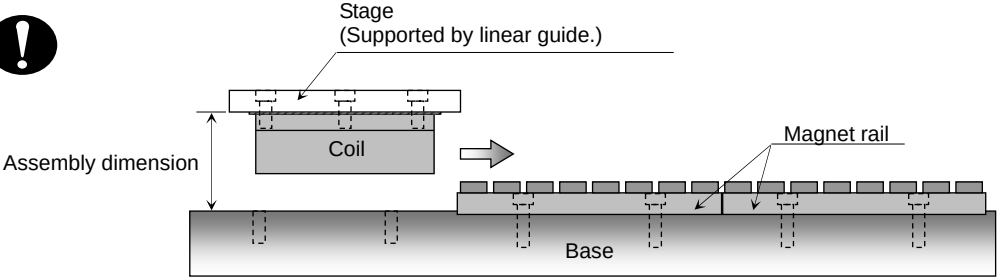
3.2.3 Installation of flat-type linear motor with core

■ Mounting magnet rail

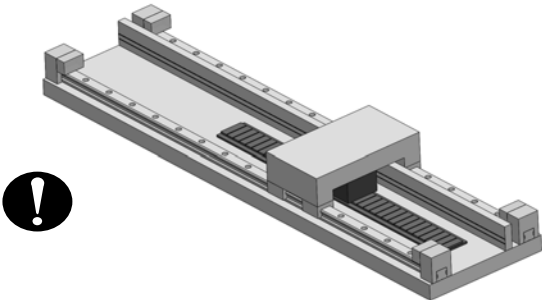
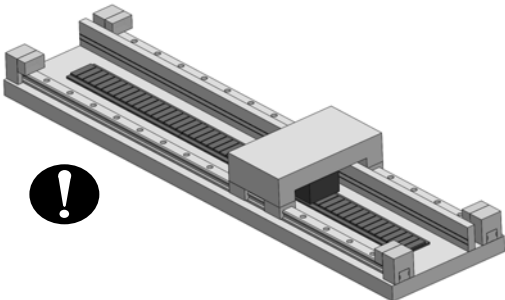
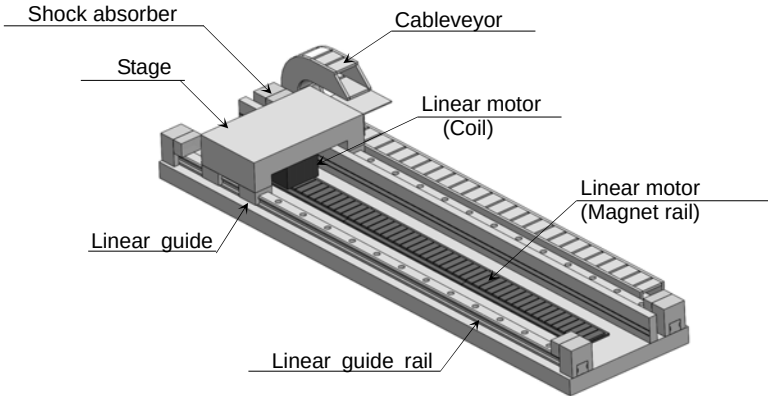
Step	Description
1	Strong magnet is mounted on the surface of magnet rail. Strong magnetic attraction works when putting magnetic substances such as motor coil, steel tools or other magnet rail closer to the magnet rail. Take great care not to get your hand stuck in.
2	Magnetic attraction works between 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. 

3. Installation

■ 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. 

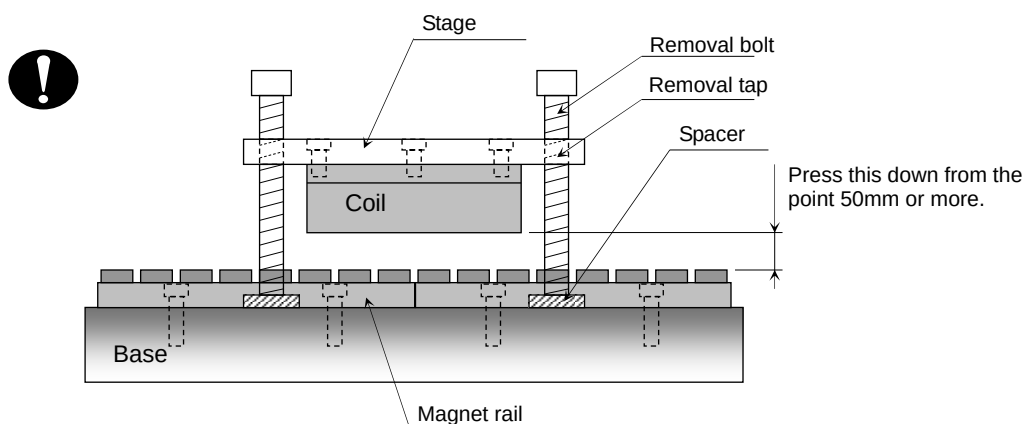
3.2 Linear motor

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 $\pm$ in cycle of approximately 16mm <table><tr><th>Series</th><th>Attraction</th></tr><tr><td>DS030C####</td><td>Approx. $\pm 60\text{N}$</td></tr><tr><td>DS045C####</td><td>Approx. $\pm 100\text{N}$</td></tr><tr><td>DS050C####</td><td>Approx. $\pm 100\text{N}$</td></tr><tr><td>DS075C####</td><td>Approx. $\pm 150\text{N}$</td></tr><tr><td>DS100C####</td><td>Approx. $\pm 200\text{N}$</td></tr><tr><td>DS150C####</td><td>Approx. $\pm 300\text{N}$</td></tr></table>	Series	Attraction	DS030C####	Approx. $\pm 60\text{N}$	DS045C####	Approx. $\pm 100\text{N}$	DS050C####	Approx. $\pm 100\text{N}$	DS075C####	Approx. $\pm 150\text{N}$	DS100C####	Approx. $\pm 200\text{N}$	DS150C####	Approx. $\pm 300\text{N}$
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DS030C####	Approx. $\pm 60\text{N}$														
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DS075C####	Approx. $\pm 150\text{N}$														
DS100C####	Approx. $\pm 200\text{N}$														
DS150C####	Approx. $\pm 300\text{N}$														
5	Mount the last half of the magnet rail. 														
6	The installation is completed when motor mounting completed. Perform wirings. 														

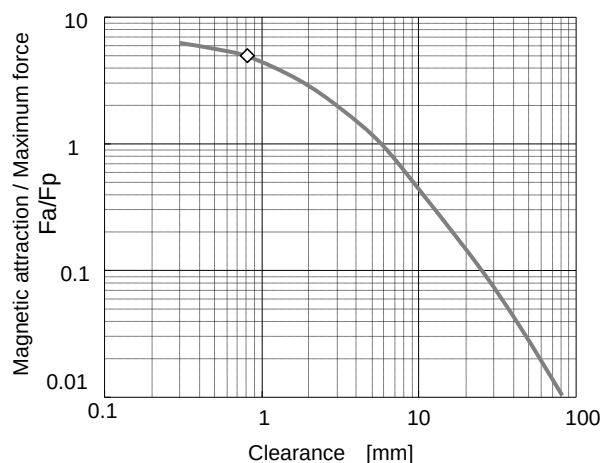
3. Installation

- 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.



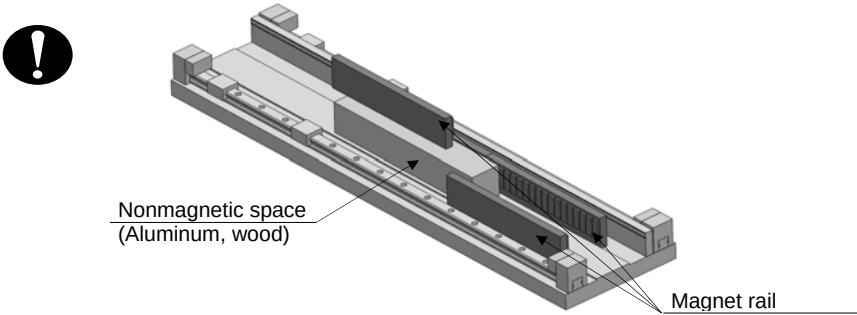
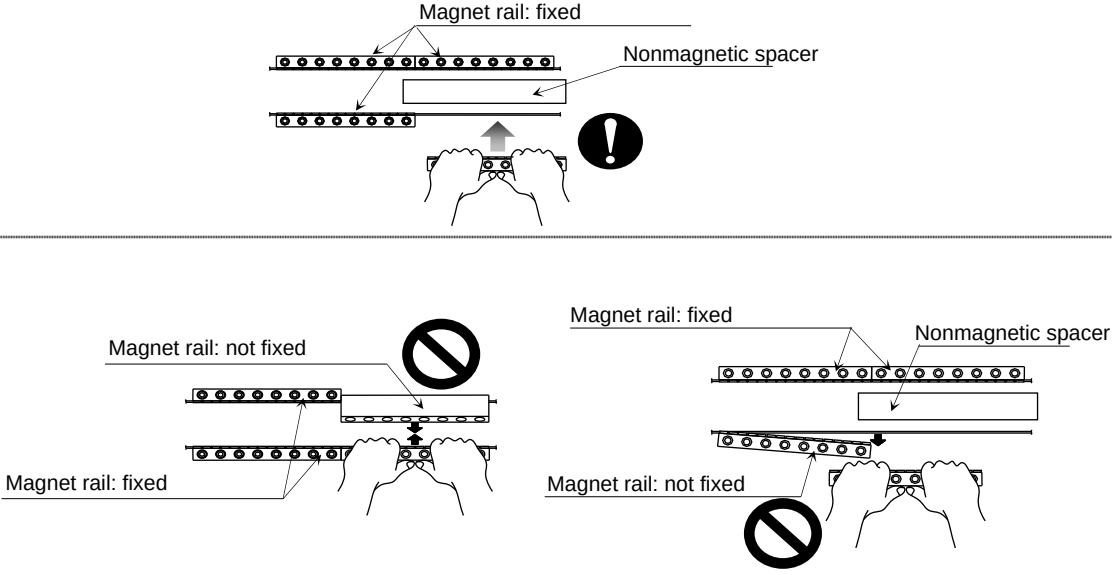
Magnetic attraction vs Clearance characteristic



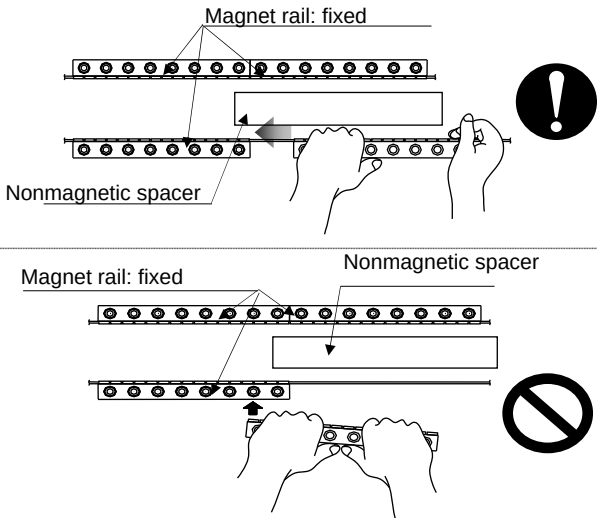
Keep clearance 50mm or more between coil and magnet rail while installing, for the safety.

3.2.4 Installation of twin-type linear motor with core

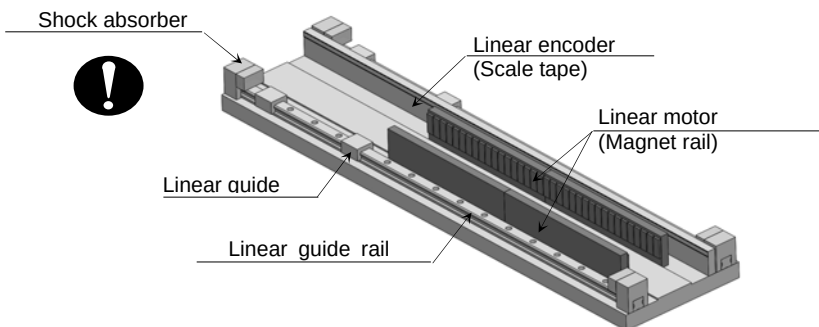
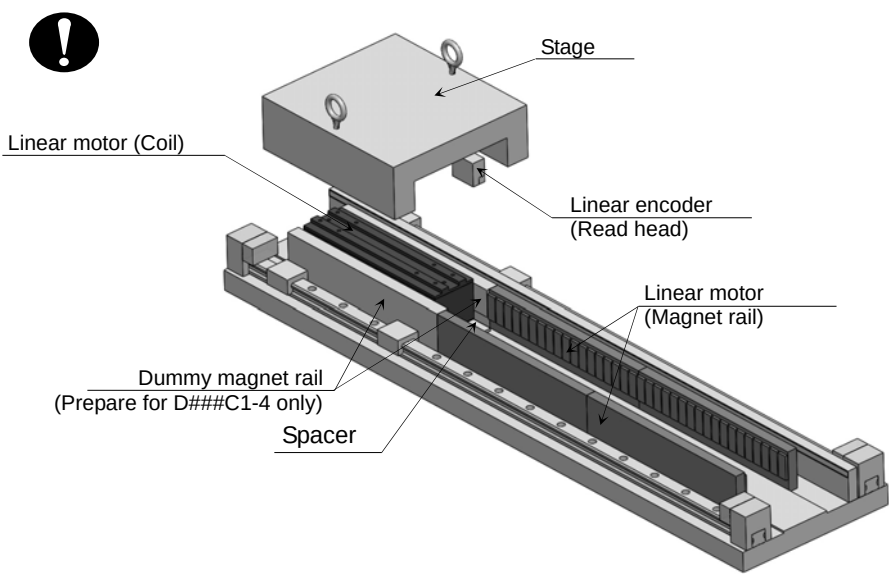
■ Mounting magnet rail and the precautions

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. 

3. Installation

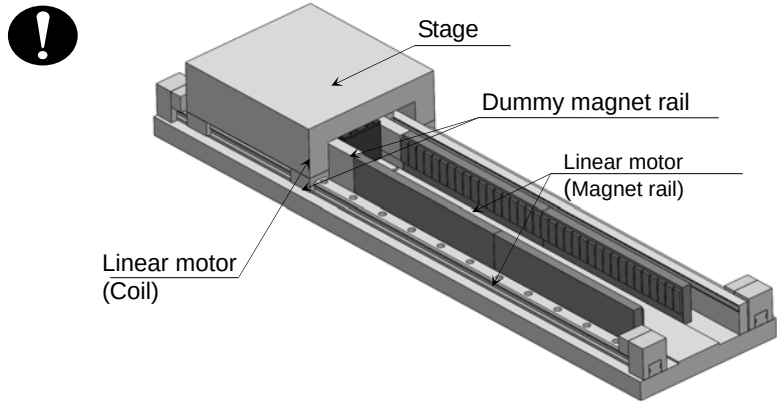
7	Place magnet rails from the end in order. When mounting a magnet rail next to the already fixed magnet rail, put the magnet rail from the stroke direction not from the orthogonal (facing magnet surface). Magnetic attraction can generate, and this can cause injuries and damages. 

■ 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.) 

3.2 Linear motor

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.



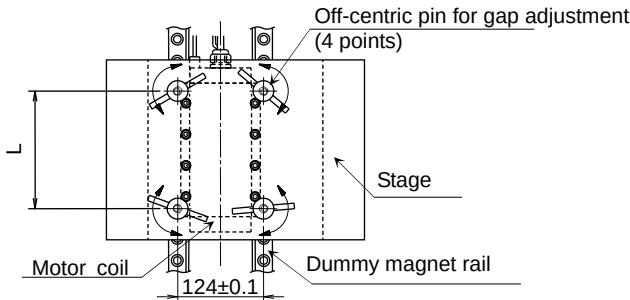
[Adjusting gap]

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)

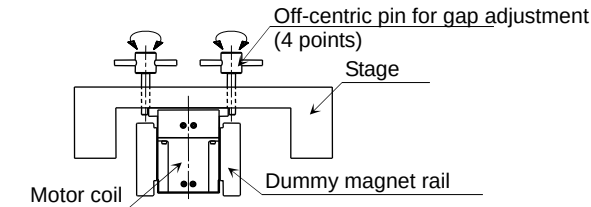
3

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. Installation

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

When using bolts, gap adjustment shall be performed from the side of stage.

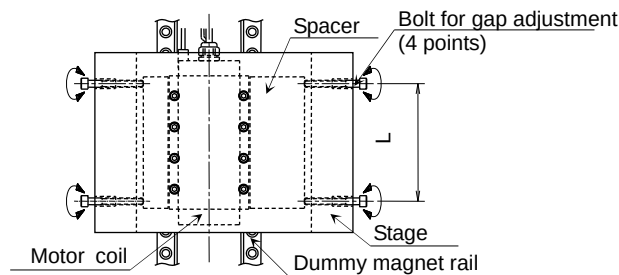
Place 4 taps for gap adjusting bolt on the side of stage.

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.

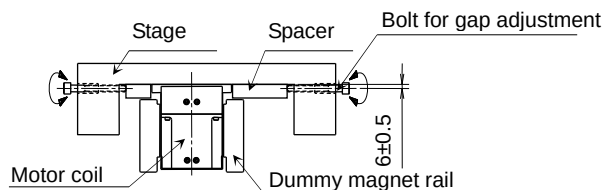
For bolt tap position, refer to the recommended values indicated in the figure below. M8 or M10 is recommended for tap diameter.

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

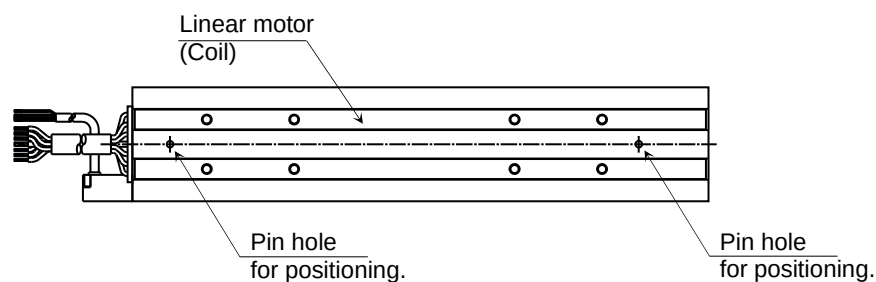
3



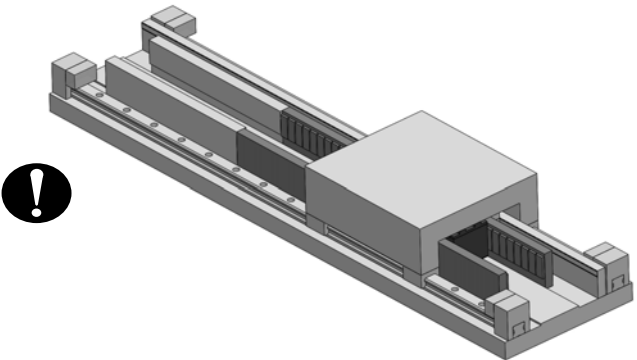
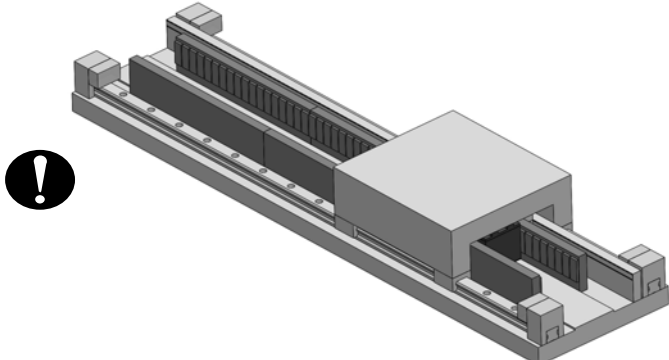
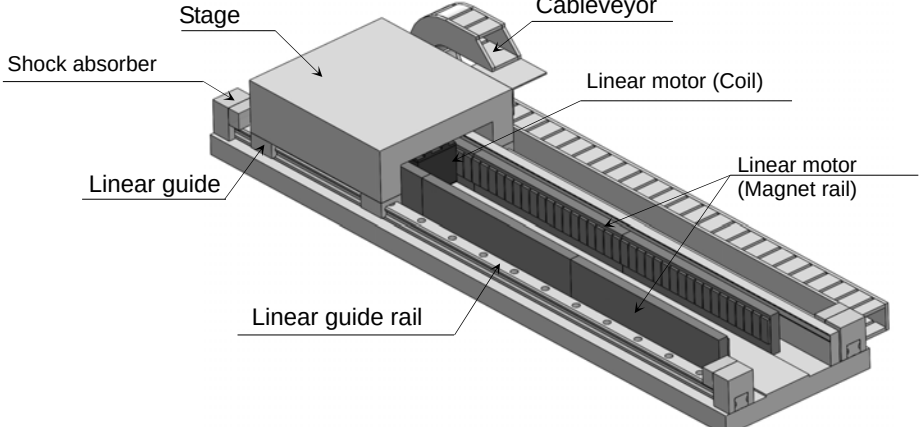
By using positioning pin (DD###CB, DD###CC)

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.



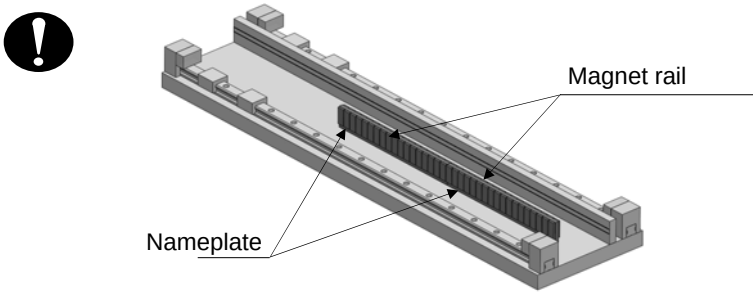
3.2 Linear motor

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 $\pm$ in cycle of approximately 16mm <table><tr><th>Series</th><th>Attraction</th></tr><tr><td>DD030C####</td><td>Approx. $\pm$ 120N</td></tr><tr><td>DD035C####</td><td>Approx. $\pm$ 160N</td></tr><tr><td>DD045C####</td><td>Approx. $\pm$ 200N</td></tr><tr><td>DD050C####</td><td>Approx. $\pm$ 200N</td></tr><tr><td>DD075C####</td><td>Approx. $\pm$ 300N</td></tr></table>	Series	Attraction	DD030C####	Approx. $\pm$ 120N	DD035C####	Approx. $\pm$ 160N	DD045C####	Approx. $\pm$ 200N	DD050C####	Approx. $\pm$ 200N	DD075C####	Approx. $\pm$ 300N
Series	Attraction												
DD030C####	Approx. $\pm$ 120N												
DD035C####	Approx. $\pm$ 160N												
DD045C####	Approx. $\pm$ 200N												
DD050C####	Approx. $\pm$ 200N												
DD075C####	Approx. $\pm$ 300N												
5	Remove dummy magnet rail and mount the last half of the magnet rail. 												
6	Perform wirings after completing motor installation. 												

3. Installation

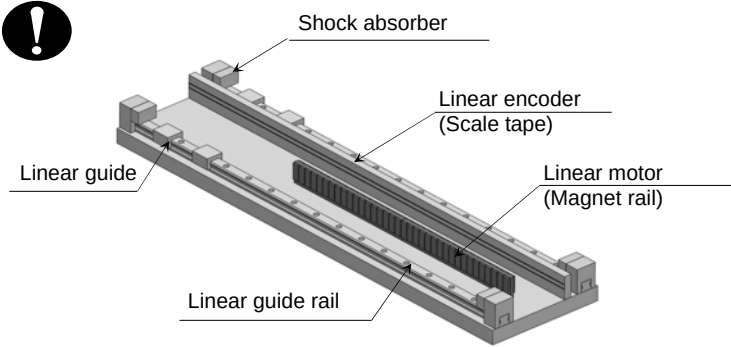
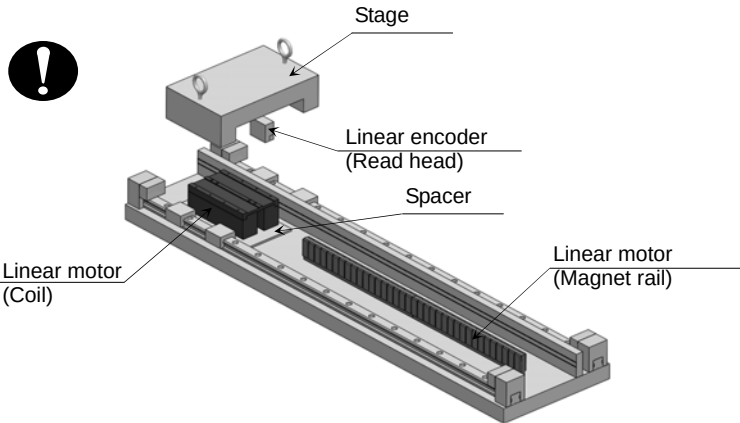
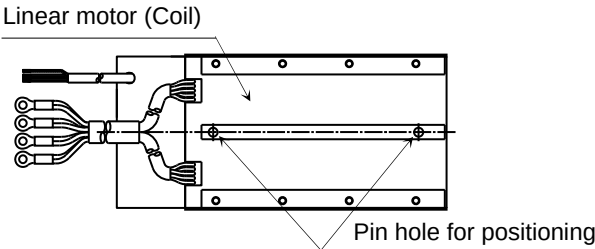
3.2.5 Installation of center magnet type linear motor with core

■ Mounting magnet rail, and caution

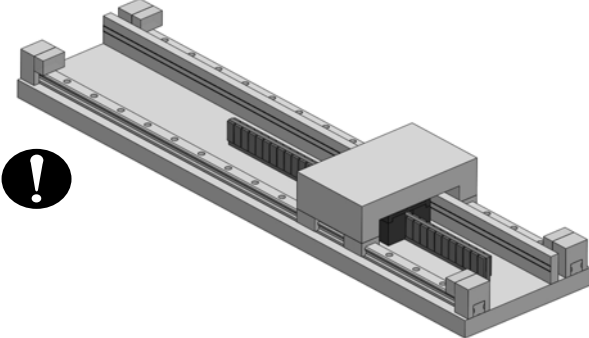
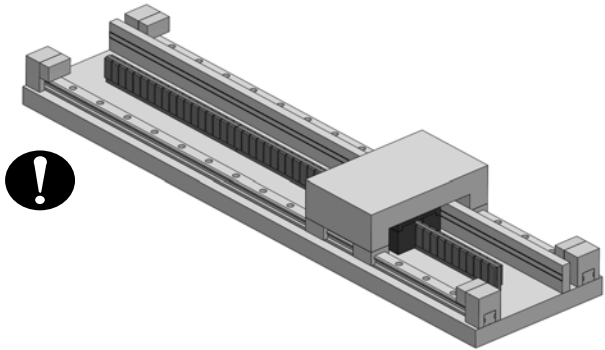
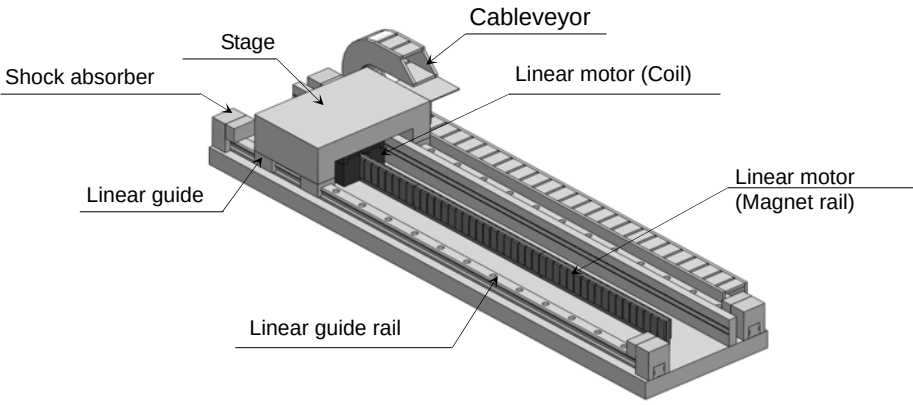
Step	Description
1	Strong magnet is mounted on the surface of magnet rail. Strong magnetic attraction works when putting magnetic substances such as motor coil, steel tools or other magnet rail closer to the magnet rail. Take great care not to get your hand stuck in.
2	Magnetic attraction works between 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.

3.2 Linear motor

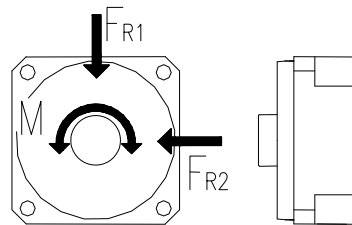
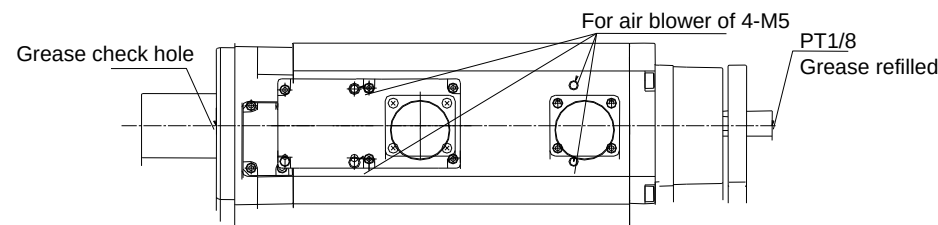
■ Mounting coil

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. 

3. Installation

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 $\pm$ in cycle of approximately 16mm <table border="1"> <thead> <tr> <th>Series</th><th>Attraction</th></tr> </thead> <tbody> <tr> <td>DT030CD###</td><td>Approx. $\pm 250\text{N}$</td></tr> </tbody> </table>	Series	Attraction	DT030CD###	Approx. $\pm 250\text{N}$
Series	Attraction				
DT030CD###	Approx. $\pm 250\text{N}$				
5	Mount the last half of the magnet rail. 				
6	The installation is completed when motor mounting completed. Perform wirings. 				

3.2.6 Installation of cylinder-type motor

Step	Description											
1	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>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> 	Maximum allowable moment load	Direction M	0.8	(N·m)	Maximum allowable radial load	Direction F_{R1}	70	(N)	Direction F_{R2}	70	(N)
Maximum allowable moment load	Direction M	0.8	(N·m)									
Maximum allowable radial load	Direction F_{R1}	70	(N)									
	Direction F_{R2}	70	(N)									
2	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.											
3	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. 											
4	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.											
5	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.											

3. Installation

3.2.7 Cable installation and its considerations

- Please be careful not to apply any stresses on or damages to cables.
- When it is anticipated to move the linear motor, allow enough flexion radius of the cable to avoid stress.
- Pass the cables through where cable outers are not damaged by cutting flakes or other sharp materials.
Avoid the areas with possibilities that cables contact with any corners of machines. Take care not to step on the cables or not to have any machine mounted on them.
- Clamp the cables to the machine to avoid stress and self-weight at the cable connecting point.
- Cables leading from the coil are not robot cables, so fix them firmly so as not to let them bend repeatedly. When cables are moved by cableveyor or others, prepare robot cables as extension cable. In that case, determine the flexion radius of cable by flexion lifetime and type of wire needed.
- It is recommended that the cables of mover should have a structure that enables periodic replacement.

Wiring

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

4.1 Wiring for the terminal of high voltage and grounding	4-1
4.1.1 Part name and function	4-1
4.1.2 Wire	4-1
4.1.3 Wire size - allowable current	4-2
4.1.4 Recommended wire size	4-2
4.1.5 Example of wiring	4-4
4.1.6 Crimping of wires.....	4-6
4.1.7 High voltage circuit terminal; tightening torque	4-6
4.2 Wiring with Host Unit	4-7
4.2.1 CN1 signal name and pin number (wiring with host unit).....	4-7
4.2.2 CN1 pin assignment	4-9
4.2.3 Signal name and its function	4-9
4.2.4 Terminal connection circuit.....	4-10
4.3 Wiring for linear encoder	4-21
4.3.1 EN1, EN2 signal names and its pin numbers.....	4-21
4.3.2 EN1, EN2 pin assignment	4-23
4.3.3 Recommended encoder cable specification	4-24
4.3.4 Encoder cable length.....	4-24
4.4 Peripheral equipments	4-25
4.4.1 Power supply capacity and peripherals list	4-25

4. Wiring

4.1 Wiring for the terminal of high voltage and grounding

4.1.1 Part name and function

Terminal name	Connector marking	Remarks	
Main circuit power supply	R·T or R·S·T	Single phase AC100 to 120V +10%, -15% 50/60Hz±3%	
		Single phase AC200 to 240V +10%, -15% 50/60Hz±3%	
		Three-phase AC200 to 240V +10%, -15% 50/60Hz±3%	
Control power supply	r·t	Single phase AC100 to 120V +10%, -15% 50/60Hz±3%	
		Single phase AC200 to 240V +10%, -15% 50/60Hz±3%	
Linear motor connector	U·V·W	Connected with linear motor	
Protective grounding terminal		Connected with grounding wire of power supply and of linear motor.	
Regeneration resistance connector	RB1·RB2 RB4	RS3A01 RS3A02 RS3A03 RS3A05 RS3A30	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.	

4.1.2 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 Wiring for the terminal of high voltage and grounding

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

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

4.1.4 Recommended wire size

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

- 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					2.0	14	2.0	14		
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			
	mm ²	AWG No		mm ²	AWG No	mm ²	AWG No	mm ²	AWG No	mm ²	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	8.0	8	RS3A15L	8.0	8			8.0	8	8.0	8
DD050C2Y2											
DD075C2Y2											
DD050C3Y2											
DD075C3Y2	14.0	6	RS3A30L	14.0	6			8.0	8	14.0	6
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			
	mm ²	AWG No		mm ²	AWG No	mm ²	AWG No	mm ²	AWG No	mm ²	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			
	mm ²	AWG No		mm ²	AWG No	mm ²	AWG No	mm ²	AWG No	mm ²	AWG No
DD035CC2AN	3.5	12	RS3A07L	3.5	12	1.25	16	3.5	12	3.5	12

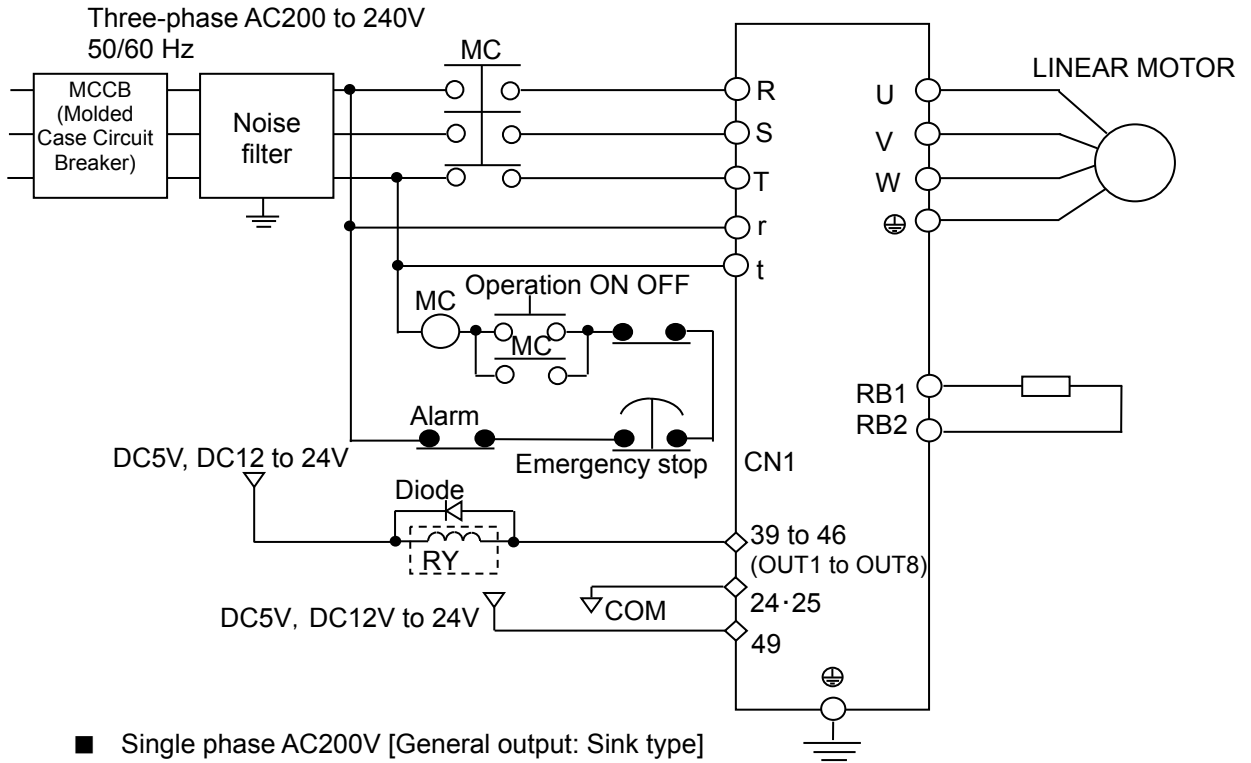
- * The information in this table is based on rated armature current flowing through three bundled lead wires at ambient temperature of 40°C.
- * When wires are bundled or put into a wire-duct, take the allowable current reduction ratio into account.
- * At high ambient temperature, service life of the 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

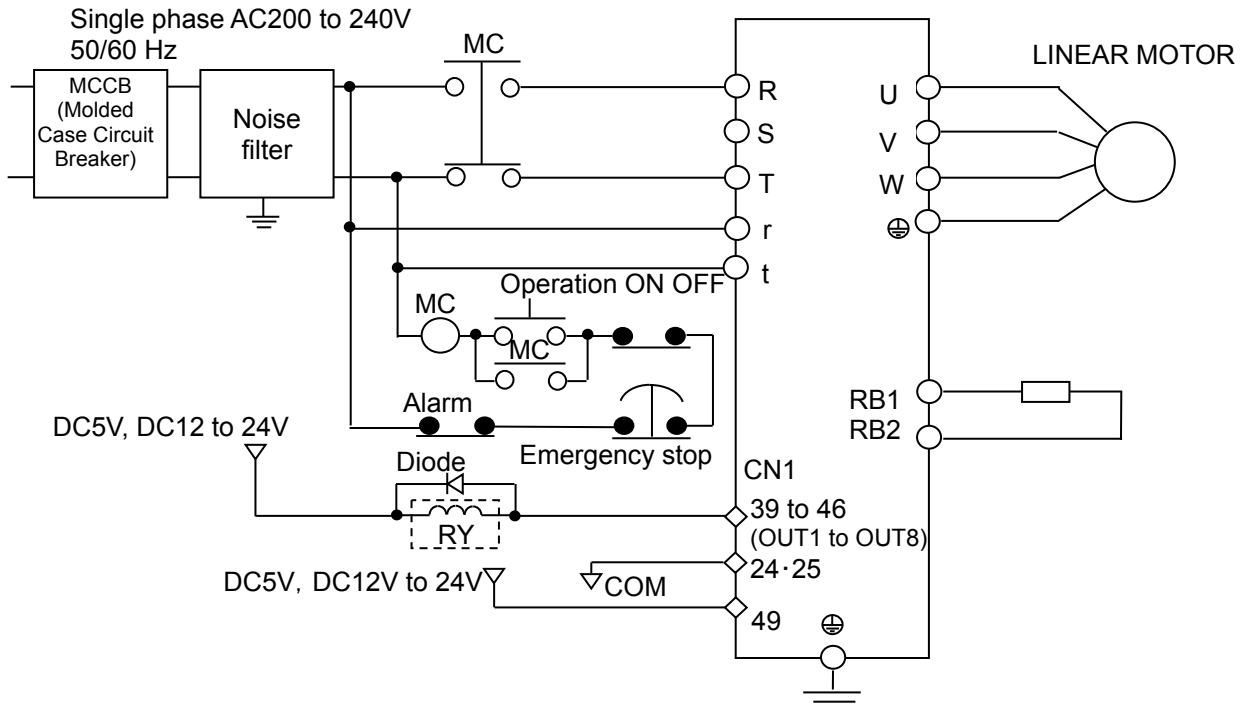
4.1.5 Example of wiring

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

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



■ Single phase AC200V [General output: Sink type]

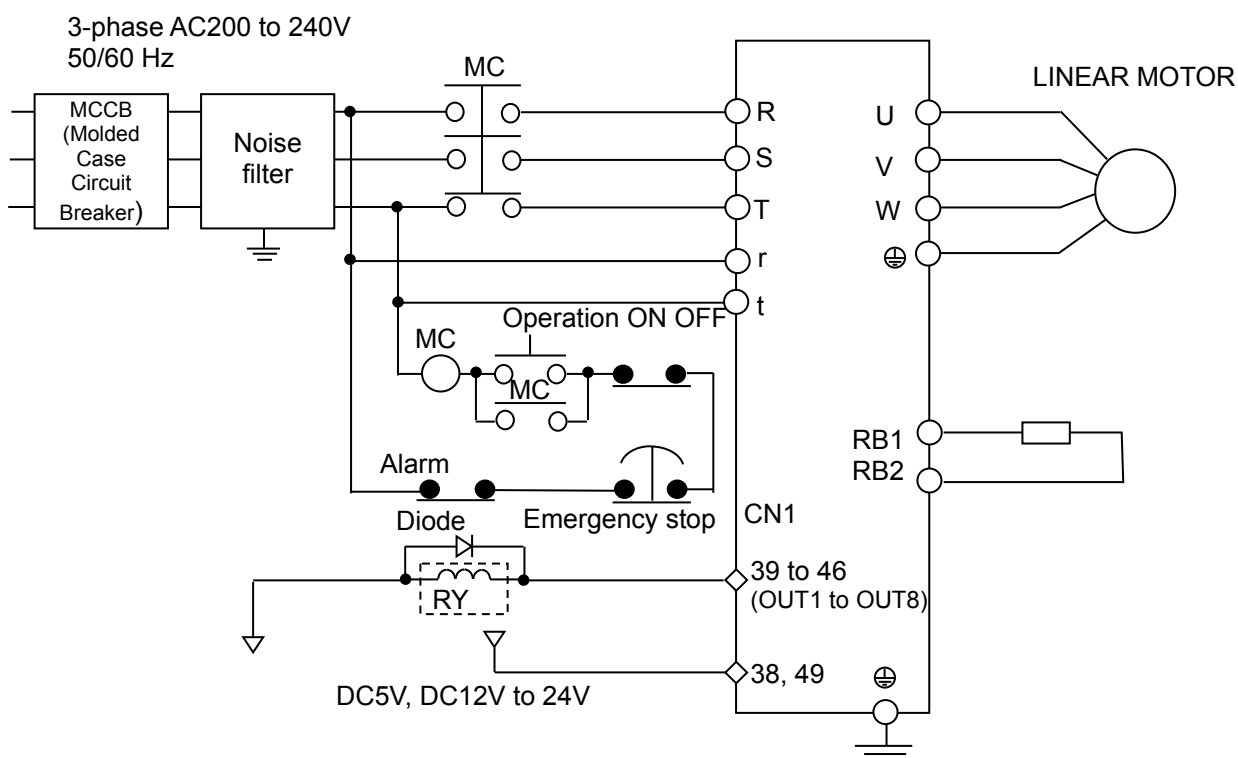


- * For safety circuit, use one of the outputs from CN1- 39 to 46 (OUT1 to OUT8) as alarm signal by setting either During ALM status output ON or During ALM status output OFF at the selection setting of Group A "General output terminal output condition" (5-111).
- * Must add the surge absorbing diode to if inductive load as relay connect to CN1- 39 to 46 (OUT1 to OUT8).

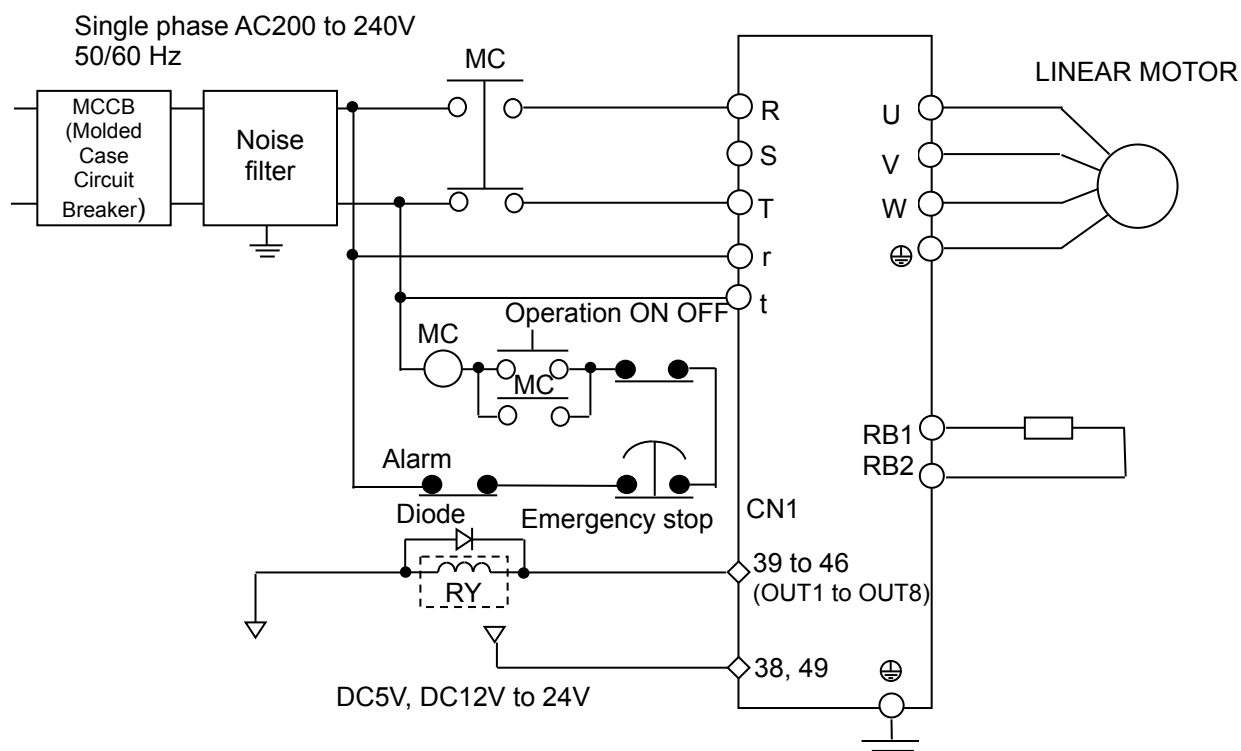
Please take care of polarity of the diode that will be cause of failure.

4. Wiring

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



■ Single phase AC200V [General output: Source type]



- * For safety circuit, use one of the outputs from CN1- 39 to 46 (OUT1 to OUT8) as alarm signal by setting either During ALM status output ON or During ALM status output OFF at the selection setting of Group A "General output terminal output condition" (5-111).
- * Must add the surge absorbing diode to if inductive load as relay connect to CN1- 39 to 46 (OUT1 to OUT8).

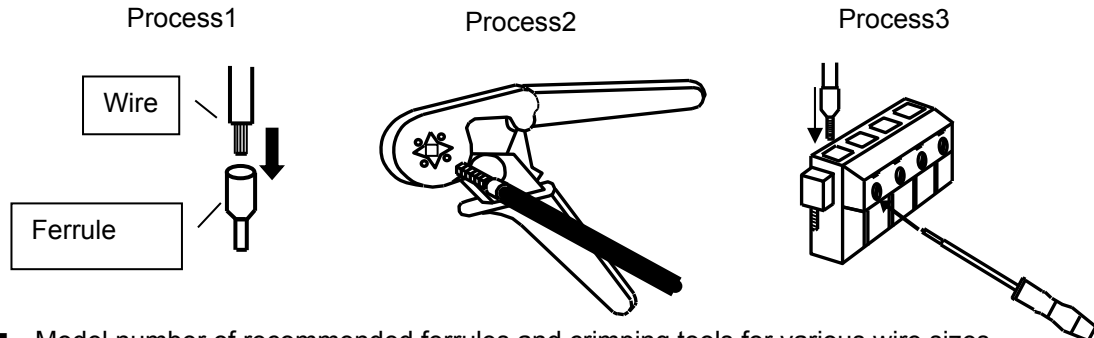
Please take care of polarity of the diode that will be cause of failure.

4.1 Wiring for the terminal of high voltage and grounding

4.1.6 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. Refer the section 4.1.8 High voltage circuit terminal; tightening torque, for recommended tightening torque.



- 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)
4.0 mm ²	12	AI4-10GY Note 1)	-	-
5.5 mm ²	10	AI6-10 Note 1) 2)	-	-

Note1) Use for CNA/CNB of RS3A07# only.

Note2) Without plastic sleeve.

* GY: Gray, RD: Red, BK: Black, BU: Blue

* Crimping tool model number: 0.14mm² to 10mm² : CRIMPFOX 10S

4.1.7 High voltage circuit terminal; tightening torque

Servo amplifier model number	Terminal marking		
	CNA	CNB	⊕
RS3A01L	[0.5 to 0.6 N·m]		[1.18 N·m] M4 (screw size)
RS3A02L			
RS3A03L			
RS3A05L			

Servo amplifier model number	Terminal marking			
	CNA	CNB	CNC	⊕
RS3A07L	Wire size 4mm ² or less	[0.5 to 0.6 N·m]	[0.5 to 0.6 N·m]	[1.18 N·m] M4 (screw size)
	Wire size 4mm ² over	[0.7 to 0.8 N·m]		

	Terminal marking											
Servo amplifier model number	R	S	T	⊖	RB4	RB1	RB2	U	V	W	⊕	CNA
RS3A10L	[1.18 N·m] M4 (screw size)											[0.5 to 0.6 N·m]
RS3A15L												

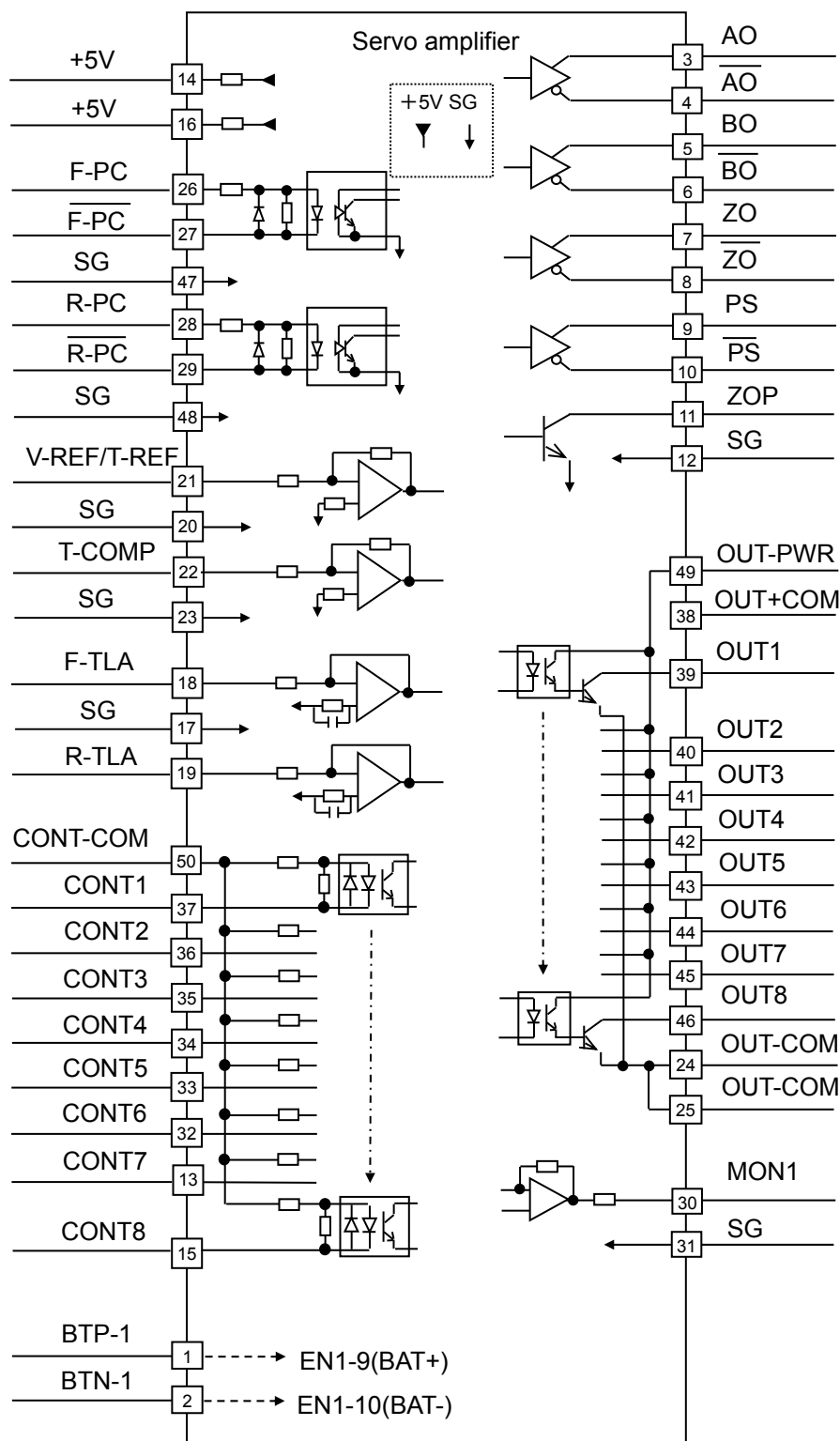
Servo amplifier model number	Terminal marking											CNA
	R	S	T	⊖	P	U	V	W	⊕	RB1	RB2	
RS3A30L	[3.73 N·m] M6 (screw size)									[1.18 N·m] M4 (screw size)		[0.5 to 0.6 N·m]

4. Wiring

4.2 Wiring with Host Unit

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

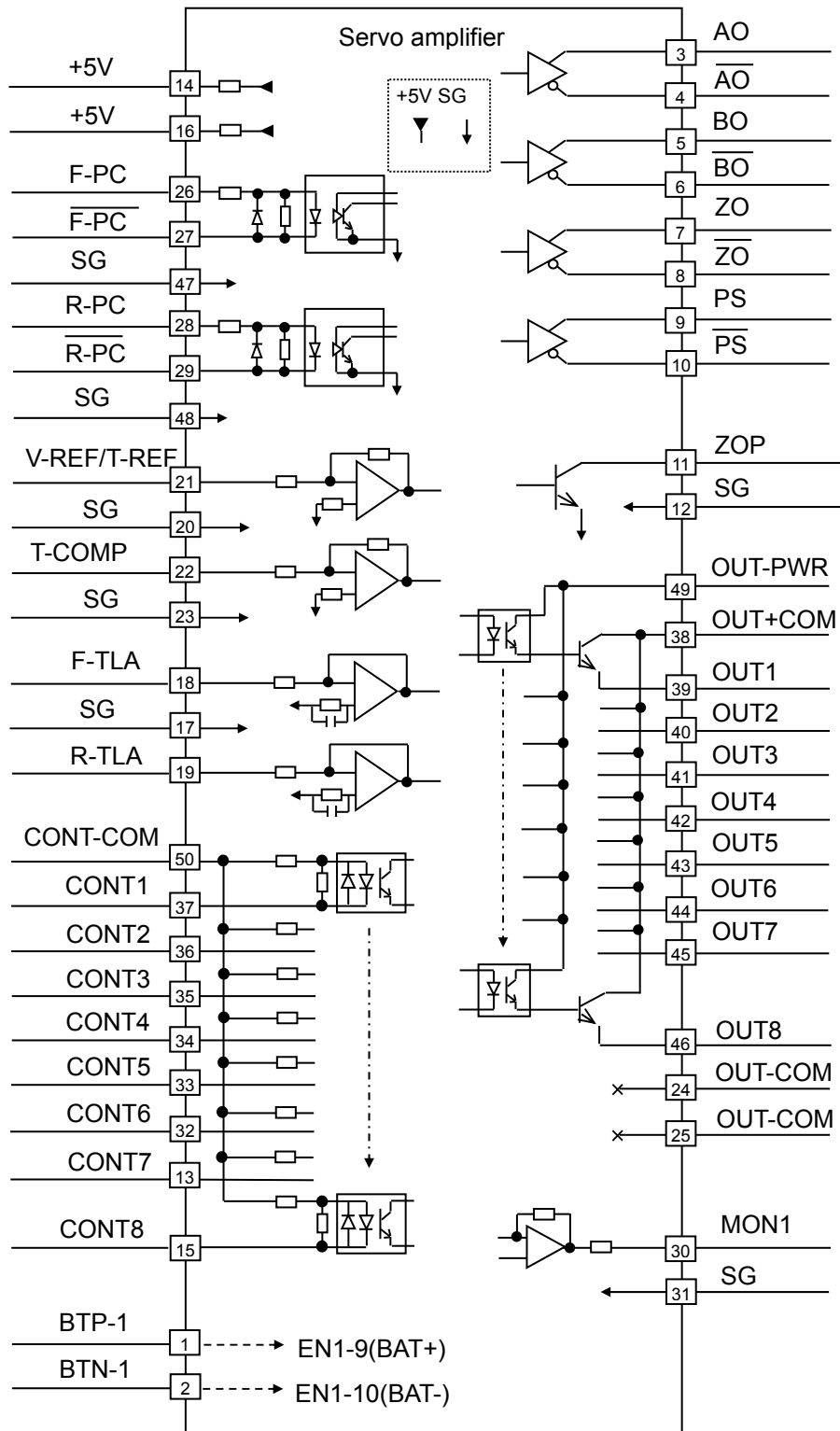
- CN1 terminal sequence [General output: Sink type output]



- * Please check "1.1.3 Notes for replacement from SANMOTION R ADVANCED MODEL" for replacement from previous product (RS1, RS2).
- * The wiring of CN1 use a twisted pair shield cable.

4.2 Wiring with Host Unit

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



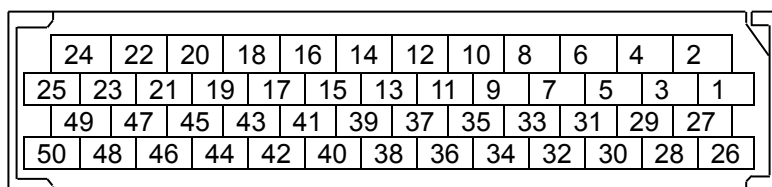
* Please check "1.1.3 Notes for replacement from SANMOTION R ADVANCED MODEL" for replacement from previous product (RS1, RS2).

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

4. Wiring

4.2.2 CN1 pin assignment

- CN1 10150-3000PE (Soldered side)



4.2.3 Signal name and its function

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

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

Note 1) 38: OUT+COM will be NC in case of sink type, general output.

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

4.2 Wiring with Host Unit

4.2.4 Terminal connection circuit

■ Battery

When using a Battery Backup Method Absolute Encoder, the battery for backup can be mounted in the host unit side, and it can connect via servo amplifier.

Terminal No.	Symbol	Name	Description
1	BTP-1	Battery plus	Do not connect anything because these are not used in the linear motor system.
2	BTN-1	Battery minus	

■ Encoder signal output: A, B, Z

Outputting Signal: A, B and origin Z of linear encoder. Connect with a line receiver.

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

* Make sure to connect SG.

■ Absolute encoder, absolute position data output

Terminal No.	Symbol	Name	Description
9	PS	Encoder signal output	
10	$\overline{PS}$	Encoder signal output	
12	SG	Common for pins 3 to 11	

* Make sure to connect SG.

4. Wiring

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

- ◆ For sink type open collector output

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

- * Make sure to connect SG.
- * Source type open collector output is not available.

4.2 Wiring with Host Unit

■ Force limit input

Forward and reverse side force is restricted on external analog voltage.

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

* Make sure to connect SG.

■ Analog command input

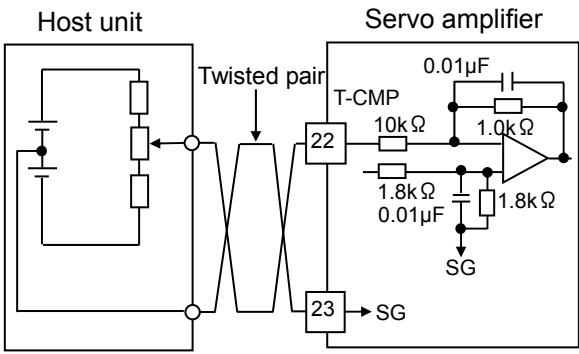
Inputting velocity addition command of position control, velocity command of velocity control and force command of force control, by analog voltage.

Terminal No.	Control type	Symbol	Name	Description
21	Position	V-REF	Velocity addition command input	[Circuit spec.] Max. allowable input voltage is $\pm 10\text{V}$. Input impedance is about 10kΩ
	Velocity	V-REF	Velocity command input	
	Force	T-REF	Force command input	
20	Position Velocity Force	SG	Common for pins 21	

* Make sure to connect SG.

4. Wiring

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

Terminal No.	Symbol	Name	Description
22	T-COMP	Force compensation input	[Circuit spec.] Max. allowable input voltage is $\pm 10\text{V}$. Input impedance is about $10\text{k}\Omega$ 
23	SG	Common for pins 22	

* Make sure to connect SG.

4.2 Wiring with Host Unit

- Command pulse input
For inputting position command pulse of position control.

[Command pulse input type]

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

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

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

[Command pulse output circuit]

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

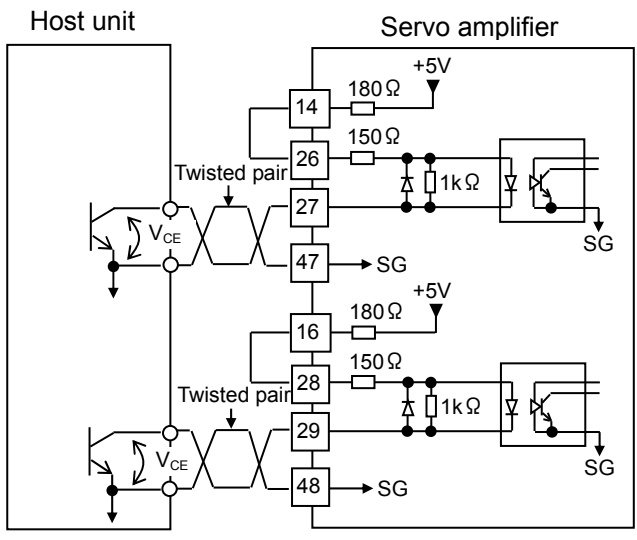
- ◆ For Differential line driver

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

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

4. Wiring

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

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

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

4.2 Wiring with Host Unit

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

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

- * It will be cause of wrong operation by pulse missing or circuit failure when input current to servo amplifier is less than 3.8mA or more than 15mA.
- * It will be cause of wrong operation by pulse missing or circuit failure when collector-emitter voltage (V_{CE}) of a transistor in host unit is more than 1.5V.

4. Wiring

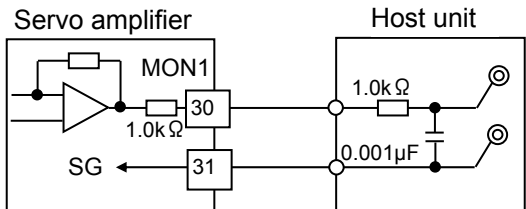
◆ For Source type open collector (External power only)

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

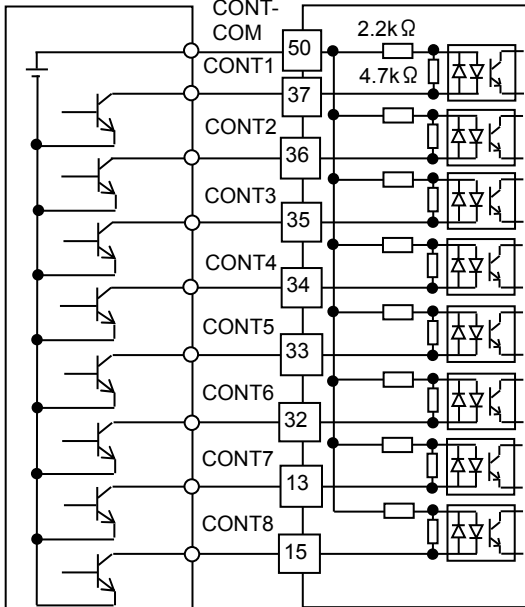
- * It will be cause of wrong operation by pulse missing or circuit failure when input current to servo amplifier is less than 3.8mA or more than 15mA.
- * It will be cause of wrong operation by pulse missing or circuit failure when collector-emitter voltage (V_{CE}) of a transistor in host unit is more than 1.5V.

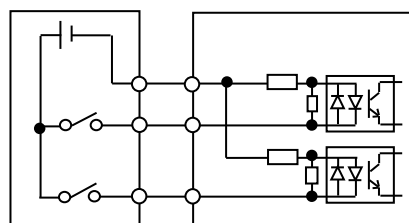
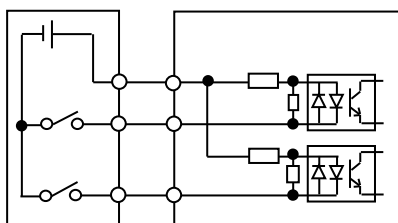
4.2 Wiring with Host Unit

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

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

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

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

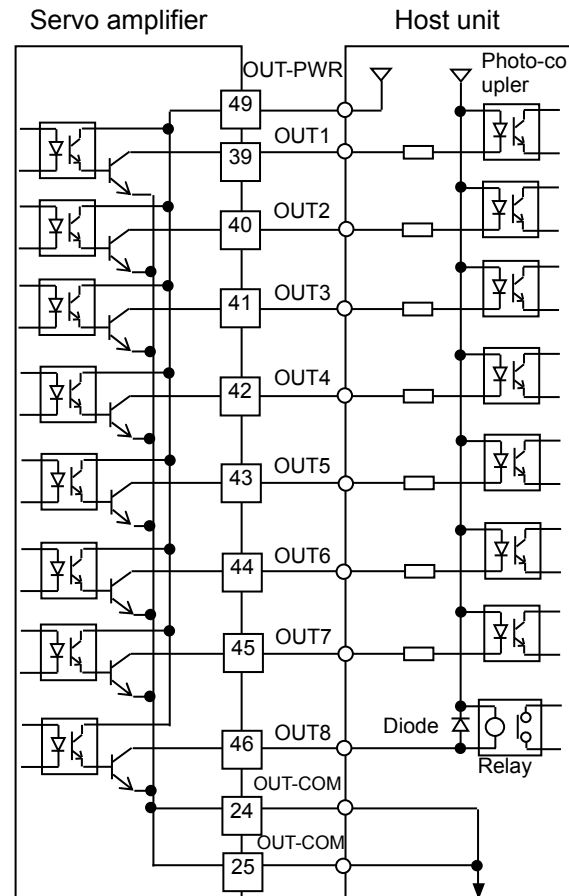


4. Wiring

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

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

Terminal No.	Symbol	Name	Description	
39	OUT1	General output	[Internal power supply spec. for general output(OUT-PWR)] Power supply voltage range: DC5V±5%, DC12V to DC24V±10% Current capacity: 20mA or more	
40	OUT2	General output		
41	OUT3	General output		
42	OUT4	General output	[General output (OUT-1 to OUT-8) spec.]	
			Power supply voltage range	Maximum output current (Each port)
			DC5V±5%	10mA
			DC12 to 15V±10%	30mA
			DC24V±10%	50mA
43	OUT5	General output		
44	OUT6	General output		
45	OUT7	General output		
46	OUT8	General output		
49	OUT-PWR	For power supply to general output		
24	OUT-COM	Minus common for general output		
25	OUT-COM	Minus common for general output		

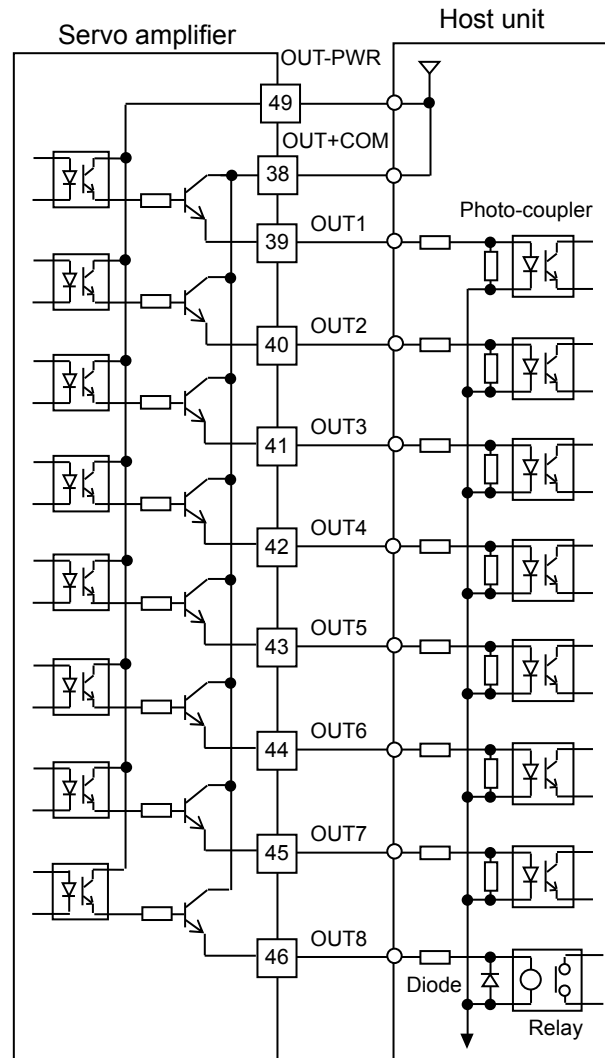


* Must add the surge absorbing diode if inductive load as relay connect to the control signal output of the amplifier. Please take care of polarity of the diode that will be cause of failure.

4.2 Wiring with Host Unit

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

Terminal No.	Symbol	Name	Description	
39	OUT1	General output	[Internal power supply spec. for general output(OUT-PWR)] Power supply voltage range: DC5V±5%, DC12V to DC24V±10% Current capacity: 20mA or more	
40	OUT2	General output		
41	OUT3	General output		
			[General output (OUT-1 to OUT-8) spec.]	
			Power supply voltage range	Maximum output current (Each port)
			DC5V±5%	10mA
			DC12 to 15V±10%	30mA
			DC24V±10%	50mA
42	OUT4	General output	Servo amplifier Host unit OUT-PWR OUT+COM OUT1 OUT2 OUT3 OUT4 OUT5 OUT6 OUT7 OUT8 Photo-coupler Diode Relay	
43	OUT5	General output		
44	OUT6	General output		
45	OUT7	General output		
46	OUT8	General output		
49	OUT-PWR	For power supply to general output		
38	COT+COM	Plus common for general output		



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

4. Wiring

4.3 Wiring for linear encoder

4.3.1 EN1, EN2 signal names and its 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 DC5.1 to 5.5V, 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.

■ 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 DC5.1 to 5.5V, 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.

4.3 Wiring for motor encoder

■ 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.

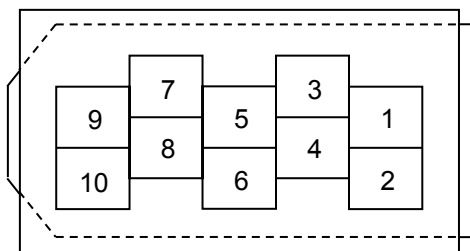
Note 2) Connect jacketed and shielded wire to metallic case (ground) on EN1 and ground on linear encoder.

Note 3) Make sure to connect power supply common.

4. Wiring

4.3.2 EN1, EN2 pin assignment

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



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

- Connector model number (3M Japan Limited)

	Model Number	Applicable wire size	Applicable cable diameter
Connector	36210-0100PL	AWG30 to AWG18	—
Shell kit	36310-3200-008	—	$\phi 7$ to $\phi 9$

4.3 Wiring for motor encoder

4.3.3 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 (mm²) 0.15 to 0.75

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

4.3.4 Encoder cable length

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

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

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

4. Wiring

4.4 Peripheral equipments

4.4.1 Power supply capacity and peripherals list

■ AC200V 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		
AC200V	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						
		DT030CD1AN	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					Model NF63 50A MITSUBISHI ELECTRIC	S-T35 MITSUBISHI ELECTRIC
		DS050C3N2	3.5						
		DS075C3N2	3.8						
		DS100C2N2	5.5						
		DS150C2N2	5.5					Model NF63 30A MITSUBISHI ELECTRIC	S-T21 MITSUBISHI ELECTRIC
		DD030C2Y4	4.5						
		DD030C3Y4	6.8						
		DD050C1Y2	4.4						
		RS3A15L	DD075C1Y2	4.8		Model NF63 50A MITSUBISHI ELECTRIC		S-T35 MITSUBISHI ELECTRIC	
			DD045CB4AN	3.2					
	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.

Operation

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

5.1 Basic setting of the system	5-1
5.1.1 Specification check	5-1
5.1.2 System parameters	5-5
5.1.3 Linear motor setting.....	5-8
5.1.4 Linear encoder setting	5-10
5.1.5 Main circuit power setting.....	5-14
5.1.6 Regenerative resistor setting.....	5-14
5.1.7 Control method selection.....	5-15
5.2 Test operation	5-17
5.2.1 Check of installation and wiring	5-17
5.2.2 Preparation before operation.....	5-18
5.2.3 Magnetic pole position estimation	5-19
5.2.4 Check of operation	5-20
5.2.5 Setting of I/O signal	5-21
5.2.6 Check of device operation.....	5-23
5.3 Servo amplifier status display	5-24
5.3.1 Normal display	5-24
5.3.2 Alarm display	5-24
5.4 Operation sequence	5-25
5.4.1 The operation sequence with factory setting from "turn power on" to "turn power off"	5-25
5.4.2 The operation sequence from "turn power on", at the magnetic pole position estimation valid.....	5-27
5.4.3 Stop sequence at alarm.....	5-28
5.4.4 Sequence of alarm reset	5-30
5.4.5 Sequence when power is turned OFF during operation (During servo ON)	5-31
5.5 Monitor function	5-32
5.5.1 Monitor list	5-32
5.5.2 Descriptions of each monitor.....	5-33
5.6 Analog monitor and digital monitor	5-42
5.7 Setting parameters	5-43
5.7.1 Parameters list.....	5-43
5.8 Parameter functions	5-53
5.9 Control block diagram.....	5-132
5.10 SEMI F47 supporting function	5-135
5.10.1 Parameter setting	5-135
5.10.2 Operational sequence	5-135
5.10.3 Notes	5-136
5.11 Virtual motor operation function	5-137
5.11.1 Setting.....	5-137
5.11.2 Restrictions	5-138
5.11.3 Digital operator display	5-139
5.11.4 Operating precautions	5-139

5. Operation

5.1 Basic setting of the system

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

5.1.1 Specification check

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

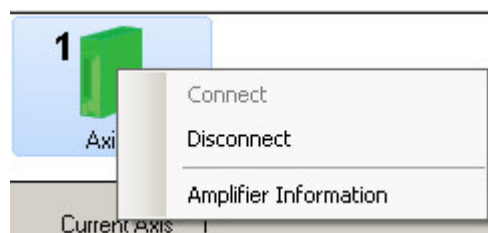
[Step 1: Check for the servo amplifier spec]

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

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

1) Check by the setup software

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



5.1 Basic setting of the system

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

Axis1[] property

Axis Number/Axis Name	1
Amplifier Model	RS3A03L2AL0
Motor Model	DS030C1N2
Amplifier ID	03080004
Software Version	01.1.05
Module Version	000C-000B-0009-060B-0006-000A-0001-0000
Communication State	● The communication is being established.
Connecting port	USB

—System Information—

Motor Structure	01:LINEAR
Main Power Supply Voltage	00:200V
Amplifier Capacity Code	0A:30A
Encoder Type	02:EN1:Ser ,EN2:Pulse

OK Cancel

- Check each item above by following description of step 2 or later.
 - * See the manual: M0010842 for detail of the setup software operation.
- 2) Check by the digital operator
- Use servo amplifier info code display function (InFo.1 to 3).
 - * See "7.4.7 How to check servo amplifier info code 1 to 3" for detail of the function use.

5. Operation

[Step 2: Check for motor structure]

This shows available motor structure with the servo amplifier. Please confirm that motor structure code is 01 (linear motor).

motor structure code	Description
01	Linear

- 1) By the setup software
Motor structure code is shown in System Information area of Axis property window.
- 2) By the digital operator
Motor structure code is shown at an upper byte of InFo.1.

1 1 1 1 1	0 0 0 0 0

Motor structure code

[Step 3: Check for main power supply voltage]

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

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

- 1) By the setup software
Main power supply voltage code is shown in System Information area of Axis property window.
- 2) By the digital operator
Main power supply voltage code is shown at a lower byte of InFo.1.

1 1 1 1 1	0 0 0 0 0

Main power supply voltage code

[Step 4: Check for amplifier capacity]

This shows servo amplifier capacity of output current.

Please confirm that the amplifier capacity code is match to combined motor.

Amplifier capacity code	Description	Servo amplifier model number
0D	10A	RS3A01L####
0B	20A	RS3A02L####
0A	30A	RS3A03L####
09	50A	RS3A05L####
08	75A	RS3A07L####
07	100A	RS3A10L####
06	150A	RS3A15L####
04	300A	RS3A30L####

- 1) By the setup software
Amplifier capacity code is shown in System Information area of Axis property window.
- 2) By the digital operator
Amplifier capacity code is shown at a lower byte of InFo.2.

1 1 1 1 1	0 0 0 0 0

Amplifier capacity code

5.1 Basic setting of the system

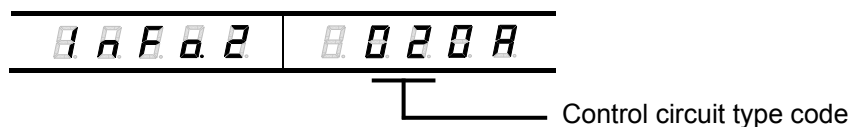
[Step 5: Check for control circuit type]

This shows the allowable encoder for the amplifier. Please confirm that combined linear encoder is available.

Servo amplifier model number	Control circuit type code	The linear encoder allowed by EN1	The linear encoder or hall effect sensor, allowed by EN2
RS3###L0###	00	Absolute encoder	N/A
RS3###L2###	02	Absolute encoder	Incremental encoder
RS3###L8###	08	Incremental encoder	N/A
RS3###LA###	0A	Incremental encoder	Hall effect sensor (Differential signal output type)
RS3###LB###	0B	Incremental encoder	Hall effect sensor (Open-collector output type)

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

- 1) By the setup software
Control circuit type code is shown in System Information area of Axis property window.
- 2) By the digital operator
Control circuit type code is shown at an upper byte of InFo.2.



5. Operation

5.1.2 System parameters

System parameters decide basic specs and functions such as linear motor setting, selection of linear encoder, main power supply and control method.

See details of each parameter through page reference table below.

1) System parameter list

ID	Parameter name	Description	Page
00	Control cycle	Changing control cycle of velocity/force control.	5-15
01	Main circuit power input type	Selecting input spec of main circuit power.	5-6, 5-14
02	Virtual mode	Selecting mode of motor operation.	5-137
03	Regenerative resistor selection	Selecting regenerative resistor.	5-6, 5-14
04	Main power discharge selection	Selecting about electric discharge of main circuit power.	5-6, 5-14
06	Control mode selection	Selecting control mode.	5-15
07	Position control selection	Selecting position control method.	5-16
08	Amplifier communication function	Selecting the target of RS422 communication function (CN5 connector).	9-4
0B	External regenerative resistor value	Setting regenerative resistor value.	5-14
10	Motor encoder input selection	Selecting connector of linear encoder to use.	5-10, 5-12
11	EN1 encoder type	Selecting encoder type of EN1 connection.	5-10, 5-12
12	EN2 encoder type	Selecting encoder type of EN2 connection.	5-12
13	EN1 absolute encoder baud rate selection	Selecting communication speed of absolute encoder of EN1 connection.	5-10
15	Absolute encoder resolution	Selecting resolution of absolute encoder.	5-11
17	Incremental encoder resolution	Selecting resolution of incremental encoder.	5-13
18	CS decision method selection	Selects the decision method for CS position of linear motor.	5-11, 5-12
19	CS normalization method selection	Selects the normalization method for CS position of linear motor.	5-13
1A	CS offset	【Incremental encoder】 Sets an offset value between U-phase electric angle 0 (deg) and S1-phase hall effect sensor output signal edge, by electric angle conversion. 【Absolute encoder】 Sets an offset value between magnetic pole position and absolute position of serial encoder, by electric angle conversion.	5-11, 5-13
1B	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.	5-13

5. Operation

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

ID	Parameter name	Symbol at "□" part that shows encoder type			
		0	2	8	A, B
11	EN1 encoder type	22:EnDat_C-ABS		82:Pulse_ without_CS	81:Pulse_ with_CS
12	EN2 encoder type	-	80:Pulse	-	-
13	EN1 absolute encoder baud rate selection	01:2Mbps		-	
15	Absolute encoder resolution	84:1000000P/mm		-	
17	Incremental encoder resolution	-	1000	1000	
18	CS decision method selection	01:Type2		01:Type2	00:Type1
19	CS normalization method selection	-	02:none	02:none	01:U_phase
1A	CS offset	0[deg]		330[deg]	
1B	Z-phase CS normalization offset	0[deg]		0[deg]	

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

5.1 Basic setting of the system

5.1.3 Linear motor setting

Combination linear motor can set by two ways below.

- ◆ Setting by the digital operator for the linear motor in use.
- ◆ Setting by the setup software for the linear motor in use.

■ Linear motor setting availability

Allowable setting method differs like as below table depending on the specs of linear motor and linear encoder.

Please select applicable method for the product in use.

Linear motor	Linear encoder	Setting method	
		Setting by the digital operator	Setting by the setup software
Applicable motor	Absolute encoder	○	○
	Incremental encoder	○	○
Except above	Absolute encoder	×	○
	Incremental encoder	×	○

* ○: Available, ×: Not available

* For applicable motor, see next "Applicable motor list".

■ Applicable motor list

This is the list of linear motor model number and motor code that are able to set by the digital operator.

Combination amplifier	Linear motor model number	Motor code
RS3A01	-	-
RS3A02	-	-
RS3A03	DS030C1N2	0343
	DS050C1N2	0347
	DS075C1N2	034C
	DS045CC1AN	03FF
	DT030CD1AN	04D3
RS3A05	DS030C2N2	0344
	DS050C2N2	0348
	DS075C2N2	034F
	DS100C1N2	0350
	DS150C1N2	0353
RS3A07	DD030C1Y4	03D2
	DS030C3N2	04D5
	DS050C3N2	04D6
	DS075C3N2	04D7
	DD030C2Y4	04D8
	DD050C1Y2	04D9
	DD075C1Y2	04DA
	DD045CB4AN	04DB
	DD035CC2AN	04D4

Combination amplifier	Linear motor model number	Motor code
RS3A10	DS030C3N2	0346
	DS050C3N2	034A
	DS075C3N2	0349
	DS100C2N2	0351
	DS150C2N2	0354
	DD030C2Y4	03D3
	DD030C3Y4	03D4
	DD050C1Y2	03D5
RS3A15	DD075C1Y2	03DA
	DD045CB4AN	03FE
	DS100C3N2	0352
	DS150C3N2	034D
RS3A30	DD050C2Y2	03D6
	DD075C2Y2	03DB
	DD050C3Y2	03D9
	DD075C3Y2	03DC
	DD075C4Y2	03DD

5. Operation

- 1) How to set motor through the digital operator

[Step 1: Selecting motor]

Set the motor code that will be used by following the steps of "7.17 How to set the linear motor code". Please have a control power-cycle after setting.

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

[Step 2: Rechecking the linear motor setting]

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



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

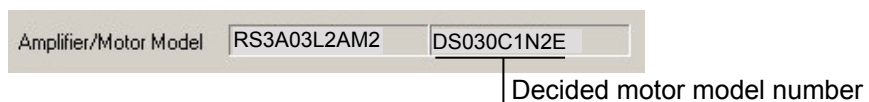
- 2) How to set motor through the setup software

[Step 1: Selecting motor]

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.

[Step 2: 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.



5.1 Basic setting of the system

5.1.4 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
	RS3xxx0xxx	RS3xxx2xxx	RS3xxx8xxx	RS3xxxAxxx RS3xxxBxxx	
Absolute encoder	○	○	×	×	1)
Incremental encoder	×	○	○	○	2)

* ○: Combination available, ×: Combination not available

1) Absolute encoder (Applicable amplifier model number: RS3xxx0xxx, RS3xxx2xxx)

■ Motor encoder connector selection

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

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

* RS3xxx0xxx 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)

■ 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).

5. Operation

- Absolute encoder resolution
Select the encoder resolution.

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

- 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

5.1 Basic setting of the system

- 2) Incremental encoder
(Applicable amplifier model number: RS3xxx2xxx, RS3xxxAxxx, RS3xxxBxxx)

■ Motor encoder connector selection

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

- ◆ Select "01:EN2" if "RS3xxx2xxx" is used.
- ◆ Select "00:EN1" if "RS3xxx8xxx, RS3xxxAxxx or RS3xxxBxxx" is used.

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

* RS3xxx8xxx, RS3xxxAxxx and RS3xxxBxxx 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 RS3xxx2xxx, select encoder type at "EN2 encoder type".
- ◆ For RS3xxx8xxx, RS3xxxAxxx and RS3xxxBxxx 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 RS3xxx8xxx 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 RS3xxx2xxx, select encoder type at this parameter.
- ◆ For RS3xxx8xxx, RS3xxxAxxx and RS3xxxBxxx, this parameter is not shown because it 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 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 the other of "01:Type1" is selected.

5. Operation

■ 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.

- ◆ Sets 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 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 (four-multiplied)	P/mm

5.1 Basic setting of the system

5.1.5 Main circuit power setting

Set the parameters about main circuit power.

■ Main circuit power input type selection

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

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

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

* For single-phase 200VAC power, AL63 (Main Power Supply phase loss) will occur if "00:AC_3-phase" is selected. So must select "01:AC_Single-phase".

■ Main power discharge selection

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

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

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

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

5.1.6 Regenerative resistor setting

Sets about a regenerative resistor.

■ Regenerative resistor selection

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

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

■ External regenerative resistor value

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

5. Operation

5.1.7 Control method selection

Set the basic control method to use.

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

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

When "01:High-freq_Sampling" is selected, the functions in table below can not use.

When high frequency sampling is used, must use the parameter setting value of table below to the limiting functions.

Limiting functions	Parameter for limiting function			
	Group	ID	Name	Selection
Model-following (vibration suppression) control	System	07	Position control selection	00:Standard

- * In case that a linear encoder is absolute encoder (EnDat), select "00: Standard_Sampling" (Standard sampling mode).

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

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

5.1 Basic setting of the system

- Position control selection
Select the type of position control.

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

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

5. Operation

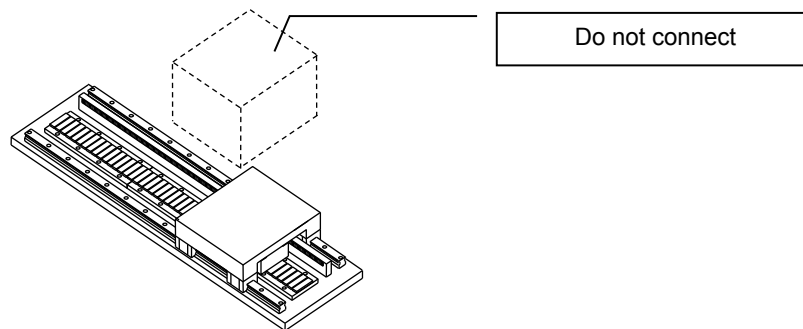
5.2 Test operation

5.2.1 Check of installation and wiring

Check the installation and wiring of 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 CN1 to the amplifier.
- Supply power. Check that the display of upper of servo amplifier front face does not show alarm code. If alarm code is shown, please take corrective action by following "8.3 Trouble shooting when alarm activated".
- If "≡" is not shown at 7-segment LED even if main power turns on, please take corrective action by following " 8.1 Trouble shooting".

5.2.2 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 (forward 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 selection". And make control power cycle.
- Supply main circuit power, and perform the magnetic pole position estimation.
- * See "5.2.3 Magnetic pole position estimation method" for detail.
- Confirm the monitor function ID37 "CS offset monitor", and then set the indicated data to the 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 selection". 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 (forward direction), 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 selection".
- * See "5.2.3 Magnetic pole position estimation method" for detail.

5. Operation

5.2.3 Magnetic pole position estimation

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

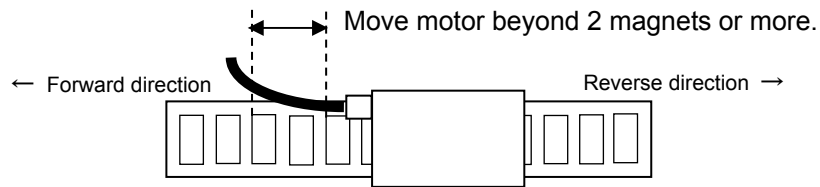
- 1) Perform through general input operation
 - ◆ Set "00: Normal" to GroupC ID0A "Magnetic pole position estimation mode".
 - ◆ Set the condition for enabling the function to Group) ID1D "Magnetic pole position estimation function".
Factory setting is "06:CONT3_ON".
 - ◆ Supply main circuit power, and 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.
- 4) Perform through the digital operator
 - See "7.10 Magnetic pole position estimation" for operation method of the digital operator.
- * 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 sec 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.

5.2 Test operation

5.2.4 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 forward 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.
 - ◆ How to operate through the digital operator
See "7.11 Velocity-controlled JOG Operation" for detail of the digital operator operation.

5. Operation

5.2.5 Setting of I/O signal

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

[Step 1: Input signal setting]

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

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

[Step 2: Output signal setting]

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

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

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

- Through monitor function, check that the I/O signal that has set works correctly.
See "5.5 Monitor function" for detail of the monitor.
 - ◆ How to check through the setup software
Select Monitor function at the menu and check.
 - ◆ How to check through the digital operator
See "7.15 Monitor display" for detail of the digital operator operation.

5.2 Test operation

[Step 4: Input servo ON signal]

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

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

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

[Step 5: Inputting the command]

- Inputting the command suitable for the control mode in use, by host unit. (see in system parameter ID06)
 - ◆ "Position control mode" ····Position command pulse
 - ◆ "Velocity control mode" ····Analog voltage
 - ◆ "Force control mode" ····Analog voltage
- * When operating by force control without load, motor might move up to high speed. Please avoid risk watching a velocity or position by host unit.
- Confirm that the shaft of the linear motor moves to commanded direction.
- If linear motor shaft does not move even if host unit gives command, please confirm command reception by monitor function.

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

- If the servo amplifier does not receive the command from the upper device, the value displayed on the monitor does not change.
Any of these cases could be the result of wrong wiring. Please double check the wiring.
- Give command after receiving command acceptance permission signal from servo amplifier. See "5.4 Operation sequence" for the details.

[Step 5: Power shut off]

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

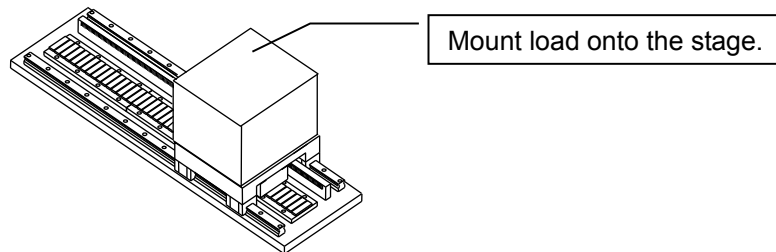
5. Operation

5.2.6 Check of device operation

Mount load onto the stage and check the operation.

[Step 1: Connection to the machine]

- Mount load onto the stage and check the operation.



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

[Step 2: Operation]

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

5.3 Servo amplifier status display

5.3 Servo amplifier status display

5.3.1 Normal display

Marking	Description	Status code
	Control power supply established. Control power supply (r, t) is established and amplifier (RDY) is on.	1
	Main circuit power supply established. Main power supply (R, S and T) is established, but operation preparation completion signal is off.	2
	Safe torque off working status. Main circuit power supply (R, S and T) is established and either safe torque off input 1 or 2 is "off". "H-->H-->H" are shown sequentially.	2
	Magnetic pole position estimation being prepared. Main circuit power supply (R, S, T) is established, but magnetic pole position estimation has not been completed. * LED is blinking.	7
	Operation setup is completed. Main power supply (R, S and T) is established and operation setup completion signal is on.	3
	Servo is on. Continue drawing of character "8", sequentially.	4
	Magnetic pole position estimation being performed. Display lights by tracing out a shape of square in the upper of 7-segment LED.	7
	Magnetic pole position estimation completed. Display lights by tracing out a shape of square in the lower of 7-segment LED.	7

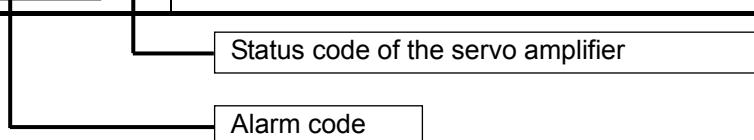
Marking	Description
	Positive direction over-travel status. Positive direction over-travel has occurred at position/velocity control.
	Negative direction over-travel status. Negative direction over-travel has occurred at position/velocity control.

