MITSUBISHI ELECTRIC

General-Purpose AC Servo

MITSUBISHI SERVO AMPLIFIERS & MOTORS

MELSERVO-JE

General-Purpose Interface AC Servo

MODEL

MR-JE-_A

SERVO AMPLIFIER

INSTRUCTION MANUAL

E

● Safety Instructions ●

Please read the instructions carefully before using the equipment.

To use the equipment correctly, do not attempt to install, operate, maintain, or inspect the equipment until you have read through this Instruction Manual, Installation guide, and appended documents carefully. Do not use the equipment until you have a full knowledge of the equipment, safety information and instructions.
In this Instruction Manual, the safety instruction levels are classified into "WARNING" and "CAUTION".

⚠ WARNING	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠ CAUTION	Indicates that incorrect handling may cause hazardous conditions, resulting in medium or slight injury to personnel or may cause physical damage.

Note that the CAUTION level may lead to a serious consequence according to conditions.
Please follow the instructions of both levels because they are important to personnel safety.
What must not be done and what must be done are indicated by the following diagrammatic symbols.

⃠	Indicates what must not be done. For example, "No Fire" is indicated by ⃠ .
●	Indicates what must be done. For example, grounding is indicated by ⏚ .

In this Instruction Manual, instructions at a lower level than the above, instructions for other functions, and so on are classified into "POINT".
After reading this Instruction Manual, keep it accessible to the operator.

1. To prevent electric shock, note the following

⚠ WARNING

- Before wiring and inspections, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Otherwise, an electric shock may occur. In addition, when confirming whether the charge lamp is off or not, always confirm it from the front of the servo amplifier.
- Ground the servo amplifier and servo motor securely.
- Any person who is involved in wiring and inspection should be fully competent to do the work.
- Do not attempt to wire the servo amplifier and servo motor until they have been installed. Otherwise, it may cause an electric shock.
- Do not operate switches with wet hands. Otherwise, it may cause an electric shock.
- The cables should not be damaged, stressed, loaded, or pinched. Otherwise, it may cause an electric shock.
- To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the servo amplifier to the protective earth (PE) of the cabinet.
- To avoid an electric shock, insulate the connections of the power supply terminals.

2. To prevent fire, note the following

⚠ CAUTION

- Install the servo amplifier, servo motor, and regenerative resistor on incombustible material. Installing them directly or close to combustibles will lead to smoke or a fire.
- Always connect a magnetic contactor between the power supply and the power supply (L1, L2, and L3) of the servo amplifier, in order to configure a circuit that shuts down the power supply on the side of the servo amplifier's power supply. If a magnetic contactor is not connected, continuous flow of a large current may cause smoke or a fire when the servo amplifier malfunctions.
- Always connect a molded-case circuit breaker, or a fuse to each servo amplifier between the power supply and the main circuit power supply (L1, L2, and L3) of the servo amplifier, in order to configure a circuit that shuts down the power supply on the side of the servo amplifier's power supply. If a molded-case circuit breaker or fuse is not connected, continuous flow of a large current may cause smoke or a fire when the servo amplifier malfunctions.
- When using the regenerative resistor, switch power off with the alarm signal. Otherwise, a regenerative transistor malfunction or the like may overheat the regenerative resistor, causing smoke or a fire.
- When you use a regenerative option with an MR-JE-40A to MR-JE-100A, remove the built-in regenerative resistor and wiring from the servo amplifier.
- Provide adequate protection to prevent screws and other conductive matter, oil and other combustible matter from entering the servo amplifier and servo motor.

3. To prevent injury, note the following

⚠ CAUTION

- Only the voltage specified in the Instruction Manual should be applied to each terminal. Otherwise, a burst, damage, etc. may occur.
- Connect cables to the correct terminals. Otherwise, a burst, damage, etc. may occur.
- Ensure that polarity (+/-) is correct. Otherwise, a burst, damage, etc. may occur.
- The servo amplifier heat sink, regenerative resistor, servo motor, etc. may be hot while power is on or for some time after power-off. Take safety measures, e.g. provide covers, to avoid accidentally touching the parts (cables, etc.) by hand.

4. Additional instructions

The following instructions should also be fully noted. Incorrect handling may cause a malfunction, injury, electric shock, fire, etc.

(1) Transportation and installation

⚠ CAUTION

- Transport the products correctly according to their mass.
- Stacking in excess of the specified number of product packages is not allowed.
- Do not hold the lead wire of the regenerative resistor when transporting the servo amplifier.
- Install the servo amplifier and the servo motor in a load-bearing place in accordance with the Instruction Manual.
- Do not get on or put heavy load on the equipment.
- The equipment must be installed in the specified direction.
- Leave specified clearances between the servo amplifier and the cabinet walls or other equipment.
- Do not install or operate the servo amplifier and servo motor which have been damaged or have any parts missing.
- Do not block the intake and exhaust areas of the servo amplifier. Otherwise, it may cause a malfunction.
- Do not drop or strike the servo amplifier and servo motor. Isolate them from all impact loads.
- When you keep or use the equipment, please fulfill the following environment.

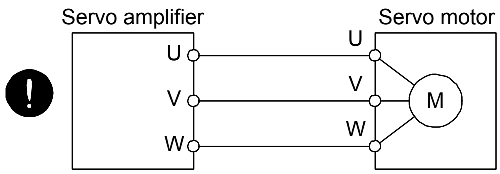
Item		Environment
Ambient temperature	Operation	0 °C to 55 °C (non-freezing)
	Storage	-20 °C to 65 °C (non-freezing)
Ambient humidity	Operation	90 %RH or less (non-condensing)
	Storage	
Ambience		Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, and dirt
Altitude		1000 m or less above sea level
Vibration resistance		5.9 m/s^2, at 10 Hz to 55 Hz (directions of X, Y and Z axes)

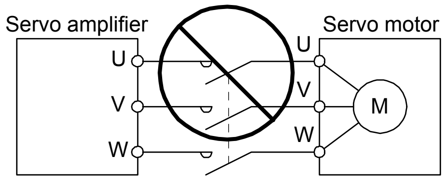
- When the product has been stored for an extended period of time, contact your local sales office.
- When handling the servo amplifier, be careful about the edged parts such as corners of the servo amplifier.
- The servo amplifier must be installed in a metal cabinet.
- When fumigants that contain halogen materials such as fluorine, chlorine, bromine, and iodine are used for disinfecting and protecting wooden packaging from insects, they cause malfunction when entering our products. Please take necessary precautions to ensure that remaining materials from fumigant do not enter our products, or treat packaging with methods other than fumigation (heat method). Additionally, disinfect and protect wood from insects before packing products.

(2) Wiring

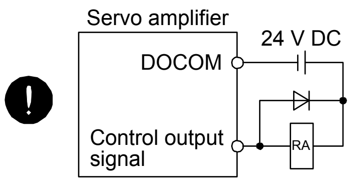
⚠ CAUTION

- Before removing the CNP1 connector of MR-JE-40A to MR-JE-100A, disconnect the lead wires of the regenerative resistor from the CNP1 connector.
- Wire the equipment correctly and securely. Otherwise, the servo motor may operate unexpectedly.
- Do not install a power capacitor, surge killer, or radio noise filter (optional FR-BIF) on the servo amplifier output side.
- To avoid a malfunction, connect the wires to the correct phase terminals (U, V, and W) of the servo amplifier and servo motor.
- Connect the servo amplifier power output (U, V, and W) to the servo motor power input (U, V, and W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.

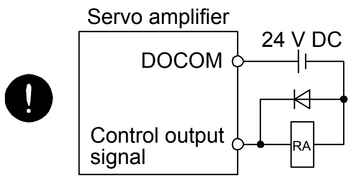




- The connection diagrams in this instruction manual are shown for sink interfaces, unless stated otherwise.
- The surge absorbing diode installed to the DC relay for control output should be fitted in the specified direction. Otherwise, the emergency stop and other protective circuits may not operate.



For sink output interface



For source output interface

- When the cable is not tightened enough to the terminal block, the cable or terminal block may generate heat because of the poor contact. Be sure to tighten the cable with specified torque.
- Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.

(3) Test run and adjustment

⚠ CAUTION

- Before operation, check the parameter settings. Improper settings may cause some machines to operate unexpectedly.
- Never make a drastic adjustment or change to the parameter values as doing so will make the operation unstable.
- Do not get close to moving parts during the servo-on status.

(4) Usage

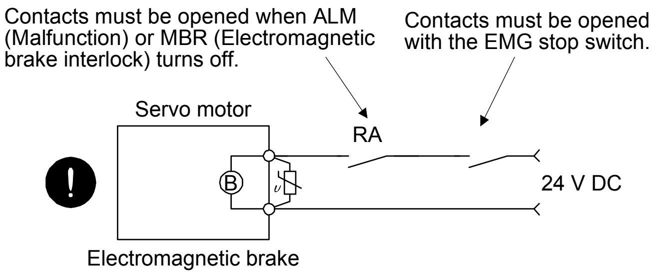
⚠ CAUTION

- When it is assumed that a hazardous condition may occur due to a power failure or product malfunction, use a servo motor with an external brake to prevent the condition.
- Do not disassemble, repair, or modify the equipment.
- Before resetting an alarm, make sure that the run signal of the servo amplifier is off in order to prevent a sudden restart. Otherwise, it may cause an accident.
- Use a noise filter, etc. to minimize the influence of electromagnetic interference. Electromagnetic interference may be given to the electronic equipment used near the servo amplifier.
- Burning or breaking a servo amplifier may cause a toxic gas. Do not burn or break it.
- Use the servo amplifier with the specified servo motor.
- The electromagnetic brake on the servo motor is designed to hold the motor shaft and should not be used for ordinary braking.
- For such reasons as service life and mechanical structure (e.g. where a ball screw and the servo motor are coupled via a timing belt), the electromagnetic brake may not hold the motor shaft. To ensure safety, install a stopper on the machine side.

(5) Corrective actions

⚠ CAUTION

- When it is assumed that a hazardous condition may occur due to a power failure or product malfunction, use a servo motor with an electromagnetic brake or external brake to prevent the condition.
- Configure an electromagnetic brake circuit so that it is activated also by an external EMG stop switch.



- When any alarm has occurred, eliminate its cause, ensure safety, and deactivate the alarm before restarting operation.
- Provide an adequate protection to prevent unexpected restart after an instantaneous power failure.

(6) Maintenance, inspection and parts replacement

⚠ CAUTION

- With age, the electrolytic capacitor of the servo amplifier will deteriorate. To prevent a secondary accident due to a malfunction, it is recommend that the electrolytic capacitor be replaced every 10 years when it is used in general environment. For replacement, please contact your local sales office.
- When using a servo amplifier whose power has not been turned on for a long time, contact your local sales office.

(7) General instruction

● To illustrate details, the equipment in the diagrams of this Instruction Manual may have been drawn without covers and safety guards. When the equipment is operated, the covers and safety guards must be installed as specified. Operation must be performed in accordance with this Instruction Manual.

● DISPOSAL OF WASTE ●

Please dispose a servo amplifier and other options according to your local laws and regulations.

⚠ EEP-ROM life

The number of write times to the EEP-ROM, which stores parameter settings, etc., is limited to 100,000. If the total number of the following operations exceeds 100,000, the servo amplifier may malfunction when the EEP-ROM reaches the end of its useful life.

- Write to the EEP-ROM due to parameter setting changes
- Write to the EEP-ROM due to device changes

Compliance with global standards

Refer to appendix 2 for the compliance with global standard.

Using HF-KN series and HF-SN series servo motors

For the combinations and characteristics when using HF-KN series and HF-SN series servo motors, refer to appendix 5.

«About the manual»

You must have this Instruction Manual and the following manuals to use this servo. Ensure to prepare them to use the servo safely.

Relevant manuals

Manual name	Manual No.
MELSERVO-JE Servo Amplifier Instruction Manual (Troubleshooting)	SH(NA)030166
MELSERVO-JE-_A Servo Amplifier Instruction Manual (Positioning Mode)	SH(NA)030150
MELSERVO-JE-_A Servo Amplifier Instruction Manual (Modbus-RTU Protocol)	SH(NA)030177
MELSERVO HG-KN/HG-SN Servo Motor Instruction Manual	SH(NA)030135
EMC Installation Guidelines	IB(NA)67310

«Cables used for wiring»

Wires mentioned in this Instruction Manual are selected based on the ambient temperature of 40 °C.

«U.S. customary units»

U.S. customary units are not shown in this manual. Convert the values if necessary according to the following table.

Quantity	SI (metric) unit	U.S. customary unit
Mass	1 [kg]	2.2046 [lb]
Length	1 [mm]	0.03937 [inch]
Torque	1 [N•m]	141.6 [oz•inch]
Moment of inertia	1 [(× 10^{-4} kg•m^2)]	5.4675 [oz•$inch^2$]
Load (thrust load/axial load)	1 [N]	0.2248 [lbf]
Temperature	N [°C] × 9/5 + 32	N [°F]

MEMO

CONTENTS

MEMO

1. FUNCTIONS AND CONFIGURATION

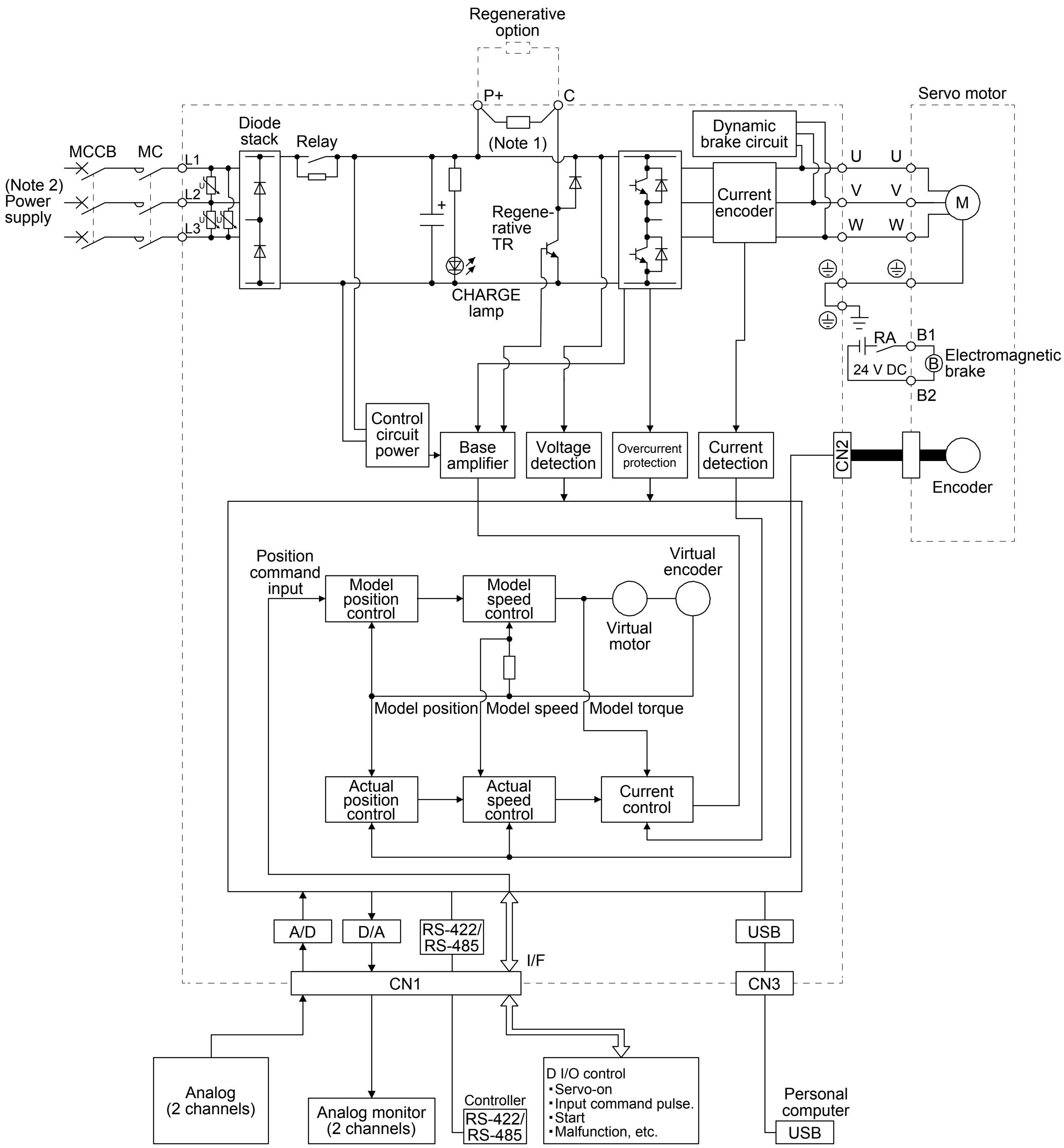
1.1 Summary

The Mitsubishi general-purpose AC servo MELSERVO-JE series have limited functions with keeping high performance based on MELSERVO-J4 series.
The servo amplifier has position, speed, and torque control modes. In the position control mode, the maximum pulse train of 4 Mpulses/s is supported. Further, it can perform operation with the control modes switched, e.g. position/speed control, speed/torque control and torque/position control. Hence, it is applicable to a wide range of fields, not only precision positioning and smooth speed control of machine tools and general industrial machines but also line control and tension control.
With one-touch tuning and real-time auto tuning, you can automatically adjust the servo gains according to the machine.
The tough drive function, drive recorder function, and preventive maintenance support function strongly support machine maintenance.
The servo amplifier has a USB communication interface. Therefore, you can connect the servo amplifier to the personal computer with MR Configurator2 installed to perform the parameter setting, test operation, gain adjustment, and others.
The MELSERVO-JE series servo motor equipped with an incremental encoder whose resolution is 131072 pulses/rev will enable a high-accuracy positioning.

1.2 Function block diagram

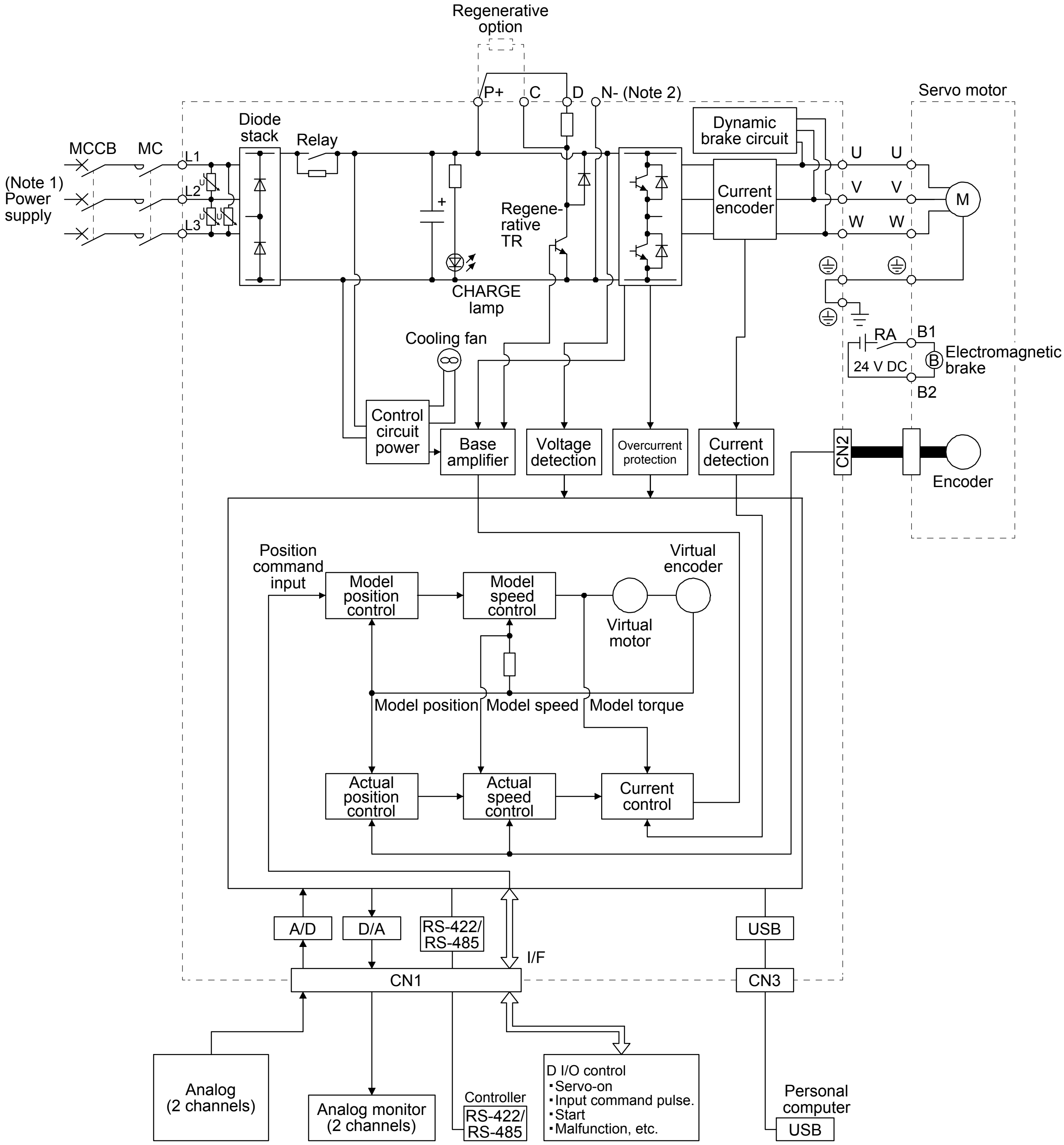
The function block diagram of this servo is shown below.

(1) MR-JE-100A or less



Note 1. The built-in regenerative resistor is not provided for MR-JE-10A and MR-JE-20A.
2. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open. For the power supply specifications, refer to section 1.3.

(2) MR-JE-200A or more



Note 1. For the power supply specifications, refer to section 1.3.
2. This is for manufacturer adjustment. Leave this open.

1.3 Servo amplifier standard specifications

Model: MR-JE-		10A	20A	40A	70A	100A	200A	300A
Output	Rated voltage	3-phase 170 V AC						
	Rated current [A]	1.1	1.5	2.8	5.8	6.0	11.0	11.0
Power supply input	Voltage/Frequency	3-phase or 1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz				3-phase or 1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz (Note 6)		3-phase 200 V AC to 240 V AC, 50 Hz/60 Hz
	Rated current (Note 5) [A]	0.9	1.5	2.6	3.8	5.0	10.5	14.0
	Permissible voltage fluctuation	3-phase or 1-phase 170 V AC to 264 V AC				3-phase or 1-phase 170 V AC to 264 V AC (Note 6)		3-phase 170 V AC to 264 V AC
	Permissible frequency fluctuation	Within ±5%						
	Power supply capacity [kVA]	Refer to section 10.2.						
	Inrush current [A]	Refer to section 10.5.						
Interface power supply	Voltage	24 V DC ± 10%						
	Current capacity [A]	(Note 1) 0.3						
Control method		Sine-wave PWM control, current control method						
Dynamic brake		Built-in						
Communication function		USB: connection to a personal computer or others (MR Configurator2-compatible) RS-422/RS-485: Connection to controller (1: n communication up to 32 axes) (Note 4, 7)						
Encoder output pulses		Compatible (A/B/Z-phase pulse)						
Analog monitor		Two channels						
Position control mode	Max. input pulse frequency	4 Mpulses/s (for differential receiver) (Note 3), 200 kpulses/s (for open collector)						
	Positioning feedback pulse	Encoder resolution (resolution per servo motor revolution): 131072 pulses/rev						
	Command pulse multiplying factor	Electronic gear A:1 to 16777215, B:1 to 16777215, 1/10 < A/B < 4000						
	In-position range setting	0 pulse to ±65535 pulses (command pulse unit)						
	Error excessive	±3 revolutions						
	Torque limit	Set by parameter setting or external analog input (0 V DC to +10 V DC/maximum torque)						
Speed control mode	Speed control range	Analog speed command 1: 2000, internal speed command 1: 5000						
	Analog speed command input	0 to ±10 V DC/rated speed (The speed at 10 V is changeable with [Pr. PC12].)						
	Speed fluctuation ratio	±0.01% or less (load fluctuation 0% to 100%), 0% (power fluctuation ±10%), ±0.2% or less (ambient temperature 25 °C ± 10 °C) when using analog speed command						
	Torque limit	Set by parameter setting or external analog input (0 V DC to +10 V DC/maximum torque)						
Torque control mode	Analog torque command input	0 V DC to ±8 V DC/maximum torque (input impedance 10 kΩ to 12 kΩ)						
	Speed limit	Set by parameter setting or external analog input (0 V DC to 10 V DC/rated speed)						
Positioning mode		Refer to section 1.1 of "MR-JE-_A Servo Amplifier Instruction Manual (Positioning Mode)" The positioning mode is available with servo amplifiers with software version B7 or later.						
Protective functions		Overcurrent shut-off, regenerative overvoltage shut-off, overload shut-off (electronic thermal), servo motor overheat protection, encoder error protection, regenerative error protection, undervoltage protection, instantaneous power failure protection, overspeed protection, and error excessive protection						
Compliance to global standards	CE marking	LVD: EN 61800-5-1 EMC: EN 61800-3 MD: EN ISO 13849-1, EN 61800-5-2, EN 62061						
	UL standard	UL 508C						
Structure (IP rating)		Natural cooling, open (IP20)					Force cooling, open (IP20)	
Close mounting (Note 2)	3-phase power supply input	Possible						
	1-phase power supply input	Possible				Impossible		

Model: MR-JE-			10A	20A	40A	70A	100A	200A	300A
Environment	Ambient temperature	Operation	0 °C to 55 °C (non-freezing)						
		Storage	-20 °C to 65 °C (non-freezing)						
	Ambient humidity	Operation	90 %RH or less (non-condensing)						
		Storage							
	Ambience		Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, and dirt						
	Altitude		1000 m or less above sea level						
	Vibration resistance		5.9 m/s^2, at 10 Hz to 55 Hz (directions of X, Y and Z axes)						
Mass [kg]			0.8			1.5		2.1	

Note 1. 0.3 A is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points.
2. When closely mounting the servo amplifier of 3.5 kW or less, operate them at the ambient temperatures of 0 °C to 45 °C or at 75% or smaller effective load ratio.
3. 1 Mpulse/s or lower commands are supported in the initial setting. When inputting commands over 1 Mpulse/s and 4 Mpulses/s or lower, change the setting in [Pr. PA13].
4. The RS-422 communication function is supported by servo amplifier manufactured in December 2013 or later. Refer to section 1.6 (1) for the year and month of manufacture.
5. These are current values for 3-phase power supply.
6. When using 1-phase 200 V AC to 240 V AC power supply, operate the servo amplifier at 75% or smaller effective load ratio.
7. The RS-485 communication function is available with servo amplifiers manufactured in May 2015 or later. Refer to section 1.6 (1) for the year and month of manufacture.

1.4 Combinations of servo amplifiers and servo motors

Servo amplifier	Servo motor
MR-JE-10A	HG-KN13_
MR-JE-20A	HG-KN23_
MR-JE-40A	HG-KN43_
MR-JE-70A	HG-KN73_ HG-SN52_
MR-JE-100A	HG-SN102_
MR-JE-200A	HG-SN152_ HG-SN202_
MR-JE-300A	HG-SN302_

1.5 Function list

The following table lists the functions of this servo. For details of the functions, refer to each section indicated in the detailed explanation field.

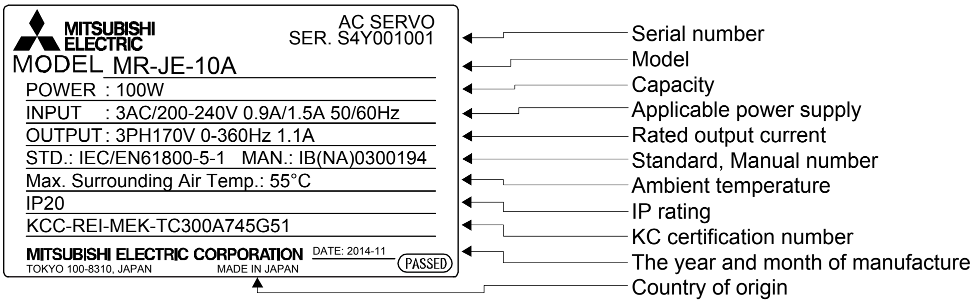
Function	Description	Detailed explanation
Model adaptive control	This function achieves a high response and stable control following the ideal model. The two-degree-of-freedom-model model adaptive control enables you to set a response to the command and response to the disturbance separately. Additionally, this function can be disabled. Refer to section 7.4 for disabling this function. Used by servo amplifiers with software version B4 or later. Check the software version using MR Configurator2.	
Position control mode	This servo is used as a position control servo.	Section 3.2.1 Section 3.6.1 Section 4.2
Speed control mode	This servo is used as a speed control servo.	Section 3.2.2 Section 3.6.2 Section 4.3
Torque control mode	This servo is used as a torque control servo.	Section 3.2.3 Section 3.6.3 Section 4.4
Position/speed control switch mode	Using an input device, control can be switched between position control and speed control.	Section 3.6.4
Speed/torque control switch mode	Using an input device, control can be switched between speed control and torque control.	Section 3.6.5
Torque/position control switch mode	Using an input device, control can be switched between torque control and position control.	Section 3.6.6
Positioning mode	In this mode, MR-JE-_A servo amplifiers are used in with point table or program method. For details, refer to "MR-JE-_A Servo Amplifier Instruction Manual (Positioning Mode)." The positioning mode is available with servo amplifiers with software version B7 or later.	MR-JE-_A Servo Amplifier Instruction Manual (Positioning Mode)
High-resolution encoder	High-resolution encoder of 131072 pulses/rev is used for the encoder of the servo motor compatible with the MELSERVO-JE series.	
Gain switching function	You can switch gains during rotation and during stop, and can use an input device to switch gains during operation.	Section 7.2
Advanced vibration suppression control II	This function suppresses vibration at the arm end or residual vibration.	Section 7.1.5
Machine resonance suppression filter	This is a filter function (notch filter) which decreases the gain of the specific frequency to suppress the resonance of the mechanical system.	Section 7.1.1
Shaft resonance suppression filter	When a load is mounted to the servo motor shaft, resonance by shaft torsion during driving may generate a mechanical vibration at high frequency. The shaft resonance suppression filter suppresses the vibration.	Section 7.1.3
Adaptive filter II	Servo amplifier detects mechanical resonance and sets filter characteristics automatically to suppress mechanical vibration.	Section 7.1.2
Low-pass filter	Suppresses high-frequency resonance which occurs as servo system response is increased.	Section 7.1.4
Machine analyzer function	Analyzes the frequency characteristic of the mechanical system by simply connecting an MR Configurator2 installed personal computer and servo amplifier. MR Configurator2 is necessary for this function.	
Robust filter	This function provides better disturbance response in case low response level that load to motor inertia ratio is high for such as roll send axes.	[Pr. PE41]
Slight vibration suppression control	Suppresses vibration of ±1 pulse produced at a servo motor stop.	[Pr. PB24]
Electronic gear	Input pulses can be multiplied by 1/10 to 4000.	[Pr. PA06] [Pr. PA07]
S-pattern acceleration/deceleration time constant	Speed can be increased and decreased smoothly.	[Pr. PC03]
Auto tuning	Automatically adjusts the gain to optimum value if load applied to the servo motor shaft varies.	Section 6.3
Regenerative option	Used when the built-in regenerative resistor of the servo amplifier does not have sufficient regenerative capability for the regenerative power generated.	Section 11.2
Alarm history clear	Alarm history is cleared.	[Pr. PC18]
Output signal selection (device settings)	ST1 (Forward rotation start), ST2 (Reverse rotation start), and SON (Servo-on) and other input device can be assigned to any pins.	[Pr. PD03] to [Pr. PD20]

Function	Description	Detailed explanation
Output signal selection (device settings)	The output devices including MBR (Electromagnetic brake interlock) can be assigned to certain pins of the CN1 connector.	[Pr. PD24] to [Pr. PD28]
Output signal (DO) forced output	Output signal can be forced on/off independently of the servo status. Use this function for checking output signal wiring, etc.	Section 4.5.8
Command pulse selection	Command pulse train form can be selected from among three different types.	[Pr. PA13]
Torque limit	Servo motor torque can be limited to any value.	Section 3.6.1 (5) [Pr. PA11] [Pr. PA12]
Speed limit	Servo motor speed can be limited to any value.	Section 3.6.3 (3) [Pr. PC05] to [Pr. PC11]
Status display	Servo status is shown on the 5-digit, 7-segment LED display.	Section 4.5.3
External I/O signal display	On/off statuses of external I/O signals are shown on the display.	Section 4.5.7
Automatic VC offset	Voltage is automatically offset to stop the servo motor if it does not come to a stop when VC (Analog speed command) or VLA (Analog speed limit is 0 V.	Section 4.5.4
Alarm code output	If an alarm has occurred, the corresponding alarm number is outputted in 3-bit code.	Chapter 8
Test operation mode	Jog operation, positioning operation, motor-less operation, DO forced output, and program operation MR Configurator2 is required for the positioning operation and program operation.	Section 4.5.9
Analog monitor output	Servo status is outputted in terms of voltage in real time.	[Pr. PC14], [Pr. PC15]
MR Configurator2	Using a personal computer, you can perform the parameter setting, test operation, monitoring, and others.	Section 11.4
One-touch tuning	Gain adjustment is performed just by one click on a certain button on MR Configurator2 or operation section.	Section 6.2
Tough drive function	This function makes the equipment continue operating even under the condition that an alarm occurs. The tough drive function includes two types: the vibration tough drive and the instantaneous power failure tough drive.	Section 7.3
Drive recorder function	This function continuously monitors the servo status and records the status transition before and after an alarm for a fixed period of time. You can check the recorded data on the drive recorder window on MR Configurator2 by clicking the "Graph" button. However, the drive recorder will not operate on the following conditions. 1. You are using the graph function of MR Configurator2. 2. You are using the machine analyzer function. 3. [Pr. PF21] is set to "-1".	[Pr. PA23]
Servo amplifier life diagnosis function	You can check the cumulative energization time and the number of on/off times of the inrush relay. This function gives an indication of the replacement time for parts of the servo amplifier including a capacitor and a relay before they malfunction. MR Configurator2 is necessary for this function.	
Power monitoring function	This function calculates the power running energy and the regenerative power from the data in the servo amplifier such as speed and current. Power consumption and others are displayed on MR Configurator2.	
Machine diagnosis function	From the data in the servo amplifier, this function estimates the friction and vibrational component of the drive system in the equipment and recognizes an error in the machine parts, including a ball screw and bearing. MR Configurator2 is necessary for this function.	
Modbus-RTU communication function	The Modbus protocol uses dedicated message frames for the serial communication between a master and slaves. The dedicated message frames have functions for reading and writing data, and users can write parameters from servo amplifiers and check the operation status of the servo amplifiers by using this function.	MR-JE-_A Servo Amplifier Instruction Manual (Modbus-RTU Protocol)

1.6 Model designation

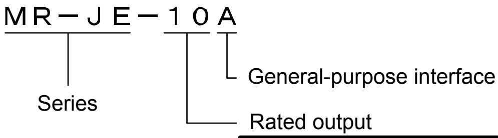
(1) Rating plate

The following shows an example of rating plate for explanation of each item.



(2) Model

The following describes what each block of a model name indicates.

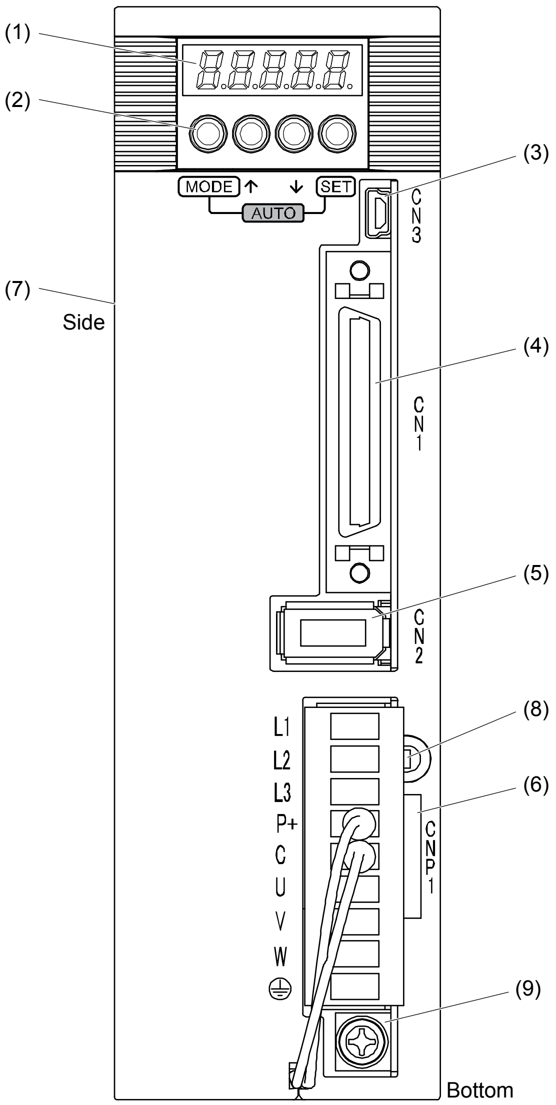


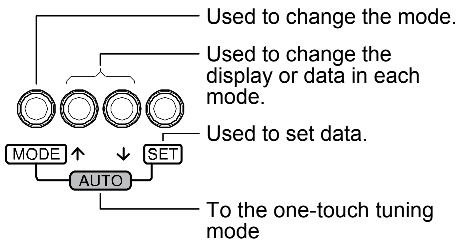
Symbol	Rated output [kW]
10	0.1
20	0.2
40	0.4
70	0.75
100	1
200	2
300	3

1.7 Structure

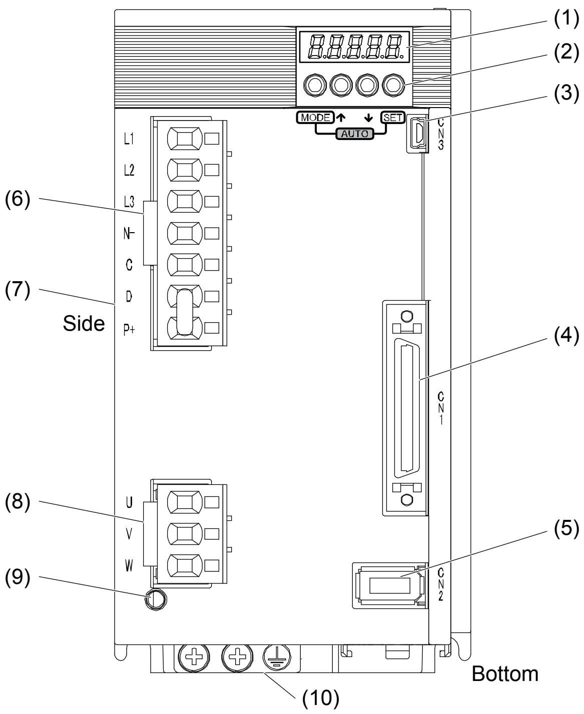
1.7.1 Parts identification

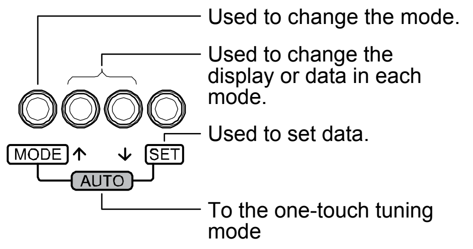
(1) MR-JE-100A or less



No.	Name/Application	Detailed explanation
(1)	Display The 5-digit, 7-segment LED shows the servo status and the alarm number.	Section 4.5
(2)	Operation section Used to perform status display, diagnostic, alarm, and parameter setting operations. Push the "MODE" and "SET" buttons at the same time for 3 s or more to switch to the one-touch tuning mode. 	Section 4.5 Section 6.2
(3)	USB communication connector (CN3) Connect with the personal computer.	Section 11.4
(4)	I/O signal connector (CN1) Digital I/O signal, analog input signal, analog monitor output signal, and RS-422/RS-485 communication controller are connected.	Section 3.2 Section 3.4 Chapter 12
(5)	Encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4
(6)	Power connector (CNP1) Input power supply, built-in regenerative resistor, regenerative option, and servo motor are connected.	Section 3.1 Section 3.3
(7)	Rating plate	Section 1.6
(8)	Charge lamp When the main circuit is charged, this will light up. While this lamp is lit, do not reconnect the cables.	
(9)	Protective earth (PE) terminal Grounding terminal	Section 3.1 Section 3.3

(2) MR-JE-200A or more



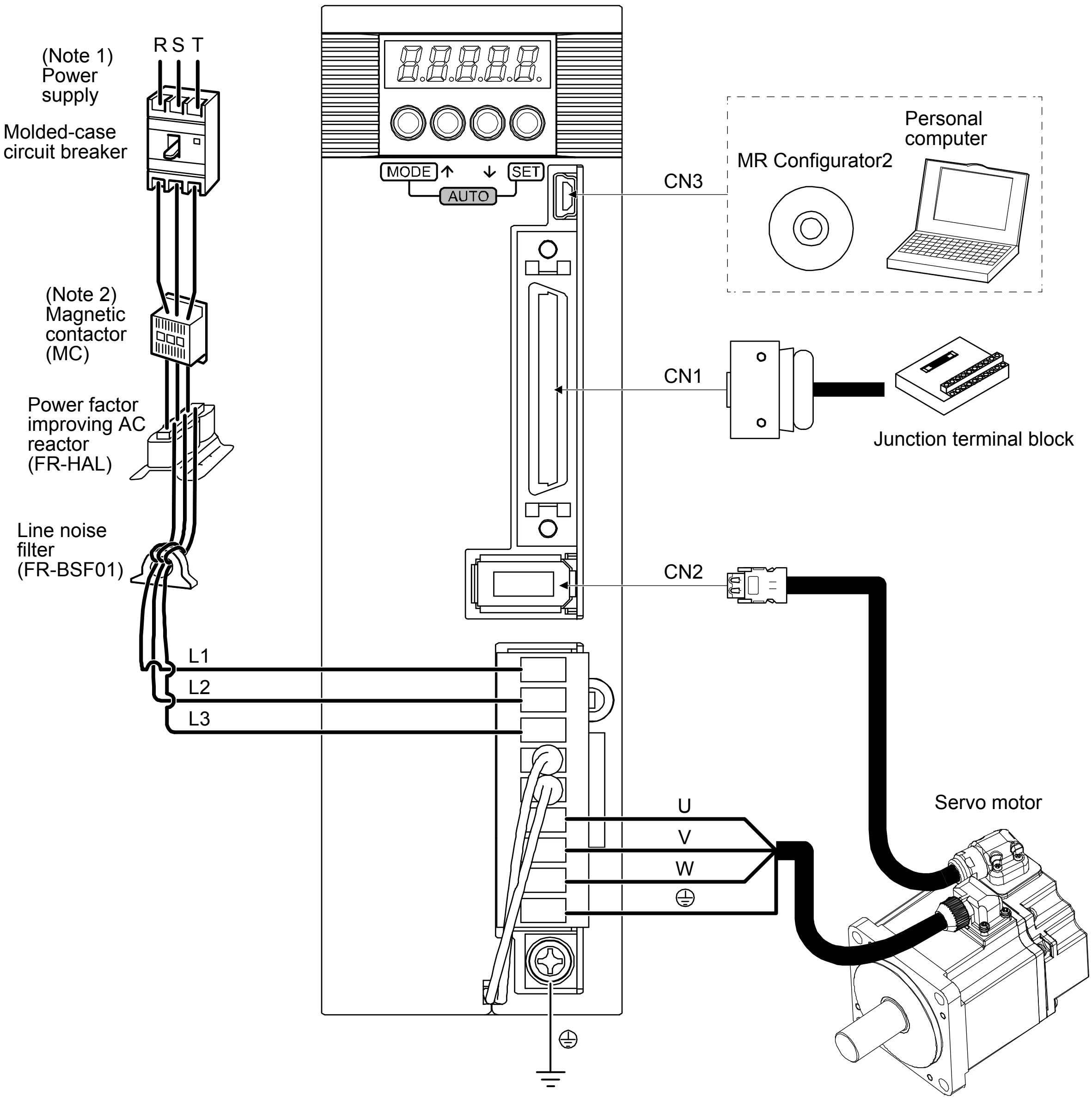
No.	Name/Application	Detailed explanation
(1)	Display The 5-digit, 7-segment LED shows the servo status and the alarm number.	Section 4.5
(2)	Operation section Used to perform status display, diagnostic, alarm, and parameter setting operations. Push the "MODE" and "SET" buttons at the same time for 3 s or more to switch to the one-touch tuning mode. 	Section 4.5 Section 6.2
(3)	USB communication connector (CN3) Connect with the personal computer.	Section 11.4
(4)	I/O signal connector (CN1) Digital I/O signal, analog input signal, analog monitor output signal, and RS-422/RS-485 communication controller are connected.	Section 3.2 Section 3.4 Chapter 12
(5)	Encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4
(6)	Power connector (CNP1) Input power supply and regenerative option are connected.	Section 3.1 Section 3.3
(7)	Rating plate	Section 1.6
(8)	Servo motor power connector (CNP2) Connect the servo motor.	Section 3.1 Section 3.3
(9)	Charge lamp When the main circuit is charged, this will light up. While this lamp is lit, do not reconnect the cables.	
(10)	Protective earth (PE) terminal Grounding terminal	Section 3.1 Section 3.3

1.8 Configuration including peripheral equipment

⚠CAUTION	●Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.

POINT
●Equipment other than the servo amplifier and servo motor are optional or recommended products.

(1) MR-JE-100A or less
The diagram shows MR-JE-40A.

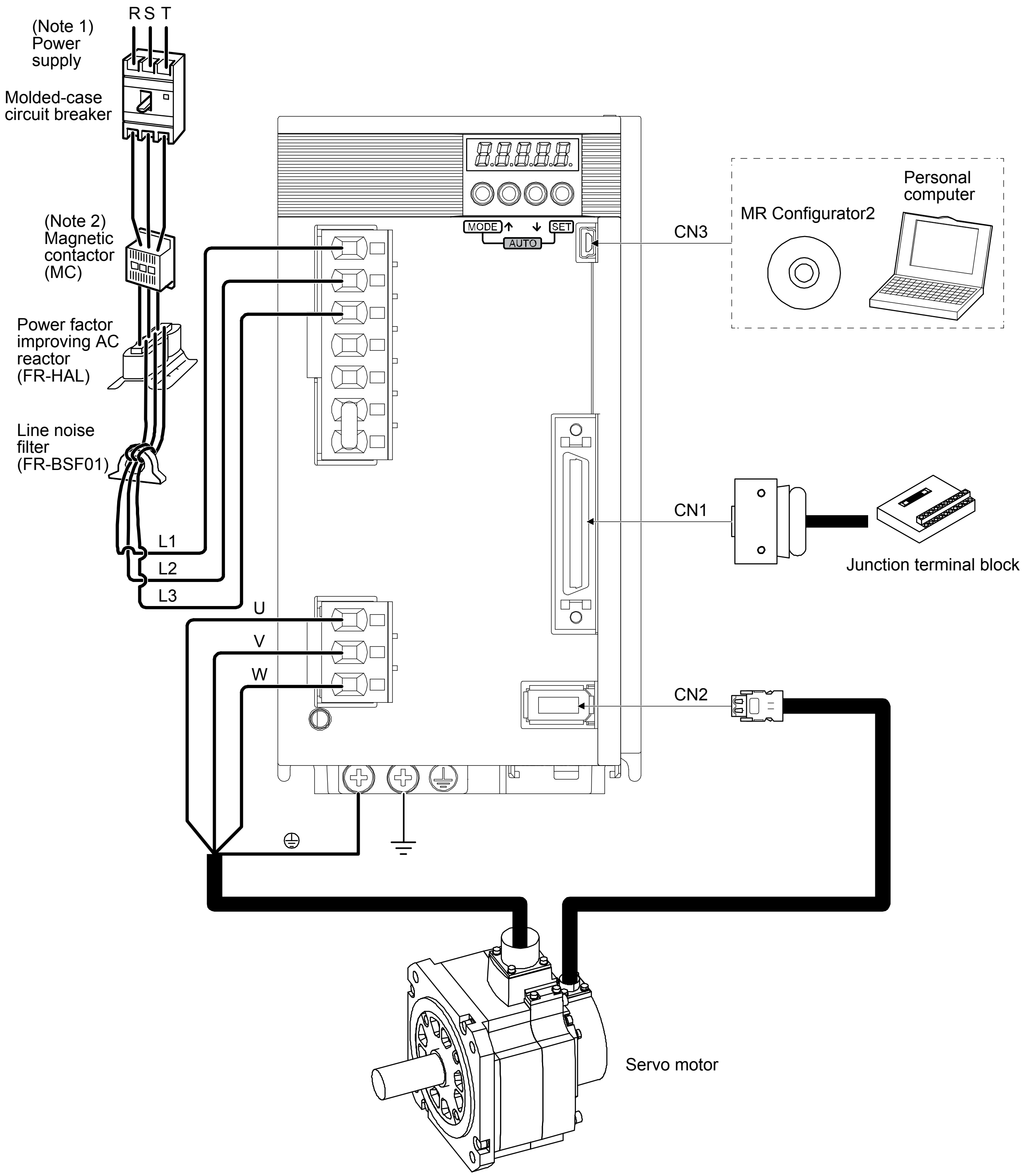


Note 1. A 1-phase 200 V AC to 240 V AC power supply may be used with the servo amplifier of MR-JE-70A or less. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open. For the power supply specifications, refer to section 1.3.

2. Depending on the power supply voltage and operation pattern, bus voltage can decrease. This can shift the mode to the dynamic brake deceleration during forced stop deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

(2) MR-JE-200A or more

The diagram shows MR-JE-200A.



Note 1. For the power supply specifications, refer to section 1.3.

2. Depending on the power supply voltage and operation pattern, bus voltage can decrease. This can shift the mode to the dynamic brake deceleration during forced stop deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

MEMO

2. INSTALLATION

⚠WARNING	●To prevent electric shock, ground each equipment securely.

⚠CAUTION	●Stacking in excess of the specified number of product packages is not allowed. ●Do not hold the lead wire of the regenerative resistor when transporting the servo amplifier. ●Install the equipment on incombustible material. Installing them directly or close to combustibles will lead to a fire. ●Install the servo amplifier and the servo motor in a load-bearing place in accordance with the Instruction Manual. ●Do not get on or put heavy load on the equipment. Otherwise, it may cause injury. ●Use the equipment within the specified environment. For the environment, refer to section 1.3. ●Provide an adequate protection to prevent screws and other conductive matter, oil and other combustible matter from entering the servo amplifier. ●Do not block the intake and exhaust areas of the servo amplifier. Otherwise, it may cause a malfunction. ●Do not drop or strike the servo amplifier. Isolate it from all impact loads. ●Do not install or operate the servo amplifier which has been damaged or has any parts missing. ●When the product has been stored for an extended period of time, contact your local sales office. ●When handling the servo amplifier, be careful about the edged parts such as corners of the servo amplifier. ●The servo amplifier must be installed in a metal cabinet. ●When fumigants that contain halogen materials such as fluorine, chlorine, bromine, and iodine are used for disinfecting and protecting wooden packaging from insects, they cause malfunction when entering our products. Please take necessary precautions to ensure that remaining materials from fumigant do not enter our products, or treat packaging with methods other than fumigation (heat method). Additionally, disinfect and protect wood from insects before packing products.

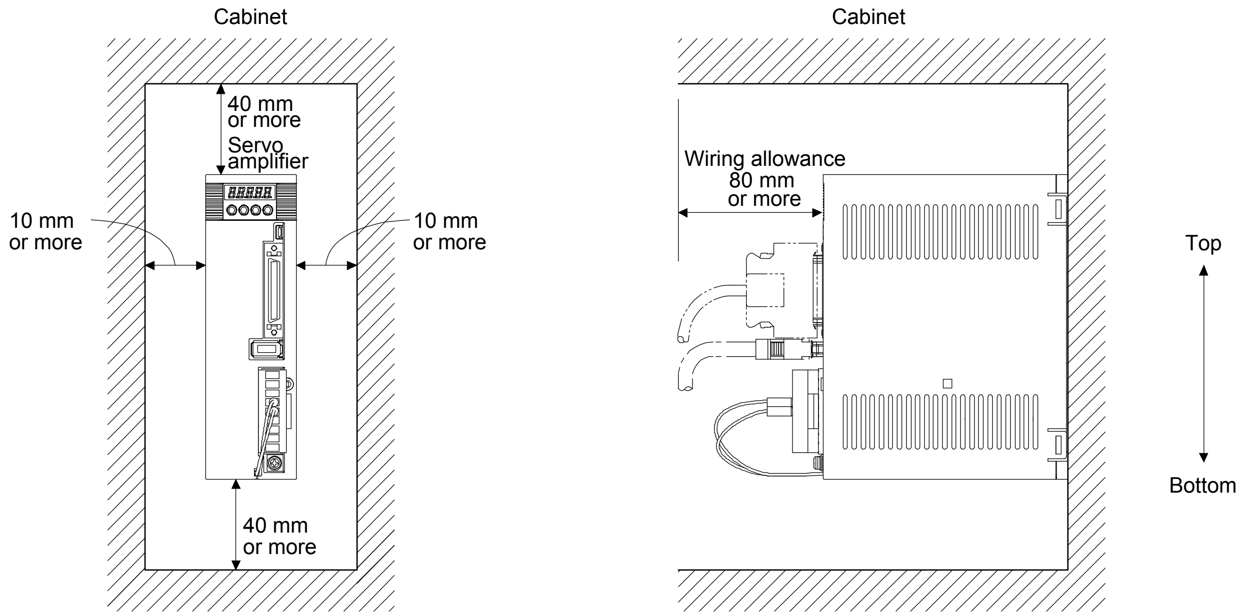
2.1 Installation direction and clearances

CAUTION	●The equipment must be installed in the specified direction. Otherwise, it may cause a malfunction. ●Leave specified clearances between the servo amplifier and the cabinet walls or other equipment. Otherwise, it may cause a malfunction.

MR-JE-40A to MR-JE-100A have a regenerative resistor on their back face. The regenerative resistor generates heat of 100 ˚C higher than the ambient temperature. Please fully consider heat dissipation, installation position, etc. when mounting it.

(1) Installation clearances of the servo amplifier

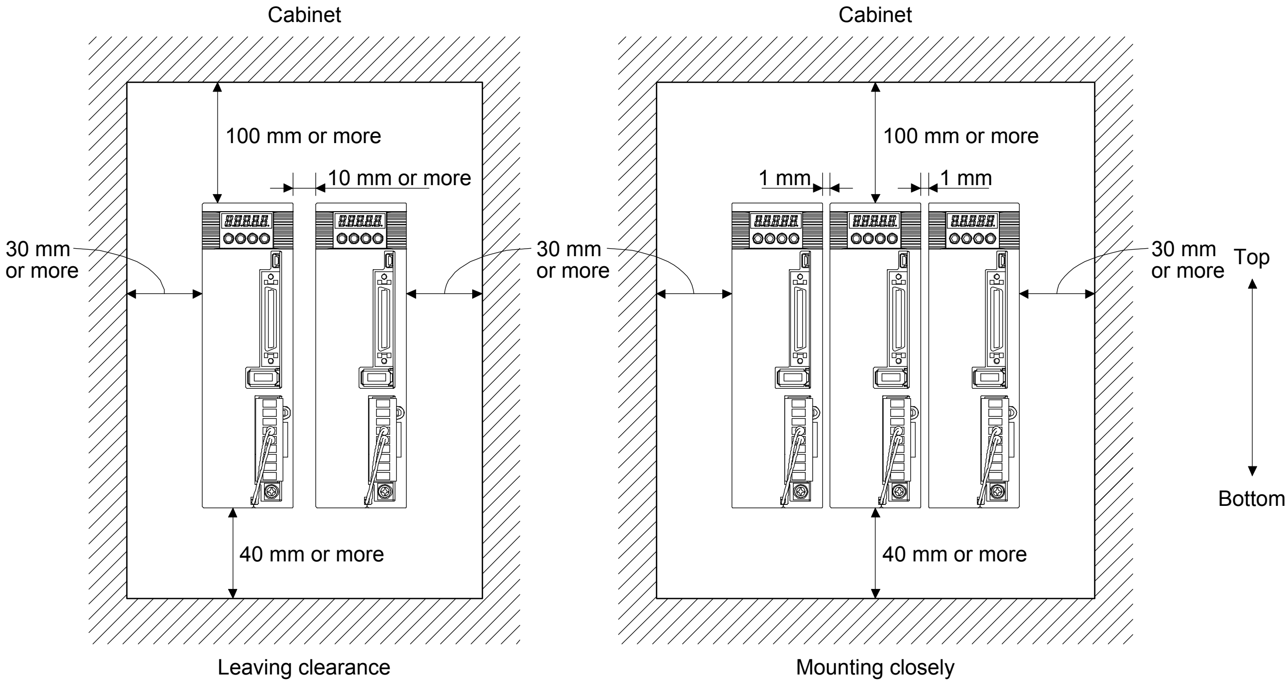
(a) Installation of one servo amplifier



(b) Installation of two or more servo amplifiers

POINT
●Close mounting is possible depending on the capacity of the servo amplifier. Refer to section 1.3 for availability of close mounting.

Leave a large clearance between the top of the servo amplifier and the cabinet walls, and install a cooling fan to prevent the internal temperature of the cabinet from exceeding the environment. When mounting the servo amplifiers closely, leave a clearance of 1 mm between the adjacent servo amplifiers in consideration of mounting tolerances. In this case, keep the ambient temperature within 0 ˚C to 45 ˚C or use the servo amplifier with 75% or less of the effective load ratio.



(2) Others
When using heat generating equipment such as the regenerative option, install them with full consideration of heat generation so that the servo amplifier is not affected.
Install the servo amplifier on a perpendicular wall in the correct vertical direction.

2.2 Keep out foreign materials

(1) When drilling in the cabinet, prevent drill chips and wire fragments from entering the servo amplifier.

(2) Prevent oil, water, metallic dust, etc. from entering the servo amplifier through openings in the cabinet or a cooling fan installed on the ceiling.

(3) When installing the cabinet in a place where toxic gas, dirt and dust exist, conduct an air purge (force clean air into the cabinet from outside to make the internal pressure higher than the external pressure) to prevent such materials from entering the cabinet.

2.3 Encoder cable stress

(1) The way of clamping the cable must be fully examined so that bending stress and cable's own weight stress are not applied to the cable connection.

(2) For use in any application where the servo motor moves, fix the cables (encoder, power supply, and brake) with having some slack from the connector connection part of the servo motor to avoid putting stress on the connector connection part. Use the optional encoder cable within the bending life range. Use the power supply and brake wiring cables within the bending life of the cables.

(3) Avoid any probability that the cable sheath might be cut by sharp chips, rubbed by a machine corner or stamped by workers or vehicles.

(4) For installation on a machine where the servo motor moves, the flexing radius should be made as large as possible. Refer to section 10.4 for the bending life.

2.4 Inspection items

⚠WARNING	●Before starting maintenance and/or inspection, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Otherwise, an electric shock may occur. In addition, when confirming whether the charge lamp is off or not, always confirm it from the front of the servo amplifier. ●To avoid an electric shock, only qualified personnel should attempt inspections. For repair and parts replacement, contact your local sales office.

⚠CAUTION	●Do not perform insulation resistance test on the servo amplifier. Otherwise, it may cause a malfunction. ●Do not disassemble and/or repair the equipment on customer side.

It is recommended that the following points periodically be checked.

(1) Check for loose terminal block screws. Retighten any loose screws.

(2) Check the cables and the like for scratches or cracks. Inspect them periodically according to operating conditions especially when the servo motor is movable.

(3) Check that the connector is securely connected to the servo amplifier.

(4) Check that the wires are not coming out from the connector.

(5) Check for dust accumulation on the servo amplifier.

(6) Check for unusual noise generated from the servo amplifier.

2.5 Parts having service lives

Service lives of the following parts are listed below. However, the service life vary depending on operating methods and environment. If any fault is found in the parts, they must be replaced immediately regardless of their service lives. For parts replacement, please contact your local sales office.

Part name	Life guideline
Smoothing capacitor	10 years
Relay	Number of power-on and forced stop times by EM1 (Forced stop 1): 100,000 times
Cooling fan	50,000 hours to 70,000 hours (7 years to 8 years)

(1) Smoothing capacitor
The characteristic of smoothing capacitor is deteriorated due to ripple currents, etc. The life of the capacitor greatly depends on ambient temperature and operating conditions. The capacitor will reach the end of its life in 10 years of continuous operation in normal air-conditioned environment (40 ˚C surrounding air temperature or less).

(2) Relays
Contact faults will occur due to contact wear arisen from switching currents. Relays will reach the end of their lives depending on their power supply capacity when the number of power-on times and number of forced stop times by EM1 (Forced stop 1) are 100,000 times in total.

(3) Servo amplifier cooling fan
The cooling fan bearings reach the end of their life in 50,000 hours to 70,000 hours. Normally, therefore, the cooling fan must be replaced in seven to eight years of continuous operation as a guideline. It must also be changed if unusual noise or vibration is found during inspection.
The life indicates under the yearly average ambient temperature of 40 ˚C, free from corrosive gas, flammable gas, oil mist, dust and dirt.

MEMO

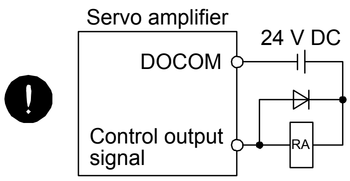
3. SIGNALS AND WIRING

WARNING

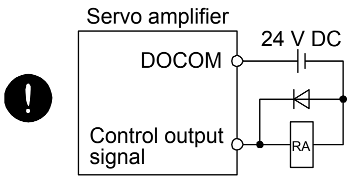
- Any person who is involved in wiring should be fully competent to do the work.
- Before wiring, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Otherwise, an electric shock may occur. In addition, when confirming whether the charge lamp is off or not, always confirm it from the front of the servo amplifier.
- Ground the servo amplifier and servo motor securely.
- Do not attempt to wire the servo amplifier and servo motor until they have been installed. Otherwise, it may cause an electric shock.
- The cables should not be damaged, stressed, loaded, or pinched. Otherwise, it may cause an electric shock.
- To avoid an electric shock, insulate the connections of the power supply terminals.

CAUTION

- Before removing the CNP1 connector from MR-JE-40A to MR-JE-100A, disconnect the lead wires of the regenerative resistor from the CNP1 connector.
- Wire the equipment correctly and securely. Otherwise, the servo motor may operate unexpectedly, resulting in injury.
- Connect cables to the correct terminals. Otherwise, a burst, damage, etc. may occur.
- Ensure that polarity (+/-) is correct. Otherwise, a burst, damage, etc. may occur.
- The surge absorbing diode installed to the DC relay for control output should be fitted in the specified direction. Otherwise, the emergency stop and other protective circuits may not operate.

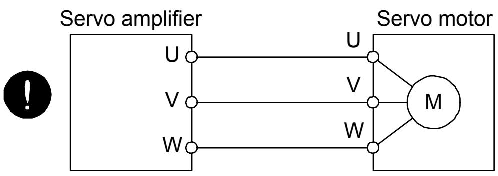


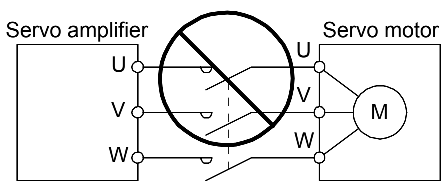
For sink output interface



For source output interface

- Use a noise filter, etc. to minimize the influence of electromagnetic interference. Electromagnetic interference may be given to the electronic equipment used near the servo amplifier.
- Do not install a power capacitor, surge killer or radio noise filter (optional FR-BIF) with the power line of the servo motor.
- When using the regenerative resistor, switch power off with the alarm signal. Otherwise, a transistor fault or the like may overheat the regenerative resistor, causing a fire.
- Do not modify the equipment.
- Connect the servo amplifier power output (U, V, and W) to the servo motor power input (U, V, and W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.





- Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.

3.1 Input power supply circuit

⚠CAUTION

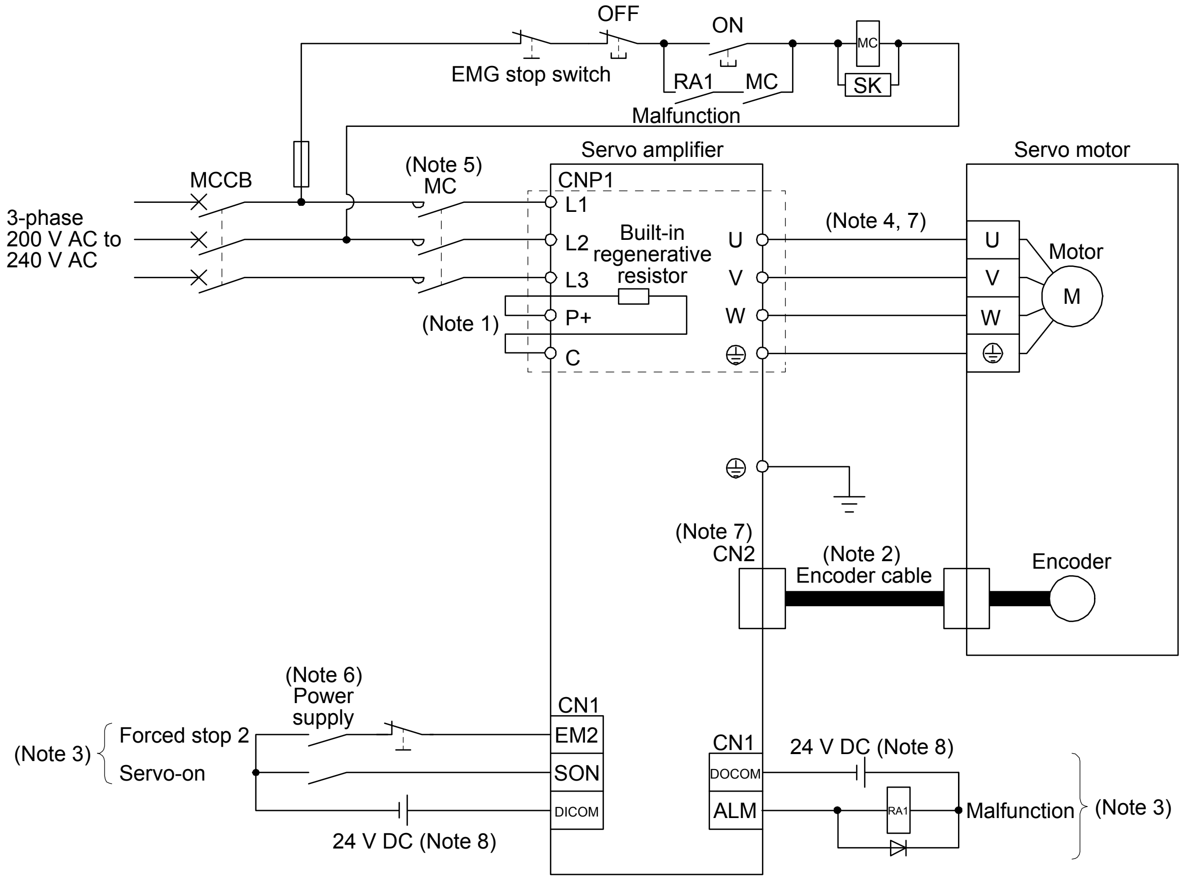
- Always connect a magnetic contactor between the power supply and the power supply (L1, L2, and L3) of the servo amplifier, in order to configure a circuit that shuts down the power supply on the side of the servo amplifier's power supply. If a magnetic contactor is not connected, continuous flow of a large current may cause a fire when the servo amplifier malfunctions.
- Use ALM (Malfunction) to switch power off. Not doing so may cause a fire when a regenerative transistor malfunctions or the like may overheat the regenerative resistor.
- Before removing the CNP1 connector from MR-JE-40A to MR-JE-100A, disconnect the lead wires of the regenerative resistor from the CNP1 connector. Not doing so may break the lead wires of the regenerative resistor.
- Check the servo amplifier model, and then input proper voltage to the servo amplifier power supply. If input voltage exceeds the upper limit of the specification, the servo amplifier will break down.
- The servo amplifier has a built-in surge absorber (varistor) to reduce noise and to suppress lightning surge. The varistor can break down due to its aged deterioration. To prevent a fire, use a molded-case circuit breaker or fuse for input power supply.
- Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
- The N- terminal is not a neutral point of the power supply. Incorrect wiring will cause a burst, damage, etc.

POINT

- EM2 has the same function as EM1 in the torque control mode.
- When a 1-phase 200 V AC to 240 V AC power supply is used, the connection destination differs depending on the servo amplifier. Ensure that the connection destination is correct.

Configure the wirings so that the power supply is shut off and SON (Servo-on) is turned off after deceleration to a stop due to an alarm occurring, enabled servo forced stop, etc. A molded-case circuit breaker (MCCB) must be used with the input cables of the main circuit power supply.

(1) For 3-phase 200 V AC to 240 V AC power supply of MR-JE-10A to MR-JE-100A



Note 1. MR-JE-40A to MR-JE-100A have a built-in regenerative resistor. (factory-wired) When using the regenerative option, refer to section 11.2.

2. For the encoder cable, use of the option cable is recommended. For selecting cables, refer to "HG-KN/HG-SN Servo Motor Instruction Manual".

3. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.

