M0009143C

SANMOTION

AC SERVO SYSTEMS

R ADVANCED MODEL

TYPE F (DC48V)

Pulse Input Type

For Rotary Motor

Instruction Manual

SANYO DENKI

Details of revision history

The third edition (C)

- Chapter 2 and 4
  - A precaution to use battery for main circuit added.

- Chapter 2
  - A precaution on control power supply added.
  - Terminal layout on connector for battery added.

- Chapter 5
  - A precaution on parameters for *Backup Type Absolute Encoder Function Selection* added.
  - Maximum number of repetitions of turning-on/off of servo amplifier added.
  - A precaution during parameter-writing to servo amplifier added.
  - A precaution on resetting alarm added.
  - A formula for converting between “effective torque monitor” and “motor utilization monitor” added.
  - A precaution on parameters for *Model Following Control* added.
  - A precaution on parameters for *Torque Limit Function* added.
  - A precaution on parameters for *Analog Monitor* added.
  - A precaution on parameters for *Dynamic Brake Operation* added.

- Chapter 10
  - Outline dimensional drawing of lithium battery added.

Carefully review this operating manual and the supporting documentations to use the product properly before perfoming installation, operation, and maintenance.
Use this product after you fully understand sufficient knowledges on all the equipments and safety information, and precautions.

This manual classifies safety precautions as follows:

- “DANGER”
- “WARNING”
- “CAUTION”

■ Signs of WARNING

	When handled incorrectly, excessive dangerous circumstances may occur to the extent that risk of death or suffering serious injuries are envisioned.
	When handled incorrectly, dangerous circumstances may occur to the extent that risk of death or suffering serious injuries are envisioned.
	When handled incorrectly, dangerous circumstances may occur to the extent that risk of moderate injuries, minor injuries, or physical damages only are envisoend.

Please be advised that even items in the scope of  may have serious consequences depending on circumstances. Fully observe every item that has important details.

■ Signs of PROHIBITION and MANDATORY

	Indicates PROHIBITIONs (actions that must not be done).
	Indicates MANDATORY actions (that must be performed without fail).

■ Operating precautions

⚠ WARNING

Fully observe the following warnings because of risk of electrical shock and injury.

- Do not operate the product in explosive atmospheres, because of risk of injuries and fire.
- Do not perform wiring and maintenance with applying current. These must be done over 10 minutes after breaking main power supply and after confirmation main power supply capacitor discharged, because of risk of electrical shock and damages.
- Surely ground earth terminal of servo amplifier (protective grounding terminal) to equipment or control board. Connect earth terminal of servo motor to earth terminal of servo amplifier without fail, because of risk of electrical shock.
- Never touch the inside of servo amplifier, because of risk of electrical.
- Do not scratch cables, apply excessive stresses, put heavy things, and tuck down any things, because of risk of electrical.
- Do not touch rotating area of servo motor while operating, because of injuries.

⚠ CAUTION

- Use designated combination of servo amplifier and motor, failure to observe this causes fire and failure.
- Person with expertise shall perform transfer, installation, wiring, operation, and maintenance, because of risk of electrical shock, injuries, and fire.
- Never install in water existed area, corrosive and flammable gas atmosphere, and near combustible materials, failure to observe this causes fire and failure.
- Read operating manual and observe the instructions prior to installation, operation, and maintenance, because of risk of electrical shock, injuries, and fire.
- Do not use servo amplifier and motor outside the scope of the specifications, because of risk of electrical shock, injuries, and fire.
- When wiring of main power supply and motor power line are relatively long, motor torque decreases due to impedance of wiring. Set acceleration and deceleration torque with sufficient margin when selecting motor, and verify them on actual equipment.

⚠ CAUTION

- Be careful of peripheral equipments of servo amplifier and motor that are subjected to high temperature, because of risk of burn injuries.
- Do not touch heat sink fin of servo amplifier and servo motor are at high temperature when applying current or for a while after breaking power supply, because of risk of burn injuries.

■ Storage

PROHIBITION
◆ Do not storage the product in water, hazardous gas, and liquid existed area, failure to observe this causes failure.

MANDATORY
◆ Storage the product within the specified temperature and himidity range ”-20°C thorugh +65°C, 90%RH” or less (no condensation) and by avoiding direct sunlight. Failure to observe this causes failure. ◆ Please contact us if storage period of servo amplifier has been long-term (for over 3 years), as long-term storage causes decrease capacity of electrolytic capacitor. Failure to observe this causes failure. ◆ Please contact us if storage period of servomotor has been long-term (for over 3 years), verification of bearing and brake are required.

■ Transportation

CAUTION
◆ When transporting the product, do not pick cables, motor shafts, and detecting devices, because of risk of failure and injuries. ◆ When transporting the product, be aware of dangers of falling and rolling over, because of risk of injuries.

MANDATORY
◆ Products overloading causes collapsing, so observe the instructions on the outer case, because of risk of injuries. ◆ Use eyebolt of servo motor to carry servo motor only, not any equipments, because of risk of injuries and failure.

■ Installation

⚠ CAUTION

- Do not put heavy things or get on top of the product, because of risk of injuries.
- Fully observe installation direction, failure to observe this causes fire and failure.
- Do not let fall and apply high impacts on the products. Failure to observe this causes failure.
- Do not shut or let foreign materials into the port, because of risk of fire.
- Keep proper distances for lay out in servo amplifier control board as instructed in operating manual, failure to observe this causes fire and failure.
- Unpack after confirming top and bottom of the case, because of risk of injuries.
- Confirm no discrepancies between delivered product and ordered item. Failure to observe this causes injuries and damages.
- Be aware of risk of falling and rolling over when installing. Use eyebolt if supplied with servo motor, because of risk of injuries.
- Install the product in incombustible materials like metal, because of risk of fire.

■ Wiring

⚠ CAUTION

- Perform wiring surely and correctly, because of risk of injuries.
- Perform wiring in accordance with instructions in wiring diagram or operating manual, because of risk of electrical shock and fire.
- Perform wiring in accordance with electrical facility technical standard and wiring regulation, because of risk of burnout and fire.
- Do not connect commercial power supply to U, V, and W terminal of servo motor, because of risk of fire and failure.
- Place safety device like braker in case of short circuit of external wiring, because of risk of fire.
- Do not band power conduit cables, I/O signal cables, and encoder cables together, or pass them through the same duct. Failure to observe this causes malfunction.
- Do not connect DC90V or AC power supply to DC24V brake of servo motor. Do not connect AC400V power supply to AC200V fan of servo motor, because of risk of burnout and fire.
- Do not use thin cables for wiring, or avoid excessive long wiring for power input cables and motor power coduit cables, as these may cause control circuit inoperative or failure of specification-compliant operation due to torque decrease. Set acceleration and deceleration torque with sufficient margin when selecting motor.

■ Operation

⚠ CAUTION

- Never make excessive adjustment change as the operation becomes unstable, and there is risk of injuries.
- Fix servo motor apart from mechanical equipments to perform test operation and install in the machine after operation check, because of risk of injuries.
- Holding brake is not a stopping device to secure machine safety. Place a stop device to secure safety on the side of machine, because of risk of injuries.
- When alarm activated, eliminate the causes, ensure the safety, and reset alarm to restart operation, because of risk of injuries.
- Confirm input power supply voltage is within the scope of the specification. Failure to observe this causes failure.
- Do not get close to machine as the machine may restart without notice after recovery from momentary stoppage. (Design machines so as to secure safety in case of restart.) There are risks of injuries.
- Do not use broken, damaged, and burnout servo amplifier and motor, because of risk of injuries and fire.
- In the event of malfunction, stop the operation immediately, because of risk of injuries, electrical shock, and fire.
- When using servo motor on the vertical axis, place safety device so as not to let works fall when alarm activated, Because of risk of injuries and damages.

PROHIBITION

- Holding brake supplied with servo motor is designed to hold only, so do not use this brake for normal braking. If used for braking, this brake is damaged. Failure to observe this causes failure.
- Do not apply static electricity and high voltage to cables for servo motor encoder. Failure to observe this causes failure.
- Do not continuously and externally rotate servomotor in combination with servo amplifier with standard dynamic brake resistance when servo is off, as dynamic brake resistance produces heat, because of risk of fire and burn injuries.
- Do not disconnect connectors when applying current, because of risk of damages.

MANDATORY

- Externally place emergency stop circuit so as to immediately stop operation and disconnect power supply. Incorporate safeguard circuit into the outside of servo amplifier so as to disconnect main circuit power when alarm activated, because of risk of going out of control, injuries, burnout, fire, and secondary damages.
- Any protective devices are not supplied with servo motor, so protect the motor with overcurrent protective device, earth leakage breaker, overtemperature preventive device, and emergency stop device, because of risk of injuries and fire.
- Operate within the scope of specified temperature and humidity.

Servo amplifier
Temperature: 0°C thorugh 40°C
Humidity: 90% RH or less (No condensation)
Servo motor
Temperature: 0°C thorugh 40°C
Humidity: 20 through 90%RH (No condensation, as this causes burnout and failure.)

■ Maintenance

CAUTION

- Some servo amplifier component parts (electrolytic capacitor and lithium battery for encoder) aged-deterioration. For preventive maintenance, replace the parts by referring standard cycle of replace, and contact us when replacing. Failure to observe this causes failure.
- Never get close to or touch terminals and connectors when applying current, because of risk of electrical shock.
- Do not disconnect connectors when applying current, because of risk of damages.
- Be aware of high temperature of servo amplifier flame when performing maintenance, because of risk of burn injuries.
- Please contact us when you would like to repair, as overhaul causes product inoperative. Failure to observe this may causes failure.

PROHIBITION

- Do not perform overhaul.
  Overhaul causes fire and electrical shock.
- Do not measure insulation resistance and dielectric strength voltage, because of risk of damage.
- When applying current, never remove terminals and connectors (except for insertable and removable ones), because of risk of electrical shock and damages.
- Do not remove nameplate

■ Disposal

MANDATORY

- Dispose servo amplifier or motor as industrial waste.

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4. Wiring

5. Operation

6. Adjustment

10. Appendix

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1. Preface

1.1 Introduction

AC servo amplifier “SANMOTION R ADVANCED MODEL low voltage-input type” is a small and one axis servo amplifier with 2 kinds of capacities, to which main circuit power DC48V<24V> and control power DC5V are input as external power supply. This model corresponds to rotary motor “series R,” and both serial encoder and pulse encoder are available. Also, this can correspond to external pulse encoder for fully closed system. Batteries for motor encoder can be installed in encoder cables. We achieved decrease in volume having great advantage over AC-input servo amplifier by decreasing voltage and down sizing of main circuit part, this can achieve down sizing in servo system

1) Changes and additions to AC Servo amplifier SANMOTION R (previous model)

The followings are differences between this model and the other SANYO DENKI products, such as “SANMOTION series R (AC100/200V-input).”

- DC-power input and down-sized

  Down-sized and DC-power input type (main circuit DC48V <24 V >, control circuit DC5V)servo amplifier.

- Placement of input power supply unit and overcurrent protection device

  Input power supply for main power (DC48V <24 V >) and control power (DC5V) of the servo amplifier is designed to use AC/DC power (switching power supply). No fuses are built in input sections of main and control power supply of the servo amplifier, so please place fuses or breakers in power supply system from AC power down to servo amplifier input sections for the purpose of overcurrent protection. (This servo amplifier is UL-approved under the condition that fuses are placed in input sections. Refer to section 10 for global standards.)

- Regenerative unit (optional)

  Main circuit voltage may increase due to regenerative energies, depending on combined motor, operation conditions, servo amplifier connection conditions. Regenerative circuit is not built in servo amplifier. We can offer an optional regenerative unit for absorbing voltage.

- Only available on pulse input mode

  Control mode is position control mode only. Command is pulse input position command only. Please note that analog velocity command, torque command, and torque limit command is not available.

- Analog monitor

  Analog monitoring function to monitor servo amplifier & motor operation is not built in this servo amplifier. You can monitor by connecting external monitor box.

- Digital operator

  Digital operator is not built in this model, such as built in our AC servo amplifier “SANMOTION R” and “SANMOTION R ADVANCED MODEL.”

- Safe torque-off function

  Safe torque-off function is not built in this model.

- Setup software

  Setup software of “SANMOTION R ADVANCED MODEL” can be used as it is. (Except for multiple-drop function to monitor multiple axes servo amplifier status.) Make sure not to disconnect the control power supply, when writing parameters via setup software.

- Cautions on wiring length

  Main circuit power and control power supply are intended to be input from commonly used AC/DC converter.
  When wiring length from power supply to servo amplifier is relatively long, the voltage might drop due to cable impedance, and this may cause motor torque decrease and control circuit error. Please perform wiring with use of thick cable and minimal-length as much as possible, so as not to let any voltage drops occur.

1.2 Instruction Manual

This manual describes specification, installation, wiring, operation, functions, maintenance of AC servo amplifier “SANMOTION R ADVANCED MODEL, low voltage-input type” as in the following order:
The figures in parentheses for main circuit voltage described in this manual are the values when the voltage is DC24V.

1) Contents

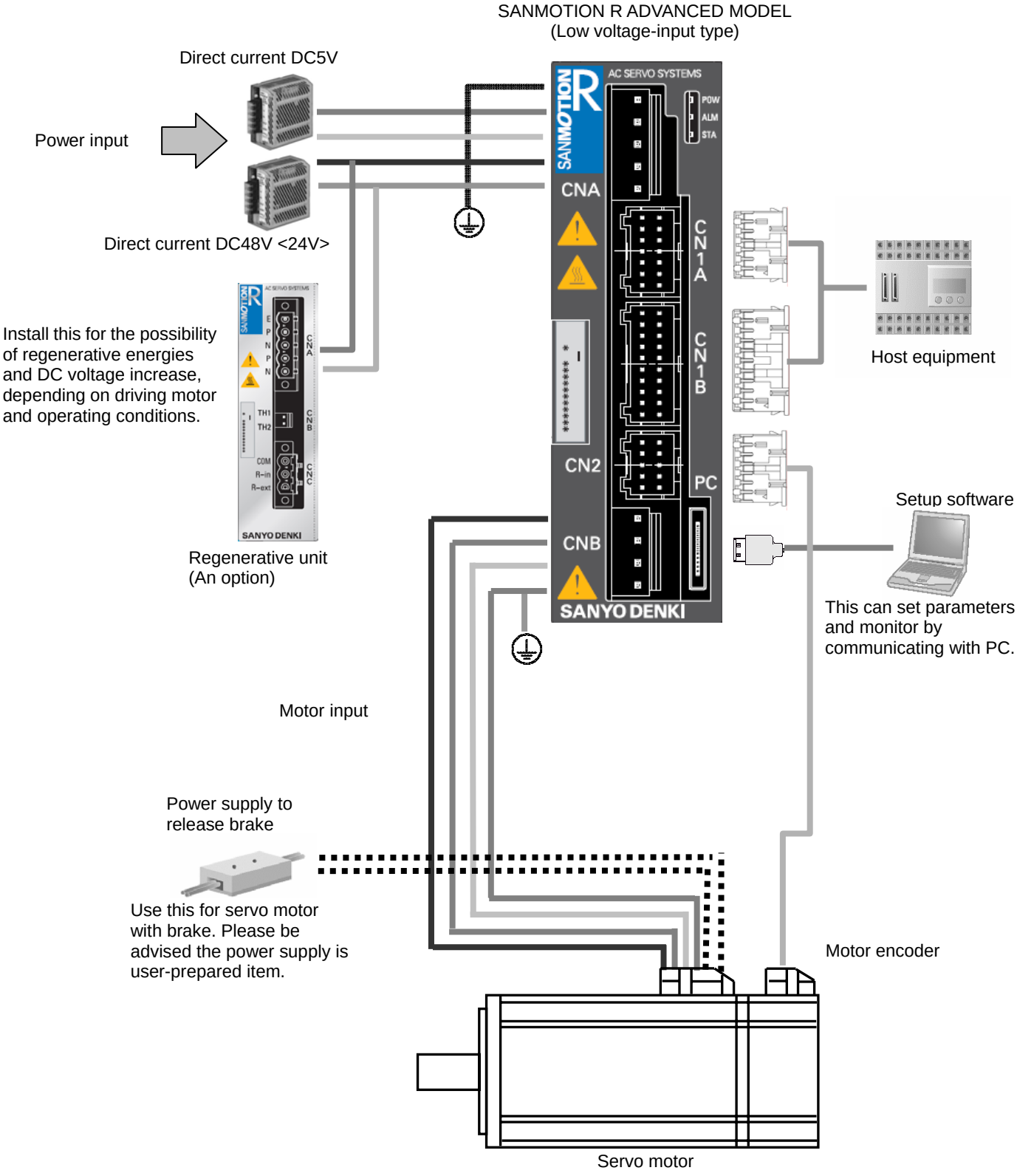
- “Section 1, Preface”
  Describes product outline, model number structure, and each part name.
- “Section 2, Specification”
  Describes detailed specifications for “servo motor,” “motor encoder,” and “servo amplifier.”
- “Section 3, Installation”
  Describes installation method of product.
- “Section 4, Wiring”
  Describes wiring method of product.
- “Section 5, Operation”
  Describes operating sequence, test operation method, parameters.
- “Section 6, Adjustment”
  Describes automatic tuning and manual servo tuning.
- “Section 7, Maintenance”
  Describes probable causes 1.2 Instruction when alarm activated, and maintenances.
- “Section 8, Fully closed cont Manual
  Describes fully closed contr
- “Section 9, Selection”
  Describes selecting method y, regenerative energy and its coping measures.
- “Section 10, Appendix”
  Describes overseas standard, servo motor data sheet, and outline dimensional drawing.

2) Precautions on this manual

Thoroughly read this manual prior to use the product to fulfill and correctly use functions of the product. After thoroughly reading this manual, keep it handy for reference when needed. Fully observe safety instructions described in this manual. Please note that we cannot guarantee the safety when you use the product in any usages other than the specified usages in this operating manual. Figures in this manual are partially schematic illustrations or abstractions. Contents of this manual are subject to change without notice depending on product version upgrade or any additions. Any changes shall be made only by revising this manual. We make assurance doubly sure on the contents of this manual, however, in the event that any suspicions, errors, or erroneous omissions, please contact our sales branch near you or head office indicated in the back of this manual.

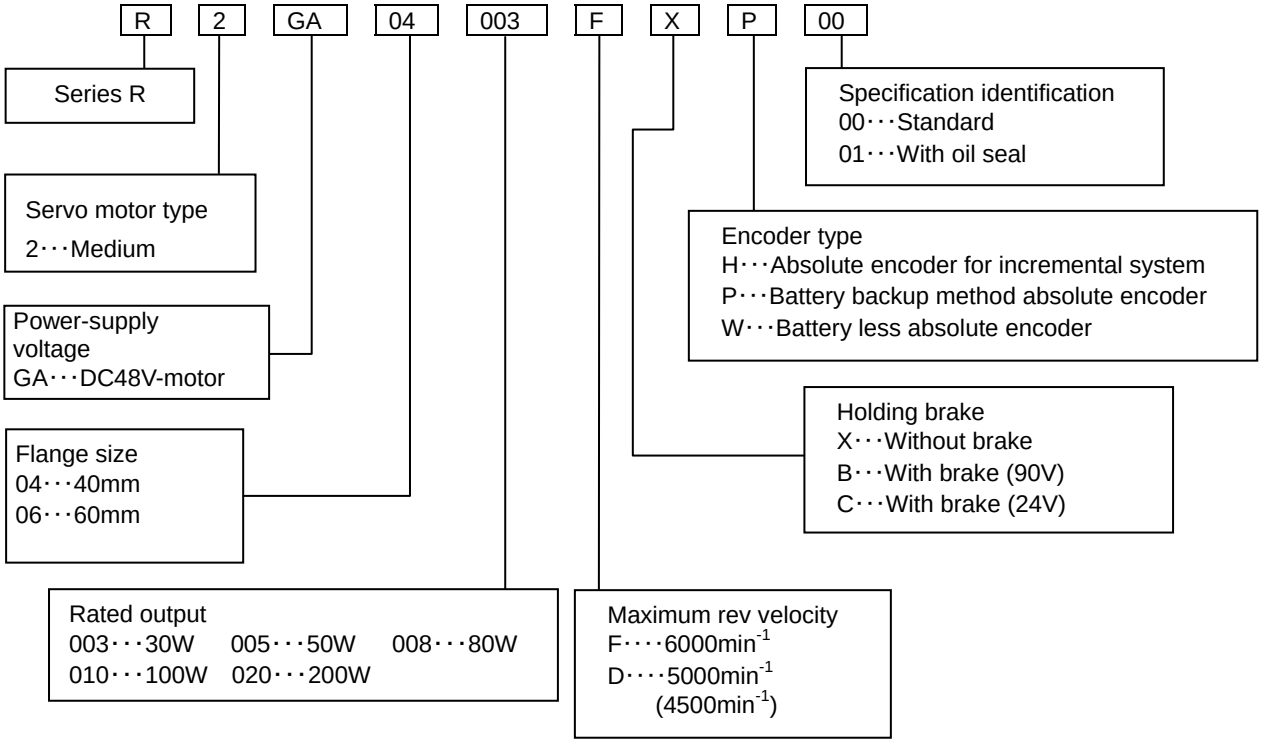
1.3 Illustration of System Components

The folowing shows an example of system configulation.



1.4 Model number structure

1) Model number of servo motor



Decreasing rating may be needed for the model with oil seal and brake.

Refer to “Section 2.1.6, Degree of decrease rating for R2AA Motor, depending on with or without oil seal/brake.”

■ Motor encoder

◆ Serial encoder

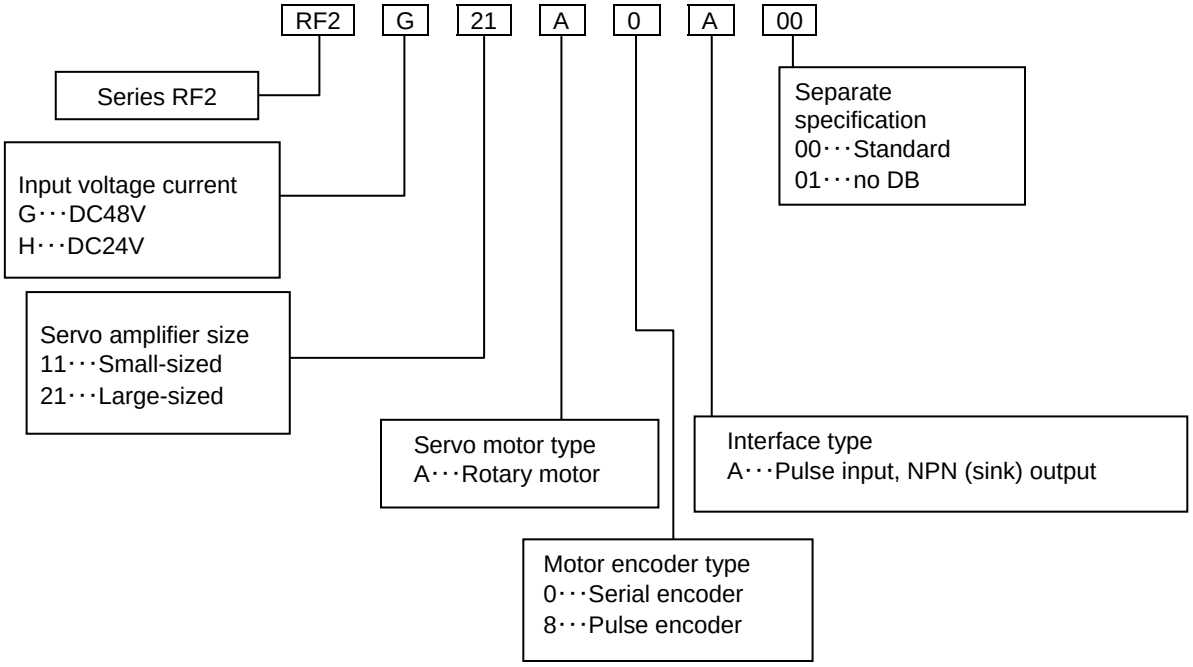
Model	Resolution within 1 rotation	Resolution within multiple rotations	Name	Transmission format
PA035S	131072(17bit)	-	Absolute encoder for incremental system	Half-duplex start/stop synchronization 2.5Mbps (standard)
PA035C	131072(17bit)	65536(16bit)	Battery backup method absolute encoder	Half-duplex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

◆ Pulse Encoder

Model	Resolution within 1 rotation	Motor flange angle	Name
PP031	1000/2000/2048/4096/5000/6000/8192/10000 (P/R)	40mm or over	Wire-saving incremental encoder

✔ Please contact us on combinations with servo motors.

2) Model numbers of servo amplifier (abbreviated model numbers)



- ✔ Set value for servo amplifier is set to “standard set value” at factory.
- ✔ User needs to changes “combination setting of servo amplifier and motor,” “system parameters,” and “general parameters” that shall be tailored to user equipment.
- ✔ Please be advised that user shall perform settings as tailored to system you use by referring to the following sections.

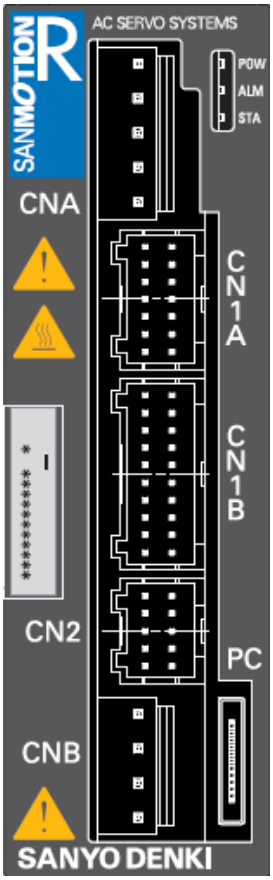
  - ◆ “Section 5-1, Setting change of servomotor combination”
  - ◆ “Section 5-2, System parameters”
  - ◆ “Section 5-2, Standard set value at factory”
  - ◆ “Section 5-8, Parameter setting”

- ✔ Standard model servo amplifier is not available for “fully-closed system.” Please contact us when you consider using.
- ✔ RF2 servo amplifier does not support “safe torque off function.”
- ✔ Output circuit of RF2 servo amplifier is exclusive for NPN (sink) output, not available for PNP (source) output.

1.5 Part names

1) Servo amplifier

Front view



Connector for inputting power supply
CNA: Plug-side model number
Housing: VHR-5N
Contact: SVH-21T-P1.1 or SVH-41T-P1.1
(J.S.T. Mfg. Co., Ltd product)

POW: LED for indication control power established
ALM: LED for alarm
STA: LED for status

Connector A for I/O signal for host equipment
CN1A: Plug-side model number
Housing: PADP-14V-1-S
Contact : SPH-002GW-P0.5S
(J.S.T. Mfg. Co., Ltd product)

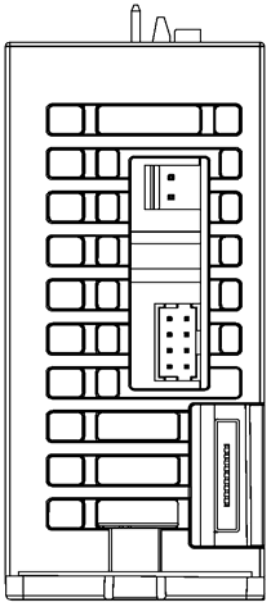
Connector B for I/O signal for host equipment
CN1B: Plug-side model number
Housing: PADP-20V-1-S
Contact: SPH-002GW-P0.5S
(J.S.T. Mfg. Co., Ltd product)

Connector for encoder signal
CN2: Plug-side model number
Housing: PADP-10V-1-S
Contact: SPH-002GW-P0.5S
(J.S.T. Mfg. Co., Ltd product)

Connector for servo motor
CNB: Plug-side model number
Housing: VHR-4N
Contact: SVH-21T-P1.1 or SVH-41T-P1.1
(J.S.T. Mfg. Co., Ltd product)

Connector for communicating with setup software

Bottom view



Connector for batteries

Connector for analog monitor box

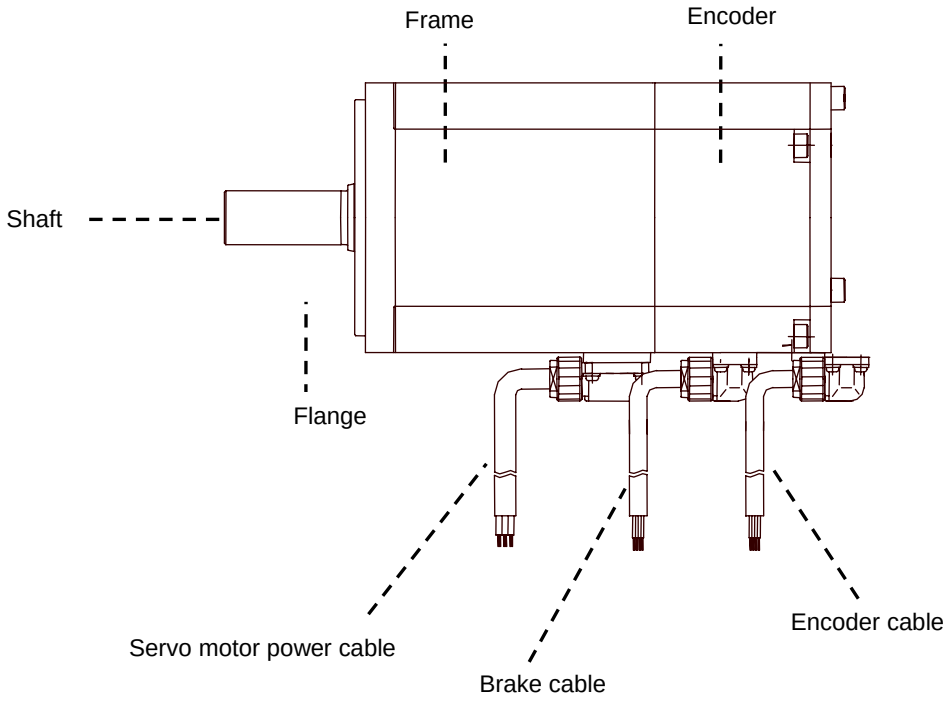
Connector for inputting external encoder

■ Use gold-plated contacts for CN1A, CN1B, and CN2.

2) Servo motor

■ Lead type

R2□A04○○○△□◇
R2□A06○○○△□◇



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2. Specification

2.1 Servo motor

1) Common specification

Series	Servo motor series R2
Time rating	Continuous
Insulation classification	Class F
Dielectric strength voltage	AC1500V for 1minute
Dielectric resistance	DC500V, over 10MΩ
Protection method	Fully closed, self-cooled
	Motor flange angle shall be 80 or less: IP67 (Except for motor passed-through part and cable tip.)
Oil sealing	Motor flange angle shall be 80 or less: none (Except for options available.)
Ambient temperature	0 through +40 degrees Celsius
Storage temperature	-20 through +65 degrees Celsius
Ambient humidity	20 through 90% (No condensation)
Vibration classification	V15
Excitation method	Permanent magnet
Mounting method	Flange

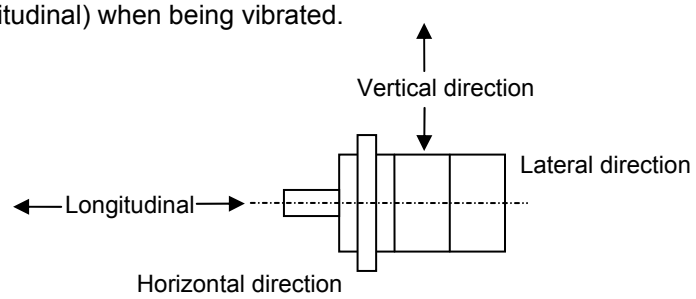
2) Servo motor external dimension, specification, and weight

Refer to 10-3, Servo motor outline dimensional drawing.
Refer to 10-4, Servo motor data sheet.

3) Mechanical specification, strength, and engineering precision

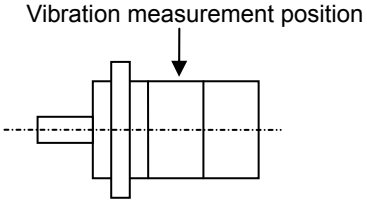
■ Vibration tolerance

Install the servo motor axis horizontally as illustrated below so that the servo motor shall be tolerant of 24.5m/s2 of vibration acceleration in three directions (vertical, horizontal, and longitudinal) when being vibrated.

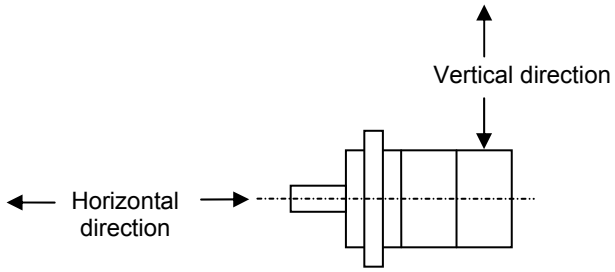


■ Vibration classification

Vibration classification of servo motor is V15 or less at maximum velocity of revolution when measuring servomotor alone as shown in the figure below.

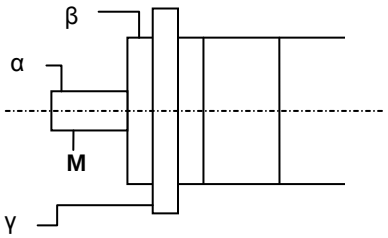


■ Shock resistance
Servo motor shaft shall be installed in the horizontal direction as indicated in the figure below so that the shaft is tolerant of 98m/s^2 of impact acceleration when being applied a vertical impact twice. Note that the servo motor comes with precise motor encoder on the opposite side of the flange, so any impacts on the shaft may cause a damage to motor encoder. Do not apply any impacts on the shaft.



■ Mechanical strength
Servo motor shaft strength is tolerant of maximum momentary torque.

■ Engineering precision
The following table shows precisions (Total Indicator Reading) of servo motor output shaft and its peripheral mounting points.

Item	T. I. R.	Reference drawing
Vibration of output shaft terminal: α	0.02	
Vibration of output shaft terminal: β	0.06 (80 or less)	
	0.08 (130 or more)	
Perpendicularity of flange face to output shaft M: γ	0.07 (80 or less)	
	0.08(130 or over)	

✔ The values in parentheses are motor flange angles.

4) Oil seal type
Oil seals for servo motor output shaft are optional extras.
So please contact us when you replace oil seal.

Servo motor model	Oil seal type
R2□A04○○○□	Standard: No oil seal Option: type G
R2□A06○○○□	Standard: No oil seal Option: type S

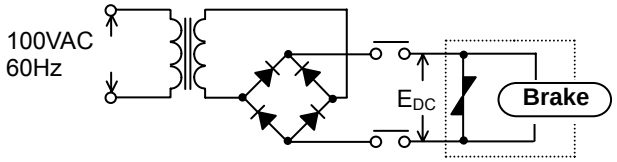
5) Holding brake

An optional holding brake is supplied with the servo motor. This brake shall not be used as braking except in emergency as this is designed to hold. Use “the timing signal output for holding brake” to turn on/off the brake excitation. To use this signal, set the command to 0min-1 in the servo amplifier only for the brake open time. To control the holding brake externally, the following operating delay time should occur. To use the motor with braking, set the sequence on the basis of the above operating delay time.

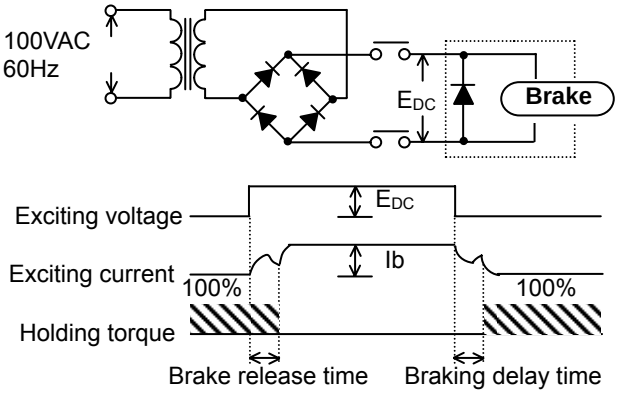
Servo motor model number	Static friction torque N·m	Release time (ms)	Braking delay time (ms)	
			Varistor	Diode
R2GA04003F	0.32	25	15	100
R2GA04005F	0.32			
R2GA04008D	0.32			
R2GA06010D	0.36	30	20	120
R2GA06020D	1.37			

■ Brake operating time is measured in the following circuit:

◆ Circuit using varistor



◆ Circuit using diode



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

6) Degree of decrease rating for R2AA Motor, depending on with or without oil seal/brake

In terms of servomotors with oil-seal and/or brake, the following derating ratio have to be applied to the torque characteristic in the continuous velocity range.

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

	R2GA04005F	R2GA04008D
Degree of decrease rating 1	-	90%
Degree of decrease rating 2	90%	85%

→ The above figures are provisional.

2.2 Motor encoder

1) Serial encoder

■ Absolute Encoder for Incremental System

Model	Resolution	Synchronization scheme	Transmission scheme	Transmission rate
PA035S	Divided into 131072 (17bit)	Start/stop synchronization	Half duplex serial communication	2.5Mbps

■ Battery Backup Method Absolute Encoder

Model	Resolution	Multiple rotations	Synchronization scheme	Transmissio n scheme	Transmission rate
PA035C	Divided into 131072 (17bit)	65536 (16bit)	Start/stop synchronization	Half duplex serial	2.5Mbps
	Divided into 131072 (17bit)	65536 (16bit)	Start/stop synchronization	Half duplex serial	4.0Mbps

■ Battery-less Absolute Encoder

Model	Resolution	Multiple rotations	Synchronization scheme	Transmission scheme	Transmission rate
RA035C	Divided into 131072 (17bit)	65536 (16bit)	Start/stop synchronization	Half duplex serial communication	2.5Mbps

2) Pulse encoder

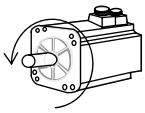
■ Wire-saving incremental encoder

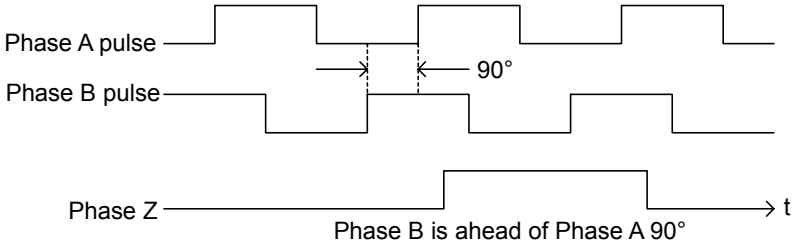
Model	Resolution	Applicable motor flange angle
PP031	1000/2000/2048/4096/5000/6000/8192/10000 P/R	40mmor over

✔ Not all the pulse encoders are applicable depending on motor types. Please contact us when you are planning to purchase.

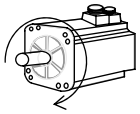
■ Servo motor rotation direction and encoder signal pulses of pulse encoder
Motor rotation direction and motor encoder signal phases are related as follows:

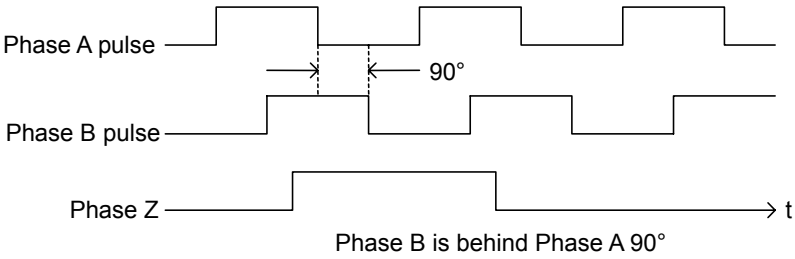
Servo motor rotation direction-Normal





Servo motor rotation direction- Reverse

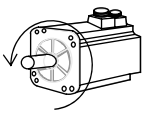




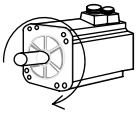
✔ When Phase Z is at high level, both phases A and B cross the low level once every rotation.

■ Serial Encoder

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



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



✔ Forward: the servo motor rotates in a counterclockwise direction from the load side
✔ PS data can be confirmed by ”Monitor ID16,17 ABSPS”

3) Battery specification

Model: ER3VLY (Consumer Marketing Corporation product)
Voltage：3.6V

2.3 Servo amplifier

1) Common specification

■ General specification

Control function	Position control	
Control system	MOS-FET：PWM control, sine wave drive	
Main circuit power supply	DC48V<24V>±10%	
Control power supply	DC5V±5%	
Environment	Operating ambient temperature	0 through 40 degree Celsius
	Operating storage temperature	-20 through +65 degree Celsius
	Operating and storage humidity	90% RH or less (No condensation)
	Height above sea level	1000m or less
	Vibration	$4.9m/s^2$ Frequency range: 10 through 55Hz in X, Y, and Z direction each, within 2H
	Impact (shock)	$19.6m/s^2$
Configuration	Tray shape, external power supply	
External dimension (H×W×D)	116×30×70mm	
Mass	0.23kg±20%	

- ✔ Input power voltage shall be within the scope of this specification.
- ✔ Main circuit power depression decrease torque in the motor momentary range. Select motor with sufficient margin.
- ✔ Encode also comes with control power supply. Pay attentions to input voltage as encoder may not operate when being input voltage lower that 5V.
- ✔ Fuses are not built in servo amplifier. Place over current protection (such as fuse) on the line toward DC input part of servo amplifier from AC power through DC power (user to prepare). (Please confirm that fuse is built in the DC power supply you purchase before use.)
- ✔ To use battery for main circuit DC power supply, make sure to install electrolytic capacitor in parallel to protect the servo amplifier. (2,000μF or more-sized capacitor is recommended)

■ Performance

Velocity control range	1：5000
Frequency characteristic	1200Hz

- ✔ Internal velocity command
- ✔ In case of high-velocity sampling mode

■ Built-in functions

Protection functions	Over current, Current detection error, Overload, Amplifier overheating, External overheating, Over voltage, Main circuit power low voltage, Control power supply low voltage, Encoder error, Over velocity, Velocity control error, Velocity feedback error, Excessive position, Position command pulse error, Built-in memory error, Parameter error
Display	Status display, Alarm display, Power-supplied-state display
Dynamic brake circuit	Built-in *Some model numbers have no dynamic brake circuit depending on specifications.

■ Options

Regenerative unit	Install when direct current of main circuit rise due to regenerative power, depending on combined motors or operating patterns.
Monitor box	You can monitor operating status (velocity or torque) with oscilloscope by connecting this monitor box.

- ✔ Refer to section 10 for details of options.

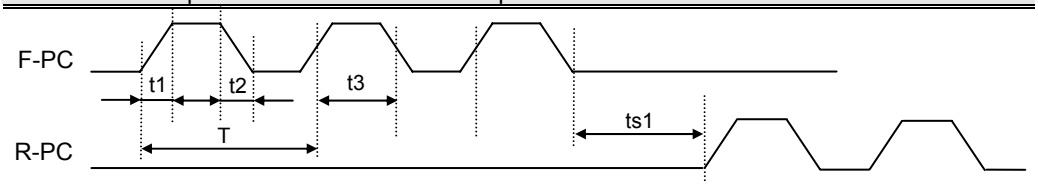
2) Input command, position output signal, general-purpose input signal, and general-purpose output signal

■ Input command

Position command	Maximum input pulse frequency	5M PPS (reverse rotation + normal rotation pulse and code + pulse) 1.25M PPS (90°-phase-difference, two-phase pulse)
	Input pulse configuration	Normal rotation + reverse rotation command pulse, code + pulse train command, or 90° phase-difference, two-phase pulse train command.
	Electronic gear	N/D (N=1 through 2097152, D=1 through 2097152) Except that 1/2097152≦N/D≦2097152

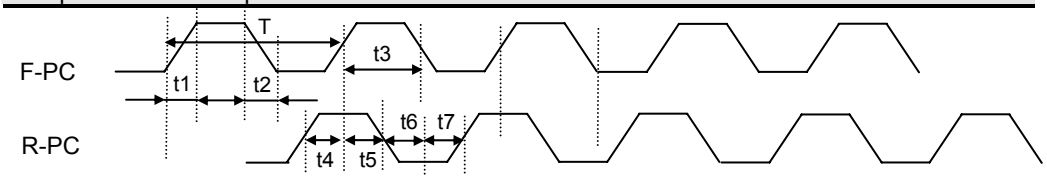
■ Timing of position command

Normal rotation pulse train + reverse rotation pulse train



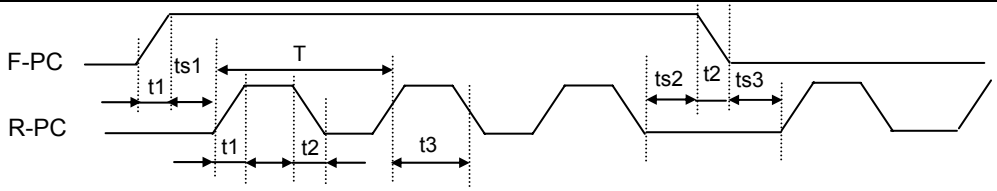
Rise time (t1): ≦0.1μs	Fall time (t2): ≦0.1μs
Duty [(t3/T)×100]: 50%	Pulse switching time: ts1> T

90° phase-difference pulse train



Rise time (t1): ≦0.1μs	Fall time (t2): ≦0.1μs
Duty [(t3/T)×100]: 50%	
Minimum phase difference between pulse edges (t4, t5, t6, and t7): >250nsec	

Code + pulse train



Rise time (t1): ≦0.1μs	Fall time (t2): ≦0.1μs
Duty [(t3/T)×100]: 50%	Pulse switching time: ts1, ts2, and ts3 > T

■ Position output signal

Encoder output Pulse frequency dividing	N/32768 (N=1 through 32767), 1/N(N=1 through 64) or 2/N(N=2 through 64)

■ General-purpose input signal

Sequence input signal	Interactive photo coupler (sink, source connection):×8-input
	Externally supplied power : DC5V±5%/DC12V through DC24V±10%, more than 100mA (DC24V)
	Servo-on, alarm reset, torque limit, encoder-clear, forward rotation prohibit, reverse rotation prohibit, command prohibit, external trip, forced discharge, emergency stop, gain switching, internal velocity setting, etc. Refer to section 5-70, “Group9, Functions enabling condition settings,” for all the functions.

■ General-purpose output signal [NPN-output]

Sequence output signal	Open collector output : ×8-output
	External power supply (OUT-PWR): DC5V±5%/ DC12V-DC24V±10%, more than 20mA
	Circuit power for output signal: DC5V±5%/ Maximum current value:10mA (per 1 output) Circuit power for output signal : DC12V through DC15V±10%/ Maximum current value: 30mA (per 1 output) Circuit power for output signal : DC24V through DC15V±10%/ Maximum current value: 50mA (per 1 output)
	Servo-ready, power-on, servo-on, holding brake timing, torque and velocity limited state, low velocity, velocity attainment, velocity-matching, zero-velocity, command acceptable, status of gain switch, velocity loop proportional control state, control mode switching state, forward OT, reverse OT, warning, alarm code (3bits), etc. Refer to “Group A Multi-purpose outputting conditions (5-73),” for all the signal names.

2.4 Power supply and amount of heat generation

1) Input current of main circuit power supply and control power supply

Servo amplifier	Servo motor model	Rated output (W)	Input current of main circuit power supply (A)	Input current of control power supply (A)
RF2G and the Subsequent models	R2GA04003F	30	2.5	0.5
	R2GA04005F	50	5.3	
	R2GA04008D	80	6.6	
	R2GA06010D	100	6.9	
	R2GA06020D	200	8.0	

- ✔ Input current value of main circuit power is effective value in the case of rated revolution velocity and rated torque. Two to three times of the current value shown in the table may be momentarily curried depending on operating patterns such as start-up or stop.
- ✔ The input current of control power supply above is the mean value. The value may vary depending on operating conditions or the encoder connected to your motor, so select the power supply with a margin of more than 1.5 times.

2) Inrush current and leakage current

■ Inrush current

Large-capacitance capacitors are not contained in main circuit power and control power input part of this series, so high inrush current is not curried at power-on.

■ Leakage current

Servo amplifier	Leakage current per motor
RF2G and the Subsequent models	0.8 mA

- ✔ When using two motors or more, add leakage current per motor.
- ✔ This is the value in the case of using 2m-length tough rubber sheath cable as a power line. Leakage current increases and decreases depending on cable length, so refer to the value in the above table only as a guide of selection.
- ✔ Grounding of control board is mandatory to prevent occurrence of dangerous level voltage on operating panel in the unlikely event of ground leakage. (Grounding resistance value shall be 100Ω or less.)
- ✔ Leakage current value is the value by measuring filter 700Hz with leak-checker. Use earth leakage breaker supporting inverter loads, which is taken as a measure against the possibility that high-frequency earth leakage current is carried and then this causes error on ground-fault circuit interrupter and earth leakage protective relay placed on power supply conducting path, that are caused by floating earth capacitance of servo motor winding, power cable, and servo amplifier.

3) Amount of heat generation

Servo amplifier	Servo motor model NO.	Servo amplifier Total amount of heat generation (W)
RF2G and the Subsequent models	R2GA04003F	9
	R2GA04005F	15
	R2GA04008D	20
	R2GA06010D	22
	R2GA06020D	26

- ✔ These are rated revolution velocity and rated torque.

2.5 Cautions on load

1) Restrictions on acceleration time, deceleration time, and effective torque

Motor acceleration time and deceleration time shall be subject to the restriction of momentary range of torque-rev characteristic of motor being operated together.
Repetitions of motor operation and stop, and load torque are subject to the restriction of rated torque.
Refer to section 9, “Selection”, for the details.

2) Negative load

Servo amplifier cannot courteously operate (for more than 1 second) to the extent that negative loads occur. Please contact us when you use this unit with negative load.

[e.g.]
- Downward driving force of motor (without counter weight)
- Generator-like application such as a winding off shaft of winder.

3) Load inertia moment

Rough reference value of ”allowable load inertia moment” shall be 10 times of “rotor inertia moment” of servo motor being operated together. Even when ”allowable load inertia moment” is ten times of “rotor inertia moment,” coping processes may be needed to deal with regenerative energies occurred at the time of stoppage.
Refer to section 9.2, “precautions on regeneration”, for coping process. The following steps are required to deal the loads under the condition that “load inertia moment” are more that 10 times.

- Set limit on normal and reverse rotation internal torque, and then decrease motor torque under the condition that the torque limitations are effective at all times to use.
- Lengthen commanded acceleration time and deceleration time.
- Slow down revolution to use.

The above case needs to contact us.

2.6 Position signal output

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

1) Positions signals by serial signals

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

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

✔ Output signals (encoder signal output -PS-) are emitted from (CNA1-8 pin, 9 pin).

■ Encoder signal output –PS- format can be selected from among the 2 values.
Select from the general parameters (Group ID07: Encoder Signal Output (PS) Format [PSOFORM]).

Selection value	00: Binary Code Output	01: ASCII Decimal Code Output
Transmission method	Start/stop synchronization	Start/stop synchronization
Baud rate	9600bps	9600bps
Format	11bits	10bits
Transmission error check	1bit Even number parity	1bit Even number parity
Transfer time	9.2ms (Typ)	16.7ms (Typ)
Transfer period	Approximately 11ms	Approximately 40ms
Increase method	Increase during forward operation	Increase during forward operation

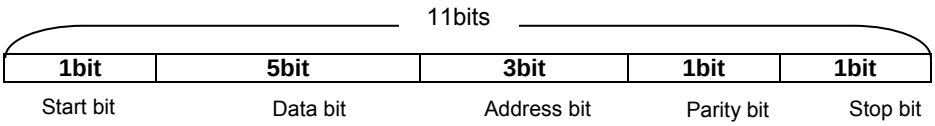
✔ Forward rotation is counter-clockwise rotation from the motor shaft axis. When absolute value increases to maximum, it becomes minimum value (0).

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

2) Binary code output format and transfer period

■ Format

◆ Data format



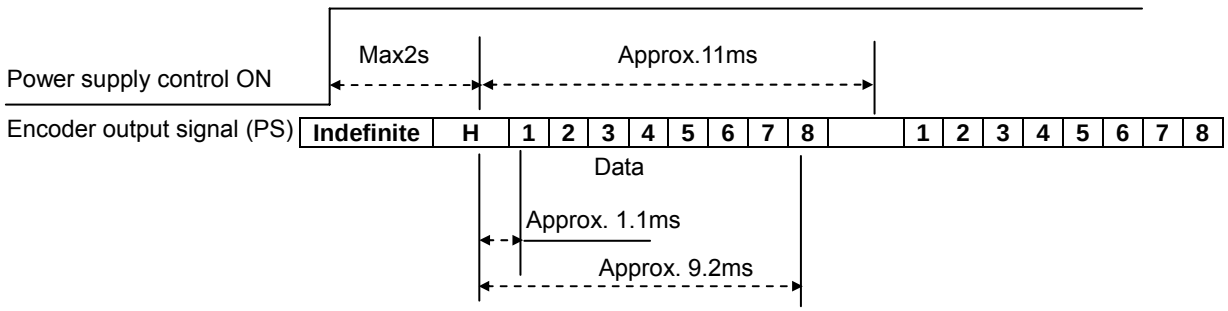
◆ Transfer format

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

◆ Data positions of absolute data for motor encoder

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

■ Transfer period

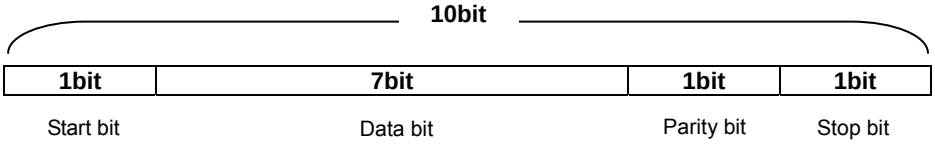


✔ The signal is indefinite for about 2 seconds after booting power and communication may not always begin from the first frame, even after 2 seconds.

3) ASCII decimal code output format and transfer period

■ Format

◆ Data format



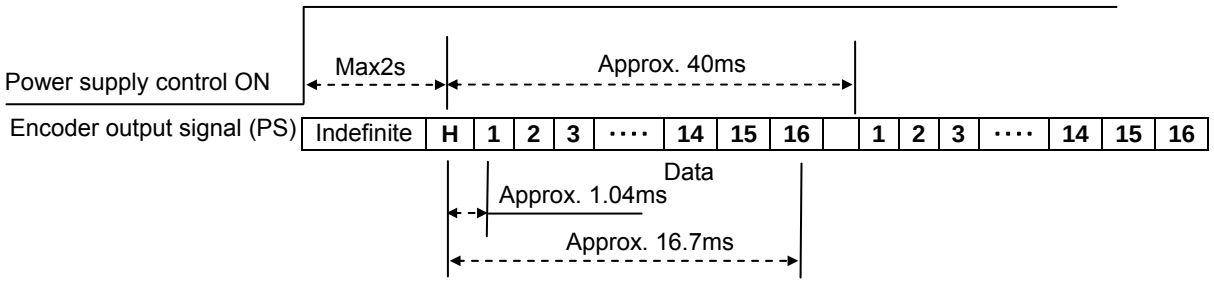
◆ Transfer format

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

◆ Absolute data of motor encoder

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

■ Transfer period



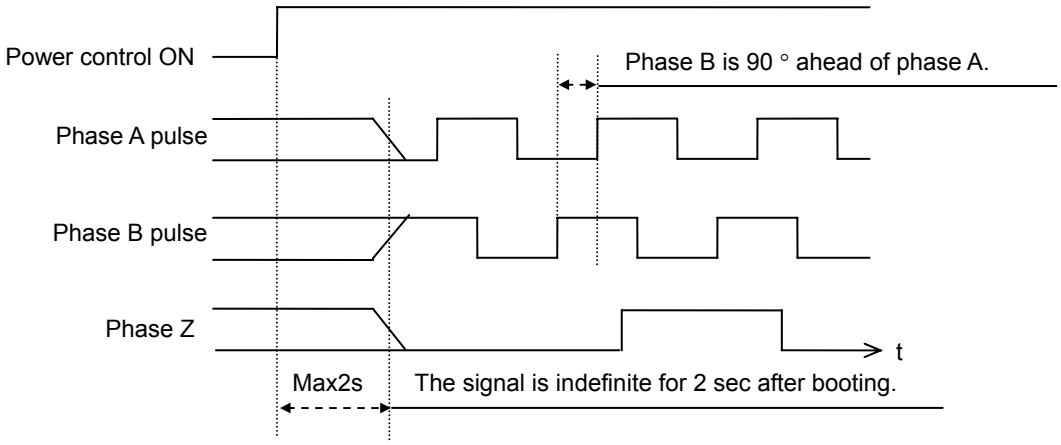
✔ The signal is indefinite for about 2 seconds after booting power and communication may not always begin from the first frame, even after 2 seconds.

4) Position signal output from pulse signal

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

- ✔ Output signal “A phase pulse output (AO/$\bar{A}\bar{O}$) “outputs from “CNA-1 pin, 3 pin”
- ✔ Output signal “B phase pulse output (BO/$\bar{B}\bar{O}$) “outputs from “CNA-4 pin, 5 pin”
- ✔ Output signal “Z phase output (ZO/$\bar{Z}\bar{O}$) “outputs from “CNA-6 pin, 7 pin”

■ Output signal under forward rotation



- ✔ Serial encoder “positions signal output” delays about 224μs.
- ✔ Serial encoder Phase Z output is once in 1-rotation (at every change of multiple rotations) based on loading or training edge of Phase A or Phase B with the width of one pulse of Phase A. (does not determine the position relation of Phase Z or Phases A&B.
- ✔ When value other than 1/1 is set as “encoder output pulse division,” ”A-phase pulse and B-phase pulse“ are output as divided signal, however ”Z-phase” is output in original pulse width instead of as divided signal. In this case, phase relationship between Z-phase and A-phase pulse/B-phase pulse is not established (fixed).

2.7 Specifications for analog monitor

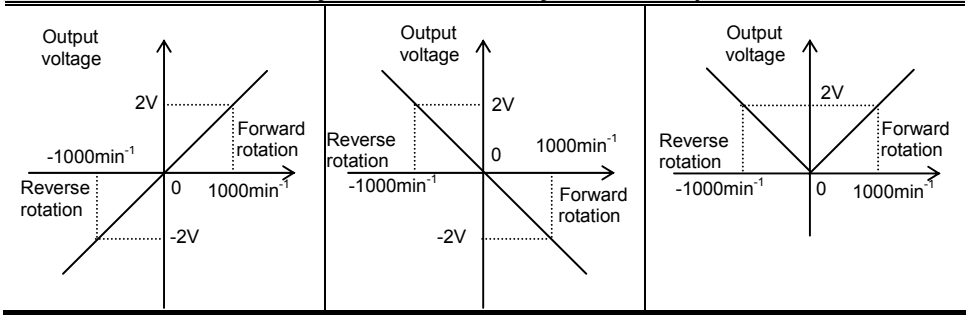
■ Analog monitor box (an option)
Analog monitor can monitor by connecting analog monitor box to connector for analog monitor on the bottom of servo amplifier.
Analog monitor box needs power supply of ±12V separately. Please be advised that this is user prepared item.

■ Electrical specifications

- ◆ Output voltage range: DC±8V
- ◆ Output resistance: 1kΩ
- ◆ Load: less than 2mA
  - ✔ Monitor output is indefinite at the time of power ON/OFF and may output DC12V+/- around 10%.

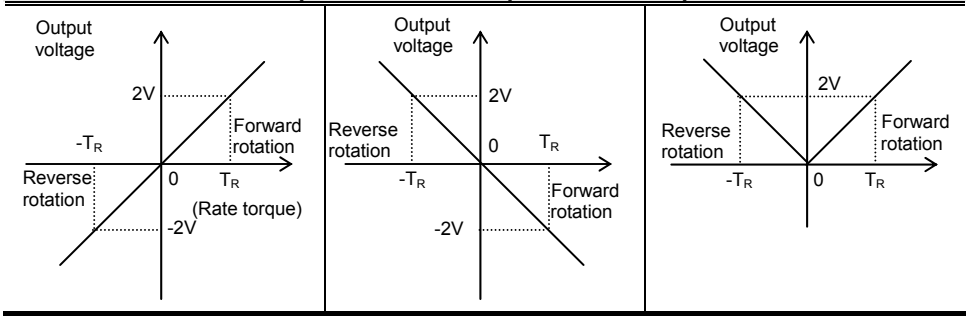
■ Velocity command, Velocity monitor

Velocity command, velocity monitor output



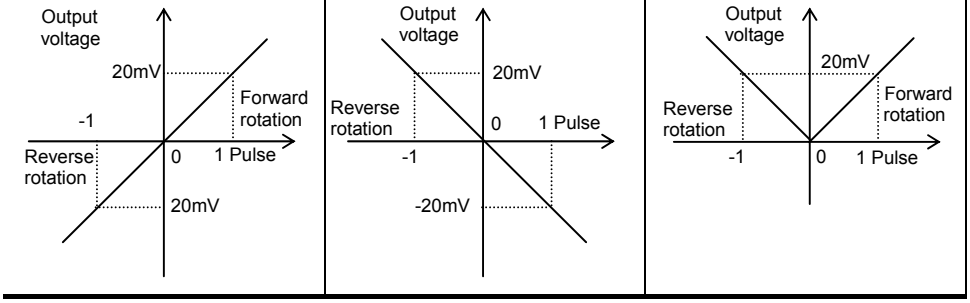
■ Torque command, torque monitor

Torque command, torque monitor output



■ Position deviation monitor

Position deviation monitor output



2.8 Specifications for dynamic brake

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

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

Less than 10 times per hour and 50 times per day at maximum velocity within the applied load inertia moment.