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

5.3.2 Alarm display

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

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



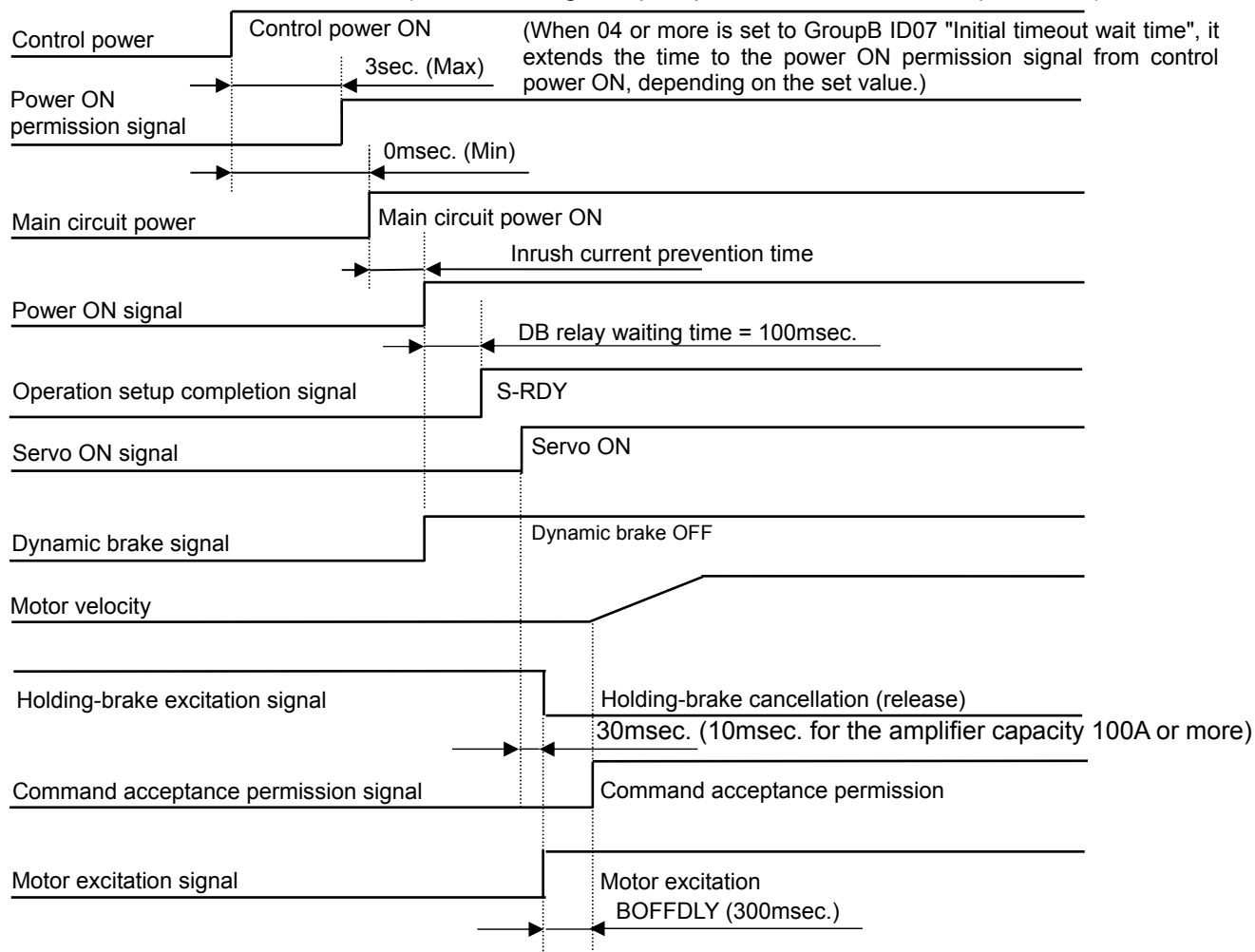
Code	Status
1	Power OFF status (P-OFF)
2	Power ON status (P-ON)
3	Servo ready status (S-RDY)
4	Servo ON status (S-ON)
5	Servo OFF and stop status (S-OFF)
6	Emergency stop status (EMR)
7	Magnetic pole position estimation status (CSET)
F	Initial status

5. Operation

5.4 Operation sequence

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

Power ON --> Servo ON (When the magnetic pole position estimation is not performed)

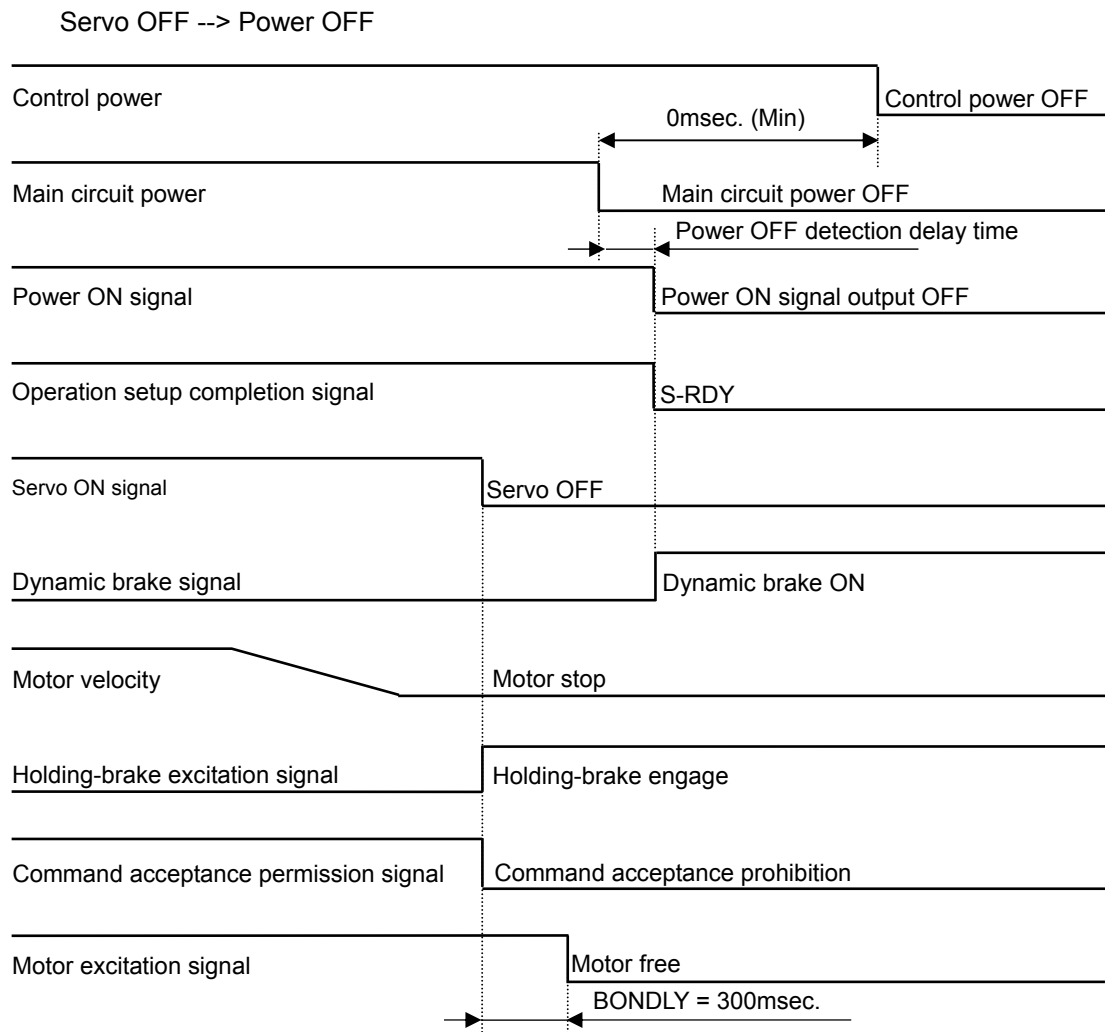


- * The frequency of the power ON/OFF of the servo amplifier shall be 5 times/hour or less and 30 times/day or less. Please set 10 minutes or more to power ON/OFF interval.
- * See below for inrush current suppression time and servo amplifier capacity.

■ 200 VAC input model

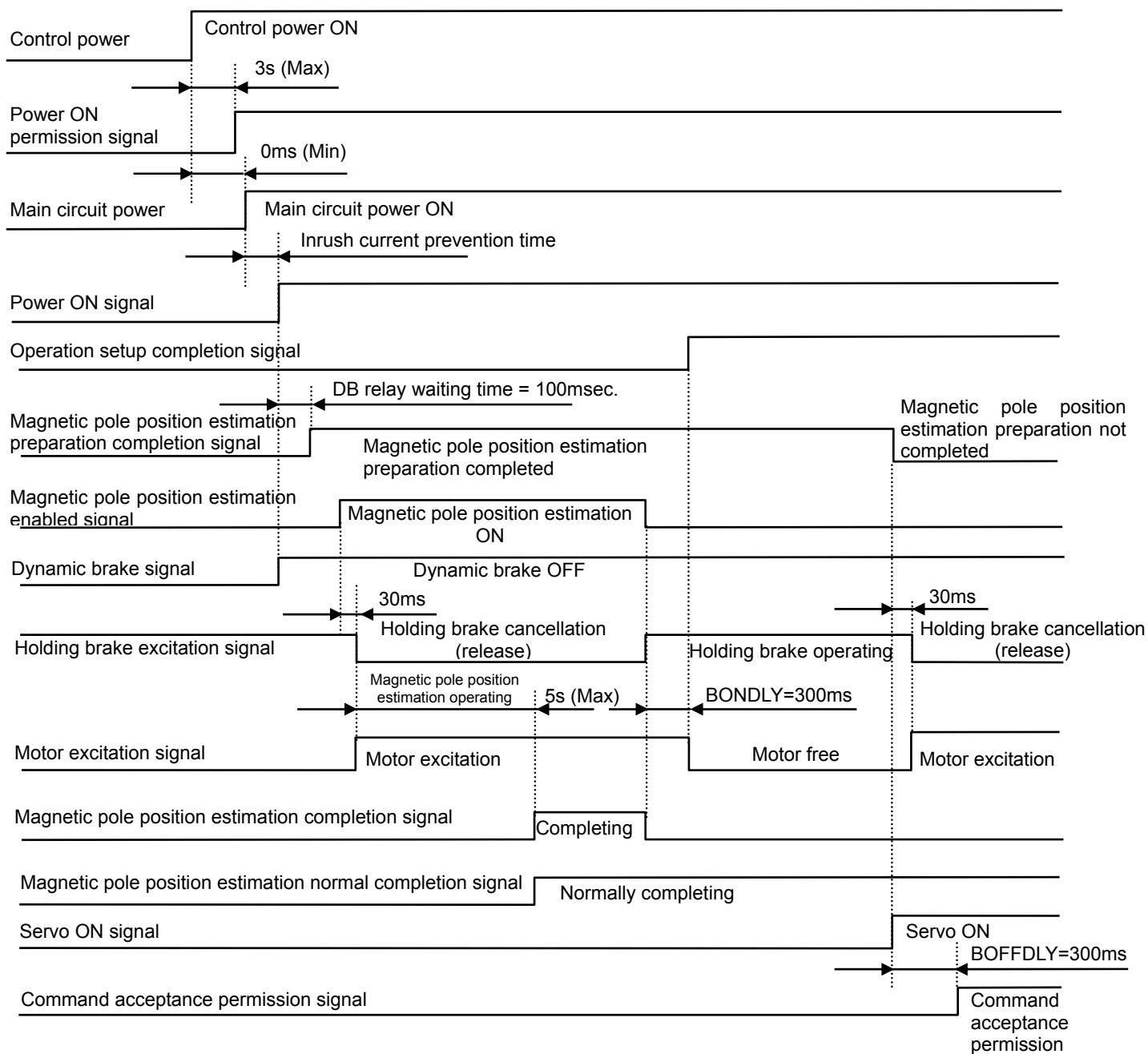
Servo amplifier capacity	Inrush current suppression time	
	3-phase	Single-phase
RS3A01#	900 [ms]	1800 [ms]
RS3A02#	900 [ms]	1800 [ms]
RS3A03#	900 [ms]	1800 [ms]
RS3A05#	900 [ms]	1800 [ms]
RS3A07#	1200 [ms]	---
RS3A10#	1200 [ms]	---
RS3A15#	1200 [ms]	---
RS3A30#	1200 [ms]	---

5.4 Operation sequence



5. Operation

5.4.2 The operation sequence from "turn power on", at the magnetic pole position estimation valid.

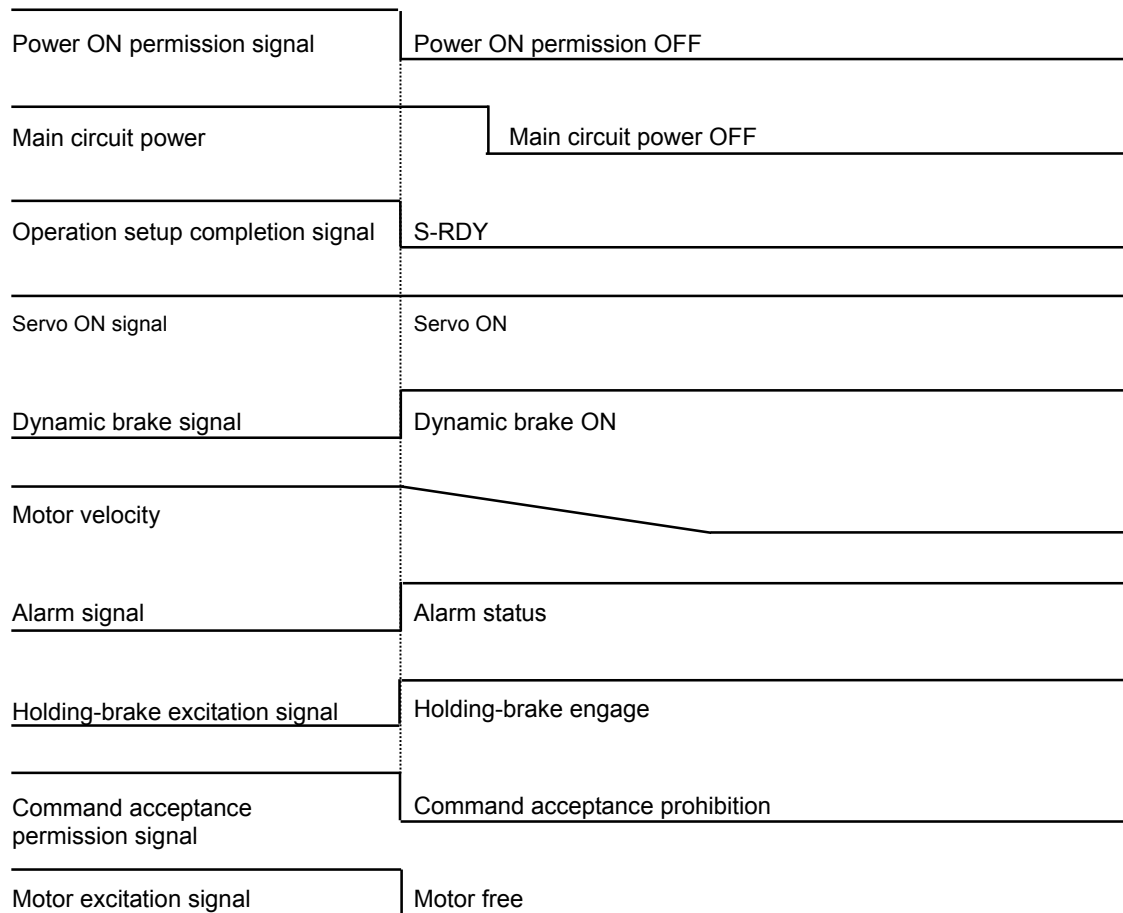


5.4 Operation sequence

5.4.3 Stop sequence at alarm

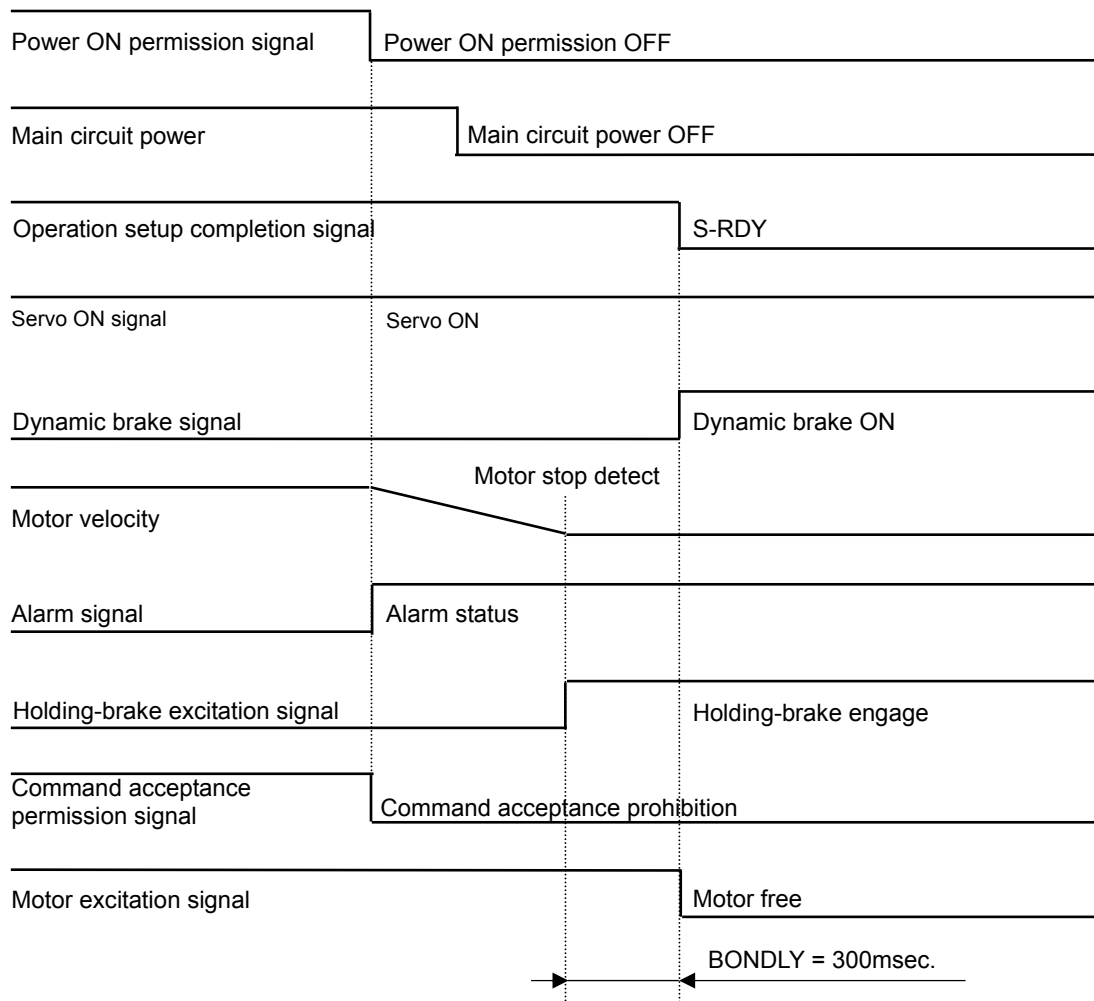
When an alarm occurs, the linear motor is stopped by either dynamic brake or servo brake. Which brake to be used is depending on alarm. See "8.2 List of warning and alarm".

Stop by dynamic brake at alarm



5. Operation

Stop by servo brake at alarm

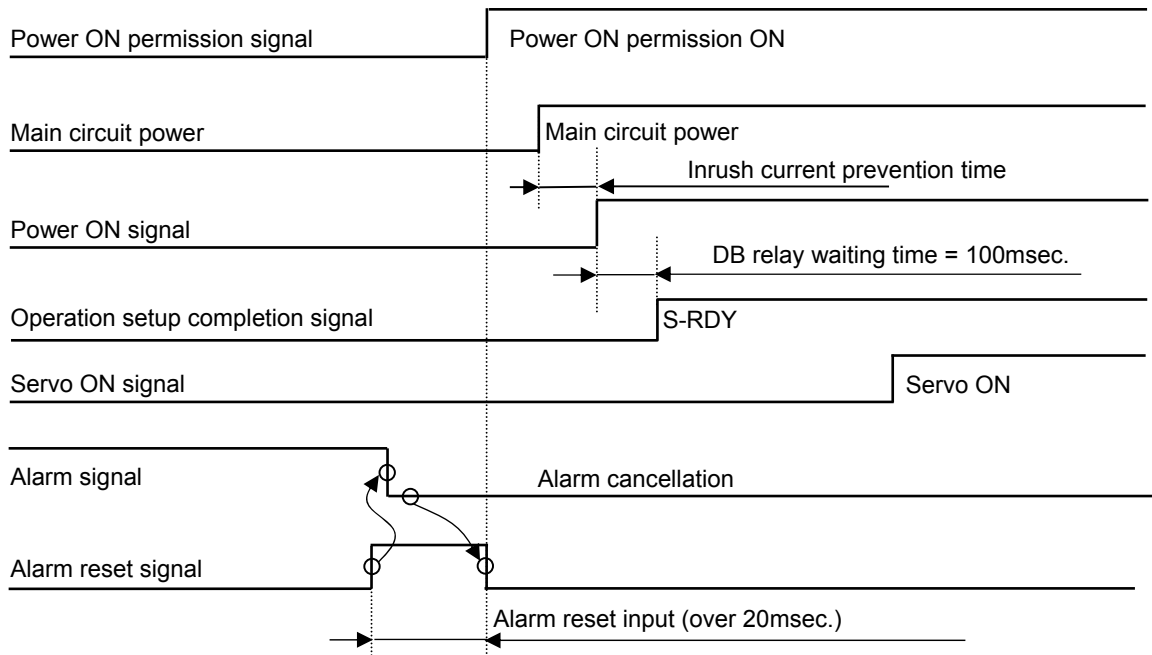


- * The above sequence is the one when protective circuit is installed. Install a protective circuit seeing "4.1.6 Wiring example".

5.4 Operation sequence

5.4.4 Sequence of alarm reset

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

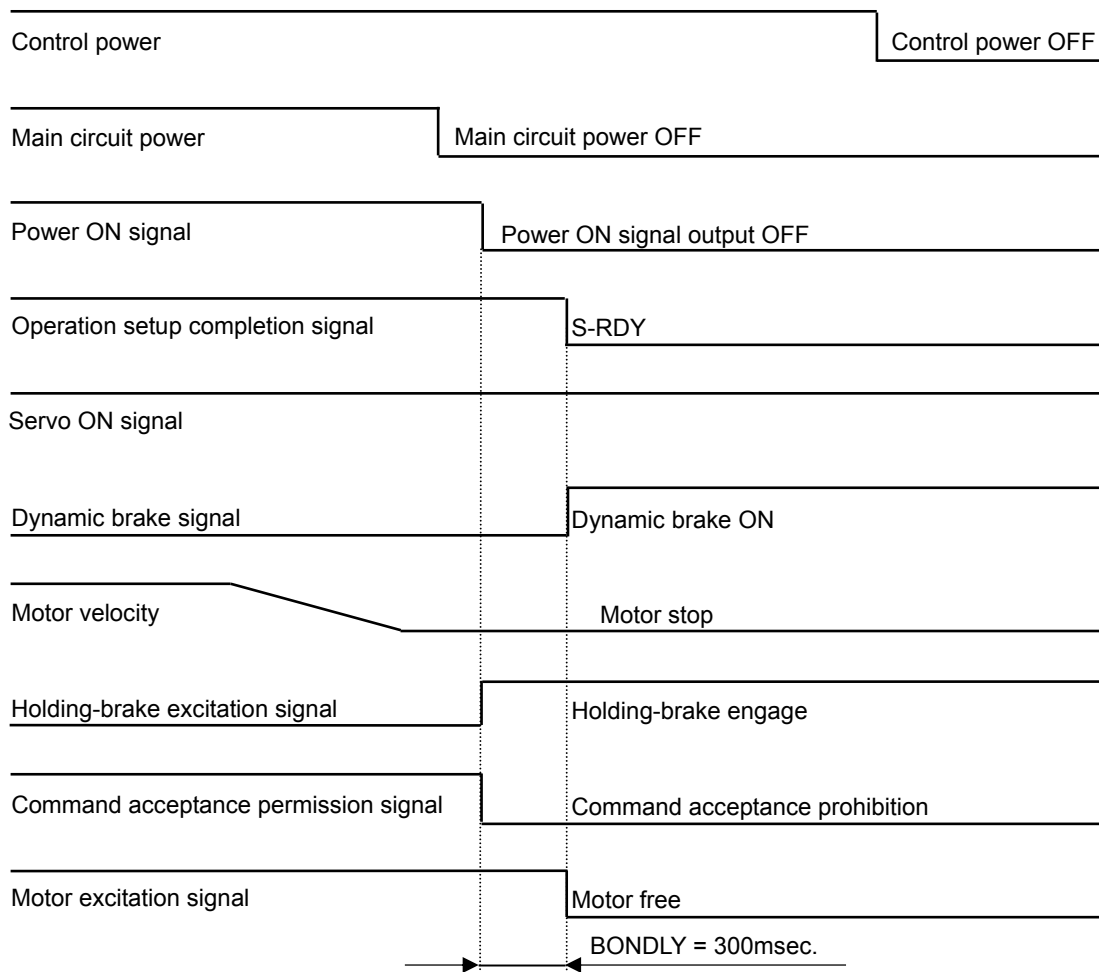


- * Some alarms cannot be reset unless the power is reset (control power is turned OFF and ON again), or encoder is cleared.
See "8.2 List of warning and alarm".
- * Turn the alarm reset signal off after checking if the alarm signal is cleared. The alarm signal cannot be cleared when the alarm condition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

5. Operation

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

Stop by servo brake



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

5.5 Monitor function

5.5.1 Monitor list

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

5. Operation

5.5.2 Descriptions of each monitor

ID	Description
00	Servo amplifier status monitor [STATUS]

5.5 Monitor function

ID	Description										
05	General input CONT8 to 1 monitor [CONT8-1]										
	■ Displays generic input terminal status. It will be in a photo coupler excitation state by "1" or "ON".										
	<table><tr><td>Bit</td><td>3</td><td>2</td><td>1</td><td>0</td></tr><tr><td>Function</td><td>CONT4</td><td>CONT3</td><td>CONT2</td><td>CONT1</td></tr></table>	Bit	3	2	1	0	Function	CONT4	CONT3	CONT2	CONT1
	Bit	3	2	1	0						
Function	CONT4	CONT3	CONT2	CONT1							
<table><tr><td>Bit</td><td>7</td><td>6</td><td>5</td><td>4</td></tr><tr><td>Function</td><td>CONT8</td><td>CONT7</td><td>CONT6</td><td>CONT5</td></tr></table>	Bit	7	6	5	4	Function	CONT8	CONT7	CONT6	CONT5	
Bit	7	6	5	4							
Function	CONT8	CONT7	CONT6	CONT5							
06	General output OUT8 to 1 monitor [OUT8-1]										
	■ Displays generic output terminal status. It will be in a photo coupler excitation state by "1" or "ON".										
	<table><tr><td>Bit</td><td>3</td><td>2</td><td>1</td><td>0</td></tr><tr><td>Function</td><td>OUT4</td><td>OUT3</td><td>OUT2</td><td>OUT1</td></tr></table>	Bit	3	2	1	0	Function	OUT4	OUT3	OUT2	OUT1
	Bit	3	2	1	0						
Function	OUT4	OUT3	OUT2	OUT1							
<table><tr><td>Bit</td><td>7</td><td>6</td><td>5</td><td>4</td></tr><tr><td>Function</td><td>OUT8</td><td>OUT7</td><td>OUT6</td><td>OUT5</td></tr></table>	Bit	7	6	5	4	Function	OUT8	OUT7	OUT6	OUT5	
Bit	7	6	5	4							
Function	OUT8	OUT7	OUT6	OUT5							
07	Incremental encodersignal monitor [INC-E MON]										
	■ Displays incremental encoder signal status. "1" or "ON" shows an incoming signal level "H" state.										
	<table><tr><td>Bit</td><td>3</td><td>2</td><td>1</td><td>0</td></tr><tr><td>Function</td><td>---</td><td>EN1 encoder Z-phase signal</td><td>EN1 encoder B-phase signal</td><td>EN1 encoder A-phase signal</td></tr></table>	Bit	3	2	1	0	Function	---	EN1 encoder Z-phase signal	EN1 encoder B-phase signal	EN1 encoder A-phase signal
	Bit	3	2	1	0						
Function	---	EN1 encoder Z-phase signal	EN1 encoder B-phase signal	EN1 encoder A-phase signal							
<table><tr><td>Bit</td><td>7</td><td>6</td><td>5</td><td>4</td></tr><tr><td>Function</td><td>---</td><td>Hall effect sensor S3-phase signal</td><td>Hall effect sensor S2-phase signal</td><td>Hall effect sensor S1-phase signal</td></tr></table>	Bit	7	6	5	4	Function	---	Hall effect sensor S3-phase signal	Hall effect sensor S2-phase signal	Hall effect sensor S1-phase signal	
Bit	7	6	5	4							
Function	---	Hall effect sensor S3-phase signal	Hall effect sensor S2-phase signal	Hall effect sensor S1-phase signal							
* Z/B/A-phases of linear encoder are output to bit 6/5/4 each if EN2 is used for linear encoder.											

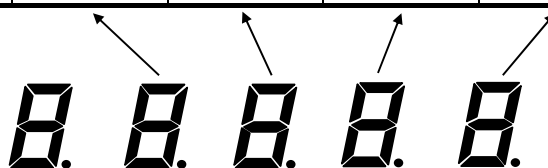
See tables below because display format of ID01 to 07 is different at the setup software and the digital operator.

- Display of the setup software

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

- Display of the Digital operator

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



Digital operator at the front of servo amplifier

5. Operation

ID	Description																		
10 11	Actual position monitor (Linear encoder) [APMON]																		
	■ Displays the current position of the linear encoder that has the origin as the position at the time the control power was turned ON. As this is a free run counter, if the current position exceeds the displayed range, the maximum reverse polarity value will be displayed. ◆ Setup software displays the data to ID10. <table><tr><td colspan="2">Display range</td><td>Unit</td></tr><tr><td colspan="2">-9223372036854775808 to 9223372036854775807</td><td>Pulse</td></tr></table> ◆ Digital operator displays the data to ID10, ID11 by hexadecimal notation (32-bit data). <table><tr><td>ID</td><td>Data range</td><td>Display range</td><td>Unit</td></tr><tr><td>10</td><td>Bit63 to Bit32</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>×2³² Pulse</td></tr><tr><td>11</td><td>Bit31 to Bit0</td><td>H.0000 L.0000 to H.FFFF L.FFFF</td><td>Pulse</td></tr></table>	Display range		Unit	-9223372036854775808 to 9223372036854775807		Pulse	ID	Data range	Display range	Unit	10	Bit63 to Bit32	H.8000 L.0000 to H.7FFF L.FFFF	×2 ³² Pulse	11	Bit31 to Bit0	H.0000 L.0000 to H.FFFF L.FFFF	Pulse
	Display range		Unit																
	-9223372036854775808 to 9223372036854775807		Pulse																
ID	Data range	Display range	Unit																
10	Bit63 to Bit32	H.8000 L.0000 to H.7FFF L.FFFF	×2 ³² Pulse																
11	Bit31 to Bit0	H.0000 L.0000 to H.FFFF L.FFFF	Pulse																
12 13	Command position monitor [CPMON]																		
	■ Displays the current position of the pulse command that has the origin as the position at the time the control power was turned ON. As this is a free run counter, if the current position exceeds the displayed range, the maximum reverse polarity value will be displayed. ◆ Setup software displays the data to ID12. <table><tr><td colspan="2">Display range</td><td>Unit</td></tr><tr><td colspan="2">-9223372036854775808 to 9223372036854775807</td><td>Pulse</td></tr></table> ◆ Digital operator displays the data to ID12, ID13 by hexadecimal notation (32-bit data). <table><tr><td>ID</td><td>Data range</td><td>Display range</td><td>Unit</td></tr><tr><td>12</td><td>Bit63 to Bit32</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>×2³² Pulse</td></tr><tr><td>13</td><td>Bit31 to Bit0</td><td>H.0000 L.0000 to H.FFFF L.FFFF</td><td>Pulse</td></tr></table>	Display range		Unit	-9223372036854775808 to 9223372036854775807		Pulse	ID	Data range	Display range	Unit	12	Bit63 to Bit32	H.8000 L.0000 to H.7FFF L.FFFF	×2 ³² Pulse	13	Bit31 to Bit0	H.0000 L.0000 to H.FFFF L.FFFF	Pulse
	Display range		Unit																
	-9223372036854775808 to 9223372036854775807		Pulse																
ID	Data range	Display range	Unit																
12	Bit63 to Bit32	H.8000 L.0000 to H.7FFF L.FFFF	×2 ³² Pulse																
13	Bit31 to Bit0	H.0000 L.0000 to H.FFFF L.FFFF	Pulse																
14	Position deviation monitor [PMON]																		
	■ Displays the position deviation value. ◆ Setup software displays values in decimal notation. <table><tr><td>Display range</td><td>Unit</td></tr><tr><td>-2147483648 to 2147483647</td><td>Pulse</td></tr></table> ◆ Digital operator displays values in hexadecimal notation. <table><tr><td>ID</td><td>Data range</td><td>Display range</td><td>Unit</td></tr><tr><td>14</td><td>Bit31 to Bit0</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>Pulse</td></tr></table>	Display range	Unit	-2147483648 to 2147483647	Pulse	ID	Data range	Display range	Unit	14	Bit31 to Bit0	H.8000 L.0000 to H.7FFF L.FFFF	Pulse						
	Display range	Unit																	
	-2147483648 to 2147483647	Pulse																	
ID	Data range	Display range	Unit																
14	Bit31 to Bit0	H.8000 L.0000 to H.7FFF L.FFFF	Pulse																

5.5 Monitor function

ID	Description							
15	Velocity monitor [VMON]							
	■ Displays the move speed of the linear motor.							
	◆ Setup software displays values in decimal notation.							
	<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-2147483648 to 2147483647</td><td>mm/s</td></tr></table>	Display range	Unit	-2147483648 to 2147483647	mm/s			
	Display range	Unit						
-2147483648 to 2147483647	mm/s							
◆ Digital operator displays values in hexadecimal notation.								
<table><tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr><tr><td>15</td><td>Bit31 to Bit0</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>mm/s</td></tr></table>	ID	Data range	Display range	Unit	15	Bit31 to Bit0	H.8000 L.0000 to H.7FFF L.FFFF	mm/s
ID	Data range	Display range	Unit					
15	Bit31 to Bit0	H.8000 L.0000 to H.7FFF L.FFFF	mm/s					
16	Velocity command monitor [VCMON]							
	■ Displays the velocity command value.							
	◆ Setup software displays values in decimal notation.							
	<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-2147483648 to 2147483647</td><td>mm/s</td></tr></table>	Display range	Unit	-2147483648 to 2147483647	mm/s			
	Display range	Unit						
-2147483648 to 2147483647	mm/s							
◆ Digital operator displays values in hexadecimal notation.								
<table><tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr><tr><td>16</td><td>Bit31 to Bit0</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>mm/s</td></tr></table>	ID	Data range	Display range	Unit	16	Bit31 to Bit0	H.8000 L.0000 to H.7FFF L.FFFF	mm/s
ID	Data range	Display range	Unit					
16	Bit31 to Bit0	H.8000 L.0000 to H.7FFF L.FFFF	mm/s					
17	Force monitor [TMON]							
	■ Displays the output force of linear motor.							
	<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-499.9 to 499.9</td><td>%</td></tr></table>	Display range	Unit	-499.9 to 499.9	%			
Display range	Unit							
-499.9 to 499.9	%							
18	Force command monitor [TCMON]							
	■ Displays the force command value.							
	<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-499.9 to 499.9</td><td>%</td></tr></table>	Display range	Unit	-499.9 to 499.9	%			
Display range	Unit							
-499.9 to 499.9	%							
19	Acceleration monitor [ACCMON]							
	■ Displays the linear motor acceleration.							
	◆ Setup software displays values in decimal notation.							
	<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-2147483648 to 2147483647</td><td>mm/s²</td></tr></table>	Display range	Unit	-2147483648 to 2147483647	mm/s ²			
	Display range	Unit						
-2147483648 to 2147483647	mm/s ²							
◆ Digital operator displays values in hexadecimal notation.								
<table><tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr><tr><td>19</td><td>Bit31 to Bit0</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>mm/s²</td></tr></table>	ID	Data range	Display range	Unit	19	Bit31 to Bit0	H.8000 L.0000 to H.7FFF L.FFFF	mm/s ²
ID	Data range	Display range	Unit					
19	Bit31 to Bit0	H.8000 L.0000 to H.7FFF L.FFFF	mm/s ²					

5. Operation

ID	Description										
1A	Load force monitor (Estimate value) [MTLMON-EST]										
	■ Displays the estimated value of load torque.										
	<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-499.9 to 499.9</td><td>%</td></tr></table>		Display range	Unit	-499.9 to 499.9	%					
Display range	Unit										
-499.9 to 499.9	%										
30	Position command pulse frequency monitor [FMON1]										
	■ Displays the entered command pulse frequency.										
	◆ Setup software displays values in decimal notation.										
	<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-2147483648 to 2147483647</td><td>kPulse/s</td></tr></table>		Display range	Unit	-2147483648 to 2147483647	kPulse/s					
	Display range	Unit									
-2147483648 to 2147483647	kPulse/s										
◆ Digital operator displays values in hexadecimal notation.											
<table><tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr><tr><td>30</td><td>Bit31 to Bit0</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>kPulse/s</td></tr></table>		ID	Data range	Display range	Unit	30	Bit31 to Bit0	H.8000 L.0000 to H.7FFF L.FFFF	kPulse/s		
ID	Data range	Display range	Unit								
30	Bit31 to Bit0	H.8000 L.0000 to H.7FFF L.FFFF	kPulse/s								
31	Analog velocity command/Analog force command input voltage monitor [VC/TC-IN]										
	■ Displays the entered command voltage.										
	◆ Displays with mV unit at the setup software.										
	<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-12000 to 12000</td><td>mV</td></tr></table>		Display range	Unit	-12000 to 12000	mV					
	Display range	Unit									
-12000 to 12000	mV										
◆ Displays with 10mV unit at the digital operator.											
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-1200 to 1200</td><td>×10mV</td></tr></table>		Display range	Unit	-1200 to 1200	×10mV						
Display range	Unit										
-1200 to 1200	×10mV										
32	Analog force addition command input voltage monitor [MTCOMP]										
	■ Displays the entered command voltage.										
	◆ Displays with mV unit at the setup software.										
	<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-12000 to 12000</td><td>mV</td></tr></table>		Display range	Unit	-12000 to 12000	mV					
	Display range	Unit									
-12000 to 12000	mV										
◆ Displays with 10mV unit at the digital operator.											
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-1200 to 1200</td><td>×10mV</td></tr></table>		Display range	Unit	-1200 to 1200	×10mV						
Display range	Unit										
-1200 to 1200	×10mV										

5.5 Monitor function

ID	Description																
33 34	Absolute encoder PS data monitor (motor encoder) [ABSPS]																
	■ Displays position data of absolute encoder. ◆ Setup software displays the data to ID33.<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 to FFFFFFFF</td><td>Pulse</td></tr></table> ◆ (Actual display range varies depending on the encoder specifications.) ◆ Digital operator displays the data to ID33, ID34 by hexadecimal notation (32-bit data).<table><tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr><tr><td>33</td><td>Bit63 to Bit32</td><td>H.0000 L.0000 to H.FFFF L.FFFF</td><td>$\times 2^{32}$ Pulse</td></tr><tr><td>34</td><td>Bit31 to Bit0</td><td>H.0000 L.0000 to H.FFFF L.FFFF</td><td>Pulse</td></tr></table>	Display range	Unit	0 to FFFFFFFF	Pulse	ID	Data range	Display range	Unit	33	Bit63 to Bit32	H.0000 L.0000 to H.FFFF L.FFFF	$\times 2^{32}$ Pulse	34	Bit31 to Bit0	H.0000 L.0000 to H.FFFF L.FFFF	Pulse
	Display range	Unit															
	0 to FFFFFFFF	Pulse															
	ID	Data range	Display range	Unit													
33	Bit63 to Bit32	H.0000 L.0000 to H.FFFF L.FFFF	$\times 2^{32}$ Pulse														
34	Bit31 to Bit0	H.0000 L.0000 to H.FFFF L.FFFF	Pulse														
35	Motor Encoder frequency monitor [MMOENCF]																
	■ Displays the linear encoder frequency of incremental encoder. ◆ Setup software displays values in decimal notation.<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-2147483648 to 2147483647</td><td>kPulse/s</td></tr></table> ◆ Digital operator displays values in hexadecimal notation.<table><tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr><tr><td>35</td><td>Bit31 to Bit0</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>kPulse/s</td></tr></table>	Display range	Unit	-2147483648 to 2147483647	kPulse/s	ID	Data range	Display range	Unit	35	Bit31 to Bit0	H.8000 L.0000 to H.7FFF L.FFFF	kPulse/s				
	Display range	Unit															
	-2147483648 to 2147483647	kPulse/s															
	ID	Data range	Display range	Unit													
35	Bit31 to Bit0	H.8000 L.0000 to H.7FFF L.FFFF	kPulse/s														
36	U-phase electric angle monitor [CSU]																
	■ Displays U-phase electric angle. Always displayed except when encoder errors. <table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 to 359</td><td>degree</td></tr></table>	Display range	Unit	0 to 359	degree												
Display range	Unit																
0 to 359	degree																
37	CS offset monitor [CS_OFFSET]																
	■ Displays the CS offset value. Updates the CS offset value to estimated value when the magnetic pole position estimation has performed. <table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 to 359</td><td>degree</td></tr></table>	Display range	Unit	0 to 359	degree												
Display range	Unit																
0 to 359	degree																
40	Regenerative resistor operation percentage monitor [RegP]																
	■ Displays the working ratio of regenerative resistor. <table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0.00 to 99.99</td><td>%</td></tr></table>	Display range	Unit	0.00 to 99.99	%												
Display range	Unit																
0.00 to 99.99	%																
41	Effective force monitor [TRMS]																
	■ Displays effective force. Depending on the operation pattern, it may take some hours to become stable. <table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 to 499</td><td>%</td></tr></table>	Display range	Unit	0 to 499	%												
Display range	Unit																
0 to 499	%																

* Please use following conversion to convert "Effective force monitor" or "Effective force monitor (Estimated value)" to Motor Operating Rate Monitor which used for RS1 amplifier.
 Motor Operating Rate Monitor [%] = (Effective force monitor display value [%] / 100)² x 100

5. Operation

ID	Description			
42	Effective force monitor (Estimated value) [ETRMS]			
	■ Displays the effective force estimation value. Estimates from short time operation. This can be confirmed shortly if the same operation pattern is repeated.			
	<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 to 499</td><td>%</td></tr></table>	Display range	Unit	0 to 499
Display range	Unit			
0 to 499	%			
44	Vbus monitor [VBUS]			
	■ Displays the dc value at main circuit.			
	<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 to 1000</td><td>V</td></tr></table>	Display range	Unit	0 to 1000
Display range	Unit			
0 to 1000	V			
46	Amplifier temperature monitor [MATEMP]			
	■ Displays internal temperature of servo amplifier.			
	<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-15 to 150</td><td>degree C</td></tr></table> ◆ Internal temperature of servo amplifier is the point near to power device.	Display range	Unit	-15 to 150
Display range	Unit			
-15 to 150	degree C			
47	Amplifier Operation Time [RUNTIM]			
	■ Displays the total time of control power ON.			
	<table><tr><th>Display format</th></tr><tr><td>Hour (h) : Minute (mm) : Second (ss) . Millisecond (ms)</td></tr></table> ◆ See "7.3 Setting and display range" for the digital operator display.	Display format	Hour (h) : Minute (mm) : Second (ss) . Millisecond (ms)	
Display format				
Hour (h) : Minute (mm) : Second (ss) . Millisecond (ms)				
4C	Regenerative power monitor [RegPOW]			
	■ Displays the consumption power of regenerative resistor.			
	<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 to 4294967.295</td><td>W</td></tr></table>	Display range	Unit	0 to 4294967.295
Display range	Unit			
0 to 4294967.295	W			

5.5 Monitor function

ID	Description											
50	Load mass ratio monitor [JRAT MON]											
	■ Displays the present load mass ratio. Value can check when using gain switching and auto-tuning function.											
51	Model Control Gain monitor [MKP MON]											
	■ Displays the present Model Control Gain. Value can check when using gain switching and auto-tuning function.											
52	Position Loop Proportional Gain monitor [KP MON]											
	■ Displays the present Position Loop Proportional Gain. Value can check when using gain switching and auto-tuning function.											
53	Position Loop Integral Time Constant monitor [TPI MON]											
	■ Displays the present Position Loop Integral Time Constant. Value can check when using gain switchinga function.											
54	Velocity Loop Proportional Gain monitor [KVP MON]											
	■ Displays the present Velocity Loop Proportional Gain. Value can check when using gain switching and auto-tuning function.											
55	Velocity Loop Integral Time Constant monitor [TVI MON]											
	■ Displays the present Velocity Loop Integral Time Constant. Value can check when using gain switching and auto-tuning function.											
56	Force Command Filter monitor [TCFIL MON]											
	■ Displays the present Force Command Filter. Value can check when using gain switching and auto-tuning function.											
58	Frequency monitor E for adaptive notch filter [ADNFE MON]											
	■ Displays the adaptive notch filter frequency. <table><tr><th>Display range</th><th>Unit</th></tr><tr><td>100 to 1000,4000</td><td>Hz</td></tr></table>	Display range	Unit	100 to 1000,4000	Hz							
Display range	Unit											
100 to 1000,4000	Hz											
66	Axes-sync error monitor [SYNERR]											
	■ Displays position deviation error between own axis and counterpart axis. ◆ Setup software displays values in decimal notation. <table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-2147483648 to 2147483647</td><td>Pulse</td></tr></table> ◆ Digital operator displays values in hexadecimal notation. <table><tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr><tr><td>66</td><td>Bit31 to Bit0</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>Pulse</td></tr></table>	Display range	Unit	-2147483648 to 2147483647	Pulse	ID	Data range	Display range	Unit	66	Bit31 to Bit0	H.8000 L.0000 to H.7FFF L.FFFF
Display range	Unit											
-2147483648 to 2147483647	Pulse											
ID	Data range	Display range	Unit									
66	Bit31 to Bit0	H.8000 L.0000 to H.7FFF L.FFFF	Pulse									

5. Operation

ID	Description			
70	Remaining life of relay for an inrush current prevention [RSRLYLF]			
	■ Displays the remaining life of relay for an inrush current prevention.			
	<table> <tr> <th>Display range</th><th>Unit</th></tr> <tr> <td>0 to 100.00</td><td>%</td></tr> </table>	Display range	Unit	0 to 100.00
Display range	Unit			
0 to 100.00	%			
71	Remaining life of relay for a dynamic brake [DBRLYLF]			
	■ Displays the remaining life of relay for a dynamic brake.			
	<table> <tr> <th>Display range</th><th>Unit</th></tr> <tr> <td>0 to 100.00</td><td>%</td></tr> </table>	Display range	Unit	0 to 100.00
Display range	Unit			
0 to 100.00	%			
73	Error rate of motor encoder communication [MOTE-ERRAT]			
	■ Displays the error rate of motor encoder communication. It shows error count ratio against communication count per second.			
	<table> <tr> <th>Display range</th><th>Unit</th></tr> <tr> <td>0.000000 to 1.000000</td><td>-</td></tr> </table>	Display range	Unit	0.000000 to 1.000000
Display range	Unit			
0.000000 to 1.000000	-			

5.6 Analog monitor and digital monitor

5.6 Analog monitor and digital monitor

All signals and internal status of the servo amplifier can be monitored by using the dedicated Monitor Box and cable. See "12.6 Optional parts" for the details of monitor box and dedicated cable.

Analog monitor output 1 is output also from "CN1-pin30".

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

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

5. Operation

5.7 Setting parameters

5.7.1 Parameters list

Below is the parameters list that classified to each Group and put in ID order. "System parameters", "General parameters" and "Motor parameters" are retained in the servo amplifier by running the parameter back-up function, and they can reload as needed.

See another manual: M0010842 for the setup software operation.

■ General parameters group list

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

* Parameters vary depending on the servo amplifier to be used.

* Setup software does not display invalid parameters.
The Digital Operator cannot change the setting value.

■ General parameters Group0 "Auto-tuning settings"

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

* M = Model following control type, P = Position control type, V = Velocity control type, T = Force control type

5.7 Settnig parameters

■ General parameters Group1 "Basic control parameter settings"

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

* M = Model following control type, P = Position control type, V = Velocity control type, T = Force control type

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

5. Operation

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

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

* M = Model following control type, P = Position control type, V = Velocity control type, T = Force control type

5.7 Settnig parameters

■ General parameters Group3 "Model following control settings"

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

* M = Model following control type, P = Position control type, V = Velocity control type,
T = Force control type

5. Operation

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

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

- * M = Model following control type, P = Position control type, V = Velocity control type, T = Force control type

- General parameters Group5 "High settling control settings"

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

- * P = Position control type

5.7 Settnig parameters

■ General parameters Group8 "Control system settings"

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

* M = Model following control type, P = Position control type, V = Velocity control type, T = Force control type

5. Operation

■ General parameters Group9 "Function enabling condition settings"

ID	Symbol	Name	Control mode	Default value	Setting range
00	F-OT	Positive Over Travel Function	M,P,V,T	0D:CONT6_OFF	00 to 29
01	R-OT	Negative Over Travel Function	M,P,V,T	0B:CONT5_OFF	00 to 29
02	AL-RST	Alarm Reset Function	M,P,V,T	10:CONT8_ON	00 to 29
03	ECLR	Encoder Clear Function	M,P,V,T	06:CONT3_ON	00 to 29
04	CLR	Deviation Clear Function	M,P	08:CONT4_ON	00 to 29
05	S-ON	Servo-ON Function	M,P,V,T	02:CONT1_ON	00 to 29
10	MS	Control Mode Switching Function	P,V,T	00:Always_Disable	00 to 29
11	INH/Z-STP	Position Command Pulse Inhibit Function, Velocity Command Zero Clamp Function	M,P,V	00:Always_Disable	00 to 29
12	GERS	Electronic Gear Switching Function	M,P	00:Always_Disable	00 to 29
13	GC1	Gain Switching Condition 1	M,P,V,T	00:Always_Disable	00 to 29
14	GC2	Gain Switching Condition 2	M,P,V,T	00:Always_Disable	00 to 29
15	SUPFSEL1	FF Vibration Suppression Frequency Select Input A1	M,P	00:Always_Disable	00 to 29
16	SUPFSEL2	FF Vibration Suppression Frequency Select Input A2	M,P	00:Always_Disable	00 to 29
17	SUPFSELB1	FF Vibration Suppression Frequency Select Input B1	M,P	00:Always_Disable	00 to 29
18	SUPFSELB2	FF Vibration Suppression Frequency Select Input B2	M,P	00:Always_Disable	00 to 29
19	PLPCON	Position Loop Proportional Control Switching Function	P	01:Always_Enable	00 to 29
1A	MODEL	Model following (vibration suppression) control/ standard position control switching function	M	00:Always_Disable	00 to 11
1B	MDLFSEL1	Model Vibration Suppression Frequency Select Input 1	M	00:Always_Disable	00 to 29
1C	MDLFSEL2	Model Vibration Suppression Frequency Select Input 2	M	00:Always_Disable	00 to 29
1D	CSET	Magnetic pole position estimation function	M,P,V,T	06:CONT3_ON	00 to 29
20	SP1	Preset Velocity Command Select Input 1	V	00:Always_Disable	00 to 29
21	SP2	Preset Velocity Command Select Input 2	V	00:Always_Disable	00 to 29
22	SP3	Preset Velocity Command Select Input 3	V	00:Always_Disable	00 to 29
23	DIR	Preset Velocity Command Operation Direction Select Input	V	00:Always_Disable	00 to 29
24	RUN	Preset Velocity Command Operation Start Signal Input	V	00:Always_Disable	00 to 29
25	RUN-F	Preset Velocity Command Positive (direction) Move Start Signal Input	V	00:Always_Disable	00 to 29
26	RUN-R	Preset Velocity Command Negative (direction) Move Start Signal Input	V	00:Always_Disable	00 to 29
27	VLPCON	Velocity Loop Proportional Control Switching Function	P,V	04:CONT2_ON	00 to 29
28	V-COMPS	Velocity Compensation Function	P	00:Always_Disable	00 to 29
30	T-COMPS1	Force Compensation Function 1	P,V	00:Always_Disable	00 to 29
31	T-COMPS2	Force Compensation Function 2	P,V	00:Always_Disable	00 to 29
32	TL	Force Limit Function	M,P,V,T	0E:CONT7_ON	00 to 29
33	OBS	Disturbance Observer Function	M,P,V	00:Always_Disable	00 to 29
34	STC	Stick-slip behavior compensation function	M,P,V,T	00:Always_Disable	00 to 29
35	FBHYST	Minor vibration (oscillation) suppression function	M,P,V,T	00:Always_Disable	00 to 29
40	EXT-E	External Trip Input Function	M,P,V,T	00:Always_Disable	00 to 29
41	EMR	Emergency Stop Function	M,P,V,T	00:Always_Disable	00 to 29
80	SYNCEN	Axes-sync compensation function	P	00:Always_Disable	00 to 11
81	SYNPCNEN	Axes-sync compensation proportional control switching function	P	00:Always_Disable	00 to 29

* M = Model following control type, P = Position control type, V = Velocity control type, T = Force control type

5.7 Settnig parameters

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

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

* M = Model following control type, P = Position control type, V = Velocity control type, T = Force control type

- General parameters GroupB "Sequence/Alarm related settings"

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

* M = Model following control type, P = Position control type, V = Velocity control type, T = Force control type

5. Operation

■ General parameters GroupC "Encoder related settings"

ID	Symbol	Name	Control mode	Default value	Unit	Setting range
00	ENFIL	Motor Incremental Encoder Digital Filter	M,P,V,T	01:220ns	—	00 to 07
01	EX-ENFIL	External Pulse Encoder Digital Filter	M,P,V,T	01:220ns	—	00 to 07
02	EX-ENPOL	External Pulse Encoder Polarity Selection	M,P,V,T	00:Type1	—	00 to 07
03	PULOUTSEL	Encoder Output Pulse Divide Selection	M,P,V,T	00:Motor_Enc	—	00 to 01
04	ENRAT	Encoder Output Pulse Division	M,P,V,T	1/1	—	1/32768 to 1/1
05	PULOUTPOL	Encoder Output Pulse Divide Polarity	M,P,V,T	00:Type1	—	00 to 03
06	PULOUTRES	Encoder Output Pulse Divide Resolution Selection	M,P,V,T	00:32768P/R	—	00 to 01
07	PSOFORM	Encoder Signal Output (PS) Format	M,P,V,T	00:MOT_Binary	—	00 to 04
09	ENCDIR	Linear encoder polarity selection	M,P,V,T	00:Standard	—	00 to 01
0A	CSETMD	Magnetic pole position estimation mode selection	M,P,V,T	00:Normal	—	00 to 01
10	DE1MSKLV	Broken wire mask level at Encoder connector 1	M,P,V,T	0	kHz	0 to 65535
11	DE3MSKLV	Broken wire mask level at Encoder connector 2	M,P,V,T	0	kHz	0 to 65535

* M = Model following control type, P = Position control type, V = Velocity control type, T = Force control type

■ General parameters GroupD "Support function related settings"

ID	Symbol	Name	Control mode	Default value	Unit	Setting range
00	JOGVC	JOG Velocity Command	M,P,V,T	50	min ⁻¹	0 to 32767
01	EMPFREQ	Excitation command frequency set value	M,P,V,T	50	Hz	30 to 70
02	TSTTCLM	Support function force limit value	M,P,V,T	120.0	%	10.0 to 500.0
10	COMAXIS	Serial Communication Axis Number	M,P,V,T	01:#1	—	01 to 0F
11	MONDISP	Monitor Display Selection	M,P,V,T	00:STATUS	—	00 to 73
20	SAMPDIV	Drec. sampling rate	M,P,V,T	20	—	0 to 65535
21	SAMPNUM	Drec. sampling mode	M,P,V,T	00:256point	—	00 to 02
22	TRGCHSEL	Drec. Trigger Channel	M,P,V,T	83:DIGITAL_4	—	00 to 83
23	TRGEDGSEL	Drec. Trigger Slope	M,P,V,T	00:POS_EDGE	—	00 to 02
24	TRGHPOS	Drec. Trigger Horizontal Position	M,P,V,T	80	%	0 to 100
25	TRGLVL	Drec. Trigger Level	M,P,V,T	1	—	-9223372036854775808 to 9223372036854775807
31	CH1SEL	Drec. Analog CH1 selection	M,P,V,T	08:PCMD1	—	00 to 22, FF
32	CH2SEL	Drec. Analog CH2 selection	M,P,V,T	01:VCMON	—	00 to 22, FF
33	CH3SEL	Drec. Analog CH3 selection	M,P,V,T	03:TCMON	—	00 to 22, FF
34	CH4SEL	Drec. Analog CH4 selection	M,P,V,T	15:VBUS	—	00 to 22, FF
35	CH5SEL	Drec. Analog CH5 selection	M,P,V,T	05:POSITION	—	00 to 22, FF
36	CH6SEL	Drec. Analog CH6 selection	M,P,V,T	00:VMON	—	00 to 22, FF
37	DCH1SEL	Drec. Digital CH1 selection	M,P,V,T	16:SRDY	—	00 to 22, FF
38	DCH2SEL	Drec. Digital CH2 selection	M,P,V,T	15:SACT	—	00 to 20, FF
39	DCH3SEL	Drec. Digital CH3 selection	M,P,V,T	1B:WRG-DF	—	00 to 20, FF
3A	DCH4SEL	Drec. Digital CH4 selection	M,P,V,T	1C:ALM	—	00 to 20, FF

* M = Model following control type, P = Position control type, V = Velocity control type, T = Force control type

5.7 Settnig parameters

■ Basic parameters

ID	Symbol	Name	Control mode	Remarks	
00	COMAXIS	Serial Communication Axis Number	M,P,V,T	This is common with GroupD ID10	
01	TUNMODE	Tuning Mode	M,P,V,T	This is common with Group0 ID00	
02	ATRES	Auto-Tuning Response	M,P,V,T	This is common with Group0 ID02	
03	PCSMT	Position Command Smoothing Constant	M,P	This is common with Group1 ID00	
04	PCFIL	Position Command Filter	M,P	This is common with Group1 ID01	
05	B-GER1	Electronic Gear 1 Numerator	M,P	This is common with Group8 ID13	
06	A-GER1	Electronic Gear 1 Denominator	M,P	This is common with Group8 ID14	
07	INP	In-Position Window	M,P	This is common with Group8 ID41	
08	F-OT	Positive Over Travel Function	M,P,V,T	This is common with Group9 ID00	
09	R-OT	Negative Over Travel Function	M,P,V,T	This is common with Group9 ID01	
0A	AL-RST	Alarm Reset Function	M,P,V,T	This is common with Group9 ID02	
0B	ECLR	Encoder Clear Function	M,P,V,T	This is common with Group9 ID03	
0C	CLR	Deviation Clear Function	M,P	This is common with Group9 ID04	
0D	S-ON	Servo-ON Function	M,P,V,T	This is common with Group9 ID05	
0E	TL	Force Limit Function	M,P,V,T	This is common with Group9 ID32	
0F	JOGVC	JOG Velocity Command	M,P,V,T	This is common with GroupD ID00	
10	ENRAT	Encoder output frequency pulse dividing	M,P,V,T	This is common with GroupC ID04	
11		Offset Adjustment of Velocity/ Force Command	P,V,T	Setting range	-9999 to 9999
12		Offset Adjustment of Analog Force Compensation Command	P,V	Setting range	-9999 to 9999

- * "Basic parameters" is able to set by the Digital operator.
- * M = Model following control type, P = Position control type, V = Velocity control type, T = Force control type

5.8 Parameter functions

- Group0 "Auto-tuning settings"

5-53

5.8 Parameter functions

—Group0—

ID	Contents																											
	Auto-Tuning Characteristic [ATCHA]		Setting range	Unit																								
			00 to 06	-																								
			Default																									
			00:Positioning1																									
01	■ Set the suitable parameters for each control method.																											
	<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Positioning1</td><td>Positioning Control 1 (General Purpose)</td></tr><tr><td>01</td><td>Positioning2</td><td>Positioning Control 2 (High Response)</td></tr><tr><td>02</td><td>Positioning3</td><td>Positioning Control 3 (High Response, FFGN Manual Setting)</td></tr><tr><td>03</td><td>Positioning4</td><td>Positioning Control 4 (High Response, Horizontal Axis Limited)</td></tr><tr><td>04</td><td>Positioning5</td><td>Positioning Control 5 (High Response, Horizontal Axis Limited, FFGN Manual Setting)</td></tr><tr><td>05</td><td>Trajectory1</td><td>Trajectory Control 1</td></tr><tr><td>06</td><td>Trajectory2</td><td>Trajectory Control 2 (KP,FFGN Manual Setting)</td></tr></table>				Selection		Contents	00	Positioning1	Positioning Control 1 (General Purpose)	01	Positioning2	Positioning Control 2 (High Response)	02	Positioning3	Positioning Control 3 (High Response, FFGN Manual Setting)	03	Positioning4	Positioning Control 4 (High Response, Horizontal Axis Limited)	04	Positioning5	Positioning Control 5 (High Response, Horizontal Axis Limited, FFGN Manual Setting)	05	Trajectory1	Trajectory Control 1	06	Trajectory2	Trajectory Control 2 (KP,FFGN Manual Setting)
	Selection		Contents																									
	00	Positioning1	Positioning Control 1 (General Purpose)																									
	01	Positioning2	Positioning Control 2 (High Response)																									
	02	Positioning3	Positioning Control 3 (High Response, FFGN Manual Setting)																									
	03	Positioning4	Positioning Control 4 (High Response, Horizontal Axis Limited)																									
	04	Positioning5	Positioning Control 5 (High Response, Horizontal Axis Limited, FFGN Manual Setting)																									
	05	Trajectory1	Trajectory Control 1																									
	06	Trajectory2	Trajectory Control 2 (KP,FFGN Manual Setting)																									
	◆ “Positioning Control 1”																											
	● Select for general purpose positioning.																											
	● Use this parameter at Velocity control mode or Force control mode.																											
	● Can be used for an axis which affected by gravity or external forces.																											
	◆ “Positioning Control 2”																											
	● Use this parameter at Position control mode.																											
	● Can be suppressed overshoot at positioning use, it will shorten positioning settling time.																											
	● Can be used for an axis which affected by gravity or external forces.																											
	◆ “Positioning Control 3”																											
	● Select for the purpose of manual tuning of FFGN.																											
◆ “Positioning Control 4”																												
● Select this mode when the machine movement is in horizontal axis and receives no impacts from external force.																												
● Positioning-settling time may shorten compared to “Positioning Control 2”.																												
● Use this parameter at Position control mode.																												
● Do not use for an axis which affected by gravity or external forces.																												
● This parameter may give shock to the application.																												
◆ “Positioning Control 5”																												
● Select for the purpose of manual tuning of FFGN when the machine movement is in horizontal axis and receives no impacts from external force.																												
● Positioning-settling time may shorten compared to “Positioning Control 3”.																												
● This parameter may give shock to the application.																												
◆ “Trajectory Control 1”																												
● This is the setting for tracking a position command from host unit as machining.																												
● Use this parameter at Position control mode.																												
● Can be used for an axis which affected by gravity or external forces.																												
● Select this parameter for single axis or asynchronous use.																												
● Select "Trajectory Control 2" when cooperating with other axes.																												
● The positioning characteristics will change when the “Position Loop Gain” is altered with fluctuation of the estimated mass. If you want to avoid this change, please adopt “Trajectory Control 2” or use manual tuning.																												
◆ “Trajectory Control 2”																												
● This is the setting for syncing a response of each axis position loop as cooperation with the other axes.																												
● Use this parameter at Position control mode.																												
● Can be used for an axis which affected by gravity or external forces.																												
* When "Trajectory control" is used, do not set "Model following vibration suppression control" to "ID07 Position Control Selection". By setting "Model following vibration suppression control", trajectory will get deviation.																												

5. Operation

—Group0—

ID	Contents											
02	Auto-Tuning Response [ATRES]	Setting range	Unit	Default								
		1 to 40	-	5								
	■ Sets the Auto-Tuning Response. ◆ The larger the set value, the higher the response. ◆ Caution, if the response is set too high, the machine may oscillate. ◆ Make the setting suited to rigidity of the device. ■ In case of following, set value will be 30 even if 31 to 40 are set. ◆ When "00: Positioning1" is set to Group0 ID01 Auto-Tuning Characteristic [ATCHA]. ◆ When "01: Enable" is set to Group0 ID04 Auto-Tuning characteristic compatible mode [ATCSEL].											
03	Auto-Tuning Automatic Parameter Saving [ATSAVE]	Setting range	Unit	Default								
		00 to 01	-	00:Auto_Saving								
	■ Select if the automatic parameter saving function is valid to save the Load mass ratio estimated by the servo amplifier Auto-tuning function in the Group1 ID14 Load Mass Ratio 1 [JRAT1]. ◆ This setting is valid when Group0 ID00 Tuning Mode is at "00: AutoTun Auto-tuning". ◆ Automatic save is done in every 30 minutes. <table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Auto_Saving</td><td>Automatically Saves in JRAT1</td></tr><tr><td>01</td><td>No_Saving</td><td>Automatic Saving is Invalid</td></tr></table>				Selection		Contents	00	Auto_Saving	Automatically Saves in JRAT1	01	No_Saving
Selection		Contents										
00	Auto_Saving	Automatically Saves in JRAT1										
01	No_Saving	Automatic Saving is Invalid										
04	Auto-Tuning characteristic compatible mode [ATCSEL]	Setting range	Unit	Default								
		00 to 01	-	00:Disable								
	■ Set "01: Enable Valid (RS2 compatible)" to set auto-tuning characteristic compatible with RS1/RS2 amplifier. In this case, gain set value will be 30 even if 31 to 40 are set. <table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Disable</td><td>Invalid</td></tr><tr><td>01</td><td>Enable</td><td>Valid (RS2 compatible)</td></tr></table>				Selection		Contents	00	Disable	Invalid	01	Enable
Selection		Contents										
00	Disable	Invalid										
01	Enable	Valid (RS2 compatible)										
10	Auto-Notch Filter Tuning Force Command [ANFILTC]	Setting range	Unit	Default								
		10.0 to 100.0	%	50.0								
	■ Sets the force value for excite the mechanical system during operation under "Auto-Notch Filter Tuning". * Larger value makes the tuning more accurate; however, note that it also makes the movement of the machine greater.											
20	Auto-FF Vibration Suppression Frequency Tuning Torque Command [ASUPTC]	Setting range	Unit	Default								
		10.0 to 100.0	%	25.0								
	■ Sets the force value for excite the mechanical system during operation under "Auto-FF Vibration Suppression Frequency Tuning". * Larger value makes the tuning more accurate; however, note that it also makes the movement of the machine greater.											
21	Auto-FF Vibration Suppression Frequency Tuning Friction Force Compensation Value [ASUPFC]	Setting range	Unit	Default								
		0.0 to 50.0	%	5.0								
	■ Sets the friction force compensation added to the motor force to excite the mechanical system at the time of Auto-FF Vibration Suppression Frequency Tuning. ◆ By setting this value close to actual friction force, Auto-FF vibration suppression frequency tuning will be more accurate. * When the set value is low, there may be cases that the vibration frequency of the mechanical system cannot be detected, or the wrong value is detected. Raise the value until the detected value settles.											

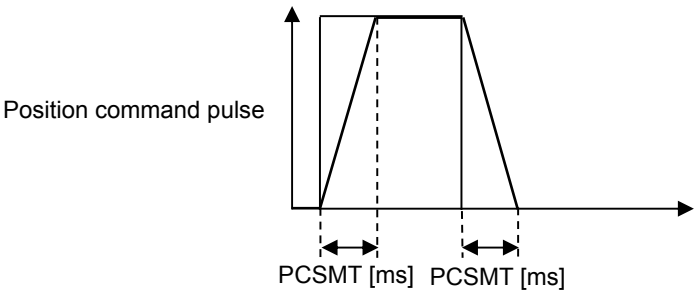
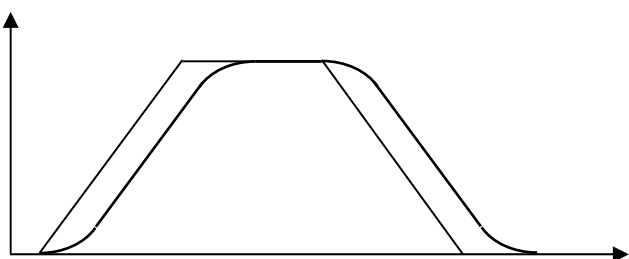
5.8 Parameter functions

—Group0—

ID	Contents													
34	Adaptive notch filter function E [ADNFE]		Setting range	Unit	Default									
			00 to 01	-	00: Adp_Filter Disable									
	■ This is the parameter which selects function of torque command notch filter E. By setting "01: Adp_Filter Enable Adaptation at all times", notch filter E will be adjusted to mechanical resonant frequency. When adaptive notch filter function is valid, Group2 ID29 will be fixed to 0. Group2 ID28 will work as initial value of adaptive notch filter.													
	<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Adp_Filter Disable</td><td>Adaptation invalid (TCNFILE manual setting)</td></tr><tr><td>01</td><td>Adp_Filter Enable</td><td>Adaptation at all times</td></tr></table>				Selection		Contents	00	Adp_Filter Disable	Adaptation invalid (TCNFILE manual setting)	01	Adp_Filter Enable	Adaptation at all times	
Selection		Contents												
00	Adp_Filter Disable	Adaptation invalid (TCNFILE manual setting)												
01	Adp_Filter Enable	Adaptation at all times												
35	Adaptive notch filter frequency upper limit E [ADNFUE]		Setting range	Unit	Default									
			100 to 1000	Hz	1000									
■ Sets adaptive notch filter frequency upper limit. Sets upper limit of mechanical variation. Please set higher value than ADNFE.														
36	Adaptive notch filter frequency lower limit E [ADNFLE]		Setting range	Unit	Default									
			100 to 1000	Hz	100									
■ Sets adaptive notch filter frequency lower limit. Sets lower limit of mechanical variation. Please set lower value than ADNFUE.														
37	Adaptive notch filter E auto saving [ADNSVE]		Setting range	Unit	Default									
			00 to 01	-	00:Auto_Saving									
■ Selects valid/invalid of the function that saves mechanical resonant frequency automatically which is estimated by the servo amplifier to force command notch filter E set value. ◆ This setting is valid when "01: Adp_Filter_Enable" is set to Group0 ID34. ◆ Estimation result is automatically saved in force command notch filter E in every 30 minutes.														
<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Auto_Saving</td><td>Save automatically</td></tr><tr><td>01</td><td>No_Saving</td><td>Without save</td></tr></table>						Selection		Contents	00	Auto_Saving	Save automatically	01	No_Saving	Without save
Selection		Contents												
00	Auto_Saving	Save automatically												
01	No_Saving	Without save												

5. Operation

■ Group1 "Basic control parameter settings"

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

5.8 Parameter functions

— Group1 —

ID	Contents			
01	Position Command Filter [PCFIL]	Setting range	Unit	Default
		0.0 to 2000.0	ms	0.0
02	Position Loop Proportional Gain 1 [KP1]	Setting range	Unit	Default
		1 to 3000	1/s	30
03	Position Loop Integral Time Constant 1 [TPI1]	Setting range	Unit	Default
		0.3 to 1000.0	ms	1000.0
04	Position loop phase lead compensation gain [PLPHLK]	Setting range	Unit	Default
		0 to 100	%	0
05	Position loop phase lead compensation frequency [PLPHLF]	Setting range	Unit	Default
		10 to 4000	Hz	500

01 This primary low-pass filter suppresses any sudden change of the position control pulse.
 Sets time constants.

- ◆ This parameter setting is valid when the value of Group1 ID08 Higher Tracking Control Position Compensation Gain is set at 0%.
- ◆ When Higher Tracking Control Position Compensation Gain is 0%, and this value is set at 0.0ms, the filter becomes invalid.
- ◆ This filter can suppress overshoot caused by the rise of the feed forward compensation gain.

PCFIL [ms] PCFIL [ms]

02 Proportional gain for position controller.

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

03 Integral time constant for position controller.
 This setting is valid when the Position Loop Proportional Control Switching Function is invalid.

- ◆ Integral term is invalid (proportional control) at the setting value 1000.0ms.
- ◆ When Gain switching function is valid, this setting value is applied by selecting gain 1.
- ◆ When Gain switching function is invalid, this setting value is applied.

04 Sets the phase improving value of Position loop phase lead compensation.

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

05 Sets the frequency that is wanted to improve the phase of position loop.

- ◆ Set value will limit 1,000Hz even if 1,000Hz or more is set.
- ◆ This parameter can set in 1 Hz unit, but it will be rounded down to the 10 Hz internally.
- * Please stop linear motor if change this value.

5. Operation

—Group1—

ID	Contents																			
06	Velocity Feed Forward Gain [FFGN]	Setting range	Unit	Default																
		0 to 100	%	0																
	■ Sets the feed forward compensation gain to position control system. ■ When "Model following control" is enabling, model velocity feed forward gain will be enabled and this parameter value will be disabled. ◆ This parameter will be valid when "Higher Tracking Control Position Compensation Gain" is set to 0%. ◆ Automatically overwrite by Auto-tuning result saving. ◆ The setting value is not applied when using the Auto-Tuning Characteristics listed below.																			
	<table><tr><td>Positioning1</td><td>Positioning Control 1 (General Purpose)</td></tr><tr><td>Positioning2</td><td>Positioning Control 2 (High Response)</td></tr><tr><td>Positioning4</td><td>Positioning Control 4 (High Response, Horizontal Axis Limited)</td></tr><tr><td>Trajectory1</td><td>Trajectory Control 1</td></tr></table>				Positioning1	Positioning Control 1 (General Purpose)	Positioning2	Positioning Control 2 (High Response)	Positioning4	Positioning Control 4 (High Response, Horizontal Axis Limited)	Trajectory1	Trajectory Control 1								
	Positioning1	Positioning Control 1 (General Purpose)																		
Positioning2	Positioning Control 2 (High Response)																			
Positioning4	Positioning Control 4 (High Response, Horizontal Axis Limited)																			
Trajectory1	Trajectory Control 1																			
07	Velocity Feed Forward Filter [FFFIL]	Setting range	Unit	Default																
		1 to 4000	Hz	4000																
	■ This is primary low-pass filter to eliminate pulsed ripple caused by the position command pulse included in the feed forward command. Sets the cutoff frequency. ■ When "Model following control" is enabling, model velocity feed forward will be enabled and this parameter value will be disabled.																			
	<table><tr><th colspan="2">Control cycle</th><th>Setting value</th><th>Valid/ Invalid</th></tr><tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling</td><td>1 to 1999Hz</td><td>Set value valid</td></tr><tr><td>2000 to 4000Hz</td><td>Filter invalid</td></tr><tr><td rowspan="2">01</td><td rowspan="2">High-freq_Sampling</td><td>1 to 1999Hz</td><td>Set value valid</td></tr><tr><td>2000 to 4000Hz</td><td>Filter invalid</td></tr></table>				Control cycle		Setting value	Valid/ Invalid	00	Standard_Sampling	1 to 1999Hz	Set value valid	2000 to 4000Hz	Filter invalid	01	High-freq_Sampling	1 to 1999Hz	Set value valid	2000 to 4000Hz	Filter invalid
	Control cycle		Setting value	Valid/ Invalid																
00	Standard_Sampling	1 to 1999Hz	Set value valid																	
		2000 to 4000Hz	Filter invalid																	
01	High-freq_Sampling	1 to 1999Hz	Set value valid																	
		2000 to 4000Hz	Filter invalid																	
08	Higher Tracking Control Position Compensation Gain [TRCPGN]	Setting range	Unit	Default																
		0 to 100	%	0																
	■ Adjusts command tracking performance of position control system. The larger value can raise command tracking performance higher. ◆ When set the value except 0%, "Position command filter" and "Velocity Feed forward gain" are set automatically in the servo amplifier. ◆ Automatically overwrite by Auto-tuning result saving. ◆ When Auto-tuning function is valid, this setting value not applied.																			
10	Velocity Command Filter [VCFIL]	Setting range	Unit	Default																
		1 to 4000	Hz	4000																
	■ This is primary low-pass filter to suppress sudden change of velocity command. Sets the cutoff frequency. Use External Velocity Command Filter when eliminating Analog velocity command noise. ◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.																			
	<table><tr><th colspan="2">Control cycle</th><th>Setting value</th><th>Valid/ Invalid</th></tr><tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling</td><td>1 to 1999Hz</td><td>Set value valid</td></tr><tr><td>2000 to 4000Hz</td><td>Filter invalid</td></tr><tr><td rowspan="2">01</td><td rowspan="2">High-freq_Sampling</td><td>1 to 3999Hz</td><td>Set value valid</td></tr><tr><td>4000Hz</td><td>Filter invalid</td></tr></table>				Control cycle		Setting value	Valid/ Invalid	00	Standard_Sampling	1 to 1999Hz	Set value valid	2000 to 4000Hz	Filter invalid	01	High-freq_Sampling	1 to 3999Hz	Set value valid	4000Hz	Filter invalid
	Control cycle		Setting value	Valid/ Invalid																
00	Standard_Sampling	1 to 1999Hz	Set value valid																	
		2000 to 4000Hz	Filter invalid																	
01	High-freq_Sampling	1 to 3999Hz	Set value valid																	
		4000Hz	Filter invalid																	

5.8 Parameter functions

— Group1 —

ID	Contents																			
11	Velocity Feedback Filter [VDFIL]		Setting range	Unit	Default															
			1 to 4000	Hz	1500															
	■ This is primary low-pass filter to eliminate ripples caused by encoder pulse included in the velocity control system feedback. Sets the cutoff frequency.																			
	◆ When the encoder resolution is low, lowering the setting value and suppressing the ripples may suppress motor drive noise. In addition, when the encoder resolution is high, raising the setting value may improve the response of the velocity control system. For general use, set at the Standard value.																			
	◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.																			
		<table><tr><th colspan="2">Control cycle</th><th>Setting value</th><th>Valid/ Invalid</th></tr><tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling</td><td>1 to 1999Hz</td><td>Set value valid</td></tr><tr><td>2000 to 4000Hz</td><td>Filter invalid</td></tr><tr><td rowspan="2">01</td><td rowspan="2">High-freq_Sampling</td><td>1 to 3999Hz</td><td>Set value valid</td></tr><tr><td>4000Hz</td><td>Filter invalid</td></tr></table>			Control cycle		Setting value	Valid/ Invalid	00	Standard_Sampling	1 to 1999Hz	Set value valid	2000 to 4000Hz	Filter invalid	01	High-freq_Sampling	1 to 3999Hz	Set value valid	4000Hz	Filter invalid
Control cycle		Setting value	Valid/ Invalid																	
00	Standard_Sampling	1 to 1999Hz	Set value valid																	
		2000 to 4000Hz	Filter invalid																	
01	High-freq_Sampling	1 to 3999Hz	Set value valid																	
		4000Hz	Filter invalid																	
12	Velocity Loop Proportional Gain 1 [KVP1]		Setting range	Unit	Default															
			1 to 2000	Hz	50															
	■ Proportional gain of velocity controller. When Load Mass Ratio 1 is same as the actual load mass, this setting value response is performed.																			
◆ Automatically overwrite by Auto-tuning result saving.																				
◆ When Auto-tuning function is valid, this setting value is not applied.																				
◆ When Gain switching function is valid, this setting value is applied by selecting gain 1.																				
◆ While system analysis function is active, this value is applied even if Auto-tuning is valid.																				
13	Velocity Loop Integral Time Constant 1 [TVI1]		Setting range	Unit	Default															
			0.3 to 1000.0	ms	20.0															
	■ Integral time constant of velocity controller. This setting value is valid when Velocity Loop Proportional Control Switching Function is invalid.																			
◆ Integral term is invalid (proportional control) with the setting value of 1000.0ms.																				
◆ Automatically overwrite by Auto-tuning result saving.																				
◆ When Auto-tuning function is valid, this setting value is not applied.																				
◆ When Gain switching function is valid, this setting value is applied by selecting gain 1.																				
◆ While system analysis function is active, this value is applied even if Auto-tuning is valid.																				

5. Operation

—Group1—

ID	Contents																		
	Load Mass Ratio 1 [JRAT1]	Setting range	Unit	Default															
		0 to 15000	%	100															
14	■ Sets the mass of the loading device to the linear motor mass. ◆ Setting value=$J_L/J_M \times 100\%$ ● J_L : Load mass ● J_M : Motor mass ◆ Automatically overwrite by Auto-tuning result saving. ◆ If this value matches the actual mechanical system, setting value of KVP will be the response frequency of the velocity control system. ◆ When Auto-Tuning Automatic Parameter Saving function is valid, this parameter is overwriting with an estimated result. ◆ When Auto-tuning Function is valid, this value is not applied. ◆ Use between the range of 100 to 3000% when driven with Model following vibration suppression control. ◆ When Gain switching function is valid, this setting value is applied by selecting gain 1. ◆ While system analysis function is active, this value is applied even if Auto-tuning is valid.																		
	Velocity loop phase lead compensation gain [VLPHLK]	Setting range	Unit	Default															
		0 to 100	%	0															
15	■ Sets the phase improving value of Velocity loop phase lead compensation. ◆ For velocity loop, adds the function that shifts phase on phase lead compensation frequency as 17deg by 50% and 35deg by 100%. Pay attention for gain increment after VLPHLF. ◆ This parameter will be disabled when 0% is set.																		
	Velocity loop phase lead compensation frequency [VLPHLF]	Setting range	Unit	Default															
		10 to 4000	Hz	500															
16	■ Sets the frequency that is wanted to improve the phase of velocity loop. ◆ This parameter can set in 1 Hz unit, but it will be rounded down to the 10 Hz internally. * Please stop linear motor if change this value.																		
	<table><tr><th colspan="2">Control cycle</th><th>Setting value</th><th>Compensation frequency</th></tr><tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling Standard sampling mode</td><td>1 to 1000Hz</td><td>Set value valid</td></tr><tr><td>1001 to 4000Hz</td><td>1000Hz</td></tr><tr><td rowspan="2">01</td><td rowspan="2">High-freq_Sampling Hi-speed sampling mode</td><td>1 to 2000Hz</td><td>Set value valid</td></tr><tr><td>2001 to 4000Hz</td><td>2000Hz</td></tr></table>				Control cycle		Setting value	Compensation frequency	00	Standard_Sampling Standard sampling mode	1 to 1000Hz	Set value valid	1001 to 4000Hz	1000Hz	01	High-freq_Sampling Hi-speed sampling mode	1 to 2000Hz	Set value valid	2001 to 4000Hz
Control cycle		Setting value	Compensation frequency																
00	Standard_Sampling Standard sampling mode	1 to 1000Hz	Set value valid																
		1001 to 4000Hz	1000Hz																
01	High-freq_Sampling Hi-speed sampling mode	1 to 2000Hz	Set value valid																
		2001 to 4000Hz	2000Hz																
	High order integral control gain [HKVIK]	Setting range	Unit	Default															
		0 to 100	%	0															
17	■ Sets the phase improving value of Velocity loop phase lead compensation. ◆ The larger value can change shorter velocity loop integral time constant. ◆ This parameter will be disabled when 0% is set.																		
	High order integral control frequency [HKVIF]	Setting range	Unit	Default															
		10 to 4000	Hz	500															
18	■ Sets when velocity loop integral time constant wants to be shorter. Sets the frequency that is wanted to improve the phase. * This parameter can set in 1 Hz unit, but it will be rounded down to the 10 Hz internally. * Please stop linear motor if change this value.																		
	<table><tr><th colspan="2">Control cycle</th><th>Setting value</th><th>Compensation frequency</th></tr><tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling Standard sampling mode</td><td>1 to 1000Hz</td><td>Set value valid</td></tr><tr><td>1001 to 4000Hz</td><td>1000Hz</td></tr><tr><td rowspan="2">01</td><td rowspan="2">High-freq_Sampling Hi-speed sampling mode</td><td>1 to 2000Hz</td><td>Set value valid</td></tr><tr><td>2001 to 4000Hz</td><td>2000Hz</td></tr></table>				Control cycle		Setting value	Compensation frequency	00	Standard_Sampling Standard sampling mode	1 to 1000Hz	Set value valid	1001 to 4000Hz	1000Hz	01	High-freq_Sampling Hi-speed sampling mode	1 to 2000Hz	Set value valid	2001 to 4000Hz
Control cycle		Setting value	Compensation frequency																
00	Standard_Sampling Standard sampling mode	1 to 1000Hz	Set value valid																
		1001 to 4000Hz	1000Hz																
01	High-freq_Sampling Hi-speed sampling mode	1 to 2000Hz	Set value valid																
		2001 to 4000Hz	2000Hz																

5.8 Parameter functions

— Group1 —

ID	Contents																					
19	Force Feed Forward Gain [TFFK]	Setting range	Unit	Default																		
		0 to 100	%	0																		
	■ Sets feed forward compensation gain to velocity control system. ◆ The setting value is not applied when "Position control selection " is "Model following control".																					
1A	Force feedforward averaging [TFFAVE]	Setting range	Unit	Default																		
		00 to 01	-	01: 4timesAverage																		
	■ Selects the average count of torque feedforward compensation.																					
	<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>2timesAverage</td><td>2 times average</td></tr><tr><td>01</td><td>4timesAverage</td><td>4 times average</td></tr></table>				Selection		Contents	00	2timesAverage	2 times average	01	4timesAverage	4 times average									
Selection		Contents																				
00	2timesAverage	2 times average																				
01	4timesAverage	4 times average																				
1B	Force feedforward output selection [TFFOUT]	Setting range	Unit	Default																		
		00 to 01	-	00:Before_filter																		
	■ Select the point that is to be added force feed forward compensation.																					
	<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Before_filter</td><td>Before force command filter</td></tr><tr><td>01</td><td>After_filter</td><td>After force command filter</td></tr></table>				Selection		Contents	00	Before_filter	Before force command filter	01	After_filter	After force command filter									
Selection		Contents																				
00	Before_filter	Before force command filter																				
01	After_filter	After force command filter																				
1C	Acceleration Feedback Gain [AFBK]	Setting range	Unit	Default																		
		-100.0 to 100.0	%	0.0																		
	■ Sets acceleration feedback compensation gain to make the velocity loop stable. Multiply this gain with the detected acceleration to compensate force command. ◆ Automatically overwrite by Auto-tuning result saving. ◆ When Auto-tuning function is valid, this setting value not applied. ◆ If the value is too large, the motor may oscillate. Sets within range ±15.0% for general use.																					
1D	Acceleration Feedback Filter [AFBFIL]	Setting range	Unit	Default																		
		1 to 4000	Hz	500																		
	■ This is primary low-pass filter to eliminate ripples caused by encoder pulse included in acceleration feedback compensation. Sets the cutoff frequency. ◆ Lower this setting value when the encoder resolution is low. ◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.																					
	<table><tr><th colspan="2">Control cycle</th><th>Setting value</th><th>Valid/ Invalid</th></tr><tr><td rowspan="2">00</td><td>Standard_Sampling</td><td>1 to 1999Hz</td><td>Set value valid</td></tr><tr><td>Standard sampling mode</td><td>2000 to 4000Hz</td><td>Filter invalid</td></tr><tr><td rowspan="2">01</td><td>High-freq_Sampling</td><td>1 to 3999Hz</td><td>Set value valid</td></tr><tr><td>Hi-speed sampling mode</td><td>4000Hz</td><td>Filter invalid</td></tr></table>				Control cycle		Setting value	Valid/ Invalid	00	Standard_Sampling	1 to 1999Hz	Set value valid	Standard sampling mode	2000 to 4000Hz	Filter invalid	01	High-freq_Sampling	1 to 3999Hz	Set value valid	Hi-speed sampling mode	4000Hz	Filter invalid
Control cycle		Setting value	Valid/ Invalid																			
00	Standard_Sampling	1 to 1999Hz	Set value valid																			
	Standard sampling mode	2000 to 4000Hz	Filter invalid																			
01	High-freq_Sampling	1 to 3999Hz	Set value valid																			
	Hi-speed sampling mode	4000Hz	Filter invalid																			
1E	Higher Tracking Control Velocity Compensation Gain [TRCVGN]	Setting range	Unit	Default																		
		0 to 100	%	0																		
	■ Adjusts command tracking performance of velocity control system. ◆ The larger value can raise command tracking performance higher. ◆ When using Velocity Loop Proportional Control Switching Function, set 0%. ◆ When synchronizing with other axes, set 0%. ◆ When corresponding with Q series servo amplifier, set 100%. ◆ Automatically overwrite by Auto-tuning result saving. ◆ When Auto-tuning function is valid, this setting value not applied. ◆ The setting value is invalid with "Model following control" or "Model following vibration suppression control".																					

5. Operation

—Group1—

ID	Contents																						
20	Force Command Filter 1 [TCFIL1]		Setting range	Unit	Default																		
			1 to 4000	Hz	600																		
	■ This is Low-pass filter to eliminate high frequency component included in the force command. Sets cutoff frequency. ◆ Automatically overwrite by Auto-tuning result saving. ◆ When Auto-tuning function is valid, this setting value is not applied. ◆ When Gain switching function is valid, this setting value is applied by selecting gain 1. ◆ While system analysis function is active, this value is applied even if Auto-tuning is valid. ◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle. (Force command filter cannot be disabled)																						
	<table><tr><th colspan="2">Control cycle</th><th>Setting value</th><th>Cut off frequency</th></tr><tr><td rowspan="2">00</td><td>Standard_Sampling</td><td>1 to 2000Hz</td><td>Set value valid</td></tr><tr><td>Standard sampling mode</td><td>2001 to 4000Hz</td><td>2000Hz</td></tr><tr><td>01</td><td>High-freq_Sampling</td><td>1 to 4000Hz</td><td>Set value valid</td></tr><tr><td></td><td>Hi-speed sampling mode</td><td></td><td></td></tr></table>				Control cycle		Setting value	Cut off frequency	00	Standard_Sampling	1 to 2000Hz	Set value valid	Standard sampling mode	2001 to 4000Hz	2000Hz	01	High-freq_Sampling	1 to 4000Hz	Set value valid		Hi-speed sampling mode		
	Control cycle		Setting value	Cut off frequency																			
00	Standard_Sampling	1 to 2000Hz	Set value valid																				
	Standard sampling mode	2001 to 4000Hz	2000Hz																				
01	High-freq_Sampling	1 to 4000Hz	Set value valid																				
	Hi-speed sampling mode																						
Use within 1 to 1,000Hz with Model following control. Use within 100 to 1,000Hz with Model following vibration suppression control.																							
21	Force Command Filter Order [TCFILOR]		Setting range	Unit	Default																		
			1 to 3	Order	2																		
■ Sets order of the torque command filter. The order will be fixed with the set value even if the cut off frequency of force command filter is changed by Gain switching.																							
80	Axes-sync compensation proportional gain [KSCPGN]		Setting range	Unit	Default																		
			0 to 1000	%	0																		
■ Sets a rate of the axes-sync compensation value. ◆ When 100% is set, adds the axes-sync compensation pulse value to the position deviation without change. ◆ Vibration might occur if set value is too large.																							
81	Axes-sync compensation integral time constant [TSCIGN]		Setting range	Unit	Default																		
			0.5 to 1000.0	ms	1000.0																		
■ Sets an integral time constant for the axes-sync compensation. ◆ This set value will be valid when axes-sync compensation proportional control function is invalid. ◆ Integral term will be invalid (proportional control) when 1000.0ms is set.																							
82	Axes-sync compensation filter [SCFIL]		Setting range	Unit	Default																		
			0.0 to 1000.0	ms	0.0																		
■ Primary low pass filter that suppress sudden variation of axes-sync compensation value. ◆ Filter will be invalid when 0.0ms is set.																							