4. For connecting servo motor power wires, refer to "HG-KN/HG-SN Servo Motor Instruction Manual".

5. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. Depending on the power supply voltage and operation pattern, bus voltage can decrease. This can shift the mode to the dynamic brake deceleration during forced stop deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

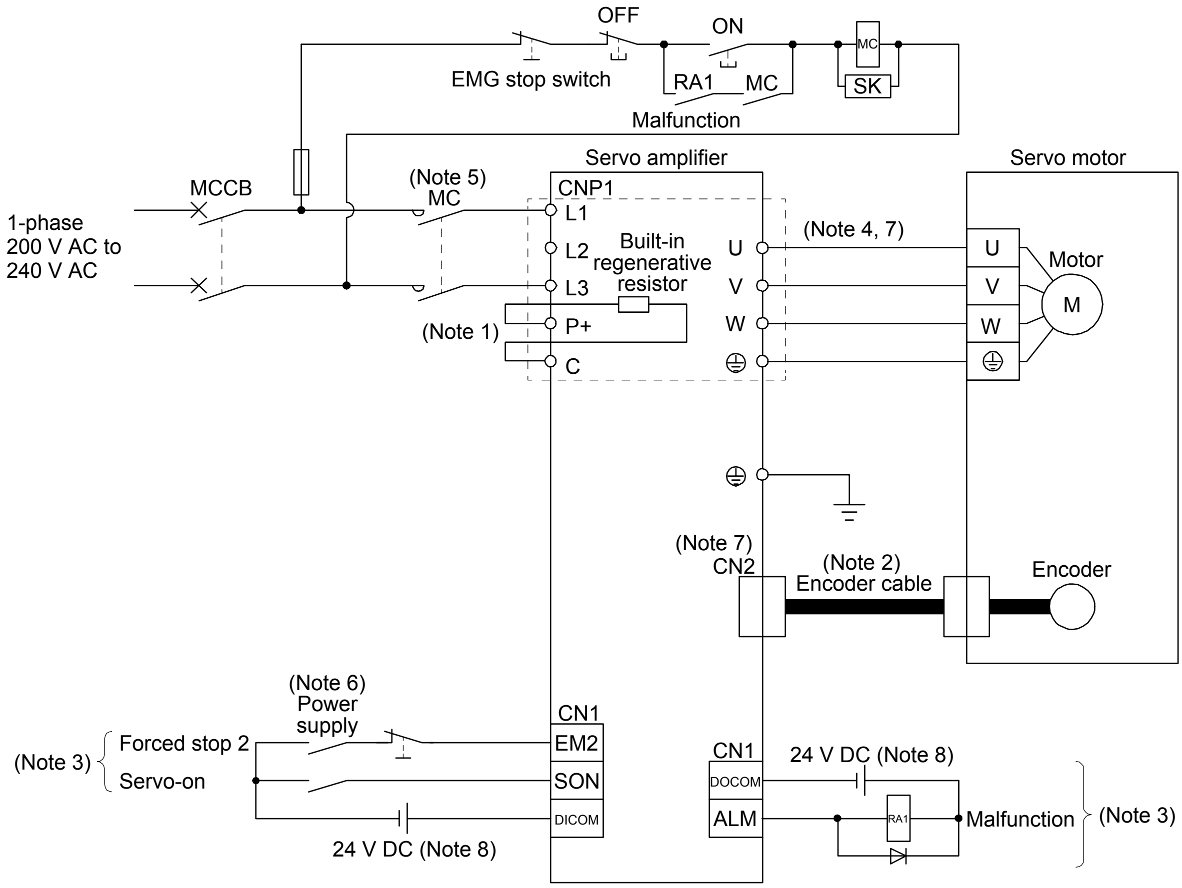
6. Configure a circuit to turn off EM2 when the power is turned off to prevent an unexpected restart of the servo amplifier.

7. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.

8. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.

(2) For 1-phase 200 V AC to 240 V AC power supply of MR-JE-10A to MR-JE-100A

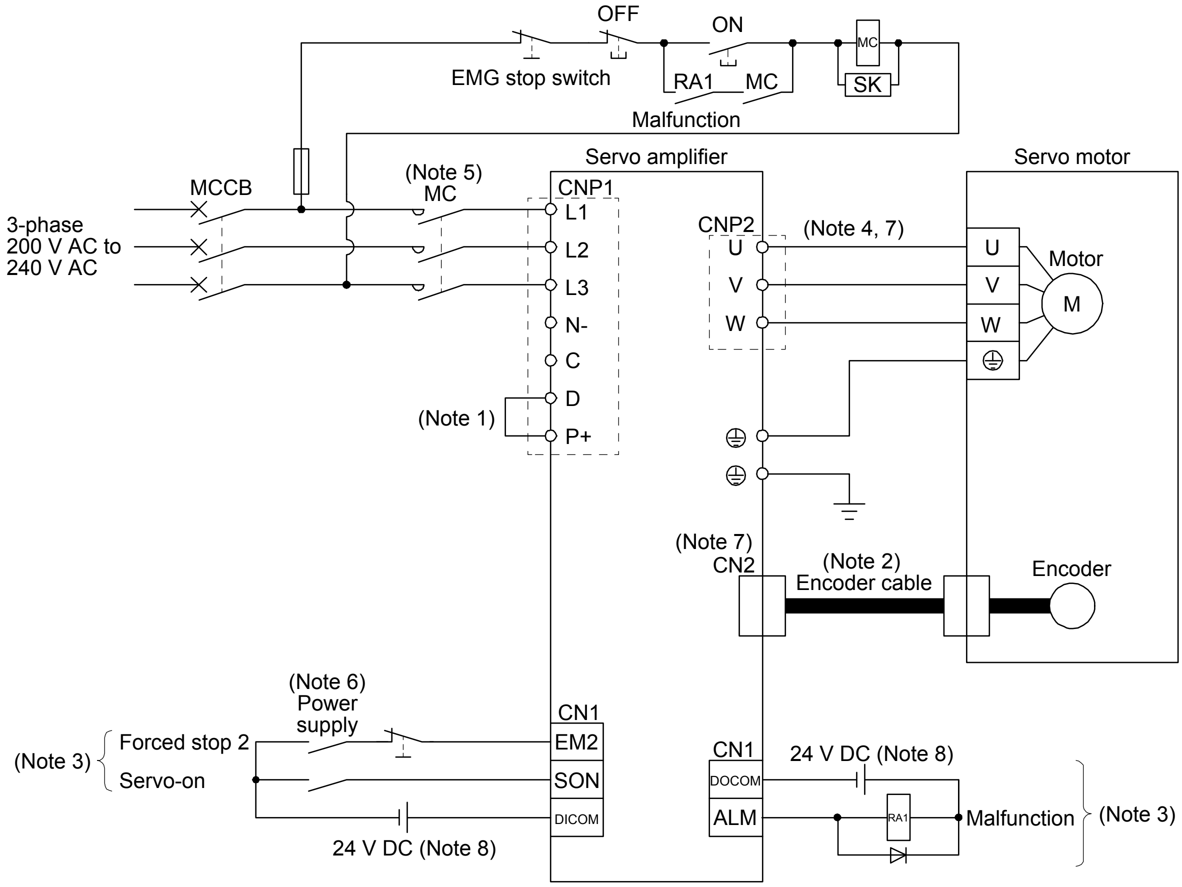
POINT
●Connect the 1-phase 200 V AC to 240 V AC power supply to L1 and L3. One of the connecting destinations is different from MR-JE-200A Servo Amplifier's.



Note 1. MR-JE-40A and MR-JE-70A have a built-in regenerative resistor. (factory-wired) When using the regenerative option, refer to section 11.2.

2. For the encoder cable, use of the option cable is recommended. For selecting cables, refer to "HG-KN/HG-SN Servo Motor Instruction Manual".
3. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
4. For connecting servo motor power wires, refer to "HG-KN/HG-SN Servo Motor Instruction Manual".
5. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. Depending on the power supply voltage and operation pattern, bus voltage can decrease. This can shift the mode to the dynamic brake deceleration during forced stop deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
6. Configure a circuit to turn off EM2 when the power is turned off to prevent an unexpected restart of the servo amplifier.
7. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
8. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.

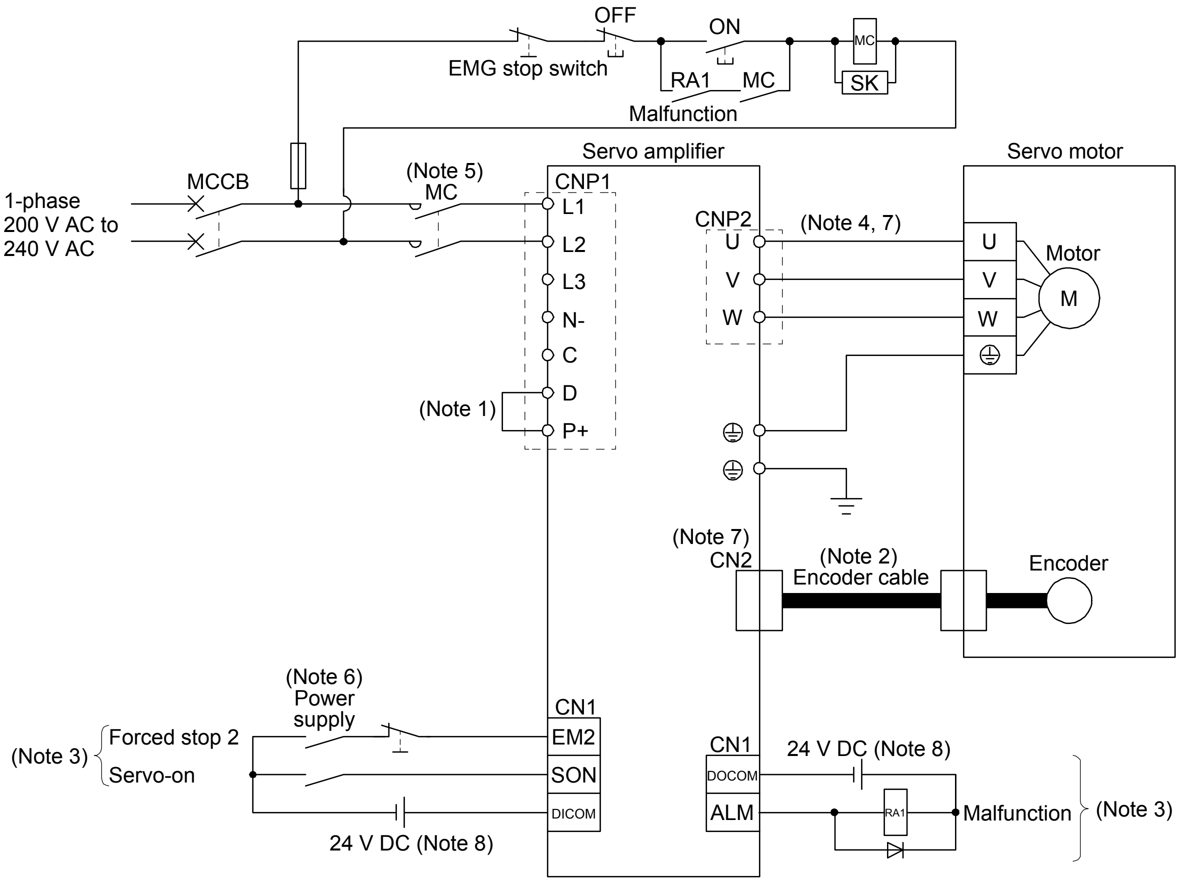
(3) For 3-phase 200 V AC to 240 V AC power supply of MR-JE-200A or MR-JE-300A



Note 1. Always connect between P+ and D terminals. (factory-wired) When using the regenerative option, refer to section 11.2.
2. For the encoder cable, use of the option cable is recommended. For selecting cables, refer to "HG-KN/HG-SN Servo Motor Instruction Manual".
3. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
4. For connecting servo motor power wires, refer to "HG-KN/HG-SN Servo Motor Instruction Manual".
5. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. Depending on the power supply voltage and operation pattern, bus voltage can decrease. This can shift the mode to the dynamic brake deceleration during forced stop deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
6. Configure a circuit to turn off EM2 when the power is turned off to prevent an unexpected restart of the servo amplifier.
7. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
8. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.

(4) For 1-phase 200 V AC to 240 V AC power supply of MR-JE-200A

POINT
●Connect the 1-phase 200 V AC to 240 V AC power supply to L1 and L2. One of the connecting destinations is different from MR-JE-100A or less Servo Amplifier's.



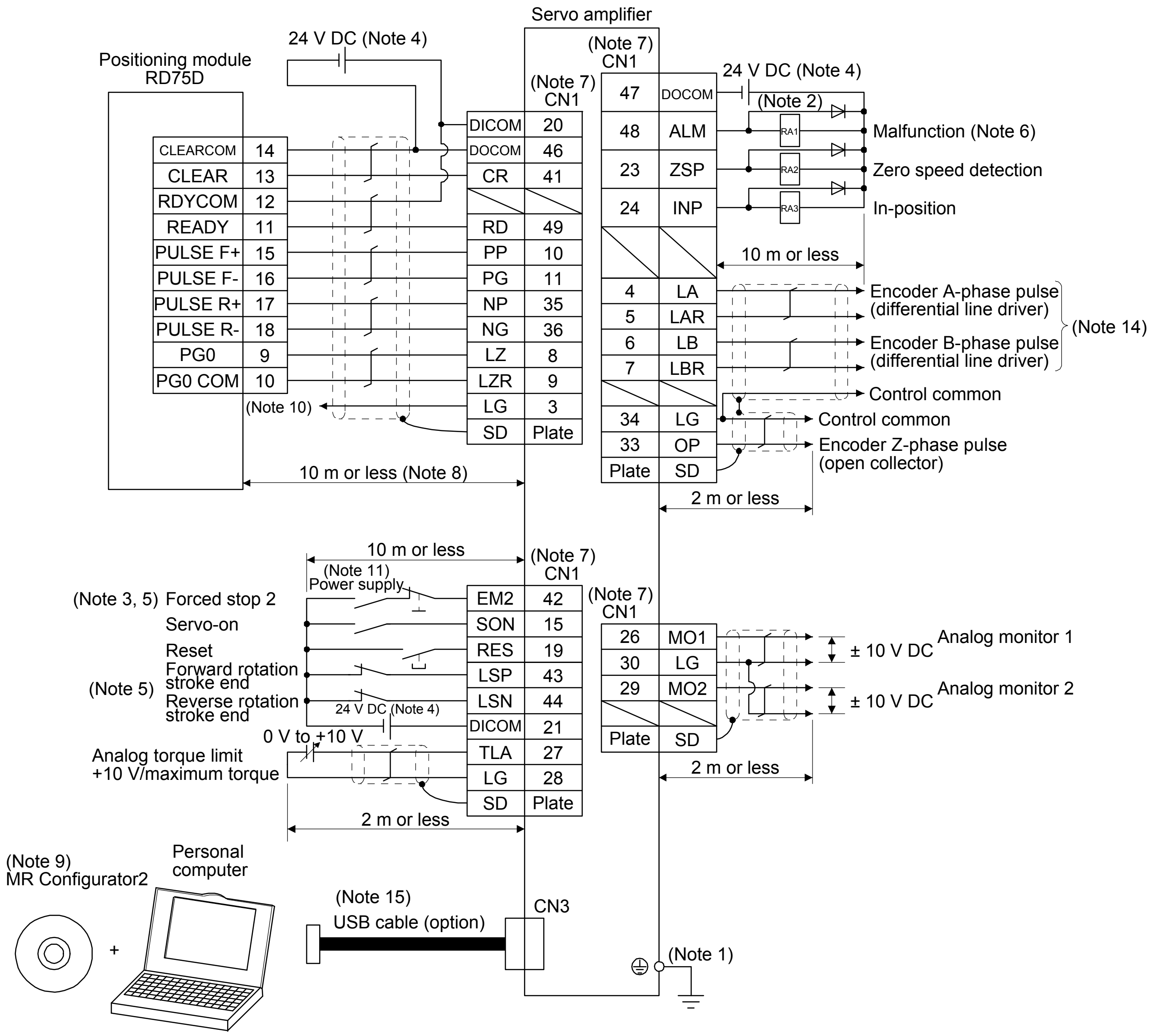
Note 1. Always connect between P+ and D terminals. (factory-wired) When using the regenerative option, refer to section 11.2.
2. For the encoder cable, use of the option cable is recommended. For cable selection, refer to "HG-KN/HG-SN Servo Motor Instruction Manual".
3. This is for the sink I/O interface. For source I/O interface, refer to section 3.9.3.
4. For connection of servo motor power wires, refer to "HG-KN/HG-SN Servo Motor Instruction Manual".
5. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. Depending on the power supply voltage and operation pattern, bus voltage can decrease. This can shift the mode to the dynamic brake deceleration during forced stop deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
6. Configure a circuit to turn off EM2 when the power is turned off to prevent an unexpected restart of the servo amplifier.
7. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
8. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.

3.2 I/O signal connection example

3.2.1 Position control mode

(1) When you use a positioning module RD75D

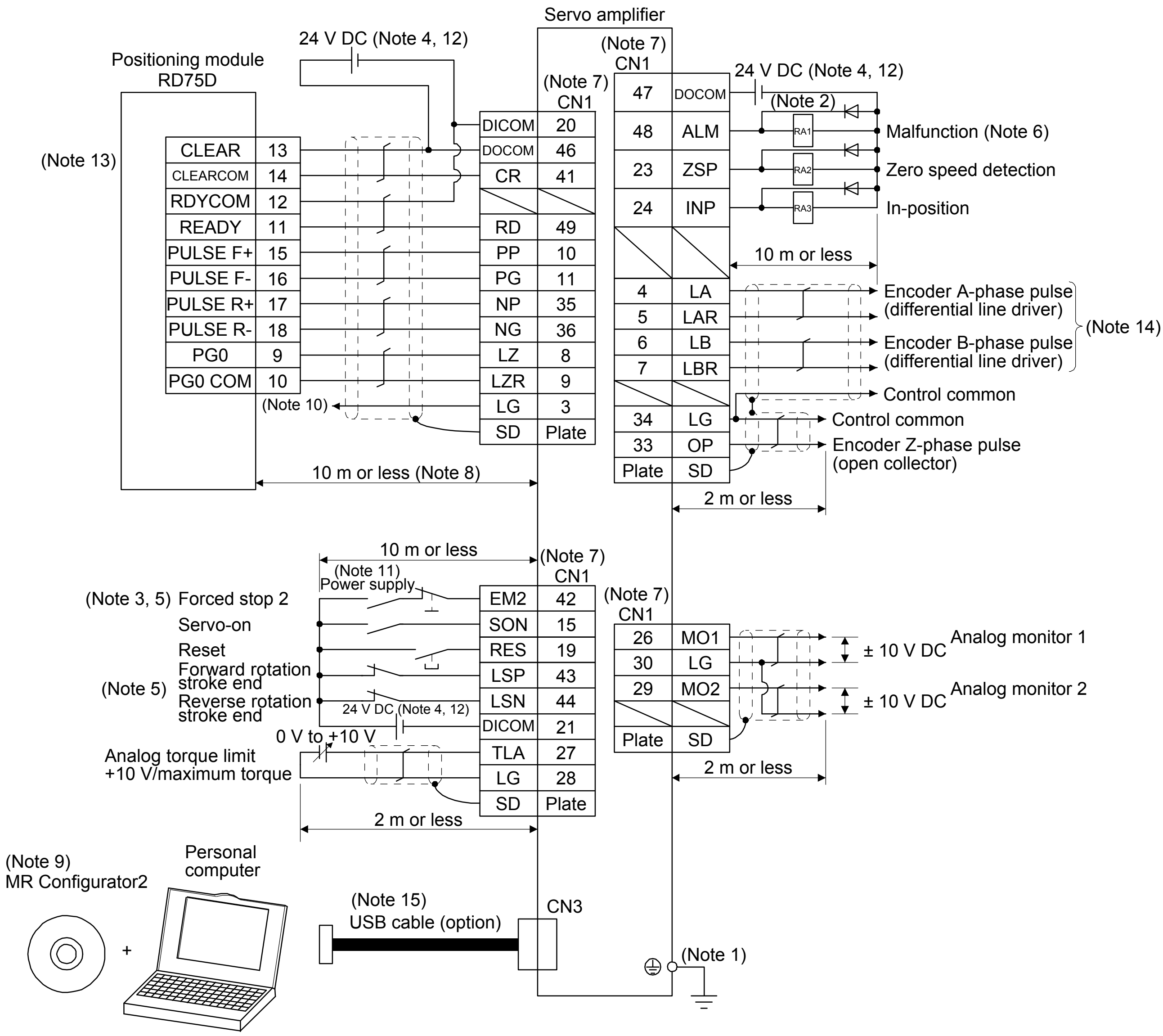
(a) For sink I/O interface



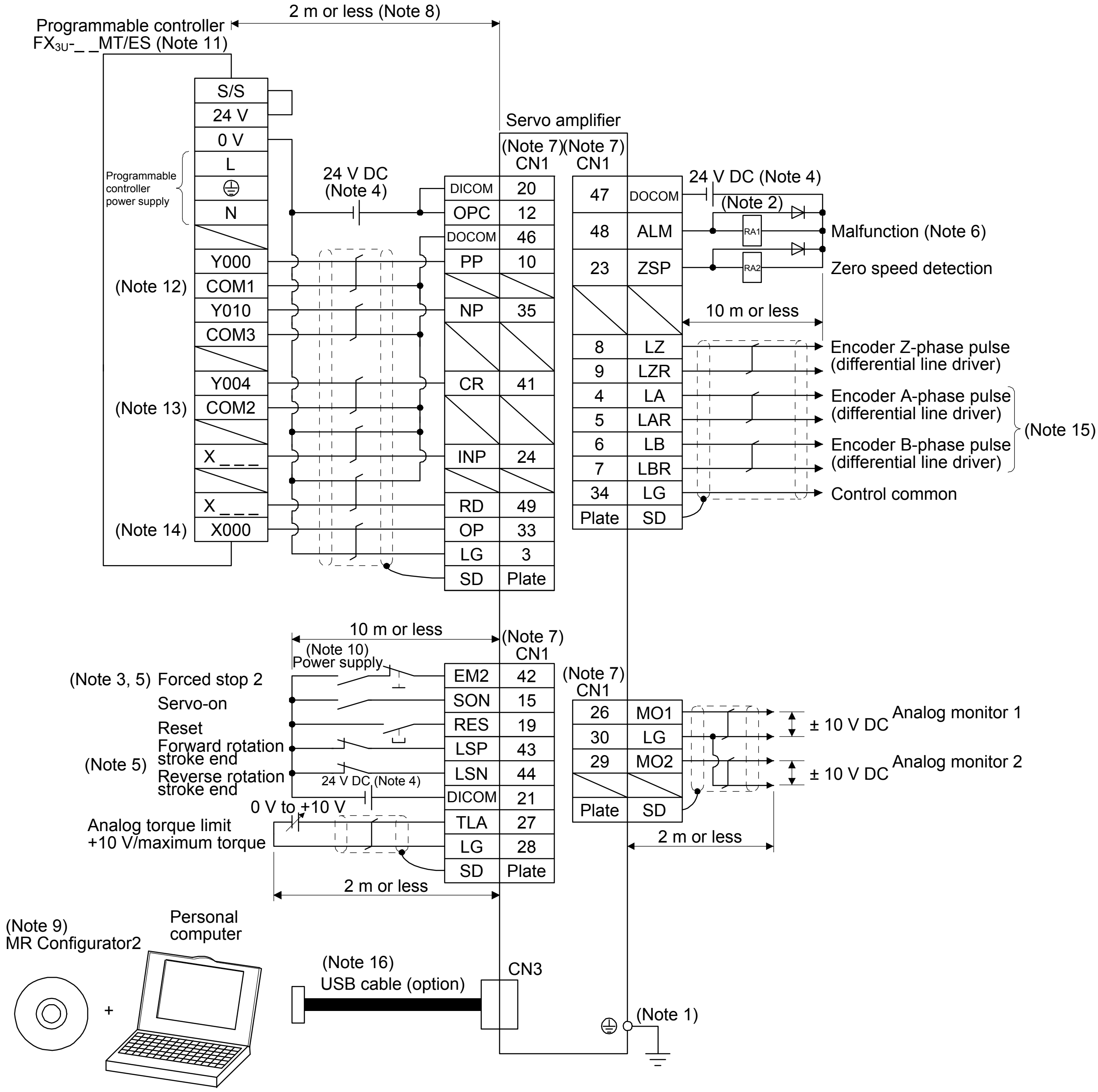
Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the servo amplifier to the protective earth (PE) of the cabinet.
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity is up to 300 mA. 300 mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.9.2 (1) that gives the current value necessary for the interface. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
5. When starting operation, always turn on EM2 (Forced stop 2), LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end) (normally closed contact).
6. ALM (Malfunction) turns on in normal alarm-free condition (normally closed contact). When this signal is switched off (at occurrence of an alarm), the output of the programmable controller should be stopped by the sequence program.
7. The pins with the same signal name are connected in the servo amplifier.
8. This length applies to the command pulse train input in the differential line driver type. It is 2 m or less in the open-collector type.
9. Use SW1DNC-MRC2-_. (Refer to section 11.4.)
10. This connection is not necessary for RD75D. However, to enhance noise tolerance, it is recommended to connect LG of servo amplifier and control common depending on the positioning module.
11. Configure a circuit to turn off EM2 when the power is turned off to prevent an unexpected restart of the servo amplifier.
12. Plus and minus of the power of source interface are the opposite of those of sink interface.
13. CLEAR and CLEARCOM of source interface are interchanged to sink interface.
14. When a command cable for connection with the controller side malfunctions due to disconnection or noise, a position mismatch can occur. To avoid position mismatch, it is recommended that Encoder A-phase pulse and Encoder B-phase pulse be checked.
15. The USB communication function and RS-422/RS-485 communication function are mutually exclusive. They cannot be used together.

(b) For source I/O interface

POINT
●For notes, refer to (1) (a) in this section.



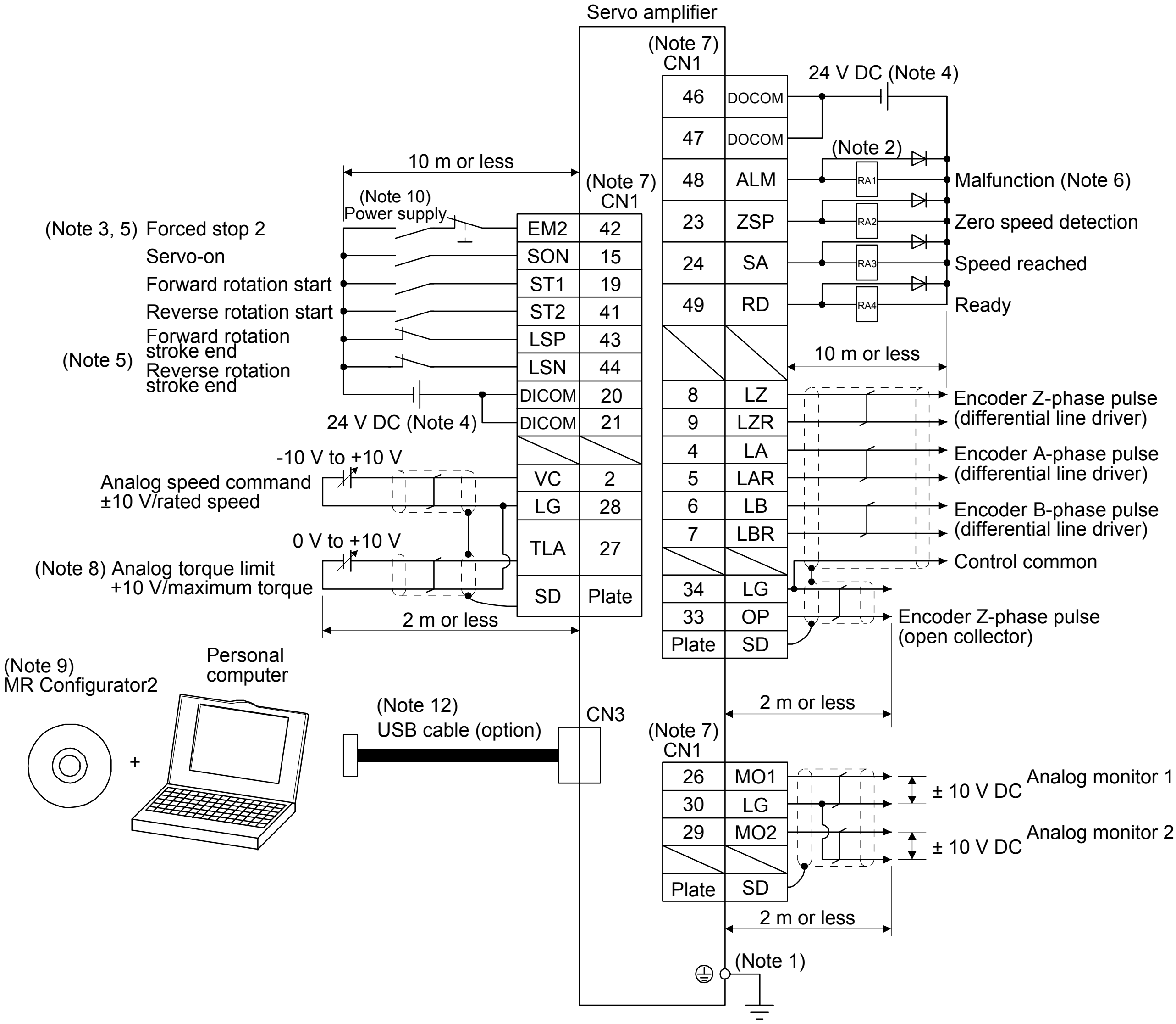
(2) When you use a positioning module FX_{3U}-_ _MT/ES (For sink I/O interface)



Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the servo amplifier to the protective earth (PE) of the cabinet.
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity is up to 300 mA. 300 mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.9.2 (1) that gives the current value necessary for the interface. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
5. When starting operation, always turn on EM2 (Forced stop 2), LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end) (normally closed contact).
6. ALM (Malfunction) turns on in normal alarm-free condition (normally closed contact). When this signal is switched off (at occurrence of an alarm), the output of the programmable controller should be stopped by the sequence program.
7. The pins with the same signal name are connected in the servo amplifier.
8. Connect them within 2 m because of open-collector type.
9. Use SW1DNC-MRC2-_. (Refer to section 11.4.)
10. Configure a circuit to turn off EM2 when the power is turned off to prevent an unexpected restart of the servo amplifier.
11. Select the number of I/O points of the programmable controller depending on your system.
12. It will be COM0 for FX_{3U}-16MT/ES.
13. It will be COM4 for FX_{3U}-16MT/ES.
14. Select it within X000 to X007.
15. When a command cable for connection with the controller side malfunctions due to disconnection or noise, a position mismatch can occur. To avoid position mismatch, it is recommended that Encoder A-phase pulse and Encoder B-phase pulse be checked.
16. The USB communication function and RS-422/RS-485 communication function are mutually exclusive. They cannot be used together.

3.2.2 Speed control mode

(1) For sink I/O interface

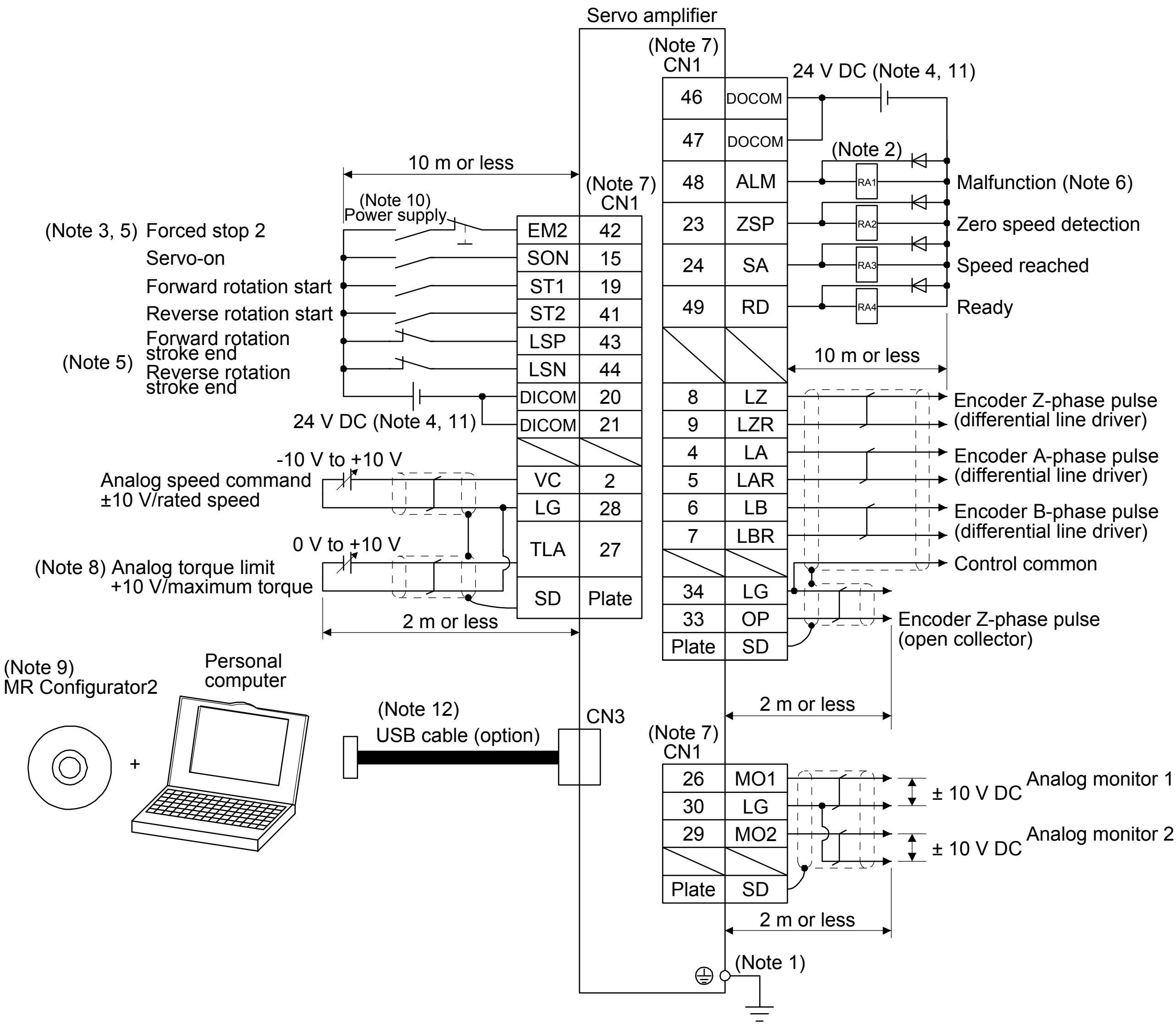


Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the servo amplifier to the protective earth (PE) of the cabinet.

2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity is up to 300 mA. 300 mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.9.2 (1) that gives the current value necessary for the interface. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
5. When starting operation, always turn on EM2 (Forced stop 2), LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end) (normally closed contact).
6. ALM (Malfunction) turns on in normal alarm-free condition (normally closed contact).
7. The pins with the same signal name are connected in the servo amplifier.
8. TLA will be available when TL (External torque limit selection) is enabled with [Pr. PD03], [Pr. PD11], [Pr. PD13], [Pr. PD17], and [Pr. PD19]. (Refer to section 3.6.1 (5).)
9. Use SW1DNC-MRC2-_. (Refer to section 11.4.)
10. Configure a circuit to turn off EM2 when the power is turned off to prevent an unexpected restart of the servo amplifier.
11. Plus and minus of the power of source interface are the opposite of those of sink interface.
12. The USB communication function and RS-422/RS-485 communication function are mutually exclusive. They cannot be used together.

(2) For source I/O interface

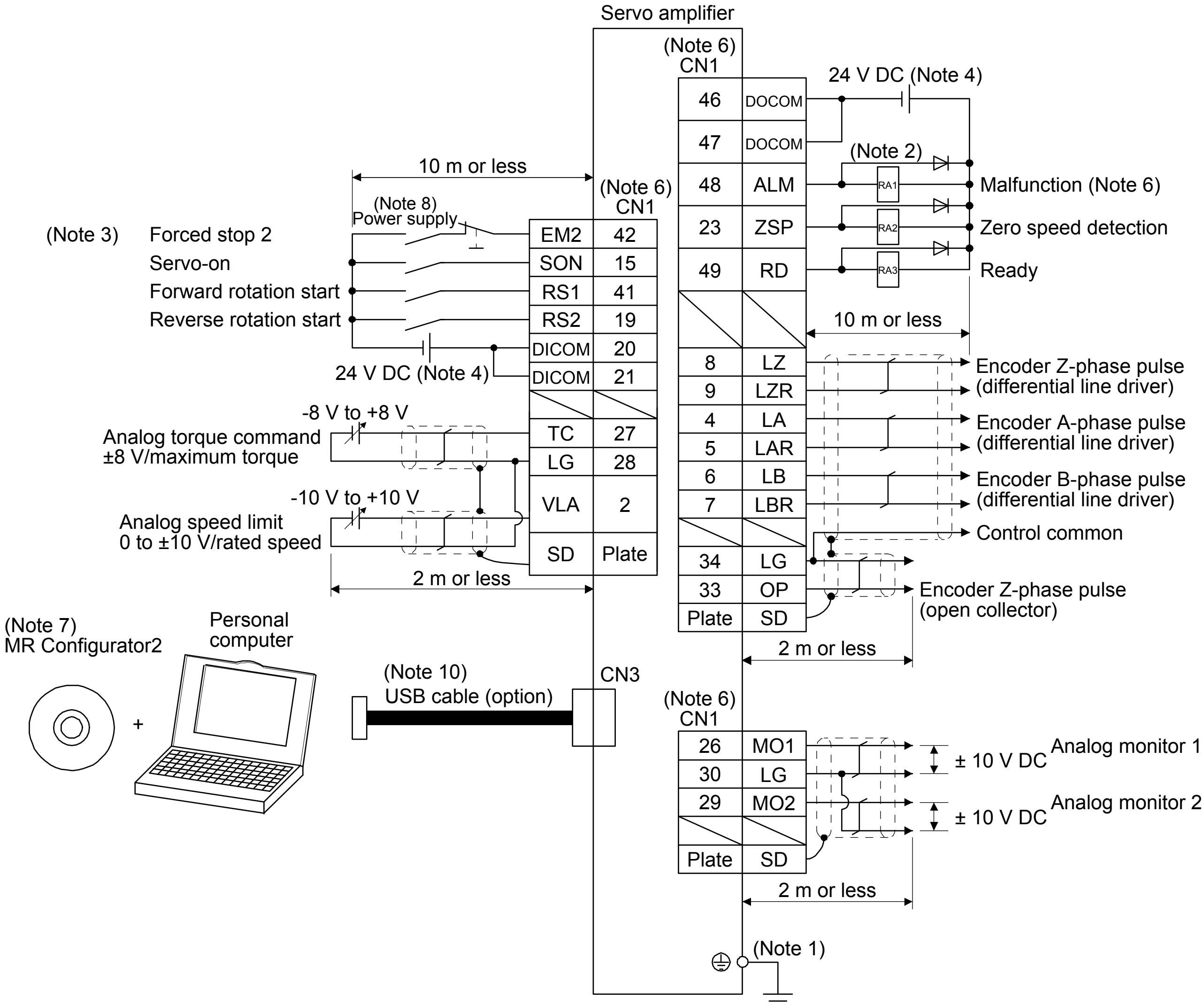
POINT
●For notes, refer to (1) in this section.



3.2.3 Torque control mode

POINT
●EM2 has the same function as EM1 in the torque control mode.

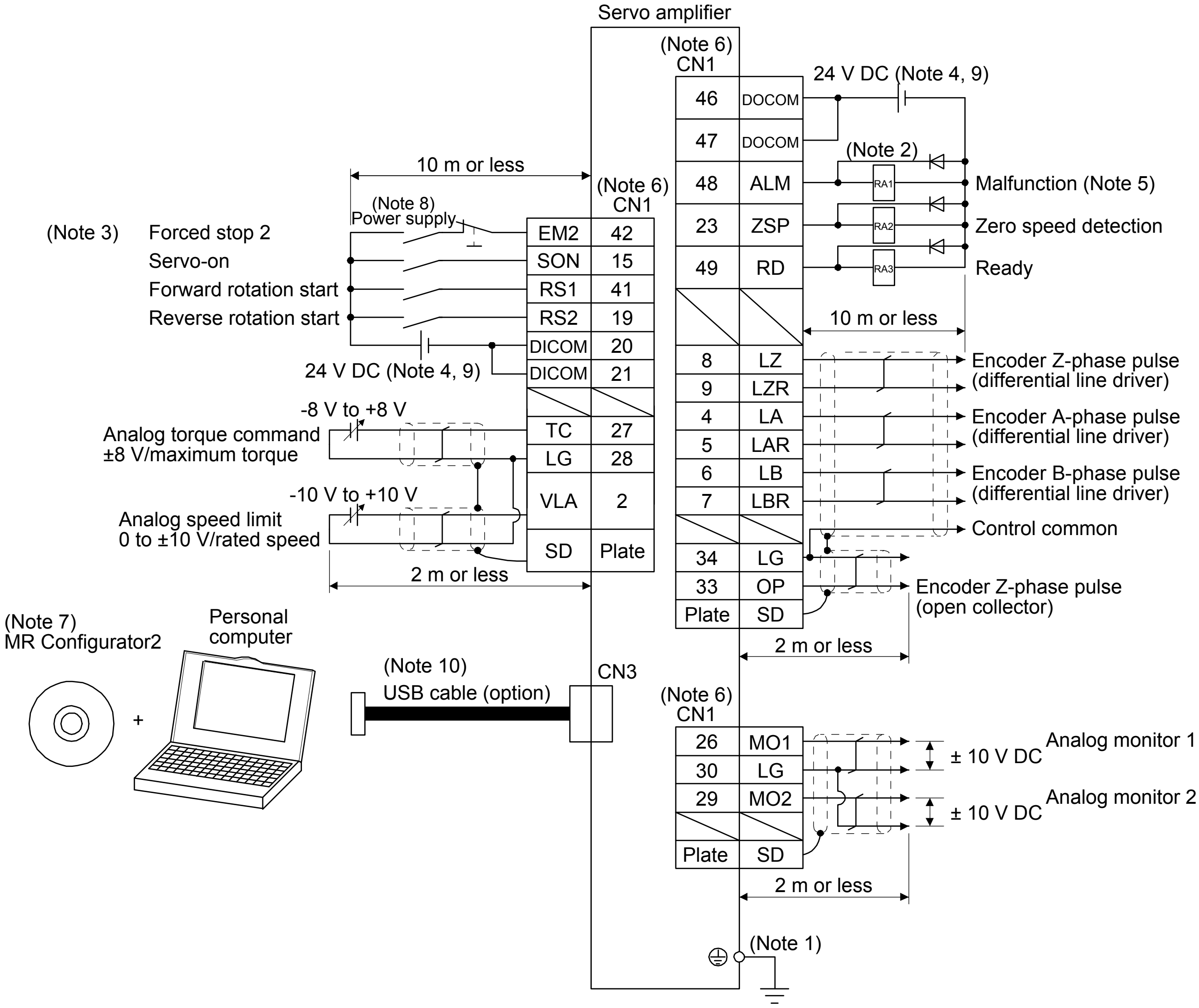
(1) For sink I/O interface



Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the servo amplifier to the protective earth (PE) of the cabinet.
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity is up to 300 mA. 300 mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.9.2 (1) that gives the current value necessary for the interface. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
5. ALM (Malfunction) turns on in normal alarm-free condition (normally closed contact).
6. The pins with the same signal name are connected in the servo amplifier.
7. Use SW1DNC-MRC2-_. (Refer to section 11.4.)
8. Configure a circuit to turn off EM2 when the power is turned off to prevent an unexpected restart of the servo amplifier.
9. Plus and minus of the power of source interface are the opposite of those of sink interface.
10. The USB communication function and RS-422/RS-485 communication function are mutually exclusive. They cannot be used together.

(2) For source I/O interface

POINT
●For notes, refer to (1) in this section.



3.3 Explanation of power supply system

3.3.1 Signal explanations

POINT

● For the layout of connector and terminal block, refer to chapter 9 DIMENSIONS.

<table>
<tr><th>Symbol</th><th>Connection target (application)</th><th>Description</th></tr>
<tr><td>L1/L2/L3</td><td>Power supply</td><td>Supply the following power to L1, L2, and L3. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open.
When using 1-phase 200 V AC to 240 V AC for MR-JE-200A, connect the power supply to L1 and L2. Leave L3 open.
<table>
<tr><th>Servo amplifier / Power supply</th><th>MR-JE-10A to MR-JE-100A</th><th>MR-JE-200A</th><th>MR-JE-300A</th></tr>
<tr><td>3-phase 200 V AC to 240 V AC, 50 Hz/60 Hz</td><td colspan="3">L1/L2/L3</td></tr>
<tr><td>1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz</td><td>L1/L3</td><td>L1/L2</td><td></td></tr>
</table></td></tr>
<tr><td>P+/C/D</td><td>Regenerative option</td><td>1) MR-JE-100A or less
MR-JE-10A to MR-JE-100A do not have D.
When using a servo amplifier built-in regenerative resistor, connect P+ and C. (factory-wired)
MR-JE-10A and MR-JE-20A do not have a built-in regenerative resistor.
When using a regenerative option, disconnect wires of P+ and C for the built-in regenerative resistor. And then connect wires of the regenerative option to P+ and C.
2) MR-JE-200A or more
When using a servo amplifier built-in regenerative resistor, connect P+ and D. (factory-wired)
When using a regenerative option, disconnect P+ and D, and connect the regenerative option to P+ and C.
Refer to section 11.2 for details.</td></tr>
<tr><td>U/V/W</td><td>Servo motor power output</td><td>Connect them to the servo motor power supply (U, V, and W). Connect the servo amplifier power output (U, V, and W) to the servo motor power input (U, V, and W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.</td></tr>
<tr><td>N-</td><td></td><td>This is for manufacturer adjustment.
Leave this open.
MR-JE-10A to MR-JE-100A do not have N-.</td></tr>
<tr><td>⏚</td><td>Protective earth (PE)</td><td>Connect it to the grounding terminal of the servo motor and to the protective earth (PE) of the cabinet for grounding.</td></tr>
</table>

3.3.2 Power-on sequence

POINT
●The voltage of analog monitor output, output signal, etc. may be unstable at power-on.

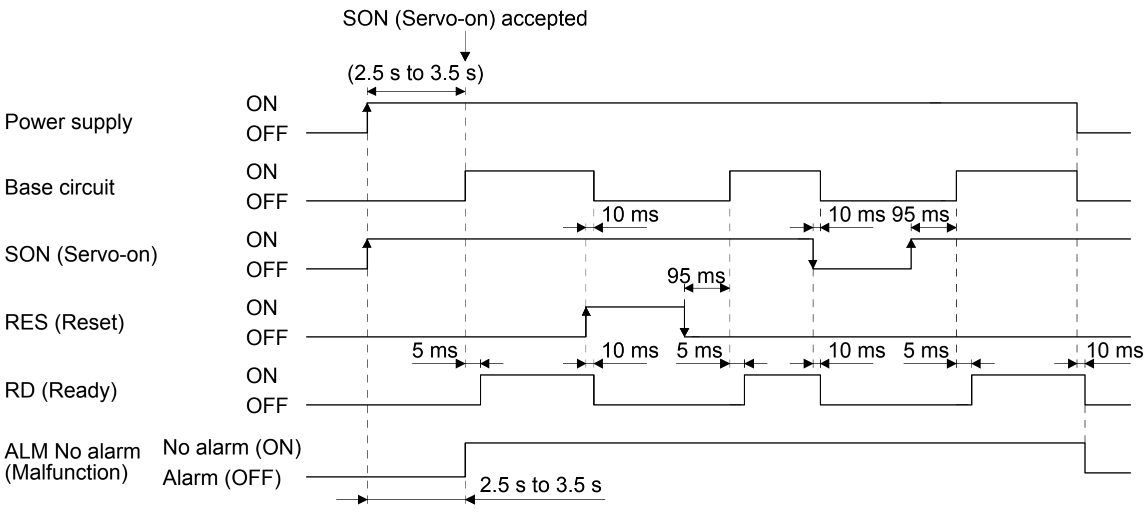
(1) Power-on procedure

1) Always wire the power supply as shown in above section 3.1 using the magnetic contactor with the power supply (L1/L2/L3). Configure an external sequence to switch off the magnetic contactor as soon as an alarm occurs.

2) The servo amplifier receives the SON (Servo-on) 2.5 s to 3.5 s after the power supply is switched on. Therefore, when SON (Servo-on) is switched on simultaneously with the power supply, the base circuit will switch on in about 2.5 s to 3.5 s, and the RD (Ready) will switch on in further about 5 ms, making the servo amplifier ready to operate. (Refer to (2) of this section.)

3) When RES (Reset) is switched on, the base circuit is shut off and the servo motor shaft coasts.

(2) Timing chart



3.3.3 Wiring CNP1 and CNP2

POINT
●For the wire sizes used for wiring, refer to section 11.5.

To wire to CNP1 and CNP2, use servo amplifier power connectors packed with the amplifier or optional connectors (refer to section 11.1.1).

(1) Connector

(a) MR-JE-10A to MR-JE-100A

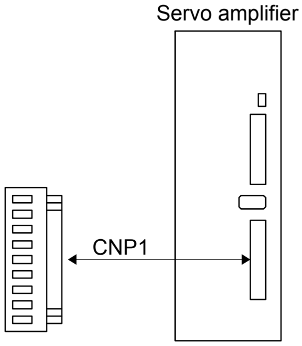


Table 3.1 Connector and applicable wire

Connector	Receptacle assembly	Applicable wire		Stripped length [mm]	Open tool	Manu-facturer
		Size	Insulator OD			
CNP1	09JFAT-SAXGDK-H5.0	AWG 18 to 14	3.9 mm or shorter	9	J-FAT-OT	JST

(b) MR-JE-200A/MR-JE-300A

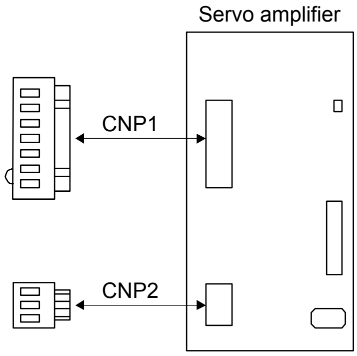


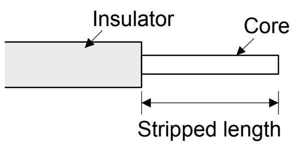
Table 3.2 Connector and applicable wire

Connector	Receptacle assembly	Applicable wire		Stripped length [mm]	Open tool	Manu-facturer
		Size	Insulator OD			
CNP1	07JFAT-SAXGFK-XL	AWG 16 to 10	4.7 mm or shorter	11.5	J-FAT-OT-EXL	JST
CNP2	03JFAT-SAXGFK-XL					

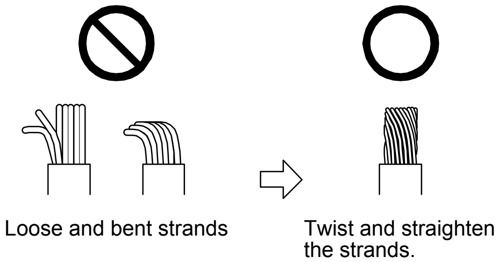
(2) Cable connection procedure

(a) Fabrication on cable insulator

Refer to table 3.1 and 3.2 for stripped length of cable insulator. The appropriate stripped length of cables depends on their type, etc. Set the length considering their status.



Twist strands lightly and straighten them as follows.



You can also use a ferrule to connect with the connectors. When you use a ferrule, use the following ferrules and crimp terminal.

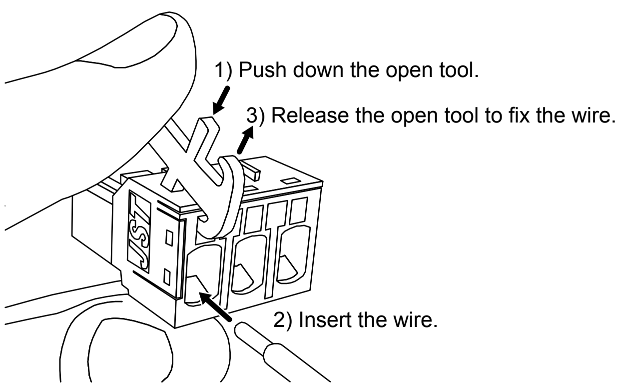
Servo amplifier	Wire size	Ferrule model (Phoenix Contact)		Crimp terminal (Phoenix Contact)
		For one	For two	
MR-JE-10A to MR-JE-100A	AWG 16	AI1.5-10BK	AI-TWIN2×1.5-10BK	CRIMPFOX-ZA3
	AWG 14	AI2.5-10BU		
MR-JE-200A to MR-JE-300A	AWG 16	AI1.5-10BK	AI-TWIN2×1.5-10BK	
	AWG 14	AI2.5-10BU	AI-TWIN2×2.5-10BU	
	AWG 12	AI4-10GY		

(b) Inserting wire

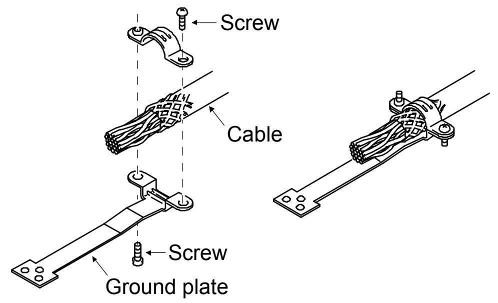
Insert the open tool as follows and push down it to open the spring. While the open tool is pushed down, insert the stripped wire into the wire insertion hole. Check the insertion depth so that the wire insulator does not get caught by the spring.

Release the open tool to fix the wire. Pull the wire lightly to confirm that the wire is surely connected.

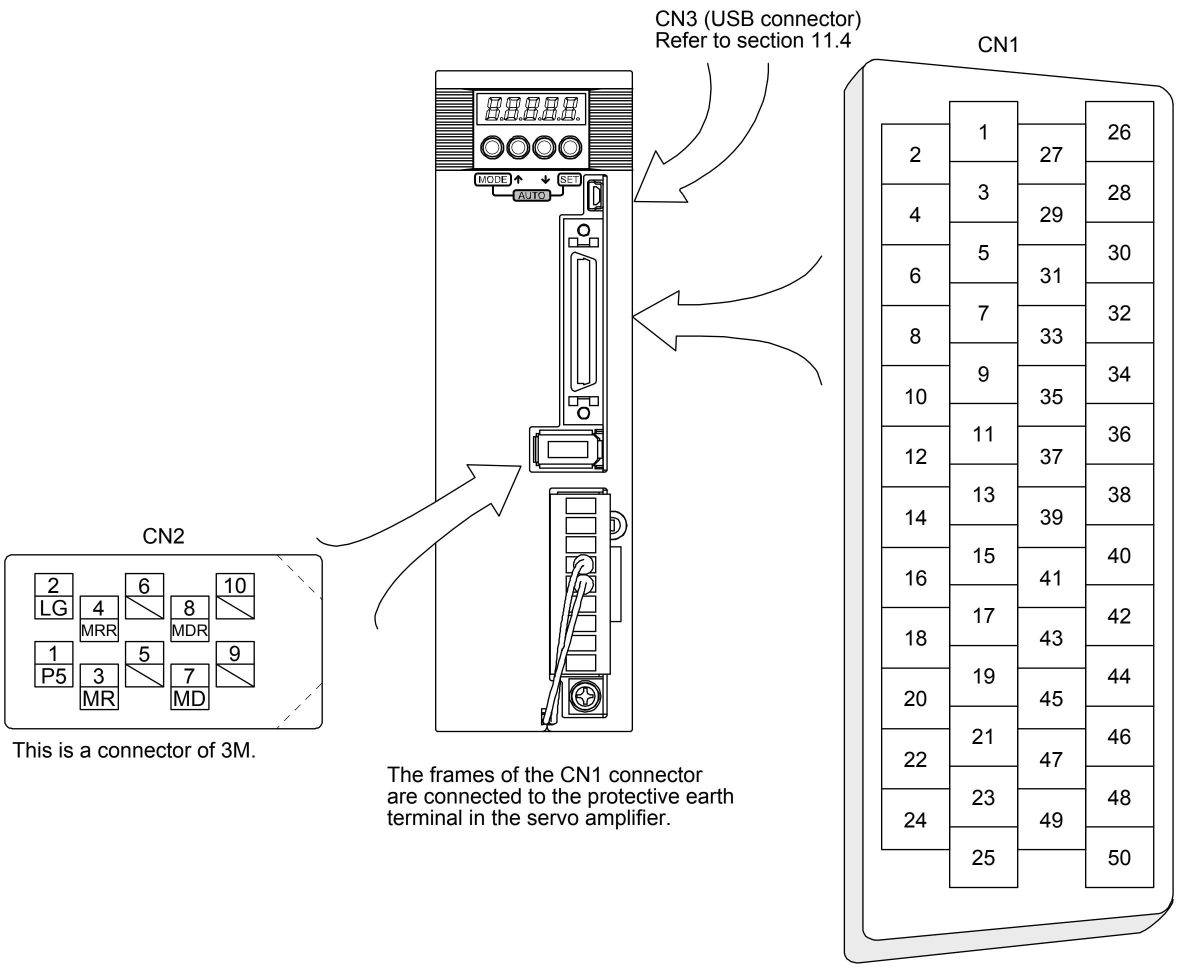
The following shows a connection example of the CNP2 connector for 2 kW and 3 kW.



3.4 Connectors and pin assignment

> **POINT**
>
> - The pin assignment of the connectors are as viewed from the cable connector wiring section.
> - For the CN1 connector, securely connect the external conductor of the shielded cable to the ground plate and fix it to the connector shell.
>
> 
>
>
> - PP (CN1-10 pin) and NP (CN1-35 pin) are mutually exclusive as well as PP2 (CN1-37 pin) and NP2 (CN1-38 pin). They cannot be used together.

The servo amplifier front view shown is that of the MR-JE-40A or less. Refer to chapter 9 DIMENSIONS for the appearances and connector layouts of the other servo amplifiers.



The device assignment of CN1 connector pins changes depending on the control mode. For the pins which are given parameters in the related parameter column, their devices will be changed using those parameters.

Pin No.	(Note 1) I/O	(Note 2) I/O signals in control modes						Related parameter
		P	P/S	S	S/T	T	T/P	
1								
2	I		-/VC	VC	VC/VLA	VLA	VLA/-	
3		LG	LG	LG	LG	LG	LG	
4	O	LA	LA	LA	LA	LA	LA	
5	O	LAR	LAR	LAR	LAR	LAR	LAR	
6	O	LB	LB	LB	LB	LB	LB	
7	O	LBR	LBR	LBR	LBR	LBR	LBR	
8	O	LZ	LZ	LZ	LZ	LZ	LZ	
9	O	LZR	LZR	LZR	LZR	LZR	LZR	
10	I	PP	PP/-	(Note 5)	(Note 5)	(Note 5)	-/PP	Pr. PD43/Pr. PD44 (Note 4)
11	I	PG	PG/-				-/PG	
12		OPC	OPC/-				-/OPC	
13	O	SDP	SDP	SDP	SDP	SDP	SDP	
14	O	SDN	SDN	SDN	SDN	SDN	SDN	
15	I	SON	SON	SON	SON	SON	SON	Pr. PD03/Pr. PD04
16								
17								
18								
19	I	RES	RES/ST1	ST1	ST1/RS2	RS2	RS2/RES	Pr. PD11/Pr. PD12
20		DICOM	DICOM	DICOM	DICOM	DICOM	DICOM	
21		DICOM	DICOM	DICOM	DICOM	DICOM	DICOM	
22								
23	O	ZSP	ZSP	ZSP	ZSP	ZSP	ZSP	Pr. PD24
24	O	INP	INP/SA	SA	SA/-		-/INP	Pr. PD25
25								
26	O	MO1	MO1	MO1	MO1	MO1	MO1	Pr. PC14
27	I	TLA	(Note 3) TLA	(Note 3) TLA	(Note 3) TLA/TC	TC	(Note 3) TC/TLA	
28		LG	LG	LG	LG	LG	LG	
29	O	MO2	MO2	MO2	MO2	MO2	MO2	Pr. PC15
30		LG	LG	LG	LG	LG	LG	
31	I	TRE	TRE	TRE	TRE	TRE	TRE	
32								
33	O	OP	OP	OP	OP	OP	OP	
34		LG	LG	LG	LG	LG	LG	
35	I	NP	NP/-	(Note 5)	(Note 5)	(Note 5)	-/NP	Pr. PD43/Pr. PD44 (Note 4)
36	I	NG	NG/-				-/NG	
37 (Note 7)	I	PP2	PP2/-	(Note 6)	(Note 6)	(Note 6)	-/PP2	Pr. PD43/Pr. PD44 (Note 4)
38 (Note 7)	I	NP2	NP2/-	(Note 6)	(Note 6)	(Note 6)	-/NP2	Pr. PD45/Pr. PD46 (Note 4)
39	I	RDP	RDP	RDP	RDP	RDP	RDP	
40	I	RDN	RDN	RDN	RDN	RDN	RDN	
41	I	CR	CR/ST2	ST2	ST2/RS1	RS1	RS1/CR	Pr. PD13/Pr. PD14
42	I	EM2	EM2	EM2	EM2	EM2	EM2	
43	I	LSP	LSP	LSP	LSP/-		-/LSP	Pr. PD17/Pr. PD18
44	I	LSN	LSN	LSN	LSN/-		-/LSN	Pr. PD19/Pr. PD20
45								

Pin No.	(Note 1) I/O	(Note 2) I/O signals in control modes						Related parameter
		P	P/S	S	S/T	T	T/P	
46		DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	
47		DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	
48	O	ALM	ALM	ALM	ALM	ALM	ALM	
49	O	RD	RD	RD	RD	RD	RD	Pr. PD28
50								

Note 1. I: input signal, O: output signal
2. P: position control mode, S: speed control mode, T: torque control mode, P/S: position/speed control switching mode, S/T: speed/torque control switching mode, T/P: torque/position control switching mode
3. TLA will be available when TL (External torque limit selection) is enabled with [Pr. PD03], [Pr. PD11], [Pr. PD13], [Pr. PD17], and [Pr. PD19].
4. This is available with servo amplifiers with software version B7 or later.
5. This is used with sink interface. Input devices are not assigned by default. Assign the input devices with [Pr. PD43] to [Pr. PD46] as necessary. In addition, supply + of 24 DC V to the CN1-12 pin of OPC (power input for open-collector sink interface). This is available with servo amplifiers with software version B7 or later.
6. This is used with source interface. Input signals are not assigned by default. Assign the input devices with [Pr. PD43] to [Pr. PD46] as necessary.
7. These pins are available with servo amplifiers having software version B7 or later, and manufactured in May, 2015 or later.

3.5 Signal (device) explanations

For the I/O interfaces (symbols in I/O division column in the table), refer to section 3.9.2. In the control mode field of the table
P: position control mode, S: speed control mode, T: torque control mode Torque control mode
○: devices used with initial setting status, △: devices used by setting [Pr. PA04] and [Pr. PD03] to [Pr. PD28]
The pin numbers in the connector pin No. column are those in the initial status.