■ Operation intervals

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

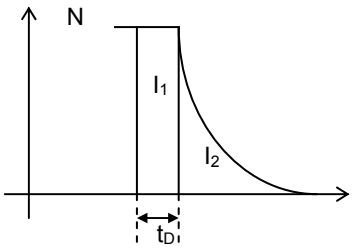
$$\frac{6\text{minutes}}{\text{(Rated rotation velocity/maximum rotation velocity in use)}^2}$$

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

$$I = I_1 + I_2$$

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

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



■ α/β:

Servo amplifier capacity	Servo motor model number	α	β	J_M(kg·m2)
After RF2G	R2GA04003F	185	5.14×10^{-6}	0.0247×10^{-4}
	R2GA04005F	93.9	3.82×10^{-6}	0.0376×10^{-4}
	R2GA04008D	32.5	2.00×10^{-6}	0.0627×10^{-4}
	R2GA06010D	21.9	7.53×10^{-6}	0.117×10^{-4}
	R2GA06020D	7.4	4.88×10^{-6}	0.219×10^{-4}

✔ The values for α and 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).

✔ Dynamic brake cannot work for servo amplifiers with no dynamic brake circuit.

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3

3. Installation

3.1 Installation

1) Servo amplifier

Fully observe the following precautions to perform installation.

■ Precautions

Installation in flammable material or its vicinity causes fire.
Do not put heavy things and get on top of servo amplifier.
Operate within the scope of specified ambient conditions.
Do not let fall and apply high impacts on servo amplifier.
Do not let electrically conductive materials like screw or metal tip, and flammable materials into servo amplifier.
Do not shut the ports. Fully observe installation direction.
Please contact us if storage period of servo amplifier has been long-term (for over 3 years), as long-term storage causes decrease capacity of electrolytic capacitor.
Please return the product to us to repair immediately when any damages found on product.

■ When storing servo amplifier in a box.

Temperature in a box can become higher than ambient temperature outside, depending on box size and power loss of equipment to be stored. Make sure that surrounding temperature of servo amplifier is at 40°C or less, taking box size, cooling, and layout into consideration.

■ When vibration source is near servo amplifier.

Install servo amplifier in the base via shock absorber, so as not to let vibration transmit directly to servo amplifier.

■ When heating element is near servo amplifier.

Make sure that servo amplifier's vicinity is at 40°C or less, even when temperature increase is likely to occur due to convective or radiation.

■ When corrosive gas exists.

Long period of operation causes bad electrical contacts on connectors or other parts having contact points. Never operate servo amplifier in the area corrosive gas exists.

■ When explosive and flammable gas exist.

Never operate servo amplifier in the area explosive and flammable gas exist. Failure to observe this may catch a fire and induce fire or explosive accident, as parts like relays, contactors, and regenerative resistor that generate arc (spark) in a box may become a source of ignition.

■ When dust and oil mist exist.

Servo amplifier cannot operate in the area dust and oil-mist exist. Dust and oil mist attached to servo amplifier and their accumulation cause insulation failure and leakage between electrically conductive parts, and then induce damages on servo amplifier.

■ When major noise source exists.

This causes malfunction as noise can contaminate input signal and power supply circuit. When any possibility of noise contamination, review line wiring and take actions on noise generation prevention. Place noise filter on the front stair of servo amplifier.

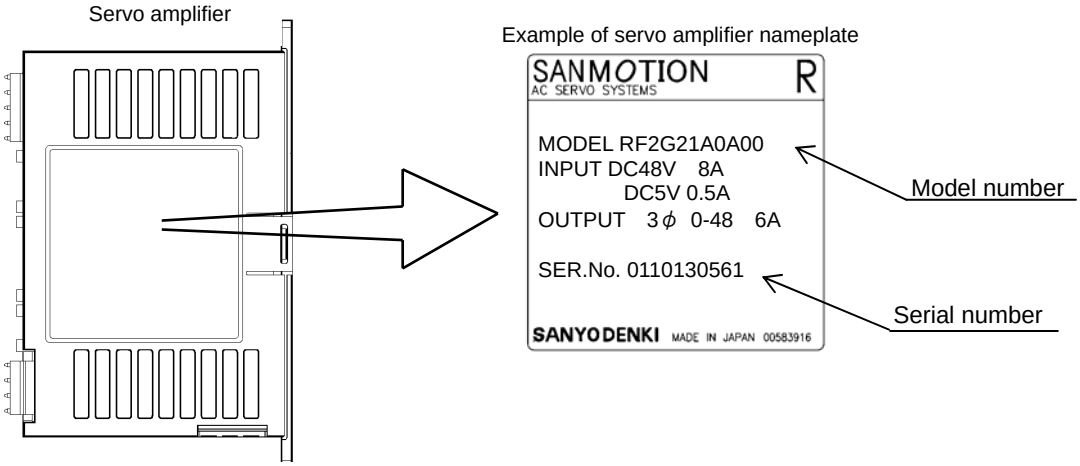
■ When connecting and disconnecting connectors.

Do not connect and disconnect connectors when applying current. This cause failure. (Except for PC operating setup software.) Disconnect power supply as well as servo amplifier to connect and disconnect relay connectors when transmitting signals with use of relay connectors.

2) Unpacking

The following items shall be checked when the product delivered. In the event that any abnormal items are found, please contact us.

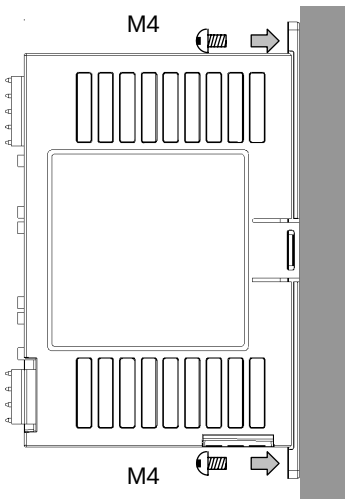
- Check servo amplifier model number to see if any discrepancies between ordered item and delivered item. Model number is marked after each product nameplate “MODEL.”
- Check servo amplifier exterior to see if any problems.
- Check servo amplifier screws to see if any loosening.



Serial number structure
Month (2-digit) + the dominical year (2-digit) + date (2-digit) + serial (4-digit) + revision (”A”-omitted)

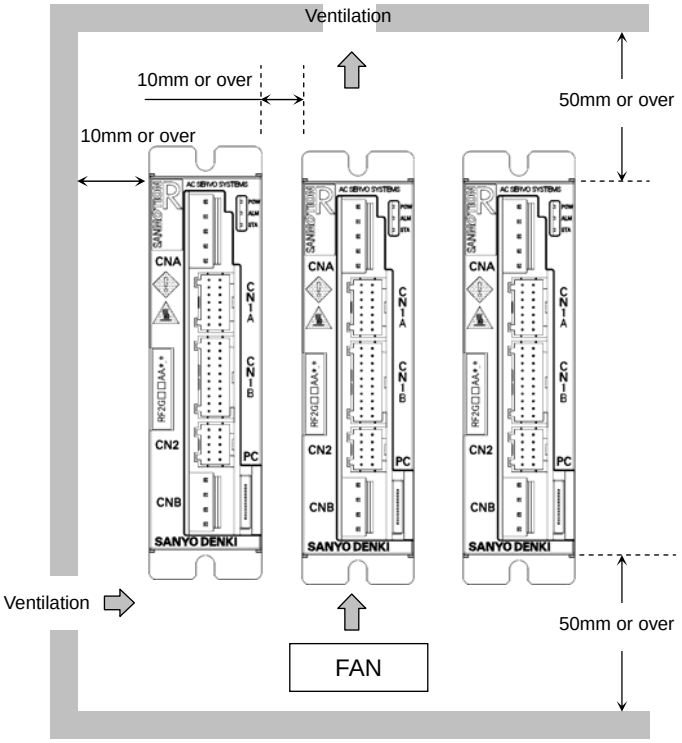
✔ Main nameplate may be changed according to overseas standard.

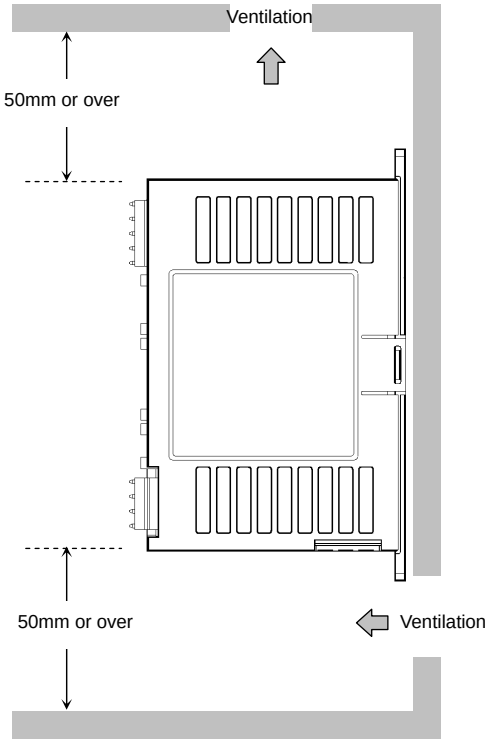
3) Installation direction and position



4) Conditions on layout in control cabinet

- Make space of over 50mm above and under servo amplifier not to prevent airflow from the interior of heat sink and servo amplifier. Create flow with cooling fan if heat remains in the vicinity of servo amplifier.
- Make sure that ambient temperature around servo amplifier shall be 40°C or less.
- Make space of over 10mm on both side of servo amplifier not to prevent heat radiation from side heat sink and airflow from interior of servo amplifier.





5) Cooling conditions

Surely perform forced air-cooling for heat sink of servo amplifier, when operating conditions (load conditions) of servo motor is as follows:

■ Verification of effective output current by calculation

Check effective torque “Trms“, which is determined by actual operating pattern and load conditions, in accordance with “Section 9.1, Capacity selection of servo motor.”

Check rated torque “T_R“ and rated current “I_R“ of servo motor which is actually combined with servo amplifier, in accordance with “Section 10.4, Servo motor data sheet.”

Obtain effective value “Irms” of actual electrical current in the motor, according to the following equation.

$$Irms = I_R \times \frac{Trms}{T_R} \quad [A]$$

T_R: Rated torque of servo motor (value on the catalog) [N·m]
I_R: Rated current of servo motor (value on the catalog) [A]
Trms: Effective torque calculated according to operating pattern and load condition [N·m]
Irms: Effective current calculated according to the above equation [A]

When “Irms” calculated by the above equation is Irms>3.3[A], perform forced air-cooling for servo amplifier.

■ Verification on actual machine.
Perform continuous running (heat-running) on actual system. When temperature in the center of heat sink is over 65°C, perform forced air-cooling for servo amplifier.

✔ Perform measuring with the operating pattern requiring the strictest load condition.
✔ Recommended FAN motors are as follows:
Manufactured by Sanyo Denki Co., Ltd.: DC San series Ace, square type: 60mm, 80mm (General model)
Manufactured by Sanyo Denki Co., Ltd.: San Ace series L, square type: 60mm, 80mm (Long-life model)
Please contact our sales department if you use FAN motor.

3.2 Servo motor

1) Precautions

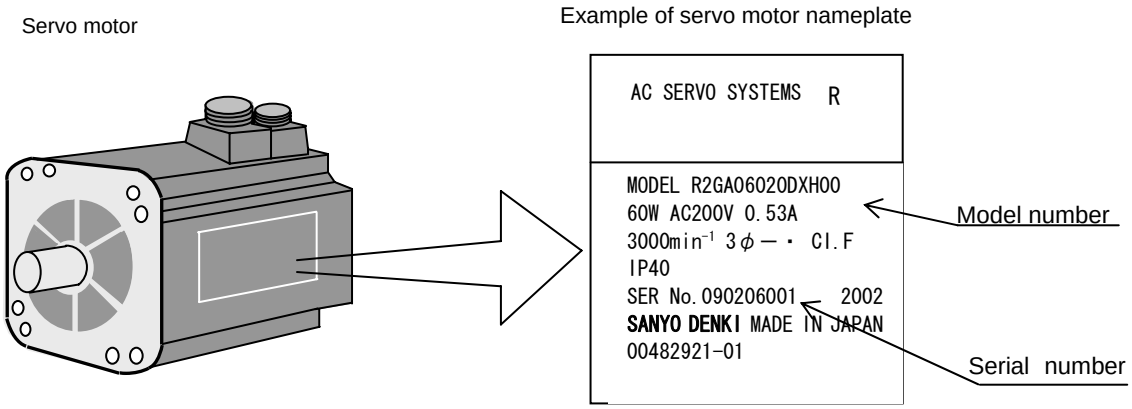
■ Precautions

Installation in flammable material or its vicinity causes fire.
Do not put heavy things and get on top of servo amplifier.
Operate within the scope of specified ambient conditions.
Fully observe installation method.
Please return the product to us to repair immediately when any damages found on product.

2) Unpacking

The following items shall be checked when the product delivered. In the event that any abnormal items are found, please contact us.

- ■ 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.”
- ■ Check servo motor exterior to see if any problems.
- ■ Check servo motor screws to see if any loosening.



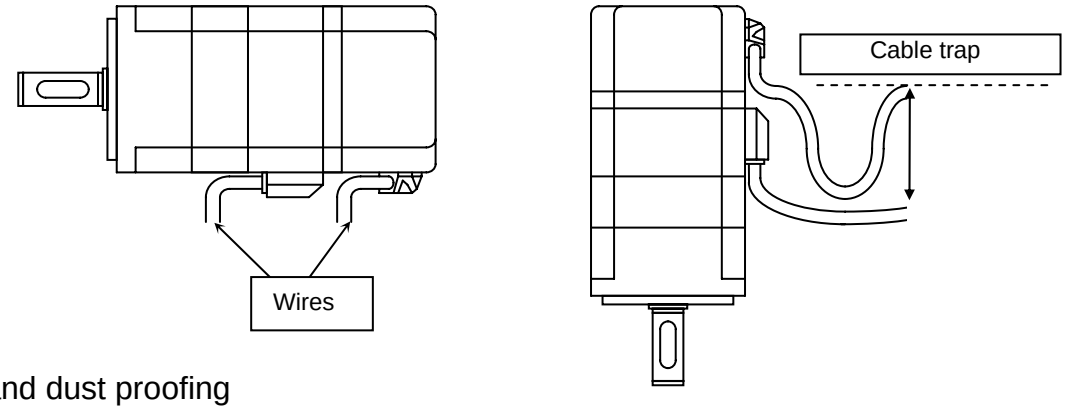
3) Installation

The following items shall be checked on installation location and method.

Servo motor is designed to be used indoors. Install servo motor indoors.	
Do not use servo amplifier for the purpose that oil seal lip constantly exposures to oil, major amounts of water/oil drop, and cutting fluid. Minor droplets are permissible as a procedure on motor can protect from at least to minor droplets.	
Ambient temperature : 0 through 40°C Storage temperature : -20 through 65°C Ambient humidity : 20 through 90%	No corrosive and explosive gas, and well ventilated. No dust and dirt. Easily checked and cleaned.

4) Installation

- Installation in horizontal direction, on the axis ends, and downward is available.
- Horizontal or downward placement is recommended, for reducer with lubricant agent like oil or grease applied onto its output shaft, or output shaft exposing to liquid. Even in the case of models with oil seal (optional extras) attached on the output shaft side, oil may invade internal motor and this causes malfunction, due to worn oil seal and respiratory operation under the circumstance oil seal lip constantly exposures to oil when shaft installed upward. For solution to this case, we recommend to place oil seal on the load side. Please contact us when you use motor in this condition.
- Place motor connector and cable outlet port downward as much as possible.
- When installing vertically, place cable trap so that oil water does not run to the motor.

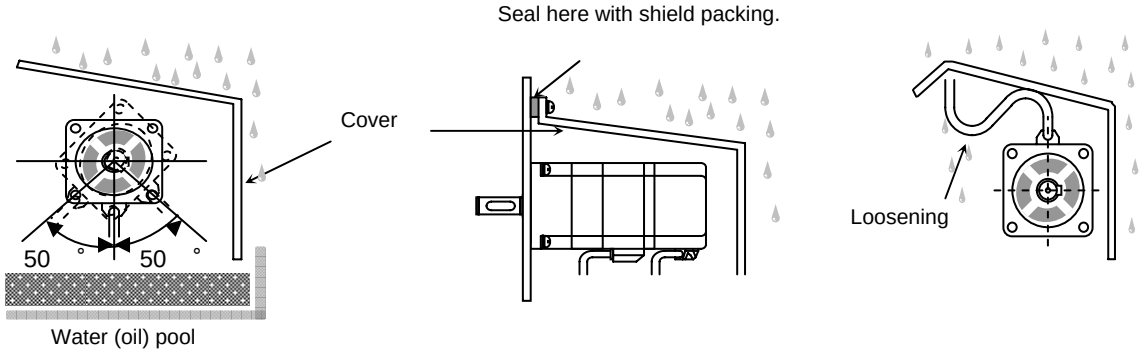


5) Water and dust proofing

- Protection method for single body of motor conforms to IEC standards (IEC34-5). However, this is intended for short-term use only. Leak protection is needed for actual use. Be careful not to scratch connector insulators (coating surface), because of the risk of loosing waterproof property.
- Be aware of the possibility that liquid can invade the inside of the motor due to motor respiration if the motor is always wet, even if protection against liquid is class IPX 7.
- Place protective cover to prevent corrosion on coating and sealing material, depending on the types of coolant. (Especially applicable to water-soluble types).
- Use waterproof plug for canon plug type motor.

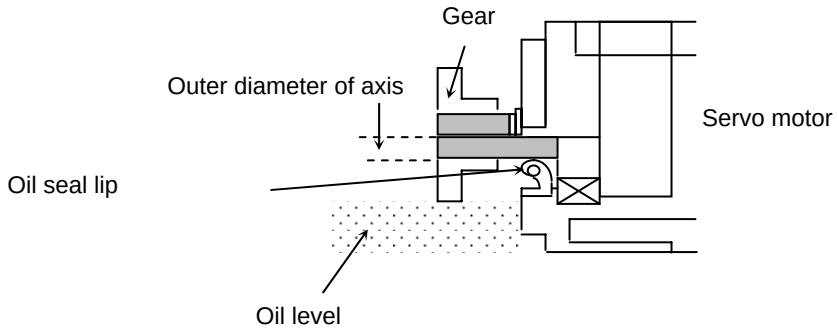
6) Protective cover placement

- Place protective cover as indicated in the figure below in the environment that motor constantly exposure to liquid.
- Direct connector (lead outlet) downward at the range of angle indicated in the figure below.
- Install cover in the direction to which water and oil scatter.
- Slope cover so as not to let water and oil gather.
- Avoid cables exposing to water and oil.
- Slack cables so as not to let water and oil in motor, even cables are outside of cover.
- When you cannot install connector (lead outlet) downward by any means, slack cables to prevent invasion of water and oil.



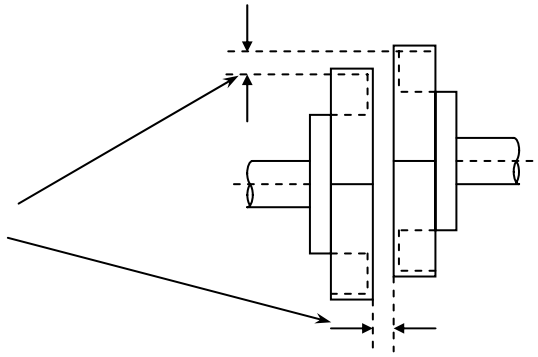
7) Gear installation and co-assembly with mating machine

- Make sure that gearbox oil level is lower than oil seal lip to the extent that oil seal lip exposures to minor oil droplets.
- Make drainage hole as water and oil can invade inside of motor through oil seal when gearbox internal pressure increased.
- If you use motor axis upward, oil seal placement on the mating side is recommended. Moreover, make drainage to let out water and oil passed through this oil seal.

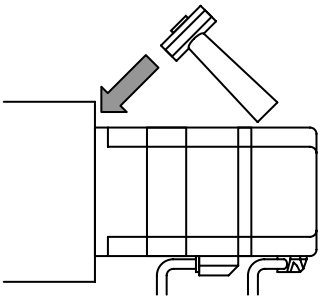


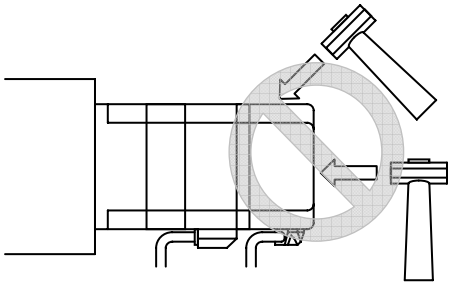
■ Perform final centering for motor shaft and mating machine as indicated in the figure below correctly. Be aware of risk of damages to output shaft due to minor misalignment of shaft, when using rigid boy coupling.

The difference between maximum and minimum value shall be 3/100mm or less, by measuring 4 points on the whole circumference.
(Coupling shall be driven together.)



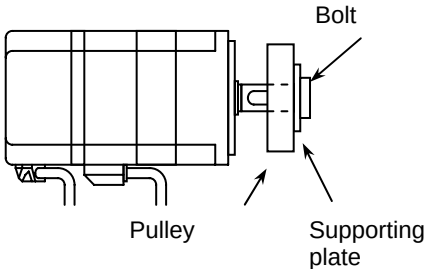
■ Do not apply any impacts on servo motor shaft as precise motor encoder is directly joined to motor shaft. If you need to hammer servo motor for positioning (alignment), hammer front flange part with use of rubber or plastic hammer.

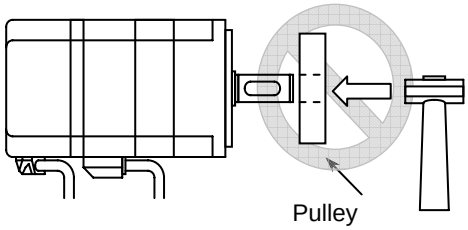




■ When installing the motor in machine, process mounting hole with the accuracy that servo motor flange rabbet easily joined. Ensure flatness for the mounting surface, because of the possibility of damages to shaft and bearing.

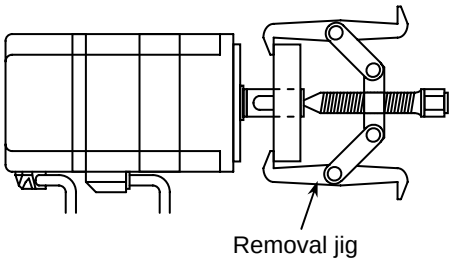
■ Utilize screw of shat end to install gear, pulley, and coupling, so as not to apply any impacts onto the motor.

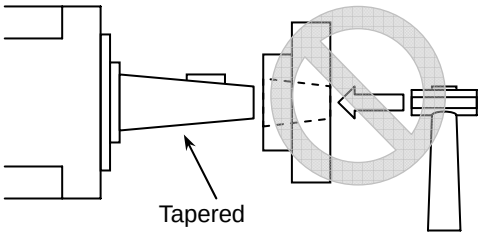




■ Tapered servo motor shaft transmits torque via the tapered surface, so make sure key fits without hammering. Process the hole so that tapered contacting surface shall be 70% or over.

■ Use exclusive removal jig to remove gear or pulley.

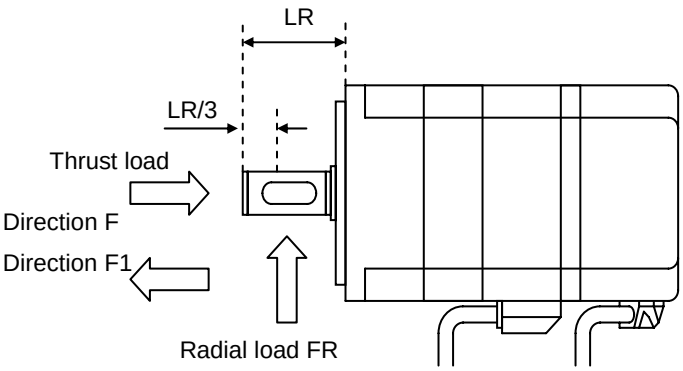




8) Allowable load for bearing

■ Allowable load for servo motor is as indicated in the table below. Do not apply excessive thrust or radial load to servo motor. When performing belt drive, make sure axis conversion value of belt tension shall not exceed the allowable values in the table below. Thrust and radial loads in the table below are the allowable loads when each load is applied to shaft separately.

Allowable radial load is the maximum load that can be applied to the 1/3 point of output shaft length measured from output shaft end.



Series	Servo motor model number	For assembling			For operation		
		Radial load (N)	Thrust load (N)		Radial load (N)	Thrust load (N)	
		FR	Direction F	Direction F1	FR	Direction F	Direction F1
R2	R2□A04003F	98	78	78	49	29	29
	R2□A04005F	150	98	98	98	29	29
	R2□A04008D	150	98	98	98	29	29
	R2□A06010D	150	98	98	98	29	29
	R2□A06020D	390	200	200	200	68	68

9) Cable installation and its related cautions

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

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4

4. Wiring

4.1 Wiring of main circuit power supply, control power supply, servomotor, and protective grounding.

1) Name and function

Name	Connector and pin number	Remarks
Main circuit power	Pin 4 and 5 of CNA	Inputs main circuit power apply (DC48V<24V>±10%)
Control power	Pin 2 and 3 of CNA	Inputs control power supply (DC5V±5%)
Servo motor input	Pin 1, 2, and 3 of CNB	Connected to servomotor.
Protective grounding (For power supply)	Pin 1 of CNA	-
Protective grounding (For motor)	Pin 4 of CNB	-

2) Electrical wire

Electrical wires for use in servo amplifier main circuit (to turn on power) and inputting from servo motor are shown in the table below.

■ Wire type

Wire type		Allowable temperature for conductor [°C]
Code	Name	
PVC	Typical vinyl covered wire	-
IV	600V-vinyl covered wire	60
HIV	Special heat-resistant vinyl covered wire	75

- ✔ The above values are provided under condition that ambient temperature is 40°C and rated current is applied to 3 lead bands.
- ✔ Consider wire allowable current reduction rate, when you band wires and then insert them into duct such as cured vinyl tube or metal tube.
- ✔ If ambient temperature is relatively high, the lifetime is shortened due to heat deterioration. In this case special heat-resistant vinyl covered wire (HIV) is recommended.

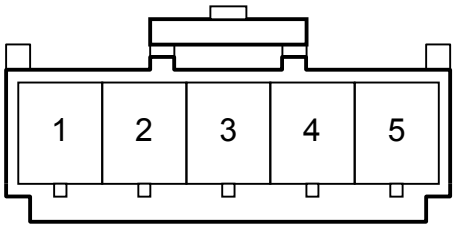
3) Wire diameter - allowable current

AWG size	Nominal sectional area [mm^2]	Conductor resistance [Ω/km]	Allowable current for 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

- ✔ The above are reference values in the case of special heat-resistance vinyl covered wire (HIV).
- ✔ The above table shows wire diameter and allowable current in the case of 3 wires banded.
- ✔ Use the above wires within allowable current.

4) Terminal layout of connector CNA and CNB

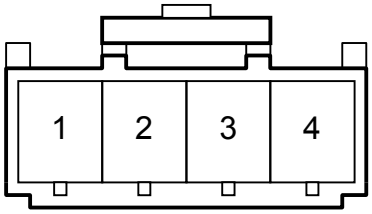
■ Terminal layout of CNA



Terminal NO.	Signal	Description
1	FG (⏚)	Frame ground (earth)
2	5V	Control power DC5V
3	5G	Control power common
4	P	Main power DC48V<24V>
5	N	Main power common

CNA	Model number	Applicable wire size	Manufacturer
Housing	VHR-5N	-	J.S.T. Mfg. Co., Ltd
Contact	SVH-21T-P1.1	AWG22 to AWG18	
	Or SVH-41T-P1.1	AWG20 to AWG16	

■ Terminal layout of CNB



Terminal NO.	Signal	Description
1	U	Motor inputting line U
2	V	Motor inputting line V
3	W	Motor inputting line W
4	FG (⏚)	Frame ground (earth)

CNA	Model number	Applicable wire size	Manufacturer
Housing	VHR-5N	-	J.S.T. Mfg. Co., Ltd
Contact	SVH-21T-P1.1	AWG22 to AWG18	
	Or SVH-41T-P1.1	AWG20 to AWG16	

5) Recommended wire diameter and cable length

■ Recommended wire diameters for use in servo amplifier and motor are shown in the table below.

Servo motor model NO.	Motor input (U·V·W·⏚)		Servo amplifier combined	Main circuit power (P·N)		Control power (5V,5G)	
	mm^2	AWG No		mm^2	AWG No	mm^2	AWG No
R2GA04003F	1.25	#16 #18	After RF2G	1.25	#16 #18	1.25	#16 #18
R2GA04005F							
R2GA04008D							
R2GA06010D							
R2GA06020D							

✔ The above values are provided under condition that ambient temperature is 40°C and rated current is applied to 3 lead bands.
✔ Consider wire allowable current reduction rate, when you band wires and then insert them into duct such as cured vinyl tube or metal tube.
✔ If ambient temperature is relatively high, the lifetime is shortened due to heat deterioration. In this case special heat-resistant vinyl covered wire (HIV) is recommended.

■ Caution on cable length

◆ Control power (5V, 5G)
When control power input part is relatively long, 5V-voltage can drop due to cable impedance. Attention necessary especially when multiple servo amplifiers are supplied power from one power supply. Control power input shall be directly applied to encoder, so if the voltage is out of the scope of 5V±5%-specification (for servo amplifier and encoder) due to voltage drop, servo amplifier and encoder cannot operate. Please consider to shorten and thicken the wiring between power and servo amplifier as much as possible, or use wire corresponding to variable output voltage power supply and remote sensing, when wiring.

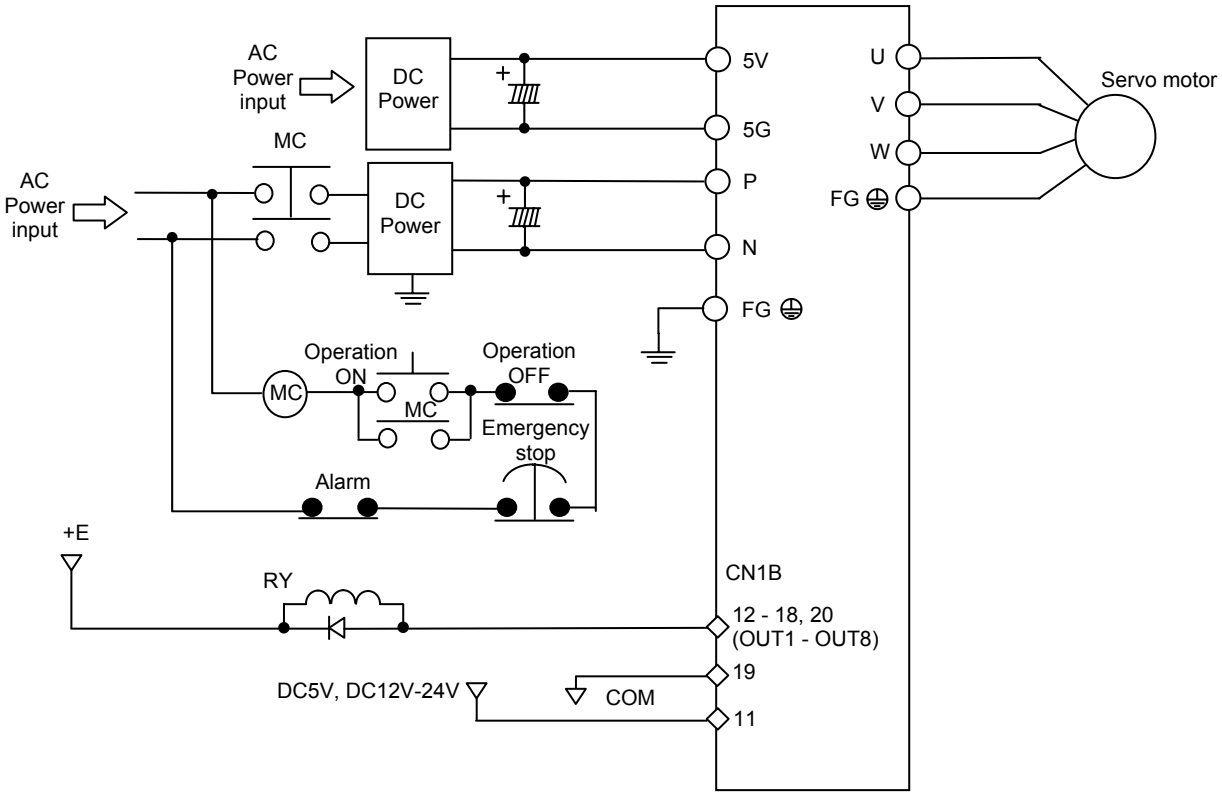
◆ Main circuit power (P, N)
When control power input part is relatively long, 48V<24V> can drop due to cable impedance. Attention necessary especially when multiple servo amplifiers are supplied power from one power supply.
Please be ware that if main circuit power drops, motor generated torque shall drop (momentary range of high-velocity revolution).

◆ Motor input (U, V, and W)
When motor input line is relatively long, the voltage can drop due to cable impedance, and then motor generated torque can decrease. (Momentary range of high-velocity revolution.)
To solve this problem, we recommend selecting motor with sufficient margin for acceleration and deceleration torque calculation.

6) Example of wiring

The following shows an example of external wiring.

■ Example of layout



✔ Use one output from “12 through 18, and 20 (OUT1 through OUT8)” of CN1B so that “parameter group A” is selected to set, and then set either ”In ALM-state _output ON” or ”In ALM-state_ output OFF.”

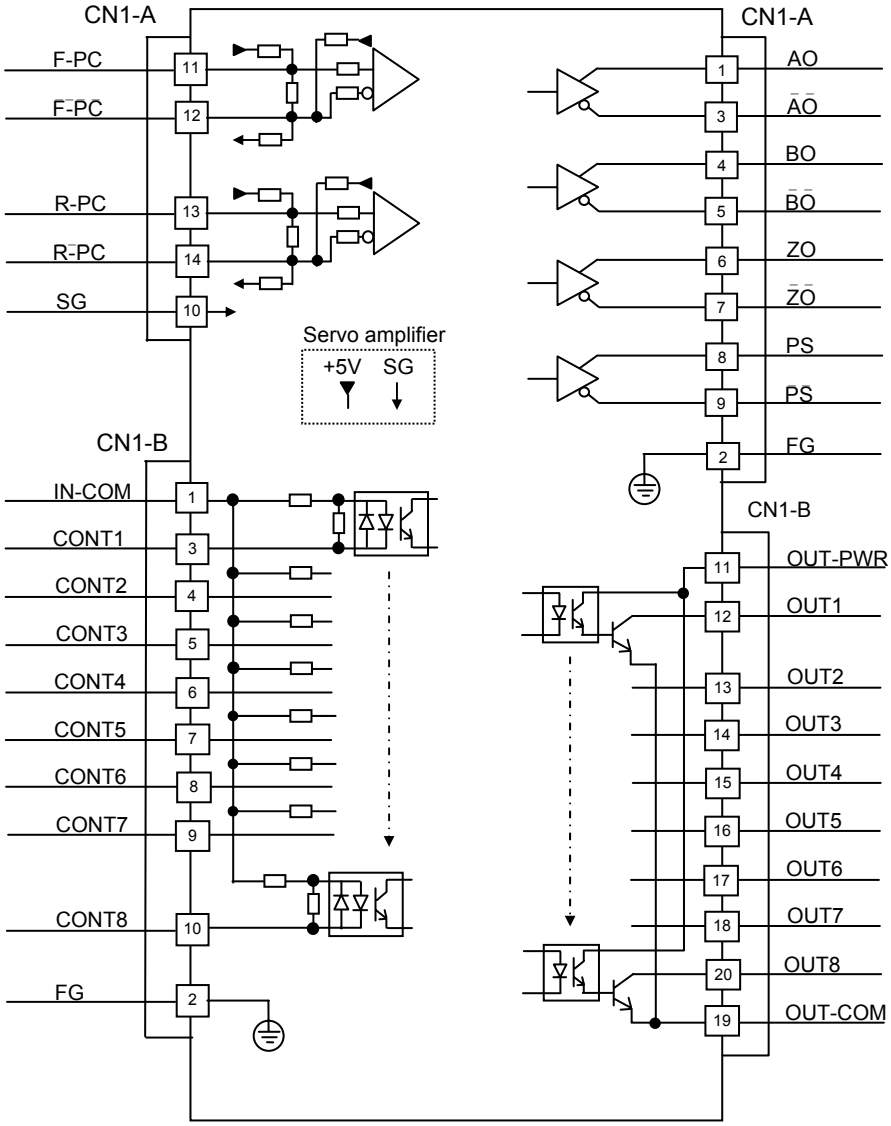
✔ Place electrolytic capacitor between 5V and 5G, or P and N on amplifier side as required, when wiring from DC power to servo amplifier is relatively long.
In this case, inrush current runs into electrolytic capacitor on power-on, so DC power needs to respond the inrush current.

✔ To use battery for main circuit DC power supply, make sure to install electrolytic capacitor in parallel to protect the servo amplifier. (2,000μF or more-sized capacitor is recommended)

4.2 Wiring connection diagram to host equipment

1) Name and pin number of signal CN1A and CN1B (wiring connection to host equipment)

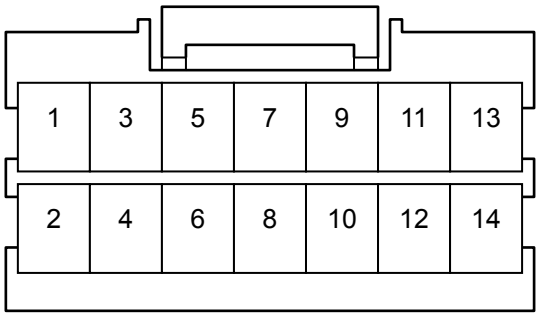
■ Terminal layout of connector interfacing with host equipment



✔ Use twisted-pair cable for use in host equipment-amplifier connection.
✔ Host equipment-amplifier cable length shall be 3m or less.

2) Layout of connector CN1-A

■ CN1-A PADP-14V-1-S (cable-crimped side)

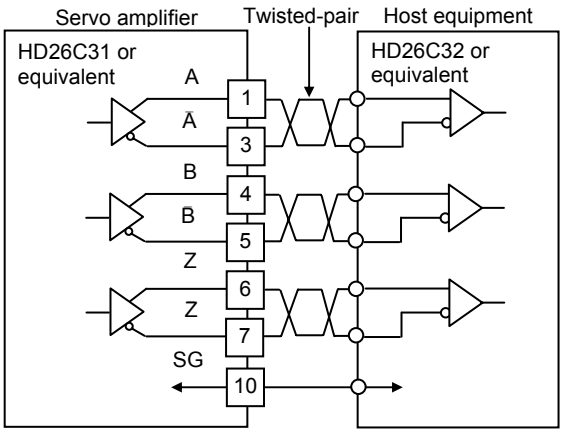
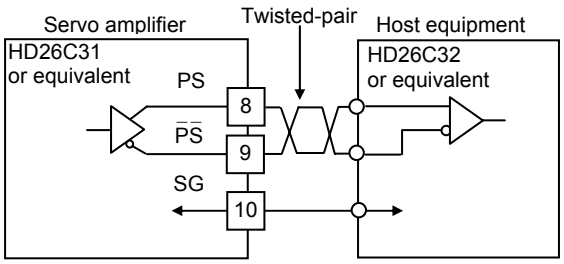


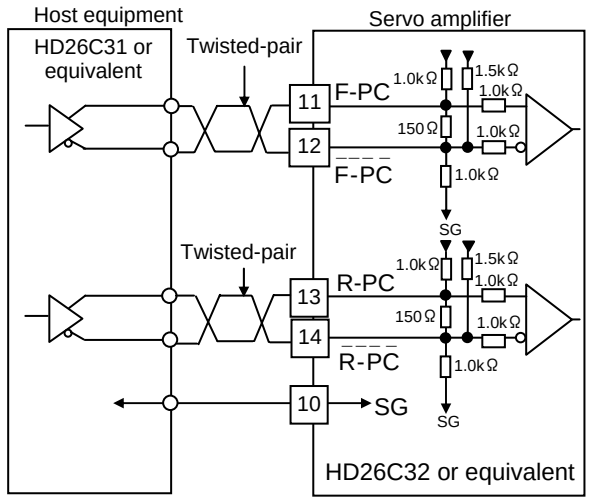
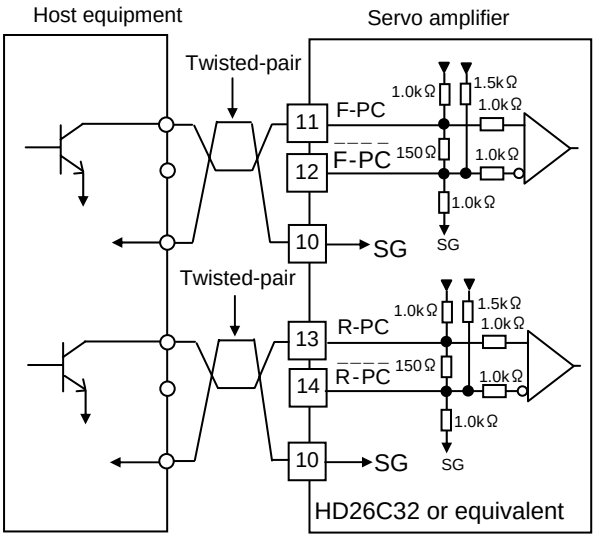
CN1-A	Model NO.	Applicable wire size	Manufacturer
Housing	PADP-14V-1-S	-	JST Mfg. Co., Ltd.
Contact	SPH-002GW-P0.5S	AWG24 - AWG28	

3) Name and its function of signal CN1-A

Terminal NO.	Signal	Description
1	AO	Phase A pulse output
2	FG	Frame ground
3	$\overline{AO}$	Phase /A pulse output
4	BO	Phase B pulse output
5	$\overline{BO}$	Phase /B pulse output
6	ZO	Phase Z pulse output
7	$\overline{ZO}$	Phase /Z pulse output
8	PS	Encoder signal output
9	$\overline{PS}$	/ Encoder signal output
10	SG	Common for pin 1 –14
11	F-PC	Command pulse input
12	$\overline{F\text{-}PC}$	Command pulse input
13	R-PC	Command pulse input
14	$\overline{R\text{-}PC}$	Command pulse input

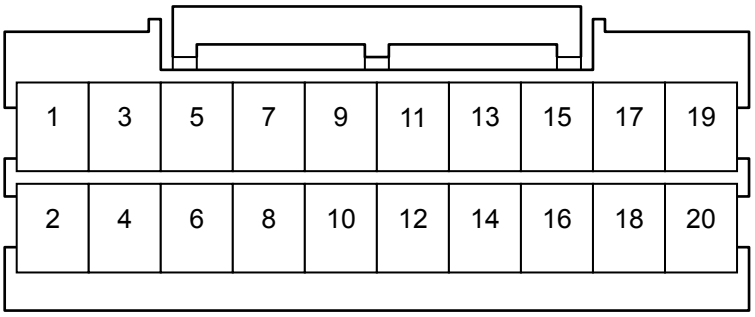
4) Connection circuit of terminal CN1-A

Terminal NO.	Mark	Name	Description
2	FG	Frame ground	Connects shielded wire of cables between host controller of CN1-A and servo amplifier.
1	A0	Phase A pulse output	Outputs (RS422-compliant) signal of phase A pulse, B pulse, and original phase Z pulse of motor encoder. Connect to RS422-compliant line receiver.  Surely connect SG.
3	$\overline{A0}$	Phase /A pulse output	
4	BO	Phase B pulse output	
5	$\overline{BO}$	Phase /B pulse output	
6	ZO	Phase Z pulse output	
7	$\overline{ZO}$	Phase /Z pulse output	
8	PS	Encoder signal output	This is absolute position data output (RS422-compliant) of serial encoder. Connect to RS422-compliant line receiver.  Surely connect SG.
9	$\overline{PS}$	Encoder signal output	

Terminal NO.	Mark	Name	Description
11	F-PC	Command pulse output	Command pulse input is position command input (RS422-compliant). Command input pulse method shall be selected from 3 types. [Clockwise pulse + counterclockwise pulse] Maximum 5M pps [Code + pulse train] Maximum 5M pps [90°-phase difference and two-phase pulse train] Maximum 1.25M pps Connection of differential output signal  Surely connect SG. Connection of open collector signal output 
12	F-PC	Command pulse output	
13	R-PC	Command pulse output	
14	R-PC	Command pulse output	
10	SG	Signal ground	

5) Layout of connector CN1-B

■ CN1-B PADP-20V-1-S (cable-crimped side)



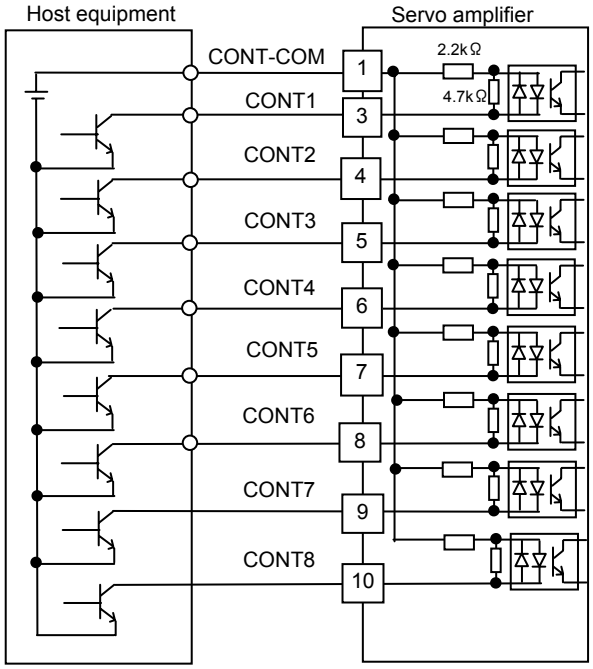
CN1-B	Model NO.	Applicable wire size	Manufacturer
Housing	PADP-20V-1-S	-	JST Mfg. Co., Ltd.
Contact	SPH-002GW-P0.5S	AWG24 - AWG28	

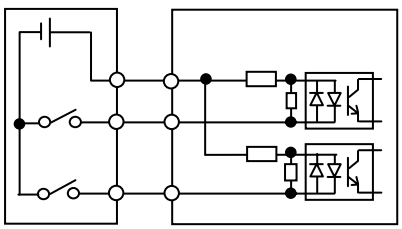
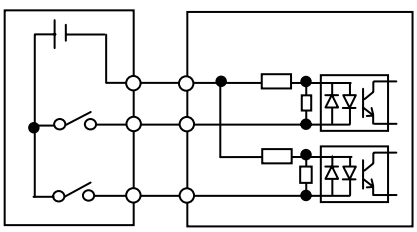
6) Signal name and its function

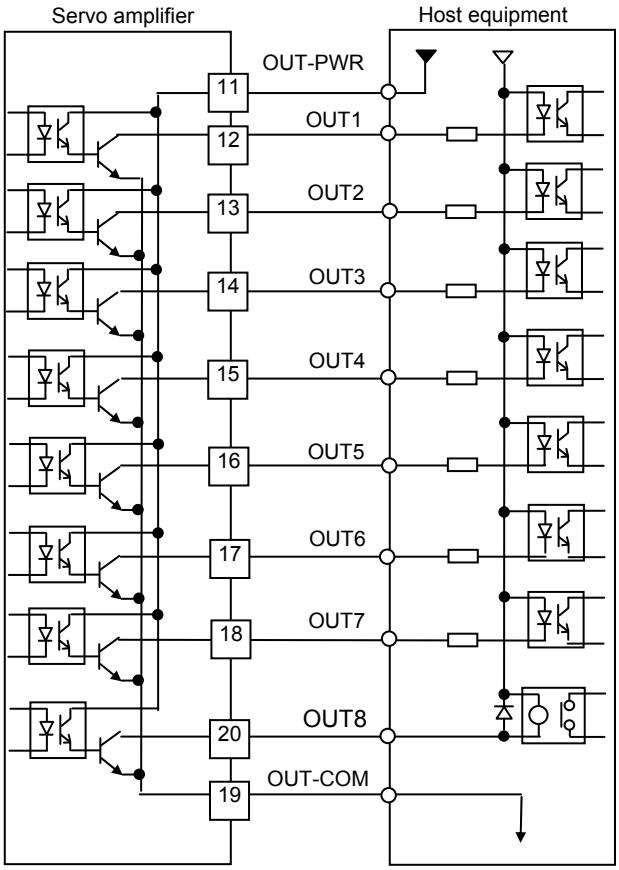
Terminal NO.	Signal	Description
1	IN-COM	Common for pin 3 -10
2	FG	Frame ground
3	CONT1	General-purpose input
4	CONT2	General-purpose input
5	CONT3	General-purpose input
6	CONT4	General-purpose input
7	CONT5	General-purpose input
8	CONT6	General-purpose input
9	CONT7	General-purpose input
10	CONT8	General-purpose input
11	OUT-PWR	For General-purpose output power supply
12	OUT1	General-purpose output
13	OUT2	General-purpose output
14	OUT3	General-purpose output
15	OUT4	General-purpose output
16	OUT5	General-purpose output
17	OUT6	General-purpose output
18	OUT7	General-purpose output
19	OUT-COM	General-purpose output common
20	OUT8	General-purpose output

7) Terminal connection circuit

Terminal NO.	Mark	Name	Description
2	FG	Frame ground	Connects shielded wire of cables between host controller of CN1-A and servo amplifier.
1	CONT-COM	General-purpose input power supply	General-purpose input circuit shall connect to relay or Open collector transistor circuit. Specification for external power supply Power-supply voltage range : DC5V±5%/ DC12V through DC24V±10% Allowable current for host equipment : Ensure 100mA (DC24V) or over. [Example of sink circuit]
3	CONT1	General-purpose input	
4	CONT2	General-purpose input	
5	CONT3	General-purpose input	
6	CONT4	General-purpose input	
7	CONT5	General-purpose input	
8	CONT6	General-purpose input	
9	CONT7	General-purpose input	
10	CONT8	General-purpose input	



Sink circuit type	Source circuit type
	

Terminal NO.	Mark	Name	Description
11	OUT-PWR	For general-purpose output power	General-purpose circuit is connected to photo coupler and relay circuit. [NPN-output (sink output)] OUT-PWR (external power supply) specification Power-supply voltage range : DC5V ±5%, DC12Vthrough24V ±10% Current capacity : 20mA or over OUT-1 through OUT-8 (output circuit) Specification for power supply Power-supply voltage range : DC5V ±5% Power-supply voltage range : DC12V through 15V ±10% Power-supply voltage range : DC24V ±10% Maximum current value : DC5V·····10mA Maximum current value : DC12V through 15V····30mA Maximum current value : DC24V·····50mA 
12	OUT1	General-purpose output	
13	OUT2	General-purpose output	
14	OUT3	General-purpose output	
15	OUT4	General-purpose output	
16	OUT5	General-purpose output	
17	OUT6	General-purpose output	
18	OUT7	General-purpose output	
20	OUT8	General-purpose output	
19	OUT-COM	General-purpose output -common	

4.3 Wiring of motor encoder

1) Name and function of connector CN2

■ Battery backup absolute encoder

Servo amplifier CN2 Terminal NO.	Servo motor lead color for	Signal	Description	Note)
1	Red	5V	Power supply	Twisted pair
2	Black	SG	Power supply common	
3	Brown	ES+	Serial data signal	Twisted pair
4	Blue	ES-		
5	Pink	BAT+	Battery	Twisted pair
6	Purple	BAT-		
7	-	N.C.	Unconnected	-
8	-	N.C.		
9	Shield	FG (earth)	Shield	-
10	Shield	FG (earth)		

✔ Use twisted-pair cable with shield inserted under jacket.
✔ Connect jacketed and shielded cable on servo amplifier side to either pin 9 or 10 of servo amplifier connector CN2.

■ Absolute encoder for incremental system

Servo amplifier CN2 Terminal NO.	Servo motor lead color for	Signal	Description	Note)
1	Red	5V	Power supply	Twisted pair
2	Black	SG	Power supply common	
3	Brown	ES+	Serial data signal	Twisted pair
4	Blue	ES-		
5	-	N.C.	Unconnected	-
6	-	N.C.		
7	-	N.C.	Unconnected	-
8	-	N.C.		
9	Shield	FG (earth)	Shield	-
10	Shield	FG (earth)		

✔ Use twisted-pair cable with shield under jacket
✔ Connect jacketed and shielded cable on servo amplifier side to either pin 9 or 10 of servo amplifier connector CN2.

■ Battery-less absolute encoder

Servo amplifier CN2 Terminal NO.	Servo motor lead color for	Signal	Description	Note1)
1	Red	5V	Power supply	Twisted pair
2	Black	SG	Power supply common	
3	Brown	ES+	Serial data signal	Twisted pair
4	Blue	ES-		
5	-	N.C.	Unconnected	-
6	-	N.C.		
7	-	N.C.	Unconnected	-
8	-	N.C.		
9	Shield	FG (earth)	Shield	-
10	Shield	FG (earth)		

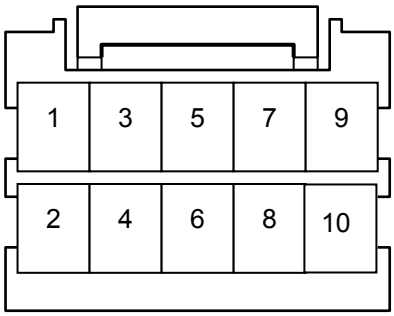
✔ Use twisted-pair cable with shield under jacket
✔ Connect jacketed and shielded cable on servo amplifier side to either pin 9 or 10 of servo amplifier connector CN2.

■ Pulse encoder

Servo amplifier CN2 Terminal NO.	Servo motor lead color for	Signal	Description	Note1)
1	Red	5V	Power supply	Twisted pair
2	Black	SG	Power supply common	
3	Blue	A	Pulse A output	Twisted pair
4	Brown	/A		
5	Green	B	Pulse B output	Twisted pair
6	Purple	/B		
7	White	Z	Pulse C output	Twisted pair
8	Yellow	/Z		
9	Shield	FG (earth)	Shield	-
10	Shield	FG (earth)		

✔ Use twisted-pair cable with shield under jacket
✔ Connect jacketed and shielded cable on servo amplifier side to either pin 9 or 10 of servo amplifier connector CN2.

2) Terminal number on servo amplifier side



✔ Wiring varies depending on encoder types connected, so make sure to confirm the wiring method.

CN2	Model NO.	Applicable wire size	Manufacturer
Housing	PADP-10V-1-S	-	JST Mfg. Co., Ltd.
Contact	SPH-002GW-P0.5S	AWG24-AWG28	

3) Recommended specification of encoder cable

Shielded many-to cable (AWG24 or equivalent)
Cable rating 80°C 30V

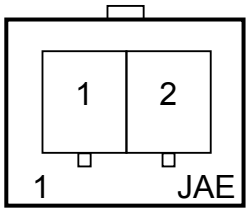
4) Encoder cable length

Maximum cable length according to conductor size of power (5V, SG) wire

Conductor size		Conductor resistance Ω/km (20°C)	Battery-back up absolute encoder Absolute encoder for incremental system Pulse encoder	Battery-less absolute encoder
			Length (m)	Length (m)
AWG	26	150 or less	4	6
	24	100 or less	6	10
	22	60 or less	10	16
	20	40 or less	15	25
	18	25 or less	25	41
SQ (mm^2)	0.15	150 or less	4	6
	0.2	100 or less	6	10
	0.3	65 or less	10	16
	0.5	40 or less	15	25
	0.75	28 or less	25	41

- ✔ The above conductor resistance values are for reference. Cable lengths are calculated according to the above conductor lengths. Please consult manufacturers, as actual conductor resistance values shall be varied by cable specifications.
- ✔ The lengths are calculated under the condition that encoder is connected with an appropriate conductor resistance cable, and the voltage at 5V-5G (control power input to servo amplifier) is 5V.
- ✔ CNA control power input at 5V-5G shall be directly output to encoder.
  When this input voltage itself is low, the voltage can drop on the cable and then encoder cannot operate correctly, even the cable length is within the range shown in the table above.
  (Encoder operating voltage specification is 5V±5%.)
- ✔ When encoder cable is relatively long, place relay connector on wiring between servo amplifier and encoder so as to ground wires in parallel, or use thicker wire diameter-conducting wire sized cable.

5) Layout of terminal of connector for battery



Terminal NO.	Signal	Description
1	BAT-	Battery-negative
2	BAT+	Battery-positive

Connector for battery	Model number	Applicable wire size	Manufacturer
Housing	IL-2S-S3L-(N)	-	Japan Aviation Electronics Industry, Limited
Contact	IL-C2-1-10000	AWG28 to AWG22	

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5

5. Operation

5.1 How to change servo motor to be combined

Change and verify servo motor to be combined with servo amplifier you use by using AC servo system supportive tool, “setup software.” Refer to separate operating manual M0008363 for more details on setup software operation.

1) Change and verify servo motor with use of setup software

Procedure	Item and Contents
1	Confirmation of the servo motor model number ■ Confirm the servo motor model number to be combined with the servo amplifier. Confirm that the model number (first 10 digits) of the servo motor to be used is the same as the model number found in the Combination Motor model number in the Setup software. If the servo motor model number to be used is the same as the Combination Motor model number, there is no need to change the settings. If not, change the number to the correct servo motor model number. ■ Input control power (5V) of servo amplifier to start-up setup software. Open the System Parameters tab of Parameters setting (P) on Menu. The first 10 digits of the servo motor number appear on the upper left side of the monitor at the Present Setting of the Motor Combination.
2	Change servo motor model number ■ The way to change servo motor to be combined with servo amplifier is to use “select from list” of setup software. ◆ Input control power (5V) of servo amplifier to start-up setup software. ◆ Open the System Parameters tab of Parameters setting (P) on menu, open “select from list” of motor to be combined located in the upper left portion of the screen, and then select file name (extension .mt1) of servo motor model number (10 digits from the first) you use.
3	Re-turning on of control power enables changed settings.

✔ When parameters in servo amplifier are changed via setup software, the changed parameters are to be written into non-volatile memory inside of the servo amplifier. Do not turn off the 5V-control power supply of servo amplifier during parameter-writing. If you turn off the control power supply after performing g parameter-writing via setup software, turn off the 5V-power supply more than 5 seconds surely after completion of parameter-writing.

5.2 System parameters

1) Specification confirmation

Confirm specification, combination of servo amplifier and motor encoder by using AC servo system supportive tool “setup software.”

<table>
<tr><th>Procedure</th><th>Item and Contents</th></tr>
<tr><td rowspan="2">1</td><td>Confirmation of servo amplifier specifications</td></tr>
<tr><td>■ Confirm that the specifications of the product purchased are the same as that of the machine being used. Also, confirm the following four (4) items with statements or codes.

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

■ Confirm the statement contents and codes with the AC servo system supportive tool “setup software.”

◆ Turn the Control Power ON and start the Setup software. Open the System Parameters tab at Parameters (P) from the Menu and the items mentioned above will be displayed on the upper right of the monitor at System Information. Confirm them using Procedure 2 and the procedures that follow it. See separate volume, M0008363, for Setup software operation.</td></tr>
<tr><td rowspan="2">2</td><td>Motor structure</td></tr>
<tr><td><table><tr><th>Code</th><th>Motor structure</th></tr><tr><td>00</td><td>Rotary</td></tr></table>
■ Confirm that rotary is displayed at motor structure.</td></tr>
</table>

<table>
<tr><th>Procedure</th><th>Item and Contents</th></tr>
<tr><td>3</td><td>Main circuit power supply voltage

<table>
<tr><th>Code</th><th>Main circuit power supply voltage display</th></tr>
<tr><td>03 (04)</td><td>48V <24V></td></tr>
</table>

■ Confirm that the main circuit power supply voltage of the connector CNA is displayed.</td></tr>
<tr><td>4</td><td>Amplifier capacity

<table>
<tr><th>Code</th><th>Amplifier capacity</th><th>Servo amplifier model number</th></tr>
<tr><td>2F</td><td>25A
(Small capacity)</td><td>RF2G (H) 01A####</td></tr>
<tr><td>2E</td><td>40A
(Large capacity)</td><td>RF2G (H) 02A####</td></tr>
</table>

■ Confirm that amplifier capacity for servo amplifier model number you use is displayed.</td></tr>
<tr><td>5</td><td>Control board code

<table>
<tr><th>Code</th><th>Motor encoder model connected to EN1</th><th>External encoder connected to EN2</th></tr>
<tr><td>#0</td><td>PA035S, PA035C, RA035C</td><td>Do not use</td></tr>
<tr><td>#2</td><td>PA035S, PA035C, RA035C</td><td>Pulse encoder</td></tr>
<tr><td>#8</td><td>PP031, PP062</td><td>Do not use</td></tr>
<tr><td>#A</td><td>PP031, PP062</td><td>Pulse encoder</td></tr>
</table>

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

<table>
<tr><th>Model</th><th>Name</th></tr>
<tr><td>PA035S</td><td>Absolute Encoder for Incremental System</td></tr>
<tr><td>PA035C</td><td>Battery Backup Method Absolute Encoder</td></tr>
<tr><td>RA035C</td><td>Battery-less Absolute Encoder</td></tr>
<tr><td>PP031, PP062</td><td>Pulse Encoder</td></tr>
</table>
</td></tr>
</table>

2) System parameters list

The following is system parameters list. Settings vary depending on system you use.
So please confirm 3) and 4) and later to surely and properly set.