5.8 Parameter functions

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

ID	Contents													
00	FF Vibration Suppression Frequency A1 [SUPFRQA1]	Setting range	Unit	Default										
		1.0 to 500.0	0.1Hz	500.0										
	■ Sets the frequency of the machine vibration to be suppressed by FF vibration suppressor function. This parameter will be overwritten by executing Auto-FF Vibration Suppression Frequency Tuning.													
	◆ Please stop servo motor if change this value.													
	◆ Tuning result will be saved to this parameter automatically.													
	◆ This setting value works when "FF Vibration Suppression Frequency Select Input A1" is enabled.													
	◆ Do not use while synchronizing with other axis such as controlling XY table trajectory for cutting operation.													
	<table><tr><th>Setting range</th><th>Unit and process inside servo amplifier</th></tr><tr><td>1.0 to 9.9Hz</td><td>Valid by 0.1Hz</td></tr><tr><td>10.0 to 99.9Hz</td><td>Valid by 0.5Hz and drop less than 0.5</td></tr><tr><td>100.0 to 499.9Hz</td><td>Valid by 5Hz and drop less than 5</td></tr><tr><td>500.0Hz</td><td>FF vibration suppression control is invalid</td></tr></table>				Setting range	Unit and process inside servo amplifier	1.0 to 9.9Hz	Valid by 0.1Hz	10.0 to 99.9Hz	Valid by 0.5Hz and drop less than 0.5	100.0 to 499.9Hz	Valid by 5Hz and drop less than 5	500.0Hz	FF vibration suppression control is invalid
	Setting range	Unit and process inside servo amplifier												
	1.0 to 9.9Hz	Valid by 0.1Hz												
10.0 to 99.9Hz	Valid by 0.5Hz and drop less than 0.5													
100.0 to 499.9Hz	Valid by 5Hz and drop less than 5													
500.0Hz	FF vibration suppression control is invalid													
* FF vibration suppression control will be invalid during this parameter change, and servo motor will rotate until rest of internal position command of FF vibration suppression control has outputted.														
* If FF vibration suppression frequency is changed, the time which will be valid of changed value varies depending on the frequency before change.														
<table><tr><th>The frequency before change</th><th>The time which will be valid of changed value</th></tr><tr><td>5.0Hz or more</td><td>1 sec.</td></tr><tr><td>3.0Hz</td><td>3 sec.</td></tr><tr><td>1.0Hz</td><td>7 sec.</td></tr></table>				The frequency before change	The time which will be valid of changed value	5.0Hz or more	1 sec.	3.0Hz	3 sec.	1.0Hz	7 sec.			
The frequency before change	The time which will be valid of changed value													
5.0Hz or more	1 sec.													
3.0Hz	3 sec.													
1.0Hz	7 sec.													
01	FF Vibration Suppression Level Selection A [SUPLVA]	Setting range	Unit	Default										
		00 to 03	—	00										
	■ Sets the FF vibration suppression control effect level.													
02	FF Vibration Suppression Frequency B1 [SUPFRQB1]	Setting range	Unit	Default										
		1.0 to 500.0	0.1Hz	500.0										
	■ See FF Vibration Suppression Frequency A1.													
03	FF Vibration Suppression Level Selection B [SUPCRB]	Setting range	Unit	Default										
		00 to 01	—	00										
	■ Vibration suppression frequency range will be narrow at set frequency when 01 is set.													

5. Operation

—Group2—

10	ID	Contents		
	Velocity Command Notch Filter [VCNFIL]		Setting range	Unit
			50 to 1000	Hz
				Default
				1000
	■ This is notch filter to eliminate frequency element arbitrarily set from velocity command. Sets the resonant frequency. ◆ When sympathetic vibration occurs in velocity control system, the gain will be able to raise by setting the resonance frequency. ◆ Do not use while synchronizing with other axis such as controlling XY table trajectory for cutting operation. ◆ Invalid setting value varies depending on the setting of the system parameter ID00 Control Cycle. This parameter can set in 1 Hz unit, but the units listed below are applied internally.			
Control cycle		Setting value	Unit and process inside servo amplifier	
00	Standard_Sampling Standard sampling mode	50 to 99Hz	Valid by 1Hz	
		100 to 499Hz	Valid by 5Hz and drop less than 5	
		500 to 1000Hz	Filter invalid	
01	High-freq_Sampling Hi-speed sampling mode	50 to 199Hz	Valid by 1Hz	
		200 to 999Hz	Valid by 10Hz and drop less than 10	
		1000Hz	Filter invalid	

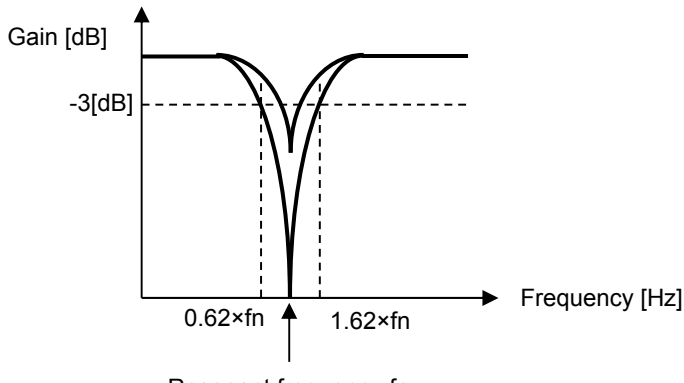
5.8 Parameter functions

—Group2—

ID	Contents																				
20	Force Command Notch Filter A [TCNFILA]		Setting range	Unit																	
			100 to 4000	Hz																	
			Default	4000																	
	■ This is notch filter to eliminate sympathetic vibration element included in force command. Sets the resonant frequency.																				
	◆ Invalid setting value varies depending on the setting of the system parameter ID00 Control Cycle.																				
	<table><tr><th colspan="2">Control cycle</th><th>Setting value</th><th>Unit and process inside servo amplifier</th></tr><tr><td rowspan="2">00</td><td>Standard_Sampling Standard sampling mode</td><td>100 to 1999Hz</td><td>Valid by 1Hz</td></tr><tr><td></td><td>2000 to 4000Hz</td><td>Filter invalid</td></tr><tr><td rowspan="2">01</td><td>High-freq_Sampling Hi-speed sampling mode</td><td>100 to 3999Hz</td><td>Valid by 1Hz</td></tr><tr><td></td><td>4000Hz</td><td>Filter invalid</td></tr></table>		Control cycle		Setting value	Unit and process inside servo amplifier	00	Standard_Sampling Standard sampling mode	100 to 1999Hz	Valid by 1Hz		2000 to 4000Hz	Filter invalid	01	High-freq_Sampling Hi-speed sampling mode	100 to 3999Hz	Valid by 1Hz		4000Hz	Filter invalid	
Control cycle		Setting value	Unit and process inside servo amplifier																		
00	Standard_Sampling Standard sampling mode	100 to 1999Hz	Valid by 1Hz																		
		2000 to 4000Hz	Filter invalid																		
01	High-freq_Sampling Hi-speed sampling mode	100 to 3999Hz	Valid by 1Hz																		
		4000Hz	Filter invalid																		
	This parameter is automatically saved by executing Notch filter tuning.																				
21	TCNFILA, Low Frequency Phase Delay Improvement [TCNFPA]		Setting range	Unit																	
			00 to 02	-																	
			Default	00																	
	■ Improves phase delay at lower frequency than resonant frequency of the Force Command Notch Filter A.																				
	◆ The larger the value is, the greater the improvement. ◆ Characteristic is same as the standard notch filter when the setting value is 0. ◆ Caution, other than the setting value 0, higher frequencies than the resonant frequency will be amplified.																				
	Gain [dB] -3 [dB] Frequency [Hz] Improvement No improvement Phase [deg] No improvement Improvement Frequency [Hz] 0.62×fn 1.62×fn Resonant frequency fn																				

5. Operation

—Group2—

ID	Contents																			
22	Force Command Notch Filter B [TCNFILB]	Setting range 100 to 4000	Unit Hz	Default 4000																
24	Force Command Notch Filter C [TCNFILC]	Setting range 100 to 4000	Unit Hz	Default 4000																
26	Force Command Notch Filter D [TCNFILD]	Setting range 100 to 4000	Unit Hz	Default 4000																
28	Force Command Notch Filter E [TCNFILE]	Setting range 100 to 4000	Unit Hz	Default 4000																
	■ This is notch filter to eliminate sympathetic vibration element included in force command. Sets the resonant frequency. ◆ Invalid "Force command notch filter" setting value varies depending on the setting of the system parameter ID00 Control Cycle. <table><thead><tr><th colspan="2">Control cycle</th><th>Setting value</th><th>Unit and process inside servo amplifier</th></tr></thead><tbody><tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling</td><td>100 to 1999Hz</td><td>Valid by 1Hz</td></tr><tr><td>2000 to 4000Hz</td><td>Filter invalid</td></tr><tr><td rowspan="2">01</td><td rowspan="2">High-freq_Sampling</td><td>100 to 3999Hz</td><td>Valid by 1Hz</td></tr><tr><td>4000Hz</td><td>Filter invalid</td></tr></tbody></table> ◆ The value set to Force Command Notch Filter E will be valid when "00: Adp_Filter Disable Adaptation invalid" is set to Group0 ID34 "Adaptive notch filter function E".				Control cycle		Setting value	Unit and process inside servo amplifier	00	Standard_Sampling	100 to 1999Hz	Valid by 1Hz	2000 to 4000Hz	Filter invalid	01	High-freq_Sampling	100 to 3999Hz	Valid by 1Hz	4000Hz	Filter invalid
Control cycle		Setting value	Unit and process inside servo amplifier																	
00	Standard_Sampling	100 to 1999Hz	Valid by 1Hz																	
		2000 to 4000Hz	Filter invalid																	
01	High-freq_Sampling	100 to 3999Hz	Valid by 1Hz																	
		4000Hz	Filter invalid																	
23	TCNFILB, Depth Selection [TCNFDB]	Setting range 0 to 15	Unit -	Default 0																
25	TCNFILC, Depth Selection [TCNFDC]	Setting range 0 to 15	Unit -	Default 0																
27	TCNFILD, Depth Selection [TCNFDD]	Setting range 0 to 15	Unit -	Default 0																
29	TCNFILE, Depth Selection [TCNFDE]	Setting range 0 to 15	Unit -	Default 0																
	■ Parameters to set the depth of each Force Command Notch Filter (TCNFILB to E). The larger the value is, the shallower the depth.  Gain [dB] -3[dB] 0.62×fn 1.62×fn Resonant frequency fn Frequency [Hz] ◆ The value set to TCNFILE, Depth Selection will be valid when "00: Adp_Filter Disable Adaptation invalid" is set to Group0 ID34 "Adaptive notch filter function E".																			

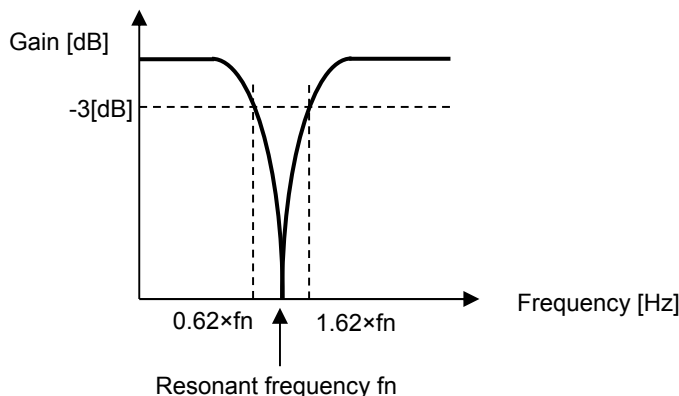
5.8 Parameter functions

—Group2—

ID	Contents														
30	Observer Characteristic [OBCHA]	Setting range	Unit	Default											
		00 to 02	—	00:Low											
	■ Selects frequency characteristic of the disturbance observer.														
	<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Low</td><td>For Low Frequency</td></tr><tr><td>01</td><td>Middle</td><td>For Middle Frequency</td></tr><tr><td>02</td><td>High</td><td>For High Frequency</td></tr></table> ◆ Select “00: Low, Low Frequency Disturbance Observer Suppressor” for Load force monitor (estimate value). ◆ Select 02: High, High Frequency Disturbance Observer Suppressor, when the encoder resolution is over 20000pulse/mm.				Selection		Contents	00	Low	For Low Frequency	01	Middle	For Middle Frequency	02	High
Selection		Contents													
00	Low	For Low Frequency													
01	Middle	For Middle Frequency													
02	High	For High Frequency													
31	Observer Compensation Gain [OBG]	Setting range	Unit	Default											
		0 to 100	%	0											
■ This is Compensation gain for Disturbance Observer. The larger the value is, the higher the suppression performance. However, if the value is too large, oscillation may sometimes occur.															
32	Observer Output Low-pass Filter [OBLPF]	Setting range	Unit	Default											
		1 to 4000	Hz	50											
	■ This is primary low-pass filter to eliminate high frequency elements included in the observer compensation. Sets the cutoff frequency. ◆ The larger the value is, the faster the response of disturbance observer suppression. However, it may cause a louder driving sound depending on the ripple components included in disturbance observer output. ◆ Filter is invalid at the setting value more than 2,000Hz. ◆ Filter is invalid when observer characteristic is set to “01: Middle, For Middle Frequency”, or “02: High, For High Frequency”.														

5. Operation

—Group2—

ID	Contents								
33	Observer Output Notch Filter [OBNFIL]	Setting range	Unit	Default					
		100 to 4000	Hz	4000					
	■ This is notch filter to eliminate arbitrarily selected frequency from observer compensation. Sets the resonant frequency. When resonance appears in disturbance observer output, such as sympathetic vibration with the mechanical system, this notch filter sometimes suppresses the vibration. ◆ This parameter can set in 1 Hz unit, but the units listed below are applied internally. <table><tr><th>Setting value</th><th>Unit and process inside servo amplifier</th></tr><tr><td>100 to 1999Hz</td><td>Valid by 10Hz and drop less than 10</td></tr><tr><td>2000 to 4000Hz</td><td>Filter invalid</td></tr></table> 				Setting value	Unit and process inside servo amplifier	100 to 1999Hz	Valid by 10Hz and drop less than 10	2000 to 4000Hz
Setting value	Unit and process inside servo amplifier								
100 to 1999Hz	Valid by 10Hz and drop less than 10								
2000 to 4000Hz	Filter invalid								
40	Effective velocity for compensating stick-slip behavior [STV]	Setting range	Unit	Default					
		0.1 to 128.0	mm/s	10.0					
	■ Sets the velocity at which stick-slip behavior compensatory function works. ◆ Stick-slip behavior compensatory function works when the velocity command inside of servo amplifier is the set value or less. ◆ Stick-slip behavior compensation is effective when the valid condition of stick-slip behavior compensatory function (Group9 ID34) is satisfied.								
41	Retention time for compensating stick-slip behavior [STHLD]	Setting range	Unit	Default					
		1 to 500	ms	20					
	■ Sets the time to retain stick-slip behavior compensation. ◆ Stick-slip behavior compensation continues till the above set time elapses even if the velocity command inside of servo amplifier exceeds the effective velocity for compensating stick-slip behavior. ◆ Increase the value of the time if velocity loop responsiveness is low. ◆ Stick-slip behavior compensation is effective when the valid condition of stick-slip behavior compensatory function (Group9 ID34) is satisfied.								
42	Velocity loop integral time constant for stick-slip behavior compensation [STTVI]	Setting range	Unit	Default					
		0.3 to 1000	ms	3.0					
	■ Sets the Velocity loop integral time constant for stick-slip behavior compensation. ◆ The above set value applies to velocity loop integral time constant while stick-slip behavior compensation is being performed. ◆ This velocity loop integral time constant for stick-slip behavior compensation sets smaller velocity loop integral time constant values than the ones normally used. If you set the value larger than the above, stick-slip behavior compensation doesn't work. ◆ Stick-slip behavior compensation doesn't work when velocity loop is in proportional control. Please carefully set the effective condition of "Velocity loop proportional control switching function" (Group9 ID27) when applying P-PI control switching to velocity control system. ◆ Stick-slip behavior compensation is effective when the valid condition of stick-slip behavior compensatory function (Group9 ID34) is satisfied.								

5.8 Parameter functions

—Group2—

ID	Contents			
50	CP vibration suppression control frequency [CPVSFQ]	Setting range	Unit	Default
		10.0 to 100.0	0.1Hz	100.0
	■ Sets the vibration frequency of Machine stand. ◆ The filter will invalid if set value is 100.0 Hz or more. ◆ This function will valid if in conditions below. • In case of standard position control. • In case of "Model-following / standard position control switching (Model 3)" is set and Standard position control is valid. • In case of "Model-following vibration suppression / standard position control switching (Model 4)" is set and Standard position control is valid. * Please stop linear motor if change this value.			
51	CP vibration suppression control level [CPVSLV]	Setting range	Unit	Default
		00 to 03	-	00
	■ This is the parameter which sets impact of CP vibration suppression control. ◆ The larger value can be impact of CP vibration suppression control big. * Please stop linear motor if change this value.			
52	CP vibration suppression control characteristics selection [CPVSCR]	Setting range	Unit	Default
		00 to 02	-	01
	■ Sets the effective frequency range of CP vibration suppression control. ◆ The larger value will be narrower the effective frequency range of CP vibration suppression control. * Please stop linear motor if change this value.			
60	Minor vibration suppression pulse compensation value [FBHPLS]	Setting range	Unit	Default
		1 to 100	Pulse	1
	■ Sets the compensation amount of Minor vibration suppression function for velocity feedback. Unit of set value is 1 pulse of encoder. * Sets by multiple of FBHTIM. If not multiple of FBHTIM, the actual Minor vibration suppression pulse compensation frequency will have deviation with FBHTIM.			
61	Minor vibration suppression pulse compensation frequency [FBHTIM]	Setting range	Unit	Default
		1 to 100	times	1
	■ Sets the number of Minor vibration suppression. * This value will be valid if Minor vibration suppression function is valid.			

5. Operation

■ Group3 "Model following control settings"

ID	Contents			
00	Model Control Gain 1 [KM1]	Setting range	Unit	Default
		1 to 3000	1/s	30
01	Model control damping coefficient [MZETA]	Setting range	Unit	Default
		0 to 100	%	100
02	Model velocity feedforward gain [MFFGN]	Setting range	Unit	Default
		0 to 100	%	0
03	Model velocity feedforward differential time constant [MTFFD]	Setting range	Unit	Default
		0.00 to 10.00	ms	0.00
04	Model velocity feedforward filter [MFFFIL]	Setting range	Unit	Default
		1 to 4000	Hz	4000

- Proportional gain for model position controller.
 - ◆ Use within the range of 15 to 315 (1/s) if operate with Model-following vibration suppression control.
 - ◆ Automatically overwrite by Auto-tuning result saving.
 - ◆ When Auto-tuning function is valid, this setting value is not applied.
 - ◆ When Gain switching function is valid, this setting value is applied by selecting gain 1.
 - ◆ Please stop linear motor if change this value.

- This is parameter which changes velocity proportional gain of Model following control.
 - ◆ The parameter value will be $\zeta=0.866$ by the set value 0% and $\zeta=1.0$ by 100%.

- This is FF compensation gain for Model position control system.
 - ◆ Automatically overwrite by Auto-tuning result saving.
 - ◆ When Auto-tuning function is valid, this setting value is not applied.

- This is the parameter which improves command-following capability of Model position control system.
The function is invalid when set value is 0.00msec.

- This is primary low-pass filter to eliminate pulsed ripple caused by the position command pulse included in the feed forward command. Sets the cutoff frequency.

The function is Invalid at 1,000Hz or more.

- * Please stop the linear motor when Gain switching function is acting.
- * Please stop the linear motor if Model vibration suppression frequency switching is used.
- * When alarm "Model Following Vibration Suppression Control Error (AL.C5)" occurs while working, please make accel/ decel gently by reducing "Model control gain (KM)" or changing operation pattern.
- * Model Following Vibration Suppression Control function does not work at JOG operation.

5.8 Parameter functions

— Group3 —

ID	Contents			
05	Overshoot Suppression Filter [OSSFIL]	Setting range	Unit	Default
		1 to 4000	Hz	1500
05	■ Filter to suppress overshoot with Model following control or Model following vibration suppression control. Sets cutoff frequency. ◆ Lower the setting value when overshoot on position deviation occurs. ◆ Filter is invalid at the setting value of 2,000Hz or more.			
06	Model Control Antiresonance Frequency 1 [ANRFRQ1]	Setting range	Unit	Default
		10.0 to 80.0	Hz	80.0
06	■ Sets the antiresonance frequency of the mechanical model in Model following vibration suppression control. Actual measurement antiresonance frequency value of the mechanical system is able to set by using System Analysis function of the setup software. ◆ This value does not apply with "Model following control". ◆ Vibration suppression control is invalid if larger value than "Model Control Resonance Frequency" has set. ◆ Please stop linear motor if change this value.			
07	Model Control Resonance Frequency 1 [RESFRQ1]	Setting range	Unit	Default
		10.0 to 80.0	Hz	80.0
07	■ Sets the resonance frequency of the mechanical model in Model-following vibration suppression control. Actual measurement resonance frequency value of the mechanical system is able to set by using System Analysis function of the setup software. ◆ This value does not apply with "Model following control". ◆ Vibration suppression control is invalid if smaller value than "Model Control Antiresonance Frequency" has set, or if 80 Hz is set. ◆ Please stop linear motor if change this value.			

- * Please stop the linear motor when Gain switching function is acting.
- * Please stop the linear motor if Model vibration suppression frequency switching is used.
- * When alarm "Model Following Vibration Suppression Control Error (AL.C5)" occurs while working, please make accel/ decel gently by reducing "Model control gain (KM)" or changing operation pattern.
- * Model Following Vibration Suppression Control function does not work at JOG operation.

5. Operation

■ Group4 "Gain switching control/ vibration suppression frequency switching settings"

ID	Contents			
00	Model Control Gain 2 [KM2]	Setting range	Unit	Default
		1 to 3000	1/s	30
10	Model Control Gain 3 [KM3]	Setting range	Unit	Default
		1 to 3000	1/s	30
20	Model Control Gain 4 [KM4]	Setting range	Unit	Default
		1 to 3000	1/s	30
	■ Proportional gain for Model position controller which is selected in the Gain switching function 1 or 2. ◆ This parameter is excepted from Auto-tuning result saving. ◆ Please stop linear motor if change this value.			
01	Position Loop Proportional Gain 2 [KP2]	Setting range	Unit	Default
		1 to 3000	1/s	30
11	Position Loop Proportional Gain 3 [KP3]	Setting range	Unit	Default
		1 to 3000	1/s	30
21	Position Loop Proportional Gain 4 [KP4]	Setting range	Unit	Default
		1 to 3000	1/s	30
	■ Proportional gain for Position controller which is selected in the Gain switching function 1 or 2. ◆ This parameter is excepted from Auto-tuning result saving.			
02	Position Loop Integral Time Constant 2 [TPI2]	Setting range	Unit	Default
		0.3 to 1000.0	ms	1000.0
12	Position Loop Integral Time Constant 3 [TPI3]	Setting range	Unit	Default
		0.3 to 1000.0	ms	1000.0
22	Position Loop Integral Time Constant 4 [TPI4]	Setting range	Unit	Default
		0.3 to 1000.0	ms	1000.0
	■ Integral time constant for Position controller which is selected in the Gain switching function 1 or 2. ◆ This parameter is excepted from Auto-tuning result saving. ◆ Integral term will be invalid (Proportional control) at 1,000.0 ms. ◆ This setting will be valid if Position loop proportional control switching function is invalid.			
03	Velocity Loop Proportional Gain 2 [KVP2]	Setting range	Unit	Default
		1 to 2000	Hz	50
13	Velocity Loop Proportional Gain 3 [KVP3]	Setting range	Unit	Default
		1 to 2000	Hz	50
23	Velocity Loop Proportional Gain 4 [KVP4]	Setting range	Unit	Default
		1 to 2000	Hz	50
	■ Proportional gain for Velocity controller which is selected in the Gain switching function 1 or 2. ◆ This parameter is excepted from Auto-tuning result saving. ◆ This value will be response frequency if corresponding Load mass ratio (JRAT2, JRAT3 and JRAT4) matches actual Load mass ratio.			

5.8 Parameter functions

— Group4 —

ID	Contents																	
04	Velocity Loop Integral Time Constant 2 [TVI2]	Setting range	Unit	Default														
		0.3 to 1000.0	ms	20.0														
14	Velocity Loop Integral Time Constant 3 [TVI3]	Setting range	Unit	Default														
		0.3 to 1000.0	ms	20.0														
24	Velocity Loop Integral Time Constant 4 [TVI4]	Setting range	Unit	Default														
		0.3 to 1000.0	ms	20.0														
	■ Integral time constant for Velocity controller which is selected in the Gain switching function 1 or 2. ◆ This parameter is excepted from Auto-tuning result saving. ◆ This setting is valid when Velocity Loop Proportional Control Switching Function is invalid. ◆ Integral term will be invalid (Proportional control) at 1,000.0 ms.																	
05	Load Inertia Moment Ratio 2 [JRAT2]	Setting range	Unit	Default														
		0 to 15000	%	100														
15	Load Inertia Moment Ratio 3 [JRAT3]	Setting range	Unit	Default														
		0 to 15000	%	100														
25	Load Inertia Moment Ratio 4 [JRAT4]	Setting range	Unit	Default														
		0 to 15000	%	100														
	■ Load mass for mover mass of linear motor which is selected in the Gain switching function 1 or 2. ◆ If this value matches the actual mechanical system, the corresponding value of Velocity Loop Proportional Gain (KVP2, KVP3, or KVP4) will be response frequency of the velocity control system. ◆ This parameter is excepted from Auto-tuning result saving. ◆ Setting value=$J_L/J_M \times 100\%$ ● J_L: Load mass ● J_M: Mover mass																	
06	Force Command Filter 2 [TCFIL2]	Setting range	Unit	Default														
		1 to 4000	Hz	600														
16	Force Command Filter 3 [TCFIL3]	Setting range	Unit	Default														
		1 to 4000	Hz	600														
26	Force Command Filter 4 [TCFIL4]	Setting range	Unit	Default														
		1 to 4000	Hz	600														
	■ This is low-pass filter to eliminate high frequency component in force command which is selected in the Gain switching function 1 or 2. Sets the cutoff frequency. ◆ This parameter is excepted from Auto-tuning result saving. ◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle. (Force command filter cannot be disabled) <table><tr><th colspan="2">Control cycle</th><th>Setting value</th><th>Cutoff frequency</th></tr><tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling</td><td>1 to 2000Hz</td><td>Set value valid</td></tr><tr><td>2001 to 4000Hz</td><td>2000Hz</td></tr><tr><td>01</td><td>High-freq_Sampling</td><td>1 to 4000Hz</td><td>Set value valid</td></tr></table>				Control cycle		Setting value	Cutoff frequency	00	Standard_Sampling	1 to 2000Hz	Set value valid	2001 to 4000Hz	2000Hz	01	High-freq_Sampling	1 to 4000Hz	Set value valid
Control cycle		Setting value	Cutoff frequency															
00	Standard_Sampling	1 to 2000Hz	Set value valid															
		2001 to 4000Hz	2000Hz															
01	High-freq_Sampling	1 to 4000Hz	Set value valid															

5. Operation

—Group4—

ID	Contents																					
30	Gain Switching Filter [GCFIL]	Setting range	Unit	Default																		
		0 to 100	ms	0																		
	■ This is primary Low-pass filter which makes gain change gently at Gain switching. Sets time constant. ◆ When the mechanical system is shocked by the change of gain resulted from gain switching, making a gentle gain change will soften the shock. ◆ The larger the value, the gentler the gain changes.																					
40	FF Vibration Suppression Frequency A2 [SUPFRQA2]	Setting range	Unit	Default																		
		1.0 to 500.0	Hz	500.0																		
41	FF Vibration Suppression Frequency A3 [SUPFRQA3]	Setting range	Unit	Default																		
		1.0 to 500.0	Hz	500.0																		
42	FF Vibration Suppression Frequency A4 [SUPFRQA4]	Setting range	Unit	Default																		
		1.0 to 500.0	Hz	500.0																		
	■ Sets the mechanical vibration frequency which is wanted to suppress by FF vibration suppression function. Selects in FF vibration suppression frequency selection 1 or 2. ◆ Please stop linear motor if change this value. ◆ This parameter is excepted from Auto-tuning result saving. ◆ This parameter can set in 0.1 Hz unit, but the units listed below are applied internally. <table><tr><th>Setting range</th><th>Unit and process inside servo amplifier</th></tr><tr><td>1.0 to 9.9Hz</td><td>Valid by 0.1Hz</td></tr><tr><td>10.0 to 99.9Hz</td><td>Valid by 0.5Hz and drop less than 0.5</td></tr><tr><td>100.0 to 499.9Hz</td><td>Valid by 5Hz and drop less than 5</td></tr><tr><td>500.0Hz</td><td>FF vibration suppression control is invalid</td></tr></table> * FF vibration suppression control will be invalid when this parameter is changed. After outputting rest of internal position command, FF vibration suppression control will be valid with the frequency changed after. * The time which will be valid of changed value varies depending on the frequency before change as follows. <table><tr><th>The frequency before change</th><th>The time which will be valid of changed value</th></tr><tr><td>5.0Hz or more</td><td>1 sec.</td></tr><tr><td>3.0Hz</td><td>3 sec.</td></tr><tr><td>1.0Hz</td><td>7 sec.</td></tr></table>				Setting range	Unit and process inside servo amplifier	1.0 to 9.9Hz	Valid by 0.1Hz	10.0 to 99.9Hz	Valid by 0.5Hz and drop less than 0.5	100.0 to 499.9Hz	Valid by 5Hz and drop less than 5	500.0Hz	FF vibration suppression control is invalid	The frequency before change	The time which will be valid of changed value	5.0Hz or more	1 sec.	3.0Hz	3 sec.	1.0Hz	7 sec.
Setting range	Unit and process inside servo amplifier																					
1.0 to 9.9Hz	Valid by 0.1Hz																					
10.0 to 99.9Hz	Valid by 0.5Hz and drop less than 0.5																					
100.0 to 499.9Hz	Valid by 5Hz and drop less than 5																					
500.0Hz	FF vibration suppression control is invalid																					
The frequency before change	The time which will be valid of changed value																					
5.0Hz or more	1 sec.																					
3.0Hz	3 sec.																					
1.0Hz	7 sec.																					
43	FF Vibration Suppression Frequency B2 [SUPFRQB2]	Setting range	Unit	Default																		
		1.0 to 500.0	Hz	500.0																		
44	FF Vibration Suppression Frequency B3 [SUPFRQB3]	Setting range	Unit	Default																		
		1.0 to 500.0	Hz	500.0																		
45	FF Vibration Suppression Frequency B4 [SUPFRQB4]	Setting range	Unit	Default																		
		1.0 to 500.0	Hz	500.0																		
	■ See FF Vibration Suppression Frequency A2 to A4. Selects these in FF Vibration Suppression Frequency Select Input B1/ B2.																					

5.8 Parameter functions

— Group4 —

ID	Contents			
50	Model Control Antiresonance Frequency 2 [ANRFRQ2]	Setting range	Unit	Default
		10.0 to 80.0	Hz	80.0
52	Model Control Antiresonance Frequency 3 [ANRFRQ3]	Setting range	Unit	Default
		10.0 to 80.0	Hz	80.0
54	Model Control Antiresonance Frequency 4 [ANRFRQ4]	Setting range	Unit	Default
		10.0 to 80.0	Hz	80.0
	■ Sets the antiresonance frequency of the mechanical device at Model-following vibration suppression control. Selects in Model Vibration Suppression Frequency Select Input 1 or 2. ◆ This value does not apply with Model following control. ◆ Vibration suppression control is invalid if larger value than "Model Control Resonance Frequency" has set. ◆ Setting by using "system analysis" function cannot be performed. ◆ Please stop linear motor if change this value.			
51	Model Control Resonance Frequency 2 [RESFRQ2]	Setting range	Unit	Default
		10.0 to 80.0	Hz	80.0
53	Model Control Resonance Frequency 3 [RESFRQ3]	Setting range	Unit	Default
		10.0 to 80.0	Hz	80.0
55	Model Control Resonance Frequency 4 [RESFRQ4]	Setting range	Unit	Default
		10.0 to 80.0	Hz	80.0
	■ Sets the resonance frequency of the mechanical device at Model-following vibration suppression control. Selects in Model Vibration Suppression Frequency Select Input 1 or 2. ◆ This value does not apply with Model following control. ◆ Vibration suppression control is invalid if smaller value than "Model Control Antiresonance Frequency" has set, or if 80 Hz is set. ◆ Setting by using "system analysis" function cannot be performed. ◆ Please stop linear motor if change this value.			

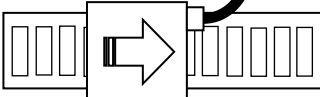
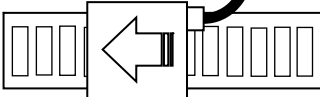
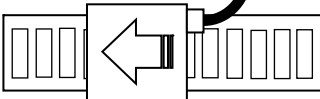
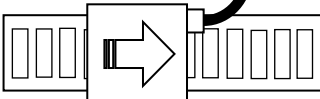
5. Operation

■ Group5 "Fast-settling control settings"

ID	Contents			
00	Command Velocity Low-pass Filter [CVFIL]	Setting range	Unit	Default
		1 to 4000	Hz	1000
00	■ This is primary low-pass filter to eliminate high frequency component such as ripples included in the velocity (command velocity) calculated from position command pulse inside of fast-settling control. ◆ Lower this setting value when the encoder resolution is low. ◆ Filter is invalid at the setting value of 2,000Hz or more.			
01	Command Velocity Threshold [CVTH]	Setting range	Unit	Default
		0 to 65535	mm/s	20
01	■ Sets the velocity threshold value that activates fast-settling control compensation (Acceleration Compensation and Deceleration Compensation). ◆ Acceleration Compensation or Deceleration Compensation will be done when velocity (command velocity) calculated from the position command pulse is larger than this value.			
02	Acceleration Compensation [ACCCO]	Setting range	Unit	Default
		-9999 to 9999	×50 Pulse	0
02	■ Sets the Acceleration Compensation value in fast-settling control. ◆ Sets in units of position deviation pulse (In case of incremental encoder, four-multiplied to encoder resolution is it). ◆ Compensation will be done to a position deviation. ◆ The larger the setting value, the greater the compensation value. ◆ The larger the acceleration value calculated from position command pulse, compensation value increases. ◆ The larger the Load mass, the greater the compensation value is. ◆ Position deviation decreases by fast-settling control. ◆ The setting value is invalid with "Model following control" or "Model following vibration suppression control".			
03	Deceleration Compensation [DECCO]	Setting range	Unit	Default
		-9999 to 9999	×50 Pulse	0
03	■ Sets the Deceleration Compensation value in fast-settling control. ◆ Sets in units of position deviation pulse (In case of incremental encoder, four-multiplied to encoder resolution is it). ◆ Compensation will be done to a position deviation. ◆ The larger the setting value, the greater the compensation value. ◆ The larger the acceleration value calculated from position command pulse, compensation value increases. ◆ The larger the Load mass, the greater the compensation value is. ◆ Position deviation decreases by fast-settling control. ◆ The setting value is invalid with "Model following control" or "Model following vibration suppression control".			

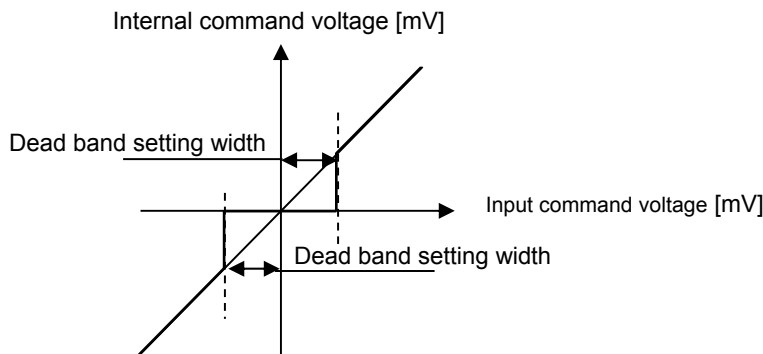
5.8 Parameter functions

■ Group8 "Control system settings"

ID	Contents																																																										
00	Position, Velocity, Force Command Input Polarity [CMDPOL]		Setting range	Unit	Default																																																						
			00 to 07	-	00:PC+_VC+_TC+																																																						
	■ Selects the combination of each command polarity for position command pulse, Analog velocity command and Analog force command input from the list below. ◆ Moving direction of the linear motor can be reversed without changing the command wiring. ◆ Moving direction which depends on the selection value will be shown below in case positive (+) polarity command is given.																																																										
	<table><tr><th colspan="2">Selection</th><th>Polarity</th><th>Position Command Pulse (PCMD)</th><th>Analog Velocity Command (VCMD)</th><th>Analog Force Command (TCMD)</th></tr><tr><td>00</td><td>PC+_VC+_TC+</td><td>+</td><td>Forward</td><td>Forward</td><td>Forward</td></tr><tr><td>01</td><td>PC+_VC+_TC-</td><td>+</td><td>Forward</td><td>Forward</td><td>Reverse</td></tr><tr><td>02</td><td>PC+_VC-_TC+</td><td>+</td><td>Forward</td><td>Reverse</td><td>Forward</td></tr><tr><td>03</td><td>PC+_VC-_TC-</td><td>+</td><td>Forward</td><td>Reverse</td><td>Reverse</td></tr><tr><td>04</td><td>PC-_VC+_TC+</td><td>+</td><td>Reverse</td><td>Forward</td><td>Forward</td></tr><tr><td>05</td><td>PC-_VC+_TC-</td><td>+</td><td>Reverse</td><td>Forward</td><td>Reverse</td></tr><tr><td>06</td><td>PC-_VC-_TC+</td><td>+</td><td>Reverse</td><td>Reverse</td><td>Forward</td></tr><tr><td>07</td><td>PC-_VC-_TC-</td><td>+</td><td>Reverse</td><td>Reverse</td><td>Reverse</td></tr></table>					Selection		Polarity	Position Command Pulse (PCMD)	Analog Velocity Command (VCMD)	Analog Force Command (TCMD)	00	PC+_VC+_TC+	+	Forward	Forward	Forward	01	PC+_VC+_TC-	+	Forward	Forward	Reverse	02	PC+_VC-_TC+	+	Forward	Reverse	Forward	03	PC+_VC-_TC-	+	Forward	Reverse	Reverse	04	PC-_VC+_TC+	+	Reverse	Forward	Forward	05	PC-_VC+_TC-	+	Reverse	Forward	Reverse	06	PC-_VC-_TC+	+	Reverse	Reverse	Forward	07	PC-_VC-_TC-	+	Reverse	Reverse	Reverse
Selection		Polarity	Position Command Pulse (PCMD)	Analog Velocity Command (VCMD)	Analog Force Command (TCMD)																																																						
00	PC+_VC+_TC+	+	Forward	Forward	Forward																																																						
01	PC+_VC+_TC-	+	Forward	Forward	Reverse																																																						
02	PC+_VC-_TC+	+	Forward	Reverse	Forward																																																						
03	PC+_VC-_TC-	+	Forward	Reverse	Reverse																																																						
04	PC-_VC+_TC+	+	Reverse	Forward	Forward																																																						
05	PC-_VC+_TC-	+	Reverse	Forward	Reverse																																																						
06	PC-_VC-_TC+	+	Reverse	Reverse	Forward																																																						
07	PC-_VC-_TC-	+	Reverse	Reverse	Reverse																																																						
	◆ Command input polarity is at standard setting value “00: PC+_VC+_TC+” Moving direction when command polarity is “+” Moving direction  Moving direction when command polarity is “-” Moving direction 																																																										
	◆ Command input polarity change “07:PC-_VC-_TC-” Moving direction when command polarity is “+” Moving direction  Moving direction when command polarity is “-” Moving direction 																																																										

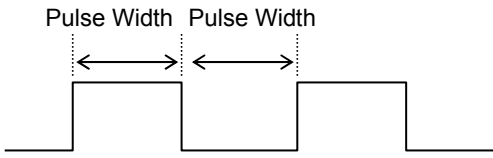
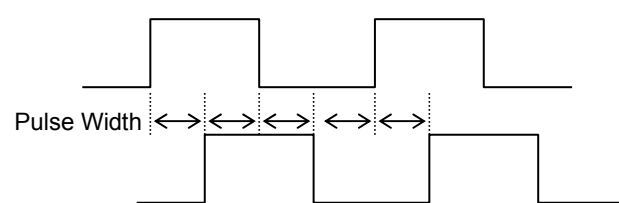
5. Operation

—Group8—

ID	Contents																							
01	Analog Velocity/ Force Command Input Dead Band Width [VC/TC-DW]	Setting range	Unit	Default																				
		0.0 to 6553.5	mV	0.0																				
	■ Sets the voltage as dead band for Analog velocity command input and Analog force command input. ◆ Command voltage within the dead band setting range is treated as 0V at internal of servo amplifier. ◆ It improves influences as noise and drift for Analog velocity command input and Analog force command input. Internal command voltage [mV]  Input command voltage [mV]																							
10	Position Command Pulse Selection [PMOD] “Power cycle for control after setting”	Setting range	Unit	Default																				
		00 to 02	-	00: F-PC_R-PC																				
	■ Sets the Position control command pulse type. ◆ Select from below to match with the upper device specifications. <table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>F-PC_R-PC</td><td>Forward direction (Positive) Pulse + Reverse direction (Negative) Pulse</td></tr><tr><td>01</td><td>PC-A_PC-B</td><td>Two-phase Pulse Train of 90°-Phase Difference</td></tr><tr><td>02</td><td>SIGN_PULS</td><td>Code + Pulse Train</td></tr></table> ◆ Connect position command pulse to CN1 pin listed below. <table><tr><th>Forward rotation</th><th>Reverse rotation</th></tr><tr><td>Forward pulse (F-PC): CN1-26</td><td>Reverse pulse (R-PC): CN1-28</td></tr><tr><td>Forward pulse (F-PC): CN1-27</td><td>Reverse pulse (R-PC): CN1-29</td></tr><tr><td>Forward pulse SG: CN1-47</td><td>Reverse pulse SG: CN1-48</td></tr></table> ◆ These output types of the upper device are allowed: Line driver output and Open collector output. Be sure to connect SG.				Selection		Contents	00	F-PC_R-PC	Forward direction (Positive) Pulse + Reverse direction (Negative) Pulse	01	PC-A_PC-B	Two-phase Pulse Train of 90°-Phase Difference	02	SIGN_PULS	Code + Pulse Train	Forward rotation	Reverse rotation	Forward pulse (F-PC): CN1-26	Reverse pulse (R-PC): CN1-28	Forward pulse (F-PC): CN1-27	Reverse pulse (R-PC): CN1-29	Forward pulse SG: CN1-47	Reverse pulse SG: CN1-48
Selection		Contents																						
00	F-PC_R-PC	Forward direction (Positive) Pulse + Reverse direction (Negative) Pulse																						
01	PC-A_PC-B	Two-phase Pulse Train of 90°-Phase Difference																						
02	SIGN_PULS	Code + Pulse Train																						
Forward rotation	Reverse rotation																							
Forward pulse (F-PC): CN1-26	Reverse pulse (R-PC): CN1-28																							
Forward pulse (F-PC): CN1-27	Reverse pulse (R-PC): CN1-29																							
Forward pulse SG: CN1-47	Reverse pulse SG: CN1-48																							

5.8 Parameter functions

—Group8—

ID	Contents																													
11	Position Command Pulse Count Polarity [PCPPOL] "Power cycle for control after setting"		Setting range	Unit																										
			00 to 03	-																										
			Default 00:Type1																											
	■ Selects the Position Command Pulse Count Polarity from the list below. ◆ Select according to host equipment.																													
	<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Type1</td><td>F-PC: Not inverted. R-PC: Not inverted.</td></tr><tr><td>01</td><td>Type2</td><td>F-PC: Inverted. R-PC: Not inverted.</td></tr><tr><td>02</td><td>Type3</td><td>F-PC: Not inverted. R-PC: Inverted.</td></tr><tr><td>03</td><td>Type4</td><td>F-PC: Inverted. R-PC: Inverted.</td></tr></table>				Selection		Contents	00	Type1	F-PC: Not inverted. R-PC: Not inverted.	01	Type2	F-PC: Inverted. R-PC: Not inverted.	02	Type3	F-PC: Not inverted. R-PC: Inverted.	03	Type4	F-PC: Inverted. R-PC: Inverted.											
Selection		Contents																												
00	Type1	F-PC: Not inverted. R-PC: Not inverted.																												
01	Type2	F-PC: Inverted. R-PC: Not inverted.																												
02	Type3	F-PC: Not inverted. R-PC: Inverted.																												
03	Type4	F-PC: Inverted. R-PC: Inverted.																												
12	Position Command Pulse Digital Filter [PCPFIL]		Setting range	Unit																										
			00 to 07	-																										
			Default 00:850ns																											
	■ This is filter to eliminate noise elements included in the Position command pulse. ◆ Select from below depending on pulse command condition.																													
	<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>850nsec.</td><td>Minimum Pulse Width =850nsec.</td></tr><tr><td>01</td><td>250nsec.</td><td>Minimum Pulse Width =250nsec.</td></tr><tr><td>02</td><td>500nsec.</td><td>Minimum Pulse Width =500nsec.</td></tr><tr><td>03</td><td>1.8μsec.</td><td>Minimum Pulse Width =1.8μsec.</td></tr><tr><td>04</td><td>3.6μsec.</td><td>Minimum Pulse Width =3.6μsec.</td></tr><tr><td>05</td><td>7.2μsec.</td><td>Minimum Pulse Width =7.2μsec.</td></tr><tr><td>06</td><td>200nsec.</td><td>Minimum Pulse Width =200nsec.</td></tr><tr><td>07</td><td>125nsec.</td><td>Minimum Pulse Width =125nsec.</td></tr></table>				Selection		Contents	00	850nsec.	Minimum Pulse Width =850nsec.	01	250nsec.	Minimum Pulse Width =250nsec.	02	500nsec.	Minimum Pulse Width =500nsec.	03	1.8μsec.	Minimum Pulse Width =1.8μsec.	04	3.6μsec.	Minimum Pulse Width =3.6μsec.	05	7.2μsec.	Minimum Pulse Width =7.2μsec.	06	200nsec.	Minimum Pulse Width =200nsec.	07	125nsec.
Selection		Contents																												
00	850nsec.	Minimum Pulse Width =850nsec.																												
01	250nsec.	Minimum Pulse Width =250nsec.																												
02	500nsec.	Minimum Pulse Width =500nsec.																												
03	1.8μsec.	Minimum Pulse Width =1.8μsec.																												
04	3.6μsec.	Minimum Pulse Width =3.6μsec.																												
05	7.2μsec.	Minimum Pulse Width =7.2μsec.																												
06	200nsec.	Minimum Pulse Width =200nsec.																												
07	125nsec.	Minimum Pulse Width =125nsec.																												
Forward/Reverse direction pulse train method or Code + Pulse train method																														
																														
■ When the Position command pulse width becomes less that the setting values of the Digital filter, the status may become Alarm Code D2 (Position command pulse frequency error 1). Set Digital filter setting value smaller than that of Pulse width at maximum command frequency.																														
■ Refer to "2.3.2 Input command, Position signal output, General input, General output" for the specification of the command pulse.																														

5. Operation

—Group8—

ID	Contents			
13	Electronic Gear 1 Numerator [B-GER1]	Setting range	Unit	Default
		1 to 2097152	-	1
14	Electronic Gear 1 Denominator [A-GER1]	Setting range	Unit	Default
		1 to 2097152	-	1
15	Electronic Gear 2 Numerator [B-GER2]	Setting range	Unit	Default
		1 to 2097152	-	1
16	Electronic Gear 2 Denominator [A-GER2]	Setting range	Unit	Default
		1 to 2097152	-	1
	■ Sets the Electronic gear ratio to position command pulse. ◆ Two settings for Electronic gear ratio are available. Set gear 1 or gear 2 by switching. * Switching of Electronic gear ratio should done at state without position command input. ◆ If the position command pulse is the same, by switching the Electronic gear, rotating velocity and distance are changed. $f_1 \longrightarrow \boxed{\begin{array}{c} \frac{B \text{ (1 to 2097152)}}{A \text{ (1 to 2097152)}} \\ 1/2^{21} \leq B/A \leq 2^{21} \end{array}} \longrightarrow f_2 \text{ (} f_2 = f_1 \times B/A \text{)}$			
	■ Example 1. Changing the unit of Position command pulse. When performing positioning in increments of 1[μm] by using 0.05[μm]-linear encoder, calculate numerator and denominator of electronic gear by the following formula. $\bullet \text{ Electronic gear ratio} = \frac{1[\mu\text{m}]}{0.05[\mu\text{m}]} = \frac{100}{5} = \frac{20}{1}$ “Electronic gearnumerator=20, Electronic geardenumerator=1” are obtained by the above formula. (The above are within the setting value of electronic gear, so no problems with setting numerator=10 denominator=5.) ■ Example 2. When resolution is changed in accordance with linear encoder change. $\bullet \text{ Electronic gear ratio} = \frac{1[\mu\text{m}]}{0.1[\mu\text{m}]} = \frac{10}{1}$ According to the above, electronic gear ratio numerator=10, electronic gear ratio denominator =1 are obtained. ■ Example 3. When avoiding limitation of position command pulse frequency. When operating lineat motor at 200[mm/s], with controller with its maximum frequency 500[kpps](half a million pulses per 1 second) and linearencoder with its resolution 0.05[μm], calculate numerator and denominator of electronic gear by the following formula. $\bullet \text{ Electronic gear ratio} = \frac{4000[\text{kpps}]}{500[\text{kpps}]} = \frac{8}{1}$ “Electronic gearnumerator=8, Electronic geardenumerator=1” are obtained by the above formula. (The above are within the setting value of electronic gear, so no problems with setting numerator=40 denominator=500.) The motor moving velocity with position command pulse frequency 500[kpps] 200[mm/s] by setting this numerator and denominator of electronic gear.			

5.8 Parameter functions

—Group8—

ID	Contents												
	Positioning Methods [EDGEPOS] "Power cycle for control after setting"	Setting range	Unit	Default									
		00 to 01	-	00:Pulse_Interval									
17	■ Selects the Encoder pulse positioning. ◆ Positioning accuracy may improved by selecting Edge positioning when the encoder resolution is coarse. However, this may cause the driving sound of the mechanical system to increase as this edge is always the center of vibration. ◆ Select standard value in usual operation. <table><thead><tr><th colspan="2">Selection</th><th>Contents</th></tr></thead><tbody><tr><td>00</td><td>Pulse_Interval</td><td>Specify Pulse Interval</td></tr><tr><td>01</td><td>Pulse_Edge</td><td>Specify Pulse Edge</td></tr></tbody></table>				Selection		Contents	00	Pulse_Interval	Specify Pulse Interval	01	Pulse_Edge	Specify Pulse Edge
	Selection		Contents										
00	Pulse_Interval	Specify Pulse Interval											
01	Pulse_Edge	Specify Pulse Edge											
	In-Position Signal/ Position Deviation Monitor [PDEVMON]	Setting range	Unit	Default									
		00 to 01	-	00:After_Filter									
18	■ Selects in-position signal (INP) and Position deviation monitor output before or after passing through the Position Command Filter. ◆ For "00: After_Filter", use the Position deviation value of the Position controller. ◆ For "01: Before_Filter", use the Position deviation value based on Position command before FF vibration suppression control. ◆ This parameter works as "01: Before_Filter" even if the other value is selected when "01: Model 1 Model Following Control" or "02: Model 2 Model Following Vibration Suppression Control" is set to the system parameter ID07 Position Control Selection. <table><thead><tr><th colspan="2">Selection</th><th>Contents</th></tr></thead><tbody><tr><td>00</td><td>After_Filter</td><td>Compare Position command value with Feedback value after passing through the filter.</td></tr><tr><td>01</td><td>Before_Filter</td><td>Compare Position command value with Feedback value before passing through the filter.</td></tr></tbody></table>				Selection		Contents	00	After_Filter	Compare Position command value with Feedback value after passing through the filter.	01	Before_Filter	Compare Position command value with Feedback value before passing through the filter.
	Selection		Contents										
00	After_Filter	Compare Position command value with Feedback value after passing through the filter.											
01	Before_Filter	Compare Position command value with Feedback value before passing through the filter.											

5. Operation

—Group8—

ID	Contents				
19	Deviation Clear Selection [CLR]		Setting range	Unit	Default
			00 to 03	-	00:Type1
	■ Sets whether a position deviation will be cleared or not during servo OFF, and how to treat deviation clear signal. ◆ Selects operation during servo OFF. Deviation cleared/ Deviation not cleared ◆ Selects deviation clear signal treatment. Level detection/ Edge detection ◆ Select proper setting corresponding to above combination from the list below.				
	Selection		Contents		
	00	Type1	At servo OFF → Deviation cleared Clear input = Level detection	Deviation clear is continuing during servo OFF. Deviation clear is continuing during Clear input is ON.	
	01	Type2	At servo OFF → Deviation cleared Clear input = Edge detection	At the edge of OFF to ON of Deviation clear input, Deviation clear is executed.	
02	Type3	At servo OFF → Deviation not cleared Clear input = Level detection	During servo OFF, Deviation clear is not executed. (After servo ON, the motor might operate suddenly.)		
03	Type4	At servo OFF → Deviation not cleared Clear input = Edge detection	During servo OFF, Deviation clear is not executed. (After servo ON, the motor might operate suddenly.)		
1A	Time to judge position command distribution completion [PCDLY]		Setting range	Unit	Default
			0.0 to 1000.0	ms	0.0
	■ Sets the time till judging position command distribution completion. ◆ Distribution completion is judged if command position does not change (means previous and present command position are same) even if spending this setting time. ◆ State will change to "during position command distribution" instantly with no matter to this setting time, when new position command is input during count of position command distribution completion.				

5.8 Parameter functions

— Group8 —

ID	Contents			
20	Preset Velocity Command 1 [VC1]	Setting range	Unit	Default
		0 to 32767	mm/s	100
21	Preset Velocity Command 2 [VC2]	Setting range	Unit	Default
		0 to 32767	mm/s	200
22	Preset Velocity Command 3 [VC3]	Setting range	Unit	Default
		0 to 32767	mm/s	300
23	Preset Velocity Command 4 [VC4]	Setting range	Unit	Default
		0 to 32767	mm/s	400
24	Preset Velocity Command 5 [VC5]	Setting range	Unit	Default
		0 to 32767	mm/s	500
25	Preset Velocity Command 6 [VC6]	Setting range	Unit	Default
		0 to 32767	mm/s	600
26	Preset Velocity Command 7 [VC7]	Setting range	Unit	Default
		0 to 32767	mm/s	700

- Sets Velocity command for internal velocity operation.

- ◆ Preset velocities are able to set upto seven.
- ◆ Use the following General parameters Group9 ID20-26 to activate the Preset velocities.

ID	Symbol	Contents
20	SP1	Preset Velocity Command Select Input 1
21	SP2	Preset Velocity Command Select Input 2
22	SP3	Preset Velocity Command Select Input 3
23	DIR	Preset Velocity Command Operation Direction Select Input
24	RUN	Preset Velocity Command Operation Start Signal Input
25	RUN-F	Preset Velocity Command Positive (direction) Move Start Signal Input
26	RUN-R	Preset Velocity Command Negative (direction) Move Start Signal Input

- ◆ Select Preset velocity command by Preset velocity selection.

	VC1	VC2	VC3	VC4	VC5	VC6	VC7	Analog velocity command
SP3	0	0	0	1	1	1	1	0
SP2	0	1	1	0	0	1	1	0
SP1	1	0	1	0	1	0	1	0

0=OFF, 1=ON

Example: VC2 is valid when SP1=OFF, SP2=ON, SP3=OFF

- ◆ Drives the linear motor

RUN: Preset Velocity Command Operation Start Signal Input	ON	Linear motor moves forward
DIR: Preset Velocity Command Operation Direction Select Input	OFF	
RUN: Preset Velocity Command Operation Start Signal Input	ON	Linear motor moves reverse
DIR: Preset Velocity Command Operation Direction Select Input	ON	
RUN-F: Preset Velocity Command Positive (direction) Move Start Signal Input	ON	Linear motor moves forward
RUN-R: Preset Velocity Command Negative (direction) Move Start Signal Input	ON	Linear motor moves reverse

5. Operation

—Group8—

ID	Contents														
■ Examples of setting and operation pattern at Preset Velocity Command Operation <table border="1"> <tr> <td>VC1 Preset Velocity Command 1</td><td>500[mm/s]</td></tr> <tr> <td>VC2 Preset Velocity Command 2</td><td>1000[mm/s]</td></tr> <tr> <td>VC3 Preset Velocity Command 3</td><td>1500[mm/s]</td></tr> <tr> <td>VC4 Preset Velocity Command 4</td><td>2000[mm/s]</td></tr> <tr> <td>VC5 Preset Velocity Command 5</td><td>2500[mm/s]</td></tr> <tr> <td>VC6 Preset Velocity Command 6</td><td>3000[mm/s]</td></tr> <tr> <td>VC7 Preset Velocity Command 7</td><td>3500[mm/s]</td></tr> </table>		VC1 Preset Velocity Command 1	500[mm/s]	VC2 Preset Velocity Command 2	1000[mm/s]	VC3 Preset Velocity Command 3	1500[mm/s]	VC4 Preset Velocity Command 4	2000[mm/s]	VC5 Preset Velocity Command 5	2500[mm/s]	VC6 Preset Velocity Command 6	3000[mm/s]	VC7 Preset Velocity Command 7	3500[mm/s]
VC1 Preset Velocity Command 1	500[mm/s]														
VC2 Preset Velocity Command 2	1000[mm/s]														
VC3 Preset Velocity Command 3	1500[mm/s]														
VC4 Preset Velocity Command 4	2000[mm/s]														
VC5 Preset Velocity Command 5	2500[mm/s]														
VC6 Preset Velocity Command 6	3000[mm/s]														
VC7 Preset Velocity Command 7	3500[mm/s]														
◆ To change the Preset velocity using external contact input, set them so that SP1, SP2 and SP3 are changed at the same timing. ◆ When RUN-F and RUN-R are ON at the same time, it is treated as Velocity command 0.															

5.8 Parameter functions

—Group8—

ID	Contents			
27	Velocity Compensation Command Input Selection [VCOMSEL]		Setting range	Unit
			01 to 02	-
	■ Selects Velocity compensation command input.			Default
				02:V-COMP
27	Selection		Contents	
	01	Analog_Input	Analog velocity compensation command value is used when velocity compensation function is valid.	
	02	V-COMP	Preset velocity compensation command is used when velocity compensation function is valid.	
28	Preset Velocity Compensation Command [V-COMP]		Setting range	Unit
			-9999 to 9999	mm/s
28	■ Sets the Velocity if the velocity compensation command is used as fixed value in Velocity Compensation Function.			Default
				0
29	Analog Velocity (Compensation) Command Scaling [VCGN]		Setting range	Unit
			0 to 4000	(mm/s)/V
	■ Sets Analog Velocity (Compensation) Command scaling.			Default
	◆ Sets the velocity value per 1 volt of Analog velocity (compensation) command input signal.			500
2A	External Velocity Command Filter [EX-VCFIL]		Setting range	Unit
			1 to 4000	Hz
	■ This is primary low-pass filter to eliminate noise component from Analog velocity (compensation) command.			Default
				4000
2A	◆ Sets cutoff frequency.			
	◆ This filter also works with Preset velocity command.			
	◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.			
	Control cycle		Setting value	Valid/ Invalid
	00	Standard_Sampling	1 to 1999Hz	Set value valid
			2000 to 4000Hz	Filter invalid
	01	High-freq_Sampling	1 to 3999Hz	Set value valid
			4000Hz	Filter invalid

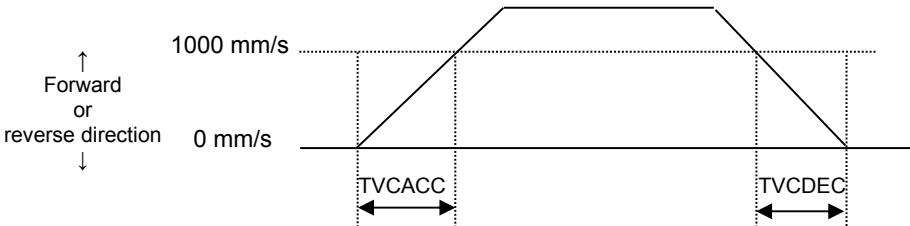
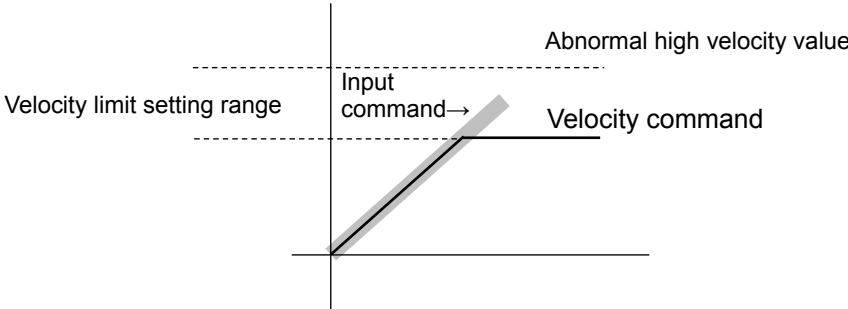
5. Operation

—Group8—

ID	Contents		
	■ About Velocity Compensation Function		
	Velocity Compensation Function is a Feed forward function for the Velocity control system.		
	There are two settings for the Velocity compensation command input function:		
	Preset velocity compensation command and Analog velocity compensation command.		
	Use preset velocity compensation command to keep the Velocity compensation command fixed.		
	Analog velocity compensation command is used when setting the Velocity compensation command input value from upper device.		
	◆ Sets preset velocity compensation command value		
	Group	ID	Symbol
	8	28	V-COMP
	Preset Velocity Compensation Command		
	◆ Selects velocity compensation command input method		
	Group	ID	Symbol
	8	27	VCOMSEL
	Velocity Compensation Command Input Selection		
	◆ Selects and sets the condition to set Velocity Compensation Function valid		
	Group	ID	Symbol
	9	28	VCOMPS
	Velocity Compensation Function		
	◆ Sets Analog velocity compensation scaling		
	Group	ID	Symbol
	8	29	VCGN
	Analog Velocity Command Scaling		
	◆ Input for Analog velocity compensation command is shared with Analog velocity command/Analog force command Input.		
	CN1-21: Input Voltage range -10V to +10V		

5.8 Parameter functions

—Group8—

ID	Contents			
2B	Velocity Command Acceleration Time Constant [TVCAACC]	Setting range	Unit	Default
		0~16000	ms	0
2C	Velocity Command Deceleration Time Constant [TVCDEC]	Setting range	Unit	Default
		0 to 16000	ms	0
	■ These are parameters to restrict Acceleration and Deceleration commands of the Analog velocity command input, Preset velocity command, Analog velocity compensation input, Preset compensation, and JOG operation. Acceleration: 0 mm/s --> forward, reverse direction Deceleration: forward, reverse direction --> 0 min⁻¹ Sets the acceleration, deceleration per 1000 mm/s. ■ These parameters can give accel/decel to a step type velocity command input. 			
2D	Velocity Limit Command [VCLM]	Setting range	Unit	Default
		1 to 65535	mm/s	65535
	■ Set to restrict Velocity command. ◆ Sets the maximum value of Velocity command. ◆ Restricts Velocity command at the setting range with position control mode or Velocity control mode. ◆ If the setting value is 50000 or more, Velocity command limit will be set to 1.1 times of maximum speed of the combination motor. Set this parameter to limit motor velocity to the value lower than 1.1 times the maximum velocity. Use the standard value for normal use. 			

5. Operation

—Group8—

ID	Contents				
30	Force Compensation Command Input Selection [TCOMSEL]		Setting range	Unit	Default
			01 to 02	-	02:T-COMP
	■ Select Force compensation command input from the list below.				
	Selection		Contents		
	01	Analog_Input	Analog force compensation command value is used when force compensation function is valid.		
	02	T-COMP	Preset force compensation command 1, 2 are used when force compensation function is valid.		
31	Preset Force Compensation Command 1 [T-COMP1]		Setting range	Unit	Default
			-500.0 to +500.0	%	0.0
	■ This is parameter for using torque compensation command with fixed value if T-COMPS1 is activated. ◆ This value will be added to the Torque command When Torque Compensation Command Input Selection is set at 02: T-COMP.				
32	Preset Force Compensation Command 2 [T-COMP2]		Setting range	Unit	Default
			-500.0 to +500.0	%	0.0
	■ This is parameter for using force compensation command with fixed value if T-COMPS2 is activated. ◆ This value will be added to the Force command When Force Compensation Command Input Selection is set at 02: T-COMP.				
33	Analog Force Command Scaling [TCGN]		Setting range	Unit	Default
			0.0 to 500.0	%/V	50.0
	■ Sets Analog Force Command Scaling. ◆ Sets the force value per 1 volt of Analog force command input signal.				
34	Analog Force Compensation Command Scaling [T-COMPGN]		Setting range	Unit	Default
			0.0 to 500.0	%/V	50.0
	■ Sets Analog Force Compensation Command Scaling. ◆ Sets the force value per 1 volt of Analog force compensation command input signal.				
35	External Force Command Filter [EX-TCFIL]		Setting range	Unit	Default
			1 to 4000	Hz	4000
	■ This is primary Low-pass filter to eliminate noise component from Analog force (compensation) command. ◆ Sets Cutoff frequency. ◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.				
	Control cycle		Setting value		Valid/ Invalid
	00	Standard_Sampling	1 to 1999Hz		Set value valid
			2000 to 4000Hz		Filter invalid
	01	High-freq_Sampling	1 to 1999Hz		Set value valid
2000 to 4000Hz			Filter invalid		

5.8 Parameter functions

—Group8—

ID	Contents																																								
	■ About Force Compensation Function The Force Compensation Function is a feed forward function for the Force control system. There are two settings for Force compensation command input function: Preset force compensation command and Analog force compensation command. Use preset force compensation command to keep the Force compensation command fixed. Analog force compensation command is used when setting the Force compensation command input value from upper device. ◆ Sets Preset Force Compensation Command Value <table> <tr> <th>Group</th><th>ID</th><th>Symbol</th><th>Contents</th></tr> <tr> <td>8</td><td>31</td><td>T-COMP1</td><td>Preset Force Compensation Command 1</td></tr> <tr> <td>8</td><td>32</td><td>T-COMP2</td><td>Preset Force Compensation Command 2</td></tr> </table> ◆ Selects Force Compensation Command Input Method. <table> <tr> <th>Group</th><th>ID</th><th>Symbol</th><th>Contents</th></tr> <tr> <td>8</td><td>30</td><td>TCOMSEL</td><td>Force Compensation Command Input Selection</td></tr> </table> ◆ Sets the condition of Force Compensation Function being Valid <table> <tr> <th>Group</th><th>ID</th><th>Symbol</th><th>Contents</th></tr> <tr> <td>9</td><td>30</td><td>T-COMPS1</td><td>Force Compensation Function 1</td></tr> <tr> <td>9</td><td>31</td><td>T-COMPS2</td><td>Force Compensation Function 2</td></tr> </table> ◆ Sets Analog Force Compensation Command Scaling <table> <tr> <th>Group</th><th>ID</th><th>Symbol</th><th>Contents</th></tr> <tr> <td>8</td><td>34</td><td>T-COMPGN</td><td>Analog Force Compensation Command Scaling</td></tr> </table> ◆ Analog force compensation command input CN1-22: Input Voltage range -10V to +10V	Group	ID	Symbol	Contents	8	31	T-COMP1	Preset Force Compensation Command 1	8	32	T-COMP2	Preset Force Compensation Command 2	Group	ID	Symbol	Contents	8	30	TCOMSEL	Force Compensation Command Input Selection	Group	ID	Symbol	Contents	9	30	T-COMPS1	Force Compensation Function 1	9	31	T-COMPS2	Force Compensation Function 2	Group	ID	Symbol	Contents	8	34	T-COMPGN	Analog Force Compensation Command Scaling
Group	ID	Symbol	Contents																																						
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Group	ID	Symbol	Contents																																						
8	34	T-COMPGN	Analog Force Compensation Command Scaling																																						
	<table> <tr> <th>Force Limit Input Selection [TLSEL]</th><th>Setting range</th><th>Unit</th><th>Default</th></tr> <tr> <td></td><td>00 to 02</td><td>-</td><td>00:TCLM</td></tr> </table> ■ Selects input system to limit Force command limit function from listed below. <table> <tr> <th>Selection</th><th>Contents</th></tr> <tr> <td>00 TCLM</td><td> Use internal force limit value Forward side/TCLM-F Reverse side/TCLM-R Forward side (forward direction): Limited at Forward Direction Internal Force Limit Value. Reverse side (reverse direction): Limited at Reverse Direction Internal Force Limit Value. </td></tr> <tr> <td>01 Analog_1</td><td> Use external force limit input Forward side/F-TLA Reverse side/R-TLA Forward side (forward direction): Limited at the voltage input to F-TLA. Reverse side (reverse direction): Limited at the voltage input to R-TLA. </td></tr> <tr> <td>02 Analog_2</td><td> Use external force limit input Forward side/F-TLA Reverse side/F-TLA Forward side (forward direction): Limited at the voltage input to F-TLA. Reverse side (reverse direction): Limited at the voltage input to F-TLA. </td></tr> </table>	Force Limit Input Selection [TLSEL]	Setting range	Unit	Default		00 to 02	-	00:TCLM	Selection	Contents	00 TCLM	Use internal force limit value Forward side/TCLM-F Reverse side/TCLM-R Forward side (forward direction): Limited at Forward Direction Internal Force Limit Value. Reverse side (reverse direction): Limited at Reverse Direction Internal Force Limit Value.	01 Analog_1	Use external force limit input Forward side/F-TLA Reverse side/R-TLA Forward side (forward direction): Limited at the voltage input to F-TLA. Reverse side (reverse direction): Limited at the voltage input to R-TLA.	02 Analog_2	Use external force limit input Forward side/F-TLA Reverse side/F-TLA Forward side (forward direction): Limited at the voltage input to F-TLA. Reverse side (reverse direction): Limited at the voltage input to F-TLA.																								
Force Limit Input Selection [TLSEL]	Setting range	Unit	Default																																						
	00 to 02	-	00:TCLM																																						
Selection	Contents																																								
00 TCLM	Use internal force limit value Forward side/TCLM-F Reverse side/TCLM-R Forward side (forward direction): Limited at Forward Direction Internal Force Limit Value. Reverse side (reverse direction): Limited at Reverse Direction Internal Force Limit Value.																																								
01 Analog_1	Use external force limit input Forward side/F-TLA Reverse side/R-TLA Forward side (forward direction): Limited at the voltage input to F-TLA. Reverse side (reverse direction): Limited at the voltage input to R-TLA.																																								
02 Analog_2	Use external force limit input Forward side/F-TLA Reverse side/F-TLA Forward side (forward direction): Limited at the voltage input to F-TLA. Reverse side (reverse direction): Limited at the voltage input to F-TLA.																																								

5. Operation

—Group8—

ID	Contents																																							
37	Forward Direction Internal Force Limit Value [TCLM-F]	Setting range	Unit	Default																																				
		10.0 to 500.0	%	100.0																																				
38	Reverse Direction Internal Force Limit Value [TCLM-R]	Setting range	Unit	Default																																				
		10.0 to 500.0	%	100.0																																				
■ Limits the Force output at this setting value when Preset force limit value is valid. ◆ Limits the force by the ratio for the force rating (100.0%= force rating) ◆ When the Force Limit Function (TL) is valid, the force output is limited by the Preset force limit setting value appropriate to the polarity of the Force command. ◆ When the following conditions are set, the force output is limited by a rate of "Peak armature current at stall (IP) / Rated armature current (IR)". - In case of exceeding Peak force at stall (Tp) of combination motor. - In case of setting of exceeding a rate of "Peak armature current at stall (IP) / Rated armature current (IR)".																																								
■ About Force limit function There are two input systems of restricting Force function: Preset force limit and External force limit. ◆ To use preset force limit ● Restricts the maximum output force by using preset force limit.<table><tr><th>Group</th><th>ID</th><th>Symbol</th><th>Contents</th></tr><tr><td>8</td><td>36</td><td>TLSEL</td><td>Force Limit Input Selection</td></tr></table><table><tr><th>Selection</th><th colspan="3">Contents</th></tr><tr><td>00</td><td>TCLM</td><td colspan="2">Use preset force limit value Forward side/TCLM-F Reverse side/TCLM-R</td></tr></table> ● Sets force limit value.<table><tr><th>Group</th><th>ID</th><th>Symbol</th><th>Contents</th></tr><tr><td>8</td><td>37</td><td>TCLM-F</td><td>Forward Direction Internal Force Limit Value</td></tr><tr><td>8</td><td>38</td><td>TCLM-R</td><td>Reverse Direction Internal Force Limit Value</td></tr></table> ● Sets force limit function ON<table><tr><th>Group</th><th>ID</th><th>Symbol</th><th>Contents</th></tr><tr><td>9</td><td>32</td><td>TL</td><td>Force Limit Function</td></tr></table> Selects to set the Force function being valid. While the Force limit function is valid, restricts force. * When setting, be cautious about acceleration/deceleration time. If the setting value is too small, enough Acceleration/Deceleration force can not get, and normal operation can not get. * Set at: Preset force limit value > Acceleration/Deceleration force. * Preset force limit can set individually to Forward and Reverse direction.					Group	ID	Symbol	Contents	8	36	TLSEL	Force Limit Input Selection	Selection	Contents			00	TCLM	Use preset force limit value Forward side/TCLM-F Reverse side/TCLM-R		Group	ID	Symbol	Contents	8	37	TCLM-F	Forward Direction Internal Force Limit Value	8	38	TCLM-R	Reverse Direction Internal Force Limit Value	Group	ID	Symbol	Contents	9	32	TL	Force Limit Function
Group	ID	Symbol	Contents																																					
8	36	TLSEL	Force Limit Input Selection																																					
Selection	Contents																																							
00	TCLM	Use preset force limit value Forward side/TCLM-F Reverse side/TCLM-R																																						
Group	ID	Symbol	Contents																																					
8	37	TCLM-F	Forward Direction Internal Force Limit Value																																					
8	38	TCLM-R	Reverse Direction Internal Force Limit Value																																					
Group	ID	Symbol	Contents																																					
9	32	TL	Force Limit Function																																					

5.8 Parameter functions

—Group8—

ID

Contents

◆ To use External force limit

- Restricts forward and reverse direction force by inputting External analog voltage to CN1.

- * Forward side force limit input (F-TLA): CN1-18 input voltage range -10V to +10V
- * Reverse side force limit input (R-TLA): CN1-19 input voltage range -10V to +10V

- Input signal specification has two ways.

Group	ID	Symbol	Contents
8	36	TLSEL	Force Limit Input Selection

Selection		Contents
00	Analog_1	Use external force limit input Forward side/ F-TLA Reverse side/ R-TLA

Selection		Contents
00	Analog_2	Use external force limit input Forward side/ } F-TLA Reverse side/ }

5. Operation

—Group8—

ID	Contents																						
	◆ Inputs the voltage corresponding to the Force limit. TR Force 0V 0.2V +2.0V Voltage setting value TR Force 0V -0.2V -2.0V Voltage setting value ● Enables the Force limit function <table><tr><th>Group</th><th>ID</th><th>Symbol</th><th>Contents</th></tr><tr><td>9</td><td>32</td><td>TL</td><td>Force Limit Function</td></tr></table> ● Selects the condition to enable the Force limit function. ● Restricts force while Force limit function is valid.				Group	ID	Symbol	Contents	9	32	TL	Force Limit Function											
	Group	ID	Symbol	Contents																			
	9	32	TL	Force Limit Function																			
	39	Sequence Operation Force Limit Value [SQTCLM]		Setting range 10.0 to 500.0	Unit % Default 120.0																		
■ Limits the output force at sequence operation. ◆ Sets the limiting force by the ratio of rated output force. (100.0%=rated force) ◆ When the following conditions are set, the force output is limited by a rate of "Peak armature current at stall (IP) / Rated armature current (IR)" of combination linear motor. - In case of exceeding Peak force at stall (Tp) of combination motor. - In case of setting of exceeding a rate of "Peak armature current at stall (IP) / Rated armature current (IR)". ◆ This parameter corresponds to JOG Operation, Over-Travel Action, Holding brake stand-by time, and Servo brake action.																							
3A	Selection of Force Limit Input Under Voltage Sag [CPETLSEL]		Setting range 00 to 03	Unit - Default 00:No_Limit																			
	■ Selects the input system of Force command limit function at voltage sag from list below. <table><tr><th colspan="2">Selection</th><th colspan="2">Contents</th></tr><tr><td>00</td><td>No_Limit</td><td>No force limit</td><td></td></tr><tr><td>01</td><td>Analog_1</td><td>Use external force limit input Forward side/ F-TLA Reverse side/ R-TLA</td><td>Forward (forward direction): Limit with voltage input at F-LTA. Reverse (reverse direction): Limit with voltage input at R-TLA.</td></tr><tr><td>02</td><td>Analog_2</td><td>Use external force limit input Forward side/ F-TLA Reverse side/ F-TLA</td><td>Forward (forward direction): Limit with voltage input at F-LTA. Reverse (reverse direction): Limit with voltage input at F-TLA.</td></tr><tr><td>03</td><td>SQTCLM</td><td>Use force limit with sequence operation</td><td>Limit force with Sequence Operation Torque Limit Value.</td></tr></table> * At "00: No_Limit" of list above, Limits the force by following Group8 ID36 if Group9 ID32 is enabled.				Selection		Contents		00	No_Limit	No force limit		01	Analog_1	Use external force limit input Forward side/ F-TLA Reverse side/ R-TLA	Forward (forward direction): Limit with voltage input at F-LTA. Reverse (reverse direction): Limit with voltage input at R-TLA.	02	Analog_2	Use external force limit input Forward side/ F-TLA Reverse side/ F-TLA	Forward (forward direction): Limit with voltage input at F-LTA. Reverse (reverse direction): Limit with voltage input at F-TLA.	03	SQTCLM	Use force limit with sequence operation
Selection		Contents																					
00	No_Limit	No force limit																					
01	Analog_1	Use external force limit input Forward side/ F-TLA Reverse side/ R-TLA	Forward (forward direction): Limit with voltage input at F-LTA. Reverse (reverse direction): Limit with voltage input at R-TLA.																				
02	Analog_2	Use external force limit input Forward side/ F-TLA Reverse side/ F-TLA	Forward (forward direction): Limit with voltage input at F-LTA. Reverse (reverse direction): Limit with voltage input at F-TLA.																				
03	SQTCLM	Use force limit with sequence operation	Limit force with Sequence Operation Torque Limit Value.																				

5.8 Parameter functions

—Group8—

ID	Contents			
3B	Force Attainment select [TASEL]		Setting range	Unit
			00 to 01	-
	■ To select a setting rate type of attaining force		Default	
			00	
	Selection		Contents	
	00	TA/TR	Sets the rate against rated force. (Rated force is 100%)	
	01	TA/TCLM	Sets the rate against Force limit value.	
	Force Attainment Setting [TA]		Setting range	Unit
			0.0 to 500.0	%
			Default 100.0	
3C	■ Sets the rate of Force attainment. Target data of the ratio set in this parameter varies depending on Group8 3B "Force attainment function selection".			
	◆ [" Force attainment function selection": 00]			
	● Sets the rate against rated force: 100%. Therefore, once the commanded force exceeds the setting value, Force attainment signal is output.			
	◆ [" Force attainment function selection": 01]			
	● Sets the rate against Force limit value. The level of attaining force is calculated from the following formula. Force attainment level = Force limit value x setting value / 100.0 [%]			
	Therefore, once the commanded force exceeds the level of attaining force that is calculated from the above formula, force attainment signal is output. Even if the setting value is set more than 100.0 [%], that is limited to 100.0[%]. If forward direction and reverse direction force limit value are different, force attainment level will be setup based on values of each of limited force.			

5. Operation

—Group8—

ID	Contents			
3D	The amounts of force limit value restoration when power restored [TLMREST]	Setting range	Unit	Default
		0.0 to 500.0	%	10.0
3E	■ Sets the force-recovering value per 1ms which is used to normal force from limited force of power supply drop. ◆ Sets the ratio to rated force. (100.0% = rated force) ◆ When setting "0.0%", operate as 10.0%.			
	■ Sets the Force compensation command at holding brake operation cancellation delay to avoid self weight fall at the time of servo OFF to ON. ◆ Self weight fall at servo ON is able to suppress by setting the force compensation value which is correspond to gravity load or external load. ◆ Force compensation command will be linear-interpolated as to be zero after spending the time of GroupB ID04 "Delay Time of Releasing Holding Brake (Holding Brake Release Delay Time)".			
3E	The diagram illustrates the timing of various signals during a servo power restoration sequence. A vertical dashed line marks the start of the sequence. S-ON (active low) transitions from high to low. Holding brake (active low) transitions from high to low. Motor excitation (active low) transitions from high to low. BDLY_TCMP (Force compensation command) is a ramp signal that starts at a high value and decreases linearly to zero. Command acceptance permission is a pulse that occurs during the 'Holding brake engaging' period, which is the time between the start of the sequence and the end of the BDLY_TCMP ramp.			
	Force compensation command Holding brake engaging Command acceptance permission Command acceptance permitted			

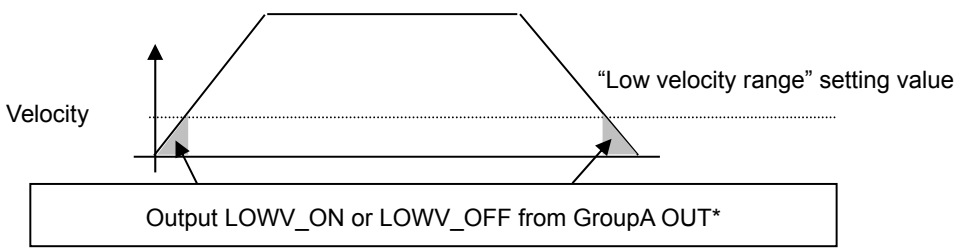
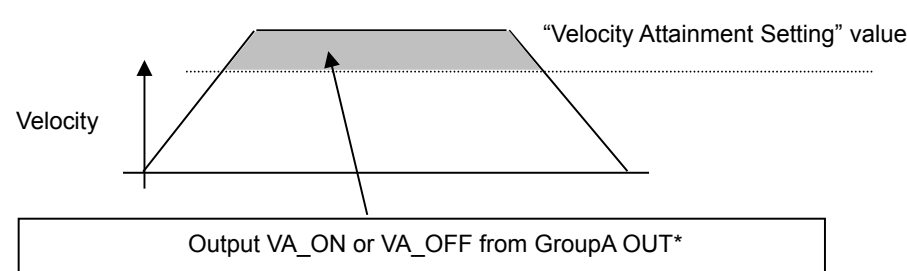
5.8 Parameter functions

—Group8—

ID	Contents												
40	Near Range [NEAR]		Setting range	Unit	Default								
			1 to 2147483647	Pulse	500								
	■ Sets the output range of near range (near in-position) signal. ◆ Outputs the Near range signal if the Position deviation counter is lower than this set value. ◆ Sets at the encoder pulse resolution without relation to Electronic gear ratio. (Not the Position command pulse resolution.) ■ Generally, near range signal is used as auxiliary of In-position signal. For example, by setting this value larger than the range of In-position, the upper device receives the NEAR signal before the In-position signal (INP), and then necessary action can smoothly be accomplished when In-position completed. ◆ Sets Near Range signal output												
	<table><tr><th>Group</th><th>ID</th><th>Symbol</th><th>Contents</th></tr><tr><td>A</td><td>0*</td><td>OUT*</td><td>Generic Purpose output*</td></tr></table>				Group	ID	Symbol	Contents	A	0*	OUT*	Generic Purpose output*	
	Group	ID	Symbol	Contents									
	A	0*	OUT*	Generic Purpose output*									
	<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>1A</td><td>NEAR_ON</td><td>Near Range Status, Output ON</td></tr><tr><td>1B</td><td>NEAR_OFF</td><td>Near Range Status, Output OFF</td></tr></table>				Selection		Contents	1A	NEAR_ON	Near Range Status, Output ON	1B	NEAR_OFF	Near Range Status, Output OFF
	Selection		Contents										
	1A	NEAR_ON	Near Range Status, Output ON										
	1B	NEAR_OFF	Near Range Status, Output OFF										
41	In-Position Window [INP]		Setting range	Unit	Default								
			1 to 2147483647	Pulse	100								
	■ Sets output range of In-Position signal. ◆ Outputs the positioning completion signal when position deviation counter value is this setting value or less. ◆ Sets at the encoder pulse resolution without relation to Electronic gear ratio. (Not the Position command pulse resolution.) ◆ In-Position completion signal will output from selected output terminal if the position deviation of a linear motor changes to less than this setting value. ◆ Sets In-Position signal output												
	<table><tr><th>Group</th><th>ID</th><th>Symbol</th><th>Contents</th></tr><tr><td>A</td><td>0*</td><td>OUT*</td><td>Generic Purpose output*</td></tr></table>				Group	ID	Symbol	Contents	A	0*	OUT*	Generic Purpose output*	
	Group	ID	Symbol	Contents									
	A	0*	OUT*	Generic Purpose output*									
	<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>18</td><td>INP_ON</td><td>In-Position Status, Output ON</td></tr><tr><td>19</td><td>INP_OFF</td><td>In-Position Status, Output OFF</td></tr></table>				Selection		Contents	18	INP_ON	In-Position Status, Output ON	19	INP_OFF	In-Position Status, Output OFF
	Selection		Contents										
	18	INP_ON	In-Position Status, Output ON										
	19	INP_OFF	In-Position Status, Output OFF										
The diagram illustrates the relationship between the position command pulse and the resulting signals. The top trace shows a trapezoidal position command pulse. Below it, the position deviation monitor shows a curve that rises and then decays. The NEAR range is defined as 500 pulses, and the In-position Window is 100 pulses. The signals NEAR, INP, and INPZ are shown as digital pulses. NEAR is ON during the NEAR range. INP is ON during the In-position Window. INPZ is ON when the position deviation counter value is below the completion range of positioning.													
◆ INPZ is a state signal turned on when the position directive pulse after position directive smoothing is 0 and a position deviation counter value is below setting of the completion range of positioning.													