(1) I/O device
(a) Input device

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Forced stop 2</td><td>EM2</td><td>CN1-42</td><td>Turn off EM2 (open between commons) to decelerate the servo motor to a stop with commands.
Turn EM2 on (short between commons) in the forced stop state to reset that state.
The following shows the setting of [Pr. PA04].
<table>
<tr><th rowspan="2">[Pr. PA04] setting</th><th rowspan="2">EM2/EM1</th><th colspan="2">Deceleration method</th></tr>
<tr><th>EM2 or EM1 is off</th><th>Alarm occurred</th></tr>
<tr><td>0 _ _ _</td><td>EM1</td><td>MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.</td><td>MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.</td></tr>
<tr><td>2 _ _ _</td><td>EM2</td><td>MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.</td><td>MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.</td></tr>
</table>
EM2 and EM1 are mutually exclusive.
EM2 has the same function as EM1 in the torque control mode.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Forced stop 1</td><td>EM1</td><td>(CN1-42)</td><td>When using EM1, set [Pr. PA04] to "0 _ _ _" to enable EM1.
Turn EM1 off (open between commons) to bring the motor to a forced stop state. The base circuit is shut off, the dynamic brake is operated and decelerate the servo motor to a stop.
Turn EM1 on (short between commons) in the forced stop state to reset that state.</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></tr>
<tr><td>Servo-on</td><td>SON</td><td>CN1-15</td><td>Turn SON on to power on the base circuit and make the servo amplifier ready to operate. (servo-on status)
Turn it off to shut off the base circuit and coast the servo motor.
Set "_ _ _ 4" in [Pr. PD01] to switch this signal on (keep terminals connected) automatically in the servo amplifier.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Reset</td><td>RES</td><td>CN1-19</td><td>Turn on RES for more than 50 ms to reset the alarm.
Some alarms cannot be deactivated by RES (Reset). Refer to section 8.1.
Turning RES on in an alarm-free status shuts off the base circuit. The base circuit is not shut off when " _ _ 1 _ " is set in [Pr. PD30].
This device is not designed to make a stop. Do not turn it on during operation.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Forward rotation stroke end</td><td>LSP</td><td>CN1-43</td><td rowspan="2">To start operation, turn on LSP and LSN. Turn it off to bring the motor to a sudden stop and make it servo-locked.
Setting [Pr. PD30] to " _ _ _ 1" will enable a slow stop.
<table>
<tr><th colspan="2">(Note) Input device</th><th colspan="2">Operation</th></tr>
<tr><th>LSP</th><th>LSN</th><th>CCW direction</th><th>CW direction</th></tr>
<tr><td>1</td><td>1</td><td>○</td><td>○</td></tr>
<tr><td>0</td><td>1</td><td></td><td>○</td></tr>
<tr><td>1</td><td>0</td><td>○</td><td></td></tr>
<tr><td>0</td><td>0</td><td></td><td></td></tr>
</table>
Note. 0: Off
1: On

Set [Pr. PD01] as indicated below to switch on the signals (keep terminals connected) automatically in the servo amplifier.
<table>
<tr><th rowspan="2">[Pr. PD01]</th><th colspan="2">Status</th></tr>
<tr><th>LSP</th><th>LSN</th></tr>
<tr><td>_ 4 _ _</td><td>Automatic on</td><td></td></tr>
<tr><td>_ 8 _ _</td><td></td><td>Automatic on</td></tr>
<tr><td>_ C _ _</td><td>Automatic on</td><td>Automatic on</td></tr>
</table>
When LSP or LSN turns off, [AL. 99 Stroke limit warning] occurs, and WNG (Warning) turns on. When using WNG, enable it by setting [Pr. PD24], [Pr. PD25] and [Pr. PD28].</td><td rowspan="2">DI-1</td><td rowspan="2">○</td><td rowspan="2">○</td><td rowspan="2"></td></tr>
<tr><td>Reverse rotation stroke end</td><td>LSN</td><td>CN1-44</td></tr>
<tr><td>External torque limit selection</td><td>TL</td><td></td><td>Turning off TL will enable [Pr. PA11 Forward torque limit] and [Pr. PA12 Reverse torque limit], and turning on it will enable TLA (Analog torque limit). For details, refer to section 3.6.1 (5).</td><td>DI-1</td><td>△</td><td>△</td><td></td></tr>
<tr><td>Internal torque limit selection</td><td>TL1</td><td></td><td>To select [Pr. PC35 Internal torque limit 2], enable TL1 with [Pr. PD03] to [Pr. PD20]. For details, refer to section 3.6.1 (5).</td><td>DI-1</td><td>△</td><td>△</td><td></td></tr>
<tr><td>Forward rotation start</td><td>ST1</td><td></td><td rowspan="2">This is used to start the servo motor.
The following shows the directions.
<table>
<tr><th colspan="2">(Note) Input device</th><th rowspan="2">Servo motor starting direction</th></tr>
<tr><th>ST2</th><th>ST1</th></tr>
<tr><td>0</td><td>0</td><td>Stop (servo-lock)</td></tr>
<tr><td>0</td><td>1</td><td>CCW</td></tr>
<tr><td>1</td><td>0</td><td>CW</td></tr>
<tr><td>1</td><td>1</td><td>Stop (servo-lock)</td></tr>
</table>
Note. 0: Off
1: On

If both ST1 and ST2 are switched on or off during operation, the servo motor will be decelerated to a stop according to the [Pr. PC02] setting and servo-locked.
When " _ _ _1" is set in [Pr. PC23], the servo motor is not servo-locked after deceleration to a stop.</td><td rowspan="2">DI-1</td><td rowspan="2"></td><td rowspan="2">△</td><td rowspan="2"></td></tr>
<tr><td>Reverse rotation start</td><td>ST2</td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Forward rotation selection</td><td>RS1</td><td></td><td rowspan="2">Select a servo motor torque generation directions.
The following shows the torque generation directions.
<table>
<tr><th colspan="2">(Note) Input device</th><th rowspan="2">Torque generation direction</th></tr>
<tr><th>RS2</th><th>RS1</th></tr>
<tr><td>0</td><td>0</td><td>Torque is not generated.</td></tr>
<tr><td>0</td><td>1</td><td>Forward rotation in power running mode/reverse rotation in regenerative mode</td></tr>
<tr><td>1</td><td>0</td><td>Reverse rotation in power running mode/forward rotation in regenerative mode</td></tr>
<tr><td>1</td><td>1</td><td>Torque is not generated.</td></tr>
</table>
Note. 0: Off
1: On</td><td rowspan="2">DI-1</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">△</td></tr>
<tr><td>Reverse rotation selection</td><td>RS2</td><td></td></tr>
<tr><td>Speed selection 1</td><td>SP1</td><td></td><td rowspan="3">1. For speed control mode
Select the command speed for operation.
<table>
<tr><th colspan="3">(Note) Input device</th><th rowspan="2">Speed command</th></tr>
<tr><th>SP3</th><th>SP2</th><th>SP1</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>VC (Analog speed command)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Pr. PC05 Internal speed command 1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Pr. PC06 Internal speed command 2</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Pr. PC07 Internal speed command 3</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Pr. PC08 Internal speed command 4</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Pr. PC09 Internal speed command 5</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Pr. PC10 Internal speed command 6</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Pr. PC11 Internal speed command 7</td></tr>
</table>
Note. 0: Off
1: On

2. For the torque control mode
Select the limited speed for operation.
<table>
<tr><th colspan="3">(Note) Input device</th><th rowspan="2">Speed limit</th></tr>
<tr><th>SP3</th><th>SP2</th><th>SP1</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>VLA (Analog speed limit)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Pr. PC05 Internal speed limit 1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Pr. PC06 Internal speed limit 2</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Pr. PC07 Internal speed limit 3</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Pr. PC08 Internal speed limit 4</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Pr. PC09 Internal speed limit 5</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Pr. PC10 Internal speed limit 6</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Pr. PC11 Internal speed limit 7</td></tr>
</table>
Note. 0: Off
1: On</td><td>DI-1</td><td></td><td>△</td><td>△</td></tr>
<tr><td>Speed selection 2</td><td>SP2</td><td></td><td>DI-1</td><td></td><td>△</td><td>△</td></tr>
<tr><td>Speed selection 3</td><td>SP3</td><td></td><td>DI-1</td><td></td><td>△</td><td>△</td></tr>
</table>

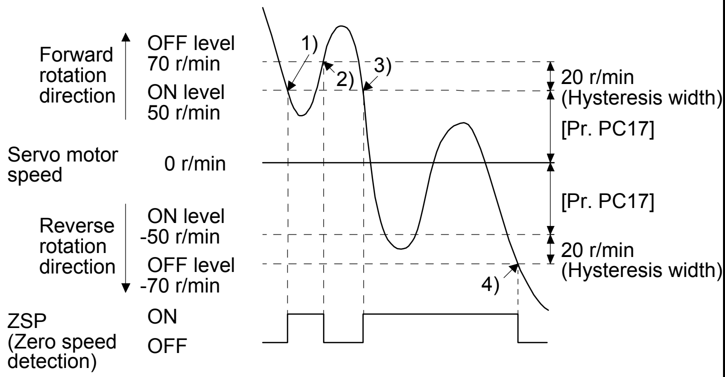
<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Proportion control</td><td>PC</td><td></td><td>Turn PC on to switch the speed amplifier from the proportional integral type to the proportional type.
If the servo motor at a stop is rotated even one pulse due to any external factor, it generates torque to compensate for a position shift. When the servo motor shaft is to be locked mechanically after positioning completion (stop), switching on the PC (Proportion control) upon positioning completion will suppress the unnecessary torque generated to compensate for a position shift.
When the shaft is to be locked for a long time, switch on the PC (Proportion control) and TL (External torque limit selection) at the same time to make the torque less than the rated by TLA (Analog torque limit).</td><td>DI-1</td><td>△</td><td>△</td><td></td></tr>
<tr><td>Clear</td><td>CR</td><td>CN1-41</td><td>Turn CR on to clear the position control counter droop pulse on its leading edge. The pulse width should be 10 ms or longer.
The delay amount set in [Pr. PB03 Position command acceleration/deceleration time constant] is also cleared. When " _ _ _1 " is set to [Pr. PD32], the pulses are always cleared while CR is on.</td><td>DI-1</td><td>○</td><td></td><td></td></tr>
<tr><td>Electronic gear selection 1</td><td>CM1</td><td></td><td rowspan="2">The combination of CM1 and CM2 enables you to select four different electronic gear numerators set in the parameters.
<table><tr><th colspan="2">(Note) Input device</th><th rowspan="2">Electronic gear numerator</th></tr><tr><th>CM2</th><th>CM1</th></tr><tr><td>0</td><td>0</td><td>Pr. PA06</td></tr><tr><td>0</td><td>1</td><td>Pr. PC32</td></tr><tr><td>1</td><td>0</td><td>Pr. PC33</td></tr><tr><td>1</td><td>1</td><td>Pr. PC34</td></tr></table>Note. 0: Off
1: On</td><td>DI-1</td><td>△</td><td></td><td></td></tr>
<tr><td>Electronic gear selection 2</td><td>CM2</td><td></td><td>DI-1</td><td>△</td><td></td><td></td></tr>
<tr><td>Gain switching</td><td>CDP</td><td></td><td>Turn on CDP to use the values of [Pr. PB29] to [Pr. PB36] and [Pr. PB56] to [Pr. PB60] as the load to motor inertia ratio and gain values.</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></tr>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Control switching</td><td>LOP</td><td></td><td>
«Position/speed control switching mode»
This is used to select the control mode in the position/speed control switching mode.
<table>
<tr><th>(Note) LOP</th><th>Control mode</th></tr>
<tr><td>0</td><td>Position</td></tr>
<tr><td>1</td><td>Speed</td></tr>
</table>
Note. 0: Off
1: On

«Speed/torque control switch mode»
This is used to select the control mode in the speed/torque control switching mode.
<table>
<tr><th>(Note) LOP</th><th>Control mode</th></tr>
<tr><td>0</td><td>Speed</td></tr>
<tr><td>1</td><td>Torque</td></tr>
</table>
Note. 0: Off
1: On

«Torque/position control switch mode»
This is used to select the control mode in the torque/position control switching mode.
<table>
<tr><th>(Note) LOP</th><th>Control mode</th></tr>
<tr><td>0</td><td>Torque</td></tr>
<tr><td>1</td><td>Position</td></tr>
</table>
Note. 0: Off
1: On
</td><td>DI-1</td><td colspan="3">Refer to Function and application.</td></tr>
<tr><td>Second acceleration/ deceleration selection</td><td>STAB2</td><td></td><td>
The device allows selection of the acceleration/deceleration time constants at servo motor rotation in the speed control mode or torque control mode. The s-pattern acceleration/deceleration time constant is always uniform.
<table>
<tr><th>(Note) STAB2</th><th>Acceleration/deceleration time constant</th></tr>
<tr><td>0</td><td>Pr. PC01 Acceleration time constant
Pr. PC02 Deceleration time constant</td></tr>
<tr><td>1</td><td>Pr. PC30 Acceleration time constant 2
Pr. PC31 Deceleration time constant 2</td></tr>
</table>
Note. 0: Off
1: On
</td><td>DI-1</td><td></td><td>△</td><td>△</td></tr>
</table>

(b) Output device

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Malfunction	ALM	CN1-48	When an alarm occurs, ALM will turn off. When an alarm does not occur, ALM will turn on after 2.5 s to 3.5 s after power-on. When [Pr. PD34] is "_ _ 1 _", an alarming or warning will turn off ALM.	DO-1	○	○	○
Ready	RD	CN1-49	Enabling servo-on to make the servo amplifier ready to operate will turn on RD.	DO-1	○	○	○
In-position	INP	CN1-24	When the number of droop pulses is in the preset in-position range, INP will turn on. The in-position range can be changed using [Pr. PA10]. When the in-position range is increased, INP may be on during low-speed rotation. INP turns on when servo-on turns on.	DO-1	○		
Speed reached	SA		When the servo motor speed reaches the following range, SA will turn on. Set speed ± ((Set speed × 0.05) + 20) r/min When the preset speed is 20 r/min or less, SA always turns on. SA does not turn on even when the SON (Servo-on) is turned off or the servo motor speed by the external force reaches the preset speed while both ST1 (Forward rotation start) and ST2 (reverse rotation start) are off.	DO-1		○	
Limiting speed	VLC		VLC turns on when speed reaches a value limited with any of [Pr. PC05 Internal speed limit 1] to [Pr. PC11 Internal speed limit 7] or VLA (Analog speed limit). This turns off when SON (Servo-on) turns off.	DO-1			△
Limiting torque	TLC		TLC turns on when a generated torque reaches a value set with any of [Pr. PA11 Forward torque limit], [Pr. PA12 Reverse torque limit], or TLA (Analog torque limit).	DO-1	△	△	
Zero speed detection	ZSP	CN1-23	ZSP turns on when the servo motor speed is zero speed (50r/min) or less. Zero speed can be changed with [Pr. PC17].  ZSP will turn on when the servo motor is decelerated to 50 r/min (at 1)), and will turn off when the servo motor is accelerated to 70 r/min again (at 2)). ZSP will turn on when the servo motor is decelerated again to 50 r/min (at 3)), and will turn off when the servo motor speed has reached -70 r/min (at 4)). The range from the point when the servo motor speed has reached on level, and ZSP turns on, to the point when it is accelerated again and has reached off level is called hysteresis width. Hysteresis width is 20 r/min for this servo amplifier.	DO-1	○	○	○
Electromagnetic brake interlock	MBR		When using the device, set operation delay time of the electromagnetic brake in [Pr. PC16]. When a servo-off status or alarm occurs, MBR will turn off.	DO-1	△	△	△
Warning	WNG		When warning has occurred, WNG turns on. When a warning is not occurring, turning on the power will turn off WNG after 2.5 s to 3.5 s.	DO-1	△	△	△

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode P	Control mode S	Control mode T
Alarm code	ACD0	(CN1-24)	To use these signals, set " _ _ _ 1" in [Pr. PD34]. This signal is outputted when an alarm occurs. When an alarm is not occurring, respective ordinary signals are outputted. For details of the alarm codes, refer to chapter 8. When you select alarm code output while MBR or ALM is selected for CN1-23, CN1-24, or CN1-49 pin, [AL. 37 Parameter error] will occur.	DI-1	△	△	△
	ACD1	(CN1-23)					
	ACD2	(CN1-49)					
Variable gain selection	CDPS		CDPS turns on during gain switching.	DO-1	△	△	△
During tough drive	MTTR		When a tough drive is enabled in [Pr. PA20], activating the instantaneous power failure tough drive will turn on MTTR.	DO-1	△	△	△

(2) Input signal

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode P	Control mode S	Control mode T
Analog torque limit	TLA	CN1-27	To use the signal, enable TL (External torque limit selection) with [Pr. PD03] to [Pr. PD20]. When TLA is enabled, torque is limited in the full servo motor output torque range. Apply 0 V to +10 V DC between TLA and LG. Connect the positive terminal of the power supply to TLA. The maximum torque is generated at +10 V. (Refer to section 3.6.1 (5).) If a value equal to or larger than the maximum torque is inputted to TLA, the value is clamped at the maximum torque. Resolution: 10 bits	Analog input	△	△	
Analog torque command	TC		This is used to control torque in the full servo motor output torque range. Apply 0 V to ±8 V DC between TC and LG. The maximum torque is generated at ±8 V. (Refer to section 3.6.3 (1).) The speed at ±8 V can be changed with [Pr. PC13]. If a value equal to or larger than the maximum torque is inputted to TC, the value is clamped at the maximum torque.	Analog input			○
Analog speed command	VC	CN1-2	Apply 0 V to ±10 V DC between VC and LG. Speed set in [Pr. PC12] is provided at ±10 V. (Refer to section 3.6.2 (1).) If a value equal to or larger than the permissible speed is inputted to VC, the value is clamped at the permissible speed. Resolution: 14 bits or equivalent	Analog input		○	
Analog speed limit	VLA		Apply 0 V to ±10 V DC between VLA and LG. Speed set in [Pr. PC12] is provided at ±10 V. (Refer to section 3.6.3 (3).) If a limited value equal to or larger than the permissible speed is inputted to VLA, the value is clamped at the permissible speed.	Analog input			○
Forward rotation pulse train Reverse rotation pulse train	PP NP PP2 NP2 PG NG	CN1-10 CN1-35 CN1-37 CN1-38 CN1-11 CN1-36	This is used to enter a command pulse train. The command input pulse train form, pulse train logic, and command input pulse train filter are changed in [Pr. PA13]. For open-collector type, set [Pr. PA13] to "_ 3 _ _". For differential receiver type, set [Pr. PA13] depending on the maximum input frequency. 1) For open-collector type (sink input interface) The maximum input frequency is 200 kpulses/s. For A-phase/B-phase pulse train, 200 kpulses/s will be the frequency after multiplication by four. a) Sink input interface Input the forward rotation pulse train between PP and DOCOM. Input the reverse rotation pulse train between NP and DOCOM. b) Source input interface Input the forward rotation pulse train between PP2 and PG. Input the reverse rotation pulse train between NP2 and NG. 2) For differential receiver type The maximum input frequency is 4 Mpulses/s. For A-phase/B-phase pulse train, 4 Mpulses/s will be the frequency after multiplication by four. Input the forward rotation pulse train between PG and PP. Input the reverse rotation pulse train between NG and NP.	DI-2	○		

(3) Output signal

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Encoder A-phase pulse (differential line driver)	LA LAR	CN1-4 CN1-5	These devices output pulses of encoder output pulse set in [Pr. PA15] in the differential line driver type. In CCW rotation of the servo motor, the encoder B-phase pulse lags the encoder A-phase pulse by a phase angle of π/2. The relation between rotation direction and phase difference of the A-phase and B-phase pulses can be changed with [Pr. PC19].	DO-2	○	○	○
Encoder B-phase pulse (differential line driver)	LB LBR	CN1-6 CN1-7					
Encoder Z-phase pulse (differential line driver)	LZ LZR	CN1-8 CN1-9	The encoder zero-point signal is outputted in the differential line driver type. One pulse is outputted per servo motor revolution. This turns on when the zero-point position is reached. (negative logic) The minimum pulse width is about 400 μs. For home position return using this pulse, set the creep speed to 100 r/min. or less.	DO-2	○	○	○
Encoder Z-phase pulse (open-collector)	OP	CN1-33	The encoder zero-point signal is outputted in the open-collector type.	DO-2	○	○	○
Analog monitor 1	MO1	CN1-26	This is used to output the data set in [Pr. PC14] to between MO1 and LG in terms of voltage. Resolution: 10 bits or equivalent	Analog output	○	○	○
Analog monitor 2	MO2	CN1-29	This signal outputs the data set in [Pr. PC15] to between MO2 and LG in terms of voltage. Resolution: 10 bits or equivalent	Analog output	○	○	○

(4) Communication

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
RS-422/RS-485 I/F	SDP SDN RDP RDN TRE	CN1-13 CN1-14 CN1-39 CN1-40 CN1-31	These are terminals for RS-422/RS-485 communication.		○	○	○

(5) Power supply

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Digital I/F power supply input	DICOM	CN1-20 CN1-21	Input 24 V DC (24 V DC ± 10% 300 mA) for I/O interface. The power supply capacity changes depending on the number of I/O interface points to be used. For sink interface, connect + of 24 V DC external power supply. For source interface, connect - of 24 V DC external power supply.		○	○	○
Open-collector sink interface power supply input	OPC	CN1-12	When inputting a pulse train in the open-collector type with sink interface, supply this terminal with the positive (+) power of 24 V DC.		○		
Digital I/F common	DOCOM	CN1-46 CN1-47	Common terminal of input signal such as EM2 of the servo amplifier. This is separated from LG. For sink interface, connect - of 24 V DC external power supply. For source interface, connect + of 24 V DC external power supply.		○	○	○
Control common	LG	CN1-3 CN1-28 CN1-30 CN1-34	This is a common terminal for TLA, TC, VC, VLA, OP, MO1, and MO2. Pins are connected internally.		○	○	○
Shield	SD	Plate	Connect the external conductor of the shielded wire.		○	○	○

3.6 Detailed explanation of signals

3.6.1 Position control mode

POINT

- Adjust the logic of a positioning module and command pulse as follows.
  - MELSEC iQ-R series/MELSEC-Q series/MELSEC-L series positioning module

Signal type	Command pulse logic setting	
	Positioning module Pr. 23 setting	MR-JE-_A servo amplifier [Pr. PA13] setting
Open-collector type	Positive logic	Positive logic (_ _ 0 _)
	Negative logic	Negative logic (_ _ 1 _)
Differential line driver type	Positive logic (Note)	Negative logic (_ _ 1 _)
	Negative logic (Note)	Positive logic (_ _ 0 _)

Note. For MELSEC iQ-R series/MELSEC-Q series/MELSEC-L series, the logic means N-side waveform. Therefore, reverse the input pulse logic of the servo amplifier.

  - MELSEC-F series positioning module

Signal type	Command pulse logic setting	
	Positioning module (fixed)	MR-JE-_A servo amplifier [Pr. PA13] setting
Open-collector type Differential line driver type	Negative logic	Negative logic (_ _ 1 _)

(1) Pulse train input

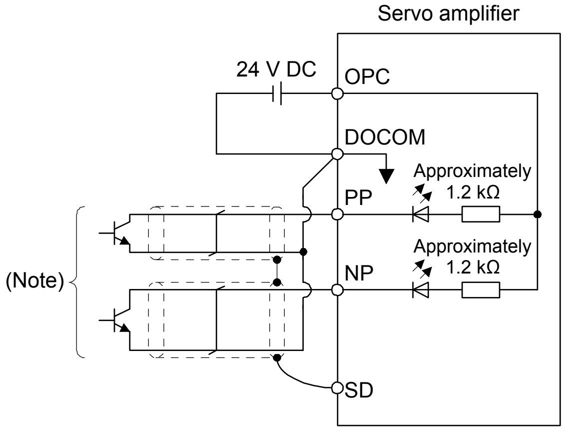
(a) Input pulse waveform selection

You can input command pulses in any of three different forms, and can choose positive or negative logic. Set the command pulse train form in [Pr. PA13]. Refer to section 5.2.1 for details.

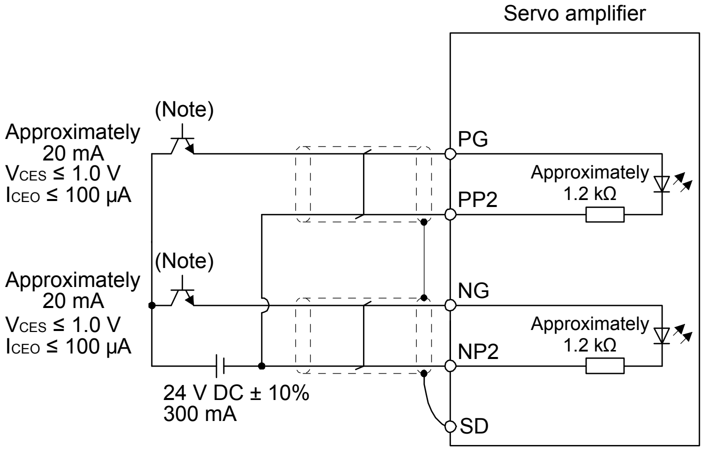
(b) Connection and waveform

1) Open-collector type

Connect as follows.



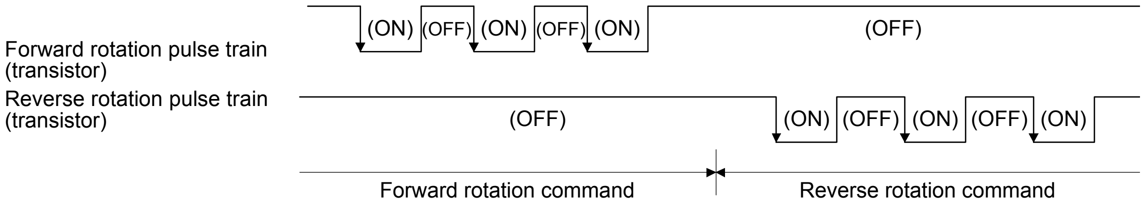
For sink input interface



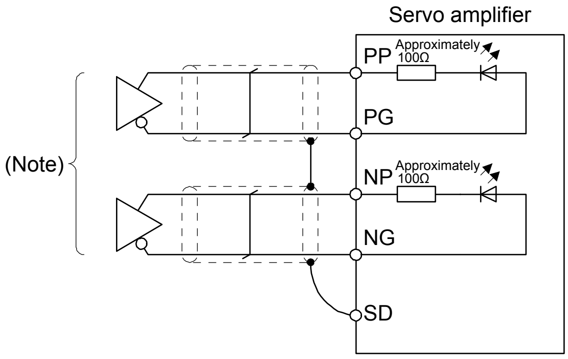
For source input interface

Note. Pulse train input interface is comprised of a photocoupler.
If a resistor is connected to the pulse train signal line, it may malfunction due to reduction in current.

The following section explains about the case where the negative logic and the forward/reverse rotation pulse trains are set to "_ _ 1 0" in [Pr. PA13].

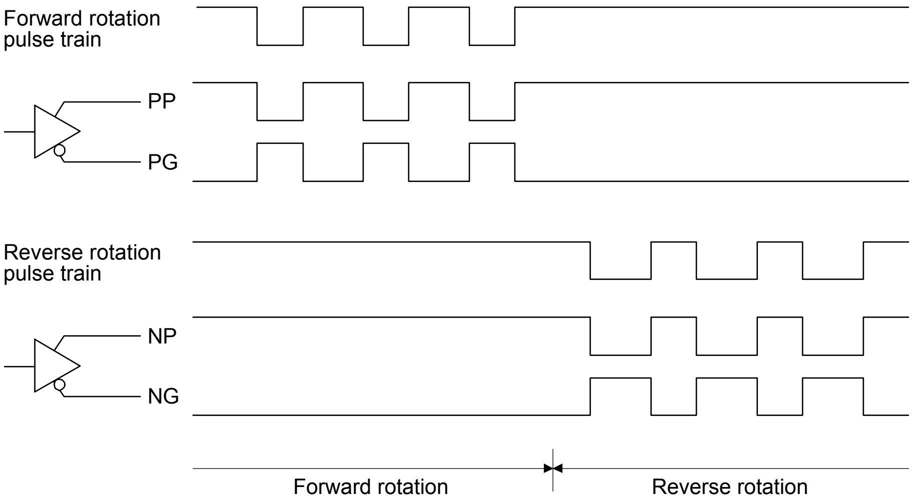


2) Differential line driver type
Connect as follows.



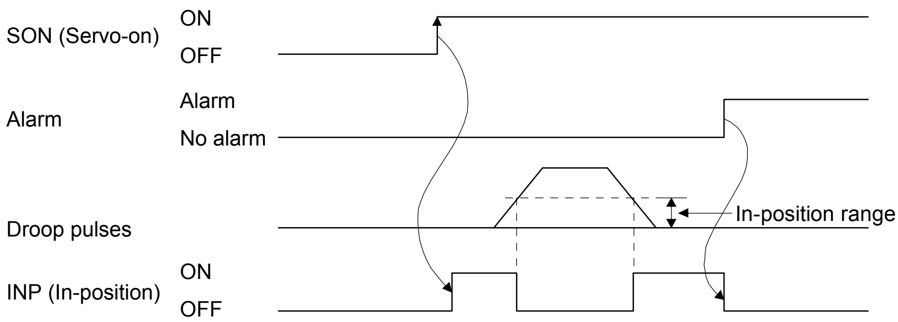
Note. Pulse train input interface is comprised of a photocoupler.
If a resistor is connected to the pulse train signal line, it may malfunction due to reduction in current.

The following example shows that an input waveform has been set to the negative logic and forward/reverse rotation pulse trains by setting "_ _ 1 0" in [Pr. PA13]. The waveforms of PP, PG, NP, and NG are based on LG.

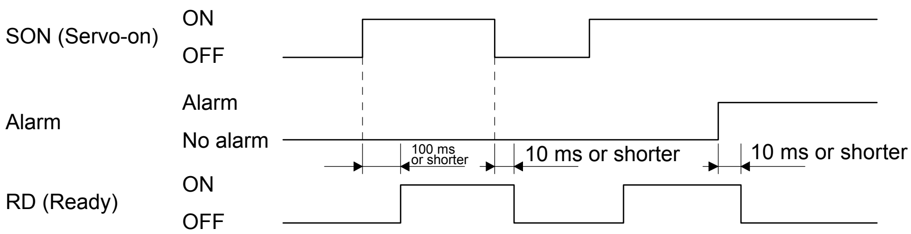


(2) INP (In-position)

INP turns on when the number of droop pulses in the deviation counter falls within the preset in-position range ([Pr. PA10]). INP may turn on continuously during a low-speed operation with a large value set as the in-position range.



(3) RD (Ready)



(4) Electronic gear switching

The combination of CM1 and CM2 enables you to select four different electronic gear numerators set in the parameters.

As soon as CM1/CM2 is turned on or off, the numerator of the electronic gear changes. Therefore, if a shock occurs at switching, use the position smoothing ([Pr. PB03]) to relieve the shock.

(Note) Input device		Electronic gear numerator
CM2	CM1	
0	0	Pr. PA06
0	1	Pr. PC32
1	0	Pr. PC33
1	1	Pr. PC34

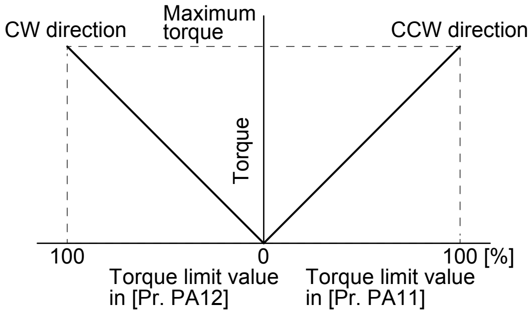
Note. 0: Off
1: On

(5) Torque limit

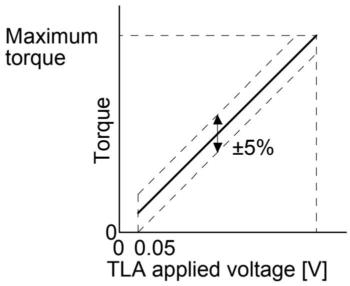
⚠CAUTION	●If the torque limit is canceled during servo-lock, the servo motor may suddenly rotate according to position deviation in respect to the command position.

(a) Torque limit and torque

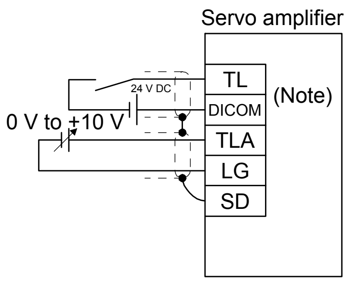
By setting [Pr. PA11 Forward rotation torque limit] or [Pr. PA12 Reverse rotation torque limit], torque is always limited to the maximum value during operation. A relation between the limit value and servo motor torque is as follows.



A relation between the applied voltage of TLA (Analog torque limit) and the torque limit value of the servo motor is as follows. Torque limit values will vary about 5% relative to the voltage depending on products. At the voltage of less than 0.05 V, torque may vary as it may not be limited sufficiently. Therefore, use this function at the voltage of 0.05 V or more.



TLA applied voltage vs. torque limit value



Connection example

Note. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.

(b) Torque limit value selection

The following shows how to select a torque limit using TL (External torque limit selection) from [Pr. PA11 Forward torque limit] or [Pr. PA12 Reverse torque limit] and TLA (Analog torque limit).
When TL1 (Internal torque limit selection) is enabled with [Pr. PD03] to [Pr. PD22], select [Pr. PC35 Internal torque limit 2].
However, if [Pr. PA11] and [Pr. PA12] value is less than the limit value selected by TL/TL1, [Pr. PA11] and [Pr. PA12] value will be enabled.

(Note) Input device		Limit value status			Enabled torque limit value	
TL1	TL				CCW power running/CW regeneration	CW power running/CCW regeneration
0	0				Pr. PA11	Pr .PA12
0	1	TLA	>	Pr. PA11 Pr. PA12	Pr. PA11	Pr. PA12
		TLA	<	Pr. PA11 Pr. PA12	TLA	TLA
1	0	Pr. PC35	>	Pr. PA11 Pr. PA12	Pr. PA11	Pr. PA12
		Pr. PC35	<	Pr. PA11 Pr. PA12	Pr. PC35	Pr. PC35
1	1	TLA	>	Pr. PC35	Pr. PC35	Pr. PC35
		TLA	<	Pr. PC35	TLA	TLA

Note. 0: Off
1: On

(c) TLC (Limiting torque)
TLC turns on when the servo motor torque reaches the torque limited using the forward rotation torque limit, reverse rotation torque limit or analog torque limit.

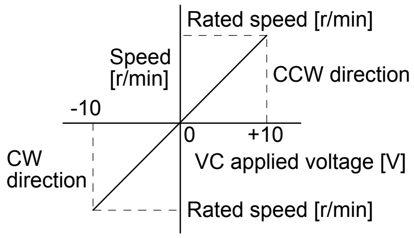
3.6.2 Speed control mode

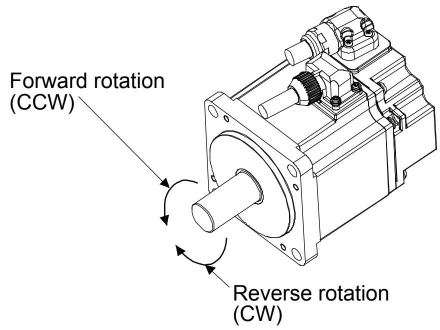
(1) Speed setting

(a) Speed command and speed

The servo motor is run at the speeds set in the parameters or at the speed set in the applied voltage of VC (Analog speed command). A relation between VC (Analog speed command) applied voltage and the servo motor speed is as follows.

Rated speed is achieved at ±10 V with initial setting. The speed at ±10 V can be changed with [Pr. PC12].



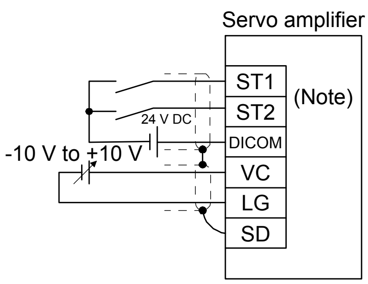


The following table indicates the rotation direction according to ST1 (Forward rotation start) and ST2 (Reverse rotation start) combination.

<table>
<tr><th colspan="2">(Note 1) Input device</th><th colspan="4">(Note 2) Rotation direction</th></tr>
<tr><th rowspan="2">ST2</th><th rowspan="2">ST1</th><th colspan="3">VC (Analog speed command)</th><th rowspan="2">Internal speed command</th></tr>
<tr><th>Polarity: +</th><th>0 V</th><th>Polarity: -</th></tr>
<tr><td>0</td><td>0</td><td>Stop
(servo-lock)</td><td>Stop
(servo-lock)</td><td>Stop
(servo-lock)</td><td>Stop
(servo-lock)</td></tr>
<tr><td>0</td><td>1</td><td>CCW</td><td rowspan="2">Stop
(no servo-lock)</td><td>CW</td><td>CCW</td></tr>
<tr><td>1</td><td>0</td><td>CW</td><td>CCW</td><td>CW</td></tr>
<tr><td>1</td><td>1</td><td>Stop
(servo-lock)</td><td>Stop
(servo-lock)</td><td>Stop
(servo-lock)</td><td>Stop
(servo-lock)</td></tr>
</table>

Note 1. 0: Off
1: On
2. If the torque limit is canceled during servo-lock, the servo motor may suddenly rotate according to position deviation in respect to the command position.

Normally, connect as follows.



Note. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.

(b) Speed command value selection

To select VC (Analog speed command) and a speed command value of internal speed commands 1 to 7, enable SP1 (Speed selection 1), SP2 (Speed selection 2), and SP3 (Speed selection 3) with [Pr. PD03] to [Pr. PD20].

(Note) Input device			Speed command value
SP3	SP2	SP1	
0	0	0	VC (Analog speed command)
0	0	1	Pr. PC05 Internal speed command 1
0	1	0	Pr. PC06 Internal speed command 2
0	1	1	Pr. PC07 Internal speed command 3
1	0	0	Pr. PC08 Internal speed command 4
1	0	1	Pr. PC09 Internal speed command 5
1	1	0	Pr. PC10 Internal speed command 6
1	1	1	Pr. PC11 Internal speed command 7

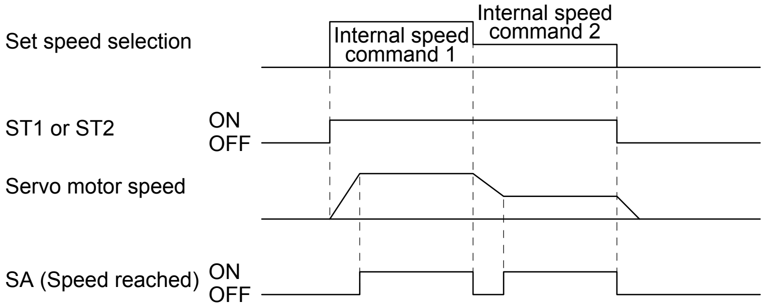
Note. 0: Off
1: On

You can change the speed during rotation. To accelerate/decelerate, set acceleration/deceleration time constant in [Pr. PC01] or [Pr. PC02].

When the internal speed commands are used to command a speed, the speed does not vary with the ambient temperature.

(2) SA (Speed reached)

SA turns on when the servo motor speed has nearly reached the speed set to the internal speed command or analog speed command.



(3) Torque limit

As in section 3.6.1 (5)

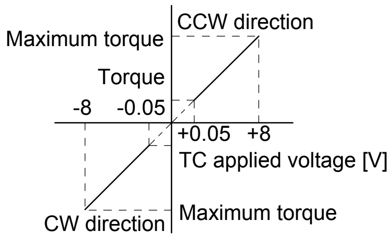
3.6.3 Torque control mode

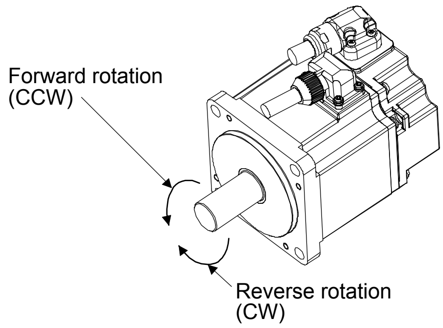
(1) Torque limit

(a) Torque command and torque

The following shows a relation between the applied voltage of TC (Analog torque command) and the torque by the servo motor.

The maximum torque is generated at ±8 V. The speed at ±8 V can be changed with [Pr. PC13].





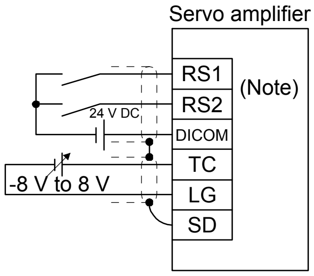
Generated torque command values will vary about 5% relative to the voltage depending on products. The torque may vary if the voltage is low (-0.05 V to 0.05 V) and the actual speed is close to the limit value. In such a case, increase the speed limit value.

The following table indicates the torque generation directions determined by RS1 (Forward rotation selection) and RS2 (Reverse rotation selection) when TC (Analog torque command) is used.

(Note) Input device		Rotation direction		
RS2	RS1	TC (Analog torque command)		
		Polarity: +	0 V	Polarity: -
0	0	Torque is not generated.	Torque is not generated.	Torque is not generated.
0	1	CCW (Forward rotation in power running mode/reverse rotation in regenerative mode)		CW (Reverse rotation in power running mode/forward rotation in regenerative mode)
1	0	CW (Reverse rotation in power running mode/forward rotation in regenerative mode)		CCW (Forward rotation in power running mode/reverse rotation in regenerative mode)
1	1	Torque is not generated.		Torque is not generated.

Note. 0: Off
1: On

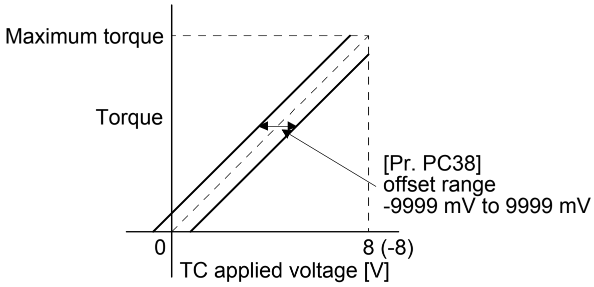
Normally, connect as follows.



Note. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.

(b) Analog torque command offset

Using [Pr. PC38], the offset voltage of -9999 mV to 9999 mV can be added to the TC applied voltage as follows.



(2) Torque limit

By setting [Pr. PA11 Forward rotation torque limit] or [Pr. PA12 Reverse rotation torque limit], torque is always limited to the maximum value during operation. A relation between limit value and servo motor torque is as in section 3.6.1 (5).

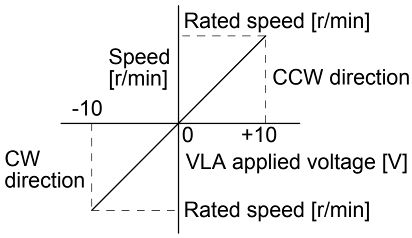
Note that TLA (Analog torque limit) is unavailable.

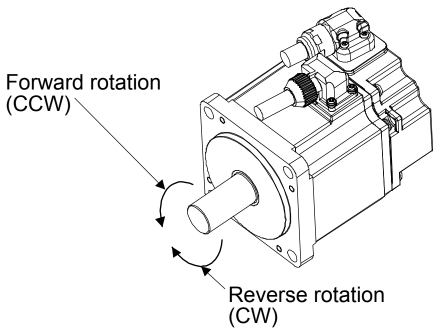
(3) Speed limit

(a) Speed limit value and speed

The speed is limited to the values set with [Pr. PC05 Internal speed limit 0] to [Pr. PC11 Internal speed limit 7] or the value set in the applied voltage of VLA (Analog speed limit). A relation between VLA (Analog speed limit) applied voltage and the servo motor speed is as follows.

When the servo motor speed reaches the speed limit value, torque control may become unstable. Make the set value more than 100 r/min greater than the desired speed limit value.



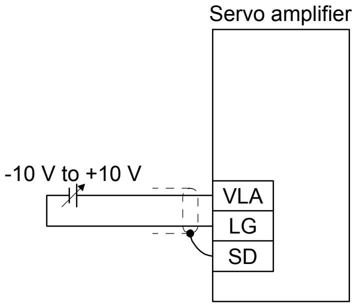


The following table indicates the limit direction according to RS1 (Forward rotation selection) and RS2 (Reverse rotation selection) combination.

(Note) Input device		Speed limit direction		
RS1	RS2	VLA (Analog speed limit)		Internal speed command
		Polarity: +	Polarity: -	
1	0	CCW	CW	CCW
0	1	CW	CCW	CW

Note. 0: Off
1: On

Normally, connect as follows.



(b) Speed limit value selection

To select VLA (Analog speed limit) and a speed limit value of internal speed limit 1 to 7, enable SP1 (Speed selection 1), SP2 (Speed selection 2), and SP3 (Speed selection 3) with [Pr. PD03] to [Pr. PD20].

(Note) Input device			Speed limit
SP3	SP2	SP1	
0	0	0	VLA (Analog speed limit)
0	0	1	Pr. PC05 Internal speed limit 1
0	1	0	Pr. PC06 Internal speed limit 2
0	1	1	Pr. PC07 Internal speed limit 3
1	0	0	Pr. PC08 Internal speed limit 4
1	0	1	Pr. PC09 Internal speed limit 5
1	1	0	Pr. PC10 Internal speed limit 6
1	1	1	Pr. PC11 Internal speed limit 7

Note. 0: Off
1: On

When the internal speed limits 1 to 7 are used to limit a speed, the speed does not vary with the ambient temperature.

(c) VLC (Limiting speed)

VLC turns on when the servo motor speed reaches a speed limited with internal speed limits 1 to 7 or analog speed limit.

3.6.4 Position/speed control switching mode

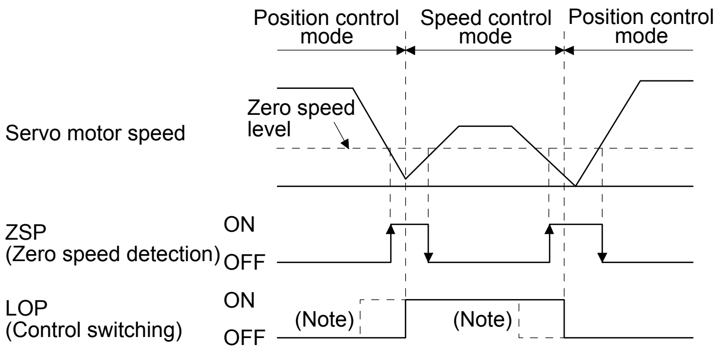
Set " _ _ _ 1" in [Pr. PA01] to switch to the position/speed control switching mode.

(1) LOP (control switching)
Use LOP (Control switching) to switch between the position control mode and the speed control mode with an external contact. The following shows a relation between LOP and control modes.

(Note) LOP	Control mode
0	Position control mode
1	Speed control mode

Note. 0: Off
1: On

You can switch the control mode in the zero speed status. To ensure safety, switch modes after the servo motor has stopped. When position control mode is switched to speed control mode, droop pulses will be reset.
If LOP is switched on/off at the speed higher than the zero speed, the control mode cannot be changed regardless of the speed. The following shows a switching timing chart.



Note. When ZSP is not turned on, the control mode is not switched even if LOP is turned on/off. After LOP is turned on/off, even if ZSP is turned on, the control mode is not switched.

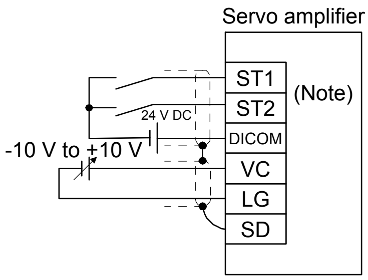
(2) Torque limit in position control mode
As in section 3.6.1 (5)

(3) Speed setting in speed control mode

(a) Speed command and speed

The servo motor is run at the speeds set in the parameters or at the speed set in the applied voltage of VC (Analog speed command). The relation between an applied voltage of VC (Analog speed command) and servo motor speed, and the rotation direction with turning on ST1/ST2 are the same as section 3.6.2 (1) (a).

Normally, connect as follows.



Note. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.

(b) Speed command value selection

To select VC (Analog speed command) and a speed command value of internal speed commands 1 to 7, enable SP1 (Speed selection 1), SP2 (Speed selection 2), and SP3 (Speed selection 3) with [Pr. PD03] to [Pr. PD20].

(Note) Input device			Speed command value
SP3	SP2	SP1	
0	0	0	VC (Analog speed command)
0	0	1	Pr. PC05 Internal speed command 1
0	1	0	Pr. PC06 Internal speed command 2
0	1	1	Pr. PC07 Internal speed command 3
1	0	0	Pr. PC08 Internal speed command 4
1	0	1	Pr. PC09 Internal speed command 5
1	1	0	Pr. PC10 Internal speed command 6
1	1	1	Pr. PC11 Internal speed command 7

Note. 0: Off
1: On

You can change the speed during rotation. Acceleration/deceleration is performed with the setting values of [Pr. PC01] and [Pr. PC02].

When the internal speed commands 1 to 7 are used to command a speed, the speed does not vary with the ambient temperature.

(c) SA (Speed reached)

As in section 3.6.2 (2)

3.6.5 Speed/torque control switching mode

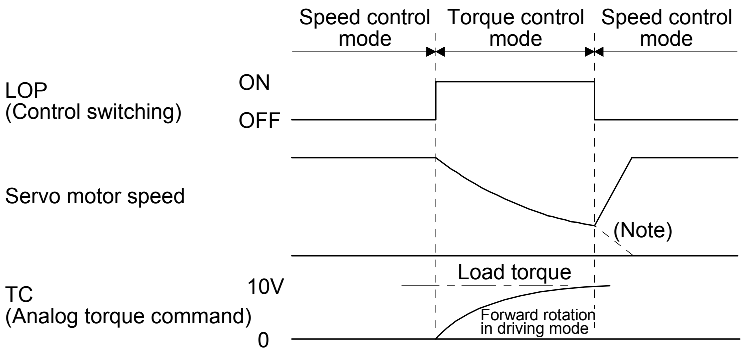
Set " _ _ _ 3" in [Pr. PA01] to switch to the speed/torque control switching mode.

(1) LOP (control switching)
Use LOP (Control switching) to switch between the speed control mode and the torque control mode with an external contact. The following shows a relation between LOP and control modes.

(Note) LOP	Control mode
0	Speed control mode
1	Torque control mode

Note. 0: Off
1: On

The control mode may be switched at any time. The following shows a switching timing chart.



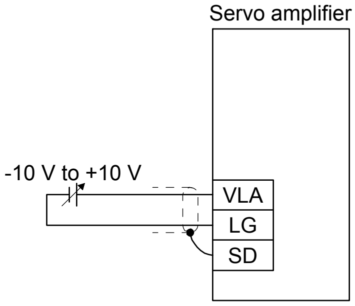
Note. When ST1 (Forward rotation start) and ST2 (Reverse rotation start) are switched off as soon as a mode is switched to the speed control, the servo motor comes to a stop according to the deceleration time constant. A shock may occur at switching control modes.

(2) Speed setting in speed control mode
As in section 3.6.2 (1)

(3) Torque limit in speed control mode
As in section 3.6.1 (5)

(4) Speed limit in torque control mode
(a) Speed limit value and speed
The speed is limited to the limit value of the parameter or the value set in the applied voltage of VLA (Analog speed limit).
A relation between the VLA (Analog speed limit) applied voltage and the limit value is as in section 3.6.3 (3) (a).

Normally, connect as follows.



(b) Speed limit value selection

To select VLA (Analog speed limit) and a speed limit value of internal speed limit 1 to 7, enable SP1 (Speed selection 1), SP2 (Speed selection 2), and SP3 (Speed selection 3) with [Pr. PD03] to [Pr. PD20].

(Note) Input device			Speed limit
SP3	SP2	SP1	
0	0	0	VLA (Analog speed limit)
0	0	1	Pr. PC05 Internal speed limit 1
0	1	0	Pr. PC06 Internal speed limit 2
0	1	1	Pr. PC07 Internal speed limit 3
1	0	0	Pr. PC08 Internal speed limit 4
1	0	1	Pr. PC09 Internal speed limit 5
1	1	0	Pr. PC10 Internal speed limit 6
1	1	1	Pr. PC11 Internal speed limit 7

Note. 0: Off
1: On

When the internal speed command 1 is used to command a speed, the speed does not vary with the ambient temperature.

(c) VLC (Limiting speed)

As in section 3.6.3 (3) (c)

(5) Torque control in torque control mode

As in section 3.6.3 (1)

(6) Torque limit in torque control mode

As in section 3.6.3 (2)

3.6.6 Torque/position control switching mode

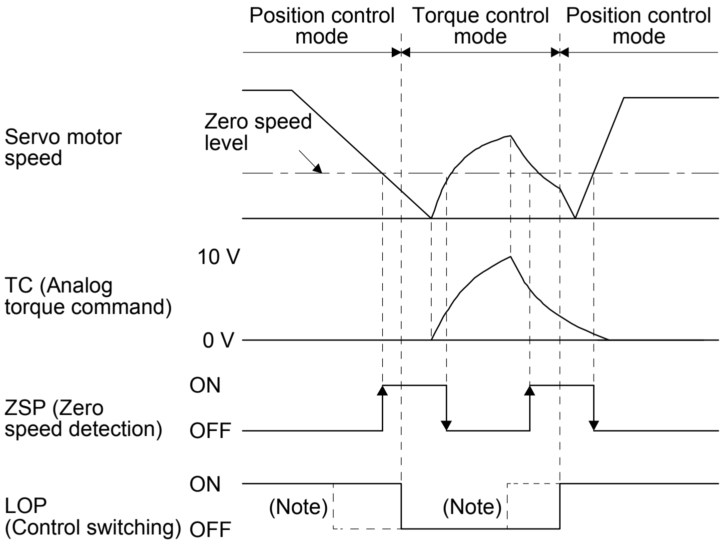
Set " _ _ _ 5" in [Pr. PA01] to switch to the torque/position control switching mode.

(1) LOP (control switching)
Use LOP (Control switching) to switch between the torque control mode and the position control mode with an external contact. The following shows a relation between LOP and control modes.

(Note) LOP	Control mode
0	Torque control mode
1	Position control mode

Note. 0: Off
1: On

You can switch the control mode in the zero speed status. To ensure safety, switch modes after the servo motor has stopped. When position control mode is switched to torque control mode, droop pulses will be reset.
If LOP is switched on/off at the speed higher than the zero speed, the control mode cannot be changed regardless of the speed. The following shows a switching timing chart.



Note. When ZSP is not turned on, the control mode is not switched even if LOP is turned on/off. After LOP is turned on/off, even if ZSP is turned on, the control mode is not switched.

(2) Speed limit in torque control mode
As in section 3.6.3 (3)

(3) Torque control in torque control mode
As in section 3.6.3 (1)

(4) Torque limit in torque control mode
As in section 3.6.3 (2)

(5) Torque limit in position control mode
As in section 3.6.1 (5)

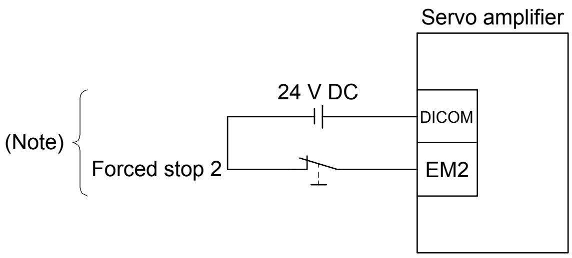
3.7 Forced stop deceleration function

POINT
●When alarms not related to the forced stop function occur, control of motor deceleration can not be guaranteed. (Refer to chapter 8.) ●In the torque control mode, the forced stop deceleration function is not available.

3.7.1 Forced stop deceleration function

When EM2 is turned off, dynamic brake will start to stop the servo motor after forced stop deceleration. During this sequence, the display shows [AL. E6 Servo forced stop warning].
During normal operation, do not use EM2 (Forced stop 2) to alternate stop and drive. The the servo amplifier life may be shortened.

(1) Connection diagram



Note. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.

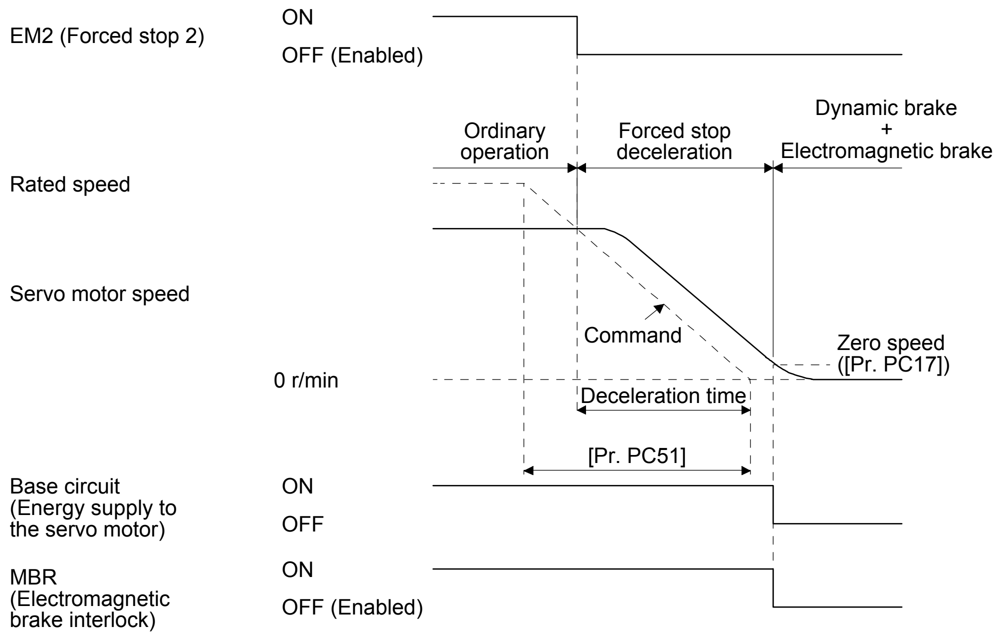
(2) Timing chart

POINT

- When LSP/LSN is turned on during a forced stop deceleration, the motor will stop depending on the setting of [Pr. PD30] as follows.

[Pr. PD30]	Stop system
_ _ _ 0	Switching to sudden stop
_ _ _ 1	Continuing forced stop deceleration

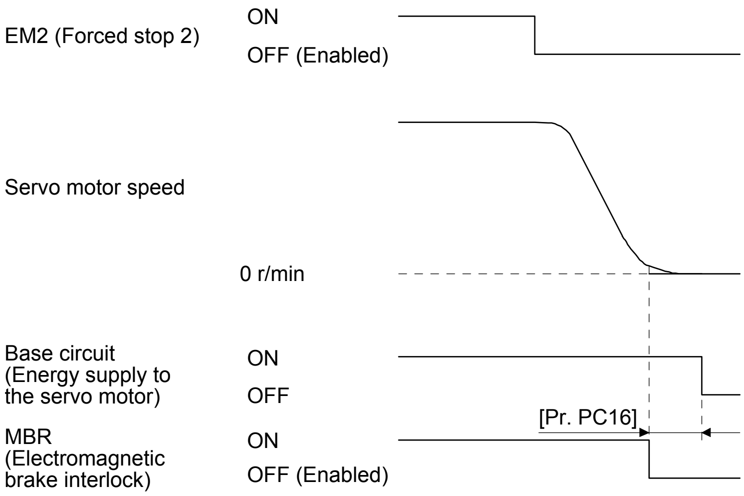
When EM2 (Forced stop 2) turns off, the motor will decelerate according to [Pr. PC51 Forced stop deceleration time constant]. Once the motor speed is below [Pr. PC17 Zero speed] after completion of the deceleration command, base power is cut and the dynamic brake activates.



3.7.2 Base circuit shut-off delay time function

The base circuit shut-off delay time function is used to prevent vertical axis from dropping at a forced stop (EM2 goes off) or alarm occurrence due to delay time of the electromagnetic brake. Use [Pr. PC16] to set the delay time between completion of EM2 (Forced stop 2) or activation of MBR (Electromagnetic brake interlock) due to an alarm occurrence, and shut-off of the base circuit.

(1) Timing chart



When EM2 (Forced stop 2) turns off or an alarm occurs during driving, the servo motor will decelerate based on the deceleration time constant. MBR (Electromagnetic brake interlock) will turn off, and then after the delay time set in [Pr. PC16], the servo amplifier will be base circuit shut-off status.

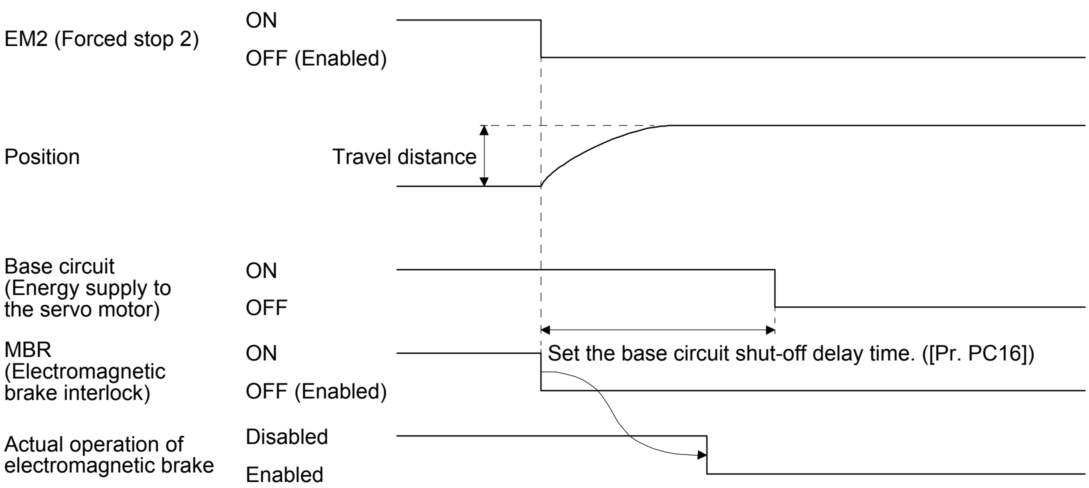
(2) Adjustment
While the servo motor is stopped, turn off EM2 (Forced stop 2), adjust the base circuit shut-off delay time in [Pr. PC16], and set the value to approximately 1.5 times of the smallest delay time in which the servo motor shaft does not freefall.

3.7.3 Vertical axis freefall prevention function

The vertical axis freefall prevention function avoids machine damage by pulling up the shaft slightly like the following case.
When the servo motor is used for operating vertical axis, the servo motor electromagnetic brake and the base circuit shut-off delay time function avoid dropping axis at forced stop. However, the functions may not avoid dropping axis a few μm due to the backlash of the servo motor electromagnetic brake.
The vertical axis freefall prevention function is enabled with the following conditions.

- Other than "0" is set to [Pr. PC54 Vertical axis freefall prevention compensation amount].
- The servo motor speed decelerates lower than the value of zero speed by turning off EM2 (Forced stop 2) or by an alarm occurrence.
- The base circuit shut-off delay time function is enabled.
- EM2 (Forced stop 2) turned off or an alarm occurred while the servo motor speed is zero speed or less.

(1) Timing chart



(2) Adjustment

- Set the freefall prevention compensation amount in [Pr. PC54].
- While the servo motor is stopped, turn off the EM2 (Forced stop 2). Adjust the base circuit shut-off delay time in [Pr. PC16] in accordance with the travel distance ([Pr. PC54). Adjust it considering the freefall prevention compensation amount by checking the servo motor speed, torque ripple, etc.

3.7.4 Residual risks of the forced stop function (EM2)

(1) The forced stop function is not available for alarms that activate the dynamic brake when the alarms occur.

(2) When an alarm that activates the dynamic brake during forced stop deceleration occurs, the braking distance until the servo motor stops will be longer than that of normal forced stop deceleration without the dynamic brake.

3.8 Alarm occurrence timing chart

CAUTION	●When an alarm has occurred, remove its cause, make sure that the operation signal is not being input, ensure safety, and reset the alarm before restarting operation.

POINT

●In the torque control mode, the forced stop deceleration function is not available.

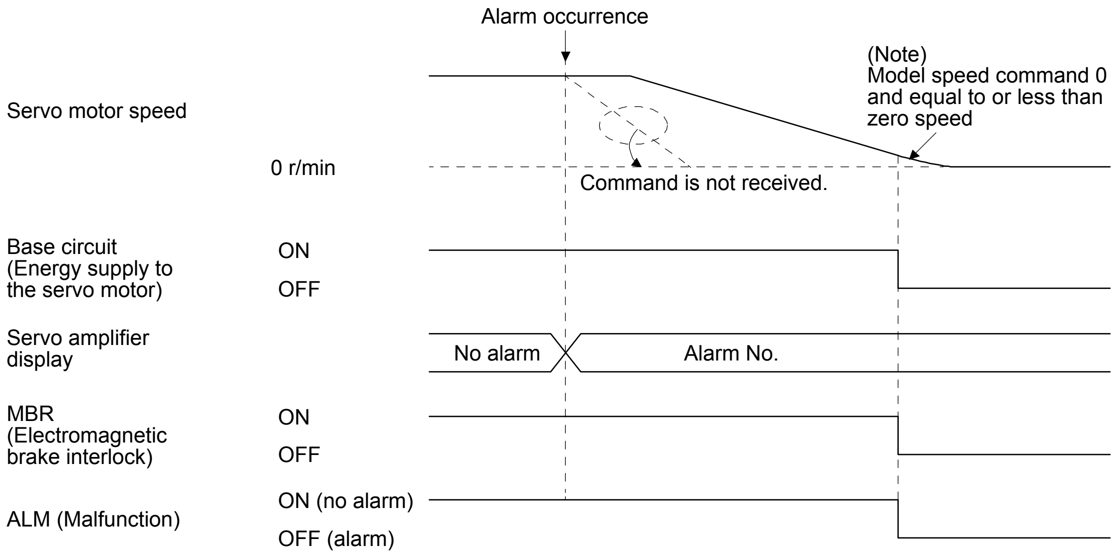
To deactivate an alarm, cycle the power, push the "SET" button in the current alarm window, or cycle the RES (Reset) However, the alarm cannot be deactivated unless its cause is removed.

3.8.1 When you use the forced stop deceleration function

POINT

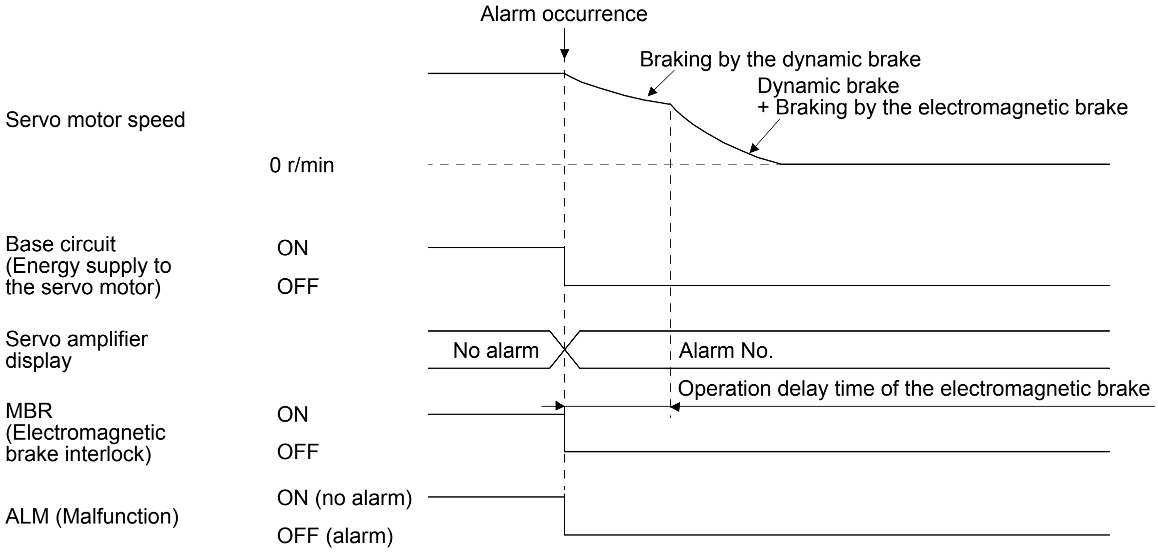
●To enable the function, set "2 _ _ _ (initial value)" in [Pr. PA04].

(1) When the forced stop deceleration function is enabled



Note. The model speed command is a speed command generated in the servo amplifier for forced stop deceleration of the servo motor.

(2) When the forced stop deceleration function is not enabled



3.8.2 When you do not use the forced stop deceleration function

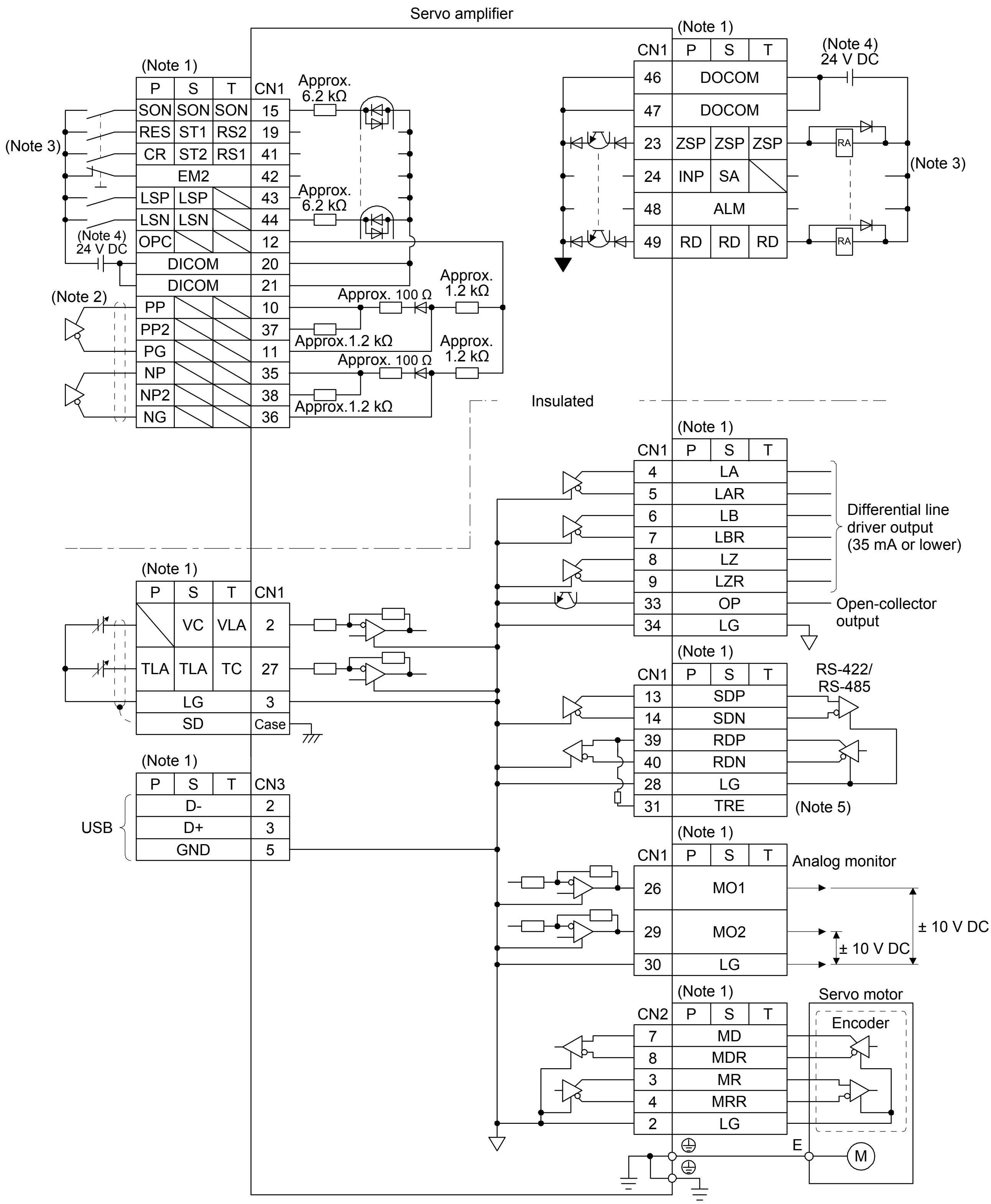
POINT
●To disable the function, set "0 _ _ _" in [Pr. PA04].

The operation status during an alarm is the same as section 3.8.1 (2).

3.9 Interfaces

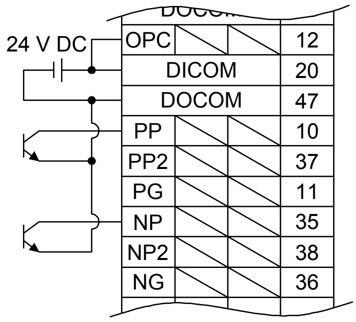
3.9.1 Internal connection diagram

The following diagram is for sink I/O interface when command pulse train input is differential line driver type.

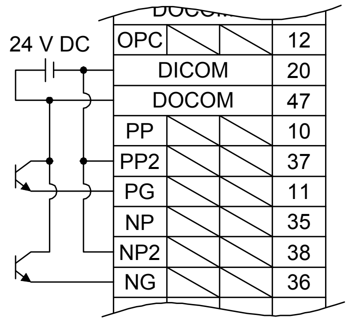


Note 1. P: position control mode, S: speed control mode, T: torque control mode

2. This is for the differential line driver pulse train input. For the open-collector pulse train input, connect as follows.



For sink input interface



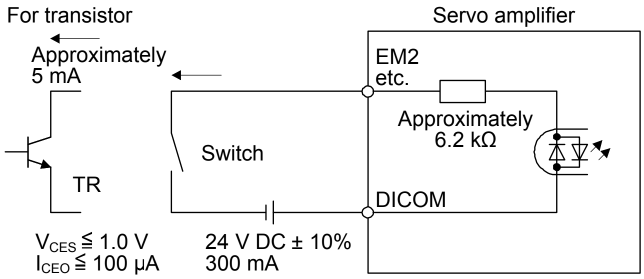
For source input interface

3. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
4. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
5. To use the RS-422/RS-485 communication function, connect between TRE and RDN of the final axis servo amplifier. (Refer to section 12.1.1.)

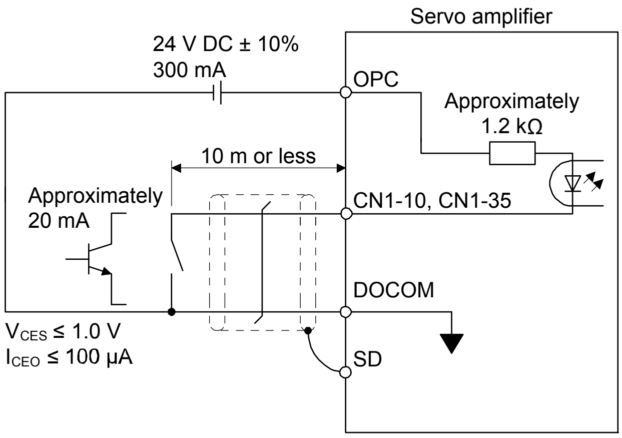
3.9.2 Detailed explanation of interfaces

This section provides the details of the I/O signal interfaces (refer to the I/O division in the table) given in section 3.5. Refer to this section and make connection with the external device.

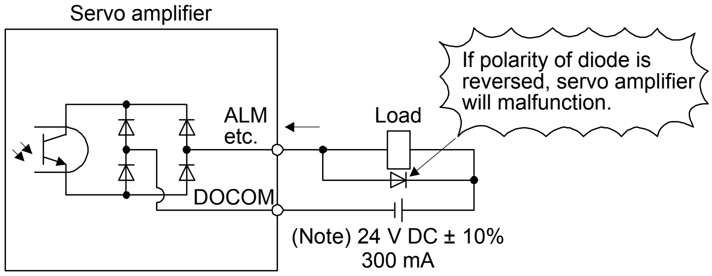
(1) Digital input interface DI-1
This is an input circuit whose photocoupler cathode side is input terminal. Transmit signals from sink (open-collector) type transistor output, relay switch, etc. The following is a connection diagram for sink input. Refer to section 3.9.3 for source input.



The following shows when the CN1-10 pin and the CN1-35 pin are used as digital input interface:



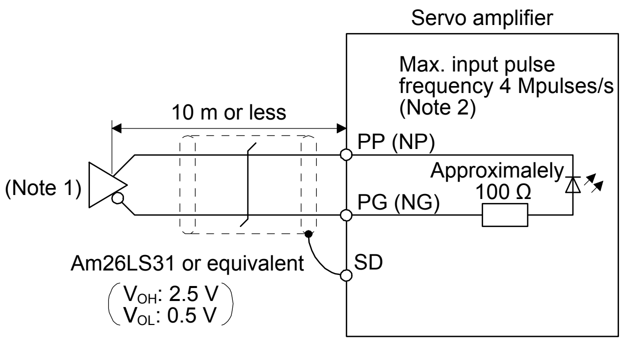
(2) Digital output interface DO-1
This is a circuit in which the collector side of the output transistor is the output terminal. When the output transistor is turned on, the current flows from the collector terminal.
A lamp, relay or photocoupler can be driven. Install a diode (D) for an inductive load, or install an inrush current suppressing resistor (R) for a lamp load.
(Rated current: 40 mA or less, maximum current: 50 mA or less, inrush current: 100 mA or less) A maximum of 2.6 V voltage drop occurs in the servo amplifier.
The following shows a connection diagram for sink output. Refer to section 3.9.3 for source output.



Note. If the voltage drop (maximum of 2.6 V) interferes with the relay operation, apply high voltage (maximum of 26.4 V) from external source.

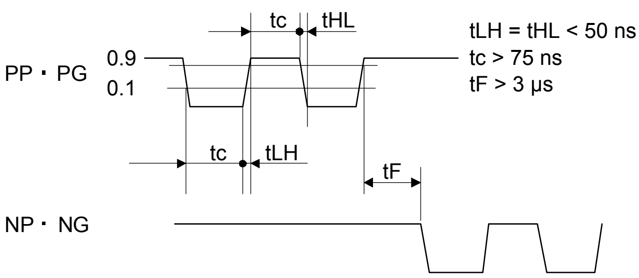
(3) Pulse train input interface DI-2
Give a pulse train signal in the differential line driver type or open-collector type.

(a) Differential line driver type
1) Interface

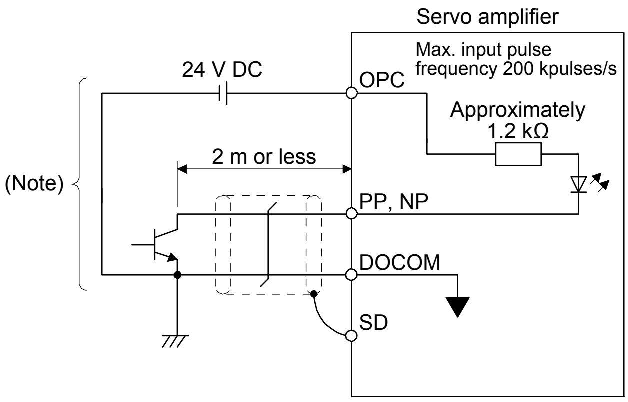


Note 1. Pulse train input interface is comprised of a photocoupler.
If a resistor is connected to the pulse train signal line, it may malfunction due to reduction in current.
2. When the input pulse frequency is 4 Mpulses/s, set [Pr. PA13] to "_ 0 _ _".