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

3) Confirmation and settings of system parameters

Use AC servo system supportive tool, setup software, to set specification for and combination of servo amplifier and motor encoder. Refer to separate operating manual “M0008363 for details on operation of setup software.

System parameters (Settings for servo amplifier)

ID 00 — Control Cycle

■ Select the control cycle for Velocity control/ Torque control.
“High Frequency Sampling” enables increasing the frequency response of the velocity control system. Please set at “00: Standard_Sampling” for normal use.

Selection		Contents
00	Standard_Sampling	Standard Sampling
01	High-freq_Sampling	High Frequency Sampling

■ “High frequency sampling mode” is not available for the following conditions:

◆ System Parameters ID0A setting value of the “Position Control Selection”

Present setting value	Contents
01:Model1	Model Following Control

or

Present setting value	Contents
02:Model2	Model Following Vibration Suppressor Control

◆ System Parameters ID0B setting value of the “Position Loop Control, Position Loop Encoder Selection”

Present setting value	Contents
01: External_Enc	Fully closed control/ External Encoder

ID 01 — Main Circuit Power Input Type

■ Set the input mode for the main circuit power supply to the servo amplifier CNA.

Selection	Description
02:DC	DC power is supplied to the main circuit

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>09</td><td>
Control Mode Selection
■ Set the control mode of the servo amplifier used as follows:
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>02</td><td>Position</td><td>Position Control Mode</td></tr>
</table>
</td></tr>
<tr><td>0A</td><td>
Position Control Selection
■ Select the function Position Control Mode.
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>Standard</td><td>Standard</td></tr>
<tr><td>01</td><td>Model1</td><td>Model Following Control</td></tr>
<tr><td>02</td><td>Model2</td><td>Model Following Vibration Suppress Control</td></tr>
</table>
■ Under the following parameter settings, ‘Model Following Control” and “Model Following Vibration Suppressor Control” are not valid.
◆ System parameter ID00 “Control Cycle” is set as follows:
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>01: High-freq_Sampling</td><td>High Frequency Sampling</td></tr>
</table>
◆ System parameter ID09 “Control Mode Selection” is not set as follows:
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>02:Position</td><td>Position Control Mode</td></tr>
</table>
■ If the parameter is set as below, the “Model Following Vibration Suppressor Control” is not valid.
◆ System parameter ID0B “Position Loop Control, Position Loop Encoder Selection” is set as below:
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>01: External_Enc</td><td>Fully closed control/ External Encoder</td></tr>
</table>
</td></tr>
<tr><td>0B</td><td>
Position Loop Control, Position Loop Encoder Selection
■ Select the encoder for “Position loop control system” and “Position loop control” for the servo amplifier under “Fully closed control”.
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>Motor_Enc</td><td>Semi-closed Control/ Motor Encoder</td></tr>
<tr><td>01</td><td>External_Enc</td><td>Fully closed control/ External Encoder</td></tr>
</table>
■ “Fully closed control” is not chosen, no need to change. Confirm that the setting is as follows:
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>00:Motor_Enc</td><td>Semi-closed control/ Motor Encoder</td></tr>
</table>
</td></tr>
<tr><td>0C</td><td>
External Pulse Encoder Resolution
■ Sets resolution of the external pulse encoder under Fully closed control. Sets the number of converted pulses for each rotation of the motor shaft.
<table>
<tr><th>Setting range</th><th>Unit</th></tr>
<tr><td>500 - 99999(multiply by 1)</td><td>P/R</td></tr>
</table>
</td></tr>
</table>

4) Change and verify system parameters (settings for motor encoder specification)

Set motor encoder you use. Items to be set vary depending on encoder you use. Parameters you need to set are listed below. Please set values for each motor encoder after checking the list in the following pages.

ID 04 — Serial Encoder Function Selection

■ Select the serial encoder function

Selection		Description	
00	PA_S_2.5M	Absolute Encoder for Incremental System	2.5Mbps
01	PA_S_4M	Absolute Encoder for Incremental System	4.0Mbps
02	PA_C_2.5M	Battery Backup Method Absolute Encoder	2.5Mbps
03	PA_C_4M	Battery Backup Method Absolute Encoder	4.0Mbps
04	RA_C_2.5M	Battery-less Absolute Encoder	2.5Mbps
05	RA_C_4M	Battery-less Absolute Encoder	4.0Mbps

ID 05 — Serial Encoder Resolution

■ Set the divisions per single (1) shaft rotation

Selection		Description
00	2048_FMT	2048 divisions
01	4096_FMT	4096 divisions
02	8192_FMT	8192 divisions
03	16384_FMT	16384 divisions
04	32768_FMT	32768 divisions
05	65536_FMT	65536 divisions

Selection		Description
06	131072_FMT	131072 divisions
07	262144_FMT	262144 divisions
08	524288_FMT	524288 divisions
09	1048576_FMT	1048576 divisions
0A	2097152_FMT	2097152 divisions

ID 06 — Backup Type Absolute Encoder Function Selection

■ Select the proper setting for the system

Selection		Description
00	Absolute_System	Absolute System
01	Incremental_System	Incremental System

✔ This is an exclusive setting for operation with battery-backup type absolute encoder connected. (Effective when either 02 or 03 is selected in the above ID04.)
Selecting 01 performs “encoder clear” at the time the power supply is turned on, and then clear “encoder status (error, warning)” and multi-turn data.

ID 07 — Pulse Encoder Function Selection

■ Select the pulse encoder to be used

Selection		Description
00	Standard	Wire-saving Incremental Encoder [Standard (4 pairs)]
01	7Pairs_INC-E	Incremental Encoder with CS Signal (7 pairs)

ID 08 — Pulse Encoder Resolution

■ Set the pulse number per single (1) shaft rotation

Setting range	Unit
500 – 65535 (multiplied by 1)	P/R

■ The following shows the setting when you use serial encoder for motor as incremental system.

Motor encoder used for CN2	PA035S: Absolute encoder for incremental system
Motor encoder specification	Resolution per 1 rotation: 131072(17bits)
	Transmission method: Half-duplex start/stop synchronization 2.5Mbps (standard)

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

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

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

Setting value	Description
06: 131072_FMT	131072 divisions

Motor encoder used for CN2	PA035C: Battery backup method absolute encoder
Motor Encoder Specification	Resolution per 1 rotation: 131072 (17bits)
	Transmission method: Half-duplex start/stop synchronization 2.5Mbps (standard)

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

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

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

Setting value	Description
06: 131072_FMT	131072 divisions

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

Setting value	Description
01: Incremental_System	Incremental System

✔ No need to connect backup battery

✔ Resolution and baud rate may vary depending on the motor encoder you use.

■ The following shows the setting when you use serial encoder for motor as absolute system.

Motor encoder used for CN2	PA035C: Battery backup method absolute encoder
Motor Encoder Specification	Resolution per 1 rotation: 131072(17bits)
	Transmission method: Half-duplex start/stop synchronization 2.5Mbps(standard)

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

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

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

Setting value	Description
06: 131072_FMT	131072 divisions

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

Setting value	Description
00: Absolute _System	Absolute System

Motor encoder used for CN2	RA035C: Battery less absolute encoder
Motor Encoder Specification	Resolution per 1 rotation: 131072(17bits)
	Transmission method: Half-duplex start/stop synchronization 2.5Mbps (standard)

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

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

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

Setting value	Description
06: 131072_FMT	131072 divisions

■ The following shows the setting when you use pulse encoder for motor.

CN2: “PP031, PP062” Connect pulse encoder

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

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

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

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

✔ Resolution and baud rate may vary depending on the motor encoder you use.

5) Default set values at factory

The following table shows the defaults for parameter settings at factory.

■ Servo amplifier model number : RF2G(H)##A0□#

ID	Name	Setting value
00	Control Cycle	00: _Standard_Sampling
01	Main Circuit Power Input Type	02: _DC
04	Serial Encoder Function Selection	00: PA_S_2.5M
05	Serial Encoder Resolution	06: 131072_FMT
06	Backup Type Absolute Encoder Function Selection	00: Absolute_System
09	Control Mode Selection	02: Position
0B	Position Loop Control, Position Loop Encoder Selection	00: Motor_Enc.

■ Servo amplifier model number : RF2G(H)##A8□#

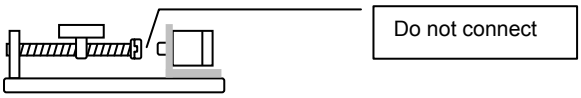
ID	Name	Setting value
00	Control Cycle	00: _Standard_Sampling
01	Main Circuit Power Input Type	02: _DC
07	Pulse Encoder Function Selection	00: Standard
08	Pulse Encoder Resolution	2000P/R
09	Control Mode Selection	02: Position
0B	Position Loop Control, Position Loop Encoder Selection	00: Motor_Enc.

- ✔ # shall be any given alphanumeric characters.
- ✔ Performing parameter backup function enables you to store “system parameters,” “general parameters,” and “motor parameters” in servo amplifier, and then restore the parameters when needed.
- ✔ Please refer to separate document: M0008363 for operating setup software.

5.3 Test operation

1) Confirmation of installation and wiring

Confirm installation and wiring of servo amplifier and motor. The connector of CN1A and CN1B is described as CN1 to represent the two in the following table.

Procedure	Item and contents
1	Installation ■ Install the servo amplifier and the servo motor by referring to [Installation (3-1)]. Do not connect the servo motor shaft to the machine to maintain the no load status. 
2	Wiring, connecting → Turning on the power supply ■ Wire power supply servo motor and host equipment by referring to [Wiring (4)]. Do not connect CN1 to the servo amplifier. ■ Turn on power supply. Confirm that alarm LED (ALM) mounted on upper front of servo amplifier is lighted. When alarm LED (ALM) is lighted, take actions according to"Section 7.3, Troubleshooting when alarm activated." ■ When status LED (STA) does not flash even though main circuit power is turned on, take actions according to"Section 7.1, Troubleshooting."

2) Confirmation of movement

Perform JOG operation by using setup software.

Procedure	Item and contents
1	JOG driving ■ Do not connect the shaft of the servo motor into the machine to keep the status of no load, and perform JOG operation. ■ Confirm that the servo motor rotates forward direction and backward direction ◆ Select JOG driving from the Test operation menu. For operating instructions, please see separate volume, M0008363, for Setup software.

3) Confirmation of input-output signal

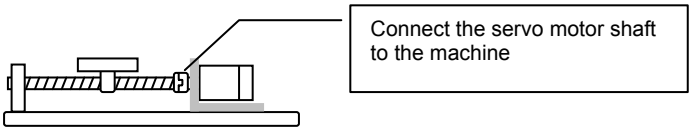
Settings for multi-purpose I/O signals (CN1) are defaults at factory.

<table>
<tr><th>Procedure</th><th>Item and contents</th></tr>
<tr><td>1</td><td>Confirmation of I/O signal
■ Select function you use from general parameters Group9 and allocate CONT1 - CONT8.
<table>
<tr><th rowspan="2">Input signal</th><th rowspan="2">CN1pin number</th><th colspan="2">Default setting value at shipment</th></tr>
<tr><th>Signal selected form general parameter Group9</th><th>Setting value</th></tr>
<tr><td>CONT1</td><td>3</td><td>Servo-on function</td><td>02:_CONT1_ON</td></tr>
<tr><td>CONT2</td><td>4</td><td>Velocity loop proportional control switching function</td><td>04:_CONT2_ON</td></tr>
<tr><td>CONT3</td><td>5</td><td>Encoder clear function</td><td>06:_CONT3_ON</td></tr>
<tr><td>CONT4</td><td>6</td><td>Deviation clear function</td><td>08:_CONT4_ON</td></tr>
<tr><td>CONT5</td><td>7</td><td>Negative over travel function</td><td>0B:_CONT5_OFF</td></tr>
<tr><td>CONT6</td><td>8</td><td>Positive over travel function</td><td>0D:_CONT6_OFF</td></tr>
<tr><td>CONT7</td><td>9</td><td>Torque limit function</td><td>0E:_CONT7_ON</td></tr>
<tr><td>CONT8</td><td>10</td><td>Alarm reset function</td><td>10:_CONT8_ON</td></tr>
</table></td></tr>
<tr><td>2</td><td>Confirmation of output signals
■ Select the output signal from general parameters GroupA and allocate OUT1 - OUT 8.
<table>
<tr><th rowspan="2">Output signal</th><th rowspan="2">CN1 Pin number</th><th>Default setting value at shipment</th></tr>
<tr><th>Setting value</th></tr>
<tr><td>OUT1</td><td>12</td><td>18:_INP_ON</td></tr>
<tr><td>OUT2</td><td>13</td><td>0C:_TLC_ON</td></tr>
<tr><td>OUT3</td><td>14</td><td>02:_S-RDY_ON</td></tr>
<tr><td>OUT4</td><td>15</td><td>0A:_MBR_ON</td></tr>
</table>
<table>
<tr><th rowspan="2">Output signal</th><th rowspan="2">CN1 Pin number</th><th>Default setting value at shipment</th></tr>
<tr><th>Setting value</th></tr>
<tr><td>OUT5</td><td>16</td><td>33:_ALM5_OFF</td></tr>
<tr><td>OUT6</td><td>17</td><td>35:_ALM6_OFF</td></tr>
<tr><td>OUT7</td><td>18</td><td>37:_ALM7_OFF</td></tr>
<tr><td>OUT8</td><td>20</td><td>39:_ALM_OFF</td></tr>
</table></td></tr>
<tr><td>3</td><td>Confirmation of I/O signal
■ Confirm that the I/O signal functions fine at the monitor.
Refer to “Section 5.6, Monitoring function” for monitor explanation.
◆ Confirm from the menu monitor.
For operating instructions of Setup software, please see the separate volume M0008363.</td></tr>
<tr><td>4</td><td>Input servo ON signal
■ Input servo ON signal. Confirm that servo motor is excited and status LED (STA) on the front of servo amplifier is flashing.
■ Setting and changing the over-travel function can be done at the general parameters Group9 ID00, ID01.</td></tr>
</table>

<table>
<tr><th>Procedure</th><th>Item and contents</th></tr>
<tr><td>5</td><td>Command input
■ Input position command pulse.
■ Confirm that the shaft of the servo motor rotates in the right direction.
■ If the shaft of the servo motor command input from the upper device does not rotate, confirm that the command is input with the monitor function.
<table>
<tr><th>ID</th><th>Symbol</th><th>Monitor name</th><th>Present value</th></tr>
<tr><td>13</td><td>FMON</td><td>Position command pulse frequency monitor</td><td>Input value to be indicated.</td></tr>
</table>
■ If the servo amplifier does not receive command from host unit, the value displayed on the monitor does not change.
Incorrect wiring may cause the above. Please re-confirm the wiring</td></tr>
<tr><td>6</td><td>Power shutdown
■ Turn OFF the servo-ON signal. Then turn OFF the power supply.</td></tr>
</table>

4) Confirmation of device operation

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

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

■ Input the command (low velocity); check the operation direction, distance, emergency stop and over-travel (F-OT·R-OT) to make sure they are operating properly.
■ Be sure to stop in the event of any abnormal operation.</td></tr>
<tr><td>2</td><td>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.) has been set and is valid. If there is nothing wrong with operation and the characteristic, manual tuning is not necessary.
Refer to [Adjustments (6)] for the Servo Tuning.</td></tr>
</table>

5.4 Servo amplifier status display

Servo amplifier status is identified by means of 3 LEDs on the front of amplifier as follows:

1) Default display

[STA] LED Marking	Description	Status code
Extinction	Control power supply established. Control power supply (5V) is established and amplifier (RDY) is ON.	0
Flashing at 256ms cycle	Main circuit power supply established. Main power supply {48V<24V>} is established, but operation preparation completion signal is OFF.	2
	Operation preparation completion signal established. Main power supply {48V<24V>} is established and operation preparation completion signal is ON.	4
Flashing at 1.024s cycle	Servo is ON.	8

[STA] LED Marking	Description
Flashing at 1.024s cycle	Warning status: Battery Warning, position deviation warning, overload warning, amplifier temperature warning, positive/negative over travel, now in velocity-limiting, and now in torque limiting.

2) Alarm display

[STA] LED Marking	Description
Lighted	When an alarm occurs, take corrective actions as instructed in [Maintenance (8)].

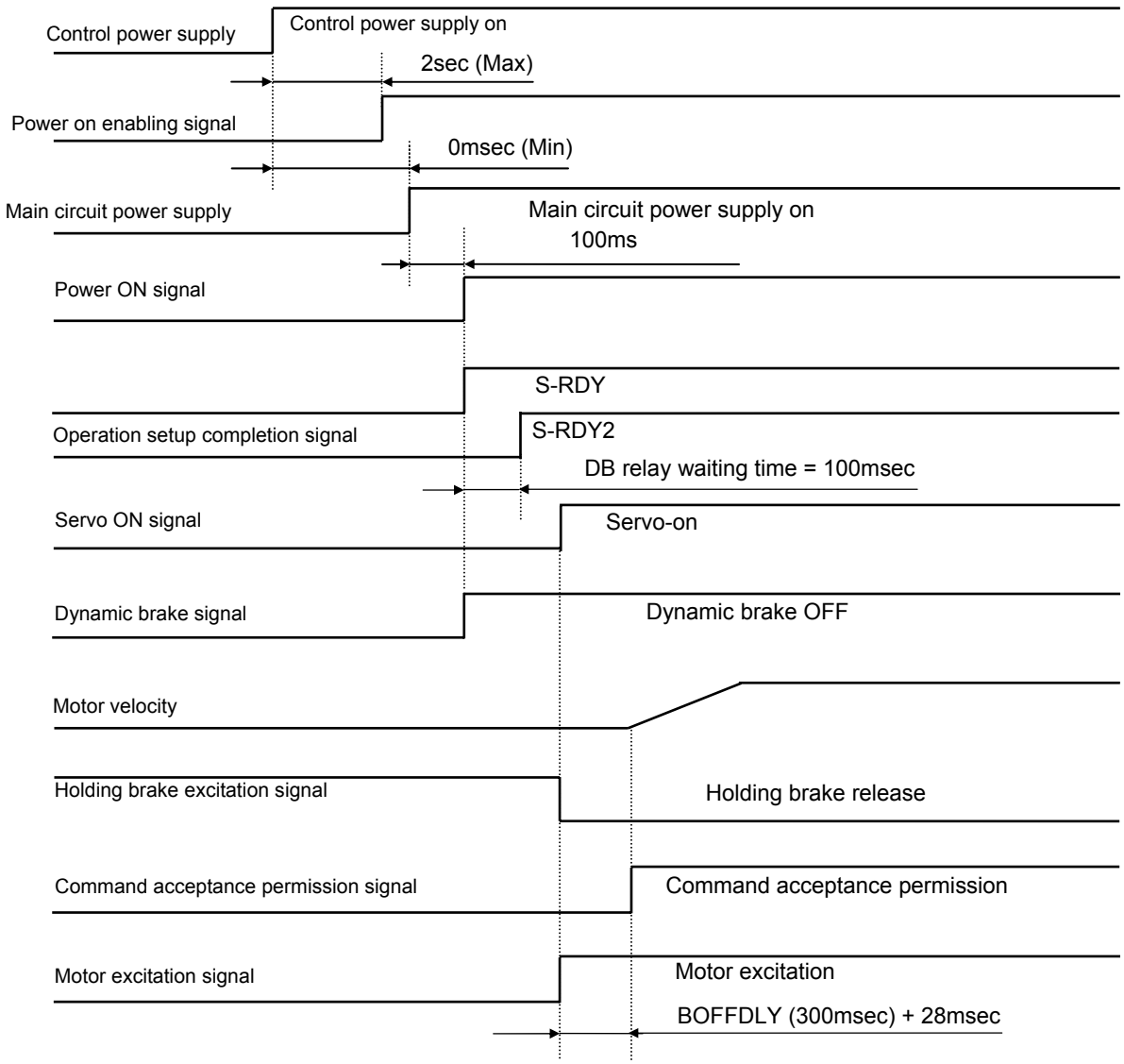
3) Control power input display

[STA] LED Marking	Description
Lighted	Shows condition that DC5V is applied to CNA control power input.

5.5 Operation sequence

1) Operational sequence from power-on through power-off in standard setting at factory

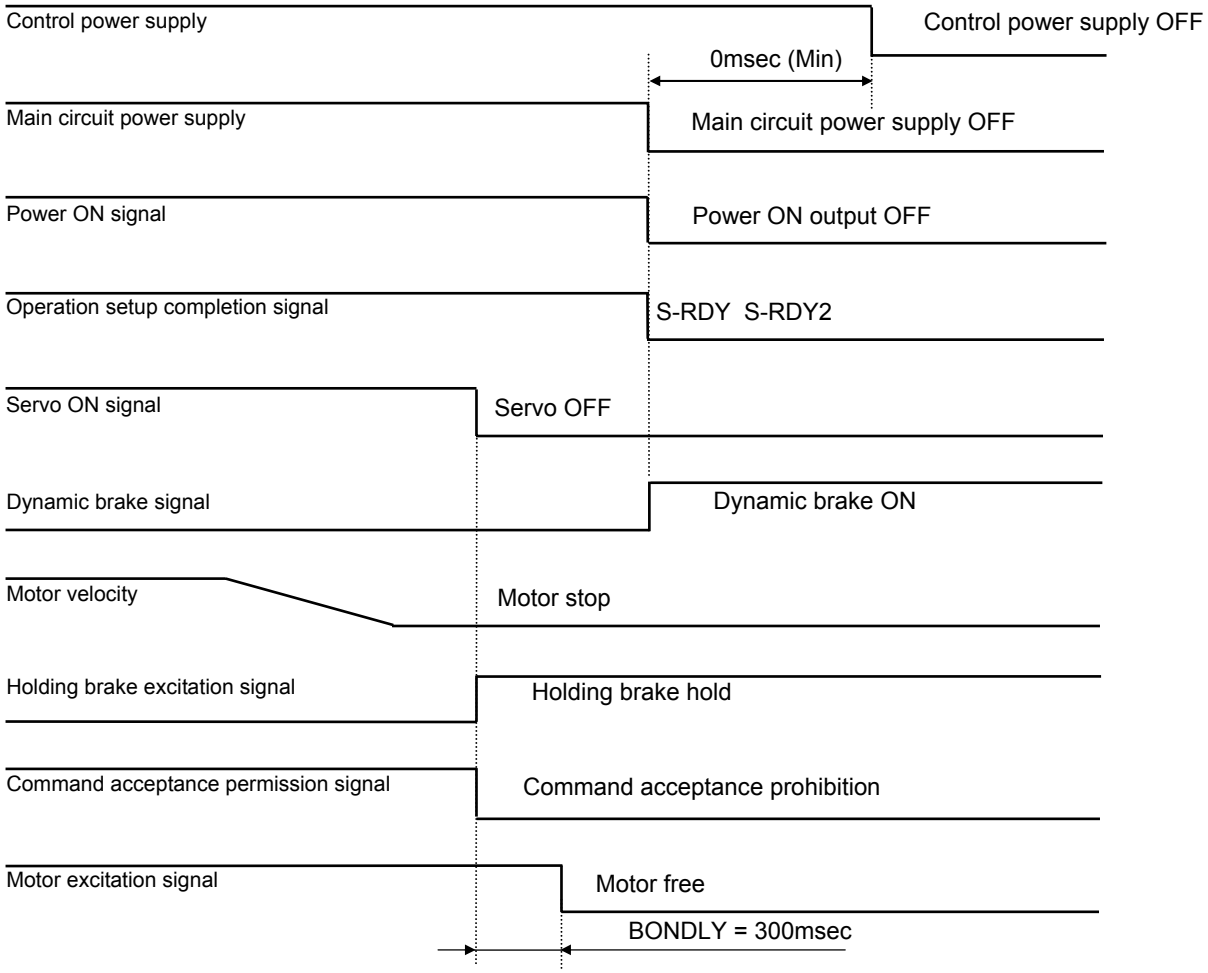
■ Power ON → Servo ON



✔ Maximum number of repetitions of turning-on/off of servo amplifier shall be 5 times or less per hour, 30 times or less a day.

* Dynamic brake cannot work for servo amplifiers without dynamic brake circuit.

■ Servo OFF → Power OFF



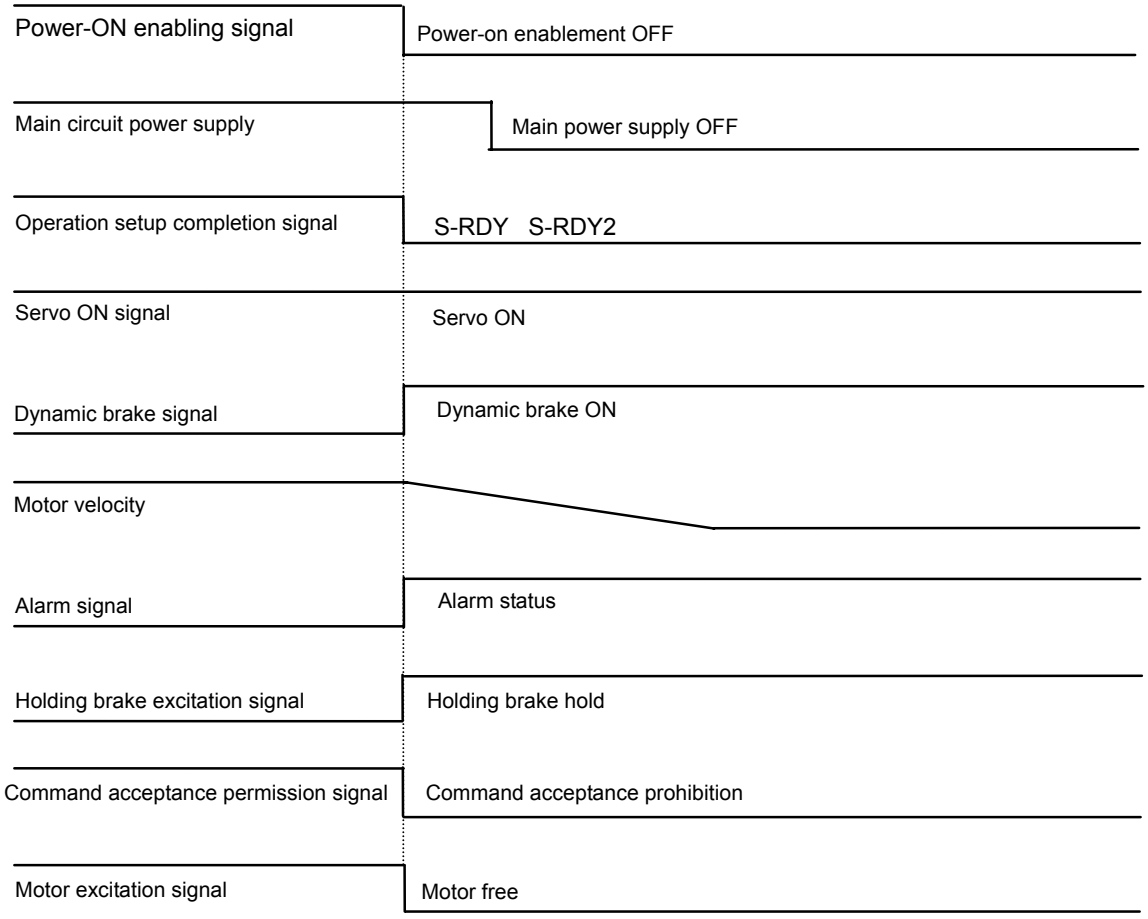
* Dynamic brake cannot work for servo amplifiers without dynamic brake circuit.

✔ Do not turn off the 5V-control power supply of servo amplifier during parameter-writing. If you turn off the control power supply after performing parameter-writing via setup software, turn off the 5V-power supply more than 5 seconds surely after completion of parameter-writing.

2) Stop sequence when alarm activated

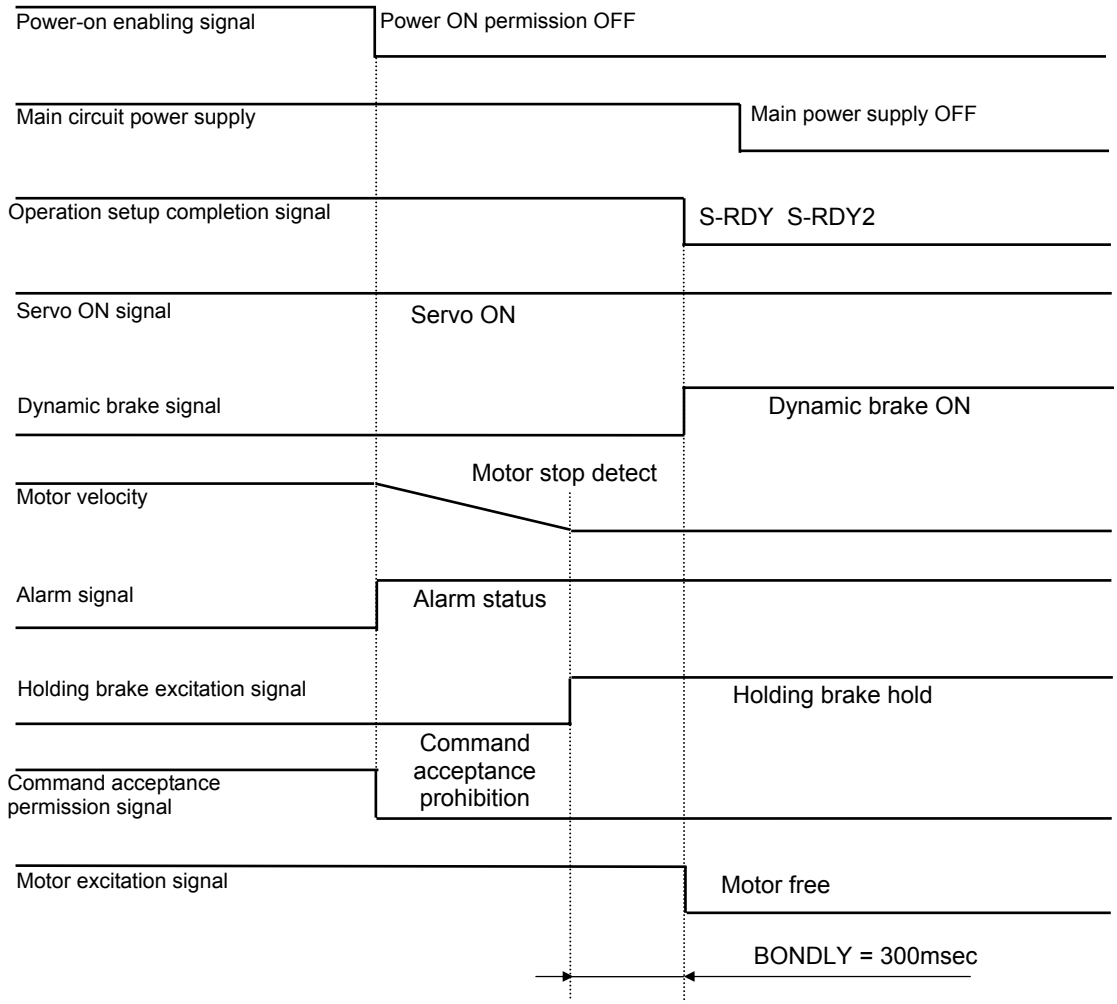
When an alarm activated, servo motor is stopped by either dynamic brake or servo brake. The selection of brake to use is depending on the alarm activated. Refer to “Section 7.2 Warning and alarm list.”

■ Stop by dynamic brake at alarm



* Dynamic brake cannot work for servo amplifiers without dynamic brake circuit.

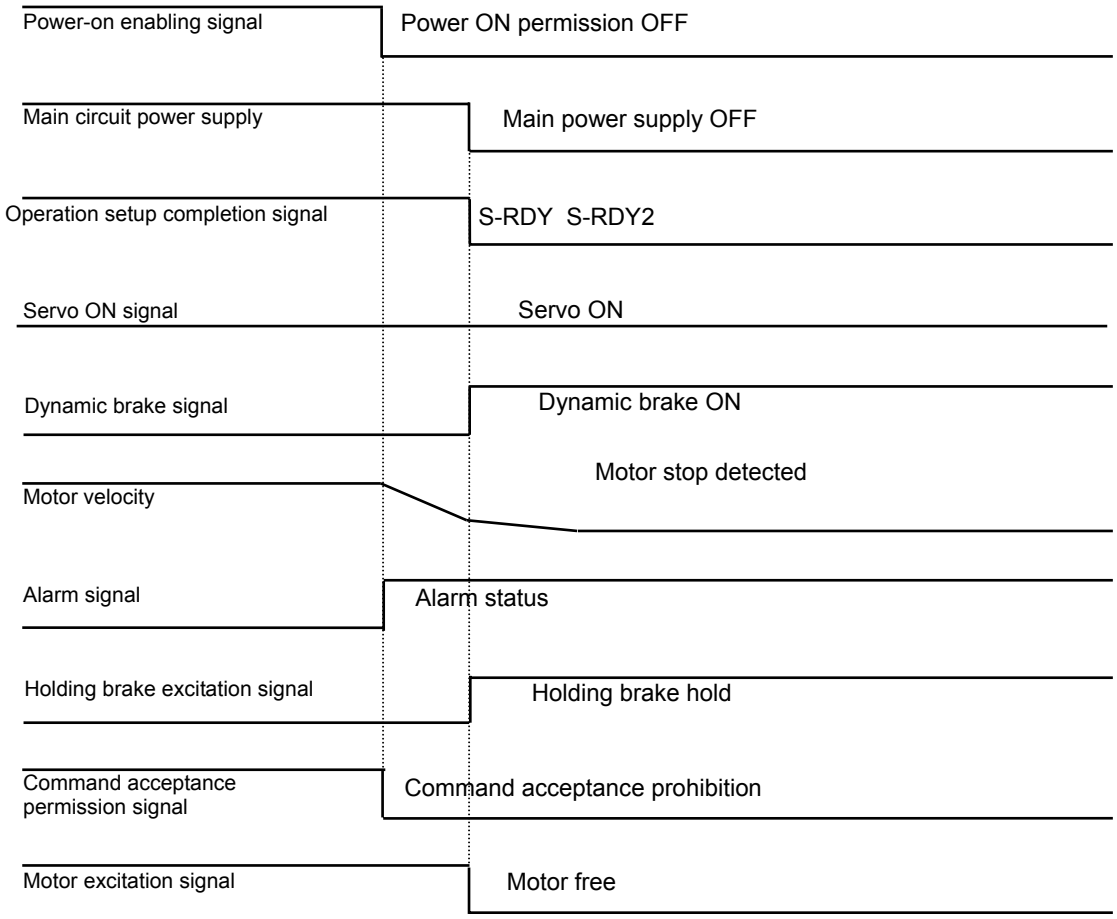
■ Stop by servo brake when alarm activated (With safeguard circuit)



✔ The above is sequence without safeguard circuit.

* Dynamic brake cannot work for servo amplifiers without dynamic brake circuit.

■ Stop by servo brake when alarm activated (With safeguard circuit)

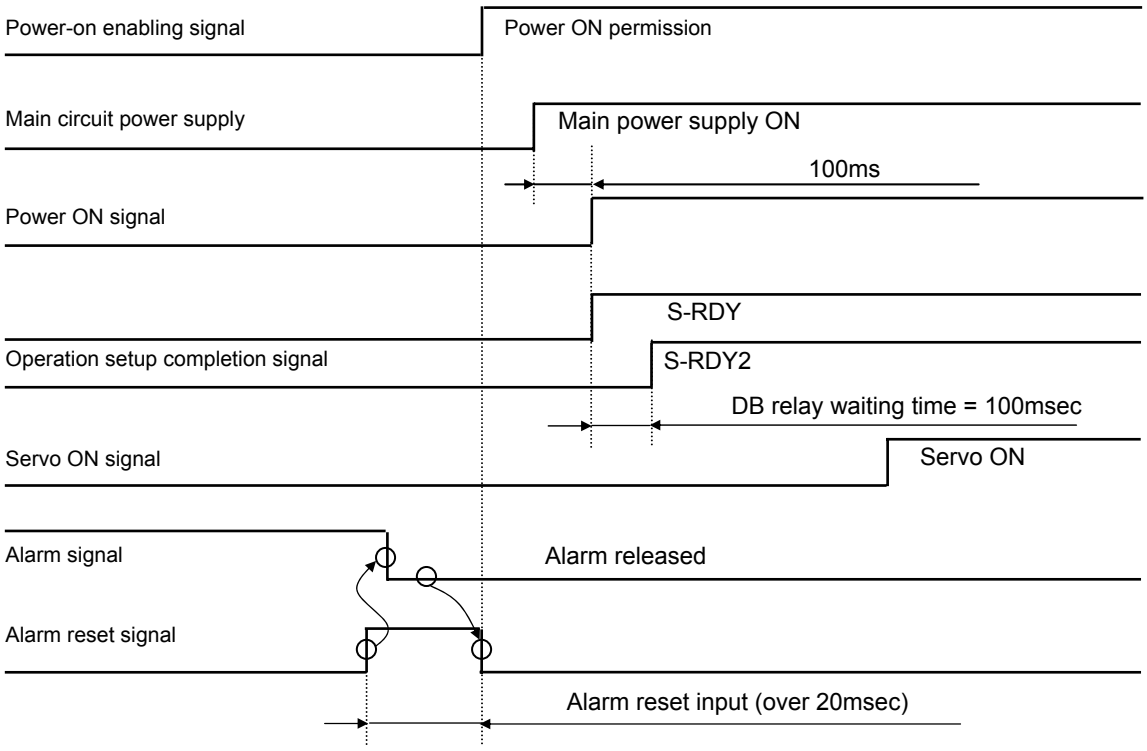


✔ The above is sequence with safeguard circuit.
When safeguard circuit breaks main circuit power, the motor operation switches to dynamic brake stop.
Refer to *Section 4.1, 6) Examples of wiring*.

* Dynamic brake cannot work for servo amplifiers without dynamic brake circuit.

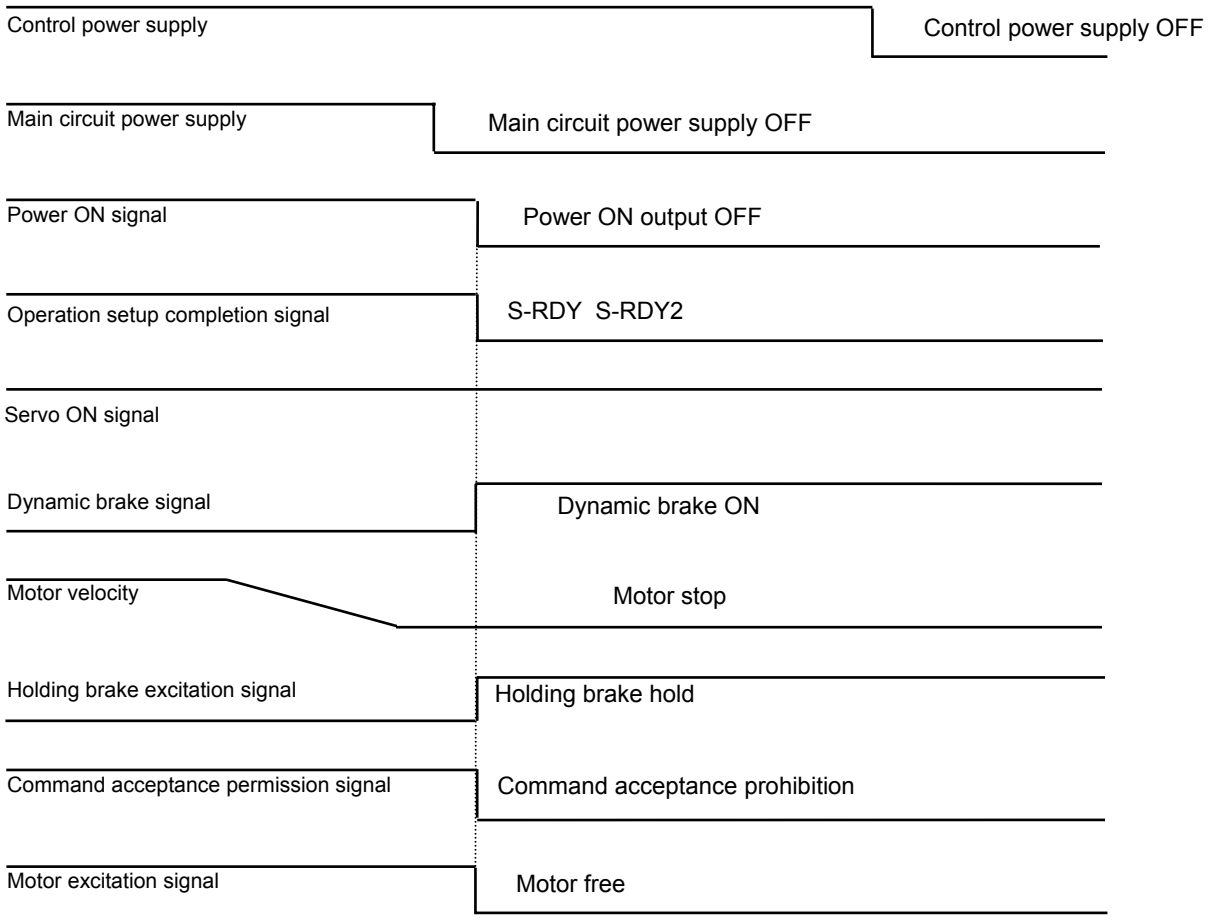
3) Sequence when alarm reset

Alarm can be reset by inputting alarm reset signal via general input.



- ✔ Some alarms cannot be reset unless the power is reset (control power is turned OFF and then returned ON), or encoder clear is performed. Refer to *Section 7.2 Warning and Alarm List*.
- ✔ Reset alarm after eliminating the alarm cause and ensuring the safety when alarm activated. The alarm signal cannot be cleared when alarm state continues, therefore, set a timeout period of 20ms or more to restore.
  Make sure to input 20msec or over to input alarm reset signal without checking alarm signal.

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



✔ Refer to *Section 5.5, 2, Dynamic brake stop when alarm activated* for sequence when “Detect main circuit power voltage decrease alarm” selected in main circuit power voltage decrease detection selection “GroupB ID18.”

* Dynamic brake cannot work for servo amplifiers without dynamic brake circuit.

5.6 Monitor function

1) Monitor function

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

2) Description of monitor

ID 00 — Servo amplifier status monitor [STATUS]

Code	Status	
0	Power OFF status	(P-OFF)
2	Power ON status	(P-ON)
4	Servo ready status	(S-RDY)
8	Servo ON status	(S-ON)
A	Emergency stop status	(EMR)
10	Alarm status and power OFF	(ALARM_P-OFF)
12	Alarm status and power ON	(ALARM_P-ON)
1A	Alarm status and emergency stop status	(ALARM_EMR)

ID 01 — Warning status 1 monitor [WARNING1]

■ Displays warning status. Displays warning status under“1”or “ON”

Bit	3	2	1	0
Function	---	Overload	---	Temperature inside the amplifier

Bit	7	6	5	4
Function	Excessive deviation	---	Velocity controlled	Torque controlled

ID 02 — Warning status 2 monitor [WARNING2]

■ Displays warning status. Valid when“1”or“ON”.

Bit	3	2	1	0
Function	Reverse direction Over-travel	Forward direction Over-travel	-	Main circuit power being charged

Bit	7	6	5	4
Function	Voltage sag	Low battery voltage	-	-

ID 03 — General Purpose Input CONT8 - 1 monitor [CONT8-1]

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

Bit	3	2	1	0
Function	CONT4	CONT3	CONT2	CONT1

Bit	7	6	5	4
Function	CONT8	CONT7	CONT6	CONT5

ID 04 — General Purpose Output OUT8 - 1 monitor [OUT8-1]

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

Bit	3	2	1	0
Function	OUT4	OUT3	OUT2	OUT1

Bit	7	6	5	4
Function	OUT8	OUT7	OUT6	OUT5

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>05</td><td>
Pulse encoder signal monitor [INC-E MON]
■ Displays pulse 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>Motor encoder
Z phase signal</td><td>Motor encoder
B phase signal</td><td>Motor encoder
A phase signal</td></tr>
</table>
<table>
<tr><td>Bit</td><td>7</td><td>6</td><td>5</td><td>4</td></tr>
<tr><td>Function</td><td>-</td><td>External encoder
Z phase signal</td><td>External encoder
B phase signal</td><td>External encoder
A phase signal</td></tr>
</table>
</td></tr>
<tr><td>06</td><td>
Velocity monitor [VMON]
■ Displays the rotation velocity of the servo motor.
<table>
<tr><td>Display range</td><td>Unit</td></tr>
<tr><td>-9999 - 9999</td><td>min^{-1}</td></tr>
</table>
</td></tr>
<tr><td>07</td><td>
Velocity command monitor [VCMON]
■ Displays the velocity command value.
<table>
<tr><td>Display range</td><td>Unit</td></tr>
<tr><td>-9999 - 9999</td><td>min^{-1}</td></tr>
</table>
</td></tr>
<tr><td>08</td><td>
Torque monitor [TMON]
■ Displays the output torque.
<table>
<tr><td>Display range</td><td>Unit</td></tr>
<tr><td>-499.9 - 499.9</td><td>%</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>09</td><td>Torque command monitor [TCMON]
■ Displays the torque command value.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-499.9 - 499.9</td><td>%</td></tr>
</table></td></tr>
<tr><td>0A</td><td>Position deviation monitor [PMON]
■ Displays the position deviation value.
◆ The values are given in decimal on the display of setup software.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-2147483648 - 2147483647</td><td>Pulse</td></tr>
</table></td></tr>
<tr><td>0C</td><td>Actual position monitor (Motor encoder) [APMON]
■ Shows current motor encoder position with the origin at the position at control power-on. As this is free-running counter, if current position exceeds display range, the value becomes the maximum value of reverse polarity.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-9223372036854775808 - 9223372036854775807</td><td>Pulse</td></tr>
</table></td></tr>
<tr><td>0E</td><td>External monitor (External encoder) [EX-APMON]
■ Shows current external encoder position with the origin at the position at control power-on. As this is free-running counter, if current position exceeds display range, the value becomes the maximum value of reverse polarity.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-9223372036854775808 - 9223372036854775807</td><td>Pulse</td></tr>
</table></td></tr>
<tr><td>10</td><td>Command position monitor [CPMON]
■ Shows current pulse command position with the origin at the position at control power-on. As this is free-running counter, if current position exceeds display range, the value becomes the maximum value of reverse polarity.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-9223372036854775808 - 9223372036854775807</td><td>Pulse</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>13</td><td>Position command pulse frequency monitor [FMON1]
■ Displays entered command pulse frequency.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-6000 - 6000</td><td>kPulse/s</td></tr></table></td></tr>
<tr><td>14</td><td>U-phase electric angle monitor [CSU]
■ Displays U-phase electric angle. Always displayed excluding encoder errors.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 - 359</td><td>deg</td></tr></table></td></tr>
<tr><td>16</td><td>Serial encoder PS data monitor [ABSPS]
■ Displays position data of serial encoder.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 - 1099511627775</td><td>Pulse</td></tr></table>(Actual display range varies depending on the encoder specifications.)</td></tr>
<tr><td>1B</td><td>Effective torque monitor [TRMS]
■ Displays effective torque. Depending on the operation pattern, it may take some hours to become stable.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 - 499</td><td>%</td></tr></table></td></tr>
<tr><td>1C</td><td>Effective torque monitor (Estimated value) [ETRMS]
■ Displays effective torque estimated value. Estimates from short time operation. This can be confirmed shortly if the same operation pattern is repeated.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 - 499</td><td>%</td></tr></table></td></tr>
</table>

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>1D</td><td>Load Inertia Moment Ratio monitor [JRAT MON]
■ Displays actual Load Inertia Moment Ratio.
Value can be confirmed when changing gain and at Auto-tuning function.</td></tr>
<tr><td>1E</td><td>Position Loop Proportional Gain monitor [KP MON]
■ Displays actual Position Loop Proportional Gain.
Value can be confirmed when changing gain and at Auto-tuning function.</td></tr>
<tr><td>1F</td><td>Position Loop Integral Time Constant monitor [TPI MON]
■ Displays actual Position Loop Integral Time Constant value.
Value can be confirmed when changing the gain function.</td></tr>
<tr><td>20</td><td>Velocity Loop Proportional Gain monitor [KVP MON]
■ Displays actual Velocity Loop Proportional Gain.
Value can be confirmed when changing gain and at Auto-tuning function.</td></tr>
<tr><td>21</td><td>Velocity Loop Integral Time Constant monitor [TVI MON]
■ Displays actual Velocity Loop Integral Time Constant.
Value can be confirmed when changing gain and at Auto-tuning function.</td></tr>
<tr><td>22</td><td>Torque Command Filter monitor [TCFIL MON]
■ Displays actual Torque Command Filter.
Value can be confirmed when changing gain and at Auto-tuning function.</td></tr>
<tr><td>23</td><td>Model Control Gain monitor [MKP MON]
■ Displays actual Model Control Gain.
Value can be confirmed when changing gain and at Auto-tuning function.</td></tr>
<tr><td>24</td><td>Load Torque monitor (Estimate value) [MTLMON-EST]
■ Displays estimated value of load torque.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-499.9 - 499.9</td><td>%</td></tr></table></td></tr>
<tr><td>25</td><td>Amplifier operation time [OPE-TIM]
■ Counted during period control power is being turned ON. The time is displayed value x 2 hours.
<table><tr><th>Unit</th></tr><tr><td>× 2 hour</td></tr></table></td></tr>
<tr><td>30</td><td>Main circuit direct current voltage monitor [VBUS]
■ Displays main circuit direct current voltage.
<table><tr><th>Unit</th></tr><tr><td>V</td></tr></table></td></tr>
</table>

✔ Use the following formula for converting from “effective torque monitor (estimated value) value” to “motor utilization monitor value” that is indicated in RS1 model amplifier.
Motor utilization monitor [%] = (effective torque monitor-indicated value [%]/100)^2×00

5.7 Analog monitor and digital monitor

All signals and internal status of servo amplifier can be monitored by using dedicated monitor box and cables. Refer to “Section 10.6, Optional parts” for details of dedicated monitor and cables.

■ Selection of output signal
Select from the following parameters to change output signal you use.

General parameters GroupA ID10	DMON: Digital Monitor Output Signal Selection
General parameters GroupA ID11	MON1: Analog Monitor Select Output 1
General parameters GroupA ID12	MON2: Analog Monitor Select Output 2

5.8 Setting of parameters

1) Parameters list

The following is parameters list. Parameters are grouped and listed in the order of ID. Store "system parameters," "general parameters," and "motor parameters" in servo amplifier by performing parameter backup function so that you can restore the parameters when needed. Refer to separate manual M0008363 for operating setup software.

✔ When parameters in servo amplifier are changed via setup software, the changed parameters are to be written into non-volatile memory inside of the servo amplifier. Do not turn off the 5V-control power supply of servo amplifier during parameter-writing. If you turn off the control power supply after performing parameter-writing via setup software, turn off the 5V-power supply more than 5 seconds surely after completion of parameter-writing.

■ General parameters group list

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

✔ Invalid parameters vary depending on the servo amplifier you use.
✔ Setup software does not display invalid parameter (s).

■ General parameters Group0 "Auto-tuning settings"

ID	Symbol	Name	Standard value	Unit	Setting range
00	TUNMODE	Tuning Mode	00:AutoTun	-	00 - 02
01	ATCHA	Auto-Tuning Characteristic	00:Positioning1	-	00 - 06
02	ATRES	Auto-Tuning Response	5	-	1 - 30
10	ANFILTC	Auto-Notch Filter Tuning Torque Command	50.0	%	10.0 - 100.0
20	ASUPTC	Auto-FF Vibration Suppressor Frequency Tuning Torque Command	25.0	%	10.0 - 100.0
21	ASUPFC	Auto-FF Vibration Suppressor Frequency Tuning Friction Compensation Value	5.0	%	0.0 - 50.0

■ General parameters Group1 “Basic control parameter settings”

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

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

ID	Symbol	Name	Standard value	Unit	Setting range
00	SUPFRQ1	FF Vibration Suppressor Frequency 1	500	Hz	5 - 500
01	SUPLV	FF Vibration Suppressor Level Selection	00	-	00 - 03
10	VCNFIL	Velocity Command Notch Filter	1000	Hz	50 - 1000
20	TCNFILA	Torque Command Notch Filter A	4000	Hz	100 - 4000
21	TCNFPA	TCNFILA, Low Frequency Phase Delay Improvement	00	-	00 - 02
22	TCNFILB	Torque Command Notch Filter B	4000	Hz	100 - 4000
23	TCNFDB	TCNFILB, Depth Selection	00	-	00 - 03
24	TCNFILC	Torque Command Notch Filter C	4000	Hz	100 - 4000
25	TCNFDC	TCNFILC, Depth Selection	00	-	00 - 03
26	TCNFILD	Torque Command Notch Filter D	4000	Hz	100 - 4000
27	TCNFDD	TCNFILD, Depth Selection	00	-	00 - 03
30	OBCHA	Observer Characteristic	00:Low	-	00 - 02
31	OBG	Observer Compensation Gain	0	%	0 - 100
32	OBLPF	Observer Output Low-pass Filter	50	Hz	1 - 4000
33	OBNFIL	Observer Output Notch Filter	4000	Hz	100 - 4000

■ General parameters Group3 " Model following control settings"

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

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

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

■ General parameters Group5 "High stabilization control settings"

ID	Symbol	Name	Standard value	Unit	Setting range
00	CVFIL	Command Velocity Low-pass Filter	1000	Hz	1 - 4000
01	CVTH	Command Velocity Threshold	20	min^{-1}	0 - 65535
02	ACCC0	Acceleration Compensation	0	×50 Pulse	-9999 - 9999
03	DECC0	Deceleration Compensation	0	×50 Pulse	-9999 - 9999

■ General parameters Group8 “Control system settings”

ID	Symbol	Name	Standard value	Unit	Setting range
00	CMDPOL	Position, Velocity, Torque Command Input Polarity	00:PC+_VC+ _TC+	-	00 - 07
10	PMOD	Position Command Pulse Selection	00:F-PC_ R-PC	-	00 - 02
11	PCPPOL	Position Command Pulse Count Polarity	00:Type1	-	00 - 03
12	PCPFIL	Position Command Pulse Digital Filter	00:834nsec	-	00 - 07
13	B-GER1	Electronic Gear 1 Numerator	1	-	1 - 2097152
14	A-GER1	Electronic Gear 1 Denominator	1	-	1 - 2097152
15	B-GER2	Electronic Gear 2 Numerator	1	-	1 - 2097152
16	A-GER2	Electronic Gear 2 Denominator	1	-	1 - 2097152
17	EDGEPOS	Positioning Methods	00:Pulse _Interval	-	00 - 01
18	PDEVMON	In-Position Signal/ Position Deviation Monitor	00:After _Filter	-	00 - 01
19	CLR	Deviation Clear Selection	00:Type1	-	00 - 03
27	VCOMSEL	Velocity Compensation Command Input Selection	02:V-COMP	-	01 - 02
28	V-COMP	Preset Velocity Compensation Command	0	min^{-1}	-9999 - 9999
2A	EX-VCFIL	External Velocity Command Filter	4000	Hz	1 - 4000
2B	TVCACC	Velocity Command Acceleration Time Constant	0	ms	0 - 16000
2C	TVCDEC	Velocity Command Deceleration Time Constant	0	ms	0 - 16000
2D	VCLM	Velocity Limit Command	65535	min^{-1}	1 - 65535
30	TCOMSEL	Torque Compensation Command Input Selection	02:T-COMP	-	01 - 02
31	T-COMP1	Preset Torque Compensation Command 1	0.0	%	-500.0 - 500.0
32	T-COMP2	Preset Torque Compensation Command 2	0.0	%	-500.0 - 500.0
35	EX-TCFIL	External Torque Command Filter	4000	Hz	1 - 4000
36	TLSEL	Torque Limit Input Selection	00:TCLM	-	00 - 02
37	TCLM-F	Forward Direction Internal Torque Limit Value	100.0	%	10.0 - 500.0
38	TCLM-R	Reverse Direction Internal Torque Limit Value	100.0	%	10.0 - 500.0
39	SQTCLM	Sequence Operation Torque Limit Value	120.0	%	10.0 - 500.0
3B	TASEL	Torque Attainment select	00	-	00 - 01
3C	TA	Torque attainment	100.0	%	0.0 - 500.0
40	NEAR	Near Range	500	Pulse	1 - 2147483647
41	INP	In-Position Window	100	Pulse	1 - 2147483647
42	ZV	Velocity Zero Range	50	min^{-1}	50 - 500
43	LOWV	Low Velocity Range	50	min^{-1}	0 - 65535
44	VA	Velocity Attainment Setting (High Velocity Range)	1000	min^{-1}	0 - 65535
45	VCMPUS	Velocity Matching Unit Selection	00:min^{-1}	-	00 - 01
46	VCMP	Velocity Matching Range	50	min^{-1}	0 - 65535
47	VCMPR	Velocity Matching Range Ratio	5.0	%	0.0 - 100.0

■ General parameters Group9 “Function enabling condition settings”

ID	Symbol	Name	Standard value	Setting range
00	F-OT	Positive Over Travel Function	0D:CONT6_OFF	00 - 27
01	R-OT	Negative Over Travel Function	0B:CONT5_OFF	00 - 27
02	AL-RST	Alarm Reset Function	10:CONT8_ON	00 - 27
03	ECLR	Encoder Clear Function	06:CONT3_ON	00 - 27
04	CLR	Deviation Clear Function	08:CONT4_ON	00 - 27
05	S-ON	Servo-ON Function	02:CONT1_ON	00 - 27
10	MS	Control Mode Switching Function	00:Always_Disable	00 - 27
11	INH/Z-STP	Position Command Pulse Inhibit Function, Velocity Command Zero Clamp Function	00:Always_Disable	00 - 27
12	GERS	Electronic Gear Switching Function	00:Always_Disable	00 - 27
13	GC1	Gain Switching Condition 1	00:Always_Disable	00 - 27
14	GC2	Gain Switching Condition 2	00:Always_Disable	00 - 27
15	SUPFSEL1	FF Vibration Suppressor Frequency Select Input 1	00:Always_Disable	00 - 27
16	SUPFSEL2	FF Vibration Suppressor Frequency Select Input 2	00:Always_Disable	00 - 27
17	PLPCON	Position Loop Proportional Control Switching Function	01:Always_Enable	00 - 27
18	MDLFSEL1	Model Vibration Suppressor Frequency Select Input 1	00:Always_Disable	00 - 27
19	MDLFSEL2	Model Vibration Suppressor Frequency Select Input 2	00:Always_Disable	00 - 27
27	VLPCON	Velocity Loop Proportional Control Switching Function	04:CONT2_ON	00 - 27
28	V-COMPS	Velocity Compensation Function	00:Always_Disable	00 - 27
30	T-COMPS1	Torque Compensation Function 1	00:Always_Disable	00 - 27
31	T-COMPS2	Torque Compensation Function 2	00:Always_Disable	00 - 27
32	TL	Torque Limit Function	0E:CONT7_ON	00 - 27
33	OBS	Disturbance Observer Function	00:Always_Disable	00 - 27
40	EXT-E	External Trip Input Function	00:Always_Disable	00 - 27
41	DISCHARG	Main Power Discharge Function	01:Always_Enable	00 - 27
42	EMR	Emergency Stop Function	00:Always_Disable	00 - 27

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

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

■ General parameters GroupB “Sequence/Alarms related settings”

ID	Symbol	Name	Standard value	Unit	Setting range
00	JOGVC	JOG Velocity Command	50	min^{-1}	0 - 32767
10	DBOPE	Dynamic Brake Operation	04:SB_Free	-	00 - 05
11	ACTOT	Over-Travel Action	00:CMDINH_ SB_SON	-	00 - 06
12	ACTEMR	Emergency Stop Operation	00:SERVO-BRAKE	-	00 - 01
13	BONDLY	Delay Time of Engaging Holding Brake (Holding Brake Holding Delay Time)	300	ms	0 - 1000
14	BOFFDLY	Delay Time of Releasing Holding Brake (Holding Brake Release Delay Time)	300	ms	0 - 1000
15	BONBGN	Brake Operation Beginning Time	10000	ms	0 - 65535
18	MPESEL	Selects Valid/Invalid of main circuit under-voltage detection	00	-	00 - 01
20	OFWLV	Excessive Deviation Warning Level	2147483647	pulse	1 - 2147483647
21	OFLV	Deviation Counter Overflow Value	5000000	pulse	1 - 2147483647
22	OLWLV	Overload Warning Level	90	%	20 - 100
23	VFBALM	Velocity Feedback Alarm (ALM_C3) Detection	01:Enabled	-	00 - 01
24	VCALM	Velocity Control Alarm (ALM_C2) Detection	00:Disabled	-	00 - 01

* ID10 Dynamic brake operation: If you select “dynamic brake” on servo amplifier without dynamic brake function, please note that the operation when motor stopped becomes free-running.