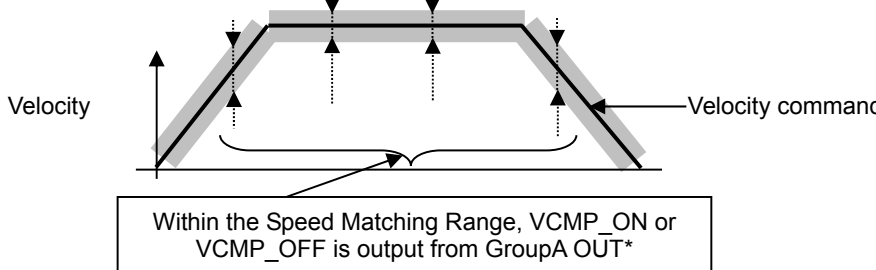
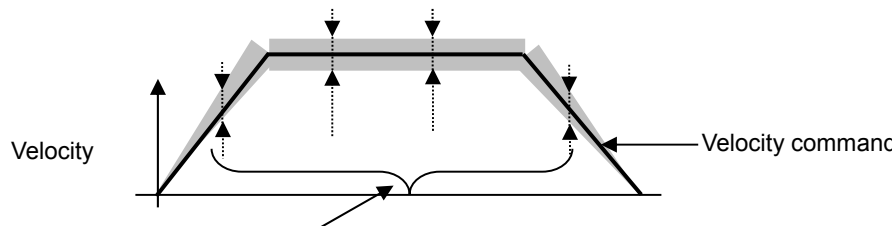
5. Operation

—Group8—

ID	Contents			
42	Speed Zero Range [ZV]	Setting range	Unit	Default
		50 to 500	mm/s	50
	■ Setting value for detecting Zero-speed status (motor stop). ◆ When the speed becomes lower than this value, Zero-speed status is out.			
43	Low Speed Range [LOWV]	Setting range	Unit	Default
		0 to 65535	mm/s	50
	■ Parameter for setting Low speed output range. ◆ When the speed is lower than this value, Low speed status is output.			
	 Output LOWV_ON or LOWV_OFF from GroupA OUT*			
	◆ Automatically overwrite by Auto-tuning result saving. ◆ When Auto-tuning function is valid, this setting value is not applied.			
44	Speed Attainment Setting (High Speed Range) [VA]	Setting range	Unit	Default
		0 to 65535	mm/s	1000
	■ Parameters for setting speed attainment output range. ◆ When the speed exceeds this setting value, Speed attainment is output.			
	◆ When the operation is switched to force control mode by using control mode switching function, in other words, when enabling “control mode switching function (MS)” after setting “03:Velo-Forc” or “04:Posi-Forc” of system parameter ID06 “control mode selection”, simplified velocity limitation is controlled by this parameter. However, this method can not control with constant speed because a force is forced to be zero when Motor speed exceeds this setting value. Avoid the use of such status to continue.			
	 Output VA_ON or VA_OFF from GroupA OUT*			

5.8 Parameter functions

—Group8—

ID	Contents			
45	Speed Matching Unit Selection [VCMPUS] "Power cycle for control after setting"		Setting range	Unit
			00 to 01	—
			Default	
			00: mm/s	
■ Selects Speed Matching Unit setting method.				
45	Selection		Contents	
	00	mm/s	Sets by [mm/s] unit. Uses the setting value of ID46 [VCMP] Speed Matching Range	
	01	Percent	Sets the ratio to velocity command by [%] unit. Uses the setting value of ID47 [VCMPR] Speed Matching Range Ratio.	
46	Speed Matching Range [VCMP]		Setting range	Unit
			0 to 65535	mm/s
			Default	
			50	
■ Sets the range regarded as Speed matching by the [mm/s] unit.				
◆ Use this setting value when ID45 [VCMPUS] Speed Matching Unit Selection is "00: mm/s".				
◆ Velocity matching is output when the Velocity deviation (difference between the velocity command and actual velocity) is within this setting range.				
46				
	Within the Speed Matching Range, VCMP_ON or VCMP_OFF is output from GroupA OUT*			
47	Speed Matching Range Ratio [VCMPR]		Setting range	Unit
			0.0 to 100.0	%
			Default	
			5.0	
■ Sets the range regarded as Speed matching ratio to Velocity command by the [%] unit.				
◆ This setting is used when "01: Percent" is set to ID45 [VCMPUS] Speed Matching Unit Selection".				
◆ The value that multiplied the velocity command by this setting value is a Speed matching range.				
◆ Speed matching is outputted when a velocity deviation (difference of commanded velocity and real one) is in this setting range.				
◆ When this value is less than 1[%], the Speed matching range is treated as 1[mm/s].				
47				
	Within the Speed Matching Range, VCMP_ON or VCMP_OFF is output from GroupA OUT*			

5. Operation

—Group8—

ID	Contents																											
	■ By combining with Group9 "Condition Settings for Enabling Functions", ID42 to ID47 will make the functions of Group9 valid. <table><thead><tr><th colspan="2">Selection</th><th>Contents</th></tr></thead><tbody><tr><td>12</td><td>LOWV_IN</td><td>Function is valid while in low speed status (speed is lower than the LOWV Setting Value).</td></tr><tr><td>13</td><td>LOWV_OUT</td><td>Function is valid while not in low speed status (speed is lower than the LOWV Setting Value).</td></tr><tr><td>14</td><td>VA_IN</td><td>Function is valid while in speed attainment status (speed is higher than the VA Setting Value).</td></tr><tr><td>15</td><td>VA_OUT</td><td>Function is valid while not in speed attainment status (speed is higher than the VA Setting Value).</td></tr><tr><td>16</td><td>VCMP_IN</td><td>Function is valid while in speed matching status (within command-actual velocity consistent range).</td></tr><tr><td>17</td><td>VCMP_OUT</td><td>Function is valid while not in speed matching status (within command-actual velocity consistent range).</td></tr><tr><td>18</td><td>ZV_IN</td><td>Function is valid while in zero speed status (speed is lower than the ZV Setting Value)</td></tr><tr><td>19</td><td>ZV_OUT</td><td>Function is valid while not in zero speed status (speed is lower than the ZV Setting Value)</td></tr></tbody></table> * Speed Matched Range is depending on “Group8 ID45 to ID47” setting. ◆ Example: The servo amplifier sets the GAIN1 and GAIN2 switching without using input signal from the host unit. ● Sets 15: VA_OUT to Group9 ID13 Gain Switching Condition 1 [GC1]. ● Sets 00: Always_Disable to Group9 ID14 Gain Switching Condition 2 [GC2]. ● Sets 50 mm/s (arbitrary value) to Group8 ID44 Speed Attainment (High Speed setting) [VA].	Selection		Contents	12	LOWV_IN	Function is valid while in low speed status (speed is lower than the LOWV Setting Value).	13	LOWV_OUT	Function is valid while not in low speed status (speed is lower than the LOWV Setting Value).	14	VA_IN	Function is valid while in speed attainment status (speed is higher than the VA Setting Value).	15	VA_OUT	Function is valid while not in speed attainment status (speed is higher than the VA Setting Value).	16	VCMP_IN	Function is valid while in speed matching status (within command-actual velocity consistent range).	17	VCMP_OUT	Function is valid while not in speed matching status (within command-actual velocity consistent range).	18	ZV_IN	Function is valid while in zero speed status (speed is lower than the ZV Setting Value)	19	ZV_OUT	Function is valid while not in zero speed status (speed is lower than the ZV Setting Value)
Selection		Contents																										
12	LOWV_IN	Function is valid while in low speed status (speed is lower than the LOWV Setting Value).																										
13	LOWV_OUT	Function is valid while not in low speed status (speed is lower than the LOWV Setting Value).																										
14	VA_IN	Function is valid while in speed attainment status (speed is higher than the VA Setting Value).																										
15	VA_OUT	Function is valid while not in speed attainment status (speed is higher than the VA Setting Value).																										
16	VCMP_IN	Function is valid while in speed matching status (within command-actual velocity consistent range).																										
17	VCMP_OUT	Function is valid while not in speed matching status (within command-actual velocity consistent range).																										
18	ZV_IN	Function is valid while in zero speed status (speed is lower than the ZV Setting Value)																										
19	ZV_OUT	Function is valid while not in zero speed status (speed is lower than the ZV Setting Value)																										
80	<table><tr><td rowspan="2">Polarity selection of axes-sync compensation input</td><td>Setting range</td><td>Unit</td><td>Default</td></tr><tr><td>[SYNCDIR]</td><td>00 to 01</td><td>-</td><td>00: Not_Reversed</td></tr></table> ■ Fit a polarity of position deviation each other. ◆ Set "01: Reversed" if rotation directions of combination axes are different. <table><thead><tr><th colspan="2">Selection</th><th>Contents</th></tr></thead><tbody><tr><td>00</td><td>Not_Reversed</td><td>Without reversing</td></tr><tr><td>01</td><td>Reversed</td><td>With reversing</td></tr></tbody></table>	Polarity selection of axes-sync compensation input	Setting range	Unit	Default	[SYNCDIR]	00 to 01	-	00: Not_Reversed	Selection		Contents	00	Not_Reversed	Without reversing	01	Reversed	With reversing										
Polarity selection of axes-sync compensation input	Setting range		Unit	Default																								
	[SYNCDIR]	00 to 01	-	00: Not_Reversed																								
Selection		Contents																										
00	Not_Reversed	Without reversing																										
01	Reversed	With reversing																										

5.8 Parameter functions

■ General parameters Group9 "Function enabling condition settings"

ID	Name	Setting range	Default value	Functions-enabled input time
00	Positive Over Travel Function [F-OT]	00 to 29	0D:CONT6_OFF	20ms
01	Negative Over Travel Function [R-OT]	00 to 29	0B:CONT5_OFF	20ms
02	Alarm Reset Function [AL-RST]	00 to 29	10:CONT8_ON	20ms
03	Encoder Clear Function [ECLR]	00 to 29	06:CONT3_ON	200ms
04	Deviation Clear Function [CLR]	00 to 29	08:CONT4_ON	2ms
05	Servo-ON Function [S-ON]	00 to 29	02:CONT1_ON	20ms
10	Control Mode Switching Function [MS]	00 to 29	00:Always_Disable	5ms
11	Position Command Pulse Inhibit Function, Velocity Command Zero Clamp Function [INH/Z-STP]	00 to 29	00:Always_Disable	20ms
12	Electronic Gear Switching Function [GERS]	00 to 29	00:Always_Disable	20ms
13	Gain Switching Condition 1 [GC1]	00 to 29	00:Always_Disable	2ms
14	Gain Switching Condition 2 [GC2]	00 to 29	00:Always_Disable	2ms
15	FF Vibration Suppressor Frequency Select Input A1 [SUPFSELA1]	00 to 29	00:Always_Disable	20ms
16	FF Vibration Suppressor Frequency Select Input A2 [SUPFSELA2]	00 to 29	00:Always_Disable	20ms
17	FF Vibration Suppressor Frequency Select Input B1 [SUPFSELB1]	00 to 29	00:Always_Disable	20ms
18	FF Vibration Suppressor Frequency Select Input B2 [SUPFSELB2]	00 to 29	00:Always_Disable	20ms
19	Position Loop Proportional Control Switching Function [PLPCON]	00 to 29	01:Always_Enable	20ms
1A	Model following (vibration suppression) control/standard position control switching function [MODEL]	00 to 11	00:Always_Disable	2ms
1B	Model Vibration Suppressor Frequency Select Input 1 [MDLFSEL1]	00 to 29	00:Always_Disable	20ms
1C	Model Vibration Suppressor Frequency Select Input 2 [MDLFSEL2]	00 to 29	00:Always_Disable	20ms
1D	Magnetic pole position estimation function [CSET]	00 to 29	06:CONT3_ON	20ms
20	Preset Velocity Command Select Input 1 [SP1]	00 to 29	00:Always_Disable	20ms
21	Preset Velocity Command Select Input 2 [SP2]	00 to 29	00:Always_Disable	20ms
22	Preset Velocity Command Select Input 3 [SP3]	00 to 29	00:Always_Disable	20ms
23	Preset Velocity Command Input Direction of Movement [DIR]	00 to 29	00:Always_Disable	20ms
24	Preset Velocity Command Operation Start Signal Input [RUN]	00 to 29	00:Always_Disable	20ms
25	Preset Velocity Command Positive (direction) Move Start Signal Input [RUN-F]	00 to 29	00:Always_Disable	20ms
26	Preset Velocity Command Negative (direction) Move Start Signal Input [RUN-F]	00 to 29	00:Always_Disable	20ms
27	Velocity Loop Proportional Control Switching Function [VLPCON]	00 to 29	04:CONT2_ON	2ms
28	Velocity Compensation Function [V-COMPS]	00 to 29	00:Always_Disable	2ms
30	Torque Compensation Function 1 [T-COMPS1]	00 to 29	00:Always_Disable	2ms
31	Torque Compensation Function 2 [T-COMPS2]	00 to 29	00:Always_Disable	2ms
32	Torque Limit Function [TL]	00 to 29	0E:CONT7_ON	20ms
33	Disturbance Observer Function [OBS]	00 to 29	00:Always_Disable	20ms
34	Compensatory function for stick-slip behavior [STC]	00 to 29	00:Always_Disable	20ms
35	Minor vibration (oscillation) suppression function [FBHYST]	00 to 29	00:Always_Disable	20ms
40	External Trip Input Function [EXT-E]	00 to 29	00:Always_Disable	20ms
41	Emergency Stop Function [EMR]	00 to 29	00:Always_Disable	20ms
80	Axes-sync compensation function [SYNCEN]	00 to 11	00:Always_Disable	20ms
81	Axes-sync compensation proportional control switching function [SYNPCNEN]	00 to 29	00:Always_Disable	20ms

5. Operation

Group9 List of selection contents

■ Keeping the function always valid or invalid

Selection		Contents
00	Always_Disable	Function is always invalid
01	Always_Enable	Function is always valid

■ Using function with the generic input signals

Selection		Contents
02	CONT1_ON	Function is valid when generic input, CONT1, is ON
03	CONT1_OFF	Function is valid when generic input, CONT1, is OFF
04	CONT2_ON	Function is valid when generic input, CONT2, is ON
05	CONT2_OFF	Function is valid when generic input, CONT2, is OFF
06	CONT3_ON	Function is valid when generic input, CONT3, is ON
07	CONT3_OFF	Function is valid when generic input, CONT3, is OFF
08	CONT4_ON	Function is valid when generic input, CONT4, is ON
09	CONT4_OFF	Function is valid when generic input, CONT4, is OFF
0A	CONT5_ON	Function is valid when generic input, CONT5, is ON
0B	CONT5_OFF	Function is valid when generic input, CONT5, is OFF
0C	CONT6_ON	Function is valid when generic input, CONT6, is ON
0D	CONT6_OFF	Function is valid when generic input, CONT6, is OFF
0E	CONT7_ON	Function is valid when generic input, CONT7, is ON
0F	CONT7_OFF	Function is valid when generic input, CONT7, is OFF
10	CONT8_ON	Function is valid when generic input, CONT8, is ON
11	CONT8_OFF	Function is valid when generic input, CONT8, is OFF

■ Activating the functions conditioning the move speed of linear motor

Selection		Contents
12	LOWV_IN	Function is valid while in low speed status (speed is lower than the LOWV Setting Value).
13	LOWV_OUT	Function is valid while not in low speed status (speed is lower than the LOWV Setting Value).
14	VA_IN	Function is valid while in speed attainment status (speed is higher than the VA Setting Value).
15	VA_OUT	Function is valid while not in speed attainment status (speed is higher than the VA Setting Value).
16	VCMP_IN	Function is valid while in speed matching status (within command-actual velocity consistent range).
17	VCMP_OUT	Function is valid while not in speed matching status (within command-actual velocity consistent range).
18	ZV_IN	Function is valid while in zero speed status (speed is lower than the ZV Setting Value).
19	ZV_OUT	Function is valid while not in zero speed status (speed is lower than the ZV Setting Value).

5.8 Parameter functions

—Group9—

■ Activating the functions using the positioning signals

Selection		Contents
20	NEAR_IN	Function is valid while in Near range status
21	NEAR_OUT	Function is valid while not in Near range status
1A	INP_IN	Function is valid while in In-Position status (position deviation < INP)
1B	INP_OUT	Function is valid while not in In-Position status (position deviation < INP)
26	INPZ_IN	Function is valid while in Position command 0 and In-Position status (position deviation < INP)
27	INPZ_OUT	Function is valid while not in Position command 0 and In-Position status (position deviation < INP)
28	TRJCMP_IN	Function is valid while in Position command distribution completion (including delay time)
29	TRJCMP_OUT	Function is valid while not in Position command distribution completion (including delay time)

■ Activating the functions using the force / speed limit

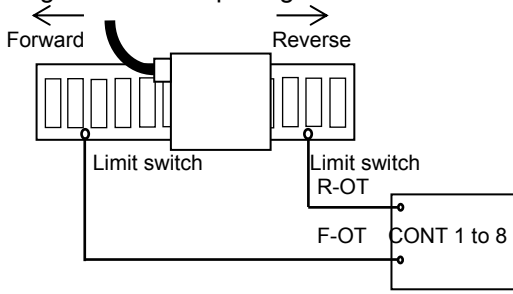
Selection		Contents
1C	TLC_IN	Function is valid while in force limit status
1D	TLC_OUT	Function is valid while not in force limit status
1E	VLC_IN	Function is valid while in velocity limit status
1F	VLC_OUT	Function is valid while not in velocity limit status

■ Activating the functions by the moving direction or zero-speed state of linear motor

Selection		Contents
22	VMON_>_LV	Function is valid while moving direction is forward (VMON>+LOWV)
23	VMON_<=_LV	Function is valid while moving direction is not forward (VMON≤+LOWV)
24	VMON_<_-LV	Function is valid while moving direction is reverse (VMON<-LOWV)
25	VMON_>=_LV	Function is valid while moving direction is not reverse (VMON≥-LOWV)

5. Operation

—Group9—

ID	Contents							
00 01	Forward Over-Travel Function [F-OT] Reverse Over-Travel Function [R-OT]							
	■ The over travel function uses limit switch to prevent damage to the unit. This function forcedly stops the unit when the movement range of the moving part is exceeded. ◆ Allocating over-travel input signal to CONT1 to CONT8.  The diagram illustrates the wiring for the over-travel function. A central motor unit is shown with 'Forward' and 'Reverse' movement directions indicated by arrows. Below the unit, two limit switches are depicted. The 'Forward' limit switch is connected to the 'F-OT' terminal, and the 'Reverse' limit switch is connected to the 'R-OT' terminal. Both terminals are connected to a terminal block labeled 'CONT 1 to 8'.							
	◆ To use over-travel function, select the operating conditions of “position command input, linear motor stop operation and servo-on signal” when over-travel occurs. <table><tr><th>Group</th><th>ID</th><th>Symbol</th><th>Contents</th></tr><tr><td>B</td><td>01</td><td>ACTOT</td><td>Over-Travel operation</td></tr></table>	Group	ID	Symbol	Contents	B	01	ACTOT
Group	ID	Symbol	Contents					
B	01	ACTOT	Over-Travel operation					

5.8 Parameter functions

Selection		Contents
00	CMDINH_SB_SON	Command input is disabled, and motor is stopped by servo-braking (with peak force) when OT occurs. Servo is turned on after motor stops. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0) (Force command for OT side is limited by the sequence force limit.)
01	CMDINH_DB_SON	Command input is disabled, and motor is stopped by dynamic-braking when OT occurs. Servo is turned on after motor stops. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0)
02	CMDINH_Free_SON	Command input is disabled, and motor is free-running when OT occurs. Servo is turned on after motor stops. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0)
03	CMDINH_SB_SOFF	Command input is disabled, and motor is stopped by servo-braking when OT occurs. Servo is turned off after motor stops. (Force command for both side is limited by the sequence force limit.)
04	CMDINH_DB_SOFF	Command input is disabled, and motor is stopped by dynamic-braking when OT occurs. Servo is turned off after motor stops.
05	CMDINH_Free_SOFF	Command input is disabled, and motor is free-running when OT occurs. Servo is turned off after motor stops.
06	CMDACK_VCLM=0	Velocity limit command for the direction on which OT occurred becomes zero when OT occurs.
08	CMDINH_SB_SON2	Command input is disabled, and motor is stopped by servo-brake operation (with sequence force limit) when OT occurs. Servo is turned on after motor stops. (For the side OT occurs, command disabled = velocity limit command = 0) (Force command for both side is limited by the sequence force limit.)

◆ Force limit value differs depending on selection code, when stopping a linear motor by servo-brake.
00: Peak force
03, 08: Sequence force limit

◆ For the velocity control mode, select from 00 to 05 or 08.

◆ For the force control mode, operates as follows:

- For 00 to 02 or 08, keeps servo-on state with force command limitation by sequence force limit.
- For 03 or 04, shift to servo-off state and stop with dynamic brake. Also keeps servo-off state after motor stop.
- For 05, shift to servo-off state and become freerun operation. Also keeps servo-off state after linear motor stop.

◆ Stop a servo motor by servo-brake when over-travel occurs
When "08: CMDINH_SB_SON2" is selected, force value of servo brake operation is set by the sequence operation force limit value.

Group	ID	Symbol	Contents
8	39	SQTCLM	Sequence operation force limit value

5. Operation

—Group9—

ID	Contents
02	Alarm reset function [AL-RST] ■ This function enables inputting alarm reset signal from host equipment. Alarm is cleared by enabling alarm reset function (AL-RST). ◆ Allocating conditions to enable alarm reset function. When AL-RST signal enabled, this function clears alarms. * Please note that the alarms which needs control power-cycle for alarm reset are not able to clear by alarm reset signal. ◆ The wiring is as follows when enabling conditions allocation is set to CONT2. Logic can be changed by selecting options of enabling conditions allocation. The diagram shows the host equipment connected to the servo amplifier. The host provides a DC5V to 24V supply and an alarm reset signal. The servo amplifier's CN1-50 is connected to CONT-COM and CN1-36 is connected to CONT2. A timing diagram below shows the sequence: 'Alarm activated' (high), 'Alarm canceled' (low), and 'Alarm reset' (a pulse of 20msec or more).
	Servo-on function [S-ON] [S-ON] ■ This function is to input servo-on signal from host equipment. Enabling servo-on function (SON) can put linear motor into current-applied state. ◆ Allocating conditions to enable servo-on function. When SON signal is enabled, the linear motor will be into current-applied state. ◆ The wiring is as follows when enabling conditions allocation is set to CONT1. Logic can be changed by selecting options of enabling conditions allocation. The diagram shows the host equipment connected to the servo amplifier. The host provides a DC5V to 24V supply and a servo-on signal. The servo amplifier's CN1-50 is connected to CONT-COM and CN1-37 is connected to CONT1.

5.8 Parameter functions

— Group9 —

ID	Contents																				
10	Control mode switching function [MS]																				
	■ 2 types of control mode can be switched and used. The control mode combination is selected by system parameter and can be switched with control mode switching function.																				
	◆ Selecting control modes from system parameters ID06.																				
	<table><tr><th>ID</th><th>Name</th><th>Setting range</th></tr><tr><td>06</td><td>Control mode</td><td>6 methods</td></tr></table>	ID	Name	Setting range	06	Control mode	6 methods														
	ID	Name	Setting range																		
	06	Control mode	6 methods																		
	<table><tr><th>Setting</th><th>Contents</th></tr><tr><td>03: Velo—Forc</td><td>Velocity control - force control switching type</td></tr><tr><td>04: Posi—Forc</td><td>Position control - force control switching type</td></tr><tr><td>05: Posi—Velo</td><td>Position control - velocity control switching type</td></tr></table>	Setting	Contents	03: Velo—Forc	Velocity control - force control switching type	04: Posi—Forc	Position control - force control switching type	05: Posi—Velo	Position control - velocity control switching type												
	Setting	Contents																			
	03: Velo—Forc	Velocity control - force control switching type																			
	04: Posi—Forc	Position control - force control switching type																			
05: Posi—Velo	Position control - velocity control switching type																				
* After setting changed --> The setting is enabled by re-turning on control power supply.																					
◆ Allocating conditions to enable control mode switching function. When MS signal is valid, control mode is switched.																					
◆ When using control mode switching type, “Auto-notch frequency tuning”, “Auto-vibration suppression frequency tuning”, and “JOG-operation” may not be used. Please use “Auto-notch frequency tuning”, “Auto-vibration suppression frequency tuning,” and “JOG-operation” after changing control mode to primary side (turning off “input signal”).																					
Position command pulse inhibiting function·velocity-zero stop function [INH/Z-STP]																					
■ When operating in position control mode, you use position command pulse inhibiting function (INHIBIT function), when in velocity control mode, you use velocity-zero stop function.																					
11	◆ Enabling the function during linear motor operation inhibits input command, and then linear motor stops with the state linear motor being excited.																				
	* When operating in position control mode, input pulse is not counted inside of the servo amplifier even if position command pulse is input.																				
	◆ Allocating conditions to enable position command pulse inhibiting function/ velocity-zero stop function. This functions when INH/Z-STP signal is enabled.																				
	Gain switching condition 1 [GC1] Gain switching condition 2 [GC2]																				
13 14	■ 4 types of gain can be used by switching them.																				
	◆ Allocating conditions to enable gain switching condition. You can switch GAIN 1 to 4 by combination of GC1 and GC2 setting.																				
	<table><tr><td>GC1 : Gain switching condition 1</td><td>Invalid</td><td>Valid</td><td>Invalid</td><td>Valid</td></tr><tr><td>GC2 : Gain switching condition 2</td><td>Invalid</td><td>Invalid</td><td>Valid</td><td>Valid</td></tr><tr><td></td><td>↓</td><td>↓</td><td>↓</td><td>↓</td></tr><tr><td>Gain becoming valid</td><td>GAIN1</td><td>GAIN2</td><td>GAIN3</td><td>GAIN4</td></tr></table>	GC1 : Gain switching condition 1	Invalid	Valid	Invalid	Valid	GC2 : Gain switching condition 2	Invalid	Invalid	Valid	Valid		↓	↓	↓	↓	Gain becoming valid	GAIN1	GAIN2	GAIN3	GAIN4
	GC1 : Gain switching condition 1	Invalid	Valid	Invalid	Valid																
	GC2 : Gain switching condition 2	Invalid	Invalid	Valid	Valid																
	↓	↓	↓	↓																	
Gain becoming valid	GAIN1	GAIN2	GAIN3	GAIN4																	

5. Operation

—Group9—

ID	Contents			
15 16	FF vibration suppression frequency selecting input A1 [SUPFSELA1]			
	FF vibration suppression frequency selecting input A2 [SUPFSELA2]			
	■ 4 types of FF vibration suppression frequency can be used by switching them. ◆ Allocating conditions to enable FF vibration suppression frequency selecting input. You can switch FF vibration suppression frequency A1 to A4 by combination of SUPFSELA1 and SUPFSELA2 setting.			
	SUPFSELA1: FF vibration suppression frequency selecting input A1	Invalid	Valid	Invalid
	SUPFSELA2: FF vibration suppression frequency selecting input A2	Invalid	Invalid	Valid
17 18	FF vibration suppression frequency selecting input B1 [SUPFSELB1]			
	FF vibration suppression frequency selecting input B2 [SUPFSELB2]			
	■ 4 types of FF vibration suppression frequency can be used by switching them. ◆ Allocating conditions to enable FF vibration suppression frequency selecting input. You can switch FF vibration suppression frequency B1 to B4 by combination of SUPFSELB1 and SUPFSELB2 setting.			
	SUPFSELB1: FF vibration suppression frequency selecting input B1	Invalid	Valid	Invalid
	SUPFSELB2: FF vibration suppression frequency selecting input B2	Invalid	Invalid	Valid

5.8 Parameter functions

— Group9 —

ID	Contents										
19	Position loop proportional control switching function [PLPCON]										
	■ You can switch between position loop PI control and P control. Enabling position loop proportional control switching function (PLPCON) enable switching. ◆ Allocating conditions to enable position loop proportional control switching function. When PLPCON signal enabled, the control is switched to proportional control. ● PI control (proportional·integral control)··Position loop proportional gain (KP)/ integral time constant (TPI) ● P control (proportional control)····· Position loop proportional gain (KP) * In the standard setting, position loop integral time constant (TPI) is 1000.0ms, so integration function is disabled. ◆ Automatically overwrite by Auto-tuning result saving. ◆ When Auto-tuning function is valid, this setting value is not applied.										
1A	Model following (vibration suppression) control/ standard position control switching function [MODEL]										
	■ Enabling Model following (vibration suppression) control. ◆ This setting value is valid only when Control mode selection is "03: Velocity / Torque control switching type" or "04: Position / Torque control switching type". * Valid condition is limited to 00 to 11. * Do not perform switching of the model following (vibration suppression) control and the standard position control, during linear motor operation. Alarm (Model Following Vibration Suppression Control Error (AL.C5)) may occur.										
1B 1C	Model vibration suppression frequency selecting input 1 [MDLFSEL1] Model vibration suppression frequency selecting input 2 [MDLFSEL2]										
	■ 4 types of model vibration suppression frequency can be used by switching them. ◆ Allocating conditions to enable model control antiresonant frequency selecting input. You can switch model control antiresonant frequency 1 to 4/ model control antiresonant frequency 1 to 4 by combination of MDLFSEL1 with MDLFSEL2.										
	<table><tr><td>MDLFSEL1: Model vibration suppression frequency selecting input 1</td><td>Invalid</td><td>Valid</td><td>Invalid</td><td>Valid</td></tr><tr><td>MDLFSEL2: Model vibration suppression frequency selecting input 2</td><td>Invalid</td><td>Invalid</td><td>Valid</td><td>Valid</td></tr></table>	MDLFSEL1: Model vibration suppression frequency selecting input 1	Invalid	Valid	Invalid	Valid	MDLFSEL2: Model vibration suppression frequency selecting input 2	Invalid	Invalid	Valid	Valid
	MDLFSEL1: Model vibration suppression frequency selecting input 1	Invalid	Valid	Invalid	Valid						
MDLFSEL2: Model vibration suppression frequency selecting input 2	Invalid	Invalid	Valid	Valid							
<table><tr><td></td><td>↓</td><td>↓</td><td>↓</td><td>↓</td></tr><tr><td>Vibration suppression frequency becoming valid</td><td>Model control antiresonant frequency 1 Group 3 ID06 Model control resonant frequency 1 Group 3 ID07</td><td>Model control antiresonant frequency 2 Group 4 ID50 Model control resonant frequency 2 Group 4 ID51</td><td>Model control antiresonant frequency 3 Group 4 ID52 Model control resonant frequency 3 Group 4 ID53</td><td>Model control antiresonant frequency 4 Group 4 ID54 Model control resonant frequency 4 Group 4 ID55</td></tr></table>		↓	↓	↓	↓	Vibration suppression frequency becoming valid	Model control antiresonant frequency 1 Group 3 ID06 Model control resonant frequency 1 Group 3 ID07	Model control antiresonant frequency 2 Group 4 ID50 Model control resonant frequency 2 Group 4 ID51	Model control antiresonant frequency 3 Group 4 ID52 Model control resonant frequency 3 Group 4 ID53	Model control antiresonant frequency 4 Group 4 ID54 Model control resonant frequency 4 Group 4 ID55	
	↓	↓	↓	↓							
Vibration suppression frequency becoming valid	Model control antiresonant frequency 1 Group 3 ID06 Model control resonant frequency 1 Group 3 ID07	Model control antiresonant frequency 2 Group 4 ID50 Model control resonant frequency 2 Group 4 ID51	Model control antiresonant frequency 3 Group 4 ID52 Model control resonant frequency 3 Group 4 ID53	Model control antiresonant frequency 4 Group 4 ID54 Model control resonant frequency 4 Group 4 ID55							
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. Operation

—Group9—

ID	Contents
27	Velocity loop proportional control switching function [VLPCON] ■ You can switch between velocity loop PI control and P control. ◆ Enabling velocity loop proportional control switching function (VLPCON) enables switching. ◆ Allocating conditions to enable velocity loop proportional control switching function. When VLPCON signal is enabled, the control is switched to proportional control. ● PI control (proportional·integral control)··Velocity loop proportional gain (KVP)/ integral time constant (TVI) ● P control (proportional control)····· Velocity loop proportional gain (KVP) * Switching to proportional control decreases servo gain, and servo system becomes easy to stable. * In the default setting, the velocity loop integral time constant (TVI) is 1000.0ms, so the integral function is invalid. ◆ Automatically overwrite by Auto-tuning result saving. ◆ When Auto-tuning function is valid, this setting value is not applied.
34	Stick-slip behavior compensation function [STC] ■ This enables stick motion compensation function in quadrant to compensate trajectory error occurred due to quadrant switching, for use in applications for arc-shape or curved surface process, such as NC machining equipments. ◆ The conditions for enabling compensatory function for stick-slip behavior are assigned. The compensatory function for stick-slip behavior becomes enabled If the STC signal is valid.
35	Minor vibration suppression function [FBHYST] ■ Minor vibration suppression function to suppress mechanical system-induced vibration caused by encoder pulse modulation is enabled when motor stops. ◆ The conditions for enabling minor vibration suppression function are assigned. The minor vibration suppression function becomes enabled If the FBHYST signal is valid.
40	External trip input function [EXT-E] ■ Contact input such as external thermal device can be taken in servo amplifier, and then output as an alarm (AL.55). ◆ Allocating conditions to enable external trip function. When EXT-E signal is enabled, this becomes alarm (AL.55).
41	Emergency stop function [EMR] ■ This can urgently stop linear motor by taking unit emergency signal into servo amplifier. ◆ Allocating conditions to enable unit emergency signal. When EMR signal is enabled, motor urgently stops.

5.8 Parameter functions

— Group9 —

ID	Contents
80	Axes-sync compensation function [SYNCEN]
	■ Tandem operation function will work when "01: Tandem" is set to system parameter ID08 "Amplifier communication function", and this parameter is valid. * Valid condition is limited to 00 to 11.
81	Axes-sync compensation proportional control switching function [SYNPCNEN]
	■ Able to switch PI control and P control, in the axes-sync compensation function. ◆ Able to switch when this parameter (SYNPCNEN) is valid. ◆ Assign conditions of becoming valid the axes-sync compensation proportional control switching function. Change to proportional control when SYNPCNEN signal is valid. ● PI (Proportional-Integral) control - Axes-sync compensation proportional gain (KSCPGN), - Axes-sync compensation integral time constant (TSCIGN) ● P (Proportional) control - Axes-sync compensation proportional gain (KSCPGN) * Servo system will ease to stable when changing to proportional control by reducing axes-sync compensation value. * In the default setting, the axes-sync compensation integral time constant (TSCIGN) is 1000.0ms, so the integral function is invalid.

5. Operation

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

ID	Contents	Setting range	Unit	Default value																																																																																														
00	General Purpose Output 1 [OUT1]	00 to 81	-	18:INP_ON																																																																																														
01	General Purpose Output 2 [OUT2]	00 to 81	-	0C:TLC_ON																																																																																														
02	General Purpose Output 3 [OUT3]	00 to 81	-	02:S-RDY_ON																																																																																														
03	General Purpose Output 4 [OUT4]	00 to 81	-	0A:MBR-ON_ON																																																																																														
04	General Purpose Output 5 [OUT5]	00 to 81	-	33:ALM5_OFF																																																																																														
05	General Purpose Output 6 [OUT6]	00 to 81	-	35:ALM6_OFF																																																																																														
06	General Purpose Output 7 [OUT7]	00 to 81	-	37:ALM7_OFF																																																																																														
07	General Purpose Output 8 [OUT8]	00 to 81	-	39:ALM_OFF																																																																																														
10	Digital Monitor Output Signal Selection [DMON]	00 to 81	-	00:Always_OFF																																																																																														
	■ Selects output signal for Output digital monitor. ◆ The logic is reversed with the Digital monitor. ◆ Output voltage is approximately 5V when OFF, and 0V when ON.																																																																																																	
	■ Selection Contents list for General Purpose Output OUT1 to General Purpose Output OUT8 /Digital monitor output selection ◆ Fix Output to either selection. <table><tr><td>01:Always_ON</td><td>00:Always_OFF</td></tr></table> ◆ When Generic input signal status is to be Output <table><tr><td>General Input, CONT1 is ON</td><td>3A:CONT1_ON</td><td>3B:CONT1_OFF</td></tr><tr><td>General Input, CONT2 is ON</td><td>3C:CONT2_ON</td><td>3D:CONT2_OFF</td></tr><tr><td>General Input, CONT3 is ON</td><td>3E:CONT3_ON</td><td>3F:CONT3_OFF</td></tr><tr><td>General Input, CONT4 is ON</td><td>40:CONT4_ON</td><td>41:CONT4_OFF</td></tr><tr><td>General Input, CONT5 is ON</td><td>42:CONT5_ON</td><td>43:CONT5_OFF</td></tr><tr><td>General Input, CONT6 is ON</td><td>44:CONT6_ON</td><td>45:CONT6_OFF</td></tr><tr><td>General Input, CONT7 is ON</td><td>46:CONT7_ON</td><td>47:CONT7_OFF</td></tr><tr><td>General Input, CONT8 is ON</td><td>48:CONT8_ON</td><td>49:CONT8_OFF</td></tr></table> ◆ When Servo amplifier Preset status is to be output. <table><tr><td>While Servo Ready Complete</td><td>02:S-RDY_ON</td><td>03:S-RDY_OFF</td></tr><tr><td>While Power Supply ON</td><td>04:P-ON_ON</td><td>05:P-ON_OFF</td></tr><tr><td>While Power Supply ON Permission</td><td>06:A-RDY_ON</td><td>07:A-RDY_OFF</td></tr><tr><td>While Motor Excitation</td><td>08:S-ON_ON</td><td>09:S-ON_OFF</td></tr><tr><td>While Holding Brake Excitation Signal Output</td><td>0A:MBR-ON_ON</td><td>0B:MBR-ON_OFF</td></tr><tr><td>While Force Limiting</td><td>0C:TLC_ON</td><td>0D:TLC_OFF</td></tr><tr><td>While Velocity Limiting</td><td>0E:VLC_ON</td><td>0F:VLC_OFF</td></tr><tr><td>While Low Speed Status</td><td>10:LOWV_ON</td><td>11:LOWV_OFF</td></tr><tr><td>While Speed Attainment Status</td><td>12:VA_ON</td><td>13:VA_OFF</td></tr><tr><td>While Speed Matching Status</td><td>14:VCMP_ON</td><td>15:VCMP_OFF</td></tr><tr><td>While Speed Zero Status</td><td>16:ZV_ON</td><td>17:ZV_OFF</td></tr><tr><td>While Command Acceptance Permission Status</td><td>1C:CMD-ACK_ON</td><td>1D:CMD-ACK_OFF</td></tr><tr><td>While Gain Switching Status</td><td>1E:GC-ACK_ON</td><td>1F:GC-ACK_OFF</td></tr><tr><td>While Velocity Loop Proportional Control Switching Status</td><td>20:PCON-ACK_ON</td><td>21:PCON-ACK_OFF</td></tr><tr><td>While Electronic Gear Switching Status</td><td>22:GERS-ACK_ON</td><td>23:GERS-ACK_OFF</td></tr><tr><td>While Control Mode Switching Status</td><td>24:MS-ACK_ON</td><td>25:MS-ACK_OFF</td></tr><tr><td>While Forward Over-Travel Status</td><td>26:F-OT_ON</td><td>27:F-OT_OFF</td></tr><tr><td>While Reverse Over-travel Status</td><td>28:R-OT_ON</td><td>29:R-OT_OFF</td></tr><tr><td>While Main Circuit Power Supply Charging</td><td>4A:CHARGE_ON</td><td>4B:CHARGE_OFF</td></tr><tr><td>While Dynamic Braking</td><td>4C:DB_OFF</td><td>4D:DB_ON</td></tr><tr><td>While Force Attainment Status</td><td>5E:TA_ON</td><td>5F:TA_OFF</td></tr><tr><td>While Model control/ Model vibration suppression control Status</td><td>68:MODLCH_ON</td><td>69:MODLCH_OFF</td></tr><tr><td>While Velocity command zero status</td><td>6A:VCZV_ON</td><td>6B:VCZV_OFF</td></tr></table>				01:Always_ON	00:Always_OFF	General Input, CONT1 is ON	3A:CONT1_ON	3B:CONT1_OFF	General Input, CONT2 is ON	3C:CONT2_ON	3D:CONT2_OFF	General Input, CONT3 is ON	3E:CONT3_ON	3F:CONT3_OFF	General Input, CONT4 is ON	40:CONT4_ON	41:CONT4_OFF	General Input, CONT5 is ON	42:CONT5_ON	43:CONT5_OFF	General Input, CONT6 is ON	44:CONT6_ON	45:CONT6_OFF	General Input, CONT7 is ON	46:CONT7_ON	47:CONT7_OFF	General Input, CONT8 is ON	48:CONT8_ON	49:CONT8_OFF	While Servo Ready Complete	02:S-RDY_ON	03:S-RDY_OFF	While Power Supply ON	04:P-ON_ON	05:P-ON_OFF	While Power Supply ON Permission	06:A-RDY_ON	07:A-RDY_OFF	While Motor Excitation	08:S-ON_ON	09:S-ON_OFF	While Holding Brake Excitation Signal Output	0A:MBR-ON_ON	0B:MBR-ON_OFF	While Force Limiting	0C:TLC_ON	0D:TLC_OFF	While Velocity Limiting	0E:VLC_ON	0F:VLC_OFF	While Low Speed Status	10:LOWV_ON	11:LOWV_OFF	While Speed Attainment Status	12:VA_ON	13:VA_OFF	While Speed Matching Status	14:VCMP_ON	15:VCMP_OFF	While Speed Zero Status	16:ZV_ON	17:ZV_OFF	While Command Acceptance Permission Status	1C:CMD-ACK_ON	1D:CMD-ACK_OFF	While Gain Switching Status	1E:GC-ACK_ON	1F:GC-ACK_OFF	While Velocity Loop Proportional Control Switching Status	20:PCON-ACK_ON	21:PCON-ACK_OFF	While Electronic Gear Switching Status	22:GERS-ACK_ON	23:GERS-ACK_OFF	While Control Mode Switching Status	24:MS-ACK_ON	25:MS-ACK_OFF	While Forward Over-Travel Status	26:F-OT_ON	27:F-OT_OFF	While Reverse Over-travel Status	28:R-OT_ON	29:R-OT_OFF	While Main Circuit Power Supply Charging	4A:CHARGE_ON	4B:CHARGE_OFF	While Dynamic Braking	4C:DB_OFF	4D:DB_ON	While Force Attainment Status	5E:TA_ON	5F:TA_OFF	While Model control/ Model vibration suppression control Status	68:MODLCH_ON	69:MODLCH_OFF	While Velocity command zero status	6A:VCZV_ON
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5.8 Parameter functions

— GroupA —

◆ When Positioning signal is to be output

While In-Position Status	18:INP_ON	19:INP_OFF
While Near Range Status	1A:NEAR_ON	1B:NEAR_OFF
While In-Position with Position Command 0 Status	5A:INPZ_ON	5B:INPZ_OFF
While position command distribution completion status	60:TRJCMP_ON	61:TRJCMP_OFF

◆ When Warning signal is to be output

While Position Deviation Excess Warning Status	2A:WNG-OFW_ON	2B:WNG-OFW_OFF
While Overload Warning Status	2C:WNG-OLW_ON	2D:WNG-OLW_OFF
While Regenerative Overload Warning Status	2E:WNG-ROLW_ON	2F:WNG-ROLW_OFF
While Voltage Sag Warning Status	5C:PEWNG_ON	5D:PEWNG_OFF
While adaptive notch filter E frequency warning status	6E:ANFEWNG_ON	6F:ANFEWNG_OFF
While axes-sync error warning status	80:SYNCEWNG_ON	81:SYNCEWNG_OFF

◆ When Alarm signals are to be output

Alarm Code Bit 5	32:ALM5_ON	33:ALM5_OFF
Alarm Code Bit 6	34:ALM6_ON	35:ALM6_OFF
Alarm Code Bit 7	36:ALM7_ON	37:ALM7_OFF
While Alarm Status	38:ALM_ON	39:ALM_OFF

◆ When PY compatible alarm signals are to be output

PY Compatible Alarm Code 1	50:PYALM1_ON	51:PYALM1_OFF
PY Compatible Alarm Code 2	52:PYALM2_ON	53:PYALM2_OFF
PY Compatible Alarm Code 4	54:PYALM4_ON	55:PYALM4_OFF
PY Compatible Alarm Code 8	56:PYALM8_ON	57:PYALM8_OFF

◆ When PY compatible alarm signals are to be output

Magnetic pole position estimation completing	4E:CRDY_ON	4F:CRDY_OFF
Magnetic pole position estimation preparation completing	62:CSETRDY_ON	63:CSETRDY_OFF
Magnetic pole position estimation normally completing	64:CSETNOR_ON	65:CSETNOR_OFF

- * "Force limiting" is performed at "before force limit filter" and "after force command filter/force FF compensation", by equipping the force FF compensation function. "While Force Limiting" is output when either condition is established. Therefore, confirm each state of the force command monitor and the force command monitor (before filter), for "Force limiting".

5. Operation

—GroupA—

ID	Contents	Setting range	Unit	Default value
11	Analog Monitor Select Output 1 [MON1]	00 to 36	-	05:VMON_2mV/ mm/s
12	Analog Monitor Select Output 2 [MON2]	00 to 36	-	02:TCMON_2V/TR

■ Selects output signals to output to Analog monitor 1 and 2 from the list below.

00: RESERVE	Monitor mode for manufacturer only	-
01: TMON_2V/TR	Force Monitor	2V/Rated force
02: TCMON_2V/TR	Force Command Monitor	2V/Rated force
03: VMON_0.2mV/ mm/s	Velocity Monitor	0.2mV/ mm/s
04: VMON_1mV/ mm/s	Velocity Monitor	1mV/ mm/s
05: VMON_2mV/ mm/s	Velocity Monitor	2mV/ mm/s
06: VMON_3mV/ mm/s	Velocity Monitor	3mV/ mm/s
07: VCMON_0.2mV/ mm/s	Velocity Command Monitor	0.2mV/ mm/s
08: VCMON_1mV/ mm/s	Velocity Command Monitor	1mV/ mm/s
09: VCMON_2mV/ mm/s	Velocity Command Monitor	2mV/ mm/s
0A: VCMON_3mV/ mm/s	Velocity Command Monitor	3mV/ mm/s
0B: PMON_0.01mV/P	Position Deviation Counter Monitor	0.01mV/Pulse
0C: PMON_0.1mV/P	Position Deviation Counter Monitor	0.1mV/Pulse
0D: PMON_1mV/P	Position Deviation Counter Monitor	1mV/Pulse
0E: PMON_10mV/P	Position Deviation Counter Monitor	10mV/Pulse
0F: PMON_20mV/P	Position Deviation Counter Monitor	20mV/Pulse
10: PMON_50mV/P	Position Deviation Counter Monitor	50mV/Pulse
11: FMON1_2mV/kP/s	Position Command Pulse Frequency Monitor 1 (Position Command Pulse Input Frequency)	2mV/kPulse/s
12: FMON1_10mV/kP/s	Position Command Pulse Frequency Monitor 1 (Position Command Pulse Input Frequency)	10mV/kPulse/s
13: FMON2_0.05mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Controller)	0.05mV/kPulse/s
14: FMON2_0.5mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Controller)	0.5mV/kPulse/s
15: FMON2_2mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Controller)	2mV/kPulse/s
16: FMON2_10mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Controller)	10mV/kPulse/s
17: TLMON_EST_2V/TR	Load Force Monitor (Estimated Value)	2V/Rated force
18: Sine-U	U Phase Electronic Angle Sine	8V _{peak}
19: ACMON_0.01mV/ mm/s ²	Acceleration monitor	0.01mV/ mm /s ²

5.8 Parameter functions

— GroupA —

1A: ACMON_0.1mV/mm/s ²	Acceleration monitor	0.1mV/ mm /s ²
1B: ACMON_1mV/mm/s ²	Acceleration monitor	1mV/ mm /s ²
1C: ACMON_10mV/mm/s ²	Acceleration monitor	10mV/ mm /s ²
1D: VBUS_1V/DC100V	Bus voltage monitor	1V/DC100V
1E: VBUS_1V/DC10V	Bus voltage monitor	1V/DC10V
1F: DFERR_10mV/P	Dual position error monitor	10mV/Pulse
20: DFERR_0.1mV/P	Dual position error monitor	0.1mV/Pulse
21: SYNERR_10mV/P	Axes-sync error monitor	10mV/Pulse
22: SYNERR_0.1mV/P	Axes-sync error monitor	0.1mV/Pulse
23: OLRAT_0.5V/%	Overload detection temperature reach rate monitor	0.5V/%
24: FMON1_0.01mV/kP/s	Position command pulse frequency monitor 1 (Position command pulse input frequency)	0.01mV/kPulse/s
25: FMON1_0.05mV/kP/s	Position command pulse frequency monitor 1 (Position command pulse input frequency)	0.05mV/kPulse/s
26: FMON1_0.5mV/kP/s	Position command pulse frequency monitor 1 (Position command pulse input frequency)	0.5mV/kPulse/s
27: FMON2_0.01mV/kP/s	Position command pulse frequency monitor 2 (Position command pulse input frequency)	0.01mV/kPulse/s
2D: TMON2_2V/TR	Force command monitor (before filter)	2V/Rated force
34: JRAT_10mV/%	Load Mass Ratio monitor	10mV/%
35: JRAT_5mV/%	Load Mass Ratio monitor	5mV/%
36: JRAT_0.5mV/%	Load Mass Ratio monitor	0.5mV/%

- ◆ Position command pulse frequency monitor 1 monitors Position command pulse before the Electronic gear.
- ◆ Position command pulse frequency monitor 2 monitors Position command pulse after passing through the Electronic gear and Position command smoothing.
- * Position command pulse frequency monitor 1, 2 will be generated in pulse-state when the position command pulse is 10 kHz or less. When converting it to position command frequency, use it after averaging.
- ◆ The following low-pass filters are placed into force monitor, acceleration monitor, and load force monitor.

Force monitor	250Hz
Velocity monitor	250Hz
Load force monitor	50Hz
- ◆ Force Command Monitor (before filter) outputs the state before filter, so force command is shown with ripple. However, motor is driven by the force command after filter. Therefore, it differs from motor behavior.

5. Operation

—GroupA—

ID	Contents			
13	Analog Monitor Output Polarity [MONPOL]	Setting range	Unit	Default value
		00 to 08	-	00:MON1+_MON2+
	■ Selects Output polarity of Analog monitor output, MON1and MON2 from below. ◆ For both MON1 and MON2, set from any of the followings: + No Polarity Rotation, - Polarity Rotation, ABS Absolute Value Output			
	Selection	Contents		
	00:MON1+_MON2+	MON1: Output positive voltage at Forward (Positive) Direction. Output positive/negative voltage. MON2: Output positive voltage at Forward (Positive) Direction. Output positive/negative voltage.		
	01:MON1-_MON2+	MON1: Output negative voltage at Forward (Positive) Direction. Output positive/negative voltage. MON2: Output positive voltage at Forward (Positive) Direction. Output positive/negative voltage.		
	02:MON1+_MON2-	MON1: Output positive voltage at Forward (Positive) Direction. Output positive/negative voltage. MON2: Output negative voltage at Forward (Positive) Direction. Output positive/negative voltage.		
	03:MON1-_MON2-	MON1: Output negative voltage at Forward (Positive) Direction. Output positive/negative voltage. MON2: Output negative voltage at Forward (Positive) Direction. Output positive/negative voltage.		
	04:MON1ABS_MON2+	MON1: Output positive voltage at Forward (Positive) and Reverse (Negative) Direction. MON2: Output negative voltage at Forward (Positive) Direction. Output positive/negative voltage.		
	05:MON1ABS_MON2-	MON1: Output positive voltage at Forward (Positive) and Reverse (Negative) Direction. MON2: Output negative voltage at Forward (Positive) Direction. Output positive/negative voltage.		
06:MON1+_MON2ABS	MON1: Output positive voltage at Forward (Positive) Direction. Output positive/negative voltage. MON2: Output positive voltage at Forward (Positive) and Reverse (Negative) Direction.			
07:MON1-_MON2ABS	MON1: Output negative voltage at Forward (Positive) Direction. Output positive/negative voltage. MON2: Output positive voltage at Forward (Positive) and Reverse (Negative) Direction.			
08:MON1ABS_MON2ABS	MON1: Output positive voltage at Forward (Positive) and Reverse (Negative) Direction. MON2: Output positive voltage at Forward (Positive) and Reverse (Negative) Direction.			

5.8 Parameter functions

■ GroupB "Sequence/Alarm related settings"

ID	Contents																															
00	Servo-OFF stop behavior [DBOPE]		Setting range	Unit	Default value																											
			00 to 07	-	04:SB_Free																											
	■ Sets the stop behavior when state changed to servo OFF from servo ON, and the dynamic brake operation during servo OFF.																															
	<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Free_Free</td><td>Free run works, at servo OFF. Motor gets free state, after motor stop.</td></tr><tr><td>01</td><td>Free_DB</td><td>Free run works, at servo OFF. Dynamic brake works, after motor stop.</td></tr><tr><td>02</td><td>DB_Free</td><td>Dynamic brake works, at servo OFF. Motor gets free state, after motor stop.</td></tr><tr><td>03</td><td>DB_DB</td><td>Dynamic brake works, at servo OFF. Dynamic brake works, after motor stop.</td></tr><tr><td>04</td><td>SB_Free</td><td>Servo brake works, at servo OFF. Motor gets free state, after motor stop.</td></tr><tr><td>05</td><td>SB_DB</td><td>Servo brake works, at servo OFF. Dynamic brake works, after motor stop.</td></tr><tr><td>06</td><td>Dec_Free</td><td>Stop after deceleration, at servo OFF. Motor gets free state, after motor stop.</td></tr><tr><td>07</td><td>Dec_DB</td><td>Stop after deceleration, at servo OFF. Dynamic brake works, after motor stop.</td></tr></table>					Selection		Contents	00	Free_Free	Free run works, at servo OFF. Motor gets free state, after motor stop.	01	Free_DB	Free run works, at servo OFF. Dynamic brake works, after motor stop.	02	DB_Free	Dynamic brake works, at servo OFF. Motor gets free state, after motor stop.	03	DB_DB	Dynamic brake works, at servo OFF. Dynamic brake works, after motor stop.	04	SB_Free	Servo brake works, at servo OFF. Motor gets free state, after motor stop.	05	SB_DB	Servo brake works, at servo OFF. Dynamic brake works, after motor stop.	06	Dec_Free	Stop after deceleration, at servo OFF. Motor gets free state, after motor stop.	07	Dec_DB	Stop after deceleration, at servo OFF. Dynamic brake works, after motor stop.
	Selection		Contents																													
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06	Dec_Free	Stop after deceleration, at servo OFF. Motor gets free state, after motor stop.																														
07	Dec_DB	Stop after deceleration, at servo OFF. Dynamic brake works, after motor stop.																														
◆ Set the deceleration time constant of decelerate stop, into GroupB ID15.																																
* Motor stops by the action which set in GroupB ID02 "Emergency Stop Operation" if Main circuit power is shut down, and dynamic brake will work after stop. However if "Main Circuit Under-voltage" or "BONBGN passing" are detected during stopping, motor stops by dynamic brake operation.																																

5. Operation

—GroupB—

ID	Contents			
01	Over-Travel Action [ACTOT]		Setting range	Unit
			00 to 08	-
			Default value	
			00:CMDINH_SB_SON	
	■ Selects operations at over-travel action.			
	Selection		Contents	
	00	CMDINH_SB_SON	Command input is disabled, and motor is stopped by servo-braking (with peak force) when OT occurs. Servo is turned on after motor stops. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0) (Force command for OT side is limited by the sequence force limit.)	
	01	CMDINH_DB_SON	Command input is disabled, and motor is stopped by dynamic-braking when OT occurs. Servo is turned on after motor stops. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0)	
	02	CMDINH_Free_SON	Command input is disabled, and motor is free-running when OT occurs. Servo is turned on after motor stops. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0)	
	03	CMDINH_SB_SOFF	Command input is disabled, and motor is stopped by servo-braking when OT occurs. Servo is turned off after motor stops. (Force command for both side is limited by the sequence force limit.)	
04	CMDINH_DB_SOFF	Command input is disabled, and motor is stopped by dynamic-braking when OT occurs. Servo is turned off after motor stops.		
05	CMDINH_Free_SOFF	Command input is disabled, and motor is free-running when OT occurs. Servo is turned off after motor stops.		
06	CMDACK_VCLM=0	Velocity limit command for the direction on which OT occurred becomes zero when OT occurs.		
08	CMDINH_SB_SON2	Command input is disabled, and motor is stopped by servo-brake operation (with sequence force limit) when OT occurs. Servo is turned on after motor stops. (For the side OT occurs, command disabled = velocity limit command = 0) (Force command for both side is limited by the sequence force limit.)		
◆ Force limit value differs depending on selection code, when stopping a linear motor by servo-brake. 00: Peak force 03, 08: Sequence force limit ◆ Select from 00-05, 08 under Velocity control mode. ◆ Under Force control mode, operations are as follows: ● When selection is 00 -02, 08 keeps servo ON status while limiting Force command by sequence force limit. ● When selection is 03 -04, servo is OFF and stops by Dynamic brake. After linear motor stop, servo OFF status is kept. ● When selection is 05, servo is OFF and free-run is operated. After linear motor stops, servo-OFF status is kept.				

5.8 Parameter functions

— GroupB —

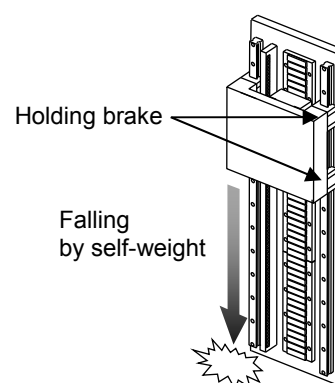
ID	Contents															
02	Emergency Stop Operation [ACTEMR]		Setting range	Unit	Default value											
			00 to 02	-	00:SERVO-BRAKE											
	■ Sets operation at Emergency Stop ◆ Selects operation at the time of emergency stop. In case of vertical axis use, please use it with default setting (00: SERVO-BRAKE).															
	<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>SERVO-BRAKE</td><td>Stops servo motor by operating servo brake at Emergency stop.</td></tr><tr><td>01</td><td>DYNAMIC-BRAKE</td><td>Stops servo motor by operating dynamic brake at Emergency stop.</td></tr><tr><td>02</td><td>DEC-STOP</td><td>Stops servo motor after deceleration at Emergency stop.</td></tr></table>				Selection		Contents	00	SERVO-BRAKE	Stops servo motor by operating servo brake at Emergency stop.	01	DYNAMIC-BRAKE	Stops servo motor by operating dynamic brake at Emergency stop.	02	DEC-STOP	Stops servo motor after deceleration at Emergency stop.
	Selection		Contents													
	00	SERVO-BRAKE	Stops servo motor by operating servo brake at Emergency stop.													
	01	DYNAMIC-BRAKE	Stops servo motor by operating dynamic brake at Emergency stop.													
	02	DEC-STOP	Stops servo motor after deceleration at Emergency stop.													
	◆ Under Force control mode, dynamic brake stops linear motor regardless of the setting value. ◆ If the alarm that has DB in "Detection operations" at 8.2.2 Alarm list occurs, and no Safe Torque Off function (servo amplifier model number option 2 is 0), stops linear motor by dynamic brake regardless of this setting. ◆ Sets the deceleration time constant of deceleration stop at GroupB ID16.															
	* Forced stop operation means “emergency stop function enabled”, “main circuit power shutoff”, “alarm activated” and “safe-torque-off operation”.															
Delay Time of Engaging Holding Brake (Holding Brake Holding Delay time) [BONDLY]		Setting range	Unit	Default value												
		0 to 1000	ms	300												
03	■ Sets the holding-brake-activation delay time from when power distribution to holding brake stopped till when holding force generated. ◆ While shifting from servo ON to servo OFF, during the setting time, Excitation command 0 is given to linear motor. (Even when servo is turned OFF, power is supplied to the linear motor until the setting time is over). By this, until Holding brake functions, linear motor generates Holding force. ◆ Setting unit is 4ms. When the setting value is 0ms, after servo OFF, command is invalid (command 0) for approximately 4ms. ◆ At the setting, GroupB ID00 [DBOPR] Servo-OFF stop behavior, when servo brake is ON at servo OFF, (04 SB_Free or 05 SB_DB), this is valid. (This function is invalid in Dynamic brake operation and Free-run operation.)															
	Delay Time of Releasing Holding Brake (Holding Brake Releasing Delay time) [BOFFDLY]		Setting range	Unit	Default value											
			0 to 1000	ms	300											
	04	■ Sets the holding-brake-release delay time from when power distribution to holding brake started till when holding force disappeared. ◆ While shifting from servo OFF to servo ON, during the setting time, Excitation command 0 is given to linear motor. (Even when servo is turned ON, command is not accepted until the setting time is complete.) Therefore, until Holding brake is released, linear motor does not operate. ◆ Setting unit is 4ms. When the setting value is 0ms, after servo ON, command is invalid (command 0) for approximately 4ms.														
Brake Operation Beginning Time [BONBGN]		Setting range	Unit	Default value												
		0 to 65535	ms	10000												
05	■ Sets permissible time from servo OFF until linear motor stop. ◆ While shifting servo ON to servo OFF, even after the selected time passed and the linear motor does not stop. Servo motor is forced to stop with Holding brake and Dynamic brake. ◆ When the linear motor stops this setting does not function. ◆ When linear motor does not stop after servo OFF at gravity axis, set this parameter. ◆ When forced to stop by holding brake, the Holding brake may possibly be broken. Be cautious about device specifications and sequence when using this function.															

5. Operation

—GroupB—

■ About Holding Brake

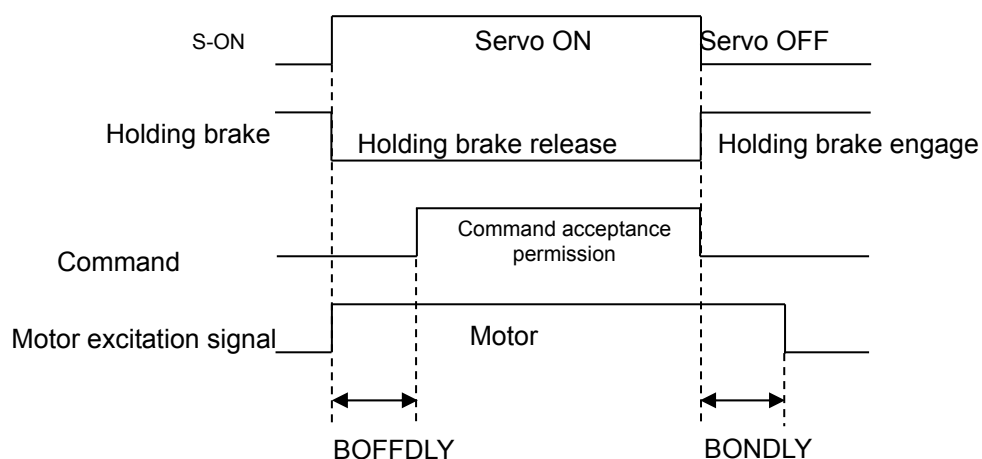
Linear motor with Holding brake function is usually used with an axis that is always affected by gravity and external forces in order to avoid movable parts falling off from its position when main circuit power is OFF, or servo OFF. Holding brake is to support the movable parts against gravity and other external force when at rest. Do not use it to stop a moving machine.



◆ Setting for Holding brake excitation signal output

Group	ID	Symbol	Contents
A	0*	OUT*	Generic Output*

Selection		Contents
0A	MBR-ON_ON	While Holding brake excitation signal output, output ON.
0B	MBR-ON_OFF	While Holding brake excitation signal output, output OFF.



5.8 Parameter functions

— GroupB —

ID	Contents																														
	Power Failure Detection Delay Time [PFDDLY] “Power cycle for control after setting”	Setting range	Unit	Default value																											
		20 to 1000	ms	32																											
06	■ Sets the delay time from Control power OFF to Control power error detection. The larger value makes the detection of Instantaneous stop slower. (Control power holding time: 200V ac input type: about 100msec 100V ac input type: about 80msec Larger set value will only result in slower detections of errors. In case of power failure of internal logic circuit, operation is same as when Control power is turned ON again. In case of energy shortage of Main circuit power, other errors such as Main circuit power loss may be detected.) In this setting, actual detection delay time varies by -12ms to +6ms.																														
	Initial timeout wait time [INTTIM] “Power cycle for control after setting”	Setting range	Unit	Default value																											
		00 to 07	-	00:Disabled																											
07	■ Selects the time till initialization completion. <table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Disabled</td><td>Without wait time</td></tr><tr><td>01</td><td>1000ms</td><td>Insert 1000ms wait</td></tr><tr><td>02</td><td>1400ms</td><td>Insert 1400ms wait</td></tr><tr><td>03</td><td>1800ms</td><td>Insert 1800ms wait</td></tr><tr><td>04</td><td>2000ms</td><td>Insert 2000ms wait</td></tr><tr><td>05</td><td>3000ms</td><td>Insert 3000ms wait</td></tr><tr><td>06</td><td>5000ms</td><td>Insert 5000ms wait</td></tr><tr><td>07</td><td>10000ms</td><td>Insert 10000ms wait</td></tr></table>				Selection		Contents	00	Disabled	Without wait time	01	1000ms	Insert 1000ms wait	02	1400ms	Insert 1400ms wait	03	1800ms	Insert 1800ms wait	04	2000ms	Insert 2000ms wait	05	3000ms	Insert 3000ms wait	06	5000ms	Insert 5000ms wait	07	10000ms	Insert 10000ms wait
Selection		Contents																													
00	Disabled	Without wait time																													
01	1000ms	Insert 1000ms wait																													
02	1400ms	Insert 1400ms wait																													
03	1800ms	Insert 1800ms wait																													
04	2000ms	Insert 2000ms wait																													
05	3000ms	Insert 3000ms wait																													
06	5000ms	Insert 5000ms wait																													
07	10000ms	Insert 10000ms wait																													
09	Magnetic pole position estimation error range [MPERR]	Setting range	Unit	Default value																											
		0 to 20	degree	0																											
	■ Sets error range of estimation result at the magnetic pole position estimation. Larger the value, the magnetic pole position detection completes early, but estimation error will be larger.																														
10	Excessive Deviation Warning Level [OFWLVL]	Setting range	Unit	Default value																											
		1 to 2147483647	Pulse	2147483647																											
	■ Sets Warning output level before Excessive position deviation alarm is output. ◆ Sets at Encoder pulse resolution regardless of Electronic gear. * It will be limited to 1073741823 [Pulse] if the value is set exceeding 1073741823[Pulse].																														
11	Deviation Counter Overflow Value [OFLV]	Setting range	Unit	Default value																											
		1 to 2147483647	Pulse	5000000																											
	■ Sets Position deviation value regarded as Excessive position deviation alarm. ◆ Sets at Encoder pulse resolution regardless of Electronic gear. * It will be limited to 1073741823 [Pulse] if the value is set exceeding 1073741823[Pulse].																														
	Overload Warning Level [OLWLVL] “Power cycle for control after setting”	Setting range	Unit	Default value																											
		20 to 100	%	90																											
12	■ Sets the Warning output level before Overload alarm output. ◆ The possible level to be set is from 20%-99%, assuming that the Overload Warning Level is 100%. When set to 100%, Overload warning and Overload alarm are output at one time. ◆ Overload detection is assumed and set as 75%, of a rated load when Control power is turned ON (hot start). Therefore, Overload warning may be output when Control power is turned ON.																														

5. Operation

—GroupB—

ID	Contents											
13	Velocity Feedback Alarm (ALM_C3) Detection [VFBALM]	Setting range	Unit	Default value								
		00 to 01	-	01:Enabled								
	■ Selects Valid/Invalid Velocity feedback error detection.											
	<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Disabled</td><td>Invalid</td></tr><tr><td>01</td><td>Enabled</td><td>Valid</td></tr></table>				Selection		Contents	00	Disabled	Invalid	01	Enabled
Selection		Contents										
00	Disabled	Invalid										
01	Enabled	Valid										
14	Velocity Control Alarm (ALM_C2) Detection [VCALM]	Setting range	Unit	Default value								
		00 to 01	-	00:Disabled								
	■ Selects Valid/Invalid Velocity control error detection.											
	<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Disabled</td><td>Invalid</td></tr><tr><td>01</td><td>Enabled</td><td>Valid</td></tr></table> In such an operation pattern as causing a linear motor overshoot to the command, Velocity control error may be detected by mistake. For this, set this parameter to invalid.				Selection		Contents	00	Disabled	Invalid	01	Enabled
Selection		Contents										
00	Disabled	Invalid										
01	Enabled	Valid										
15	Deceleration Time Constant at Servo off Stopping [SOFDEC]	Setting range	Unit	Default value								
		0 to 16000	ms	0								
■ This is the parameter which sets the deceleration time constant in case of servo OFF during linear motor motion. Sets deceleration time per 1000 mm/s. Will be valid when 06 or 07 is set to GroupB ID00.												
16	Deceleration Time Constant at Emergency Stopping [EMRDEC]	Setting range	Unit	Default value								
		0 to 16000	ms	0								
	■ This is the parameter which sets the deceleration time constant in case of Emergency stop (Status of "emergency stop function enabled", "main circuit power shutoff", "alarm activated" and "safe-torque-off operation") during linear motor motion. Sets deceleration time per 1000 mm/s. Will be valid when 02 is set to GroupB ID02.											
	◆ Operation will shift to dynamic brake stop sequence when main circuit power falls lower or safe torque-off time has passed during deceleration stop.											
17	External command effectivity selection at holding brake operation cancellation delay time [SONFALL]	Setting range	Unit	Default value								
		00 to 01	-	00:Disabled								
	■ Selects valid/invalid of external position/velocity command during the holding-brake-release delay time. Self weight fall can suppress at servo ON by setting of position/velocity command that corresponded to gravity load or external load.											
	<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Disabled</td><td>Invalid</td></tr><tr><td>01</td><td>Enabled</td><td>Valid</td></tr></table> ◆ As notes, when the command that exceeds gravity load or external load is given, linear motor will move and it may cause of holding-brake failure.				Selection		Contents	00	Disabled	Invalid	01	Enabled
Selection		Contents										
00	Disabled	Invalid										
01	Enabled	Valid										

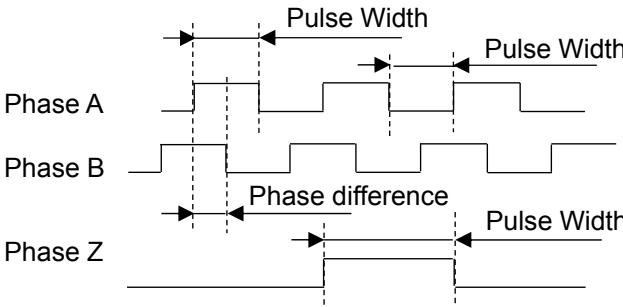
5.8 Parameter functions

— GroupB —

ID	Contents											
18	External command effectivity selection at holding brake operation delay time [SOFFFALL]	Setting range	Unit	Default value								
		00 to 01	-	00:Disabled								
	■ Selects valid/invalid of external position/velocity command during the holding-brake-activation delay time. Self weight fall can suppress at servo OFF by setting of position/velocity command that corresponded to gravity load or external load.											
	<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Disabled</td><td>Invalid</td></tr><tr><td>01</td><td>Enabled</td><td>Valid</td></tr></table> ◆ As notes, when the command that exceeds gravity load or external load is given, linear motor will move and it may cause of holding-brake failure.				Selection		Contents	00	Disabled	Invalid	01	Enabled
Selection		Contents										
00	Disabled	Invalid										
01	Enabled	Valid										
80	Axes-sync error warning level [PSDEVW]	Setting range	Unit	Default value								
		1 to 2147483647	Pulse	2147483647								
■ Warning occurs when position deviation error between own axis and counterpart axis exceeds this set value. Uses as warning output before outputting the axes-sync error excess alarm.												
81	Axes-sync error excess value [PSDEVA]	Setting range	Unit	Default value								
		1 to 2147483647	Pulse	5000000								
■ Will be the axes-sync error excess when position deviation error between own axis and counterpart axis exceeds this set value.												

5. Operation

■ GroupC "Encoder related settings"

ID	Contents				
00	Motor Incremental Encoder Digital Filter [ENFIL]		Setting range	Unit	Default value
			00 to 07	-	01:220ns
	■ This parameter is settable only when using incremental encoder. Sets Digital filter to motor Incremental encoder. Pulse lower than the set value is eliminated as noise when noise superposition occurs in encoder signals. Consider Encoder resolution and Maximum 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.				
	Selection		Contents		
	00	110nsec	Minimum Pulse Width = 110nsec (Minimum pulse Phase Difference = 37.5nsec)		
	01	220nsec	Minimum Pulse Width = 220nsec		
	02	440nsec	Minimum Pulse Width = 440nsec		
	03	880nsec	Minimum Pulse Width = 880nsec		
	04	75nsec	Minimum Pulse Width = 75nsec (Minimum pulse Phase Difference = 37.5nsec)		
	05	150nsec	Minimum Pulse Width = 150nsec		
06	300nsec	Minimum Pulse Width = 300nsec			
07	600nsec	Minimum Pulse Width = 600nsec			
					
01	Hall Effect Sensor Digital Filter [EX-ENFIL]		Setting range	Unit	Default value
			00 to 07	-	01:220ns
	■ This parameter is settable only when using Hall effect sensor. Sets Digital filter to Hall effect sensor input. Pulse lower than the set value is eliminated as noise when noise superposition occurred in Hall effect sensor signals. Consider Encoder resolution and Maximum rotation velocity of the servo motor in operation when selecting value. Set the value roughly less than 1/4 of the Encoder pulse width at Maximum rotation velocity.				
	Selection		Contents		
	00	110nsec	Minimum Pulse Width = 110nsec (Minimum pulse Phase Difference = 37.5nsec)		
	01	220nsec	Minimum Pulse Width = 220nsec		
	02	440nsec	Minimum Pulse Width = 440nsec		
	03	880nsec	Minimum Pulse Width = 880nsec		
	04	75nsec	Minimum Pulse Width = 75nsec (Minimum pulse Phase Difference = 37.5nsec)		
	05	150nsec	Minimum Pulse Width = 150nsec		
06	300nsec	Minimum Pulse Width = 300nsec			
07	600nsec	Minimum Pulse Width = 600nsec			

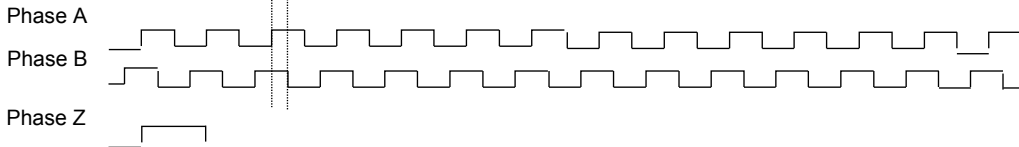
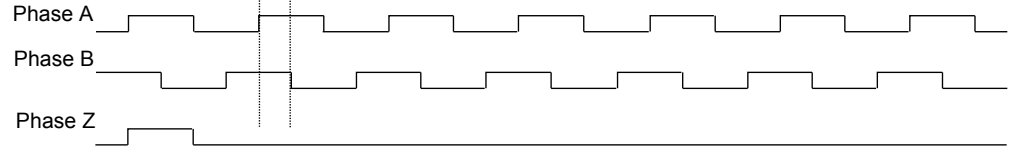
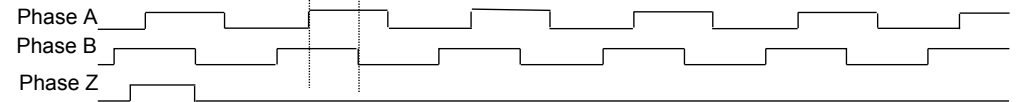
5.8 Parameter functions

— GroupC —

ID	Contents																																																	
02	Hall Effect Sensor Polarity Selection [EX-ENPOL] “Power cycle for control after setting”			Setting range	Unit	Default value																																												
				00 to 07	-	00:Type1																																												
	■ This parameter is settable only when using Hall effect sensor signal. ◆ Select Hall effect sensor signal polarity.																																																	
	<table><tr><th colspan="2">Selection</th><th colspan="3">Contents</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>					Selection		Contents			00	Type1	EX-Z/Not Reversed	EX-B/ Not Reversed	EX-A/ Not Reversed	01	Type2	EX-Z/Not Reversed	EX-B/ Not Reversed	EX-A/ Reversed	02	Type3	EX-Z/Not Reversed	EX-B/ Reversed	EX-A/ Not Reversed	03	Type4	EX-Z/Not Reversed	EX-B/ Reversed	EX-A/ Reversed	04	Type5	EX-Z/Reversed	EX-B/ Not Reversed	EX-A/ Not Reversed	05	Type6	EX-Z/Reversed	EX-B/ Not Reversed	EX-A/ Reversed	06	Type7	EX-Z/Reversed	EX-B/ Reversed	EX-A/ Not Reversed	07	Type8	EX-Z/Reversed	EX-B/ Reversed	EX-A/ Reversed
	Selection		Contents																																															
00	Type1	EX-Z/Not Reversed	EX-B/ Not Reversed	EX-A/ Not Reversed																																														
01	Type2	EX-Z/Not Reversed	EX-B/ Not Reversed	EX-A/ Reversed																																														
02	Type3	EX-Z/Not Reversed	EX-B/ Reversed	EX-A/ Not Reversed																																														
03	Type4	EX-Z/Not Reversed	EX-B/ Reversed	EX-A/ Reversed																																														
04	Type5	EX-Z/Reversed	EX-B/ Not Reversed	EX-A/ Not Reversed																																														
05	Type6	EX-Z/Reversed	EX-B/ Not Reversed	EX-A/ Reversed																																														
06	Type7	EX-Z/Reversed	EX-B/ Reversed	EX-A/ Not Reversed																																														
07	Type8	EX-Z/Reversed	EX-B/ Reversed	EX-A/ Reversed																																														
03	Encoder Output Pulse Divide Selection [PULOUTSEL] “Power cycle for control after setting”			Setting range	Unit	Default value																																												
				00 to 01	-	00:Motor_ Enc.																																												
	■ Sets Encoder output pulse division signal. Select linear encoder or Hall Effect Sensor to load Encoder pulse to upper device.																																																	
	<table><tr><th colspan="3">Selection</th></tr><tr><td>00</td><td>Motor_ Enc</td><td>Linear Encoder</td></tr><tr><td>01</td><td>External_ Enc</td><td>Hall Effect Sensor</td></tr></table>					Selection			00	Motor_ Enc	Linear Encoder	01	External_ Enc	Hall Effect Sensor																																				
Selection																																																		
00	Motor_ Enc	Linear Encoder																																																
01	External_ Enc	Hall Effect Sensor																																																

5. Operation

—GroupC—

ID	Contents																	
04	Encoder Output Pulse Division [ENRAT]		Setting range	Unit	Default value													
			1/1 to 1/64 2/3 to 2/64 1/32768 to 32767/32768	-	1/1													
	■ Sets ratio of Encoder output pulse division. ◆ When the numerator of the dividing ratio is 1, setting range of the denominator is 1 (not divide), 2-64 or 32768. ◆ When the numerator of the dividing ratio is 2, setting range of the denominator is 3-64 or 32768. ◆ When the denominator of the dividing ratio is 32768, setting range of the numerator is 1-32767. ◆ Z phase output is not divided. ◆ After Control power ON, for 3sec at maximum, the ratio is unstable.																	
	Dividing ratio 1/1 (forward direction) 90° Phase A Phase B Phase Z 																	
	Dividing ratio 1/2 (forward direction) 90° Phase A Phase B Phase Z 																	
Dividing ratio 2/5 (forward direction) 108° (90° is not possible phase relation does not change) Phase A Phase B Phase Z 																		
05	Encoder Output Pulse Divide Polarity [PULOUTPOL]		Setting range	Unit	Default value													
			00 to 03	-	00:Type1													
	■ Sets division polarity of Encoder output pulse. <table><thead><tr><th colspan="2">Selection</th><th>Contents</th></tr></thead><tbody><tr><td>00</td><td>Type1</td><td>A Phase Signal/Not Reversed Z Phase Signal Logic/High Active</td></tr><tr><td>01</td><td>Type2</td><td>A Phase Signal/Reversed Z Phase Signal Logic/High Active</td></tr><tr><td>02</td><td>Type3</td><td>A Phase Signal/Not Reversed Z Phase Signal Logic/Low Active</td></tr><tr><td>03</td><td>Type4</td><td>A Phase Signal/Reversed Z Phase Signal Logic/Low Active</td></tr></tbody></table>				Selection		Contents	00	Type1	A Phase Signal/Not Reversed Z Phase Signal Logic/High Active	01	Type2	A Phase Signal/Reversed Z Phase Signal Logic/High Active	02	Type3	A Phase Signal/Not Reversed Z Phase Signal Logic/Low Active	03	Type4
Selection		Contents																
00	Type1	A Phase Signal/Not Reversed Z Phase Signal Logic/High Active																
01	Type2	A Phase Signal/Reversed Z Phase Signal Logic/High Active																
02	Type3	A Phase Signal/Not Reversed Z Phase Signal Logic/Low Active																
03	Type4	A Phase Signal/Reversed Z Phase Signal Logic/Low Active																

5.8 Parameter functions

— GroupC —

ID	Contents											
06	Encoder Output Pulse Divide Resolution Selection [PULOUTRES] “Power cycle for control after setting”	Setting range	Unit	Default value								
		80 to 81	-	81: 2000nm/P								
	■ This parameter is settable only when using absolute encoder. ◆ Sets resolution of Encoder output pulse divide. ◆ Set at 2000nm/P when Output pulse frequency exceeds the specification of the upper controller. ◆ Use linear motor at motor move speed of 3m/sec or less when 500nm/P is selected. ◆ Outputs divided pulse by setting resolution to ID04 Encoder output divide. <table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>80</td><td>500nm/P</td><td>Outputs a pulse (4-multiplied) per 500nm.</td></tr><tr><td>81</td><td>2000nm/P</td><td>Outputs a pulse (4-multiplied) per 2000nm.</td></tr></table>				Selection		Contents	80	500nm/P	Outputs a pulse (4-multiplied) per 500nm.	81	2000nm/P
Selection		Contents										
80	500nm/P	Outputs a pulse (4-multiplied) per 500nm.										
81	2000nm/P	Outputs a pulse (4-multiplied) per 2000nm.										
07	Encoder Signal Output(PS) Format [PSOFORM] “Power cycle for control after setting”	Setting range	Unit	Default value								
		00	-	00:MOT_Binary								
	■ Sets signal format of Encoder signal output (PS). <table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>MOT_Binary</td><td>Encoder Binary Code Output for motor encoder</td></tr></table>				Selection		Contents	00	MOT_Binary	Encoder Binary Code Output for motor encoder		
Selection		Contents										
00	MOT_Binary	Encoder Binary Code Output for motor encoder										
09	Linear Encoder Polarity Selection [ECDIR] “Perform control power cycle after setting.”	Setting range	Unit	Default value								
		00 to 01 80 to 81	-	00:Status_MultiTurn								
	■ Selects polarity of linear encoder count against move direction of linear motor. ◆ When moving linear motor to the direction where motor wire lead pulled out, set "00 Standard" if the monitor ID10 "Current position monitor (motor encoder)" increased. Otherwise set "01: Reversed". <table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Standard</td><td>Without reversing encoder operation direction.</td></tr><tr><td>01</td><td>Reversed</td><td>With reversing encoder operation direction.</td></tr></table>				Selection		Contents	00	Standard	Without reversing encoder operation direction.	01	Reversed
Selection		Contents										
00	Standard	Without reversing encoder operation direction.										
01	Reversed	With reversing encoder operation direction.										
0A	Magnetic pole position estimation mode selection [CSETMD] “Perform control power cycle after setting.”	Setting range	Unit	Default value								
		00 to 01	—	00: Normal								
	■ Set the condition performing magnetic pole position estimation. <table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Normal</td><td>Performs when valid condition of magnetic pole position estimation (Group9 ID1D) is satisfied</td></tr><tr><td>01</td><td>Auto_Pon</td><td>Performs automatically when supplying main circuit power, first time.</td></tr></table> ◆ Precautions for selecting 01: Auto_pon. * Automatic run is not performed if detecting alarm or emergency stop when supplying main circuit power or if magnetic pole position estimation valid condition is satisfied. Automatic run performs soon if these conditions are cleared. * Alarm 44 or DF occurs if magnetic pole position estimation is not completed correctly. * 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.				Selection		Contents	00	Normal	Performs when valid condition of magnetic pole position estimation (Group9 ID1D) is satisfied	01	Auto_Pon
Selection		Contents										
00	Normal	Performs when valid condition of magnetic pole position estimation (Group9 ID1D) is satisfied										
01	Auto_Pon	Performs automatically when supplying main circuit power, first time.										

5. Operation

—GroupC—

ID	Contents			
10	Broken wire mask level at Encoder connector 1 [DE1MSKLVL]	Setting range	Unit	Default value
		0 to 65535	kHz	0
	■ 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.			
11	Broken wire mask level at Encoder connector 2 [DE3MSKLVL]	Setting range	Unit	Default value
		0 to 65535	kHz	0
	■ 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.			