2) Input pulse condition

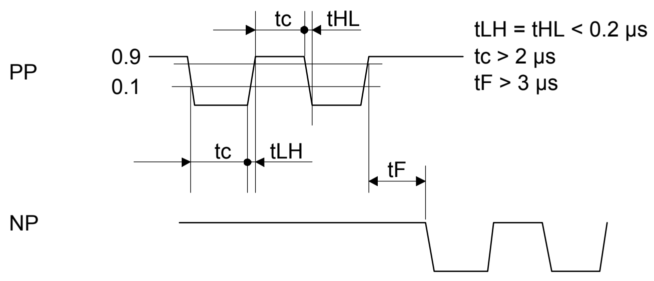


(b) Open-collector type
1) Interface



Note. Pulse train input interface is comprised of a photocoupler.
If a resistor is connected to the pulse train signal line, it may malfunction due to reduction in current.

2) Input pulse condition

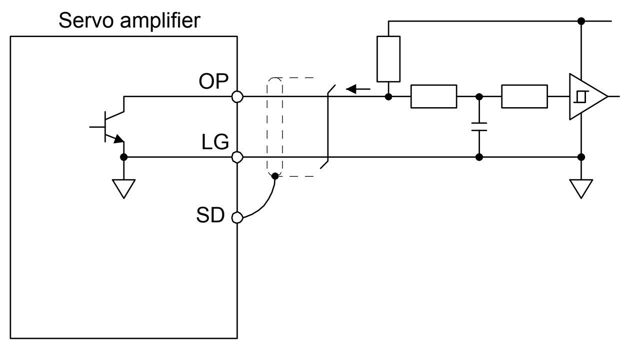


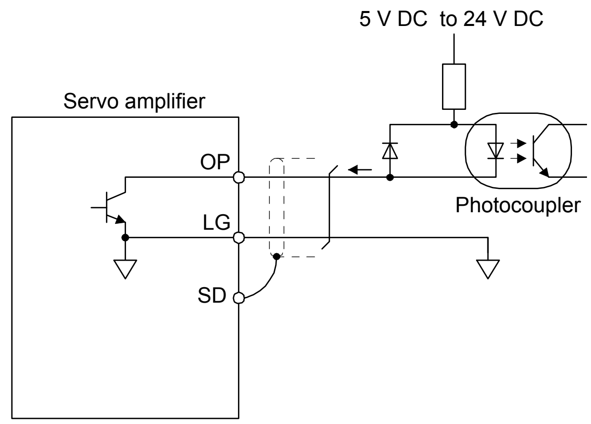
(4) Encoder output pulse DO-2

(a) Open-collector type

Interface

Maximum sink current: 35 mA

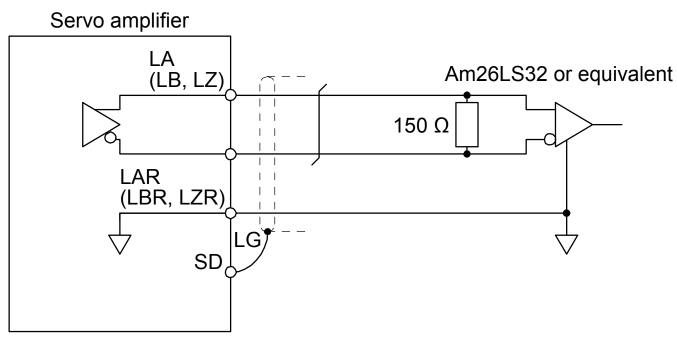


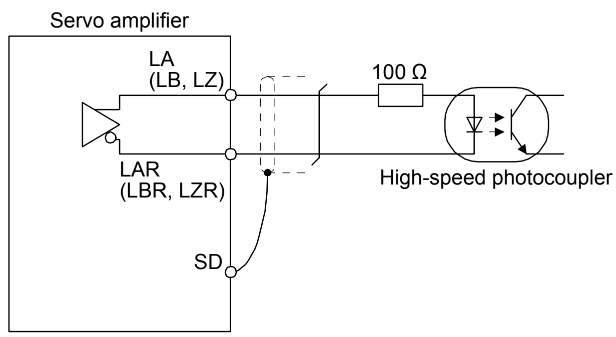


(b) Differential line driver type

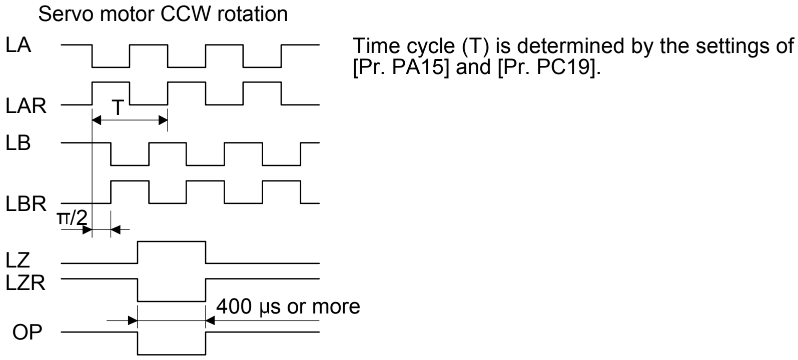
1) Interface

Maximum output current: 35 mA

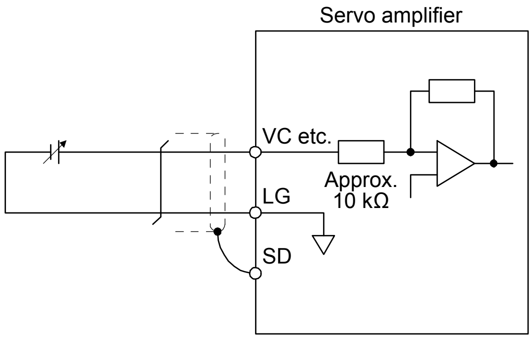




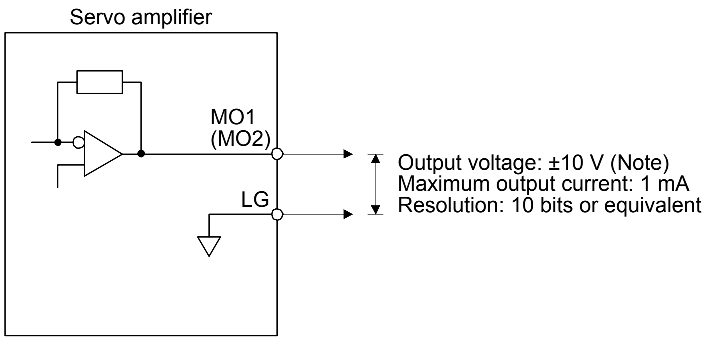
2) Output pulse



(5) Analog input
Input impedance
10 kΩ to 12 kΩ



(6) Analog output



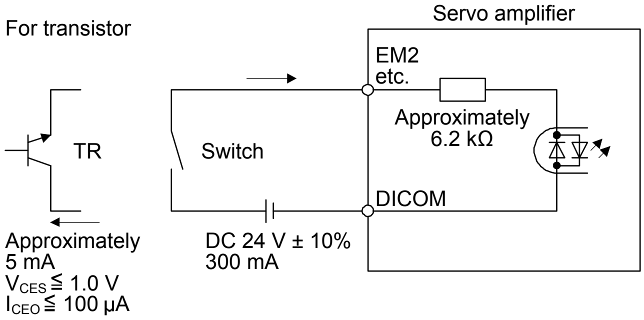
Note. Output voltage range varies depending on the monitored signal.

3.9.3 Source I/O interfaces

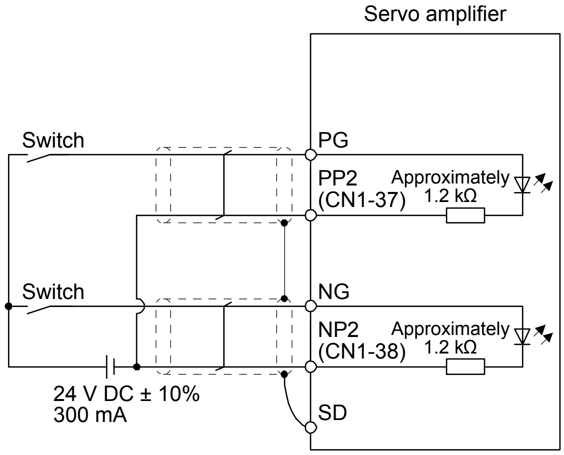
In this servo amplifier, source type I/O interfaces can be used.

(1) Digital input interface DI-1

This is an input circuit whose photocoupler anode side is the input terminal. Transmit signals from source (open-collector) type transistor output, relay switch, etc.



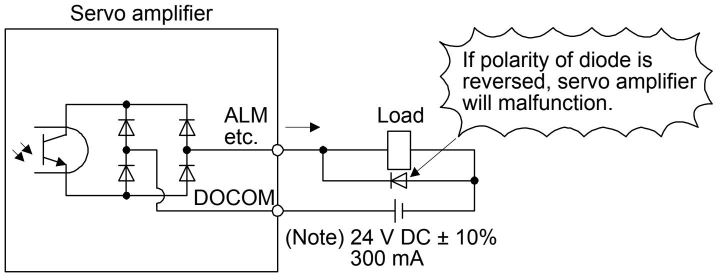
The following shows when the CN1-37 pin and the CN1-38 pin are used as digital input interface:



(2) Digital output interface DO-1

This is a circuit in which the emitter side of the output transistor is the output terminal. When the output transistor is turned on, the current flows from the output terminal to a load.

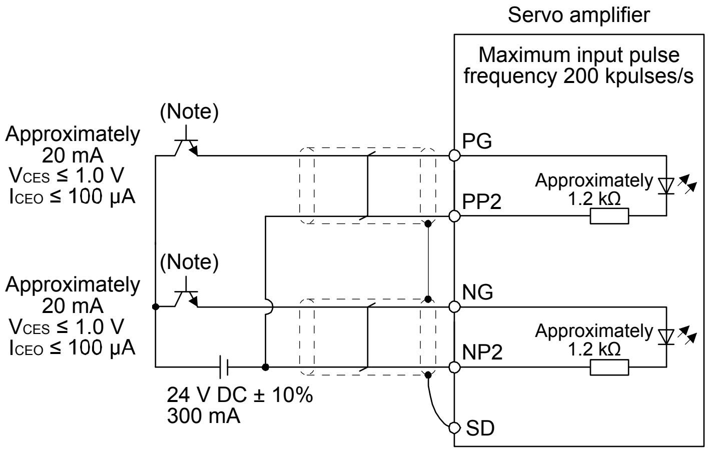
A maximum of 2.6 V voltage drop occurs in the servo amplifier.



Note. If the voltage drop (maximum of 2.6 V) interferes with the relay operation, apply high voltage (maximum of 26.4 V) from external source.

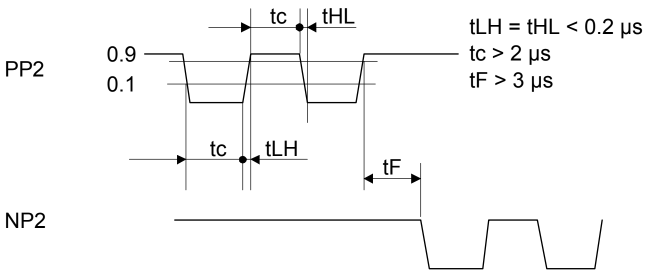
(3) Pulse train input interface DI-2
Give a pulse train signal in the open-collector type.

1) Interface



Note. Pulse train input interface is comprised of a photocoupler.
If a resistor is connected to the pulse train signal line, it may malfunction due to reduction in current.

2) Input pulse condition

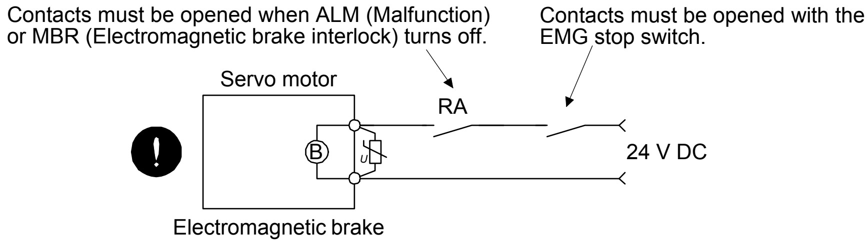


3.10 Servo motor with an electromagnetic brake

3.10.1 Safety precautions

⚠CAUTION

- Configure an electromagnetic brake circuit so that it is activated also by an external EMG stop switch.



- The electromagnetic brake is provided for holding purpose and must not be used for ordinary braking.
- Before operating the servo motor, be sure to confirm that the electromagnetic brake operates properly.
- Do not use the 24 V DC interface power supply for the electromagnetic brake. Always use the power supply designed exclusively for the electromagnetic brake. Otherwise, it may cause a malfunction.
- When using EM2 (Forced stop 2), use MBR (Electromagnetic brake interlock) for operating the electromagnetic brake. Operating the electromagnetic brake without using MBR during deceleration to a stop will saturate servo motor torques at the maximum value due to brake torques of the electromagnetic brake and can result in delay of the deceleration to a stop from a set value.

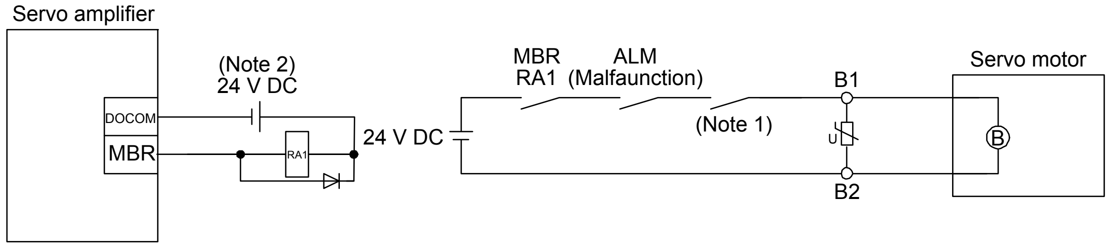
POINT

- Refer to "HG-KN/HG-SN Servo Motor Instruction Manual" for specifications such as the power supply capacity and operation delay time of the electromagnetic brake.
- Refer to "HG-KN/HG-SN Servo Motor Instruction Manual" for the selection of a surge absorber for the electromagnetic brake.

Note the following when the servo motor with an electromagnetic brake is used.

1) The brake will operate when the power (24 V DC) turns off.
2) The status is base circuit shut-off during RES (Reset) on. When you use the motor in vertical axis system, use MBR (Electromagnetic brake interlock).
3) Turn off SON (Servo-on) after the servo motor stopped.

(1) Connection diagram



Note 1. Create the circuit in order to shut off by interlocking with the emergency stop switch.
2. Do not use the 24 V DC interface power supply for the electromagnetic brake.

(2) Setting

(a) Enable MBR (Electromagnetic brake interlock) with [Pr. PD03] to [Pr. PD20].

(b) In [Pr. PC16 Electromagnetic brake sequence output], set a delay time (Tb) from MBR (Electromagnetic brake interlock) off to base circuit shut-off at a servo-off as in the timing chart in section 3.10.2 (1).

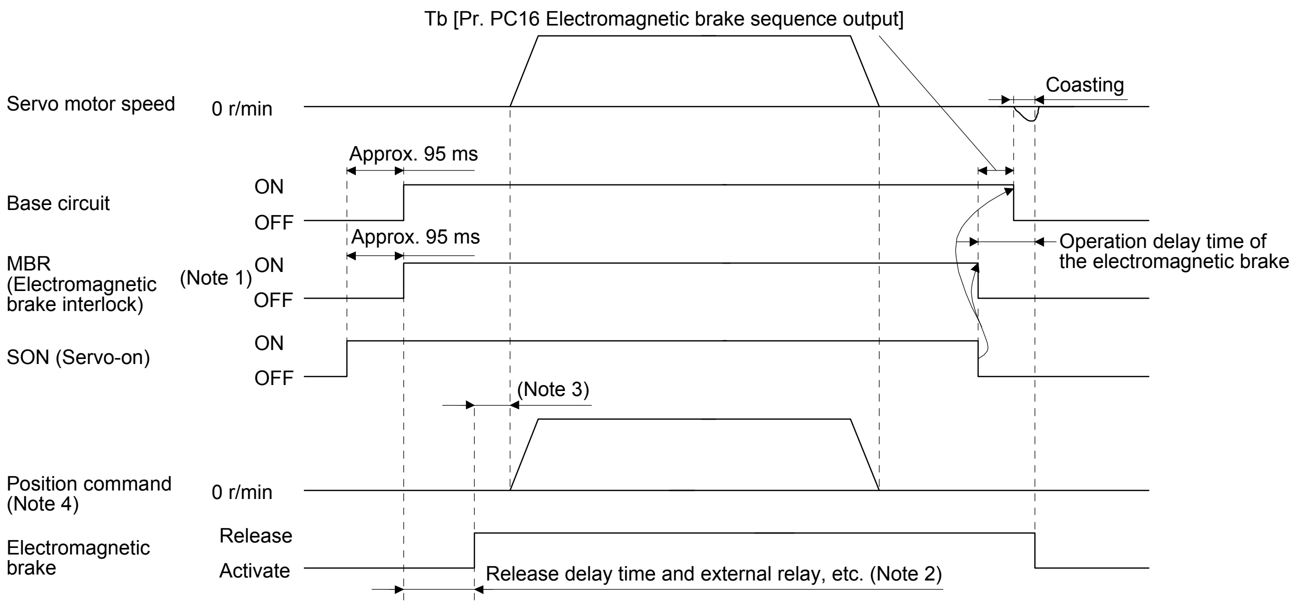
3.10.2 Timing chart

(1) When you use the forced stop deceleration function

POINT
●To enable the function, set "2 _ _ _ (initial value)" in [Pr. PA04].

(a) SON (Servo-on) on/off

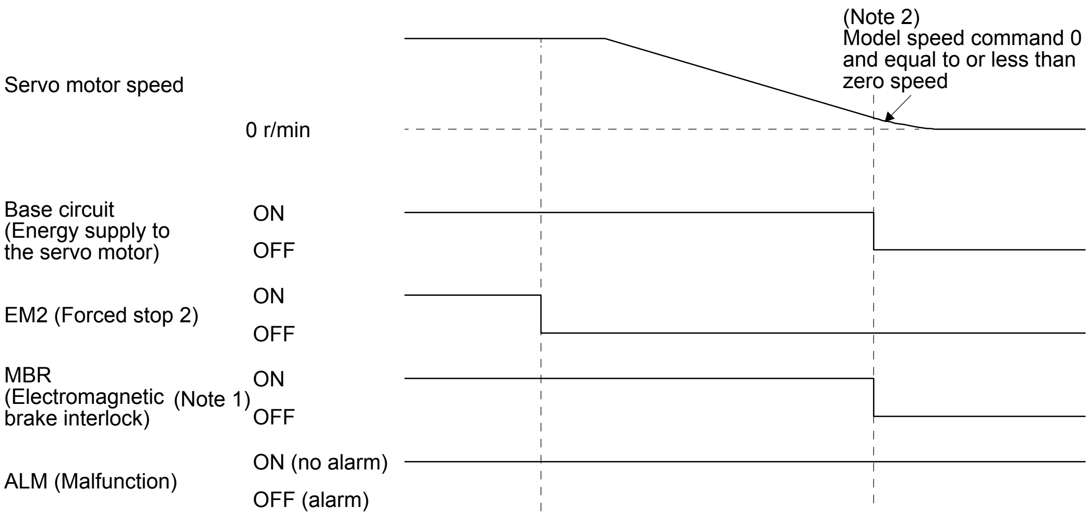
When SON (Servo-on) is turned off, the servo lock will be released after Tb [ms], and the servo motor will coast. If the electromagnetic brake is enabled during servo-lock, the brake life may be shorter. Therefore, set Tb about 1.5 times of the minimum delay time where the moving part will not drop down for a vertical axis system, etc.



Note 1. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake has been activated.
2. Electromagnetic brake is released after the release delay time of electromagnetic brake and operation time of external circuit relay, etc. For the release delay time of electromagnetic brake, refer to "HG-KN/HG-SN Servo Motor Instruction Manual".
3. Give a position command after the electromagnetic brake is released.
4. This is in position control mode.

(b) Forced stop 2 on/off

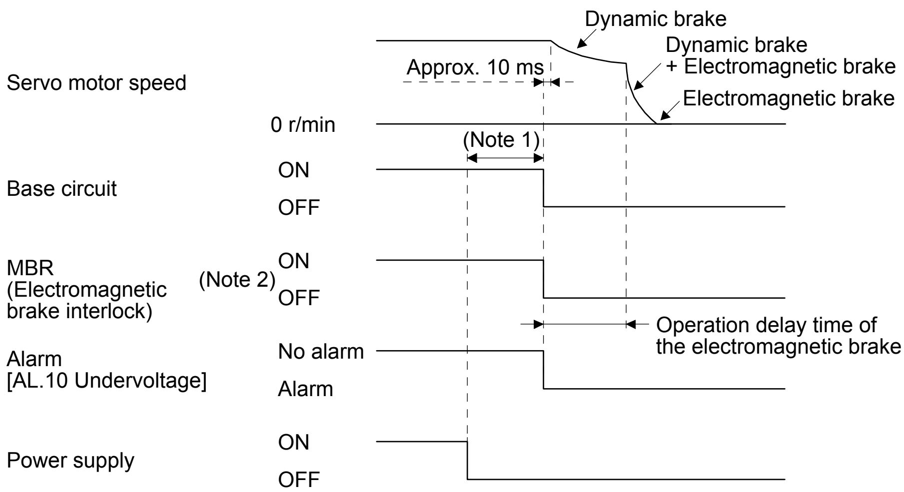
POINT
●In the torque control mode, the forced stop deceleration function is not available.



Note 1. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake has been activated.
2. The model speed command is a speed command generated in the servo amplifier for forced stop deceleration of the servo motor.

(c) Alarm occurrence
The operation status during an alarm is the same as section 3.8.

(d) Power off



Note 1. Variable according to the operation status.
2. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake has been activated.

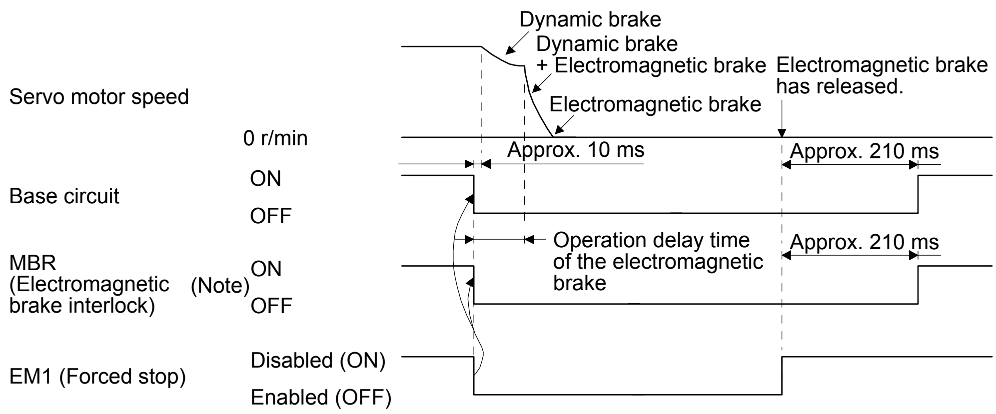
(2) When you do not use the forced stop deceleration function

POINT
●To disable the function, set "0 _ _ _" in [Pr. PA04].

(a) SON (Servo-on) on/off

It is the same as (1) (a) in this section.

(b) EM1 (Forced stop 1) on/off



Note. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake has been activated.

(c) Alarm occurrence

The operation status during an alarm is the same as section 3.8.

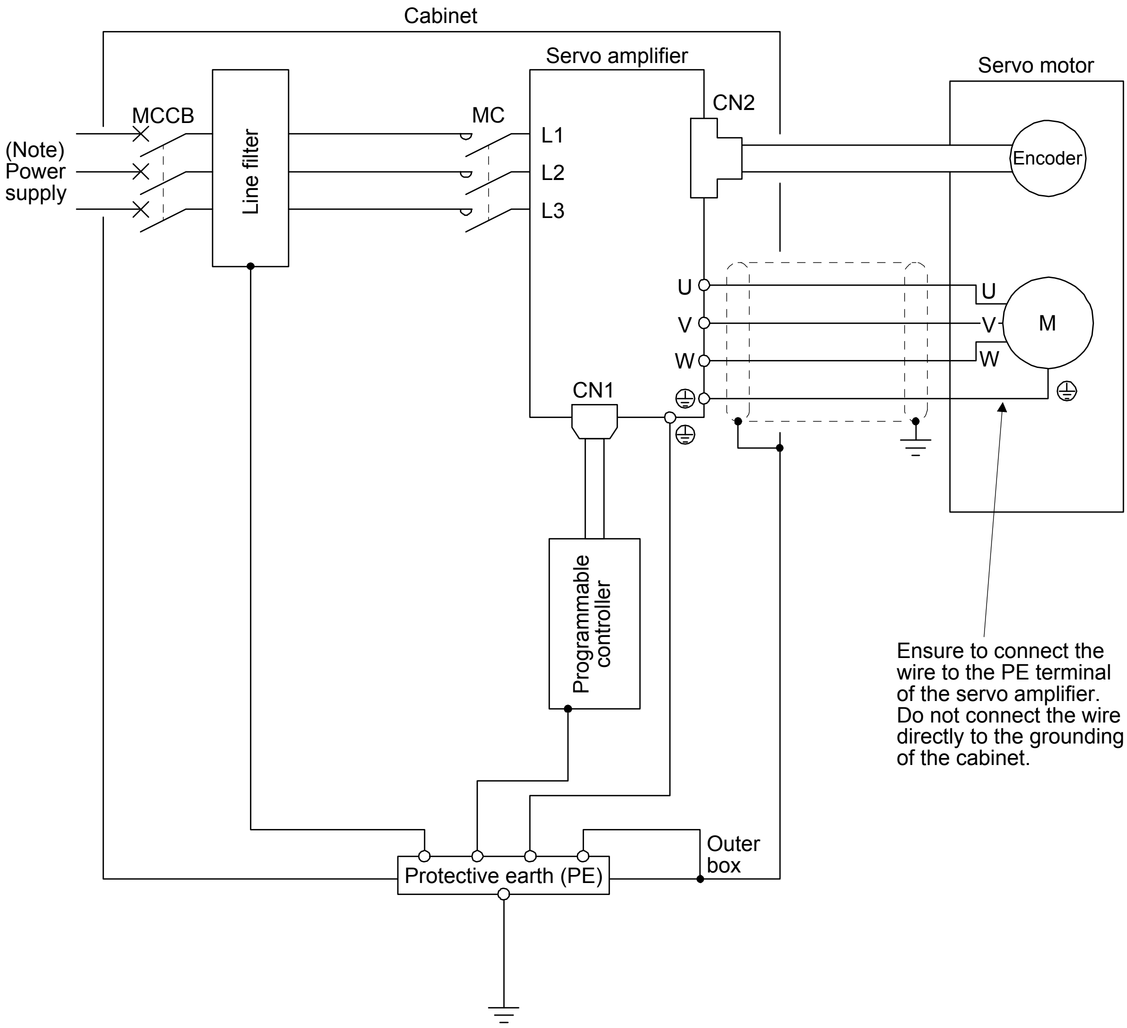
(d) Power off

It is the same as (1) (d) of this section.

3.11 Grounding

> ⚠WARNING
> - Ground the servo amplifier and servo motor securely.
> - To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the servo amplifier to the protective earth (PE) of the cabinet.

The servo amplifier switches the power transistor on-off to supply power to the servo motor. Depending on the wiring and ground cable routing, the servo amplifier may be affected by the switching noise (due to di/dt and dv/dt) of the transistor. To prevent such a fault, refer to the following diagram and always ground.
To conform to the EMC Directive, refer to the EMC Installation Guidelines (IB(NA)67310).



Note. For the power supply specifications, refer to section 1.3.

MEMO

4. STARTUP

⚠WARNING	●Do not operate the switches with wet hands. Otherwise, it may cause an electric shock.

⚠CAUTION	●Before starting operation, check the parameters. Improper settings may cause some machines to operate unexpectedly. ●The servo amplifier heat sink, regenerative resistor, servo motor, etc. may be hot while power is on or for some time after power-off. Take safety measures, e.g. provide covers, to avoid accidentally touching the parts (cables, etc.) by hand. ●During operation, never touch the rotor of the servo motor. Otherwise, it may cause injury.

4.1 Switching power on for the first time

When switching power on for the first time, follow this section to make a startup.

4.1.1 Startup procedure

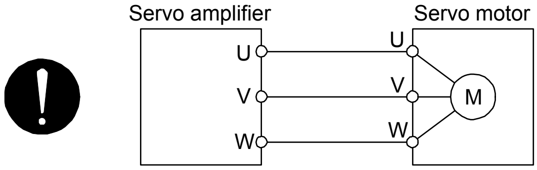
Wiring check	Check whether the servo amplifier and servo motor are wired correctly using visual inspection, DO forced output function (section 4.5.8), etc. (Refer to section 4.1.2.)
↓	
Surrounding environment check	Check the surrounding environment of the servo amplifier and servo motor. (Refer to section 4.1.3.)
↓	
Parameter setting	Set the parameters as necessary, such as the used operation mode and regenerative option selection. (Refer to chapter 5, and sections 4.2.4, 4.3.4, and 4.4.4.)
↓	
Test operation of the servo motor alone in test operation mode	For the test operation, with the servo motor disconnected from the machine and operated at the speed as low as possible, check whether the servo motor rotates correctly. (Refer to sections 4.2.3, 4.3.3, and 4.4.3.)
↓	
Test operation of the servo motor alone by commands	For the test operation with the servo motor disconnected from the machine and operated at the speed as low as possible, give commands to the servo amplifier and check whether the servo motor rotates correctly.
↓	
Test operation with the servo motor and machine connected	After connecting the servo motor with the machine, check machine motions with sending operation commands from the controller.
↓	
Gain adjustment	Make gain adjustment to optimize the machine motions. (Refer to chapter 6.)
↓	
Actual operation	
↓	
Stop	Stop giving commands and stop operation. Other conditions that stop the servo motor are mentioned in sections 4.2.2, 4.3.2, and 4.4.2.

4.1.2 Wiring check

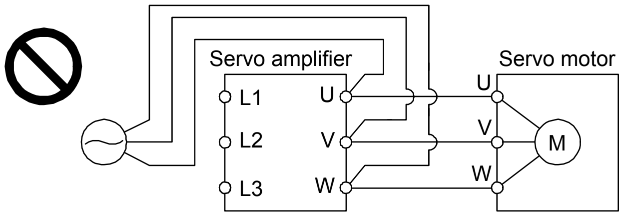
(1) Power supply system wiring
Before switching on the power supply, check the following items.

(a) Power supply system wiring
The power supplied to the power input terminals (L1, L2, and L3) of the servo amplifier should satisfy the defined specifications. (Refer to section 1.3.)

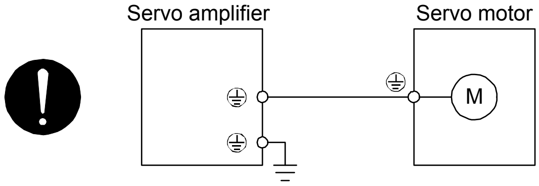
(b) Connection of servo amplifier and servo motor
1) The servo amplifier power output (U, V, and W) should match in phase with the servo motor power input terminals (U, V, and W).



2) The power supplied to the servo amplifier should not be connected to the power outputs (U, V, and W). Doing so will fail the connected servo amplifier and servo motor.



3) The grounding terminal of the servo motor is connected to the PE terminal of the servo amplifier.



4) The CN2 connector of the servo amplifier should be connected to the encoder of the servo motor securely using the encoder cable.

(c) When you use an option and peripheral equipment
1) When you use a regenerative option for 1 kW or less servo amplifiers
- The built-in regenerative resistor and wirings should be removed from the servo amplifier.
- The lead wire of built-in regenerative resistor connected to P+ terminal and C terminal should not be connected.
- The regenerative option should be connected to P+ terminal and C terminal.
- A twisted cable should be used. (Refer to section 11.2.4.)

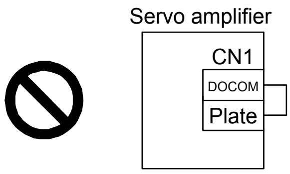
2) When you use a regenerative option for 2 kW or more servo amplifiers
- The lead wire between P+ terminal and D terminal should not be connected.
- The regenerative option should be connected to P+ terminal and C terminal.
- A twisted cable should be used. (Refer to section 11.2.4.)

(2) I/O signal wiring

(a) The I/O signals should be connected correctly.
Use DO forced output to forcibly turn on/off the pins of the CN1 connector. This function can be used to perform a wiring check. Switch off SON (Servo-on) to enable the function.
Refer to section 3.2 for details of I/O signal connection.

(b) A voltage exceeding 24 V DC is not applied to the pins of the CN1 connector.

(c) Between Plate and DOCOM of the CN1 connector should not be shorted.



4.1.3 Surrounding environment

(1) Cable routing

(a) The wiring cables should not be stressed.

(b) The encoder cable should not be used in excess of its bending life. (Refer to section 10.4.)

(c) The connector of the servo motor should not be stressed.

(2) Environment
Signal cables and power cables are not shorted by wire offcuts, metallic dust or the like.

4.2 Startup in position control mode

Make a startup in accordance with section 4.1. This section provides descriptions specific to the position control mode.

4.2.1 Power on and off procedures

(1) Power-on
Switch power on in the following procedure. Always follow this procedure at power-on.

1) Switch off SON (Servo-on).

2) Make sure that a command pulse train is not input.

3) Turn on the power.
When main circuit power/control circuit power is switched on, the display shows "C (Cumulative feedback pulses)", and in 2 s later, shows data.

(2) Power-off

1) Make sure that a command pulse train is not input.

2) Switch off SON (Servo-on).

3) Shut off the power.

4.2.2 Stop

If any of the following situations occurs, the servo amplifier suspends the running of the servo motor and brings it to a stop. Refer to section 3.10 for the servo motor with an electromagnetic brake.

Operation/command	Stopping condition
Switch off SON (Servo-on).	The base circuit is shut off and the servo motor coasts.
Alarm occurrence	The servo motor decelerates to a stop with the command. With some alarms, however, the dynamic brake operates to bring the servo motor to a stop. (Refer to chapter 8.)
EM2 (Forced stop 2) off	The servo motor decelerates to a stop with the command. [AL. E6 Servo forced stop warning] occurs. EM2 has the same function as EM1 in the torque control mode. Refer to section 3.5 for EM1.
LSP (Forward rotation stroke end) off, LSN (Reverse rotation stroke end) off	It will bring the motor to a sudden stop and make it servo-locked. It can be run in the opposite direction.

4.2.3 Test operation

Before starting actual operation, perform test operation to make sure that the machine operates normally.
Refer to section 4.2.1 for how to power on and off the servo amplifier.

Test operation of the servo motor alone in JOG operation of test operation mode

In this step, confirm that the servo amplifier and servo motor operate normally.
With the servo motor disconnected from the machine, use the test operation mode and check whether the servo motor correctly rotates at the slowest speed. Refer to section 4.5.9 for the test operation mode.

Test operation of the servo motor alone by commands

In this step, confirm that the servo motor correctly rotates at the slowest speed under the commands from the controller.
Make sure that the servo motor rotates in the following procedure.

1) Switch on EM2 (Forced stop 2) and SON (Servo-on). When the servo amplifier is put in a servo-on status, RD (Ready) switches on.
2) Switch on LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end).
3) When a pulse train is input from the controller, the servo motor starts rotating. Give a low speed command at first and check the rotation direction, etc. of the servo motor. If the machine does not operate in the intended direction, check the input signal.

Test operation with the servo motor and machine connected

In this step, connect the servo motor with the machine and confirm that the machine operates normally under the commands from the controller.
Make sure that the servo motor rotates in the following procedure.

1) Switch on EM2 (Forced stop 2) and SON (Servo-on). When the servo amplifier is put in a servo-on status, RD (Ready) switches on.
2) Switch on LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end).
3) When a pulse train is input from the controller, the servo motor starts rotating. Give a low speed command at first and check the operation direction, etc. of the machine. If the machine does not operate in the intended direction, check the input signal. In the status display, check for any problems of the servo motor speed, command pulse frequency, load ratio, etc.
4) Then, check automatic operation with the program of the controller.

4.2.4 Parameter setting

POINT

- The following encoder cables are of four-wire type. When using any of these encoder cables, set [Pr. PC22] to "1 _ _ _" to select the four-wire type. Incorrect setting will result in [AL. 16 Encoder initial communication error 1].

MR-EKCBL30M-L
MR-EKCBL30M-H
MR-EKCBL40M-H
MR-EKCBL50M-H

In the position control mode, the servo amplifier can be used by merely changing the basic setting parameters ([Pr. PA _ _]) mainly.
As necessary, set other parameters.

4.2.5 Actual operation

Start actual operation after confirmation of normal operation by test operation and completion of the corresponding parameter settings. Perform a home position return as necessary.

4.2.6 Trouble at start-up

CAUTION	●Never make a drastic adjustment or change to the parameter values as doing so will make the operation unstable.

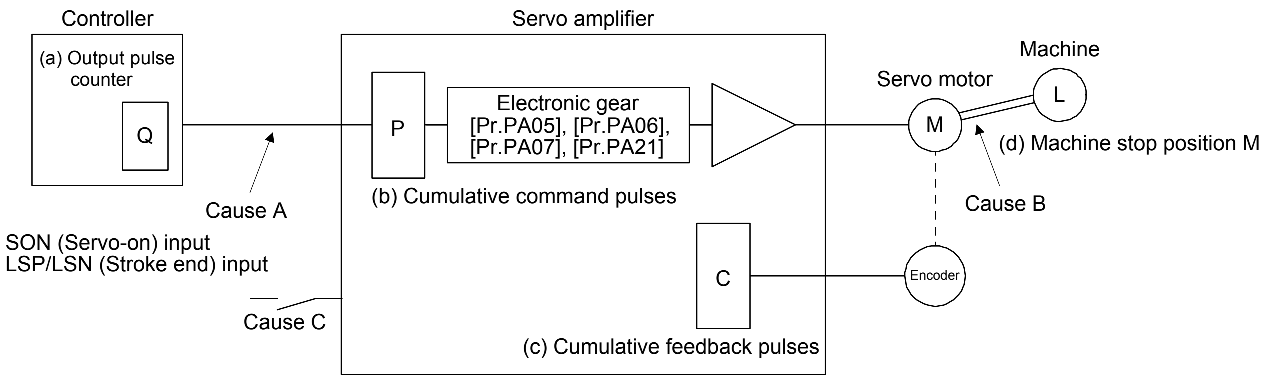
POINT
●Using the optional MR Configurator2, you can refer to reason for rotation failure, etc.

The following faults may occur at start-up. If any of such faults occurs, take the corresponding action.

(1) Troubleshooting

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on	・7-segment LED is not lit. ・7-segment LED flickers.	Not improved even if CN1 and CN2 connectors are disconnected.	1. Power supply voltage fault 2. The servo amplifier is malfunctioning.	
			Improved when CN1 connector is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when CN2 connector is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is malfunctioning.	
		Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8
2	Switch on SON (Servo-on).	Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8
		Servo motor shaft is not servo-locked. (Servo motor shaft is free.)	1. Check the display to see if the servo amplifier is ready to operate. 2. Check the external I/O signal indication (section 4.5.7) to see if SON (Servo-on) is on.	1. SON (Servo-on) is not input. (wiring mistake) 2. 24 V DC power is not supplied to DICOM.	Section 4.5.7
3	Input command pulse (test operation).	Servo motor does not rotate.	Check the cumulative command pulse on the status display (section 4.5.3).	1. Wiring mistake (a) For open collector pulse train input, 24 V DC power is not supplied to OPC. (b) LSP and LSN are not on. 2. Pulse is not input from the controller.	Section 4.5.3
				Mistake in setting of [Pr. PA13].	Chapter 5
		Servo motor run in reverse direction.		1. Mistake in wiring to controller. 2. Mistake in setting of [Pr. PA14].	
4	Gain adjustment	Rotation ripples (speed fluctuations) are large at low speed.	Make gain adjustment in the following procedure. 1. Increase the auto tuning response level. 2. Repeat acceleration and deceleration three times to complete auto tuning.	Gain adjustment fault	Chapter 6
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	If the servo motor may be driven with safety, repeat acceleration and deceleration three times to complete auto tuning.	Gain adjustment fault	Chapter 6
5	Cyclic operation	Position shift occurs	Confirm the cumulative command pulses, cumulative feedback pulses and actual servo motor position.	Pulse counting error, etc. due to noise.	(2) of this section

(2) How to find the cause of position shift



When a position shift occurs, check (a) output pulse counter Q, (b) cumulative command pulse P, (c) cumulative feedback pulse C, and (d) machine stop position M in the above diagram.
Also, Causes A, B, and C indicate the causes of position mismatch. For example, Cause A indicates that noise entered the wiring between the controller and servo amplifier, causing command input pulses to be miscounted.

In a normal status without position shift, there are the following relationships.

1) Q = P (Output counter = Cumulative command pulses)

2) When [Pr. PA21] is "0 _ _ _"

$$P \cdot \frac{\text{CMX [Pr. PA06]}}{\text{CDV [Pr. PA07]}} = C$$ (Cumulative command pulses × Electronic gear = Cumulative feedback pulses)

3) When [Pr. PA21] is "1 _ _ _"

$$P \cdot \frac{131072}{\text{FBP [Pr. PA05]}} = C$$

4) $C \cdot \Delta\ell = M$ (Cumulative feedback pulses × Travel distance per pulse = Machine position)

Check for a position mismatch in the following sequence.

1) When Q ≠ P
Noise entered the pulse train signal wiring between the controller and servo amplifier, causing command input pulses to be miscounted. (Cause A)
Make the following check or take the following measures.
・Check how the shielding is done.
・Change the open collector type to the differential line driver type.
・Run wiring away from the power circuit.
・Install a data line filter. (Refer to section 11.9 (2) (a).)
・Change the [Pr. PA13 Command pulse input form] setting.

2) When $P \cdot \frac{CMX}{CDV} \neq C$
   During operation, SON (Servo-on), LSP (Forward rotation stroke end), or LSN (Reverse rotation stroke end) was switched off; or CR (Clear) or RES (Reset) was switched on. (Cause C)

3) When $C \cdot \Delta\ell \neq M$
   Mechanical slip occurred between the servo motor and machine. (Cause B)

4.3 Startup in speed control mode

Make a startup in accordance with section 4.1. This section provides the methods specific to the speed control mode.

4.3.1 Power on and off procedures

(1) Power-on
Switch power on in the following procedure. Always follow this procedure at power-on.

1) Switch off SON (Servo-on).

2) Make sure that ST1 (Forward rotation start) and ST2 (Reverse rotation start) are off.

3) Turn on the power.
   When main circuit power/control circuit power is switched on, the display shows "r (Servo motor speed)", and in 2 s later, shows data.

(2) Power-off

1) Switch off ST1 (Forward rotation start) and ST2 (Reverse rotation start).

2) Switch off SON (Servo-on).

3) Shut off the power.

4.3.2 Stop

If any of the following situations occurs, the servo amplifier suspends the running of the servo motor and brings it to a stop.
Refer to section 3.10 for the servo motor with an electromagnetic brake.

Operation/command	Stopping condition
Switch off SON (Servo-on).	The base circuit is shut off and the servo motor coasts.
Alarm occurrence	The servo motor decelerates to a stop with the command. With some alarms, however, the dynamic brake operates to bring the servo motor to a stop. (Refer to chapter 8.)
EM2 (Forced stop 2) off	The servo motor decelerates to a stop with the command. [AL. E6 Servo forced stop warning] occurs. EM2 has the same function as EM1 in the torque control mode. Refer to section 3.5 for EM1.
LSP (Forward rotation stroke end) off, LSN (Reverse rotation stroke end) off	It will bring the motor to a sudden stop and make it servo-locked. It can be run in the opposite direction.
Simultaneous on or off of ST1 (Forward rotation start) and ST2 (Reverse rotation start)	The servo motor is decelerated to a stop.

4.3.3 Test operation

Before starting actual operation, perform test operation to make sure that the machine operates normally.
Refer to section 4.3.1 for how to power on and off the servo amplifier.

Test operation of the servo motor alone in JOG operation of test operation mode

In this step, confirm that the servo amplifier and servo motor operate normally.
With the servo motor disconnected from the machine, use the test operation mode and check whether the servo motor correctly rotates at the slowest speed. Refer to section 4.5.9 for the test operation mode.

↓

Test operation of the servo motor alone by commands

In this step, confirm that the servo motor correctly rotates at the slowest speed under the commands from the controller.
Make sure that the servo motor rotates in the following procedure.

1) Switch on EM2 (Forced stop 2) and SON (Servo-on). When the servo amplifier is put in a servo-on status, RD (Ready) switches on.
2) Switch on LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end).
3) When VC (Analog speed command) is input from the controller and ST1 (Forward rotation start) or ST2 (Reverse rotation start) is switched on, the servo motor starts rotating. Give a low speed command at first and check the rotation direction, etc. of the servo motor. If the machine does not operate in the intended direction, check the input signal.

↓

Test operation with the servo motor and machine connected

In this step, connect the servo motor with the machine and confirm that the machine operates normally under the commands from the controller.
Make sure that the servo motor rotates in the following procedure.

1) Switch on EM2 (Forced stop 2) and SON (Servo-on). When the servo amplifier is put in a servo-on status, RD (Ready) switches on.
2) Switch on LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end).
3) When VC (Analog speed command) is input from the controller and ST1 (Forward rotation start) or ST2 (Reverse rotation start) is switched on, the servo motor starts rotating. Give a low speed command at first and check the operation direction, etc. of the machine. If the machine does not operate in the intended direction, check the input signal. In the status display, check for any problems of the servo motor speed, load ratio, etc.
4) Then, check automatic operation with the program of the controller.

4.3.4 Parameter setting

POINT
●The following encoder cables are of four-wire type. When using any of these encoder cables, set [Pr. PC22] to "1 _ _ _" to select the four-wire type. Incorrect setting will result in [AL. 16 Encoder initial communication error 1]. MR-EKCBL30M-L MR-EKCBL30M-H MR-EKCBL40M-H MR-EKCBL50M-H

When using this servo in the speed control mode, change [Pr. PA01] setting to select the speed control mode. In the speed control mode, the servo can be used by merely changing the basic setting parameters ([Pr. PA _ _]) and extension setting parameters ([Pr. PC _ _]) mainly.
As necessary, set other parameters.

4.3.5 Actual operation

Start actual operation after confirmation of normal operation by test operation and completion of the corresponding parameter settings.

4.3.6 Trouble at start-up

CAUTION	●Never make a drastic adjustment or change to the parameter values as doing so will make the operation unstable.

POINT
●Using the optional MR Configurator2, you can refer to reason for rotation failure, etc.

The following faults may occur at start-up. If any of such faults occurs, take the corresponding action.

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on	・7-segment LED is not lit. ・7-segment LED flickers.	Not improved even if CN1 and CN2 connectors are disconnected.	1. Power supply voltage fault 2. The servo amplifier is malfunctioning.	
			Improved when CN1 connector is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when CN2 connector is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is malfunctioning.	
		Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8
2	Switch on SON (Servo-on).	Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8
		Servo motor shaft is not servo-locked. (Servo motor shaft is free.)	1. Check the display to see if the servo amplifier is ready to operate. 2. Check the external I/O signal indication (section 4.5.7) to see if SON (Servo-on) is on.	1. SON (Servo-on) is not input. (wiring mistake) 2. 24 V DC power is not supplied to DICOM.	Section 4.5.7
3	Switch on ST1 (Forward rotation start) or ST2 (Reverse rotation start).	Servo motor does not rotate.	Call the status display (section 4.5.3) and check the input voltage of VC (Analog speed command).	Analog speed command is 0 V.	Section 4.5.3
			Call the external I/O signal display (section 4.5.7) and check the on/off status of the input signal.	LSP, LSN, ST1, and ST2 are off.	Section 4.5.7
			Check the internal speed commands 1 to 7 ([Pr. PC05] to [Pr. PC11]).	Set value is 0.	Section 5.2.3
			Check the forward rotation torque limit ([Pr. PA11]) and the reverse rotation torque limit ([Pr. PA12]).	Torque limit level is too low as compared to the load torque.	Section 5.2.1
			When TLA (Analog torque limit) is usable, check the input voltage on the status display.	Torque limit level is too low as compared to the load torque.	Section 4.5.3

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
4	Gain adjustment	Rotation ripples (speed fluctuations) are large at low speed.	Make gain adjustment in the following procedure. 1. Increase the auto tuning response level. 2. Repeat acceleration and deceleration three times to complete auto tuning.	Gain adjustment fault	Chapter 6
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	If the servo motor may be driven with safety, repeat acceleration and deceleration three times to complete auto tuning.	Gain adjustment fault	Chapter 6

4.4 Startup in torque control mode

Make a startup in accordance with section 4.1. This section provides the methods specific to the torque control mode.

4.4.1 Power on and off procedures

(1) Power-on
Switch power on in the following procedure. Always follow this procedure at power-on.

1) Switch off SON (Servo-on).

2) Make sure that RS1 (Forward rotation selection) and RS2 (Reverse rotation selection) are off.

3) Turn on the power.
Data is displayed in 2 s after "U" (Analog torque command) is displayed.

(2) Power-off
1) Switch off RS1 (Forward rotation selection) or RS2 (Reverse rotation selection).

2) Switch off SON (Servo-on).

3) Shut off the power.

4.4.2 Stop

If any of the following situations occurs, the servo amplifier suspends the running of the servo motor and brings it to a stop. Refer to section 3.10 for the servo motor with an electromagnetic brake.

Operation/command	Stopping condition
Switch off SON (Servo-on).	The base circuit is shut off and the servo motor coasts.
Alarm occurrence	The servo motor decelerates to a stop with the command. With some alarms, however, the dynamic brake operates to bring the servo motor to a stop. (Refer to chapter 8.)
EM2 (Forced stop 2) off	This stops the servo motor with the dynamic brake. [AL. E6 Servo forced stop warning] occurs. EM2 has the same function as EM1 in the torque control mode. Refer to section 3.5 for EM1.
Simultaneous on or off of RS1 (Forward rotation selection) and RS2 (Reverse rotation selection)	The servo motor coasts.

4.4.3 Test operation

Before starting actual operation, perform test operation to make sure that the machine operates normally. Refer to section 4.4.1 for how to power on and off the servo amplifier.

Test operation of the servo motor alone in JOG operation of test operation mode

In this step, confirm that the servo amplifier and servo motor operate normally.
With the servo motor disconnected from the machine, use the test operation mode and check whether the servo motor correctly rotates at the slowest speed. Refer to section 4.5.9 for the test operation mode.

↓

Test operation of the servo motor alone by commands

In this step, confirm that the servo motor correctly rotates at the slowest speed under the commands from the controller.
Make sure that the servo motor rotates in the following procedure.

1) Switch on SON (Servo-on). When the servo amplifier is put in a servo-on status, RD (Ready) switches on.
2) When TC (Analog speed command) is input from the controller and RS1 (Forward rotation start) or RS2 (Reverse rotation start) is switched on, the servo motor starts rotating. Give a low torque command at first and check the rotation direction, etc. of the servo motor. If the machine does not operate in the intended direction, check the input signal.

↓

Test operation with the servo motor and machine connected

In this step, connect the servo motor with the machine and confirm that the machine operates normally under the commands from the controller.
Make sure that the servo motor rotates in the following procedure.

1) Switch on SON (Servo-on). When the servo amplifier is put in a servo-on status, RD (Ready) switches on.
2) When TC (Analog speed command) is input from the controller and RS1 (Forward rotation start) or RS2 (Reverse rotation start) is switched on, the servo motor starts rotating. Give a low torque command at first and check the operation direction, etc. of the machine. If the machine does not operate in the intended direction, check the input signal. In the status display, check for any problems of the servo motor speed, load ratio, etc.
3) Then, check automatic operation with the program of the controller.

4.4.4 Parameter setting

POINT
● The following encoder cables are of four-wire type. When using any of these encoder cables, set [Pr. PC22] to "1 _ _ _" to select the four-wire type. Incorrect setting will result in [AL. 16 Encoder initial communication error 1]. MR-EKCBL30M-L MR-EKCBL30M-H MR-EKCBL40M-H MR-EKCBL50M-H

When using this servo in the torque control mode, change [Pr. PA01] setting to select the torque control mode. In the torque control mode, the servo can be used by merely changing the basic setting parameters ([Pr. PA _ _]) and extension setting parameters ([Pr. PC _ _]) mainly.
As necessary, set other parameters.

4.4.5 Actual operation

Start actual operation after confirmation of normal operation by test operation and completion of the corresponding parameter settings.

4.4.6 Trouble at start-up

CAUTION	●Never make a drastic adjustment or change to the parameter values as doing so will make the motion unstable.

POINT
●Using the optional MR Configurator2, you can refer to reason for rotation failure, etc.

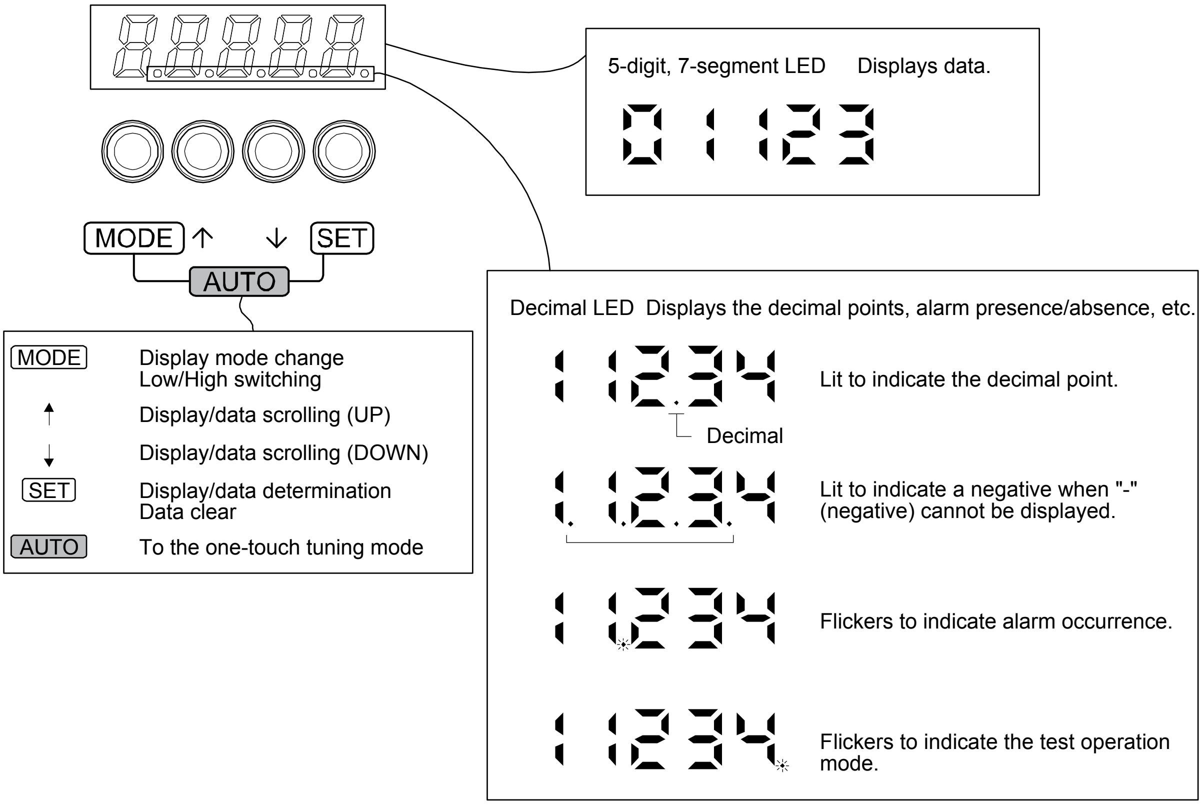
The following faults may occur at start-up. If any of such faults occurs, take the corresponding action.

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on	・7-segment LED is not lit. ・7-segment LED flickers.	Not improved even if CN1 and CN2 connectors are disconnected.	1. Power supply voltage fault 2. The servo amplifier is malfunctioning.	
			Improved when CN1 connector is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when CN2 connector is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is malfunctioning.	
		Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8
2	Switch on SON (Servo-on).	Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8
		Servo motor shaft is free.	Call the external I/O signal display (section 4.5.7) and check the on/off status of the input signal.	1. SON (Servo-on) is not input. (wiring mistake) 2. 24 V DC power is not supplied to DICOM.	Section 4.5.7
3	Switch on RS1 (Forward rotation start) or RS2 (Reverse rotation start).	Servo motor does not rotate.	Call the status display (section 4.5.3) and check the input voltage of TC (Analog torque command).	Analog torque command is 0 V.	Section 4.5.3
			Call the external I/O signal display (section 4.5.7) and check the on/off status of the input signal.	RS1 and RS2 are off.	Section 4.5.7
			Check the internal speed limit 1 to 7 ([Pr. PC05] to [Pr. PC11]).	Set value is 0.	Section 5.2.3
			Check the analog torque command maximum output ([Pr. PC13]) value.	Torque command level is too low as compared to the load torque.	Section 5.2.3
			Check the forward rotation torque limit ([Pr. PA11]) and the reverse rotation torque limit ([Pr. PA12]).	Set value is 0.	Section 5.2.1

4.5 Display and operation sections

4.5.1 Summary

The MR-JE-A servo amplifier has the display section (5-digit, 7-segment LED) and operation section (4 pushbuttons) for servo amplifier status display, alarm display, parameter setting, etc. Push the "MODE" and "SET" buttons at the same time for 3 s or more to switch to the one-touch tuning mode.
The operation section and display data are described below.



4.5.2 Display flowchart

Press the "MODE" button once to shift to the next display mode. Refer to section 4.5.3 and later for the description of the corresponding display mode.
To refer to and set the gain/filter parameters, extension setting parameters and I/O setting parameters, enable them with [Pr. PA19 Parameter writing inhibit].

Display mode transition	Initial screen	Function	Reference
Status display	C	Servo status display. C appears at power-on. (Note)	Section 4.5.3
One-touch tuning	Auto	One-touch tuning Select this when performing the one-touch tuning.	Section 6.2
Diagnosis	rd-oF	Sequence display, external signal display, output signal (DO) forced output, test operation, software version display, VC automatic offset, servo motor series ID display, servo motor type ID display, servo motor encoder ID display, drive recorder enabled/disabled display.	Section 4.5.4
Alarms	AL---.	Current alarm display, alarm history display, parameter error number display.	Section 4.5.5
Basic setting parameters	P A01	Display and setting of basic setting parameters.	Section 4.5.6
Gain/filter parameters	P b01	Display and setting of gain/filter parameters.	
Extension setting parameters	P C01	Display and setting of extension setting parameters.	
I/O setting parameters	P d01	Display and setting of I/O setting parameters.	
Extension setting 2 parameters	P E01	Display and setting of extension setting 2 parameters.	
Extension setting 3 parameters	P F01	Display and setting of extension setting 3 parameters.	

Button MODE

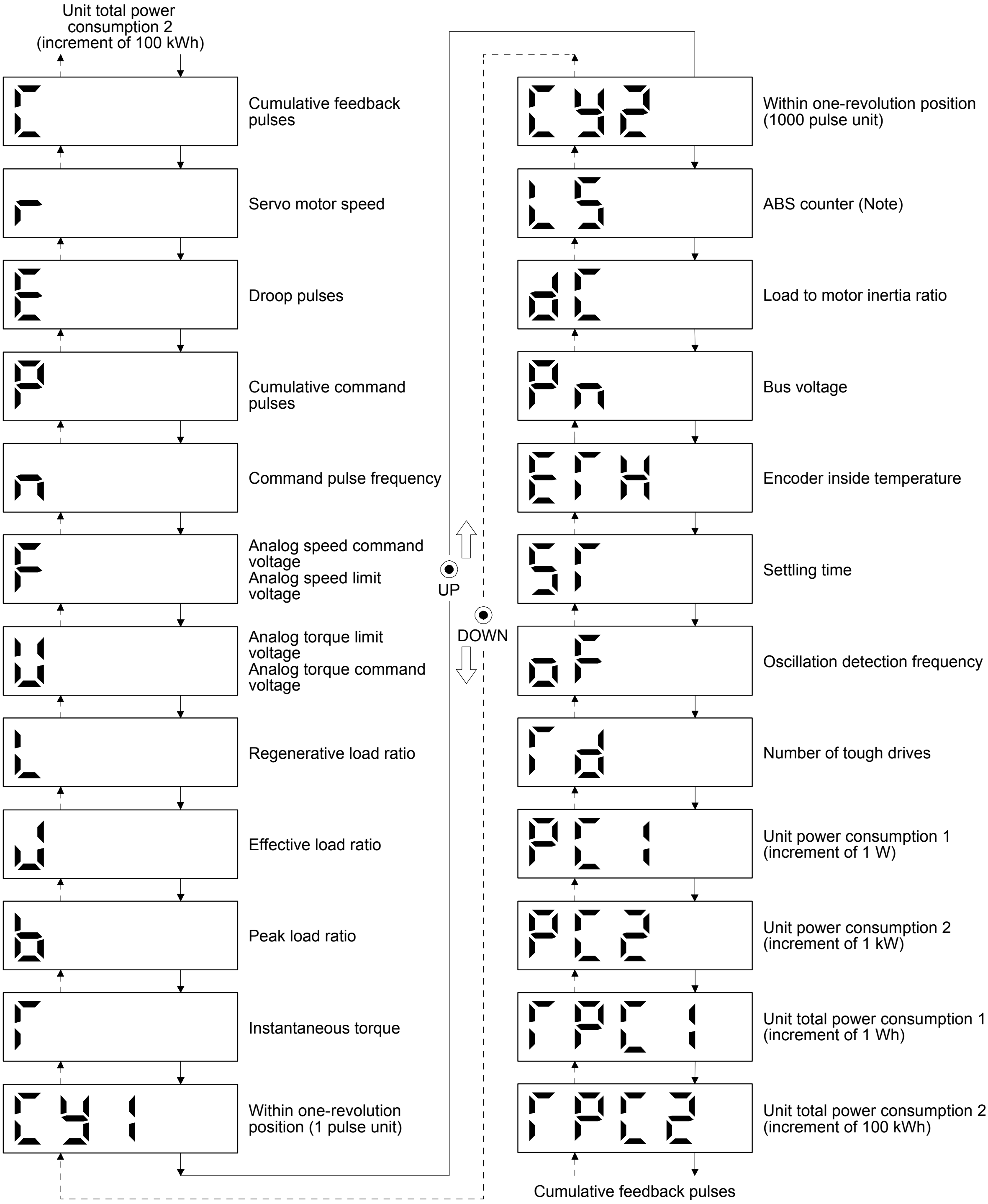
Note. When the axis name is set to the servo amplifier using MR Configurator2, the axis name is displayed and the servo status is then displayed.

4.5.3 Status display mode

The servo status during operation is shown on the 5-digit, 7-segment LED display. Press the "UP" or "DOWN" button to change display data as desired. When the required data is selected, the corresponding symbol is displayed. Press the "SET" button to display that data. At only power-on, however, data appears after the symbol of the status display selected in [Pr. PC36] has been shown for 2 s.

(1) Display transition

After selecting the status display mode with the "MODE" button, pressing the "UP" or "DOWN" button changes the display as shown below.



Note. Travel distance from power on is displayed by counter value.

(2) Display examples

The following table shows the display examples.

Item	Status	Displayed data Servo amplifier display
Servo motor speed	Forward rotation at 2500 r/min	2500
	Reverse rotation at 3000 r/min	-3000 Reverse rotation is indicated by "- ".
Load to motor inertia ratio	7.00 times	7.00
Cumulative feedback pulses	11252 pulses	11252
	-12566 pulses	1.2.5.6.6 Lit Negative value is indicated by the lit decimal points in the upper four digits.

(3) Status display list

The following table lists the servo statuses that may be shown. Refer to appendix 5 for the measurement point.

Status display	Symbol	Unit	Description
Cumulative feedback pulses	C	pulse	Feedback pulses from the servo motor encoder are counted and displayed. The values in excess of ±99999 can be counted. However, the counter shows only the lower five digits of the actual value since the servo amplifier display is five digits. Press the "SET" button to reset the display value to zero. The value of minus is indicated by the lit decimal points in the upper four digits.
Servo motor speed	r	r/min	The servo motor speed is displayed. It is displayed rounding off 0.1 r/min unit.
Droop pulses	E	pulse	The number of droop pulses in the deviation counter are displayed. The decimal points in the upper four digits are lit for reverse rotation pulses. The values in excess of ±99999 can be counted. However, the counter shows only the lower five digits of the actual value since the servo amplifier display is five digits. The number of pulses displayed is in the encoder pulse unit.
Cumulative command pulses	P	pulse	Position command input pulses are counted and displayed. As the value displayed is not yet multiplied by the electronic gear (CMX/CDV), it may not match the indication of the cumulative feedback pulses. The values in excess of ±99999 can be counted. However, the counter shows only the lower five digits of the actual value since the servo amplifier display is five digits. Press the "SET" button to reset the display value to zero. When the servo motor is rotating in the reverse direction, the decimal points in the upper four digits are lit.
Command pulse frequency	n	kpulse/s	The frequency of position command input pulses is counted and displayed. The value displayed is not multiplied by the electronic gear (CMX/CDV).
Analog speed command voltage Analog speed limit voltage	F	V	1) Torque control mode Input voltage of VLA (Analog speed limit) voltage is displayed. 2) Speed control mode Input voltage of VC (Analog speed command) voltage is displayed
Analog torque command voltage Analog torque limit voltage	U	V	1) Position control mode and speed control mode Voltage of TLA (Analog torque limit) voltage is displayed. 2) Torque control mode Voltage of TC (Analog torque command) voltage is displayed.
Regenerative load ratio	L	%	The ratio of regenerative power to permissible regenerative power is displayed in %.
Effective load ratio	J	%	The continuous effective load current is displayed. The effective value in the past 15 s is displayed relative to the rated current of 100 %.
Peak load ratio	b	%	The maximum occurrence torque is displayed. The highest value in the past 15 s is displayed relative to the rated current of 100 %.
Instantaneous torque	T	%	The instantaneous occurrence torque is displayed. The value of torque being occurred is displayed in real time considering a rated torque as 100%.
Within one-revolution position (1 pulse unit)	Cy1	pulse	Position within one revolution is displayed in encoder pulses. The values in excess of ±99999 can be counted. However, the counter shows only the lower five digits of the actual value since the servo amplifier display is five digits. When the servo motor rotates in the CCW direction, the value is added.
Within one-revolution position (1000 pulses unit)	Cy2	1000 pulses	The within one-revolution position is displayed in 1000 pulse increments of the encoder. When the servo motor rotates in the CCW direction, the value is added.
ABS counter	LS	rev	Travel distance from power on is displayed by counter value.
Load to motor inertia ratio	dC	Multiplier	The estimated ratio of the load inertia moment to the servo motor shaft inertia moment is displayed.

Status display	Symbol	Unit	Description
Bus voltage	Pn	V	The voltage of main circuit converter (between P+ and N-) is displayed.
Encoder inside temperature	ETh	°C	Inside temperature of encoder detected by the encoder is displayed.
Settling time	ST	ms	Settling time is displayed. When it exceeds 1000 ms, "1000" will be displayed.
Oscillation detection frequency	oF	Hz	Frequency at the time of oscillation detection is displayed.
Number of tough drive operations	Td	times	The number of tough drive functions activated is displayed.
Unit power consumption 1 (increment of 1 W)	PC1	W	Unit power consumption is displayed by increment of 1 W. Positive value indicate power running, and negative value indicate regeneration. The values in excess of ±99999 can be counted. However, the counter shows only the lower five digits of the actual value since the servo amplifier display is five digits.
Unit power consumption 2 (increment of 1 kW)	PC2	kW	Unit power consumption is displayed by increment of 1 kW. Positive value indicate power running, and negative value indicate regeneration.
Unit total power consumption 1 (increment of 1 Wh)	TPC1	Wh	Unit total power consumption is displayed by increment of 1 Wh. Positive value is cumulated during power running and negative value during regeneration. The values in excess of ±99999 can be counted. However, the counter shows only the lower five digits of the actual value since the servo amplifier display is five digits.
Unit total power consumption 2 (increment of 100 kWh)	TPC2	100 kWh	Unit total power consumption is displayed by increment of 100 kWh. Positive value is cumulated during power running and negative value during regeneration.

(4) Changing the status display screen

The status display item of the servo amplifier display shown at power-on can be changed by changing [Pr. PC36] settings. The item displayed in the initial status changes with the control mode as follows.

Control mode	Status display
Position	Cumulative feedback pulses
Position/speed	Cumulative feedback pulses/servo motor speed
Speed	Servo motor speed
Speed/torque	Servo motor speed/analog torque command voltage
Torque	Analog torque command voltage
Torque/position	Analog torque command voltage/cumulative feedback pulses

4.5.4 Diagnostic mode

<table>
<tr><th colspan="2">Name</th><th>Display</th><th>Description</th></tr>
<tr><td colspan="2" rowspan="2">Sequence</td><td>rd-oF</td><td>Not ready
Indicates that the servo amplifier is being initialized or an alarm has occurred.</td></tr>
<tr><td>rd-on</td><td>Ready
Indicates that the servo was switched on after completion of initialization and the servo amplifier is ready to operate.</td></tr>
<tr><td colspan="2" rowspan="2">Drive recorder enabled/disabled display</td><td>d-on</td><td>Drive recorder enabled
When an alarm occurs in the status, the drive recorder will operate and write the status of occurrence.</td></tr>
<tr><td>d-oF</td><td>Drive recorder disabled
The drive recorder will not operate on the following conditions.
1. You are using the graph function of MR Configurator2.
2. You are using the machine analyzer function.
3. [Pr. PF21] is set to "-1".</td></tr>
<tr><td colspan="2">External I/O signal display</td><td>Refer to section 4.5.7.</td><td>This Indicates the on/off status of external I/O signal.
The upper segments correspond to the input signals and the lower segments to the output signals.</td></tr>
<tr><td colspan="2">Output signal (DO) forced output</td><td>do-on</td><td>This allows digital output signal to be switched on/off forcibly.
For details, refer to section 4.5.8.</td></tr>
<tr><td rowspan="6">Test operation mode</td><td>JOG operation</td><td>TEST1</td><td>JOG operation can be performed when there is no command from an external controller.
For details, refer to section 4.5.9 (2).</td></tr>
<tr><td>Positioning operation</td><td>TEST2</td><td>Positioning operation can be performed when there is no command from an external controller.
MR Configurator2 is required to perform positioning operation.
For details, refer to section 4.5.9 (3).</td></tr>
<tr><td>Motor-less operation</td><td>TEST3</td><td>Without connecting the servo motor, this test operation mode enables to output signals and check the status display in response to the input device as if the servo motor is actually running.
For details, refer to section 4.5.9 (4).</td></tr>
<tr><td>Machine analyzer operation</td><td>TEST4</td><td>Merely connecting the servo amplifier allows the resonance point of the mechanical system to be measured.
MR Configurator2 is required to perform machine analyzer operation.
Refer to section 11.4 for details.</td></tr>
<tr><td>For manufacturer adjustment</td><td>TEST5</td><td>This is for manufacturer adjustment.</td></tr>
<tr><td>For manufacturer adjustment.</td><td>TEST6</td><td>This is for manufacturer adjustment.</td></tr>
</table>

Name	Display	Description
Software version - Lower	-A0	Indicates the version of the software.
Software version - Upper	- 100	Indicates the system number of the software.
Automatic VC offset	H1 0	If offset voltages in the analog circuits inside and outside the servo amplifier cause the servo motor to rotate slowly at VC (Analog speed command) or VLA (Analog speed limit) of 0 V, this function automatically makes zero-adjustment of offset voltages. When using this function, enable the function in the following procedure. When it is enabled, [Pr. PC37] value changes to the automatically adjusted offset voltage. 1) Push "SET" once. 2) Set the number in the first digit to 1 with "UP". 3) Push "SET". This function cannot be used if the input voltage of VC or VLA is -0.4 V or less, or +0.4 V or more. (Note)
Servo motor series ID	H2 0	Push the "SET" button to show the series ID of the servo motor currently connected. For indication details, refer to appendix 1 of "HG-KN/HG-SN servo Motor Instruction Manual".
Servo motor type ID	H3 0	Push the "SET" button to show the type ID of the servo motor currently connected. For indication details, refer to appendix 1 of "HG-KN/HG-SN servo Motor Instruction Manual".
Servo motor encoder ID	H4 0	Push the "SET" button to show the encoder ID of the servo motor currently connected. For indication details, refer to appendix 1 of "HG-KN/HG-SN servo Motor Instruction Manual".
For manufacturer adjustment	H5 0	This is for manufacturer adjustment.
For manufacturer adjustment	H6 0	This is for manufacturer adjustment.