■ General parameters GroupC “Encoder related settings”

ID	Symbol	Name	Standard value	Unit	Setting range
00	ENFIL	Motor Pulse Encoder Digital Filter	01:220nsec	-	00 - 07
01	EX-ENFIL	External Pulse Encoder Digital Filter	01:220nsec	-	00 - 07
02	EX-ENPOL	External Pulse Encoder Polarity Selection	00:Type1	-	00 - 07
03	PULOUTSEL	Encoder Output Pulse Divide Selection	00:Motor_Enc.	-	00 - 01
04	ENRAT	Encoder Output Pulse Division	1/1	-	1/32768 - 1/1
05	PULOUTPOL	Encoder Output Pulse Divide Polarity	00:Type1	-	00 - 03
06	PULOUTRES	Encoder Output Pulse Divide Resolution Selection	00:32768P/R	-	00 - 01
07	PSOFORM	Encoder Signal Output (PS) Format	00:MOT_Binary	-	00 - 01
08	ECLRFUNC	Encoder Clear Function Selection	00:Status_ MultiTurn	-	00 - 01

5.9 Parameter functions

Each parameter function is explained below.

■ Group0 “Auto-tuning settings”

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="2">00</td><td>Tuning Mode
[TUNMODE]</td><td>Setting range
00 - 02</td><td>Unit
-</td><td>Selection
00:AutoTun</td></tr>
<tr><td colspan="4">■ Set the validity, invalidity of Auto-tuning, and Load inertia moment ratio estimation.

<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>AutoTun</td><td>Automatic Tuning</td></tr>
<tr><td>01</td><td>AutoTun_JRAT-Fix</td><td>Automatic Tuning (JRAT Manual Setting)</td></tr>
<tr><td>02</td><td>ManualTun</td><td>Manual Tuning</td></tr>
</table>
◆ Under the following operating conditions, Load inertia rate is not estimated properly: operation at low velocity, at low acceleration and at low acceleration/deceleration torque. In these cases, please set “Automatic Tuning (JRAT Manual Setting)” and set proper value at JRAT 1.

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

✔ Set to “02 manual tuning” if system parameter ID0A Position Control Selection is set at Model Following Vibration Suppressor Control.</td></tr>
</table>

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

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

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

◆ “Positioning Control 1”
- Used for general purpose positioning.
- Can be used for always affected by gravity and external forces.

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

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

◆ “Positioning Control 4”
- Select this control when machine operates in horizontal axis and is not affected by external forces.
- Positioning settling time may be reduced, compared to positioning control 2.
- Use this control in “position control mode.”
- Do not use this mode in gravity axis or axes being affected by external forces. This selection may cause impacts on machine.

◆ “Positioning Control 5”.
- Select this control when machine operates in horizontal axis and is not affected by external forces, and you would like to manually adjust FFGN.
- Positioning settling time may be reduced, compared to positioning control 3.
- This selection may cause impacts on machine.

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

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

✔ Do not set “ID0A Position Control Selection” to “Model following vibration suppressor control” to use Trajectory control. Trajectory is out of alignment in Model following vibration suppressor control.

ID	Contents			
02	Auto-Tuning Response [ATRES]	Setting range	Unit	Standard value
		1 - 30	-	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 suitable for rigidity of the device.			
10	Auto-Notch Filter Tuning Torque Command [ANFILTC]	Setting range	Unit	Standard value
		10.0 - 100.0	%	50.0
	■ Sets the torque value to excite the mechanical system during operation under “Auto-Notch Filter Tuning.” ✔ Larger value makes the tuning more accurate; however, also makes the movement of the machine greater.			
20	Auto-FF Vibration Suppressor Frequency Tuning Torque Command [ASUPTC]	Setting range	Unit	Standard value
		10.0 - 100.0	%	25.0
	■ Sets the torque value to excite the mechanical system during run time “Auto-FF Vibration Suppressor Frequency Tuning.” ✔ Larger value makes the tuning more accurate; however, also makes the movement of the machine greater.			
21	Auto-FF Vibration Suppressor Frequency Tuning Friction Compensation Value [ASUPFC]	Setting range	Unit	Standard value
		0.0 - 50.0	%	5.0
	■ Sets the friction torque compensation added to the motor torque to excite the mechanical system at the time of Auto-FF Vibration Suppressor Frequency Tuning. ◆ Set this value close to actual friction torque, and vibration suppressor frequency tuning will be more accurate. ✔ Setting low value may cause that the vibration frequency of the mechanical system cannot be detected, or the wrong value is detected. Increase the value until the detected value becomes stable.			

■ Group1 “Basic control parameter settings”

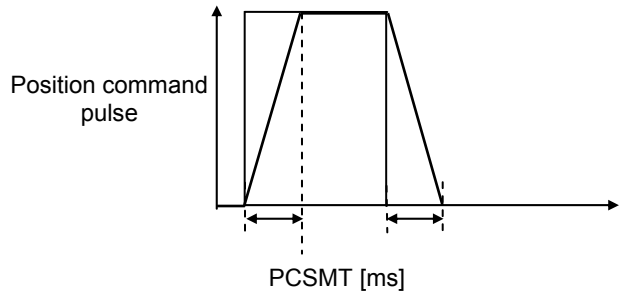
ID	Contents			
	Position Command Smoothing Constant [PCSMT]	Setting range	Unit	Standard value
		0.0 - 500.0	ms	0.0

00

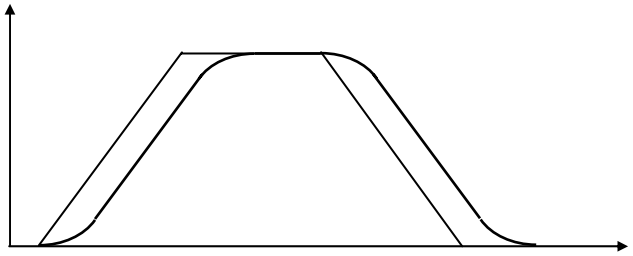
■ This moving low-pass filter smoothes the position command pulse.
Sets time constants.

- ◆ Applies gradient to the step condition positioning pulse.
- ◆ Applies S curve to the lamp condition position command pulse.
- ◆ Smoothes the position command pulse when the electronic gear ratio is greater or the position command pulse is coarse. (This may decrease the operating noise of the servo motor.)
- ◆ Sets the value at “0.3ms and higher”.
- ◆ When the set value is “0.0ms - 0.2ms”, this filter is invalid.
- ◆ Setting shall be in increments of 0.5ms. (When the increment of setting is “0.4ms and less”, there may be cases where the set value cannot be reflected to the operation.)

- ● Position command pulse with step condition applied



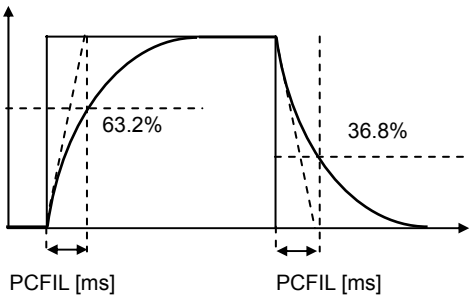
- ● Position command pulse with lamp condition applied.



ID	Contents			
01	Position Command Filter [PCFIL]	Setting range	Unit	Standard value
		0.0 - 2000.0	ms	0.0

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

- ◆ This parameter setting is valid when the value of Group1ID04 Higher Tracking Control Position Compensation Gain is set at 0%.
- ◆ When Higher Tracking Control Position Compensation Gain is 0%, value is set at 0.0ms, the filter becomes invalid.
- ◆ This filter can suppress overshoot caused by the rise of the feed forward compensation gain.



02	Position Loop Proportional Gain 1 [KP1]	Setting range	Unit	Standard value
		1 - 3000	1/s	30

■ Proportional gain for position controller.

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

03	Position Loop Integral Time Constant 1 [TPI1]	Setting range	Unit	Standard value
		0.3 - 1000.0	ms	1000.0

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

- ◆ Integral time is invalid (proportional control) at the setting value 1000.0ms.
- ◆ When Auto-tuning function is valid, this setting value not applied.
- ◆ When Gain switching function is valid, select gain 1 and this setting value is applied.
- ◆ When Gain switching function is invalid, this setting value is applied.

04	Higher Tracking Control Position Compensation Gain [TRCPGN]	Setting range	Unit	Standard value
		0 - 100	%	0

■ Adjusts the performance of command tracking of the position control system.
The larger value can raise command-tracking performance.

- ◆ When a value other than 0% is set, Position Command Filter and Feed Forward Gain are automatically set in the servo amplifier.
- ◆ When Auto-tuning function is valid, this setting value not applied.

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

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

◆ Valid when Higher Tracking Control Position Compensation Gain is set at 0%.
◆ The setting value is not applied when using the Auto-Tuning Characteristics listed below.

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

06	Feed Forward Filter [FFFIL]	Setting range	Unit	Standard value
		1 - 4000	Hz	4000

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

◆ Depending on the setting of the system parameter ID0A Position Control Selection, the point the filter becomes invalid causes the value to vary.

Position Control Selection		Value when the filter is invalid
00	Standard Standard	More than 2000Hz
01	Model 1 Model Following Control	More than 1000Hz
02	Model 2 Model Flowing Vibration Suppress Control	More than 1000Hz

10	Velocity Command Filter [VCFIL]	Setting range	Unit	Standard value
		1 - 4000	Hz	4000

■ First low-pass filter to suppress sudden change of velocity command.
Sets the cutoff frequency.

◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.

Control Cycle		Setting value	Valid/Invalid
00	Standard_Sampling Standard Sampling	1 - 1999Hz	Valid
		2000 - 4000Hz	Filter invalid
01	High-freq_Sampling High Frequency Sampling	1 - 3999Hz	Valid
		4000Hz	Filter invalid

ID	Contents

11 — Velocity Feedback Filter [VDFIL]

Setting range	Unit	Standard value
1 - 4000	Hz	1500

■ First low-pass filter to eliminate ripples caused by encoder pulse included in the velocity control system feedback. Sets the cutoff frequency.

- ◆ When the encoder resolution is low, lowering the setting value and suppressor the ripples can suppress motor drive noise. In addition, when the encoder resolution is high, raising the setting value may improve the response of the velocity control system. For general use, set at the Standard value.
- ◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.

Control Cycle		Setting value	Valid/Invalid
00	Standard_Sampling Standard Sampling	1 - 1999Hz	Valid
		2000 - 4000Hz	Filter invalid
01	High-freq_Sampling High Frequency Sampling	1 - 3999Hz	Valid
		4000Hz	Filter invalid

12 — Velocity Loop Proportional Gain 1 [KVP1]

Setting range	Unit	Standard value
1 - 2000	Hz	50

■ Proportional gain of velocity controller.
When Load Inertia Moment Ratio 1 is same as the actual load inertia moment, this setting value response is performed.

- ◆ Automatically saved by Auto-tuning result saving.
- ◆ When Auto-tuning function is valid, this setting value is not applied.
- ◆ When the Gain switching function is valid, select gain 1 and this setting value is applied.
- ◆ When Auto-tuning is valid, while system analysis function is active, this value is applied.

13 — Velocity Loop Integral Time Constant 1 [TVI1]

Setting range	Unit	Standard value
0.3 - 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 saved by Auto-tuning result saving.
- ◆ When Auto-tuning function is valid, this setting value is not applied.
- ◆ When Gain switching function is valid, select gain 1 and this setting value is applied.
- ◆ When Auto-tuning is valid, while system analysis function is active, this value is applied.

ID	Contents			
14	Load Inertia Moment Ratio 1 [JRAT1]	Setting range	Unit	Standard value
		0 - 15000	%	100

■ Sets inertia moment of the loading device to the servo motor inertia moment.

- ◆ Setting value=J_L/J_M×100%
  J_L: Load inertia moment
  J_M: Motor inertia moment
- ◆ Automatically saved by Auto-tuning result saving.
- ◆ If this value matches the actual mechanical system, setting value of KVP is the response frequency of the velocity control system.
- ◆ When Auto-tuning function is valid, this setting value not applied.
- ◆ Use between the range 100~3000% when driven with Model following vibration suppressor control.
- ◆ When Gain switching function is valid, select gain 1 and this setting value is applied.
- ◆ When Auto-tuning is valid, while system analysis function is active, this value is applied.

15	Higher Tracking Control Velocity Compensation Gain [TRCVGN]	Setting range	Unit	Standard value
		0 - 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 it to 0%.
- ◆ When synchronizing with other axes, set it to 0%.
- ◆ When corresponding with Q series servo amplifier, set it to 100%.
- ◆ When Auto-tuning function is valid, this setting value not applied.
- ◆ The setting value is invalid with Model following control or Model following vibration suppressor control.

16	Acceleration Feedback Gain [AFBK]	Setting range	Unit	Standard value
		-100.0 - 100.0	%	0.0

■ Sets acceleration feedback compensation gain to make the velocity loop stable. Multiply this gain with the detected acceleration to compensate torque command.

- ◆ When Auto-tuning function is valid, this setting value not applied.
- ◆ If the value is too large, the motor may oscillate. Set within range ±15.0% for general use.

17	Acceleration Feedback Filter [AFBFIL]	Setting range	Unit	Standard value
		1 - 4000	Hz	500

■ First low-pass filter to eliminate ripples caused by encoder pulse included in acceleration feedback compensation. Sets the cutoff frequency.

- ◆ Lower this setting value when the encoder resolution is low.
- ◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.

Control Cycle		Setting value	Valid/Invalid
00	Standard_Sampling	1 - 1999Hz	Valid
	Standard Sampling	2000 - 4000Hz	Filter invalid
01	High-freq_Sampling	1 - 3999Hz	Valid
	High Frequency Sampling	4000Hz	Filter invalid

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="2">20</td><td>Torque Command Filter 1
[TCFIL1]</td><td>Setting range
1 - 4000</td><td>Unit
Hz</td><td>Standard value
600</td></tr>
<tr><td colspan="4">■ Low-pass filter to eliminate high frequency component included in the torque command.
Sets cutoff frequency.

◆ Automatically saved by Auto-tuning result saving.
◆ When Auto-tuning function is valid, this setting value is not applied.
◆ When Gain switching function is valid, select gain 1 and this setting value is applied.
◆ When Auto-tuning is valid, while system analysis function is active, this value is applied.
◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle. (Torque command filter cannot be disabled)
<table>
<tr><th colspan="2">Control Cycle</th><th>Control Cycle</th><th>Cutoff frequency</th></tr>
<tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling
Standard Sampling</td><td>1 - 2000Hz</td><td>Same as the setting value</td></tr>
<tr><td>2001 - 4000Hz</td><td>2000Hz</td></tr>
<tr><td>01</td><td>High-freq_Sampling
High Frequency Sampling</td><td>1 - 4000Hz</td><td>Same as the setting value</td></tr>
</table>
Use within 1 - 1000Hz with Model following control.
Use within 100 - 1000Hz with Model following vibration suppressor control.</td></tr>
<tr><td rowspan="2">21</td><td>Torque Command Filter Order
[TCFILOR]</td><td>Setting range
1 - 3</td><td>Unit
Order</td><td>Standard value
2</td></tr>
<tr><td colspan="4">■ Sets order of the torque command filter.
The order is set within the setting range even if the cut off frequency of torque command filter is changed by gain switching.</td></tr>
</table>

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

ID 00

FF Vibration Suppressor Frequency 1 [SUPFRQ1]	Setting range	Unit	Standard value
	5 - 500	Hz	500

■ Sets the frequency of the machine vibration to be suppressed by FF vibration suppressor function.

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

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

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

ID 01

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

■ Sets FF vibration suppressor control effect level.

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

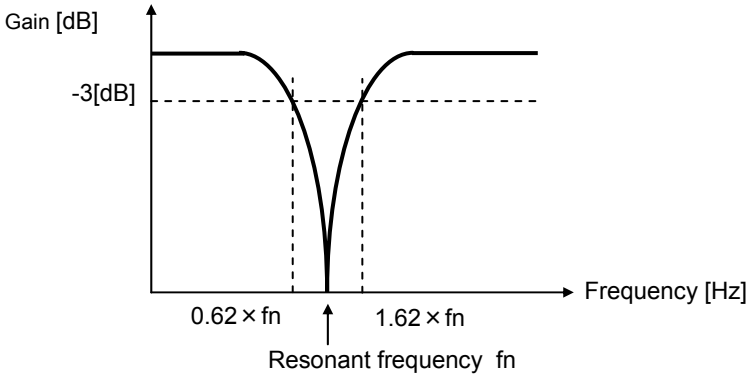
ID 10

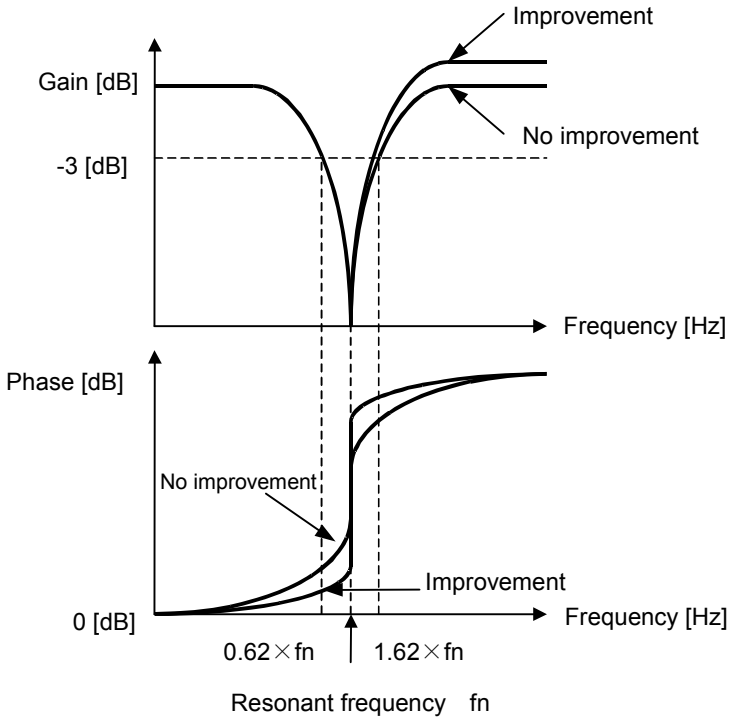
Velocity Command Notch Filter [VCNFIL]	Setting range	Unit	Standard value
	50 - 1000	Hz	1000

■ Notch filter to eliminate frequency element arbitrarily set from velocity command. Sets the resonant frequency.

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

Control Cycle		Setting value	Unit value inside servo amplifier
00	Standard_Sampling Standard Sampling	50 - 99Hz	Valid by 1Hz
		100 - 499Hz	Valid by 5Hz and drop less than 5
		500 - 1000Hz	Filter invalid
01	High-freq_Sampling High Frequency Sampling	50 - 199Hz	Valid by 1Hz
		200 - 999Hz	Valid by 10Hz and drop less than 10
		1000Hz	Filter invalid



<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>20</td><td>
Torque Command Notch Filter A [TCNFILA]
Setting range: 100 - 4000 | Unit: Hz | Standard value: 4000
■ Notch filter to eliminate sympathetic vibration element included in torque command. Sets the resonant frequency.
◆ Setting value varies depending on the setting of the system parameter ID00 Control Cycle. Setting value can be input by 1Hz; inside the servo amplifier, the units listed below are applied.
◆ This parameter is automatically saved by executing Notch filter tuning.
<table>
<tr><th colspan="2">Control Cycle</th><th>Setting value</th><th>Unit value inside servo amplifier</th></tr>
<tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling
Standard Sampling</td><td>100 - 1999Hz</td><td>Valid by 10Hz and drop less than 10</td></tr>
<tr><td>2000 - 4000Hz</td><td>Filter invalid</td></tr>
<tr><td rowspan="2">01</td><td rowspan="2">High-freq_Sampling
High Frequency Sampling</td><td>100 - 3999Hz</td><td>Valid by 10Hz and drop less than 10</td></tr>
<tr><td>4000Hz</td><td>Filter invalid</td></tr>
</table>
</td></tr>
<tr><td>21</td><td>
TCNFILA, Low Frequency Phase Delay Improvement [TCNFPA]
Setting range: 00 - 02 | Unit: - | Standard value: 00
■ Improves phase delay at lower frequency than resonant frequency of the Torque Command Notch Filter A.
◆ The larger the value is, the greater the improvement.
◆ Characteristic is the same as the standard notch filter at the setting value 0.
◆ Caution, other than the setting value 0, higher frequencies than the middle frequency will be amplified.


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

ID	Contents			
22	Torque Command Notch Filter B [TCNFILB]	Setting range	Unit	Standard value
		100 - 4000	Hz	4000
24	Torque Command Notch Filter C [TCNFILC]	Setting range	Unit	Standard value
		100 - 4000	Hz	4000
26	Torque Command Notch Filter D [TCNFILD]	Setting range	Unit	Standard value
		100 - 4000	Hz	4000

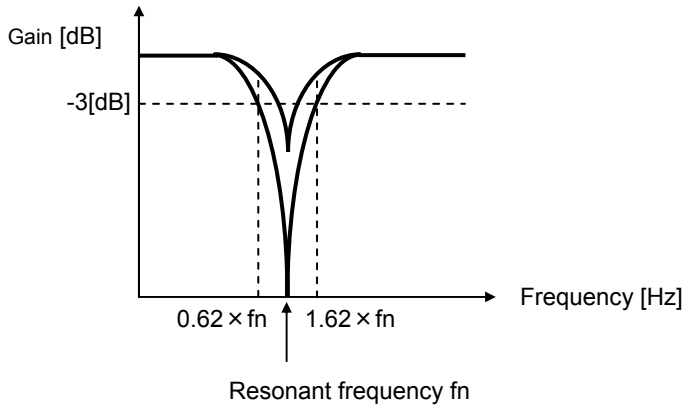
■ Notch filter to eliminate sympathetic vibration element included in torque command. Sets the resonant frequency.

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

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

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

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



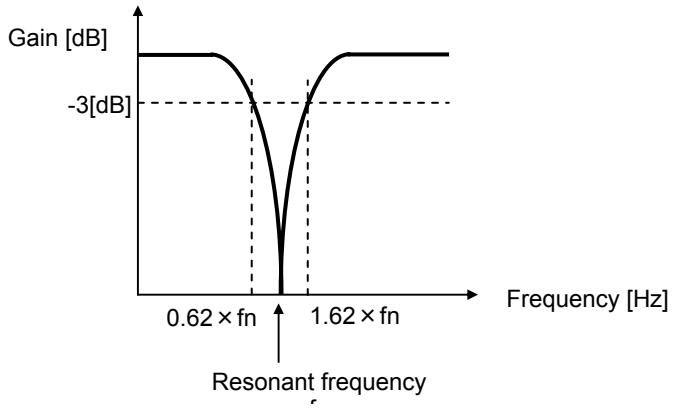
<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>30</td><td>
Observer Characteristic [OBCHA]
Setting range: 00 - 02 | Unit: - | Standard value: 00:Low
■ Select frequency characteristic of the disturbance observer
<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>Low</td><td>For Low Frequency</td></tr>
<tr><td>01</td><td>Middle</td><td>For Middle Frequency</td></tr>
<tr><td>02</td><td>High</td><td>For High Frequency</td></tr>
</table>
◆ Select “00 Low, Low Frequency Disturbance Observer Suppressor” for Load torque monitor (estimate value).
◆ Select 02 High, High Frequency Disturbance Observer Suppressor, when the encoder resolution is over 1048576P/R.
</td></tr>
<tr><td>31</td><td>
Observer Compensation Gain [OBG]
Setting range: 0 - 100 | Unit: % | Standard value: 0
■ Compensation gain for Disturbance Observer.
The larger the value is, the higher the suppression performance. However, if the value is too large, oscillation may sometimes occur.
</td></tr>
<tr><td>32</td><td>
Observer Output Low-pass Filter [OBLPF]
Setting range: 1 - 4000 | Unit: Hz | Standard value: 50
■ First low-pass filter to eliminate high frequency elements included in the observer compensation.
Sets the cutoff frequency.
◆ The larger the value is, the faster the response of disturbance observer suppression. However, it may cause a louder driving sound depending on the ripple components included in disturbance observer output.
◆ Filter is invalid at the setting value more than 2000Hz.
◆ Filter is invalid when observer characteristic is set to [01 Middle, For Middle Frequency], or [02 High, For High Frequency].
</td></tr>
</table>

ID	Contents			
33	Observer Output Notch Filter [OBNFIL]	Setting range	Unit	Standard value
		100 - 4000	Hz	4000

■ Notch filter to eliminate arbitrarily selected frequency from observer compensation.
Sets the resonant frequency.
When resonance appears in disturbance observer output, such as sympathetic vibration with the mechanical system, this notch filter sometimes suppresses the vibration.

◆ Setting value can be input by 1Hz; inside the servo amplifier, the units listed below are applied.

Setting value	Unit value inside servo amplifier
100 - 1999Hz	Valid by 10Hz and drop less than 10
2000 - 4000Hz	Filter invalid



■ Group3 “Model following control settings”

ID	Contents			
00	Model Control Gain 1 [KM1]	Setting range	Unit	Standard value
		1 - 3000	1/s	30
	■ Proportional gain for model position controller. ◆ Set within the range of 15 - 315 (1/s) when operating with Model following vibration suppressor control. ◆ Automatically saved by Auto-tuning result saving. ◆ When the Gain switching function is valid, select gain 1 and this setting value is applied. ◆ Change value while the servo motor is OFF.			
01	Overshoot Suppressor Filter [OSSFIL]	Setting range	Unit	Standard value
		1 - 4000	Hz	1500
	■ Filter to suppress overshoot with Model following control or Model following vibration suppressor control. Sets cutoff frequency. ◆ Lower the setting value when overshoot occurs on position deviation. ◆ Filter is invalid at the setting value more than 2000Hz.			
02	Model Control Antiresonance Frequency 1 [ANRFRQ1]	Setting range	Unit	Standard value
		10.0 - 80.0	Hz	80.0
	■ Sets antiresonance frequency to the mechanical device with Model following vibration suppressor control. Sets actual antiresonance frequency value of the mechanical system by using System Analysis function of the Setup software. ◆ Setting value is invalid with following control. ◆ If the sitting value is over the Model Control Resonance Frequency, vibration suppressor control is invalid. ◆ Change value while the servo motor is OFF.			
03	Model Control Resonance Frequency 1 [RESFRQ1]	Setting range	Unit	Standard value
		10.0 - 80.0	Hz	80.0
	■ Sets resonance frequency of the mechanical device with Model following vibration suppressor control. Sets actual resonance frequency value of the mechanical system by using System Analysis function of the Setup software. ◆ Setting value is invalid with Model following control. ◆ Vibration suppressor control becomes invalid at the setting value 80.0Hz. ◆ Change value while the servo motor is OFF.			

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

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

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

ID	Contents			
04	Velocity Loop Integral Time Constant 2 [TVI2]	Setting range	Unit	Standard value
		0.3 - 1000.0	ms	20.0
14	Velocity Loop Integral Time Constant 3 [TVI3]	Setting range	Unit	Standard value
		0.3 - 1000.0	ms	20.0
24	Velocity Loop Integral Time Constant 4 [TVI4]	Setting range	Unit	Standard value
		0.3 - 1000.0	ms	20.0
	■ Integral time constant for velocity controller. Select from gain switching function 1 and 2. ◆ This parameter is not covered by Auto-tuning result saving. ◆ This setting is valid when Velocity Loop Proportional Control Switching Function is invalid. ◆ Integral time is invalid (proportional control) with the setting value 1000.0ms.			
05	Load Inertia Moment Ratio 2 [JRAT2]	Setting range	Unit	Standard value
		0 - 15000	%	100
15	Load Inertia Moment Ratio 3 [JRAT3]	Setting range	Unit	Standard value
		0 - 15000	%	100
25	Load Inertia Moment Ratio 4 [JRAT4]	Setting range	Unit	Standard value
		0 - 15000	%	100
	■ Sets inertia moment of load device to the servo motor inertia moment. Select from Gain switching function 1 or 2. ◆ If this value matches the actual mechanical system, the setting value corresponding to Velocity Loop Proportional Gain (KVP2, KVP3, and KVP4) is response frequency of the velocity control system. ◆ This parameter is not covered by Auto-Tuning Automatic Parameter Saving function. ◆ Setting value=J_L/J_M×100% ● J_L: Load inertia moment ● J_M: Motor inertia moment			
06	Torque Command Filter 2 [TCFIL2]	Setting range	Unit	Standard value
		1 - 4000	Hz	600
16	Torque Command Filter 3 [TCFIL3]	Setting range	Unit	Standard value
		1 - 4000	%	600
26	Torque Command Filter 4 [TCFIL4]	Setting range	Unit	Standard value
		1 - 4000	%	600

■ Low-pass filter to eliminate high frequency element included in torque command. Select from gain switching function 1 or 2. Sets cutoff frequency.

◆ This parameter is not covered by Auto-tuning result saving.
◆ Setting range varies depending on the setting of system parameter ID00 Control Cycle. (Torque command filter cannot be disabled.)

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

ID	Contents			
30	Gain Switching Filter [GCFIL]	Setting range	Unit	Standard value
		0 - 100	ms	0
	■ Low-pass filter to change gain moderately when switching. Sets time constant. ◆ When the mechanical system is shocked by the change of gain resulted from gain switching, making a moderate gain change will modify the shock. ◆ The larger the value, the gentler the gain changes.			
40	FF Vibration Suppressor Frequency 2 [SUPFRQ2]	Setting range	Unit	Standard value
		5 - 500	Hz	500
41	FF Vibration Suppressor Frequency 3 [SUPFRQ3]	Setting range	Unit	Standard value
		5 - 500	Hz	500
42	FF Vibration Suppressor Frequency 4 [SUPFRQ4]	Setting range	Unit	Standard value
		5 - 500	Hz	500
	■ Sets mechanical vibration frequency to be suppressed with this function. Select from FF vibration suppressor frequency selection 1 or 2. ◆ Change value while the servo motor is OFF. ◆ This parameter is not covered by Auto-tuning result saving. ◆ Setting value can be input by 1Hz; inside the servo amplifier, the units listed below are applied.			

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

50	Model Control Antiresonance Frequency 2 [ANRFRQ2]	Setting range	Unit	Standard value
		10.0 - 80.0	Hz	80.0
52	Model Control Antiresonance Frequency 3 [ANRFRQ3]	Setting range	Unit	Standard value
		10.0 - 80.0	Hz	80.0
54	Model Control Antiresonance Frequency 4 [ANRFRQ4]	Setting range	Unit	Standard value
		10.0 - 80.0	Hz	80.0
	■ Sets antiresonance frequency of the mechanical device with Model following vibration suppressor control. Select from Model Vibration Suppressor Frequency Select Input 1 or 2. ◆ Setting value is invalid with Model following control. ◆ Vibration suppressor is invalid when it is set over the value of Model Control Resonance Frequency. ◆ Setting by using system analysis function is not available. ◆ Change value while the servo motor is OFF.			
51	Model Control Resonance Frequency 2 [RESFRQ2]	Setting range	Unit	Standard value
		10.0 - 80.0	Hz	80.0
53	Model Control Resonance Frequency 3 [RESFRQ3]	Setting range	Unit	Standard value
		10.0 - 80.0	Hz	80.0
55	Model Control Resonance Frequency 4 [RESFRQ4]	Setting range	Unit	Standard value
		10.0 - 80.0	Hz	80.0
	■ Sets resonance frequency of the mechanical device with Model following vibration suppressor control. Select from Model Vibration Suppressor Frequency Select Input 1 or 2. ◆ Setting value is invalid under Model following control. ◆ Vibration suppressor control becomes invalid at the setting value 80.0Hz. ◆ Setting by using system analysis function is not available. ◆ Change value while the servo motor is OFF.			

■ Group5 “High setting control settings”

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>00</td><td>
<table>
<tr><td>Command Velocity Low-pass Filter
[CVFIL]</td><td>Setting range
1 - 4000</td><td>Unit
Hz</td><td>Standard value
1000</td></tr>
</table>
■ First low-pass filter to eliminate high frequency elements such as ripples included in the velocity (command velocity) calculated from position command pulse inside high setting control. Sets cutoff frequency.

◆ Lower the cutoff frequency when the encoder resolution is low.
◆ Filter is invalid at setting the value more then 2000Hz.
</td></tr>
<tr><td>01</td><td>
<table>
<tr><td>Command Velocity Threshold
[CVTH]</td><td>Setting range
0 - 65535</td><td>Unit
min^{-1}</td><td>Standard value
20</td></tr>
</table>
■ Sets velocity threshold value to make high setting control compensation (Acceleration Compensation and Deceleration Compensation) valid.

◆ Acceleration Compensation or Deceleration Compensation is done when velocity (command velocity) calculated from the position command pulse reaches this value.
</td></tr>
<tr><td>02</td><td>
<table>
<tr><td>Acceleration Compensation
[ACCCO]</td><td>Setting range
-9999 - 9999</td><td>Unit
×50 Pulse</td><td>Standard value
0</td></tr>
</table>
■ Sets Acceleration Compensation value with high setting control.

◆ Sets at position deviation pulse unit (encoder resolution unit x4 with pulse encoder)
◆ Compensates to position deviation.
◆ The larger the setting value, the greater the compensation value.
◆ The larger the acceleration value calculated from position command pulse, compensation value increases.
◆ The larger the Load inertia moment, the greater the compensation value is.
◆ Position deviation decreases with high setting control.
◆ The setting value is invalid with Model following control or Model following vibration suppressor control.
</td></tr>
<tr><td>03</td><td>
<table>
<tr><td>Deceleration Compensation
[DECCO]</td><td>Setting range
-9999 - 9999</td><td>Unit
×50 Pulse</td><td>Standard value
0</td></tr>
</table>
■ Sets Deceleration Compensation value with high setting control.

◆ The setting is in units of position deviation pulse (for pulse encoder, in units of encoder resolution 4-multiplied).
◆ Compensation is performed for position deviation.
◆ The higher the set value, the larger the compensation amount.
◆ The bigger the acceleration converted from position command pulse, the larger the compensation amount.
◆ The bigger the load inertia moment, the larger the compensation amount.
◆ Position deviation decreases by high settling.
◆ This setting value is not reflected in “model following control” or “model following vibration suppression control.”
</td></tr>
</table>

■ Group8 “Control system settings”

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

■ Select the combination of each command polarity for position command pulse from the list below.

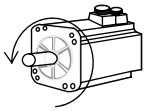
◆ Rotating direction of the servo motor can be reversed without changing the command wiring.

◆ Rotating direction with positive (+) polarity command supply according to the setting value is shown below.

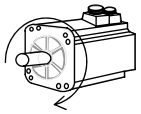
Selection		Polarity	Position Command Pulse (PCMD)
00	PC+_VC+_TC+	+	Forward
01	PC+_VC+_TC-	+	Forward
02	PC+_VC-_TC+	+	Forward
03	PC+_VC-_TC-	+	Forward
04	PC-_VC+_TC+	+	Reverse
05	PC-_VC+_TC-	+	Reverse
06	PC-_VC-_TC+	+	Reverse
07	PC-_VC-_TC-	+	Reverse

◆ Command input polarity is at standard setting value「00:PC+_VC+_TC+」

Forward rotation with (+) polarity command (CCW)

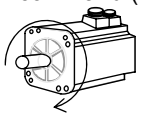


Reverse rotation with (-) polarity command (CW)

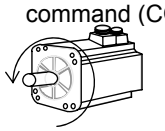


◆ Command input polarity change「07:PC-_VC-_TC-」

Reverse rotation with (+) polarity command (CW)



Forward rotation with (-) polarity command (CCW)



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

■ Set the Position control command pulse type.

◆ Select from below to match with the upper device specifications.

Selection		Contents
00	F-PC_R-PC	Forward Rotation (Positive) Pulse + Reverse Rotation (Negative) Pulse
01	PC-A_PC-B	Two-phase Pulse Train of 90° Phase Difference
02	SIGN_PULS	Code + Pulse Train

◆ Connect position command pulse to CN1 pin listed below:

Forward rotation	Reverse rotation
Forward pulse (F-PC) : CN1A-11	Reverse pulse (R-PC): CN1A-13
Forward pulse ($\overline{\text{F-PC}}$) : CN1A-12	Reverse pulse ($\overline{\text{R-PC}}$): CN1A-14
Forward pulse SG : CN1A-10	Reverse pulse SG: CN1A-10

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

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

■ Select the Position Command Pulse Count Polarity from the list below:

◆ Select to match with the upper device.

Selection		Contents
00	Type1	F-PC: not reversed R-PC: not reversed
01	Type2	F-PC: reversed R-PC: not reversed
02	Type3	F-PC: not reversed R-PC: reversed
03	Type4	F-PC: reversed R-PC: reversed

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

■ Filter to eliminate noise elements included in the Position command pulse.

◆ Select from the following list:

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

■ When the Position command pulse width becomes less that the setting values of the Digital filter, the status becomes Alarm Code D2 (Position command pulse frequency error 1). Set Digital filter setting value smaller than that of Pulse width at maximum command frequency.

■ Refer to [Input command, Position output signal, General input signal, General output signal (2-7)] for the specification of the command pulse.

ID	Contents			
13	Electronic Gear 1 Numerator [B-GER1]	Setting range	Unit	Standard value
		1 - 2097152	-	1
14	Electronic Gear 1 Denominator [A-GER1]	Setting range	Unit	Standard value
		1 - 2097152	-	1
15	Electronic Gear 2 Numerator [B-GER2]	Setting range	Unit	Standard value
		1 - 2097152	-	1
16	Electronic Gear 2 Denominator [A-GER2]	Setting range	Unit	Standard value
		1 - 2097152	-	1

■ Sets the Electronic gear ratio to position command pulse.

- ◆ Either electronic gear1 or 2 is selectable by setting 2 kinds of electronic gear ratio.
- ◆ If position command pulses are the same, rotational velocity and travel distance can be changed by changing gear ratio.

$$f1 \longrightarrow \boxed{\frac{B\ (1\ -\ 2097152)}{A\ (1\ -\ 2097152)} \qquad 1/2^{21} \leqq B/A \leqq 2^{21}} \longrightarrow f2\ (f2 = f1 \times B/A)$$

■ Example 1. Changing the Position command pulse the unit to the feed shaft with ball screw.

Use serial encoder, 131072[P/R] , decide the position of the lead 10[mm] ball screw. To calculate by 1μm unit, use the calculation formula below and calculate the Electronic gear ratio numerator and denominator:

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

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

■ Example 2. When the encoder resolution is changed by the motor exchange.

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

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

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

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

■ Example 3. To bypass the frequency constraint of Position command pulse.

In case you operate a servomotor with 131072 [P/R] resolution of serial encoder at 6000 [min^{-1}] using a controller having maximum frequency of 600 [kpps] (600K pps), use the following formula to get the value of the numerator and the denominator of the electric gearing.

◆ Position command pulse frequency at the encoder resolution
= 131072[P/R] × 6000[min-1]/60 = 13107.2[kpps]

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

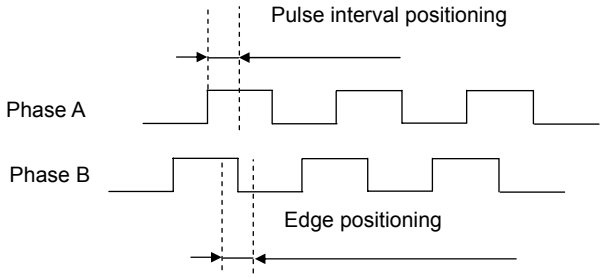
Thus, Electronic gear numerator = 8192, Electronic gear denominator = 375.
(Setting value of numerator = 131072, denominator = 6000 are fine as they are within the setting range of Electronic gear.)
By setting this Electronic gear numerator, denominator, the motor rotation velocity is 6000[min^{-1}]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

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

■ Select the Encoder pulse positioning.

◆ Positioning accuracy is improved by selecting Edge positioning when the encoder resolution is coarse. However, this may cause the driving sound of the mechanical system to increase as this edge is always the center of vibration.
◆ Select standard value for usual operation.

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

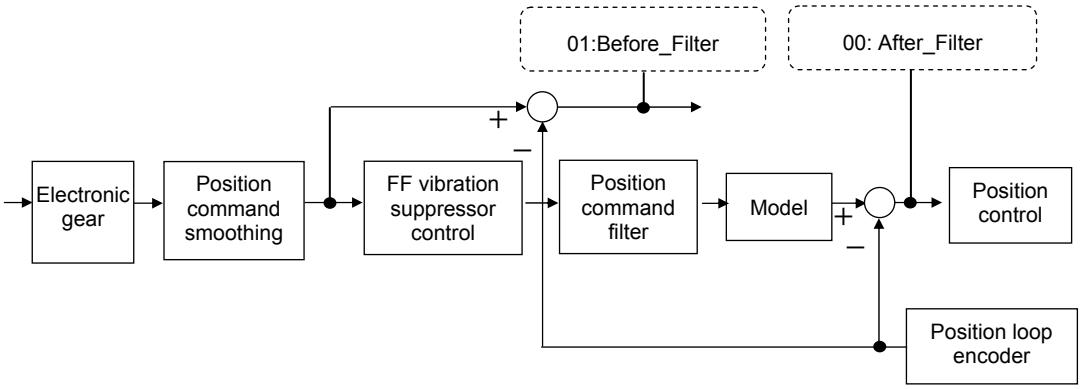


ID	Contents			
18	In-Position Signal/ Position Deviation Monitor [PDEVMON]	Setting range 00 - 01	Unit -	Standard value 00:After_Filter

■ Select in-position signal (INP) and Position deviation monitor output before and after passing through the Position Command Filter.

◆ For 00 After_Filter, use the Position deviation value of the Position controller.
◆ For 01 Before_Filter, use the Position deviation value based on Position command before FF vibration suppressor control.
◆ With system parameter ID0A Position Control Selection at 01 Model 1 Model Following Control, or 02 Model 2 Model Following Vibration Suppress Control, 01: Before_Filter always operates no matter the selection.

Selection		Contents
00	After_Filter	Compare Position command value with Feedback value after passing through the filter.
01	Before_Filter	Compare Position command value with Feedback value before passing through the filter.



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

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

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

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

ID	Contents			
27	Velocity Compensation Command Input Selection [VCOMSEL]	Setting range	Unit	Standard value
		02	-	02:V-COMP

■ Select Velocity compensation command input.

Selection		Contents
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	Standard value
		-9999 - 9999	min^{-1}	0

■ Sets the Velocity in a fixed compensation command value with Velocity Compensation Function.

2A	External Velocity Command Filter [EX-VCFIL]	Setting range	Unit	Standard value
		1 - 4000	Hz	4000

■ This is the first-order low-pass filter of velocity (addition) command.

- ◆ Sets cutoff frequency.
- ◆ This filter acts on JOG velocity command and velocity addition command.
- ◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.

Control Cycle		Setting Value	Filter Valid/invalid
00	Standard_Sampling Standard Sampling	1 - 1999Hz	Valid
		2000 - 4000Hz	Filter Invalid
01	High-freq_Sampling High Frequency Sampling	1 - 3999Hz	Valid
		4000Hz	Filter Invalid

■ About Velocity Compensation Function
Velocity Compensation Function is a Feed forward function for the Velocity control system.

- ◆ Set preset velocity compensation command

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

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

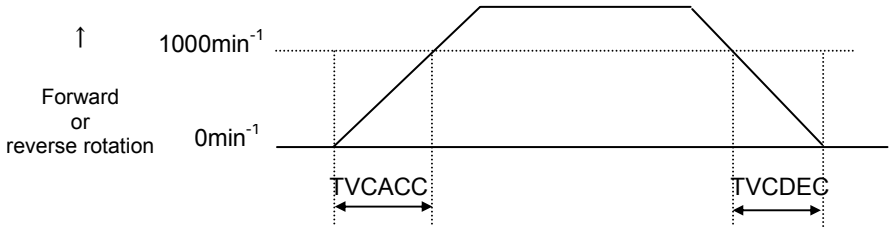
Group	ID	Symbol	Contents
9	28	VCOMPS	Velocity Compensation Function

ID	Contents			
2B	Velocity Command Acceleration Time Constant [TVCACC]	Setting range	Unit	Standard value
		0 - 16000	ms	0
2C	Velocity Command Deceleration Time Constant [TVCDEC]	Setting range	Unit	Standard value
		0 - 16000	ms	0

■ These are parameters to limit acceleration and deceleration commands given to internal velocity addition and JOG operation.

Acceleration: 0 min^{-1} → forward, reverse rotation
Deceleration: forward, reverse rotation → 0 min^{-1}
Sets acceleration, deceleration per 1000 min^{-1}.

■ With Velocity command acceleration, deceleration time constant, and Step input velocity, the command can be accelerated or decelerated.

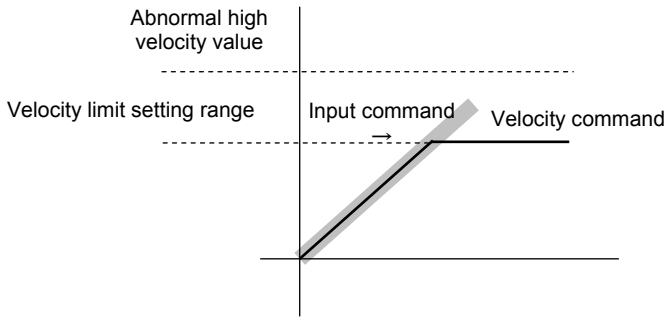


	Velocity Limit Command [VCLM]	Setting range	Unit	Standard value
2D		1 - 65535	min^{-1}	65535

■ Set this parameter to limit velocity command.

- ◆ Sets the maximum value of velocity command.
- ◆ This set value limits velocity command.
- ◆ At the setting value 50000 or more, velocity command is restricted at maximum velocity of the combined motor x 1.1.

Set this parameter to limit motor rotational velocity to *1.1 times maximum motor rotational velocity or less*. Use the standard value for normal use.



ID 30

Torque Compensation Command Input Selection [TCOMSEL]	Setting range	Unit	Standard value
	02	-	02:T-COMP

■ Select Torque compensation command input from the list below:

Selection		Contents
02	T-COMP	When Torque compensation function in valid, Preset torque compensation command 1 or 2 is used.

ID 31

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

■ Parameter for using Torque Compensation Function 1 (T-COMPS1) at a fixed value.

◆ When Torque Compensation Command Input Selection is set at 02: T-COMP, the value is added to the Torque command.

ID 32

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

■ Parameter for using Torque Compensation Function 2 (T-COMPS2) at a fixed value.

◆ When Torque Compensation Command Input Selection is set at 02: T-COMP, the value is added to the Torque command.

ID 35

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

■ This is primary low-pass filter to eliminate noise elements from Analog torque (compensation) command.

◆ Sets Cutoff frequency.
◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.

Control Cycle		Setting value	Filter Valid/Invalid
00	Standard_Sampling Standard Sampling	1 - 1999Hz	Valid
		2000 - 4000Hz	Filter invalid
01	High-freq_Sampling High Frequency Sampling	1 - 3999Hz	Valid
		4000Hz	Filter invalid

■ About Torque Compensation Function:
The Torque Compensation Function is a feed forward function for the Torque control system.

◆ Sets Preset Torque Compensation Command Value

Group	ID	Symbol	Contents
8	31	T-COMP1	Preset Torque Compensation Command 1
8	32	T-COMP2	Preset Torque Compensation Command 2

◆ Sets the condition to set Torque Compensation Function Valid

Group	ID	Symbol	Contents
9	30	T-COMPS1	Torque Compensation Function 1
9	31	T-COMPS2	Torque Compensation Function 2

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

■ Only internal torque limit in limit value input system can be used when torque command limit function-enabled.

Selection		Contents	
00	TCLM	Use internal torque limit value Forward side/TCLM-F Reverse side/TCLM-R	Forward side (forward direction): Limited at Forward Direction Internal Torque Limit Value. Reverse side (reverse direction): Limited at Reverse Direction Internal Torque Limit Value.

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

■ Limits the Torque output at the setting value when Preset torque limit value is valid.

- ◆ Limits the torque by the ratio for the torque rating (100.0%= torque rating)
- ◆ When the Torque Limit Function (TL) is valid, the torque output is limited by the Preset torque limit setting value appropriate to the polarity of the Torque command.
- ◆ When the value is set exceeding the Maximum Instant Stall Torque (T_P) of the combining servo motor, it is limited by the Maximum Instant Stall Torque (T_P) of the combining servo motor.

■ About torque limit function

- ● Restricts the maximum output torque by sing preset torque limit.

Group	ID	Symbol	Contents
8	36	TLSEL	Torque Limit Input Selection

Setting value		Contents
00	TCLM	Use preset torque limit value Forward side/TCLM-F Reverse side/TCLM-R

- ● Sets torque limit value.

Group	ID	Symbol	Contents
8	37	TCLM-F	Forward Direction Internal Torque Limit Value
8	38	TCLM-R	Reverse Direction Internal Torque Limit Value

- ● Sets torque limit function ON

Group	ID	Symbol	Contents
9	32	TL	Torque Limit Function

Selects to set the Torque function valid.
While the Torque limit function is valid, restricts torque.

- ✔ Set in consideration of acceleration/deceleration time. Setting the value too low causes insufficient acceleration/deceleration torque, and this disables normal control.
- ✔ Set as follows: internal torque limit value > |acceleration/deceleration torque|
- ✔ Internal torque limit value can be set depending on forward /reverse rotation respectively.

39	Sequence Operation Torque Limit Value [SQTCLM]	Setting range	Unit	Standard value
		10.0 - 500.0	%	120.0

■ Limits output torque at sequence operation.

- ◆ Sets the limiting torque by the ratio of rated output torque. (100.0%=rated torque)
- ◆ When the value is set exceeding the Maximum instant stall torque (T_P) of the combining servo motor, it is limited by the Maximum instant stall torque (T_P) of the combining servo motor.
- ◆ During the sequence operation, Torque limit corresponds to JOG Operation, Over-Travel Action, Holding brake stand-by time, and Servo brake action.

ID	Contents			
3B	Torque attainment function selection [TASEL]	Setting range	Unit	Standard value
		00 - 01	-	00

■ Selects torque attainment setting method.

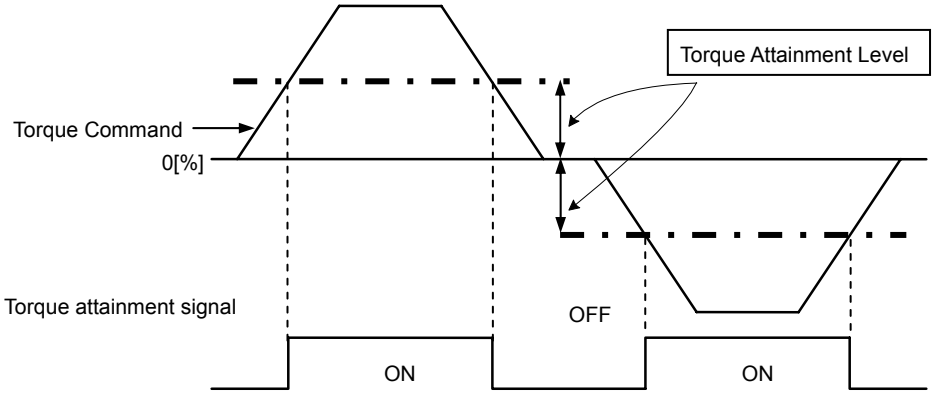
Selection		Contents
00	TA/TR	Sets percentage to rated torque. (100% for rated torque)
01	TA/TCLM	Sets percentage to torque limit value.

3C	Torque attainment setting [TA]	Setting range	Unit	Standard value
		0.0 - 500.0	%	100.0

■ Sets ratio of torque attainment

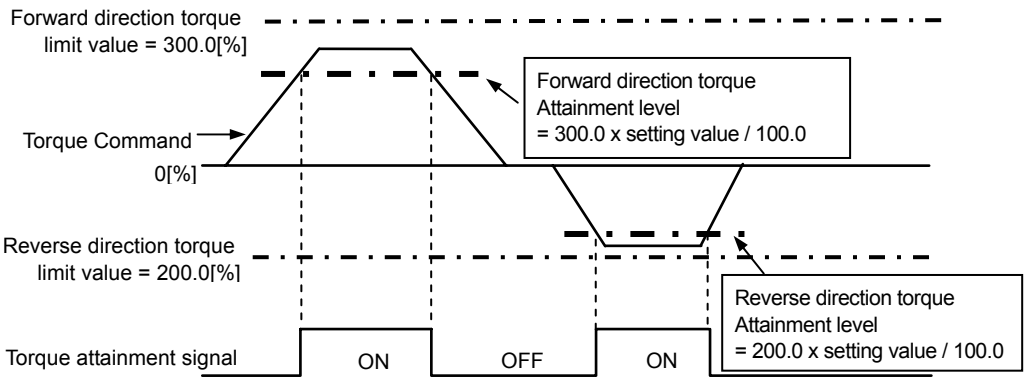
◆ Data corresponding to the ratio set in this parameter vary depending on torque attainment function selection (Group8-3B).

◆ [Torque attainment function selection: 00]
Sets ratio to rated torque. [100%]
Torque attainment signal is output when torque command value exceeds the set value.



◆ [Torque attainment function selection: 01]
Sets ratio to torque limit value. Torque attainment level is calculated according to the following formula.
Torque attainment level = Torque limit value x set value / 100.0 [%]

When torque command value exceeds the torque attainment level as calculated by the above, torque attainment signal is output. When the value exceeding 100.0 [%] is set, this shall be limited to 100.0[%]. When normal and reverse rotation torque limit value is different, torque attainment level shall be set according to each torque limit value.



ID 40

Near Range [NEAR]	Setting range	Unit	Standard value
	1 - 2147483647	Pulse	500

■ Sets the output range of near range (near in-position) signal.

◆ Outputs Near range signal when the Position deviation counter is set lower that this set value.
◆ Sets at the resolution of the encoder pulse at any Electronic gear. (Not the Position command pulse resolution.)

■ Generally, near range signal is used as auxiliary of In-position signal. For example, by setting this value larger than the range of In-position, it can receive the NEAR signal before the upper device receives the In-position signal (INP), thus when In-position the necessary action can smoothly be accomplished.

◆ Sets Near range signal output

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

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

ID 41

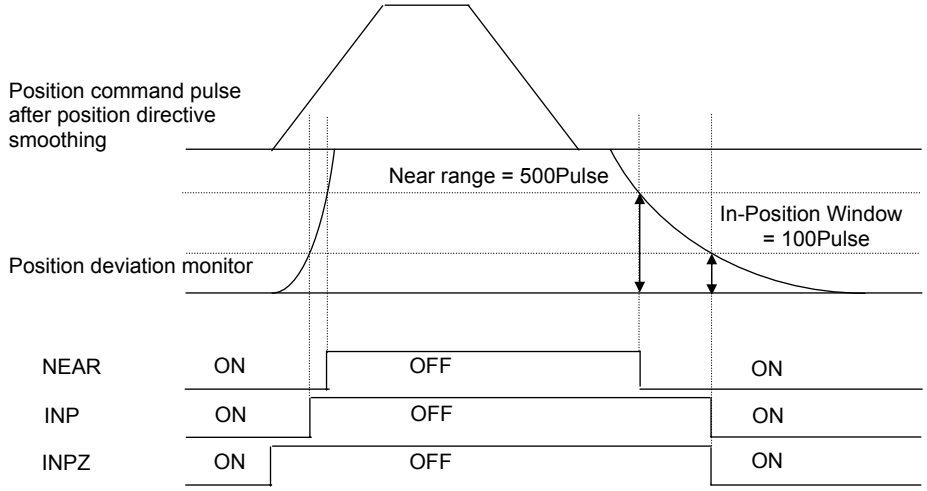
In-Position Window [INP]	Setting range	Unit	Standard value
	1 - 2147483647	Pulse	100

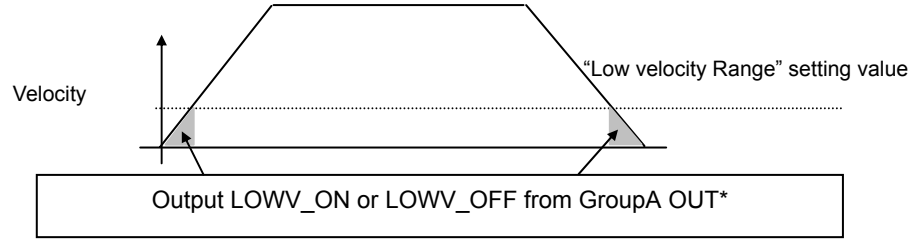
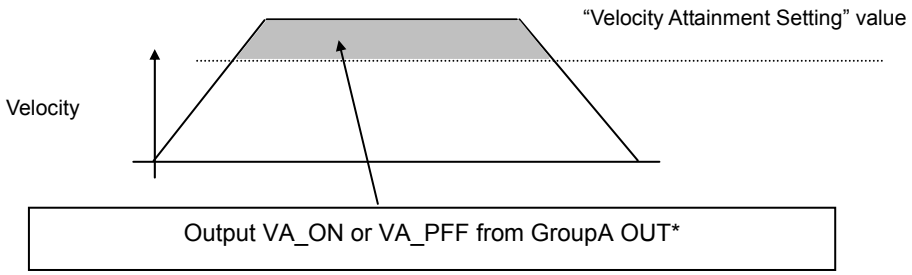
■ Sets output range of In-position signal.

◆ Outputs signal when the Deviation counter value is lower than the setting value.
◆ Sets at the resolution of the encoder pulse at any Electronic gear. (Not the Position command pulse resolution.)
◆ When the Position deviation of the servo motor is lower than the setting value with Position control mode, the signal is output from the Output terminal where the In-position signal is selected.
◆ Sets In-position signal output

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

Selection		Contents
18	INP_ON	In-Position Status, Output ON
19	INP_OFF	In-Position Status, Output OFF

ID	Contents
	 ◆ INPZ is a state signal turned on when the position directive pulse after position directive smoothing is 0 and a position deviation counter value is below setting of the completion range of positioning.

ID	Contents			
42	Velocity Zero Range [ZV]	Setting range: 50 - 500	Unit: min^{-1}	Standard value: 50
	■ Setting value for detecting Zero-velocity status (motor stop). ◆ When the velocity becomes lower than this value, Zero-velocity status is out.			
43	Low Velocity Range [LOWV]	Setting range: 0 - 65535	Unit: min^{-1}	Standard value: 50
	■ Parameter for setting Low velocity output range. ◆ When the velocity is lower than this value, Low velocity range is output. 			
44	Velocity Attainment Setting (High Velocity Range) [VA]	Setting range: 0 - 65535	Unit: min^{-1}	Standard value: 1000
	■ Parameters for setting velocity attainment output range. ◆ When the velocity exceeds this setting value, Velocity attainment is output. ◆ When switched to torque control mode by using control mode switching function, simplified velocity control is performed by this parameter. (When "control mode switching function (MS)" is enabled after setting "03:Velo-Torq" or "04: Posi-Torq" in system parameter ID09 "control mode selection.") Provided that when motor velocity is over this set value, control at constant velocity is not available as torque command is forcedly set to zero. Do not operate under these circumstances continuously. 			

ID 45

Velocity Matching Unit Selection [VCMPUS]	Setting range	Unit	Standard value
	00 - 01	-	00:min^{-1}

■ Selects Velocity Matching Unit setting method.

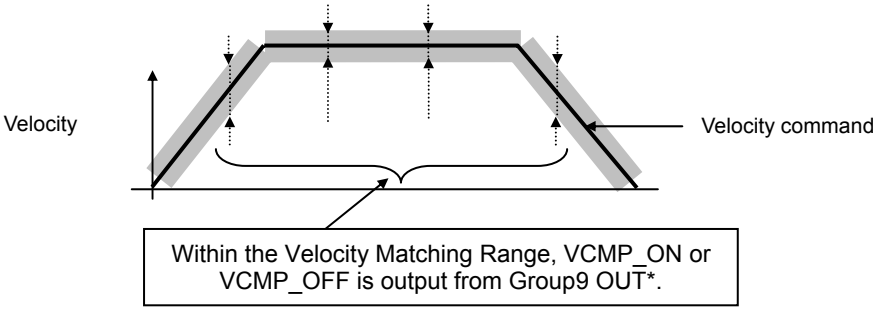
Selection		Contents
00	min^{-1}	Sets by unit [min^{-1}] Uses the setting value of ID46 [VCMP] Velocity Matching Range
01	Percent	Sets the ratio to velocity command by [%] unit Uses the setting value of ID47 [VCMPR] Velocity Matching Range Ratio

ID 46

Velocity Matching Range [VCMP]	Setting range	Unit	Standard value
	0 - 65535	min^{-1}	50

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

- ◆ Use this setting value when ID45 [VCMPUS] Velocity Matching Unit Selection is「00 min^{-1}」.
- ◆ Velocity matching is output when the Velocity deviation (difference between the velocity command and actual velocity) is within this setting range.