5.8 Parameter functions

■ GroupD "Supporting function related settings"

ID	Contents																																																
00	JOG velocity command [JOGVC]					Setting range		Unit		Default value																																							
						0 to 32767		mm/s		50																																							
	■ Sets the velocity command value for JOG operation. ◆ This value will be initial setting value of JOG velocity command in the Setup software.																																																
01	Excitation command frequency set value [EMPFREQ]					Setting range		Unit		Default value																																							
						30 to 70		Hz		50																																							
	■ Sets the frequency of force command for detecting magnetic pole position.																																																
02	Support function force limit [TSTTCLM]					Setting range		Unit		Default value																																							
						10.0 to 500.0		%		120.0																																							
	■ Sets the limit value of force command at the support function (JOG, positioning and homing) operation. ◆ This value will be initial setting value of force command limit for the support function operation in the Setup software.																																																
10	Serial Communication Axis Number [COMAXIS] “Power cycle for control after setting”					Setting range		Unit		Default value																																							
						01 to 0F		-		01:#1																																							
	■ Selects axis number when communicating with the setup software. ◆ Please set different number for each axis when multi axes are connecting at once because the setup software identifies servo amplifiers by this number.																																																
	<table><tr><th colspan="2">Selection</th><th colspan="2">Selection</th><th colspan="2">Selection</th><th colspan="2">Selection</th><th colspan="2">Selection</th></tr><tr><td>01</td><td>#1</td><td>04</td><td>#4</td><td>07</td><td>#7</td><td>0A</td><td>#A</td><td>0D</td><td>#D</td></tr><tr><td>02</td><td>#2</td><td>05</td><td>#5</td><td>08</td><td>#8</td><td>0B</td><td>#B</td><td>0E</td><td>#E</td></tr><tr><td>03</td><td>#3</td><td>06</td><td>#6</td><td>09</td><td>#9</td><td>0C</td><td>#C</td><td>0F</td><td>#F</td></tr></table>										Selection		Selection		Selection		Selection		Selection		01	#1	04	#4	07	#7	0A	#A	0D	#D	02	#2	05	#5	08	#8	0B	#B	0E	#E	03	#3	06	#6	09	#9	0C	#C	0F
Selection		Selection		Selection		Selection		Selection																																									
01	#1	04	#4	07	#7	0A	#A	0D	#D																																								
02	#2	05	#5	08	#8	0B	#B	0E	#E																																								
03	#3	06	#6	09	#9	0C	#C	0F	#F																																								
11	Monitor Display Selection [MONDISP]					Setting range		Unit		Default value																																							
						00 to 73		-		00:STATUS																																							
	■ Selects the contents of status display of the digital operator.																																																
	<table><tr><th colspan="2">Selection</th><th colspan="8">Contents</th></tr><tr><td>00</td><td>STATUS</td><td colspan="8">Shows the status of servo amplifier. See "5.3 Servo amplifier status display" for details.</td></tr><tr><td>01 to 73</td><td>WARNING1 to MOTE-ERRAT</td><td colspan="8">Selects the monitor data showing at monitor function. See "5.5 Monitor function" for details.</td></tr></table>										Selection		Contents								00	STATUS	Shows the status of servo amplifier. See "5.3 Servo amplifier status display" for details.								01 to 73	WARNING1 to MOTE-ERRAT	Selects the monitor data showing at monitor function. See "5.5 Monitor function" for details.																
Selection		Contents																																															
00	STATUS	Shows the status of servo amplifier. See "5.3 Servo amplifier status display" for details.																																															
01 to 73	WARNING1 to MOTE-ERRAT	Selects the monitor data showing at monitor function. See "5.5 Monitor function" for details.																																															

5. Operation

—GroupD—

ID	Contents																																																			
20	Drec. sampling rate [SAMPDIV]	Setting range	Unit	Default value																																																
		0 to 65535	-	20																																																
	■ Sets the sampling rate of the Drive recorder. ◆ Minimum sampling rate (Ts) is fixed to 112 μs. ◆ Sampling timing (T) is shown by T=Ts*n, and this parameter sets "n". ◆ Drive recorder will stop if 0 is set.																																																			
21	Drec. sampling mode [SAMPNUM]	Setting range	Unit	Default value																																																
		00 to 02	-	00:256point																																																
	■ Selects total data points per channel that will record by the Drive recorder. ◆ Recordable channel numbers will limit if larger data point is selected.																																																			
	<table><tr><th colspan="2">Selection</th><th colspan="2">Maximum recordable channel at once</th></tr><tr><td>00</td><td>256point</td><td colspan="2">6 channels</td></tr><tr><td>01</td><td>512point</td><td colspan="2">3 channels</td></tr><tr><td>02</td><td>1024point</td><td colspan="2">1 channel</td></tr></table>				Selection		Maximum recordable channel at once		00	256point	6 channels		01	512point	3 channels		02	1024point	1 channel																																	
Selection		Maximum recordable channel at once																																																		
00	256point	6 channels																																																		
01	512point	3 channels																																																		
02	1024point	1 channel																																																		
22	Drec. Trigger Channel [TRGCHSEL]	Setting range	Unit	Default value																																																
		00 to 83	-	83:DIGITAL_4																																																
	■ Selects the channel for trigger on the Drive recorder. ◆ Digital ch. and analog ch. can set.																																																			
	<table><tr><th colspan="2">Selection</th><th colspan="2">Setting value</th><th colspan="2">Selection</th><th colspan="2">Setting value</th></tr><tr><td>00</td><td>ANALOG_1</td><td colspan="2">Analog CH1</td><td>05</td><td>ANALOG_6</td><td colspan="2">Analog CH6</td></tr><tr><td>01</td><td>ANALOG_2</td><td colspan="2">Analog CH2</td><td>80</td><td>DIGITAL_1</td><td colspan="2">Digital CH1</td></tr><tr><td>02</td><td>ANALOG_3</td><td colspan="2">Analog CH3</td><td>81</td><td>DIGITAL_2</td><td colspan="2">Digital CH2</td></tr><tr><td>03</td><td>ANALOG_4</td><td colspan="2">Analog CH4</td><td>82</td><td>DIGITAL_3</td><td colspan="2">Digital CH3</td></tr><tr><td>04</td><td>ANALOG_5</td><td colspan="2">Analog CH5</td><td>83</td><td>DIGITAL_4</td><td colspan="2">Digital CH4</td></tr></table>				Selection		Setting value		Selection		Setting value		00	ANALOG_1	Analog CH1		05	ANALOG_6	Analog CH6		01	ANALOG_2	Analog CH2		80	DIGITAL_1	Digital CH1		02	ANALOG_3	Analog CH3		81	DIGITAL_2	Digital CH2		03	ANALOG_4	Analog CH4		82	DIGITAL_3	Digital CH3		04	ANALOG_5	Analog CH5		83	DIGITAL_4	Digital CH4	
Selection		Setting value		Selection		Setting value																																														
00	ANALOG_1	Analog CH1		05	ANALOG_6	Analog CH6																																														
01	ANALOG_2	Analog CH2		80	DIGITAL_1	Digital CH1																																														
02	ANALOG_3	Analog CH3		81	DIGITAL_2	Digital CH2																																														
03	ANALOG_4	Analog CH4		82	DIGITAL_3	Digital CH3																																														
04	ANALOG_5	Analog CH5		83	DIGITAL_4	Digital CH4																																														
23	Drec. Trigger Slope [TRGEDGSEL]	Setting range	Unit	Default value																																																
		00 to 02	-	00:POS_EDGE																																																
	■ Sets the trigger edge condition on the Drive recorder.																																																			
	<table><tr><th colspan="2">Selection</th><th colspan="2">Setting value</th></tr><tr><td>00</td><td>POS_EDGE</td><td colspan="2">↑ edge</td></tr><tr><td>01</td><td>NEG_EDGE</td><td colspan="2">↓ edge</td></tr><tr><td>02</td><td>BOTH_EDGE</td><td colspan="2">↑ edge or ↓ edge</td></tr></table>				Selection		Setting value		00	POS_EDGE	↑ edge		01	NEG_EDGE	↓ edge		02	BOTH_EDGE	↑ edge or ↓ edge																																	
Selection		Setting value																																																		
00	POS_EDGE	↑ edge																																																		
01	NEG_EDGE	↓ edge																																																		
02	BOTH_EDGE	↑ edge or ↓ edge																																																		
24	Drec. Trigger Horizontal Position [TRGHPOS]	Setting range	Unit	Default value																																																
		0 to 100	%	80																																																
	■ Sets the horizontal position of trigger on the Drive recorder. ◆ Set the rate of the total sampling time and the trigger position from sampling start by [0 -100%].																																																			
25	Drec. Trigger Level [TRGLVL]	Setting range	Unit	Default value																																																
		-9223372036854775808 to 9223372036854775807	-	1																																																
	■ Set the trigger level on the Drive recorder. ◆ Shows by hexadecimal (32 bit data) at ID25 and ID26 of the Digital operator.																																																			
	<table><tr><th>ID</th><th>Data range</th><th colspan="2">Display range</th></tr><tr><td>25</td><td>Bit63 to Bit32</td><td colspan="2">H.8000 L.0000 to H.7FFF L.FFFF</td></tr><tr><td>26</td><td>Bit31 to Bit0</td><td colspan="2">H.0000 L.0000 to H.FFFF L.FFFF</td></tr></table>				ID	Data range	Display range		25	Bit63 to Bit32	H.8000 L.0000 to H.7FFF L.FFFF		26	Bit31 to Bit0	H.0000 L.0000 to H.FFFF L.FFFF																																					
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26	Bit31 to Bit0	H.0000 L.0000 to H.FFFF L.FFFF																																																		

5.8 Parameter functions

— GroupD —

ID	Contents																																																																																		
31	Drec. Analog CH1 selection [CH1SEL]	Setting range	Unit	Default value																																																																															
		00 to 22, FF	-	08:PCMDF1																																																																															
32	Drec. Analog CH2 selection [CH2SEL]	Setting range	Unit	Default value																																																																															
		00 to 22, FF	-	01:VCMON																																																																															
33	Drec. Analog CH3 selection [CH3SEL]	Setting range	Unit	Default value																																																																															
		00 to 22, FF	-	03:TCMON																																																																															
34	Drec. Analog CH4 selection [CH4SEL]	Setting range	Unit	Default value																																																																															
		00 to 22, FF	-	15:VBUS																																																																															
35	Drec. Analog CH5 selection [CH5SEL]	Setting range	Unit	Default value																																																																															
		00 to 22, FF	-	05:POSITION																																																																															
	Drec. Analog CH6 selection [CH6SEL]	Setting range	Unit	Default value																																																																															
		00 to 22, FF	-	00:VMON																																																																															
36	■ Selects the data which is measured as Analog channel on the Drive recorder.																																																																																		
	◆ The datas below will need 2 ch data capacity when it set.																																																																																		
	● Present position monitor (Linear encoder/ External encoder)																																																																																		
	● Command position monitor																																																																																		
	● PS data monitor (Linear encoder/ External encoder)																																																																																		
	* For example, ch.2 setting will invalid if encoder PS data is set to ch.1.																																																																																		
	Above channels will be invalid if sampling point: 1024 is selected.																																																																																		
	◆ Do not set FF because it is for Manufacturer only.																																																																																		
	<table><tr><th colspan="2">ID</th><th>Setting value</th><th colspan="2">ID</th><th>Setting value</th></tr><tr><td>00</td><td>VMON</td><td>Velocity monitor</td><td>0E</td><td>ETRMS</td><td>Effective force monitor (Estimated value)</td></tr><tr><td>01</td><td>VCMON</td><td>Velocity command monitor</td><td>0F</td><td>JRAT</td><td>Load Mass Ratio monitor</td></tr><tr><td>02</td><td>TMON</td><td>Force monitor</td><td>10</td><td>MTL-EST</td><td>Load Force monitor (Estimate value)</td></tr><tr><td>03</td><td>TCMON</td><td>Force command monitor</td><td>11</td><td>SINEU</td><td>U-phase electric angle monitor</td></tr><tr><td>04</td><td>PMON</td><td>Position deviation monitor</td><td>13</td><td>ACCMON</td><td>Acceleration monitor</td></tr><tr><td>05</td><td>POSITION</td><td>Present position monitor (Motor encoder)</td><td>15</td><td>VBUS</td><td>Main circuit bus voltage monitor</td></tr><tr><td>07</td><td>PCMDSUM</td><td>Command position integration value</td><td>16</td><td>OLRAT</td><td>Reaching rate of OL detection level of motor temperature rise estimation value</td></tr><tr><td>08</td><td>PCMDF1</td><td>Position command pulse frequency monitor 1</td><td>18</td><td>TCMON2</td><td>Force command monitor (before filter)</td></tr><tr><td>09</td><td>PCMDF2</td><td>Position command pulse frequency monitor 2</td><td>19</td><td>SYNERR</td><td>Axes-sync error monitor</td></tr><tr><td>0A</td><td>PS_MOT</td><td>Absolute encoder PS data monitor (Motor encoder)</td><td>21</td><td>RegPOW</td><td>Regenerative power monitor</td></tr><tr><td>0C</td><td>RegR</td><td>Regenerative resistor operation percentage monitor</td><td>22</td><td>MOTE-ERRAT</td><td>Error rate of motor encoder communication</td></tr><tr><td>0D</td><td>TRMS</td><td>Effective force monitor</td><td>FF</td><td>RESERVE</td><td>Monitqqor mode, for manufacturer only</td></tr></table>					ID		Setting value	ID		Setting value	00	VMON	Velocity monitor	0E	ETRMS	Effective force monitor (Estimated value)	01	VCMON	Velocity command monitor	0F	JRAT	Load Mass Ratio monitor	02	TMON	Force monitor	10	MTL-EST	Load Force monitor (Estimate value)	03	TCMON	Force command monitor	11	SINEU	U-phase electric angle monitor	04	PMON	Position deviation monitor	13	ACCMON	Acceleration monitor	05	POSITION	Present position monitor (Motor encoder)	15	VBUS	Main circuit bus voltage monitor	07	PCMDSUM	Command position integration value	16	OLRAT	Reaching rate of OL detection level of motor temperature rise estimation value	08	PCMDF1	Position command pulse frequency monitor 1	18	TCMON2	Force command monitor (before filter)	09	PCMDF2	Position command pulse frequency monitor 2	19	SYNERR	Axes-sync error monitor	0A	PS_MOT	Absolute encoder PS data monitor (Motor encoder)	21	RegPOW	Regenerative power monitor	0C	RegR	Regenerative resistor operation percentage monitor	22	MOTE-ERRAT	Error rate of motor encoder communication	0D	TRMS	Effective force monitor	FF	RESERVE	Monitqqor mode, for manufacturer only
	ID		Setting value	ID		Setting value																																																																													
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0D	TRMS	Effective force monitor	FF	RESERVE	Monitqqor mode, for manufacturer only																																																																														

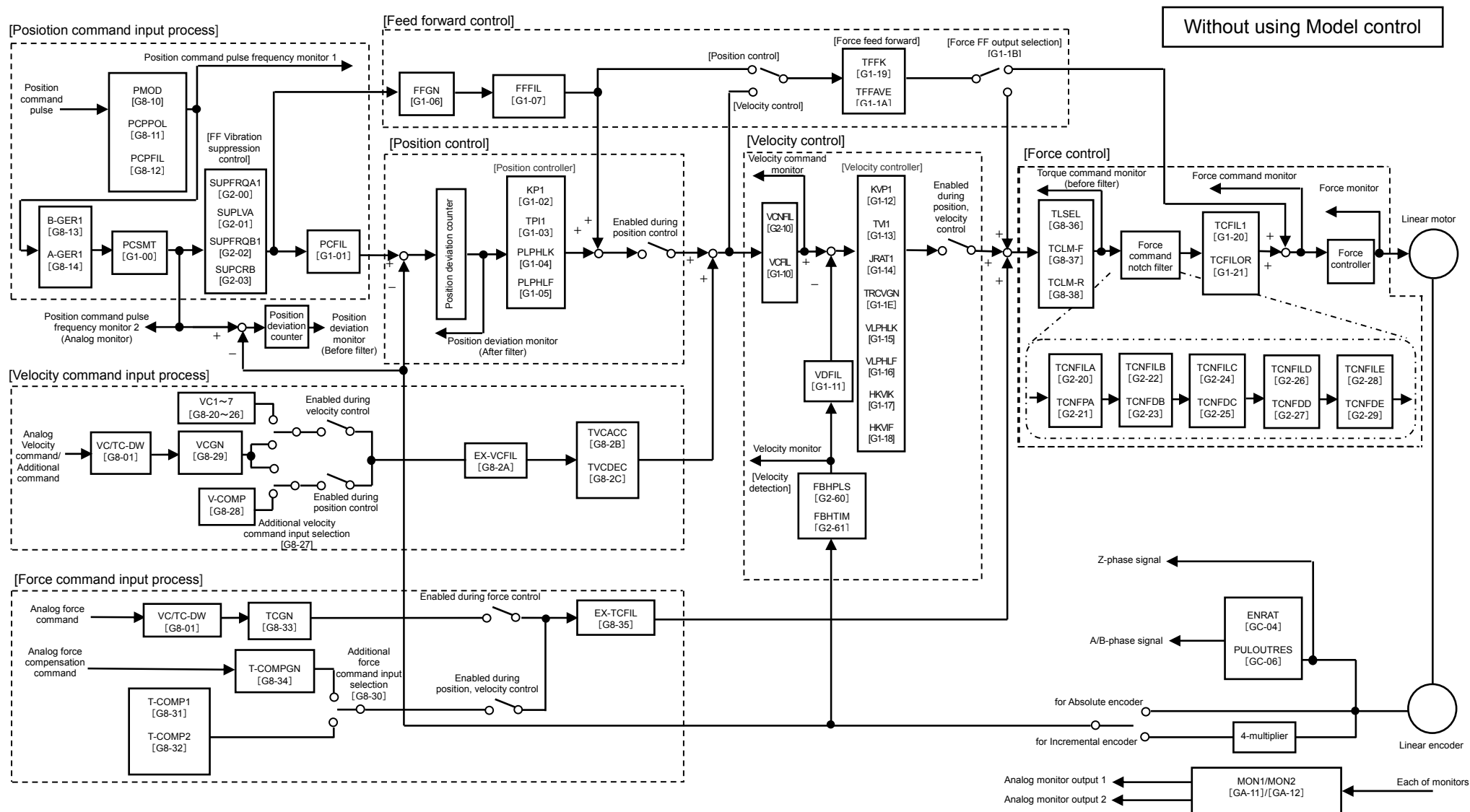
5. Operation

—GroupD—

ID	Contents					
37	Drec. Digital CH1 selection [DCH1SEL]		Setting range	Unit	Default value	
			00 to 20, FF	-	16:SRDY	
38	Drec. Digital CH2 selection [DCH2SEL]		Setting range	Unit	Default value	
			00 to 20, FF	-	15:SACT	
39	Drec. Digital CH3 selection [DCH3SEL]		Setting range	Unit	Default value	
			00 to 20, FF	-	1B:WRG-OL	
	Drec. Digital CH4 selection [DCH4SEL]		Setting range	Unit	Default value	
			00 to 20, FF	-	1C:ALM	
3A	■ Selects the data which is measured as Digital channel on the Drive recorder.					
	◆ Do not set FF because it is for Manufacturer only.					
	ID		Setting value		ID	Setting value
	00	GIN1	General input 1	10	INP	While In-Position Status
	01	GIN2	General input 2	11	NEAR	While Near Range Status
	02	GIN3	General input 3	12	VCMP	While Speed Matching Status
	03	GIN4	General input 4	13	TLIM	While Force Limiting
	04	GIN5	General input 5	14	VLIM	While Velocity Limiting
	05	GIN6	General input 6	15	SACT	While Motor Excitation
	06	GIN7	General input 7	16	SRDY	While Servo Ready Status
	07	GIN8	General input 8	17	CMD-ACK	While Command Acceptance Permission Status
	08	GOUT1	General output 1	18	PCON-ACK	While Velocity Loop Proportional Control Switching Status
	09	GOUT2	General output 2	19	GC-ACK	While Electronic Gear Switching Status
	0A	GOUT3	General output 3	1A	WRG-OVF	While Excessive Deviation Warning Status
	0B	GOUT4	General output 4	1B	WRG-OL	While Overload Warning Status
	0C	GOUT5	General output 5	1C	ALM	While Alarm Status
0D	GOUT6	General output 6	1E	TRJCMP	While position command distribution completion status (Delay time included)	
0E	GOUT7	General output 7	20	WRG-SY	While Axes-sync Error Excess Warning	
0F	GOUT8	General output 8	FF	RESERVE	Monitor mode, for manufacturer only	

5.9 Control block diagram

5.9 Control block diagram

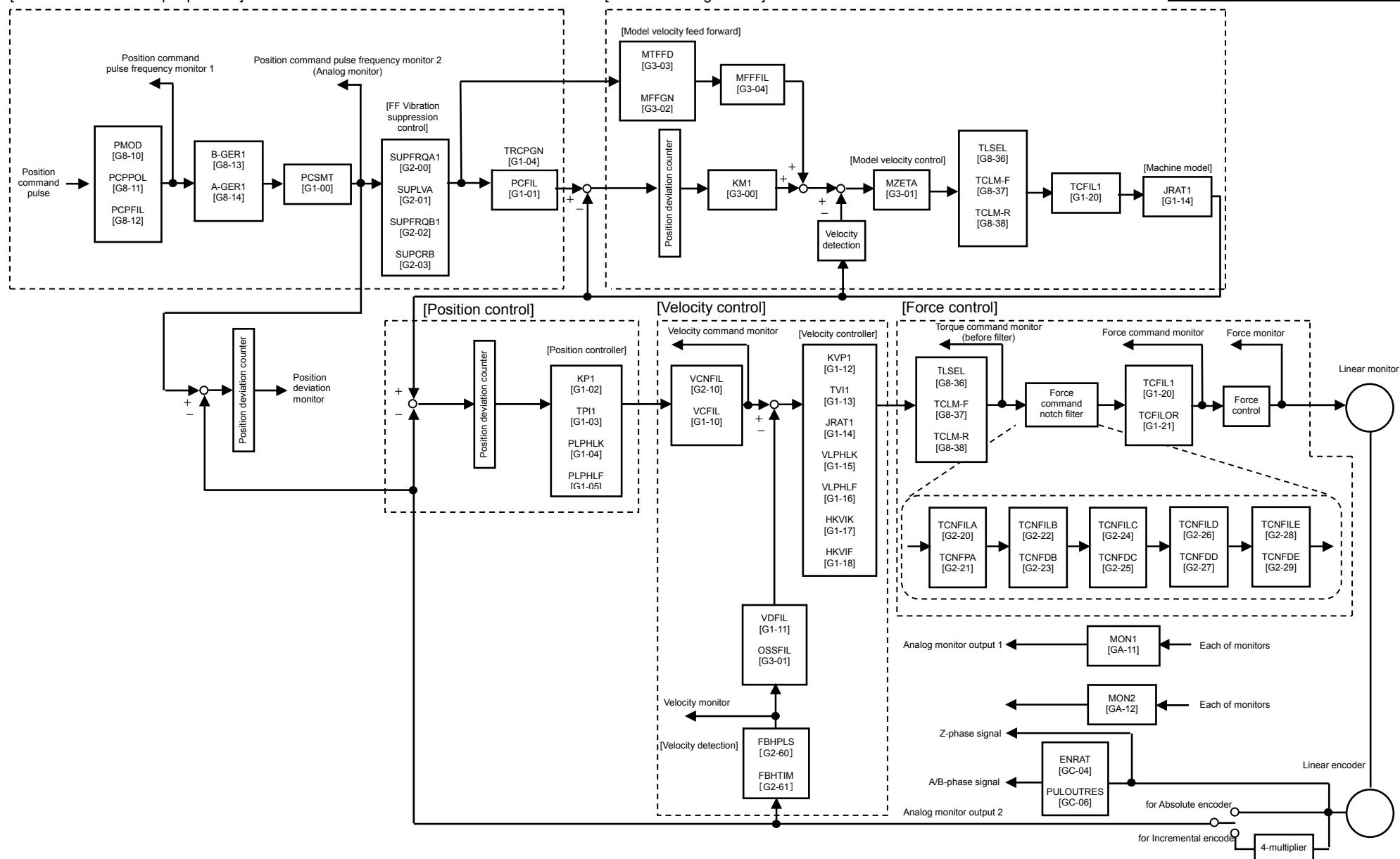


5. Operation

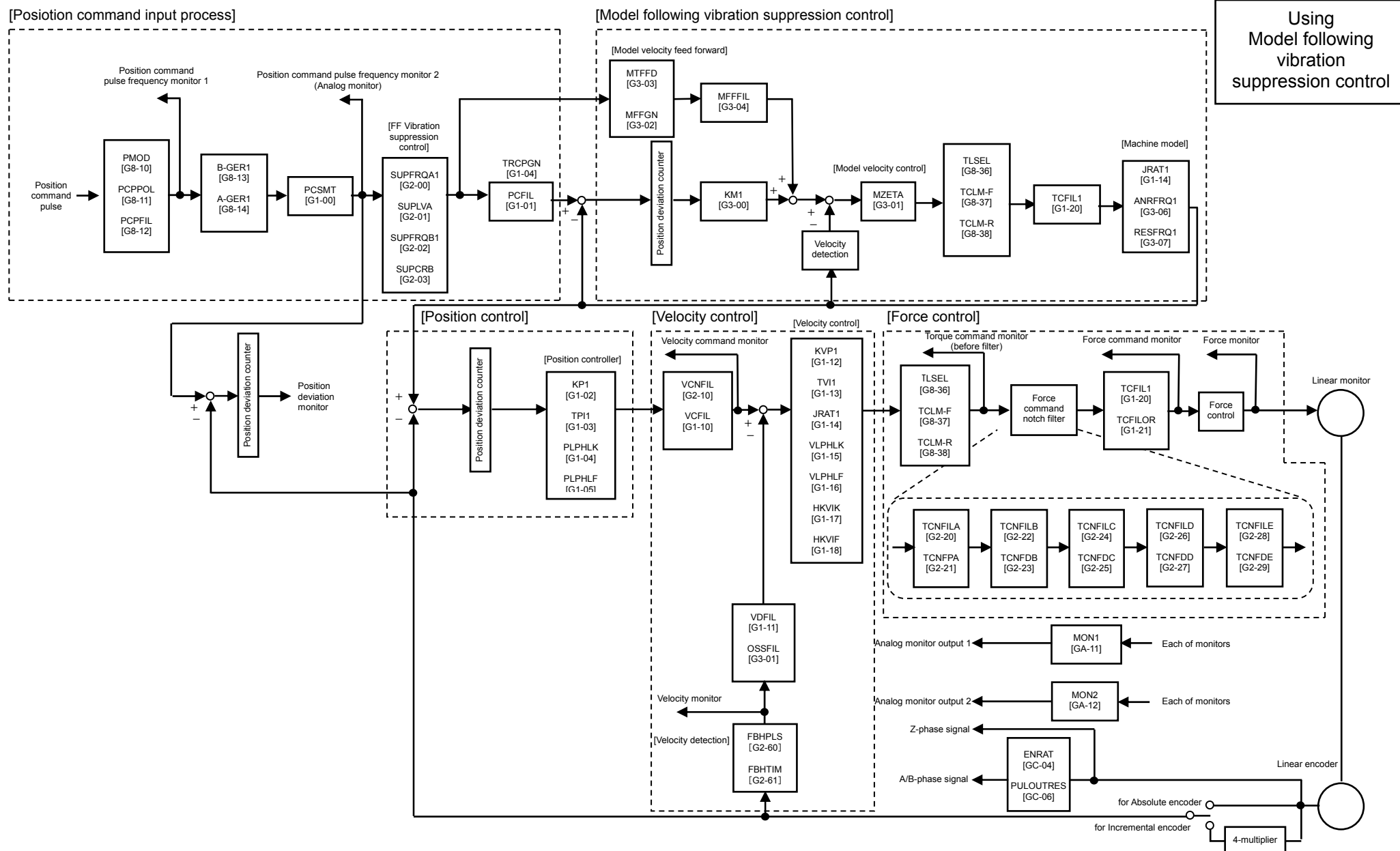
[Position command input process]

[Model following control]

Using Model following control



5.9 Control block diagram



5. Operation

5.10 SEMI F47 supporting function

This function limits motor current when it detects voltage sag warning due to instantaneous power failure (when voltage dropped to 135 - 152VAC).

This function is provided to support acquiring “SEMI F47 Standard” that is requisite for semiconductor equipments.

Combined with Power Failure Detection Delay Time [GroupB ID16], it prevents motor stop with alarm when in instantaneous power failure and enables to continue operation.

5.10.1 Parameter setting

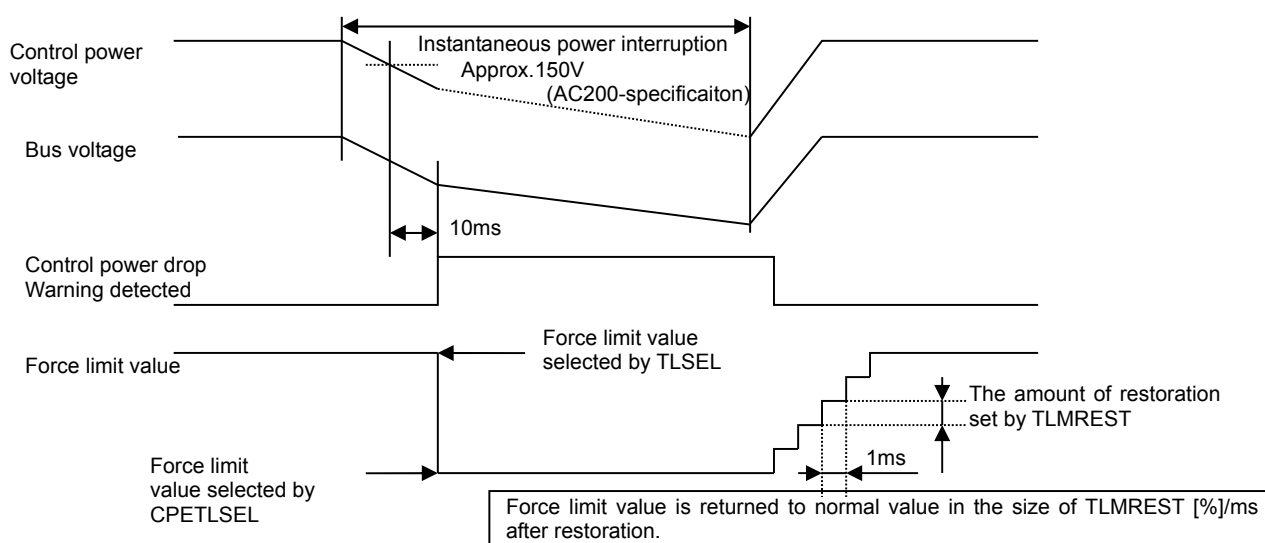
■ General parameters Group8 “Control system”

ID	Symbol	Name	Default value	Unit	Setting range
3A	CPETLSEL	Force limit input selection during power drop	00	-	00 to 03
3D	TLMREST	The amounts of force limit value restoration when power restored	0.0	%	0.0 to 500.0

* TLMREST works as 10% if 0.0% is set.

5.10.2 Operational sequence

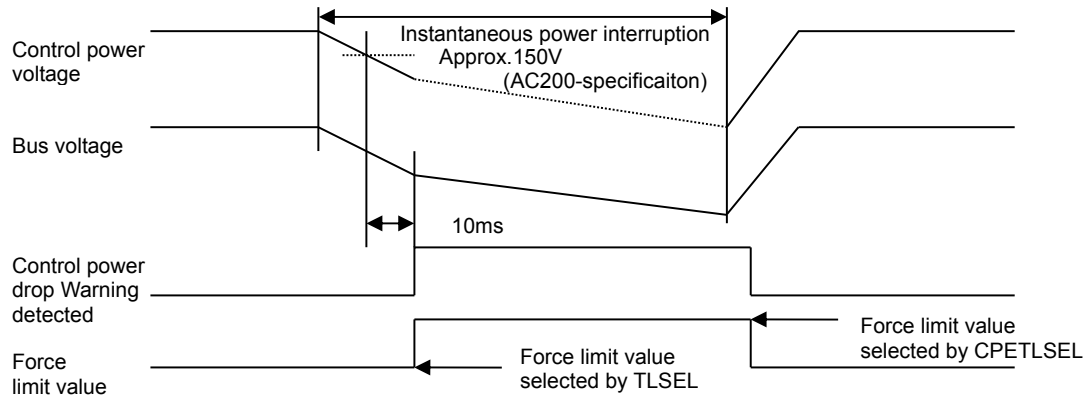
This shows the operational sequence from detecting warning of low control power voltage to restoration of control power voltage.



5.10 SEMI F47 supporting function

5.10.3 Notes

Set force limit value under voltage sag warning smaller than that of normal operation.
Even if the force limit value of voltage sag is greater than that of normal operation, it limits the force at the set value when in voltage sag. After power restoration, the limiting value goes back to that of normal operation.



5. Operation

5.11 Virtual motor operation function

This is the function which simulates linear motor behavior and servo amplifier status at internal of the servo amplifier. This function is able to check a sequence with output signal and check a wiring with upper controller, without actual motor operation. Thus, safer and faster start-up of a system is available by this function.

As note, linear motor and encoder connection is not necessary for this function use.

5.11.1 Setting

Sets the system parameter below for this function use.

ID	Contents													
02	Operation mode selection													
	■ Selects the operation mode.													
	<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Normal</td><td>Normal operation mode</td></tr><tr><td>01</td><td>Virtual1</td><td>Virtual operation mode (virtual P_ON valid)</td></tr><tr><td>02</td><td>Virtual2</td><td>Virtual operation mode (virtual P_ON invalid)</td></tr></table>		Selection		Contents	00	Normal	Normal operation mode	01	Virtual1	Virtual operation mode (virtual P_ON valid)	02	Virtual2	Virtual operation mode (virtual P_ON invalid)
	Selection		Contents											
	00	Normal	Normal operation mode											
	01	Virtual1	Virtual operation mode (virtual P_ON valid)											
	02	Virtual2	Virtual operation mode (virtual P_ON invalid)											
	* “Power cycle for control after setting”													
	■ Operation mode action													
	◆ 01: Virtual1 Virtual operation mode (virtual P_ON valid) In this mode, linear motor operation can simulate by control power supply only. Automatically change state to main power ON, after control power supplied.													
◆ 02: Virtual2 Virtual operation mode (virtual P_ON invalid) In this mode, linear motor operation can simulate after main circuit power supplied. Main circuit power supply is necessary, after control power supplied.														

5.11 Virtual motor operation function

5.11.2 Restrictions

There are restrictions below for this function.

- Load model for virtual motor operation is rigid body system by load mass.

Item	Conditions
Load force	0 [N·m]
Load mass	Load mass ratio × Linear motor mover mass
Mechanical stiffness	Rigid body

- * Load mass ratio is used from Group1 ID14.

The value set by the parameter below is used depending on gain switching condition if gain switching function is used.

Selection	Used Load mass ratio		
	Group	ID	Name
1	1	14	Load mass ratio 1
2	4	05	Load mass ratio 2
3	4	15	Load mass ratio 3
4	4	25	Load mass ratio 4

- Encoder position data does not backup. Position data is zero when power is on.
- Detection of alarm and warning for encoder does not work.
- In use of incremental encoder, output pulse resolution will be 512 [P/mm] (4-multiplied) regardless of the encoder resolution setting.
Dividing is available for this resolution by the setting of GroupC ID04 Encoder Output Pulse Division. And, Z-phase is output with 64mm per cycle.
- U-phase electric angle monitor might show wrong value if incremental encoder is used.
- Position, velocity and force of linear motor is simulated to response of control system against virtual motor operation load model.
- Action of linear motor and load model is stop at servo OFF. Free-run operation at servo OFF can not simulate.
- When "01: Virtual" is set to Operation mode selection, main circuit power is supplied virtually, and regard as supplying rated power. As note, Alarm and regenerative operation for main power can not simulate.
- Dynamic brake does not work. Stop operation by servo OFF or dynamic brake of emergency stop can not simulate. However, the signal of While Dynamic Braking is output from general purpose output.
- When linear encoder is absolute encoder (EnDat), it works with data length 36bit.

5. Operation

5.11.3 Digital operator display

Digital operator display will change during virtual motor operation.

Display	Description
	Alphabet "t" shows at second LED from right, during virtual motor operation. The other LEDs show same as normal status display. In case except status display mode, also the same as normal.

5.11.4 Operating precautions

- Holding-brake release signal outputs same as normal operation even if virtual motor operation is executed. At vertical axis use, avoid holding-brake release as follows: Cancel the allocation of holding-brake release signal for general output. Shut off the holding-brake power. etc.

Servo Tuning

In this chapter, tuning of servo amplifier is explained.

6.1 Servo tuning functions and basic adjustment procedure.....	6-1
6.1.1 Servo tuning functions.....	6-1
6.1.2 Tuning method selection procedure	6-3
6.2 Adaptive notch filter function	6-4
6.3 Auto-tuning function	6-5
6.3.1 Selection of tuning method.....	6-5
6.3.2 Automatically adjusted parameters in auto-tuning	6-10
6.3.3 Adjustable main parameters during auto-tuning.....	6-12
6.3.4 Unavailable functions during auto-tuning	6-13
6.3.5 Auto-tuning characteristic selection.....	6-14
6.3.6 Adjustment method for auto-tuning	6-15
6.3.7 Monitoring servo gain adjustment parameters	6-15
6.3.8 Manual tuning method using auto-tuning results	6-16
6.4 Manual tuning function	6-17
6.4.1 Servo system configuration and servo adjustment parameters	6-17
6.4.2 Basic manual tuning method for velocity control.....	6-19
6.4.3 Basic manual tuning method for position control	6-19
6.5 The function of making servo gain higher.....	6-20
6.5.1 Velocity loop phase lead compensation	6-20
6.5.2 Position loop phase lead compensation.....	6-21
6.5.3 Force feed forward compensation.....	6-22
6.6 Model following control function	6-23
6.6.1 Manual tuning method for model following control.....	6-24
6.6.2 Switching of the Feedback control and the Model-following (vibration suppression) control	6-25
6.6.3 Model velocity feed forward differential compensation	6-26
6.7 Auto notch filter tuning function	6-27
6.8 Vibration suppression function.....	6-29
6.8.1 Model following vibration suppression control.....	6-29
6.8.2 Auto FF Vibration Suppression Frequency Tuning.....	6-32
6.8.3 FF vibration suppression control	6-33
6.8.4 CP vibration suppression control.....	6-35
6.8.5 Minor vibration suppression	6-36
6.9 Disturbance impact suppression function	6-37
6.9.1 High order integral control	6-37
6.9.2 Disturbance Observer Function.....	6-38
6.10 Stick-slip behavior compensation function.....	6-39

6. Servo Tuning

6.1 Servo tuning functions and basic adjustment procedure

To operate the linear 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 mass 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]
Load mass ratio is not estimated. This is automatically adjusted based on load mass ratio to which servo gain and filter frequency are set, and responsiveness. Use this tuning when load mass ratio is not correctly estimated by Auto-tuning, or the load mass ratio of the machine in use is already known and there are no or less fluctuations in load mass ratio during operation.
- Manual Tuning
Set all parameters, such as Load mass 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.
 - ◆ Force feed forward compensation
This is the function which improve response for the command of control system by applying feed forward compensation to force 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 linear 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 linear motor in a short time.

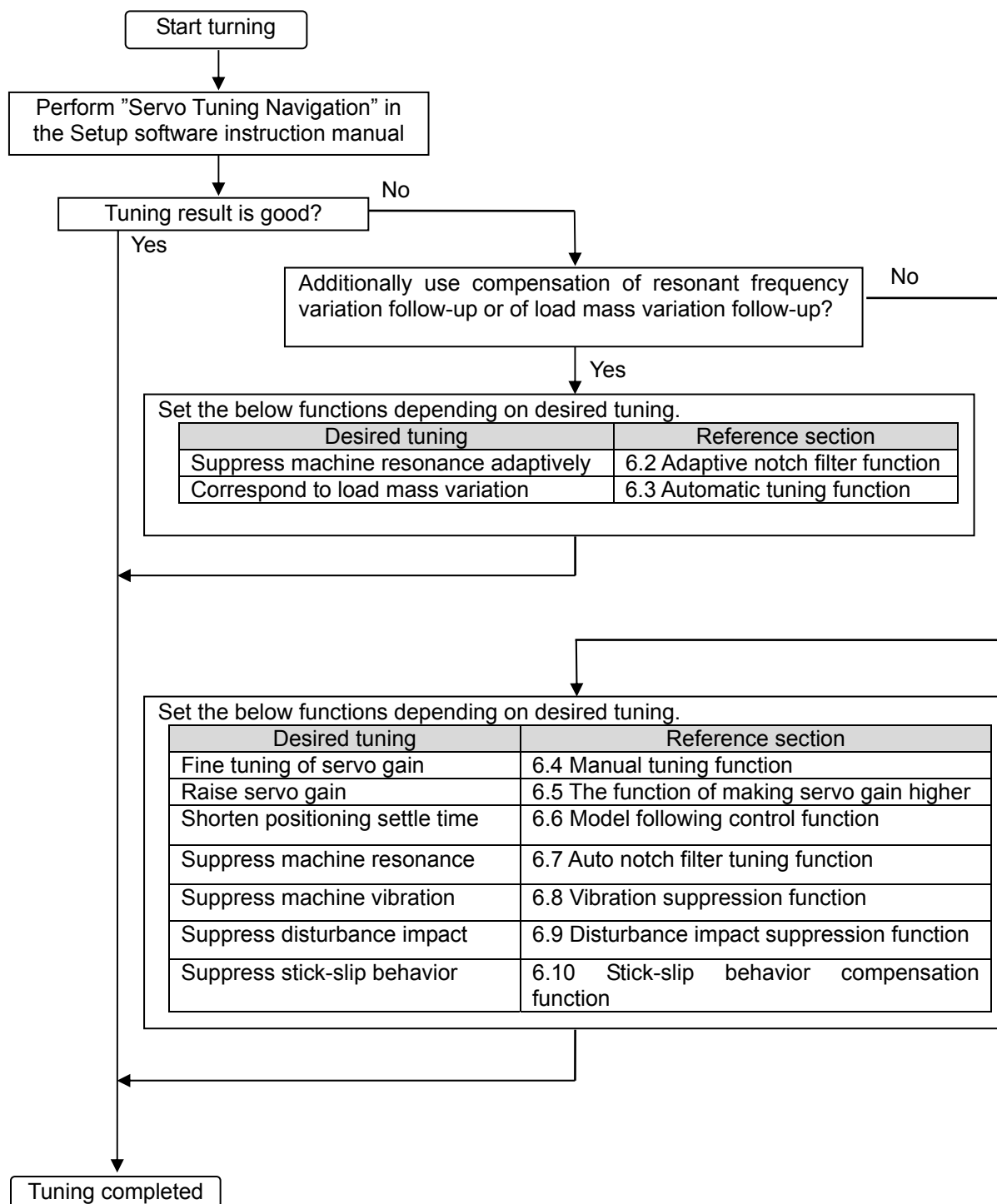
6.1 Servo tuning functions and basic adjustment procedure

- 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 moving linear 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 linear 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 force by estimating the load force internally and adding compensation against load force to a force command, if external load force is applied to a linear 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

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 linear 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 a operation with getting the value of "Group2 ID28: Force Command Notch Filter E [TCNFILE]" as the initial value.
- ◆ Tuning result of Adaptive notch filter is saved to "Force 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 linear 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 can not 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)

6.3 Auto-tuning function

- Explanation for each parameter
Details of each parameter are shown below.

◆ General Parameter Group0 Auto-Tuning

ID	Contents				
00	Tuning Mode [TUNMODE]				
	<table><tr><th>Selection</th><th>Contents</th></tr><tr><td>00: AutoTun</td><td>Auto-Tuning</td></tr></table> ◆ Servo amplifier estimates Load mass 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 mass ratio at the time of acceleration/deceleration. Therefore, for operations only with excessively long acceleration/deceleration time constants or with only low force in low velocity, this mode cannot be used. Also, for operations with high disturbance mass or with major mechanical clearance, this mode cannot be used. Use in [01:_AutoTun_JRAT-Fix Automatic Tuning [JRAT Manual Setting].	Selection	Contents	00: AutoTun	Auto-Tuning
	Selection	Contents			
	00: AutoTun	Auto-Tuning			
	<table><tr><th>Selection</th><th>Contents</th></tr><tr><td>01: AutoTun_JRAT-Fix</td><td>Auto-Tuning [JRAT manual setting]</td></tr></table> ◆ Based on Group1 ID14 "Load mass 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	01: AutoTun_JRAT-Fix	Auto-Tuning [JRAT manual setting]
	Selection	Contents			
	01: AutoTun_JRAT-Fix	Auto-Tuning [JRAT manual setting]			
	<table><tr><th>Selection</th><th>Contents</th></tr><tr><td>02: ManualTun</td><td>Manual Tuning</td></tr></table> ◆ This mode is used in order to adjust the servo gain to the machine or equipment to ensure maximum response as well as when characteristics in auto-tuning are insufficient.	Selection	Contents	02: ManualTun	Manual Tuning
	Selection	Contents			
	02: ManualTun	Manual Tuning			

6.3 Auto-tuning function

ID

Contents

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

01

6. Servo Tuning

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.
	Auto-Tuning Automatic Parameter Saving [ATSAVE]
03	■ "Load mass ratio" obtained from the result of auto-tuning is automatically saved in Group1 ID14 "Load Mass 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 Auto-tuning function

6.3.2 Automatically adjusted parameters in auto-tuning

These parameters will not reflect on linear 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 Mass Ratio 1	Note 3)
1C	AFBK	Acceleration Feedback Gain	
1E	TRCVGN	Higher Tracking Control Velocity Compensation Gain	
20	TCFIL1	Force 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 Mass Ratio 1	Note 3)
1C	AFBK	Acceleration Feedback Gain	
1E	TRCVGN	Higher Tracking Control Velocity Compensation Gain	
20	TCFIL1	Force 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 Auto-tuning function

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	Force Feed Forward Gain
1A	TFFAVE	Force feed forward averaging
1B	TFFOUT	Force Feed Forward output selection
21	TCFILOR	Force 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 1
01	SUPLVA	FF Vibration Suppression Level Selection A
02	SUPFREQB1	FF Vibration Suppression Frequency B1
03	SUPCRB	FF Vibration Suppression Level Selection B
10	VCNFIL	Velocity Command Notch Filter
20	TCNFILA	Force Command Notch Filter A
21	TCNFPA	TCNFILA, Low Frequency Phase Delay Improvement
22	TCNFILB	Force Command Notch Filter B
23	TCNFDB	TCNFILB, Depth Selection
24	TCNFILC	Force Command Notch Filter C
25	TCNFDC	TCNFILC, Depth Selection
26	TCNFILD	Force Command Notch Filter D
27	TCNFDD	TCNFILD, Depth Selection
28	TCNFIE	Force Command Notch Filter E
29	TCNFDE	TCNFIE, 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

6. Servo Tuning

◆ General parameters Group5 "High setting control setting"

ID	Symbol	Name
00	CVFIL	Command Velocity Low-pass Filter
01	CVTH	Command Velocity Threshold
02	ACCCO	Acceleration Compensation
03	DECCO	Deceleration Compensation

6.3.4 Unavailable functions during auto-tuning

- The following functions CANNOT be used during auto-tuning:

◆ General parameters Group9 "Function enabling condition settings"

ID	Symbol	Name
13	GC1	Gain Switching Condition 1
14	GC2	Gain Switching Condition 2
19	PLPCON	Position Loop Proportional Control Switching Function
27	VLPCON	Velocity Loop Proportional Control Switching Function
33	OBS	Disturbance Observer Function
80	SYNCEN	Axes-sync compensation function
81	SYNPCNEN	Axes-sync compensation proportional control switching function

- * "Disturbance Observer" is not able to use together with Auto-Tuning. If desired to use Auto-Tuning, make Group9 ID33 "Disturbance Observer Function [OBS]" invalid.
- * SYNCEN and SYNPCNEN are able to use when "01: AutoTun_JRAT-Fix" is set to Group0 ID00 "Tuning mode". If "00: AutoTun" is set, disable Group9 ID80 [SYNCEN] and Group9 ID81 [SYNPCNEN].

◆ General parameters Group1 "Basic control parameter settings"

ID	Symbol	Name
08	TRCPGN	Higher Tracking Control Position Compensation Gain
1C	AFBK	Acceleration Feedback Gain
1E	TRCVGN	Higher Tracking Control Velocity Compensation Gain

◆ General parameters Group8 "Control system settings"

ID	Symbol	Name
43	LOWV	Low Speed Range

- * "Low Speed Range [LOWV]" is able to use when "00: Positioning Control 1 (General Purpose)", "01: Positioning Control 2 (High Response)", "02: Positioning Control 3 (High Response, FFGN Manual Setting)", "05: Trajectory Control 1" or "06: Trajectory Control 2 (KP,FFGN Manual Setting)" are selected at the Auto-Tuning Characteristic [ATCHA].

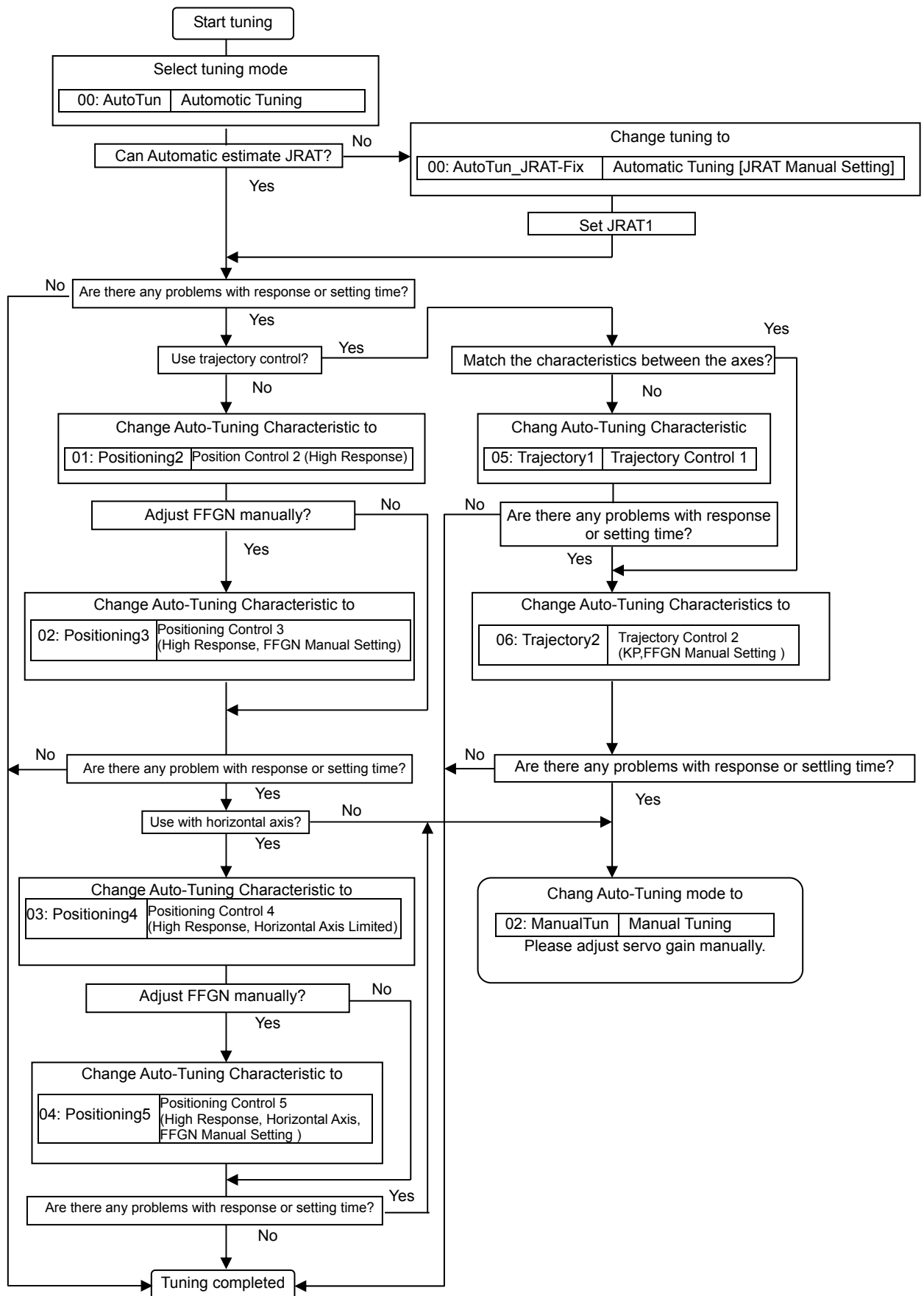
◆ General parameters Group3 "Model following control settings"

ID	Symbol	Name
06	ANRFRQ1	Model Control Antiresonance 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 system parameter ID07 "Position control selection".

6.3 Auto-tuning function

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 mass 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 Mass 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 linear 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 Mass 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	Force Command Filter monitor	Hz

6.3 Auto-tuning function

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 Mass Ratio 1	%
1C	AFBK	Acceleration Feedback Gain	%
1E	TRCVGN	Higher Tracking Control Velocity Compensation Gain	%
20	TCFIL1	Force 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	mm/s

◆ 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

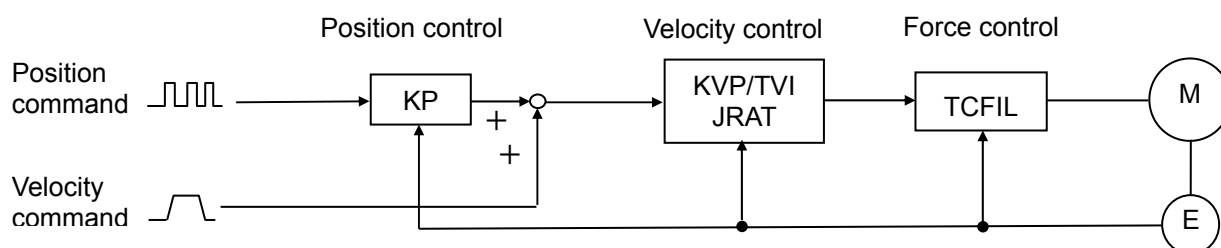
All gain is adjustable manually using manual tuning mode when characteristics in auto-tuning are insufficient. Select "02: ManualTun Manual Tuning" at Group0 ID00 "Tuning mode [TUNMODE]".

- 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 Force control", and the control system response should be "Position control < Velocity control < Force 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: $KP1 [1/S] = KVP1 [Hz] / 4 \cdot 2\pi$ as a rough indication.

6.4 Manual tuning function

- 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 Mass 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 Mass Ratio 1 [JRAT1]"
Set this value to the calculation shown below:

$$JRAT = \frac{\text{Load mass (M)}}{\text{Linear motor mover mass (M}_c\text{)}} \times 100\%$$

- 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 Mass 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 "Force 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. Servo Tuning

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 Force 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]/ $4 \cdot 2 \pi^2$ ", 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 Force notch filter and/or FF vibration suppression frequency to suppress resonance) try the procedure again.

6.5 The function of making servo gain higher

6.5 The function of making servo gain higher

There are explanations of the function for improving response, for position/ velocity/ force control system each.

6.5.1 Velocity loop phase lead compensation

This is the function to compensate phase delay of Velocity control system, and helps Group1 ID12 "Velocity loop proportional gain 1 [KVP1]" change higher.

Use this when "Velocity loop proportional gain 1 [KVP1]" is not able to increase because there is no gain margin, phase margin.

■ How to use

- ◆ Please get a frequency characteristic of machine. (In case use of the System Analysis, see "10.3 System Analysis" in M0010842.)
- ◆ Set 3 times of "Velocity Loop Proportional Gain 1 [KVP1]" to Group1 ID16 "Velocity loop phase lead compensation frequency [VLPHLF]", and set near 30% to Group1 ID15 "Velocity loop phase lead compensation gain [VLPHLK]", and then confirm increase of phase margin at higher frequency.
- ◆ Group1 ID15 "Velocity loop phase lead compensation gain [VLPHLK]" is able to increase up to the value of allowed phase margin at higher frequency.
- ◆ "Velocity Loop Proportional Gain 1 [KVP1]" is able to increase up to the value of allowed phase margin at around of "Velocity Loop Proportional Gain 1 [KVP1]".

■ Velocity loop phase lead compensation gain

Sets the compensation value of Velocity loop phase lead compensation.

- ◆ General parameters Group1 "Basic Control parameter settings"

ID	Symbol	Name	Unit	Setting range
15	VLPHLK	Velocity loop phase lead compensation gain	%	0 to 100

* This function will be disabled when 0% is set.

■ Velocity loop phase lead compensation frequency

Sets the frequency of Velocity loop phase lead compensation.

- ◆ General parameters Group1 "Basic Control parameter settings"

ID	Symbol	Name	Unit	Setting range
16	VLPHLF	Velocity loop phase lead compensation frequency	Hz	10 to 4000

* Up to 1000Hz setting is valid at normal sampling mode.

* Up to 2000Hz setting is valid at high rate sampling mode.

6. Servo Tuning

6.5.2 Position loop phase lead compensation

This is the function to compensate phase delay of Position control system, and helps Group1 ID02 "Velocity Loop Proportional Gain 1 [KVP1]" change higher.
Use when "Velocity Loop Proportional Gain 1 [KVP1]" is not able to change higher by overshoot occurring.

■ How to use

- ◆ Set 4 times of "Position Loop Proportional Gain 1 [KP1]" ($KP1 [1/s]/2\pi \times 4 [Hz]$) 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 linear 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 Force feed forward compensation

There is explanation of function which improving response against a command of control system and applying feed forward compensation to the force control system. Use when response is not good against command during circular machining etc.

■ How to use

- ◆ Improve response by increasing Group1 ID19 "Force 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 "Force feed forward gain [TFFK]", please change value of Group1 ID1A "Force feed forward averaging [TFFAVE]" or Group1 ID1B "Force feed forward output selection [TFFOUT]", and then confirm impact.

■ Force Feed Forward Gain

Sets the compensation value of Force -Feed Forward.

- ◆ General parameters Group1 "Basic Control parameter settings"

ID	Symbol	Name	Unit	Setting range
19	TFFK	Force 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 force 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]".

■ Force feed forward gain averaging

Selects the average count of force feed forward compensation.

- ◆ General parameters Group1 "Basic Control parameter settings"

ID	Symbol	Name	Unit	Setting range
1A	TFFAVE	Force feed forward gain averaging	-	00 to 01

Selection		Contents
00	2timesAverage	2 times
01	4timesAverage	4 times

■ Force feed forward output selection

Select the point that is to be added force feed forward compensation.

- ◆ General parameters Group1 "Basic Control parameter settings"

ID	Symbol	Name	Unit	Setting range
1B	TFFOUT	Force feed forward output selection	-	00 to 01

Selection		Contents
00	Before_Filter	Before force command filter
01	After_Filter	After force 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 linear motor in order to track the Model control system.

Select "02: Position Position control type" at the system parameter ID06 "Control mode selection", and "01: Model1 Model-following control" at the system parameter ID07 "Position control selection".

■ How to use

- ◆ See "6.3.6 Adjustment method for auto-tuning" when using this function together with the auto-tuning.
- ◆ See "6.6.1 Manual tuning method for model following control" when setting the parameter manually without the auto-tuning.
- ◆ See "6.6.3 Model velocity feed forward differential compensation", for command-following improvement after the auto-tuning or the manual tuning.

■ Setting parameters

◆ System parameters

ID	Content	
06	Control Mode Selection	
	Select value	Content
	02 Position	Position control type
07	Position Control Selection	
	Select value	Content
	01 Model1	Model following control

- * Model following control cannot be used when in velocity control type or force control type.
- * Model following control can be used with auto-tuning at the same time.
- * Model following control can be used with full-closed control at the same time.

6.6 Model following control function

6.6.1 Manual tuning method for model following control

- Set value of Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]" as high a value as possible within the range that mechanical system stably works without any oscillation. If vibration occurs, lower the value.
- Set value of Group1 ID13 "Velocity Loop Integral Time Constant 1 [TVI1]" by referring "TVI1 [ms] = 1000/ KVP1 [Hz]", as a rough indication.
- Set value of Group1 ID12 "Position Loop Proportional Gain 1 [KP1]" by referring to "KP1 [1/s] = KVP1 [Hz]/ $4 \cdot 2 \pi$ ", as a rough indication.
- Set value of Group3 ID03 "Model control gain 1 [KM1]" by referring to "KM1 $\doteq$ 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 Force notch filter and/or FF Vibration suppression frequency to suppress resonance and attempt it again.
- Adjustable parameters in Model following control
In addition to the parameters in Standard position control, the following parameters are also adjustable:

- ◆ General Parameters Group3 "Model following control settings"

ID	Symbol	Name
00	KM1	Model Control Gain 1
01	MZETA	Model control damping coefficient
05	OSSFIL	Overshoot Suppression Filter

- ◆ Model Control Gain 1 [KM1]
Proportional gain fro Model following control position controller.
Adjust this to: KM1 $\doteq$ 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 $\zeta=0.866$ by 0% and $\zeta=1.0$ 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. Servo Tuning

6.6.2 Switching of the Feedback control and the Model-following (vibration suppression) control

Explains the function which switches standard position control, model-following control and model-following vibration suppression control, on real-time.

Select "02: Position Position control type" at the system parameter ID06 "Control mode selection", and select "03: Model3 Model-following / standard position control switching" or "04: Model4 Model-following vibration suppression / standard position control switching" at the system parameter ID07 "Position control selection".

■ How to use

- ◆ The function is valid when condition that is selected in Group9 ID1A "Model following (vibration suppression) control/ standard position control switching function" is satisfied.
- ◆ "Model following (vibration suppression) control/ standard position control switching function" supports "00: Always_Disable", "01: Always_Enable" and "General input signal (CONT1 to CONT8)".

■ Setting parameters

◆ System parameters

ID	Content		
06	Control Mode Selection		
	Select value		Content
	02	Position	Position control type
07	Position Control Selection		
	Select value		Content
	03	Model3	Model-following / standard position control switching
	04	Model4	Model-following vibration suppression / standard position control switching

- * Model following control cannot be used when in velocity control type or force control type.
- * Model following control can be used with auto-tuning at the same time.
- * Model following control / Model-following vibration suppression control can be used with full-closed control at the same time.

- Model following (vibration suppression) control/ standard position control switching function
Sets the valid condition for Model-following (vibration suppression) control.

◆ General parameters Group9 "Function enabling condition settings"

ID	Symbol	Name	Unit	Setting range
1A	MODEL	Model following (vibration suppression) control/ standard position control switching function	-	00 to 11

- * Control mode will be Model-following (vibration suppression) control when this function is valid.
- * This setting value is valid only when Control mode selection is "03: Model3 Model-following / standard position control switching" or "04: Model4 Model-following vibration suppression / standard position control switching".
- * Do not perform switching of the model following (vibration suppression) control and the standard position control, during linear motor operation. Alarm (Model Following Vibration Suppression Control Error (AL.C5)) may occur.

6.6 Model following control function

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 linear 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 "Force 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]".
- * Force command notch filter function can be used together with Auto-tuning at the same time.
- * Holding force falls while auto notch filter is running. Do not use as a gravity axis.

■ Force command value for auto notch filter tuning

Setting the Force command value to the linear 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 Force 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	Force Command Notch Filter A	Hz	100 to 4000

- * The above parameter is saved automatically with auto notch filter tuning.

6.7 Auto notch filter tuning function

- 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 ADNFE.

- 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 ADNFE.

- 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 linear motor to drive tables on a machine stand, the stand itself may vibrate as a reciprocal reactor of the linear 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 linear motor is smaller than the machine stand mass, the anti-resonance and resonance frequencies may not be measured in system analysis. And, system analysis can not 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 " $KP1 [1/s] = KVP1 [Hz] / 4 \cdot 2\pi$ ", as a rough indication.
- ◆ Set value of Group3 ID00 "Model Control Gain 1 [KM1]" by referring to " $KM1 \doteq KP1$ ", as a rough indication.
If vibration increases, lower the value.

6.8 Vibration suppression function

- ◆ 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 Force 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 Force 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 Antiresonance 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 linear 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 $\doteq$ 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 ξ 0.866 by 0% and ξ 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 Antiresonance Frequency 1 [ANRFRQ1]
This is to set the Anti-resonance frequency of the machine using Model following vibration suppression control.
When the value is set higher than Model Control Resonance Frequency, vibration suppression control will be invalid.
 - Model Control Resonance Frequency 1 [RESFRQ1]
This is to set the Resonance frequency of the machine model using Model following vibration suppression control.
Vibration suppression control will be invalid at 80.0Hz.

6. Servo Tuning

- 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 Mass Ratio 1	%	100 to 3000
20	TCFIL1	Force 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 Vibration suppression function

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 linear 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 force falls while Auto FF Vibration Suppression Frequency tuning is executing. Do not use as gravity axis.

- Force command value of Auto FF vibration suppression frequency tuning
Sets force command value giving to linear 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 Force 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 force compensation amount when Auto FF Vibration Suppression Frequency Tuning is executed. By setting the value close to the actual friction force, 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

6. Servo Tuning

- 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 linear 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

6.8 Vibration suppression function

◆ 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 linear 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 linear motor is running.

6. Servo Tuning

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 linear 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 linear 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 linear motor when selecting this value.

6.8 Vibration suppression function

6.8.5 Minor vibration suppression

Explains the function which suppresses a minor vibration against velocity feedback during linear 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 linear 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 linear 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 can not use along with higher tracking control. For use of High order integral control, set 0% to Group1 ID1E "Higher Tracking Control Velocity Compensation Gain [TRCVGN]".

■ High order integral control gain

- ◆ General parameters Group1 "Basic control parameter settings"

ID	Symbol	Name	Unit	Setting range
17	HKVIK	High order integral control gain	%	0 to 100

- * This function will be disabled when 0% is set.

■ High order integral control frequency

- ◆ General parameters Group1 "Basic control parameter settings"

ID	Symbol	Name	Unit	Setting range
18	HKVIF	High order integral control frequency	Hz	10 to 4000

- * Up to 1000Hz setting is valid at normal sampling mode.
- * Up to 2000Hz setting is valid at high rate sampling mode.

6.9 Disturbance impact suppression function

6.9.2 Disturbance Observer Function

The Disturbance Observer is a function to suppress the influence of external load force by estimating the load force inside the servo amplifier and adding the load force compensation to the force 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 mass 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 20000 pulse/mm.
- * Force 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	mm/s	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.

Digital Operator

In this chapter, details of the Digital operator are explained.

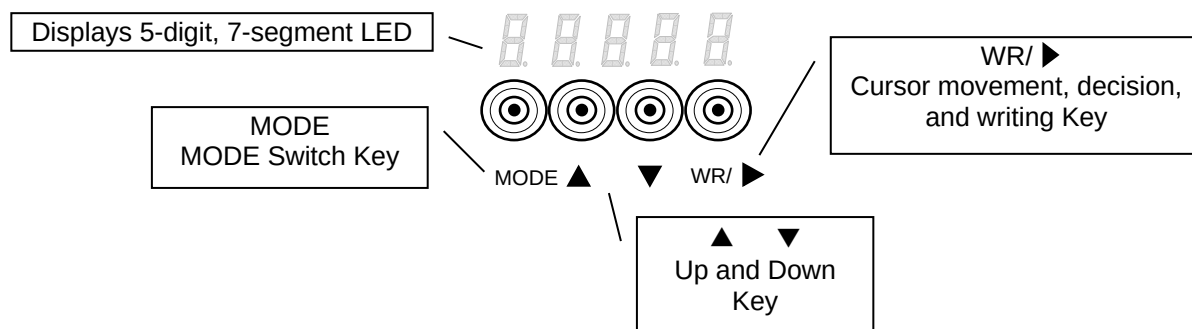
7.1 Digital Operator names and functions	7-1
7.2 Modes	7-1
7.2.1 Changing modes	7-1
7.2.2 Mode contents	7-2
7.3 Setting and display range	7-3
7.4 Status display mode	7-6
7.4.1 Status display mode	7-6
7.4.2 Over-travel status display	7-6
7.4.3 Status display of warning	7-7
7.4.4 Alarm code and servo amplifier status code when alarm occurs	7-8
7.4.5 Alarm reset when alarm activated	7-8
7.4.6 How to check the software version of servo amplifier	7-8
7.4.7 How to check the servo amplifier information 1 to 3	7-9
7.4.8 How to set pass ward	7-10
7.4.9 How to cancel password	7-11
7.5 Editing parameters	7-12
7.5.1 Basic parameters, editing system parameters	7-12
7.5.2 Editing general parameters	7-13
7.6 How to tune automatic notch frequency	7-15
7.7 Auto FF vibration suppression frequency tuning	7-16
7.8 Offset adjustment of velocity/ force command	7-17
7.9 Offset adjustment of analog force compensation command.....	7-18
7.10 Magnetic pole position estimation	7-19
7.11 Velocity-controlled JOG Operation	7-20
7.12 Automatic tuning result writing	7-21
7.13 Alarm history display	7-22
7.14 How to clear alarm history	7-23
7.15 Monitor display	7-23
7.16 Fixed monitor display.....	7-24
7.17 Motor code-setting of linear motor used	7-24

7. Digital Operator

7.1 Digital Operator names and functions

It is possible to change or set the parameters and to confirm the status display, monitor display, test operation and alarm history with the built-in digital operator.

■ Names



◆ Functions

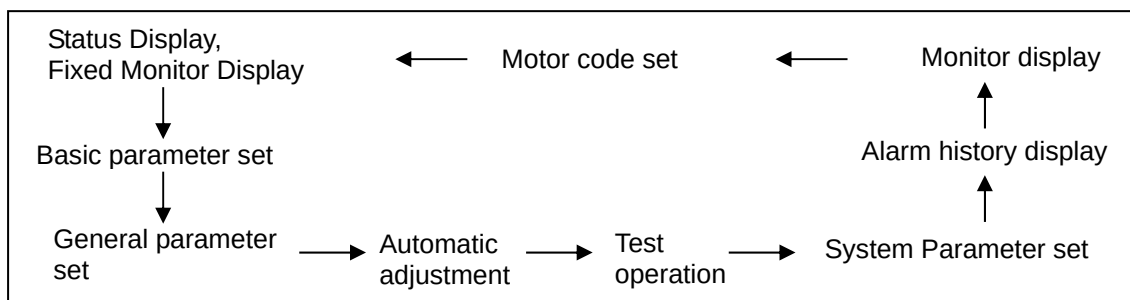
Displayed marks	Functions	Input time
WR	To input selections and write edited data.	More than 1 second
MODE	Changes the Mode.	Less than 1 second
►	Cursor Key Changes the cursor position when editing	Less than 1 second
▲ ▼	Up/ Down key. Changes the numeric value.	Less than 1 second
7 segment LED	Displays monitor value or parameter setting value in five digits.	—

7.2 Modes

It is possible to display the status, to change or set the parameters, to automatically set the notch filter, to change linear motor, and to confirm test operation, alarm history and monitor display with the built-in digital operator.

7.2.1 Changing modes

Change in the mode presses the "MODE key." The mode switches in order of the following figure.



7.2.2 Mode contents

Mode	Contents																										
Status Display	Displays the establishment of control or main power supply, Servo ON, over-travel, warning and alarm status.																										
Basic parameter B A 0 0 0	Parameters necessary for test operations by JOG and auto-tuning. Can be set at general parameter mode.																										
General parameter G P 0 0 0	Settings can be made suitable for machines and equipment. Parameters for adjusting servo gain can be changed. Classified into 12 groups according to the functions. <table border="1"> <thead> <tr> <th>Group</th><th>Description of Group</th></tr> </thead> <tbody> <tr> <td>Group0</td><td>Settings of automatic tuning.</td></tr> <tr> <td>Group1</td><td>Settings of basic control parameters.</td></tr> <tr> <td>Group2</td><td>Settings of damping control/notch filter/disturbance observer.</td></tr> <tr> <td>Group3</td><td>Settings of model following control.</td></tr> <tr> <td>Group4</td><td>Settings of gain switching control/damping frequency switching.</td></tr> <tr> <td>Group5</td><td>To set high setting control.</td></tr> <tr> <td>Group8</td><td>Settings of control system.</td></tr> <tr> <td>Group9</td><td>Settings of various functional effective conditions.</td></tr> <tr> <td>GroupA</td><td>Setting of general output terminal output condition / monitor output selection</td></tr> <tr> <td>GroupB</td><td>Setting related to sequence / alarm.</td></tr> <tr> <td>GroupC</td><td>Settings related to encoder.</td></tr> <tr> <td>GroupD</td><td>Settings related to supporting function.</td></tr> </tbody> </table>	Group	Description of Group	Group0	Settings of automatic tuning.	Group1	Settings of basic control parameters.	Group2	Settings of damping control/notch filter/disturbance observer.	Group3	Settings of model following control.	Group4	Settings of gain switching control/damping frequency switching.	Group5	To set high setting control.	Group8	Settings of control system.	Group9	Settings of various functional effective conditions.	GroupA	Setting of general output terminal output condition / monitor output selection	GroupB	Setting related to sequence / alarm.	GroupC	Settings related to encoder.	GroupD	Settings related to supporting function.
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GroupC	Settings related to encoder.																										
GroupD	Settings related to supporting function.																										
Automatic adjustment A 0 0 0 0	Enables Adjustment for Force Command Notch Filter A, Vibration Suppression frequency 1 and Offset of Analog Velocity/ Force / Force Addition Command.																										
Test operation A A 0 0 0	JOG operation, encoder clear, auto tuning result writing and motor origin search are available.																										
System parameter S Y 0 0 0	Sets the parameters related to linear amplifier - motor encoder.																										
Alarm history A 0 H 0 0	Displays the latest 15 alarm events.																										
Monitor 0 0 0 0 0	Displays the servo amplifier status such as Velocity, Velocity Command, Force, Force command, Position Deviation and Servo Adjustment Gain when using auto-tuning.																										
Motor code set 0 0 S E 0	Sets the motor cord corresponding to linear motor, and changes the servo motor to be used.																										

7. Digital Operator

7.3 Setting and display range

Digital operator displays data becomes the following form.

■ Data of 0 to +65535

Symbol	Digital operator display	Range of a digit display	
Plus		Position of 1 display	0 to 9
Plus		Position of 10 display	10 to 99
Plus		Position of 100 display	100 to 999
Plus		Position of 1000 display	1000 to 9999
Plus		Position of 10000 display	10000 to 99999

■ Data of -9999 to +9999

Symbol	Digital operator display	Range of a digit display	
Plus		Position of 1 display	0 to 9
Plus		Position of 10 display	10 to 99
Plus		Position of 100 display	100 to 999
Plus		Position of 1000 display	1000 to 9999
Minus		Position of 10000 display	1000 to 9999

✓ Left end – expresses minus.

■ Data of 0 to +4199999999

Symbol	Digital operator display	Range of a digit display	
Plus		Low position of 1 to 1000 display	0 to 9999
Plus		Middle position of 10000 to 10000000 display	0 to 9999
Plus		High position of 100000000 to 1000000000 display	0 to 41

✓ Left end LED expresses low position, middle position, and high position.
Press and hold MODE for 1 sec or more to switch.

7.3 Setting and display range

■ Hexadecimal data

Data size	Digital operator display	Range of a digit display
1 byte		00 to FF
2 byte		0000 to FFFF
4 byte Low		0000 to FFFF (Bit15 to Bit0) display
4 byte High		0000 to FFFF (Bit31 to Bit16) display

■ Example display of decimal point data

First position of a decimal point	
Second position of a decimal point	

■ The data of servo amplifier operating time

Digits of the data	Digital operator display	Range of a digit display
Digits of milisec unit		0 to 999
Digits of sec unit		0 to 59
Digits of minute unit		0 to 59
Lower 4 digits of hour unit		0 to 9999
Upper 4 digits of hour unit		0 to 9999

✓ Left end LED expresses digits of the data. Press and hold MODE for 1 sec or more to switch.

7. Digital Operator

- Regenerative power monitor display (Monitor ID: 4C)
Display range of regenerative power is automatically changed depending on the value, to indicate optimum range.

Regenerative power range				Example display	Unit
0.000 W	≤	Regenerative power	≤	99.999 W	W
100.000 W	≤	Regenerative power	<	999.995 W	W
999.995 W	≤	Regenerative power	<	9,999.950 W	W
9,999.950 W	≤	Regenerative power			W

7.4 Status display mode

7.4 Status display mode

In this mode, the state of servo amplifier and the display of the alarm number when alarm occurring can be checked. In addition to these, reset of alarm, the software version check of servo amplifier, and setup of a password can be performed at the time of an alarm number display.

7.4.1 Status display mode

Marking	Description	Status code
	Control power supply established. Control power supply (r, t) is established and amplifier (RDY) is ON.	1
	Main circuit power supply established. Main power supply (R, S, and T) is established, but operation preparation completion signal is OFF.	2
	Safe Torque Off working status. Main circuit power supply (R, S, and T) is established and either safe torque off input 1 or 2 is "OFF". " → → " are shown sequentially.	2
	Magnetic pole position estimation being prepared. Main circuit power supply (R, S, T) is established, but magnetic pole position estimation has not been completed. LED is blinking.	7
	Operation preparation completion signal established. Main power supply (R, S, T) is established and operation preparation completion signal is ON.	3
	Servo is ON. Rotates after displaying the character "8".	4
	Magnetic pole position estimation being performed. Display lights by tracing out a shape of square in the upper of 7-segment LED.	7
	Magnetic pole position estimation completed. Display lights by tracing out a shape of square in the lower of 7-segment LED.	7

7.4.2 Over-travel status display

Marking	Description
	Over-travel status at forward motion. Forward motion is in 'Over-Travel' status in position and speed control type.
	Over-travel status at reverse motion. Reverse motion is in 'Over-Travel' status in position and speed control type.

7. Digital Operator

7.4.3 Status display of warning

Marking	Description
	Encoder system warning status Occurred warning below ■ Battery voltage sag
	Load system warning status Occurred one of warnings below ■ Regeneration overload ■ Overload ■ Servo amplifier internal temperature
	Power system warning status Occurred warning below ■ Battery voltage sag
	Control system warning status Occurred one of warnings below ■ Restricting force command ■ Restricting velocity command ■ Excessive position deviation ■ Dual position error excess ■ Sync error excess ■ Adaptive notch filter E frequency

- ✓ Descriptions of each warning are shown at "8.2.1 Warning List".
- ✓ Confirm occurring warning by the digital operator referring "7.15 Monitor display" or by warning information of the setup software. For operation of the setup software, see another document: M0010842.

7.4 Status display mode

7.4.4 Alarm code and servo amplifier status code when alarm occurs

Marking	Description
	Please take a measure according to the contents of "Maintenance" when alarm occurs.

7.4.5 Alarm reset when alarm activated

Alarm can be reset from the digital operator. However, the alarm that needs to perform power supply reset cannot be reset from the digital operator. About the alarm that performs power supply reset, can check by [8.2 Warning and Alarm List]

Step	Displayed Character, number, code	Input button				How to operate
1						Make the state where the alarm number is displayed.
2		● MODE	● ▲	● ▼	● WR/▶	Push MODE for more than 1 second.
3						Display changes as the left.
4		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
5						Display changes as the left for 2 seconds.
6						When the cause of alarm is removed, the state of servo amplifier is displayed.

7.4.6 How to check the software version of servo amplifier

The software version of servo amplifier can be checked from the digital operator.

Step	Displayed Character, number, code	Input button				How to operate
1						Make the state of servo amplifier, or the state where alarm is displayed.
2		● MODE	● ▲	● ▼	● WR/▶	Push the subtraction button for more than 1 second.
3						Display changes as the left.
4		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
5						The present software version is displayed.
6		● MODE	● ▲	● ▼	● WR/▶	Push MODE once.
7						Display changes as the left.
8		● MODE	● ▲	● ▼	● WR/▶	Push MODE once.
9						Returns to Process 1.

7. Digital Operator

7.4.7 How to check the servo amplifier information 1 to 3

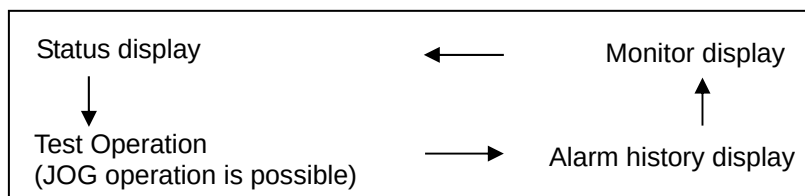
Step	Displayed Character, number code	Input button				How to operate
1						Make the state of servo amplifier, or the state where alarm is displayed.
2						Push the subtraction button for more than 1 second.
3						Display changes as the left.
4						Push addition and subtraction button.
5						Display changes as the left.
6						Push WR for more than 1 second.
7						The selected information is displayed.
8						Push MODE once.
9						Returns to Process 5.
10						Push MODE once.
11						Returns to Process 1.

✓ The contents of display information 1, information 2, and information 3 are described to “5.1.1 Specification check”.

7.4 Status display mode

7.4.8 How to set pass ward

The function that can be used by setting up a password from digital operator can be restricted, and change of a parameter etc. can be forbidden. The function and the setting method can be used is the following.



Step	Displayed character, number, code	Input button				How to operate
1						Make the state of servo amplifier, or the state where alarm is displayed.
2		MODE			WR/▶	Push addition button for more than 1 second.
3						Display switches as the left and the whole display blinks. When setup of the password has ended, display does not blink.
4		MODE			WR/▶	Push WR for more than 1 second.
5						Display changes as the left and right end LED blinks.
6		MODE			WR/▶	Display arbitrary numerical values with addition and subtraction and the cursor button. 0000 and FFFF cannot be set up.
7		MODE			WR/▶	Push WR for more than 1 second.
8						Display blinks 3 times, and setup will be completed if blink stops.
9		MODE			WR/▶	Push MODE once.
10						Returns to process 1.
11						Password will become effective if power supply is turned on again.

7. Digital Operator

7.4.9 How to cancel password

Step	Displayed character, number, code	Input button				How to operate
3						Display switches as the left and the whole display lights up. Password is not set up when the display is blinking.
4						Push WR for more than 1 second.
5						Display switches as the left and right end LED blinks.
6						Set up password is displayed with addition and subtraction and the cursor button.
7						Push WR for more than 1 second.
8						Display blinks 3 times, and cancel will be completed if blink stops.
9						Push MODE once. Then returns to Process 1.
10						After cancel does not need to turn on power supply again.

7.6 How to tune automatic notch frequency

7.5 Editing parameters

The parameter inside servo amplifier can be changed into a setup put together with equipment and the machine of usage in fundamental parameter edit mode, general parameter edit mode, and system-parameter edit mode.

Here, the setting method is explained to an example for fundamental parameter edit mode.

7.5.1 Basic parameters, editing system parameters

Step	Displayed character, number, code	Input button				How to operate
1		● MODE	● ▲	● ▼	● WR/▶	Push MODE until it displays the left.
2						Display changes as left, and right end LED blinks.
3		● MODE	● ▲	● ▼	● WR/▶	Display ID of the parameter changed with addition and subtraction and the cursor button.
4		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
5						The data set up is displayed.
6		● MODE	● ▲	● ▼	● WR/▶	Display a value to set up with addition and subtraction and the cursor button.
7		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
8						Setup is completion when blink stops, after a display blinks 3 times. When the set-up value is outside a setting range, setting of Process 5 is display without a display blinking 3 times.
9		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
10						Display switches ad the left. When you set other parameters continuously, repeat from Process 3.
11		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
12						Changes to the left display.

5		When reservation parameter cannot be set, the left is displayed in Process 5.			

- ✓ When operating in system parameter editing mode, the displayed character in step 1 shall be "SY."

7. Digital Operator

7.5.2 Editing general parameters

For example, method of changing Group9 ID01 “Negative Over Travel Function [R-OT]” from “0B” to “00” is as follows. Also, see next example for GroupC ID04 “Encoder Output Pulse Division [ENRAT]”.

Step	Displayed character, number, code	Input button				How to operate
1		MODE	▲	▼	WR/▶	Hold down MODE until the figure left is displayed.
2						Display changes as left, and right end LED blinks.
3		MODE	▲	▼	WR/▶	Display ID of parameter to be changed by addition/ subtraction, cursor button.
4		MODE	▲	▼	WR/▶	Hold down WR for over a second.
5						“0b” is displayed.
6		MODE	▲	▼	WR/▶	Set figure “00” by addition/ subtraction, cursor button.
7		MODE	▲	▼	WR/▶	Hold down WR for over a second.
8		MODE	▲	▼	WR/▶	Press MODE.
9						Display to be switched to the display left.

Editing general parameter GroupC ID04 “Encoder Output Pulse Division [ENRAT]”
For example, method to change from 1/1 to 2/64 is as follows.

Step	Displayed character, number, code	Input button				How to operate
1		MODE	▲	▼	WR/▶	Hold down MODE until the figure left is displayed.
2						Display changes as left, and right end LED blinks.
3		MODE	▲	▼	WR/▶	Display ID of parameter to be changed by addition/ subtraction, cursor button.
4		MODE	▲	▼	WR/▶	Hold down WR for over a second.
5						“Gr nu” is displayed.
6		MODE	▲	▼	WR/▶	Hold down MODE for over a second to change the display to Gr dE. “nu” stands for numerator, “dE” stands for denominator. Hold down MODE for over a second to switch between “nu” and “dE.” Set “Gr dE (denominator)” first.
7		MODE	▲	▼	WR/▶	Hold down WR for over a second.
8						Display to be switched, and then rightmost LED flashes. When setting dE first, holding down WR displays the denominator. The display left shows “1” as dE is set first. When you set nu first, holding down WR displays numerator.
9		MODE	▲	▼	WR/▶	Set figure “64” (denominator) by addition/ subtraction, cursor button.
10		MODE	▲	▼	WR/▶	Hold down WR for over a second.

7.5 Editing parameters

Step	Displayed character, number, code	Input button				How to operate
11						When display flashes 3 times, and then the flashing stops, the setting of denominator is completed. If the set value is out of the setting range, the set value in the step 6 is displayed without flashing 3 times. When the numerator is "1," "1 to 64" or "32768" is settable as the denominator.
12		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
13						"GrC.04" is displayed.
14		● MODE	● ▲	● ▼	● WR/▶	Hold down WR for over a second.
15		● MODE	● ▲	● ▼	● WR/▶	"Gr nu" is displayed.
16		● MODE	● ▲	● ▼	● WR/▶	Hold down WR for over a second.
17						Display to be switched, and then rightmost LED flashes. The set data are displayed. The display left shows "1" as nu is set first.
18		● MODE	● ▲	● ▼	● WR/▶	Display the figure "2 (numerator)" you want to set by addition/ subtraction, cursor button.
19		● MODE	● ▲	● ▼	● WR/▶	Hold down WR for over a second.
20						When display flashes 3 times, and then the flashing stops, the setting is completed. If the set value is out of the setting range, the set value in the step 13 is displayed without flashing 3 times.
21		● MODE	● ▲	● ▼	● WR/▶	Press MODE.
22						Display to be switched to the display left.

- ✓ There are three setting ranges of pulse frequency dividing, "1/1 to 1/64," "2/3 to 2/64," and "1/32768 to 32767/32768."

If you set the figure out of the ranges, the figure is not displayed, the figure before the setting flashes.

When setting numerator, the figure of denominator is applicable to the figure presently established.

For example, to change from 1/1 to 2/64, you need to set the denominator first, as the numerator is already fixed to "1," and "2/1" is out of the ranges.

- ✓ "nu" stands for numerator, "dE" stands for denominator.

7. Digital Operator

7.6 How to tune automatic notch frequency

Step	Displayed character, number, code	Input button				How to operate
1		● MODE	● ▲	● ▼	● WR/▶	Push MODE until it displays the left.
2						Display changes and right end LED blinks.
3		● MODE	● ▲	● ▼	● WR/▶	Make as the left display with addition and subtraction and the cursor button.
4		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
5						Changes to the left display.
6		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
7						The character of 8 is drawn and servo is on.
8		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
9						A display change as the left and it performs.
10						Changes to the display of the left after a normal end.
11		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
12						Servo is off and changes to the left display.
13		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
14						Completes and changes to the left display.

■ For stopping during operation, please push the MODE button.

MODE is pushed in Process 2.

Changes to the left display.

MODE is pushed in Process 5.

Changes to the left display and return to Process 2.

MODE is pushed in Process 7.

Changes to the left display and return to Process 5.

Mode is pushed again.

Complete and changes to the left display.

MODE is pushed in Process 9.

Complete and changes to the left display.

■ Error is displayed when cannot end normally.

Changes to the left display.

Will end, if MODE is pushed.

Complete to the left display.

7.8 Offset adjustment of velocity/ force command

7.7 Auto FF vibration suppression frequency tuning

Step	Displayed character, number, code	Input button				How to operate
1		MODE	▲	▼	WR/▶	Push MODE until it displays the left.
2						Display changes and right end LED blinks.
3		MODE	▲	▼	WR/▶	Make as the left display with addition and subtraction and the cursor button.
4		MODE	▲	▼	WR/▶	Push WR for more than 1 second.
5						Changes to the left display.
6		MODE	▲	▼	WR/▶	Push WR for more than 1 second.
7						The character of 8 is drawn and servo is on.
8		MODE	▲	▼	WR/▶	Push WR for more than 1 second.
9						A display change as the left and it performs.
10						Changes to the display of the left after a normal end.
11		MODE	▲	▼	WR/▶	Push MODE.
12						Servo is off and changes to the left display.
13		MODE	▲	▼	WR/▶	Push MODE.
14						Completes and changes to the left display.

- For stopping during operation, please push the MODE button.

MODE is pushed in Process 2.

Changes to the left display.

MODE is pushed in Process 5.

Changes to the left display and return to Process 2.

MODE is pushed in Process 7.

Changes to the left display and return to Process 5.

MODE is pushed again.

Complete and changes to the left display.

MODE is pushed in Process 9.

Complete and changes to the left display.

- Error is displayed when cannot end normally.

Changes to the left display.

Will end, if MODE is pushed.

Completes and changes to the left display.

7. Digital Operator

7.8 Offset adjustment of velocity/ force command

■ Method of auto offset

Step	Displayed character, number, code	Input button				How to operate
1		● MODE	● ▲	● ▼	● WR/▶	Push MODE until it displays the left.
2						Display changes and right end LED blinks.
3		● MODE	● ▲	● ▼	● WR/▶	Make as the left display with addition and subtraction and the cursor button.
4		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
5						Changes to the left display.
6		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
7						Changes to the left display.
8		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
9						A display change as the left and it performs.
10						Changes to the display of the left after a normal end.
						Error is displayed when cannot end normally.
11		● MODE	● ▲	● ▼	● WR/▶	Push MODE and finish.
12						Changes to the left display.
13		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
14						Changes to the left display.

■ The method of manual offset

From Process 1 to 7 are the same as auto offset.						
7						Changes to the left display.
8		● MODE	● ▲	● ▼	● WR/▶	Push subtraction button.
9						Changes to the left display.
10		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
11						The data setup is displayed.
12		● MODE	● ▲	● ▼	● WR/▶	Adjust offset value with the addition-and-subtraction button.
13		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
14						Changes to the left display.
15		● MODE	● ▲	● ▼	● WR/▶	Push MODE and finish.
16						Changes to the left display.
17		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
18						Changes to the left display.

7.10 Magnetic pole position estimation

7.9 Offset adjustment of analog force compensation command

■ Method of auto offset

Step	Displayed character, number, code	Input button				How to operate
1		● MODE	● ▲	● ▼	● WR/▶	Push MODE until it displays the left.
2						Display changes and right end LED blinks.
3		● MODE	● ▲	● ▼	● WR/▶	Make as the left display with addition and subtraction and the cursor button.
4		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
5						Changes to the left display.
6		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
7						Changes to the left display.
8		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
9						A display change as the left and it performs.
10						Changes to the display of the left after a normal end.
						Error is displayed when cannot end normally.
11		● MODE	● ▲	● ▼	● WR/▶	Push MODE and finish.
12						Changes to the left display.
13		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
14						Changes to the left display.

■ The method of manual offset

From Process 1 to 7 are same as auto offset.

7						Changes to the left display.
8		● MODE	● ▲	● ▼	● WR/▶	Push subtraction button.
9						Changes to the left display.
10		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
11						The data set up is displayed.
12		● MODE	● ▲	● ▼	● WR/▶	Adjust offset value with an addition-and-subtraction button.
13		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
14						Changes to the left display.
15		● MODE	● ▲	● ▼	● WR/▶	Push MODE and finish.
16						Changes to the left display.
17		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
18						Changes to the left display.

7. Digital Operator

7.10 Magnetic pole position estimation

Step	Displayed character, number, code	Input button				How to operate
1	A 0 0 0 0	MODE	▲	▼	WR/▶	Push MODE until it displays the left.
2	A 0 0 0 0					Display changes and right end LED blinks.
3	A 0 0 0 4	MODE	▲	▼	WR/▶	Make as the left display with addition and subtraction and the cursor button.
4		MODE	▲	▼	WR/▶	Push WR for more than 1 second.
5	0 0 5 0 0					Changes to the left display.
6		MODE	▲	▼	WR/▶	Push WR for more than 1 second.
7	0 0 0 0 0					A display changes as the left and indicates performing of the magnetic pole position estimation (about 2sec).
8	0 0 0 0 0					Indicates the magnetic pole position estimation completion processing (about 0.5sec).
9	0 0 0 0 0					A display changes as the left when completed normally.

- ✓ Magnetic pole position estimation is not able to perform in cases as below.
 - "01h" is not set to the system parameter ID18 "CS decision method selection".
Control power cycle is required if this parameter is changed.
 - Main circuit power is off, alarm occurring, or the safe torque off function is working.
 - Servo amplifier is not set to linear motor operation.
- ✓ Pay attention at step 9, for slight move of linear motor by excitation.
- Alarm will detect when the function can not complete normally.

A 0 4 4 0	Magnetic pole position estimation is completed, and a display changes as the left. (Magnetic pole position detection error)

- ✓ Main cause that the function cannot complete normally is below.
 - Linear motor was moved or fixed, by something external force (gravity, friction, spring etc).
 - Enough stroke for estimation is not there. (Longer than magnetic pole pitch.)
 - Motor parameter setting is wrong.
 - Resolution/polarity setting of linear motor is wrong.
- ✓ Precautions for the magnetic pole position estimation
 - 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 sec will be required for the detection.
 - Please stop the magnetic pole position estimation immediately if problem occurred on the motion, by shutting down main circuit power etc.
 - Magnetic pole position is not able to detect correct if GroupD ID01 "Excitation command frequency set value [EMPFREQ]" is near to a resonance frequency of mechanical system. In this case, change the excitation command frequency set value (default 50Hz).
 - This function is not able to use to the machine which is gravity (vertical) axis or getting a large external force.

7.10 Magnetic pole position estimation

7.11 Velocity-controlled JOG Operation

Step	Displayed character, number, code	Input button				How to operate
1		● MODE	● ▲	● ▼	● WR/▶	Push MODE until it displays the left.
2						Display changes and right end LED blinks.
3		● MODE	● ▲	● ▼	● WR/▶	Make as the left display with addition and subtraction and the cursor button.
4		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
5						Changes to the left display.
6		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
7						The character of 8 is drawn and servo is on.
8		● MODE	● ▲	● ▼	● WR/▶	If it continues pushing an addition button, a linear motor will move in the forward direction. Will stop when an addition button is detached.
9		● MODE	● ▲	● ▼	● WR/▶	If it continues pushing an addition button, a linear motor will move in the reverse direction. Will stop when a subtraction button is detached.
10		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
11						Servo is off and it changes to the left display.
12		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
13						Completes and changes to the left display.

- For stopping during operation, please push the MODE button.

MODE is pushed in Process 2.	
	Changes to the left display and shifts to system parameter.
MODE is pushed in Process 5.	
	Changes to the left display and returns to step 2.
MODE is pushed in Process 7.	
	Changes to the left display and returns to step 5.
Mode is pushed again.	
	Completes and changes to the left display.

- Display below is state of over travel.

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

- ✓ Over-travel functions are set at general parameter Group9 ID00 "Positive Over Travel Function [F-OT]", ID01 "Negative Over Travel Function [R-OT]".
See detail in "5.8 Parameter functions", Group9 "Function enabling condition settings".

7. Digital Operator

7.12 Automatic tuning result writing

Step	Displayed character, number, code	Input button				How to operate
1		● MODE	● ▲	● ▼	● WR/▶	Push MODE until it displays the left.
2						Display changes and right end LED blinks.
3		● MODE	● ▲	● ▼	● WR/▶	Make as the left display with addition and subtraction and the cursor button.
4		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
5						Changes to the left display.
8		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
9						A display change as the left and it performs.
10						Changes to the display of the left after a normal end.
11		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
12						Changes to the left display.
13		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
14						Changes to the left display.

7.14 Alarm history display

7.13 Alarm history display

Step	Displayed character, number, code	Input button				How to operate
1		● MODE	● ▲	● ▼	● WR/▶	Push MODE until it displays the left.
2						Display changes and right end LED blinks.
3		● MODE	● ▲	● ▼	● WR/▶	Display the number of an alarm history to check with an addition-and-subtraction button. The history of 15 times past before can be displayed.
4		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
5						The alarm of 3 times ago is displayed.
6		● MODE	● ▲	● ▼	● WR/▶	Push WR for more than 1 second.
7						The passed time of alarm generating is displayed. Digits of millisecond unit.
8		● MODE	● ▲	● ▼	● WR/▶	Press and hold MODE for more than 1 second.
9						The passed time of alarm generating is displayed. Digits of sec unit.
10		● MODE	● ▲	● ▼	● WR/▶	Press and hold MODE for more than 1 second.
11						The passed time of alarm generating is displayed. Digits of minute unit
12		● MODE	● ▲	● ▼	● WR/▶	Press and hold MODE for more than 1 second.
13						The passed time of alarm generating is displayed. Lower 4 digits of hour unit
14		● MODE	● ▲	● ▼	● WR/▶	Press and hold MODE for more than 1 second.
15						The passed time of alarm generating is displayed. Upper 4 digits of hour unit
16		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
17						Returns to Process 5.
18		● MODE	● ▲	● ▼	● WR/▶	Push MODE.
19						Returns to Process 3.
20						Changes to the left display.

7. Digital Operator

7.14 How to clear alarm history

Step	Displayed character, number, code	Input button				How to operate
1						Push MODE until it displays the left.
2						Display changes and right end LED blinks.
3						Display the left with the addition-and-subtraction button.
4						Push WR for more than 1 second.
5						Changes to the left display and it blinks.
7						Push WR for more than 1 second.
8						A display change as the left and it performs.
9						Changes to the display of the left after a normal end.
10						Push MODE.
11						Changes to the left display.

7.15 Monitor display

Step	Displayed character, number, code	Input button				How to operate
1						Push MODE until it displays the left.
2						Display changes and right end LED blinks.
3						Display ID of the monitor with addition and subtraction and the cursor button.
4						Push WR for more than 1 second.
5						The data is displayed.
6						Push MODE.
7						Changes to the left display. When you monitor other data continuously, repeat from Process 3.
8						Push MODE.
9						Changes to the left display.

Note)		When it is a monitor that cannot be displayed, the left is displayed in Process 5.

✓ See "5.5.1 Monitor list" for ID of monitor items.

7.17 Fixed monitor display

7.16 Fixed monitor display

The display shows monitoring value in 3 seconds after powering up.

It shows monitoring value set at Group D ID11 "Monitor Display Selection [MONDISP]" in status display mode.

"Monitor" to be displayed is the same as parameter ID in monitor display mode, but in the setting value "00 STATUS servo amplifier status monitor", the display will be different from the code display in the monitor mode and will show the amplifier status in the status display mode (- or $\exists$).

In the state of alarm occurring, requiring safety function input, requiring motor magnetic pole detection or detecting the poles, the monitor display prioritize these status over the fixed display.

7.17 Motor code-setting of linear motor used

Step	Displayed character, number, code	Input button				How to operate
1						Push MODE until it displays the left.
2						Display changes and right end LED blinks.
3						Push WR for more than 1 second.
4						Display the motor cord of the linear motor used with addition and subtraction and the cursor button.
5						Push WR for more than 1 second.
6						A display changes as the left and it performs.
7						Changes to the display of the left after a normal end.
8						Turn on the power supply again.

Note)		The linear motor that cannot be combined or used displays the left in Process 5. In this display, please set up by "Setup Software".

- ✓ Check the Applicable motor list at "5.1.3 Linear motor setting" about applicable linear motor and motor code.

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Maintenance

In this chapter, trouble shooting, inspection and service parts are explained.

8.1 Trouble shooting.....	8-1
8.2 List of warning and alarm	8-4
8.2.1 Warning List.....	8-4
8.2.2 Alarm list.....	8-5
8.3 Trouble shooting when alarm activated	8-8
8.3.1 Alarm display	8-8
8.3.2 Corrective action for alarm	8-8
8.3.3 Correspondence table for EnDat Error message and alarm code	8-32
8.4 Inspection.....	8-33
8.5 Service parts	8-34
8.5.1 The parts requiring Inspection	8-34

8. Maintenance

8.1 Trouble shooting

When troubles occurred without any alarm displayed, check and take corrective actions for them by referring to the description below. When alarm occurs, take corrective measures referring to “8.3 Trouble shooting when alarm is activated”.

- “≡” does not blink in 7-segment LED even if main power is ON.

Investigation	Assumed causes and corrective actions
Check the voltage at the power input terminal.	■ If voltage is low, check the power supply. ■ Check that wires and screws are fastened properly.
Red “CHARGE” LED goes out.	■ Internal power circuit of servo amplifier is defective, so replace the servo amplifier.
Over-travel status. Emergency Stop status.	■ Stop the input of Over-travel or the input of Emergency Stop. ■ Check of “Functions enabling condition settings”.
Safe Torque Off working status	■ Turn on /HWGOFF1 and /HWGOFF2 inputs.

- The linear motor does not move although 7-segment LED is drawing a character “8”.

Investigation	Assumed causes and corrective actions
Check an inputting command by using digital operator monitor. Page16: Velocity command monitor Page18: Force command monitor Page30: Position command pulse frequency monitor	■ Inputting a command if the monitor value is zero.
Check the servo motor is locked or not.	■ Check that the power line of a linear motor is connected.
Check if force limit is input.	■ When force restriction is inputted, a linear motor cannot output the force beyond the load force. ■ Check of "Functions enabling condition settings "
Check the deviation clear input status.	■ Stop the input of deviation clear if the signal is in. ■ Check of "Functions enabling condition settings "

- * When performing the work for correction and investigation processing about wiring, be sure to intercept power supply.

8.1 Trouble shooting

- Linear motor operation is unstable or lower speed than the specified velocity command.

Investigation	Assumed causes and corrective actions
Check the status of proportional control input signal.	■ Stop the input of proportional control if the signal is in. ■ Check of “Functions enabling condition settings “
Check the status of force limit input signal.	■ Stop the input of force limit if the signal is in. ■ Check of “Functions enabling condition settings “

- Linear motor moves only moment, and stops.

Investigation	Assumed causes and corrective actions
Check the linear motor power line.	■ Some of the linear motor power line is not connected.
Check a setup of combination motor. Check a setup of encoder resolution. (in System parameter)	■ Change the settings and turn ON the power again.

- * When performing the work for correction and investigation processing about wiring, be sure to intercept power supply.

- Linear motor runs away.

Investigation	Assumed causes and corrective actions
Check the linear motor power line.	■ Phase order of linear motor power line is wrong.
Check the wiring of encoder cable.	■ Wiring of the encoder is incorrect.

- * When performing the work for correction and investigation processing about wiring, be sure to intercept power supply.

- Linear motor is vibrating.

Investigation	Assumed causes and corrective actions
Check that linear motor is vibrating over 200Hz.	■ Reduce the loop gain speed, or set the force command low-pass filter / force command notch filter.

- Occurs over shoot/ under shoot when starting / stopping.

Assumed causes and corrective actions
■ Adjust the auto tuning “response “. ■ Reduce the velocity loop gain. ■ Increase the velocity integral time constant. ■ Loose the slope of acceleration / deceleration command. ■ Use position command low-pass filter

8. Maintenance

■ Abnormal sound occurs

Investigation	Assumed causes and corrective actions
Check whether there is any problem in mechanical attachment.	■ Observe by operating linear motor by stand alone. ■ Check if loose screw/backlash is there.
Operate at a low speed and check whether abnormal sound has periodicity.	■ Confirm that the twisted pair and shield processing of linear encoder signal line are correct. ■ Confirm that the wiring for linear encoder line and linear motor power line are not installed in the same duct. ■ Confirm that the power supply voltage is sufficient.

8.2 List of warning and alarm

8.2 List of warning and alarm

Names, contents and stopping operation of warning/ alarm, and alarm-reset methods are listed below.

8.2.1 Warning List

	Name	Contents
Load system	Overload Warning	■ When the effective force exceeds the Overload Warning Level
	Regeneration Overload Warning	■ In case of overload of regenerative resistance
	Amplifier Temperature Warning	■ Ambient temperature of the amplifier is out of range of the operation temperature
Power supply system	Control power voltage sag warning	■ Voltage of control power is below AC152V (AC200V input type), or AC76V (AC100V input type).
External input system	Forward over travel	■ While entering forward over travel
	Reverse over travel	■ While entering reverse over travel
Control system	Restricting force command	■ While restricting the force command by force restriction value
	Restricting velocity command	■ While restricting the velocity command by velocity restriction value
	Excessive position deviation	■ While position deviation exceeds warning setting value.
	Dual position error excess	■ The difference between servo motor position and load position is exceeding the warning set value.
	Adaptive notch filter E frequency warning	■ Estimated frequency of the adaptive notch filter E is out of setting range.
	Axes-sync error excess	■ While position deviation error between own axis and counterpart axis exceeds warning setting value.
Encoder system	Absolute encoder warning	■ Warning of EnDat encoder is occurring.

8. Maintenance

8.2.2 Alarm list

Operation at detecting: “DB” performs the slowdown stop of the linear motor by dynamic brake operation at the alarm generating.

Operation at detecting: “SB” performs the slowdown stop of the linear motor with sequence current limiting value.