Note. Even if Automatic VC offset is performed and 0 V is input, the servo motor may not completely stop due to an internal error. To completely stop the servo motor, switch off ST1 or ST2.

4.5.5 Alarm mode

The current alarm, past alarm history and parameter error are displayed. The lower 3 digits on the display indicate the alarm number that has occurred or the parameter number in error.

Name	Display	Description
Current alarm	AL---	Indicates no occurrence of an alarm.
	AL33.1	Indicates the occurrence of [AL. 33.1 Main circuit voltage error]. Flickers at alarm occurrence.
Alarm history	A050.1	Indicates that the last alarm is [AL. 50.1 Thermal overload error 1 during operation].
	A133.1	Indicates the second last alarm is [AL. 33.1 Main circuit voltage error].
	A210.1	Indicates the third last alarm is [AL. 10.1 Voltage drop in the power].
	⋮	⋮
	A9---	Indicates that there is no tenth alarm in the past.
	AA---	Indicates that there is no eleventh alarm in the past.
	Ab---	Indicates that there is no twelfth alarm in the past.
	⋮	⋮
	AF---	Indicates that there is no sixteenth alarm in the past.
Parameter error No.	E --	This indicates no occurrence of [AL. 37 Parameter error].
	E A12	The data content error of [Pr. PA12 Reverse rotation torque limit].

Functions at occurrence of an alarm

(1) Any mode screen displays the current alarm.

(2) Even during alarm occurrence, the other screen can be viewed by pressing the button in the operation area. At this time, the decimal point in the fourth digit remains flickering.

(3) For any alarm, remove its cause and clear it in any of the following methods. (Refer to chapter 8 for the alarms that can be cleared.)

(a) Switch power off, then on.

(b) Push the "SET" button on the current alarm screen.

(c) Turn on RES (Reset).

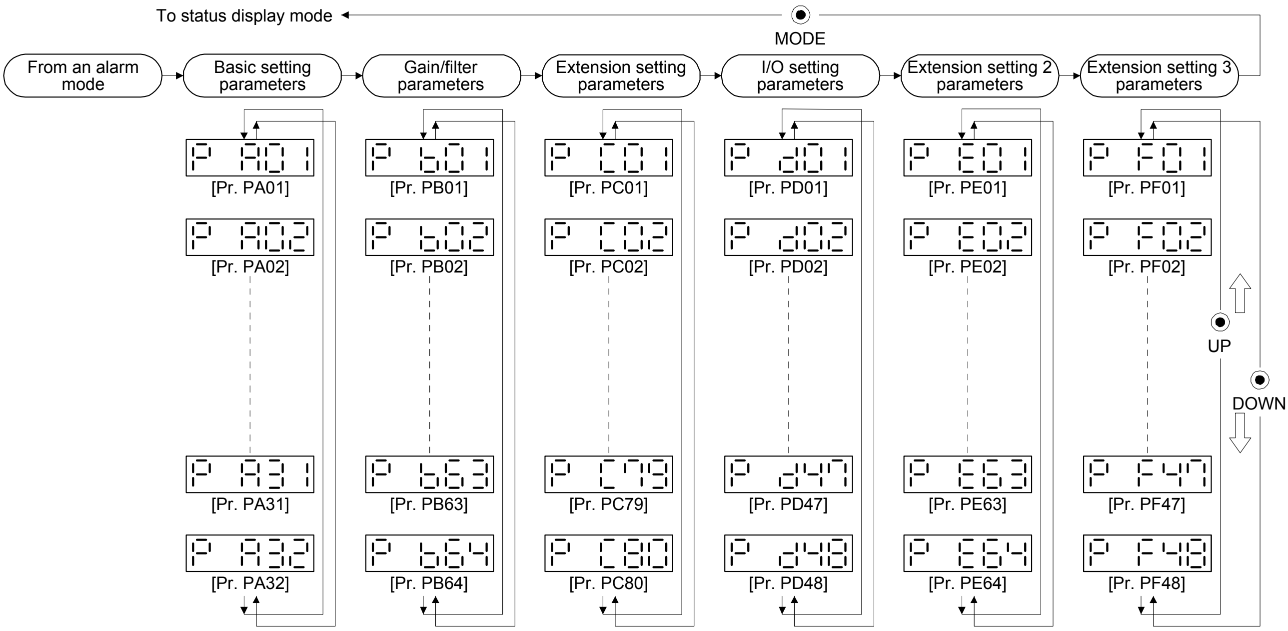
(4) Use [Pr. PC18] to clear the alarm history.

(5) Push "UP" or "DOWN" to move to the next history.

4.5.6 Parameter mode

(1) Parameter mode transition

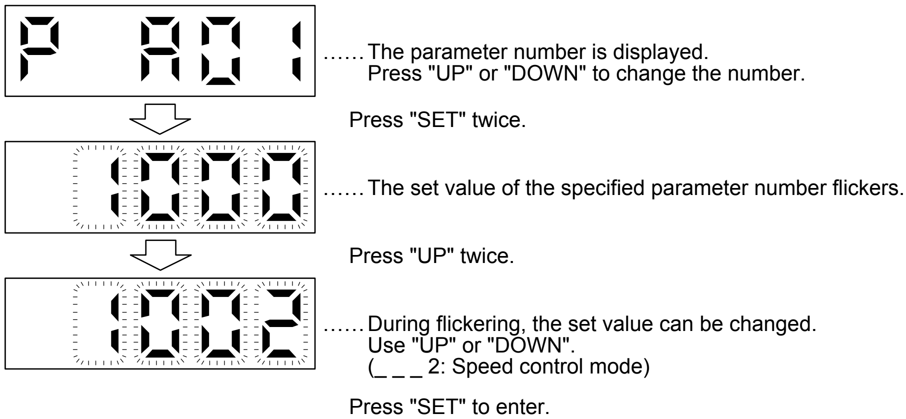
After selecting the corresponding parameter mode with the "MODE" button, pushing the "UP" or "DOWN" button changes the display as shown below.



(2) Operation example

(a) Parameters of 5 or less digits

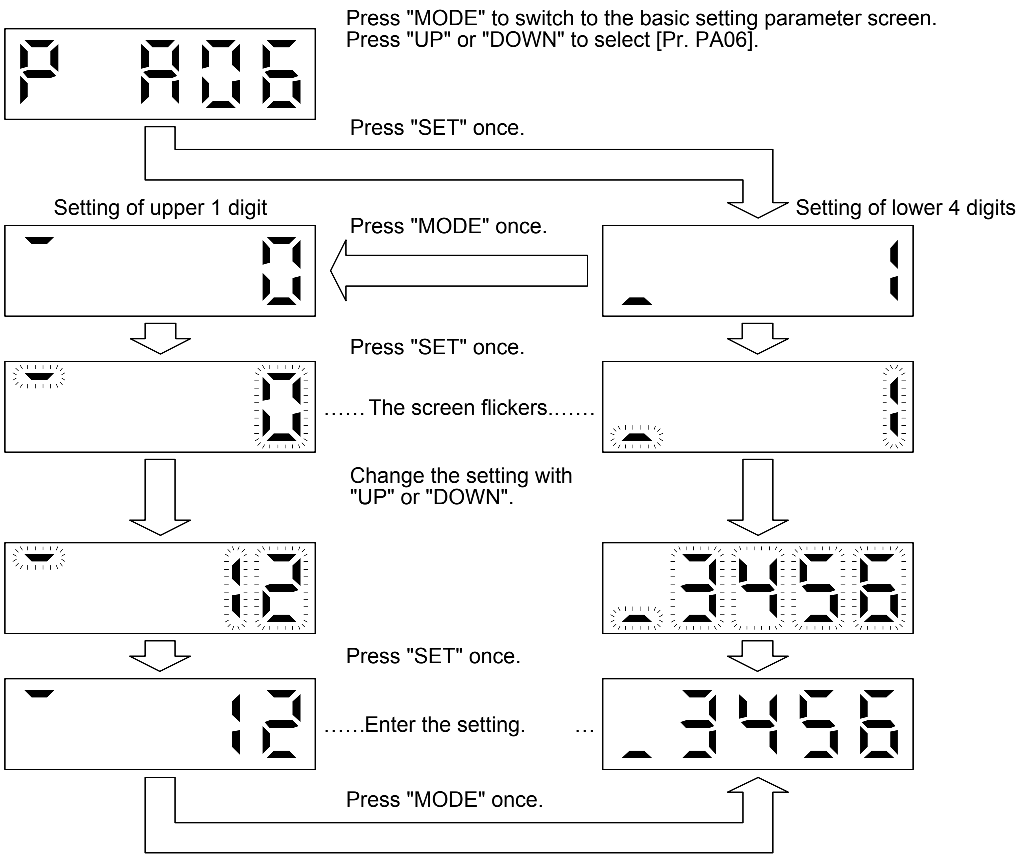
The following example shows the operation procedure performed after power-on to change the control mode to the speed control mode with [Pr. PA01 Operation mode]. Press "MODE" to switch to the basic setting parameter screen.



To shift to the next parameter, press the "UP" or "DOWN" button.
When changing the [Pr. PA01] setting, change its set value, then switch power off once and switch it on again to enable the new value.

(b) Parameters of 6 or more digits

The following example gives the operation procedure to change the electronic gear numerator to "123456" with [Pr. PA06 Electronic gear numerator].



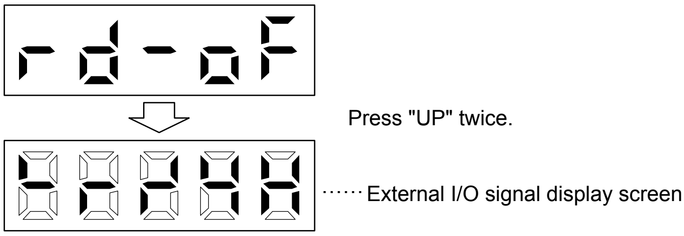
4.5.7 External I/O signal display

POINT
●The I/O signal settings can be changed using the I/O setting parameters [Pr. PD03] to [Pr. PD28].

The on/off states of the digital I/O signals connected to the servo amplifier can be confirmed.

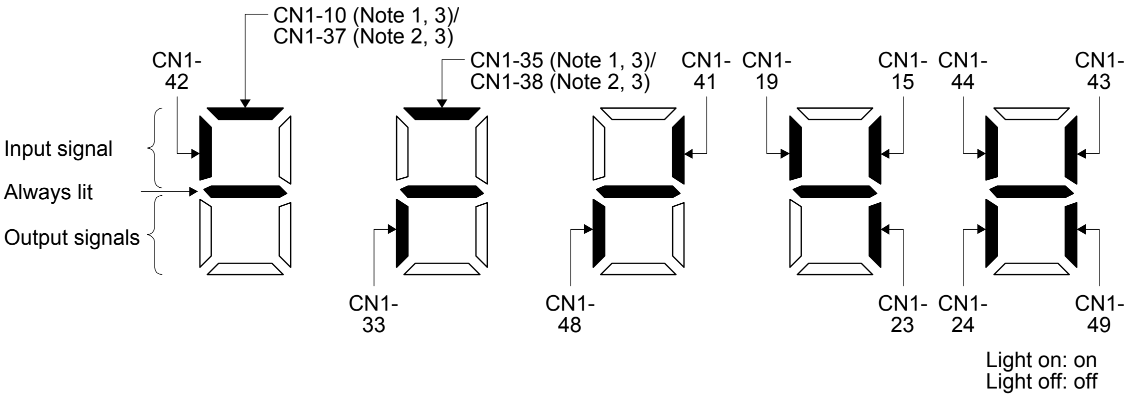
(1) Operation

The display screen at power-on. Using the "MODE" button, display the diagnostic screen.



(2) Display definition

The 7-segment LED segments and CN1 connector pins correspond as shown below.



Note 1. This is available with servo amplifiers with software version B7 or later.
2. This is available with servo amplifiers having software version B7 or later, and manufactured in May, 2015 or later.
3. The CN1-10 pin and the CN1-37 pin are mutually exclusive as well as the CN1-35 pin and the CN1-38 pin.

The LED segment corresponding to the pin is lit to indicate on, and is extinguished to indicate off.
The signals corresponding to the pins in the respective control modes are indicated below.

(a) Control modes and I/O signals

Connector	Pin No.	Signal input/output (Note 1) I/O	(Note 2) Symbols of I/O signals in control modes						Related parameter
			P	P/S	S	S/T	T	T/P	
CN1	10	I	PP	PP/-	(Note 4)	(Note 4)	(Note 4)	-/PP	Pr. PD43/Pr. PD44 (Note 3)
	15	I	SON	SON	SON	SON	SON	SON	Pr. PD03/Pr. PD04
	16								
	17								
	18								
	19	I	RES	RES/ST1	ST1	ST1/RS2	RS2	RS2/RES	Pr. PD11/Pr. PD12
	22								
	23	O	ZSP	ZSP	ZSP	ZSP	ZSP	ZSP	Pr. PD24
	24	O	INP	INP/SA	SA	SA/-		-/INP	Pr. PD25
	25								
	33	O	OP	OP	OP	OP	OP	OP	
	35	I	NP	NP/-	(Note 4)	(Note 4)	(Note 4)	-/NP	Pr. PD45/Pr. PD46 (Note 3)
	37 (Note 6)	I	PP2	PP2/-	(Note 5)	(Note 5)	(Note 5)	-/PP2	Pr. PD43/Pr. PD44 (Note 3)
	38 (Note 6)	I	NP2	NP2/-	(Note 5)	(Note 5)	(Note 5)	-/NP2	Pr. PD45/Pr. PD46 (Note 3)
	41	I	CR	CR/ST2	ST2	ST2/RS1	RS1	RS1/CR	Pr. PD13/Pr. PD14
	42	I	EM2	EM2	EM2	EM2	EM2	EM2	
	43	I	LSP	LSP	LSP	LSP/-		-/LSP	Pr. PD17/Pr. PD18
	44	I	LSN	LSN	LSN	LSN/-		-/LSN	Pr. PD19/Pr. PD20
	45								
	48	O	ALM	ALM	ALM	ALM	ALM	ALM	
	49	O	RD	RD	RD	RD	RD	RD	Pr. PD28

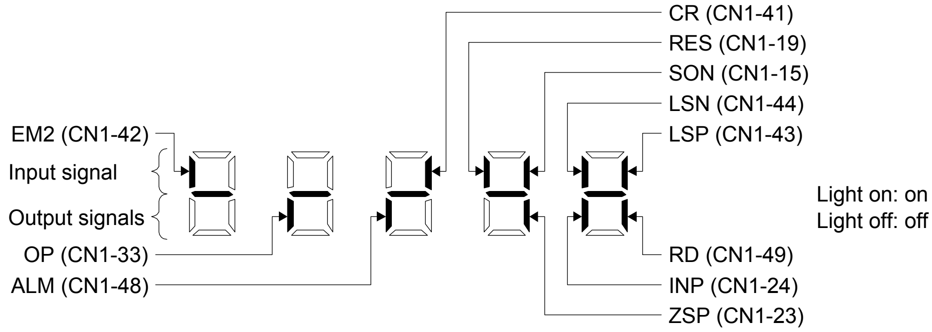
Note 1. I: input signal, O: output signal
2. P: position control mode, S: speed control mode, T: torque control mode
P/S: position/speed control switching mode, S/T: speed/torque control switching mode, T/P: torque/position switching mode
3 This is available with servo amplifiers with software version B7 or later.
4. This is used with sink interface. Input signals are not assigned by default. Assign the input devices with [Pr. PD43] to [Pr. PD46] as necessary. In addition, supply + of 24 DC V to the CN1-12 pin of OPC (power input for open-collector sink interface). This is available with servo amplifiers with software version B7 or later.
5. This is used with source interface. Input signals are not assigned by default. Assign the input devices with [Pr. PD43] to [Pr. PD46] as necessary.
6. These pins are available with servo amplifiers having software version B7 or later, and manufactured in May, 2015 or later.

(b) Symbol and signal names

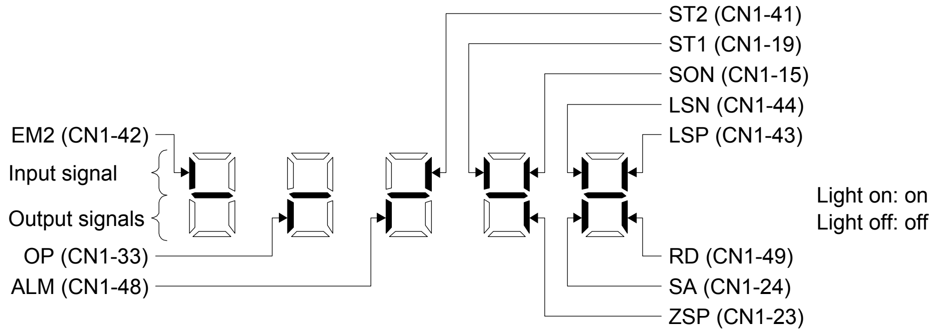
Symbol	Signal name	Symbol	Signal name
SON	Servo-on	RES	Reset
LSP	Forward rotation stroke end	EM2	Forced stop 2
LSN	Reverse rotation stroke end	LOP	Control switching
CR	Clear	TLC	Limiting torque
SP1	Speed selection 1	VLC	Limiting speed
SP2	Speed selection 2	RD	Ready
PC	Proportion control	ZSP	Zero speed detection
ST1	Forward rotation start	INP	In-position
ST2	Reverse rotation start	SA	Speed reached
RS1	Forward rotation selection	ALM	Malfunction
RS2	Reverse rotation selection	OP	Encoder Z-phase pulse (open collector)
TL	External torque limit selection		

(3) Display data at initial values

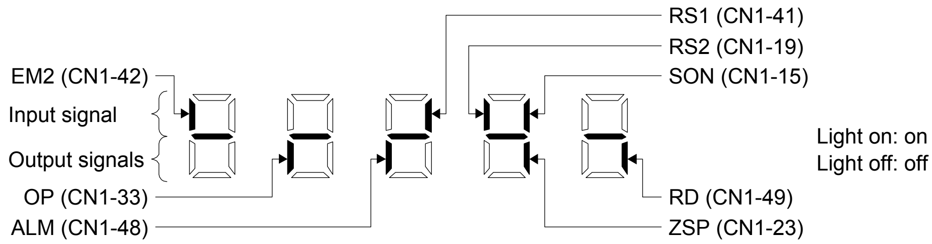
(a) Position control mode



(b) Speed control mode



(c) Torque control mode



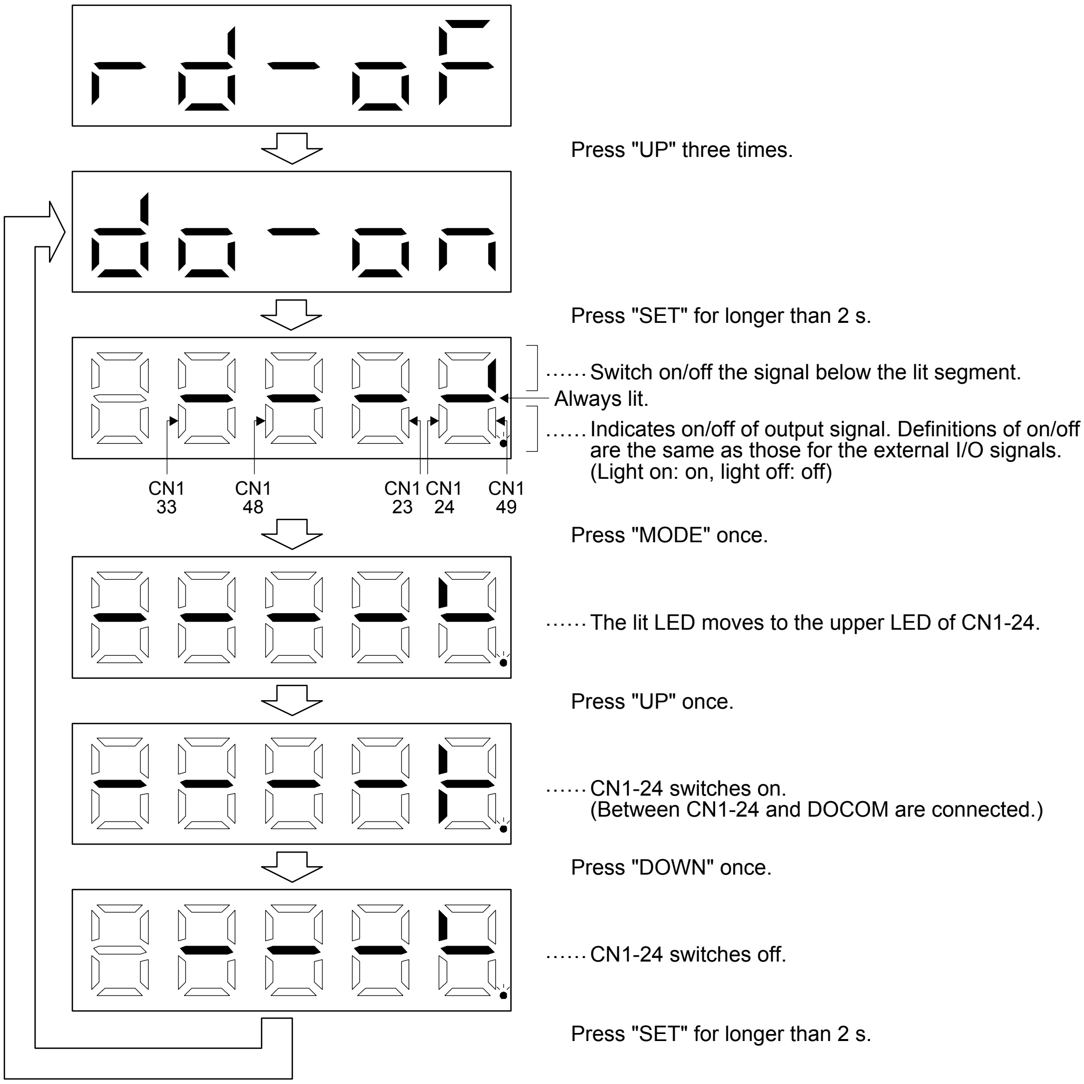
4.5.8 Output signal (DO) forced output

POINT
●When the servo system is used in a vertical lift application, turning on MBR (Electromagnetic brake interlock) by the DO forced output after assigning it to connector CN1 will release the electromagnetic brake, causing a drop. Take drop preventive measures on the machine side.

Output signals can be switched on/off forcibly independently of the servo status. Use this function for output signal wiring check, etc. This operation must be performed in the servo off state by turning off SON (Servo-on).

Operation

The display screen at power-on. Using the "MODE" button, display the diagnostic screen.



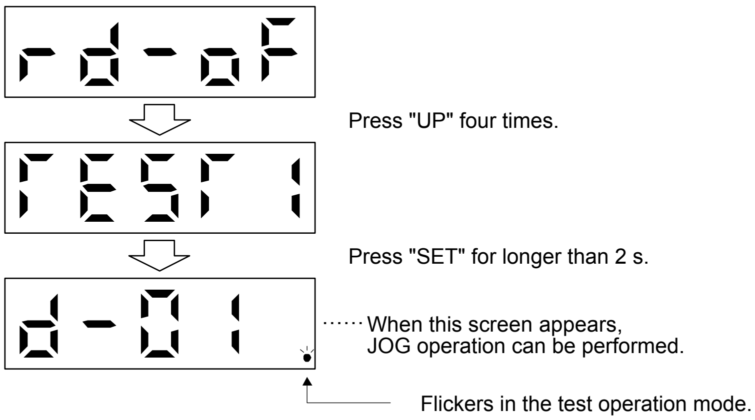
4.5.9 Test operation mode

CAUTION	
	●The test operation mode is designed for checking servo operation. Do not use it for actual operation. ●If the servo motor operates unexpectedly, use EM2 (Forced stop 2) to stop it.

POINT
●MR Configurator2 is required to perform positioning operation. ●Test operation cannot be performed if SON (Servo-on) is not turned off.

(1) Mode switching

The display screen at power-on. Select JOG operation or motor-less operation in the following procedure. Using the "MODE" button, display the diagnostic screen.



(2) JOG operation

POINT
●When performing JOG operation, turn on EM2, LSP and LSN. LSP and LSN can be set to automatic on by setting [Pr. PD01] to " _ C _ _ ".

JOG operation can be performed when there is no command from the controller.

(a) Operation

The servo motor rotates while holding down the "UP" or the "DOWN" button. The servo motor stops rotating by releasing the button. The operation condition can be changed using MR Configurator2. The initial operation condition and setting range for operation are listed below.

Item	Initial setting	Setting range
Speed [r/min]	200	0 to permissible instantaneous speed
Acceleration/deceleration time constant [ms]	1000	0 to 50000

The following table shows how to use the buttons.

Button	Description
"UP"	Press to start CCW rotation. Release to stop.
"DOWN"	Press to start CW rotation. Release to stop.

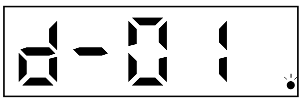
If the USB cable is disconnected during JOG operation using the MR Configurator2, the servo motor decelerates to a stop.

(b) Status display

Press the "MODE" button in the JOG operation-ready status to call the status display screen. When the JOG operation is performed using the "UP" or "DOWN" button, the servo status is displayed during the JOG operation. Every time the "MODE" button is pressed, the next status display screen appears. When one cycle of the screen display is complete, it returns to the JOG operation-ready status screen. Refer to section 4.5.3 for details of status display. Note that the status display screen cannot be changed by the "UP" or "DOWN" button during the JOG operation.

(c) Termination of JOG operation

To end the JOG operation, shut the power off once, or press the "MODE" button to switch to the next screen, and then hold down the "SET" button for 2 s or longer.

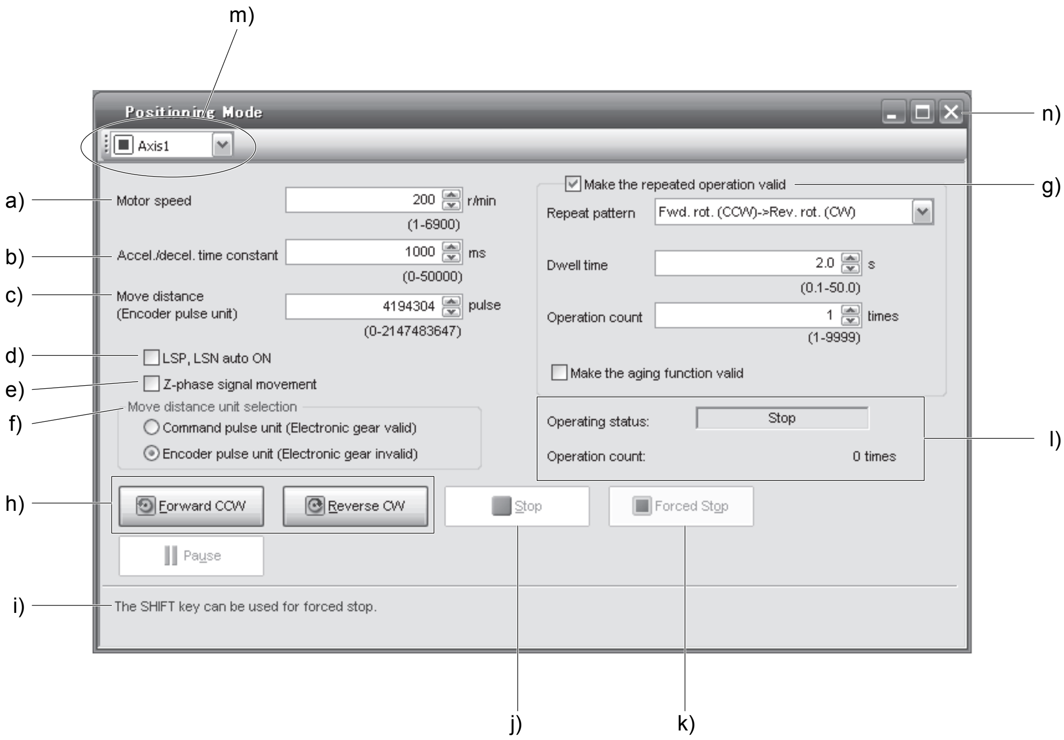


(3) Positioning operation

POINT
●MR Configurator2 is required to perform positioning operation. ●Turn on EM2 (forced stop 2) when performing positioning operation.

Positioning operation can be performed when there is no command from the controller.

(a) Operation



a) Motor speed [r/min]
   Enter the servo motor speed into the "Motor speed" input field.

b) Acceleration/deceleration time constant [ms]
   Enter the acceleration/deceleration time constant into the "Accel/decel time" input field.

c) Travel distance [pulse]
   Enter the travel distance into the "Travel distance" input field.

d) LSP/LSN are automatically turned on
   When setting the external stroke signal to automatic on, click the check box to enable it. When it is not selected, turn on LSP and LSN externally.

e) Move till Z-phase signal
   Travel is made until the travel distance is reached and the first Z-phase signal in the travelling direction turns on.

f) Travel distance unit selection
Select with the option buttons whether the travel distance set in c) is in the command pulse unit or in the encoder pulse unit.
When the command input pulse unit is selected, the value, which is the set travel distance multiplied by the electronic gear, will be the command value. When the encoder pulse unit is selected, the travel distance is not multiplied by the electronic gear.

g) Enable repeat operation
To perform repeat operation, click the check. The initial setting and setting range for the repeat operation are listed below.

Item	Initial setting	Setting range
Repeat pattern	Fwd. rot. (CCW) to rev. rot. (CW)	Fwd. rot. (CCW) to rev. rot. (CW) Fwd. rot. (CCW) to fwd. rot. (CCW) Rev. rot. (CW) to fwd. rot. (CCW) Rev. rot. (CW) to rev. rot. (CW)
Dwell time [s]	2.0	0.1 to 50.0
Number of operations [times]	1	1 to 9999

To perform continuous operation with the repeat pattern and dwell time settings, which are set by referring to the above table, click the check box of "Make the aging function enabled".

h) Forward/reverse the servo motor
Click the "Forward CCW" button to rotate the servo motor in the forward rotation direction.
Click the "Reverse CW" button to rotate the servo motor in the reverse rotation direction.

i) Pause the servo motor
Click the "Pause" button during servo motor rotation to temporarily stop the servo motor.
This button is enabled during servo motor rotation.

h) Stop the servo motor
Click the "Stop" button during servo motor rotation to stop the servo motor.

k) Forced stop
Click the "Forced stop" button during servo motor rotation to make a sudden stop.
This button is enabled during servo motor rotation.

l) Operation status
The operation status during the repeat operation, and the number of operations are displayed

m) Axis No.
Axis No. in operation is displayed.

n) Termination of positioning operation window
Click the close button to cancel the positioning operation mode and close the window.

(b) Status display
The status display can be checked during positioning operation.

(4) Motor-less operation
Without connecting the servo motor, output signals or status display can be provided in response to the input device as if the servo motor is actually running. This operation can be used to check the sequence of a controller or the like.

(a) Start of motor-less operation
After setting "_ _ _ 1" in [Pr. PC60], cycle the power. After that, perform external operation as in ordinary operation.

(b) Termination of motor-less operation
To terminate the motor-less operation, set [Pr. PC60] to "_ _ _ 0" and then turn the power off.

(5) Program operation
Positioning operation can be performed in two or more operation patterns combined, without using a controller. Use this operation with the forced stop reset. This operation may be used independently of whether servo-on or servo-off and whether a controller is connected or not.
Exercise control on the program operation screen of MR Configurator2. For full information, refer to the MR Configurator2 Installation Guide.

Operation	Screen control
Start	Click the "Operation start" button.
Stop	Click the "Stop" button.
Forced stop	Click the "Forced Stop" button.

(6) Output signal (DO) forced output
Output signals can be switched on/off forcibly independently of the servo status. This function is used for output signal wiring check, etc. Exercise control on the DO forced output screen of MR Configurator2.

5. PARAMETERS

⚠CAUTION	
	●Never make a drastic adjustment or change to the parameter values as doing so will make the operation unstable. ●If fixed values are written in the digits of a parameter, do not change these values. ●Do not change parameters for manufacturer setting. ●Do not set a value other than the described values to each parameter.

5.1 Parameter list

POINT

- ●To enable a parameter whose symbol is preceded by *, turn off the power for 1 s or more after setting and turn it on again. However, the time will be longer depending on a setting value of [Pr. PF25 instantaneous power failure tough drive - detection time] when "Instantaneous power failure tough drive selection" is enabled in [Pr. PA20].
- ●The symbols in the control mode column mean as follows.
  P: Position control mode
  S: Speed control mode
  T: Torque control mode

5.1.1 Basic setting parameters ([Pr. PA_ _])

No.	Symbol	Name	Initial value	Unit	Control mode		
					P	S	T
PA01	*STY	Operation mode	1000h		○	○	○
PA02	*REG	Regenerative option	0000h		○	○	○
PA03		For manufacturer setting	0000h				
PA04	*AOP1	Function selection A-1	2000h		○	○	
PA05	*FBP	Number of command input pulses per revolution	10000		○		
PA06	CMX	Electronic gear numerator (command pulse multiplication numerator)	1		○		
PA07	CDV	Electronic gear denominator (command pulse multiplication denominator)	1		○		
PA08	ATU	Auto tuning mode	0001h		○	○	
PA09	RSP	Auto tuning response	16		○	○	
PA10	INP	In-position range	100	[pulse]	○		
PA11	TLP	Forward rotation torque limit	100.0	[%]	○	○	○
PA12	TLN	Reverse rotation torque limit	100.0	[%]	○	○	○
PA13	*PLSS	Command pulse input form	0100h		○		
PA14	*POL	Rotation direction selection	0		○		
PA15	*ENR	Encoder output pulses	4000	[pulse/rev]	○	○	○
PA16	*ENR2	Encoder output pulses 2	1		○	○	○
PA17		For manufacturer setting	0000h				
PA18			0000h				
PA19	*BLK	Parameter writing inhibit	00AAh		○	○	○
PA20	*TDS	Tough drive setting	0000h		○	○	○
PA21	*AOP3	Function selection A-3	0001h		○	○	
PA22		For manufacturer setting	0000h				
PA23	DRAT	Drive recorder arbitrary alarm trigger setting	0000h		○	○	○
PA24	AOP4	Function selection A-4	0000h		○	○	
PA25	OTHOV	One-touch tuning - Overshoot permissible level	0	[%]	○	○	
PA26	*AOP5	Function selection A-5	0000h		○	○	
PA27		For manufacturer setting	0000h				
PA28			0000h				

No.	Symbol	Name	Initial value	Unit	Control mode P	Control mode S	Control mode T
PA29		For manufacturer setting	0000h				
PA30			0000h				
PA31			0000h				
PA32			0000h				

5.1.2 Gain/filter setting parameters ([Pr. PB_ _])

No.	Symbol	Name	Initial value	Unit	Control mode P	Control mode S	Control mode T
PB01	FILT	Adaptive tuning mode (adaptive filter II)	0000h		○	○	○
PB02	VRFT	Vibration suppression control tuning mode (advanced vibration suppression control II)	0000h		○		
PB03	PST	Position command acceleration/deceleration time constant (position smoothing)	0	[ms]	○		
PB04	FFC	Feed forward gain	0	[%]	○		
PB05		For manufacturer setting	500				
PB06	GD2	Load to motor inertia ratio	7.00	[Multiplier]	○	○	
PB07	PG1	Model loop gain	15.0	[rad/s]	○	○	
PB08	PG2	Position loop gain	37.0	[rad/s]	○		
PB09	VG2	Speed loop gain	823	[rad/s]	○	○	
PB10	VIC	Speed integral compensation	33.7	[ms]	○	○	
PB11	VDC	Speed differential compensation	980		○	○	
PB12	OVA	Overshoot amount compensation	0	[%]	○		
PB13	NH1	Machine resonance suppression filter 1	4500	[Hz]	○	○	○
PB14	NHQ1	Notch shape selection 1	0000h		○	○	○
PB15	NH2	Machine resonance suppression filter 2	4500	[Hz]	○	○	○
PB16	NHQ2	Notch shape selection 2	0000h		○	○	○
PB17	NHF	Shaft resonance suppression filter	0000h		○	○	○
PB18	LPF	Low-pass filter setting	3141	[rad/s]	○	○	
PB19	VRF11	Vibration suppression control 1 - Vibration frequency	100.0	[Hz]	○		
PB20	VRF12	Vibration suppression control 1 - Resonance frequency	100.0	[Hz]	○		
PB21	VRF13	Vibration suppression control 1 - Vibration frequency damping	0.00		○		
PB22	VRF14	Vibration suppression control 1 - Resonance frequency damping	0.00		○		
PB23	VFBF	Low-pass filter selection	0100h		○	○	○
PB24	*MVS	Slight vibration suppression control	0000h		○		
PB25	*BOP1	Function selection B-1	0000h		○		
PB26	*CDP	Gain switching function	0000h		○	○	
PB27	CDL	Gain switching condition	10	[kpulse/s]/ [pulse]/ [r/min]	○	○	
PB28	CDT	Gain switching time constant	1	[ms]	○	○	
PB29	GD2B	Load to motor inertia ratio after gain switching	7.00	[Multiplier]	○	○	
PB30	PG2B	Gain switching position loop gain	0.0	[rad/s]	○		
PB31	VG2B	Gain switching speed loop gain	0	[rad/s]	○	○	
PB32	VICB	Speed integral compensation after gain switching	0.0	[ms]	○	○	
PB33	VRF1B	Vibration suppression control 1 - Vibration frequency after gain switching	0.0	[Hz]	○		
PB34	VRF2B	Vibration suppression control 1 - Resonance frequency after gain switching	0.0	[Hz]	○		
PB35	VRF3B	Vibration suppression control 1 - Vibration frequency damping after gain switching	0.00		○		
PB36	VRF4B	Vibration suppression control 1 - Resonance frequency damping after gain switching	0.00		○		
PB37		For manufacturer setting	1600				
PB38			0.00				
PB39			0.00				
PB40			0.00				

No.	Symbol	Name	Initial value	Unit	Control mode P	Control mode S	Control mode T
PB41		For manufacturer setting	0000h				
PB42			0000h				
PB43			0000h				
PB44			0.00				
PB45	CNHF	Command notch filter	0000h		○		
PB46	NH3	Machine resonance suppression filter 3	4500	[Hz]	○	○	○
PB47	NHQ3	Notch shape selection 3	0000h		○	○	○
PB48	NH4	Machine resonance suppression filter 4	4500	[Hz]	○	○	○
PB49	NHQ4	Notch shape selection 4	0000h		○	○	○
PB50	NH5	Machine resonance suppression filter 5	4500	[Hz]	○	○	○
PB51	NHQ5	Notch shape selection 5	0000h		○	○	○
PB52	VRF21	Vibration suppression control 2 - Vibration frequency	100.0	[Hz]	○		
PB53	VRF22	Vibration suppression control 2 - Resonance frequency	100.0	[Hz]	○		
PB54	VRF23	Vibration suppression control 2 - Vibration frequency damping	0.00		○		
PB55	VRF24	Vibration suppression control 2 - Resonance frequency damping	0.00		○		
PB56	VRF21B	Vibration suppression control 2 - Vibration frequency after gain switching	0.0	[Hz]	○		
PB57	VRF22B	Vibration suppression control 2 - Resonance frequency after gain switching	0.0	[Hz]	○		
PB58	VRF23B	Vibration suppression control 2 - Vibration frequency damping after gain switching	0.00		○		
PB59	VRF24B	Vibration suppression control 2 - Resonance frequency damping after gain switching	0.00		○		
PB60	PG1B	Model loop gain after gain switching	0.0	[rad/s]	○	○	
PB61		For manufacturer setting	0.0				
PB62			0000h				
PB63			0000h				
PB64			0000h				

5.1.3 Extension setting parameters ([Pr. PC_ _])

No.	Symbol	Name	Initial value	Unit	Control mode P	Control mode S	Control mode T
PC01	STA	Acceleration time constant	0	[ms]		○	○
PC02	STB	Deceleration time constant	0	[ms]		○	○
PC03	STC	S-pattern acceleration/deceleration time constant	0	[ms]		○	○
PC04	TQC	Torque command time constant	0	[ms]			○
PC05	SC1	Internal speed command 1	100	[r/min]		○	
		Internal speed limit 1					○
PC06	SC2	Internal speed command 2	500	[r/min]		○	
		Internal speed limit 2					○
PC07	SC3	Internal speed command 3	1000	[r/min]		○	
		Internal speed limit 3					○
PC08	SC4	Internal speed command 4	200	[r/min]		○	
		Internal speed limit 4					○
PC09	SC5	Internal speed command 5	300	[r/min]		○	
		Internal speed limit 5					○
PC10	SC6	Internal speed command 6	500	[r/min]		○	
		Internal speed limit 6					○
PC11	SC7	Internal speed command 7	800	[r/min]		○	
		Internal speed limit 7					○
PC12	VCM	Analog speed command - Maximum speed	0	[r/min]		○	
		Analog speed limit - Maximum speed					○
PC13	TLC	Analog torque command maximum output	100.0	[%]			○
PC14	MOD1	Analog monitor 1 output	0000h		○	○	○
PC15	MOD2	Analog monitor 2 output	0001h		○	○	○

No.	Symbol	Name	Initial value	Unit	Control mode		
					P	S	T
PC16	MBR	Electromagnetic brake sequence output	0	[ms]	○	○	○
PC17	ZSP	Zero speed	50	[r/min]	○	○	○
PC18	*BPS	Alarm history clear	0000h		○	○	○
PC19	*ENRS	Encoder output pulse selection	0000h		○	○	○
PC20	*SNO	Station number setting (Note)	0	[Station]	○	○	○
PC21	*SOP	RS-422 communication function selection (Note)	0000h		○	○	○
PC22	*COP1	Function selection C-1	0020h		○	○	○
PC23	*COP2	Function selection C-2	0000h			○	○
PC24	*COP3	Function selection C-3	0000h		○		
PC25		For manufacturer setting	0000h				
PC26	*COP5	Function selection C-5	0000h		○	○	
PC27		For manufacturer setting	0000h				
PC28		For manufacturer setting	0000h				
PC29			0000h				
PC30	STA2	Acceleration time constant 2	0	[ms]		○	○
PC31	STB2	Deceleration time constant 2	0	[ms]		○	○
PC32	CMX2	Command input pulse multiplication numerator 2	1		○		
PC33	CMX3	Command input pulse multiplication numerator 3	1		○		
PC34	CMX4	Command input pulse multiplication numerator 4	1		○		
PC35	TL2	Internal torque limit 2	100.0	[%]	○	○	○
PC36	*DMD	Status display selection	0000h		○	○	○
PC37	VCO	Analog speed command offset	0	[mV]		○	
		Analog speed limit offset					○
PC38	TPO	Analog torque command offset	0	[mV]			○
		Analog torque limit offset				○	
PC39	MO1	Analog monitor 1 offset	0	[mV]	○	○	○
PC40	MO2	Analog monitor 2 offset	0	[mV]	○	○	○
PC41		For manufacturer setting	0				
PC42			0				
PC43	ERZ	Error excessive alarm level	0	[rev]	○		
PC44		For manufacturer setting	0000h				
PC45			0000h				
PC46			0				
PC47			0				
PC48			0				
PC49			0				
PC50			0000h				
PC51	RSBR	Forced stop deceleration time constant	100	[ms]	○	○	
PC52		For manufacturer setting	0				
PC53			0				
PC54	RSUP1	Vertical axis freefall prevention compensation amount	0	[0.0001rev]	○		
PC55		For manufacturer setting	0				
PC56			100				
PC57			0000h				
PC58			0				
PC59			0000h				
PC60	*COPD	Function selection C-D	0000h		○	○	○
PC61		For manufacturer setting	0000h				
PC62			0000h				
PC63			0000h				
PC64			0000h				
PC65			0000h				
PC66			0				
PC67			0				
PC68			0				

Note. This parameter is supported by servo amplifier manufactured in December 2013 or later.

No.	Symbol	Name	Initial value	Unit	Control mode P	Control mode S	Control mode T
PC69		For manufacturer setting	0				
PC70			0				
PC71			0040h				
PC72			0000h				
PC73	ERW	Error excessive warning level	0	[rev]	○		
PC74		For manufacturer setting	0000h				
PC75			0000h				
PC76			0000h				
PC77			0000h				
PC78			0000h				
PC79			0000h				
PC80			0000h				

5.1.4 I/O setting parameters ([Pr. PD_ _])

No.	Symbol	Name	Initial value	Unit	Control mode P	Control mode S	Control mode T
PD01	*DIA1	Input signal automatic on selection 1	0000h		○	○	○
PD02		For manufacturer setting	0000h				
PD03	*DI1L	Input device selection 1L	0202h		○	○	
PD04	*DI1H	Input device selection 1H	0202h				○
PD05		For manufacturer setting	0000h				
PD06			0000h				
PD07			0000h				
PD08			0000h				
PD09			0000h				
PD10			0000h				
PD11	*DI5L	Input device selection 5L	0703h		○	○	
PD12	*DI5H	Input device selection 5H	3807h				○
PD13	*DI6L	Input device selection 6L	0806h		○	○	
PD14	*DI6H	Input device selection 6H	3908h				○
PD15		For manufacturer setting	0000h				
PD16			0000h				
PD17	*DI8L	Input device selection 8L	0A0Ah		○	○	
PD18	*DI8H	Input device selection 8H	0700h				○
PD19	*DI9L	Input device selection 9L	0B0Bh		○	○	
PD20	*DI9H	Input device selection 9H	0800h				○
PD21		For manufacturer setting	0000h				
PD22			0000h				
PD23			0000h				
PD24	*DO2	Output device selection 2	000Ch		○	○	○
PD25	*DO3	Output device selection 3	0004h		○	○	○
PD26		For manufacturer setting	0000h				
PD27			0003h				
PD28	*DO6	Output device selection 6	0002h		○	○	○
PD29	*DIF	Input filter setting	0004h		○	○	○
PD30	*DOP1	Function selection D-1	0000h		○	○	○
PD31		For manufacturer setting	0000h				
PD32	*DOP3	Function selection D-3	0000h		○		
PD33		For manufacturer setting	0000h				
PD34	DOP5	Function selection D-5	0000h		○	○	○
PD35		For manufacturer setting	0000h				
PD36			0000h				
PD37			0000h				
PD38			0				

No.	Symbol	Name	Initial value	Unit	Control mode P	S	T
PD39		For manufacturer setting	0				
PD40			0				
PD41			0000h				
PD42			0000h				
PD43	*DI11L	Input device selection 11L	0000h			○	
PD44	*DI11H	Input device selection 11H	2000h				○
PD45	*DI12L	Input device selection 12L	0000h			○	
PD46	*DI12H	Input device selection 12H	2B00h				○
PD47		For manufacturer setting	0000h				
PD48			0000h				

5.1.5 Extension setting 2 parameters ([Pr. PE_ _])

No.	Symbol	Name	Initial value	Unit	Control mode P	S	T
PE01		For manufacturer setting	0000h				
PE02			0000h				
PE03			0000h				
PE04			0				
PE05			0				
PE06			0				
PE07			0				
PE08			0				
PE09			0000h				
PE10			0000h				
PE11			0000h				
PE12			0000h				
PE13			0000h				
PE14			0111h				
PE15			20				
PE16			0000h				
PE17			0000h				
PE18			0000h				
PE19			0000h				
PE20			0000h				
PE21			0000h				
PE22			0000h				
PE23			0000h				
PE24			0000h				
PE25			0000h				
PE26			0000h				
PE27			0000h				
PE28			0000h				
PE29			0000h				
PE30			0000h				
PE31			0000h				
PE32			0000h				
PE33			0000h				
PE34			0				
PE35			0				
PE36			0.0				
PE37			0.00				
PE38			0.00				
PE39			0				
PE40			0000h				

No.	Symbol	Name	Initial value	Unit	Control mode P	Control mode S	Control mode T
PE41	EOP3	Function selection E-3	0000h		○	○	○
PE42		For manufacturer setting	0				
PE43			0.0				
PE44			0000h				
PE45			0000h				
PE46			0000h				
PE47			0000h				
PE48			0000h				
PE49			0000h				
PE50			0000h				
PE51			0000h				
PE52			0000h				
PE53			0000h				
PE54			0000h				
PE55			0000h				
PE56			0000h				
PE57			0000h				
PE58			0000h				
PE59			0000h				
PE60			0000h				
PE61			0.00				
PE62			0.00				
PE63			0.00				
PE64			0.00				

5.1.6 Extension setting 3 parameters ([Pr. PF_ _])

No.	Symbol	Name	Initial value	Unit	Control mode P	Control mode S	Control mode T
PF01		For manufacturer setting	0000h				
PF02			0000h				
PF03			0000h				
PF04			0				
PF05			0				
PF06			0000h				
PF07			1				
PF08			1				
PF09	*FOP5	Function selection F-5	0000h		○	○	○
PF10			0000h				
PF11			0000h				
PF12			10000				
PF13			100				
PF14			100				
PF15			2000				
PF16			0000h				
PF17			10				
PF18			0000h				
PF19			0000h				
PF20			0000h				
PF21	DRT	Drive recorder switching time setting	0	[s]	○	○	○
PF22		For manufacturer setting	200				
PF23	OSCL1	Vibration tough drive - Oscillation detection level	50	[%]	○	○	
PF24	*OSCL2	Vibration tough drive function selection	0000h		○	○	
PF25	CVAT	Instantaneous power failure tough drive - detection time	200	[ms]	○	○	○

No.	Symbol	Name	Initial value	Unit	Control mode P	S	T
PF26		For manufacturer setting	0				
PF27			0				
PF28			0				
PF29			0000h				
PF30			0				
PF31	FRIC	Machine diagnosis function - Friction judgement speed	0	[r/min]	○	○	○
PF32		For manufacturer setting	50				
PF33			0000h				
PF34			0000h				
PF35			0000h				
PF36			0000h				
PF37			0000h				
PF38			0000h				
PF39			0000h				
PF40			0				
PF41			0				
PF42			0				
PF43			0				
PF44			0				
PF45			0000h				
PF46			0				
PF47			0000h				
PF48			0000h				

5.2 Detailed list of parameters

POINT
●Set a value to each "x" in the "Setting digit" columns.

5.2.1 Basic setting parameters ([Pr. PA_ _])

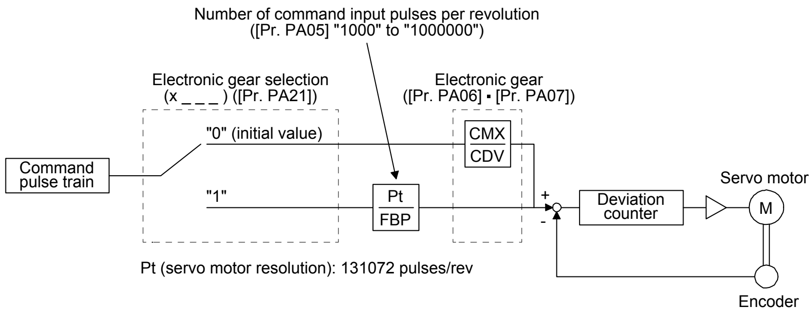
No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PA01 *STY Operation mode	_ _ _ x	Control mode selection Select a control mode. 0: Position control mode 1: Position control mode and speed control mode 2: Speed control mode 3: Speed control mode and torque control mode 4: Torque control mode 5: Torque control mode and position control mode	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		1h			

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PA02 *REG Regenerative option	_ _ x x	Regenerative option Select a regenerative option. Incorrect setting may cause the regenerative option to burn. If a selected regenerative option is not for use with the servo amplifier, [AL. 37 Parameter error] occurs. 00: Regenerative option is not used. ・For servo amplifier of 200 W or less, regenerative resistor is not used. ・For servo amplifier of 0.4 kW to 3 kW, built-in regenerative resistor is used. 02: MR-RB032 03: MR-RB12 04: MR-RB32 05: MR-RB30 06: MR-RB50 (Cooling fan is required.)	00h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PA04 *AOP1 Function selection A-1	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _		0h			
	x _ _ _	Forced stop deceleration function selection 0: Forced stop deceleration function disabled (EM1) 2: Forced stop deceleration function enabled (EM2) Refer to table 5.1 for details.	2h	○	○	

Table 5.1 Deceleration method

Setting value	EM2/EM1	Deceleration method: EM2 or EM1 is off	Deceleration method: Alarm occurred
0 _ _ _	EM1	MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.	MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.
2 _ _ _	EM2	MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.	MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PA05 *FBP Number of command input pulses per revolution		The servo motor rotates based on set command input pulses. To enable the parameter value, select "Number of command input pulses per revolution (1 _ _ _)" of "Electronic gear selection" in [Pr. PA21]. Setting range: 1000 to 1000000	10000	○		

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PA06 CMX Electronic gear numerator (command pulse multiplication numerator)		Set the numerator of the electronic gear. To enable the parameter, select "Electronic gear (0 _ _ _)" of "Electronic gear selection" in [Pr. PA21]. The following shows a standard of the setting range of the electronic gear. $\frac{1}{10} < \frac{CMX}{CDV} < 4000$ If the set value is outside this range, noise may be generated during acceleration/deceleration or operation may not be performed at the preset speed and/or acceleration/deceleration time constants.  Always set the electronic gear with servo-off state to prevent unexpected operation due to improper setting. Setting range: 1 to 16777215	1	○		
PA07 CDV Electronic gear denominator (command pulse multiplication denominator)		Set the denominator of the electronic gear. To enable the parameter, select "Electronic gear (0 _ _ _)" of "Electronic gear selection" in [Pr. PA21]. Setting range: 1 to 16777215	1	○		

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PA08 ATU Auto tuning mode	_ _ _ x	Gain adjustment mode selection Select the gain adjustment mode. 0: 2 gain adjustment mode 1 (interpolation mode) 1: Auto tuning mode 1 2: Auto tuning mode 2 3: Manual mode 4: 2 gain adjustment mode 2 Refer to table 5.2 for details.	1h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			

Table 5.2 Gain adjustment mode selection

Setting value	Gain adjustment mode	Automatically adjusted parameter
_ _ _ 0	2 gain adjustment mode 1 (interpolation mode)	[Pr. PB06 Load to motor inertia ratio] [Pr. PB08 Position loop gain] [Pr. PB09 Speed loop gain] [Pr. PB10 Speed integral compensation]
_ _ _ 1	Auto tuning mode 1	[Pr. PB06 Load to motor inertia ratio] [Pr. PB07 Model loop gain] [Pr. PB08 Position loop gain] [Pr. PB09 Speed loop gain] [Pr. PB10 Speed integral compensation]
_ _ _ 2	Auto tuning mode 2	[Pr. PB07 Model loop gain] [Pr. PB08 Position loop gain] [Pr. PB09 Speed loop gain] [Pr. PB10 Speed integral compensation]
_ _ _ 3	Manual mode	
_ _ _ 4	2 gain adjustment mode 2	[Pr. PB08 Position loop gain] [Pr. PB09 Speed loop gain] [Pr. PB10 Speed integral compensation]

<table>
<tr><th rowspan="2">No./
symbol/name</th><th rowspan="2">Setting
digit</th><th rowspan="2">Function</th><th rowspan="2">Initial
value
[unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>PA09
RSP
Auto tuning
response</td><td colspan="2">Set a response of the auto tuning.
<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Machine characteristic</th><th rowspan="2">Setting value</th><th colspan="2">Machine characteristic</th></tr>
<tr><th>Response</th><th>Guideline for machine resonance frequency [Hz]</th><th>Response</th><th>Guideline for machine resonance frequency [Hz]</th></tr>
<tr><td>1</td><td>Low response</td><td>2.7</td><td>21</td><td>Middle response</td><td>67.1</td></tr>
<tr><td>2</td><td>↑</td><td>3.6</td><td>22</td><td>↑</td><td>75.6</td></tr>
<tr><td>3</td><td></td><td>4.9</td><td>23</td><td></td><td>85.2</td></tr>
<tr><td>4</td><td></td><td>6.6</td><td>24</td><td></td><td>95.9</td></tr>
<tr><td>5</td><td></td><td>10.0</td><td>25</td><td></td><td>108.0</td></tr>
<tr><td>6</td><td></td><td>11.3</td><td>26</td><td></td><td>121.7</td></tr>
<tr><td>7</td><td></td><td>12.7</td><td>27</td><td></td><td>137.1</td></tr>
<tr><td>8</td><td></td><td>14.3</td><td>28</td><td></td><td>154.4</td></tr>
<tr><td>9</td><td></td><td>16.1</td><td>29</td><td></td><td>173.9</td></tr>
<tr><td>10</td><td></td><td>18.1</td><td>30</td><td></td><td>195.9</td></tr>
<tr><td>11</td><td></td><td>20.4</td><td>31</td><td></td><td>220.6</td></tr>
<tr><td>12</td><td></td><td>23.0</td><td>32</td><td></td><td>248.5</td></tr>
<tr><td>13</td><td></td><td>25.9</td><td>33</td><td></td><td>279.9</td></tr>
<tr><td>14</td><td></td><td>29.2</td><td>34</td><td></td><td>315.3</td></tr>
<tr><td>15</td><td></td><td>32.9</td><td>35</td><td></td><td>355.1</td></tr>
<tr><td>16</td><td></td><td>37.0</td><td>36</td><td></td><td>400.0</td></tr>
<tr><td>17</td><td></td><td>41.7</td><td>37</td><td></td><td>446.6</td></tr>
<tr><td>18</td><td></td><td>47.0</td><td>38</td><td></td><td>501.2</td></tr>
<tr><td>19</td><td>↓</td><td>52.9</td><td>39</td><td>↓</td><td>571.5</td></tr>
<tr><td>20</td><td>Middle response</td><td>59.6</td><td>40</td><td>High response</td><td>642.7</td></tr>
</table>
Setting range: 1 to 40</td><td>16</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PA10
INP
In-position
range</td><td></td><td>Set an in-position range per command pulse.
To change it to the servo motor encoder pulse unit, set [Pr. PC24].

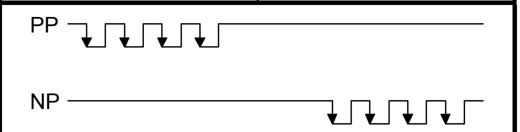
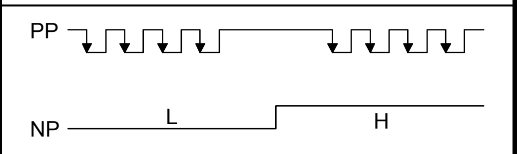
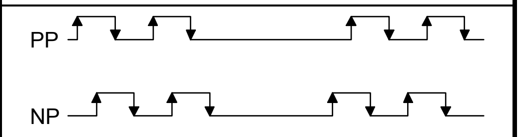
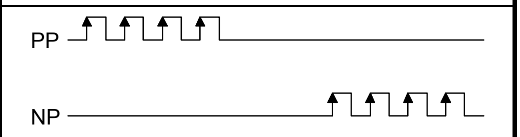
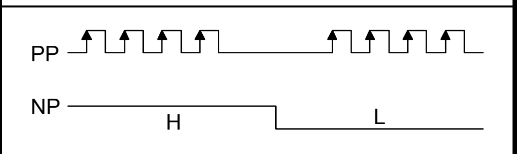
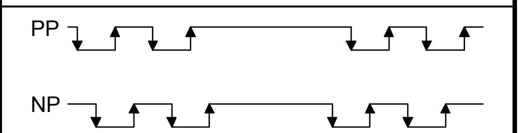
Setting range: 0 to 65535</td><td>100
[pulse]</td><td>○</td><td></td><td></td></tr>
<tr><td>PA11
TLP
Forward
rotation
torque limit</td><td></td><td>You can limit the torque generated by the servo motor. Set the parameter referring section 3.6.1 (5).
The larger value of [Pr. PA11 Forward rotation torque limit] or [Pr. PA12 Reverse rotation torque limit] will be the maximum output voltage (8 V).
Set the parameter on the assumption that the maximum torque is 100 [%]. The parameter is for limiting the torque of the servo motor in the CCW power running or CW regeneration. Set this parameter to "0.0" to generate no torque.

Setting range: 0.0 to 100.0</td><td>100.0
[%]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PA12
TLN
Reverse
rotation
torque limit</td><td></td><td>You can limit the torque generated by the servo motor. Set the parameter referring section 3.6.1 (5).
The larger value of [Pr. PA11 Forward rotation torque limit] or [Pr. PA12 Reverse rotation torque limit] will be the maximum output voltage (8 V).
Set the parameter on the assumption that the maximum torque is 100 [%]. The parameter is for limiting the torque of the servo motor in the CW power running or CCW regeneration. Set this parameter to "0.0" to generate no torque.

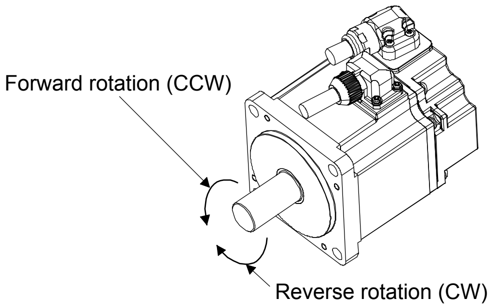
Setting range: 0.0 to 100.0</td><td>100.0
[%]</td><td>○</td><td>○</td><td>○</td></tr>
</table>

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PA13 *PLSS Command pulse input form	_ _ _ x	Command input pulse train form selection 0: Forward/reverse rotation pulse train 1: Signed pulse train 2: A-phase/B-phase pulse train (The servo amplifier imports input pulses after multiplying by four.) Refer to table 5.3 for settings.	0h	○		
	_ _ x _	Pulse train logic selection 0: Positive logic 1: Negative logic Select the same one as a logic of command pulse train from controller to connect. Refer to POINT of section 3.6.1 for logic of MELSEC iQ-R series/MELSEC-Q series/MELSEC-L series/MELSEC-F series. Refer to table 5.3 for settings.	0h	○		
	_ x _ _	Command input pulse train filter selection Selecting proper filter enables to enhance noise tolerance. 0: Command input pulse train is 4 Mpulses/s or less. 1: Command input pulse train is 1 Mpulse/s or less. 2: Command input pulse train is 500 kpulses/s or less. 3: Command input pulse train is 200 kpulses/s or less. 1 Mpulse/s or lower commands are supported by "1". When inputting commands over 1 Mpulse/s and 4 Mpulses/s or lower, set "0". Setting a value not according to the command pulse frequency may cause the following malfunctions. ・Setting a value higher than actual command will lower noise tolerance. ・Setting a value lower than actual command will cause a position mismatch.	1h	○		
	x _ _ _	For manufacturer setting	0h			

Table 5.3 Command input pulse train form selection

Setting value	Pulse train form		Forward rotation command / Reverse rotation command
_ _ 1 0h	Negative logic	Forward rotation pulse train Reverse rotation pulse train	
_ _ 1 1h	Negative logic	Signed pulse train	
_ _ 1 2h	Negative logic	A-phase pulse train B-phase pulse train	
_ _ 0 0h	Positive logic	Forward rotation pulse train Reverse rotation pulse train	
_ _ 0 1h	Positive logic	Signed pulse train	
_ _ 0 2h	Positive logic	A-phase pulse train B-phase pulse train	

Arrows in the table indicate the timing of importing pulse trains. A-phase pulse train and B-phase pulse train are imported after they have been multiplied by 4.

<table>
<tr><th rowspan="2">No./
symbol/name</th><th rowspan="2">Setting
digit</th><th rowspan="2">Function</th><th rowspan="2">Initial
value
[unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>PA14
*POL
Rotation direction selection</td><td></td><td>Select servo motor rotation direction relative to the input pulse train.
<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Servo motor rotation direction</th></tr>
<tr><th>When forward rotation pulse is input</th><th>When reverse rotation pulse is input</th></tr>
<tr><td>0</td><td>CCW</td><td>CW</td></tr>
<tr><td>1</td><td>CW</td><td>CCW</td></tr>
</table>
The following shows the servo motor rotation directions.


Setting range: 0, 1</td><td>0</td><td>○</td><td></td><td></td></tr>
<tr><td>PA15
*ENR
Encoder output pulses</td><td></td><td>Set the encoder output pulses from the servo amplifier by using the number of output pulses per revolution, dividing ratio, or electronic gear ratio. (after multiplication by 4)
Set a numerator of the electronic gear when "A-phase/B-phase pulse electronic gear setting (_ _ 3 _)" is selected in [Pr. PC19 Encoder output pulser setting selection].
The maximum output frequency is 4.6 Mpulses/s. Set the parameter within this range.

Setting range: 1 to 4194304</td><td>4000
[pulse/
rev]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PA16
*ENR2
Encoder output pulses 2</td><td></td><td>Set a denominator of the electronic gear for the A/B-phase pulse output.
To set a denominator of the electronic gear, select "A-phase/B-phase pulse electronic gear setting (_ _ 3 _)" of "Encoder output pulse setting selection" in [Pr. PC19].

Setting range: 1 to 4194304</td><td>1</td><td>○</td><td>○</td><td>○</td></tr>
</table>

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PA19 *BLK Parameter writing inhibit		Select a reference range and writing range of the parameter. Refer to table 5.4 for settings.	00AAh	○	○	○

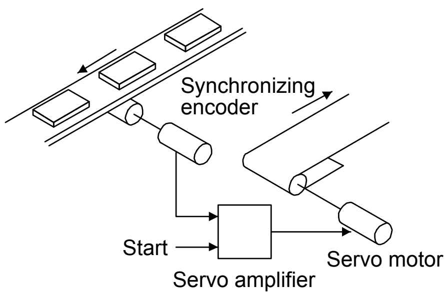
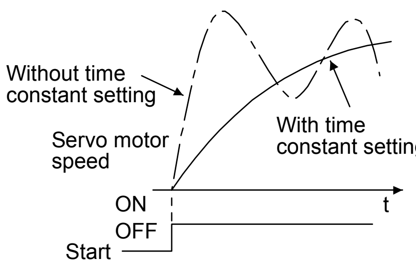
Table 5.4 [Pr. PA19] setting value and reading/writing range

PA19	Setting operation	PA	PB	PC	PD	PE	PF
Other than below	Reading	○					
	Writing	○					
000Ah	Reading	Only 19					
	Writing	Only 19					
000Bh	Reading	○	○	○			
	Writing	○	○	○			
000Ch	Reading	○	○	○	○		
	Writing	○	○	○	○		
00AAh (initial value)	Reading	○	○	○	○	○	○
	Writing	○	○	○	○	○	○
100Bh	Reading	○					
	Writing	Only 19					
100Ch	Reading	○	○	○	○		
	Writing	Only 19					
10AAh	Reading	○	○	○	○	○	○
	Writing	Only 19					

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PA20 *TDS Tough drive setting		Alarms may not be avoided with the tough drive function depending on the situations of the power supply and load fluctuation. You can assign MTTR (During tough drive) to pins CN1-23, CN1-24, and CN1-49 with [Pr. PD24], [Pr. PD25], and [Pr. PD28].				
	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Vibration tough drive selection 0: Disabled 1: Enabled Selecting "1" enables to suppress vibrations by automatically changing setting values of [Pr. PB13 Machine resonance suppression filter 1] and [Pr. PB15 Machine resonance suppression filter 2] in case that the vibration exceed the value of the oscillation level set in [Pr. PF23]. To output the oscillation detection alarm as a warning, set [Pr. PF24 Vibration tough drive function selection]. Refer to section 7.3 for details.	0h	○	○	
	_ x _ _	Instantaneous power failure tough drive selection 0: Disabled 1: Enabled Selecting "1" enables to avoid occurring [AL. 10 Undervoltage] using the electrical energy charged in the capacitor in the servo amplifier in case that an instantaneous power failure occurs during operation. In [Pr. PF25 Instantaneous power failure tough drive - Detection time], set the time until the occurrence of [AL. 10.1 Voltage drop in the power]. When the parameter is enabled, the power should be off for the setting value of [Pr. PF25] + 1 s or more before cycling the power to enable a parameter whose symbol is preceded by "*".	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PA21 *AOP3 Function selection A-3	_ _ _ x	One-touch tuning function selection 0: Disabled 1: Enabled When the digit is "0", the one-touch tuning is not available.	1h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _	Electronic gear selection 0: Electronic gear ([Pr. PA06] and [Pr. PA07]) 1: Number of command input pulses per revolution ([Pr. PA05])	0h	○		
PA23 DRAT Drive recorder arbitrary alarm trigger setting	_ _ x x	Alarm detail No. setting Set the digits when you execute the trigger with arbitrary alarm detail No. for the drive recorder function. When these digits are "0 0", only the arbitrary alarm No. setting will be enabled.	00h	○	○	○
	x x _ _	Alarm No. setting Set the digits when you execute the trigger with arbitrary alarm No. for the drive recorder function. When "0 0" are set, arbitrary alarm trigger of the drive recorder will be disabled.	00h	○	○	○
	Setting example: To activate the drive recorder when [AL. 50 Overload 1] occurs, set "5 0 0 0". To activate the drive recorder when [AL. 50.3 Thermal overload error 4 during operation] occurs, set "5 0 0 3".					
PA24 AOP4 Function selection A-4	_ _ _ x	Vibration suppression mode selection 0: Standard mode 1: 3 inertia mode 2: Low response mode When you select the standard mode or low response mode, "Vibration suppression control 2" is not available. When you select the 3 inertia mode, the feed forward gain is not available. Before changing the control mode during the 3 inertia mode or low response mode, stop the motor.	0h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PA25 OTHOV One-touch tuning - Overshoot permissible level		Set a permissible value of overshoot amount for one-touch tuning as a percentage of the in-position range. However, setting "0" will be 50%.	0 [%]	○	○	
PA26 *AOP5 Function selection A-5	_ _ _ x	Torque limit function selection at instantaneous power failure 0: Disabled 1: Enabled Selecting "1" for this digit will limit torques to save electric energy when an instantaneous power failure occurs during operation and will make [AL. 10 Undervoltage] less likely to occur. The torque limit function at instantaneous power failure is enabled when "Instantaneous power failure tough drive selection" in [Pr. PA20] is "Enabled (_ 1 _ _)".	0h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			

5.2.2 Gain/filter setting parameters ([Pr. PB_ _])

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PB01 FILT Adaptive tuning mode (adaptive filter II)	_ _ _ x	Filter tuning mode selection Set the adaptive filter tuning. Select the adjustment mode of the machine resonance suppression filter 1. Refer to section 7.1.2 for details. 0: Disabled 1: Automatic setting (Do not use this in the torque control mode.) 2: Manual setting	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PB02 VRFT Vibration suppression control tuning mode (advanced vibration suppression control II)	_ _ _ x	Vibration suppression control 1 tuning mode selection Select the tuning mode of the vibration suppression control 1. Refer to section 7.1.5 for details. 0: Disabled 1: Automatic setting 2: Manual setting	0h	○		
	_ _ x _	Vibration suppression control 2 tuning mode selection Select the tuning mode of the vibration suppression control 2. To enable the digit, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. Refer to section 7.1.5 for details. 0: Disabled 1: Automatic setting 2: Manual setting	0h	○		
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PB03 PST Position command acceleration/ deceleration time constant (position smoothing)		Set the constant of a primary delay to the position command. You can select a control method from "Primary delay" or "Linear acceleration/deceleration" in [Pr. PB25 Function selection B-1]. The setting range of "Linear acceleration/deceleration" is 0 ms to 10 ms. Setting of longer than 10 ms will be recognized as 10 ms. When the linear acceleration/deceleration is selected, do not set the "Control mode selection" ([Pr. PA01]) to the setting other than "_ _ _ 0". Doing so will cause the servo motor to make a sudden stop at the time of position control mode switching. (Example) When a command is given from a synchronizing encoder, synchronous operation will start smoothly even if it start during line operation.   Setting range: 0 to 65535	0 [ms]	○		

<table>
<tr><th rowspan="2">No./
symbol/name</th><th rowspan="2">Setting
digit</th><th rowspan="2">Function</th><th rowspan="2">Initial
value
[unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>PB04
FFC
Feed forward gain</td><td></td><td>Set the feed forward gain.
When the setting is 100%, the droop pulses during operation at constant speed are nearly zero. However, sudden acceleration/deceleration will increase the overshoot. As a guideline, when the feed forward gain setting is 100%, set 1 s or more as the acceleration time constant up to the rated speed.