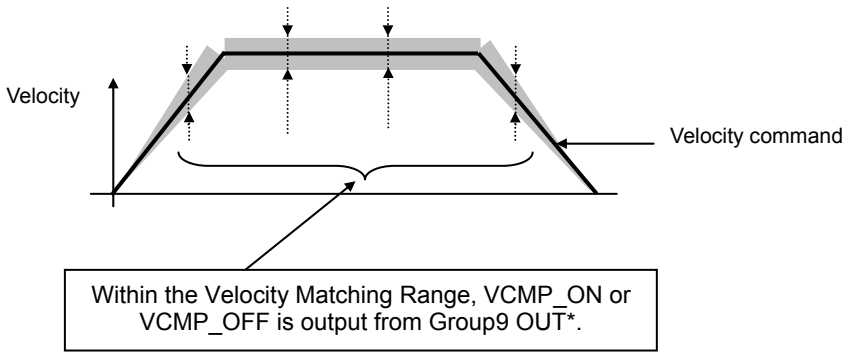


ID 47

Velocity Matching Range Ratio [VCMPR]	Setting range	Unit	Standard value
	0.0 - 100.0	%	5.0

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

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



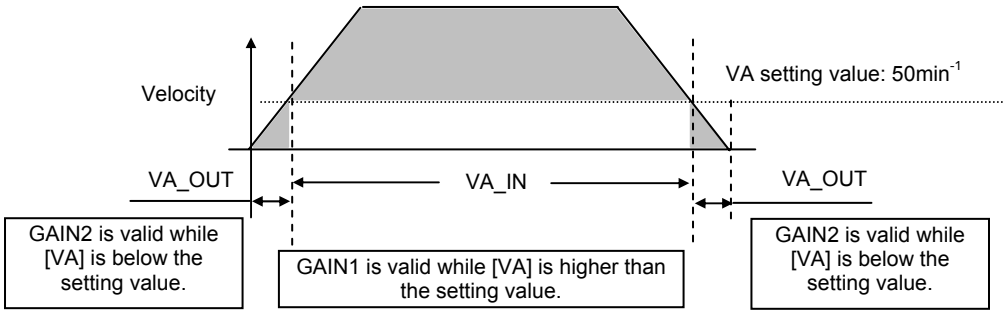
■ By combining with Group9, Condition Settings for Enabling Functions, the functions of Group9 are valid for ID42 - ID47.

Selection		Contents
12	LOWV_IN	Function is valid during low velocity status (velocity is lower than the LOWV Setting Value).
13	LOWV_OUT	Function is valid during not low velocity status (velocity is lower than the LOWV Setting Value).
14	VA_IN	Function is valid during velocity attainment status (velocity is higher than the VA Setting Value).
15	VA_OUT	Function is valid during not velocity attainment status (velocity is higher than the VA Setting Value).
16	VCMP_IN	Function is valid during velocity matching status (velocity is lower than Velocity Matching Range).
17	VCMP_OUT	Function is valid during not velocity matching status (velocity is lower than Velocity Matching Range)
18	ZV_IN	Function is valid during zero velocity status (velocity is lower than the ZV Setting Value)
19	ZV_OUT	Function is valid during zero velocity status (velocity is lower than the ZV Setting Value)

✔ Range that actual velocity is coincident with the commanded one is based on setting of “Group8 ID45, ID47.”

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

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



■ Group9 “Functions enabling condition settings”

ID	Contents	Setting range	Standard value	Maximum input time when function-enabled
00	Positive Over Travel Function [F-OT]	00 - 27	0D:CONT6_OFF	20ms
01	Negative Over Travel Function [R-OT]	00 - 27	0B:CONT5_OFF	20ms
02	Alarm Reset Function [AL-RST]	00 - 27	10:CONT8_ON	20ms
03	Encoder Clear Function [ECLR]	00 - 27	06:CONT3_ON	200ms
04	Deviation Clear Function [CLR]	00 - 27	08:CONT4_ON	1ms
05	Servo-ON Function [S-ON]	00 - 27	02:CONT1_ON	20ms
10	Control Mode Switching Function [MS]	00 - 27	00:Always_Disable	4ms
11	Position Command Pulse Inhibit Function, Velocity Command Zero Clamp Function [INH/Z-STP]	00 - 27	00:Always_Disable	20ms
12	Electronic Gear Switching Function [GERS]	00 - 27	00:Always_Disable	20ms
13	Gain Switching Condition 1 [GC1]	00 - 27	00:Always_Disable	1ms
14	Gain Switching Condition 2 [GC2]	00 - 27	00:Always_Disable	1ms
15	FF Vibration Suppressor Frequency Select Input 1 [SUPFSEL1]	00 - 27	00:Always_Disable	20ms
16	FF Vibration Suppressor Frequency Select Input 2 [SUPFSEL2]	00 - 27	00:Always_Disable	20ms
17	Position Loop Proportional Control Switching Function [PLPCON]	00 - 27	01:Always_Enable	20ms
18	Model Vibration Suppressor Frequency Select Input 1 [MDLFSEL1]	00 - 27	00:Always_Disable	20ms
19	Model Vibration Suppressor Frequency Select Input 2 [MDLFSEL2]	00 - 27	00:Always_Disable	20ms
27	Velocity Loop Proportional Control Switching Function [VLPCON]	00 - 27	04:CONT2_ON	1ms
28	Velocity Compensation Function [V-COMPS]	00 - 27	00:Always_Disable	1ms
30	Torque Compensation Function 1 [T-COMPS1]	00 - 27	00:Always_Disable	1ms
31	Torque Compensation Function 2 [T-COMPS2]	00 - 27	00:Always_Disable	1ms
32	Torque Limit Function [TL]	00 - 27	0E:CONT7_ON	20ms
33	Disturbance Observer Function [OBS]	00 - 27	00:Always_Disable	20ms
40	External Trip Input Function [EXT-E]	00 - 27	00:Always_Disable	20ms
42	Emergency Stop Function [EMR]	00 - 27	00:Always_Disable	20ms

Group 9 “Function enabling condition list”

■ Keeping the function always valid or invalid

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

■ Using function with the generic input signals

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

■ Activating the functions conditioning the rotational velocity of servomotor

Selection		Contents
12	LOWV_IN	Function is valid during low velocity status (velocity is lower than the LOWV Setting Value).
13	LOWV_OUT	Function is valid during not low velocity status (velocity is lower than the LOWV Setting Value).
14	VA_IN	Function is valid during velocity attainment status (velocity is higher than the VA Setting Value).
15	VA_OUT	Function is valid during not velocity attainment status (velocity is higher than the VA Setting Value).
16	VCMP_IN	Function is valid during velocity matching status (velocity is lower than Velocity Matching Range)
17	VCMP_OUT	Function is valid during not velocity matching status (velocity is lower than Velocity Matching Range)
18	ZV_IN	Function is valid during zero velocity status (velocity is lower than the ZV Setting Value)
19	ZV_OUT	Function is valid during not zero velocity status (velocity is lower than the ZV Setting Value)

■ Activating the functions using the positioning signals

Selection		Contents
20	NEAR_IN	Function is valid during Near status
21	NEAR_OUT	Function is valid during not Near status
1A	INP_IN	Function is valid during In-Position status (position deviation < INP)
1B	INP_OUT	Function is valid during not In-Position status (position deviation < INP)
26	INPZ_IN	Function is valid during Position command 0 and In-Position status (position deviation < INP)
27	INPZ_OUT	Function is valid during Position command 0 and In-Position status (position deviation < INP)

■ Activating the functions using the torque / velocity limit

Selection		Contents
1C	TLC_IN	Function is valid during torque limit status
1D	TLC_OUT	Function is valid during not torque limit status
1E	VLC_IN	Function is valid during velocity limit status
1F	VLC_OUT	Function is valid during not velocity limit status

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

Selection		Contents
22	VMON_>_+LV	Function is valid while rotation direction is forward. (VMON>+LOWV)
23	VMON_<=_+LV	Function is valid while rotation direction is not forward. (VMON≦+LOWV)
24	VMON_<_-LV	Function is valid while rotation direction is reverse. (VMON<-LOWV)
25	VMON_>=_-LV	Function is valid while rotation direction is not reverse. (VMON≧-LOWV)

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

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

■ Select output signal for Output digital monitor
- ◆ The logic is reversed with the Digital monitor.
- ◆ Output voltage is approximately 5V when OFF, and 0V when ON.

■ Selection Contents list for General Purpose Output OUT1 - General Purpose Output OUT8 /Digital monitor output selection

◆ Fix Output on either selection.

01:Always_ON	00:Always_OFF

◆ When Generic input signal status it to be Output.

General Input, CONT1 is ON	3A:CONT1_ON	3B:CONT1_OFF
General Input, CONT2 is ON	3C:CONT2_ON	3D:CONT2_OFF
General Input, CONT3 is ON	3E:CONT3_ON	3F:CONT3_OFF
General Input, CONT4 is ON	40:CONT4_ON	41:CONT4_OFF
General Input, CONT5 is ON	42:CONT5_ON	43:CONT5_OFF
General Input, CONT6 is ON	44:CONT6_ON	45:CONT6_OFF
General Input, CONT7 is ON	46:CONT7_ON	47:CONT7_OFF
General Input, CONT8 is ON	48:CONT8_ON	49:CONT8_OFF

◆ When Servo amplifier Preset status is to be output.

During Servo Ready Complete	02:S-RDY_ON	03:S-RDY_OFF
	58:S-RDY2_ON	59:S-RDY2_OFF
During Power Supply ON	04:P-ON_ON	05:P-ON_OFF
During Power Supply ON Permission	06:A-RDY_ON	07:A-RDY_OFF
During Motor Excitation	08:S-ON_ON	09:S-ON_OFF
During Holding Brake Excitation Signal Output	0A:MBR-ON_ON	0B:MBR-ON_OFF
During Torque Limiting	0C:TLC_ON	0D:TLC_OFF
During Velocity Limiting	0E:VLC_ON	0F:VLC_OFF
During Low Velocity Status	10:LOWV_ON	11:LOWV_OFF
During Velocity Attainment Status	12:VA_ON	13:VA_OFF
During Velocity Matching Status	14:VCMP_ON	15:VCMP_OFF
During Velocity Zero Status	16:ZV_ON	17:ZV_OFF
During Command Acceptance Permission Status	1C:CMD-ACK_ON	1D:CMD-ACK_OFF
During Gain Switching Status	1E:GC-ACK_ON	1F:GC-ACK_OFF
During Velocity Loop Proportional Control Switching Status	20:PCON-ACK_ON	21:PCON-ACK_OFF
During Electronic Gear Switching Status	22:GERS-ACK_ON	23:GERS-ACK_OFF
During Control Mode Switching Status	24:MS-ACK_ON	25:MS-ACK_OFF
During Forward Over-Travel Status	26:F-OT_ON	27:F-OT_OFF
During Reverse Over-travel Status	28:R-OT_ON	29:R-OT_OFF
During Main Circuit Power Supply Charging	4A:CHARGE_ON	4B:CHARGE_OFF
During Dynamic Braking	4C:DB_OFF	4D:DB_ON
In the state of torque attainment	5E:TA_ON	5F:TA_OFF

✔ The display showing main circuit is charging the power is the state main circuit power is being input.

✔ Dynamic brake cannot work even if the setting became DB_ON output, if it is servo amplifier without dynamic brake function.

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◆ When positioning signal is to be output.

During In-Position Status	18:INP_ON	19:INP_OFF
During Near Range Status	1A:NEAR_ON	1B:NEAR_OFF
During In-Position with Position Command 0 Status	5A:INPZ_ON	5B:INPZ_OFF

◆ When Warning signal is to be output

During Excessive Deviation Warning Status	2A:WNG-OFW_ON	2B:WNG-OFW_OFF
During Overload Warning Status	2C:WNG-OLW_ON	2D:WNG-OLW_OFF
During Regenerative Overload Warning Status	2E:WNG-ROLW_ON	2F:WNG-ROLW_OFF
During Battery Warning status	30:WNG-BAT_ON	31:WNG-BAT_OFF
During Under Voltage Sag Warning Status	5C:PEWNG_ON	5D:PEWNG_OFF

◆ When Alarm signals are to be output

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

◆ When PY compatible alarm signals are to be output

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

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

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

01:TMON_2V/TR	Torque Monitor	2V/rated torque (force)
02:TCMON_2V/TR	Torque Command Monitor	2V/rated torque (force)
03:VMON_0.2mV/ min^{-1}	Velocity Monitor	0.2mV/min^{-1}
04:VMON_1mV/ min^{-1}	Velocity Monitor	1mV/min^{-1}
05:VMON_2mV/ min^{-1}	Velocity Monitor	2mV/min^{-1}
06:VMON_3mV/ min^{-1}	Velocity Monitor	3mV/min^{-1}
07:VCMON_0.2mV/ min^{-1}	Velocity Command Monitor	0.2mV/min^{-1}
08:VCMON_1mV/ min^{-1}	Velocity Command Monitor	1mV/min^{-1}
09:VCMON_2mV/ min^{-1}	Velocity Command Monitor	2mV/min^{-1}
0A:VCMON_3mV/ min^{-1}	Velocity Command Monitor	3mV/min^{-1}
0B:PMON_0.01mV/P	Position Deviation Counter Monitor	0.01mV/Pulse
0C:PMON_0.1mV/P	Position Deviation Counter Monitor	0.1mV/Pulse
0D:PMON_1mV/P	Position Deviation Counter Monitor	1mV/Pulse
0E:PMON_10mV/P	Position Deviation Counter Monitor	10mV/Pulse
0F:PMON_20mV/P	Position Deviation Counter Monitor	20mV/Pulse
10:PMON_50mV/P	Position Deviation Counter Monitor	50mV/Pulse
11:FMON1_2mV/kP/s	Position Command Pulse Frequency Monitor 1 (Position Command Pulse Input Frequency	2mV/kPulse/s
12:FMON1_10mV/kP/s	Position Command Pulse Frequency Monitor 1 (Position Command Pulse Input Frequency)	10mV/kPulse/s
13:FMON2_0.05mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Control)	0.05mV/kPulse/s
14:FMON2_0.5mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Control)	0.5mV/kPulse/s
15:FMON2_2mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Control)	2mV/kPulse/s
16:FMON2_10mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Control)	10mV/kPulse/s
17:TLMON_EST_2V/TR	Load Torque Monitor (Estimated Value)	2V/ Rated torque
18:Sine-U	U Phase Electronic Angle Sin	8Vpeak
19:ACMON_0.01mV/rad/s^2	Acceleration monitor	0.01mV/rad/s^2
1A:ACMON_0.1mV/rad/s^2	Acceleration monitor	0.1mV/rad/s^2
1B:ACMON_1mV/rad/s^2	Acceleration monitor	1mV/rad/s^2
1C:ACMON_10mV/rad/s^2	Acceleration monitor	10mV/rad/s^2
1F:VBUS_1V/DC10V	Bus voltage monitor	1V/DC10V

- 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 shall be output in pulse-state when the position command pulse is 10kHz or less. Average them to convert to position command frequency.
- The following low-pass filters are inserted in *torque (force) monitor*, *velocity monitor*, and *load torque monitor*, respectively.
  Torque (force) monitor : 250Hz
  velocity monitor : 250Hz
  Load torque monitor : 20Hz

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

■ Select Output polarity of Analog monitor output, MON1and MON2

◆ For both MON1 and MON2, set from any of the followings:
＋No Polarity Rotation, - Polarity Rotation, ABS Absolute Value Output

Selection	Contents
00:MON1+_MON2+	MON1: Output positive voltage at Forward (Positive) Rotation. Output positive/negative voltage. MON2: Output positive voltage at Forward (Positive) Rotation. Output positive/negative voltage.
01:MON1-_MON2+	MON1: Output negative voltage at Forward (Positive) Rotation. Output positive/negative voltage. MON2: Output positive voltage at Forward (Positive) Rotation. Output positive/negative voltage.
02:MON1+_MON2-	MON1: Output positive voltage at Forward (Positive) Rotation. Output positive/negative voltage. MON2: Output negative voltage at Forward (Positive) Rotation. Output positive/negative voltage.
03:MON1-_MON2-	MON1: Output negative voltage at Forward (Positive) Rotation. Output positive/negative voltage. MON2: Output negative voltage at Forward (Positive) Rotation. Output positive/negative voltage.
04:MON1ABS_MON2+	MON1: Output positive voltage at Forward (Positive) and Reverse (Negative) Rotation. MON2: Output negative voltage at Forward (Positive) Rotation. Output positive/negative voltage.
05:MON1ABS_MON2-	MON1: Output positive voltage at Forward (Positive) and Reverse (Negative) Rotation. MON2: Output negative voltage at Forward (Positive) Rotation. Output positive/negative voltage.
06:MON1+_MON2ABS	MON1: Output positive voltage at Forward (Positive) Rotation. Output positive/negative voltage. MON2: Output positive voltage at Forward (Positive) and Reverse (Negative) Rotation.
07:MON1-_MON2ABS	MON1: Output negative voltage at Forward (Positive) Rotation. Output positive/negative voltage. MON2: Output positive voltage at Forward (Positive) and Reverse (Negative) Rotation.
08:MON1ABS_MON2ABS	MON1: Output positive voltage at Forward (Positive) and Reverse (Negative) Rotation. MON2: Output positive voltage at Forward (Positive) and Reverse (Negative) Rotation.

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>20</td><td>
Serial Communication Axis Number [COMAXIS] Control power reactivation after setting

Setting range	Unit	Standard value
01 - 0F	-	01:#1

■ Select Axis number from below for Serial communication (RS-232C/RS-422A) with PC or upper controller:

◆ As this number identifies each servo amplifier, assign the different number so that the servo amplifiers connected to PC or upper controllers do not have the same number.

Selection		Selection		Selection		Selection		Selection	
01	#1	04	#4	07	#7	0A	#A	0D	#D
02	#2	05	#5	08	#8	0B	#B	0E	#E
03	#3	06	#6	09	#9	0C	#C	0F	#F
</td></tr>
<tr><td>21</td><td>
Serial Communication Baud Rate [COMBAUD] Control power reactivation after setting

Setting range	Unit	Standard value
03 - 06	-	05:38400bps

■ Select Communication velocity (Baud rate) with PC or upper controller from below:

Selection	
03	9600bps
04	19200bps
05	38400bps
06	57600bps
</td></tr>
<tr><td>22</td><td>
Latency to start sending response message [RSPWAIT] “Re-turn on control power supply after setting”

Setting range	Unit	Standard value
0 - 500	ms	0

■ Set minimum latency to start sending response message after servo amplifier receives request message for the communication between controller and servo amplifier via RS-422 communication system.

◆ Actual latency varies to the degree of range 0 to +3m for this set value. Make sure to set to “0” to communicate with setup software.

*** This servo amplifier does not support RS-422 communication system, so this function is not available.**
</td></tr>
</table>

■ GroupB “Sequence/Alarm related settings”

ID	Contents			
00	JOG Velocity Command [JOGVC]	Setting range	Unit	Standard value
		0 - 32767	min^{-1}	50
	■ Set velocity command value for JOG operation. ◆ This value is set as initial setting value for JOG Velocity Command for Setup software.			
10	Dynamic Brake Operation [DBOPE]	Setting range	Unit	Standard value
		00 - 05	-	04:SB_Free

■ Select Dynamic Brake Operation when shifted from serve ON to servo OFF, and during servo OFF.

Selection		Contents
00	Free_Free	When Servo OFF, Free-Run Operation After Motor Stop, Motor-Free Operation
01	Free_DB	When Servo OFF, Free-Run Operation After Motor Stop, Dynamic Brake Operation
02	DB_Free	When Servo OFF, Dynamic Brake Operation After Motor Stop, Motor-Free Operation
03	DB_DB	When Servo OFF, Dynamic Brake Operation After Motor Stop, Dynamic Brake Operation
04	SB_Free	When Servo OFF, Servo Brake Operation After Motor Stop, Motor-Free Operation
05	SB_DB	When Servo OFF, Servo Brake Operation After Motor Stop, Dynamic Brake Operation

✔ When the main circuit power supply is shut-off, the motor stops in a method set in “GroupB ID12: Emergency Stop Operation [ACTEMER]” and the behavior becomes dynamic brake operation after the stop.
Note that the motor stops in dynamic brake operation after detecting “Main circuit voltage drop” or “BONBGN elapsed.”

✔ Selecting “dynamic brake” for operation with servo amplifier without dynamic brake function makes the motor stop behavior free-running.

ID	Contents			
11	Over-Travel Action [ACTOT]	Setting range	Unit	Standard value
		00 - 06	-	00:CMDINH_SB_SON

■ Select operations at over-travel action

Selection		Contents
00	CMDINH_SB_SON	When in Over-travel action, Command input is invalid and servo brake stops servo motor. After servo motor stops, servo is ON. (command at OT side = velocity limit command =0)
01	CMDINH_DB_SON	When in Over-travel action, Command input is invalid and dynamic brake stops servo motor. After servo motor stops, servo is ON. (command at OT side = velocity limit command =0)
02	CMDINH_Free_SON	When in Over-travel action, Command input is invalid and Free run is operated. After servo motor stops, servo is ON. (command at OT side = velocity limit command =0)
03	CMDINH_SB_SOFF	When in Over-travel action, Command input is invalid and servo brake stops servo motor. After servo motor stops, servo is OFF.
04	CMDINH_DB_SOFF	When in Over-travel action, Command input is invalid and dynamic brake stops servo motor. After servo motor stops, servo is OFF.
05	CMDINH_Free_SOFF	When in Over-travel action, Command input is invalid and Free-running is operated. After servo motor stops, servo is OFF.
06	CMDACK_VCLM=0	When in Over-travel action, Command input to the Over -travel side is 0.

◆ Torque limit value to stop servo motor by servo brake is the setting value of sequence Torque limit.

◆ Note that if you select “dynamic brake” on servo amplifier without dynamic brake function, the operation when motor stopped becomes free-running.

ID	Contents			
12	Emergency Stop Operation [ACTEMR]	Setting range	Unit	Standard value
		00 - 01	-	00:SERVO-BRAKE

■ Sets operation at Emergency Stop

◆ From the following contents, select operation at the time of emergency stop (EMR, main power OFF). Besides, in usage by a vertical axis, please use it with standard setting 00: _SERVO-BRAKE).

Selection		Contents
00	SERVO-BRAKE	This stops servo motor by activating servo brake, and after servo motor stopped, dynamic brake starts to work.
01	DYNAMIC-BRAKE	This stops servo motor by activating dynamic brake, and after servo motor stopped, the dynamic brake continues to work.

◆ If stopping operation (8-4) when alarm activated is DB alarm, servo motor stops by dynamic brake activation regardless of this setting.

◆ Forced stop operation means ”emergency stop function-enabled,” “main circuit power supply cutoff,” “alarm activated,” and “safe-torque-off operation.”

◆ Servo amplifiers without dynamic brake function operate as follows:
- ・Becomes free-running when servo brake selected.
- ・Stop in free-running when dynamic brake selected.

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>13</td><td>
<table>
<tr><td>Delay Time of Engaging Holding Brake
(Holding Brake Holding Delay time) [BONDLY]</td><td>Setting range
0 - 1000</td><td>Unit
ms</td><td>Standard value
300</td></tr>
</table>
■ Sets holding-brake-activation delay time from when power distribution to holding brake stops till when holding torque generated.

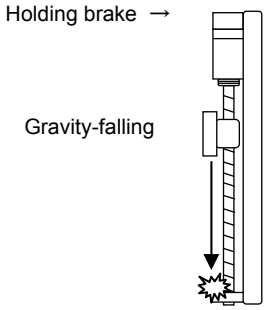
◆ While shifting from servo ON to servo OFF, during the setting time, Excitation command 0 is given to servo motor. (Even when servo is turned OFF, power is supplied to servo motor until the setting time is over.)
By this, until Holding brake functions, servo motor generates Holding torque.
◆ Setting unit is 4ms. When the setting value is 0ms, after servo OFF, command is invalid (command 0) for approximately 4ms.
◆ At the setting, Group8 ID10 [DBOPE] Dynamic Brake Operation, when servo brake is ON at servo OFF, (04 SB_Free or 05 SB_DB), it is valid.
(This function is invalid in Dynamic brake operation and Free-run operation.)
</td></tr>
<tr><td>14</td><td>
<table>
<tr><td>Delay Time of Releasing Holding Brake
(Holding Brake Releasing Delay time) [BOFFDLY]</td><td>Setting range
0 - 1000</td><td>Unit
ms</td><td>Standard value
300</td></tr>
</table>
■ Sets holding-brake-release delay time from when power distribution to holding brake started till when holding torque disappeared..

◆ While shifting from servo OFF to servo ON, during the setting time, Excitation command 0 is given to servo motor. (Even when servo is turned ON, command is not accepted until the setting time is complete.)
Therefore, until Holding brake is released, servo motor does not operate.
◆ Setting unit is 4ms. When the setting value is 0ms, after servo ON, command is invalid (command 0) for approximately 4ms.
</td></tr>
<tr><td>15</td><td>
<table>
<tr><td>Brake Operation Beginning Time
[BONBGN]</td><td>Setting range
0 - 65535</td><td>Unit
ms</td><td>Standard value
10000</td></tr>
</table>
■ Sets permissible time from servo OFF until servo motor stop.

◆ While shifting servo ON to servo OFF, even after the selected time passed and the servo motor does not stop. Servo motor is forced to stop with Holding brake and Dynamic brake.
◆ When the servo motor stops this setting does not function.
◆ When servo motor does not stop after servo OFF at gravity axis, set this parameter.
◆ When forced to stop by Holding brake, the Holding brake may possibly be broken. Be cautious about device specifications and sequence when using this function.
◆ Dynamic brake does not work on servo amplifiers without dynamic brake functions.
</td></tr>
</table>

■ About Holding Brake

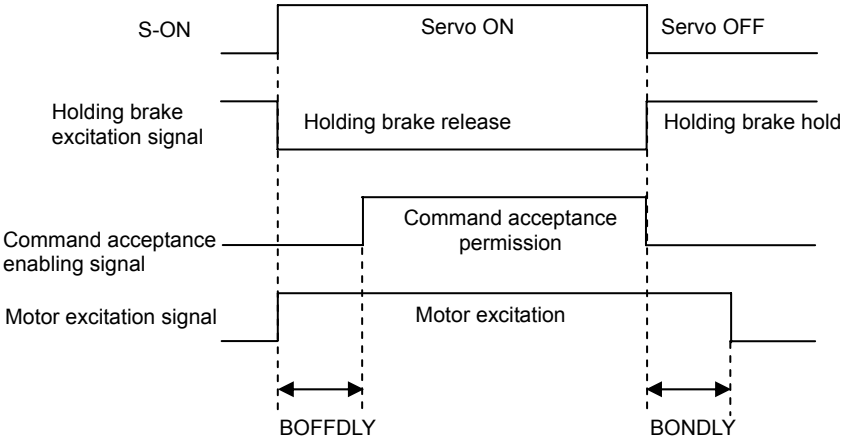
Servo motor with holding brake function is usually used with one axis, which is always affected by gravity and external forces
In order to avoid moving parts falling-off from its position when main circuit power is OFF, or servo OFF.
Holding brake is to support the movable parts against gravity and other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



◆ Setting for Holding brake excitation signal output

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

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



ID 18

Selection to detect main circuit power decrease [MPESEL]	Setting range	Unit	Standard value
	00 - 01	-	00

■ Selects enabling/disabling of main circuit power decrease detection.

Selection		Contents
00	MPE_DIS	Doesn't detect Main power under voltage Alarm
01	MPE_ENA	Detect Main power under voltage Alarm

◆ When "Detect main circuit power decrease" selected, alarm is activated when main circuit power decreased during gate-on. Decreasing of main circuit power during gate-off is power-off state.

ID 20

Excessive Deviation Warning Level [OFWLV]	Setting range	Unit	Standard value
	1 - 2147483647	Pulse	2147483647

■ Sets Warning output level before Excessive position deviation alarm is output.

◆ Sets at Encoder pulse resolution regardless of Electronic gear.

ID 21

Deviation Counter Overflow Value [OFLV]	Setting range	Unit	Standard value
	1 - 2147483647	Pulse	5000000

■ Sets Position deviation value regarded as Excessive position deviation alarm.

◆ Sets at Encoder pulse resolution regardless of Electronic gear.

ID 22

Overload Warning Level [OLWLV] Control power reactivation after setting	Setting range	Unit	Standard value
	20 - 100	%	90

■ Sets Warning output level before Overload alarm output.

◆ The possible level to be set is from 20%-99%, assuming that the Overload Warning Level is 100%. When set to 100%, Overload warning and Overload alarm are output at one time.

◆ Overload detection is assumed and set as 75%, of a rated load when Control power is turned ON (hot start). Therefore, Overload warning may be output when Control power is turned ON.

ID 23

Velocity Feedback Alarm (ALM_C3) Detection [VFBALM]	Setting range	Unit	Standard value
	00 - 01	-	01:Enabled

■ Selects Valid/Invalid Velocity feedback error detection.

Selection		Contents
00	Disabled	Invalid
01	Enabled	Valid

ID 24

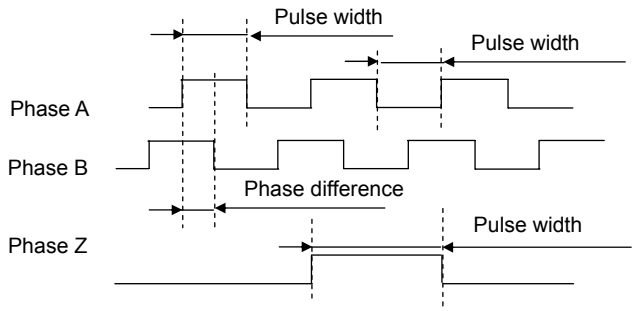
Velocity Control Alarm (ALM_C2) Detection [VCALM]	Setting range	Unit	Standard value
	00 - 01	-	00:Disabled

■ Selects Valid/Invalid Velocity control error detection.

Selection		Contents
00	Disabled	Invalid
01	Enabled	Valid

◆ Operation pattern such as servo motor overshoots corresponding to command may cause false velocity control error detection. In this case, set the parameter to "invalid."

■ GroupC “Encoder related settings”

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="2">00</td><td>Motor Pulse Encoder Digital Filter
[ENFIL]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td></td><td>00 - 07</td><td>-</td><td>01:220nsec</td></tr>
<tr><td></td><td colspan="4">■ This parameter can be set only when you use pulse encoder.
Sets Digital filter to motor Pulse encoder.
Pulse lower than the set value is eliminated as noise when noise superposition occurs in encoder signals.
Consider Encoder resolution and Maximum rotation velocity of the servo motor in operation when selecting value. Set the value roughly less than 1/4 of the Encoder pulse width at Maximum rotation velocity.</td></tr>
<tr><td></td><td colspan="4">
<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>110nsec</td><td>Minimum Pulse Width =110nsec
(Minimum pulse Phase Difference = 37.5nsec)</td></tr>
<tr><td>01</td><td>220nsec</td><td>Minimum Pulse Width = 220nsec</td></tr>
<tr><td>02</td><td>440nsec</td><td>Minimum Pulse Width = 440nsec</td></tr>
<tr><td>03</td><td>880nsec</td><td>Minimum Pulse Width = 880nsec</td></tr>
<tr><td>04</td><td>75nsec</td><td>Minimum Pulse Width = 75nsec
(Minimum pulse Phase Difference = 37.5nsec)</td></tr>
<tr><td>05</td><td>150nsec</td><td>Minimum Pulse Width = 150nsec</td></tr>
<tr><td>06</td><td>300nsec</td><td>Minimum Pulse Width = 300nsec</td></tr>
<tr><td>07</td><td>600nsec</td><td>Minimum Pulse Width = 600nsec</td></tr>
</table>


</td></tr>
<tr><td rowspan="2">01</td><td>External Pulse Encoder Digital Filter
[EX-ENFIL]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td></td><td>00 - 07</td><td>-</td><td>01:220nsec</td></tr>
<tr><td></td><td colspan="4">■ This parameter can be set only when you use fully closed control function.
Sets Digital filter to External Pulse Encoder.
Pulse lower than the set value is eliminated as noise when noise superposition occurred in encoder signals.
Consider Encoder resolution and Maximum rotation velocity of the servo motor in operation when selecting value. Set the value roughly less than 1/4 of the Encoder pulse width at Maximum rotation velocity.</td></tr>
<tr><td></td><td colspan="4">
<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>110nsec</td><td>Minimum Pulse Width =110nsec
(Minimum pulse Phase Difference = 37.5nsec)</td></tr>
<tr><td>01</td><td>220nsec</td><td>Minimum Pulse Width = 220nsec</td></tr>
<tr><td>02</td><td>440nsec</td><td>Minimum Pulse Width = 440nsec</td></tr>
<tr><td>03</td><td>880nsec</td><td>Minimum Pulse Width = 880nsec</td></tr>
<tr><td>04</td><td>75nsec</td><td>Minimum Pulse Width = 75nsec
(Minimum pulse Phase Difference = 37.5nsec)</td></tr>
<tr><td>05</td><td>150nsec</td><td>Minimum Pulse Width = 150nsec</td></tr>
<tr><td>06</td><td>300nsec</td><td>Minimum Pulse Width = 300nsec</td></tr>
<tr><td>07</td><td>600nsec</td><td>Minimum Pulse Width = 600nsec</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>02</td><td>
External Pulse Encoder Polarity Selection [EX-ENPOL] Control power reactivation after setting

Setting range	Unit	Standard value
00 - 07	-	00:Type1

■ This parameter can be set only when you use fully closed control function.

◆ Select External pulse encoder signal polarity.

Selection		Contents		
00	Type1	EX-Z/Not Reversed	EX-B/ Not Reversed	EX-A/ Not Reversed
01	Type2	EX-Z/Not Reversed	EX-B/ Not Reversed	EX-A/ Reversed
02	Type3	EX-Z/Not Reversed	EX-B/ Reversed	EX-A/ Not Reversed
03	Type4	EX-Z/Not Reversed	EX-B/ Reversed	EX-A/ Reversed
04	Type5	EX-Z/Reversed	EX-B/ Not Reversed	EX-A/ Not Reversed
05	Type6	EX-Z/Reversed	EX-B/ Not Reversed	EX-A/ Reversed
06	Type7	EX-Z/Reversed	EX-B/ Reversed	EX-A/ Not Reversed
07	Type8	EX-Z/Reversed	EX-B/ Reversed	EX-A/ Reversed
</td></tr>
<tr><td>03</td><td>
Encoder Output Pulse Divide Selection [PULOUTSEL] Control power reactivation after setting

Setting range	Unit	Standard value
00 - 01	-	00:Motor_Enc.

■ Sets Encoder output pulse division signal.

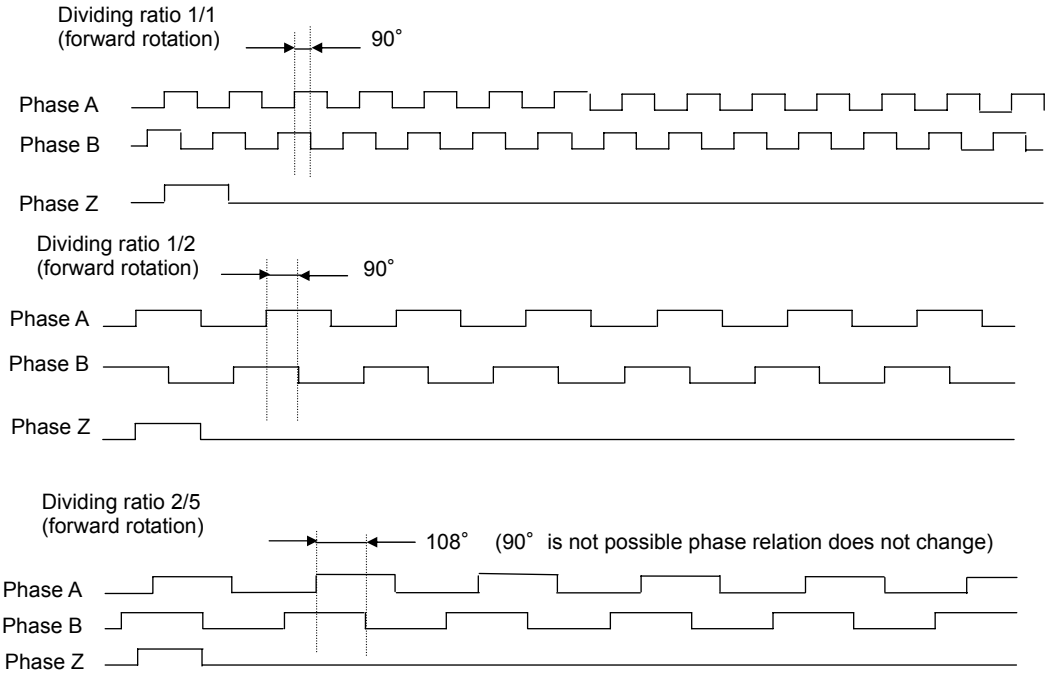
Select Motor encoder or External encoder to load Encoder pulse to upper device.

Selection		
00	Motor_Enc	Motor Encoder
01	External_Enc	External Encoder
</td></tr>
</table>

ID	Contents			
04	Encoder Output Pulse Division [ENRAT]	Setting range 1/1 - 1/64 2/3 - 2/64 1/32768 - 32767/32768	Unit -	Standard value 1/1

■ Sets ratio of Encoder output pulse division.

- ◆ When the numerator of the dividing ratio is 1, setting range of the denominator is 1 (not divide), 2-64, or 32768.
- ◆ When the numerator of the dividing ratio is 2, setting range of the denominator is 3-64, or 32768.
- ◆ When the denominator of the dividing ratio is 32768, setting range of the numerator is 1-32767.
- ◆ Z phase output is not divided
- ◆ After Control power ON, for 2s at maximum, the ratio is unstable.



05	Encoder Output Pulse Divide Polarity [PULOUTPOL]	Setting range	Unit	Standard value
		00 - 03	-	00:Type1

■ Sets division polarity of Encoder output pulse.

Selection		Contents
00	Type1	A Phase Signal/Not Reversed Z Phase Signal Logic/High Active
01	Type2	A Phase Signal/Reversed Z Phase Signal Logic/High Active
02	Type3	A Phase Signal/Not Reversed Z Phase Signal Logic/Low Active
03	Type4	A Phase Signal/Reversed Z Phase Signal Logic/Low Active

06

Encoder Output Pulse Divide Resolution Selection [PULOUTRES] Control power reactivation after setting

Setting range	Unit	Standard value
00 - 01	-	00:32768P/R

■ This parameter can be set only when you use serial encoder.

- ◆ Sets resolution of encoder output pulse divided.
- ◆ Set at 8192P/R to make the Output pulse same as that of RS1 series servo amplifier.
- ◆ Set at 8192P/R when Output pulse frequency exceeds the specification of the upper controller.
- ◆ Outputs divided pulse by setting resolution to ID04 Encoder output divide.

Selection		Contents
00	32768P/R	32768 Pulse per 1 Motor Rotation
01	8192P/R	8192 Pulse per 1 Motor Rotation

07

Encoder Signal Output (PS) Format [PSOFORM] Control power reactivation after setting

Setting range	Unit	Standard value
00 - 01	-	00:MOT_Binary

■ Sets signal format of Encoder signal output (PS).

Selection		Contents
00	MOT_Binary	Motor Encoder Binary Code Output
01	MOT_ASCII	Motor Encoder Decimal ASCII Code Output

08

Encoder Clear Function Selection [ECLRFUNC]

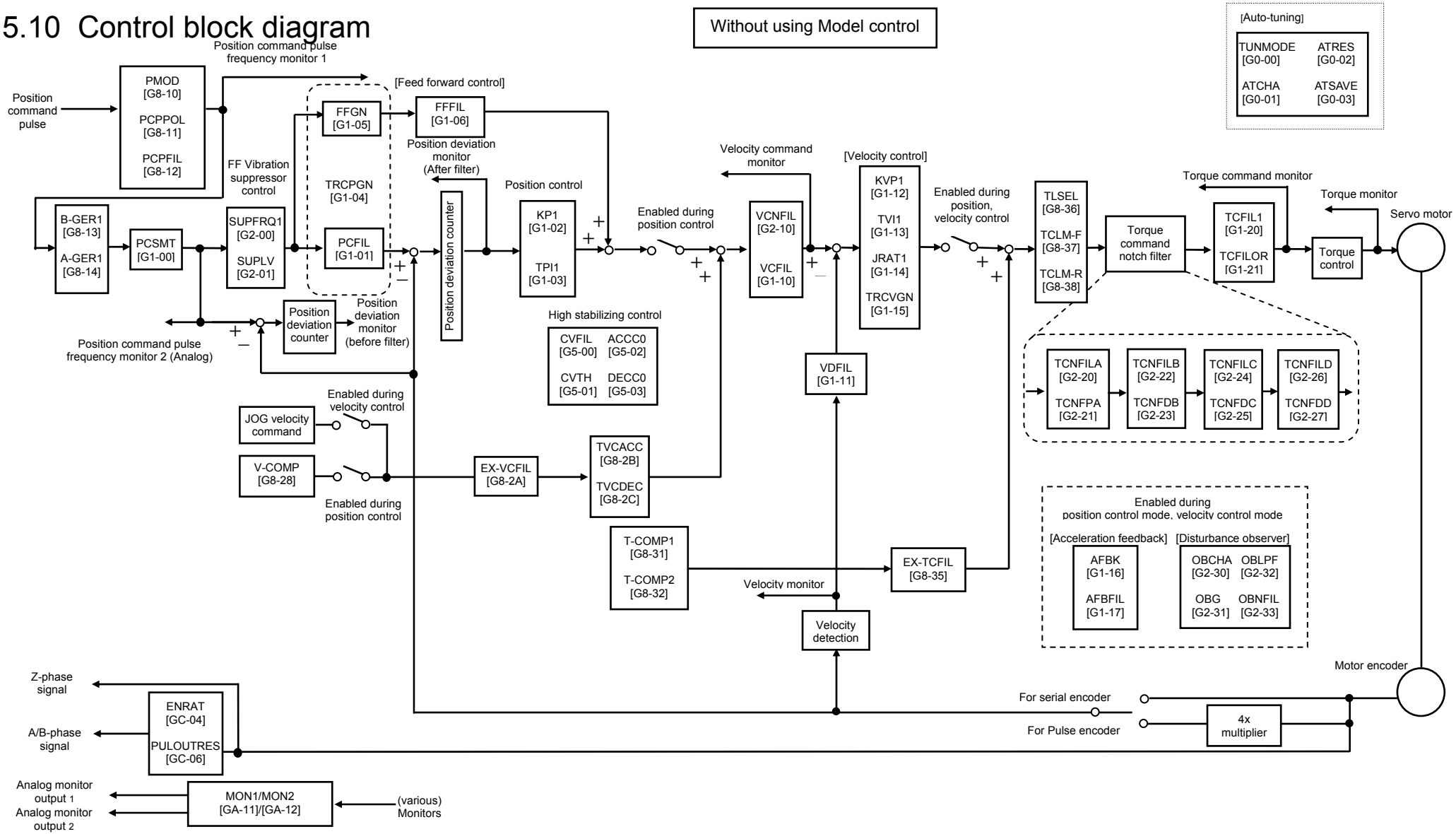
Setting range	Unit	Standard value
00 - 01	-	00:Status_MultiTurn

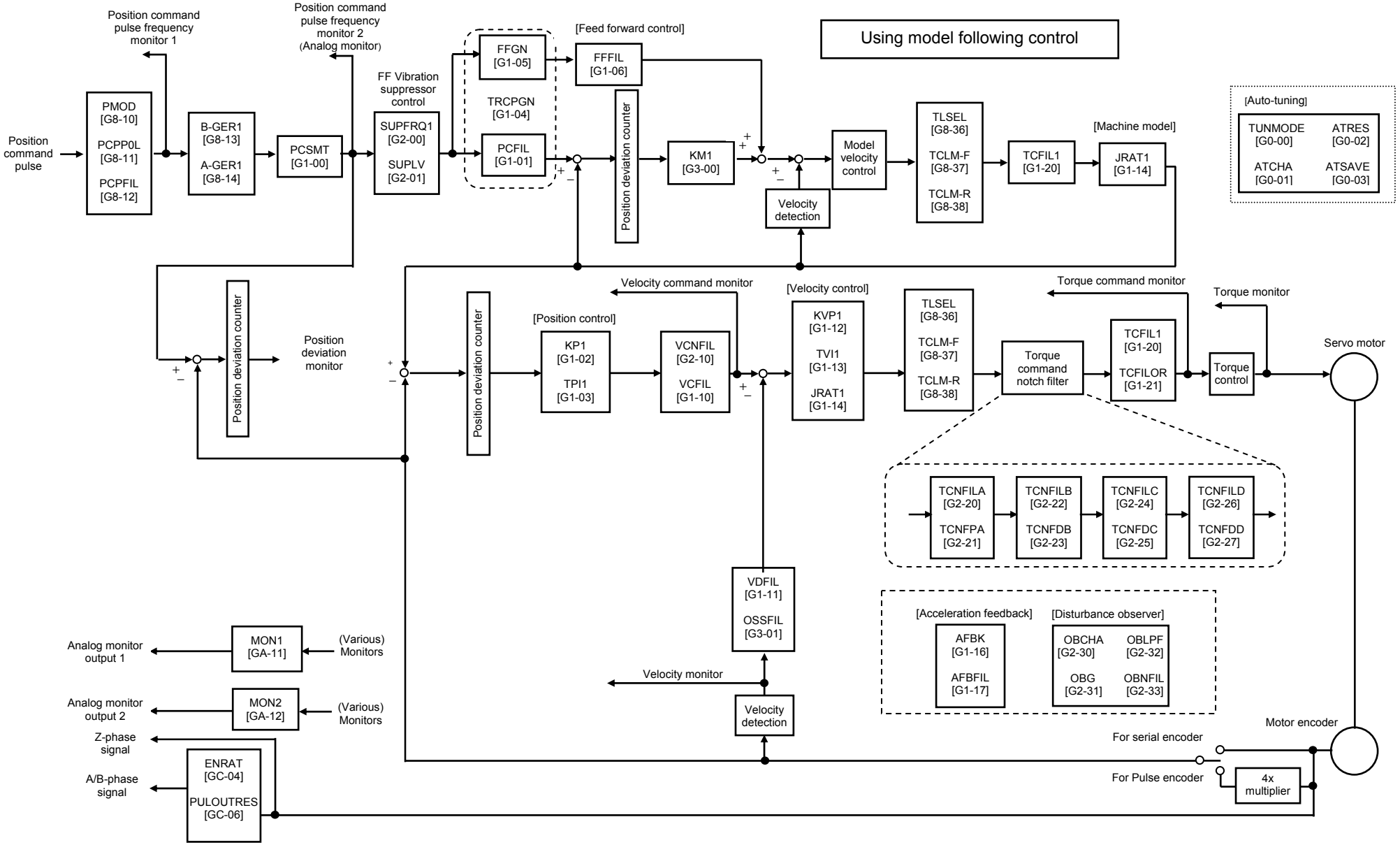
■ This parameter can be set only when you use serial encoder.

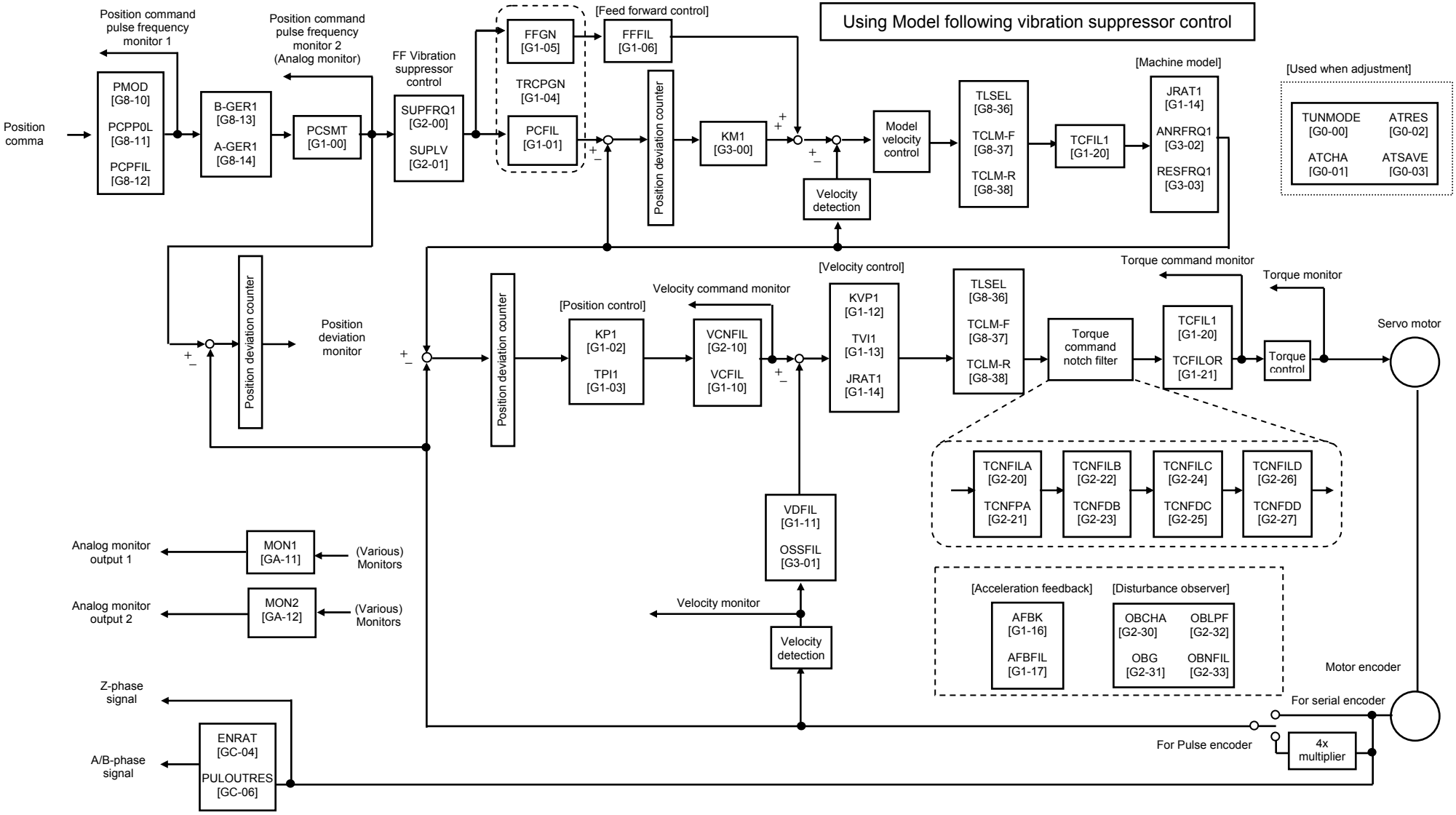
- ◆ Use to clear serial encoder warning when the warning is not automatically restored. Valid when using with Battery Backup Method Absolute Encoder and Battery-less Absolute Encoder.
- ◆ When used with Absolute Encoder for Incremental System, even 01: _Status_MultiTurn is selected; it works as the selection, clear only encoder status.

Selection		Contents
00	Status_MultiTurn	Clear Encoder Status (Alarm and Warning) and Multi Turn Data
01	Status	Clear Only Encoder Status (Alarm and Warning)

5.10 Control block diagram




Using model following control
Position command pulse
Position command pulse frequency monitor 1
Position command pulse frequency monitor 2 (Analog monitor)
PMOD [G8-10]
PCPP0L [G8-11]
PCPFIL [G8-12]
B-GER1 [G8-13]
A-GER1 [G8-14]
PCSMT [G1-00]
FF Vibration suppressor control
SUPFRQ1 [G2-00]
SUPLV [G2-01]
[Feed forward control]
FFGN [G1-05]
TRCPGN [G1-04]
PCFIL [G1-01]
FFFIL [G1-06]
Position deviation counter
KM1 [G3-00]
Velocity detection
Model velocity control
TLSEL [G8-36]
TCLM-F [G8-37]
TCLM-R [G8-38]
TCFIL1 [G1-20]
[Machine model]
JRAT1 [G1-14]
[Auto-tuning]
TUNMODE [G0-00]
ATRES [G0-02]
ATCHA [G0-01]
ATSAVE [G0-03]
Position deviation monitor
Velocity command monitor
[Position control]
KP1 [G1-02]
TPI1 [G1-03]
VCNFIL [G2-10]
VCFIL [G1-10]
[Velocity control]
KVP1 [G1-12]
TVI1 [G1-13]
JRAT1 [G1-14]
Torque command monitor
Torque monitor
Torque command notch filter
TCFIL1 [G1-20]
TCFILOR [G1-21]
Torque control
Servo motor
TCNFILA [G2-20]
TCNFPA [G2-21]
TCNFILB [G2-22]
TCNFDB [G2-23]
TCNFILC [G2-24]
TCNFDC [G2-25]
TCNFILD [G2-26]
TCNFDD [G2-27]
VDFIL [G1-11]
OSSFIL [G3-01]
[Acceleration feedback]
AFBK [G1-16]
AFBFIL [G1-17]
[Disturbance observer]
OBCHA [G2-30]
OBLPF [G2-32]
OBG [G2-31]
OBNFIL [G2-33]
Velocity monitor
Analog monitor output 1
MON1 [GA-11]
(Various) Monitors
Analog monitor output 2
MON2 [GA-12]
(Various) Monitors
Z-phase signal
A/B-phase signal
ENRAT [GC-04]
PULOUTRES [GC-06]
Motor encoder
For serial encoder
For Pulse encoder
4x multiplier


Using Model following vibration suppressor control
Position command pulse frequency monitor 1
Position command pulse frequency monitor 2 (Analog monitor)
FF Vibration suppressor control
[Feed forward control]
[Machine model]
[Used when adjustment]
Position comma
PMOD [G8-10]
PCPP0L [G8-11]
PCPFIL [G8-12]
B-GER1 [G8-13]
A-GER1 [G8-14]
PCSMT [G1-00]
SUPFRQ1 [G2-00]
SUPLV [G2-01]
FFGN [G1-05]
TRCPGN [G1-04]
PCFIL [G1-01]
FFFIL [G1-06]
Position deviation counter
KM1 [G3-00]
Velocity detection
Model velocity control
TLSEL [G8-36]
TCLM-F [G8-37]
TCLM-R [G8-38]
TCFIL1 [G1-20]
JRAT1 [G1-14]
ANRFRQ1 [G3-02]
RESFRQ1 [G3-03]
TUNMODE [G0-00]
ATRES [G0-02]
ATCHA [G0-01]
ATSAVE [G0-03]
Position deviation counter
Position deviation monitor
[Position control]
Velocity command monitor
KP1 [G1-02]
TPI1 [G1-03]
VCNFIL [G2-10]
VCFIL [G1-10]
[Velocity control]
KVP1 [G1-12]
TVI1 [G1-13]
JRAT1 [G1-14]
TLSEL [G8-36]
TCLM-F [G8-37]
TCLM-R [G8-38]
Torque command notch filter
Torque command monitor
Torque monitor
TCFIL1 [G1-20]
TCFILOR [G1-21]
Torque control
Servo motor
TCNFILA [G2-20]
TCNFPA [G2-21]
TCNFILB [G2-22]
TCNFDB [G2-23]
TCNFILC [G2-24]
TCNFDC [G2-25]
TCNFILD [G2-26]
TCNFDD [G2-27]
VDFIL [G1-11]
OSSFIL [G3-01]
Velocity monitor
Velocity detection
[Acceleration feedback]
[Disturbance observer]
AFBK [G1-16]
AFBFIL [G1-17]
OBCHA [G2-30]
OBLPF [G2-32]
OBG [G2-31]
OBNFIL [G2-33]
Analog monitor output 1
MON1 [GA-11]
(Various) Monitors
Analog monitor output 2
MON2 [GA-12]
(Various) Monitors
Motor encoder
For serial encoder
For Pulse encoder
4x multiplier
Z-phase signal
A/B-phase signal
ENRAT [GC-04]
PULOUTRES [GC-06]

6

6. Adjustment

6.1 Servo tuning functions and basic adjustment procedure

Adjustments to servo gain and control system configuration are required to operate servo motor and machines by using servo amplifier. Generally, machine response can be improved by increasing servo gain, except that response performance of machines with low rigidity cannot be improved because of vibrations when servo gain is increased to excess. For servo gain and control system configuration, appropriated adjustments to operating servo motor and mechanical system in which motor is installed are required. This adjustment process is called “servo tuning.” The followings describe servo-tuning procedures:

1) Servo tuning functions

■ Servo gain tuning procedures

Servo gain tuning methods are as follows:

- ◆ Automatic tuning
  Servo amplifier estimates load inertia moment 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]
  This does not estimate load inertia moment ratio. Servo gain and filter frequency are automatically adjusted according to set load inertia moment ratio and responses performance. Use this tuning when load inertia moment ratio cannot be correctly estimated with auto-tuning, or operating machine’s load inertia moment ratio is already obtained and then the load inertia moment ratio does not fluctuate when operating.
- ◆ Manual tuning
  This sets all parameters, such as load inertia moment ratio, servo gain, and filter frequency. Use this tuning when sufficient result was not obtained with auto-tuning.

■ Mechanical system vibration suppression

- ◆ Automatic tuning for FF vibration suppression frequency
  Use to obtain vibration frequency to perform FF vibration suppressor control.
- ◆ Automatic tuning for notch filter
  Use to suppress high frequency resonance caused by mechanical system coupling or rigidity with notch filter.

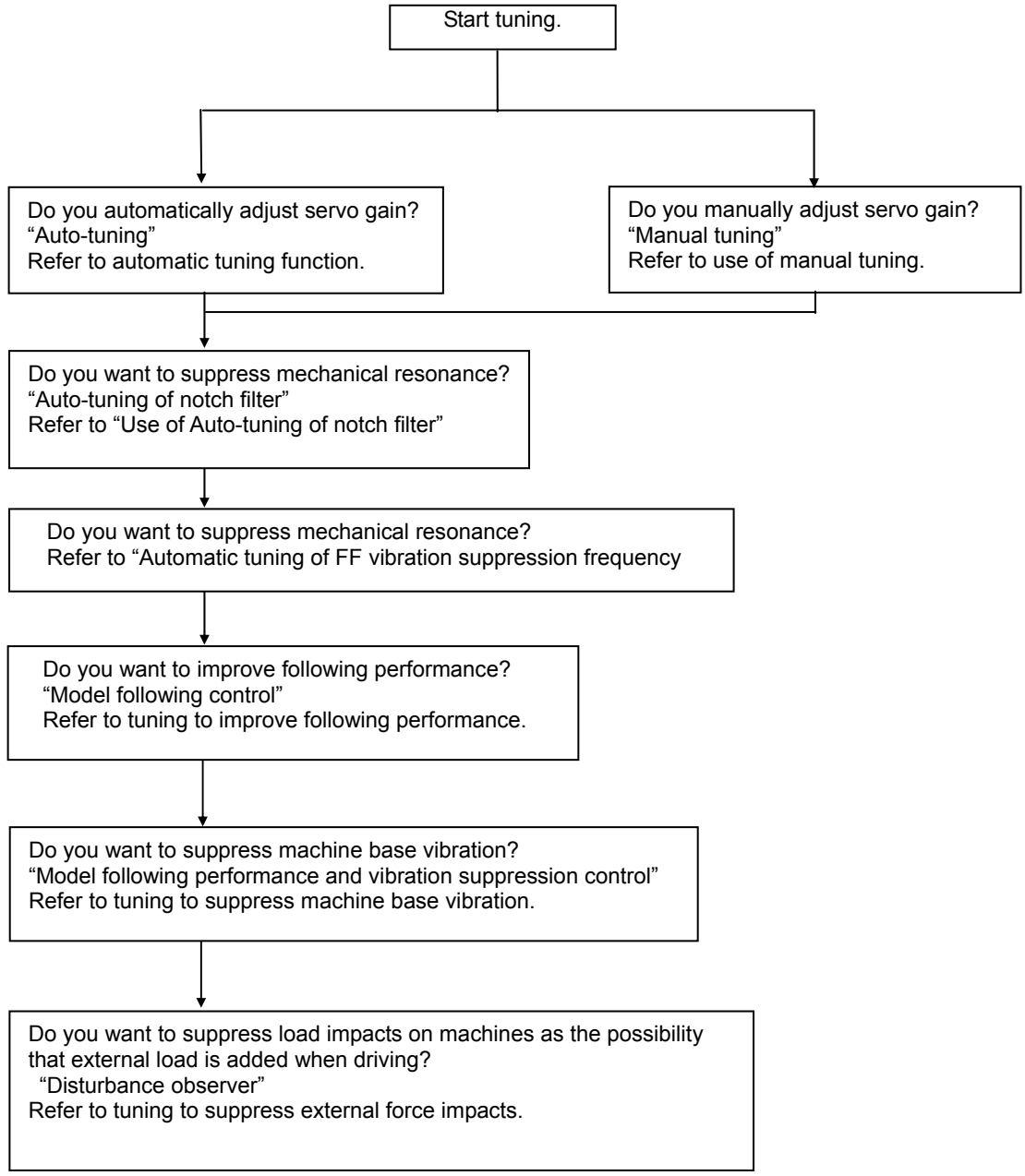
■ Model-following control

Model-following control is a control method ensuring response to command by configuring model control system including mechanical system in servo amplifier to operate actual servo motor so as to follow model control system.

- ◆ Model-following control
  Use model control system to improve response to command.
- ◆ Model-following vibration suppression control
  Use the model control system to suppress machine base vibration and improve response to command.

2) Selection of tuning method

Selecting procedure of tuning method is shown in the flowchart below.



✔ Some functions cannot be used together, depending on the combinations of functions.

6.2 Automatic Tuning

1) Parameters for use in automatic tuning.

■ Parameters list

Use the following parameters when performing automatic tuning.