When dynamic brake is selected by Emergency Stop Operation selection, the linear motor is decelerating stopped for the dynamic brake operation regardless of the operation when detecting it. (However, it stops in free servo brake operation at the time of alarm 53H (DB resistor overheating) detection.)

	Alarm code								Alarm name	Alarm contents	Detection Operations	Alarm reset
	Display	3bits output			PY compatible code							
		Bit7	Bit6	Bit5	ALM8	ALM4	ALM2	ALM1				
Abnormality related to drive	21	0	0	1	0	0	0	1	Main Circuit Power Device Error (Over current)	■ Over current of drive module ■ Abnormality in drive power supply ■ Overheating of drive module	DB	Yes
	22				0	0	0	1	Current Detection Error 0	■ Abnormality of electric current detection value	DB	Yes
	23				0	0	0	1	Current Detection Error 1	■ Abnormality of Electric current detection circuit	DB	Yes
	24				0	0	0	1	Current Detection Error 2	■ Abnormality in communication with Electric current detection circuit	DB	Yes
	25				1	1	1	0	Safe Torque Off Error 1	■ Logic unmatched in safe torque off input	DB	No
	26				1	1	1	0	Safe Torque Off Error 2	■ Failure of safe torque off circuit	DB	No
	27				0	0	0	1	Fan stop	■ Speed reduction of fan	DB	No
Abnormality related to load	41	0	1	0	0	0	1	0	Overload 1	■ Excessive effective torque	SB	Yes
	42				0	0	1	0	Overload 2	■ Stall over load	DB	Yes
	43				0	1	0	1	Regenerative Overload	■ Regeneration load ratio exorbitance	DB	Yes
	44				1	0	0	0	Magnetic pole position estimation error	■ Magnetic pole position estimation operation is failed	DB	Yes
	45				0	0	1	0	Average continuous over speed	■ Over speed in average speed	SB	Yes
	52				0	0	1	1	RS Overheat	■ Detection of in-rush prevention resistance overheating	SB	Yes
	53				0	0	1	1	Dynamic Brake Resistance Overheat	■ Overheating detection of dynamic brake resistor	SB	Yes
	54				0	1	0	1	Internal Regenerative Resister Overheat	■ Overheating detection of Internal regenerative resistor	DB	Yes
	55				0	0	1	1	External Error	■ Overheating detection of External regenerative resistor	DB	Yes
	56				0	0	1	1	Main Circuit Power Device Overheat	■ Overheating detection of Drive module	DB	Yes
Abnormality in power supply	61	0	1	1	0	1	0	1	Over-voltage	■ DC Excess voltage of main circuit	DB	Yes
	62				1	0	0	1	Main Circuit Under-voltage Note1)	■ DC Main circuit low voltage	DB	Yes
	63				1	0	1	0	Main Power Supply Fail Phase Note1)	■ 1 phase of the 3 phase main circuit power supply disconnected	SB	Yes
	68				0	1	0	1	Main circuit voltage detection error	■ Failure of VBUS detection circuit	DB	No
	71				0	1	1	1	Control Power Supply Under-voltage Note2)	■ Control power supply low voltage	DB	Yes Note 3)
	72				0	1	1	1	Control Circuit Under-voltage 1	■ Under voltage of ±12V	SB	Yes
	73				0	1	1	1	Control Circuit Under-voltage 2	■ Under voltage of +5V	DB	No

8.2 List of warning and alarm

	Alarm code								Alarm name	Alarm contents	Detection Operations	Alarm reset
	Display	3bits output			PY compatible code							
		Bit7	Bit6	Bit5	ALM8	ALM4	ALM2	ALM1				
Abnormality related to encoder wiring	81	1	0	0	1	0	0	0	Encoder Connector 1 Disconnection	■ Linear encoder (A, B, Z) signal line break ■ Power supply break	DB	No
	83				1	0	0	0	Encoder Connector 2 Disconnection	■ Hall effect sensor (S1,S2,S3) signal line break ■ Power supply break	DB	Yes
	84				1	0	0	0	Absolute Encoder Communication Error	■ Encoder serial signal time out ■ Serial communication data error	DB	No
	85				1	0	0	0	Encoder Initial Process Error	■ Failed to read CS data of incremental encoder ■ Abnormality in initial process of absolute encoder	—	No
	86				1	0	0	0	CS error	■ Position discontinuity of CS data	DB	No
	87				1	0	0	0	CS Signal Disconnection	■ CS signal line break	DB	No
	8C				1	0	0	0	Motor encoder (EnDat) combination error	■ Motor encoder (EnDat) is out of applicable range.	—	No
Abnormality in encoder main body	A0	1	0	1	1	0	0	0	Absolute Encoder Internal Error 0	■ Encoder internal error	DB	No
	A1				1	0	0	0	Absolute Encoder Internal Error 1	■ Encoder internal error	DB	No
	A3				1	0	0	0	Absolute Encoder Internal Error 3	■ Encoder internal error	DB	No
	A4				1	0	0	0	Absolute Encoder Internal Error 4	■ Encoder internal error	DB	No
	A5				1	0	0	0	Absolute Encoder Internal Error 5	■ Encoder internal error	DB	No
	A6				1	0	0	0	Absolute Encoder Internal Error 6	■ Encoder internal error	DB	No
	A7				1	0	0	0	Absolute Encoder Internal Error 7	■ Encoder internal error	DB	No
	A8				1	0	0	0	Absolute Encoder Internal Error 8	■ Encoder internal error	DB	No
	A9				1	0	0	0	Absolute Encoder Internal Error 9	■ Encoder internal error	DB	No
	AA				1	0	0	0	Absolute Encoder Internal Error 10	■ Encoder internal error	DB	No
	AB				1	0	0	0	Absolute Encoder Internal Error 11	■ Encoder internal error	DB	No
	AC				1	0	0	0	Absolute Encoder Internal Error 12	■ Encoder internal error	DB	No
	AD				1	0	0	0	Absolute Encoder Internal Error 13	■ Encoder internal error	DB	No
	AE				1	0	0	0	Absolute Encoder Internal Error 14	■ Encoder internal error	DB	No
	AF				1	0	0	0	Absolute Encoder Internal Error 15	■ Encoder internal error	DB	No

8. Maintenance

	Alarm code								Alarm name	Alarm contents	Detection Operations	Alarm reset
	Display	3bits output			PY compatible code							
		Bit7	Bit6	Bit5	ALM8	ALM4	ALM2	ALM1				
Control system abnormality	C1	1	1	0	0	1	1	0	Over-speed	■ Linear motor speed reaches 120 % of the highest speed limit.	DB	Yes
	C2				1	1	0	0	Velocity Control Error	■ Force command and acceleration direction are not matching.	DB	Yes
	C3				1	1	0	0	Velocity Feedback Error	■ Linear motor power disconnection Note 4)	DB	Yes
	C5				1	1	0	0	Model tracking vibration suppression control error	■ Operation pattern is not mach with model following vibration suppression control.	DB	Yes
	D1				1	1	0	1	Excessive Position Deviation	■ Position Deviation exceeds setup value.	DB	Yes
	D2				1	1	0	1	Faulty Position Command Pulse Frequency 1	■ Frequency of entered position command pulse is excessive	SB	Yes
	D3				1	1	0	1	Faulty Position Command Pulse Frequency 2	■ Position command frequency after electronic gear is high.	SB	Yes
	D4				1	1	0	1	Axes-sync error excess	■ Position deviation error between own axis and counterpart axis exceeds setting value.	DB	Yes
	D7				1	1	0	1	Amplifier communication error	■ Amplifier communication error during axes-sync operation	DB	No
	DF				1	1	0	1	Test Run Close	Note 5)	■ Detection in "Test mode end" status	DB
Control system/Memory system abnormality	E1				1	1	1	1	Memory Error 1	■ Abnormality of amplifier with built-in EEPROM	DB	No
	E2				1	1	1	1	Memory Error 2	■ Error in check sum of EEPROM (entire area)	—	No
	E3				1	1	1	1	CPU error 1	■ Access error in CPU built in RAM	—	No
	E4				1	1	1	1	CPU error 2	■ Checksum error of FLASH memory with built in CPU	—	No
	E5				1	1	1	1	System Parameter Error 1	■ System parameter is outside a setting range.	—	No
	E6				1	1	1	1	System Parameter Error 2	■ The combination of a system parameter is abnormal.	—	No
	E7				1	1	1	1	Motor Parameter Error	■ Setup of a motor parameter is abnormal.	—	No
	E8				1	1	1	1	Control circuit error 1	■ Access abnormality in CPU to ASIC	—	No
	E9				1	1	1	1	Control circuit error 2	■ Abnormalities of control circuit.	—	No
	EA				1	1	1	1	Memory Error 3	■ Abnormality of FLASH memory in servo amplifier.	SB	No
	EB				1	1	1	1	Control circuit error 3	■ Abnormalities of control circuit.	—	No
	F1				1	1	1	1	Task Process Error	■ Error in interruption process of CPU	DB	No
	F2				1	1	1	1	Initial Process Time-Out	■ Initial process does not end within initial process time	—	No
	F3				1	1	1	1	CPU error 3	■ Abnormality of CPU setting	—	No

Note 1) When the main power voltage increases or decreases gradually or is suspended, main circuit low voltage or main power failed phase may be detected.

Note 2) Control power supply under-voltage or servo ready OFF is detected during instantaneous break of 1.5 to 2 cycles. Detection of control power supply under-voltage and servo ready OFF can be delayed by setting larger value of Group B ID16 "Power Failure Detection Delay Time [PFDDLY]".

Note 3) When moment cutting of a control power source is long, it regards in power supply interception and re-input, and does not leave detected control power supply under-voltage to an alarm history. (If cutting exceeds 1 second at the moment, it will be certainly judged as power supply interception.)

Note 4) When there is a rapid linear motor slow down simultaneous with servo ON, there is a possibility that a break in the linear motor's power line cannot be detected.

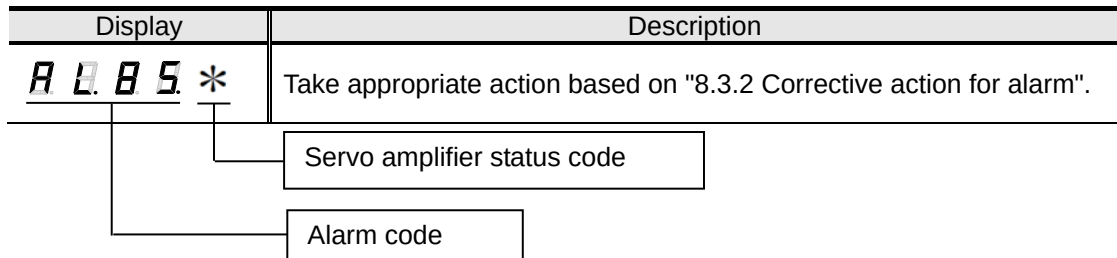
Note 5) Alarm that occurs in 'Test mode end' status is not recorded in the alarm history.

8.3 Trouble shooting when alarm activated

8.3 Trouble shooting when alarm activated

8.3.1 Alarm display

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



■ Status code

Code	Status
1	Power OFF status (P-OFF)
2	Power ON status (P-ON)
3	Servo ready status (S-RDY)
4	Servo ON status (S-ON)
5	Servo OFF status (S-OFF)
6	Emergency stop status (EMR)
7	Magnetic pole position estimation state (CSET)
F	Initial status

8.3.2 Corrective action for alarm

■ Alarm code 21 (Main Circuit Power Device Error)

Status at the time of alarm	Cause			
	1	2	3	4
Issued when control power is turned ON.	✓		✓	✓
Issued at input of servo ON.	✓	✓	✓	
Issued while starting and stopping the linear motor.	✓	✓	✓	
Issued after operation for some time.	✓	✓	✓	✓



◆ Corrective actions

	Cause	Investigation and corrective actions
1	Short circuit is there at U/V/W-phases of amplifier, or wiring between amplifier and linear motor. Otherwise, U/V/W-phases are grounded to the earth.	Check the wiring conditions and correct it if improper.
2	Short circuit or earth fault in U/V/W phases on linear motor side.	Replace the linear motor.
3	Defect in internal circuit of servo amplifier.	Replace the servo amplifier.
4	Overheating detection of the main circuit power device functioned. (50A or more of models only)	Confirm temperature in cabinet (or ambient of the amplifier), then refine installation method of the servo amplifier and ventilation of the cabinet to keep 55°C or lower of ambient temperature.

8. Maintenance

■ Alarm code 22 (Current Detection Error 0)

☆☆☆☆☆
AL22*

Status at the time of alarm	Cause	
	1	2
Issued at input of servo ON.	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Servo amplifier and linear motor are not combined properly.	■ Check that the linear motor is fit to the motor code, if not, change linear motor correctly.

■ Alarm code 23 (Current Detection Error 1)

☆☆☆☆☆
AL23*

■ Alarm code 24 (Current Detection Error 2)

☆☆☆☆☆
AL24*

Status at the time of alarm	Cause	
	1	2
Issued during operation.	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Malfunction due to noise.	■ Confirm proper grounding of the amplifier. ■ Add ferrite core or similar countermeasures to against noise.

■ Alarm code 25 (Safe Torque Off error 1)

☆☆☆☆☆
AL25*

Status at the time of alarm	Cause	
	1	2
Occurred in about 10 sec. after control power turned on.	✓	✓
Occurred during operation.	✓	

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Discrepancy of the input logic level between /HWGOFF1 and /HWGOFF2.	■ Match the input logic level of /HWGOFF1 and /HWGOFF2. ■ Check the wiring of both the HWGOFF1 and /HWGOFF2 signals, and correct the wiring if needed. ■ After switching the logic level of either /HWGOFF1 or /HWGOFF2 signal, make sure to switch the logic of the other signal also within 10 seconds.
2	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

8.3 Trouble shooting when alarm activated

■ Alarm code 26 (Safe Torque Off error 2)

Status at the time of alarm	Cause	
	1	2
Occurred when control power is turned on.	✓	✓
Occurred during the operation.		✓



◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Malfunction due to noise.	■ Check grounding of the amplifier. ■ Take care of noise by adding ferrite core etc.

■ Alarm code 27 (Fan stop)

Status at the time of alarm	Cause	
	1	2
Occurred during the operation.	✓	✓

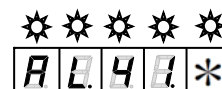


◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ The end of fan life.	■ Replace the cooling fan.

8. Maintenance

■ Alarm code 41 (Overload 1)



Status at the time of alarm	Cause								
	1	2	3	4	5	6	7	8	9
Issued at input of servo ON.	✓	✓							✓
After command input, issued without moving the linear motor.		✓			✓	✓	✓		✓
After command input, brief motor rotation			✓	✓	✓		✓	✓	

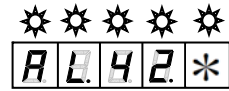
◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Defect in internal circuit of linear encoder.	■ Replace the linear motor.
3	■ Effective force exceeds the rated force.	■ Monitor the load status using the monitor function ID41 "Effective force monitor [TRMS]", and check if effective force exceeds the rated value. Or, calculate the motor effective force from load conditions and operation conditions. If the effective force is excessive, check the operation or load condition, or replace to the capacity of the large linear motor.
4	■ Defect in linear motor and servo amplifier combination.	■ Check if the linear motor in use matches with the recommended type, and replace if it is improper.
5	■ Holding brake of linear motor has not released.	■ Check that the wiring and voltage of the holding brake are correct; if not, correct it. If the above are OK, replace the linear motor.
6	■ Wiring of U/V/W -phase between servo amplifier and linear motor is wrong.	■ Check the wiring conditions and correct it if improper.
7	■ One or all connections of U/V/W -phase wiring of servo amplifier / linear motor is disconnected.	■ Check the wiring conditions and correct it if improper.
8	■ Application collided to something.	■ Check the operating conditions and limit switch.
9	■ Linear encoder resolution setting is wrong.	■ For incremental encoder Set correct value to the System parameter ID17 "Incremental encoder resolution". ■ For absolute encoder Set correct value to the System parameter ID15 "Absolute encoder resolution".

* In case of the alarm caused by conditions in #3 (above), there is a risk of burning out the linear motor if OFF and ON of control power supply is repeated. Wait for longer than 30 min for cooling purposes after power shut OFF, and resume operations.

8.3 Trouble shooting when alarm activated

- Alarm code 42 (Overload 2)



Status at the time of alarm	Cause										
	1	2	3	4	5	6	7	8	9	10	11
Issued at input of servo ON.	✓	✓							✓		
After command input, issued without moving the linear motor.		✓			✓	✓	✓		✓	✓	✓
After command input, brief motor rotation.			✓	✓	✓		✓	✓			

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Defect in internal circuit of linear encoder.	■ Replace the linear motor.
3	■ Motion is less than 50mm/s and force command exceeds approx. 2 times of rated force.	■ Check if force command exceeds approx. 2 times of the rated force by the monitor function ID18 "Torque command monitor [TCMON]". If any of the conditions (load condition when motor stops, operation condition at low velocity, and static load condition) exceed twice of rated force, review an operation or load condition. Or replace with larger sized linear motor.
4	■ Defect in linear motor and servo amplifier combination.	■ Check if the linear motor in use matches with the recommended type, and replace if it is improper.
5	■ Holding brake of linear motor has not released.	■ Check that the wiring and voltage of the holding brake are correct; if not, correct it. If the above are OK, replace the linear motor.
6	■ Wiring of U/V/W -phase between servo amplifier and linear motor is wrong.	■ Check the wiring conditions and correct it if improper.
7	■ One or all connections of U/V/W -phase wiring of servo amplifier / linear motor is disconnected.	■ Check the wiring conditions and correct it if improper.
8	■ Application collided to something.	■ Check the operating conditions and limit switch.
9	■ Linear encoder resolution setting is wrong.	■ For incremental encoder Set correct value to the System parameter ID17 "Incremental encoder resolution". ■ For absolute encoder Set correct value to the System parameter ID15 "Absolute encoder resolution".
10	■ Move directions of 2 axes are different, in the tandem operation.	■ Set "04: PC- _VC+ _TC+" to Group8 ID00 "Position, Velocity, Force Command Input Polarity". Change to "01: Reversed", in Group8 ID00 "Position, Velocity, Torque Command Input Polarity".
11	■ Wiring of linear motor and encoder is wrong, in the tandem operation.	■ Check the wiring and fix if wrong.

8. Maintenance

- Alarm code 43 (Regenerative Overload)



Status at the time of alarm	Cause							
	1	2	3	4	5	6	7	8
Issued when control power supply is turned ON.							✓	
Issued when main circuit power supply is turned ON.		✓	✓	✓		✓	✓	✓
Issued during operation.	✓			✓	✓		✓	

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Exceeds a permitted value of the regenerative power at built-in regenerative resistance model. ■ Excessive load mass ratio, or tact time is short.	■ Check the load and operating conditions. ■ Change to external regenerative resistor. ■ Set to be the load mass ratio within the specified range. ■ Increase the deceleration time. ■ Increase the tact time.
2	■ Regenerative resistor is connected to the model without regenerative resistor.	■ Remove regenerative resistor.
3	■ Resistor wiring is wrong at built-in or external regenerative resistor model.	■ Check the wiring conditions and correct it if improper.
4	■ Regenerative resistor wire breaks.	■ For built-in regeneration resistor specifications, replace the servo amplifier. ■ For external regeneration resistor specifications, replace the regeneration resistor.
5	■ Resistance value of external regenerative resistor is excessive.	■ Replace to the resistor that matching the specifications.
6	■ Input power supply voltage exceeds the specified range.	■ Check the input power supply voltage level.
7	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
8	■ External regenerative resistor does not connect although "02: External_R" is set in the system parameter ID03 "Regenerative resistor selection".	■ Connect external regenerative resistor. ■ Set "00: Not_connect" in the system parameter ID03 "Regenerative resistor selection".

- * If the setting of system parameter ID03 "Regenerative Resistor Selection" is incorrect, regeneration overload is not detected properly, and the amplifier and surrounding circuit may be damaged or burnt.

8.3 Trouble shooting when alarm activated

■ Alarm code 44 (Magnetic pole position estimation error)



Status at the time of alarm	Cause							
	1	2	3	4	5	6	7	8
Issued when control power supply is turned ON.				✓				
Issued during magnetic pole position detection.	✓	✓	✓		✓	✓	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Magnetic pole position detecting frequency is same as mechanical resonance. ■ Motor reaches to end of stroke.	■ Changing GroupD ID01 "Excitation command frequency setting value". ■ Keep distance to end of stroke.
2	■ Load mass is too large.	■ Sizing a linear motor, again.
3	■ Force limitation command is too small.	■ For internal limitation of force Increase a set value of Group8 ID37 "Forward Direction Internal Force Limit Value", Group8 ID38 "Reverse Direction Internal Force Limit Value". ■ For external limitation of force Increase an input voltage.
4	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
5	■ Wiring of U/V/W-phase between servo amplifier and linear motor is wrong.	■ Check the wiring conditions and correct it if improper.
6	■ Wiring of A/B-phase of linear encoder is wrong.	■ Check the wiring conditions and correct it if improper.
7	■ Linear encoder resolution setting is wrong.	■ For incremental encoder Set correct value to the System parameter ID17 "Incremental encoder resolution". ■ For absolute encoder Set correct value to the System parameter ID15 "Absolute encoder resolution".
8	■ Operation direction of linear encoder is wrong.	■ Set the GroupC ID09 "Linear Encoder Polarity Selection" correctly.

■ Alarm code 45 (Average continuous over speed)



Status at the time of alarm	Cause
	1
Occurred during operation.	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ The average speed exceeds the maximum speed of continuous speed range.	■ Review the operating conditions. ■ Resize the linear motor.

8. Maintenance

■ Alarm Code 52 (In-rush prevention resistance Overheat)



Status at the time of alarm	Cause		
	1	2	3
Issued when control power supply is turned ON.	✓		
Issued when main circuit power supply is turned ON.		✓	
Issued during operation.			✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Power turning ON is repeated too frequently.	■ Turn ON/OFF the power less frequently.
3	■ Ambient temperature is high.	■ Confirm temperature in cabinet (or ambient of the amplifier), then refine installation method of the servo amplifier and ventilation of the cabinet to keep 55°C or lower of ambient temperature.

■ Alarm Code 53 (Dynamic Brake Resistor Overheat)



Status at the time of alarm	Cause	
	1	2
Issued when control power supply is turned ON.	✓	
Issued during operation.	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Dynamic Brake operation is repeated too frequently.	■ Use the dynamic brake so as not to exceed the permissive frequency.

■ Alarm Code 54 (Built-in Regenerative Resistance Overheat)



Status at the time of alarm	Cause		
	1	2	3
Issued when control power supply is turned ON.	✓		✓
Issued during operation.	✓	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Regenerative power excessive.	■ Check the built-in regenerative resistor allowable power. ■ Check the operating conditions to keep that consumption power is below of allowable power. ■ Use an external regenerative resistor.
3	■ Resistor wiring is wrong at built-in regenerative resistor model.	■ Check the wiring conditions and correct it if improper.

* When using a regenerative resistor built in the servo amplifier, make sure to set "01: Built-in_R" at the system parameter ID03. This setting decides enabled/disabled of the overheating protection detection treatment of the built-in regeneration resistance.

* Built-in regenerative resistance overheat does not detected when "02 External_R" is selected. Therefore, there is a danger that built-in regenerative resistance will burn out or be damaged.

8.3 Trouble shooting when alarm activated

■ Alarm Code 55 (External Error)

When host device or thermal output signal of external regenerative resistor are not connected

Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✓	✓



◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Validity condition for external trip function is set to 'Valid'.	■ When not used, set "00: _Always_Disable" at Group9 ID40 " External Trip Input Function [EXT-E]".
2	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

When thermal signal of the external regenerative resistor is connected

Status at the time of alarm	Cause		
	1	2	3
Issued when control power is turned ON.	✓		✓
Issued after operation for some time.		✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Improper wiring of external regenerative resistance.	■ Check the wiring conditions and correct it if improper.
2	■ External regenerative resistor is operating.	■ Check the operating conditions. ■ Increase the capacity of the external regeneration resistor.
3	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

- * When output terminal of upper level device is connected, eliminate the alarm trigger of the host level device.

8. Maintenance

■ Alarm Code 56 (Main Circuit Power Device Overheat)



Status at the time of alarm	Cause			
	1	2	3	4
Issued when control power is turned ON.	✓		✓	✓
Issued at input of servo ON.	✓	✓	✓	
Issued while starting and stopping the linear motor.	✓	✓	✓	
Issued after operation for some time.	✓	✓	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	U/V/W-phase of amplifier is short circuited due to the wiring in amplifier and linear motor. Or, U/V/W-phases have earth fault.	Check the wiring conditions and correct it if improper.
2	Short circuit or earth fault of U/V/W phases, at linear motor side.	Replace the linear motor.
3	Defect in internal circuit of servo amplifier.	Replace the servo amplifier.
4	Ambient temperature is high.	Confirm temperature in cabinet (or ambient of the amplifier), then refine installation method of the servo amplifier and ventilation of the cabinet to keep 55°C or lower of ambient temperature.

■ Alarm Code 61 (Over-Voltage)



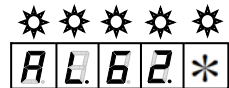
Status at the time of alarm	Cause			
	1	2	3	4
Issued when control power is turned ON.	✓			
Issued when main circuit power supply is turned ON.	✓	✓		
Issued while starting and stopping the linear motor.		✓	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	Defect in internal circuit of servo amplifier.	Replace the servo amplifier.
2	The power supply voltage of main circuit is out of the specification.	Reduce the power supply voltage to within the specified range.
3	Excessive load mass ratio.	Reduce the load mass ratio to within the specified range.
4	- Incorrect wiring of regenerative resistor. - Built-in regenerative circuit is not functioning.	- Wire the regenerative resistor correctly. - Check the wiring and resistance value if using the external regenerative resistor. - Replace the servo amplifier if any abnormality occurs after countermeasure above.

8.3 Trouble shooting when alarm activated

■ Alarm Code 62 (Main Circuit Under-voltage)



Status at the time of alarm	Cause				
	1	2	3	4	5
Issued when control power is turned ON.				✓	✓
Issued when main circuit power supply is turned ON.	✓	✓	✓		
Issued during operation.		✓	✓		

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Input power supply voltage is below the specified range.	■ Check the power supply and set it within the specified range.
2	■ Rectifier of main circuit is broken.	■ Replace the servo amplifier.
3	■ Input power supply voltage is reduced, or instantaneous power interruption is occurred.	■ Check the power supply, and confirm that there is no instantaneous power interruption or low voltage.
4	■ Low voltage outside of the specified range is supplied to the main circuit (R/S/T).	■ Check the main circuit voltage. Confirm that there is no external power supply to R/S/T when the main circuit is OFF.
5	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ Alarm Code 63 (Main Power Supply phase loss)



Status at the time of alarm	Cause		
	1	2	3
Issued when control power is turned ON.		✓	
Issued when main circuit power supply is turned ON	✓	✓	✓
Issued during operation.	✓	✓	

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ One of 3 phases (R/S/T) is not connected.	■ Check the wiring conditions and correct it if improper.
2	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
3	■ Servo amplifier is not specified for single phase.	■ Change the system parameter ID01 "Main circuit power input type" to "01:AC_Single-phase".

■ Alarm Code 68 (Main circuit voltage detection error)



Status at the time of alarm	Cause
	1
Issued when control power is turned ON.	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

8. Maintenance

■ Alarm Code 71 (Control Power Supply Under-voltage)



Status at the time of alarm	Cause		
	1	2	3
Issued when control power is turned ON.	✓	✓	
Issued during operation.	✓		✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Input power supply voltage is below the specified range.	■ Confirm that the power supply is set within the specified range.
3	■ Input power supply voltage is fluctuating or having phase loss.	■ Confirm power supply to avoid phase loss or voltage reduction.

■ Alarm Code 72 (Control Circuit voltage reduction 1)



Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Defect in external circuit.	■ Restart the power supply after removing the connector: CN1. Check the external circuit if alarm is not issued.

■ Alarm Code 73 (Control Circuit voltage reduction 2)



Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Defect in external circuit.	■ Restart the power supply after removing the connector: CN1. Check the external circuit if alarm is not issued. ■ Restart the power supply after replacing the linear motor; if alarm is not issued, there is defect in internal circuit of linear encoder. Replace the linear encoder or Hall effect sensor.

8.3 Trouble shooting when alarm activated

- Alarm Code 81 (Encoder Connector 1 Disconnection)
- Alarm Code 83 (Encoder Connector 2 Disconnection)
- Alarm Code 87 (CS Signal Disconnection)

Status at the time of alarm	Cause			
	1	2	3	4
Issued when control power is turned ON.	✓	✓	✓	✓
Issued during operation.	✓		✓	✓

☆☆☆☆☆
A L B 1 *

☆☆☆☆☆
A L B 3 *

☆☆☆☆☆
A L B 7 *

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ For linear encoder wiring: ◆ Improper wiring. ◆ Connector is removed. ◆ Loose connection. ◆ Encoder cable is too long. ◆ Encoder cable is too thin.	■ Check the wiring conditions and correct it if improper. ■ Confirm that the encoder power supply voltage at the linear motor side is above 4.75 V, correct it if improper.
2	■ Servo amplifier and linear encoder are not combined properly.	■ Replace with linear motor equipped with proper encoder.
3	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
4	■ Defect in internal circuit of linear encoder.	■ Replace the linear motor.

- Alarm Code 84 (Absolute Encoder Communication Error)

Status at the time of alarm	Cause		
	1	2	3
Issued when control power is turned ON.	✓	✓	✓
Issued during operation.		✓	

☆☆☆☆☆
A L B 4 *

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of linear encoder.	■ Replace the linear motor.
2	■ Malfunction due to noise.	■ Confirm proper grounding of the amplifier. ■ Check the shielding of the encoder cable. ■ Add ferrite core or similar countermeasures to against noise.
3	■ Linear encoder wiring has abnormalities.	■ Check the wiring conditions and correct it if improper.

8. Maintenance

■ Alarm Code 85 (Encoder Initial Process Error)



Status at the time of alarm	Cause				
	1	2	3	4	5
Issued when control power is turned ON.	✓	✓	✓	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ For linear encoder wiring: ◆ Improper wiring. ◆ Connector is removed. ◆ Loose connection. ◆ Encoder cable is too long. ◆ Encoder cable is too thin.	■ Check the wiring conditions and correct it if improper. ■ Confirm that the encoder power supply voltage at the linear motor side is above 4.75 V, correct it if improper.
2	■ Servo amplifier and linear encoder are not combined properly.	■ Set the system parameter ID11 "EN1 encoder type" and ID18 "CS decision method selection", correctly. ■ Replace with proper linear encoder.
3	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
4	■ Defect in internal circuit of linear encoder.	■ Replace the linear motor.
5	■ CS position is not able to calculate correctly.	■ Replace to recommendation linear encoder. (See "2.2 Linear encoder".)

■ Alarm Code 86 (CS error)



Status at the time of alarm	Cause
	1
Issued during motor operation.	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Malfunction depends on noise for linear encoder wiring.	■ Check grounding of the amplifier. ■ Check the shielding of the encoder cable. ■ Take care of noise by adding ferrite core etc.

■ Alarm Code 8C (Motor encoder (EnDat) combination error)



Status at the time of alarm	Cause
	1
Issued when control power is turned ON.	✓

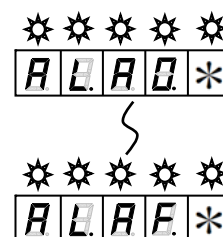
◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Combination linear encoder is not apply to servo amplifier.	■ Replace to recommendation linear encoder. (See "2.2 Linear encoder".)

8.3 Trouble shooting when alarm activated

- Alarm Code A0 to AF (Absolute Encoder Internal Error 0 to 15)

Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✓	✓
Issued during operation.	✓	✓



◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of linear encoder.	■ Turn ON the power supplies again, if not corrected, replace the linear encoder.
2	■ Malfunction due to noise.	■ Confirm proper grounding of the amplifier. ■ Check the shielding of the encoder cable. ■ Add ferrite core or similar countermeasures to against noise.

8. Maintenance

■ Alarm Code C1 (Over-speed)



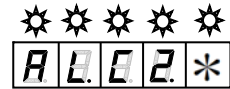
Status at the time of alarm	Cause						
	1	2	3	4	5	6	7
Issued when command is entered after Servo ON.	✓	✓		✓	✓	✓	✓
Issued when the linear motor is started or stopped.			✓				
Issued other than operating and starting the motor.		✓	✓				

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Defect in internal circuit of linear encoder.	■ Replace the linear encoder.
3	■ Excessive overshoot while starting.	■ Adjust the servo parameters. ■ Loose the slope of acceleration / deceleration command. ■ Reduce the load mass ratio, or change motor capacity.
4	■ Wiring of U/V/W-phase between servo amplifier and linear motor is wrong.	■ Check the wiring conditions and correct it if improper.
5	■ Wiring of A/B-phase of linear encoder is wrong.	■ Check the wiring conditions and correct it if improper.
6	■ Linear encoder resolution setting is wrong.	■ For incremental encoder Set correct value to the System parameter ID17 "Incremental encoder resolution". ■ For absolute encoder Set correct value to the System parameter ID15 "Absolute encoder resolution".
7	■ Operation direction of linear encoder is wrong.	■ Set the GroupC ID09 "Linear Encoder Polarity Selection" correctly.

8.3 Trouble shooting when alarm activated

■ Alarm Code C2 (Velocity Control Error)



Status at the time of alarm	Cause				
	1	2	3	4	5
Issued while due to input of Servo ON.	✓		✓		
Issued when command has entered.	✓	✓	✓		✓
Issued while starting and stopping the linear motor.				✓	

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Wiring of U/V/W-phase between servo amplifier and linear motor is wrong.	■ Check the wiring conditions and correct it if improper.
2	■ Wiring of A/B-phase of pulse encoder is wrong.	■ Check the wiring conditions and correct it if improper.
3	■ The linear motor is vibrating (oscillating).	■ Adjust the servo parameters so that servo motor will not vibrate (oscillate).
4	■ Excessive overshoot and undershoot.	■ Adjust the servo parameters to reduce overshoot and undershoot. ■ Loosen the slope of acceleration / deceleration command. ■ Change Group B ID14 "Velocity Control Alarm (ALM_C2) Detection" to "00: Disabled".
5	■ Operation direction of linear encoder is wrong.	■ Set the GroupC ID09 "Linear Encoder Polarity Selection" correctly.

* Velocity control error alarm is set to "00:Disabled" as default because the alarm may be detected if it is available in case of accel/decel with large load mass ratio or vertical application. If its detection is needed, consult our representatives.

8. Maintenance

■ Alarm Code C3 (Velocity Feedback Error)



Status at the time of alarm	Cause		
	1	2	3
Issued when command has entered.	✓	✓	✓
Issued when control power is turned ON.		✓	

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Linear motor is not moving.	■ Check the wiring conditions of linear motor power line and correct it if improper. ■ Replace the linear motor.
2	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
3	■ The linear motor is vibrating (oscillating).	■ Adjust the servo parameters so that servo motor will not vibrate (oscillate).

■ Alarm Code C5 (Model Following Vibration Suppression Control Error)



Status at the time of alarm	Cause			
	1	2	3	4
Issued when position command pulse is entered.	✓	✓	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Setup of model control gain is high.	■ Lower model control gain.
2	■ The accel/decel time of a position command is short.	■ Loose the slope of acceleration / deceleration command.
3	■ Force limiting value is low.	■ Enlarge a force limit value, or disable a force limitation.
4	■ Switched to the model following vibration suppression control from the standard position control	■ Switches at the state of linear motor stop.

- * Other alarms are generated, and this alarm might be generated if a servo brake performs alarm reset during a slowdown.

8.3 Trouble shooting when alarm activated

■ Alarm Code D1 (Excessive Position Deviation)



Status at the time of alarm	Cause													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Issued when control power is turned ON.												✓		
Issued when servo ON and while motor stopping.						✓							✓	
Issued immediately after entering the command.	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	
Issued during starting / stopping at high speed.	✓	✓					✓	✓	✓				✓	✓
Issued during the operations by lengthy command.		✓					✓	✓					✓	

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Position command frequency is too high.	■ Correct the position command of the controller.
2	■ Excessive load mass ratio or low motor capacity.	■ Correct the load condition or increase the linear motor capacity.
3	■ Holding brake is not released.	■ Check the wiring conditions and correct it if improper. Replace the linear motor even brake is not released if brake is excited with proper voltage.
4	■ Application collided to something or locked mechanically.	■ Refine application system.
5	■ One or all phases of U/V/W -phase of the servo amplifier and linear motor has disconnected.	■ Check the wiring conditions and correct it if improper.
6	■ Linear motor is being moved by an external force (Gravity, etc.) during stopping (positioning completion).	■ Check the load, or increase the linear motor capacity.
7	■ Valid force limit command is entered by the controller, and its setting is too small. ■ Setting of a velocity limit command is too small. ■ Linear encoder pulse setting is not match with actual servo motor.	■ Enlarge a force limit value, or disable a force limitation. ■ Enlarge setting value of velocity limit command. ■ For incremental encoder Set correct value to the System parameter ID17 "Incremental encoder resolution". ■ For absolute encoder Set correct value to the System parameter ID15 "Absolute encoder resolution".
8	■ Settings of servo parameters (Position Loop Gain, etc.) are not appropriate.	■ Adjust the servo parameter settings (Raise the position loop gain, etc.).
9	■ Setting of a excessive position deviation is too small.	■ Set a value larger of GroupB ID11 "Deviation Counter Overflow Value".
10	■ Rotation directions of 2 axes are different, in the tandem operation.	■ Set "04: PC- _VC+ _TC+" to Group8 ID00 "Position, Velocity, Force Command Input Polarity". Change to "01: Reversed", in Group8 ID00 "Position, Velocity, Torque Command Input Polarity".
11	■ Wiring of linear motor and encoder is wrong, in the tandem operation.	■ Check the wiring and fix if wrong.
12	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
13	■ Defect in internal circuit of linear encoder.	■ Replace the linear encoder.
14	■ Power supply voltage is low.	■ Check the power supply voltage.

8. Maintenance

■ Alarm Code D2 (Faulty Position Command Pulse Frequency 1)



Status at the time of alarm	Cause
	1
Issued after entering position command pulse.	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ The command that exceeded digital filter setting for command pulse is entered.	■ Decrease the frequency of the command pulse. ■ Decrease minimum pulse width of digital filter setting in Group 8 ID12 "Position command pulse digital filter [PCPFIL]".

■ Alarm Code D3 (Faulty Position Command Pulse Frequency 2)



Status at the time of alarm	Cause	
	1	2
Issued after entering position command pulse.	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Frequency of command pulse input is too high.	■ Reduce the frequency of command pulse input.
2	■ Setting value of electronic gear is excessive.	■ Decrease the electronic gear setting value in ID 13 to 16: Electric gear, Group 8 parameter.

■ Alarm Code D4 (Axes-sync error excess)



Status at the time of alarm	Cause				
	1	2	3	4	5
Issued immediately after entering the command.	✓	✓	✓	✓	✓
Issued during starting / stopping at high speed.	✓		✓	✓	✓

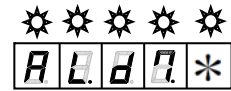
◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Parameter settings of 2 axes are different.	■ Sets the parameters follow 9.2.5.
2	■ Same command is not entered to both axes.	■ Check the wiring and fix if wrong.
3	■ Axes-sync error set value is too small.	■ Increase setting of GroupB ID81 "Axes-sync error excess value".
4	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
5	■ Defect in internal circuit of linear encoder.	■ Replace the linear encoder.

8.3 Trouble shooting when alarm activated

■ Alarm Code D7 (Amplifier communication error)

Status at the time of alarm	Cause				
	1	2	3	4	5
Issued after control power is turned ON.	✓	✓	✓	✓	
Issued during operation.					✓



◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ For wiring between amplifiers: ◆ Improper wiring. ◆ Connector is removed. ◆ Loose connection. ◆ Encoder cable is too long.	■ Check the wiring conditions and correct it if improper. ■ Use recommendation cable.
2	■ For use of the tandem operation function: Tandem operation is not set to the parameter in counterpart axis.	■ Set "01: Tandem" to the system parameter ID08 "Amplifier communication function" in counterpart axis.
3	■ For non use of the tandem operation function: Tandem operation is set to the parameter in own axis.	■ Set "00: Invalid" to the system parameter ID08 "Amplifier communication function" in own axis.
4	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
5	■ Malfunction due to noise.	■ Confirm proper grounding of the amplifier. ■ Add ferrite core or similar countermeasures to against noise.

■ Alarm Code DF (Test mode has closed)

Status at the time of alarm	Cause
	1
Occurred after execution of test mode.	✓



◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Normal operation.	■ Return to normal operation by alarm clear. (This is caution because test mode might have some deviation in control side after finish.)

8. Maintenance

■ Alarm Code E1 (Memory Error 1)

☆☆☆☆☆
AL E1 *

Status at the time of alarm	Cause 1
Issued during display key operation or setup software operation.	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ Alarm Code E2 (Memory Error 2)

☆☆☆☆☆
AL E2 *

Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Correct value did not read to CPU from EEPROM of servo amplifier.	■ Replace the servo amplifier.
2	■ Failed to write into the EEPROM during last power supply cutoff.	■ Replace the servo amplifier.

■ Alarm Code E3 (CPU error 1)

☆☆☆☆☆
AL E3 *

■ Alarm Code E4 (CPU error 2)

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AL E4 *

■ Alarm Code E8 (Control power circuit error 1)

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AL E8 *

■ Alarm Code E9 (Control power circuit error 2)

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AL E9 *

■ Alarm Code EB (Control power circuit error 3)

☆☆☆☆☆
AL EB *

Status at the time of alarm	Cause 1
Issued when control power is turned ON.	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

8.3 Trouble shooting when alarm activated

■ Alarm Code E5 (System Parameter Error 1)



Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ The data out of setting range was given to system parameter.	■ Confirm the model number of the servo amplifier. Check and correct the setting value of system parameter. Turn ON the control power again and confirm that alarm is cleared.
2	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ Alarm Code E6 (System Parameter Error 2)



Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Wrong combination of system parameter setting value and actual hardware. ■ Wrong combination between system parameters.	■ Confirm the model number of the servo amplifier. ■ Check and correct the setting value of system parameter. Turn ON the control power again and confirm that alarm is cleared.
2	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ Alarm Code E7 (Motor Parameter Error)



Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Correct value did not read to CPU from non-volatile memory of servo amplifier.	■ If alarm recurs by control power cycle after re-setting the motor parameter, replace servo amplifier.
2	■ Failed to write into the non-volatile memory when changing motor parameter.	■ If alarm recurs by control power cycle after re-setting the motor parameter, replace servo amplifier.

8. Maintenance

■ Alarm Code EA (Memory Error 3)



Status at the time of alarm	Cause 1
Issued during display key operation or setup software operation.	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ Alarm Code F1 (Task Process Error)



Status at the time of alarm	Cause 1
Issued during operation.	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ Alarm Code F2 (Initial Process Time-Out)



Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✓	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Malfunction due to noise.	■ Confirm proper grounding of the amplifier. ■ Add ferrite core or similar countermeasures to against noise.

■ Alarm Code F3 (CPU error 3)



Status at the time of alarm	Cause 1
Issued after firmware updating.	✓

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ CPU setting was wrong at firmware updating.	■ Correcting CPU setting of firmware updating tool.

8.3 Trouble shooting when alarm activated

8.3.3 Correspondence table for EnDat Error message and alarm code

EnDat Error message		RS3 Servo Amplifier	
Bit		Alarm Code	Priority
0	Light Source	B0	1
1	Signal amplitude	B1	2
2	Position	B2	3
3	Overvoltage	B3	4
4	Undervoltage	B4	5
5	Overcurrent	B5	6
6	Battery	B6	7
7	Currently not allocated Extension planned	B7	8
8		B8	9
9		B9	10
10		B10	11
11		B11	12
12		B12	13
13		B13	14
14		B14	15
15		B15	16

- * "Error message" means Operation Status Word0 of EnDat.
- * "Alarm Code" means the alarm code output from servo amplifier against applicable Error Message.
- * "Priority" is given to alarm codes to be output when Error Messages are received simultaneously. Alarm Code output from servo amplifier is only one (which has higher priority) even if Error Messages are received multiple.

8. Maintenance

8.4 Inspection

For maintenance purposes, a daily inspection is typically sufficient because servo amplifier and linear motor are not use attrition part. Upon inspection, refer to the following description.

Inspection target	Conditions			Items	Methods	Solution if abnormal
	Time	During operation	While stopping			
Linear motor	Daily	✓		Vibration	Check for excessive vibration than usual.	Contact dealer or sales office.
	Daily	✓		Sound	Check for abnormal sound than usual.	
	Periodic		✓	cleanliness	Check for dirt and dust.	Clean with cloth or air blow. Note 1)
	Yearly		✓	Measure a insulation resistance	Contact dealer or sales office.	
	5000 hours Note 2)		✓	Replacement of oil seal		
Servo amplifier	Periodic		✓	Cleaning	Check for dust accumulated in the accessories.	Clean with air. Note 1)
	Yearly		✓	Loose screws	Check for loose connections.	Fasten the screws properly.
Battery for serial encoder	Regularly		✓	Battery voltage	Confirm that battery voltage is more than DC3.6V.	Replace the Battery.
Temperature	Periodic	✓		Measure temperature	Ambient temperature Mover temperature	Set the ambient temperature within the specified range. Check the load condition.

Note 1) Before cleaning, confirm that there is no oil content and/or moisture in compression air.

Note 2) This inspection and replacement period is when water- or oil-proof functions are required.

8.5 Service parts

8.5.1 The parts requiring inspection

Some parts have aging degradation.

Please request us an overhaul by referring to the periods below for preventive maintenance.

No.	Part name	Number of average replacement periods	Corrective measures / usage conditions
1	Aluminum electrolytic capacitor for smoothing main circuit	5 Years	Replacement with new part is necessary. Load ratio: 50% of rated output current of amplifier. Usage condition: Yearly average 40°C
2	Cooling Fan motor	5 Years	Replacement with new part is necessary. Usage condition: Yearly average 40°C
3	Aluminum electrolytic capacitor (other than capacitor for smoothing main circuit)	5 Years	Replacement with new part is necessary. Usage condition: Yearly average 40°C Annual total usage time is 4800 hours.
4	Fuse	10 Years	Replacement with new part is necessary.
5	Relays	(Power-cycle: a hundred thousand times)	Replacement with new part is necessary.

■ Capacitor for smoothing the main circuit, and relays

- ◆ Inspection is needed if the servo amplifier has stored for more than 3 years. Contact the dealer or sales office.
- ◆ It is necessary to replace the capacitor that is earlier than 5 years when it is used to exceed yearly average 40°C or exceed more than 50% of the rated output current of servo amplifier.
- ◆ It is necessary to replace the capacitor or relays that are earlier than periods above where the main power-cycle is repeated more than 30 times per day or 5 times per hour. Capacity reduction or early failure of relays is considered.

■ Cooling Fan motor

- ◆ The servo amplifier is designed corresponding to the pollution degree specified in EN61800-5-1 or IEC 664-1. It is not for dust proof or oil proof, so use it in an environment at Pollution Level 2 or less (i.e., Pollution Level 1, 2).
- ◆ RS3 series servo amplifier models RS3A02, RS3A03, RS3A05, RS3A07, RS3A10, RS3A15 and RS3A30 have a built-in cooling fan; therefore be sure to maintain a space of 50mm on the upper and lower side of the amplifier for airflow.
Installation in a narrow space may cause failure due to a static pressure reduction of the cooling fan and/or electronic parts degradation. Replacement is necessary if abnormal noise occurs or oil / dust are observed on the parts. Also, at an average temperature of 40°C year-round, the life expectancy is 5 years.

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Dedicated function

In this chapter, the things concerning dedicated function are explained.

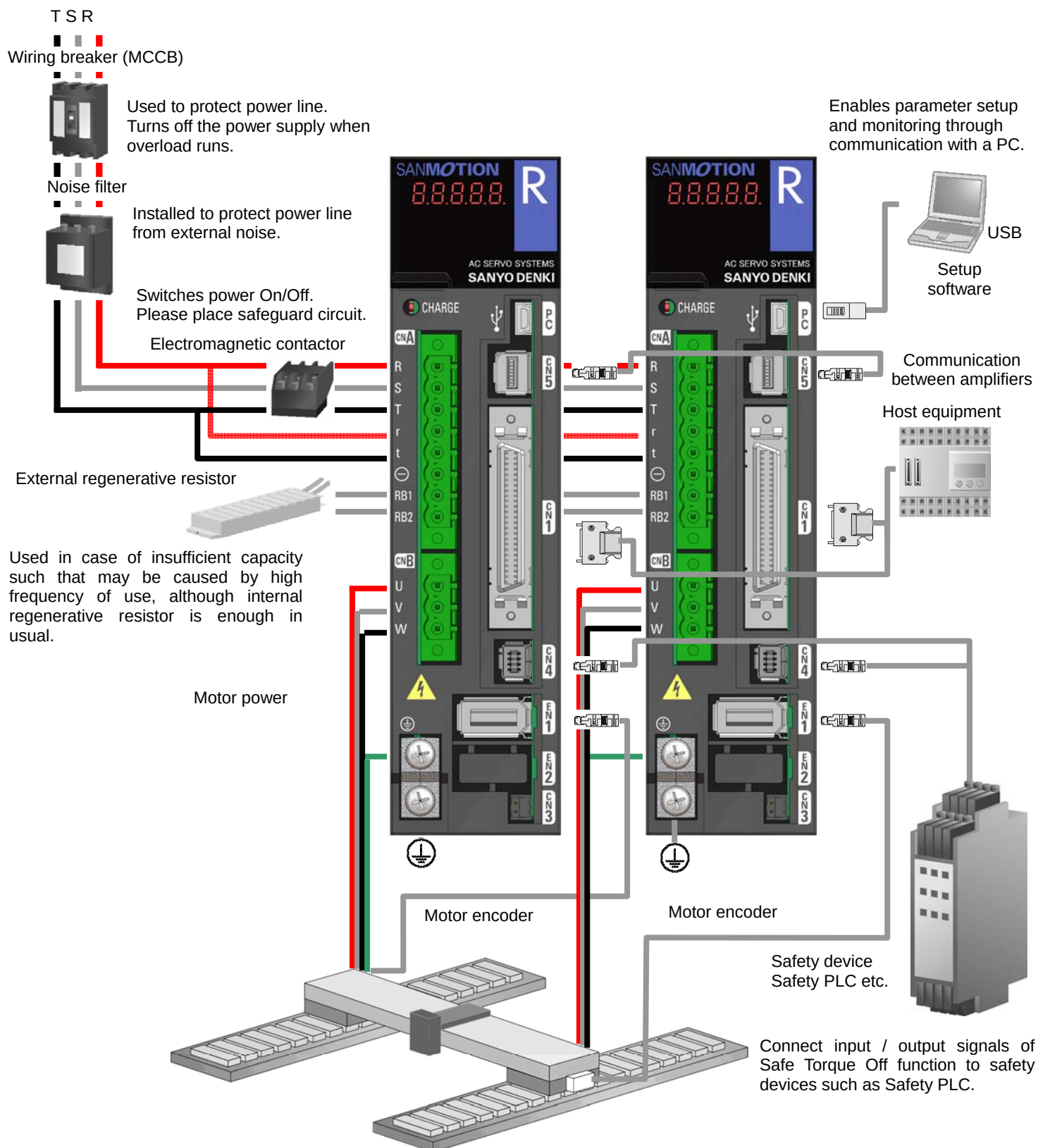
9.1 Tandem operation	9-1
9.1.1 Illustration of system components	9-1
9.1.2 Internal block diagram	9-3
9.1.3 Wiring	9-4
9.1.4 Setting for the tandem operation function	9-4
9.1.5 How to use	9-6
9.1.6 Error detection	9-7
9.1.7 Precaution	9-8

9. Dedicated function

9.1 Tandem operation

This is the function that operates 2 axes with checking position error each other and compensating difference, through local communication function built in the servo amplifier.

9.1.1 Illustration of system components

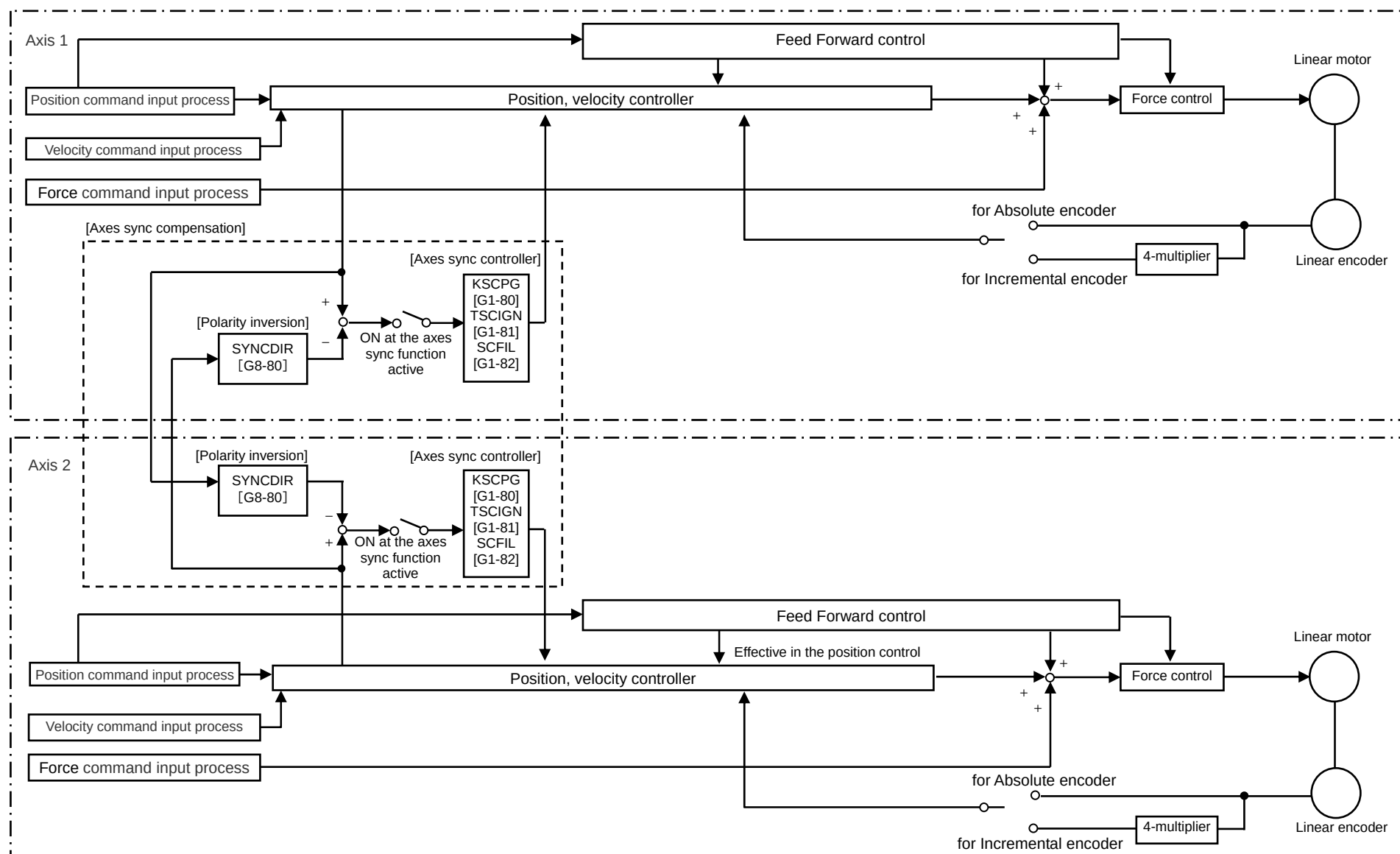


9.1.1 Illustration of system components

- Precaution for system construction
 - * Construct system as balance of machine system (load mass, friction, load force) will be same in 2 axes. When that balance differs in 2 axes, overload alarm might occur only in 1 axis.
 - * At the tandem operation, please use servo motors and amplifiers with a same model number, in 2 axes.
 - * Please place safeguard circuit that is able to stop both axes by single axis alarm (like as power supply breaker).
 - * When overtravel function is used, construct system as inputting an overtravel status to both axes with same timing, after sending individual overtravel signal to a host equipment.

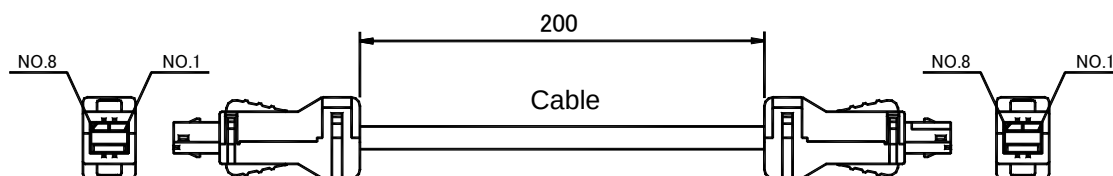
9. Dedicated function

9.1.2 Internal block diagram



9.1.3 Wiring

For use of the tandem operation, connect the communication cable to CN5.



- * For use of the Safe Torque Off function, connect the wiring of CN4 (connector for safety device connection), between 2 axes.
- * See "12.6.4 Communication cable between servo amplifiers" for detail of the communication cable.

9.1.4 Setting for the tandem operation function

For use of the Safe Torque Off function, set the parameters below.

- Amplifier communication function selection
Select use of the RS422 communication function (at CN5 connector).
Select "01: Tandem" for use of this function.
It will activate after power cycle for control.

Group	ID	Selection	Contents
System	08	01 Tandem	Uses as for the tandem operation.

- * Select "01: Tandem" in both axes.
If it is not selected at one side, "AL.D7(Amplifier communication error)" will occur.

- Axes-sync compensation proportional gain
Sets a rate of the axes-sync compensation value.
When 100% is set, adds the axes-sync compensation pulse value to the position deviation without change.
Vibration might occur if set value is too large.

Group	ID	Setting range	Default	Unit
1	80	0 to 300	0	%

- Axes-sync compensation integral time constant
Sets an integral time constant for the axes-sync compensation.
This set value will be valid when axes-sync compensation proportional control function is invalid.
Integral term will be invalid (proportional control) when 1000.0ms is set.

Group	ID	Setting range	Default	Unit
1	81	0.5 to 1000.0	1000.0	ms

- Axes-sync compensation filter
Primary low pass filter that suppress sudden variation of axes-sync compensation value.
Filter will be invalid when 0.0ms is set.

Group	ID	Setting range	Default	Unit
1	82	0.0 to 1000.0	0.0	ms

9. Dedicated function

- Polarity selection of axes-sync compensation input
Fit a polarity of position deviation each other.
Set "01: Reversed" to one axis if rotation directions of combination axes are different.

Group	ID	Selection	Default	Contents
8	80	00:Not_Reversed	00:Not_Reversed	Without reversing
		01:Reversed		With reversing

- Axes-sync compensation function
Selects an input condition to activate the axes-sync compensation function.
Tandem operation function will work when "01: Tandem" is set to system parameter ID08 "Amplifier communication function", and this parameter is valid.

Group	ID	Setting range	Default	Unit
9	80	00 to 11	00	--

- * See "Group9 Function enabling condition settings" in "5.8 Parameter functions", for detail of the selection.

- Axes-sync compensation proportional control switching function
Selects an input condition to activate the axes-sync compensation proportional control switching function.

Group	ID	Setting range	Default	Unit
9	81	00 to 29	00	--

- * See "Group9 Function enabling condition settings" in "5.8 Parameter functions", for detail of the selection.

9.1.5 How to use

- Tandem operation has the mutual compensating method and the Master-Slave method.
 - ◆ Mutual compensating method: This is the method that 2 axes are checking position error each other and compensating difference, through local communication function built in the servo amplifier. Use this method if same motion is required to both axes.
 - ◆ Master-Slave method: This is the method that one side (Slave) checks position deviation with the other side (Master) and compensates difference. Use this method if a follow-up motion against the Master axis is required to the Slave axis.
- For the mutual compensating method
 - ◆ If motion directions of 2 axes are same, set all parameters same in 2 axes.
 - ◆ If motion directions of 2 axes are different, set "04: PCMD-_VCMD+_TCMD+" to Group8 ID00 "Position, Velocity, Force Command Input Polarity", at one axis. And, set "01: Reversed" to Group1 ID83 "Polarity selection of axes-sync compensation", at both axes. For the other parameters, set same parameters, at both axes.
 - ◆ Recommends parameters below, at adjustment starting.
Axes-sync compensation proportional gain: 30%, Axes-sync compensation integral time constant: 1000ms (equal to invalid), Axes-sync compensation filter: 0.0ms
 - ◆ Adjust the value of the axes-sync compensation proportional gain and the axes-sync compensation filter for minimizing deviation, with checking the axes-sync error monitor.
 - ◆ Make tune of servo gain. See "6. Servo tuning" for tuning procedure. However, some of functions are not able to use. See "9.2.7 Precautions" for the functions which are not able to use.
- For the Master-Slave method
 - ◆ When Master-Slave method is used, the axes-sync compensation function is set as invalid at Master axis, and set as valid at Slave axis.
 - ◆ If motion directions of 2 axes are same, set same parameter to Group8 ID00 "Position, Velocity, Force Command Input Polarity", in 2 axes. And, set "00: Not_Reversed" to Group8 ID80 "Polarity selection of axes-sync compensation", at Slave axis.
 - ◆ If motion directions of 2 axes are different, set "04: PCMD-_VCMD+_TCMD+" to Group8 ID00 "Position, Velocity, Force Command Input Polarity" and set "01: Reversed" to Group1 ID83 "Polarity selection of axes-sync compensation", at Slave axis.
 - ◆ Set Master side parameters as below.
Axes-sync compensation proportional gain: 0% (equal to invalid), Axes-sync compensation integral time constant: 1000ms (equal to invalid), Axes-sync compensation filter: 0.0ms
 - ◆ Slave side parameters are recommended as below.
Axes-sync compensation proportional gain: 30%, Axes-sync compensation integral time constant: 1000ms (equal to invalid), Axes-sync compensation filter: 0.0ms
 - ◆ Adjust the value of the axes-sync compensation proportional gain, the axes-sync compensation integral time constant and the axes-sync compensation filter for minimizing deviation, with checking the axes-sync error monitor.
 - ◆ Make tune of servo gain. See "6. Servo tuning" for tuning procedure. However, some of functions are not able to use. See "9.1.7 Precautions" for the functions which are not able to use.

9. Dedicated function

9.1.6 Error detection

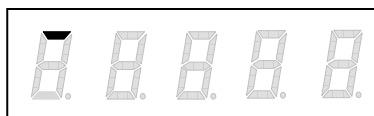
Warnings or alarms are able to output by detecting position deviation error of own axis and counterpart axis. Avoids continuance of linear motor motion if motions between 2 axes have gap by something cause.

■ Axes-sync error warning level

Warning outputs when position deviation error between own axis and counterpart axis exceeds this set value.

Group	ID	Setting range	Unit
B	80	1 to 2147483647	Pulse

- * Warning status is able to check by the monitor indication and the front LED.



■ Axes-sync error excess value

Outputs the axes-sync error excess (alarm code: D4) when position deviation error between own axis and counterpart axis exceeds this set value.

Group	ID	Setting range	Unit
B	81	1 to 2147483647	Pulse

- * Axes-sync error pulse is able to check by the monitor indication: ID66 Axes-sync error monitor.
- * Axes-sync error pulse is able to reset by the position deviation clear.

9.1.7 Precaution

- ◆ At the tandem operation, different load mass ratios can not use in 2 axes. (Please set same load mass ratio in 2 axes if using the value estimated by the load mass ratio estimation.)
- ◆ Do not use functions below, in the tandem operation.
 - * Adaptive notch filter function
 - * Model control switching function
 - * Model vibration suppression control switching function
 - * Auto tuning function (Auto tuning [JRAT manual setting] is available)
 - * Auto notch filter tuning function
 - * Auto FF vibration suppression frequency tuning
 - * CP vibration suppression control
 - * Minor vibration suppression
 - * Disturbance observer function
 - * Gain switching function (In case of "always valid" and "operating by using general input signal", function is available.)
 - * System analysis function
 - * Servo tuning navigation
- ◆ In use of mutual compensating method, please operate at same timing in 2 axes for active status control of each function which assigned to general input.
- ◆ When alarm is occurred, 2 axes might have position deviation.
In that case, please adjust machine positions of 2 axes.
- ◆ For one side axis operation, disable Group9 ID80 "Axes-sync compensation function" and make counterpart axis servo off.
 - * Avoid high speed operation. (Dynamic brake of counterpart axis might burn out.)

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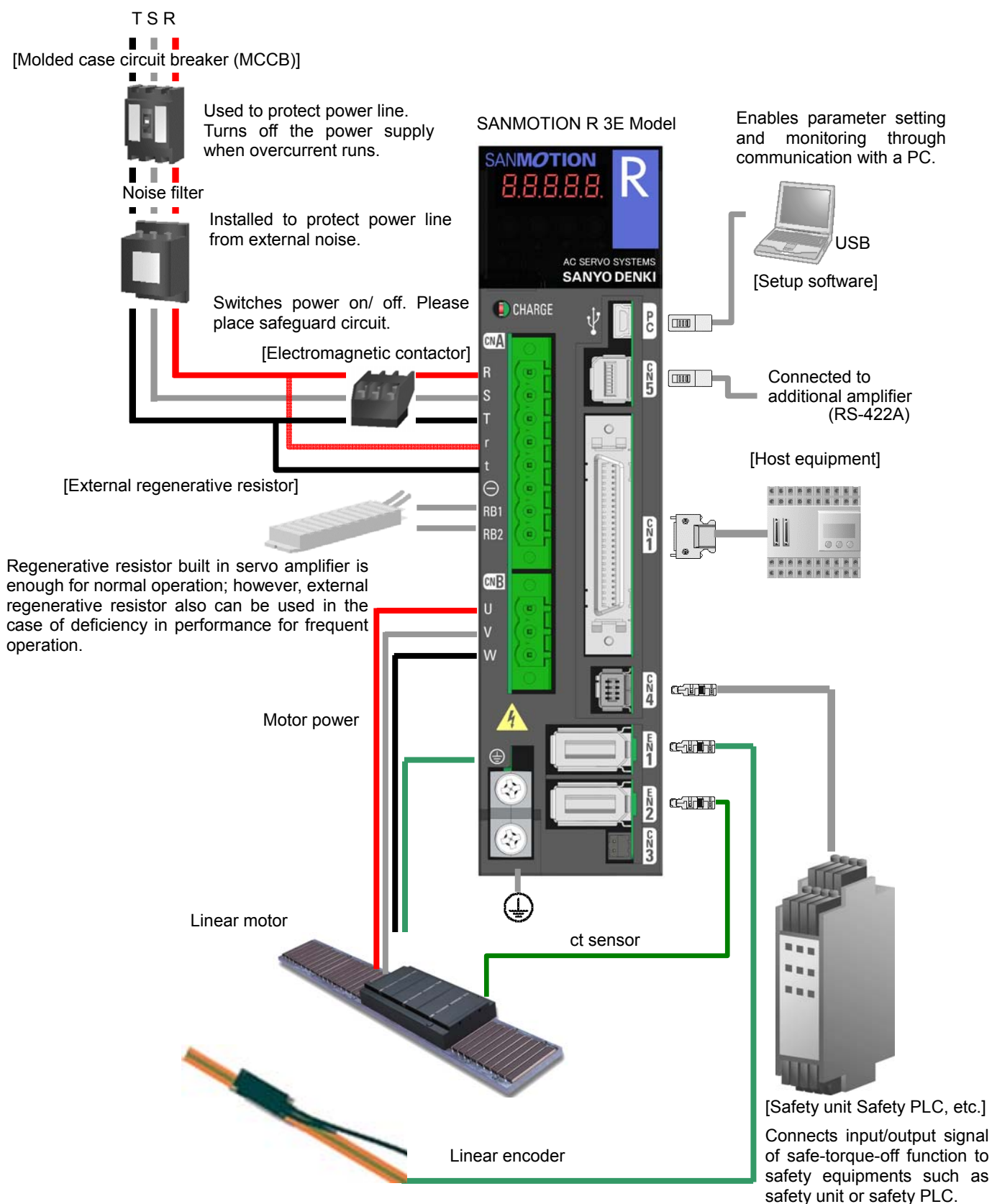
Safe-Torque-Off (STO) function

In this chapter, details of Safe-Torque-Off (STO) function are explained.

10.1 Illustration of system configuration.....	10-1
10.2 Safe-Torque-Off function.....	10-2
10.2.1 Outline	10-2
10.2.2 Standards conformity.....	10-3
10.2.3 Risk assessment	10-3
10.2.4 Residual risk	10-3
10.2.5 Delay circuit.....	10-4
10.3 Wiring	10-5
10.3.1 CN4 connector layout.....	10-5
10.3.2 Connection diagram of CN4-terminals	10-5
10.3.3 Example of wiring	10-6
10.3.4 Safety input-off shot pulse for safety device self-diagnosis	10-8
10.4 Safe-Torque-Off operation	10-9
10.4.1 Safe-torque-off state.....	10-9
10.4.2 Restoration from safe-torque-off state.....	10-10
10.4.3 Safe-Torque-Off during linear motor running.....	10-11
10.4.4 Safe-Torque-Off during linear motor stoppage	10-14
10.4.5 Deviation clear.....	10-15
10.4.6 Safety input signal failure detection	10-15
10.5 Error Detection Monitor (EDM)	10-16
10.5.1 Specifications	10-16
10.5.2 Connection example.....	10-16
10.5.3 Error detection method.....	10-16
10.6 Verification test.....	10-17
10.6.1 Preparation	10-17
10.6.2 Confirmation procedure.....	10-17
10.6.3 Acceptance criteria	10-17
10.7 Safety precautions.....	10-18

10. Safe-Torque-Off function

10.1 Illustration of system configuration



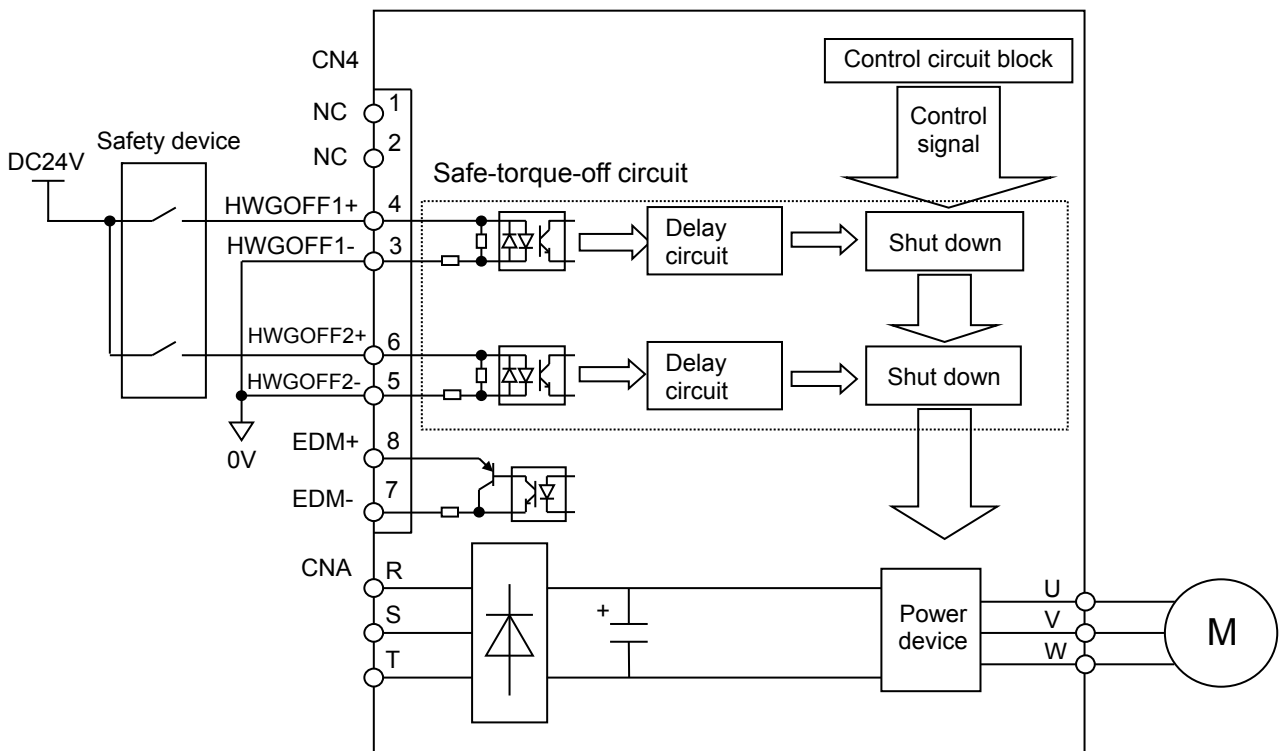
10.2 Safe-Torque-Off function

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 linear 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 linear 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 linear 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 ■ IEC60204, Stop Category 0 / EN60204
Safety Standards	■ IEC61508(2nd), SIL3, HFT=1, type B / EN61508 ■ IEC62061, SILCL3, HFT=1, type B / EN62061 ■ ISO13849-1:2006, Cat3, PL = e (When error detection performed by using EDM) / EN ISO 13849-1 / AC:2009 ■ ISO13849-1:2006, PL = c (When error detection not performed.) / EN ISO 13849-1 / AC:2009

- * Probability of a dangerous Failure per Hour (PFH) of this function (Safe Torque Off circuit) achieves less than 25% of required level of SIL3 and 2% of required level of SIL2.
- * To suffice ISO13849-1:2006, Cat3, PL=d, you need to design machine safety system so as to detect failure of STO circuit by surely using Error Detection Monitor (EDM).
- * The Mean Time to Dangerous Failure (MTTFd) for this function is a hundred year. The Diagnostic coverage (DC) for this function with use of Error Detection Monitor (EDM) is 92%.
- * For another standards conformity of Safety Function and Safety Standard, refer to Chapter 12.
- * Please contact us if error detection by EDM is not used.

10.2.3 Risk assessment

This servo amplifier unit meets the requirements of the above functional safety standards. However, before activating this safety function, make sure to assess the risks associated with the overall equipment to ensure safety.

10.2.4 Residual risk

Even if this function activated, the following risks remain. Please ensure the safety is maintained even if these risks occur, by performing risk assessments.

- When this function is activated while linear 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 linear motor used in vertical axes, the motor moves 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 linear motor holding brake are not safety related devices.
- If the power device malfunctions and causes inter-phase shorting, the linear motor may move within a range of up to 180 degrees in electrical angle and remain in the excited state. Please use this system in the situation that the above action is allowable.
- 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 Safe-Torque-Off function

10.2.5 Delay circuit

We offer two paths, with or without delay circuit between safety input 1(HGWOFF1)/safety input 2 (HGWOFF2) input circuit and linear motor current control signal blocking circuit. When using in vertical axis, please use path with delay circuit to prevent motor shaft falling due to holding brake operation delay during safe torque off function operation.

Servo amplifier model number	Delay circuit (Max. delay time)
RS3#####2	No delay circuit (Max.20ms)
RS3#####4	With delay circuit (Max.700ms)

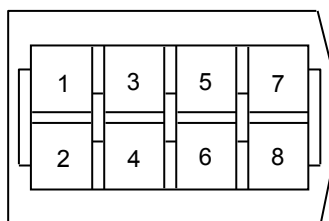
- * Even the hardware without delay circuit, there are still max. 20ms of delay until the safe torque off function works due to the delay in the input circuit.

10. Safe-Torque-Off function

10.3 Wiring

10.3.1 CN4 connector layout

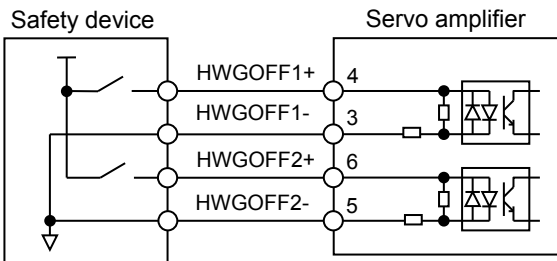
- CN4 2013595-3 (soldered side)



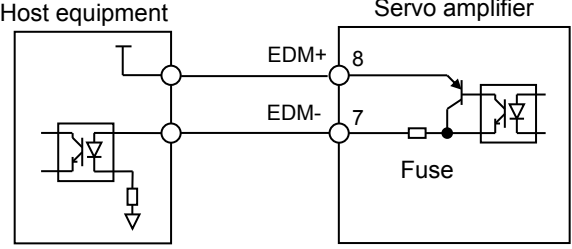
10.3.2 Connection diagram of CN4-terminals

Functions and connection circuit of each CN4-terminal are as shown below.

Signal	Terminal No.	Code	Description
	1		These are connecting terminals when the function is not used. Do not use these terminals.
	2		
Safety input 1	3	HWGOFF1-	This is an input signal to control safe-torque-off state. Connection circuit Connects to relay or transistor circuit of open collector. Power supply voltage range: DC24V±10% Internal impedance: 2.2kΩ
	4	HWGOFF1+	
Safety input 2	5	HWGOFF2-	
	6	HWGOFF2+	



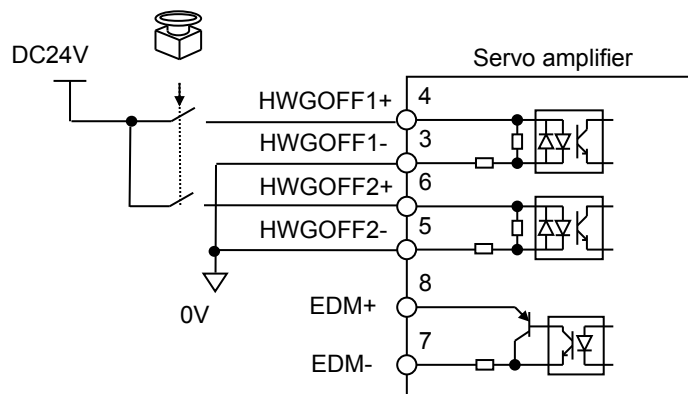
10.3 Wiring

Signal	Terminal No.	Code	Description
Error detection monitor	7	EDM-	This is a signal to monitor safe-torque-off functions faults. Connection circuit: Connects to photo coupler or relay circuit. Power supply voltage range (Uext): DC24V±10% Maximum current value: 50mA Output voltage: Uext-0.5 -Uext 
	8	EDM+	

- * When you do not use this function, connect terminal 1 and 3, 5, and also connect terminal 2 and 4, 6 (short-circuit). A connector for short-circuit, PN# AL-00718251-01, is available as an option.

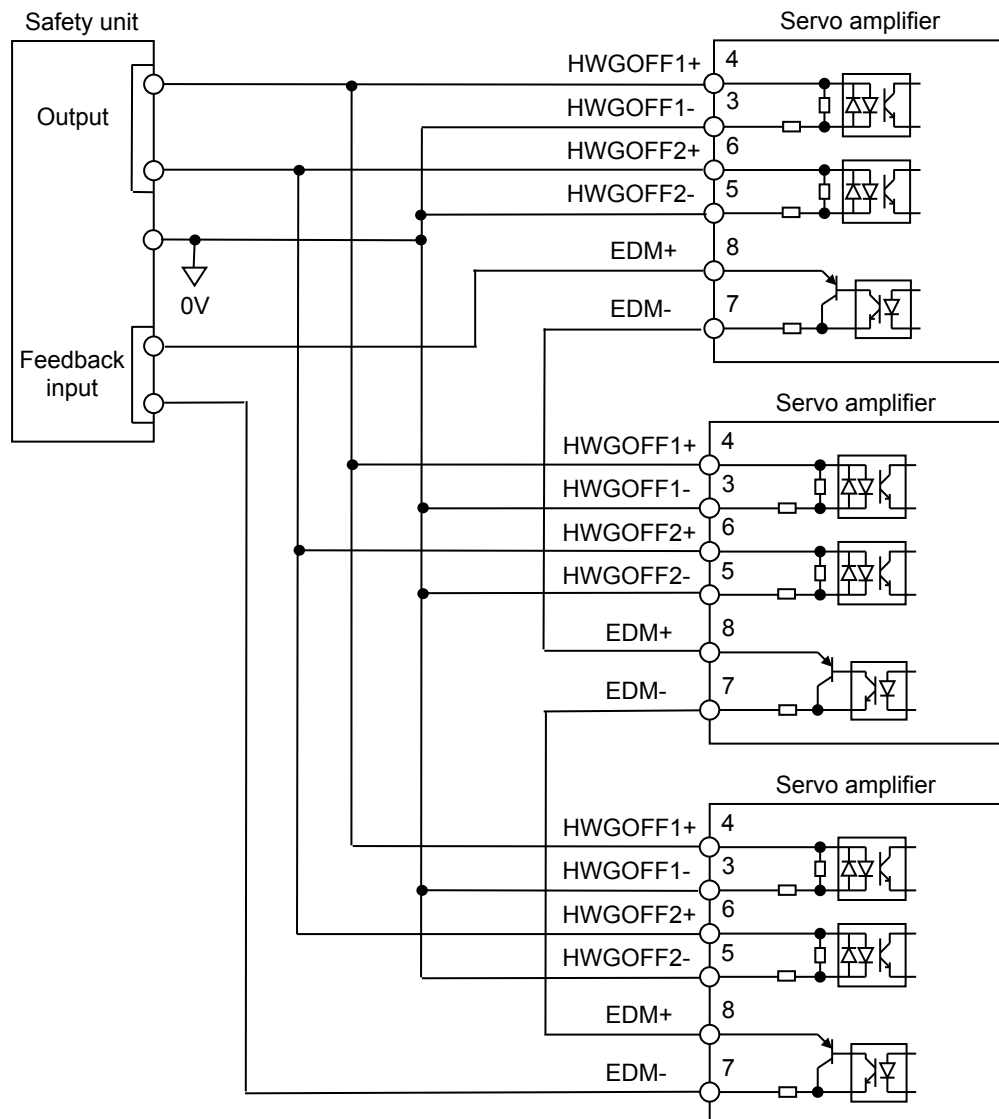
10.3.3 Example of wiring

Example of wiring to safety switch (single servo amplifier connected)



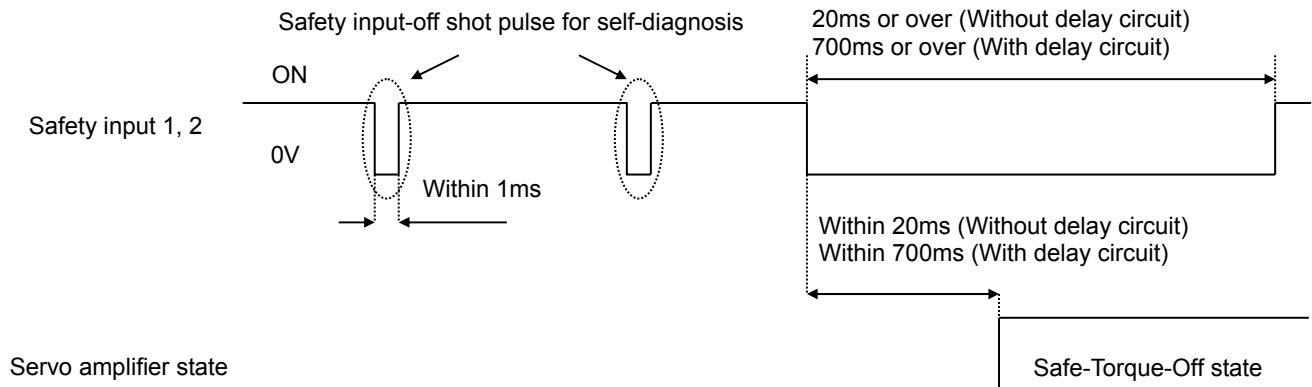
10. Safe-Torque-Off function

Example of wiring to safety unit (multiple-servo amplifier connected)



10.3.4 Safety input-off shot pulse for safety device self-diagnosis

When you connect safety device supplied with safety input-off shot pulse signal for self-diagnosis added to safety output signal, such as safety unit or safety sensor, use safety device whose safety input-off shot pulse signal is 1ms or less. Safe-torque-off function is not activated when the period of safety input signal (HWGOFF1, HWGOFF2)-OFF is 1ms or less. In order to surely fulfill safe-torque-off function, turn off safety input signal for 20ms or more (without delay circuit) or 700ms or more (with delay circuit).



- * Torque may turn off for a moment if the pulse of 1ms over to less than 8ms is input.

10. Safe-Torque-Off function

10.4 Safe-Torque-Off operation

10.4.1 Safe-torque-off state

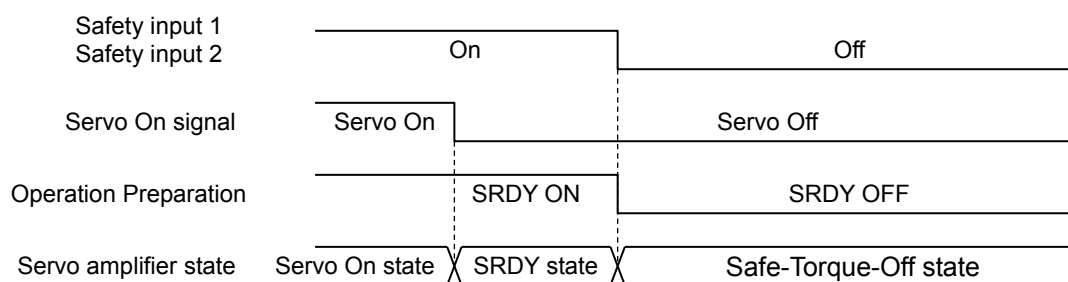
When safety input 1 (HWGOFF1) or safety input 2 (HWGOFF2) signal is off (as shown the table below), the state becomes safe-torque-off state.

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).

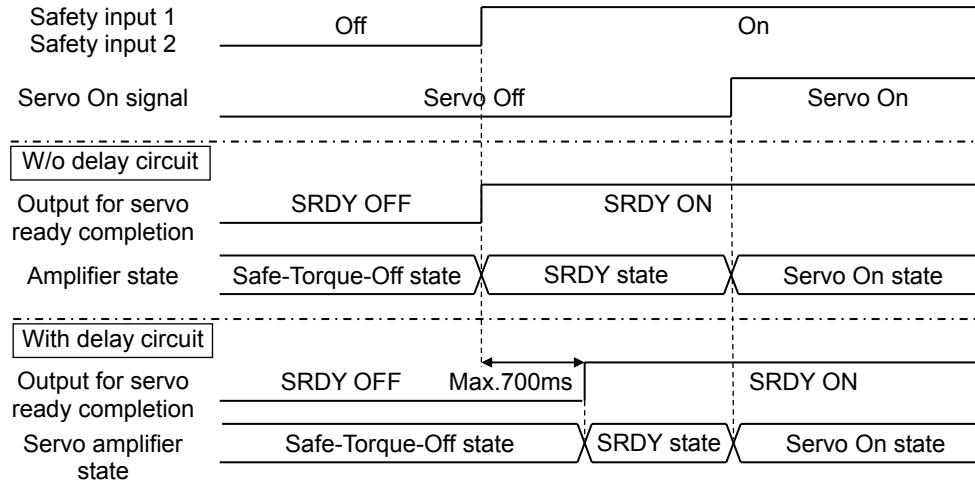
* On: Electric current will flow (contact closed).



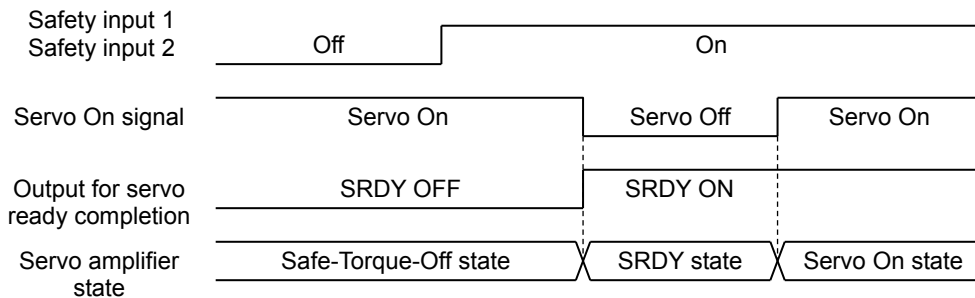
10.4 Safe-Torque-Off operation

10.4.2 Restoration from safe-torque-off state

In the state servo-on signal is not input as described in 10.4.1, turning on safety input 1 or 2 activates SRDY state. Operation is restarted on inputting servo-on signal. (For delay circuit equipped hardware, it takes maximum 700ms to become SRDY state.)



In the state servo-on signal is input, safe-torque-off activated state remains even if safety input 1 or 2 is turned on. To restart operation, turn off servo-on signal to activate SRDY state, then input servo-on signal.



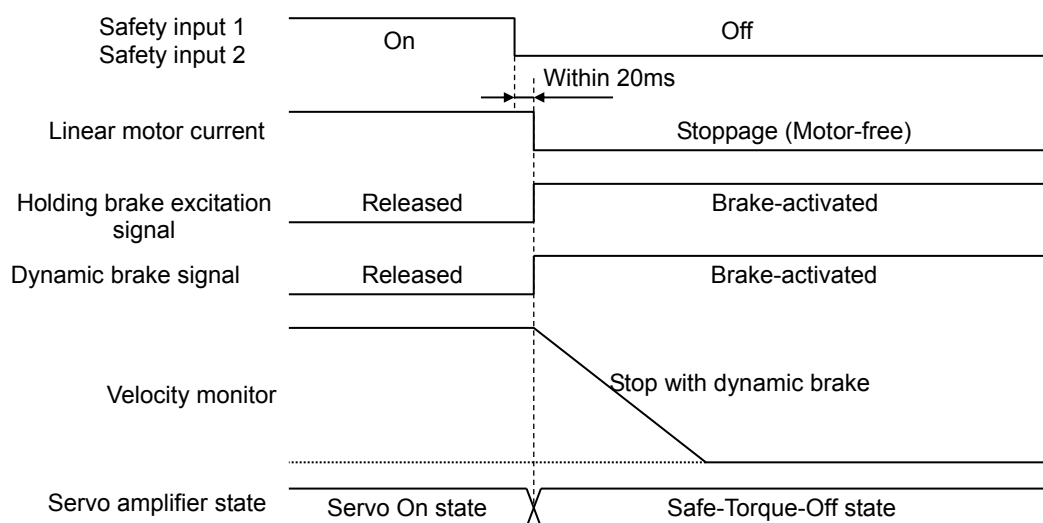
- * Group9 ID05: Setting the Servo-ON Function parameter to "01: Always On" disables resets from the safe torque off state. Avoid this setting when using the safe torque off function .

10. Safe-Torque-Off function

10.4.3 Safe-Torque-Off during linear motor running

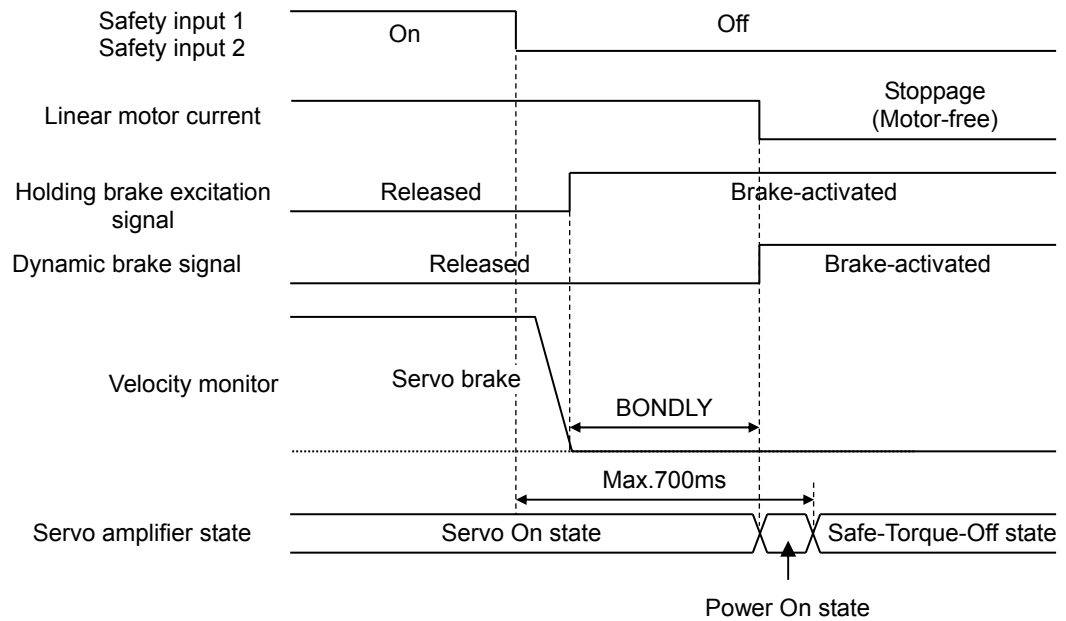
Stoppage behavior varies depending on forced outage operation settings (ACTEMR Group B ID02).