Setting range: 0 to 100</td><td>0
[%]</td><td>○</td><td></td><td></td></tr>
<tr><td rowspan="2">PB06
GD2
Load to motor inertia ratio</td><td></td><td>Set the load to motor inertia ratio.
The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the following table for details. When the parameter is automatic setting, the value will vary between 0.00 and 100.00.

Setting range: 0.00 to 300.00</td><td>7.00
[Multiplier]</td><td>○</td><td>○</td><td></td></tr>
<tr><td colspan="6"><table>
<tr><th>Pr. PA08</th><th>This parameter</th></tr>
<tr><td>_ _ _ 0 (2 gain adjustment mode 1 (interpolation mode)</td><td rowspan="2">Automatic setting</td></tr>
<tr><td>_ _ _ 1: (Auto tuning mode 1)</td></tr>
<tr><td>_ _ _ 2: (Auto tuning mode 2)</td><td rowspan="3">Manual setting</td></tr>
<tr><td>_ _ _ 3: (Manual mode)</td></tr>
<tr><td>_ _ _ 4: (2 gain adjustment mode 2)</td></tr>
</table></td></tr>
<tr><td rowspan="2">PB07
PG1
Model loop gain</td><td></td><td>Set the response gain up to the target position.
Increasing the setting value will also increase the response level to the position command but will be liable to generate vibration and/or noise.
The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the following table for details.

Setting range: 1.0 to 2000.0</td><td>15.0
[rad/s]</td><td>○</td><td>○</td><td></td></tr>
<tr><td colspan="6"><table>
<tr><th>Pr. PA08</th><th>This parameter</th></tr>
<tr><td>_ _ _ 0 (2 gain adjustment mode 1 (interpolation mode)</td><td>Manual setting</td></tr>
<tr><td>_ _ _ 1: (Auto tuning mode 1)</td><td rowspan="2">Automatic setting</td></tr>
<tr><td>_ _ _ 2: (Auto tuning mode 2)</td></tr>
<tr><td>_ _ _ 3: (Manual mode)</td><td rowspan="2">Manual setting</td></tr>
<tr><td>_ _ _ 4: (2 gain adjustment mode 2)</td></tr>
</table></td></tr>
<tr><td rowspan="2">PB08
PG2
Position loop gain</td><td></td><td>Set the gain of the position loop.
Set this parameter to increase the position response to level load disturbance.
Increasing the setting value will also increase the response level to the load disturbance but will be liable to generate vibration and/or noise.
The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the following table for details.

Setting range: 1.0 to 2000.0</td><td>37.0
[rad/s]</td><td>○</td><td></td><td></td></tr>
<tr><td colspan="6"><table>
<tr><th>Pr. PA08</th><th>This parameter</th></tr>
<tr><td>_ _ _ 0 (2 gain adjustment mode 1 (interpolation mode)</td><td rowspan="3">Automatic setting</td></tr>
<tr><td>_ _ _ 1: (Auto tuning mode 1)</td></tr>
<tr><td>_ _ _ 2: (Auto tuning mode 2)</td></tr>
<tr><td>_ _ _ 3: (Manual mode)</td><td>Manual setting</td></tr>
<tr><td>_ _ _ 4: (2 gain adjustment mode 2)</td><td>Automatic setting</td></tr>
</table></td></tr>
</table>

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PB09 VG2 Speed loop gain		Set the gain of the speed loop. Set this parameter when vibration occurs on machines of low rigidity or large backlash. Increasing the setting value will also increase the response level but will be liable to generate vibration and/or noise. The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the table of [Pr. PB08] for details. Setting range: 20 to 65535	823 [rad/s]	○	○	
PB10 VIC Speed integral compensation		Set the integral time constant of the speed loop. Decreasing the setting value will increase the response level but will be liable to generate vibration and/or noise. The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the table of [Pr. PB08] for details. Setting range: 0.1 to 1000.0	33.7 [ms]	○	○	
PB11 VDC Speed differential compensation		Set the differential compensation. To enable the setting value, turn on PC (proportional control). Setting range: 0 to 1000	980	○	○	
PB12 OVA Overshoot amount compensation		Set a viscous friction torque per percent to the servo motor rated speed. When the response level is low, or when the torque is limited, the efficiency of the parameter can be lower. Setting range: 0 to 100	0 [%]	○		
PB13 NH1 Machine resonance suppression filter 1		Machine resonance suppression filter 1 Set the notch frequency of the machine resonance suppression filter 1. When "Automatic setting (_ _ _ 1)" of "Filter tuning mode selection" is selected in [Pr. PB01], this parameter will be adjusted automatically. When you select "Manual setting (_ _ _ 2)" of "Filter tuning mode selection" in [Pr. PB01], the setting value will be enabled. Setting range: 10 to 4500	4500 [Hz]	○	○	○
PB14 NHQ1 Notch shape selection 1	Set the shape of the machine resonance suppression filter 1. When you select "Automatic setting (_ _ _ 1)" of "Filter tuning mode selection" in [Pr. PB01], this parameter will be adjusted automatically. Set manually for the manual setting.					
	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: α = 2 1: α = 3 2: α = 4 3: α = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PB15 NH2 Machine resonance suppression filter 2		Set the notch frequency of the machine resonance suppression filter 2. To enable the setting value, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 2 selection" in [Pr. PB16]. Setting range: 10 to 4500	4500 [Hz]	○	○	○

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PB16 NHQ2 Notch shape selection 2		Set the shape of the machine resonance suppression filter 2.				
	_ _ _ x	Machine resonance suppression filter 2 selection 0: Disabled 1: Enabled	0h	○	○	○
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: α = 2 1: α = 3 2: α = 4 3: α = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PB17 NHF Shaft resonance suppression filter		Set the shaft resonance suppression filter. Use this filter to suppress a low-frequency machine vibration. When you select "Automatic setting (_ _ _ 0)" of "Shaft resonance suppression filter selection" in [Pr. PB23], the value will be calculated automatically from the servo motor you use and load to motor inertia ratio. Set manually for "Manual setting (_ _ _ 1)". When "Shaft resonance suppression filter selection" is "Disabled (_ _ _ 2)" in [Pr. PB23], the setting value of this parameter will be disabled. When you select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 4 selection" in [Pr. PB49], the shaft resonance suppression filter is not available.				
	_ _ x x	Shaft resonance suppression filter setting frequency selection Refer to table 5.5 for settings. Set the value closest to the frequency you need.	00h	○	○	○
	_ x _ _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			

Table 5.5 Shaft resonance suppression filter setting frequency selection

Setting value	Frequency [Hz]	Setting value	Frequency [Hz]
00	Disabled	10	562
01	Disabled	11	529
02	4500	12	500
03	3000	13	473
04	2250	14	450
05	1800	15	428
06	1500	16	409
07	1285	17	391
08	1125	18	375
09	1000	19	360
0A	900	1A	346
0B	818	1B	333
0C	750	1C	321
0D	692	1D	310
0E	642	1E	300
0F	600	1F	290

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PB18 LPF Low-pass filter setting		Set the low-pass filter. The following shows a relation of a required parameter to this parameter. Setting range: 100 to 18000	3141 [rad/s]	○	○	
		[Pr. PB23] / [Pr. PB18]: _ _ 0 _ (Initial value): Automatic setting _ _ 1 _: Setting value enabled _ _ 2 _: Setting value disabled				
PB19 VRF11 Vibration suppression control 1 - Vibration frequency		Set the vibration frequency for vibration suppression control 1 to suppress low-frequency machine vibration. When "Vibration suppression control 1 tuning mode selection" is "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. Set manually for "Manual setting (_ _ _ 2)". Refer to section 7.1.5 for details. Setting range: 0.1 to 300.0	100.0 [Hz]	○		
PB20 VRF12 Vibration suppression control 1 - Resonance frequency		Set the resonance frequency for vibration suppression control 1 to suppress low-frequency machine vibration. When "Vibration suppression control 1 tuning mode selection" is "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. Set manually for "Manual setting (_ _ _ 2)". Refer to section 7.1.5 for details. Setting range: 0.1 to 300.0	100.0 [Hz]	○		
PB21 VRF13 Vibration suppression control 1 - Vibration frequency damping		Set a damping of the vibration frequency for vibration suppression control 1 to suppress low-frequency machine vibration. When "Vibration suppression control 1 tuning mode selection" is "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. Set manually for "Manual setting (_ _ _ 2)". Refer to section 7.1.5 for details. Setting range: 0.00 to 0.30	0.00	○		
PB22 VRF14 Vibration suppression control 1 - Resonance frequency damping		Set a damping of the resonance frequency for vibration suppression control 1 to suppress low-frequency machine vibration. When "Vibration suppression control 1 tuning mode selection" is "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. Set manually for "Manual setting (_ _ _ 2)". Refer to section 7.1.5 for details. Setting range: 0.00 to 0.30	0.00	○		
PB23 VFBF Low-pass filter selection	_ _ _ x	Shaft resonance suppression filter selection Select the shaft resonance suppression filter. 0: Automatic setting 1: Manual setting 2: Disabled When you select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 4 selection" in [Pr. PB49], the shaft resonance suppression filter is not available.	0h	○	○	○
	_ _ x _	Low-pass filter selection Select the low-pass filter. 0: Automatic setting 1: Manual setting 2: Disabled	0h	○	○	
	_ x _ _	For manufacturer setting	1h			
	x _ _ _		0h			

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PB24 *MVS Slight vibration suppression control	_ _ _ x	Slight vibration suppression control selection Select the slight vibration suppression control. 0: Disabled 1: Enabled To enable the slight vibration suppression control, select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08]. Slight vibration suppression control cannot be used in the speed control mode.	0h	○		
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PB25 *BOP1 Function selection B-1	_ _ _ x	Model adaptive control selection 0: Enabled (model adaptive control) 2: Disabled (PID control) This parameter setting is available with servo amplifiers with software version B4 or later.	0h			
	_ _ x _	Position acceleration/deceleration filter type selection Select the position acceleration/deceleration filter type. 0: Primary delay 1: Linear acceleration/deceleration When you select "Linear acceleration/deceleration", do not switch the control mode. Doing so will cause the servo motor to make a sudden stop at the time of control mode switching.	0h	○		
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PB26 *CDP Gain switching function		Select the gain switching condition. Set conditions to enable the gain switching values set in [Pr. PB29] to [Pr. PB36] and [Pr. PB56] to [Pr. PB60].				
	_ _ _ x	Gain switching selection 0: Disabled 1: Input device (gain switching (CDP)) 2: Command frequency 3: Droop pulses 4: Servo motor speed	0h	○	○	
	_ _ x _	Gain switching condition selection 0: Gain after switching is enabled with gain switching condition or more 1: Gain after switching is enabled with gain switching condition or less	0h	○	○	
	_ x _ _	Gain switching time constant disabling condition selection 0: Switching time constant enabled 1: Switching time constant disabled 2: Return time constant disabled Refer to section 7.2.4 for details. This parameter setting is available with servo amplifiers with software version B4 or later.	0h	○	○	
	x _ _ _	For manufacturing setting	0h			
PB27 CDL Gain switching condition		Set the value of gain switching (command frequency, droop pulses, and servo motor speed) selected in [Pr. PB26]. The set value unit differs depending on the switching condition item. (Refer to section 7.2.3.) Setting range: 0 to 9999	10 [kpulse/s] /[pulse] /[r/min]	○	○	
PB28 CDT Gain switching time constant		Set the time constant at which the gains will change in response to the conditions set in [Pr. PB26] and [Pr. PB27]. Setting range: 0 to 100	1 [ms]	○	○	
PB29 GD2B Load to motor inertia ratio after gain switching		Set the load to motor inertia ratio when gain switching is enabled. This parameter is enabled only when you select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08]. Setting range: 0.00 to 300.00	7.00 [Multiplier]	○	○	
PB30 PG2B Gain switching position loop gain		Set the position loop gain when the gain switching is enabled. When you set a value less than 1.0 rad/s, the value will be the same as [Pr. PB08]. This parameter is enabled only when you select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08]. Setting range: 0.0 to 2000.0	0.0 [rad/s]	○		

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PB31 VG2B Gain switching speed loop gain		Set the speed loop gain when the gain switching is enabled. When you set a value less than 20 rad/s, the value will be the same as [Pr. PB09]. This parameter is enabled only when you select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08]. Setting range: 0 to 65535	0 [rad/s]	○	○	
PB32 VICB Speed integral compensation after gain switching		Set the speed integral compensation when the gain changing is enabled. When you set a value less than 0.1 ms, the value will be the same as [Pr. PB10]. This parameter is enabled only when you select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08]. Setting range: 0.0 to 5000.0	0.0 [ms]	○	○	
PB33 VRF1B Vibration suppression control 1 - Vibration frequency after gain switching		Set the vibration frequency for vibration suppression control 1 when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PB19]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ _ 2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.0 to 300.0	0.0 [Hz]	○		
PB34 VRF2B Vibration suppression control 1 - Resonance frequency after gain switching		Set the resonance frequency for vibration suppression control 1 when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PB20]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ _ 2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.0 to 300.0	0.0 [Hz]	○		
PB35 VRF3B Vibration suppression control 1 - Vibration frequency damping after gain switching		Set a damping of the vibration frequency for vibration suppression control 1 when the gain switching is enabled. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ _ 2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.00 to 0.30	0.00	○		
PB36 VRF4B Vibration suppression control 1 - Resonance frequency damping after gain switching		Set a damping of the resonance frequency for vibration suppression control 1 when the gain switching is enabled. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ _ 2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.00 to 0.30	0.00	○		

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PB45 CNHF Command notch filter	Set the command notch filter.					
	_ _ x x	Command notch filter setting frequency selection Refer to table 5.6 for the relation of setting values to frequency.	00h	○		
	_ x _ _	Notch depth selection Refer to table 5.7 for details.	0h	○		
	x _ _ _	For manufacturer setting	0h			

Table 5.6 Command notch filter setting frequency selection

Setting value	Frequency [Hz]	Setting value	Frequency [Hz]	Setting value	Frequency [Hz]
00	Disabled	20	70	40	17.6
01	2250	21	66	41	16.5
02	1125	22	62	42	15.6
03	750	23	59	43	14.8
04	562	24	56	44	14.1
05	450	25	53	45	13.4
06	375	26	51	46	12.8
07	321	27	48	47	12.2
08	281	28	46	48	11.7
09	250	29	45	49	11.3
0A	225	2A	43	4A	10.8
0B	204	2B	41	4B	10.4
0C	187	2C	40	4C	10
0D	173	2D	38	4D	9.7
0E	160	2E	37	4E	9.4
0F	150	2F	36	4F	9.1
10	140	30	35.2	50	8.8
11	132	31	33.1	51	8.3
12	125	32	31.3	52	7.8
13	118	33	29.6	53	7.4
14	112	34	28.1	54	7.0
15	107	35	26.8	55	6.7
16	102	36	25.6	56	6.4
17	97	37	24.5	57	6.1
18	93	38	23.4	58	5.9
19	90	39	22.5	59	5.6
1A	86	3A	21.6	5A	5.4
1B	83	3B	20.8	5B	5.2
1C	80	3C	20.1	5C	5.0
1D	77	3D	19.4	5D	4.9
1E	75	3E	18.8	5E	4.7
1F	72	3F	18.2	5F	4.5

Table 5.7 Notch depth selection

Setting value	Depth [dB]	Setting value	Depth [dB]
0	-40.0	8	-6.0
1	-24.1	9	-5.0
2	-18.1	A	-4.1
3	-14.5	B	-3.3
4	-12.0	C	-2.5
5	-10.1	D	-1.8
6	-8.5	E	-1.2
7	-7.2	F	-0.6

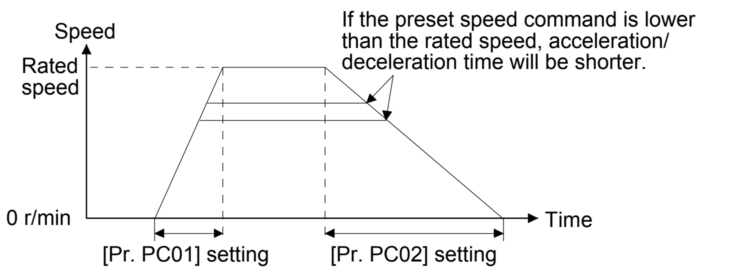
No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PB46 NH3 Machine resonance suppression filter 3		Set the notch frequency of the machine resonance suppression filter 3. To enable the setting value, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 3 selection" in [Pr. PB47]. Setting range: 10 to 4500	4500 [Hz]	○	○	○
PB47 NHQ3 Notch shape selection 3		Set the shape of the machine resonance suppression filter 3.				
	_ _ _ x	Machine resonance suppression filter 3 selection 0: Disabled 1: Enabled	0h	○	○	○
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: α = 2 1: α = 3 2: α = 4 3: α = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PB48 NH4 Machine resonance suppression filter 4		Set the notch frequency of the machine resonance suppression filter 4. To enable the setting value, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 4 selection" in [Pr. PB49]. Setting range: 10 to 4500	4500 [Hz]	○	○	○
PB49 NHQ4 Notch shape selection 4		Set the shape of the machine resonance suppression filter 4.				
	_ _ _ x	Machine resonance suppression filter 4 selection 0: Disabled 1: Enabled When you select "Enabled" of this digit, [Pr. PB17 Shaft resonance suppression filter] is not available.	0h	○	○	○
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: α = 2 1: α = 3 2: α = 4 3: α = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PB50 NH5 Machine resonance suppression filter 5		Set the notch frequency of the machine resonance suppression filter 5. To enable the setting value, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 5 selection" in [Pr. PB51]. Setting range: 10 to 4500	4500 [Hz]	○	○	○

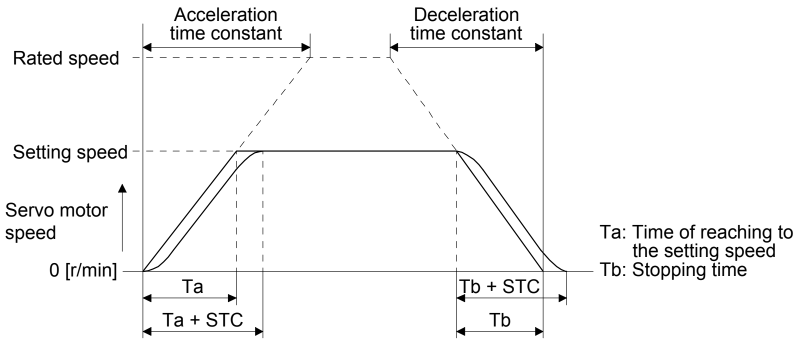
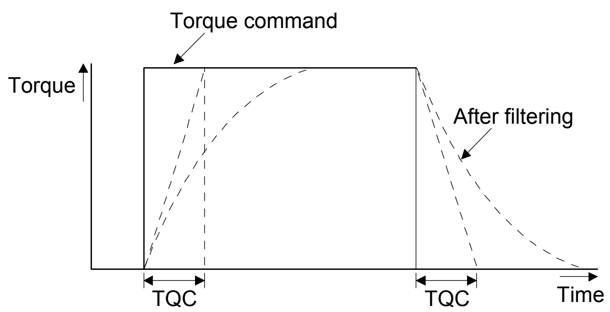
No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PB51 NHQ5 Notch shape selection 5	Set the shape of the machine resonance suppression filter 5. When you select "Enabled (_ _ _ 1)" of "Robust filter selection" in [Pr. PE41], the machine resonance suppression filter 5 is not available.					
	_ _ _ x	Machine resonance suppression filter 5 selection 0: Disabled 1: Enabled	0h	○	○	○
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: α = 2 1: α = 3 2: α = 4 3: α = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PB52 VRF21 Vibration suppression control 2 - Vibration frequency		Set the vibration frequency for vibration suppression control 2 to suppress low-frequency machine vibration. When "Vibration suppression control 2 tuning mode selection" is "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. Set manually for "Manual setting (_ _ 2 _)". To enable the digit, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. Setting range: 0.1 to 300.0	100.0 [Hz]	○		
PB53 VRF22 Vibration suppression control 2 - Resonance frequency		Set the resonance frequency for vibration suppression control 2 to suppress low-frequency machine vibration. When "Vibration suppression control 2 tuning mode selection" is "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. Set manually for "Manual setting (_ _ 2 _)". To enable the digit, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. Setting range: 0.1 to 300.0	100.0 [Hz]	○		
PB54 VRF23 Vibration suppression control 2 - Vibration frequency damping		Set a damping of the vibration frequency for vibration suppression control 2 to suppress low-frequency machine vibration. When "Vibration suppression control 2 tuning mode selection" is "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. Set manually for "Manual setting (_ _ 2 _)". To enable the digit, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. Setting range: 0.00 to 0.30	0.00	○		
PB55 VRF24 Vibration suppression control 2 - Resonance frequency damping		Set a damping of the resonance frequency for vibration suppression control 2 to suppress low-frequency machine vibration. When "Vibration suppression control 2 tuning mode selection" is "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. Set manually for "Manual setting (_ _ 2 _)". To enable the digit, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. Setting range: 0.00 to 0.30	0.00	○		

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PB56 VRF21B Vibration suppression control 2 - Vibration frequency after gain switching		Set the vibration frequency for vibration suppression control 2 when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PB52]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression mode selection" in [Pr. PA24] is "3 inertia mode (_ _ _ 1)". ・"Vibration suppression control 2 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.0 to 300.0	0.0 [Hz]	○		
PB57 VRF22B Vibration suppression control 2 - Resonance frequency after gain switching		Set the resonance frequency for vibration suppression control 2 when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PB53]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression mode selection" in [Pr. PA24] is "3 inertia mode (_ _ _ 1)". ・"Vibration suppression control 2 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.0 to 300.0	0.0 [Hz]	○		
PB58 VRF23B Vibration suppression control 2 - Vibration frequency damping after gain switching		Set a damping of the vibration frequency for vibration suppression control 2 when the gain switching is enabled. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression mode selection" in [Pr. PA24] is "3 inertia mode (_ _ _ 1)". ・"Vibration suppression control 2 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.00 to 0.30	0.00	○		
PB59 VRF24B Vibration suppression control 2 - Resonance frequency damping after gain switching		Set a damping of the resonance frequency for vibration suppression control 2 when the gain switching is enabled. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression mode selection" in [Pr. PA24] is "3 inertia mode (_ _ _ 1)". ・"Vibration suppression control 2 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.00 to 0.30	0.00	○		

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PB60 PG1B Model loop gain after gain switching		Set the model loop gain when the gain switching is enabled. When you set a value less than 1.0 rad/s, the value will be the same as [Pr. PB07]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.0 to 2000.0	0.0 [rad/s]	○	○	

5.2.3 Extension setting parameters ([Pr. PC_ _])

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PC01 STA Acceleration time constant		Set the acceleration time required to reach the rated speed from 0 r/min in response to VC (Analog speed command) and [Pr. PC05 Internal speed command 1] to [Pr. PC11 Internal speed command 7].  For example for the servo motor of 3000 r/min rated speed, set 3000 (3s) to increase speed from 0 r/min to 1000 r/min in 1 second. Setting range: 0 to 50000	0 [ms]		○	○
PC02 STB Deceleration time constant		Set the deceleration time required to reach 0 r/min from the rated speed in response to VC (Analog speed command) and [Pr. PC05 Internal speed command 1] to [Pr. PC11 Internal speed command 7]. Setting range: 0 to 50000	0 [ms]		○	○

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PC03 STC S-pattern acceleration/ deceleration time constant		This is used to smooth start/stop of the servo motor. Set the time of the arc part for S-pattern acceleration/deceleration. Servo is usually operated with linear acceleration and deceleration; however, smooth start and stop are enabled by setting [Pr. PC03 S-pattern acceleration/deceleration time constants]. When the S-pattern acceleration/deceleration time constants are set, smooth positioning is enabled as shown in the following figure. Note that when it is set, a time period from the start to output of MEND (Travel completion) is longer by the S-pattern acceleration/ deceleration time constants.  When the STC value is set longer than the constant speed time, the speed may not reach to the command speed. Additionally, when 1000 ms or more value is set, it will be clamped to 1000 ms. Setting range: 0 to 5000	0 [ms]		○	○
PC04 TQC Torque command time constant		Set the constant of a primary delay to the torque command.  TQC: Torque command time constant Setting range: 0 to 50000	0 [ms]			○

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PC05 SC1 Internal speed command 1/internal speed limit 1		Set speed 1 of internal speed commands. Setting range: 0 to permissible instantaneous speed	100 [r/min]		○	
		Set speed 1 of internal speed limits. Setting range: 0 to permissible instantaneous speed				○
PC06 SC2 Internal speed command 2 Internal speed limit 2		Set speed 2 of internal speed commands. Setting range: 0 to permissible instantaneous speed	500 [r/min]		○	
		Set speed 2 of internal speed limits. Setting range: 0 to permissible instantaneous speed				○
PC07 SC3 Internal speed command 3 Internal speed limit 3		Set speed 3 of internal speed commands. Setting range: 0 to permissible instantaneous speed	1000 [r/min]		○	
		Set speed 3 of internal speed limits. Setting range: 0 to permissible instantaneous speed				○
PC08 SC4 Internal speed command 4 Internal speed limit 4		Set speed 4 of internal speed commands. Setting range: 0 to permissible instantaneous speed	200 [r/min]		○	
		Set speed 4 of internal speed limits. Setting range: 0 to permissible instantaneous speed				○
PC09 SC5 Internal speed command 5 Internal speed limit 5		Set speed 5 of internal speed commands. Setting range: 0 to permissible instantaneous speed	300 [r/min]		○	
		Set speed 5 of internal speed limits. Setting range: 0 to permissible instantaneous speed				○
PC10 SC6 Internal speed command 6 Internal speed limit 6		Set speed 6 of internal speed commands. Setting range: 0 to permissible instantaneous speed	500 [r/min]		○	
		Set speed 6 of internal speed limits. Setting range: 0 to permissible instantaneous speed				○
PC11 SC7 Internal speed command 7 Internal speed limit 7		Set speed 7 of internal speed commands. Setting range: 0 to permissible instantaneous speed	800 [r/min]		○	
		Set speed 7 of internal speed limits. Setting range: 0 to permissible instantaneous speed				○

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PC12 VCM Analog speed command - Maximum speed		Set the speed at the maximum input voltage (10 V) of VC (Analog speed command). When "0" is set, the analog speed command maximum speed would be the rated speed of the servo motor connected. If a value equal to or larger than the permissible speed is inputted to VC, the value is clamped at the permissible speed. Setting range: 0 to 50000	0 [r/min]		○	
Analog speed limit - Maximum speed		Set the speed at the maximum input voltage (10 V) of VLA (Analog speed limit). When "0" is set, the analog speed command maximum speed would be the rated speed of the servo motor connected. If a limited value equal to or larger than the permissible speed is inputted to VLA, the value is clamped at the permissible speed. Setting range: 0 to 50000				○
PC13 TLC Analog torque command maximum output		Set the output torque at the analog torque command voltage (TC = ±8 V) of +8 V on the assumption that the maximum torque is 100.0%. For example, set 50.0. The maximum torque × $\frac{50.0}{100.0}$ is outputted. If a value equal to or larger than the maximum torque is inputted to TC, the value is clamped at the maximum torque. Setting range: 0.0 to 1000.0	100.0 [%]			○
PC14 MOD1 Analog monitor 1 output	_ _ x x	Analog monitor 1 output selection Select a signal to output to MO1 (Analog monitor 1). Refer to appendix 3 (3) for detection point of output selection. Refer to table 5.8 for settings.	00h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

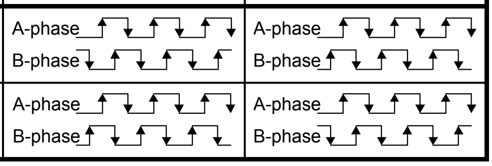
Table 5.8 Analog monitor setting value

Setting value	Item
00	Servo motor speed (±8 V/max. speed) (Note 3)
01	Torque (±8 V/max. torque) (Note 2)
02	Servo motor speed (+8 V/max. speed) (Note 3)
03	Torque (+8 V/max. torque) (Note 2)
04	Current command (±8 V/max. current command)
05	The command pulse frequency (±10 V/4 Mpulses/s)
06	Servo motor-side droop pulses (±10 V/100 pulses) (Note 1)
07	Servo motor-side droop pulses (±10 V/1000 pulses) (Note 1)
08	Servo motor-side droop pulses (±10 V/10000 pulses) (Note 1)
09	Servo motor-side droop pulses (±10 V/100000 pulses) (Note 1)
0D	Bus voltage (+8 V/400 V)
0E	Speed command 2 (±8 V/max. speed) (Note 3)
17	Encoder inside temperature (±10 V/±128 °C)

Note 1. Encoder pulse unit
2. The value in [Pr. PA11] or [Pr. PA12] whichever higher is applied for the maximum torque.
3. The maximum speed of the HF-KN series servo motor is 4500 r/min and that of the HG-KN series is 5000 r/min. Please watch out when using an HG-KN series servo motor as a replacement for the HF-KN series servo motor because HG-KN series output 8 V at 5000 r/min.

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PC15 MOD2 Analog monitor 2 output	_ _ x x	Analog monitor 2 output selection Select a signal to output to MO2 (Analog monitor 2). Refer to appendix 3 (3) for detection point of output selection. Refer to [Pr. PC14] for settings.	01h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PC16 MBR Electromagnetic brake sequence output		Set the delay time between MBR (Electromagnetic brake interlock) and the base drive circuit is shut-off. Setting range: 0 to 1000	0 [ms]	○	○	○
PC17 ZSP Zero speed		Set the output range of ZSP (Zero speed detection). ZSP (Zero speed detection) has hysteresis of 20 r/min. Setting range: 0 to 10000	50 [r/min]	○	○	○
PC18 *BPS Alarm history clear	_ _ _ x	Alarm history clear selection Used to clear the alarm history. 0: Disabled 1: Enabled When you select "Enabled", the alarm history will be cleared at next power-on. After the alarm history is cleared, the setting is automatically disabled.	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PC19 *ENRS Encoder output pulse selection	_ _ _ x	Encoder output pulse phase selection Select the encoder pulse direction. 0: Increasing A-phase 90° in CCW 1: Increasing A-phase 90° in CW	0h	○	○	○

Setting value	Servo motor rotation direction CCW	CW
0	A-phase B-phase	A-phase B-phase
1	A-phase B-phase	A-phase B-phase



No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
	_ _ x _	Encoder output pulse setting selection 0: Output pulse setting 1: Dividing ratio setting 2: The same output pulse setting as the command pulse 3: A-phase/B-phase pulse electronic gear setting When you select "1", the settings of [Pr. PA16 Encoder output pulses 2] will be disabled. When you select "2", the settings of [Pr. PA15 Encoder output pulses] and [Pr. PA16 Encoder output pulses 2] will be disabled. When you select the setting, do not change the settings in [Pr. PA06] and [Pr. PA07] after the power-on.	0h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PC20 *SNO Station No. setting		Set a station No. of the servo amplifier for RS-422 communication. Always set one station to one axis of the servo amplifier. Setting one station number to two or more stations will disable a normal communication. Setting range: 0 to 31	0 [Station]	○	○	○

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PC21 *SOP RS-422 communi-cation function selection	Select the details of RS-422/RS-485 communication function.					
	_ _ _ x	For manufacturer setting	0h	○	○	○
	_ _ x _	RS-422 communication baud rate selection 0: 9600 [bps] 1: 19200 [bps] 2: 38400 [bps] 3: 57600 [bps] 4: 115200 [bps] 6: 4800 [bps]	0h			
	_ x _ _	RS-422 communication response delay time selection 0: Disabled 1: Enabled (responding after 800 μs or longer delay time)	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PC22 *COP1 Function selection C-1	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		2h			
	_ x _ _		0h			
	x _ _ _	Encoder cable communication method selection Select the encoder cable communication method. 0: Two-wire type 1: Four-wire type If the setting is incorrect, [AL. 16 Encoder initial communication error 1] or [AL. 20 Encoder normal communication error 1] occurs.	0h	○	○	○
PC23 *COP2 Function selection C-2	_ _ _ x	Servo-lock selection at speed control stop Select the servo-lock selection at speed control stop. In the speed control mode, the servo motor shaft can be locked to prevent the shaft from being moved by an external force. 0: Enabled (servo-lock) The operation to maintain the stop position is performed. 1: Disabled (no servo-lock) The stop position is not maintained. The control to make the speed 0 r/min is performed.	0h		○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _	VC/VLA voltage averaging selection Select the VC/VLA voltage average. Set the filtering time when VC (Analog speed command) or VLA (Analog speed limit) is imported. Set 0 to vary the speed to voltage fluctuation in real time. Increase the set value to vary the speed slower to voltage fluctuation.	0h		○	○

Setting value	Filtering time [ms]
0	0
1	0.444
2	0.888
3	1.777
4	3.555
5	7.111

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
	x _ _ _	Speed limit selection at torque control Select the speed limit selection at torque control. 0: Enabled 1: Disabled Do not use this function except when configuring an external speed loop.	0h			○

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PC24 *COP3 Function selection C-3	_ _ _ x	In-position range unit selection Select a unit of in-position range. 0: Command input pulse unit 1: Servo motor encoder pulse unit	0h	○		
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _	Error excessive alarm/error excessive warning level unit selection Select a setting unit for the error excessive alarm level set in [Pr. PC43] and for error excessive warning level setting with [Pr. PC73]. 0: 1 rev unit 1: 0.1 rev unit 2: 0.01 rev unit 3: 0.001 rev unit	0h	○		
PC26 *COP5 Function selection C-5	_ _ _ x	[AL. 99 Stroke limit warning] selection Select [AL. 99 Stroke limit warning]. 0: Enabled 1: Disabled	0h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PC27 *COP6 Function selection C-6	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _	Undervoltage alarm selection Select the alarm and warning that occurs when the bus voltage drops to the undervoltage alarm level. 0: [AL. 102] regardless of servo motor speed 1: [AL. E9.1] occurs when the servo motor speed is 50 r/min or less, and [AL. 10.2] occurs when the servo motor speed is over 50 r/min.	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PC30 STA2 Acceleration time constant 2		To enable the parameter, turn on STAB2 (Speed acceleration/deceleration selection). Set the acceleration time required to reach the rated speed from 0 r/min in response to VC (Analog speed command) and [Pr. PC05 Internal speed command 1] to [Pr. PC11 Internal speed command 7]. Setting range: 0 to 50000	0 [ms]		○	○
PC31 STB2 Deceleration time constant 2		To enable the parameter, turn on STAB2 (Speed acceleration/deceleration selection). Set the deceleration time required to reach 0 r/min from the rated speed in response to VC (Analog speed command) and [Pr. PC05 Internal speed command 1] to [Pr. PC11 Internal speed command 7]. Setting range: 0 to 50000	0 [ms]		○	○
PC32 CMX2 Commanded pulse multiplication numerator 2		To enable the parameter, select "Electronic gear (0 _ _ _)" of "Electronic gear selection" in [Pr. PA21]. Setting range: 1 to 16777215	1	○		
PC33 CMX3 Commanded pulse multiplication numerator 3		To enable the parameter, select "Electronic gear (0 _ _ _)" of "Electronic gear selection" in [Pr. PA21]. Setting range: 1 to 16777215	1	○		

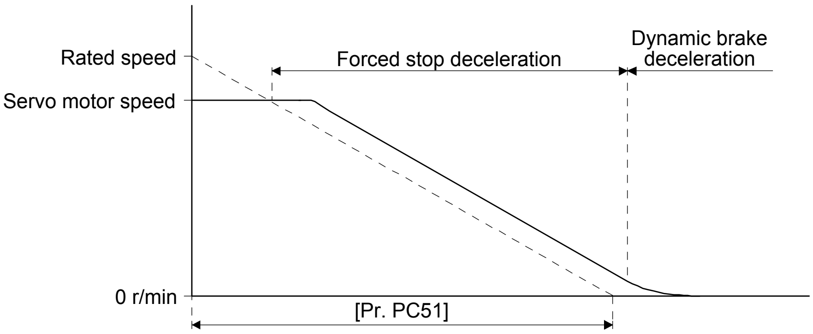
<table>
<tr><th rowspan="2">No./
symbol/name</th><th rowspan="2">Setting
digit</th><th rowspan="2">Function</th><th rowspan="2">Initial
value
[unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>PC34
CMX4
Commanded pulse multiplication numerator 4</td><td></td><td>To enable the parameter, select "Electronic gear (0 _ _ _)" of "Electronic gear selection" in [Pr. PA21].

Setting range: 1 to 16777215</td><td>1</td><td>○</td><td></td><td></td></tr>
<tr><td>PC35
TL2
Internal torque limit 2</td><td></td><td>Set the parameter on the assumption that the maximum torque is 100 %. The parameter is for limiting the torque of the servo motor.
No torquet is generated when this parameter is set to "0.0".
When TL1 (Internal torque limit selection) is turned on, Internal torque limits 1 and 2 are compared and the lower value will be enabled.

Setting range: 0.0 to 100.0</td><td>100.0
[%]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td rowspan="3">PC36
*DMD
Status display selection</td><td>_ _ x x</td><td>Status display selection at power-on
Select a status display shown at power-on.
00: Cumulative feedback pulses
01: Servo motor speed
02: Droop pulses
03: Cumulative command pulses
04: Command pulse frequency
05: Analog speed command voltage (Note 1)
06: Analog torque command voltage (Note 2)
07: Regenerative load ratio
08: Effective load ratio
09: Peak load ratio
0A: Instantaneous torque
0B: Within one-revolution position (1 pulse unit)
0C: Within one-revolution position (100 pulses unit)
0D: ABS counter (Note 3)
0E: Load to motor inertia ratio
0F: Bus voltage
10: Encoder inside temperature
11: Settling time
12: Oscillation detection frequency
13: Number of tough operations
14: Unit power consumption (increment of 1 W)
15: Unit power consumption (increment of 1 kW)
16: Unit total power consumption (increment of 1 Wh)
17: Unit total power consumption (increment of 100 kWh)

Note 1. It is for the speed control mode. It will be the analog speed limit voltage in the torque control mode.
2. It is for the torque control mode. It will be the analog torque limit voltage in the speed control mode and position control mode.
3. Travel distance from power on is displayed by counter value.</td><td>00h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ x _ _</td><td>Status display at power-on in corresponding control mode
0: Depends on the control mode
<table><tr><th>Control mode</th><th>Status display at power-on</th></tr><tr><td>Position</td><td>Cumulative feedback pulses</td></tr><tr><td>Position/speed</td><td>Cumulative feedback pulses/servo motor speed</td></tr><tr><td>Speed</td><td>Servo motor speed</td></tr><tr><td>Speed/torque</td><td>Servo motor speed/analog torque command voltage</td></tr><tr><td>Torque</td><td>Analog torque command voltage</td></tr><tr><td>Torque/position</td><td>Analog torque command voltage/cumulative feedback pulses</td></tr></table>1: Depends on the last two digit setting of the parameter</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
</table>

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PC37 VCO Analog speed command offset/Analog speed limit offset		Set the offset voltage of VC (Analog speed command). For example, if CCW rotation is provided by switching on ST1 (Forward rotation start) with applying 0 V to VC, set a negative value. When automatic VC offset is used, the automatically offset value is set to this parameter. (Refer to section 4.5.4.) The initial value is provided before shipment by the automatic VC offset function on condition that the voltage between VC and LG is 0 V. Setting range: -9999 to 9999	The value differs depending on the servo amplifiers. [mV]		○	
		Set the offset voltage of VLA (Analog speed limit). For example, if CCW rotation is provided by switching on RS1 (Forward rotation selection) with applying 0 V to VLA, set a negative value. When automatic VC offset is used, the automatically offset value is set to this parameter. (Refer to section 4.5.4.) The initial value is provided before shipment by the automatic VC offset function on condition that the voltage between VLA and LG is 0 V. Setting range: -9999 to 9999				○
PC38 TPO Analog torque command offset/Analog torque limit offset		Set the offset voltage of TC (Analog torque command). Setting range: -9999 to 9999	0 [mV]			○
		Set the offset voltage of TLA (Analog torque limit). Setting range: -9999 to 9999			○	
PC39 MO1 Analog monitor 1 offset		Set the offset voltage of MO1 (Analog monitor 1). Setting range: -9999 to 9999	0 [mV]	○	○	○
PC40 MO2 Analog monitor 2 offset		Set the offset voltage of MO2 (Analog monitor 2). Setting range: -9999 to 9999	0 [mV]	○	○	○
PC43 ERZ Error excessive alarm level		Set an error excessive alarm level. You can change the setting unit with "Error excessive alarm/error excessive warning level unit selection" in [Pr. PC24]. However, setting "0" will be 3 rev. Setting over 200 rev will be clamped with 200 rev. Setting range: 0 to 1000	0 [rev]	○		

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	 S	 T
PC51 RSBR Forced stop deceleration time constant		Set deceleration time constant when you use the forced stop deceleration function. Set the time per ms from the rated speed to 0 r/min.  [Precautions] ・If the servo motor torque is saturated at the maximum torque during forced stop deceleration because the set time is too short, the time to stop will be longer than the set time constant. ・[AL. 50 Overload alarm 1] or [AL. 51 Overload alarm 2] may occur during forced stop deceleration, depending on the set value. ・After an alarm that leads to a forced stop deceleration, if an alarm that does not lead to a forced stop deceleration occurs or if the power supply is cut, dynamic braking will start regardless of the deceleration time constant setting. Setting range: 0 to 20000	100 [ms]	○	○	
PC54 RSUP1 Vertical axis freefall prevention compensation amount		Set the compensation amount of the vertical axis freefall prevention function. Set it per servo motor rotation amount. The function will pull up an shaft per rotation amount to the servo motor rotation direction at the time of inputting forward rotation pulse for a positive value, and at the time of inputting reverse rotation pulse for a negative value. For example, if a positive compensation amount is set when the [Pr. PA14 Rotation direction selection] setting is "1", compensation will be performed to the CW direction. The vertical axis freefall prevention function is performed when all of the following conditions are met. 1) Position control mode 2) The value of the parameter is other than "0". 3) The forced stop deceleration function is enabled. 4) Alarm occurs or EM2 turns off when the servo motor speed is zero speed or less. 5) MBR (Electromagnetic brake interlock) was enabled in [Pr. PD24], [Pr. PD25], and [Pr. PD28], and the base circuit shut-off delay time was set in [Pr. PC16]. Setting range: -25000 to 25000	0 [0.0001 rev]	○		
PC60 *COPD Function selection C-D	_ _ _ x	Motor-less operation selection Select the motor-less operation. 0: Disabled 1: Enabled	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _	[AL. 9B Error excessive warning] selection 0: [AL. 9B Error excessive warning] is disabled. 1: [AL. 9B Error excessive warning] is enabled. This parameter is available with servo amplifiers with software version B4 or later.	0h	○	○	○

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PC73 ERW Error excessive warning level		Set an error excessive warning level. To enable the parameter, select "Enabled (1 _ _ _)" of "[AL. 9B Error excessive warning] selection" in [Pr. PC60]. You can change the setting unit with "Error excessive alarm/error excessive warning level unit selection" in [Pr. PC24]. Set the level in rev unit. When "0" is set, 1 rev will be applied. Setting over 200 rev will be clamped with 200 rev. When an error reaches the set value, [AL. 9B Error excessive warning] will occur. When the error decreases lower than the set value, the warning will be canceled automatically. The minimum pulse width of the warning signal is 100 [ms]. Set as follows: [Pr. PC73 Error excessive warning level] < [Pr. PC43 Error excessive alarm level] When you set as [Pr. PC73 Error excessive warning level] ≥ [Pr. PC43 Error excessive alarm level], [AL. 52 Error excessive] will occur earlier than the warning. This parameter setting is available with servo amplifiers with software version B4 or later. Setting range: 0 to 1000	0 [rev]	○		

5.2.4 I/O setting parameters ([Pr. PD_ _])

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PD01 *DIA1 Input signal automatic on selection 1		Select input devices to turn on them automatically.				
	_ _ _ x (HEX)	_ _ _ x (BIN): For manufacturer setting	0h			
		_ _ x _ (BIN): For manufacturer setting				
		_ x _ _ (BIN): SON (Servo-on) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	○
		x _ _ _ (BIN): For manufacturer setting				
	_ _ x _ (HEX)	_ _ _ x (BIN): PC (Proportional control) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)	0h	○	○	
		_ _ x _ (BIN): TL (External torque limit selection) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	
		_ x _ _ (BIN): For manufacturer setting				
		x _ _ _ (BIN): For manufacturer setting				
	_ x _ _ (HEX)	_ _ _ x (BIN): For manufacturer setting	0h			
		_ _ x _ (BIN): For manufacturer setting				
		_ x _ _ (BIN): LSP (Forward rotation stroke end) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	
		x _ _ _ (BIN): LSN (Reverse rotation stroke end) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	
	x _ _ _	For manufacturer setting	0h			

Convert the setting value into hexadecimal as follows.

0 □ □ □

Signal name	Initial value BIN	Initial value HEX
	0	0
	0	
SON (Servo-on)	0	
	0	

Signal name	Initial value BIN	Initial value HEX
PC (Proportional control)	0	0
TL (External torque limit selection)	0	
	0	
	0	

Signal name	Initial value BIN	Initial value HEX
	0	0
	0	
LSP (Forward rotation stroke end)	0	
LSN (Reverse rotation stroke end)	0	

BIN 0: Use for an external input signal.
BIN 1: Automatic on

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PD03 *DI1L Input device selection 1L		Any input device can be assigned to the CN1-15 pin.				
	_ _ x x	Position control mode - Device selection Refer to table 5.9 for settings.	02h	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.9 for settings.	02h		○	

Table 5.9 Selectable input devices

Setting value	Input device (Note 1) P	Input device (Note 1) S	Input device (Note 1) T
02	SON	SON	SON
03	RES	RES	RES
04	PC	PC	
05	TL	TL	
06	CR		
07		ST1	RS2
08		ST2	RS1
09	TL1	TL1	
0A	LSP	LSP	
0B	LSN	LSN	
0D	CDP	CDP	
20		SP1	SP1
21		SP2	SP2
22		SP3	SP3
23	LOP (Note 2)	LOP (Note 2)	LOP (Note 2)
24	CM1		
25	CM2		
26		STAB2	STAB2

Note 1. P: position control mode, S: speed control mode, T: torque control mode
The diagonal lines indicate manufacturer settings. Never change the setting.
2. When assigning LOP (Control switching), assign it to the same pin in all control modes.

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PD04 *DI1H Input device selection 1H		Any input device can be assigned to the CN1-15 pin.				
	_ _ x x	Torque control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	02h			○
	_ x _ _	For manufacturer setting	2h			
	x _ _ _		0h			
PD11 *DI5L Input device selection 5L		Any input device can be assigned to the CN1-19 pin.				
	_ _ x x	Position control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	03h	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	07h		○	
PD12 *DI5H Input device selection 5H		Any input device can be assigned to the CN1-19 pin.				
	_ _ x x	Torque control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	07h			○
	_ x _ _	For manufacturer setting	8h			
	x _ _ _		3h			
PD13 *DI6L Input device selection 6L		Any input device can be assigned to the CN1-41 pin.				
	_ _ x x	Position control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	06h	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	08h		○	

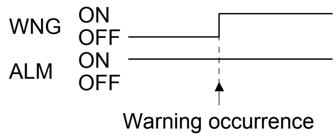
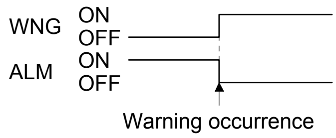
No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PD14 *DI6H Input device selection 6H		Any input device can be assigned to the CN1-41 pin.				
	_ _ x x	Torque control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	08h			○
	_ x _ _	For manufacturer setting	9h			
	x _ _ _		3h			
PD17 *DI8L Input device selection 8L		Any input device can be assigned to the CN1-43 pin.				
	_ _ x x	Position control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	0Ah	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	0Ah		○	
PD18 *DI8H Input device selection 8H		Any input device can be assigned to the CN1-43 pin.				
	_ _ x x	Torque control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	00h			○
	_ x _ _	For manufacturer setting	7h			
	x _ _ _		0h			
PD19 *DI9L Input device selection 9L		Any input device can be assigned to the CN1-44 pin.				
	_ _ x x	Position control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	0Bh	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	0Bh		○	
PD20 *DI9H Input device selection 9H		Any input device can be assigned to the CN1-44 pin.				
	_ _ x x	Torque control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	00h			○
	_ x _ _	For manufacturer setting	8h			
	x _ _ _		0h			
PD24 *DO2 Output device selection 2	_ _ x x	Device selection Any output device can be assigned to the CN1-23 pin. Refer to table 5.10 for settings.	0Ch	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

Table 5.10 Selectable output devices

Setting value	Output device (Note) P	Output device (Note) S	Output device (Note) T
00	Always off	Always off	Always off
02	RD	RD	RD
03	ALM	ALM	ALM
04	INP	SA	Always off
05	MBR	MBR	MBR
07	TLC	TLC	VLC
08	WNG	WNG	WNG
0A	Always off	SA	Always off
0B	Always off	Always off	VLC
0C	ZSP	ZSP	ZSP
0D	MTTR	MTTR	MTTR
0F	CDPS	Always off	Always off

Note. P: position control mode, S: speed control mode, T: torque control mode

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PD25 *DO3 Output device selection 3	_ _ x x	Device selection Any output device can be assigned to the CN1-24 pin. Refer to table 5.10 in [Pr. PD24] for settings.	04h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD28 *DO6 Output device selection 6	_ _ x x	Device selection Any output device can be assigned to the CN1-49 pin. Refer to table 5.10 in [Pr. PD24] for settings.	02h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD29 *DIF Input filter setting	Select a filter for the input signal.					
	_ _ _ x	Input signal filter selection If external input signal causes chattering due to noise, etc., input filter is used to suppress it. 0: None 1: 0.888 [ms] 2: 1.777 [ms] 3: 2.666 [ms] 4: 3.555 [ms]	4h	○	○	○
	_ _ x _	RES (Reset) dedicated filter selection 0: Disabled 1: Enabled (50 [ms])	0h	○	○	○
	_ x _ _	CR (Clear) dedicated filter selection 0: Disabled 1: Enabled (50 [ms])	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PD30 *DOP1 Function selection D-1	_ _ _ x	Stop method selection for LSP (Forward rotation stroke end) off and LSN (Reverse rotation stroke end) off Select a stop method for LSP (Forward rotation stroke end) off and LSN (Reverse rotation stroke end) off 0: Quick stop 1: Slow stop	0h	○	○	
	_ _ x _	Base circuit status selection for RES (Reset) on 0: Base circuit shut-off 1: No base circuit shut-off	0h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD32 *DOP3 Function selection D-3	_ _ _ x	CR (Clear) selection Set CR (Clear). 0: Deleting droop pulses at the leading edge of turning on of CR 1: Continuous deleting of droop pulses while CR is on	0h	○		
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			

<table>
<tr><th rowspan="2">No./
symbol/name</th><th rowspan="2">Setting
digit</th><th rowspan="2">Function</th><th rowspan="2">Initial
value
[unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="4">PD34
*DOP5
Function
selection D-5</td><td>_ _ _ x</td><td>Alarm code output
Select if output alarm codes.
Alarm codes are outputted to pins CN1-23, CN1-24, and CN1-49.
0: Disabled
1: Enabled
For details of the alarm codes, refer to chapter 8.
When you select alarm code output while MBR or ALM is selected for CN1-23, CN1-24, or CN1-49 pin, [AL. 37 Parameter error] will occur.</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ _ x _</td><td>Selection of output device at warning occurrence
Select ALM (Malfunction) output status at warning occurrence.
<table>
<tr><th>Setting
value</th><th>Device status</th></tr>
<tr><td>0</td><td>
</td></tr>
<tr><td>1</td><td>
</td></tr>
</table></td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">PD43
*DI11L
Input device
selection 11L</td><td colspan="6">Any input device can be assigned to the CN1-10 pin and the CN1-37 pin.
When "00" is set, PP/PP2 (Forward rotation pulse/Manual pulse generator) will be assigned.
The CN1-37 pin is available with servo amplifiers having software version B7 or later, and manufactured in May, 2015 or later.
This parameter setting is available with servo amplifiers with software version B7or later.</td></tr>
<tr><td>_ _ x x</td><td>Position control mode - Device selection
This setting is invalid.</td><td>00h</td><td></td><td></td><td></td></tr>
<tr><td>x x _ _</td><td>Speed control mode - Device selection
Refer to table 5.9 in [Pr. PD03] for settings.</td><td>00h</td><td></td><td>○</td><td></td></tr>
<tr><td rowspan="3">PD44
*DI11H
Input device
selection 11H</td><td colspan="6">Any input device can be assigned to the CN1-10 pin and the CN1-37 pin.
When "00" is set, PP/PP2 (Forward rotation pulse/Manual pulse generator) will be assigned.
The CN1-37 pin is available with servo amplifiers having software version B7 or later, and manufactured in May, 2015 or later.
This parameter setting is available with servo amplifiers with software version B7or later.</td></tr>
<tr><td>_ _ x x</td><td>Torque control mode - Device selection
Refer to table 5.9 in [Pr. PD03] for settings.</td><td>00h</td><td></td><td></td><td>○</td></tr>
<tr><td>x x _ _</td><td>For manufacturer setting</td><td>20h</td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">PD45
*DI12L
Input device
selection 12L</td><td colspan="6">Any input device can be assigned to the CN1-35 pin and the CN1-38 pin.
When "00" is set, NP/NP2 (Reverse rotation pulse/Manual pulse generator) will be assigned.
The CN1-38 pin is available with servo amplifiers having software version B7 or later, and manufactured in May, 2015 or later.
This parameter setting is available with servo amplifiers with software version B7or later.</td></tr>
<tr><td>_ _ x x</td><td>Position control mode - Device selection
This setting is invalid.</td><td>00h</td><td></td><td></td><td></td></tr>
<tr><td>x x _ _</td><td>Speed control mode - Device selection
Refer to table 5.9 in [Pr. PD03] for settings.</td><td>00h</td><td></td><td>○</td><td></td></tr>
</table>

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PD46 *DI12H Input device selection 12H		Any input device can be assigned to the CN1-35 pin and the CN1-38 pin. When "00" is set, NP/NP2 (Reverse rotation pulse/Manual pulse generator) will be assigned. The CN1-38 pin is available with servo amplifiers having software version B7 or later, and manufactured in May, 2015 or later. This parameter setting is available with servo amplifiers with software version B7or later.				
	_ _ x x	Torque control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	00h			○
	x x _ _	For manufacturer setting	2Bh			

5.2.5 Extension setting 2 parameters ([Pr. PE_ _])

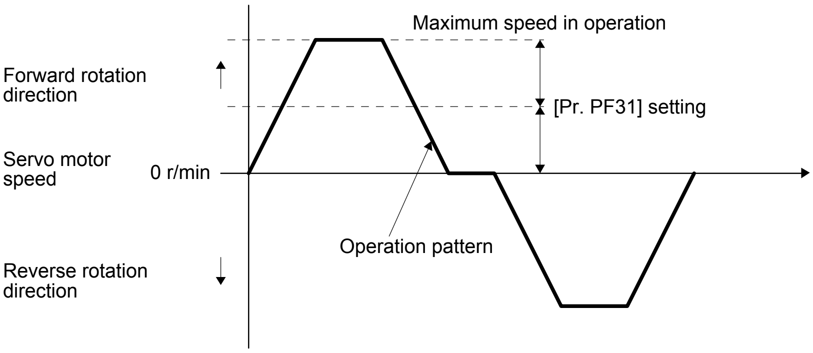
No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PE41 EOP3 Function selection E-3	_ _ _ x	Robust filter selection 0: Disabled 1: Enabled When you select "Enabled" of this digit, the machine resonance suppression filter 5 set in [Pr. PB51] is not available.	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			

5.2.6 Extension setting 3 parameters ([Pr. PF_ _])

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PF09 *FOP5 Function selection F-5	_ _ _ x	Electronic dynamic brake selection 0: Disabled 3: Automatic (enabled only for specified servo motors) Refer to the following table for the specified servo motors.	0h	○	○	○

Series	Servo motor
HG-KN	HG-KN053/HG-KN13/HG-KN23/HG-KN43
HG-SN	HG-SN52

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
		This parameter setting is available with servo amplifiers with software version B5 or later.				
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PF21 DRT Drive recorder switching time setting		Set a drive recorder switching time. When a USB communication is cut during using a graph function or a graph function is terminated, the function will be changed to the drive recorder function after the setting time of this parameter. When a value from "1" to "32767" is set, it will switch after the setting value. When "0" is set, it will switch after 600 s. When "-1" is set, the drive recorder function is disabled. Setting range: -1 to 32767	0 [s]	○	○	○

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PF23 OSCL1 Vibration tough drive - Oscillation detection level		Set a filter readjustment sensitivity of [Pr. PB13 Machine resonance suppression filter 1] and [Pr. PB15 Machine resonance suppression filter 2] while the vibration tough drive is enabled. However, setting "0" will be 50%. Example: When you set "50" to the parameter, the filter will be readjusted at the time of 50% or more oscillation level. Setting range: 0 to 100	50 [%]	○	○	
PF24 *OSCL2 Vibration tough drive function selection	_ _ _ x	Oscillation detection alarm selection Select alarm or warning when an oscillation continues at a filter readjustment sensitivity level of [Pr. PF23]. The digit is continuously enabled regardless of the vibration tough drive in [Pr. PA20]. 0: [AL. 54 Oscillation detection] will occur at oscillation detection. 1: [AL. F3.1 Oscillation detection warning] will occur at oscillation detection. 2: Oscillation detection function disabled	0h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PF25 CVAT instantaneous power failure tough drive - detection time		Set the time of the [AL. 10.1 Voltage drop in the power] occurrence. To disable the parameter, select "Disabled (_ 0 _ _)" of "Instantaneous power failure tough drive selection" in [Pr. PA20]. When "Enabled (_ 1 _ _)" is selected of "Instantaneous power failure tough drive selection" in [Pr. PA20], the power should be off for the setting value of this parameter + 1.5 s or more before cycling the power to enable a parameter whose symbol is preceded by "*". Setting range: 30 to 2000	200 [ms]	○	○	○
PF31 FRIC Machine diagnosis function - Friction judgement speed		Set a servo motor speed to divide a friction estimation area into high and low for the friction estimation process of the machine diagnosis. However, setting "0" will be the value half of the rated speed. When your operation pattern is under rated speed, we recommend that you set half value to the maximum speed with this.  Setting range: 0 to permissible speed	0 [r/min]	○	○	○

MEMO

6. NORMAL GAIN ADJUSTMENT

> POINT
>
> ●In the torque control mode, you do not need to make gain adjustment.
>
> ●Before making gain adjustment, check that your machine is not being operated at maximum torque of the servo motor. If operated over maximum torque, the machine may vibrate and may operate unexpectedly. In addition, make gain adjustment with a safety margin considering characteristic differences of each machine. It is recommended that generated torque during operation is under 90% of the maximum torque of the servo motor.

6.1 Different adjustment methods

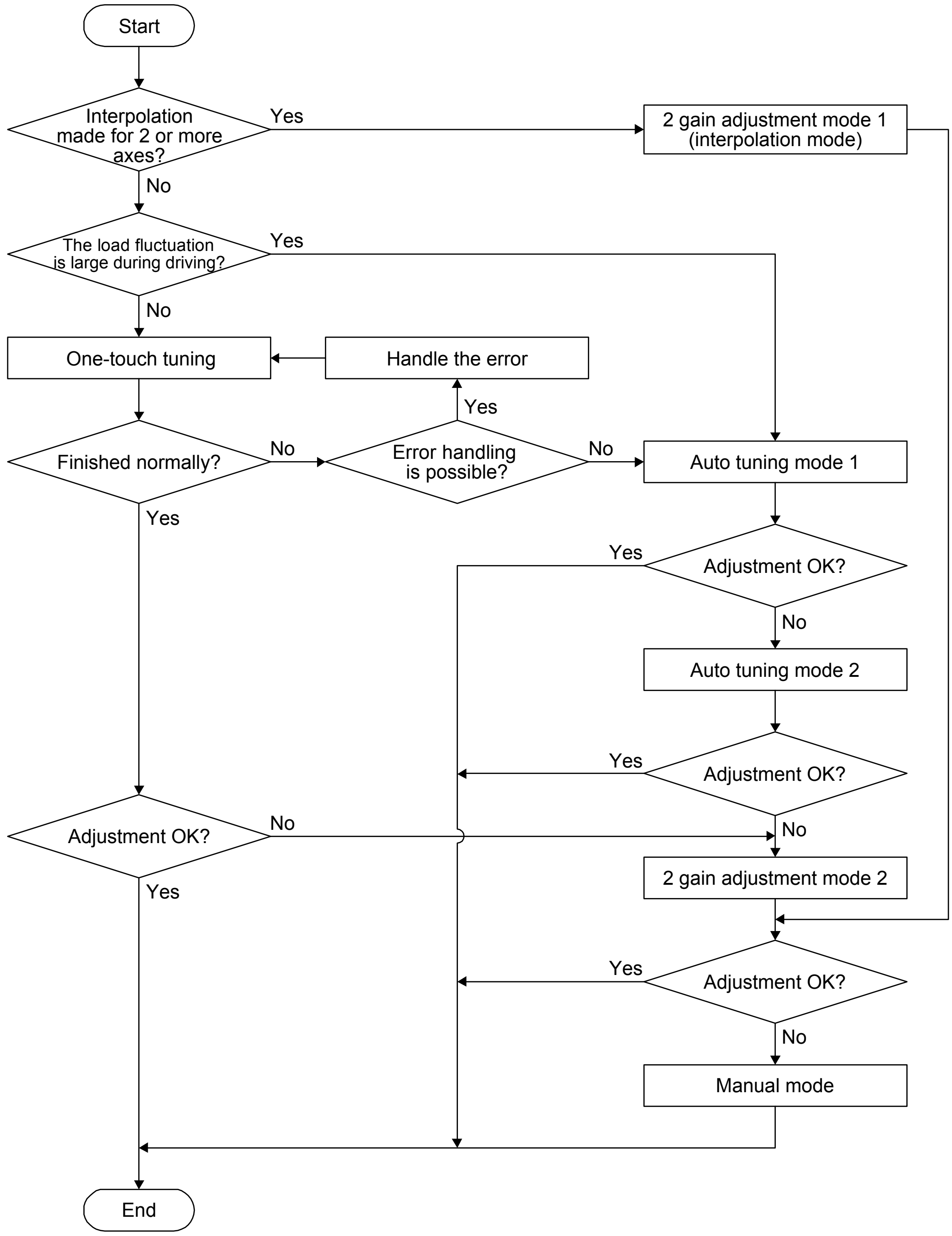
6.1.1 Adjustment on a single servo amplifier

The following table shows the gain adjustment modes that can be set on a single servo amplifier. For gain adjustment, first execute "Auto tuning mode 1". If you are not satisfied with the result of the adjustment, execute "Auto tuning mode 2" and "Manual mode" in this order.

(1) Gain adjustment mode explanation

Gain adjustment mode	[Pr. PA08] setting	Estimation of load to motor inertia ratio	Automatically set parameters	Manually set parameters
Auto tuning mode 1 (initial value)	_ _ _ 1	Always estimated	GD2 ([Pr. PB06]) PG1 ([Pr. PB07]) PG2 ([Pr. PB08]) VG2 ([Pr. PB09]) VIC ([Pr. PB10])	RSP ([Pr. PA09])
Auto tuning mode 2	_ _ _ 2	Fixed to [Pr. PB06] value	PG1 ([Pr. PB07]) PG2 ([Pr. PB08]) VG2 ([Pr. PB09]) VIC ([Pr. PB10])	GD2 ([Pr. PB06]) RSP ([Pr. PA09])
Manual mode	_ _ _ 3			GD2 ([Pr. PB06]) PG1 ([Pr. PB07]) PG2 ([Pr. PB08]) VG2 ([Pr. PB09]) VIC ([Pr. PB10])
2 gain adjustment mode 1 (interpolation mode)	_ _ _ 0	Always estimated	GD2 ([Pr. PB06]) PG2 ([Pr. PB08]) VG2 ([Pr. PB09]) VIC ([Pr. PB10])	PG1 ([Pr. PB07]) RSP ([Pr. PA09])
2 gain adjustment mode 2	_ _ _ 4	Fixed to [Pr. PB06] value	PG2 ([Pr. PB08]) VG2 ([Pr. PB09]) VIC ([Pr. PB10])	GD2 ([Pr. PB06]) PG1 ([Pr. PB07]) RSP ([Pr. PA09])

(2) Adjustment sequence and mode usage



6.1.2 Adjustment using MR Configurator2

This section explains the functions and adjustment using the servo amplifier with MR Configurator2.

Function	Description	Adjustment
Machine analyzer	With the machine and servo motor coupled, the characteristic of the mechanical system can be measured by giving a random vibration command from a personal computer to the servo and measuring the machine response.	You can grasp the machine resonance frequency and determine the notch frequency of the machine resonance suppression filter.

6.2 One-touch tuning

> POINT
>
> ● When executing the one-touch tuning, check the [Pr. PA21 One-touch tuning function selection] is "_ _ _ 1" (initial value).

You can execute the one-touch tuning with MR Configurator2 or push buttons. The following parameters are set automatically with one-touch tuning.

Table 6.1 List of parameters automatically set with one-touch tuning

Parameter	Symbol	Name
PA08	ATU	Auto tuning mode
PA09	RSP	Auto tuning response
PB01	FILT	Adaptive tuning mode (adaptive filter II)
PB02	VRFT	Vibration suppression control tuning mode (advanced vibration suppression control II)
PB03	PST	Position command acceleration/deceleration time constant (position smoothing)
PB06	GD2	Load to motor inertia ratio
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation
PB12	OVA	Overshoot amount compensation
PB13	NH1	Machine resonance suppression filter 1
PB14	NHQ1	Notch shape selection 1
PB15	NH2	Machine resonance suppression filter 2
PB16	NHQ2	Notch shape selection 2
PB18	LPF	Low-pass filter setting
PB19	VRF11	Vibration suppression control 1 - Vibration frequency
PB20	VRF12	Vibration suppression control 1 - Resonance frequency
PB21	VRF13	Vibration suppression control 1 - Vibration frequency damping
PB22	VRF14	Vibration suppression control 1 - Resonance frequency damping
PB23	VFBF	Low-pass filter selection
PB47	NHQ3	Notch shape selection 3
PB48	NH4	Machine resonance suppression filter 4
PB49	NHQ4	Notch shape selection 4
PB51	NHQ5	Notch shape selection 5
PE41	EOP3	Function selection E-3

6.2.1 One-touch tuning flowchart

(1) When you use MR Configurator2

Make one-touch tuning as follows.

Start

Startup of the system	Startup a system referring to chapter 4.
Operation	Rotate the servo motor by an external controller, etc. (The one-touch tuning cannot be performed if the servo motor is not operating.)
One-touch tuning start	Start one-touch tuning of MR Configurator2.
Response mode selection	Select a response mode (high mode, basic mode, and low mode) in the one-touch tuning window of MR Configurator2.
One-touch tuning execution	Push the start button to start one-touch tuning. Push it during servo motor driving. When one-touch tuning is completed normally, the parameters described in table 6.1 will be set automatically.

End

(2) When you use push buttons

Make one-touch tuning as follows.