◆ Group0 ID00 [Tuning Mode]

00:_AutoTun	Automatic Tuning
01:_AutoTun_JRAT-Fix	Automatic Tuning [JRAT manual setting]
02:_ManualTun	Manual Tuning

◆ Group0 ID01 [Auto-Tuning Characteristic]

00:_Positioning1	Positioning Control 1(General Purpose)
01:_Positioning2	Positioning Control 2(High Response)
02:_Positioning3	Positioning Control 3 (High Response, FFGN Manual Setting)
03:_Positioning4	Positioning Control 4 (High Response, Horizontal Axis Limited)
04:_Positioning5	Positioning Control 5 (High Response, Horizontal Axis Limited, FFGN Manual Setting)
05:_Trajectory1	Trajectory Control 1
06:_Trajectory2	Trajectory Control 2(KP, FFGN Manual Setting)

◆ Group0 ID02 [Auto-Tuning Response]

1-30	Automatic Tuning Response

■ Descriptions for each parameter

The details of each parameter are listed below.

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>00</td><td>
Tuning Mode [TUNMODE]

<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>AutoTun</td><td>Automatic Tuning</td></tr>
</table>
◆ Servo amplifier estimates Load inertia moment ratio of the machine or equipment during real time and automatically tunes the servo gain.
◆ Parameters for the servo amplifier to automatically tune vary depending on selected auto-tuning characteristics.
◆ Servo amplifier estimates the Load inertia moment ratio at the time of acceleration/deceleration. Therefore, for operations only with excessively long acceleration/deceleration time constants or with only low torque in low velocity, this mode cannot be used.
Also, for operations with high disturbance torque or with major mechanical clearance, this mode cannot be used.
[01: _AutoTun_JRAT-Fix Automatic Tuning [JRAT Manual Setting]

<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>01</td><td>AutoTun_JRAT-Fix</td><td>Automatic Tuning [JRAT manual setting]</td></tr>
</table>
◆ Based on the Load inertia moment ratio (JRAT1) [Group1 ID14], which has to be set, the servo amplifier automatically tunes to the best servo gain.
◆ Parameters for the servo amplifier to automatically tune will vary depending on the selected auto-tuning characteristics.

<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>02</td><td>ManualTun</td><td>Manual Tuning</td></tr>
</table>
◆ This mode is used in order to adjust the servo gain to the machine or equipment to ensure maximum response as well as when characteristics in auto-tuning are insufficient.
</td></tr>
</table>

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>01</td><td>
Auto-Tuning Characteristic [ATCHA]
■ Auto-Tuning Characteristic to fit the mechanical requirements and movements are provided. Parameters that can be adjusted vary depending on each auto-tuning characteristic. Set the parameters based on the situation.
■ [Positioning control (Positioning)]
Positioning control is a control method used to reach the servo motor quickly to target a position from the present position by disregarding the trajectory between the positions. Select this mode when positioning point by point is necessary.
■ [Trajectory control (Trajectory)]
Trajectory control is a method used to move the servo motor to the target position from the present position while considering the trajectory between the positions. Select this mode when the Position command corresponding trajectory control is needed such as in processing work.
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>Positioning 1</td><td>Positioning Control 1(General Purpose)</td></tr>
</table>
◆ Select for general positioning purposes.
◆ Parameters shown in table 2 cannot be adjusted manually.

<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>01</td><td>Positioning 2</td><td>Positioning Control 2(High Response)</td></tr>
</table>
◆ Select for high response positioning.
◆ Parameters shown in table 2 cannot be adjusted manually.

<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>02</td><td>Positioning 3</td><td>Positioning control 3(High Response, FFGN Manual Setting)</td></tr>
</table>
◆ Select this mode to adjust FFGN manually.
◆ The following parameter adjustment is made manually:

General parameters GROUP1 [Basic control parameter settings]
<table>
<tr><th>ID</th><th>Code</th><th>Name</th></tr>
<tr><td>05</td><td>FFGN</td><td>Feed Forward Gain</td></tr>
</table>
</td></tr>
</table>

01

Auto-Tuning Characteristic [ATCHA] (cont'd)

Selection		Description
03	Positioning 4	Positioning control 4(High Response, Horizontal Axis Limited)

- Select this mode when the machine movement is on a horizontal axis and receives no disturbing influence from external sources.
- Positioning time may be shortened compared to “Positioning Control 2”.
- Parameters shown in table 2 cannot be adjusted manually.

Selection		Description
04	Positioning 5	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 or when you want to adjust FFGN manually.
- Positioning time may be shortened compared to “Positioning control 3”.
- The following parameter adjustment is done manually.
  General parameters GROUP1 [Basic Control Parameter Settings]

ID	Code	Name
05	FFGN	Feed Forward Gain

Selection		Description
05	Trajectory1	Trajectory Control 1

- Select this mode for single axis use. The response of each axis can be different.
- Parameters shown in table 2 cannot be adjusted manually.

Selection		Description
06	Trajectory2	Trajectory Control 2 (KP, FFGN Manual Setting)

- Select this mode when you need equal responses from multiple axes, respectively. Adjust KP, FFGN.
- The following parameter adjustment is done manually.
  General parameters GROUP1 [Basic control parameter settings]

ID	Code	Name
02	KP1	Position Loop Proportional Gain 1
05	FFGN	Feed Forward Gain

02

Auto-Tuning Response [ATRES]

- Select this mode when Auto-tuning and Auto-tuning [JRAT manual setting] are used.
- As the setting value rises, the response increases.
  Set the value suitable for equipment rigidity.
- This does not function for manual tuning.

2) Parameters automatically adjusted during automatic tuning

Parameters automatically adjusted during automatic tuning are shown below.
Parameters automatically adjusted shall not be reflected to motor operation if you change ser values. Provided that some parameters are manually adjustable, depending on selected “automatic tuning mode” or “automatic tuning characteristics.”

■ General parameter Group1 [Basic control parameter settings]

ID	Code	Name	Remarks
02	KP1	Position Loop Proportional Gain 1	Note 1)
05	FFGN	Feed Forward Gain	Note1) Note2)
12	KVP1	Velocity Loop Proportional Gain 1	
13	TVI1	Velocity Loop Integral Time Constant 1	
14	JRAT1	Load Inertia Moment Ratio 1	Note 3)
15	TRCVGN	Higher Tracking Control Velocity Compensation Gain	
20	TCFIL1	Torque Command Filter 1	

Note 1) Trajectory control 2 [KP, FFGN-manual setting] can manually set.
Note 2) Positioning control 3 [high response performance, FFGN-manual setting] can manually set. Positioning control 5 [high response performance, horizontal axis-only, FGN-manual setting] can manually set.
Note 3) Automatic tuning [JRAT-manual setting] can manually set.

3) Adjustable parameters when auto-tuning in progress

The following parameters are adjustable during auto-tuning:

■ General parameter Group1 [Basic control parameter settings]

ID	Code	Name
00	PCSMT	Position Command Smoothing Constant
01	PCFIL	Position Command Filter
06	FFFIL	Feed Forward Filter
10	VCFIL	Velocity Command Filter
11	VDFIL	Velocity Feedback Filter
21	TCFILOR	Torque Command Filter Order

■ General parameters Group2
[FF vibration suppression control/ Notch filter/ Disturbance observer settings]

ID	Code	Name
00	SUPFRQ1	FF Vibration Suppressor Frequency 1
01	SUPLV	FF Vibration Suppressor Level Selection
10	VCNFIL	Velocity Command Notch Filter
20	TCNFILA	Torque Command Notch Filter A
21	TCNFPA	TCNFILA, Low Frequency Phase Delay Improvement
22	TCNFILB	Torque Command Notch Filter B
23	TCNFDB	TCNFILB, Depth Selection
24	TCNFILC	Torque Command Notch Filter C
25	TCNFDC	TCNFILC, Depth Selection
26	TCNFILD	Torque Command Notch Filter D
27	TCNFDD	TCNFILD, Depth Selection
30	OBCHA	Observer Characteristic
31	OBG	Observer Compensation Gain
32	OBLPF	Observer Output Low-pass Filter
33	OBNFIL	Observer Output Notch Filter

■ General parameter Group4
[Gain switching control/Vibration suppressor frequency switching settings]

ID	Code	Name
40	SUPFRQ2	FF Vibration Suppressor Frequency 2
41	SUPFRQ3	FF Vibration Suppressor Frequency 3
42	SUPFRQ4	FF Vibration Suppressor Frequency 4

■ General parameter Group5 [High setting control setting]

ID	Code	Name
00	CVFIL	Command Velocity Low-pass Filter
01	CVTH	Command Velocity Threshold
02	ACCC0	Acceleration Compensation
03	DFCC0	Deceleration Compensation

4) Unstable functions during auto-tuning

The following functions cannot be used during auto-tuning:

■ General parameter Group9 [Function enabling condition settings]

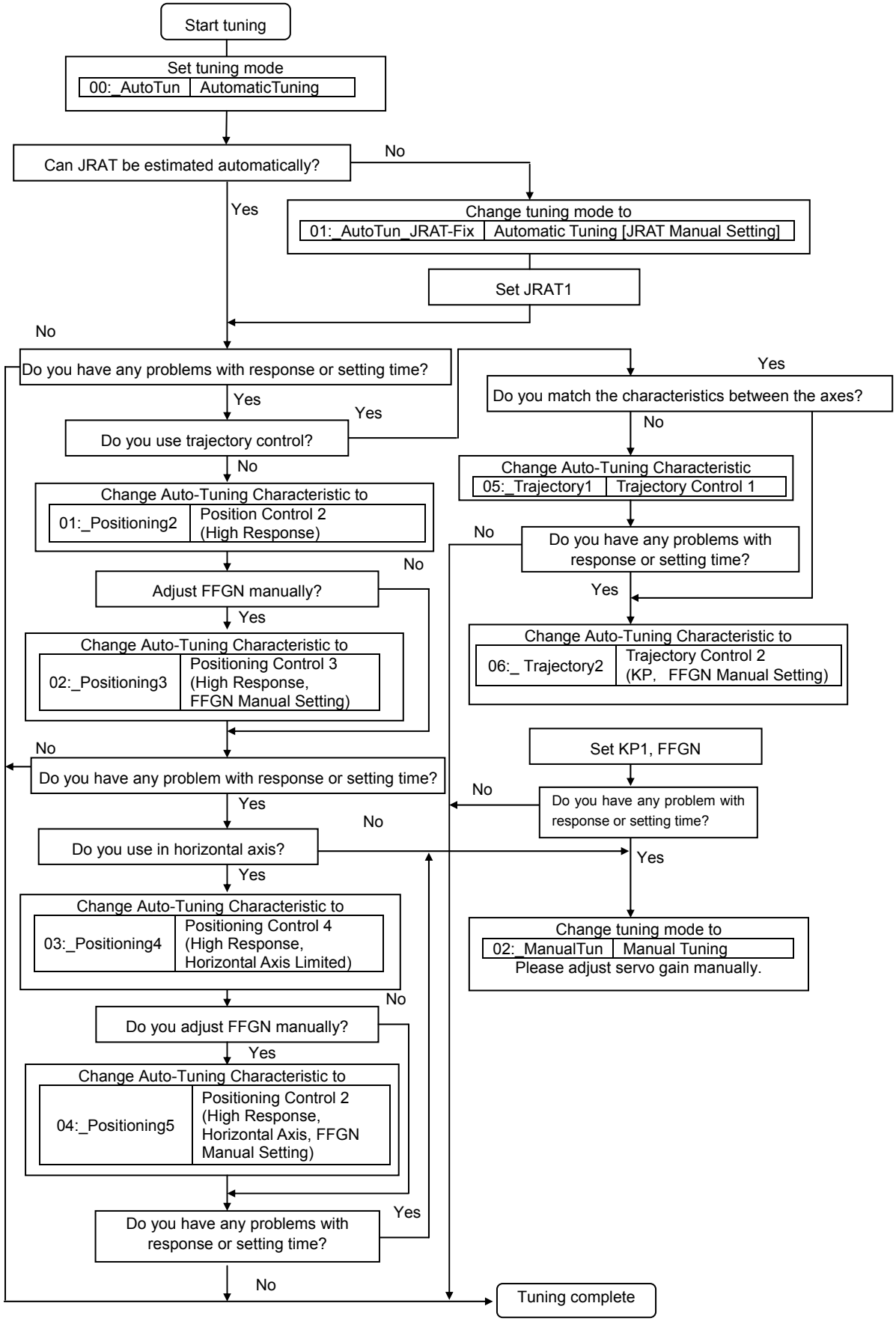
ID	Code	Name
13	GC1	Gain Switching Condition 1
14	GC2	Gain Switching Condition 2
17	PLPCON	Position Loop Proportional Control Switching Function
26	VLPCON	Velocity Loop Proportional Control Switching Function

■ General parameter Group1 [Basic control parameter settings]

ID	Code	Name
04	TRCPGN	Higher Tracking Control Position Compensation Gain
16	AFBK	Acceleration Feedback Gain

✔ [Disturbance observer] cannot be used together with auto-tuning.
Render [Disturbance observer] function invalid when auto-tuning is used.

5) Auto-Tuning Characteristic selection flowchart



6) Adjustment method for auto-tuning

Auto-tuning is a function where the servo amplifier automatically tunes to the best servo gain in real time.

Procedure 1	■ To estimate load inertia moment ratio with use of servo amplifier in real time and automatically adjust servo gain, set [00: _AutoTun Automatic Tuning] to [Tuning Mode]. To automatically adjust optimum gain based on manually set load inertia moment ratio (JRAT1), set [01: _AutoTun_JRAT-Fix Automatic Tuning [JRAT Manual Setting] to [Tuning Mode].
Procedure 2	■ After setting [Tuning Mode] select [Auto-Tuning Characteristic] for the machine or equipment.
Procedure 3	■ Next, boot the servo motor and adjust [Auto-Tuning Response] according to equipment rigidity. ◆ Set [Auto-Tuning Response] at a low value initially and allow the machine to work about 10 times or more by commanding higher-rank equipment. ◆ When response is low and the positioning setting time is slow, after machine movement, try to improve the response and positioning times by increasing [Auto-tuning] gradually. ◆ If increasing the response has caused the machine to develop vibration, lower the value of the [Auto-Tuning Response] slightly. ✔ If the machine has not developed vibration, enable the Vibration suppressor by setting the Notch filter and /or FF Vibration suppressor frequency. Set the filter frequency to suppress mechanical vibration by using [Automatic tuning of notch filter] and/or [Automatic tuning of FF Vibration Suppression Frequency]. ✔ Tuning methods are the same in [01: _AutoTun_JRAT-Fix [JRAT Manual Setting].

7) Monitoring servo gain adjustment parameters

Parameters automatically adjusted while auto-tuning is used can be monitored by setup software.

ID	Symbol	Name	Unit
1D	JRAT MON	Load Inertia Moment Ratio monitor	%
1E	KP MON	Position Loop Proportional Gain monitor	1/s
20	KVP MON	Velocity Loop Proportional Gain monitor	Hz
21	TVI MON	Velocity Loop Integral Time Constant monitor	ms
22	TCFIL MON	Torque Command Filter monitor	Hz
23	MKP MON	Model Control Gain monitor	1/s

8) Manual tuning method using auto-tuning results

Auto-tuning result can be stored in block and used for manual tuning. Perform “auto-tuning” → “store auto-tuning result.”

- Saving parameters
  - General parameters Group1 [Basic control parameter settings]

ID	Symbol	Name	Unit
02	KP1	Position Loop Proportional Gain 1	1/s
12	KVP1	Velocity Loop Proportional Gain 1	Hz
13	TVI1	Velocity Loop Integral Time Constant 1	ms
14	JRAT1	Load Inertia Moment Ratio 1	%
20	TCFIL1	Torque Command Filter 1	Hz

  - General parameters Group3 [Model following control settings]

ID	Symbol	Name	Unit
00	KM1	Model Control Gain 1	1/s

6.3 Automatic tuning of notch filter

Notch filter can suppress high frequency resonance caused by mechanical coupling and rigidity. Automatic tuning of notch filter can easily search mechanical resonance frequency by operating servo amplifier and motor in a short time.

1) Operation method

■ Start to operate from auto-tuning mode in setup software.
■ Tuning results are automatically saved in [Group2 ID20: Torque command notch filter A (TCNFILA)].
✔ Torque command notch filter function can be used together with auto-tuning.
✔ Holding torque decreases during auto-tuning of notch filter. Do not operate in gravity axis.

■ When mechanical resonance does not stop even after automatic tuning of notch filter, several resonances may exist. In this case, examine mechanical resonance frequencies by using system analysis function to suppress each resonance by using notch filter B, C, and D (manual setting). If resonance still exists, auto-tuning response performance or control gain may be too high. If so, decrease tuning response performance or control gain.

2) Parameters to be set

■ Torque command value for auto-tuning of notch filter
Set torque command value given to motor during auto-tuning of notch filter.
◆ General parameter Group0 [Auto-tuning settings]

ID	Symbol	Name	Unit	Setting range
10	ANFILTC	Torque command of automatic tuning of notch filter	%	10.0-100.0

✔ As value increases, so does tuning accuracy. However, machine movement will increase as well. Please monitor closely.

■ Parameters automatically saved by automatic tuning of notch filter
◆ General parameter Group2
[FF vibration suppression control/ notch filter/ disturbance observer settings]

ID	Symbol	Name	Unit	Setting range
20	TCNFILA	Torque command notch filter A	Hz	100-4000

✔ The value is automatically saved in the above parameter by automatic tuning of notch filter.

6.4 Automatic tuning of FF vibration suppression frequency

Set value of FF vibration suppression frequency to suppress low frequency vibration such as machine end vibration. Automatic tuning of FF vibration suppression frequency can easily set FF vibration suppression frequency by operating servo amplifier and motor in a short time.

1) Operation method

- Start to operate from auto-tuning mode in setup software.
- Tuning results are automatically saved in [Group2 ID00: FF vibration suppression frequency 1[SUPFREQ1]]
- FF vibration suppression frequency is obtained to set by performing auto-tuning of vibration suppression frequency or by calculating frequency according to machine vibration cycle in positioning.
  - ✔ When vibration does not stop even after setting FF vibration suppression frequency, control system gain may be too high. If so, decrease control system gain.
  - ✔ Vibration suppression effect may be improved when using together with high tracking control velocity compensation gain.
  - ✔ FF vibration suppression function can be used together with auto-tuning.
  - ✔ Holding torque decreases during FF vibration suppression frequency tuning. Please do not use servo amplifier and motor in gravity axis.

2) Parameters to be set

- Torque command value of automatic tuning of FF vibration suppression frequency
  Set torque command value given to motor during automatic tuning of FF vibration suppression frequency.

  ◆ General parameter Group0 [Auto-tuning setup]

ID	Symbol	Name	Unit	Setting range
20	ASUPTC	Automatic tuning of FF vibration suppression frequency torque command	%	10.0-100.0

  ✔ Please note that as value increases, so does tuning accuracy, and machine movement also increase as well.

- Friction torque compensation amount during automatic tuning of FF vibration suppression frequency.
  Sets frictional torque compensation amount added to torque given to servo motor during automatic tuning of FF vibration suppression frequency. The accuracy of automatic tuning of FF vibration suppression frequency can be improved by setting the value closed to actual friction torque.

  ◆ General parameter Group0 [Auto-tuning setup]

ID	Symbol	Name	Unit	Setting range
21	ASUPFC	Automatic tuning of FF vibration suppression frequency friction compensation value	%	0.0-50.0

- Parameter automatically saved by automatic tuning of FF vibration suppression frequency.
  ◆ General parameter Group2
  [FF vibration suppression control/ notch filter/ disturbance observer settings]

ID	Symbol	Name	Unit	Setting range
00	SUPFRQ1	FF vibration suppression frequency 1	Hz	5-500

6.5 Use of manual tuning

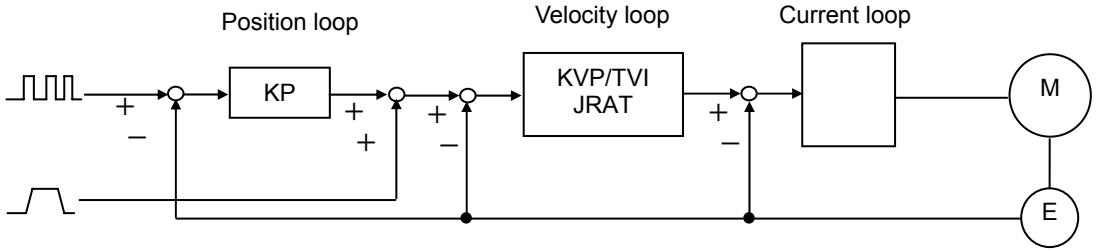
When sufficient adjustment was not achieved by using automatic tuning, use manual tuning mode to manually adjust all the gains. Set the tuning mode to manual tuning.

■ General parameter Group0 ID00: tuning mode [TUNMOD]

02: _ManualTun	Manual Tuning

1) Servo system configuration and servo adjustment parameter

Servo system consists of 3 systems, position loop, velocity loop, and current loop. The most inner side of loop needs to be high response performance. When this relationship is disrupted, the system becomes unstable, decreases the response performance, vibrates, or oscillates.



The following describes servo parameters (Group1).

■ Constant for smoothing position command [PCSMT]
Moving average filter to smooth position command pulse. When electronic gear ratio is high, or position command pulse is coarse, set this parameter to smooth position command pulse.

■ Position command filter [PCFIL]
When resolution is low, set this parameter to suppress ripples contained in position command. The more you increase parameter value, the more enhanced ripple suppression effects, but delay increases.

✔ If you set advanced following control position compensation to other than 0%, parameter shall be automatically set.

■ Position loop proportional gain [KP]
Set position command response performance. Set by referring to $KP_{[1/S]}=KVP_{[Hz]}/4\cdot2\pi$.

■ Advanced following control position compensation gain [TRCPGN]
When position command resolution is high and you want to enhance following performance, increase this parameter after adjusting advanced following control velocity compensation gain to improve following performance.

■ Feed forward gain [FFGN]
Increase this gain to improve following performance for position command.
Set the gain 30%-40% for positioning control as a guide.
✔ When advanced following control position compensation gain set to other than 0%, this parameter shall be automatically set.

■ Feed forward filter [FFFIL]
Set this parameter to suppress ripples when position command resolution is low.

■ Velocity loop proportional gain [KVP]
Set response performance of velocity control. Set the value as high as possible in the range that mechanical system does not vibrate and oscillate, and stably operates. If JRAT is correctly set, the value set as KVP shall be response bandwidth of velocity loop.

■ Velocity loop constant in integral [TVI]
Set by referring "$TVI_{[ms]}=1000/(KVP_{[Hz]})$."

■ Load inertia moment ratio [JRAT]
Set the following calculated value.

$$JRAT=\frac{\text{Motor axis-converted load inertia moment } (J_L)}{\text{Motor inertia moment } (J_M)}\times 100\%$$

■ High tracking control velocity compensation gain [TRCVGN]
Increase compensation gain to improve following performance. Adjust so as to shorten position setting time.
✔ Set properly JRAT when using this function.
✔ Set to 0% when using "velocity loop proportional control switching function (Group9 ID27)" during operation.
✔ Set 100% to ensure the performance equivalent to series Q servo amplifier.

■ Torque command filter 1 [TCFIL1]
When mechanical system rigidity is high, increase set value to set velocity loop proportional gain high. When mechanical system rigidity is low, decrease set value to suppress resonance and abnormal noise in high frequency range. Set to 1200Hz or less for normal use.

2) Basic manual tuning method for velocity control

- Set velocity loop proportional gain [KVP1] as high value as possible within the range that motor does not vibrate, oscillate, and operate safely. When vibration occurs decrease the set value.

- Set velocity loop constant in integral [TVI1] by referring to "TVI $_{[ms]}$=1000/KVP $_{[Hz]}$."
  - ✔ When you cannot increase the gain because of mechanical resonance, etc., and the response is insufficient (after using the Torque notch filter and/or FF vibration suppressor frequency to suppress resonance) try the procedure again.

3) Basic manual tuning method for position control

- Set Velocity Loop Proportional Gain (KVP1) as high as possible within the range that allows the mechanical device to maintain stability without causing vibration or oscillation.
  If vibration increases, lower the value.
- Set Velocity Loop Integral Time Constant (TVI1) to: TVI $_{[ms]}$=1000/ (KVP $_{[Hz]}$)
- Position Loop Proportional Gain (KP1) to: KP $_{[1/S]}$ = KVP$_{[HZ]}$/4·2π
  In case vibration occurs, lower the value.
  - ✔ When you cannot increase the gain because of mechanical resonance, etc., and the response is insufficient (after using the Torque notch filter and/or FF vibration suppressor frequency to suppress resonance) try the procedure again.

6.6 Model-following control

Model control is a control method configuring model control system including mechanical system in servo amplifier and operating actual servo motor so as to follow model control system to enhance response performance. Select “Position control” in “Control mode selection” and “Model-following control” in “Position control selection.”

ID	Content
09	Control Mode Selection Select value: 02 Position — Description: Position control form
0A	Position Control Selection Select value: 01 Model1 — Description: Model following control

✔ Model-following control can be used together with auto-tuning.
✔ Model-following control can be used together with fully closed control.

1) Automatic tuning method of model-following control

Model-following control can be used together with automatic tuning. Perform tuning in the same procedure as “Automatic tuning adjustment method.” Automatic tuning of model-following control tunes ”Model control gain 1” in addition to parameters tuned by standard position control.

■ Parameters automatically-adjusted by model-following control automatic tuning.

◆ General parameter Group1 “Setting of basic control parameters”

ID	Code	Name	Remarks
02	KP1	Position Loop Proportional Gain 1	Note 1)
12	KVP1	Velocity Loop Proportional Gain 1	
13	TVI1	Velocity Loop Integral Time Constant 1	
14	JRAT1	Load Inertia Moment Ratio 1	Note 2)
20	TCFIL1	Torque Command Filter 1	

Note 1) Manual setting is available on trajectory control 2(KP, FFGN-manual setting).
Note 2) Manual setting is available on automatic tuning [JRAT-manual setting].

◆ General parameter Group3 “Setting of model-following control”

ID	Code	Name	Remarks
00	KM1	Model Control Gain 1	Note 3)

Note 3) Setting value KP1 shall be set in trajectory control 2(KP, FFGN-manual setting).

✔ Parameters automatically adjusted by servo amplifier shall be differ depending on selected automatic tuning characters.

2) Manual tuning method of model-following control

- Set velocity loop proportional gain [KVP1] as high as possible in the range that machine does not vibrate and oscillate, and stable operates. When vibrations occurred, decrease the set value.

- Set velocity loop constant in integral [TVI1] by referring "$TVI_{[ms]}=1000/KVP_{[Hz]}$."

- Set position loop proportional gain [KP1] by referring "$KP_{[1/S]}=KVP_{[Hz]}/4\cdot2\pi$."

- Set model control gain [KM1] by referring "KM≒KP." When vibrations occurred, decrease the set value.

- If you feel response performance is low, set model control gain [KM1] to the value of 1.1 to 1.2 times.
  - ✔ When you cannot obtain sufficient positioning setting time or response performance because you cannot increase gain due to mechanical system resonance, re-perform setting after suppressing resonance by using torque command notch filter or FF vibration suppression frequency.

- Adjustable parameters with model-following control
  Model-following control can control the following parameters in addition to adjustable parameters by existing position control.

  - General parameter Group3 "Setting of model-following control"

ID	Code	Name
00	KM1	Model Control Gain 1
01	OSSFIL	Overshoot Suppressor Filter

  - Model control gain1 [KM1]
    This is proportional gain of model-following control position control equipment. Adjust by referring to "KM≒KP."
  - Overshoot suppression filter [OSSFIL]
    Set cut-off frequency of filter to suppress overshoot in model-following control. When overshoot occurred in position deviation, decrease the set value.

6.7 Tuning to suppress vibration

1) FF vibration suppression control

Use ”FF vibration suppression control” to suppress vibrations occurred at the end of machine.

- Adjust gain in the same procedure as basic position control tuning procedure.
- When vibrations occurred at the end of machine during operation, use “Automatic FF vibration suppression frequency tuning,” or calculate vibration frequency according to machine oscillation cycle to set vibration frequency in “FF vibration suppression frequency 1[SUPFRQ1].”

  ◆ General parameter Group2 “Setting of FF vibration suppression control / notch filter/ disturbance observer”

ID	Code	Name	Unit	Setting range
00	SUPFRQ1	FF Vibration Suppressor Frequency 1	Hz	5-500

✔ If vibrations occurred at the end of machine is not suppressed with the above method, control system gain may be too high. In this case, decrease the gain.

✔ Please do not change the set value during motor operation.

2) Model-following and vibration suppression control

If you drive table by using servo motor on machine stand, the machine stand itself may vibrate due to force applied to the stand as a reaction of servo motor operation. This stand vibration can adversely affect positioning setting of table operating on it. “Model-following vibration suppression control” suppresses the above stand vibrations and improves machine positioning setting time and response performance.

- Select “Position control” of system parameter “control mode selection”, and then select “Model-following vibration suppression control” in “Position control selection” to use model-following vibration suppression control. You can operate servo motor under the condition that model control system suppresses machine stand oscillating component.

ID	Contents
09	Control Mode Selection Select value: 02 Position — Description: Position Control
0A	Position Control Selection Select value: 02 Model2 — Description: Model-following vibration suppression control

✔ Please do not use auto-tuning with model-following vibration suppression control.

✔ Fully closed control cannot be used with model-following vibration suppression control.

■ Adjustable parameters with model-following control

◆ General parameter Group3 “Setting of model-following control“

ID	Code	Name	Unit	Setting range
00	KM1	Model Control Gain 1	1/s	15-315
01	OSSFIL	Overshoot Suppressor Filter	Hz	1-4000
02	ANRFRQ1	Model Control Anti-resonance Frequency 1	Hz	10.0-80.0
03	RESFRQ1	Model Control Resonance Frequency 1	Hz	10.0-80.0

◆ Model control gain1 [KM1]
This is proportional gain of model-following control position control equipment. Adjust by referring to “KM≒KP.”

◆ Overshoot suppression filter [OSSFIL]
Set cut-off frequency of filter to suppress overshoot in model-following control.
When overshoot occurred in position deviation, decrease the set value.

◆ Model control anti-resonance frequency 1 [ANRFRQ1]
Set the anti-resonance frequency of machine model used in model-following vibration suppression control.
Vibration suppression control becomes invalid when setting to the value over model-following resonance frequency.

◆ Model control resonance frequency 1 [RESFRQ1]
Set the resonance frequency of machine model used in model-following vibration suppression control.
Vibration suppression control becomes invalid at setting value 80.0Hz.

✔ Please do not change the set value during operation.

■ Parameter setting range in model-following control
The following parameters shall be limited in setting range in model-following control.

◆ General parameter Group1 “Setting of basic control parameters”

ID	Code	Name	Unit	Setting Range
14	JRAT1	Load Inertia Moment Ratio 1	%	100-3000
20	TCFIL1	Torque Command Filter 1	Hz	100-1000

◆ General parameter Group3 “Setting of model-following control”

ID	Code	Name	Unit	Setting range
00	KM1	Model Control Gain 1	1/s	15-315

3) Tuning method

- Select ”01: _Model_1 model–following control” of system parameter ”ID0A: position control selection” in advance, and then perform automatic tuning by ”model–following control” to tune to optimum servo gain for machine. Refer to “Automatic tuning method for model-following control” for the tuning method.
  - ✔ When already appropriately tuned for machine, please ignore this term.

- Change tuning mode to “manual tuning” after performing storing-function of auto-tuning results.

- Set system parameter “ID0A: position control selection” to “02: _Model_2 model following vibration suppression control” to set mechanical antiresonant frequency and resonant frequency. If you already know antiresonant frequency and resonant frequency in advance, set the values. If not, you can measure antiresonant frequency and resonant frequency to set by using system analysis.

  - ✔ Refer to ”Setup software operating manual M0008363” for the operating method of system analysis.
  - ✔ Set “frequency range selection” to low frequency range to measure anti-resonance and resonance frequency by using system analysis. If set in high frequency range, anti-resonance and resonance frequency in suppressible range with use of model-following vibration suppression control cannot be measured. We recommend selecting 1-125[Hz] in “frequency range selection.”
  - ✔ When the mass of moving part running on motor is less than the one of machine stand, anti-resonance and resonance frequency may not be measured by using system analysis. In this case, measure vibration cycle of machine at positioning, calculate the reciprocal number to obtain vibration frequency (model anti-resonance frequency), and then set model resonance frequency to the value of 1.05 - 1.2 times of anti-resonance frequency.

- Set velocity loop proportional gain [KVP1] as high as possible in the range that machine does not vibrate and oscillate, and stable operates. When vibrations occurred, decrease the set value.

- Set velocity loop constant in integral [TVI1] by referring “$TVI_{[ms]}=1000/KVP_{[Hz].}$”

- Set position loop proportional gain [KP1] by referring $KP_{[1/S]}=KVP_{[Hz]}/4\cdot2\pi$.”

- Set model control gain [KM1] by referring “KM≒KP.” When vibrations occurred, decrease the set value.

- If you feel response performance is low, set model control gain [KM1] to the value of 1.1 to 1.2 times.

- Frequency vibrations other than set anti-resonance and resonance frequency may exist depending on mechanical system configurations. In this case, use FF vibration suppression control together to suppress vibrations. Calculate vibration frequency according to vibration cycle, and then set the vibration frequency into “Group2 ID00: vibration suppression frequency 1[SUPFRQ1].”

- When you cannot increase gain due to mechanical system resonance, and cannot obtain sufficient response performance, re-perform after suppressing resonance by using torque command notch filter and FF vibration suppression frequency.

6.8 Use of disturbance observer functions

Disturbance observer is a function to suppress external load torque impacts as follows: When external load torque is applied to servo motor, disturbance observer estimates load torque inside servo amplifier, adds compensation for load torque to torque command. Set ”Group9 ID33: disturbance observer function [OBS]” to “function enabled” to use disturbance observer. Adjust parameters related to observer in “Group2 ID30 - 33” to suppress disturbance impacts.

■ Parameters for use in disturbance observer

◆ Group9 “Setting of each function enabling conditions”

ID	Code	Description	Setting range
33	OBS	Disturbance Observer Function	00 - 27

◆ General parameter Group2 “setting of FF vibration suppression control/notch filter/ disturbance observer”

ID	Code	Name	Unit	Setting range
30	OBCHA	Observer Characteristic	-	00 - 02
31	OBG	Observer Compensation Gain	%	0 - 100
32	OBLPF	Observer Output Low-pass Filter	Hz	1 - 4000
33	OBNFIL	Observer Output Notch Filter	Hz	100 - 4000

■ Descriptions of parameters for use in disturbance observer

◆ Observer characteristics ”00_Low Low-frequency disturbance suppression”, ”01_Middle Middle-frequency disturbance suppression”, and ”02_High High disturbance suppression” are provided.
Select the optimum characteristic depending on disturbance frequency you want to suppress.

Frequency	Type
10 - 40[Hz]	00_Low : For low-frequency disturbance suppression
40 - 80[Hz]	01_Middle: For mid-frequency disturbance suppression
80 - 200[Hz]	02_High : For high frequency disturbance suppression

◆ Gradually increase set value of observer compensation gain, not immediately increase from the start. The more you increase observer compensation gain, the more improved disturbance suppression characteristic becomes. Provided that motor may oscillate when observer compensation gain increases to excess, so keep the range motor does not oscillate.

✔ Do not use automatic tuning together with disturbance observer.
✔ Use observer output low-pass filter to modify observer characteristic by setting high frequency when encoder resolution is high or load inertia moment ratio is low.
✔ Use observer output notch filter to suppress vibrations when resonance changed in high-frequency range.
✔ Use “02_High High disturbance suppression” when encoder resolution is over 1048576 divisions.

7

7. Maintenance

7.1 Troubleshooting

When any failures occur without any alarm code display, refer to the following items and then examine causes and take appropriate corrective actions. When alarm code displayed, take corrective actions indicated in “Troubleshooting when alarm activated.”

■ [STA] LED does not rapidly flash after main circuit power supply on.

Check item	Probable cause and corrective action
Check voltage on power input terminal.	■ Check power supply if the voltage is low. ■ Check wiring and screw-tightening.

■ [STA] LED flashes at a low velocity, but servo motor does not rotate.

Check item	Probable cause and corrective action
Check to see if command is input with monitor of setup software. Page 13: Position command pulse frequency monitor	■ If monitored value is zero, input command.
Confirm servo-lock is established.	When servo-lock is not established, ■ Confirm Servo motor input line is connected. ■ Confirm emergency stop is not input. ■ Confirm “function enabling condition setting” for the parameter.
Confirm input signal state of torque limit.	■ When torque limit is input, and the limit value is less than load torque, servo motor cannot output torque more than load torque. ■ Confirm “function enabling condition setting” for the parameter.
Confirm input signal state of deviation-clear.	■ When deviation-clear is input, do not perform deviation -clear input. ■ Confirm “function enabling condition setting” for the parameter.
Confirm input signal state of encoder-clear.	■ When encoder-clear is input, do not perform encoder-clear input. ■ Confirm “function enabling condition setting” for the parameter.
OT-state	■ Do not perform OT-input. ■ Confirm “function enabling condition setting” for the parameter.

✔ Make sure to turn off power supply when you perform corrective actions.

■ Servo motor operates unstably, and the operation velocity is lower than commanded velocity.

Check item	Probable cause and corrective action
Confirm input signal state of proportional control.	■ When proportional control is input, do not perform proportional control input. ■ Confirm “function enabling condition setting” for the parameter.
Confirm input signal state of torque limit.	■ When torque limit is input, do not perform torque limit input. ■ Confirm “function enabling condition setting” for the parameter.

■ Servo motor momentarily operates but will not operate after that.

Check item	Probable cause and corrective action
Check servo motor power line.	■ Any of servo motor power lines are disconnected.
Check setting of motor to be combined.	■ Change the setting and then re-turn on power.
Check setting of encoder resolution. (System parameter)	

✔ Make sure to turn off power supply when you perform corrective actions.

■ Servo motor goes out of control.

Check item	Probable cause and corrective action
Check servo motor power line.	■ Order of servo motor power line phase is incorrect.
Check wiring of encoder cable.	■ Wiring of encoder is incorrect.

✔ Make sure to turn off power supply when you perform corrective actions.

■ Servo motor vibrates.

Check item	Probable cause and corrective action
Check to see if servo motor vibrates at frequency over 200Hz.	■ Decrease velocity loop gain, set torque command low-pass filter and torque command notch filter.

■ Overshoot or undershoot occurs at start-up/stop.

Probable cause and corrective action
■ Adjust automatic tuning “response performance.”
■ Decrease velocity loop gain.
■ Increase constant in velocity integration.
■ Slow down command acceleration and deceleration pattern.
■ Activate position command low-pass filter.

■ Abnormal noise occurred.

Check item	Probable cause and corrective action
Check machine installation.	■ Operate servo motor in stand-alone style. ■ Check gap or misalignment between couplings.
Check to see if abnormal noise has any periodicities by operating at low velocity.	■ Check to see if twisted-pair and shielding are applied to signal lines of motor encoder. ■ Check if motor encoder line and servo motor power line are wired in the same duct. ■ Check for power supply voltage decrease.

7.2 Warning and alarm list

Warning, alarm, description, stoppage when failures detected, and alarm reset procedure are described below.

1) Warning list

	Warning	Description
Load system	Overload warning	■ Effective torque has exceeded “overload warning level.”
	Servo amplifier temperature warning	■ Ambient temperature of servo amplifier is out of specification scope.
Power system	Main circuit in the process of charging	■ Main circuit voltage is DC38V <19V> or over.
External input system	Over travel in normal rotation	■ Over travel in normal rotation is now in inputting.
	Over travel in reverse rotation	■ Over travel in reverse rotation is now in inputting.
Encoder system	Serial encoder battery warning	■ Battery voltage: 3.0V or less
Control system	Torque command being limited	■ Torque command is now limited to torque limit value.
	Velocity command being limited	■ Velocity command is now limited to velocity limit value.
	Position deviation in excess	■ Position deviation is exceeding warning-set value.

2) Alarm List

Operation at detecting: "DB" performs the slowdown stop of the servo motor in dynamic brake operation when the alarm generating. Operation at detecting: "SB" performs the slowdown stop of the servo motor with sequence current limiting value.
When dynamic brake is selected by Emergency Stop Operation selection, the servo motor is decelerating stopped for the dynamic brake operation regardless of the operation when detecting it. (However, it stops in free servo brake operation at the time of alarm 53H (DB resistor overheating) detection.
* Note that servo amplifier without dynamic brake function stopps in free-running.

	Alarm code								Alarm name	Alarm contents	Detection Operations	Alarm Clear
	Display	3 bits output			PY compatible code							
		Bit7	Bit6	Bit5	ALM8	ALM4	ALM2	ALM1				
Drive error	21	0	0	1	0	0	0	1	Main Circuit Power Device Error (Over current)	■ Over current of drive module ■ Abnormality in drive power supply ■ Overheating of drive module	DB	V
	22				0	0	0	1	Current Detection Error 0	■ Abnormality of electric current detection value	DB	V
	23				0	0	0	1	Current Detection Error 1	■ Abnormality of Electric current detection circuit	DB	V
	24				0	0	0	1	Current Detection Error 2	■ Abnormality in communication with Electric current detection circuit	DB	V
Load error	41	0	1	0	0	0	1	0	Overload 1	■ Excessive effective torque	SB	V
	45				0	0	1	0	Average continuous over velocity	■ Over velocity in average rotational velocity	SB	V
	51				0	0	1	1	Servo Amplifier Temperature Error	■ Overheating detection of amplifier ambient temperature	SB	V
	55				0	0	1	1	External Error	■ Overheating detection of External regeneration resistor	DB	V
Power supply error	61	0	1	1	0	1	0	1	Over-voltage	■ DC Excess voltage of main circuit		
	62				1	0	0	1	Main Circuit Under-voltage Note1)	■ DC Main circuit low voltage	DB	V
	73				0	1	1	1	Control Circuit Under-voltage 2	■ Under voltage of +5V	SB	NA

	Alarm code							Alarm name	Alarm contents	Detection Operations	Alarm Clear
	Display	3 bits output			PY compatible code						
		Bit7	Bit6	Bit5	ALM8	ALM4	ALM2	ALM1				
Abnormality related to encoder wiring	81	1	0	0	1	0	0	0	Encoder Connector 1 Disconnection	■ Pulse encoder (A, B, Z) signal line break ■ Power supply break	DB	NA
	83				1	0	0	0	Encoder Connector 2 Disconnection	■ Breaking of fully closed Encoder (A, B, Z) signal line	DB	V
	84				1	0	0	0	Serial Encoder Communication Error	■ Encoder serial signal time out ■ Serial communication data error	DB	NA
	85				1	0	0	0	Encoder Initial Process Error	■ Failed to read CS data of pulse encoder ■ Abnormality in initial process of serial encoder	–	NA
	87				1	0	0	0	CS Signal Disconnection	■ CS signal line break	DB	NA
Abnormality in encoder main body	A0	1	0	1	1	0	0	0	Serial Encoder Internal Error 0	■ Encoder failure	DB	NA
	A1				1	0	0	0	Serial Encoder Internal Error 1	■ Multi-turn error	DB	Note 2)
	A2				1	0	0	0	Serial Encoder Internal Error 2	■ Accelerate error	DB	Note 2)
	A3				1	0	0	0	Serial Encoder Internal Error 3	■ Over-velocity	DB	Note 2)
	A4				1	0	0	0	Serial Encoder Internal Error 4	■ Access error of Encoder internal EEPROM	DB	Note 2)
	A5				1	0	0	0	Serial Encoder Internal Error 5	■ 1 rotation coefficient incorrect	DB	Note 2)
	A6				1	0	0	0	Serial Encoder Internal Error 6	■ Multiple rotations coefficient incorrect	DB	Note 2)
	A9				1	0	0	0	Serial Encoder Internal Error 9	■ Servo motor built-in Encoder Overheating	DB	Note 2)
	AA				1	0	0	0	Serial Encoder Internal Error 10	■ Position data incorrect	DB	Note 2)
	AB				1	0	0	0	Serial Encoder Internal Error 11	■ Encoder incorrect	DB	Note 2)
	AC				1	0	0	0	Serial Encoder Internal Error 12	■ Error generation of multi-rotation data	DB	Note 2)
	AD				1	0	0	0	Serial Encoder Internal Error 13	■ Encoder internal EEPROM data is not set	DB	Note 2)
	AE				1	0	0	0	Serial Encoder Internal Error 14	■ Resolver Abnormality	DB	Note 2)
	AF				1	0	0	0	Serial Encoder Internal Error 15	■ Resolver disconnection	DB	Note 2)

	Alarm code							Alarm name	Alarm contents	Detection Operations	Alarm Clear
	Display	3 bits output			PY compatible code						
		Bit7	Bit6	Bit5	ALM8	ALM4	ALM2	ALM1				
Control system abnormality	C1	1	1	0	0	1	1	0	Over-velocity	■ Motor rotation velocity is 120 % more than the highest velocity limit	DB	V
	C2				1	1	0	0	Velocity Control Error	■ Torque command and acceleration direction are not matching.	DB	V
	C3				1	1	0	0	Velocity Feedback Error	■ Servo motor power disconnection Note 3)	DB	V
	C5				1	1	0	0	Model tracking vibration suppression control error	■ Machine cycle time is not mach with model following vibration suppression control.	DB	V
	D1				1	1	0	1	Excessive Position Deviation	■ Position Deviation exceeds setup value.	DB	V
	D2				1	1	0	1	Faulty Position Command Pulse Frequency 1	■ Frequency of entered position command pulse is excessive	SB	V
	D3				1	1	0	1	Faulty Position Command Pulse Frequency 2	■ Position command frequency after electronic gear is high.	SB	V
	DF				1	1	0	1	Test Run Close Note 4)	■ Detection in 'Test mode end' status	DB	V
Control system/ Memory system abnormality	E1	1	1	1	1	1	1	1	EEPROM Error	■ Abnormality of amplifier with built-in EEPROM	DB	NA
	E2				1	1	1	1	EEPROM Check Sum Error	■ Error in check sum of total range of EEPROM	–	NA
	E3				1	1	1	1	Memory Error 1	■ Access error in CPU built in RAM	–	NA
	E4				1	1	1	1	Memory Error 2	■ Checksum error of FLASH memory with built in CPU	–	NA
	E5				1	1	1	1	System Parameter Error 1	■ System parameter is outside a setting range.	–	NA
	E6				1	1	1	1	System Parameter Error 2	■ The combination of a system parameter is abnormal.	–	NA
	E7				1	1	1	1	Motor Parameter Error	■ Setup of a motor parameter is abnormal.	–	NA
	E8				1	1	1	1	Abnormalities in CPU circumference circuit	■ Access abnormality in CPU to ASIC	–	NA
	E9				1	1	1	1	System Code Error	■ Abnormalities of control circuit.	–	NA
	EE				1	1	1	1	Motor Parameter Automatic Setting Error 1	■ Motor parameter automatic setting function cannot be performed.	–	NA
	EF				1	1	1	1	Motor Parameter Automatic Setting Error 2	■ The result of motor parameter automatic setting is abnormal.	–	NA
	F1				1	1	1	1	Task Process Error	■ Error in interruption process of CPU	DB	NA
	F2				1	1	1	1	Initial Process Time-Out	■ Initial process does not end within initial process time	–	NA

Note 1) The detector may detect main circuit power undervoltage when main circuit power voltage increases/ decreases with moderate slope or voltage is temporarily cut.
Note 2) Encoder-clear may be required due to encoder body unit error. Encode-clear and alarm reset procedure vary, depending on motor encoder you use. Please refer to "Section 8-29, Encoder-clear and alarm reset procedures."
Note 3) The detector may not be able to detect breaking of wires in servo motor power line when servo motor rapidly falls at the same time of servo-on.
Note 4) The alarms, which are activated at the test mode completion, are not stored as alarm histories.

7.3 Troubleshooting when alarm activated

■ Alarm code 21 (Main circuit power device error)

State when alarm activated	Cause		
	1	2	3
Activated when turning on control power.	✔		✔
Activated when inputting servo-on.	✔	✔	✔
Activated at start-up and stop of servo motor.	✔	✔	✔
Activated after operating for a while.	✔	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Phase U, V, and W of servo amplifier are short-circuited on the wiring between servo amplifier and servo motor. Or phase U, V, and W have earth fault.	■ Verify wiring and if it is not correct, correct the wiring.
2	■ Phase U, V, and W of servo amplifier are short-circuited or have earth fault on servo motor side.	■ Replace servo motor.
3	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.

■ Alarm code 22 (Electrical current detection error 0)

State when alarm activated	Cause	
	1	2
Activated when inputting servo-on.	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.
2	■ Combination of servo amplifier and servo motor is incorrect.	■ Check to see if the installed servo motor is in accordance with motor code, and if it is not correct, replace it with a correct one.

■ Alarm code 23 (Electrical current detection error 1)
■ Alarm code 24 (Electrical current detection error 2)

State when alarm activated	Cause	
	1	2
Activated during operation.	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.
2	■ Malfunction due to noise.	■ Check to see if servo amplifier ground wire is correctly grounded. ■ Take actions against noise, such as ferritic core.

■ Alarm code 41 (Overload 1)

State when alarm activated	Cause								
	1	2	3	4	5	6	7	8	9
Activated when inputting servo-on.	✔	✔							✔
Activated because servo motor does not rotate after inputting command.		✔			✔	✔	✔		✔
Activated after operating for a while.			✔	✔	✔		✔	✔	

◆ Corrective action

Cause		Check item and action
1	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.
2	■ Motor encoder internal circuit error.	■ Replace servo motor.
3	■ Effective torque exceeds rated torque.	■ Check to see if effective torque exceeds rated torque by monitoring load status with effective torque monitor (TRMS). Or calculate effective torque according to load condition and operation condition, and if the value exceeds rated torque, review load condition and operation condition, or replace with servo amplifier with large capacity.
4	■ Combination of servo amplifier and servo motor is incorrect.	■ Confirm motor model number setting and servo motor you use correspond each other, if not, correct the combination.
5	■ Servo motor holding brake is not released.	■ Check if holding brake wiring and applied voltage are correct, and if not, correct them. If correct, replace servo motor.
6	■ Wiring of phase U, V, and W between servo amplifier and servo motor is not correct.	■ Verify wiring and if it is not correct, correct the wiring.
7	■ One phase or all phases are missing in wiring of phase U, V, and W between servo amplifier and servo motor.	■ Verify wiring and if it is not correct, correct the wiring.
8	■ Machine collided.	■ Review operation conditions and limit switch.
9	■ Motor encoder pulse number setting does not conform to servo motor.	■ Conform to servo motor encoder pulse number.

✔ When alarm activated cause is NO.3, repetition of control power-off and on can cause servo motor burnout. Re-operate after taking sufficient time to cool down (30 minutes or over) after power-off.

■ Alarm code 45（Excessive continuous revolution velocity）

State when alarm activated	Cause
	1
Activated during operation.	✔

◆ Corrective action

Cause		Check item and action
1	■ Average revolution velocity exceeds maximum revolution velocity in continuous range.	■ Review operation conditions. ■ Re-select servo motor.

■ Alarm code 51 (Abnormal amplifier temperature)

State when alarm activated	Cause				
	1	2	3	4	5
Activated when turning on control power.	✔		✔	✔	
Activated during operation.	✔	✔	✔	✔	
Activated after emergency stop.					✔

◆ Corrective action

Cause		Check item and action
1	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.
2	■ Regenerative power is too high.	■ Review operation conditions. ■ Use regenerative unit.
3	■ Regenerative power is within specification scope, but ambient temperature of servo amplifier is out of specification scope.	■ Verify internal temperature of control board (ambient temperature of servo amplifier), and then review installation method of servo amplifier and cooling method of control board so that the above temperature is 40°C or less.
4	■ Regenerative energy at emergency stop is too large.	■ Replace servo amplifier. ■ Review load conditions.

✔ Errors are detected according to internal temperature of servo amplifier regardless of ambient temperature. Make sure to re-examine cooling method for internal control board at the time temperature warning detected.

■ Alarm code 55 (External error)

State when alarm activated	Cause	
	1	2
Activated when turning on control power.	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Set external trip function enabling condition to “enable.”	■ Set “00：_Always_Disable” to “Group9 ID40” when you do not use.
2	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.

■ Alarm code 61 (Overvoltage)

State when alarm activated	Cause		
	1	2	3
Activated when turning on control power.	✔		
Activated when turning on main circuit power.	✔	✔	
Activated at servo motor start-up and stop.		✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.
2	■ Main circuit power voltage is out of specification scope.	■ Keep power voltage within specification scope.
3	■ Load inertia moment is too large.	■ Keep load inertia moment within specification scope.

■ Alarm code 62 (Main circuit undervoltage)

State when alarm activated	Cause		
	1	2	3
Activated when turning on control power.			✔
Activated after turning on main circuit power.	✔	✔	
Activated during operation.		✔	

◆ Corrective action

Cause		Check item and action
1	■ Input power voltage does not reach at value in specification scope.	■ Review and keep power supply within specification scope.
2	■ Input power voltage decreased. Or temporary stop occurred.	■ Check and re-exam power supply so that no temporary stop and voltage decrease occur.
3	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.

✔ Alarm activated only when “Detect main circuit power decrease alarm (GroupB ID18)” selected in main circuit power decrease selection, and then main circuit power decreased during servo-on.

■ Alarm code 73 (Control circuit undervoltage 2)

State when alarm activated	Cause	
	1	2
Activated when turning on control power.	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.
2	■ External circuit error.	■ Re-turn on power after removing connector, and then if alarm not activated even after that, check external circuit.

■ Alarm code 81 (Encoder connector 1 disconnected)
■ Alarm code 83 (Encoder connector 2 disconnected)
■ Alarm code 87 (CS disconnected)

State when alarm activated	Cause				
	1	2	3	4	5
Activated when turning on control power.	✔	✔	✔	✔	✔
Activated during operation.	✔		✔	✔	

◆ Corrective action

Cause		Check item and action
1	■ In motor encoder wiring, ◆ Some errors exist. ◆ Connectors are disconnected. ◆ Contact failures of connectors exist. ◆ Encoder cables are too long. ◆ Encoder cables are too thin.	■ Verify wiring and if it is not correct, correct the wiring. ■ Check if encoder power voltage on servo motor side is 4.75V or over, and if less than 4.75V, correct the difference.
2	■ Combination of servo amplifier and motor encode is not correct.	■ Replace with servo motor with correct encoder.
3	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.
4	■ Motor encoder internal circuit error.	■ Replace servo motor.
5	■ Parameter is set to fully closed system.	■ Change system parameter “ID0B” to “semi-closed control/Motor encoder.” (Only for Alarm code 83)

■ Alarm code 84 (Serial encoder communication error)

State when alarm activated	Cause		
	1	2	3
Activated when turning on control power.	✔	✔	✔
Activated during operation.		✔	

◆ Corrective action

Cause		Check item and action
1	■ Motor encoder internal circuit error.	■ Replace servo motor.
2	■ Malfunction due to noise.	■ Check to see if servo amplifier ground wire is correctly grounded. ■ Check shielding of encoder cables. ■ Take actions against noise, such as ferritic core.
3	■ Motor encoder wiring has errors.	■ Verify wiring and if it is not correct, correct the wiring.

■ Alarm code 85 (Encoder initial process error)

State when alarm activated	Cause				
	1	2	3	4	5
Activated when turning on control power.	✔	✔	✔	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ In motor encoder wiring, ◆ Some errors exist. ◆ Connectors are disconnected. ◆ Contact failures of connectors exist. ◆ Encoder cables are too long. ◆ Encoder cables are too thin.	■ Verify wiring and if it is not correct, correct the wiring. ■ Check if encoder power voltage on servo motor side is 4.75V or over, and if less than 4.75V, correct the difference.
2	■ Combination of servo amplifier and motor encode is not correct.	■ Replace with servo motor with correct encoder.
3	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.
4	■ Motor encoder internal circuit error.	■ Replace servo motor.
5	■ Initial setting for position data was not performed as servo motor rotated at a revolution velocity of 250min^{-1} when turning on power.	■ Re-turn on power supply with servo motor stopped. (Only when encoderPA035C and PA035S used.)

■ Alarm code A0 (Serial encoder internal error 0)

State when alarm activated	Cause	
	1	2
Activated when turning on control power.	✔	✔
Activated during operation.	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Motor encoder internal circuit error.	■ Re-turn on power, but if still unable to restore even after that, replace servo motor.
2	■ Malfunction due to noise.	■ Check to see if servo amplifier ground wire is correctly grounded. ■ Check shielding of encoder cable. ■ Take actions against noise, such as ferritic core.

■ Alarm code A1 (Serial encoder internal error 1)

State when alarm activated	Cause			
	1	2	3	4
Activated when turning on control power.	✔	✔		
Activated during operation.			✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Contact failure of battery cables.	■ Check battery connector with encoder cables.
2	■ Battery voltage decreased.	■ Check battery voltage.
3	■ Contact failure of encoder connector.	■ Verify wiring and if it is not correct, correct the wiring.
4	■ Motor encoder internal circuit error.	■ Re-turn on power, but if still unable to restore even after that, replace servo motor.

✔ “Encoder-clear” and “alarm-reset” procedures vary depending on motor encoder you use.
✔ Refer to “Section 7.4, Encoder-clear” and “alarm-reset” procedures.”

■ Alarm code A2 (Serial encoder internal error 2)

State when alarm activated	Cause		
	1	2	3
Activated during servo motor stop.	✔	✔	
Activated while servo motor is rotating.	✔	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Motor encoder internal circuit error.	■ Re-turn on power, but if still unable to restore even after that, replace servo motor.
2	■ Malfunction due to noise.	■ Check to see if servo amplifier ground wire is correctly grounded. ■ Check shielding of encoder cables. ■ Take actions against noise, such as ferritic core.
3	■ Acceleration velocity of servo motor exceeds allowable acceleration velocity.	■ Review operation conditions and extend acceleration and deceleration time.

✔ “Encoder-clear” and “alarm-reset” procedures vary depending on motor encoder you use.
✔ Refer to “Section 7.4, Encoder-clear” and “alarm-reset” procedures.”

■ Alarm code A3 (Serial encoder internal error 3)

State when alarm activated	Cause		
	1	2	3
Activated when turning on control power.	✔		✔
Activated during servo motor stop.	✔	✔	
Activated while servo motor rotates.	✔	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Motor encoder internal circuit error.	■ Re-turn on power, but if still unable to restore even after that, replace motor.
2	■ Malfunction due to noise.	■ Check to see if servo amplifier ground wire is correctly grounded. ■ Check shielding of encoder cables. ■ Take actions against noise, such as ferritic core.
3	■ Servo motor revolution velocity exceeds allowable velocity.	■ Review operation conditions and decrease maximum revolution velocity.

✔ “Encoder-clear” and “alarm-reset” procedures vary depending on motor encoder you use.
✔ Refer to “Section 7.4, Encoder-clear” and “alarm-reset” procedures.”

■ Alarm code A4 through A6 (Serial encoder internal error 4 through 6)
■ Alarm code AA through AF (Serial encoder internal error 10 through 15)

State when alarm activated	Cause	
	1	2
Activated when turning on control power.	✔	
Activated during operation.	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Motor encoder internal circuit error.	■ Re-turn on power, but if still unable to restore even after that, replace servo motor.
2	■ Malfunction due to noise.	■ Check to see if ground wire between servo amplifier and servo motor is correctly grounded. ■ Check shielding of encoder cables. ■ Take actions against noise such as ferritic core.

✔ “Encoder-clear” and “alarm-reset” procedures vary depending on motor encoder you use.
✔ Refer to “Section 7.4, Encoder-clear” and “alarm-reset” procedures.”

■ Alarm code A9 (Serial encoder internal error 9)

State when alarm activated	Cause		
	1	2	3
Activated when turning on control power.	✔	✔	
Activated during servo motor stop.	✔	✔	
Activated while servo motor rotates.		✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Motor encoder internal circuit error.	■ Re-turn on power, but if still unable to restore even after that, replace servo motor.
2	■ Servo motor does not generate heat, but ambient temperature of encoder is too high.	■ Review cooling method so that ambient temperature of motor encoder becomes 80°C or less.
3	■ Servo motor is overheated.	■ Review cooling method of servo motor.

✔ "Encoder-clear" and "alarm-reset" procedures vary depending on motor encoder you use.
✔ Refer to "Section 7.4, Encoder-clear" and "alarm-reset" procedures."

■ Alarm code C1 (Overvelocity)

State when alarm activated	Cause			
	1	2	3	4
Activated on inputting command after servo-on.	✔	✔		
Activated at servo motor start-up.			✔	✔
Activated during operation other than start-up.		✔	✔	

◆ Corrective action

Cause		Check item and action
1	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.
2	■ Motor encoder internal circuit error.	■ Replace servo motor.
3	■ Excessive overshoot at start-up.	■ Adjust servo parameters. ■ Slow down command acceleration and deceleration pattern. ■ Decrease load inertia moment.
4	■ Wiring of phase U, V, and W between servo amplifier and servo motor is not correct.	■ Verify wiring and if it is not correct, correct the wiring.

■ Alarm code C2 (Velocity control error)

State when alarm activated	Cause			
	1	2	3	4
Activated on servo-on.	✔		✔	
Activated on inputting command.	✔	✔	✔	
Activated at servo motor start-up and stop.				✔

◆ Corrective action

Cause		Check item and action
1	■ Wiring of phase U, V, and W between servo amplifier and servo motor is not correct.	■ Verify wiring and if it is not correct, correct the wiring.
2	■ Wiring of phase A and B of pulse encoder wiring is not correct.	■ Verify wiring and if it is not correct, correct the wiring.
3	■ Servo motor vibrates (oscillates).	■ Adjust servo parameters so as not to vibrate (oscillate).
4	■ Excessive overshoot and undershoot.	■ Monitor velocity monitor with analog monitor. ■ Adjust servo parameters to minimize overshoot and undershoot. ■ Slow down command acceleration and deceleration pattern. ■ Mask the alarm.