- In case of setting "00: SERVO-BRAKE" at GroupB ID02 "Emergency Stop Operation [ACTEMR]".
Stoppage behavior varies depending on amplifier model numbers.
- ◆ RS3#####2 (without safe-torque-off delay circuit)
Motor cannot stop with servo brake when safety input 1 or 2 is turned off because linear motor current is blocked. So motor shall be stopped with dynamic brake or holding brake.



10.4 Safe-Torque-Off operation

- ◆ RS3#####4 (with safe-torque-off delay circuit)
Motor stops with servo brake when safety input 1 or 2 is turned off.



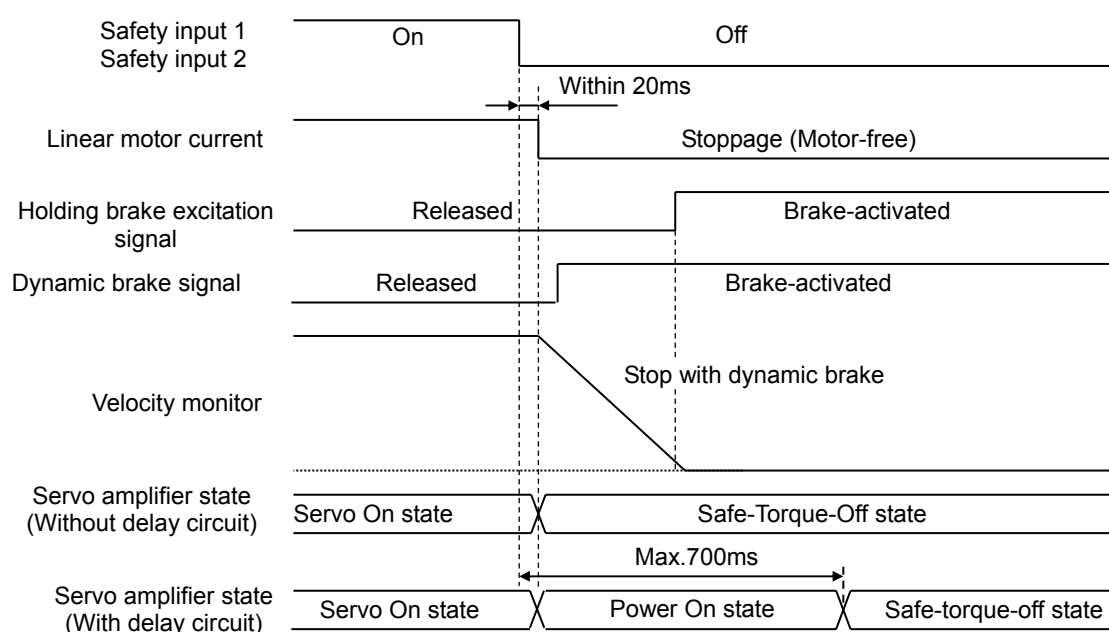
- * When set value of GroupB ID03 "Holding brake activation delay time [BONDLY]" is more than safe-torque-off delay time (700ms max.), the state becomes motor-free after period of safe-torque-off delay time. Please note that recommended set value for BONDLY is less than 300ms.
- * Servo brake circuit, dynamic brake circuit, and holding brake excitation signal are not safety-related sections.

10. Safe-Torque-Off function

- 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 linear motor current, and then stops linear motor with dynamic brake after. Transition behavior to safe-torque-off state varies depending on amplifier model numbers.

- ◆ RS3#####2 (without safe-torque-off delay circuit)
Safety input is turned off and then the status comes to safe-torque-off state at the same time dynamic brake applied.
- ◆ RS3#####4 (with safe-torque-off delay circuit)
The state moves to safe-torque-off state after period of delay time (500ms max.) from turning off safety input. Dynamic brake is activated on turning off safety input.

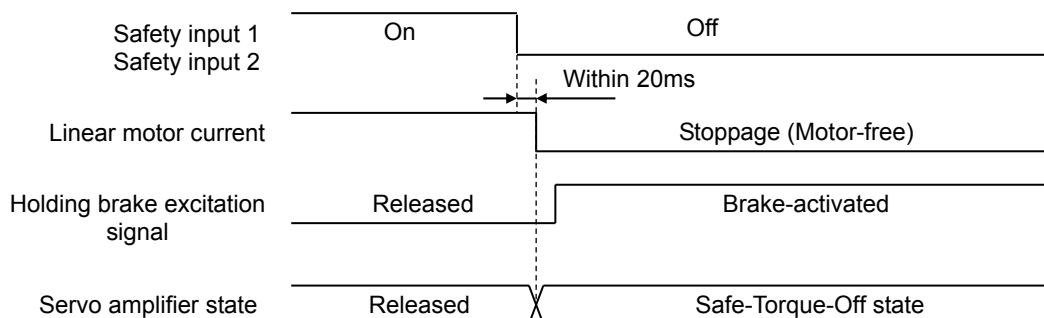


* Dynamic brake circuit and holding brake excitation signal are not safety-related sections.

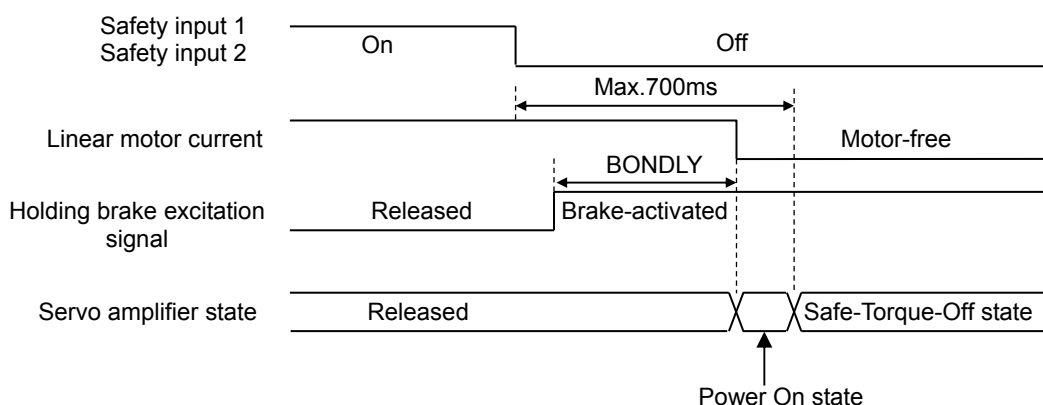
10.4 Safe-Torque-Off operation

10.4.4 Safe-Torque-Off during linear motor stoppage

When safety input 1 or safety input 2 is turned off, holding brake signal outputs brake-activated state, however this blocks linear motor current, so “holding brake activation delay time” becomes invalid. In line with this, linear motor may run by an external force during the period from the time holding brake signal activation state output to the time holding brake being activated.



When you use amplifier model number RS3#####4 (with safe-torque-off delay circuit), you can ensure the time to activate holding brake because of maximum 700ms of delay time by the time safe-torque-off function activated after safety input 1 or 2 is input. Select amplifier model number RS3#####4 for use in gravity axes.



- * Set GroupB ID03 “Holding brake activation delay time [BONDLY]” to the value less than 700ms.
- * Set GroupB ID02 “Emergency Stop Operation [Emergency Stop Operation]” to “00: SERVO-BRAKE”.

10. Safe-Torque-Off function

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, linear 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 Error Detection Monitor (EDM)

10.5.1 Specifications

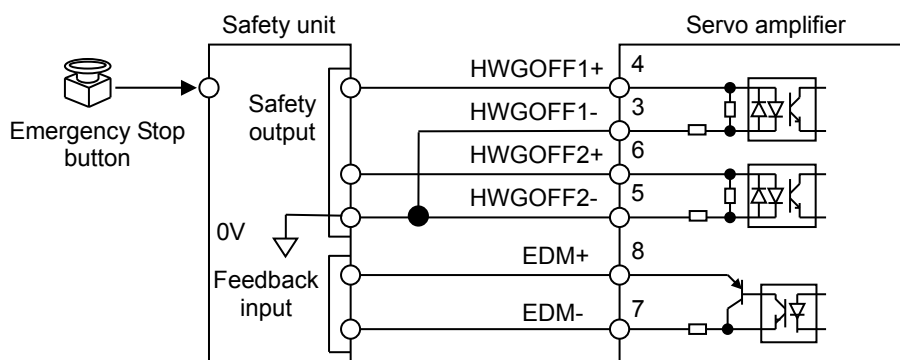
Error detection monitor (EDM) output is a signal to monitor wiring errors in safe-torque-off circuit or between safety equipment and safety input. The following table shows connections between safety input (HWGOFF1 and HWGOFF2) and error detection monitor (EDM) output.

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. Safe-Torque-Off function

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 amp 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 linear motor properly operate. Refer to “3. Installation” through “5.2 Test Operation” for installation, wiring, and test operation.

10.6.2 Confirmation procedure

Perform verification test for safe-torque-off in accordance with the follow the procedures:

Procedure 1. Supply control power and main circuit power.

Procedure 2. Turn on both safety input 1 and 2.

Procedure 3. Input servo-on signal to excite linear motor.

Procedure 4. Turn off both safety input 1 and 2.

10.6.3 Acceptance criteria

In steps 2 to 4, verify the states listed below.

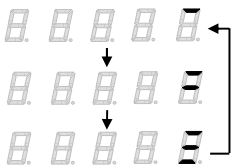
Procedure 1. In step 2, make sure that EDM output and LED indication are as follows:

Confirmation item	State
EDM output	Off
LED indication	

Procedure 2. In step 3, verify that linear motor is excited.

Procedure 3. In step 4, verify that EDM output and LED indication are as follows:

Also, verify that linear motor excitation is cancelled.

Confirmation item	State
EDM output	On
LED indication	

10.7 Safety precautions

Please thoroughly observe the following safety precautions to use safe-torque-off functions. Incorrect use of the functions can lead to personal injury or death.

- * Safety system with safe-torque-off function shall be designed by the person with expertise of related safety standards and through understanding of the descriptions specified in this manual.
- * Surely perform system risk assessment when you design safety system by using this function.
- * When safe-torque-off function activated during linear motor running, power supply to linear motor is blocked but linear motor remains running through inertia. Please design your safety system so that no risks occur until linear motor comes to a complete stop.
- * When used in vertical axes, linear 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 linear motor holding brake are not safety-related sections.
- * There is a possibility that linear motor runs in the range of maximum 180 electrical degree and linear 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.

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Selection

In this chapter, each kind of selections are explained.

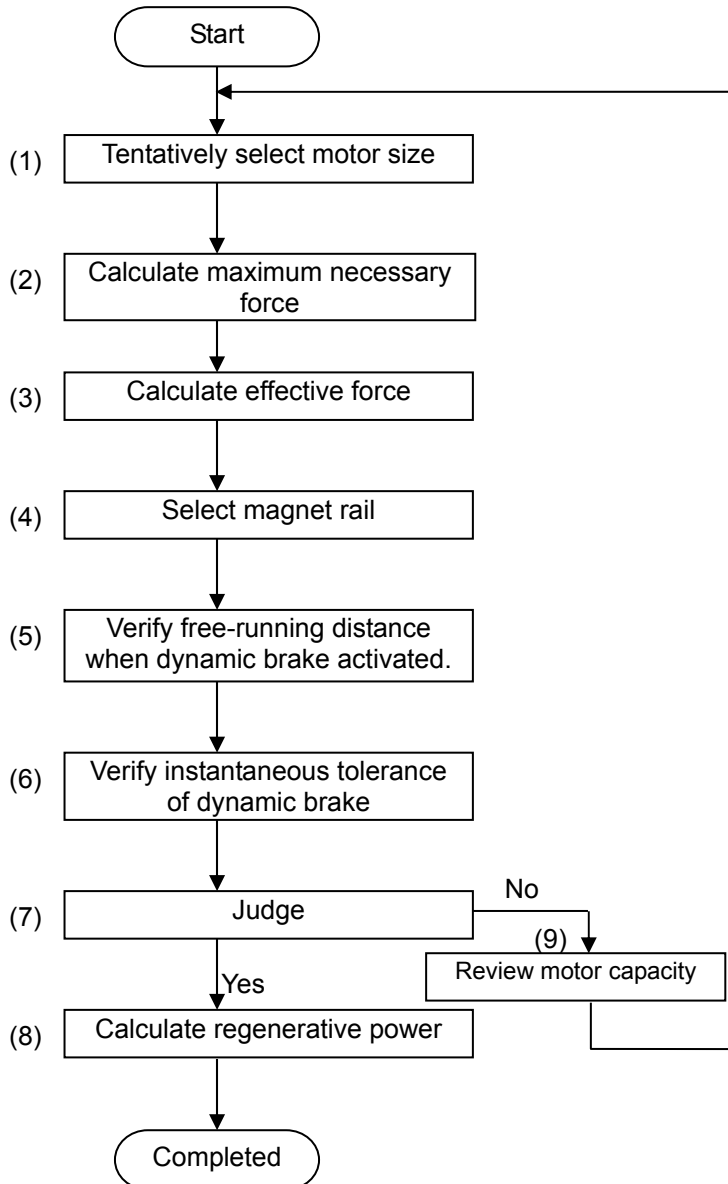
11.1 Linear motor sizing	11-1
11.1.1 Flowchart of linear motor sizing	11-1
11.1.2 Maximum necessary force and necessary effective force.....	11-2
11.1.3 Select magnet rail	11-3
11.1.4 Cautions on load conditions	11-4
11.2 Regenerative resistor sizing	11-5
11.2.1 Calculate "regenerative effective power (PM)" of driving in a horizontal axis.	11-5
11.2.2 Selection of regenerative resistor	11-6
11.2.3 Selection of external regenerative resistor	11-7
11.2.4 Specification of external regenerative resistor.....	11-8
11.2.5 Connection of regenerative resistor.....	11-9
11.2.6 Thermostat connection of external regenerative resistor	11-10
11.2.7 Protection function of regenerative resistor	11-10
11.2.8 Confirmation method of regeneration power PM in actual operation	11-11
11.2.9 Precautions for external regenerative resistor use	11-12

11. Selection

11.1 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.

11.1.1 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

11.1 Linear motor sizing

11.1.2 Maximum necessary force and necessary effective force

- Calculate frictional force: F_f

$$F_f = (M \cdot g \cdot \cos\theta + F_{att}) \cdot \mu + F_{add} \quad [\text{N}]$$

M_c	: Mover mass	[kg]	
M_L	: Load mass	[kg]	
M	: Moving part mass = $M_c + M_L$	[kg]	
g	: Gravity acceleration= 9.8	[m/s ²]	
$\cos\theta$	: Angle to horizontal driving surface	[rad]	(For horizontal surface, $\cos\theta=1$)
F_{att}	: magnetic attractive force	[N]	
μ	: Frictional coefficient		
F_{add}	: Sealing resistance	[N]	(including kinetic friction, cover friction, and cable routing resistance)

- Calculate gravity applied to moving parts.

$$F_w = M \cdot g \cdot \sin\theta \quad [\text{N}]$$

M	: Mover mass = $M_c + M_L$	[kg]	
g	: Gravity acceleration= 9.8	[m/s ²]	
θ	: Angle to horizontal driving surface	[rad]	(For horizontal surface, $\sin\theta=0$)

- Calculate maximum necessary force: F_{max} , and then confirm that "maximum motor force $F_p > \text{maximum necessary force: } F_{max}$ ".

$$F_{max} = M \cdot a_{max} + F_f + F_w + F_{work} \quad [\text{N}]$$

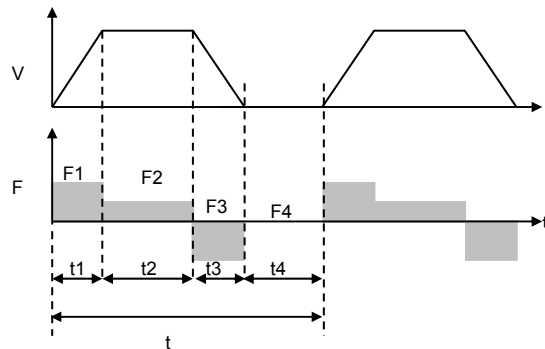
M	: Mover mass= $M_c + M_L$	[kg]	
a_{max}	: Maximum acceleration	[m/s ²]	
F_f	: Frictional force	[N]	
F_w	: Gravity	[N]	
F_{work}	: Process reaction force	[N]	

- * Having a margin of " $0.9 \cdot F_p \geq F_{max}$ " or more is recommended in consideration of load fluctuation.

11. Selection

- Confirm that "motor continuous rated force: $F_r > \text{effective force: } F_{rms}$ ".

$$F_{rms} = \sqrt{\frac{(F_1^2 \cdot t_1 + F_2^2 \cdot t_2 + F_3^2 \cdot t_3 + \dots)}{t}} \quad [N]$$



- * Having a margin of " $0.9 \cdot F_r \geq F_{rms}$ " or more is recommended in consideration of load fluctuation.

11.1.3 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 $\geq$ 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.

11.1.4 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. Selection

11.2 Regenerative resistor sizing

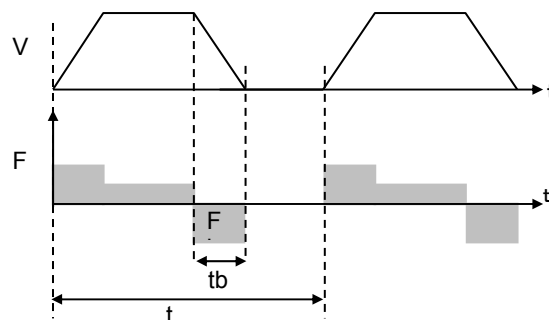
Decide regenerative resistor capacity you use by calculating "regenerative effective power (PM)".
You can judge whether built-in resistor can be used or not, based on this calculation result.

11.2.1 Calculate "regenerative effective power (PM)" of driving in a horizontal axis.

- Calculate regenerative energy.

$$PM = \left[\left[\frac{1}{2 \cdot t} \cdot M \cdot V^2 \right] - \left[\frac{v}{2 \cdot t} \cdot F_f \cdot t_b \right] \right] - \left[\left[\frac{3 \cdot R \phi \cdot t_b}{t} \right] \times \left[\frac{M \cdot V - F_f \cdot t_b}{K_f \cdot t_b} \right]^2 \right] \quad [J/s]=[W]$$

PM	: Regenerative power	[W]
M	: Moving part mass	[kg]
V	: Velocity immediately before deceleration	[m/s]
t	: Cycle	[s]
t _b	: Deceleration time	[s]
F _f	: Frictional force	[N]
Rφ	: Resistance per 1 phase of motor	[Ω]
K _f	: Force constant	[N/A]



$$F_b = M \cdot V / t_b - F_f$$

11.2 Regenerative resistor sizing

11.2.2 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 resistance capacity	Resistance value
RS3A01L##A#	Less than 5W	408J	50Ω
RS3A02L##A#	Less than 5W	408J	50Ω
RS3A03L##A#	Less than 5W	408J	50Ω
RS3A05L##A#	Less than 20W	743J	17Ω
RS3A07L##A#	Less than 60W	2300J	10Ω
RS3A10L##A#	Less than 90W	4400J	10Ω
RS3A15L##A#	Less than 120W	6400J	6Ω

- Allowable power of an external regenerative resistor
When regeneration effective power "PM" becomes more than the allowable power of the amplifier internal regenerative resistor, the optional external regenerative resistor which is shown at "11.2.4" can be connected and operated. Allowable regenerative power and minimum resistance value of regenerative resistor are shown in below table.

Servo amplifier model number	Allowable regeneration resistance power to be used by an external regenerative resistor [PRO]	Allowable minimum resistance value of external regenerative resistor
RS3A01L##L#	Less than 125W	35Ω
RS3A02L##L#	Less than 125W	35Ω
RS3A03L##L#	Less than 125W	35Ω
RS3A05L##L#	Less than 250W	17Ω
RS3A07L##L#	Less than 500W	10Ω
RS3A10L##L#	Less than 500W	10Ω
RS3A15L##L#	Less than 500W	6Ω
RS3A30L##L#	Less than 500W	2.5Ω

- * When regeneration effective power PM exceeds the maximum permitted power (PRO) of the external regeneration resistor, reconsider the acceleration constant, load inertia, etc.

11. Selection

11.2.3 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
RS3A01L##L# RS3A02L##L# RS3A03L##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
RS3A05L##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
RS3A07L##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
RS3A10L##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
RS3A15L##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
RS3A30L##L#	Resistor Sign	J×1	L×1	L×2
	Connection Number	III	III	V

- * The resistor sign of an external regeneration resistor and the connection number correspond with the following page.
- * The permissible effective power of external regenerative resistor is maximum 25% of the rated power under natural air cooling.
- * The permissible effective power of external regenerative resistor is maximum 50% of the rated power under forced air cooling by fan.

11.2 Regenerative resistor sizing

11.2.4 Specification of external regenerative resistor

The resistor model name corresponds with the sign of the external regeneration resistor selected for the preceding clause.

Resistor Sign	Resistor Model Number	Rated power [PR]	Resistance Value	Thermostat Detection temperature (Contact specification)	Permissible Effective Power [PM]	Allowable instantaneous capacity [JI]	Mass
A	REGIST-080W100B	80W	100 Ω	135°C $\pm$ 7°C (Switching contact b)	20W	35J	0.19kg
B	REGIST-080W50B	80W	50 Ω		20W	35J	
C	REGIST-120W100B	120W	100 Ω		30W	50J	0.24kg
D	REGIST-120W50B	120W	50 Ω		30W	80J	
E	REGIST-220W100B	220W	100 Ω		55W	90J	0.44kg
F	REGIST-220W50B	220W	50 Ω		55W	125J	
G	REGIST-220W20B	220W	20 Ω		55W	210J	
H	REGIST-500CW20B	500W	20 Ω	100°C $\pm$ 5°C (Switching contact b)	125W	9700J	1.4kg
I	REGIST-500CW10B	500W	10 Ω		125W	9300J	
J	REGIST-500CW7B	500W	7 Ω		125W	7500J	
K	REGIST-500CW14B	500W	14 Ω		125W	13000J	
L	REGIST-1000W6R7B	1000W	6.7 Ω	140°C $\pm$ 5°C (Switching contact b)	250W	26000J	3.0kg

* See "12.7.5 Outline drawing of regenerative resistor" for external dimension of regenerative resistor.

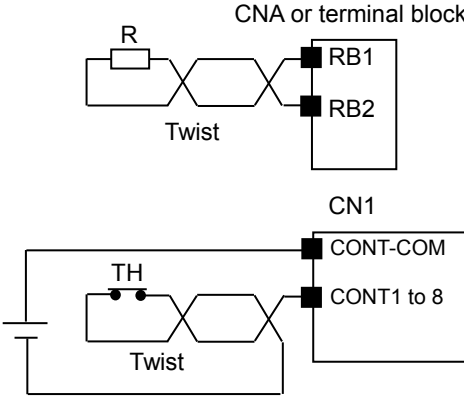
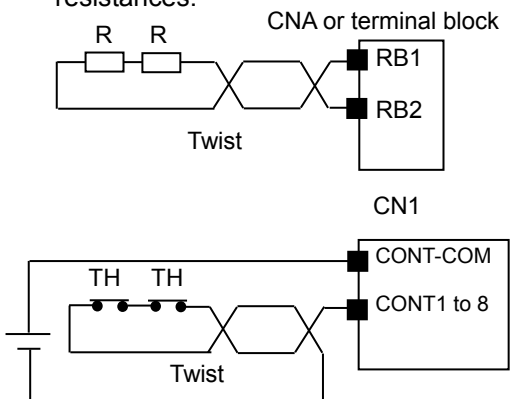
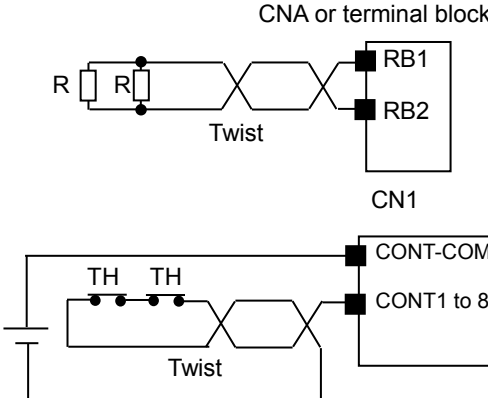
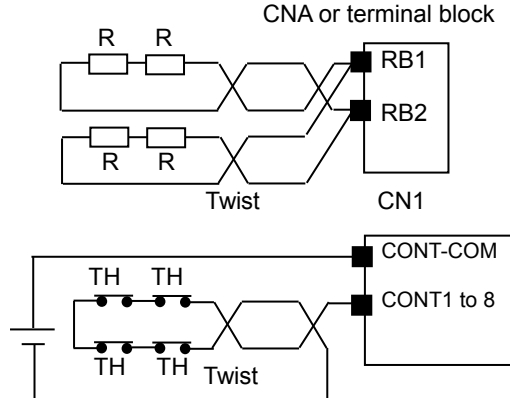
* Permissible Effective Power value is at condition of natural air cooling.

11. Selection

11.2.5 Connection of regenerative resistor

The connection method of a resistor corresponds with the connection number of the external regeneration resistor selected by the 11.2.3 clause.

■ Connection of regenerative resistor

Connection Number III	Connection Number IV
■ One resistance is connected.  Connect a thermostat to the general-purpose input of CN1.	■ Series connection about two resistances.  Connect a thermostat to the general-purpose input of CN1.
Connection Number V	Connection Number VI
■ Parallel connection about two resistances.  Connect a thermostat to the general-purpose input of CN1.	■ Series/ parallel connection about four resistances.  Connect a thermostat to the general-purpose input of CN1.

* For amplifier: capacity 75A/100A/150A, mount an external regenerative resistor to terminals of RB1 and RB2 after removing short-bar between RB1 and RB4.

11.2 Regenerative resistor sizing

11.2.6 Thermostat connection of external regenerative resistor

Connect a thermostat to either of "the general-purpose inputs CONT1-CONT8". Depending on the connected general-purpose input signal terminal, please set Group9 ID40 "External Trip Input Function [EXT-E]".

- Example: when connecting the thermostat to CONT6
The external trip function will be valid when "0DH:CONT6_OFF" is set to Group9 ID40 "External Trip Input Function" and CONT6 is turned off. Alarm AL.55 will be output from the servo amplifier when the thermostat of a regenerative resistor trips (the contact point comes off) because of heating. Refer to "4.2 Wiring with host unit for the wiring method".

11.2.7 Protection function of regenerative resistor

The regenerative resistor protection function is specified by parameter selections. Appropriate protection for regenerative resistor is applied by setting parameters according to the type of regenerative resistor to be connected. Set the appropriate parameters by following the instructions given below.

- The two parameters requiring settings are given below.
 - ◆ System parameter ID03 "Regenerative resistor selection"
 - Must set "01: Built-in_R" when internal regenerative resistor is used.
 - Must set "02: External_R" when external regenerative resistor is used.
 - ◆ Group9 ID40 "External Trip Input Function"
 - When thermostat is connected to the servo amplifier, please set Group9 ID40 "External Trip Input Function [EXT-E]" depending on the connected general-purpose input signal terminal.
- The protection functions are divided into three main types:
 - ◆ Protection for a short-time, high load factor (using built-in or external regenerative resistor):
 - ◆ An error is detected when the power absorption of regenerative resistor is extremely high over a short time period (100msec to 10 seconds). A 'Regenerative Error' alarm "AL.43" is issued when this error is detected.
 - ◆ Protection when allowable power absorption is exceeded for long time (using built-in regenerative resistor):
An error is detected when the power absorption of the built-in regenerative resistor exceeds the allowable power absorption over a long time period (from a few seconds to a few minutes). An 'Internal Overheat' alarm "AL.54" is issued when this error is detected.
 - ◆ Protection during thermostat operation of the external regenerative resistor:
An error will be detected when External Trip Function works. An 'External Error' alarm "AL.55" is issued when this error is detected.

11. Selection

11.2.8 Confirmation method of regeneration power PM in actual operation

Regeneration power PM can be easily confirmed through the digital operator or 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 AC200V specification

$$\text{Regeneration effective power [PM](W)} = \frac{400(\text{V}) \times 400(\text{V})}{\text{Regeneration resistance}(\Omega)} \times \frac{\text{Regenerative Resistor Operation Percentage}(\%)}{100(\%)}$$

◆ Input Supply Voltage: In case of AC100V specification

$$\text{Regeneration effective power [PM](W)} = \frac{200(\text{V}) \times 200(\text{V})}{\text{Regeneration resistance}(\Omega)} \times \frac{\text{Regenerative Resistor Operation Percentage}(\%)}{100(\%)}$$

- Calculation Example

Input Supply Voltage: [AC200V Specification]

Regeneration resistance value: 50 Ω [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.

11.2 Regenerative resistor sizing

11.2.9 Precautions for external regenerative resistor use

- The place where corrosive gas has occurred, and when there is much dust, insulated degradation, corrosion, etc .may arise. There fore be careful of an attachment place.
- External regeneration resistor should be placed by keeping enough distance from the other parts so as not to be affected by the other parts-generated heat.
- Must wiring by twisted lines to external regenerative resistor. Wiring length keeps 5 m or less, and aims as short as it can.
- Wiring should keep no contact with regenerative resister, and using flame-retardant cable or giving flame-retardant by silicon tube.

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Appendix

In this chapter, linear motor outline drawing and datasheet, servo amplifier outline drawing and option parts are explained.

12.1 Standards Conformity	12-1
12.1.1 Standards Conformity	12-1
12.1.2 Over-voltage Category, Protection Grade, Pollution Level	12-2
12.1.3 Connection and installation	12-2
12.1.4 UL File Number	12-2
12.2 Compliance with EN Directives	12-3
12.2.1 Conformity verification test	12-3
12.2.2 EMC Installation Requirements	12-4
12.3 Linear motor dimensions	12-5
12.3.1 Linear motor with core, flat-type	12-5
12.3.2 Linear motor with core, twin-type	12-8
12.3.3 Linear motor, twin-type	12-11
12.3.4 Linear motor, center magnet-type	12-12
12.3.5 Linear motor, cylinder-type	12-13
12.4 Linear motor data sheet	12-14
12.4.1 Characteristics table	12-14
12.4.2 Velocity-force characteristics	12-17
12.4.3 Overload characteristics	12-21
12.5 Servo amplifier dimensions	12-25
12.5.1 RS3A01L□□L□	12-25
12.5.2 RS3A02L□□L□	12-25
12.5.3 RS3A03L□□L□	12-26
12.5.4 RS3A05L□□L□	12-26
12.5.5 RS3A07L□□L□	12-27
12.5.6 RS3A10L□□A□	12-27
12.5.7 RS3A15L□□A□	12-28
12.5.8 RS3A30L□□L□	12-28
12.6 Optional parts	12-29
12.6.1 Connectors of servo amplifier	12-29
12.6.2 Fixing bracket	12-35
12.6.3 Analog monitor related item	12-37
12.6.4 Communication cable of tandem operation between amplifiers	12-37
12.6.5 External regenerative resistor	12-38
12.7 Optional parts dimensions	12-39
12.7.1 Monitor box outline drawing	12-39
12.7.2 Dedicated Cable outline drawing	12-39
12.7.3 Outline drawing of USB communication cable	12-40
12.7.4 Outline drawing of communication cable of tandem operation between amplifiers	12-40
12.7.5 Outline drawing of regenerative resistor	12-41

12. Appendix

12.1 Standards Conformity

In our company, compatibility examinations of standards concerned are carried out in certificate authorities, and attestation markings are done based on the published certificate of attestation.

12.1.1 Standards Conformity

■ This servo amplifier implements the standards examinations below.

Product model NO.	Applicable laws and Regulations		Standard code	Certificate authorities
	Class	Detailed class		
RS3###L### #	UL/c-UL standards	---	UL61800-5-1	UL (Underwriters Laboratories inc.) 
RS3###L### 0 (Safe Torque Off function Unequipped model)	Electrical safety	Electrical safety under Low Voltage Directive (2014/35/EU)	IEC61800-5-1:2007/ EN61800-5-1:2007	TÜV (TÜV SÜD Japan, Ltd.) 
	EMC	EMC under EMC Directive (2014/30/EU)	EN61000-6-2:2005 IEC61800-3:2004(Note.1)/ EN61800-3:2004 A1:2012(Note.1)	TÜV (TÜV SÜD Japan, Ltd.)
RS3###L### 2 RS3###L### 4 (Safe Torque Off function equipped model)	Electrical safety	Electrical safety under Low Voltage Directive (2014/35/EU)	IEC61800-5-1:2007/ EN61800-5-1:2007	TÜV (TÜV SÜD Japan, Ltd.)  (Blue octagon)
	Mechanical safety	Machine safety under Machinery Directive (2006/42/EC)	IEC60204-1:2005/ EN60204-1:2006	
	Functional Safety	Generic Functional safety	IEC61508:2010/ EN61508:2010(SIL3)	
		Functional safety under Machinery Directive (2006/42/EC)	IEC62061/A1:2012/ EN62061/A1:2013 (SILCL3)	
		Functional safety under Machinery Directive (2006/42/EC)	EN ISO13849-1/ AC:2009(Cat.3, PL=e)	
		Functional safety for PDS under Machinery Directive (2006/42/EC)	IEC61800-5-2:2007/ EN61800-5-2:2007	
	EMC	EMC under EMC Directive(2014/30/EU)	IEC61800-3:2004(Note.1)/ EN61800-3:2004 A1:2012(Note.1)	
		Functional safety EMC for machine, factory automation application	IEC61326-3-1:2008/ EN61326-3-1:2008	
RS3###L### #	KC Mark		KN61000-6-2 KN61000-6-4	Ministry of Science, ICT & Future Planning 

■ Linear motors are not certified by the standards concerned.

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.

12.1 Standards Conformity

12.1.2 Over-voltage Category, Protection Grade, Pollution Level

- The "over-voltage category" of servo amplifier is "III" (EN61800-5-1). For the interface, use a DC power supply with reinforced and insulated input and outputs.
- Make sure to install the servo amplifier in your control panel in an environment where the pollution level specified in EN61800-5-1 and IEC664 is no less than 2 (pollution level 1, 2). The protection grade of servo amplifiers are IP2X for 50A or less and IP1X for 100A or more. The control panel installation configuration (under IP54) must exclude exposure to water, oil, carbon, dust, etc.

12.1.3 Connection and installation

Be careful of connection and installation as follows.

- ✓ Always ground the protective ground terminals of the servo amplifier to the power supply ground.
- ✓ When connecting grounding wire to the protective ground 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 ground terminal to the power supply ground.
- ✓ Connect grounding wire by using a crimping terminal with insulated tube, so that the connected wire will not touch the neighboring terminals.
- ✓ For wire relays, use a fixed terminal block to connect wires; never connect wires directly.
- ✓ Connect an EMC filter to the input power supply of the unit.
- ✓ Use an EN/ IEC-standard compatible no-fuse Circuit breaker and electromagnetic contactor.
- ✓ Wiring for main circuit power shall be done as with the circuit shown in the section "4.1.6 Example of wiring", to break power at alarm.

12.1.4 UL File Number

The UL file number of servo amplifier and servo motor is as follows.
Can check from the website of UL. <http://www.ul.com/database/>

- The UL file number of servo amplifier: E179775

12. Appendix

12.2 Compliance with EN Directives

We implement the conformity verification test of "Low Voltage Directive" and "an EMC Directive" 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.

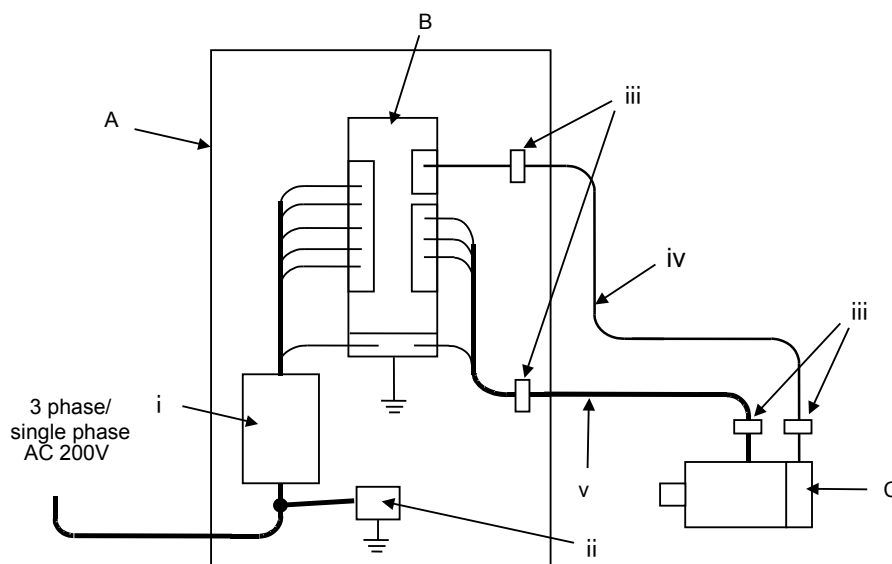
Directive classification	Classification	Test	Test standard
Low voltage Directive (Servo mplifier)	—	—	EN61800-5-1
EMC Directive (Servo mplifier)	Emission	Conducted emission	EN61800-3
		Radiated emission	EN61800-3
	Immunity	Electrostatic discharge immunity	EN61000-4-2
		Radiated electromagnetic field immunity	EN61000-4-3
		Electrical first transient/ burst immunity	EN61000-4-4
		Conducted disturbance immunity	EN61000-4-6
		Surge immunity	EN61000-4-5
		Voltage Dips & Interruptions immunity	EN61000-4-11
		Adjustable speed electrical power drive system	EN61800-3
		Safety of machinery	EN62061 (Annex E) Note 1)

Note 1) Standards applicable only to Safe Torque Off function equipped models.

12.2 Compliance with EN directives

12.2.2 EMC Installation Requirements

For the installation requirements, in our company the verification test is implemented by the following installations and measures methods, as machines and configurations differ depending on customers' needs. This servo amplifier has been authorized to display CE marking based on the recognition certificate issued by a certifying authority. Customers are instructed to perform the final conformity tests for all instruments and devices in use.



No.	Name	Remarks
A	Control panel	-
B	Servo amplifier	-
C	Servo motor	-
i	Noise filter (Recommended prevention components)	RS3A01 to RS3A07: HF3030C-SZA: SOSHIN ELECTRIC Co. Ltd. Rated voltage/rated current: Line-Line 480V AC / 30A RS3A10 to RS3A15: 3SUPF-CH40M-F: OKAYA ELECTRIC INDUSTRIES CO., LTD. Rated voltage/rated current: Line-Line 500V AC / 40A RS3A30: 3SUPF-CH80M-F: OKAYA ELECTRIC INDUSTRIES CO., LTD. Rated voltage/rated current: Line-Line 500V AC / 40A
ii	Surge-absorber (Recommended prevention components)	LV275DI-U4: OKAYA ELECTRIC INDUSTRIES CO., LTD.
iii	Clamp grounding	-
iv	Linear encoder cable Hall effect sensor cable	Shield cable
v	Linear 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 linear encoder cable, Hall effect sensor cable and linear motor power line. 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.

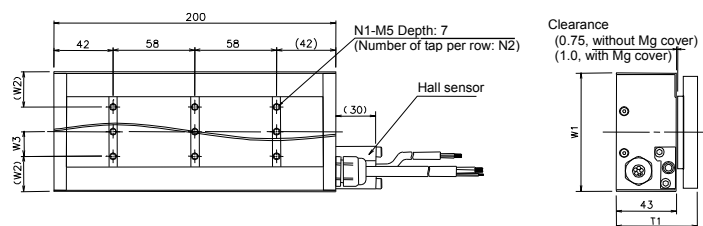
12. Appendix

12.3 Linear motor dimensions

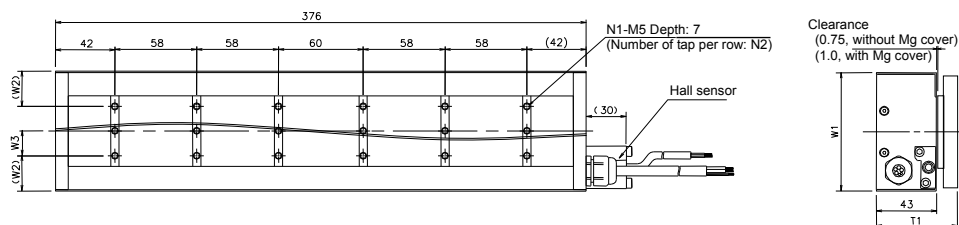
12.3.1 Linear motor with core, flat-type

- Outline dimensional drawing of coil with core, flat-type

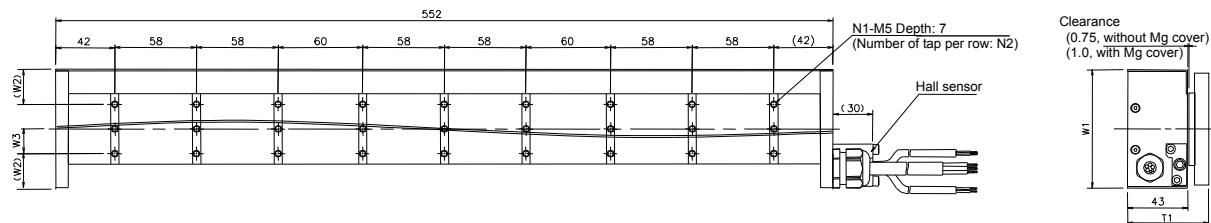
DS□□□C1



DS□□□C2



DS□□□C3

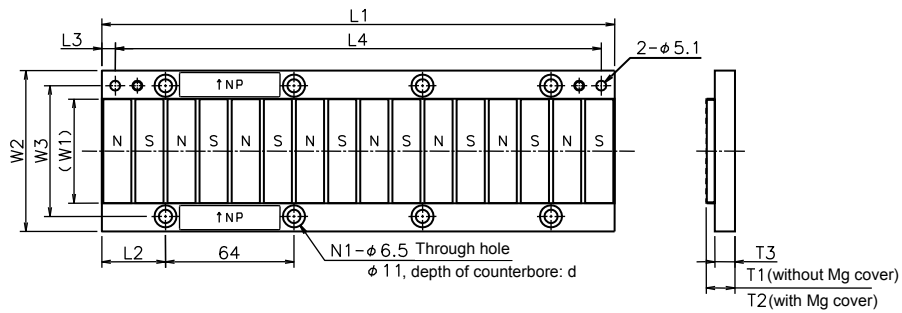


Coil model number		Dimensions and amount					
		W1(mm)	W2(mm)	W3(mm)	N1	N2	T1(mm)
DS030	C1N2	65	25	15	6	2	58
	C2N2				12		
	C3N2				18		
DS050	C1N2	85	25	35	6	2	58
	C2N2				12		
	C3N2				18		
DS075	C1N2	110	25	30	9	3	58
	C2N2				18		
	C3N2				27		
DS100	C1N2	135	32.5	35	9	3	58
	C2N2				18		
	C3N2				27		
DS150	C1N2	185	32.5	30	15	5	60
	C2N2				30		
	C3N2				45		

12.3 Linear motor dimensions

- Outline dimensional drawing of magnet rail with core, flat-type

DS□□□M□□□B00

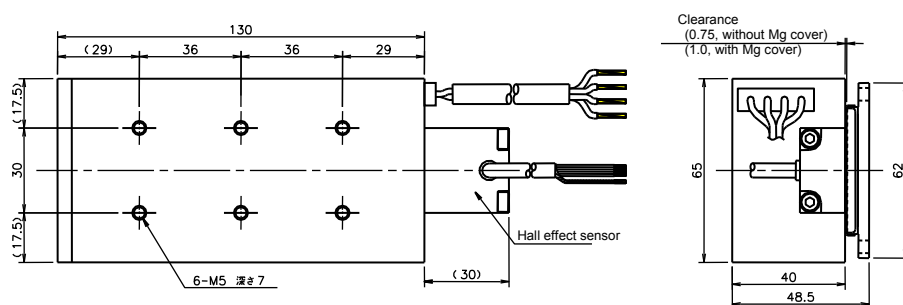


Magnet rail model number		Dimensions and amount											d (mm)
		L1 (mm)	L2 (mm)	L3 (mm)	L4 (mm)	W1 (mm)	W2 (mm)	W3 (mm)	T1 (mm)	T2 (mm)	T3 (mm)	N1	
DS030	M064	63.3	31.65	6.65	50	30	60	45	14	14.25	10	2	6
	M128	127.3			114							4	
	M256	255.3			242							8	
	M512	511.3			498							16	
DS050	M064	63.3	31.65	6.65	50	50	80	65	14	14.25	10	2	5
	M128	127.3			114							4	
	M256	255.3			242							8	
	M512	511.3			498							16	
DS075	M064	63.3	31.65	6.65	50	75	105	90	14	14.25	10	2	5
	M128	127.3			114							4	
	M256	255.3			242							8	
	M512	511.3			498							16	
DS100	M064	63.3	32	7	50	100	130	115	14	14.25	10	2	5
	M128	127.3			114							4	
	M256	255.3			242							8	
	M512	511.3			498							16	
DS150	M064	63.3	32	7	50	150	180	165	16	16.25	12	2	5
	M128	127.3			114							4	
	M256	255.3			242							8	
	M512	511.3			498							16	

12. Appendix

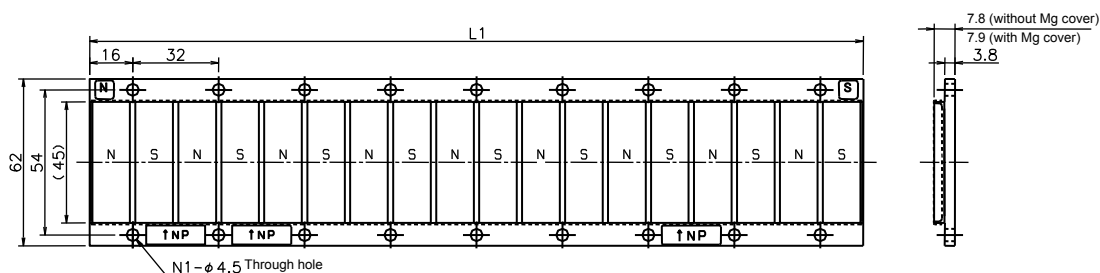
- Outline dimensional drawing of coil with core, flat-type (small type)

DS045CC1□□□□□00



- Outline dimensional drawing of magnet rail with core, flat-type (small type)

DS045MC□□□□□00

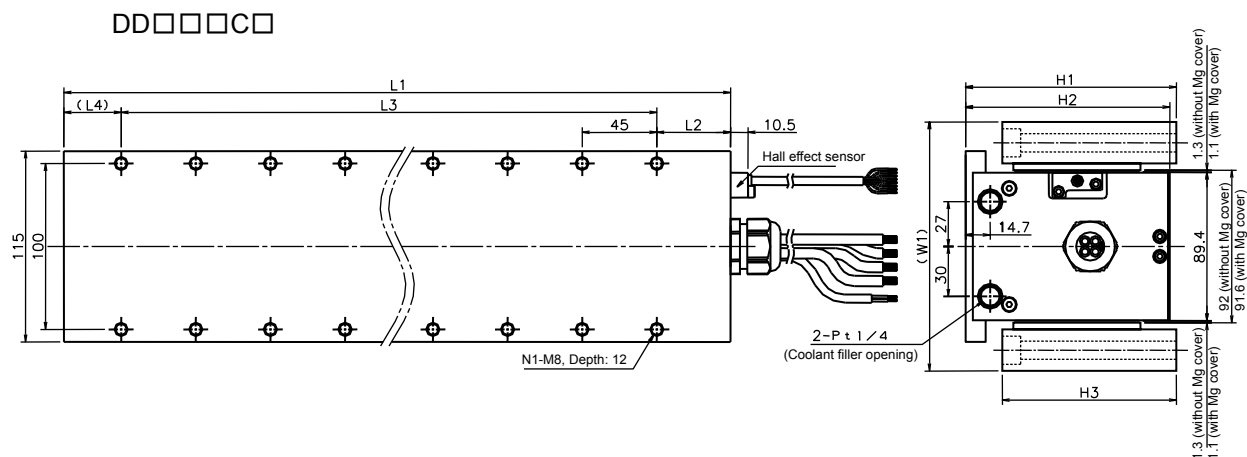


Magnet rail model number		Dimensions and amount	
		L1[mm]	N1
DS045M	C064□00	64	4
	C128□00	128	8
	C256□00	256	16
	C512□00	512	32

12.3 Linear motor dimensions

12.3.2 Linear motor with core, twin-type

- Outline dimensional drawing of coil with core, twin-type

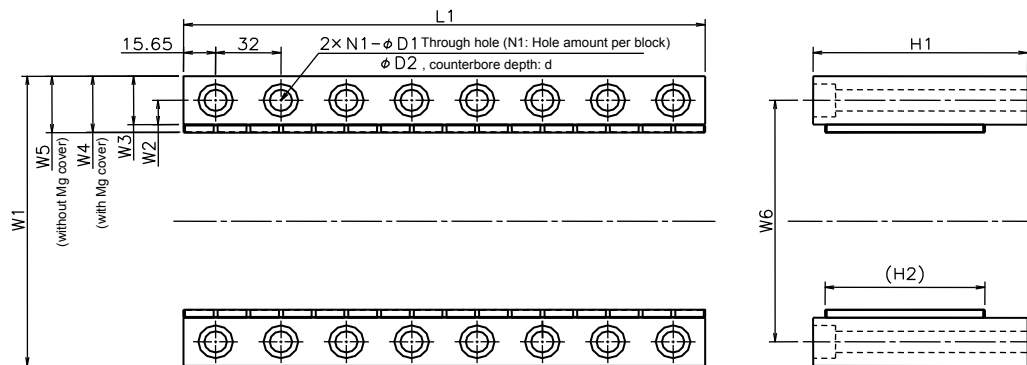


Coil model number		Dimensions and amount								
		L1(mm)	L2(mm)	L3(mm)	L4(mm)	N1	W1(mm)	H1(mm)	H2(mm)	H3(mm)
DD030	C1Y4	226	50.5	135	40.5	8	130	82	78	60
	C2Y4	402	48.5	315	38.5	16				
	C3Y4	578	46.5	495	36.5	24				
DD050	C1Y2	226	50.5	135	40.5	8	140	102	98	80
	C2Y2	402	48.5	315	38.5	16				
	C3Y2	578	46.5	495	36.5	24				
DD075	C1Y2	226	50.5	135	40.5	8	150	127	123	105
	C2Y2	402	48.5	315	38.5	16				
	C3Y2	578	46.5	495	36.5	24				
	C4Y2	754	44.5	675	34.5	32				

12. Appendix

- Outline dimensional drawing of magnet rail with core, twin-type

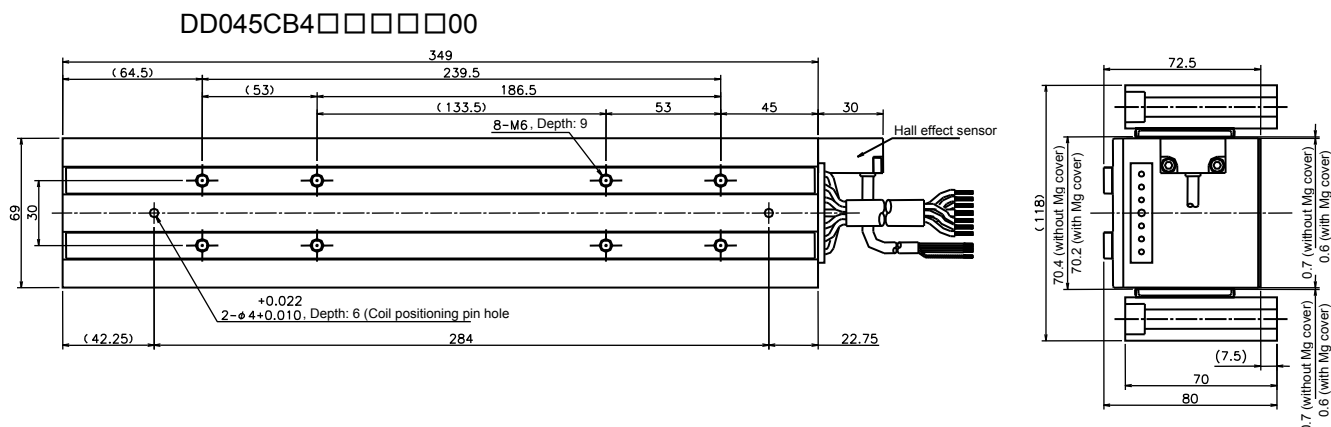
DD□□□M□□□□B02



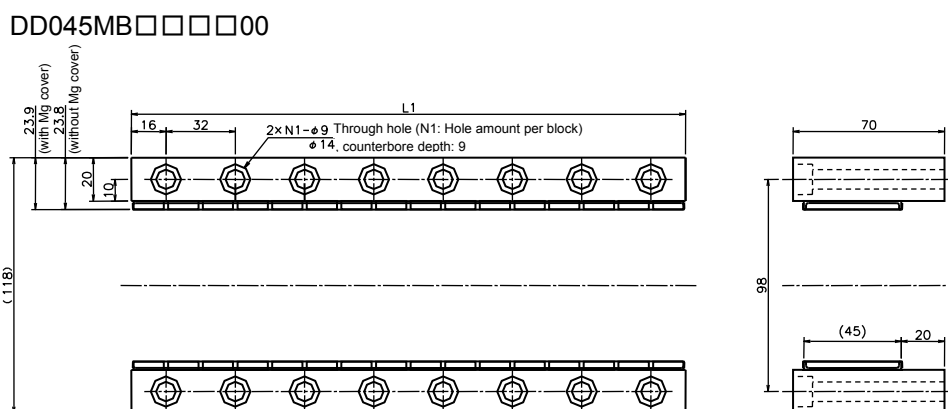
Magnet rail model number		Dimensions and amount												
		L1 (mm)	W1 (mm)	W2 (mm)	W3 (mm)	W4 (mm)	W5 (mm)	W6 (mm)	H1 (mm)	H2 (mm)	N1	D1 (mm)	D2 (mm)	d (mm)
DD030	M064	63.3	130	7.5	15	19	19.2	115	60	30	2	7	11	7
	M128	127.3									4			
	M256	255.3									8			
	M512	511.3									16			
DD050	M064	63.3	140	10	20	24	24.2	120	80	50	2	9	14	9
	M128	127.3									4			
	M256	255.3									8			
	M512	511.3									16			
DD075	M064	63.3	150	12.5	25	29	29.2	125	105	75	2	11	17	11
	M128	127.3									4			
	M256	255.3									8			
	M512	511.3									16			

12.3 Linear motor dimensions

- Outline dimensional drawing of coil with core, twin-type (small type)



- Outline dimensional drawing of magnet rail with core, twin-type (small type)

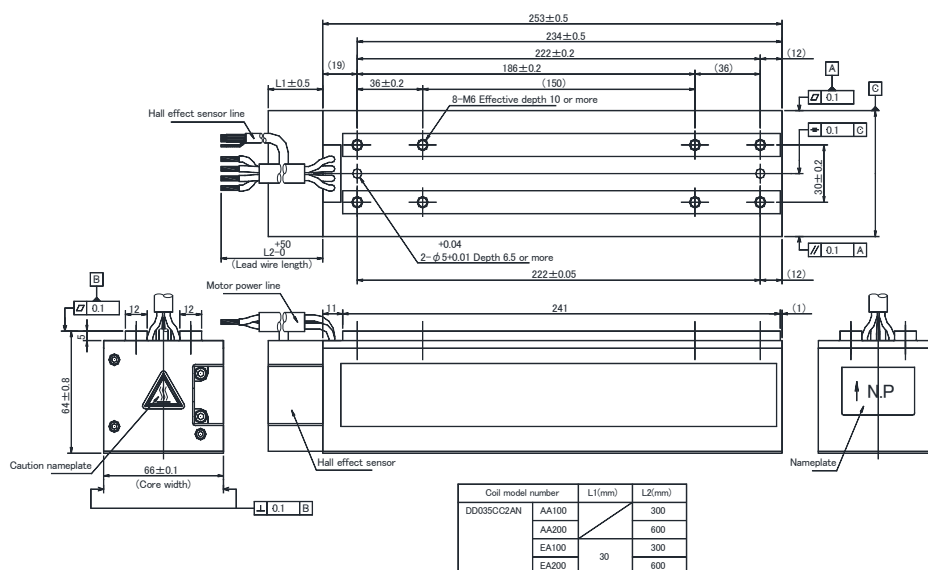


Magnet rail model number		Dimensions and amount	
		L1[mm]	N1
DD045M	B064□00	64	2
	B128□00	128	4
	B256□00	256	8
	B512□00	512	16

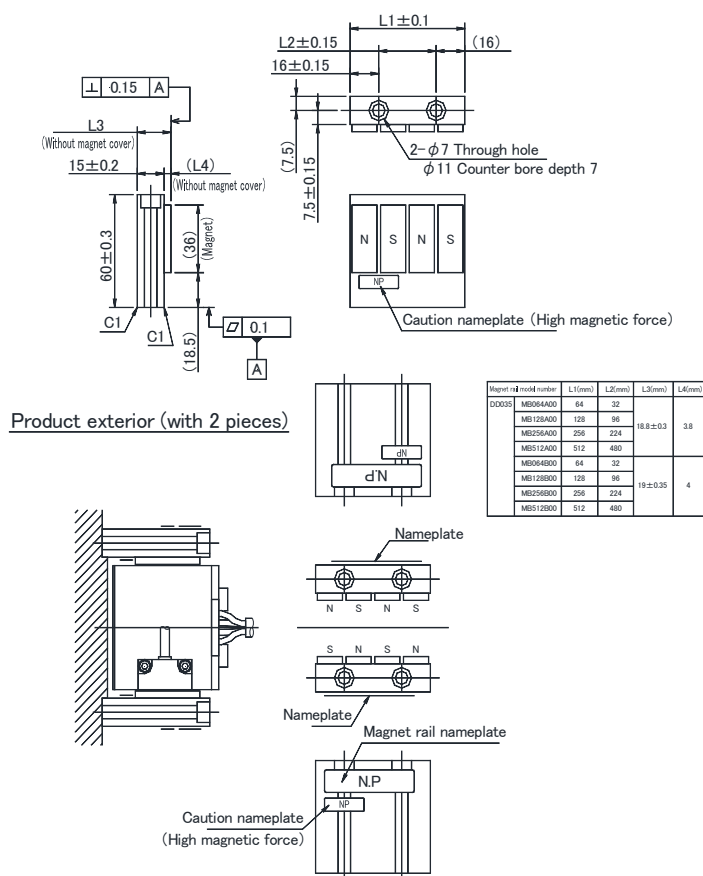
12. Appendix

12.3.3 Linear motor, twin-type

- Outline dimensional drawing of coil, twin-type DD035CC



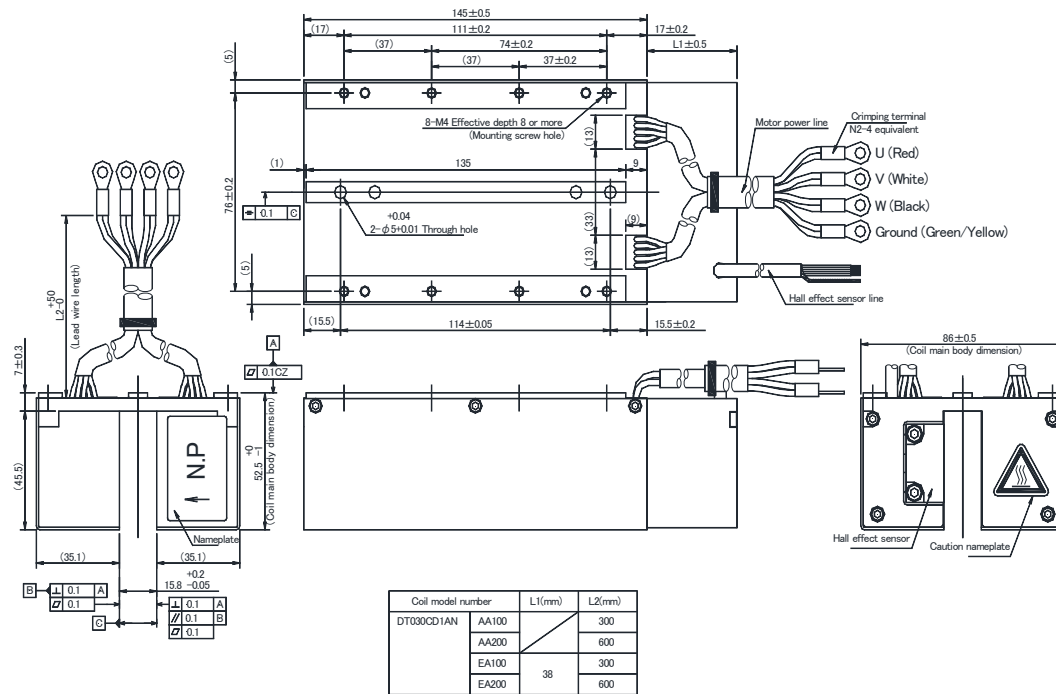
- Outline dimensional drawing of magnet rail, twin-type DD035MB□□□



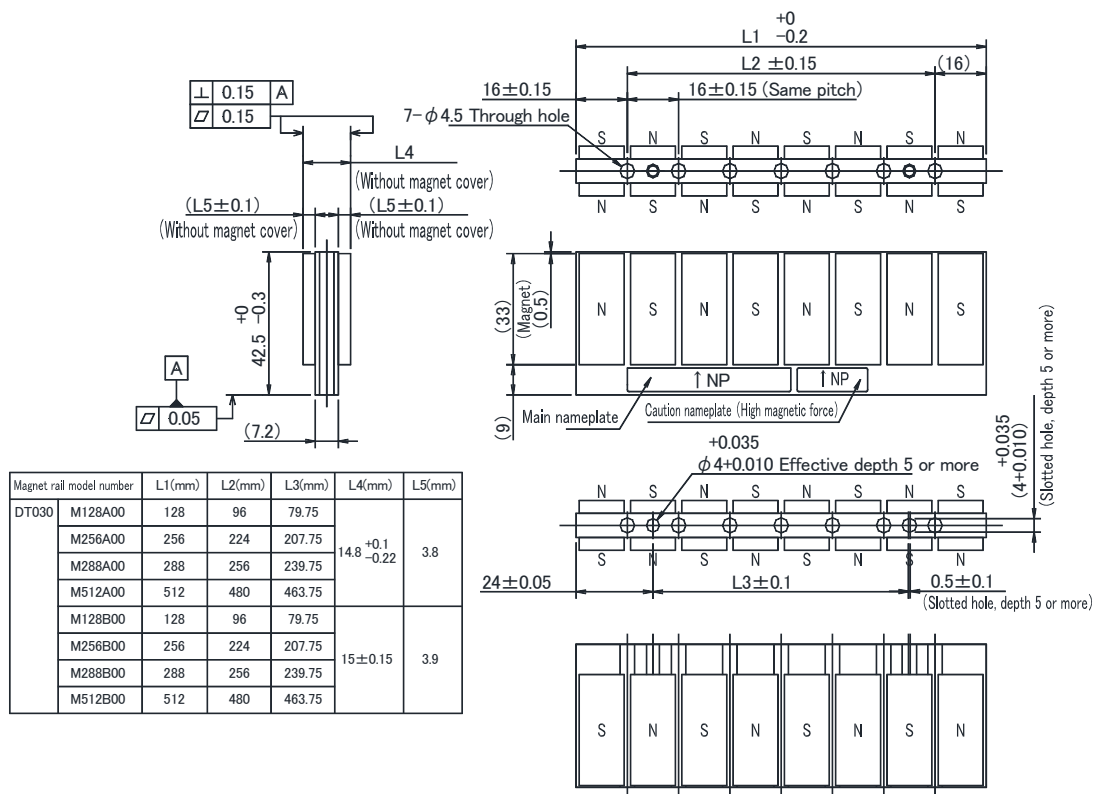
12.3 Linear motor dimensions

12.3.4 Linear motor, center magnet-type

- Outline dimensional drawing of coil, center magnet type DT030CD

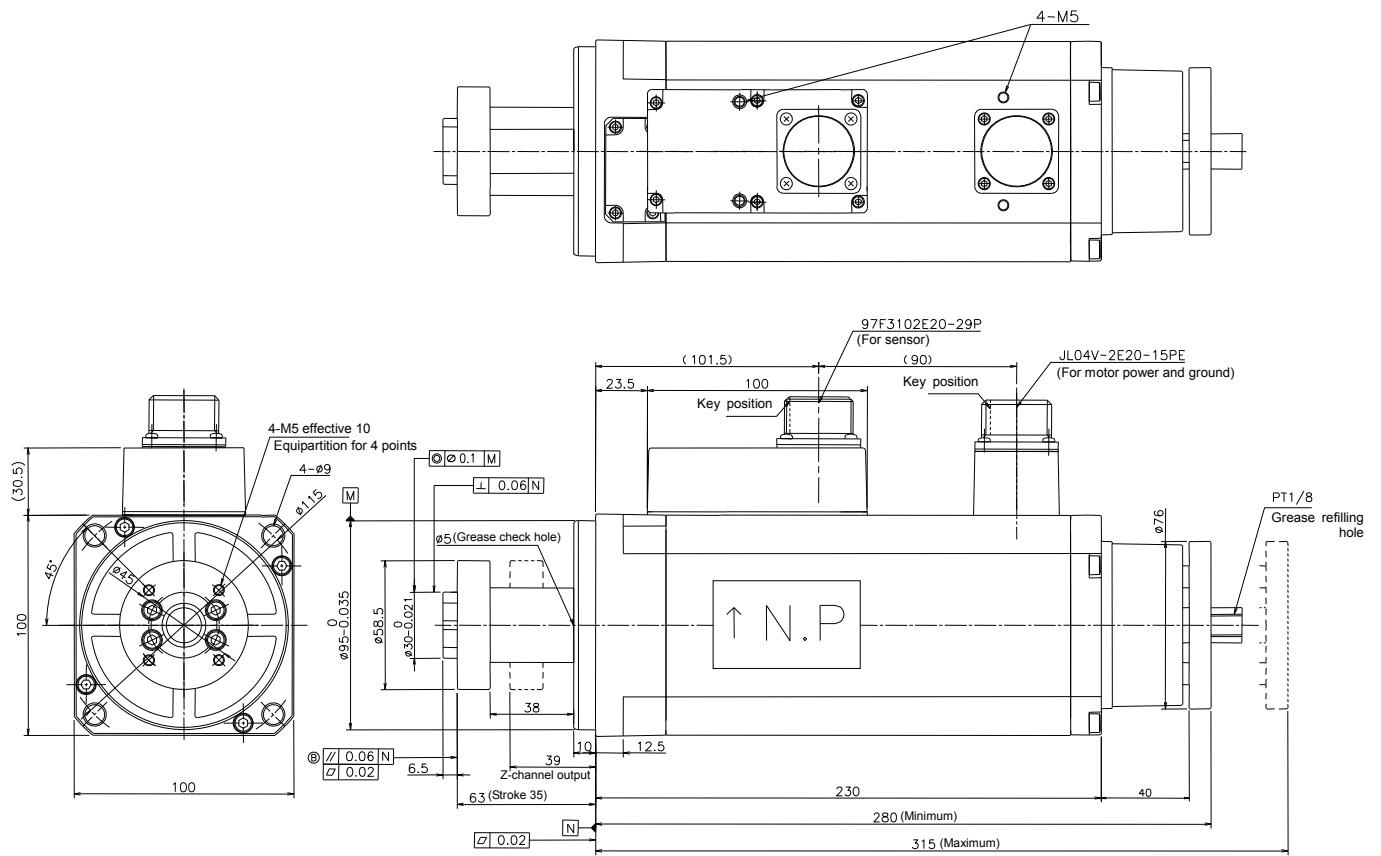


- Outline dimensional drawing of magnet rail, center magnet-type DT030M□□□



12. Appendix

12.3.5 Linear motor, cylinder-type



12.4 Linear motor data sheet

12.4 Linear motor data sheet

12.4.1 Characteristics table

- Flat-type with core (AC200V-specification)

Linear motor model number DS			030C1N2	030C2N2	030C3N2	050C1N2	050C2N2	050C3N2
Combination servo amplifier capacity			RS3A03L	RS3A05L	RS3A07L/ RS3A10L (Note)	RS3A03L	RS3A05L	RS3A07L/ RS3A10L (Note)
Rated output	Pr	kW	0.64	1.28	1.92	0.62	1.25	1.87
Continuous rated force	Fr	N	160	320	480	260	520	780
Maximum force	Fp	N	350	700	1050	580	1160	1740
Continuous current	Ir	Arms	4.3	8.6	12.9	4.3	8.6	12.9
Maximum current	Ip	Arms	11.3	22.6	33.9	11.3	22.6	33.9
Rated velocity	vr	m/s	4	4	4	2.4	2.4	2.4
Maximum velocity	vp	m/s	5.5	5.5	5.5	3.5	3.5	3.5
Mover mass	Mc	kg	2.8	5.4	7.8	3.8	7.4	10.9
Magnet rail mass	Mw	kg/m	5.5	5.5	5.5	7.6	7.6	7.6
Magnetic pitch (N-N)	2tp	mm	32	32	32	32	32	32
Phase resistance	Rφ	Ω	0.92	0.46	0.31	1.32	0.66	0.44
Phase inductance	Lφ	mH	9.2	4.6	3.07	14.6	7.3	4.87
Force constant	Kf	N/Arms	43.5	43.5	43.5	71	71	71
Inductive voltage constant	Keφ	Vrms/(m/s)	14.5	14.5	14.5	23.7	23.7	23.7
*Motor constant	Km	N/√W	18.9	26.8	32.6	25.7	36.3	44.5
Magnet rail model number	—	—	DS030M064, 128, 256, 512			DS050M064, 128, 256, 512		

Linear motor model number DS			075C1N2	075C2N2	075C3N2	100C1N2	100C2N2	100C3N2
Combination servo amplifier capacity			RS3A03L	RS3A05L	RS3A07L/ RS3A10L (Note)	RS3A05L	RS3A10L	RS3A15L
Rated output	Pr	kW	0.64	1.28	1.92	1.51	3.02	4.54
Continuous rated force	Fr	N	400	800	1200	540	1080	1620
Maximum force	Fp	N	850	1700	2550	1150	2300	3450
Continuous current	Ir	Arms	4.4	8.8	13.2	9.5	19	28.5
Maximum current	Ip	Arms	11.3	22.6	33.9	24.5	49	73.5
Rated velocity	vr	m/s	1.6	1.6	1.6	2.8	2.8	2.8
Maximum velocity	vp	m/s	2.4	2.4	2.4	4	4	4
Mover mass	Mc	kg	5.2	10	14.8	6.6	12.6	18.6
Magnet rail mass	Mw	kg/m	10.2	10.2	10.2	12.8	12.8	12.8
Magnetic pitch (N-N)	2tp	mm	32	32	32	32	32	32
Phase resistance	Rφ	Ω	1.78	0.89	0.59	0.49	0.245	0.163
Phase inductance	Lφ	mH	20.5	10.25	6.83	6.00	3.00	2.00
Force constant	Kf	N/Arms	102	102	102	62.8	62.8	62.8
Inductive voltage constant	Keφ	Vrms/(m/s)	34.0	34.0	34.0	20.9	20.9	20.9
*Motor constant	Km	N/√W	33.2	47.0	57.8	39.6	56.0	68.6
Magnet rail model number	—	—	DS075M064, 128, 256, 512			DS100M064, 128, 256, 512		

Linear motor model number DS			150C1N2	150C2N2	150C3N2	045CC1AN
Combination servo amplifier capacity			RS3A05L	RS3A10L	RS3A15L	RS3A03L
Rated output	Pr	kW	1.44	2.88	4.32	0.47
Continuous rated force	Fr	N	800	1600	2400	260
Maximum force	Fp	N	1700	3400	5100	500
Continuous current	Ir	Arms	9.5	19	28.5	4.0
Maximum current	Ip	Arms	24.5	49	73.5	10.3
Rated velocity	vr	m/s	1.8	1.8	1.8	1.8
Maximum velocity	vp	m/s	2.6	2.6	2.6	3.0
Mover mass	Mc	kg	9.4	17.8	26.2	1.8
Magnet rail mass	Mw	kg/m	20.9	20.9	20.9	3.0
Magnetic pitch (N-N)	2tp	mm	32	32	32	32
Phase resistance	Rφ	Ω	0.68	0.34	0.23	1.8
Phase inductance	Lφ	mH	8.8	4.40	2.93	25.1
Force constant	Kf	N/Arms	94.2	94.2	94.2	66.4
Inductive voltage constant	Keφ	Vrms/(m/s)	31.4	31.4	31.4	22.1
*Motor constant	Km	N/√W	49.8	70.5	85.7	24.0
Magnet rail model number	—	—	DS150M064, 128, 256, 512			DS045MC064, 128, 256, 512

12. Appendix

■ Twin-type with core (AC200V-specification)

Linear motor model number DD			030C1Y4	030C2Y4	030C3Y4	050C1Y2	050C2Y2	050C3Y2
Combination servo amplifier capacity			RS3A05L	RS3A07L/ RS3A10L (Note)	RS3A10L	RS3A07L/ RS3A10L (Note)	RS3A15L	RS3A30L
Rated output	Pr	kW	0.95	1.89	2.84	1.75	3.50	5.25
Continuous rated force	Fr	N	430	860	1290	700	1400	2100
Maximum force	Fp	N	630	1260	1890	1050	2100	3150
Continuous current	Ir	Arms	7.8	15.6	23.4	16	32	48
Maximum current	Ip	Arms	13.1	26.2	39.3	27.4	54.8	82.2
Rated velocity	vr	m/s	2.2	2.2	2.2	2.5	2.5	2.5
Maximum velocity	vp	m/s	3.0	3.0	3.0	3.0	3.0	3.0
Mover mass	Mc	kg	8.3	15.0	21.6	11.2	21.2	29.0
Magnet rail mass	Mw	kg/m	15.5	15.5	15.5	26.5	26.5	26.5
Magnetic pitch (N-N)	2tp	mm	32	32	32	32	32	32
Phase resistance	Rφ	Ω	1.82	0.91	0.61	0.6	0.3	0.20
Phase inductance	Lφ	mH	14.1	7.05	4.70	5	2.5	1.67
Force constant	Kf	N/Arms	68	68	68	53.5	53.5	53.5
Inductive voltage constant	Keφ	Vrms/(m/s)	22.7	22.7	22.7	17.8	17.8	17.8
*Motor constant	Km	N/√W	20.0	28.3	34.5	27.6	39.0	47.7
Magnet rail model number	—	—	DD030M064, 128, 256, 512			DD050M064, 128, 256, 512		

Linear motor model number DD			075C1Y2	075C2Y2	075C3Y2	075C4Y2	045CB4AN	035CC2AN
Combination servo amplifier capacity			RS3A07L/ RS3A10L (Note)	RS3A15L	RS3A30L	RS3A30L	RS3A07L/ RS3A10L (Note)	RS3A07L
Rated output	Pr	kW	2.10	4.20	6.20	8.30	1.52	1.2
Continuous rated force	Fr	N	1050	2100	3100	4150	800	610
Maximum force	Fp	N	1600	3200	4800	6400	2200	1400
Continuous current	Ir	Arms	16	32	48	64	10.0	9.6
Maximum current	Ip	Arms	28.7	57.4	86.1	114.8	36.0	33.6
Rated velocity	vr	m/s	2.0	2.0	2.0	2.0	1.9	2.0
Maximum velocity	vp	m/s	3.0	3.0	3.0	3.0	3.0	3.0
Mover mass	Mc	kg	14.7	26.5	38.1	49.5	8.6	5.0
Magnet rail mass	Mw	kg/m	42.5	42.5	42.5	42.5	21.7	14.6
Magnetic pitch (N-N)	2tp	mm	32	32	32	32	32	32
Phase resistance	Rφ	Ω	0.8	0.4	0.27	0.20	0.56	0.57
Phase inductance	Lφ	mH	7.2	3.6	2.40	1.80	5.37	7.2
Force constant	Kf	N/Arms	78	78	78	78	82.8	63.3
Inductive voltage constant	Keφ	Vrms/(m/s)	26.0	26.0	26.0	26.0	27.6	21.1
*Motor constant	Km	N/√W	35.8	50.6	61.6	71.6	52.9	41.7
Magnet rail model number	—	—	DD075M064, 128, 256, 512				DD045MB064, 128, 256, 512	DD035MB064, 128, 256, 512

Note) It can combine with RS3A07 or RS3A10, but motor characteristics are same.

- ✓ Mark "*" indicates the value after temperature increase. The other values are the ones at 25°C. Each value is typical.
- ✓ The magnetic attractive force is reference value when coil-magnet rail mounting accuracy is ±0.1mm.
- ✓ Each numerical value and characteristic indicates the value when iron stage of "t30 × coil length ×400mm" mounted.
- ✓ Each force-velocity characteristic indicates the values when amplifier power supply voltage is AC200V, 3Φ.
- ✓ When power supply voltage is under AC200V, instantaneous range decreases.

12.4 Linear motor data sheet

■ Center magnet-type (AC200V-specification)

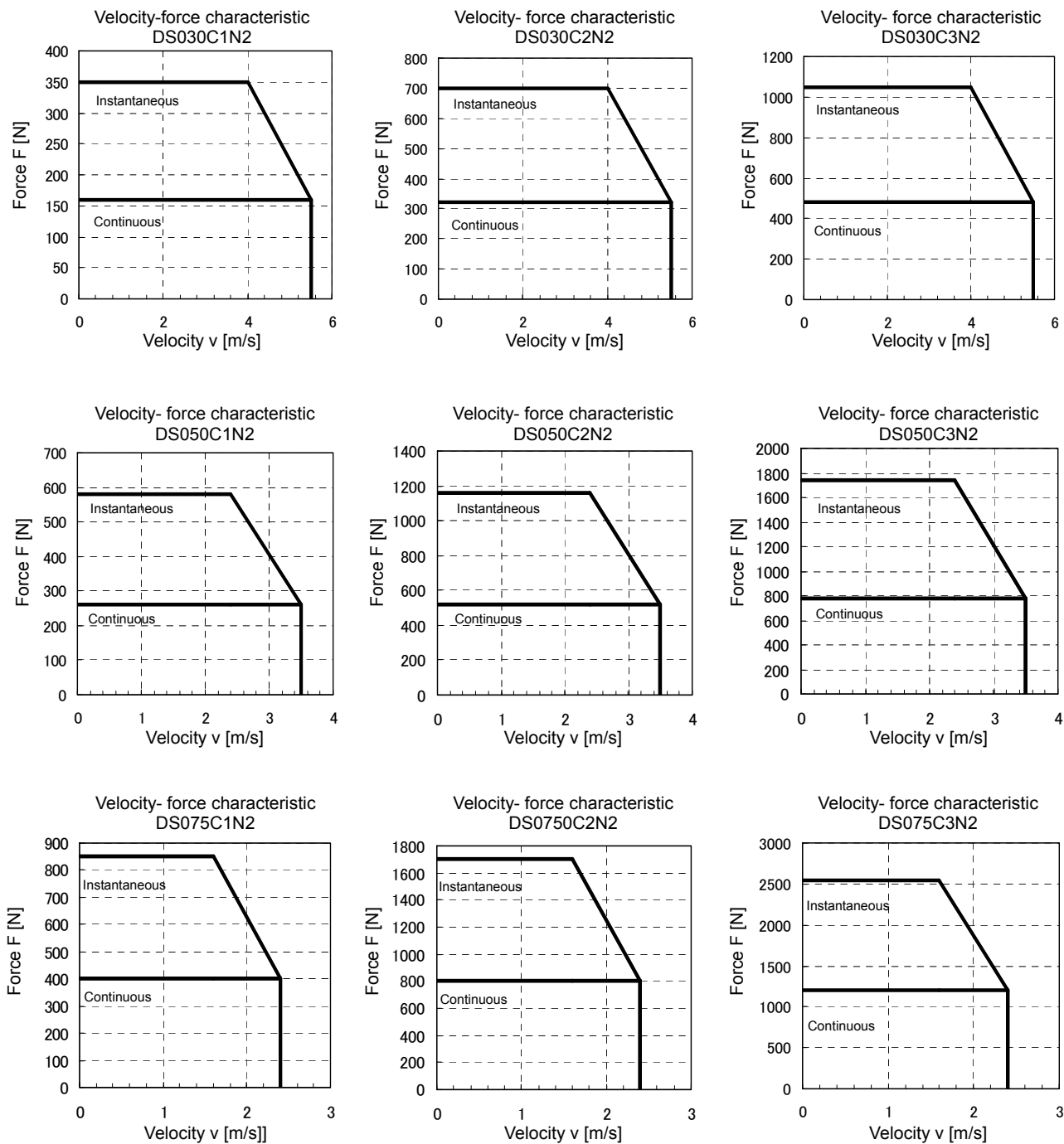
Linear motor model number: DT			030CD1AN
Combination servo amplifier capacity			RS3A03L
Rated output	Pr	kW	0.67
Continuous rated force	Fr	N	350
Maximum force	Fp	N	650
Continuous current	Ir	Arms	4.4
Maximum current	Ip	Arms	11.3
Rated velocity	vr	m/s	1.9
Maximum velocity	vp	m/s	3.0
Mover mass	Mc	kg	2.4
Magnet rail mass	Mw	kg/m	3.7
Magnetic pitch (N-N)	2tp	mm	32
Phase resistance	Rφ	Ω	1.82
Phase inductance	Lφ	mH	16.5
Force constant	Kf	N/Arms	79.7
Inductive voltage constant	Keφ	Vrms/(m/s)	26.6
* Motor constant	Km	N/√W	29.3
Magnet rail model number	—	—	DT030M128, 256, 288, 512

- ✓ Mark "*" indicates the value after temperature increase. The other values are the ones at 20°C. Each value is typical.
- ✓ Each numerical value and characteristic indicates the value when aluminum heatsink of "t20 x 105mm-square" mounted.
- ✓ Each force-velocity characteristic indicates the values when amplifier power supply voltage is AC200V, 3Φ.
- ✓ When power supply voltage is under AC200V, instantaneous range decreases.

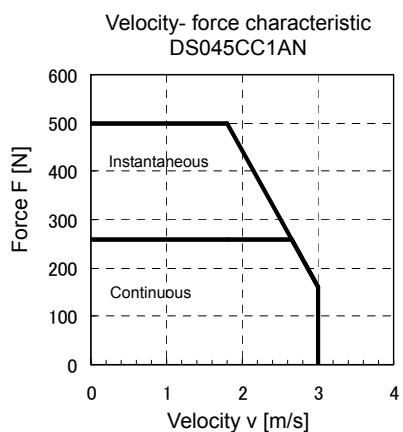
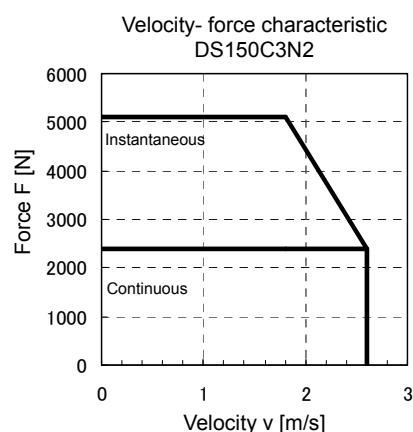
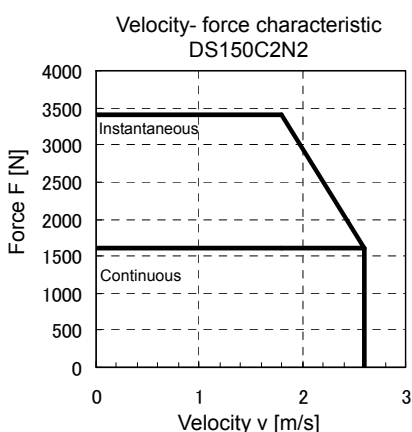
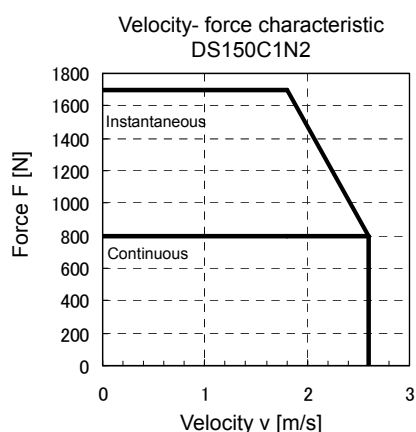
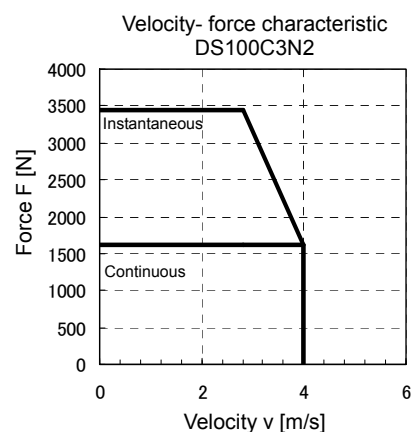
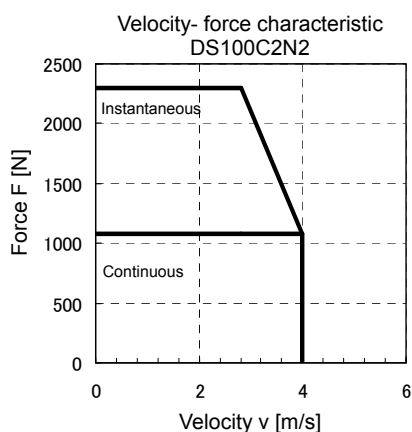
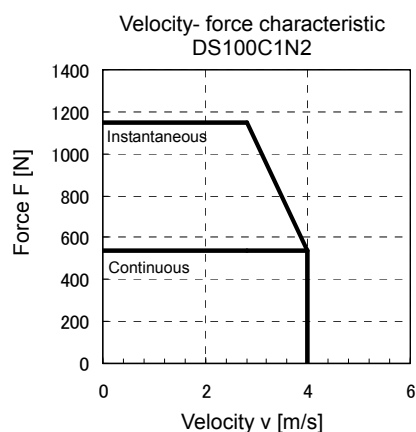
12. Appendix

12.4.2 Velocity-force characteristics

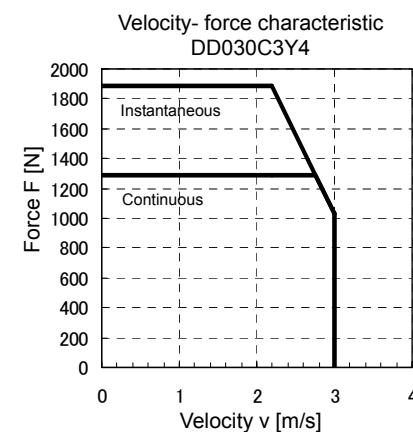
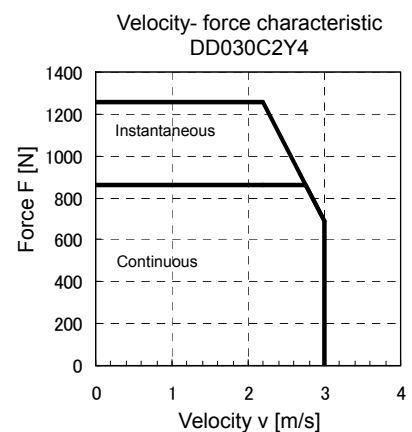
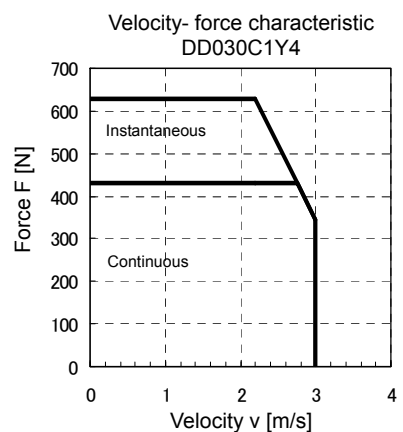
Velocity-force characteristics of flat-type with core indicate the values when input power supply is AC200V, 3-phase. When power supply voltage is under 200V, instantaneous range decreases.



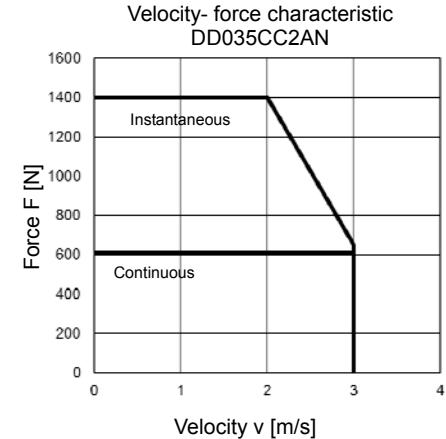
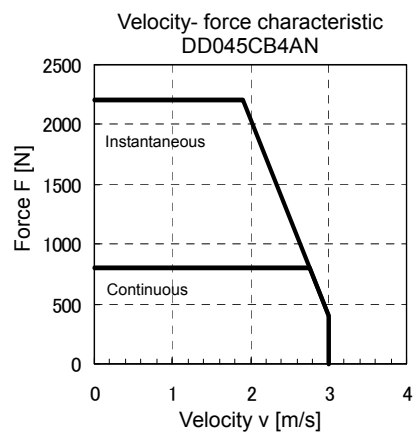
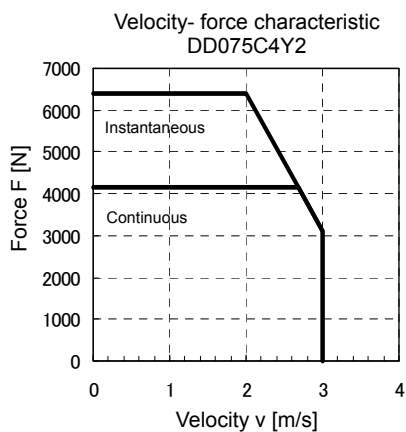
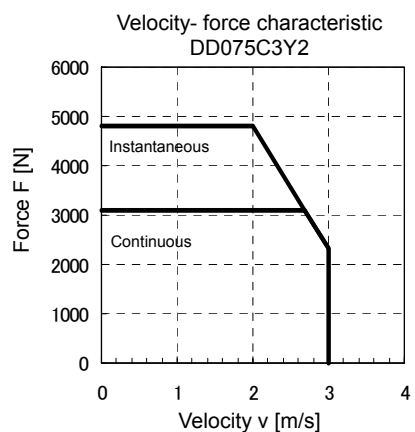
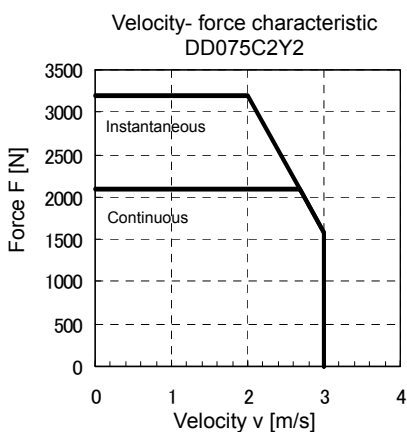
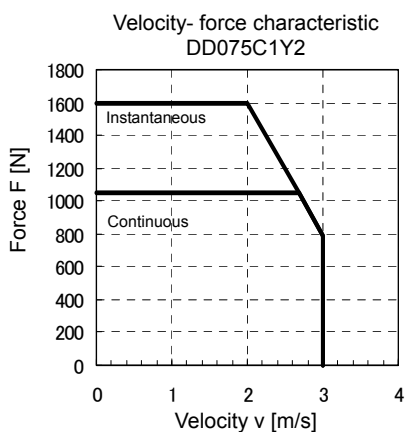
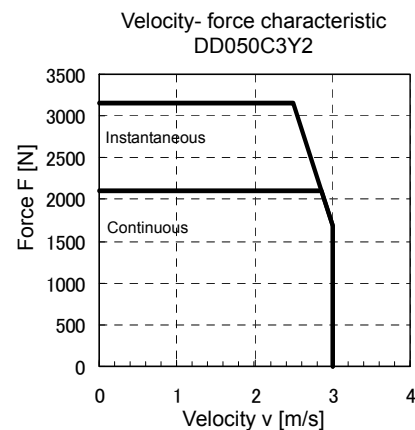
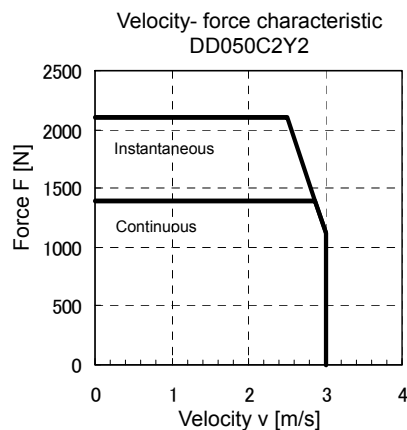
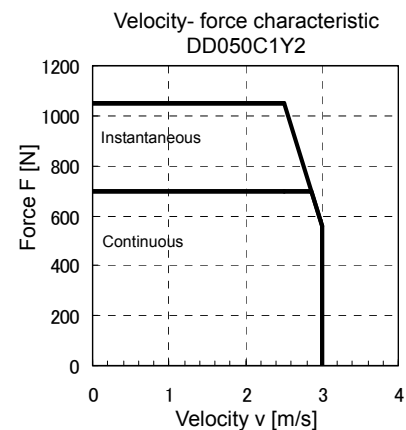
12.4 Linear motor data sheet



Velocity-force characteristics of twin-type with core indicate the values when input power supply is AC200V, 3-phase. When power supply voltage is under 200V, instantaneous range decreases.