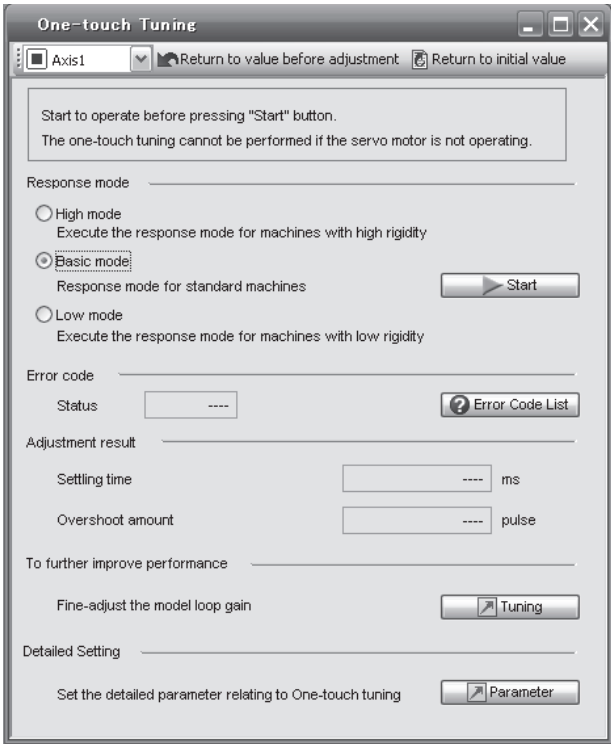
Start	
Startup of the system	Startup a system referring to chapter 4.
Operation	Rotate the servo motor by an external controller, etc. (The one-touch tuning cannot be performed if the servo motor is not operating.)
One-touch tuning start	Select the initial screen ("AUTO") of the one-touch tuning with the "MODE" button during motor driving. Push the "SET" button for 2 s or more during displaying "AUTO" to switch to the response mode selection ("AUTO."). Push the "MODE" and "SET" buttons at the same time for 3 s or more to switch to the response mode selection ("AUTO.") without going through the initial screen of the one-touch tuning ("AUTO").
Response mode selection	The initial value of response mode is "AUTO." (basic mode). As necessary, push the "UP" or "DOWN" button to select "AUTO.H" (high mode) or "AUTO.L" (low mode).
One-touch tuning execution	Push the "SET" button to start one-touch tuning. Push the "SET" button during servo motor driving. When one-touch tuning is completed normally, the parameters described in table 6.1 will be set automatically.
End	

6.2.2 Display transition and operation procedure of one-touch tuning

(1) When you use MR Configurator2

(a) Response mode selection

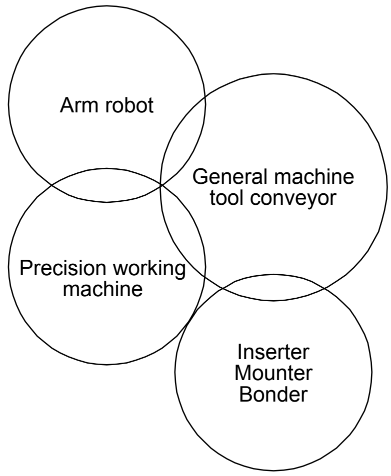
Select a response mode from three modes in the one-touch tuning window of MR Configurator2.



Response mode	Explanation
High mode	This mode is for high rigid system.
Basic mode	This mode is for standard system.
Low mode	This mode is for low rigid system.

Refer to the following table for selecting a response mode.

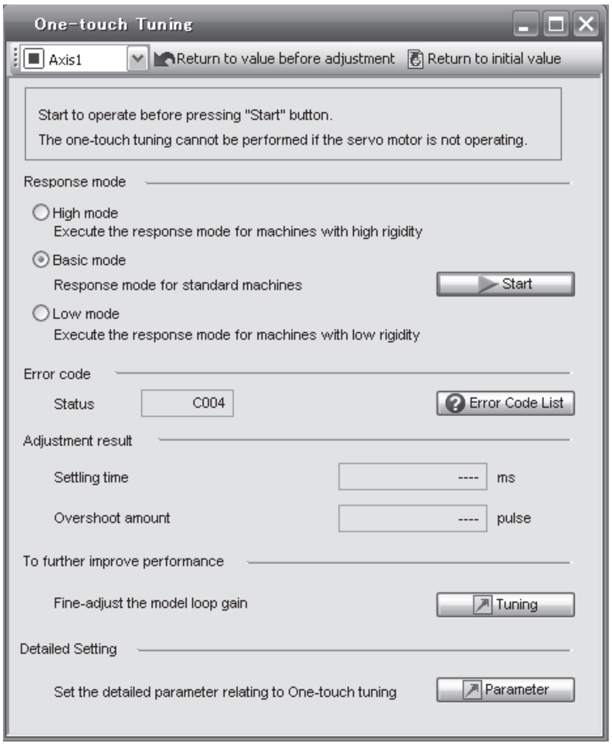
Response mode			Response	Machine characteristic
Low mode	Basic mode	High mode		Guideline of corresponding machine
			Low response High response	



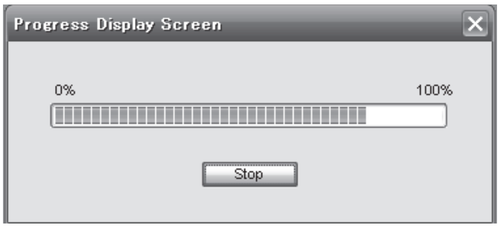
(b) One-touch tuning execution

> POINT
>
> ●For equipment in which overshoot during one-touch tuning is in the permissible level of the in-position range, changing the value of [Pr. PA25 One-touch tuning - Overshoot permissible level] will shorten the settling time and improve the response.

After the response mode is selected in (a), pushing the start button during servo motor driving will start one-touch tuning. If the start button is pushed while the servo motor stops, "C 0 0 2" or "C 0 0 4" will be displayed at status in error code. (Refer to table 6.2 of (1) (d) of this section for error codes.)



During processing of one-touch tuning, the status will be displayed in the progress window as follows. One-touch tuning will be finished at 100%.



Completing the one-touch tuning starts writing tuning parameters to the servo amplifier. "0 0 0 0" is displayed at status in error code. In addition, settling time and overshoot amount will be displayed in "Adjustment result" after adjustment.

(c) Stop of one-touch tuning
During one-touch tuning, pushing the stop button stops one-touch tuning.
If the one-touch tuning is stopped, "C 0 0 0" will be displayed at status in error code.

(d) Error occurrence
If a tuning error occurs during tuning, one-touch tuning will be forcibly terminated. With that, the following error code will be displayed in status. Check the cause of tuning error.

Table 6.2 Error code list during one-touch tuning

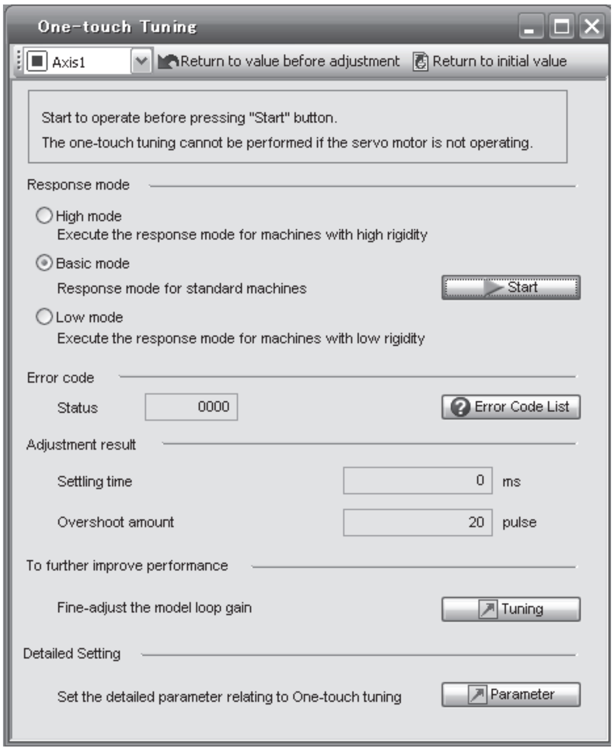
Error code	Name	Description	Action
C000	Tuning canceled	The stop button or "SET" of the push button was pushed.	
C001	Overshoot exceeded	The overshoot amount is lager than the value set in [Pr. PA10 In-position range].	Increase the in-position range.
C002	Servo-off during tuning	The one-touch tuning was attempted during servo-off.	Perform the one-touch tuning after servo-on.
C003	Control mode error	The one-touch tuning was attempted while the torque control mode was selected in the control modes.	Select the position control mode or speed control mode for the control mode from the controller, and then make one-touch tuning.
C004	Time-out	1. One cycle time during the operation has been over 30 s.	Set the one cycle time during the operation to 30 s or less.
		2. The command speed is low.	Set the servo motor speed to100 r/min or higher.
		3. The operation interval of the continuous operation is short.	Maintain the operation interval during motor driving about 200 ms.
C005	Load to motor inertia ratio misestimated	1. The estimation of the load to motor inertia ratio at one-touch tuning was a failure.	Drive the motor with meeting conditions as follows. ・Time to reach 2000 r/min is the acceleration/deceleration time constant of 5 s or less. ・Speed is 150 r/min or higher. ・The load to motor inertia ratio is 100 times or less. ・The acceleration/deceleration torque is 10% or more of the rated torque.
		2. The load to motor inertia ratio was not estimated due to such as an oscillation.	Set to the auto tuning mode that does not estimate the load to motor inertia ratio as follows, and then execute the one-touch tuning. ・Select "Auto tuning mode 2 (_ _ _ 2)", "Manual mode (_ _ _ 3)", or "2 gain adjustment mode 2 (_ _ _ 4)" of "Gain adjustment mode selection" in [Pr. PA08]. ・Set [Pr. PB06 Load to motor inertia ratio] properly with manual setting.
C00F	One-touch tuning disabled	"One-touch tuning function selection" in [Pr. PA21] is "Disabled (_ _ _ 0)".	Select "Enabled (_ _ _ 1)".

(e) If an alarm occurs
If an alarm occurs during tuning, one-touch tuning will be forcibly terminated.
Remove the cause of the alarm and execute one-touch tuning again.

(f) If a warning occurs
If a warning which continue the motor driving occurs during the tuning, one-touch tuning will be continued.
If a warning which does not continue the motor driving occurs during the tuning, one-touch tuning will be stopped.

(g) Clearing one-touch tuning

You can clear the parameter values set with one-touch tuning.
Refer to table 6.1 for the parameters which you can clear.
Pushing "Return to value before tuning" in the one-touch tuning window of MR Configurator2 enables to rewrite the parameter to the value before pushing the start button.
In addition, pushing "Return to initial value" in the one-touch tuning window enables to rewrite the parameter to the initial value.



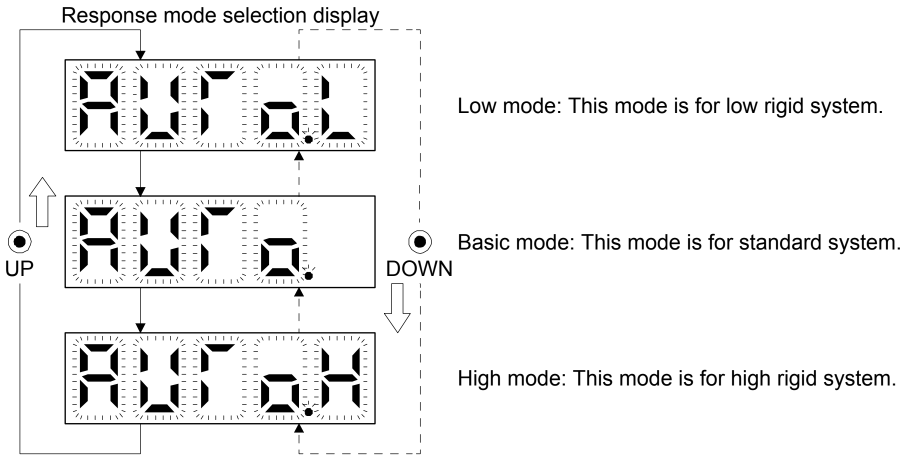
When clearing one-touch tuning is completed, the following window will be displayed. (returning to initial value)

(2) When you use push buttons

POINT
●Push the "MODE" and "SET" buttons at the same time for 3 s or more to switch to the response mode selection ("AUTO.") without going through the initial screen of the one-touch tuning ("AUTO").

(a) Response mode selection

Select a response mode of the one-touch tuning from 3 modes with "UP" or "DOWN". Refer to (1) (a) of this section for a guideline of response mode.



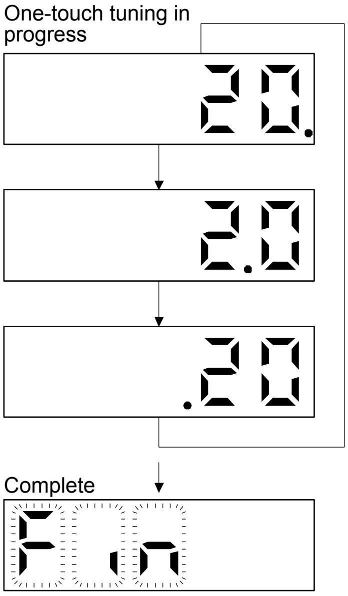
(b) One-touch tuning execution

POINT

- For equipment in which overshoot during one-touch tuning is in the permissible level of the in-position range, changing the value of [Pr. PA25 One-touch tuning - Overshoot permissible level] will shorten the settling time and improve the response.

After the response mode is selected in (a), pushing the "SET" button will start one-touch tuning.

One-touch tuning in progress



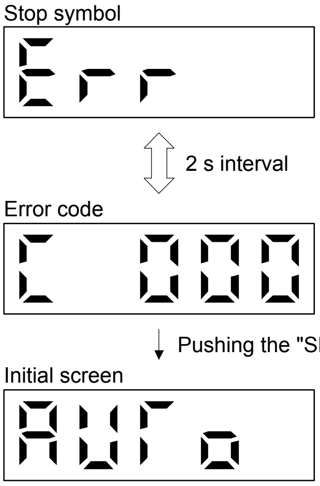
The one-touch tuning progress is displayed with 0% to 100%.
The decimal point moves left to right in rotation during the tuning.
To switch the display to the status display during the tuning, push the "MODE" button.

Complete

Completing the one-touch tuning will start writing the auto-tuned parameters to the servo amplifier.

(c) Stop of one-touch tuning

Stop symbol



The one-touch tuning mode can be stopped by pushing the "SET" button regardless of displayed item.

2 s interval

The stop symbol and error code "C 000" (cancel during tuning) will be displayed by turns with 2 s interval.

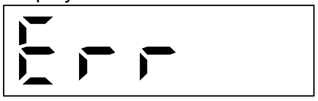
Error code

Pushing the "SET" button will switch to the initial screen.

Initial screen

(d) If an error occurs

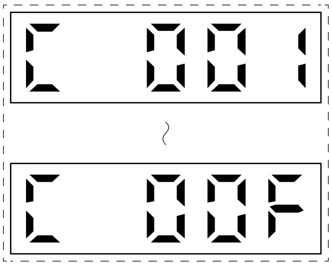
Stop symbol



If an error occurs during the one-touch tuning, the tuning will be forcibly terminated and the stop symbol and error code from "C 001" to "C 00F" will be displayed by turns with 2 s interval.

2 s interval

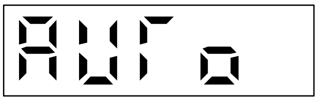
Error code



Check the error cause referring table 6.2 of (1) (d) of this section.

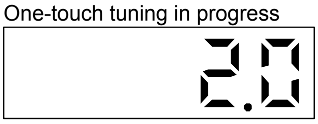
Pushing the "SET" button will switch to the initial screen.

Initial screen



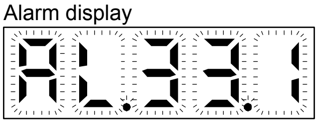
(e) If an alarm occurs

One-touch tuning in progress



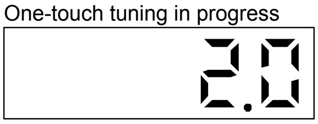
If an alarm occurs during tuning, one-touch tuning will be forcibly terminated and the alarm No. will be displayed.

Alarm display



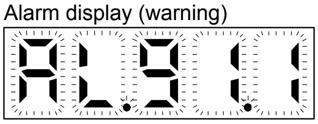
(f) If a warning occurs

One-touch tuning in progress



If a warning occurs during tuning, the alarm No. of the warning will be displayed.
When the warning is one which continue the motor driving, the one-touch tuning will be continued.

Alarm display (warning)



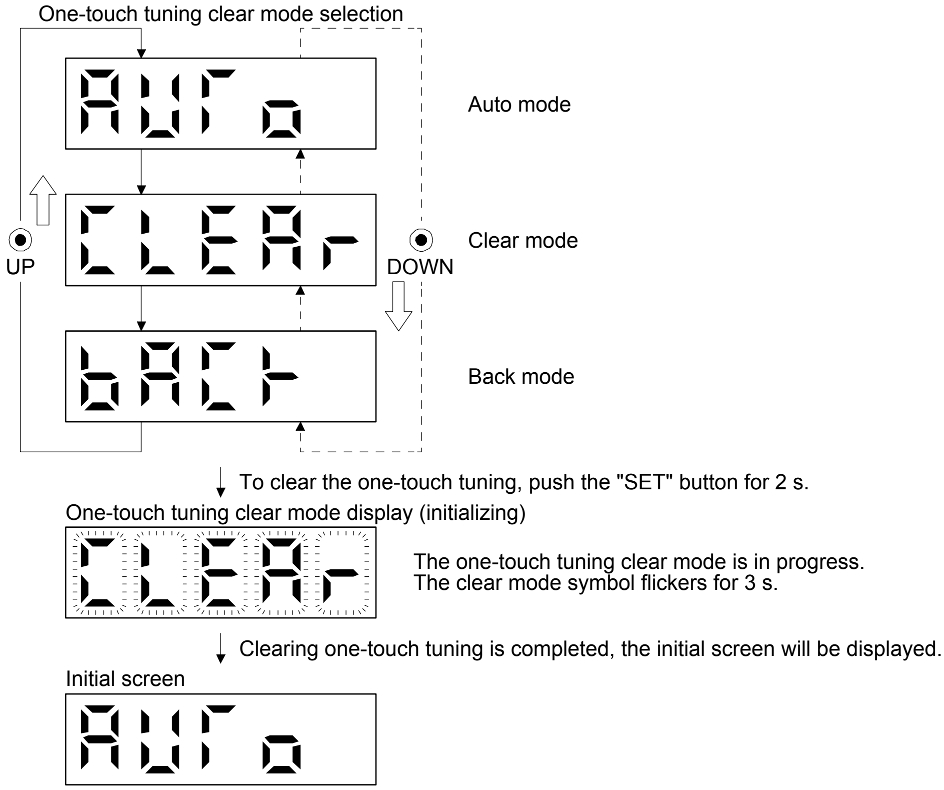
(g) Clearing one-touch tuning

Refer to table 6.1 for the parameters which you can clear.

You can initialize the parameters changed by the one-touch tuning with the clear mode. You can reset the parameters to before tuning with the back mode.

1) Switch to the initial screen "AUTO" of the one-touch tuning with the "MODE" button.

2) Select the clear mode or back mode with the "UP" or "DOWN" button.



6.2.3 Caution for one-touch tuning

(1) The tuning is not available in the torque control mode.

(2) The one-touch tuning cannot be executed while an alarm or warning which withholds the motor driving is occurring.

(3) You can execute the one-touch tuning during the following test operation modes marked by "○".

How to one-touch tuning	Test operation mode				
	Output signal (DO) forced output	JOG operation	Positioning operation	Motor-less operation	Program operation
MR Configurator2		○	○		○
Push buttons					

6.3 Auto tuning

6.3.1 Auto tuning mode

The servo amplifier has a real-time auto tuning function which estimates the machine characteristic (load to motor inertia ratio) in real time and automatically sets the optimum gains according to that value. This function permits ease of gain adjustment of the servo amplifier.

(1) Auto tuning mode 1

The servo amplifier is factory-set to the auto tuning mode 1.
In this mode, the load to motor inertia ratio of a machine is always estimated to set the optimum gains automatically.
The following parameters are automatically adjusted in the auto tuning mode 1.

Parameter	Symbol	Name
PB06	GD2	Load to motor inertia ratio
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

POINT

- The auto tuning mode 1 may not be performed properly if all of the following conditions are not satisfied.
  - Time to reach 2000 r/min is the acceleration/deceleration time constant of 5 s or less.
  - Speed is 150 r/min or higher.
  - The load to motor inertia ratio is 100 times or less.
  - The acceleration/deceleration torque is 10% or more of the rated torque.
- Under operating conditions which will impose sudden disturbance torque during acceleration/deceleration or on a machine which is extremely loose, auto tuning may not function properly, either. In such cases, use the auto tuning mode 2 or manual mode to make gain adjustment.

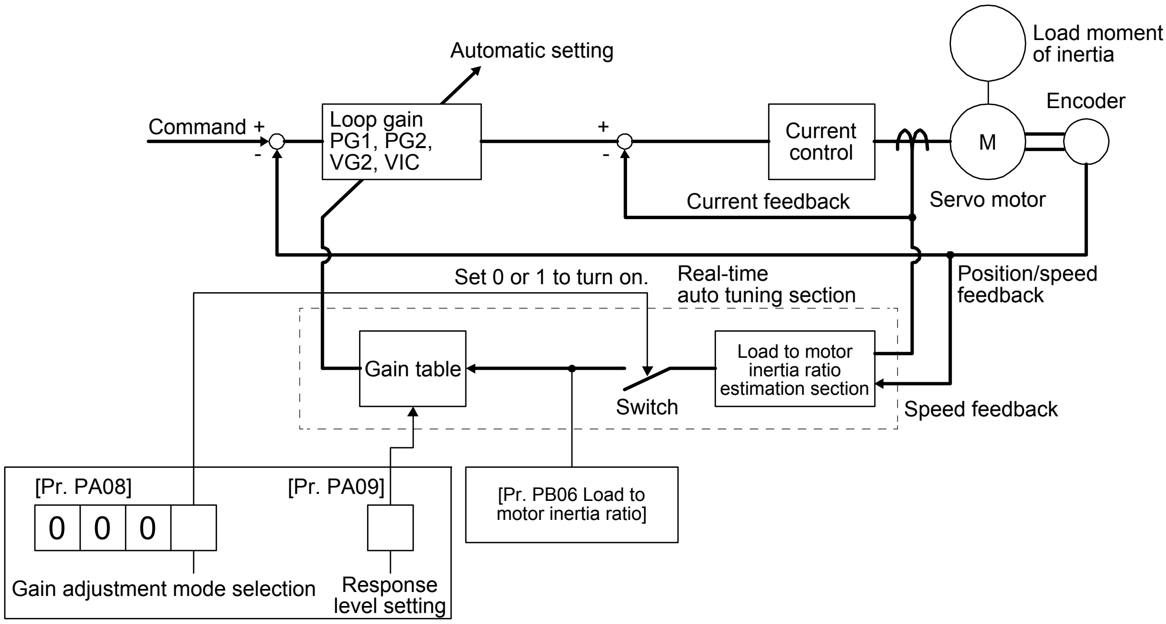
(2) Auto tuning mode 2

Use the auto tuning mode 2 when proper gain adjustment cannot be made by auto tuning mode 1. Since the load to motor inertia ratio is not estimated in this mode, set the value of a correct load to motor inertia ratio in [Pr. PB06].
The following parameters are automatically adjusted in the auto tuning mode 2.

Parameter	Symbol	Name
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

6.3.2 Auto tuning mode basis

The block diagram of real-time auto tuning is shown below.



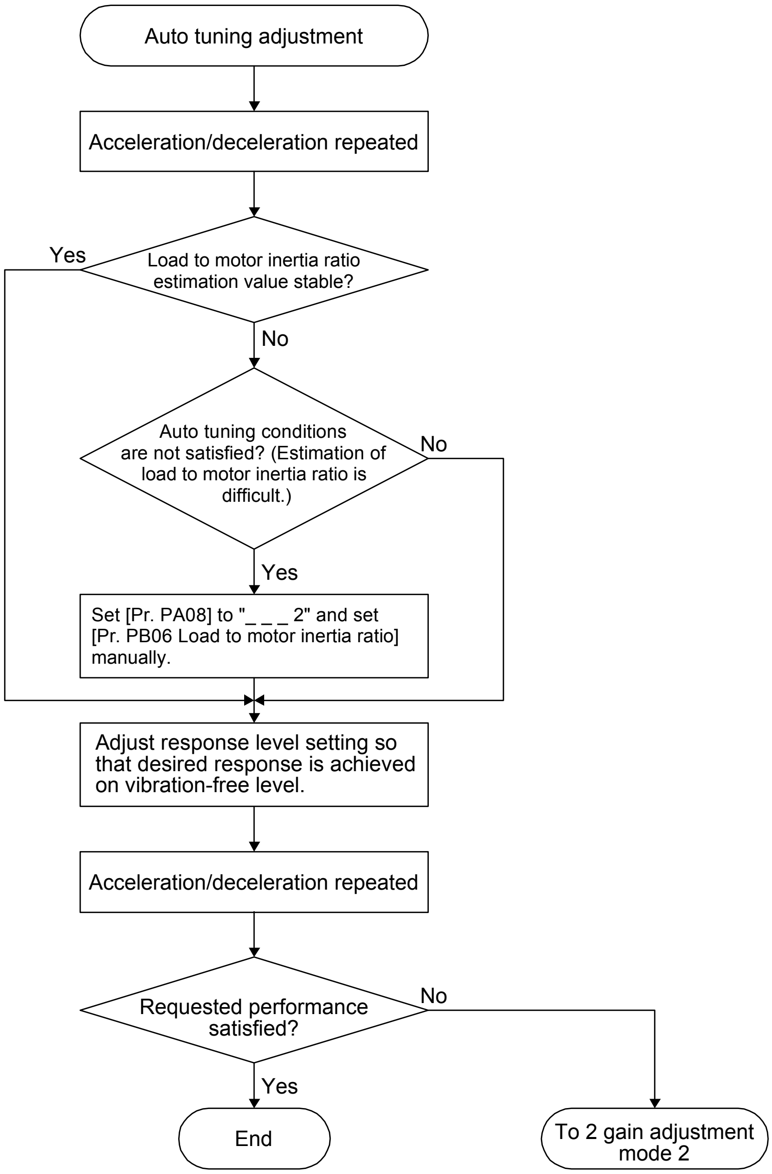
When a servo motor is accelerated/decelerated, the load to motor inertia ratio estimation section always estimates the load to motor inertia ratio from the current and speed of the servo motor. The results of estimation are written to [Pr. PB06 Load to motor inertia ratio]. These results can be confirmed on the status display screen of the MR Configurator2.
If you have already known the value of the load to motor inertia ratio or failed to estimate, set "Gain adjustment mode selection" to "Auto tuning mode 2 (_ _ _ 2)" in [Pr. PA08] to stop the estimation (turning off the switch in above diagram), and set the load to motor inertia ratio ([Pr. PB06]) manually.
From the preset load to motor inertia ratio ([Pr. PB06]) value and response ([Pr. PA09]), the optimum loop gains are automatically set on the basis of the internal gain table.
The auto tuning results are saved in the EEP-ROM of the servo amplifier every 60 minutes since power-on. At power-on, auto tuning is performed with the value of each loop gain saved in the EEP-ROM being used as an initial value.

POINT

- If sudden disturbance torque is imposed during operation, the load to motor inertia ratio may be misestimated temporarily. In such a case, set "Gain adjustment mode selection" to "Auto tuning mode 2 (_ _ _ 2)" in [Pr. PA08] and then set the correct load to motor inertia ratio in [Pr. PB06].
- When any of the auto tuning mode 1 and auto tuning mode settings is changed to the manual mode 2 setting, the current loop gains and load to motor inertia ratio estimation value are saved in the EEP-ROM.

6.3.3 Adjustment procedure by auto tuning

Since auto tuning is enabled before shipment from the factory, simply running the servo motor automatically sets the optimum gains that match the machine. Merely changing the response level setting value as required completes the adjustment. The adjustment procedure is as follows.



6.3.4 Response level setting in auto tuning mode

Set the response of the whole servo system by [Pr. PA09]. As the response level setting is increased, the track ability and settling time for a command decreases, but a too high response level will generate vibration. Hence, make setting until desired response is obtained within the vibration-free range.
If the response level setting cannot be increased up to the desired response because of machine resonance beyond 100 Hz, filter tuning mode selection in [Pr. PB01] or machine resonance suppression filter in [Pr. PB13] to [Pr. PB16], and [Pr. PB46] to [Pr. PB51] may be used to suppress machine resonance. Suppressing machine resonance may allow the response level setting to increase. Refer to section 7.1.1 and 7.1.2 for settings of the adaptive tuning mode and machine resonance suppression filter.

[Pr. PA09]

Setting value	Machine characteristic	
	Response	Guideline for machine resonance frequency [Hz]
1	Low response	2.7
2	↕	3.6
3		4.9
4		6.6
5		10.0
6		11.3
7		12.7
8		14.3
9		16.1
10		18.1
11		20.4
12		23.0
13		25.9
14		29.2
15		32.9
16		37.0
17		41.7
18		47.0
19		52.9
20	Middle response	59.6

Setting value	Machine characteristic	
	Response	Guideline for machine resonance frequency [Hz]
21	Middle response	67.1
22	↕	75.6
23		85.2
24		95.9
25		108.0
26		121.7
27		137.1
28		154.4
29		173.9
30		195.9
31		220.6
32		248.5
33		279.9
34		315.3
35		355.1
36		400.0
37		446.6
38		501.2
39		571.5
40	High response	642.7

6.4 Manual mode

If you are not satisfied with the adjustment of auto tuning, you can make simple manual adjustment with three parameters.

POINT

- If machine resonance occurs, filter tuning mode selection in [Pr. PB01] or machine resonance suppression filter in [Pr. PB13] to [Pr. PB16] and [Pr. PB46] to [Pr. PB51] may be used to suppress machine resonance. (Section 7.1.1, 7.1.2)

(1) For speed control

(a) Parameter

The following parameters are used for gain adjustment.

Parameter	Symbol	Name
PB06	GD2	Load to motor inertia ratio
PB07	PG1	Model loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

(b) Adjustment procedure

Step	Operation	Description
1	Brief-adjust with auto tuning. Refer to section 6.3.3.	
2	Change the setting of auto tuning to the manual mode ([Pr. PA08]: _ _ _ 3).	
3	Set an estimated value to the load to motor inertia ratio. (If the estimate value with auto tuning is correct, setting change is not required.)	
4	Set a slightly smaller value to the model loop gain Set a slightly larger value to the speed integral compensation.	
5	Increase the speed loop gain within the vibration- and unusual noise-free range, and return slightly if vibration takes place.	Increase the speed loop gain.
6	Decrease the speed integral compensation within the vibration-free range, and return slightly if vibration takes place.	Decrease the time constant of the speed integral compensation.
7	Increase the model loop gain, and return slightly if overshoot takes place.	Increase the model loop gain.
8	If the gains cannot be increased due to mechanical system resonance or the like and the desired response cannot be achieved, response may be increased by suppressing resonance with the adaptive tuning mode or machine resonance suppression filter and then executing steps 3 to 7.	Suppression of machine resonance Refer to section 7.1.1 and 7.1.2.
9	While checking the motor status, fine-adjust each gain.	Fine adjustment

(c) Parameter adjustment

1) [Pr. PB09 Speed loop gain]

This parameter determines the response level of the speed control loop. Increasing the setting increases the response level, but the mechanical system is liable to vibrate. The actual response frequency of the speed loop is as indicated in the following expression.

$$\text{Speed loop response frequency [Hz]} = \frac{\text{Speed loop gain}}{(1 + \text{Load to motor inertia ratio}) \times 2\pi}$$

2) [Pr. PB10 Speed integral compensation]

To eliminate stationary deviation against a command, the speed control loop is under proportional integral control. For the speed integral compensation, set the time constant of this integral control. Increasing the setting lowers the response level. However, if the load to motor inertia ratio is large or the mechanical system has any vibratory element, the mechanical system is liable to vibrate unless the setting is increased to some degree. The guideline is as indicated in the following expression.

$$\text{Speed integral compensation setting [ms]} \geq \frac{\text{2000 to 3000}}{\text{Speed loop gain}/(1 + \text{Load to motor inertia ratio})}$$

3) [Pr. PB07 Model loop gain]

This parameter determines the response level to a speed command. Increasing the value improves track ability to a speed command, but a too high value will make overshoot liable to occur at settling.

$$\text{Estimated model loop gain} \leq \frac{\text{Speed loop gain}}{(1 + \text{Load to motor inertia ratio})} \times \left(\frac{1}{4} \text{ to } \frac{1}{8}\right)$$

(2) For position control

(a) Parameter

The following parameters are used for gain adjustment.

Parameter	Symbol	Name
PB06	GD2	Load to motor inertia ratio
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

(b) Adjustment procedure

Step	Operation	Description
1	Brief-adjust with auto tuning. Refer to section 6.3.3.	
2	Change the setting of auto tuning to the manual mode ([Pr. PA08]: _ _ _ 3).	
3	Set an estimated value to the load to motor inertia ratio. (If the estimate value with auto tuning is correct, setting change is not required.)	
4	Set a slightly smaller value to the model loop gain and the position loop gain. Set a slightly larger value to the speed integral compensation.	
5	Increase the speed loop gain within the vibration- and unusual noise-free range, and return slightly if vibration takes place.	Increase the speed loop gain.
6	Decrease the speed integral compensation within the vibration-free range, and return slightly if vibration takes place.	Decrease the time constant of the speed integral compensation.
7	Increase the position loop gain, and return slightly if vibration takes place.	Increase the position loop gain.
8	Increase the model loop gain, and return slightly if overshoot takes place.	Increase the model loop gain.
9	If the gains cannot be increased due to mechanical system resonance or the like and the desired response cannot be achieved, response may be increased by suppressing resonance with the adaptive tuning mode or machine resonance suppression filter and then executing steps 3 to 8.	Suppression of machine resonance Section 7.1.1 and 7.1.2
10	While checking the settling characteristic and motor status, fine-adjust each gain.	Fine adjustment

(c) Parameter adjustment

1) [Pr. PB09 Speed loop gain]

This parameter determines the response level of the speed control loop. Increasing the setting increases the response level, but the mechanical system is liable to vibrate. The actual response frequency of the speed loop is as indicated in the following expression.

$$\text{Speed loop response frequency [Hz]} = \frac{\text{Speed loop gain}}{(1 + \text{Load to motor inertia ratio}) \times 2\pi}$$

2) [Pr. PB10 Speed integral compensation]

To eliminate stationary deviation against a command, the speed control loop is under proportional integral control. For the speed integral compensation, set the time constant of this integral control. Increasing the setting lowers the response level. However, if the load to motor inertia ratio is large or the mechanical system has any vibratory element, the mechanical system is liable to vibrate unless the setting is increased to some degree. The guideline is as indicated in the following expression.

$$\text{Speed integral compensation setting [ms]} \geq \frac{2000 \text{ to } 3000}{\text{Speed loop gain}/(1 + \text{Load to motor inertia ratio})}$$

3) [Pr. PB08 Position loop gain]
This parameter determines the response level to a disturbance to the position control loop. Increasing the position loop gain increases the response level to a disturbance, but the mechanical system is liable to vibrate.

$$\text{Position loop gain guideline} \leq \frac{\text{Speed loop gain}}{(1 + \text{Load to motor inertia ratio})} \times \left(\frac{1}{4} \text{ to } \frac{1}{8}\right)$$

4) [Pr. PB07 Model loop gain]
This parameter determines the response level to a position command. Increasing the value improves track ability to a position command, but a too high value will make overshoot liable to occur at settling.

$$\text{Estimated model loop gain} \leq \frac{\text{Speed loop gain}}{(1 + \text{Load to motor inertia ratio})} \times \left(\frac{1}{4} \text{ to } \frac{1}{8}\right)$$

6.5 2 gain adjustment mode

Use the 2 gain adjustment mode to match the position loop gains of the axes when performing the interpolation operation of servo motors of two or more axes for an X-Y table or the like. In this mode, manually set the model loop gain that determines command track ability. Other parameters for gain adjustment are set automatically.

(1) 2 gain adjustment mode 1
For the 2 gain adjustment mode 1, manually set the model loop gain that determines command track ability. The mode constantly estimates the load to motor inertia ratio, and automatically set other parameters for gain adjustment to optimum gains using auto tuning response.
The following parameters are used for 2 gain adjustment mode 1.

(a) Automatically adjusted parameter
The following parameters are automatically adjusted by auto tuning.

Parameter	Symbol	Name
PB06	GD2	Load to motor inertia ratio
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

(b) Manually adjusted parameter
The following parameters are adjustable manually.

Parameter	Symbol	Name
PA09	RSP	Auto tuning response
PB07	PG1	Model loop gain

(2) 2 gain adjustment mode 2
Use 2 gain adjustment mode 2 when proper gain adjustment cannot be made with 2 gain adjustment mode 1. Since the load to motor inertia ratio is not estimated in this mode, set the value of a proper load to motor inertia ratio in [Pr. PB06].
The following parameters are used for 2 gain adjustment mode 2.

(a) Automatically adjusted parameter
The following parameters are automatically adjusted by auto tuning.

Parameter	Symbol	Name
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

(b) Manually adjusted parameter
The following parameters are adjustable manually.

Parameter	Symbol	Name
PA09	RSP	Auto tuning response
PB06	GD2	Load to motor inertia ratio
PB07	PG1	Model loop gain

(3) Adjustment procedure of 2 gain adjustment mode

POINT

● Set the same value in [Pr. PB07 Model loop gain] for the axis used in 2 gain adjustment mode.

Step	Operation	Description
1	Set to the auto tuning mode.	Select the auto tuning mode 1.
2	During operation, increase the response level setting value in [Pr. PA09], and return the setting if vibration occurs.	Adjustment in auto tuning mode 1
3	Check value of the model loop gain and the load to motor inertia ratio in advance.	Check the upper setting limits.
4	Set the 2 gain adjustment mode 1 ([Pr. PA08]: _ _ _ 0).	Select the 2 gain adjustment mode 1 (interpolation mode).
5	When the load to motor inertia ratio is different from the design value, select the 2 gain adjustment mode 2 ([Pr. PA08]: _ _ _ 4) and then set the load to motor inertia ratio manually in [Pr. PB06].	Check the load to motor inertia ratio.
6	Set the model loop gain of all the axes to be interpolated to the same value. At that time, adjust to the setting value of the axis, which has the smallest model loop gain.	Set position loop gain.
7	Considering the interpolation characteristic and motor status, fine-adjust the model loop gain and response level setting.	Fine adjustment

(4) Parameter adjustment

[Pr. PB07 Model loop gain]

This parameter determines the response level of the position control loop. Increasing the value improves track ability to a position command, but a too high value will make overshoot liable to occur at settling. The droop pulse value is determined by the following expression.

$$\text{Number of droop pulses [pulse]} = \frac{\text{Position command frequency [pulse/s]}}{\text{Model loop gain setting}}$$

$$\text{Position command frequency} = \frac{\text{Speed [r/min]}}{60} \times \text{Encoder resolution (number of pulses per servo motor revolution)}$$

MEMO

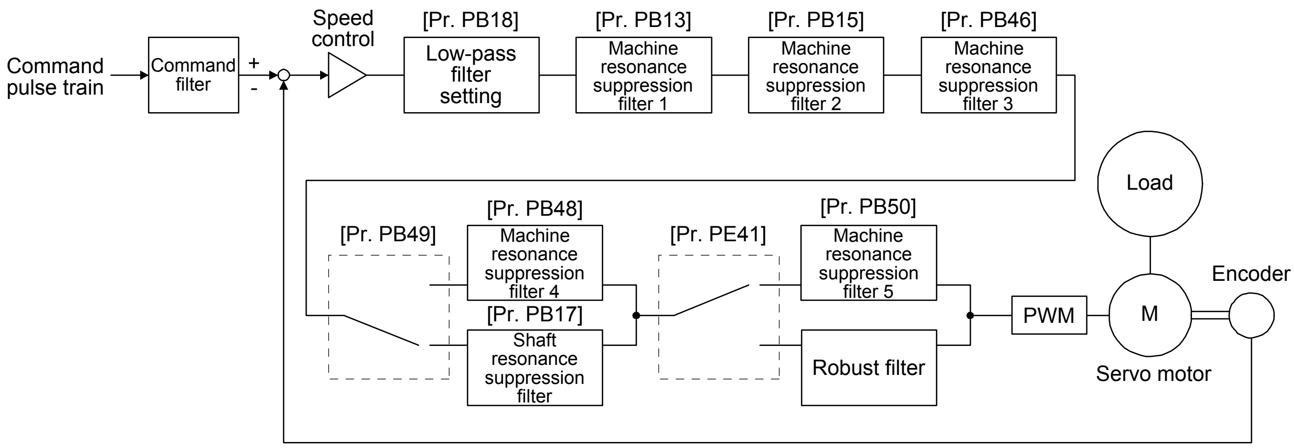
7. SPECIAL ADJUSTMENT FUNCTIONS

POINT

- The functions given in this chapter need not be used normally. Use them if you are not satisfied with the machine status after making adjustment in the methods in chapter 6.

7.1 Filter setting

The following filters are available with MR-JE servo amplifiers.



7.1.1 Machine resonance suppression filter

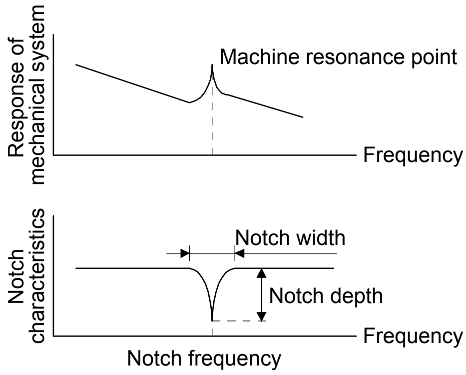
POINT

- The machine resonance suppression filter is a delay factor for the servo system. Therefore, vibration may increase if you set an incorrect resonance frequency or set notch characteristics too deep or too wide.
- If the frequency of machine resonance is unknown, decrease the notch frequency from higher to lower ones in order. The optimum notch frequency is set at the point where vibration is minimal.
- A deeper notch has a higher effect on machine resonance suppression but increases a phase delay and may increase vibration.
- A deeper notch has a higher effect on machine resonance suppression but increases a phase delay and may increase vibration.
- The machine characteristic can be grasped beforehand by the machine analyzer on MR Configurator2. This allows the required notch frequency and notch characteristics to be determined.

If a mechanical system has a natural resonance point, increasing the servo system response level may cause the mechanical system to produce resonance (vibration or unusual noise) at that resonance frequency. Using the machine resonance suppression filter and adaptive tuning can suppress the resonance of the mechanical system. The setting range is 10 Hz to 4500 Hz.

(1) Function

The machine resonance suppression filter is a filter function (notch filter) which decreases the gain of the specific frequency to suppress the resonance of the mechanical system. You can set the gain decreasing frequency (notch frequency), gain decreasing depth and width.



You can set five machine resonance suppression filters at most.

Filter	Setting parameter	Precaution	Parameter that is reset with vibration tough drive function	Parameter automatically adjusted with one-touch tuning
Machine resonance suppression filter 1	PB01/PB13/PB14	The filter can be set automatically with "Filter tuning mode selection" in [Pr. PB01].	PB13	PB01/PB13/PB14
Machine resonance suppression filter 2	PB15/PB16		PB15	PB15/PB16
Machine resonance suppression filter 3	PB46/PB47			PB47
Machine resonance suppression filter 4	PB48/PB49	Enabling the machine resonance suppression filter 4 disables the shaft resonance suppression filter. Using the shaft resonance suppression filter is recommended because it is adjusted properly depending on the usage situation. The shaft resonance suppression filter is enabled for the initial setting.		PB48/PB49
Machine resonance suppression filter 5	PB50/PB51	Enabling the robust filter disables the machine resonance suppression filter 5. The robust filter is disabled for the initial setting.		PB51

(2) Parameter

(a) Machine resonance suppression filter 1 ([Pr. PB13] and [Pr. PB14])
Set the notch frequency, notch depth and notch width of the machine resonance suppression filter 1 ([Pr. PB13] and [Pr. PB14])
When you select "Manual setting (_ _ _ 2)" of "Filter tuning mode selection" in [Pr. PB01], the setting of the machine resonance suppression filter 1 is enabled.

(b) Machine resonance suppression filter 2 ([Pr. PB15] and [Pr. PB16])
To use this filter, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 2 selection" in [Pr. PB16].
How to set the machine resonance suppression filter 2 ([Pr. PB15] and [Pr. PB16]) is the same as for the machine resonance suppression filter 1 ([Pr. PB13] and [Pr. PB14]).

(c) Machine resonance suppression filter 3 ([Pr. PB46] and [Pr. PB47])
To use this filter, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 3 selection" in [Pr. PB47].
How to set the machine resonance suppression filter 3 ([Pr. PB46] and [Pr. PB47]) is the same as for the machine resonance suppression filter 1 ([Pr. PB13] and [Pr. PB14]).

(d) Machine resonance suppression filter 4 ([Pr. PB48] and [Pr. PB49])
To use this filter, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 4 selection" in [Pr. PB49]. However, enabling the machine resonance suppression filter 4 disables the shaft resonance suppression filter.
How to set the machine resonance suppression filter 4 ([Pr. PB48] and [Pr. PB49]) is the same as for the machine resonance suppression filter 1 ([Pr. PB13] and [Pr. PB14]).

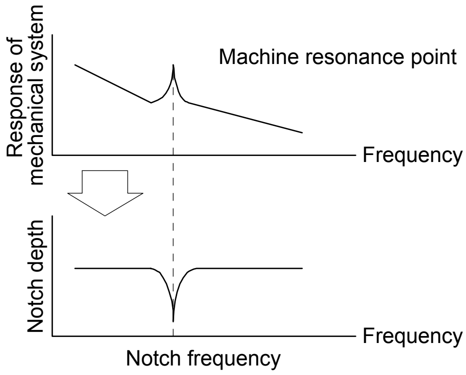
(e) Machine resonance suppression filter 5 ([Pr. PB50] and [Pr. PB51])
To use this filter, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 5 selection" in [Pr. PB51]. However, enabling the robust filter ([Pr. PE41: _ _ _ 1]) disables the machine resonance suppression filter 5.
How to set the machine resonance suppression filter 5 ([Pr. PB50] and [Pr. PB51]) is the same as for the machine resonance suppression filter 1 ([Pr. PB13] and [Pr. PB14]).

7.1.2 Adaptive filter II

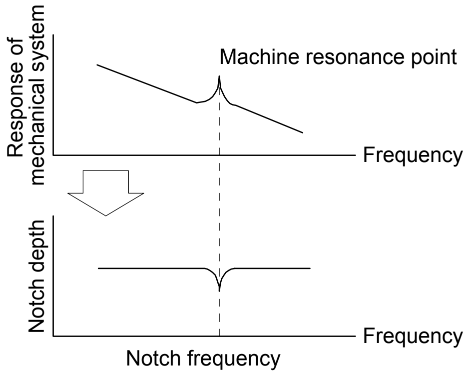
POINT
●The machine resonance frequency which adaptive filter II (adaptive tuning) can respond to is about 100 Hz to 2.25 kHz. As for the resonance frequency out of the range, set manually. ●When adaptive tuning is executed, vibration sound increases as an excitation signal is forcibly applied for several seconds. ●When adaptive tuning is executed, machine resonance is detected for a maximum of 10 s and a filter is generated. After filter generation, the adaptive tuning mode automatically shifts to the manual setting. ●Adaptive tuning generates the optimum filter with the currently set control gains. If vibration occurs when the response setting is increased, execute adaptive tuning again. ●During adaptive tuning, a filter having the best notch depth at the set control gain is generated. To allow a filter margin against machine resonance, increase the notch depth in the manual setting. ●Adaptive vibration suppression control may provide no effect on a mechanical system which has complex resonance characteristics.

(1) Function

Adaptive filter II (adaptive tuning) is a function in which the servo amplifier detects machine vibration for a predetermined period of time and sets the filter characteristics automatically to suppress mechanical system vibration. Since the filter characteristics (frequency, depth) are set automatically, you need not be conscious of the resonance frequency of a mechanical system.



When machine resonance is large and frequency is low



When machine resonance is small and frequency is high

(2) Parameter

Select how to set the filter tuning in [Pr. PB01 Adaptive tuning mode (adaptive filter II)].

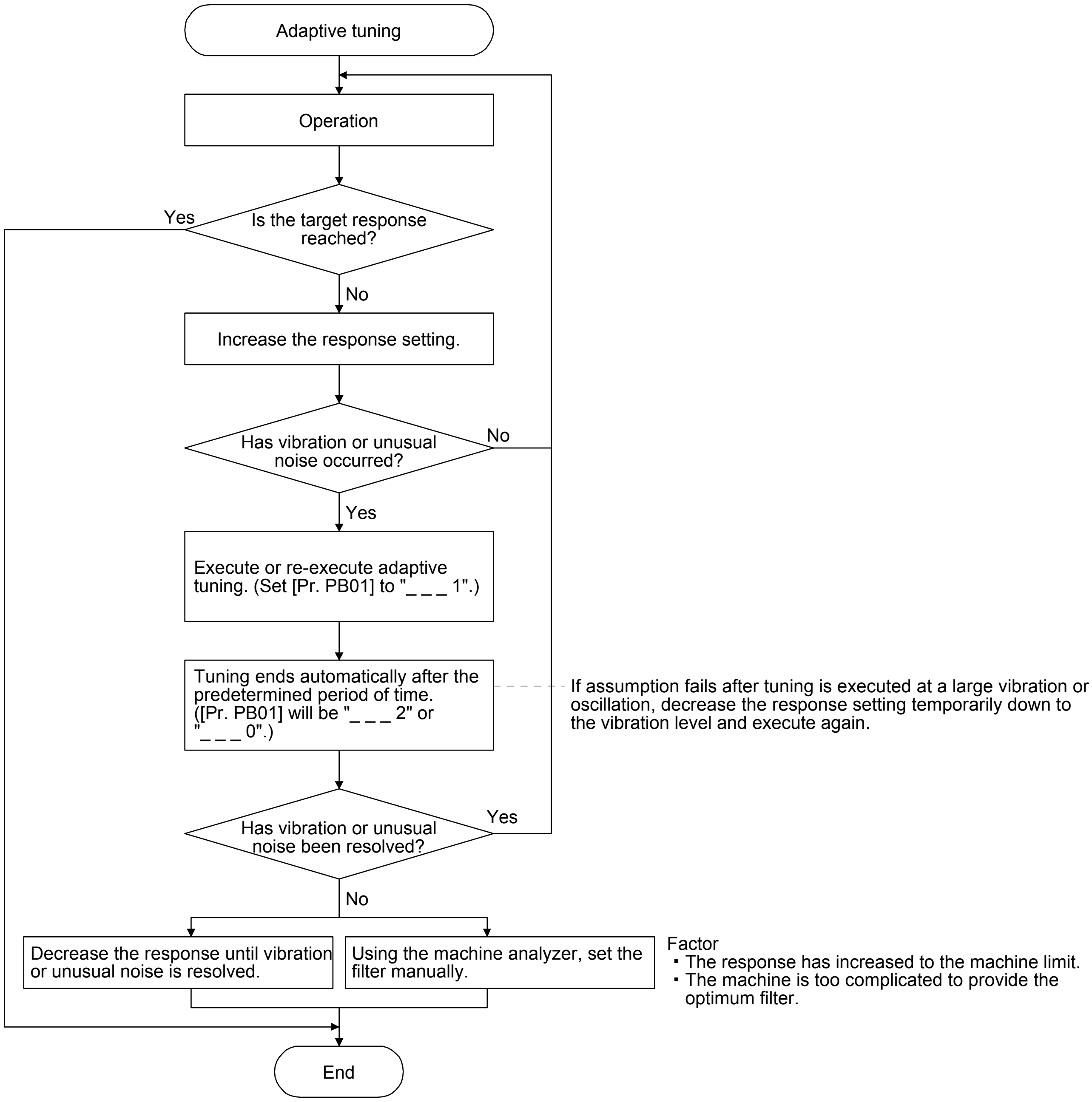
[Pr. PB01]

0	0	0	

Filter tuning mode selection

Setting value	Filter tuning mode selection	Automatically set parameter
0	Disabled	
1	Automatic setting	PB13/PB14
2	Manual setting	

(3) Adaptive tuning mode procedure



7.1.3 Shaft resonance suppression filter

POINT

- This filter is set properly by default according to servo motor you use and load moment of inertia. For [Pr. PB23], "_ _ _ 0" (automatic setting) is recommended because setting "Shaft resonance suppression filter selection" in [Pr. PB23] or setting [Pr. PB17 Shaft resonance suppression filter] can degrades in performance.

(1) Function

When a load is mounted to the servo motor shaft, resonance by shaft torsion during driving may generate a mechanical vibration at high frequency. The shaft resonance suppression filter suppresses the vibration.

When you select "Automatic setting", the filter will be set automatically on the basis of the servo motor you use and the load to motor inertia ratio. The disabled setting increases the response of the servo amplifier for high resonance frequency.

(2) Parameter

Set "Shaft resonance suppression filter selection" in [Pr. PB23].

[Pr. PB23]

0	1	0	

Shaft resonance suppression filter selection
0: Automatic setting
1: Manual setting
2: Disabled

To set [Pr. PB17 Shaft resonance suppression filter] automatically, select "Automatic setting".
To set [Pr. PB17 Shaft resonance suppression filter] manually, select "Manual setting". The setting values are as follows.

Shaft resonance suppression filter setting frequency selection

Setting value	Frequency [Hz]	Setting value	Frequency [Hz]
_ _ 0 0	Disabled	_ _ 1 0	562
_ _ 0 1	Disabled	_ _ 1 1	529
_ _ 0 2	4500	_ _ 1 2	500
_ _ 0 3	3000	_ _ 1 3	473
_ _ 0 4	2250	_ _ 1 4	450
_ _ 0 5	1800	_ _ 1 5	428
_ _ 0 6	1500	_ _ 1 6	409
_ _ 0 7	1285	_ _ 1 7	391
_ _ 0 8	1125	_ _ 1 8	375
_ _ 0 9	1000	_ _ 1 9	360
_ _ 0 A	900	_ _ 1 A	346
_ _ 0 B	818	_ _ 1 B	333
_ _ 0 C	750	_ _ 1 C	321
_ _ 0 D	692	_ _ 1 D	310
_ _ 0 E	642	_ _ 1 E	300
_ _ 0 F	600	_ _ 1 F	290

7.1.4 Low-pass filter

(1) Function

When a ball screw or the like is used, resonance of high frequency may occur as the response level of the servo system is increased. To prevent this, the low-pass filter is enabled for a torque command as the initial value. The filter frequency of the low-pass filter is automatically adjusted to the value in the following equation.

$$\text{Filter frequency ([rad/s])} = \frac{VG2}{1 + GD2} \times 10$$

However, when an automatically adjusted value is smaller than VG2, the filter frequency will be the VG2 value.

To set [Pr. PB18] manually, select "Manual setting (_ _ 1 _)" of "Low-pass filter selection" in [Pr. PB23].

(2) Parameter

Set "Low-pass filter selection" in [Pr. PB23].

[Pr. PB23]

0	1		0

Low-pass filter selection
0: Automatic setting
1: Manual setting
2: Disabled

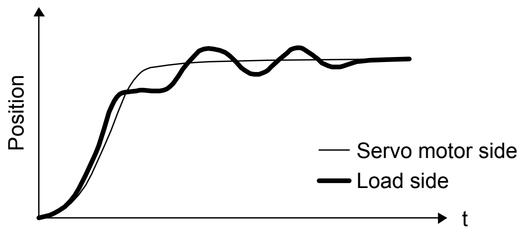
7.1.5 Advanced vibration suppression control II

POINT

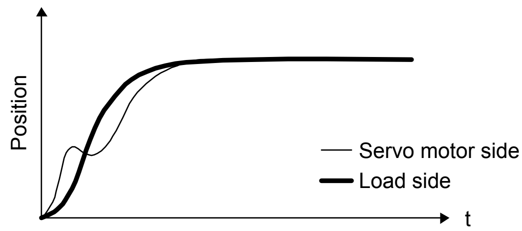
- The function is enabled when "Gain adjustment mode selection" in [Pr. PA08] is "Auto tuning mode 2 (_ _ _ 2)", "Manual mode (_ _ _ 3)", or "2 gain adjustment mode 2 (_ _ _ 4)".
- The machine resonance frequency supported in the vibration suppression control tuning mode is 1.0 Hz to 100.0 Hz. As for the vibration out of the range, set manually.
- Stop the servo motor before changing the vibration suppression control-related parameters. Otherwise, it may cause an unexpected operation.
- For positioning operation during execution of vibration suppression control tuning, provide a stop time to ensure a stop after vibration damping.
- Vibration suppression control tuning may not make normal estimation if the residual vibration at the servo motor side is small.
- Vibration suppression control tuning sets the optimum parameter with the currently set control gains. When the response setting is increased, set vibration suppression control tuning again.
- When using the vibration suppression control 2, set "_ _ _ 1" in [Pr. PA24].

(1) Function

Use the vibration suppression control to further suppress load-side vibration, such as work-side vibration and base shake. The servo motor-side operation is adjusted for positioning so that the machine does not vibrate.



Vibration suppression: off (normal)



Vibration suppression control: on

When the advanced vibration suppression control II ([Pr. PB02 Vibration suppression control tuning mode]) is executed, the vibration frequency at load side is automatically estimated to suppress machine side vibration two times at most.

In the vibration suppression control tuning mode, this mode shifts to the manual setting after the positioning operation is performed the predetermined number of times. For manual setting, adjust the vibration suppression control 1 with [Pr. PB19] to [Pr. PB22] and vibration suppression control 2 with [Pr. PB52] to [Pr. PB55].

(2) Parameter

Set [Pr. PB02 Vibration suppression control tuning mode (advanced vibration suppression control II)]. When you use a vibration suppression control, set "Vibration suppression control 1 tuning mode selection". When you use two vibration suppression controls, set "Vibration suppression control 2 tuning mode selection" in addition.

[Pr. PB02]

0	0		

Vibration suppression control 1 tuning mode

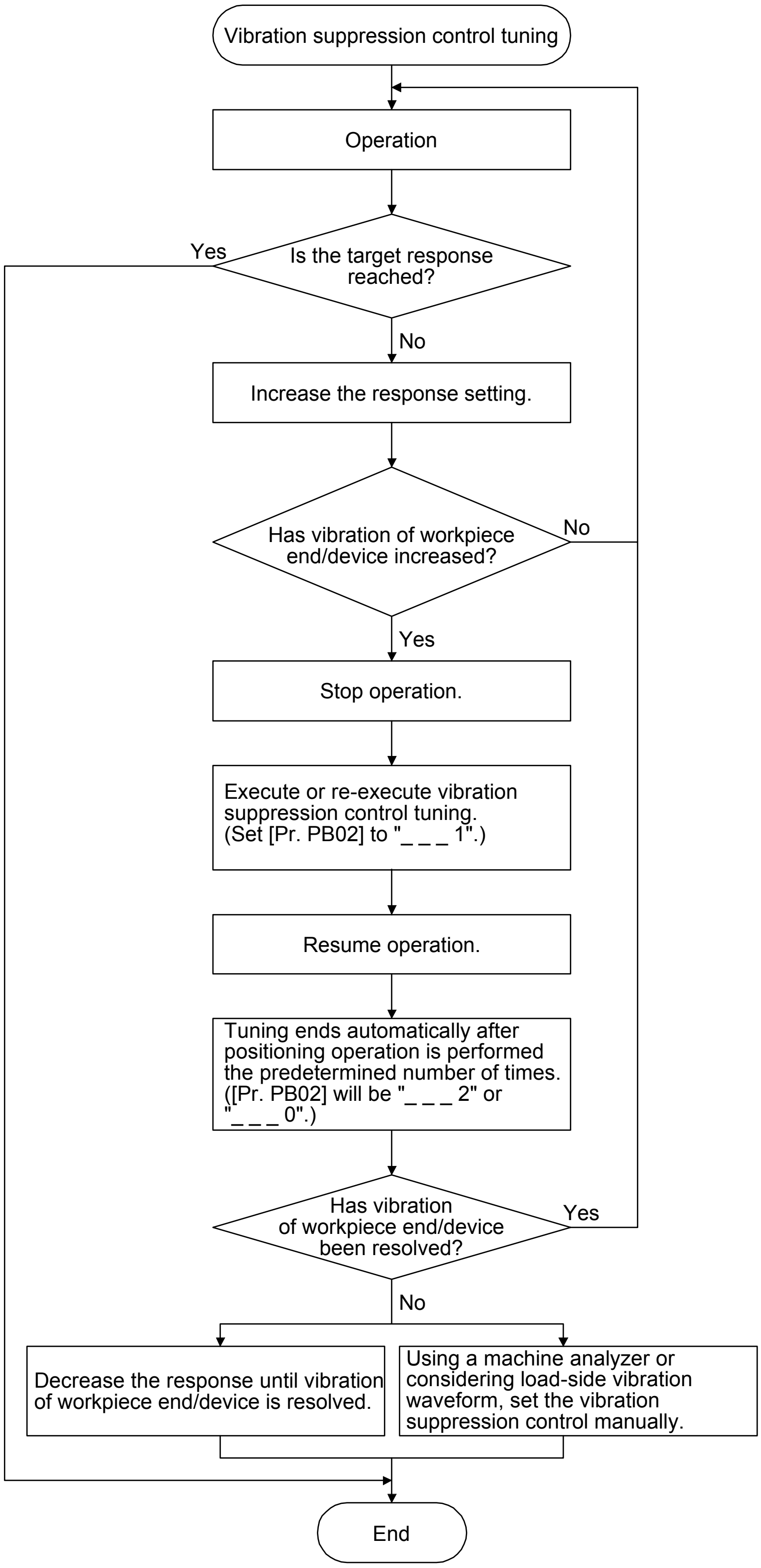
Setting value	Vibration suppression control 1 tuning mode selection	Automatically set parameter
_ _ _ 0	Disabled	
_ _ _ 1	Automatic setting	PB19/PB20/PB21/PB22
_ _ _ 2	Manual setting	

Vibration suppression control 2 tuning mode

Setting value	Vibration suppression control 2 tuning mode selection	Automatically set parameter
_ _ 0 _	Disabled	
_ _ 1 _	Automatic setting	PB52/PB53/PB54/PB55
_ _ 2 _	Manual setting	

(3) Vibration suppression control tuning procedure

The following flow chart is for the vibration suppression control 1. For the vibration suppression control 2, set "_ _ 1 _" in [Pr. PB02] to execute the vibration suppression control tuning.



Factor
- Estimation cannot be made as load-side vibration has not been transmitted to the servo motor side.
- The response of the model loop gain has increased to the load-side vibration frequency (vibration suppression control limit).

(4) Vibration suppression control manual mode

POINT

- When load-side vibration does not show up in servo motor-side vibration, the setting of the servo motor-side vibration frequency does not produce an effect.
- When the anti-resonance frequency and resonance frequency can be confirmed using the machine analyzer or external equipment, do not set the same value but set different values to improve the vibration suppression performance.

Measure work-side vibration and device shake with the machine analyzer or external measuring instrument, and set the following parameters to adjust vibration suppression control manually.

Setting item	Vibration suppression control 1	Vibration suppression control 2
Vibration suppression control - Vibration frequency	[Pr. PB19]	[Pr. PB52]
Vibration suppression control - Resonance frequency	[Pr. PB20]	[Pr. PB53]
Vibration suppression control - Vibration frequency damping	[Pr. PB21]	[Pr. PB54]
Vibration suppression control - Resonance frequency damping	[Pr. PB22]	[Pr. PB55]

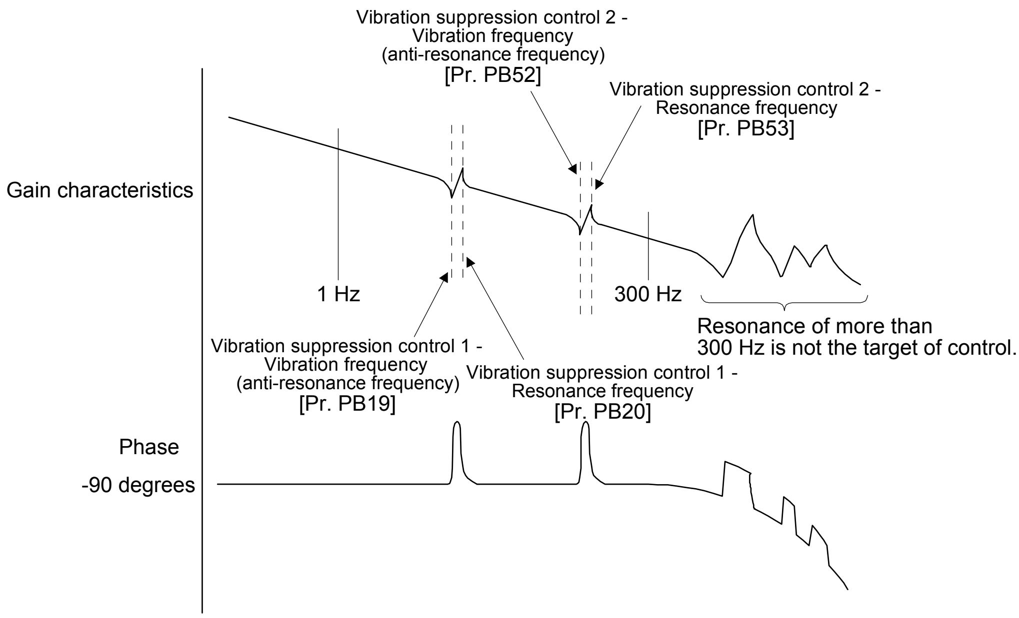
Step 1. Select "Manual setting (_ _ _ 2)" of "Vibration suppression control 1 tuning mode selection" or "Manual setting (_ _ 2 _)" of "Vibration suppression control 2 tuning mode selection" in [Pr. PB02].

Step 2. Set "Vibration suppression control - Vibration frequency" and "Vibration suppression control - Resonance frequency" as follows.

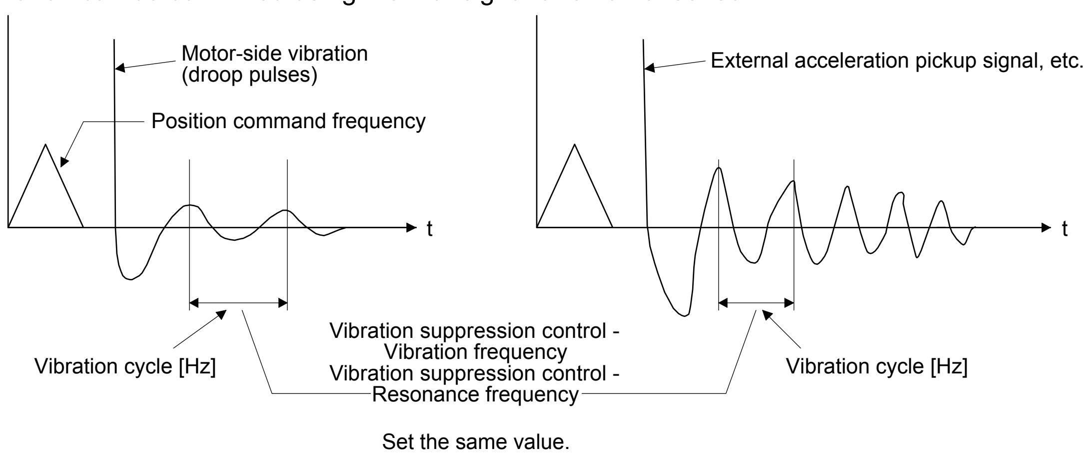
However, the value of [Pr. PB07 Model loop gain], vibration frequency, and resonance frequency have the following usable range and recommended range.

Vibration suppression control	Usable range	Recommended setting range
Vibration suppression control 1	[Pr. PB19] > 1/2π × (0.9 × [Pr. PB07]) [Pr. PB20] > 1/2π × (0.9 × [Pr. PB07])	[Pr. PB19] > 1/2π × (1.5 × [Pr. PB07]) [Pr. PB20] > 1/2π × (1.5 × [Pr. PB07])
Vibration suppression control 2	When [Pr. PB19] < [Pr. PB52], [Pr. PB52] > (5.0 + 0.1 × [Pr. PB07]) [Pr. PB53] > (5.0 + 0.1 × [Pr. PB07]) 1.1 < [Pr. PB52]/[Pr. PB19] < 5.5 [Pr. PB07] < 2π (0.3 × [Pr. PB19] + 1/8 × [Pr. PB52])	When [Pr. PB19] < [Pr. PB52], [Pr. PB52], [Pr. PB53] > 6.25 Hz 1.1 < [Pr. PB52]/[Pr. PB19] < 4 [Pr. PB07] < 1/3 × (4 × [Pr. PB19] + 2 × [Pr. PB52])

(a) When a vibration peak can be confirmed with machine analyzer using MR Configurator2, or external equipment.



(b) When vibration can be confirmed using monitor signal or external sensor



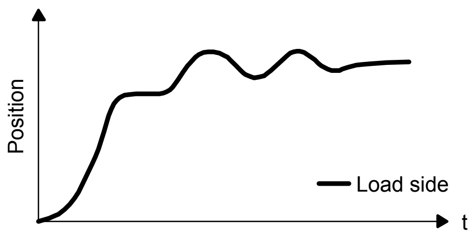
Step 3. Fine-adjust "Vibration suppression control - Vibration frequency damping" and "Vibration suppression control - Resonance frequency damping".

7.1.6 Command notch filter

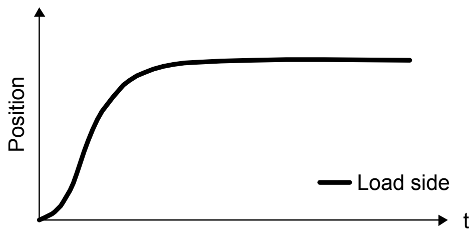
POINT
●By using the advanced vibration suppression control II and the command notch filter, the load-side vibration of three frequencies can be suppressed. ●The frequency range of machine vibration, which can be supported by the command notch filter, is between 4.5 Hz and 2250 Hz. Set a frequency close to the machine vibration frequency and within the range. ●When [Pr. PB45 Command notch filter] is changed during the positioning operation, the changed setting is not reflected. The setting is reflected approximately 150 ms after the servo motor stops (after servo-lock).

(1) Function

Command notch filter has a function that lowers the gain of the specified frequency contained in a position command. By lowering the gain, load-side vibration, such as work-side vibration and base shake, can be suppressed. Which frequency to lower the gain and how deep to lower the gain can be set.



Command notch filter: disabled



Command notch filter: enabled

(2) Parameter
Set [Pr. PB45 Command notch filter] as shown below. For the command notch filter setting frequency, set the closest value to the vibration frequency [Hz] at the load side.