✔ Standard velocity control error alarm is set to “not detected” as the alarm have the possibility to detect alarms even at start-up and stop when load inertia moment is relatively large or in gravity axis applications. If you need to detect, please consult us.

■ Alarm code C3 (Velocity feed-back error)

State when alarm activated	Cause		
	1	2	3
Activated after inputting command.	✔	✔	✔
Activated when turning on control power.		✔	

◆ Corrective action

Cause		Check item and action
1	■ Servo motor does not rotate.	■ Verify wiring of servo motor power line and if it is not correct, correct the wiring. ■ Replace servo motor.
2	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.
3	■ Servo motor vibrates (oscillates).	■ Adjust servo parameters so as not to vibrate (oscillate).

■ Alarm code C5 (Model-following vibration suppression control error)

State when alarm activated	Cause		
	1	2	3
Activated after inputting position command pulse.	✔	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Setting of model control gain is high.	■ Decrease model control gain.
2	■ Acceleration and deceleration of position command is short.	■ Slow down command acceleration and deceleration command.
3	■ Torque limit value is low.	■ Increase torque limit value. Or disable torque limit.

✔ This alarm may be activated, when the other alarm activated and then alarm-reset performed during decelerating by servo brake.

■ Alarm code D1 (Excessive position deviation)

State when alarm activated	Cause											
	1	2	3	4	5	6	7	8	9	10	11	12
Activated when turning on control power.										✔		
Activated on servo-on and stop.						✔					✔	
Activated shortly after starting to input command.	✔	✔	✔	✔	✔		✔	✔	✔		✔	
Activated on high-velocity start-up and stop.	✔	✔					✔	✔	✔		✔	✔
Activated during operation by long command.		✔					✔	✔			✔	

◆ Corrective action

Cause		Check item and action
1	■ Position command frequency is too high, or acceleration and deceleration time is too short.	■ Review position command from controller.
2	■ Load inertia moment is too large, or motor capacity is too small.	■ Review load conditions, or increase servo motor capacity.
3	■ Holding brake is not released.	■ Verify wiring and if it is not correct, correct the wiring. If correct (specified voltage is applied), replace servo motor.
4	■ Servo motor is mechanically locked, or machine collided.	■ Review mechanical system.
5	■ One phase or all phases are missing in wiring of phase U, V, and W between servo amplifier and servo motor.	■ Verify wiring and if it is not correct, correct the wiring.
6	■ Servo motor was forced to rotate by external force (gravity) at stoppage (at positioning completion).	■ Review load conditions, or increase servo motor capacity.
7	■ Torque limit enabling command is input from controller, and torque limit setting is too small. ■ Set value of velocity limit command is too small. ■ Motor encoder pulse number setting does not conform to servo motor.	■ Increase torque limit value. Or disable torque limit. ■ Increase velocity limit command set value. ■ Confirm to servo motor encoder pulse number.
8	■ Settings of servo parameters (such as position loop gain) are not proper.	■ Adjust servo parameters. (e.g. Increase position loop gain.)
9	■ Set value of deviation excess is too small.	■ Increase deviation excess set value.
10	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.
11	■ Motor encoder internal circuit error.	■ Replace servo motor.
12	■ Power voltage decrease of main circuit.	■ Review main circuit power voltage.

■ Alarm code D2 (Position command pulse frequency error 1)

State when alarm activated	Cause
	1
Activated after inputting position command pulse.	✔

◆ Corrective action

Cause		Check item and action
1	■ Command more than digital filter set value of pulse input is input.	■ Decrease command pulse input frequency. ■ Increase digital filter frequency.

■ Alarm code D3 (Position command pulse frequency error 2)

State when alarm activated	Cause	
	1	2
Activated after inputting position command pulse.	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Command pulse input frequency is too high.	■ Decrease command pulse input frequency.
2	■ Set value of electronic gear is too large.	■ Decrease set value of electronic gear.

■ Alarm code DF (Test mode end)

State when alarm activated	Cause
	1
Activated after performing test mode.	✔

◆ Corrective action

Cause		Check item and action
1	■ Normal operation.	■ Perform alarm-reset to restore. (Error shall be detected in consideration that deviation may remain on controller side after performing test mode.)

■ Alarm code E1 (EEPROM error)

State when alarm activated	Cause
	1
Activated during operating displayed keys or setup software.	✔

◆ Corrective action

Cause		Check item and action
1	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.

■ Alarm code E2 (EEPROM check sum error)

State when alarm activated	Cause	
	1	2
Activated when turning on control power.	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Correct value was not loaded into CPU from EEPROM built in servo amplifier.	■ Replace servo amplifier.
2	■ Writing error to EEPROM at previous power-off	■ Replace servo amplifier.

■ Alarm code E3 (Memory error 1)
■ Alarm code E4 (Memory error 2)
■ Alarm code E8 (CPU peripheral circuit error)
■ Alarm code E9 (System code error)

State when alarm activated	Cause
	1
Activated when turning on control power supply.	✔

◆ Corrective action

Cause		Check item and action
1	■ Servo amplifier internal circuit error	■ Replace servo amplifier.

■ Alarm code E5 (System parameter error 1)

State when alarm activated	Cause	
	1	2
Activated when turning on control power.	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Parameter is set to the value out of set scope.	■ Check servo amplifier model number. Confirm system parameter setting value, and then correct value. Verify no alarm is activated after re-turning on control power.
2	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.

■ Alarm code E6 (System parameter error 2)

State when alarm activated	Cause	
	1	2
Activated when turning on control power.	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Combination of system parameter set value and actual hardware is not correct. ■ Combinations of system parameter settings are not correct.	■ Check servo amplifier model number. Confirm system parameter setting value, and then correct value. Verify no alarm is activated after re-turning on control power.
2	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.

■ Alarm code E7 (Motor parameter error)

State when alarm activated	Cause	
	1	2
Activated when turning on control power.	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Correct value was not loaded into CPU from EEPROM built in servo amplifier.	■ Re-turn on control power after re-set motor parameter, if still alarm activated even after that, replace servo amplifier.
2	■ Writing error to EEPROM at motor parameter change.	■ Re-turn on control power after re-set motor parameter, if still alarm activated even after that, replace servo amplifier.

■ Alarm code EE (Motor parameter auto-setting error 1)

State when alarm activated	Cause	
	1	2
Activated after performing motor parameter auto-setting function.	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Encoder connected does not support auto-setting function of motor parameter.	■ Replace with applicable servo motor.
2	■ Servo motor connected does not support auto-setting function of motor parameter.	■ Down load motor parameters from setup software as servo motor you use cannot support this function.
3	■ Motor encoder internal circuit error.	■ Replace servo motor.

■ Alarm code EF (Motor parameter auto-setting error 2)

State when alarm activated	Cause	
	1	2
Activated after performing motor parameter auto-setting function.	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Combination of servo motor and servo amplifier is incorrect.	■ Check servo amplifier and servo motor model number, and then correct the combination.
2	■ Motor encoder internal circuit error.	■ Replace servo motor.

■ Alarm code F1 (Task process error)

State when alarm activated	Cause
	1
Activated during operation.	✔

◆ Corrective action

Cause		Check item and action
1	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.

■ Alarm code F2 (Initial timeout)

State when alarm activated	Cause	
	1	2
Activated when turning on control power.	✔	✔

◆ Corrective action

Cause		Check item and action
1	■ Servo amplifier internal circuit error.	■ Replace servo amplifier.
2	■ Malfunction due to noise.	■ Check to see if servo amplifier ground wire is correctly grounded. ■ Take actions against noise such as ferritic core.

7.4 Encoder-clear and alarm-reset procedure

"Encoder-clear" and "alarm-reset" procedures vary depending on motor encoder you use. Perform "encoder clear, alarm reset" corresponding to "motor encoder" you use by referring to "2) Alarm code activated." Make sure to perform "encoder clear, alarm reset" after alarm causes eliminated.

1) Motor encoder model

■ Absolute encoder for incremental system

Model	Resolution	Synchro system	Transmission method	Transmission rate
PA035S	131072-division (17 bits)	Start/stop synchronization	Half-duplex serial communication	2.5Mbps

■ Battery-backup absolute encoder

Model	Resolution	Multiply-rotating part	Synchro system	Transmission method	Transmission rate
PA035C	131072-division (17 bits)	65536 (16 bits)	Start/stop synchronization	Half-duplex serial communication	2.5Mbps
	131072-division (17 bits)	65536 (16 bits)	Start/stop synchronization	Half-duplex serial communication	4.0Mbps

■ Battery-less absolute encoder

Model	Resolution	Multiply-rotating part	Synchro system	Transmission method	Transmission rate
RA035C	131072-division (17 bits)	65536 (16 bits)	Start/stop synchronization	Half-duplex serial communication	2.5Mbps

2) Alarm code activated

■ Alarm code A1 (Serial encoder internal error 1)

◆ Motor encoder you use and "encoder-clear" and "alarm-reset" method.

Model	Method
PA035S	"Alarm-reset" after "encoder-clear"
PA035C	
RA035C	"Alarm-reset" after "encoder-clear" or "Re-turn on control power supply."

■ Alarm code A2 (Serial encoder internal error 2)

◆ Motor encoder you use and "encoder-clear" and "alarm-reset" method.

Model	Method
PA035S	"Re-turn on control power supply."
PA035C	
RA035C	"Alarm-reset" after "encoder-clear" or "Re-turn on control power supply."

■ Alarm code A3 (Serial encoder internal error 3)

◆ Motor encoder you use and "encoder-clear" and "alarm-reset" method.

Model	Method
PA035S	"Alarm-reset" after "encoder-clear" or "Re-turn on control power supply."
PA035C	
RA035C	

■ Alarm code A4 (Serial encoder internal error 4)

◆ Motor encoder you use and “encoder-clear” and “alarm-reset” method.

Model	Method
PA035S	“Alarm-reset” after “encoder-clear” or “Re-turn on control power supply.”
PA035C	
RA035C	

■ Alarm code A5 (Serial encoder internal error 5)

◆ Motor encoder you use and “encoder-clear” and “alarm-reset” method.

Model	Method
PA035S	“Re-turn on control power supply.”
PA035C	
RA035C	

■ Alarm code A6 (Serial encoder internal error 6)

◆ Motor encoder you use and “encoder-clear” and “alarm-reset” method.

Model	Method
PA035S	“Re-turn on control power supply.”
PA035C	
RA035C	

■ Alarm code A9 (Serial encoder internal error 9)

◆ Motor encoder you use and “encoder-clear” and “alarm-reset” method.

Model	Method
PA035S	“Alarm-reset”
PA035C	
RA035C	

■ Alarm code AA through AF (Serial encoder internal error 10 through 15)

◆ Motor encoder you use and “encoder-clear” and “alarm-reset” method.

Model	Method
PA035S	“Re-turn on control power supply.”
PA035C	
RA035C	

7.5 Inspection

1) Items to be checked and corrective actions for operation error

Servo amplifier and motor do not employ any wear components, so ordinary simple inspections are sufficient for the maintenance. Refer to the following items to perform inspections.

Item to be checked	Inspection condition			Point to be checked	Point of inspection method	Action when error found
	Timing	During operation	During operation stop			
Servo motor	Daily	✔		Vibration	See if vibration increases compared to normal basis.	Please contact us.
	Daily	✔		Noise	See if abnormal noise exists compared to normal basis.	
	Timely		✔	Cleaning	See if any dusts and dirt on the exterior.	Clean with clothes or compressed air. Note 1)
	Annual		✔	Measurement of insulation resistance value	Please contact us.	
	5000 hours Note 2)		✔	Oil seal replacement		
Servo amplifier	Timely		✔	Cleaning	See if any dusts accumulated on the equipments.	Clean with compressed air. Note 1)
	Annual		✔	Screw looseness	See if any connectors are loosened.	Enhance tightening.
Battery for serial encoder	Daily Note 3)		✔	Battery voltage	See if battery voltage is DC3.6V or over.	Replace battery.
Temperature	Timely	✔		Temperature measurement	Ambient temperature. Motor frame temperature.	Set the ambient temperature within the scope of specification. Review load conditions.

Note1) Make sure to check no oil and moisture contained in compressed air before air cleaning.
Note2) Indicates inspection and replacement timing when waterproof and oilproof function required.
Note3) Estimated battery lifetime is about two years in the state power supply is thoroughly turned on. When replacing battery, we recommend our product lithium battery (our product model number: AL-00494635-01).

7.6 Service parts

1) Parts to be inspected

No.	Part	Standard replacement cycle	Action/condition of use
1	Lithium battery for serial encoder [ER3V]	3-year	Required to replace with a new one.
2	Electrolytic capacitor other than capacitors for smoothing main circuit	5-year	Required to replace with a new one. Condition of use: full-year average temperature at 40°C Operating time for a year: 4800 hours

■ Lithium battery for serial encoder
- ◆ Normal replacement period of the recommended lithium battery is an estimated lifetime. Motor unused for a long time shortens lithium battery's lifetime. Replace the battery with a new one if battery voltage is 3.6V or less during inspection.

■ We deliver servo amplifier with the parameters reverted to the previous state before overhaul after we conducted servo amplifier overhaul, however, please surely verify parameters prior to operation, just in case.

2) Motor encoder battery replacement

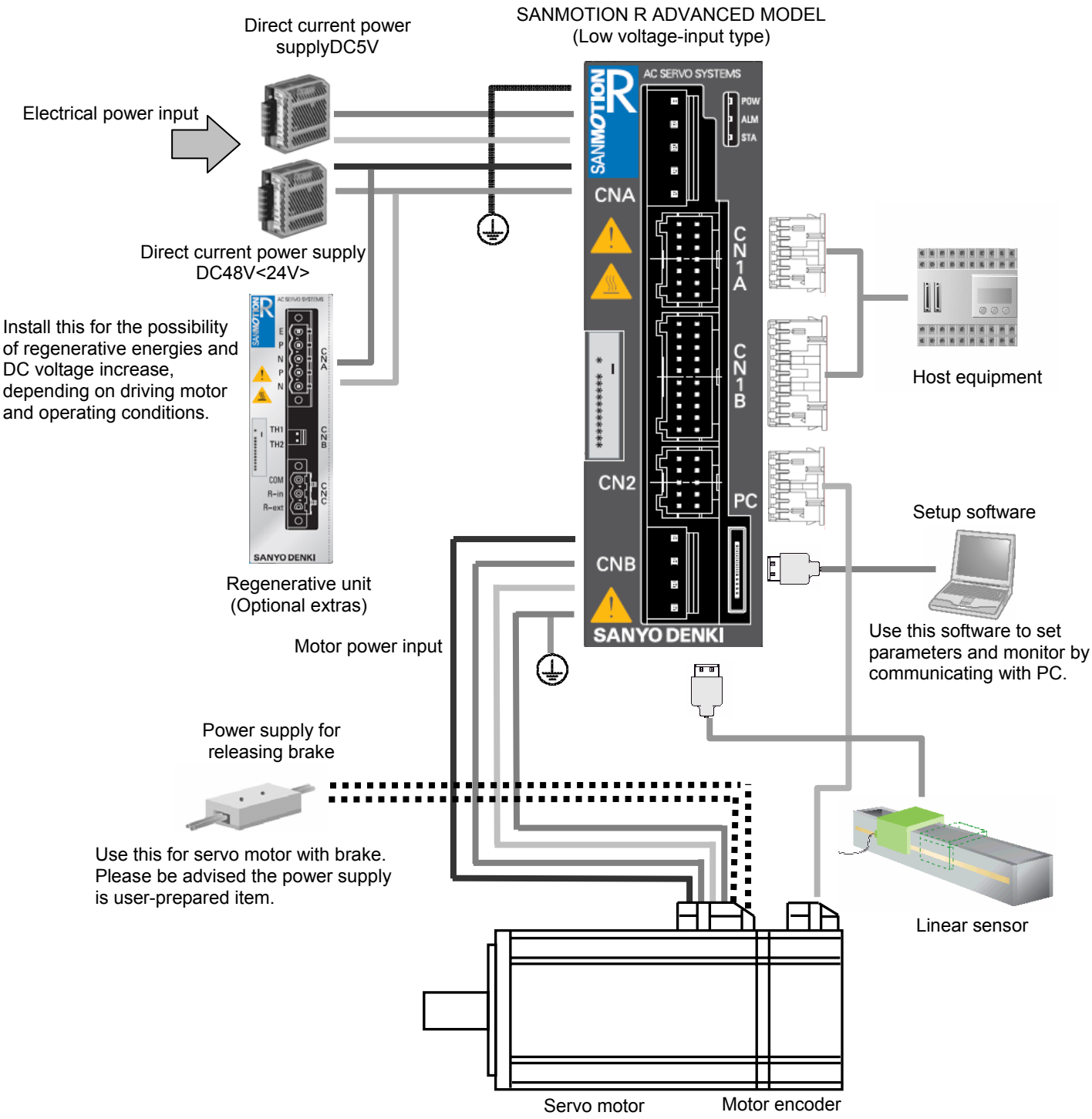
Replacing batteries with control power turned off may cause multiply-rotating counter (position data) of Motor encoder to become unstable. If you turn on control power of amplifier in this state, alarm (Serial encoder internal error 1) is activated. To cope with this, perform encoder-clear and alarm-reset to deactivate alarm state. Verify and adjust correlation between position data and machine coordinate system, because absolute encoder position data may be indefinite.

8

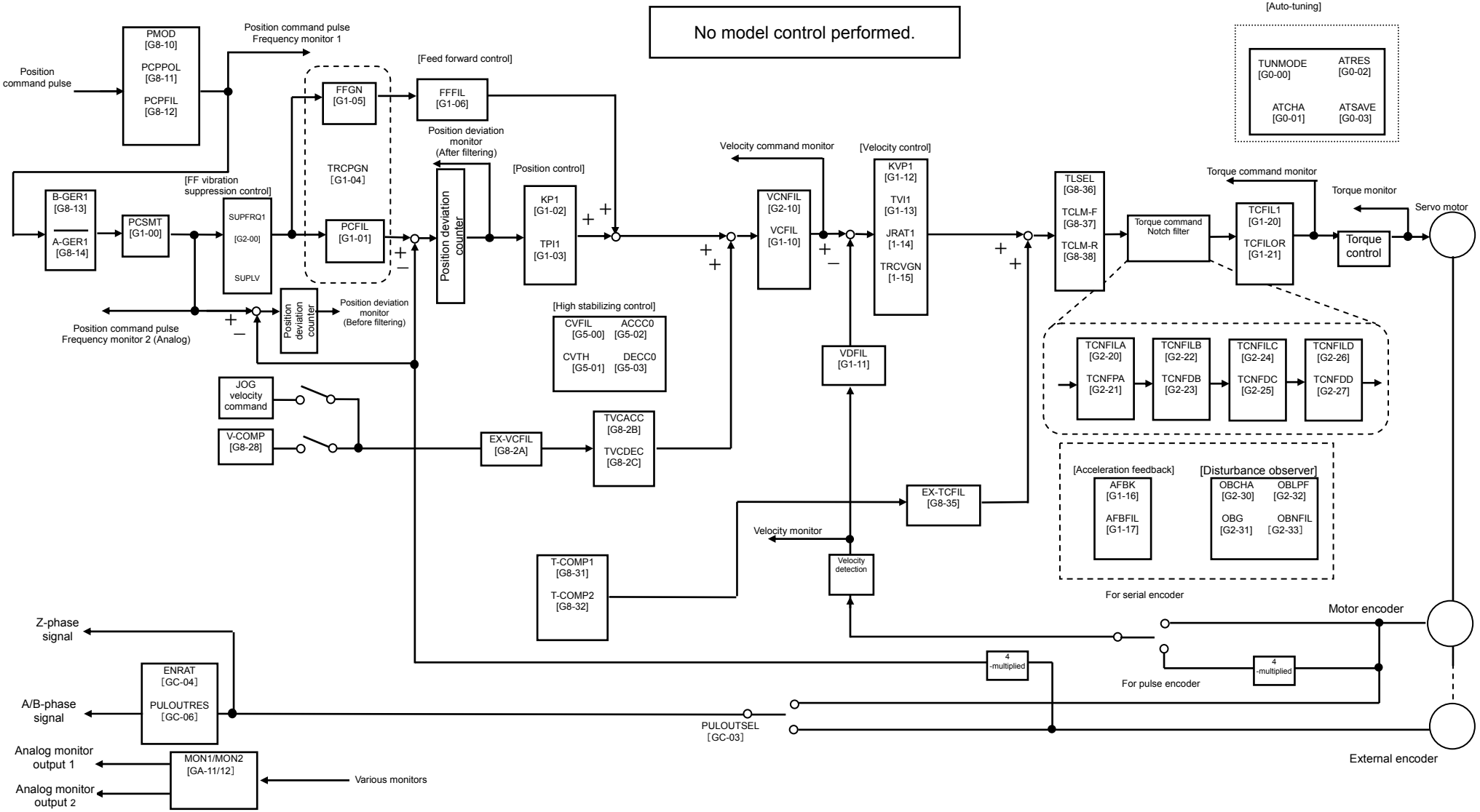
8. Fully-closed control

8.1 Illustration of system configuration

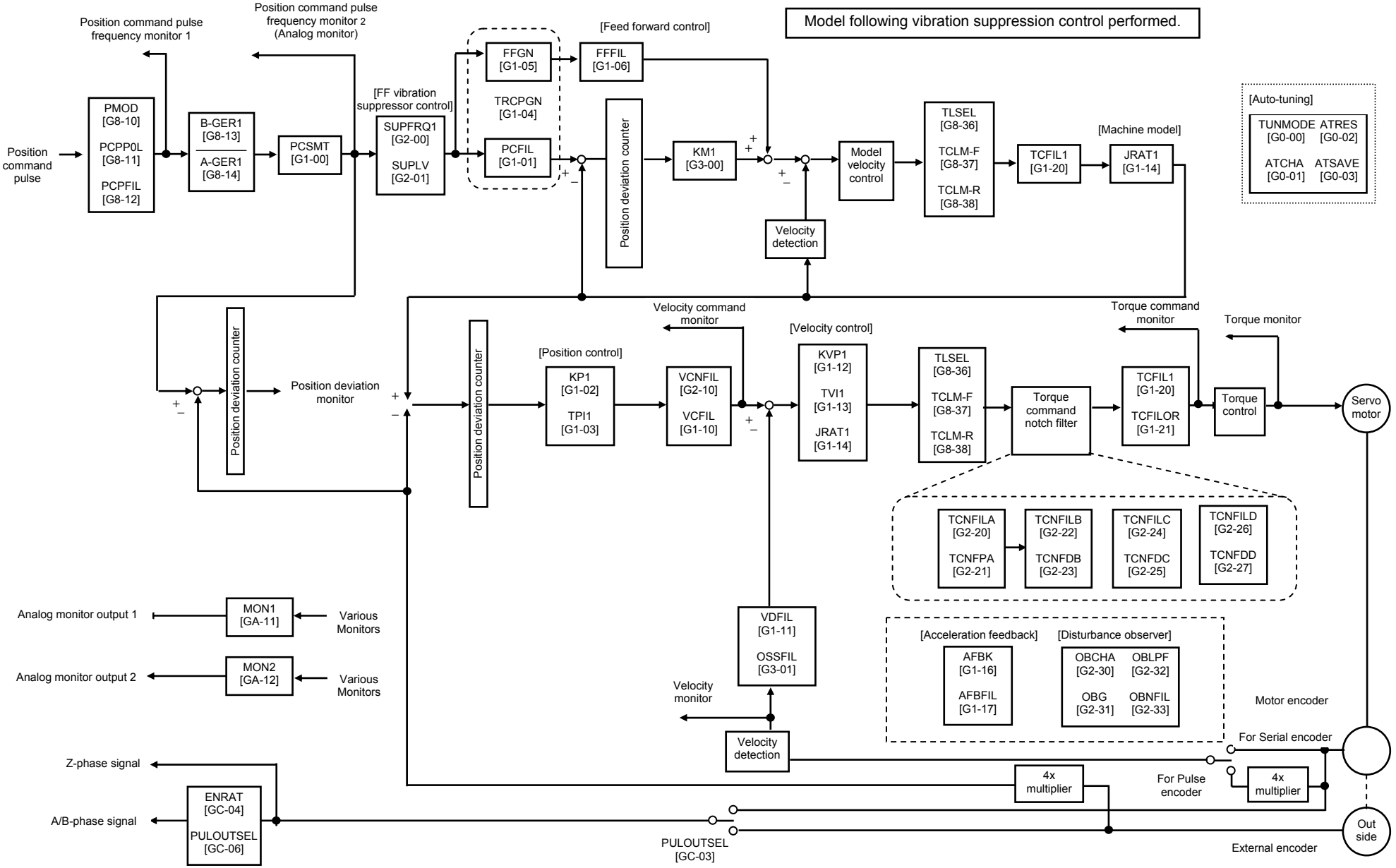
Fully-closed control is not available on our standard model servo amplifier. When you would like to use fully-closed control, please cosult us in advance.



8.2 Internal block diagram



Block diagram not using model control



8.3 Wiring

1) Connector name and its function

Connector model No.	Manufacturer
3240-10P-C	HIROSE ELECTRIC Co.,LTD.

■ Battery backup method absolute encoder

Servo Amplifier CN2 Terminal No.	Servo motor Cable color	Servo motor Cannon plug pin No.	Signal name	Description
1	Red	5V	Power supply	Twisted pair
2	Black	SG	Power supply common	
3	Brown	ES+	Serial data signal	Twisted pair
4	Blue	ES-		
5	Pink	BAT+	Battery	Twisted pair
6	Purple	BAT-		
7	-	N.C.	Unconnected	-
8	-	N.C.		
9	Shield	FG (earth)	Shield	-
10	Shield	FG (earth)		

Note) Use jacketed, shielded, and twisted pair cables.

■ Absolute encoder for incremental system

Servo Amplifier CN2 Terminal No.	Servo motor Cable color	Servo motor Cannon plug pin No.	Signal name	Description
1	Red	5V	Power supply	Twisted pair
2	Black	SG	Power supply common	
3	Brown	ES+	Serial data signal	Twisted pair
4	Blue	ES-		
5	-	N.C.	Unconnected	-
6	-	N.C.		
7	-	N.C.	Unconnected	-
8	-	N.C.		
9	-	FG (earth)	Shield	-
10	-	FG (earth)		

Note) Use jacketed, shielded, and twisted pair cables.

■ Battery less absolute encoder

Servo Amplifier CN2 Terminal No.	Servo motor Cable color	Servo motor Cannon plug pin No.	Signal name	Description
1	Red	5V	Power supply	Twisted pair
2	Black	SG	Power supply common	
3	Brown	ES+	Serial data signal	Twisted pair
4	Blue	ES-		
5	-	N.C.	Unconnected	-
6	-	N.C.		
7	-	N.C.	Unconnected	-
8	-	N.C.		
9	-	FG (earth)	Shield	-
10	-	FG (earth)		

Note) Use jacketed, shielded, and twisted pair cables.

■ Pulse Encoder

Servo Amplifier CN2 Terminal No.	Servo motor Cable color	Servo motor Cannon plug pin No.	Signal name	Description
1	Red	5V	Power supply	Twisted pair (Recommended)
2	Black	SG	Power supply common	
3	Blue	A	Phase A pulse output	Twisted pair
4	Brown	/A		
5	Green	B	Phase B pulse output	Twisted pair
6	Purple	/B		
7	White	Z	Phase Z pulse output	Twisted pair
8	Yellow	/Z		
9	Shield	FG (earth)	Shield	-
10	Shield	FG (earth)		

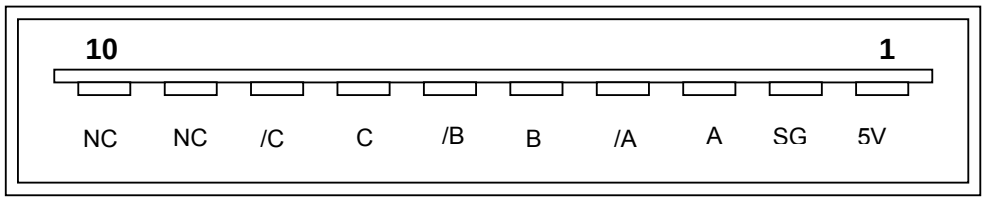
Note) Use jacketed, shielded, and twisted pair cables.

■ External encoder

Terminal NO.	Signal	Description	Note1)
1	5V	Note 3)	Twisted pair
2	SG	Power supply common Note4)	
3	A	Phase A pulse output	Twisted pair
4	/A		
5	B	Phase B pulse output	Twisted pair
6	/B		
7	C	Phase C pulse output	Twisted pair
8	/C		
9	N.C.	Unconnected	Twisted pair
10	N.C.		
Note 2)	Earth	Shield	-

Note 1) Use jacketed, shielded, and twisted pair cables.
Note 2) Jacketed shielded cables shall be connected to metal case (earth) on connector side and connected to earth on motor encoder side.
Note 3) Please be advised that power supply for external pulse encoder shall be user-prepared item.
Note 4) Surely connect power supply common.
Note 5) Connector of external encoder is placed at the bottom of amplifier.

2) Terminal numbers on servo amplifier side



Connector-connected side

8.4 Fully closed control-related parameters

To operate under fully-closed control, set the parameters as follows:

1) System parameter setting

The following restrictions on system parameters shall be observed for operation under fully-closed control. Fully-closed control becomes valid when control mode “position control” is selected. Operation under fully-closed control is not supported in mode selections other than “position control form.” Control cycle is only valid on “standard smapling,” and position control selection is only valid on “standard” and “model-following control.”

<table>
<tr><th>ID</th><th>Description</th></tr>
<tr><td>00</td><td>Control cycle
■ Select velocity control and control cycle.

Set as follows:
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>Standard_Sampling</td><td>Standard sampling mode</td></tr>
</table></td></tr>
<tr><td>0A</td><td>Position control selection
■ Select position control mode function.
Select from the following to set.
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>Standard</td><td>Standard</td></tr>
<tr><td>01</td><td>Model1</td><td>Model-following control</td></tr>
</table></td></tr>
<tr><td>0B</td><td>Position loop control and position loop encoder selection
■ Select “position loop control method” of servo amplifier and encoder that servo amplifier uses for “position loop control loop” for “fully-closed control”-applied system.
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>Motor_Enc</td><td>Semi-closed control/ motor encoder</td></tr>
<tr><td>01</td><td>External－Enc</td><td>Fully-closed control/ external encoder</td></tr>
</table>
■ Confirm set value is the value below.
<table>
<tr><th>Current set value</th><th>Description</th></tr>
<tr><td>01: External-Enc</td><td>Fully-closed control/ external encoder</td></tr>
</table>
✓ No change is needed for the system performing no fully-closed control.</td></tr>
</table>

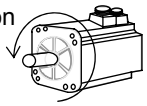
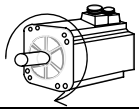
2) Servo motor rotation direction setting

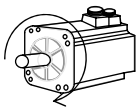
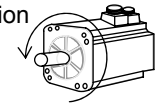
Servo motor rotation direction shall be determined according to command and external pulse encoder polarity under fully-closed control.

Description

Position, velocity, and torque command input polarity “Group 8 ID00”

■ Selects command polarity of position command pulse from the following items.
This setting can change servo motor rotation direction without changing command wiring.

Selection		Position command pulse Positive (PCMD)	Position command pulse Negative (PCMD)
00	PC+_VC+_TC+	CCW-rotation 	CW-rotation 
01	PC+_VC+_TC-		
02	PC+_VC-_TC+		
03	PC+_VC-_TC-		
ID: 0C/0D“APMON”		Current position monitor value increases	Current position monitor value decreases

Selection		Position command pulse Positive (PCMD)	Position command pulse Negative (PCMD)
04	PC-_VC+_TC+	CW-rotation 	CCW-rotation 
05	PC-_VC+_TC-		
06	PC-_VC-_TC+		
07	PC-_VC-_TC-		
ID:0C/0D“APMON”		Current position monitor value decreases	Current position monitor value increases

External pulse encoder polarity selection“re-turn on control power after setting”, “Group C ID02”

■ Sets signal polarity of external pulse encoder.

Selection		Description		
00	Type1	EX-Z/ Un-reversed	EX-B/ Un-reversed	EX-A/ Un-reversed
01	Type2	EX-Z/ Un-reversed	EX-B/ Un-reversed	EX-A/ Reversed

Set “signal polarity of external pulse encoder” in order that increase and decrease of current position monitor (external encoder) “ID: 0E/0F ’EX-APMON’” is the same as the one of current position monitor (motor encoder) “ID: 0C/0D ’APMON’.”
This parameter becomes valid on re-power on.

3) External encoder resolution setting

"Re-supply control power after setting" - "System parameter ID0C" - external pulse encoder resolution

■ Input the number of pulse converted into 1 rotation of motor axis.

Setting range	Unit
500 through 99999 (1 multiplier)	P/R

■ e.g.

◆ The minimum resolution of external pulse encoder to be used : 1.0μm

◆ WORK moving distance for 1 rotation of motor axis: 10mm
Pulse number converted to external pulse encoder resolution per 1mm is 1000P/mm.
Pulse number converted to 1 motor-rotation is 10mm/1R×1000P/mm = 10000P/R (4-multiplied), as WORK moving distance for 1 motor axis rotation is 10 mm.
Set 10000/4 = 2500P/R (as the value set is 1-multiplied.)

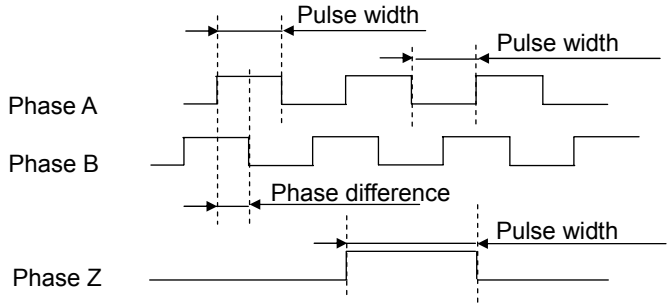
✓ Please round off the value below a decimal point.

4) Digital filter setting

External pulse encoder digital filter "Group C ID01"

■ Set digital filter of external pulse encoder.
Remove pulse below set value as noise, when noise is superimposed on external pulse encoder.
Consider encoder resolution you use and maximum revolution velocity of servo motor when operating to set. Set by referring the 1/4 or less of encoder pulse width at maximum revolution velocity.

Selection		Description
00	110nsec	Minimum pulse width=110nsec (Minimum phase difference=37.5nsec)
01	220nsec	Minimum pulse width =220nsec
02	440nsec	Minimum pulse width =440nsec
03	880nsec	Minimum pulse width =880nsec
04	75nsec	Minimum pulse width =75nsec (Minimum phase difference =37.5nsec)
05	150nsec	Minimum pulse width =150nsec
06	300nsec	Minimum pulse width =300nsec
07	600nsec	Minimum pulse width =600nsec



5) Encoder output pulse signal

"Re-turn on control power after setting", encoder output pulse frequency dividing selection "Group C ID03"

■ Set signal for encoder output pulse frequency dividing.
Select between "motor encoder" and "external encoder", when incorporating "encoder pulse signal " into upper-level equipment.

Selection		Description
00	Motor_Enc	Motor encoder
01	External_Enc	External encoder

8.5 Remarks

1) Timing to power-on external pulse encoder

- Please be advised the power supply for external pulse encoder shall be user-prepared.
- Power on prior to or at the same time of servo amplifier control power supply on. If there is more than 1s delay for the time of control power supply on, “AL 83 alarm (encoder connector 2-disconnected)” may occur.

2) Operation of external pulse encoder

- Servo motor can go out of control in the following circumstances. Make sure no problems on external pulse encoder prior to turning on the servo (exciting servomotor).
  - ◆ When counting direction (increase/decrease) of ”APMON: monitoring current position (motor encoder)” and “EX-APMON: monitoring current position (external encoder)”, calculated according to monitored value, is reversal. Change “Group C ID02”, polarity selection of external pulse encoder to adjust counting direction (increase/decrease).
- When operation of external pulse encoder is disconnected.
  Operate external pulse encoder with the encoder mechanically connected.

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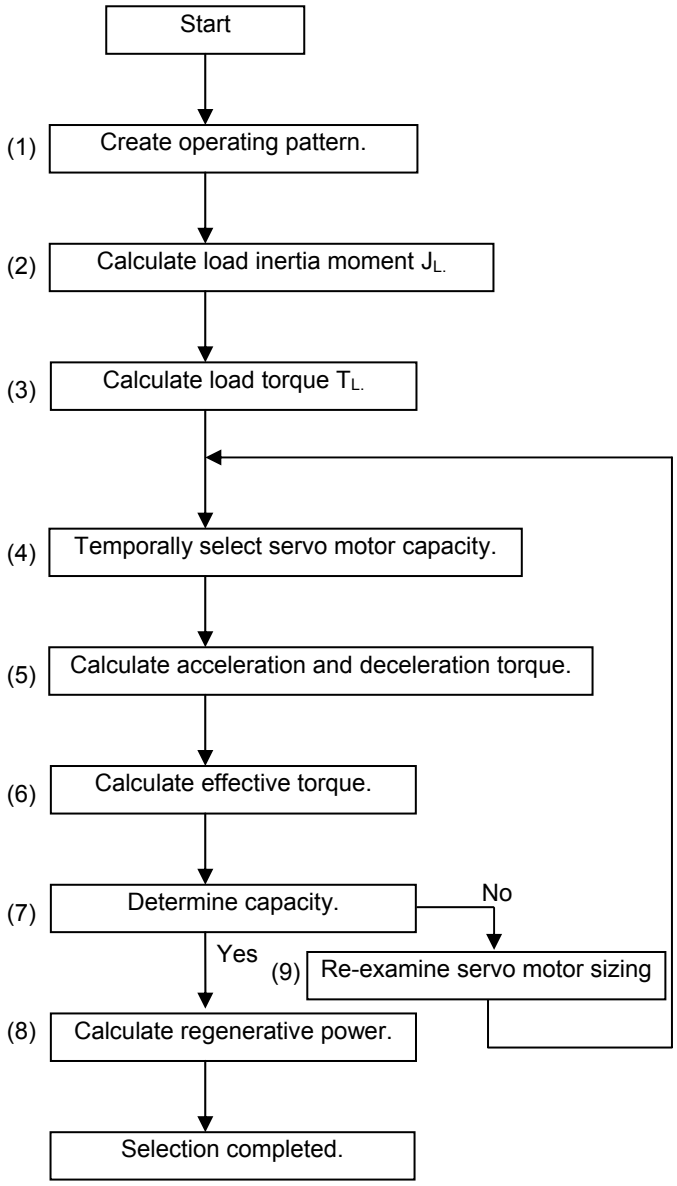
9

9 Selection

9.1 Servo motor volume selection

Selection of servo motor capacity is to calculate servo motor capacity needed for mechanical specification (configuration). A basic calculating formula is shown below.

1) Servo motor capacity selection flowchart



(1) Create operation pattern.
(2) Calculate load inertia moment according to mechanical configuration.
(3) Calculate load torque according to mechanical configuration.
(4) Temporarily select the motor whose load inertia moment (J_L) is less than 10-times of servo motor rotor inertia moment (J_M) and whose load torque (T_L) is less than motor rated torque (T_R).

$$J_L \leqq J_M \times 10$$

$$T_L < T_R$$

Calculate acceleration and deceleration torque according to operation torque.
Calculate effective torque according to torque pattern.

(5)(6)(7)
Determine acceleration and deceleration torque (Ta, Tb) is less than 80% of servo motor momentary maximum torque (Tp×0.8), and then effective torque (Trms) is less than 70% of servo motor rated torque (TR×0.7).

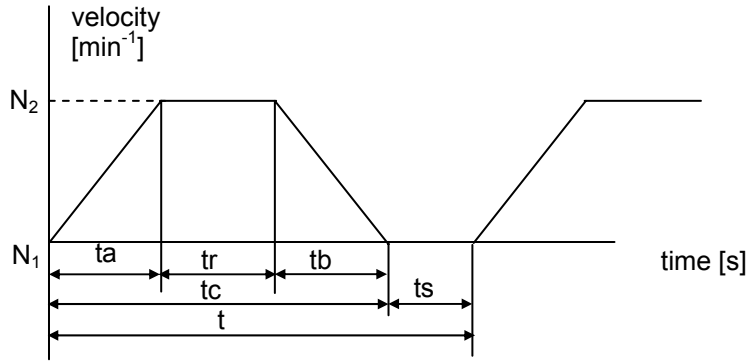
$$T_a < T_p \times 0.8$$

$$T_b < T_p \times 0.8$$

$$Trms < T_R \times 0.7$$

(8) Calculate regenerative power, and then consider to place regenerative unit, if needed. Refer to “section 9.2, caution on regenerative unit” for the calculation.
(9) Review servo motor capacity, increase the capacity if needed.

2) Create operation pattern.



ta= Acceleration time
tb= Deceleration time
tr= Constant-velocity time
ts= Downtime
t= 1 cycle

3) Calculate motor axis-converted load inertia moment (J_L).

■ Inertia moment of moving part

$$J_L = \left(\frac{1}{G}\right)^2 \times \frac{\pi\pi \times \rho \times D^4 \times L}{32} \quad [kg \cdot m^2]$$

G: Velocity reduction ratio
ρ: Motion part specific gravity [kg/m^3]
D: Motion part diameter [m]
L: Motion part length [m]

■ Inertia moment of working part

$$J_L = \left(\frac{1}{G}\right)^2 \times W \times \left(\frac{P}{2\pi}\right)^2 \quad [kg \cdot m^2]$$

G: Velocity reduction ratio
W: Moving part weight [kg]
P: Ball screw lead [m] when ball screw is applied.
Pulley circumference [m] when belt pulley is applied.
($P=\pi D$)

4) Calculate motor axis-converted load torque (T_L).

■ Ball screw (horizontal)

$$T_L = \frac{(F+\mu W)}{\eta} \times \frac{P}{2\pi} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

◆ When motor stops (horizontal)

$$T_L = \frac{F}{\eta} \times \frac{P}{2\pi} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

■ Ball screw (vertical)

◆ When motor drives upward

$$T_L = \frac{(F+(\mu+1)W)}{\eta} \times \frac{P}{2\pi} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

◆ When motor drives downward

$$T_L = \frac{(F+(\mu-1)W)}{\eta} \times \frac{P}{2\pi} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

◆ When motor stops (vertical)

$$T_L = \frac{(F+W)}{\eta} \times \frac{P}{2\pi} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

F: External force [kg]
η: Transmission efficiency
μ: Friction coefficient
W: Movable part mass [kg]
P: Ball screw lead [m]
G: Velocity reduction ratio

■ Belt pulley (horizontal)

$$T_L = \frac{(F+\mu W)}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

◆ When motor stops (horizontal)

$$T_L = \frac{F}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

■ Belt pulley (vertical)

◆ When motor drives upward

$$T_L = \frac{(F+(\mu+1)W)}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

◆ When motor drives downward

$$T_L = \frac{(F+(\mu-1)W)}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

◆ When motor stops (vertical)

$$T_L = \frac{F}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

F: External force [kg]
η: Transmission efficiency
μ: Friction coefficient
W: Movable part mass [kg]
D: Pulley diameter [m]
G: Velocity reduction ratio

5) Calculate acceleration torque (T_a).

$$T_a = \frac{2\pi(N_2-N_1) \times (J_L+J_M)}{60 \times ta} + T_L \quad [N \cdot m]$$

N_2: Servo motor revolution velocity after accelerated [min^{-1}]
N_1: Servo motor revolution velocity before acceleration [min^{-1}]
J_L: Load inertia moment [$kg \cdot m^2$]
J_M: Servo motor rotor inertia moment [$kg \cdot m^2$]

6) Calculate deceleration torque (T_b).

$$T_b = \frac{2\pi(N_2-N_1) \times (J_L+J_M)}{60 \times tb} - T_L \quad [N \cdot m]$$

N_2: Servo motor revolution velocity after decelerated [min^{-1}]
N_1: Servo motor revolution velocity before deceleration [min^{-1}]
J_L: Load inertia moment [$kg \cdot m^2$]
J_M: Servo motor rotor inertia moment [$kg \cdot m^2$]

7) Calculate effective torque (Trms).

$$Trms = \sqrt{\frac{(T_a^2 \times ta) + (T_L^2 \times tr) + (T_b^2 \times tb)}{t}} \quad [N \cdot m]$$

8) Judgment condition (determination condition)

■ The following judgment conditions are applied to SANMOTION, series R, RF2 (DC48V<24V >-input), as a guide.

- ◆ Load factor of load torque $T_L < T_R \times 0.8$
  (Load torque shall be less than 80% of rated torque.)
- ◆ Load factor of acceleration torque $T_a < T_P \times 0.8$
  (Acceleration torque shall be less than 80% of momentary maximum torque.)
- ◆ Load factor of deceleration torque $T_b < T_P \times 0.8$
  (Deceleration torque shall be les than 80% of momentary maximum torque.)
- ◆ Load factor of effective torque $Trms < T_R \times 0.7$
  (Effective torque shall be less than 70% of rated torque.)
- ◆ Inertia moment ratio $J_L < J_M \times 10$
  (Shall be less than 10-times of rotor inertia moment of motor.)

✔ Consider sufficient margin for torque load ratio so as to prevent motor temperature increase. Inertia moment ratio can be controlled even it is 10 times of the above value, when slowly rotating table mechanical. We recommend verification on actual machine.

✔ In DC48V<24V>-input servo system, when wiring of main circuit power or motor input line is relatively long, motor-generated torque notably decreases due to voltage drop on cables. Make sure to verify torque on actual machine with sufficient torque to select motor capacity.

✔ Regenerative energy can occur, depending on mechanical specification and selected motor. Refer to “Section 9.2, Caution on regeneration” for the detail of regenerative energy and confirm.

✔ Forced cooling can be required for servo amplifier, depending on effective torque and combined motor. Refer to “Section 3.1 (5), Cooling conditions for servo amplifier” for the details.

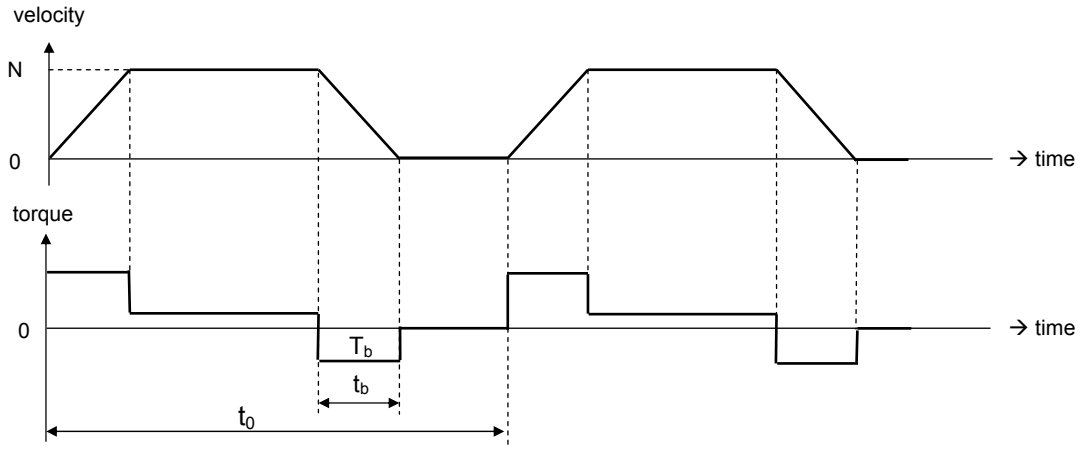
9.2 Remarks on regeneration

Regenerative circuit and regenerative resistance are not built in SANMOTION R low-voltage -input servo amplifier. You can use the amplifier as it is when actual system you use is in the condition no regenerative energies occur. However, some coping processes are needed as regenerative energies can occur depending on combines motor, load conditions, and operation patterns.
The followings are calculation methods of regenerative energies and coping processes.

1) Calculation of regenerative energy EM

■ Horizontal axis drive

When performing horizontal axis drive, regenerative energy during velocity reduction time $T_{b.}$ The energy is indicated by the following formula.



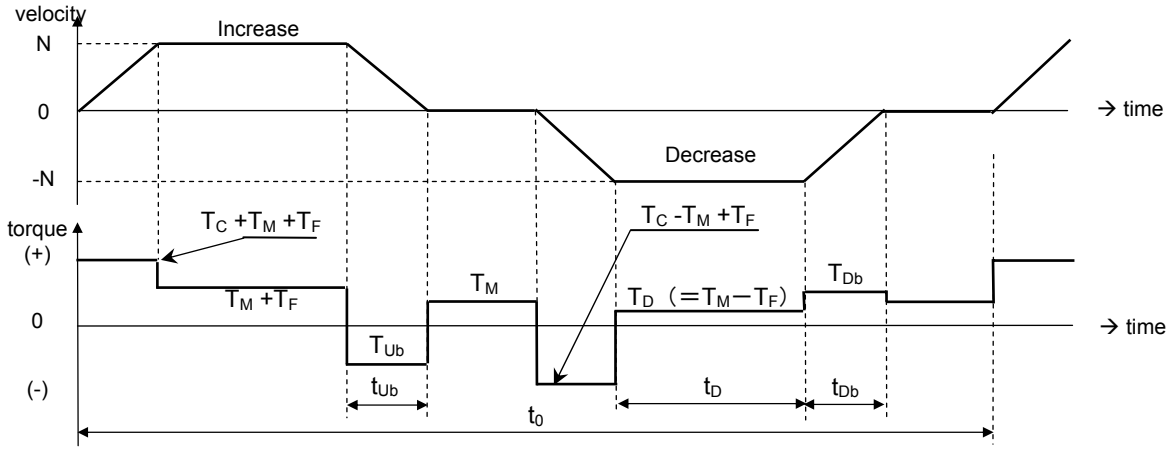
$$EM = \frac{1}{2} \times N \times 3 \cdot K_{E\varphi} \times \frac{T_b}{K_T} \times t_b - \left(\frac{T_b}{K_T} \right)^2 \times 3 \cdot R_\varphi \times t_b \cdots\cdots (J)$$

EM	:Regenerative energy in horizontal drive (J)
$K_{E\varphi}$	:Each phase voltage constant (Vrms/min^{-1}) (motor constant)
K_T	:Torque constant (N·m/Arms)(motor constant)
N	:Motor revolution velocity (min^{-1})
R_φ	:Armature resistance (Ω) (motor constant)
t_b	:Velocity reduction time (sec)
T_b	:Torque during velocity reduction time (N·m)

- ✔ In horizontal drive, regenerative energy occurs during velocity reduction time 'tb.'
- ✔ When calculation result of EM is negative value, regenerative energy does not occur.
- ✔ When any parameters such as gain improperly set, regenerative energy can occur on start –up due to velocity overshoot. In this case, re-set proper parameters to remove overshoot so that regenerative energy does not occur.

■ Vertical axis drive (When gravity load added.)

In operation pattern in vertical axis drive, regenerative energy occurs during work-lifting & velocity reduction time t_{Ub}, work-falling & constant velocity period t_D, and work-falling & velocity reduction time. Regenerative energies shall be calculated according to each period.



Regenerative energy during t_{Ub}: $E_{VUb}=\frac{1}{2} \times N\times 3\cdot K_{E\varphi}\times \frac{T_{Ub}}{K_T} \times t_{Ub} - \left(\frac{T_{Ub}}{K_T}\right)^2 \times 3\cdot R_\varphi \times t_{Ub}$ ····· (J)

Regenerative energy during t_D: $E_{VD} = N\times 3\cdot K_{E\varphi}\times \frac{T_D}{K_T} \times t_D - \left(\frac{T_D}{K_T}\right)^2 \times 3\cdot R_\varphi \times t_D$ ····· (J)

Regenerative energy during t_{Db}: $E_{VDb} = \frac{1}{2} \times N\times 3\cdot K_{E\varphi}\times \frac{T_{Db}}{K_T} \times t_{Db} - \left(\frac{T_{Db}}{K_T}\right)^2 \times 3\cdot R_\varphi \times t_{Db}$ ····· (J)

Regenerative energy amount value during operating cycle t_0: $EM=E_{VUb}+E_{VD}+E_{VDb}$ ····· (J)

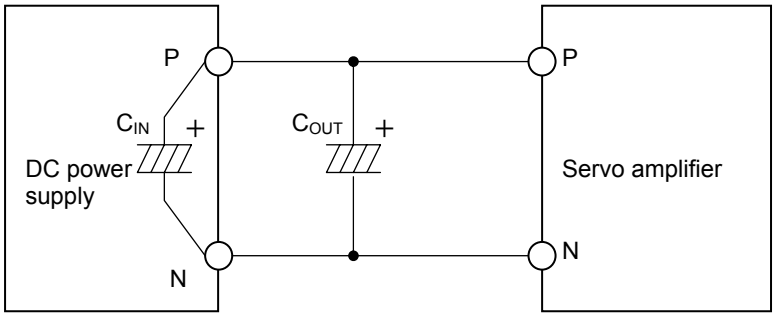
EM	:Regenerative energy amount value in vertical axis drive (J)
E_{VUb}	:Regenerative energy during work-ascending and velocity reduction time (J)
E_{VD}	:Regenerative energy during descending-running.(J)
E_{VDb}	:Regenerative energy during work-descending and velocity reduction time (J)
T_{Ub}	:Torque during work-ascending and velocity reduction time (N·m)($T_{Ub}=T_C-T_F-T_M$)
t_{Ub}	:Work-ascending and velocity reduction time (sec)
T_D	:Torque during descending-running (N·m)($T_D=T_M-T_F$)
t_D	:Descending running time (sec)
T_{Db}	:Torque during work-descending and velocity reduction time (N·m) ($T_{Db}=T_C-T_F+T_M$)
t_{Db}	:Work-descending and velocity reduction time (sec)
T_M	:Gravity load torque (N·m)
T_F	:Friction torque (N·m)
T_C	:Acceleration and deceleration torque (N·m) with gravity and friction ignored

- ✔ The above pattern is in the estimation that regenerative energy occurs during work-ascending and velocity reduction time t_{Ub}, work-descending and constant velocity period t_D, work-descending and velocity reduction time. Regenerative energy can occur during time divisions other than the above, depending on operating pattern in vertical axis drive or machine conditions.
- ✔ Regenerative energy occurs the time division that velocity (motor revolution) and torque polarity are out of out of synchronization.
- ✔ When calculated result of any of the energies (E_{VUb}, E_{VD}, and E_{VDb}) are negative values, no regenerative energies occur. In this case, calculate EM with that time division term set to “0 (zero).”

2) Coping process for regenerative energy

Voltage at main circuit power input P-N (DC48V<24V>) of servo amplifier increases when regenerative energy occurs. Main circuit voltage increase shall be less than DC60V to protect internal circuit of servo amplifier. To prevent main circuit voltage increase, place electrolytic capacitor on main circuit, or place regenerative unit.

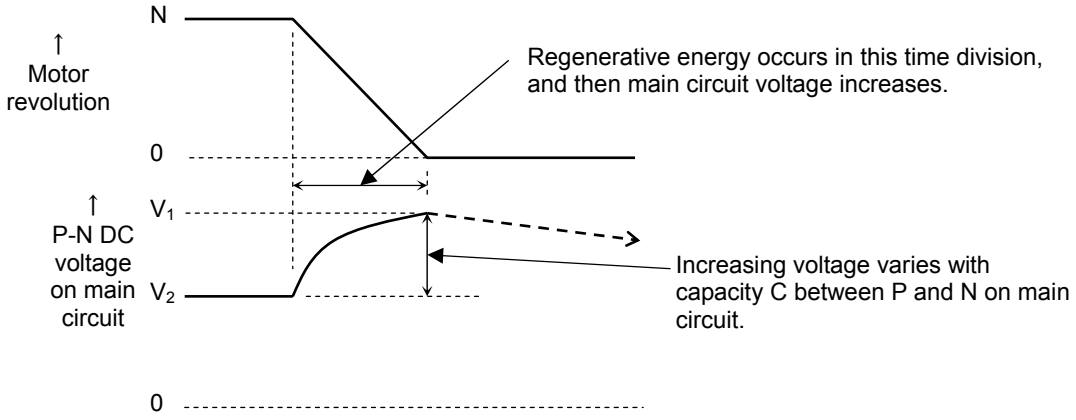
■ Calculation of main circuit voltage increase



(1) Calculate total amount C of capacities connected between P and N on DC line of main circuit.

$$C = C_{IN} + C_{OUT} \cdots\cdots \text{formula (1)}$$

(2). Calculate regenerative energy according to ”Section 9.2, Calculation of regenerative energy EM.” Provided that consider any regenerative energies E_V that occur in operating pattern, not amount value Em of operating cycle t_0. (See figure below.)



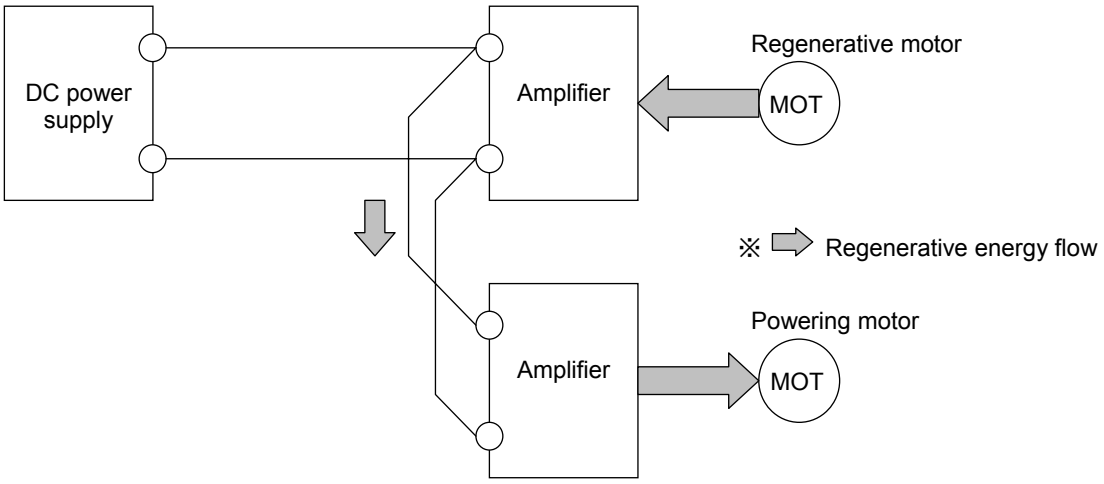
(3) Occurred regenerative energy and increasing voltage on main circuit have the following relational expression:

$$E_V = \frac{1}{2} \times C \times (V_1^2 - V_2^2) \cdots\cdots \text{Formula (2) (C: Capacity amount according to formula (1))}$$

(4) Increasing voltage V_1 of main circuit when regenerative energy occurred can be calculated according to formula (2). Ensure that increasing voltage V_1 of main circuit shall not exceed DC60V. According to formula (2), properly setting of capacitor C_{OUT} placed on the outside of power unit can prevent main circuit voltage increase.

- ✔ Select DC power to meet output voltage increasing due to regenerative energy. Some DC power types have protective function to stop voltage output when main circuit voltage increased. Please consult power supply manufacturers you use for the details.
- ✔ Placing high-capacity electrolytic capacitor on output part can prevent voltage increase. Please note that inrush current runs to charge electrolytic capacitor on powering-on. Select DC power with care.

■ Consumption with power running energy using multiple axes



When multiple servo amplifiers are connected to DC power, regenerative energy occurred in one axis, and power running occurred in the other axes, main circuit voltage increase can be suppressed because regenerative energy is consumed as powering energy of powering motor.
In this case, it is difficult to calculate voltage increasing according to powering motor load condition and operating pattern, so please verify on actual machine.

■ Regenerative unit placement

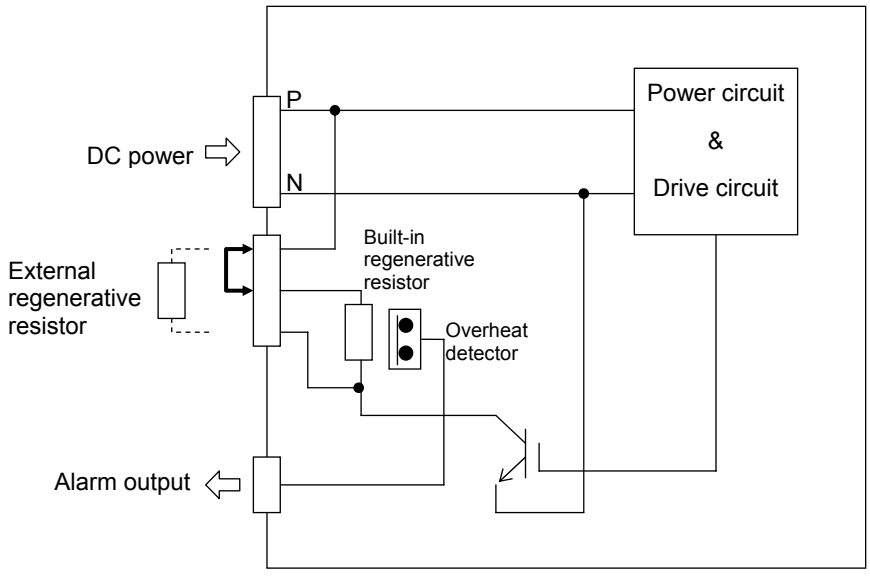
We offer optional regenerative unit that is to be inserted in parallel with main circuit.
Refer to “Section 9.3, Regenerative unit” for the specification for regenerative unit.