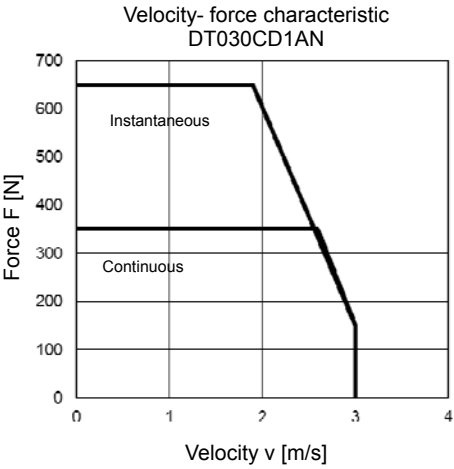


12. Appendix



12.4 Linear motor data sheet

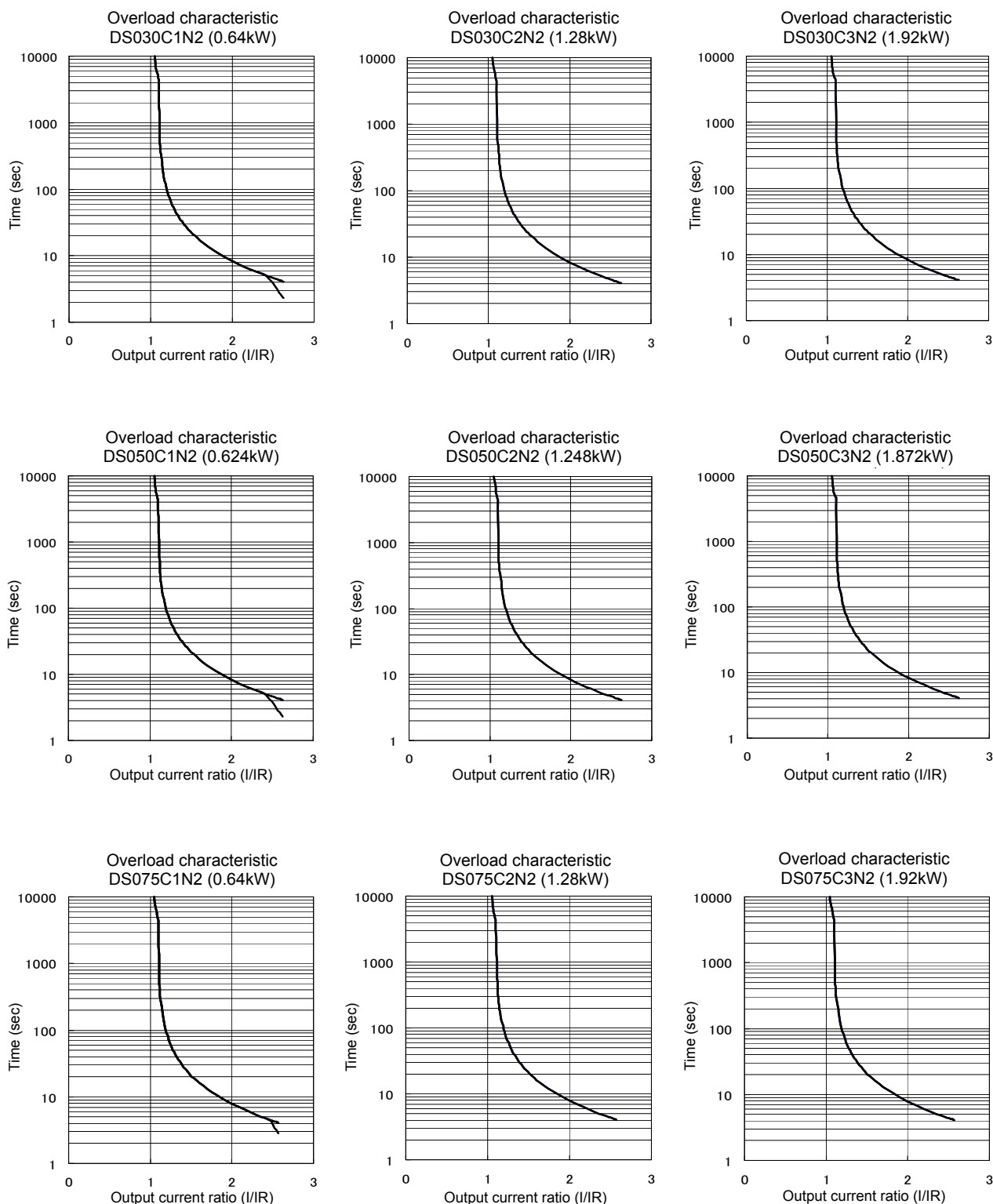
Velocity-force characteristics of center magnet-type indicate the values when input power supply is AC200V, 3-phase. When power supply voltage is under 200V, instantaneous range decreases.



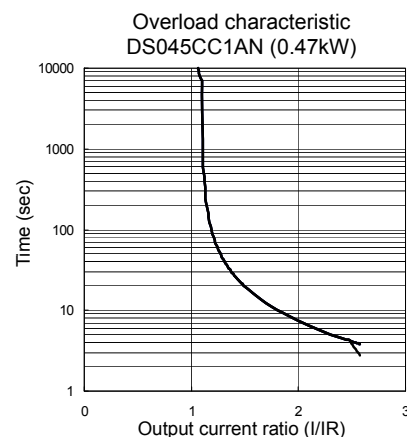
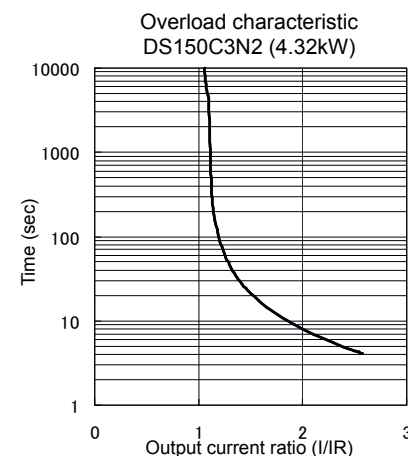
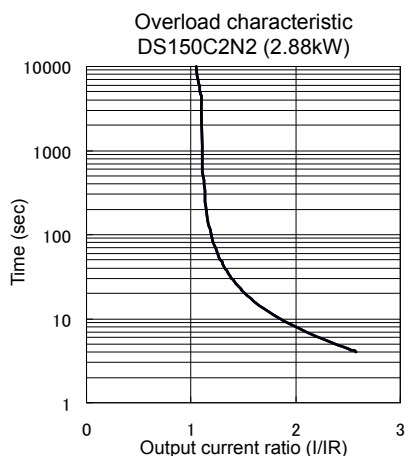
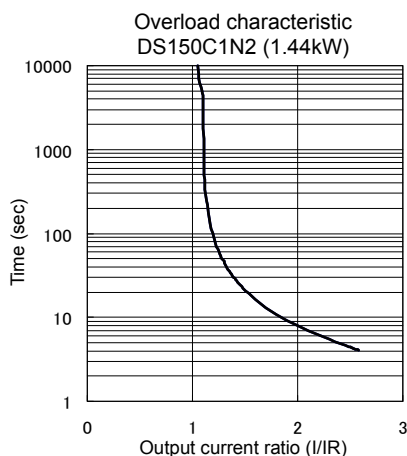
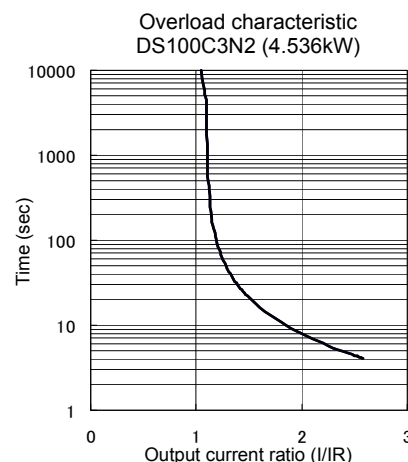
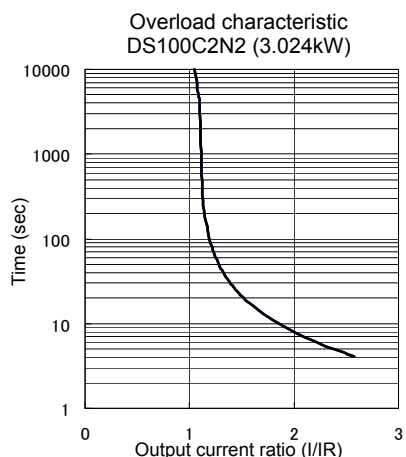
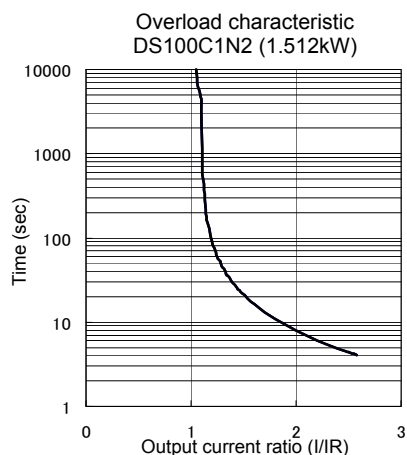
12. Appendix

12.4.3 Overload characteristics

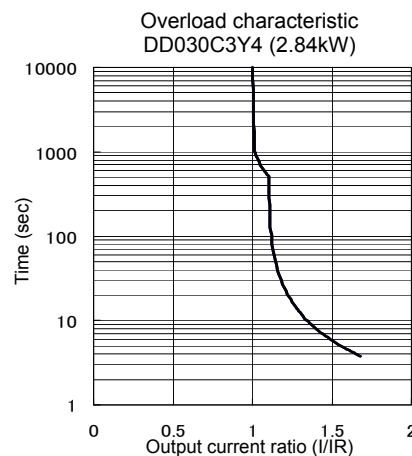
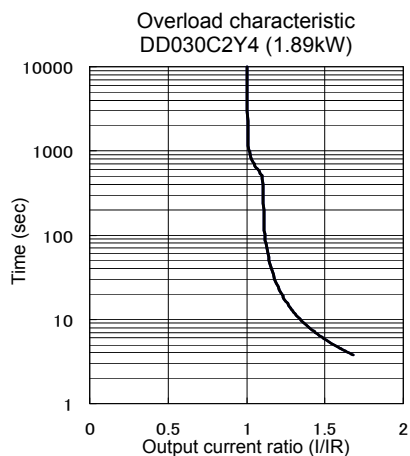
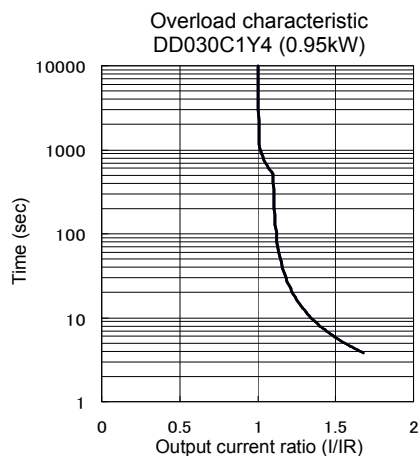
Overload characteristics of flat-type motor with core are shown as follows:



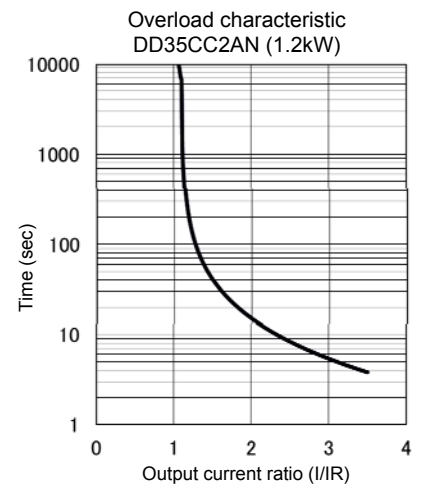
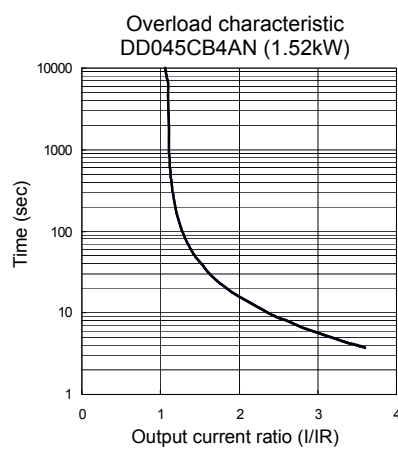
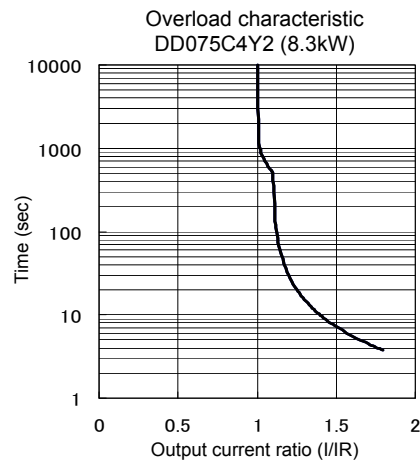
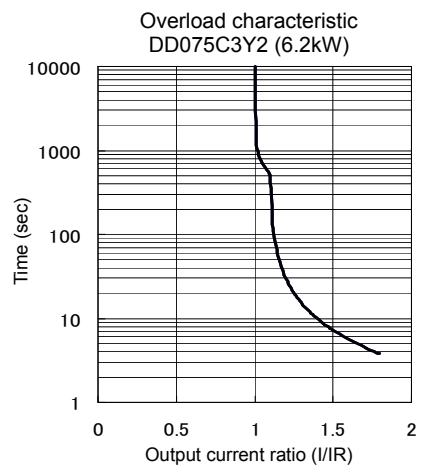
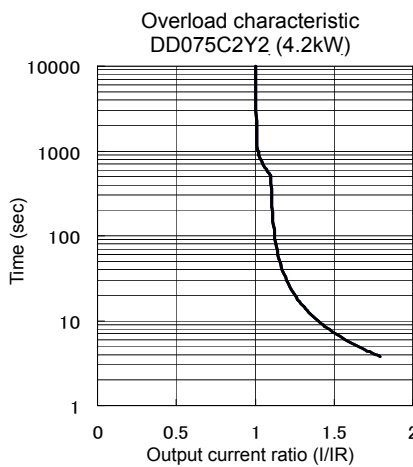
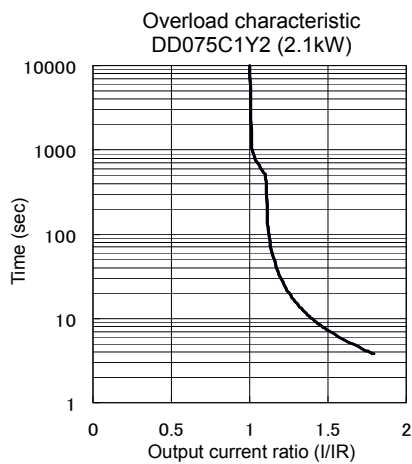
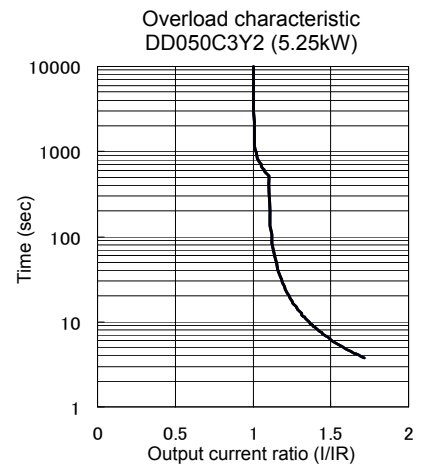
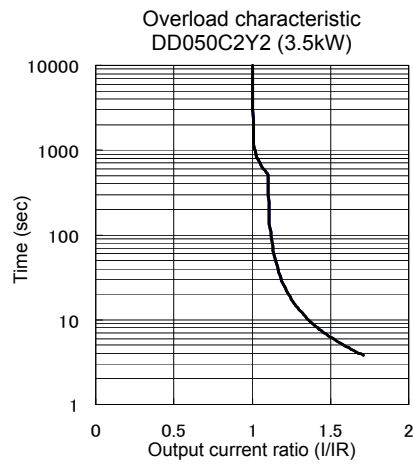
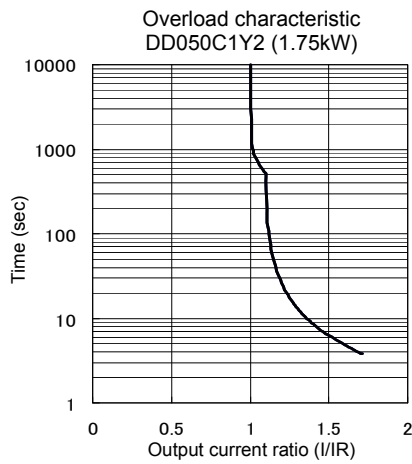
12.4 Linear motor data sheet



Overload characteristics of twin-type motor with core are shown as follows:

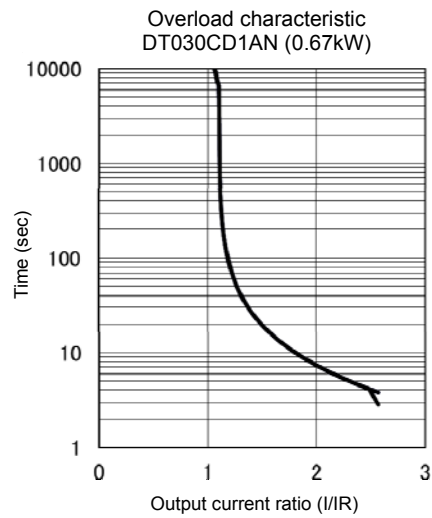


12. Appendix



12.4 Linear motor data sheet

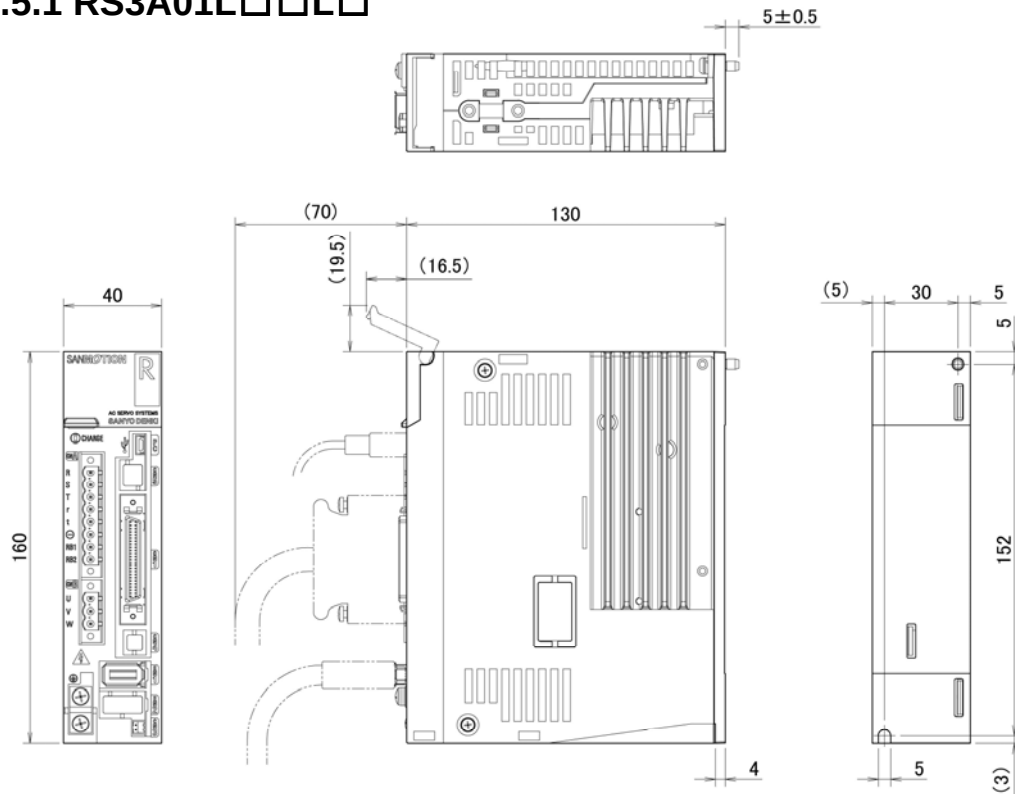
Overload characteristics of center magnet-type motor are shown as follows:



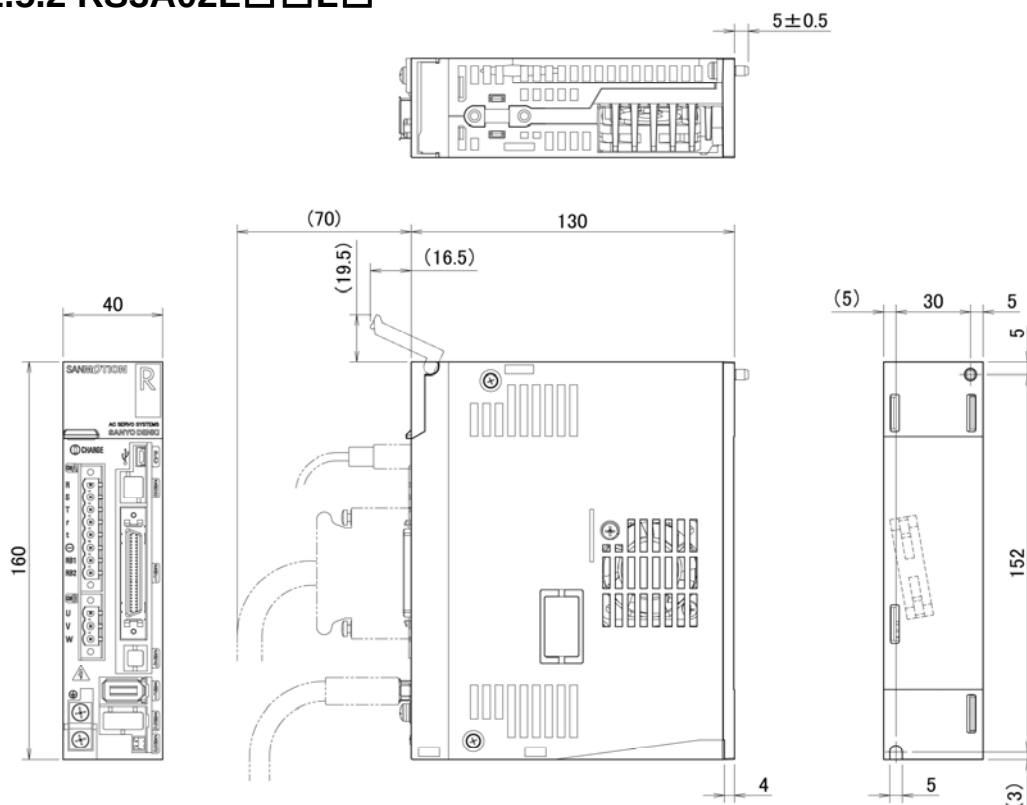
12. Appendix

12.5 Servo amplifier dimensions

12.5.1 RS3A01L□□L□

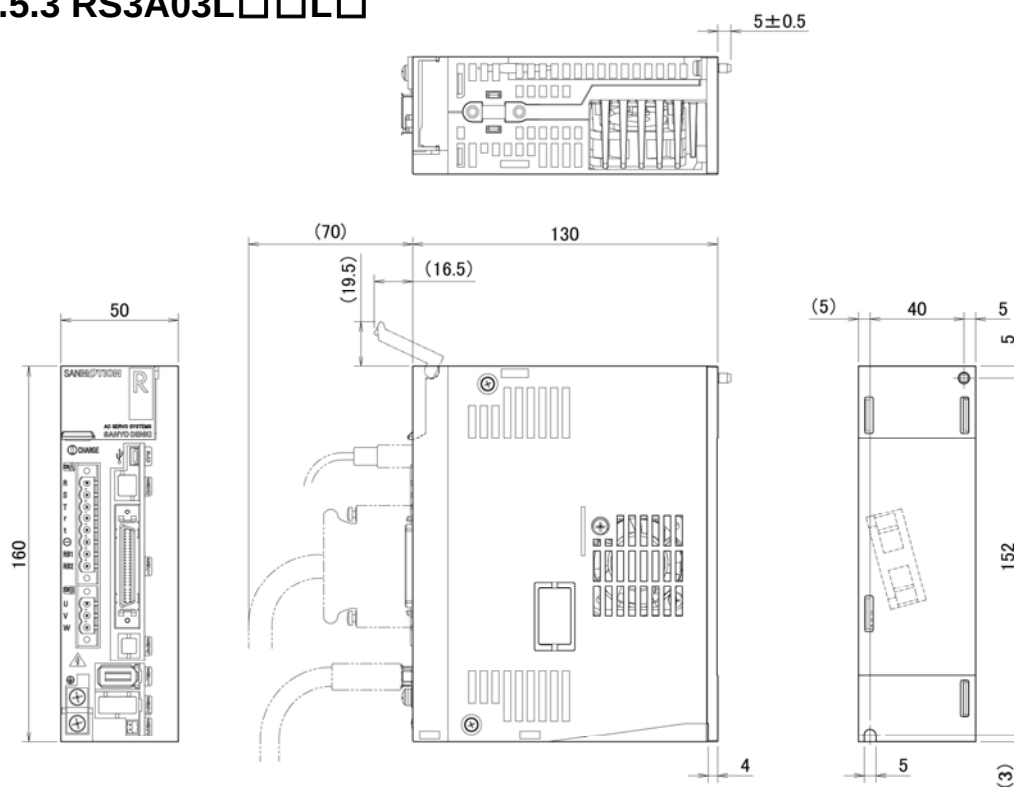


12.5.2 RS3A02L□□L□

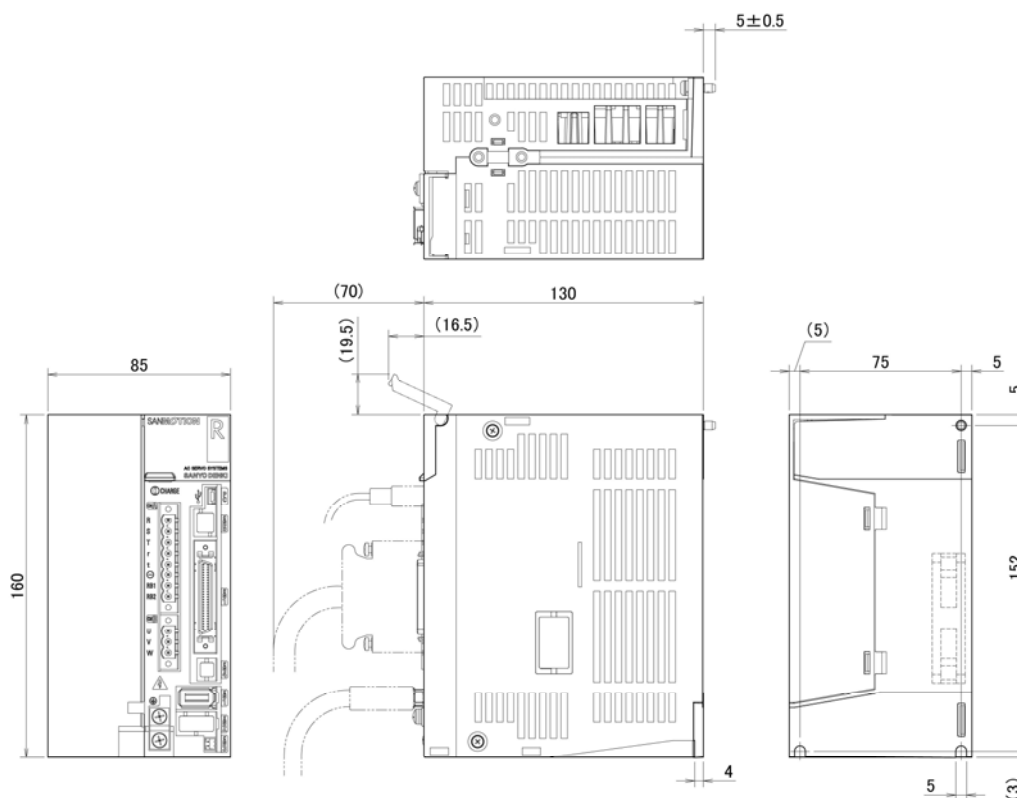


12.5 Servo amplifier dimensions

12.5.3 RS3A03L□□L□

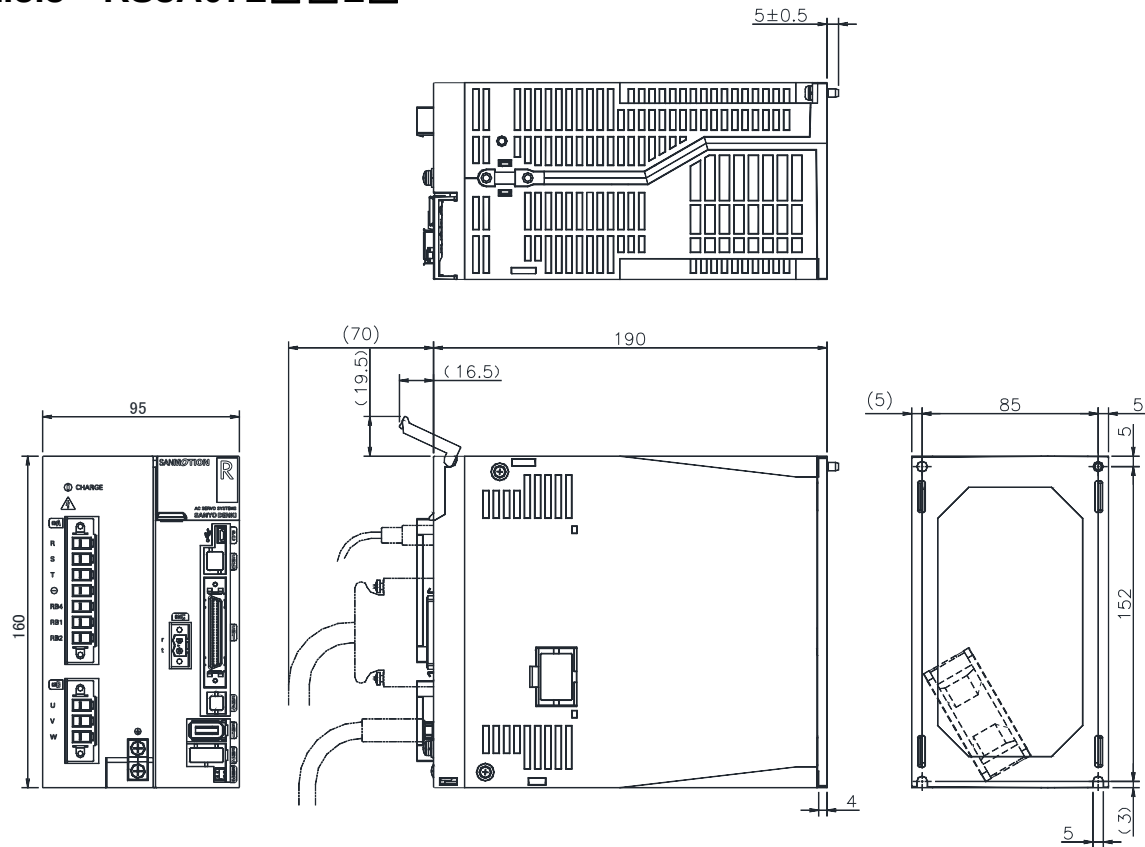


12.5.4 RS3A05L□□L□

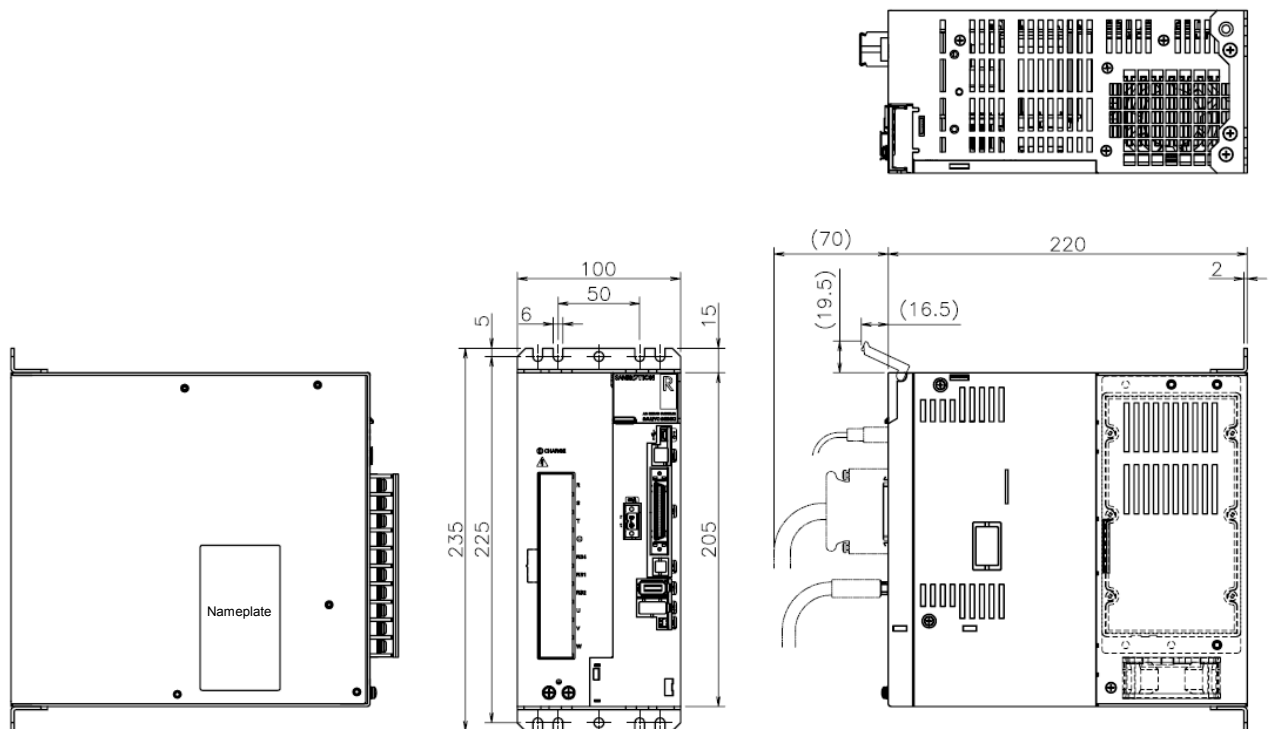


12. Appendix

12.5.5 RS3A07L□□L□

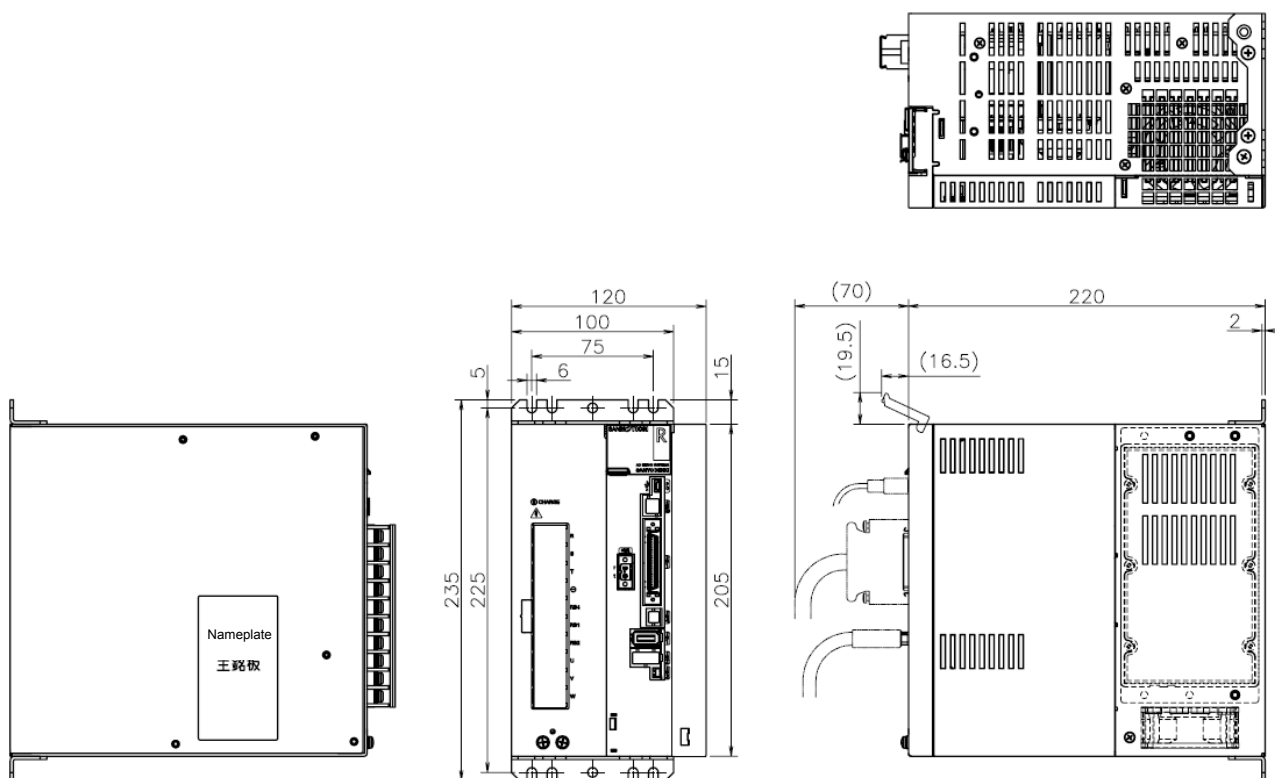


12.5.6 RS3A10L□□A□

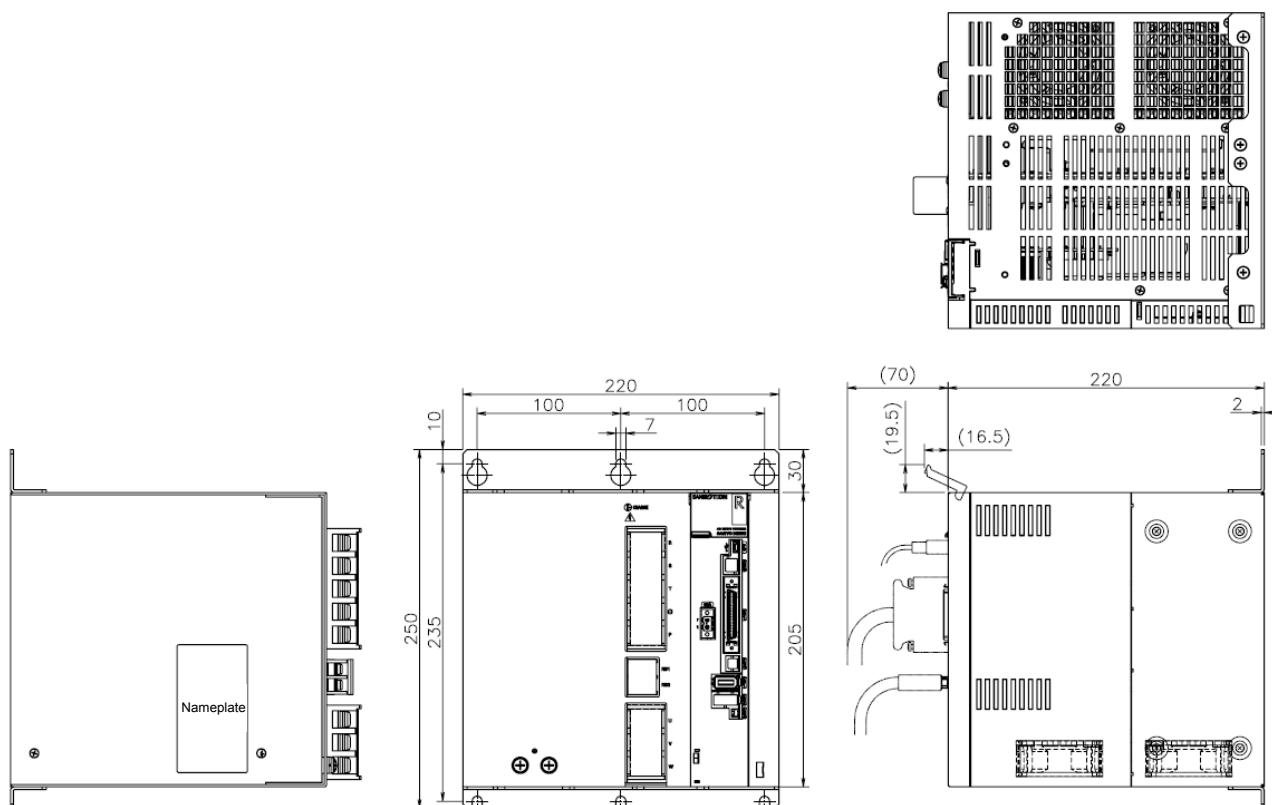


12.5 Servo amplifier dimensions

12.5.7 RS3A15L□□A□



12.5.8 RS3A30L□□L□



12. Appendix

12.6 Optional parts

SANYO DENKI offers the following optional parts.

12.6.1 Connectors of servo amplifier

■ Model numbers of single connectors for RS3A01, RS3A02, RS3A03 and RS3A05

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN1	For host unit connection	AL-00385594	10150-3000PE and 10350-52A0-008	3M Japan Limited
EN1,EN2	For linear encoder and Hall effect sensor connection	AL-00632607	36210-0100PL and 36310-3200-008	
CNA	For input power supply, and regenerative resistance connection	AL-00686902-01	MSTBT2.5/8-STF-5.08LUB	Phoenix Contact Co. Ltd.
CNB	For linear 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 connector for safety device (for short circuit) to CN4 of servo amplifier.

■ Model numbers of connector-kits for RS3A01, RS3A02, RS3A03 and RS3A05 (No safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
CN1,EN1,CNA,CNB	Standard set without Hall effect sensor	AL-00723282	RS3###L0#L0/RS3###L8#L0	No regenerative resistance
CN1,EN1,CNB		AL-00723284	RS3###L0#A0/RS3###L8#A0	With regenerative resistance
CN1,EN1,EN2,CNA,CNB		AL-00723286	RS3###LA#L0/RS3###LB#L0	No regenerative resistance
CN1,EN1,EN2,CNB		AL-00723288	RS3###LA#A0/RS3###LB#A0	With regenerative resistance
CN1,EN1	Low voltage set without Hall effect sensor	AL-00723290	RS3###L0##0/RS3###L8##0	-
CN1,EN1,EN2	Low voltage set with Hall effect sensor	AL-00781940	RS3###LA##0/RS3###LB##0	-
CNA,CNB	High voltage set	AL-00696037	RS3###L##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.

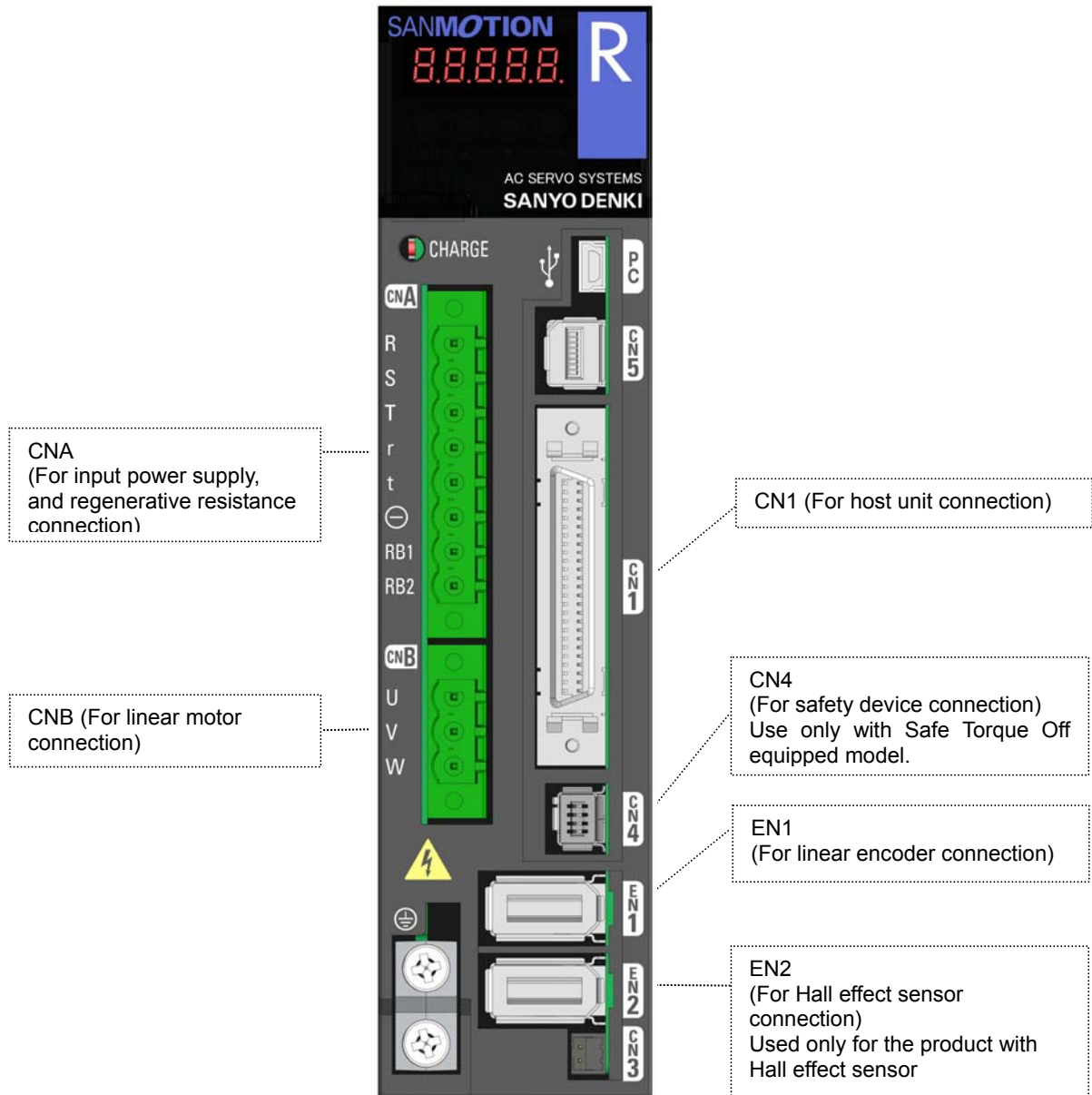
■ Model numbers of connector-kits for RS3A01, RS3A02, RS3A03 and RS3A05 (With Safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
CN1,EN1,CNA,CNB,CN4	Standard set without Hall effect sensor	AL-00723155	RS3###L0#L2(4)/RS3###L8#L2(4)	No regenerative resistance
CN1,EN1,CNB,CN4		AL-00723156	RS3###L0#A2(4)/RS3###L8#A2(4)	With regenerative resistance
CN1,EN1,EN2,CNA,CNB,CN4	Standard set with Hall effect sensor	AL-00723157	RS3###LA#L0/ RS3###LB#L2(4)	No regenerative resistance
CN1,EN1,EN2,CNB,CN4		AL-00723158	RS3###LA#A0/ RS3###LB#A2(4)	With regenerative resistance
CN1,EN1,CN4	Low voltage set without Hall effect sensor	AL-00723159	RS3###L0##2(4)/RS3###L8##2(4)	-
CN1,EN1,EN2,CN4	Low voltage set with Hall effect sensor	AL-00781942	RS3###LA##2(4)/ RS3###LB##2(4)	-

- ✓ Mark “#” shows arbitrary numerical values or alphabets.
- ✓ CN4 of the connector kit is for connection with safety devices (for wiring), part number: AL-00718252-01.
- ✓ For amplifier with regenerative resistor, the wire of the regenerative resistor is to be connected to CNA, so CNA is equipped with amplifier. So no optional provisions are offered.

12.6 Optional parts

RS3A01, RS3A02, RS3A03, RS3A05



12. Appendix

■ Model numbers of single connectors for RS3A07

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN1	For host unit connection	AL-00385594	10150-3000PE and 10350-52A0-008	3M Japan Limited
EN1,EN2	For linear encoder and Hall effect sensor connection	AL-00632607	36210-0100PL and 36310-3200-008	
CNA	For input power supply, and regenerative resistance connection	AL-Y0011766-01	PC5/7-STF1-7.62	Phoenix Contact Co. Ltd.
CNB	For linear 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 注 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 connector for safety device (for short circuit) to CN4 of servo amplifier.

■ Model numbers of connector-kits for RS3A07 (No safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
CN1,EN1,CNA,CNB,CNC	Standard set without Hall effect sensor	AL-00946084	RS3A07L0#L0/RS3A07L8#L0	No regenerative resistance
CN1,EN1,CNB,CNC		AL-00946086	RS3A07L0#A0/RS3A07L8#A0	With regenerative resistance
CN1,EN1,EN2,CNA,CNB,CNC	Standard set with Hall effect sensor	AL-00946088	RS3A07LA#L0/RS3A07LB#L0	No regenerative resistance
CN1,EN1,EN2,CNB,CNC		AL-00946090	RS3A07LA#A0/RS3A07LB#A0	With regenerative resistance
CN1,EN1	Low voltage set without Hall effect sensor	AL-00723290	RS3###L0##0/RS3###L8##0	-
CN1,EN1,EN2	Low voltage set with Hall effect sensor	AL-00781940	RS3###LA##0/RS3###LB##0	-
CNA,CNB,CNC	High voltage set	AL-00946092	RS3L07L##L#	No regenerative resistance
CNB,CNC	High voltage set	AL-00946094	RS3L07L##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.

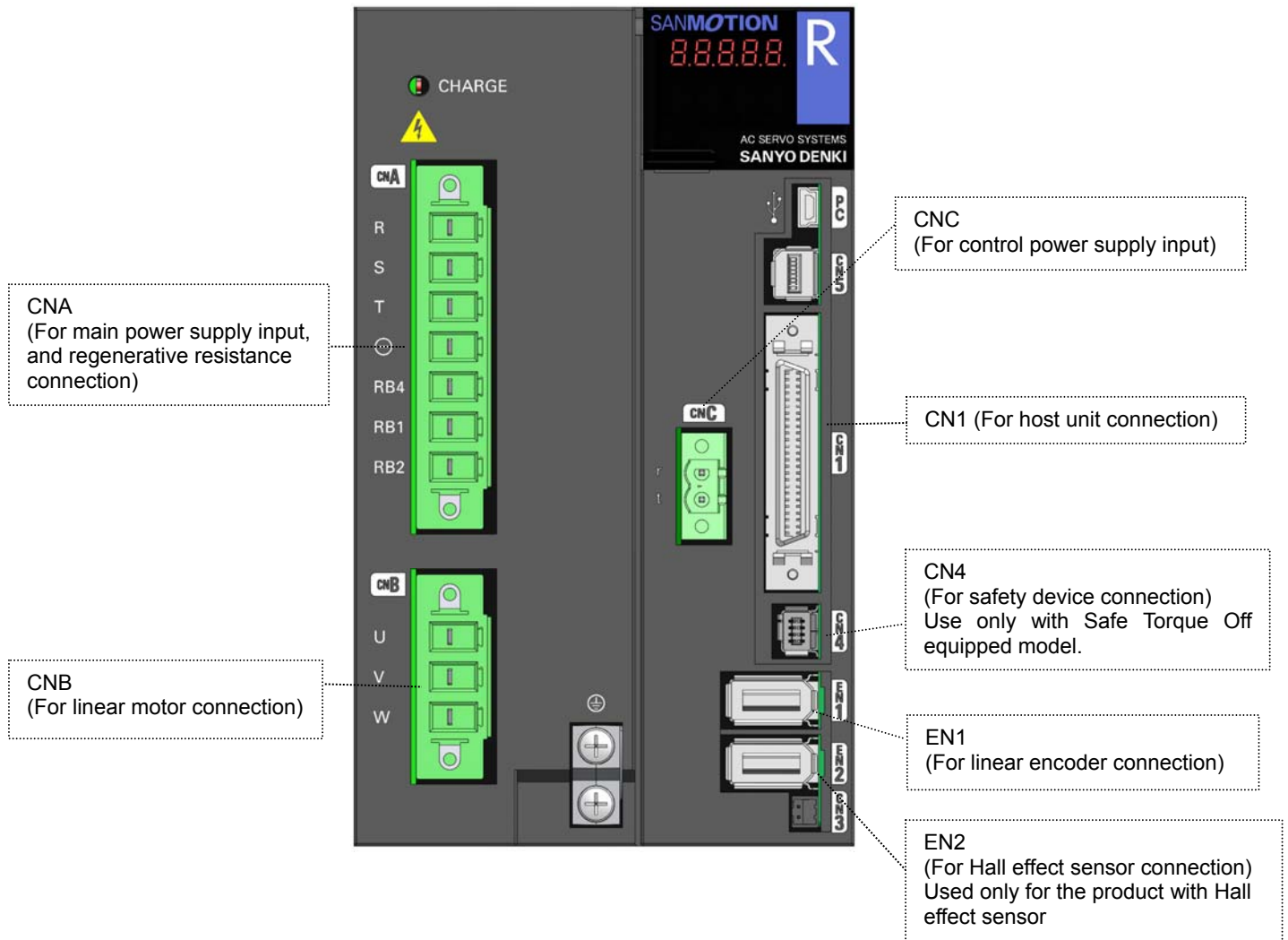
■ Model numbers of connector-kits for RS3A07 (With safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
CN1,EN1,CNA,CNB,CNC,CN4	Standard set without Hall effect sensor	AL-00946096	RS3A07L0#L2(4)/RS3A07L8#L2(4)	No regenerative resistance
CN1,EN1,CNB,CNC,CN4		AL-00946098	RS3A07L0#A2(4)/RS3A07L8#A2(4)	With regenerative resistance
CN1,EN1,EN2,CNA,CNB,CNC,CN4	Standard set with Hall effect sensor	AL-00946100	RS3A07LA#L0/RS3A07LB#L2(4)	No regenerative resistance
CN1,EN1,EN2,CNB,CNC,CN4		AL-00946102	RS3A07LA#A0/RS3A07LB#A2(4)	With regenerative resistance
CN1,EN1,CN4	Low voltage set without Hall effect sensor	AL-00723159	RS3###L0##2(4)/RS3###L8##2(4)	-
CN1,EN1,EN2,CN4	Low voltage set with Hall effect sensor	AL-00781942	RS3###LA##2(4)/RS3###LB##2(4)	-

- ✓ Mark “#” shows arbitrary numerical values or alphabets.
- ✓ CN4 of the connector kit is for connection with safety devices (for wiring), part number: AL-00718252-01.
- ✓ For amplifier with regenerative resistor, the wire of the regenerative resistor is to be connected to CNA, so CNA is equipped with amplifier. So no optional provisions are offered.

12.6 Optional parts

RS3A07



12. Appendix

■ 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 unit connection	AL-00385594	10150-3000PE and 10350-52A0-008	3M Japan Limited
EN1,EN2	For encoder connection	AL-00632607	36210-0100PL and 36310-3200-008	
CNA	For control power input	AL-Y0005159-01	MSTBT2.5/2-STF-5.08	Phoenix Contact Co. Ltd.
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 connector for safety device (for short circuit) to CN4 of servo amplifier.

■ Model numbers of connector-kits for RS3A10, RS3A15 and RS3A30 (No safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number
CN1,EN1,CNA	Standard set without Hall effect sensor	AL-00751448	RS3###L0##0/RS3###L8##0
CN1,EN1,EN2,CNA	Standard set with Hall effect sensor	AL-00751450	RS3###LA##0/RS3###LB##0
CN1,EN1	Low voltage set without Hall effect sensor	AL-00723290	RS3###L0##0/RS3###L8##0
CN1,EN1,EN2	Low voltage set with Hall effect sensor	AL-00781940	RS3###LA##0/RS3###LB##0

✓ Mark “#” shows arbitrary numerical values or alphabets.

■ Model numbers of connector-kits for RS3A10, RS3A15 and RS3A30 (With safe-torque-off function)

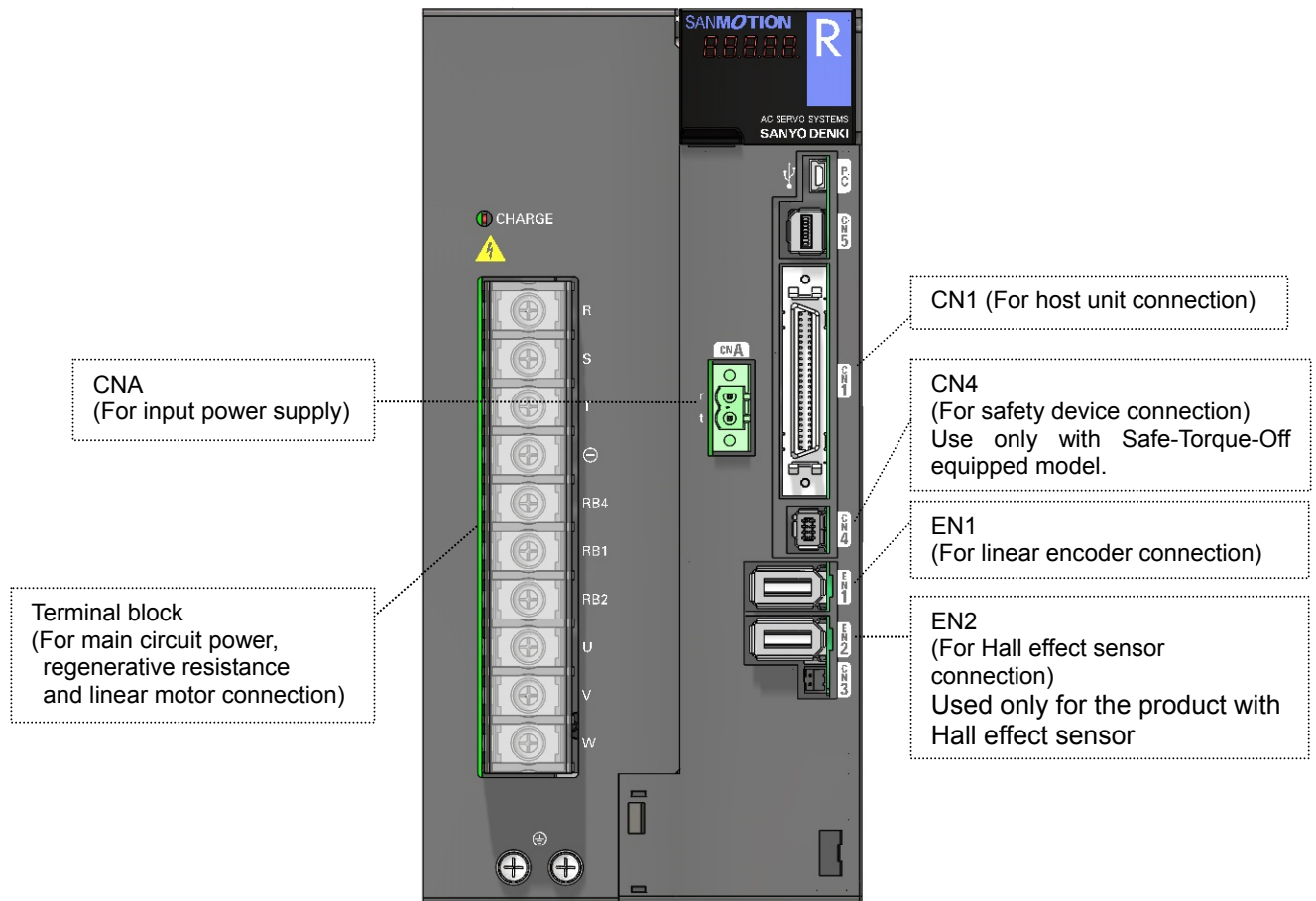
Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number
CN1,EN1,CNA,CN4	Standard set without Hall effect sensor	AL-00751452	RS3###L0##2(4)/RS3###L8##2(4)
CN1,EN1,EN2,CNA, CN4	Standard set with Hall effect sensor	AL-00751454	RS3###LA##2(4)/RS3###LB##2(4)
CN1,EN1,CN4	Low voltage set without Hall effect sensor	AL-00723159	RS3###L0##2(4)/RS3###L8##2(4)
CN1,EN1,EN2,CN4	Low voltage set with Hall effect sensor	AL-00781942	RS3###LA##2(4)/RS3###LB##2(4)

✓ Mark “#” shows arbitrary numerical values or alphabets.

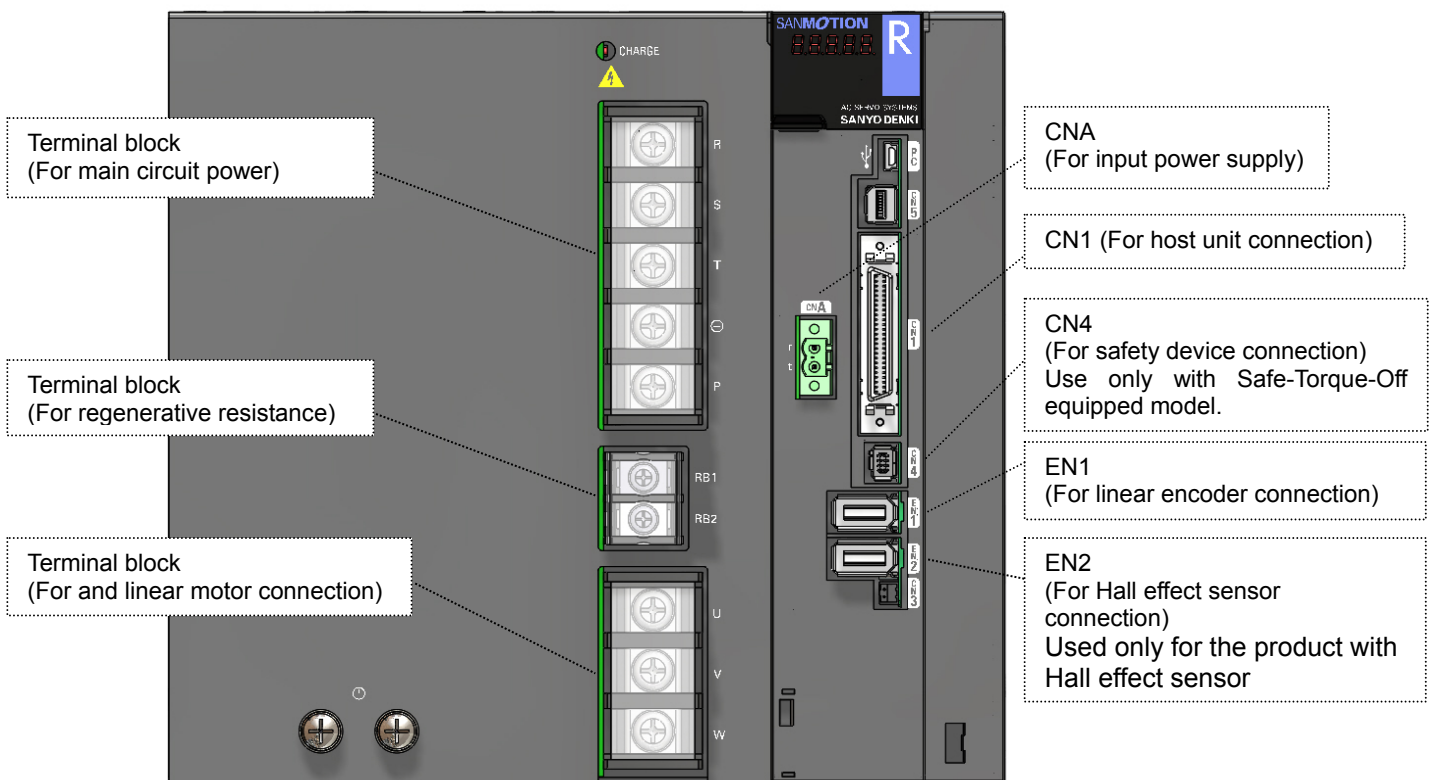
✓ CN4 of the connector kit is for connection with safety devices (for wiring), part number: AL-00718252-01.

12.6 Optional parts

RS3A10, RS3A15



RS3A30



12. Appendix

12.6.2 Fixing bracket

Fixing brackets for mounting servo amplifier front side are prepared.

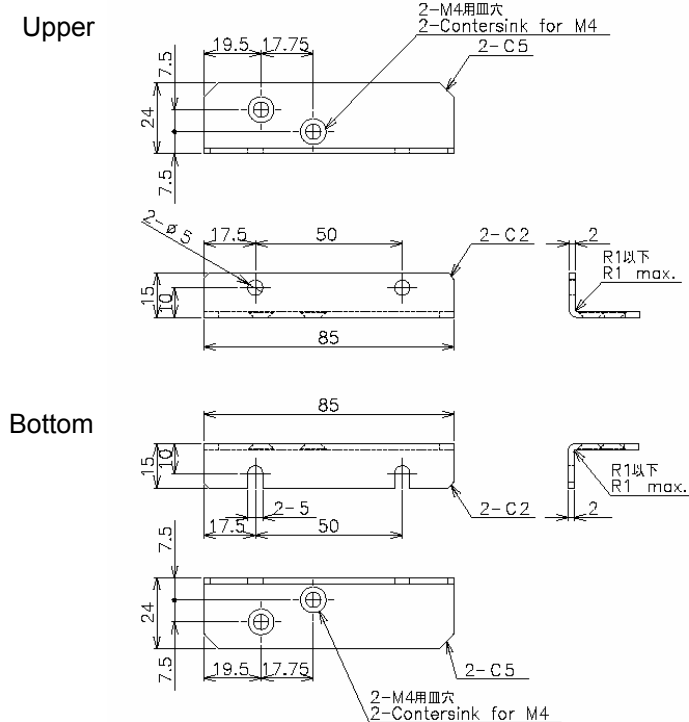
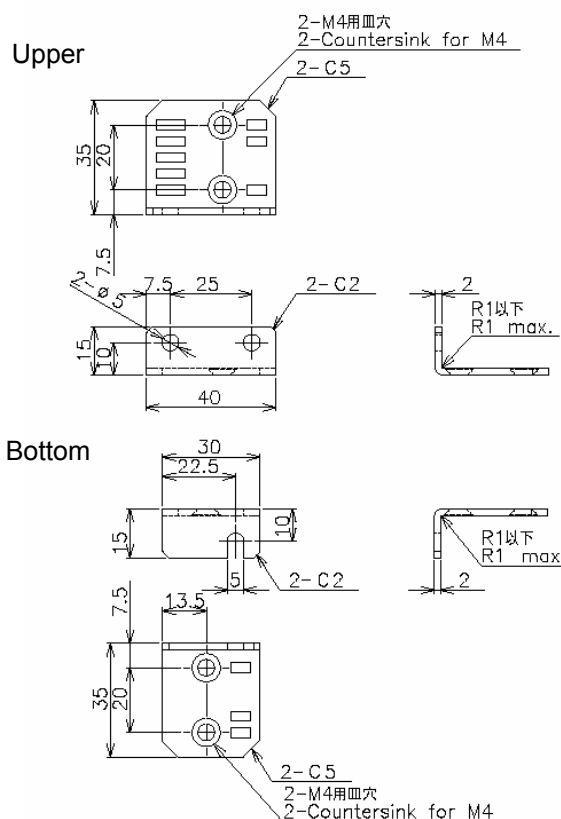
■ List of fixing brackets for RS3A01 to 30

Servo amplifier model number	Bracket fixing position	Model number	Contents
RS3A01,02,03	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 RS3A01, RS3A02, RS3A03
AL-00880390-01

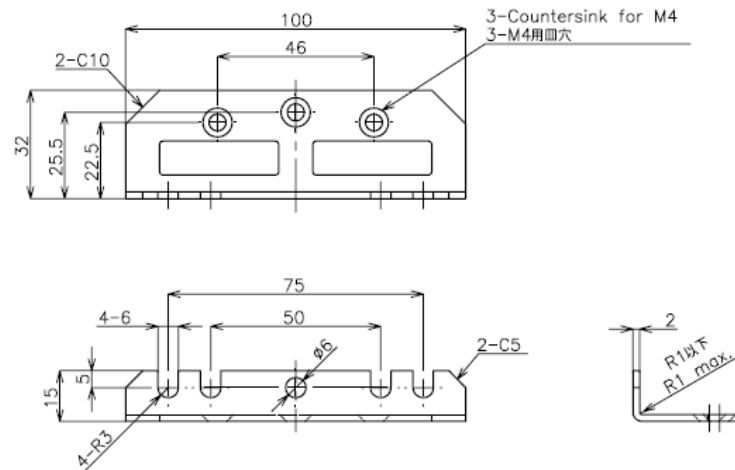
For RS3A05,07
AL-00880391-01



12.6 Optional parts

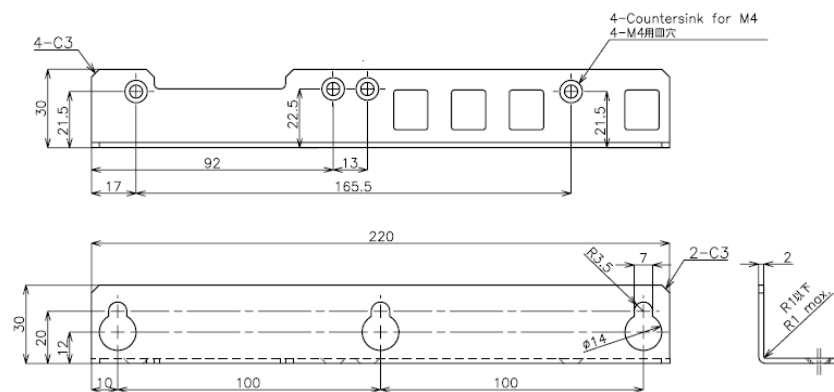
For RS3A10, RS3A15
AL-00907039-01

Common parts (Upper / Bottom)

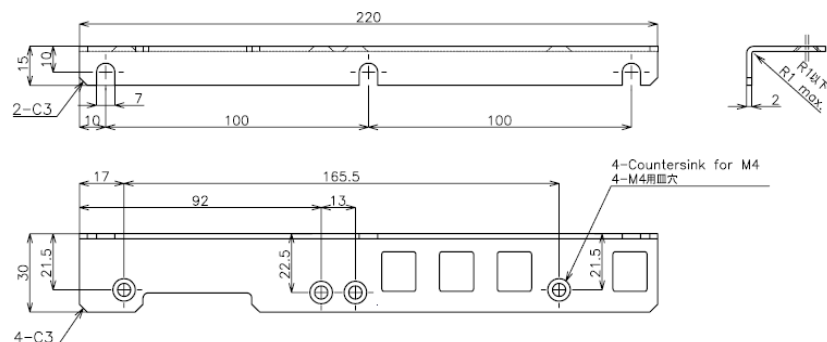


For RS3A30
AL-00907040-01

Upper



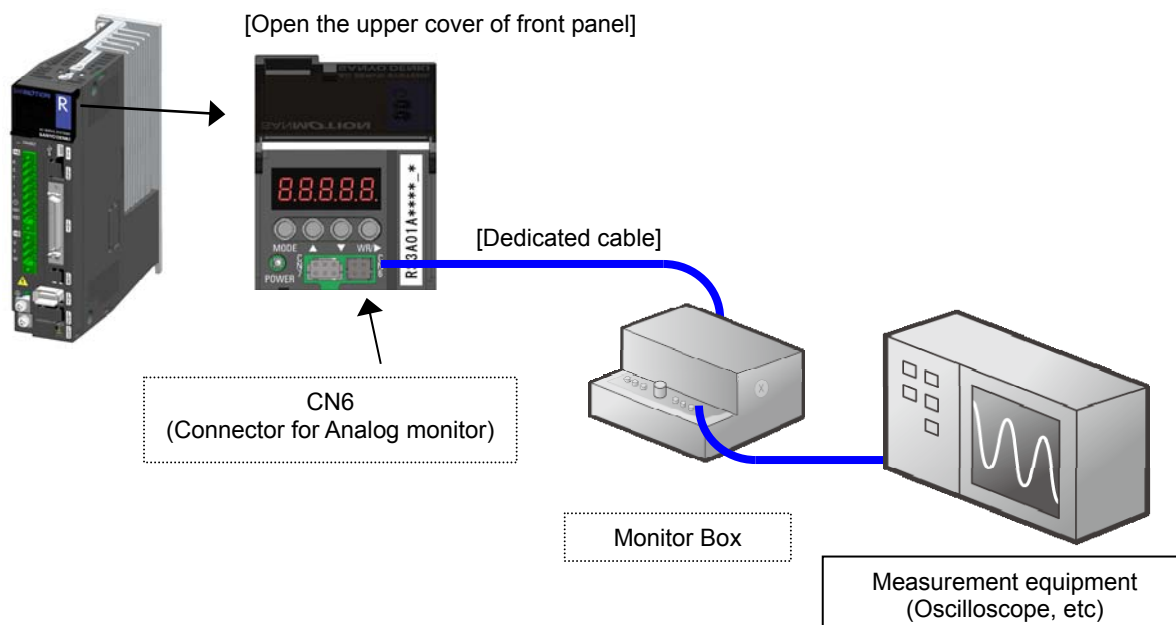
Bottom



12. Appendix

12.6.3 Analog monitor related item

Name	Details	SANYO DENKI model No.
Monitor Box	Monitor box body 2 dedicated cables	Q-MON-3
Dedicated cable	1 dedicated cables	AL-00690525-01



12.6.4 Communication cable of tandem operation between amplifiers

Name	Details	SANYO DENKI model No.
Communication cable between amplifiers (0.2m)	Servo amplifier(CN5)⇔Servo amplifier(CN5)	AL-00911582-01
Communication cable between amplifiers (3.0m)		AL-00911582-02

12.6 Optional parts

12.6.5 External regenerative resistor

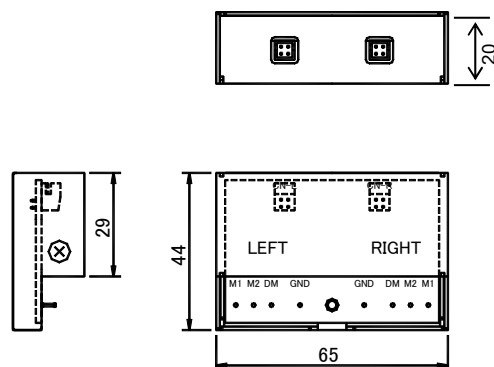
Resistor Model Number	Rated power [PR]	Resistance value	Thermostat Detection temperature (Contact specification)	Mass
REGIST-080W100B	80W	100 Ω	135°C $\pm$ 7°C (Switching contact b)	0.19kg
REGIST-080W50B	80W	50 Ω		
REGIST-120W100B	120W	100 Ω		0.24kg
REGIST-120W50B	120W	50 Ω		
REGIST-220W100B	220W	100 Ω		0.44kg
REGIST-220W50B	220W	50 Ω		
REGIST-220W20B	220W	20 Ω	100°C $\pm$ 5°C (Switching contact b)	
REGIST-500CW20B	500W	20 Ω		
REGIST-500CW10B	500W	10 Ω		1.4kg
REGIST-500CW7B	500W	7 Ω		
REGIST-500CW14B	500W	14 Ω	140°C $\pm$ 5°C (Switching contact b)	
REGIST-1000W6R7B	1000W	6.7 Ω		3.0kg

12. Appendix

12.7 Optional parts dimensions

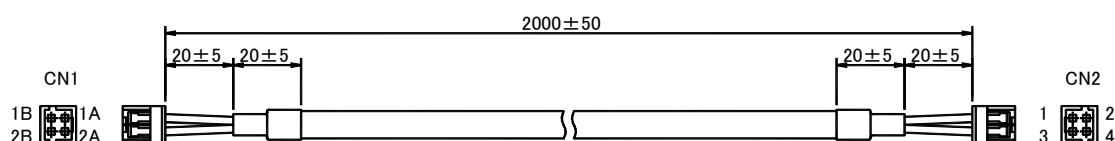
12.7.1 Monitor box outline drawing

- Monitor Box (Model No.: Q-MON-3)



12.7.2 Dedicated Cable outline drawing

- Dedicated Cable (Model No.: AL-00690525-01)



Note 1) A pair of the dedicated cable shown above (model number: AL-00690525-01) are supplied with the Monitor Box (model number: Q-MON-3).

Terminal No. on CN1	Signal name	Terminal No. on CN2
1A	Analog monitor 1	3
1B	Analog monitor 2	4
2A	GND	1
2B	Digital monitor	2

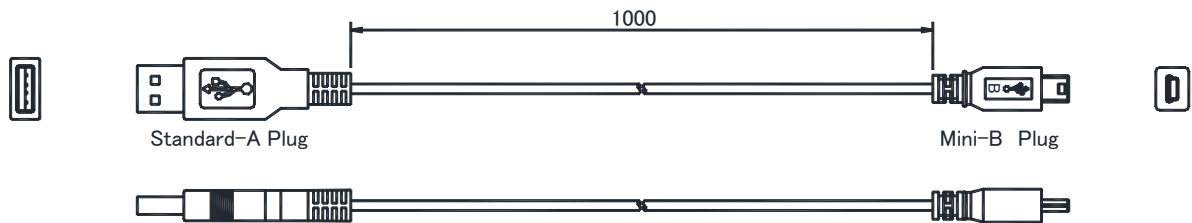
CN1	Manufacturer model No.	Manufacturer
Connector	LY10-DC4BR	Japan Aviation Electronics Industry, Limited
Contact	LY10-C1-A1-1000	Japan Aviation Electronics Industry, Limited

CN2	Manufacturer model No.	Manufacturer
Connector	DF11-4DS-2C	HIROSE ELECTRIC CO., LTD.
Contact	DF11-2428SCA	HIROSE ELECTRIC CO., LTD.

12.7 Optional parts dimensions

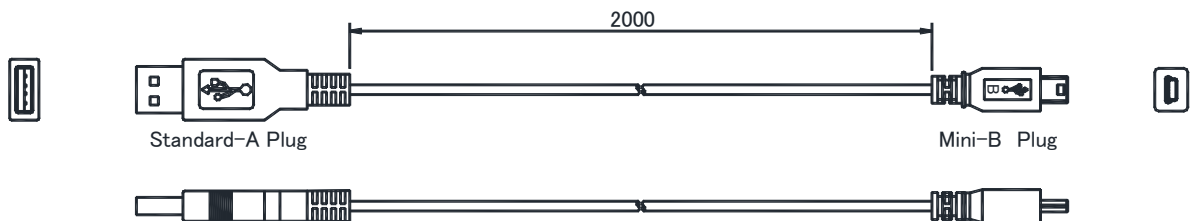
12.7.3 Outline drawing of USB communication cable

- USB communication cable (1.0m) (Model number: AL-00896515-01)



- ✓ Appearance and spec may change without prior notice.

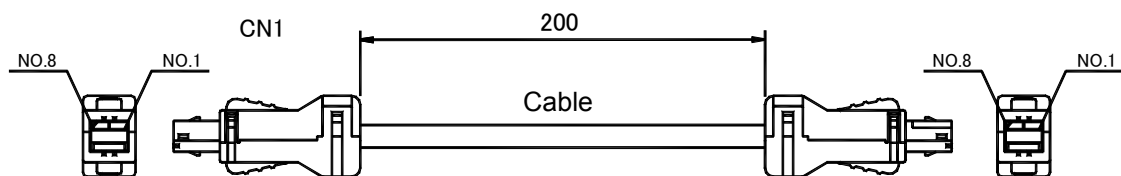
- USB communication cable (2.0m) (Model number: AL-00896515-02)



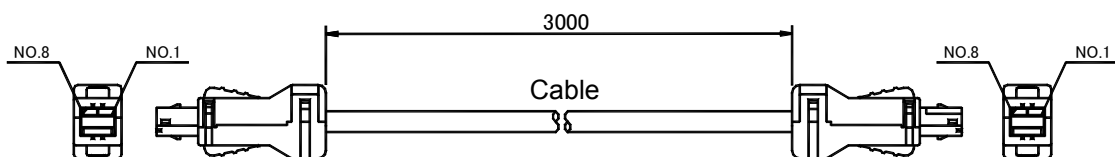
- ✓ Appearance and spec may change without prior notice.

12.7.4 Outline drawing of communication cable of tandem operation between amplifiers

- Communication cable of tandem operation between amplifiers (0.2m) (Model number: AL-00911582-01)



- Communication cable of tandem operation between amplifiers (3.0m) (Model number: AL-00911582-02)

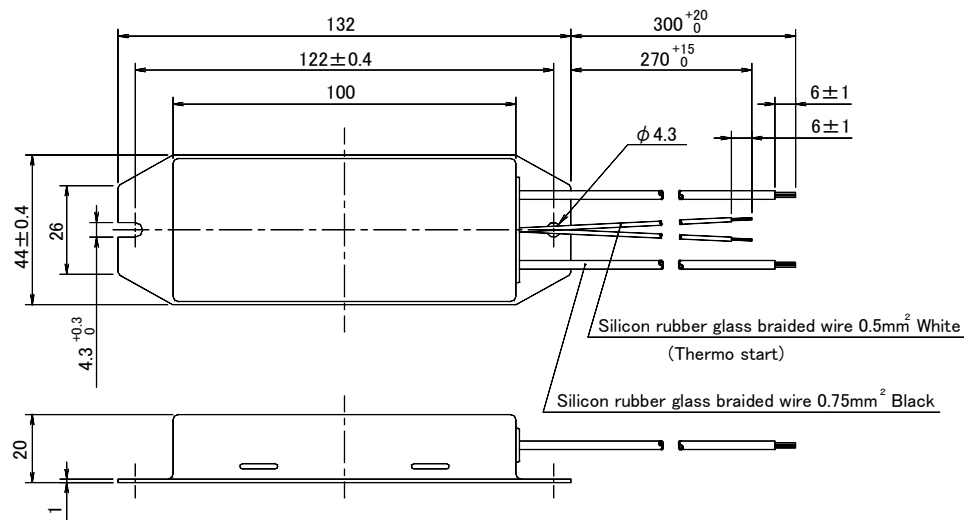


- ✓ As note, the wiring differs from the communication cable between amplifiers for R ADVANCED MODEL (Model number: AL-00695974-**).

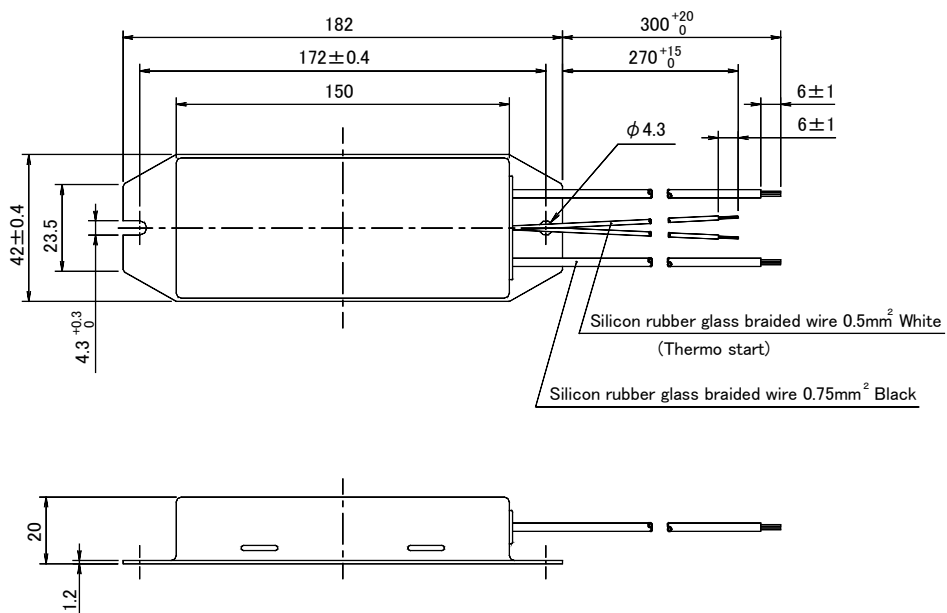
12. Appendix

12.7.5 Outline drawing of regenerative resistor

■ REGIST-080W

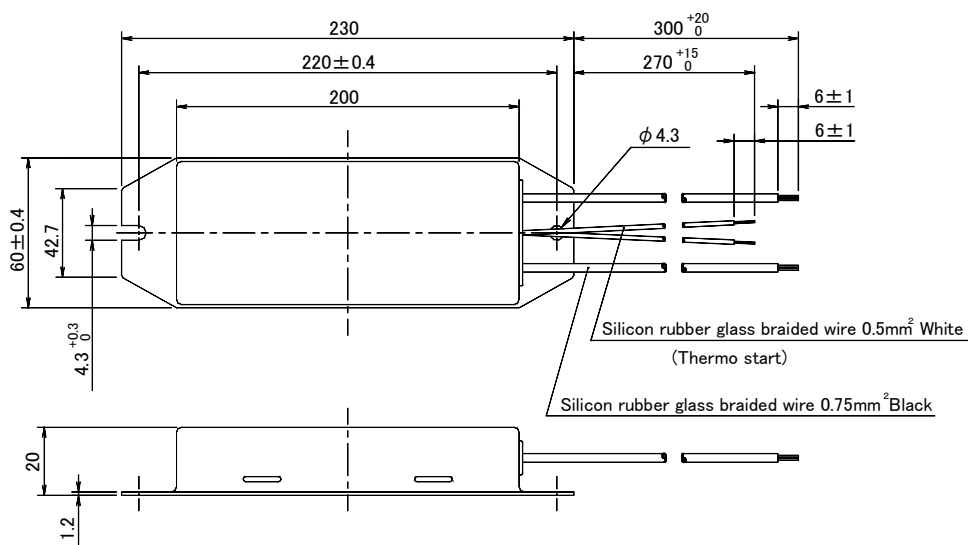


■ REGIST-120W

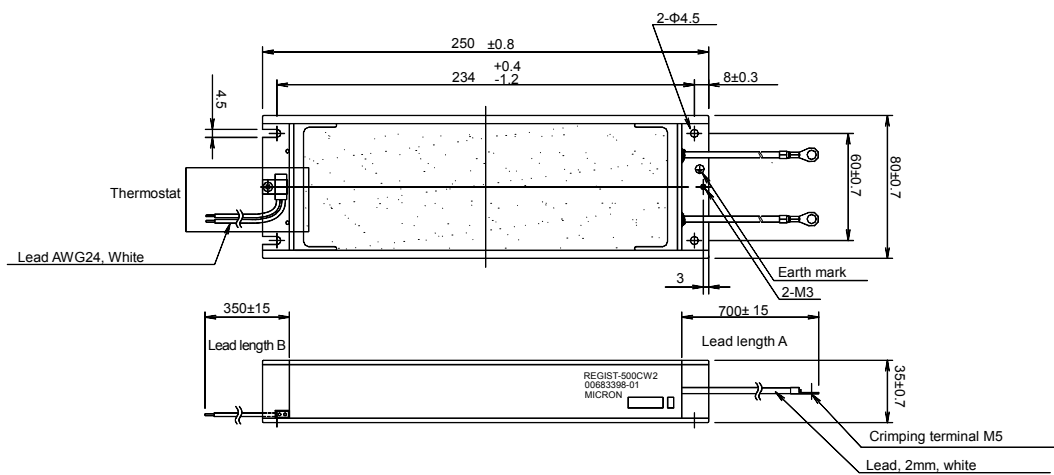


12.7 Optional parts dimensions

■ REGIST-220W

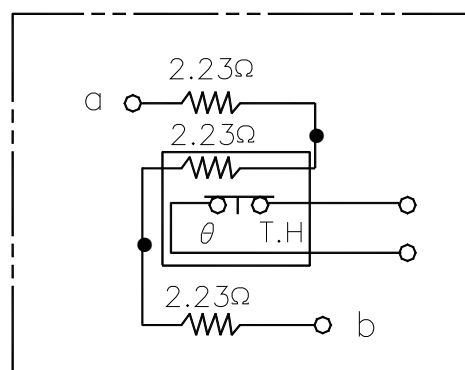
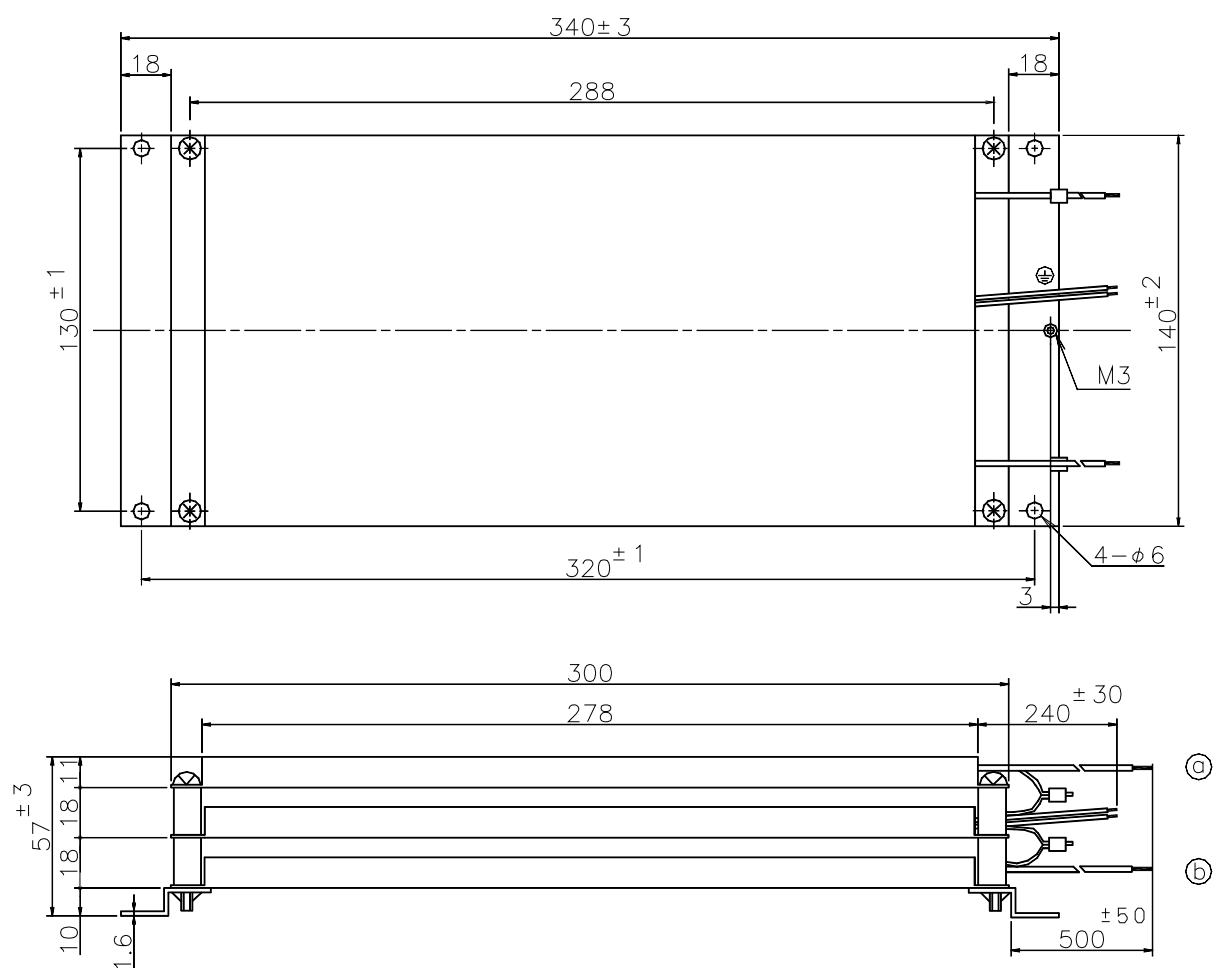


■ REGIST-500CW



12. Appendix

■ REGIST-1000W



Wiring diagram

Release	
Revision A	Feb. 2015
Revision B	Jun. 2016
Revision C	Jul. 2018



■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