9.3 Specification for regenerative unit

1) Specification

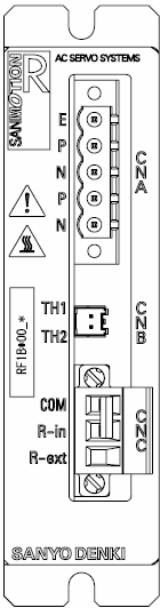
Regenerative unit model NO.	RF1BB(A)00	
Power supply	Power supplied by main circuit power (DC48V<24V>)	
Regenerative performance	Regenerative initiation voltage	55V<28V>±1.5V
	Hysteresis width	2V±0.5V
	Built-in regenerative resistance	30Ω ±5%
	Allowable absorbed power for built-in regenerative resistance	7W
Environment	Operating ambient temperature	0 through 40°C
	Storage temperature	-20 through +65°C
	Operating and storage humidity	90% RH or less (No condensation)
	Height above sea level	1000m or less
	Vibration	4.9m/sec^2 Frequency range: 10 though 55Hz Within 2Hs in direction X, Y, and Z respectively.
	Impact	19.6m/sec^2
Structure	Tray type	
Mass	0.18kg±10%	
Protective feature	Resistance overheat detection with built-in thermostat (Signal output at contact point B) Note) Please detect contacting signal output for thermostat, and then stop servo motor operation by your self.	

2) Internal block diagram



✔ Internal control circuit power shall be created (generated) from DC input (P-N, DC48V<24V>).

3) Regenerative unit front view



1.DC power input connector (CNA)
This is input connector connected to power line of servo amplifier main power supply (DC48V<24V>).
Input terminal P and N are located 2 parts respectively.

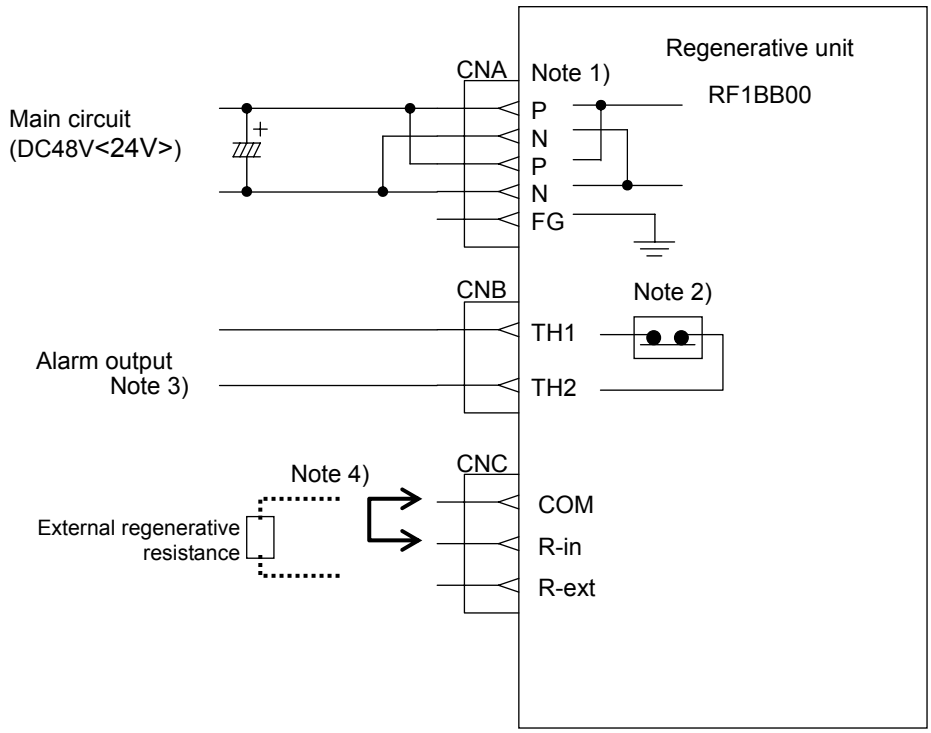
2.Alarm output connector (CNB)
This is output connector of thermostat for detecting built-in regenerative resistance overheating.
Alarm is output when built-in regenerative resistance overheated.

3.Connecting connector for external regenerative unit resistance (CNC)
This is an interface to external regenerative resistance. When you use eternal regenerative resistance, remove short bar originally placed between COM and R-in to enable built-in regenerative resistance, and then connect eternal resistance between COM and R-ext.

■ Connectors

Connector NO.	Connector NO. on user side	Connector NO. on amplifier	Manufacturer
CNA	MSTB2.5/5-STF-5.08	MSTB2.5/5-GF-5.08	Phoenix contact
CNB	PAP-02V-S (Housing) SPHD-001GU-P0.5 (Contact)	S02B-PASK-2GW	J.S.T. Mfg. Co.,Ltd
CNC	IC2.5/3-STF-5.08	IC2.5/3-GF-5.08	Phoenix contact

4) Connection diagram of regenerative unit



Note 1) Terminal P and N by two respectively are provided to CNA.

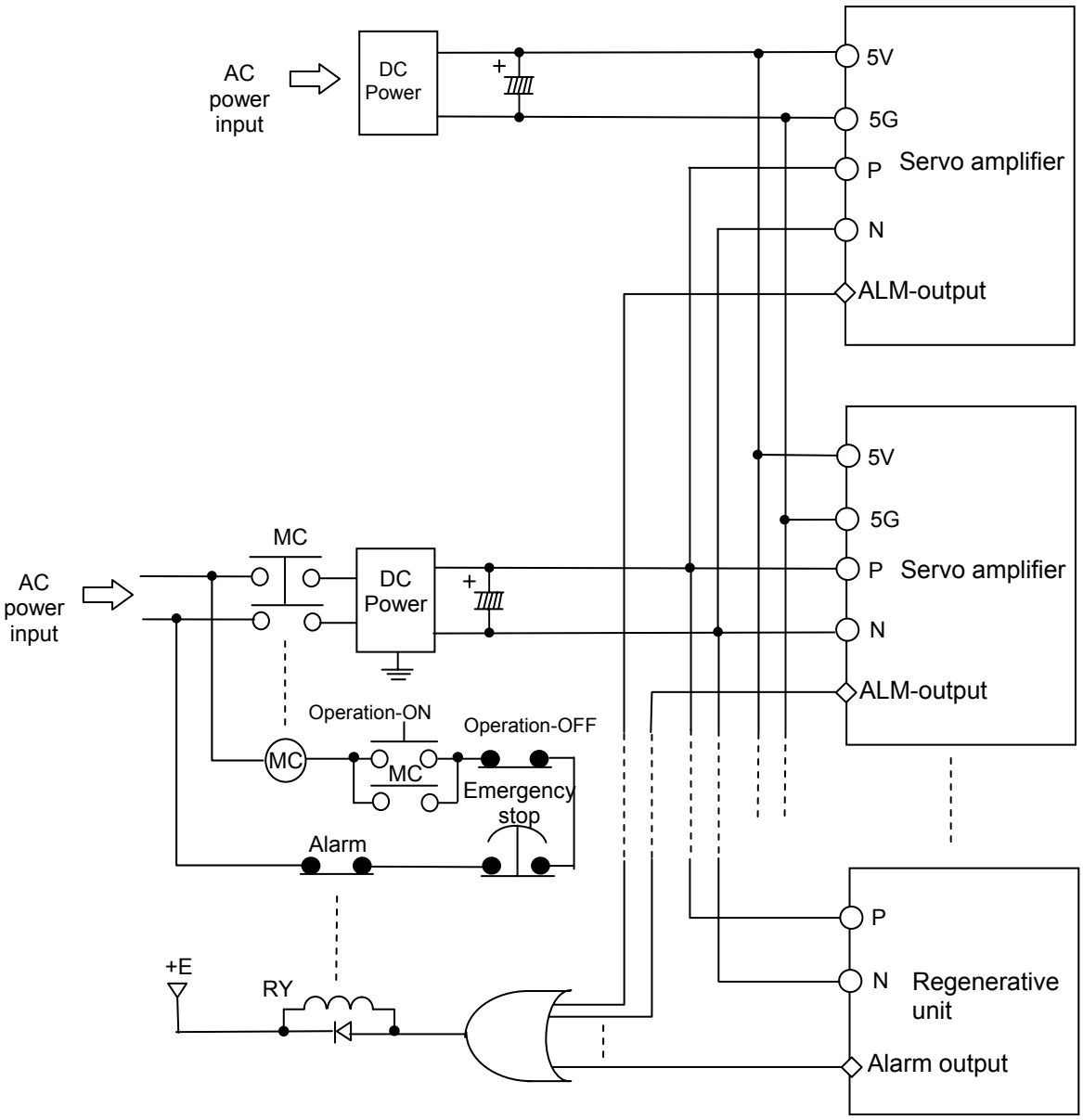
Note 2) Thermal guard (OHD5R-110B, NEC/TOKINproduct) is built in the unit as a overheat detection for built-in regenerative resistance

Thermal guard specification:
Contact point type: B-contacting (brake)
Maximum switching voltage: 30V DC
Maximum switching current: 0.1A DC
Maximum switching electrical power: 1W DC
Minimum switching current: 0.1mA/1V DC

Note 3) Regenerative unit is not able to stop motor operation when thermostat overheat is detected as in the above note 2. Please be advised that operations to monitor alarm output and stop servo amplifier (connected to regenerative unit) at your end are needed to stop motor operation. Please design your system so as to stop motor operation as well as shutdown main power supply (P, N) connected to servo amplifier and regenerative unit, when regenerative unit overheat detection is activated.

Note 4) When using built-in regenerative resistance, use CNC with COM-R-in short-circuited. Effective regenerative electrical power consumable with built-in regenerative resistance is 7W. When exceeding 7[W], external regenerative resistance is required. In this case, remove short bar between COM-Rin, and then connect regenerative unit between COM-R-ext.

■ Example of amplifier-regenerative unit connection



✔ Regenerative unit shall be connected to plural servo amplifiers' main circuit powers (P, N).
✔ Make sure to design your system so as to shutdown main circuit power supply when ALM output (alarm output) according to either plural servo amplifiers ALM-output or regenerative unit alarm output.（see above）
✔ Regenerative unit has no control power inputs. Internal circuit can operate by connecting to PN-power.

5) Calculation of regenerative effective electrical power

Review system connected to regenerative unit to see if resistance built in regenerative unit can absorb regenerative energy.

■ Calculation of regenerative effective electrical power

Calculate regenerative energy EM occurred in all the servo amplifiers connected to regenerative unit according to “Section9.2, calculation of regenerative energy EM.”
Calculate regenerative effective electrical power PM that is consumed by regenerative unit, according to the amount value ΣEM of regenerative energy EM from all the amplifiers and operating cycle t_0.

$$PM = \frac{\Sigma EM}{t_0} [W]$$

■ Judgment

If regenerative effective electrical power PM according to the above formula is less than 7[W], regenerative unit can absorb regenerative energy.
When calculation result is above 7[W], install external regenerative resistance in regenerative unit to absorb regenerative energy.

■ External regenerative resistance

Use the following external regenerative resistances according to calculation result of effective regenerative power.

Resistance name	Resistance value	Thermostat	Allowable effective regenerative power PM
REGIST-080W50B	50Ω	Contact b	10W
REGIST-120W50B	50Ω		30W
REGIST-220W50B	50Ω		55W

- ✔ Refer to “Section 9.3 (4), Connection diagram of regenerative unit” for connecting method of external regenerative resistance.
- ✔ Perform overheat protection by removing signal built in external regenerative resistance. When overheat detection activated, take actions such like servo motor operation stop for servo amplifier.

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10.

10. Appendix

10.1 Conformance to standards

We perform global standard conformance testing via certification organization, and then certification marking according to certificates issued by the certification organization.

1) Conformance to standards

■ We perform the following overseas standard conformance tests.

Rule of law	Standard number	Certification organization
UL/c-UL-standard	UL508C	UL (Underwriters Laboratories inc.)
Low Voltage Directive: LVD	EN61800-5-1	TÜV (TÜV SÜD Japan, Ltd.)
EMC Directive: EMC (Electromagnetic Compatibility)	EN55011 G1 Class A EN61000-6-2 EN61800-3	TÜV （TÜV SÜD Japan, Ltd.）

■ We perform accreditation test for following standards.

Standard	Standard number	Certification organization
UL-standard	UL1004 UL1446	UL (Underwriters Laboratories inc.)
European Directive	EN60034-1 EN60034-5	TÜV (TÜV SÜD Japan, Ltd.)

✔ Specification of standard–conformance servo motor may partially vary from the one of standard servo motor, due to standard obtaining conditions, so please consult us.

2) Overvoltage category, Ingress Protection code, and degree of contamination

■ Please use DC power (for main, control, and interfacing power) with its input and output reinforced insulated for the use of servo amplifier.

■ Make sure to place servo amplifier inside your control board, and surely use servo amplifier in the environment of contamination degree 2 or higher (degree of contamination 1 or 2) as specified in EN61800-5-1 or IEC664. Ingress Protection code for servo amplifier is IP1X. Make sure to design control board structure (IP54) so as not to let water, oil, carbon, dust intrude.

3) Connection and installation

Please use caution with the following items:

- ✔ Ground protective grounding terminal of servo amplifier to power earth.
- ✔ Ensure 1 terminal-1 wire connection when connecting protective grounding terminal, do not tighten together with wires for grounding.
- ✔ Make sure to connect protective grounding terminal of leakage breaker to power earth.
- ✔ Use fixed terminal block to relay wires. Do not directly connect wire to wire.
- ✔ Connect EMC filter to the front stage of power unit input power.
- ✔ Use no-fuse breaker and electromagnetic contactor, which are EN standard-conformance item or IEC standard–conformance item.
- ✔ We obtained standard approvals for servo amplifier and regenerative unit with the following fuses placed in the power input section.

(Amplifier unit)

	Type	Manufacturer	Current [A]	Voltage [V]	Specification
Main power input	0324020.MXP	Littelfuse	20A	250Vac/125Vdc	UL-approved item
Control power input	0224002.MXP	Littelfuse	2A	250Vac/125Vdc	UL-approved item

(Regenerative unit)

	Type	Manufacturer	Current [A]	Voltage [V]	Specification
Main power input	0324020.MXP	Littelfuse	20A	250Vac/125Vdc	UL-approved item

- ✔ We obtained standard approvals for servo amplifier and regenerative unit with the following forced cooling for FAN performed.

Model number	Manufacturer	Specification
109P0624S702	SANYO DENKI	Air volume: 0.3m^3/min

4) UL-file number

Servo amplifier and motor UL-file number are as follows.
You can check them on UL's website, http://www.ul.com/database/.

- ■ Servo amplifier UL-file number: E179775
- ■ Servo motor UL-file number: E179832

10.2 Conformance to EU Directive

SANYO DENKI performed conformance verification test for low-voltage-Directive and EMC-Directive via certification organization, and then perform CE-marking for servo amplifier in accordance with certificates issued by the certification organization so as to ease your CE-marking obtaining.

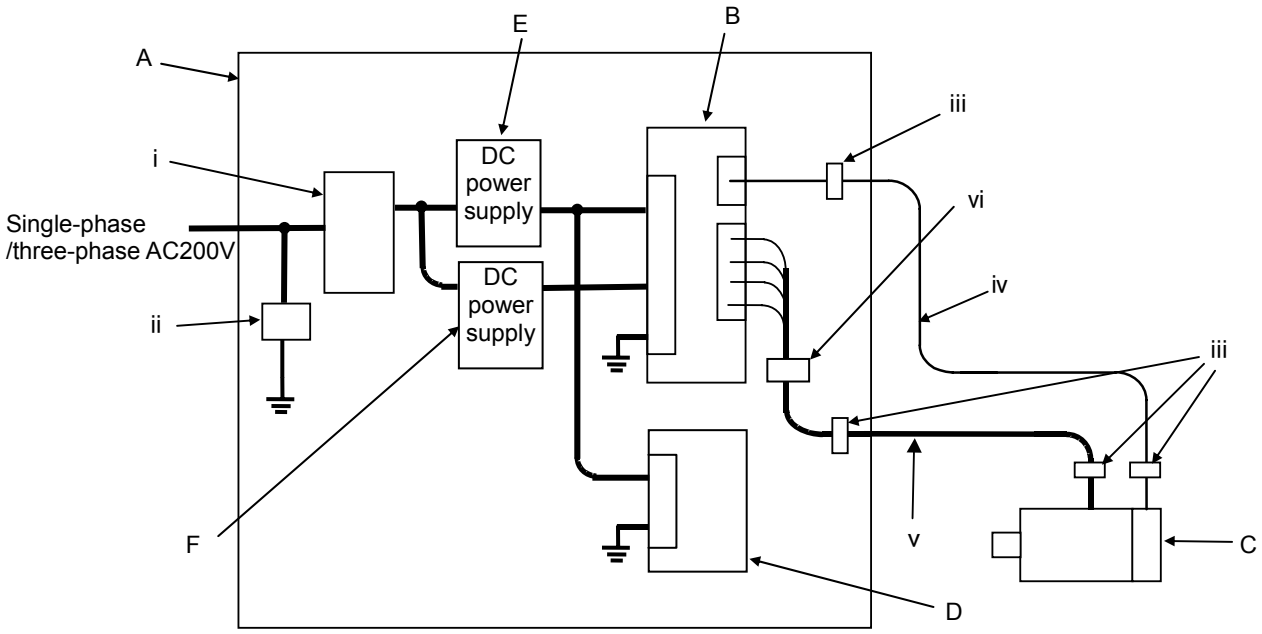
1) Conformity verification test

SANYO DENKI performed the following standard conformance verification tests:

Directive section	Section	Test name	Standard
Low-voltage-directive (Servo amplifier)	-	-	EN61800-5-1: 2007
Low-voltage-Directive (Servo motor)	-	Rotating electrical machines-Part1: Rating and performance	EN60034-1:2004
		Rotating electrical machines-Part5: Classification of degrees of protection provided by enclosures of rotating electrical machines (IP code)	EN60034-5:2007
EMC-Directive (Servo amplifier and Servo motor)	Emission	Conducted emission	EN55011: A2/2007
		Radiated emission	EN55011: A2/2007
	Immunity	Electrostatic discharge immunity	EN61000-4-2: A2/2001
		Radiated electromagnetic field immunity	EN61000-4-3: A1/2002
		Electrical first transient/ burst immunity	EN61000-4-4: 2004
		Conducted disturbance immunity	EN61000-4-6: A1/2001
		Surge immunity	EN61000-4-5: A1/2001
		Voltage Dips & Interruptions immunity	EN61000-4-11: 2004
		Adjustable velocity electrical power drive system	EN61800-3/ 2004

2) EMC installation requirements

Installation requirements vary depending on your machines and equipment configuration, so we perform verification test in the following installation method and countermeasure. CE marking shall be applied on servo amplifier in accordance with this conformance verification test result and certificates issued by accreditation organizations. Please be advised that CE-marking for your own machines and equipment need to perform definitive conformance verification test by yourself.

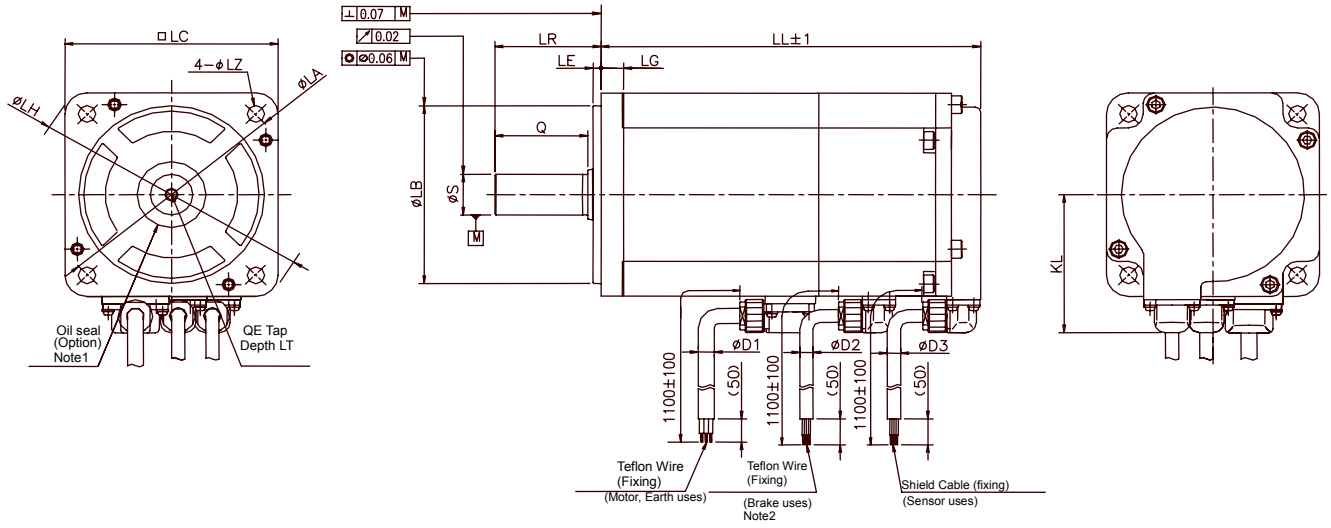


No	Name	Remarks
A	Control board	-
B	Servo amplifier	-
C	Servo motor	-
D	Regenerative unit	
E	DC power supply	HWS1500-48:TDK-Lambda
F	DC power supply	HWS50-5/A:TDK-Lambda
i	Noise filter (Recommended countermeasure item)	HF3030C-UQA: SOSHIN ELECTRIC CO., LTD-manufactured Rated voltage/ rated current：Line-Line 480V AC / 30A
ii	Surge absorber (Recommended countermeasure item)	LT-C32G801WS: SOSHIN ELECTRIC CO., LTD-manufactured
iii	Clamping ground	-
iv	Encoder cable	Shielded cable
v	Servo motor power cable	Shielded cable
vi	Toroidal Core	MA070 r-63/38/25A:JEF-FERRITE (Measured with 3-turned)

- ✔ Use metallic materials to manufacture door and control board body.
- ✔ Use EMI gasket so that any gaps are left between door and control board. Evenly apply EMI gasket to the part with which door and control board body contact, and then confirm electrical continuity.
- ✔ Ground noise filter frame to control board.
- ✔ Use shielded cable as encoder cable and motor power cable. Ground shields to frame of control board and equipment with clamp.
- ✔ Use metallic P-clip or U-clip having continuity to ground shielded wire with clamp and directly fasten them with metallic screw. Do not ground by soldering shielded wire with electrical wire.
- ✔ Shorten distance from secondary wiring of noise filter through servo amplifier, and perform separate wiring for primary and secondary wiring of noise filter.

10.3 Outline dimensional drawing of servo motor

■ Flange size 40mm, 60mm



	Without Oil Seal		With Oil Seal									
	Battery backup method absolute encoder		Battery backup method absolute encoder									
	Without Brake	With Brake	Without Brake	With Brake								
Servo motor model number	**LL**	**LL**	**LL**	**LL**	**LG**	**KL**	**LA**	**LB**	**LE**	**LH**	**LC**	**LZ**
R2GA04003△□◇	**51.5**	**87.5**	**56.5**	**92.5**	**5**	**35.4**	**46**	**0 30-0.021**	**2.5**	**56**	**40**	**2-Φ4.5**
R2GA04005△□◇	**56.5**	**92.5**	**61.5**	**97.5**								
R2GA04008△□◇	**72**	**108**	**77**	**113**								
R2GA06010△□◇	**58.5**	**82.5**	**65.5**	**89.5**	**6**	**44.6**	**70**	**0 50-0.025**	**3**	**82**	**60**	**4-Φ5.5**
R2GA06020△□◇	**69.5**	**97.5**	**76.5**	**104.5**								

Servo motor model number	**LR**	**S**	**Q**	**QE**	**LT**	**D1**	**D2**	**D3**
R2GA04003△□◇	**25**	**0 6 -0.008**	**20**	**-**	**-**	**6**	**5**	**5**
R2GA04005△□◇		**0 8 –0.009**						
R2GA04008△□◇								
R2GA06010△□◇	**25**	**0 8 – 0.009**	**20**	**-**	**-**			
R2GA06020△□◇	**30**	**0 14 – 0.011**	**25**	**M5**	**12**			

Note 1) If oil seal is required, whole motor length shall be changed.
Note 2) For the motor without brake, no brake cable shall be supplied.
Note 3) All the dimensions above shall be applicable to motor with battery-back up absolute encoder. If you use servo motor having the other encoder specification, please consult us as the dimensions shall be changed.

10.4 Servo motor data sheet

1) Characteristics

Servo amplifier model number				RF2G21A△A□□				
Servo motor model number/< >Flange size R2GA				04003F < 40>	04005F < 40>	04008D < 40>	06010D < 60>	06020D < 60>
Item	Condition	Code	Unit					
Rated output	★	P_R	W	30	50	80	100	200
Rated revolution velocity	★	N_R	min^{-1}	3000	3000	3000	3000	3000
Maximum revolution velocity	★	N_{max}	min^{-1}	6000	6000	5000	5000	4500
Rated torque	★	T_R	N·m	0.098	0.159	0.255	0.318	0.637
Continuous stall torque	★	T_S	N·m	0.108	0.167	0.255	0.353	0.637
Momentary maximum torque	★	T_P	N·m	0.24	0.54	0.86	0.84	1.5
Rated current	★	I_R	Arms	1.9	3.8	4.1	5.1	6.0
Continuous stall current	★	I_S	Arms	2.0	3.9	4.1	5.5	6.0
Momentary maximum current	★	I_P	Arms	4.8	13.7	14.1	14.1	14.1
Torque constant		K_T	N·m/ Arms	0.0582	0.047	0.0693	0.0673	0.117
Voltage constant per phase		$K_{E\varphi}$	mV/ min^{-1}	2.03	1.64	2.42	2.35	4.07
Phase resistance		R_φ	+Ω	1.00	0.33	0.32	0.19	0.19
Rates power rate	★	Q_R	kW/s	3.9	6.7	10	8.6	19
Inertia moment note 1)		J_M	$Kg \cdot m^2 (GD^2/4) \times 10^{-4}$	0.0247	0.0376	0.0627	0.117	0.219
Mss note 1)		WE	kg	0.35	0.39	0.51	0.71	0.96
Brake mass		W	kg	0.27	0.27	0.27	0.34	0.39

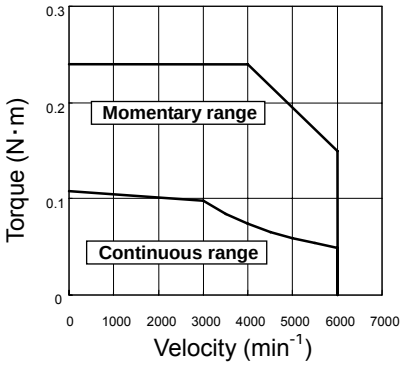
Note 1) The above values indicate the figures with battery-back up absolute encoder included.

- ✔ The above values show the figures with motor mounted in t6x250mm-heat sink aluminum plate.
- ✔ Items marked with "★" and velocity-torque characteristics show the values after temperature saturation. The other items indicate values at 20°C.
- ✔ Each value shows value TYP.

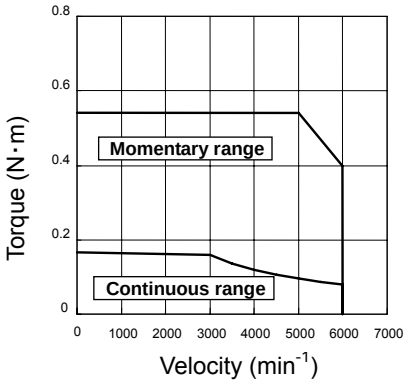
2) Velocity-torque characteristic

Velocity-torque characteristic of R2GA servo motor shows the value when input power is DC48V. When power voltage drops, impedance on power input line is high, or cable between amplifier and servo motor is relatively long, high-velocity revolution in momentary range shall decrease, so please consider sufficient margins for these values when selecting servo motor.

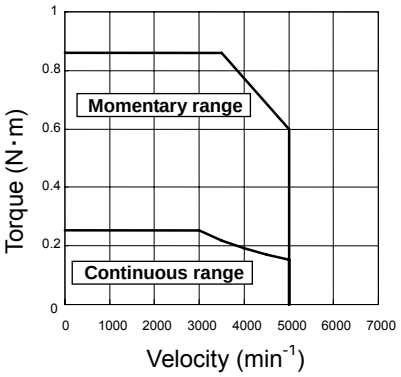
R2GA04003F



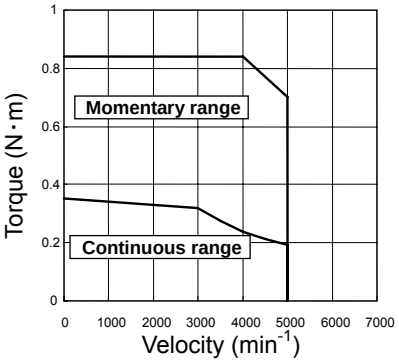
R2GA04005F



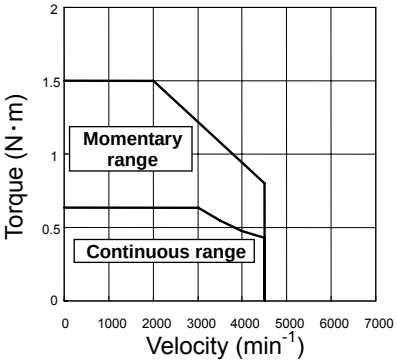
R2GA04008D



R2GA06010D



R2GA06020D

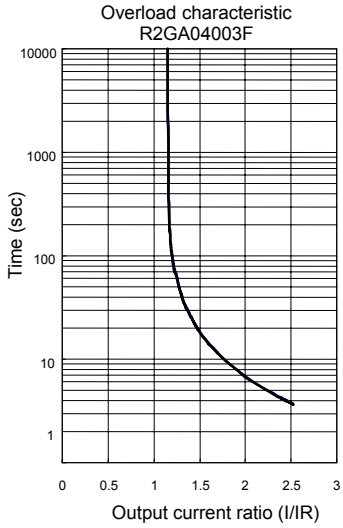


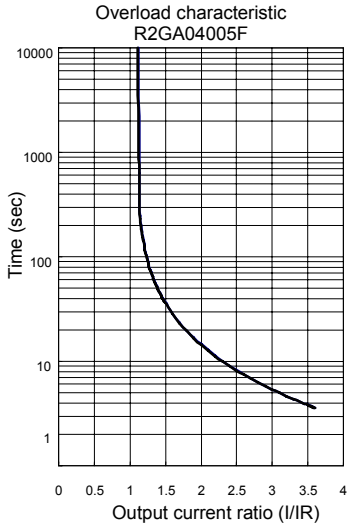
3) Rating decrease rate of motor with oil seal

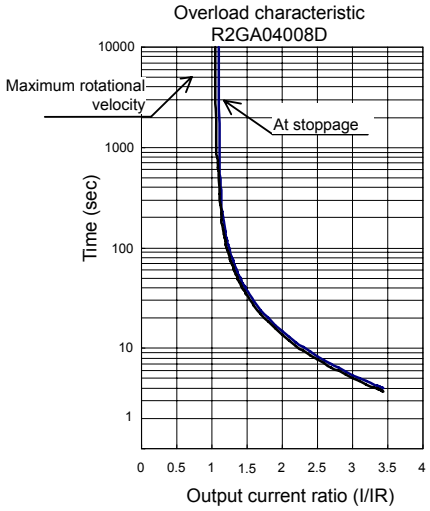
For the servo motor model R2GA04005F (50W) with oil seal, 90% of decreasing rating rate shall be applied to continuous range of torque characteristic.

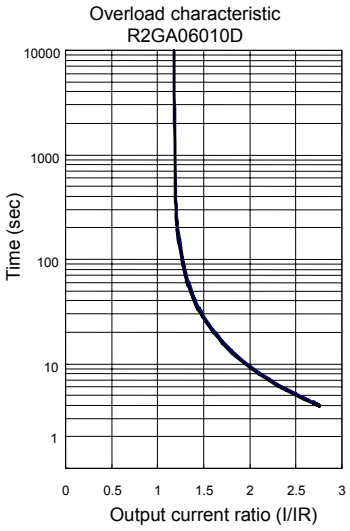
4) Overload characteristics

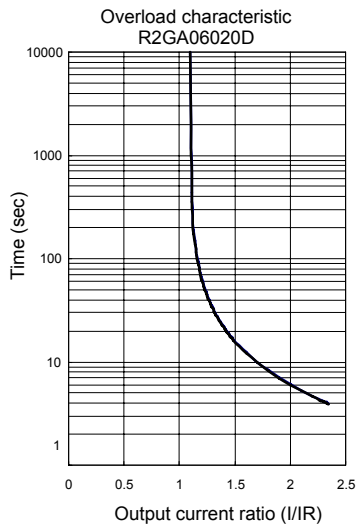
R2GA Motor overload characteristics are indicated below.





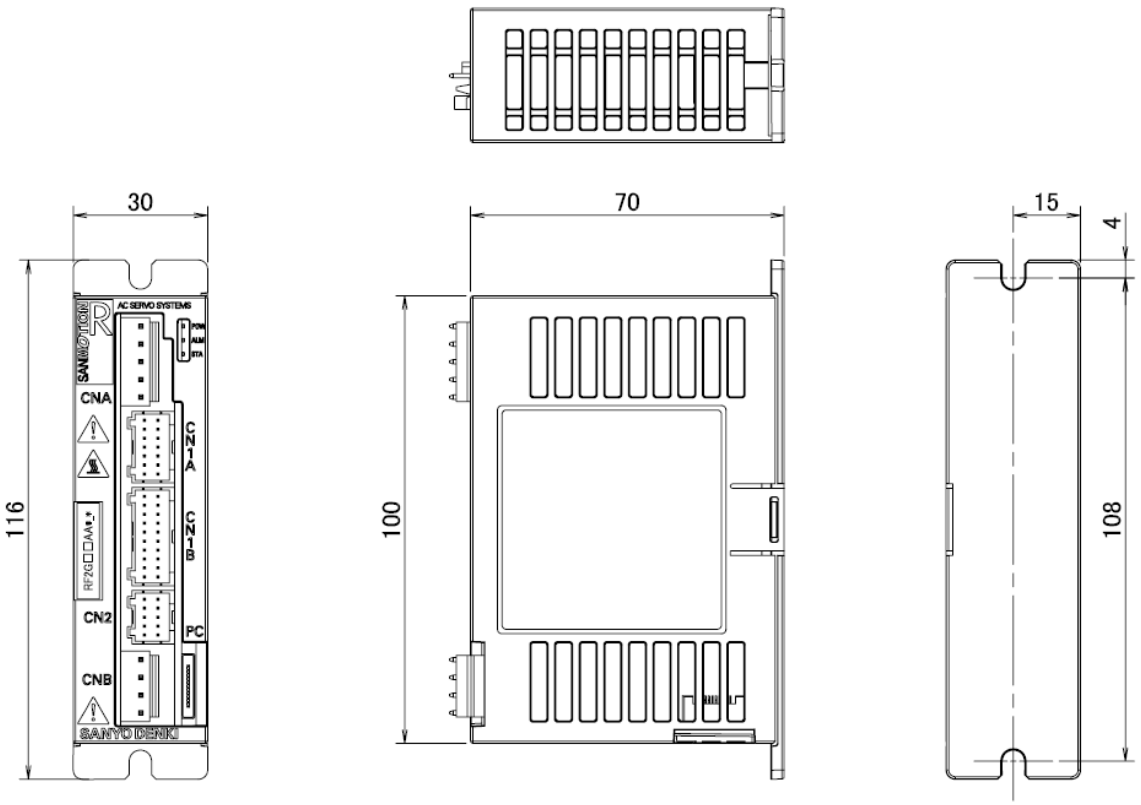






10.5 Outline dimensional drawing of servo amplifier

■ RF2G(H)□1□A

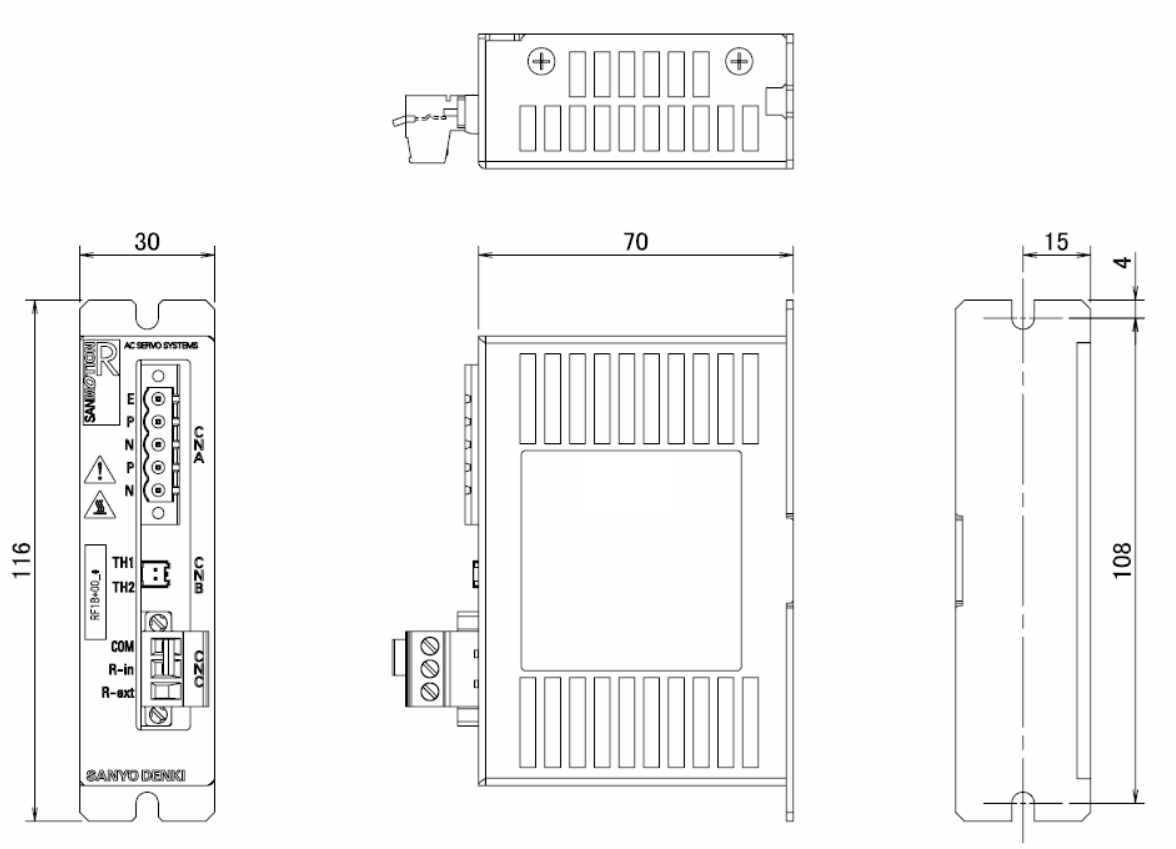


10.6 Optional items

The following optional items are available.

1) Regenerative unit, RF1BB (A) 00

■ Outline dimensional drawing

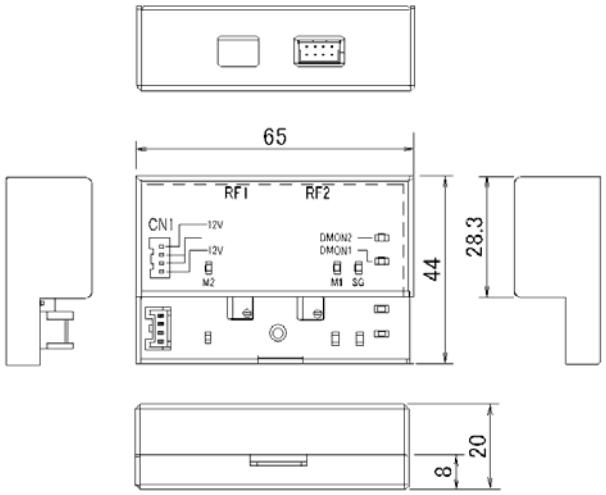


2) Analog monitor box

SANYO DENKI offers monitor box for use in monitoring operating wave profile with measuring equipment.

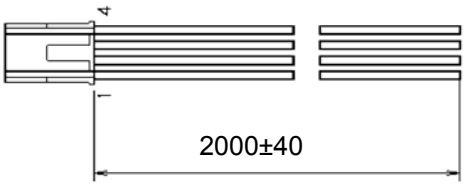
Analog monitor box model number	Q-MON-5
Power supply	±12V±5%, externally-supplied (Power supply is user-prepared.)
Monitor channel	Analog×2CH, digital 2CH, signal is to be selected according to setup software.
Output voltage range, output error	DC±8Vmax, within ±20%
Offset voltage	Within ±100mV
Output resistance	1kΩ
Load	Within 2mA
Mass	40g±20%

■ Outline dimensional drawing of analog monitor box



✔ Cable connected to servo amplifier and power input cable are supplied.
✔ Connect servo amplifier to connector RF2, and ±12V-power to CN1.

■ Specification for power-supply cable for analog monitor box



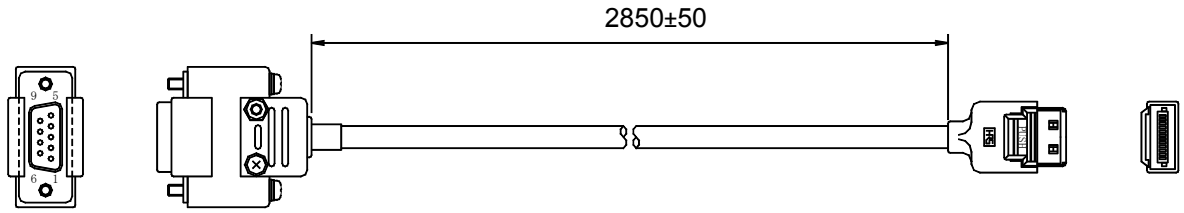
Pin NO.	Color	Definition
1	Red	+12V
2	Black	SG
3	Black	SG
4	Blue	-12V

✔ Leads are cut off on the opposite side of connectors, so please connect these leads to power supply (±12V).
✔ Please be advised that power supply is user-prepared item.

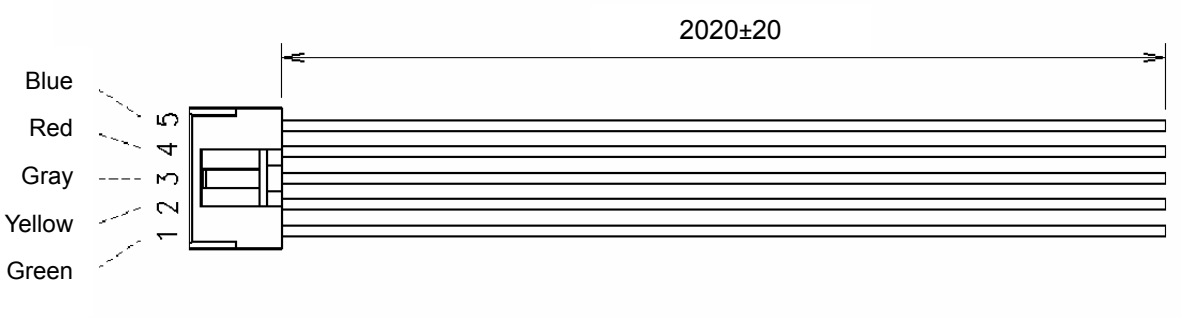
3) Connecting cable

Connector code	Description	Model number
PC	Cable connected to PC	AL-00490833-01
CNA	Power input	AL-00745943-01
CNB	Motor input	AL-00745944-01
CN1A, CN1B	For I/O (set of 20-pin/14-pin)	AL-00745949-01
CN2	For absolute encoder	AL-00745946-01
	For pulse encoder	AL-00745945-01

■ Cable connected to PC (AL-00490833-01)



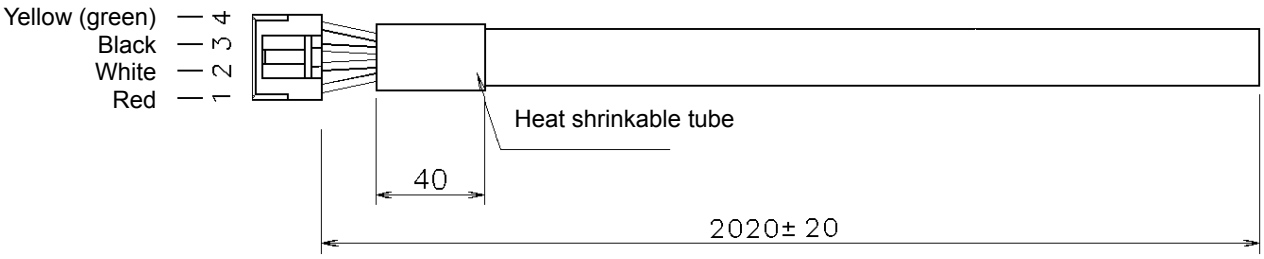
■ Power input cable (AL-00745943-01)



Connector NO.	Pin NO.	Code (Name)	Wire color	Connector NO.
CNA	1	FG	Frame ground	Green
	2	5V	5V-control power	Yellow
	3	5G	Control power ground	Gray
	4	P	DC48V-main power<24V>	Red
	5	N	Main power ground	Blue

✔ Leads are cut off on the opposite side of connectors, so please connect these leads to DC power.

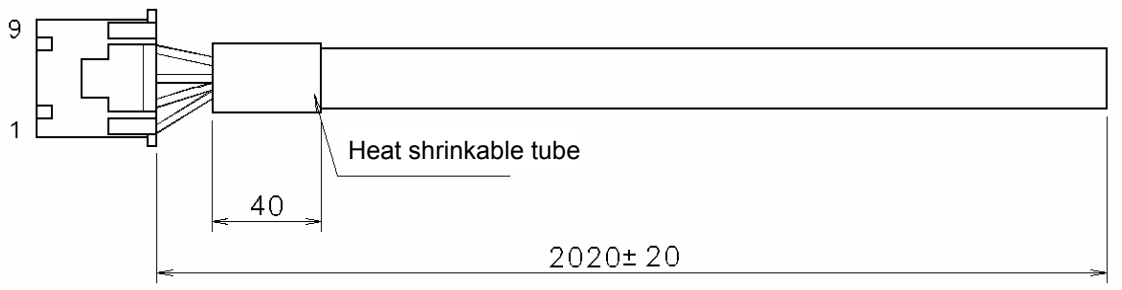
■ Motor input cable (AL-00745944-01)



Connector NO.	Pin NO.	Code (Name)	Wire color	Connector NO.
CNB	1	U	Phase U	Red
	2	V	Phase V	White
	3	W	Phase W	Black
	4	FG	Frame ground	Yellow (green)

✔ Leads are cut off on the opposite side of connectors, so please connect these leads to motor.

■ Cable for encoder (AL-00745945-01 (for pulse encoder), AL-00745946-01(for absolute encoder))



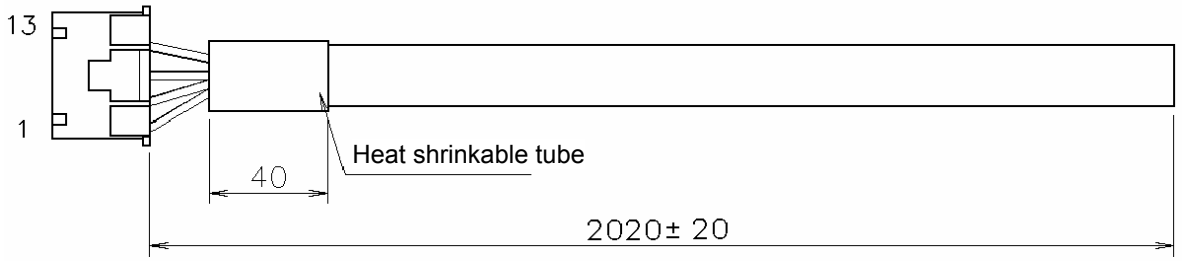
◆For pulse encoder (AL-00745945-01)				
Connector NO.	Pin NO.	Code (Name)	Wire color	
CN2	1	5V	Red	Twisted wire
	2	SG	White	
	3	A	Blue	Twisted wire
	4	/A	White	
	5	B	Green	Twisted wire
	6	/B	White	
	7	C	Yellow	Twisted wire
	8	/C	White	
	9			
	10	FG	Drain wire	Shielded

◆For absolute encoder (AL-00745946-01)				
Connector NO.	Pin NO.	Code (Name)	Wire color	
CN2	1	5V	Red	Twisted wire
	2	SG	White	
	3	ES+	Blue	Twisted wire
	4	ES-	White	
	5	BAT+	Yellow	Twisted wire
	6	BAT-	White	
	7			
	8			
	9			
	10	FG	Drain wire	Shielded

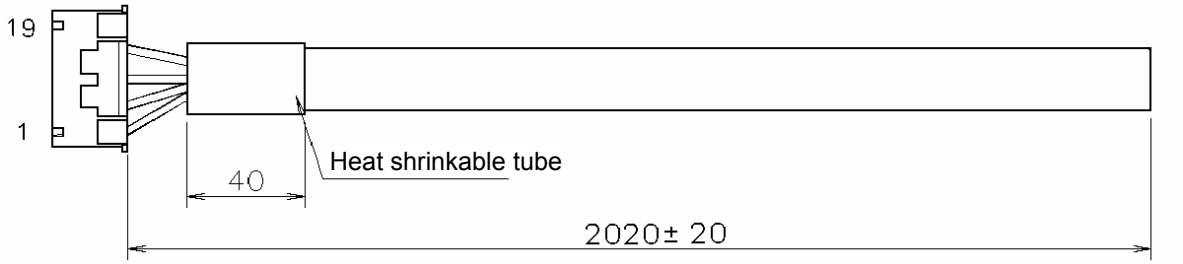
✔ Leads are cut off on the opposite side of connectors, so please connect these leads to encoder.

■ I/O cable（AL-00745949-01）

◆ For CN1-A



◆ For CN1-B



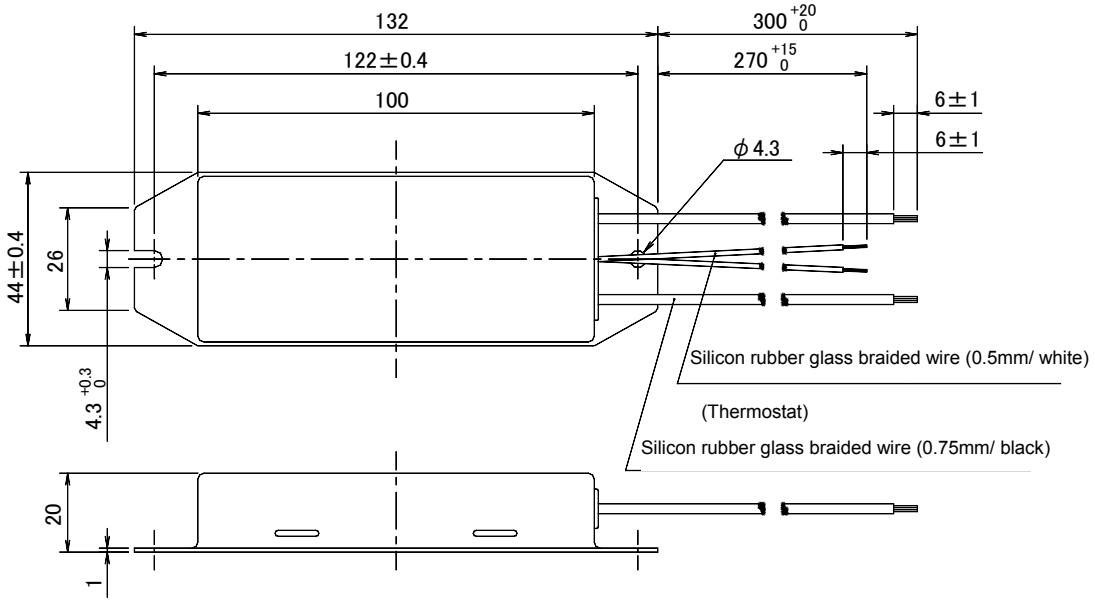
Connector NO.	Pin NO.	Code (Name)	Wire color	
CN1-A	1	A0	Blue	Twisted wire
	3	/A0	White	
	4	B0	Green	Twisted wire
	5	/B0	White	
	6	Z0	Yellow	Twisted wire
	7	/Z0	White	
	8	PS	Red	Twisted wire
	9	/PS	White	
	11	F-PC	Blue	Twisted wire
	12	/F-PC	Brown	
	13	R-PC	Yellow	Twisted wire
	14	/R-PC	Brown	
	10	SG	Purple	
	2	FG	Drain wire	

Connector NO.	Pin NO.	Code (Name)	Wire color	
CN1-B	1	IN-COM	Blue	
	3	CONT1	Yellow	Twisted wire
	4	CONT2	White	
	5	CONT3	Green	Twisted wire
	6	CONT4	White	
	7	CONT5	Red	Twisted wire
	8	CONT6	White	
	9	CONT7	Purple	Twisted wire
	10	CONT8	White	
	11	OUT-PWR	Blue	Twisted wire
	19	OUT-COM	Brown	
	12	OUT1	Yellow	Twisted wire
	13	OUT2	Brown	
	14	OUT3	Green	Twisted wire
	15	OUT4	Brown	
	16	OUT5	Red	Twisted wire
	17	OUT6	Brown	
	18	OUT7	Purple	Twisted wire
	20	OUT8	Brown	
	2	FG	Drain wire	

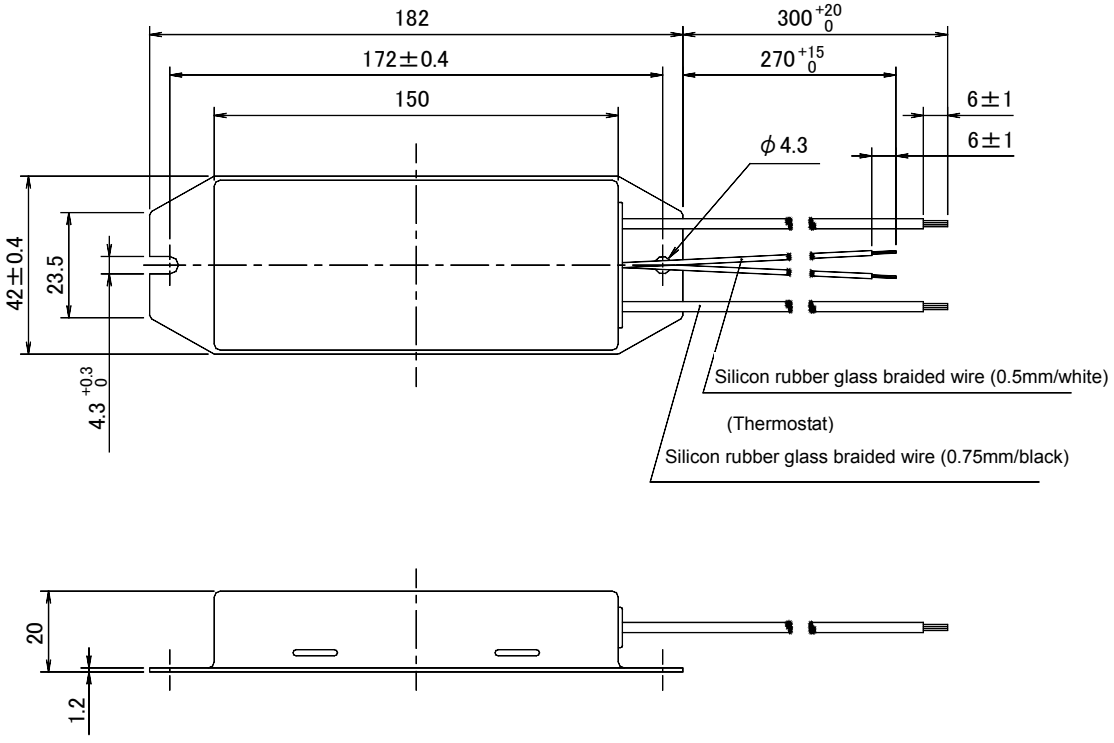
✔ Leads are cut off on the opposite side of connectors, so please connect these leads to higher-level equipment.

4) External regenerative resistor

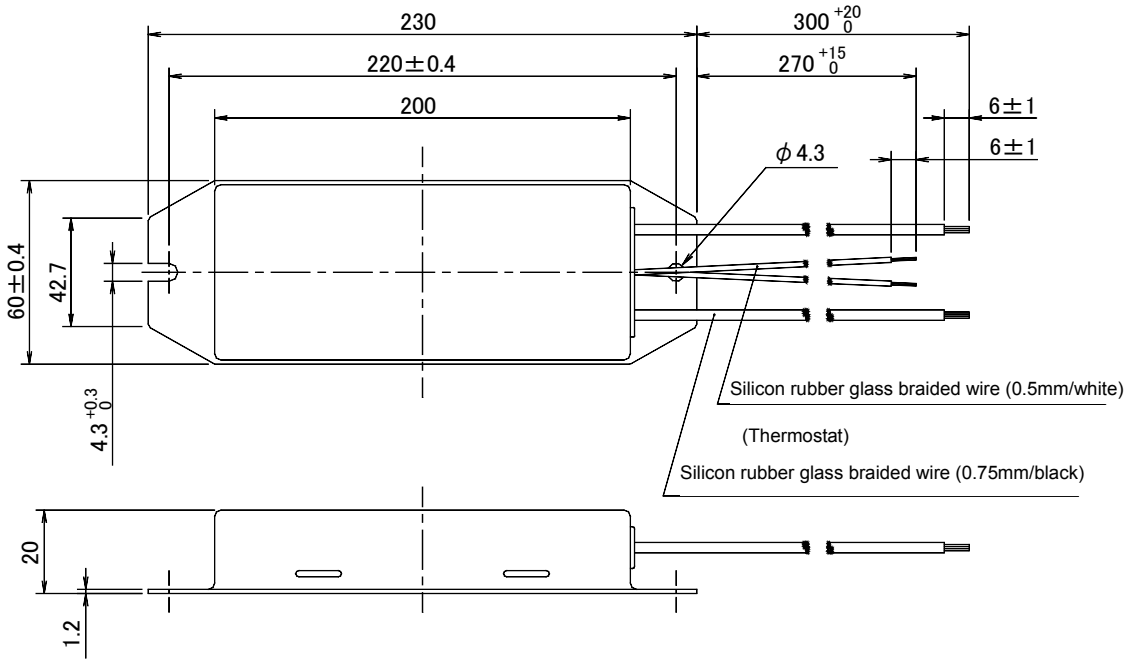
■ REGIST-080W



■ REGIST-120W

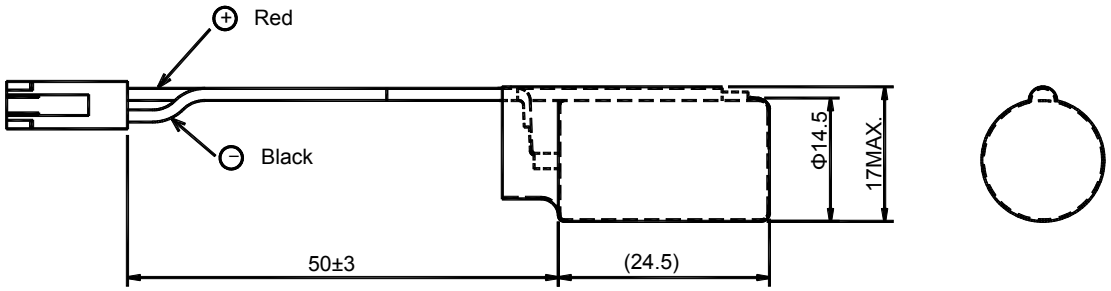


■ REGIST-220W



5) Lithium battery

Model number	Remarks
AL-00494635-01	ER3VLY



Mass: 0.02kg

	Manufacturer mdel number	Manufacturer
Connector	IL-2S-S3L-(N)	Japan Aviation Electronics Industry, Ltd.
Contact	IL-C2-1-10000	Japan Aviation Electronics Industry, Ltd.
Battery	ER3VLY	Toshiba Consumer Marketing Ltd.

No Text on This Page.

Release	
Revision A	Jul. 2010
Revision B	Jan. 2011
Revision C	Mar. 2012

ECO PRODUCTS

■ECO PRODUCTS
Sanyo Denki's ECO PRODUCTS are designed with the concept of lessening impact on the environment in the process from product development to waste. The product units and packaging materials are designed for reduced environmental impact.
We have established our own assessment criteria on the environmental impacts applicable to all processes, ranging from design to manufacture.

■Precautions For Adoption

Failure to follow the precautions on the right may cause moderate injury and property damage, or in some circumstances, could lead to a serious accident.
Always follow all listed precautions.

⚠ Cautions

- Read the accompanying Instruction Manual carefully prior to using the product.
- If applying to medical devices and other equipment affecting people's lives please contact us beforehand and take appropriate safety measures.
- If applying to equipment that can have significant effects on society and the general public, please contact us beforehand.
- Do not use this product in an environment where vibration is present, such as in a moving vehicle or shipping vessel.
- Do not perform any retrofitting, re-engineering, or modification to this equipment.
- The Products presented in this Instruction Manual are meant to be used for general industrial applications. If using for special applications related to aviation and space, nuclear power, electric power, submarine repeaters, etc., please contact us beforehand.

* For any question or inquiry regarding the above, contact our Sales Department.

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