[Pr. PB45]

0 □ □ □

Notch depth

Setting value	Depth [dB]
0	-40.0
1	-24.1
2	-18.1
3	-14.5
4	-12.0
5	-10.1
6	-8.5
7	-7.2
8	-6.0
9	-5.0
A	-4.1
B	-3.3
C	-2.5
D	-1.8
E	-1.2
F	-0.6

Command notch filter setting frequency

Setting value	Frequency [Hz]	Setting value	Frequency [Hz]	Setting value	Frequency [Hz]
00	Disabled	20	70	40	17.6
01	2250	21	66	41	16.5
02	1125	22	62	42	15.6
03	750	23	59	43	14.8
04	562	24	56	44	14.1
05	450	25	53	45	13.4
06	375	26	51	46	12.8
07	321	27	48	47	12.2
08	281	28	46	48	11.7
09	250	29	45	49	11.3
0A	225	2A	43	4A	10.8
0B	204	2B	41	4B	10.4
0C	187	2C	40	4C	10.0
0D	173	2D	38	4D	9.7
0E	160	2E	37	4E	9.4
0F	150	2F	36	4F	9.1
10	140	30	35.2	50	8.8
11	132	31	33.1	51	8.3
12	125	32	31.3	52	7.8
13	118	33	29.6	53	7.4
14	112	34	28.1	54	7.0
15	107	35	26.8	55	6.7
16	102	36	25.6	56	6.4
17	97	37	24.5	57	6.1
18	93	38	23.4	58	5.9
19	90	39	22.5	59	5.6
1A	86	3A	21.6	5A	5.4
1B	83	3B	20.8	5B	5.2
1C	80	3C	20.1	5C	5.0
1D	77	3D	19.4	5D	4.9
1E	75	3E	18.8	5E	4.7
1F	72	3F	18.2	5F	4.5

7.2 Gain switching function

You can switch gains with the function. You can switch gains during rotation and during stop, and can use an input device to switch gains during operation.

7.2.1 Applications

The following shows when you use the function.

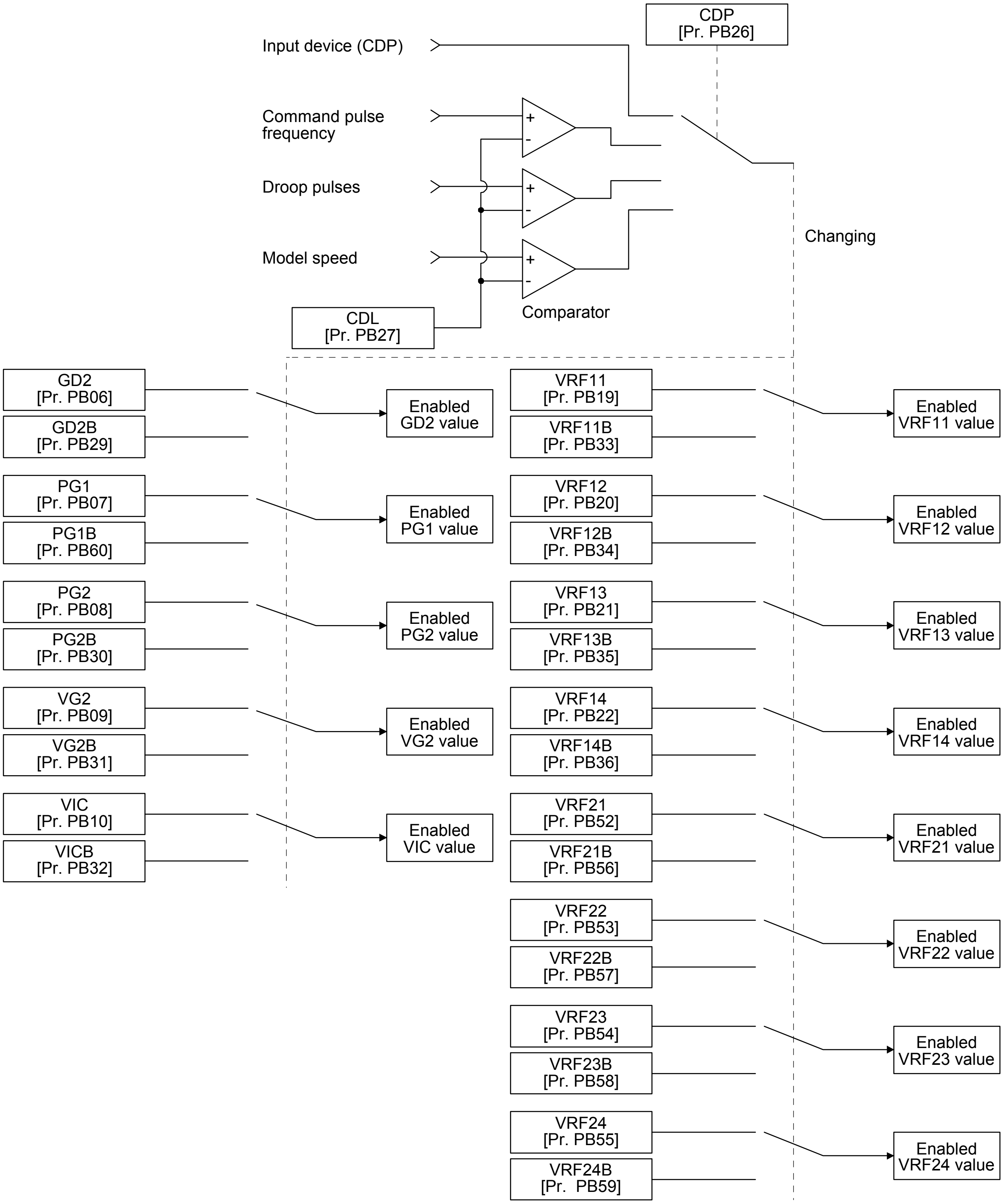
(1) You want to increase the gains during servo-lock but decrease the gains to reduce noise during rotation.

(2) You want to increase the gains during settling to shorten the stop settling time.

(3) You want to change the gains using an input device to ensure stability of the servo system since the load to motor inertia ratio varies greatly during a stop (e.g. a large load is mounted on a carrier).

7.2.2 Function block diagram

The control gains, load to motor inertia ratio, and vibration suppression control settings are changed according to the conditions selected by [Pr. PB26 Gain switching function] and [Pr. PB27 Gain switching condition].



7.2.3 Parameter

When using the gain switching function, always select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08 Auto tuning mode]. The gain switching function cannot be used in the auto tuning mode.

(1) Parameter for setting gain switching condition

Parameter	Symbol	Name	Unit	Description
PB26	CDP	Gain switching selection		Select the changing condition.
PB27	CDL	Gain switching condition	[kpulse/s] /[pulse] /[r/min]	Set the changing condition values.
PB28	CDT	Gain switching time constant	[ms]	You can set the filter time constant for a gain change at changing.

(a) [Pr. PB26 Gain switching function]
Set the gain switching condition. Select the switching condition in the first to third digits.

[Pr. PB26]

0

Gain switching selection
0: Disabled
1: Input device (gain switching (CDP))
2: Command frequency
3: Droop pulses
4: Servo motor speed

Gain switching condition
0: Gain after switching is enabled with gain switching condition or more
1: Gain after switching is enabled with gain switching condition or less

Gain switching time constant disabling condition selection (Note)
0: Switching time constant enabled
1: Switching time constant disabled
2: Return time constant disabled

Note. This parameter setting is available with servo amplifiers with software version B4 or later.

(b) [Pr. PB27 Gain switching condition]
Set a level to switch gains after you select "Command frequency", "Droop pulses", or "Servo motor speed" in [Pr. PB26 Gain switching function].
The setting unit is as follows.

Gain switching condition	Unit
Command frequency	[kpulse/s]
Droop pulses	[pulse]
Servo motor speed	[r/min]

(c) [Pr. PB28 Gain switching time constant]
You can set the primary delay filter to each gain at gain switching. Use this parameter to suppress shock given to the machine if the gain difference is large at gain switching, for example.

(2) Switchable gain parameter

Loop gain	Before switching			After switching		
	Parameter	Symbol	Name	Parameter	Symbol	Name
Load to motor inertia ratio	PB06	GD2	Load to motor inertia ratio	PB29	GD2B	Load to motor inertia ratio after gain switching
Model loop gain	PB07	PG1	Model loop gain	PB60	PG1B	Gain switching Model loop gain
Position loop gain	PB08	PG2	Position loop gain	PB30	PG2B	Gain switching Position loop gain
Speed loop gain	PB09	VG2	Speed loop gain	PB31	VG2B	Gain switching Speed loop gain
Speed integral compensation	PB10	VIC	Speed integral compensation	PB32	VICB	Gain switching Speed integral compensation
Vibration suppression control 1 Used to set the value of the after-changing vibration suppression control vibration frequency setting.	PB19	VRF11	Vibration suppression control 1 Used to set the value of the after-changing vibration suppression control vibration frequency setting.	PB33	VRF11B	Vibration suppression control 1 - Vibration frequency after gain switching
Vibration suppression control 1 - Resonance frequency	PB20	VRF12	Vibration suppression control 1 - Resonance frequency	PB34	VRF12B	Vibration suppression control 1 - Resonance frequency after gain switching
Vibration suppression control 1 - Vibration frequency damping	PB21	VRF13	Vibration suppression control 1 - Vibration frequency damping	PB35	VRF13B	Vibration suppression control 1 - Vibration frequency damping after gain switching
Vibration suppression control 1 - Resonance frequency damping	PB22	VRF14	Vibration suppression control 1 - Resonance frequency damping	PB36	VRF14B	Vibration suppression control 1 - Resonance frequency damping after gain switching
Vibration suppression control 2 - Vibration frequency	PB52	VRF21	Vibration suppression control 2 - Vibration frequency	PB56	VRF21B	Vibration suppression control 2 - Vibration frequency after gain switching
Vibration suppression control 2 - Resonance frequency	PB53	VRF22	Vibration suppression control 2 - Resonance frequency	PB57	VRF22B	Vibration suppression control 2 - Resonance frequency after gain switching
Vibration suppression control 2 - Vibration frequency damping	PB54	VRF23	Vibration suppression control 2 - Vibration frequency damping	PB58	VRF23B	Vibration suppression control 2 - Vibration frequency damping after gain switching
Vibration suppression control 2 - Resonance frequency damping	PB55	VRF24	Vibration suppression control 2 - Resonance frequency damping	PB59	VRF24B	Vibration suppression control 2 - Resonance frequency damping after gain switching

(a) [Pr. PB06] to [Pr. PB10]
These parameters are the same as in ordinary manual adjustment. Gain switching allows the values of load to motor inertia ratio, position loop gain, speed loop gain, and speed integral compensation to be switched.

(b) [Pr.PB19] to [Pr.PB22]/[Pr.PB52] to [Pr.PB55]
These parameters are the same as in ordinary manual adjustment. You can switch the vibration frequency, resonance frequency, vibration frequency damping, and resonance frequency damping by switching gain during motor stop.

(c) [Pr. PB29 Load to motor inertia ratio after gain switching]
Set the load to motor inertia ratio after gain switching. If the load to motor inertia ratio does not change, set it to the same value as [Pr. PB06 Load to motor inertia ratio].

(d) [Pr. PB30 Position loop gain after gain switching], [Pr. PB31 Speed loop gain after gain switching], and [Pr. PB32 Speed integral compensation after gain switching]
Set the values of after switching position loop gain, speed loop gain and speed integral compensation.

(e) Vibration suppression control after gain switching ([Pr. PB33] to [Pr. PB36]/[Pr. PB56] to [Pr. PB59])/[Pr. PB60 Model loop gain after gain switching]
The gain switching vibration suppression control and model loop gain are used only with input device (CDP) on/off.
You can switch the vibration frequency, resonance frequency, vibration frequency damping, resonance frequency damping, and model loop gain of the vibration suppression control 1 and vibration suppression control 2.

7.2.4 Gain switching procedure

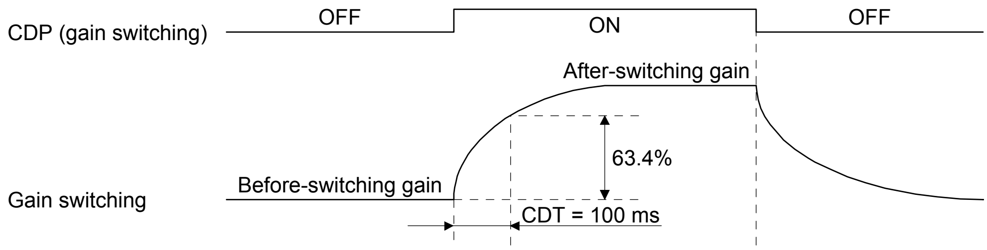
This operation will be described by way of setting examples.

(1) When you choose switching by input device (CDP)
(a) Setting

Parameter	Symbol	Name	Setting value	Unit
PB06	GD2	Load to motor inertia ratio	4.00	[Multiplier]
PB07	PG1	Model loop gain	100	[rad/s]
PB08	PG2	Position loop gain	120	[rad/s]
PB09	VG2	Speed loop gain	3000	[rad/s]
PB10	VIC	Speed integral compensation	20	[ms]
PB19	VRF11	Vibration suppression control 1 - Vibration frequency	50	[Hz]
PB20	VRF12	Vibration suppression control 1 - Resonance frequency	50	[Hz]
PB21	VRF13	Vibration suppression control 1 - Vibration frequency damping	0.20	
PB22	VRF14	Vibration suppression control 1 - Resonance frequency damping	0.20	
PB52	VRF21	Vibration suppression control 2 - Vibration frequency	20	[Hz]
PB53	VRF22	Vibration suppression control 2 - Resonance frequency	20	[Hz]
PB54	VRF23	Vibration suppression control 2 - Vibration frequency damping	0.10	
PB55	VRF24	Vibration suppression control 2 - Resonance frequency damping	0.10	
PB29	GD2B	Load to motor inertia ratio after gain switching	10.00	[Multiplier]
PB60	PG1B	Model loop gain after gain switching	50	[rad/s]
PB30	PG2B	Gain switching position loop gain	84	[rad/s]
PB31	VG2B	Gain switching speed loop gain	4000	[rad/s]
PB32	VICB	Speed integral compensation after gain switching	50	[ms]
PB26	CDP	Gain switching function	0001 (Switch by input device (CDP) on/off.)	

Parameter	Symbol	Name	Setting value	Unit
PB28	CDT	Gain switching time constant	100	[ms]
PB33	VRF11B	Vibration suppression control 1 - Vibration frequency after gain switching	60	[Hz]
PB34	VRF12B	Vibration suppression control 1 - Resonance frequency after gain switching	60	[Hz]
PB35	VRF13B	Vibration suppression control 1 - Vibration frequency damping after gain switching	0.15	
PB36	VRF14B	Vibration suppression control 1 - Resonance frequency damping after gain switching	0.15	
PB56	VRF21B	Vibration suppression control 2 - Vibration frequency after gain switching	30	[Hz]
PB57	VRF22B	Vibration suppression control 2 - Resonance frequency after gain switching	30	[Hz]
PB58	VRF23B	Vibration suppression control 2 - Vibration frequency damping after gain switching	0.05	
PB59	VRF24B	Vibration suppression control 2 - Resonance frequency damping after gain switching	0.05	

(b) Switching timing chart



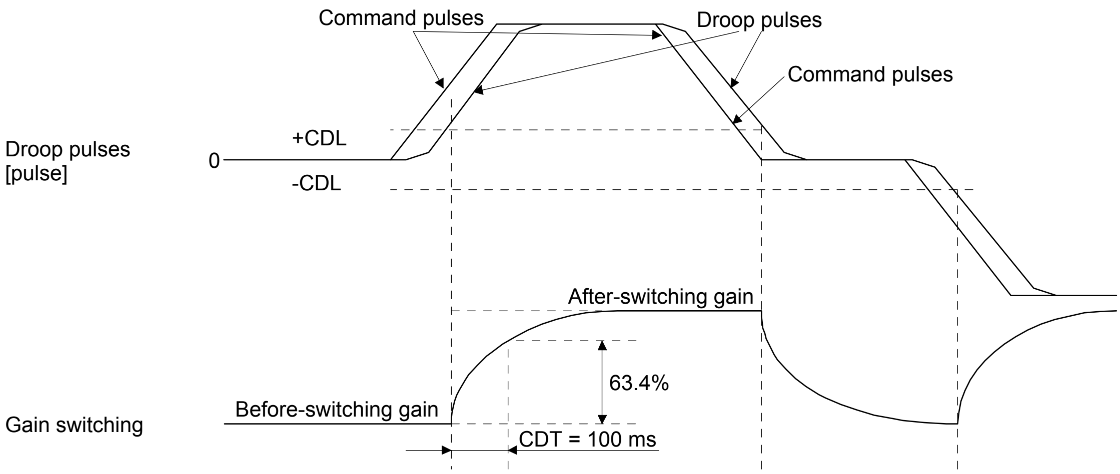
Model loop gain	100	→	50	→	100
Load to motor inertia ratio	4.00	→	10.00	→	4.00
Position loop gain	120	→	84	→	120
Speed loop gain	3000	→	4000	→	3000
Speed integral compensation	20	→	50	→	20
Vibration suppression control 1 - Vibration frequency	50	→	60	→	50
Vibration suppression control 1 - Resonance frequency	50	→	60	→	50
Vibration suppression control 1 - Vibration frequency damping	0.20	→	0.15	→	0.20
Vibration suppression control 1 - Resonance frequency damping	0.20	→	0.15	→	0.20
Vibration suppression control 2 - Vibration frequency	20	→	30	→	20
Vibration suppression control 2 - Resonance frequency	20	→	30	→	20
Vibration suppression control 2 - Vibration frequency damping	0.10	→	0.05	→	0.10
Vibration suppression control 2 - Resonance frequency damping	0.10	→	0.05	→	0.10

(2) When you choose switching by droop pulses
In this case, the vibration suppression control after gain switching and model loop gain after gain switching cannot be used.

(a) Setting

Parameter	Symbol	Name	Setting value	Unit
PB06	GD2	Load to motor inertia ratio	4.00	[Multiplier]
PB08	PG2	Position loop gain	120	[rad/s]
PB09	VG2	Speed loop gain	3000	[rad/s]
PB10	VIC	Speed integral compensation	20	[ms]
PB29	GD2B	Load to motor inertia ratio after gain switching	10.00	[Multiplier]
PB30	PG2B	Gain switching position loop gain	84	[rad/s]
PB31	VG2B	Gain switching speed loop gain	4000	[rad/s]
PB32	VICB	Speed integral compensation after gain switching	50	[ms]
PB26	CDP	Gain switching selection	0003 (switching by droop pulses)	
PB27	CDL	Gain switching condition	50	[pulse]
PB28	CDT	Gain switching time constant	100	[ms]

(b) Switching timing chart



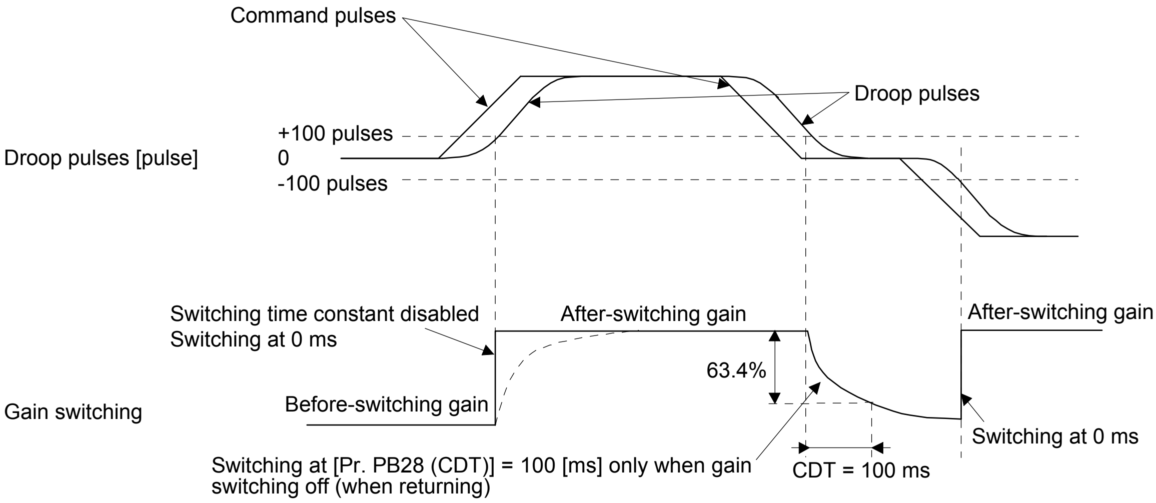
Load to motor inertia ratio	4.00	→	10.00	→	4.00	→	10.00
Position loop gain	120	→	84	→	120	→	84
Speed loop gain	3000	→	4000	→	3000	→	4000
Speed integral compensation	20	→	50	→	20	→	50

(3) When the gain switching time constant is disabled

(a) Gain switching time constant disabled was selected.

The gain switching time constant is disabled with this setting. The time constant is enabled at gain return.

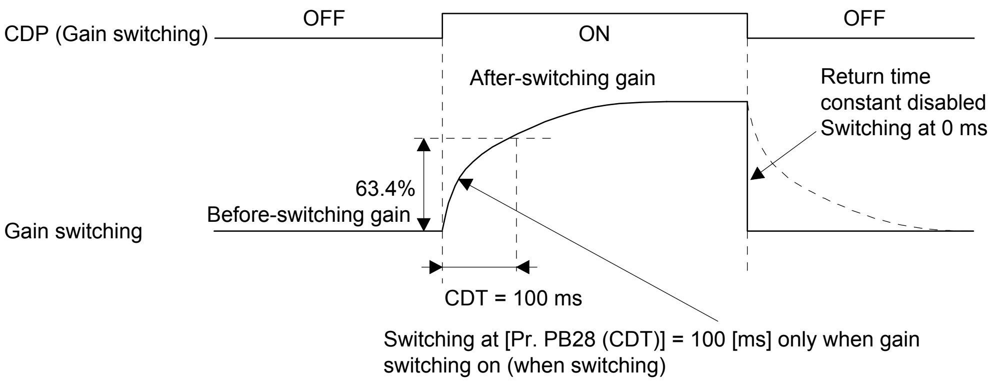
The following example shows for [Pr. PB26 (CDP)] = 0103, [Pr. PB27 (CDL)] = 100 [pulse], and [Pr. PB28 (CDT)] = 100 [ms].



(b) Gain return time constant disabled was selected.

The gain switching time constant is enabled with this setting. The time constant is disabled at gain return.

The following example shows for [Pr. PB26 (CDP)] = 0201, [Pr. PB27 (CDL)] = 0, and [Pr. PB28 (CDT)] = 100 [ms].



7.3 Tough drive function

POINT
●Set enable/disable of the tough drive function with [Pr. PA20 Tough drive setting]. (Refer to section 5.2.1.)

This function makes the equipment continue operating even under the condition that an alarm occurs. The tough drive functions are the vibration tough drive and the instantaneous power failure tough drive.

7.3.1 Vibration tough drive function

This function prevents vibration by resetting a filter instantaneously when machine resonance occurs due to varied vibration frequency caused by machine aging.
To reset the machine resonance suppression filters with the function, [Pr. PB13 Machine resonance suppression filter 1] and [Pr. PB15 Machine resonance suppression filter 2] should be set in advance.
Set [Pr. PB13] and [Pr. PB15] as follows.

(1) One-touch tuning execution (section 6.2)

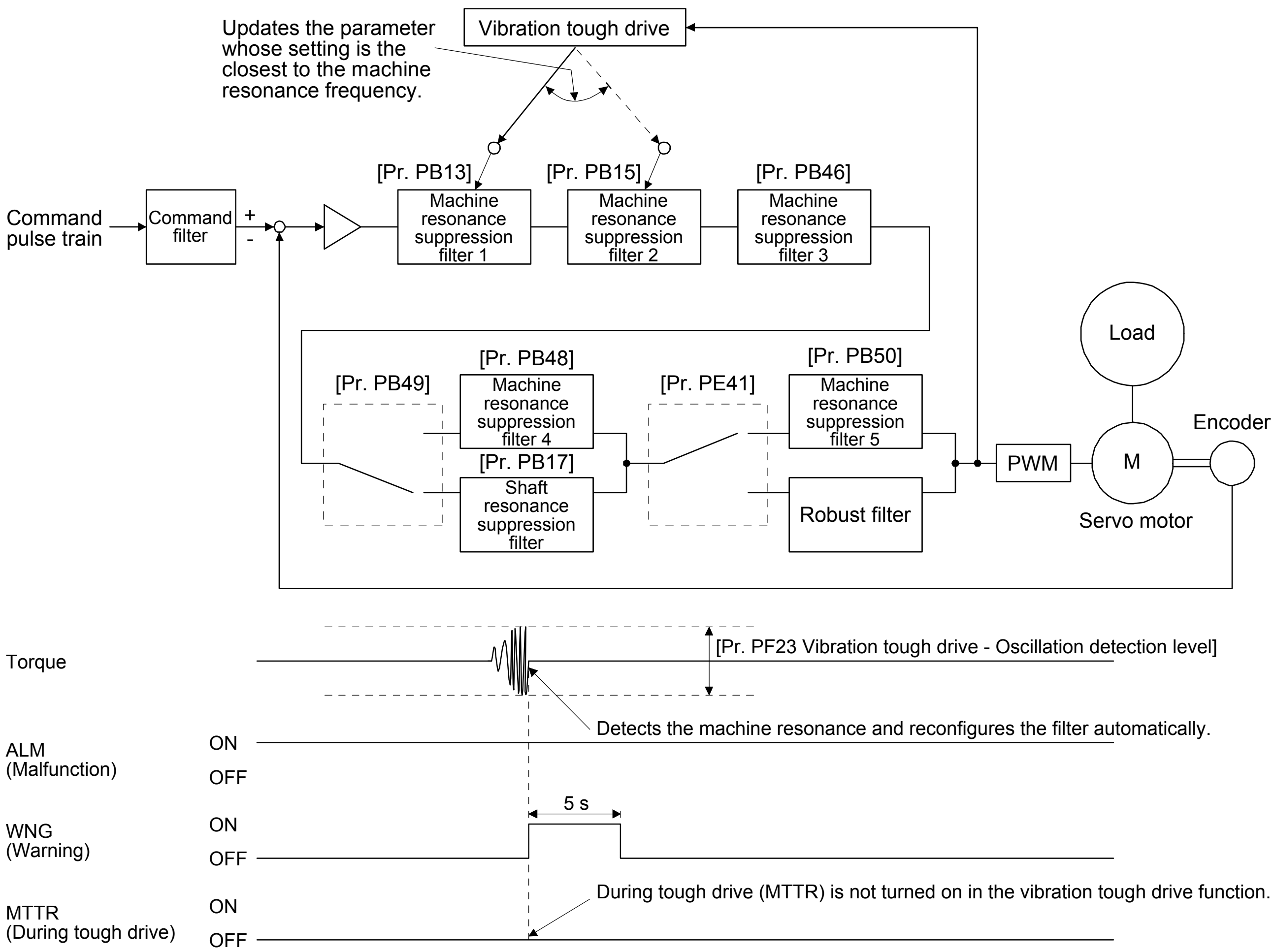
(2) Manual setting (section 5.2.2)

The vibration tough drive function operates when a detected machine resonance frequency is within ±30% for a value set in [Pr. PB13 Machine resonance suppression filter 1] or [Pr. PB15 Machine resonance suppression filter 2].
To set a detection level of the function, set sensitivity in [Pr. PF23 Vibration tough drive - Oscillation detection level].

POINT
●Resetting [Pr. PB13] and [Pr. PB15] by the vibration tough drive function is performed constantly. However, the number of write times to the EEPROM is limited to once per hour. ●The vibration tough drive function does not reset [Pr. PB46 Machine resonance suppression filter 3], [Pr. PB48 Machine resonance suppression filter 4], and [Pr. PB50 Machine resonance suppression filter 5]. ●The vibration tough drive function does not detect a vibration of 100 Hz or less.

The following shows the function block diagram of the vibration tough drive function.
The function detects machine resonance frequency and compare it with [Pr. PB13] and [Pr. PB15], and reset a machine resonance frequency of a parameter whose set value is closer.

Filter	Setting parameter	Precaution	Parameter that is reset with vibration tough drive function
Machine resonance suppression filter 1	PB01/PB13/PB14	The filter can be set automatically with "Filter tuning mode selection" in [Pr. PB01].	PB13
Machine resonance suppression filter 2	PB15/PB16		PB15
Machine resonance suppression filter 3	PB46/PB47		
Machine resonance suppression filter 4	PB48/PB49	Enabling the machine resonance suppression filter 4 disables the shaft resonance suppression filter. Using the shaft resonance suppression filter is recommended because it is adjusted properly depending on the usage situation. The shaft resonance suppression filter is enabled for the initial setting.	
Machine resonance suppression filter 5	PB50/PB51	Enabling the robust filter disables the machine resonance suppression filter 5. The robust filter is disabled for the initial setting.	



7.3.2 Instantaneous power failure tough drive function

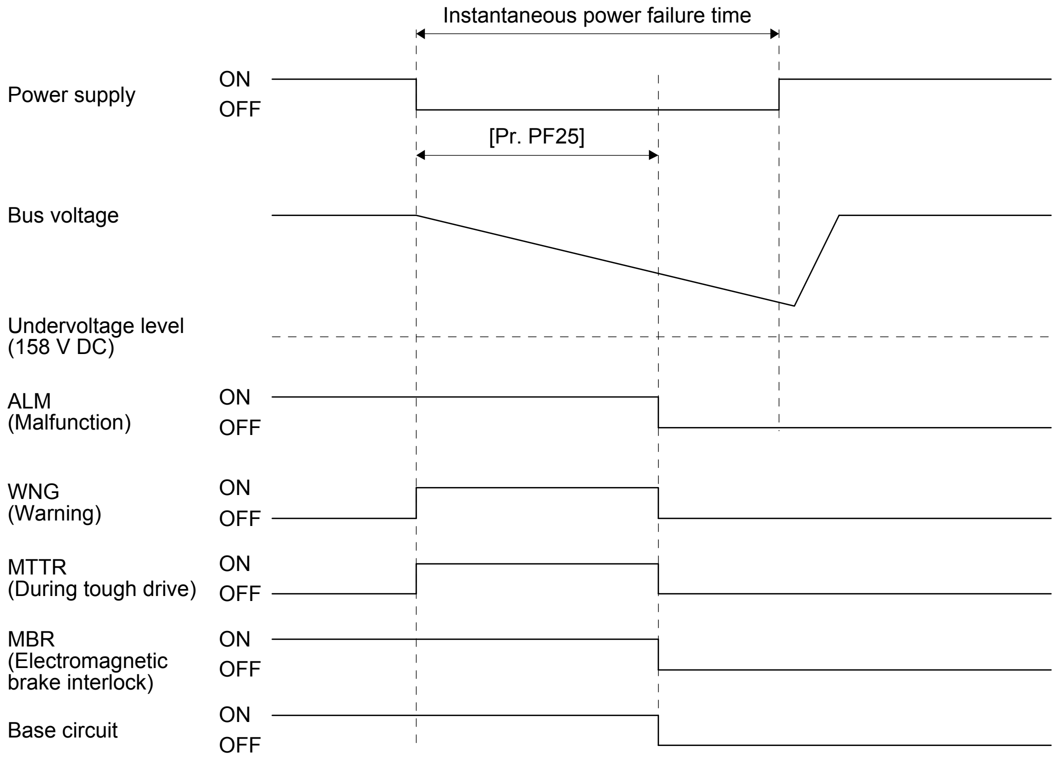
CAUTION	
	●The tolerance against instantaneous power failure is increased by the instantaneous power failure tough drive function. However, it is not guarantee to comply with the SEMI-F47 standard.

The instantaneous power failure tough drive function avoids [AL. 10 Undervoltage] even when an instantaneous power failure occurs during operation. When the instantaneous power failure tough drive activates, the function will increase the tolerance against instantaneous power failure using the electrical energy charged in the capacitor in the servo amplifier and will change an alarm level of [AL. 10 Undervoltage] simultaneously. The [AL. 10.1 Voltage drop in the power] detection time for the power supply can be changed by [Pr. PF25 Instantaneous power failure tough drive - detection time]. In addition, [AL.10.2 Bus voltage drop] detection level for the bus voltage is changed automatically.

POINT

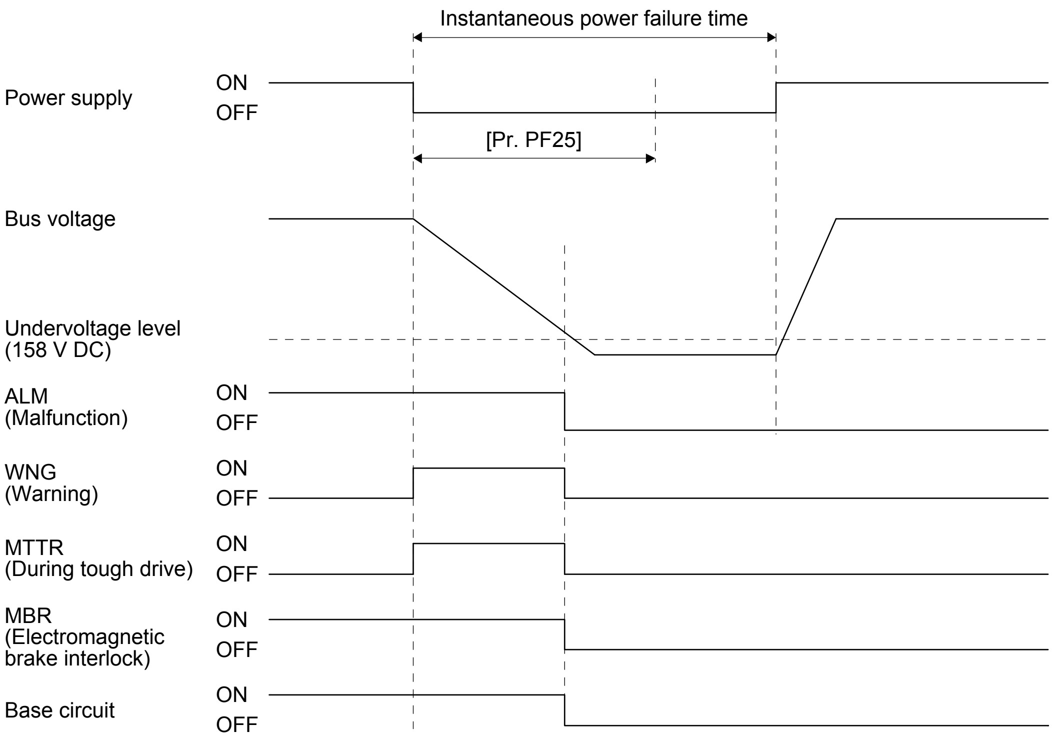
- ●MBR (Electromagnetic brake interlock) will not turn off during the instantaneous power failure tough drive.
- ●Selecting "Enabled (_ _ _ 1)" for "Torque limit function selection at instantaneous power failure" in [Pr. PA26] will limit torques to save electric energy when an instantaneous power failure occurs during operation and will make [AL. 10 Undervoltage] less likely to occur.
- ●When the load of instantaneous power failure is large, the undervoltage alarm ([AL. 10.2]) caused by the bus voltage drop may occur regardless of the set value of [Pr. PF25 Instantaneous power failure tough drive - detection time].

(1) Instantaneous power failure time > [Pr. PF25 Instantaneous power failure tough drive - detection time]
The alarm occurs when the instantaneous power failure time exceeds [Pr. PF25 Instantaneous power failure tough drive - detection time].
MTTR (During tough drive) turns on after the instantaneous power failure is detected.
MBR (Electromagnetic brake interlock) turns off when the alarm occurs.

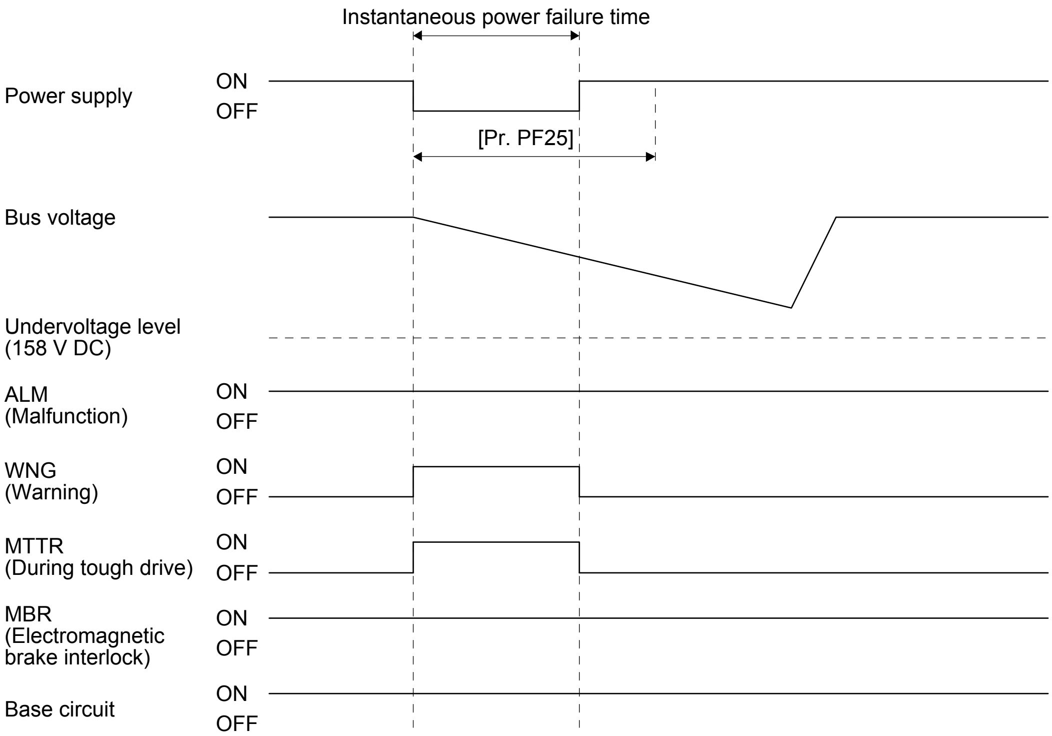


(2) Instantaneous power failure time < [Pr. PF25 Instantaneous power failure tough drive - detection time]
Operation status differs depending on how bus voltage decrease.

(a) When the bus voltage decreases lower than 158 V DC within the instantaneous power failure time
[AL. 10 Undervoltage] occurs when the bus voltage decrease lower than 158 V DC regardless of the enabled instantaneous power failure tough drive.



(b) When the bus voltage does not decrease lower than 158 V DC within the instantaneous power failure time
The operation continues without alarming.



7.4 Model adaptive control disabled

POINT

- Change the parameters while the servo motor stops.
- When setting auto tuning response ([Pr. PA09]), change the setting value one by one to adjust it while checking operation status of the servo motor.
- This is used with servo amplifiers with software version B4 or later. Check the software version of the servo amplifier using MR Configurator2.

(1) Summary

The servo amplifier has a model adaptive control. The servo amplifier has a virtual motor model and drives the servo motor following the output of the motor model in the model adaptive control. At model adaptive control disabled, the servo amplifier drives the motor with PID control without using the model adaptive control.

The following shows the available parameters at model adaptive control disabled.

Parameter	Symbol	Name
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

(2) Parameter setting

Set [Pr. PB25] to "_ _ _ 2".

(3) Restrictions

The following functions are not available at model adaptive control disabled.

Function	Explanation
Forced stop deceleration function ([Pr. PA04])	Disabling the model adaptive control while the forced stop deceleration function is enabled, [AL. 37] will occur. The forced stop deceleration function is enabled at factory setting. Set [Pr. PA04] to "0 _ _ _" (Forced stop deceleration function disabled).
Vibration suppression control 1 ([Pr. PB02]/[Pr. PB19]/[Pr. PB20]) Vibration suppression control 2 ([Pr. PB02]/[Pr. PB52]/[Pr. PB53])	The vibration suppression control uses the model adaptive control. Disabling the model adaptive control will also disable the vibration suppression control.
Overshoot amount compensation ([Pr. PB12])	The overshoot amount compensation uses data used by the model adaptive control. Disabling the model adaptive control will also disable the overshoot amount compensation.

MEMO

8. TROUBLESHOOTING

POINT
●Refer to "MELSERVO-JE Servo Amplifier Instruction Manual (Troubleshooting)" for details of alarms and warnings. ●As soon as an alarm occurs, turn SON (Servo-on) off and interrupt the power. ●[AL. 37 Parameter error] and warnings (except [AL. F0 Tough drive warning]) are not recorded in the alarm history.

When an error occurs during operation, the corresponding alarm or warning is displayed. When the alarm or the warning occurs, refer to "MELSERVO-JE Servo Amplifier Instruction Manual (Troubleshooting)" to remove the failure. When an alarm occurs, ALM (Malfunction) will turn off.

8.1 Explanations of the lists

(1) No./Name/Detail No./Detail name
Indicates the No./name/detail No./detail name of alarms or warnings.

(2) Stop method
For the alarms and warnings in which "SD" is written in the stop method column, the servo motor stops with the dynamic brake after forced stop deceleration. For the alarms and warnings in which "DB" or "EDB" is written in the stop method column, the servo motor stops with the dynamic brake without forced stop deceleration.

(3) Alarm deactivation
After its cause has been removed, the alarm can be deactivated in any of the methods marked ○ in the alarm deactivation column. Warnings are automatically canceled after the cause of occurrence is removed. Alarms are deactivated by alarm reset or power cycling.

Alarm deactivation	Explanation
Alarm reset	1. Turn on RES (Reset) with an input device. 2. Push the "SET" button while the display of the servo amplifier is in the current alarm display mode. 3. Click the "Occurring Alarm Reset" button in the "Alarm Display" window of MR Configurator2.
Cycling the power	Turn off the power, check that the 5-digit, 7-segment LED display is off, and then turn on the power.

(4) Alarm code
To output alarm codes, set [Pr. PD34] to "_ _ _ 1". Alarm codes are outputted by turning on/off bit 0 to bit 2. Warnings ([AL. 90] to [AL. F3]) do not have alarm codes. The alarm codes in the following table will be outputted when they occur. The alarm codes will not be outputted in normal condition.

8.2 Alarm list

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)	Alarm deactivation		Alarm code		
						Alarm reset	Cycling the power	CN1 49 (Bit 2)	CN1 23 (Bit 1)	CN1 24 (Bit 0)
Alarm	10	Undervoltage	10.1	Voltage drop in the power	EDB	○	○	0	1	0
			10.2	Bus voltage drop	SD	○	○			
	12	Memory error 1 (RAM)	12.1	RAM error 1	DB		○	0	0	0
			12.2	RAM error 2	DB		○			
			12.3	RAM error 3	DB		○			
			12.4	RAM error 4	DB		○			
			12.5	RAM error 5	DB		○			
	13	Clock error	13.1	Clock error 1	DB		○	0	0	0
			13.2	Clock error 2	DB		○			
	14	Control process error	14.1	Control process error 1	DB		○	0	0	0
			14.2	Control process error 2	DB		○			
			14.3	Control process error 3	DB		○			
			14.4	Control process error 4	DB		○			
			14.5	Control process error 5	DB		○			
			14.6	Control process error 6	DB		○			
			14.7	Control process error 7	DB		○			
			14.8	Control process error 8	DB		○			
			14.9	Control process error 9	DB		○			
			14.A	Control process error 10	DB		○			
	15	Memory error 2 (EEP-ROM)	15.1	EEP-ROM error at power on	DB		○	0	0	0
			15.2	EEP-ROM error during operation	DB		○			
	16	Encoder initial communication error 1	16.1	Encoder initial communication - Receive data error 1	DB		○	1	1	0
			16.2	Encoder initial communication - Receive data error 2	DB		○			
			16.3	Encoder initial communication - Receive data error 3	DB		○			
			16.5	Encoder initial communication - Transmission data error 1	DB		○			
			16.6	Encoder initial communication - Transmission data error 2	DB		○			
			16.7	Encoder initial communication - Transmission data error 3	DB		○			
			16.A	Encoder initial communication - Process error 1	DB		○			
			16.B	Encoder initial communication - Process error 2	DB		○			
			16.C	Encoder initial communication - Process error 3	DB		○			
			16.D	Encoder initial communication - Process error 4	DB		○			
			16.E	Encoder initial communication - Process error 5	DB		○			
			16.F	Encoder initial communication - Process error 6	DB		○			
	17	Board error	17.1	Board error 1	DB		○	0	0	0
			17.3	Board error 2	DB		○			
			17.4	Board error 3	DB		○			
			17.5	Board error 4	DB		○			
			17.6	Board error 5	DB		○			
	19	Memory error 3 (Flash-ROM)	19.1	Flash-ROM error 1	DB		○	0	0	0
			19.2	Flash-ROM error 2	DB		○			
	1A	Servo motor combination error	1A.1	Servo motor combination error 1	DB		○	1	1	0
	1E	Encoder initial communication error 2	1E.1	Encoder malfunction	DB		○	1	1	0
	1F	Encoder initial communication error 3	1F.1	Incompatible encoder	DB		○	1	1	0

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)	Alarm deactivation: Alarm reset	Alarm deactivation: Cycling the power	Alarm code: CN1 49 (Bit 2)	Alarm code: CN1 23 (Bit 1)	Alarm code: CN1 24 (Bit 0)
Alarm	20	Encoder normal communication error 1	20.1	Encoder normal communication - Receive data error 1	EDB		○	1	1	0
			20.2	Encoder normal communication - Receive data error 2	EDB		○			
			20.3	Encoder normal communication - Receive data error 3	EDB		○			
			20.5	Encoder normal communication - Transmission data error 1	EDB		○			
			20.6	Encoder normal communication - Transmission data error 2	EDB		○			
			20.7	Encoder normal communication - Transmission data error 3	EDB		○			
			20.9	Encoder normal communication - Receive data error 4	EDB		○			
			20.A	Encoder normal communication - Receive data error 5	EDB		○			
	21	Encoder normal communication error 2	21.1	Encoder data error 1	EDB		○	1	1	0
			21.2	Encoder data update error	EDB		○			
			21.3	Encoder data waveform error	EDB		○			
			21.5	Encoder hardware error 1	EDB		○			
			21.6	Encoder hardware error 2	EDB		○			
			21.9	Encoder data error 2	EDB		○			
	24	Main circuit error	24.1	Ground fault detected at hardware detection circuit	DB		○	1	0	0
			24.2	Ground fault detected by software detection function	DB	○	○			
	25	Absolute position erased	25.1	Servo motor encoder - Absolute position erased	DB		○			
	30	Regenerative error	30.1	Regeneration heat error	DB	○ (Note 1)	○ (Note 1)	0	0	1
			30.2	Regeneration signal error	DB	○ (Note 1)	○ (Note 1)			
			30.3	Regeneration feedback signal error	DB	○ (Note 1)	○ (Note 1)			
	31	Overspeed	31.1	Abnormal motor speed	SD	○	○	1	0	1
	32	Overcurrent	32.1	Overcurrent detected at hardware detection circuit (during operation)	DB		○	1	0	0
			32.2	Overcurrent detected at software detection function (during operation)	DB	○	○			
			32.3	Overcurrent detected at hardware detection circuit (during a stop)	DB		○			
			32.4	Overcurrent detected at software detection function (during a stop)	DB	○	○			
	33	Overvoltage	33.1	Main circuit voltage error	EDB	○	○	0	0	1
	34	SSCNET receive error 1	34.1	SSCNET receive data error	SD	○	○			
			34.2	SSCNET connector connection error	SD	○	○			
			34.3	SSCNET communication data error	SD	○	○			
			34.4	Hardware error signal detection	SD	○	○			
	35	Command frequency error	35.1	Command frequency error	SD	○	○	1	0	1
	36	SSCNET receive error 2	36.1	Continuous communication data error	SD	○	○			
	37	Parameter error	37.1	Parameter setting range error	DB		○	0	0	0
			37.2	Parameter combination error	DB		○			
			37.3	Point table setting error	DB		○			

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)	Alarm deactivation		Alarm code		
						Alarm reset	Cycling the power	CN1 49 (Bit 2)	CN1 23 (Bit 1)	CN1 24 (Bit 0)
Alarm	39	Program error	39.1	Program error	DB		○	0	0	0
			39.2	Command argument external error	DB		○			
			39.3	Register No. error	DB		○			
			39.4	Non-correspondence command error	DB		○			
	3E	Operation mode error	3E.1	Operation mode error	DB		○			
			3E.6	Operation mode switch error	DB		○	0	0	0
	45	Main circuit device overheat	45.1	Main circuit device overheat error 1	SD	○ (Note 1)	○ (Note 1)	0	1	1
	46	Servo motor overheat	46.1	Abnormal temperature of servo motor 1	SD	○ (Note 1)	○ (Note 1)	0	1	1
			46.5	Abnormal temperature of servo motor 3	DB	○ (Note 1)	○ (Note 1)			
			46.6	Abnormal temperature of servo motor 4	DB	○ (Note 1)	○ (Note 1)			
	47	Cooling fan error	47.2	Cooling fan speed reduction error	SD		○	0	1	1
	50	Overload 1	50.1	Thermal overload error 1 during operation	SD	○ (Note 1)	○ (Note 1)	0	1	1
			50.2	Thermal overload error 2 during operation	SD	○ (Note 1)	○ (Note 1)			
			50.3	Thermal overload error 4 during operation	SD	○ (Note 1)	○ (Note 1)			
			50.4	Thermal overload error 1 during a stop	SD	○ (Note 1)	○ (Note 1)			
			50.5	Thermal overload error 2 during a stop	SD	○ (Note 1)	○ (Note 1)			
			50.6	Thermal overload error 4 during a stop	SD	○ (Note 1)	○ (Note 1)			
	51	Overload 2	51.1	Thermal overload error 3 during operation	DB	○ (Note 1)	○ (Note 1)	0	1	1
			51.2	Thermal overload error 3 during a stop	DB	○ (Note 1)	○ (Note 1)			
	52	Error excessive	52.1	Excess droop pulse 1	SD	○	○	1	0	1
			52.3	Excess droop pulse 2	SD	○	○			
			52.4	Error excessive during 0 torque limit	SD	○	○			
			52.5	Excess droop pulse 3	EDB	○	○			
	54	Oscillation detection	54.1	Oscillation detection error	EDB	○	○	0	1	1
	56	Forced stop error	56.2	Over speed during forced stop	EDB	○	○	1	1	0
			56.3	Estimated distance over during forced stop	EDB	○	○			
	61	Operation error	61.1	Point table setting range error	DB	○	○	1	0	1
	8A	USB communication time-out error/Serial communication time-out error	8A.1	USB communication time-out error/Serial communication time-out error	SD	○	○	0	0	0
	8E	USB communication error/Serial communication error	8E.1	USB communication receive error/Serial communication receive error	SD	○	○	0	0	0
			8E.2	USB communication checksum error/Serial communication checksum error	SD	○	○			
			8E.3	USB communication character error/Serial communication character error	SD	○	○			
			8E.4	USB communication command error/Serial communication command error	SD	○	○			
			8E.5	USB communication data number error/Serial communication data number error	SD	○	○			
	88888	Watchdog	8888._	Watchdog	DB		○			

Note 1. Leave for about 30 minutes of cooling time after removing the cause of occurrence.

2. The following shows three stop methods of DB, EDB, and SD.

DB: Dynamic brake stop (For a servo amplifier without the dynamic brake, the servo motor coasts.)

EDB: Electronic dynamic brake stop (available with specified servo motors)

Refer to the following table for the specified servo motors. The stop method for other than the specified servo motors is DB.

Setting [Pr. PF09] to "(_ _ _ 3)" enables the electronic dynamic brake.

Series	Servo motor
HG-KN	HG-KN053/HG-KN13/HG-KN23/HG-KN43
HG-SN	HG-SN52

SD: Forced stop deceleration

3. This is applicable when [Pr. PA04] is set to the initial value. The stop method of SD can be changed to DB using [Pr. PA04].

8.3 Warning list

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)
Warning	90	Home position return incomplete warning	90.1	Home position return incomplete	
			90.2	Home position return abnormal termination	
			90.5	Z-phase unpassed	
	91	Servo amplifier overheat warning (Note 1)	91.1	Main circuit device overheat warning	
	92	Battery cable disconnection warning	92.1	Encoder battery cable disconnection warning	
			92.3	Battery degradation	
	96	Home position setting warning	96.1	In-position warning at home positioning	
			96.2	Command input warning at home positioning	
			96.3	Servo off warning at home positioning	
	97	Program operation disabled/next station position warning	97.1	Program operation disabled warning	
	98	Software limit warning	98.1	Forward rotation-side software stroke limit reached	
			98.2	Reverse rotation-side software stroke limit reached	
	99	Stroke limit warning	99.1	Forward rotation stroke end off	(Note 4)
			99.2	Reverse rotation stroke end off	(Note 4)
	9B	Error excessive warning	9B.1	Excess droop pulse 1 warning	
			9B.3	Excess droop pulse 2 warning	
			9B.4	Error excessive warning during 0 torque limit	
	9F	Battery warning	9F.1	Low battery	
	E0	Excessive regeneration warning	E0.1	Excessive regeneration warning	
	E1	Overload warning 1	E1.1	Thermal overload warning 1 during operation	
			E1.2	Thermal overload warning 2 during operation	
			E1.3	Thermal overload warning 3 during operation	
			E1.4	Thermal overload warning 4 during operation	
			E1.5	Thermal overload warning 1 during a stop	
			E1.6	Thermal overload warning 2 during a stop	
			E1.7	Thermal overload warning 3 during a stop	
			E1.8	Thermal overload warning 4 during a stop	
	E3	Absolute position counter warning	E3.2	Absolute position counter warning	
			E3.5	Encoder absolute positioning counter warning	
	E4	Parameter warning	E4.1	Parameter setting range error warning	
	E6	Servo forced stop warning	E6.1	Forced stop warning	SD
	E7	Controller forced stop warning	E7.1	Controller forced stop input warning	SD
	E8	Cooling fan speed reduction warning	E8.1	Decreased cooling fan speed warning	

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)
Warning	E9	Main circuit off warning	E9.1	Servo-on signal on during main circuit off	DB
			E9.2	Bus voltage drop during low speed operation	DB
			E9.3	Ready-on signal on during main circuit off	DB
	EC	Overload warning 2	EC.1	Overload warning 2	
	ED	Output watt excess warning	ED.1	Output watt excess warning	
	F0	Tough drive warning	F0.1	Instantaneous power failure tough drive warning	
			F0.3	Vibration tough drive warning	
	F2	Drive recorder - Miswriting warning	F2.1	Drive recorder - Area writing time-out warning	
			F2.2	Drive recorder - Data miswriting warning	
	F3	Oscillation detection warning	F3.1	Oscillation detection warning	

Note 1. Leave for about 30 minutes of cooling time after removing the cause of occurrence.
2. The following shows two stop methods of DB and SD.
DB: Dynamic brake stop (For a servo amplifier without the dynamic brake, the servo motor coasts.)
SD: Forced stop deceleration
3. This is applicable when [Pr. PA04] is set to the initial value. The stop method of SD can be changed to DB using [Pr. PA04].
4. Quick stop or slow stop can be selected using [Pr. PD30].

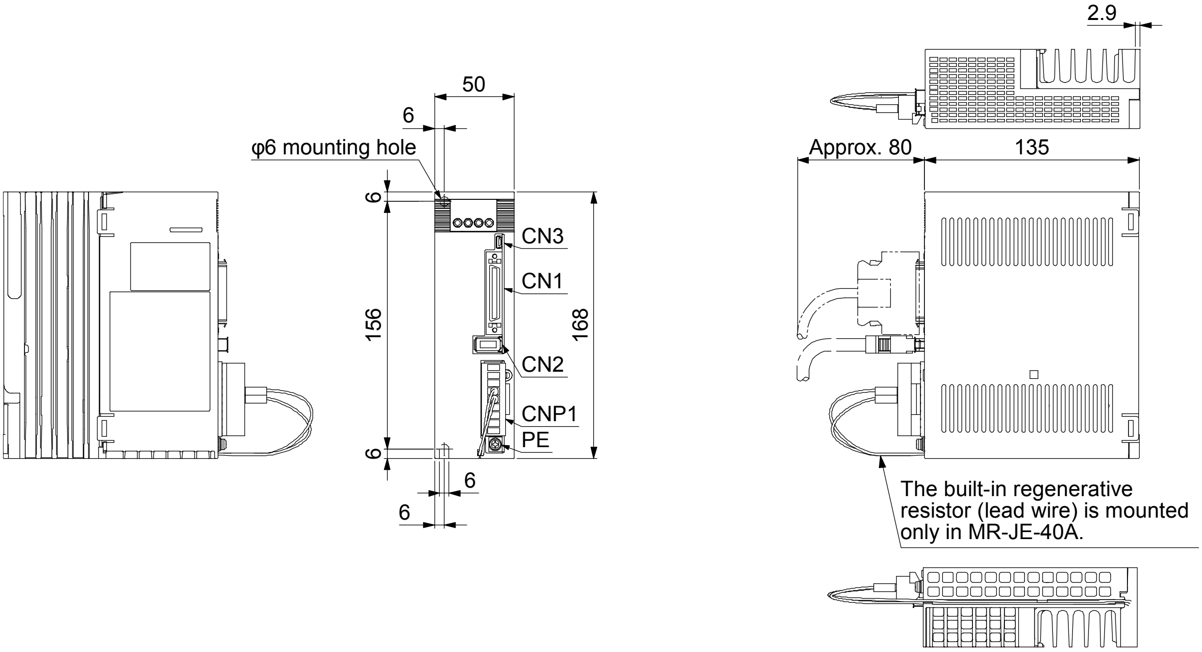
MEMO

9. DIMENSIONS

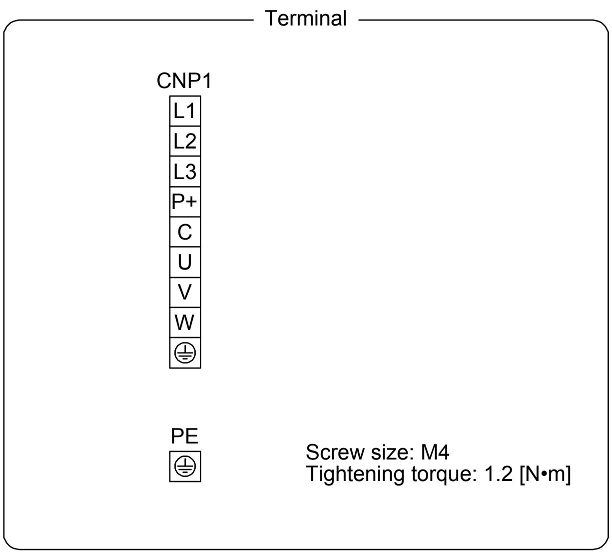
9.1 Servo amplifier

(1) MR-JE-10A to MR-JE-40A

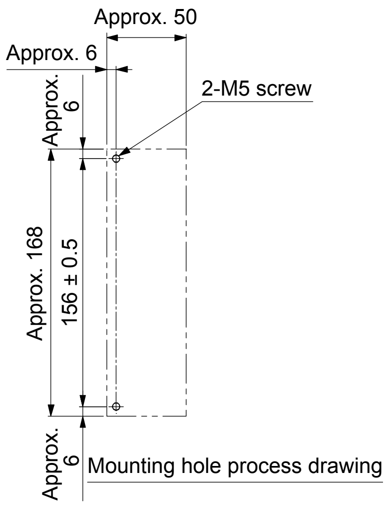
[Unit: mm]



Mass: 0.8 [kg]



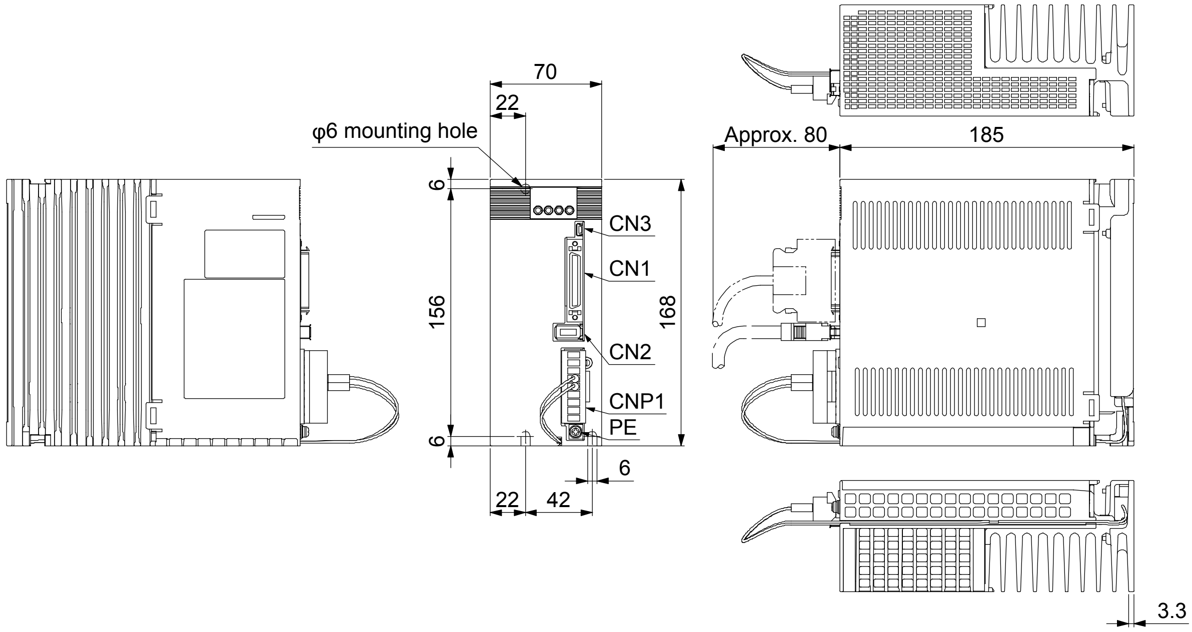
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]



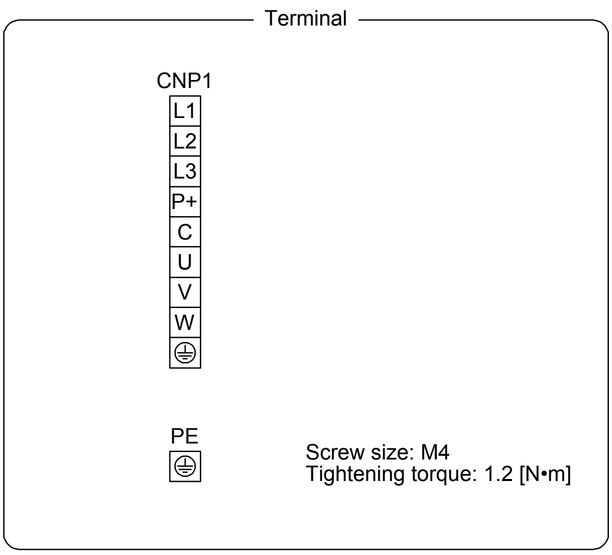
Mounting hole process drawing

(2) MR-JE-70A/MR-JE-100A

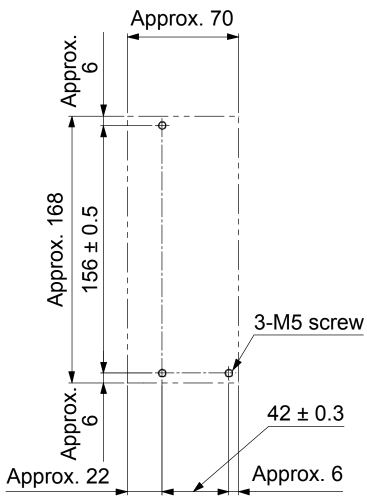
[Unit: mm]



Mass: 1.5 [kg]



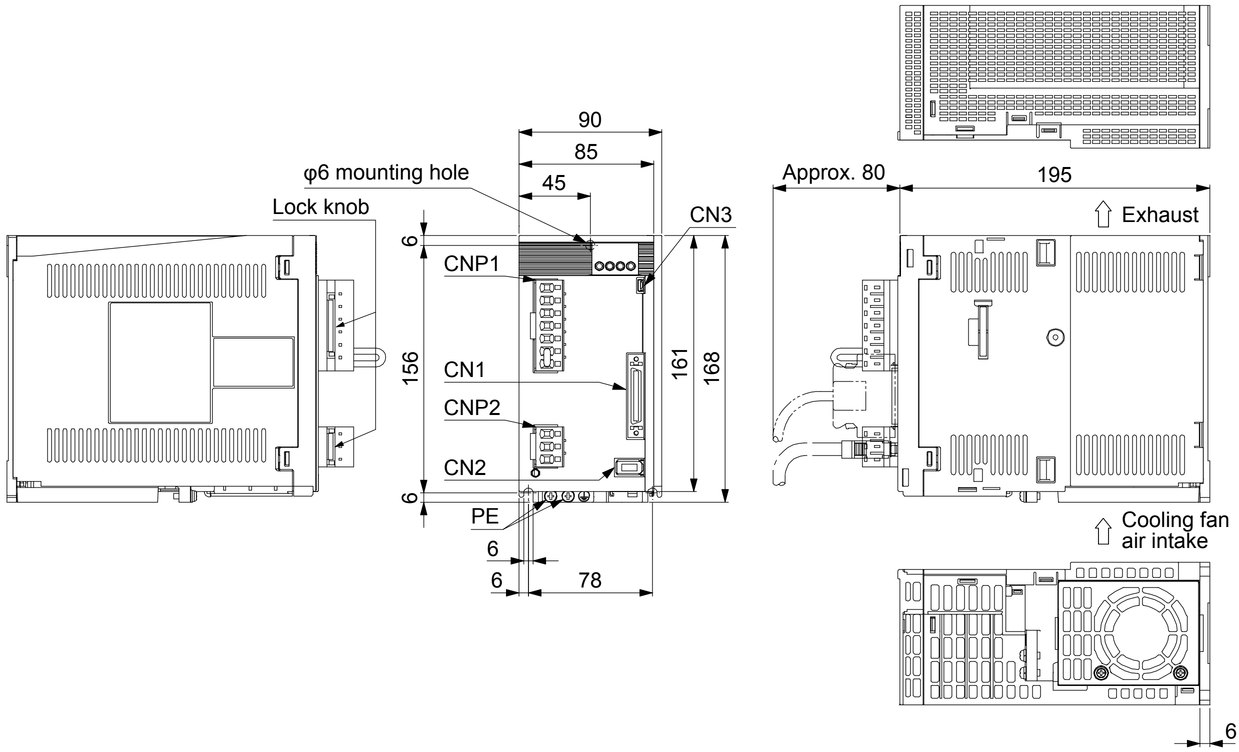
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]



Mounting hole process drawing

(3) MR-JE-200A/MR-JE-300A

[Unit: mm]

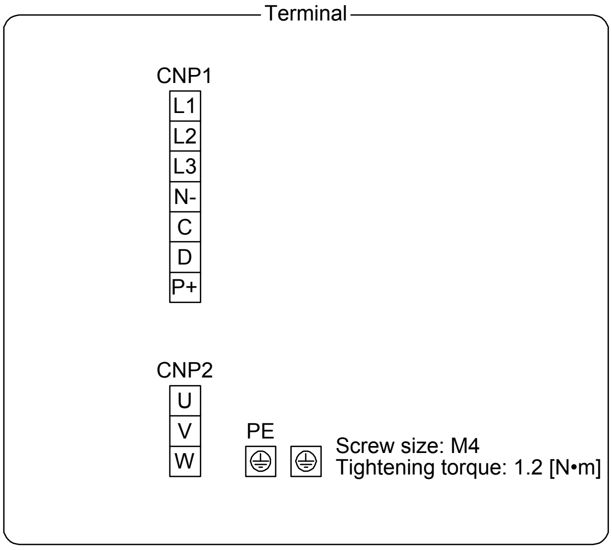


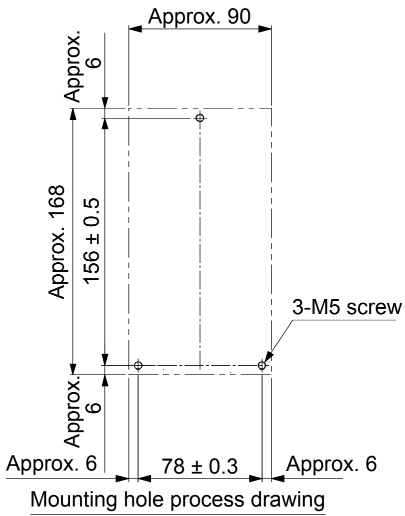
Mass: 2.1 [kg]

Mounting screw

Screw size: M5

Tightening torque: 3.24 [N•m]





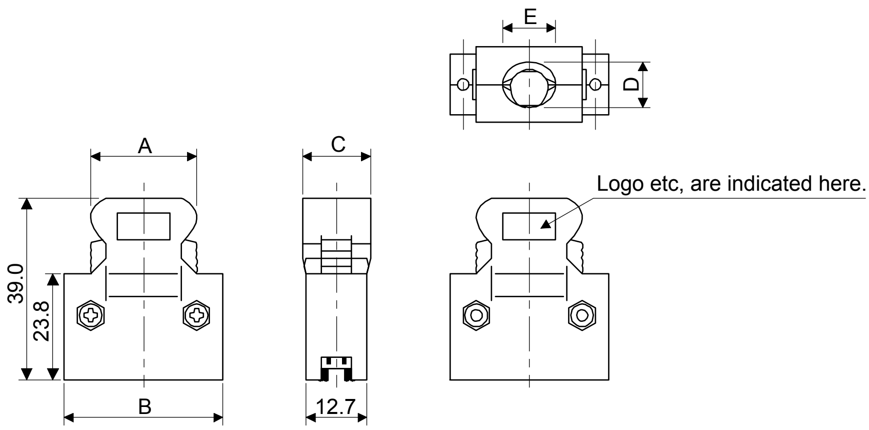
Mounting hole process drawing

9.2 Connector

(1) Miniature delta ribbon (MDR) system (3M)

(a) One-touch lock type

[Unit: mm]

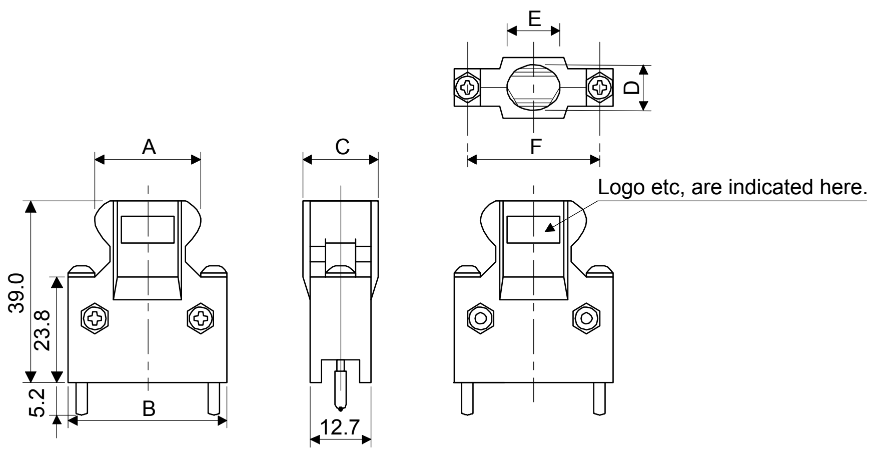


Connector	Shell kit	Variable dimensions				
		A	B	C	D	E
10150-3000PE	10350-52F0-008	41.1	52.4	18.0	14.0	17.0

(b) Jack screw M2.6 type

This is not available as option.

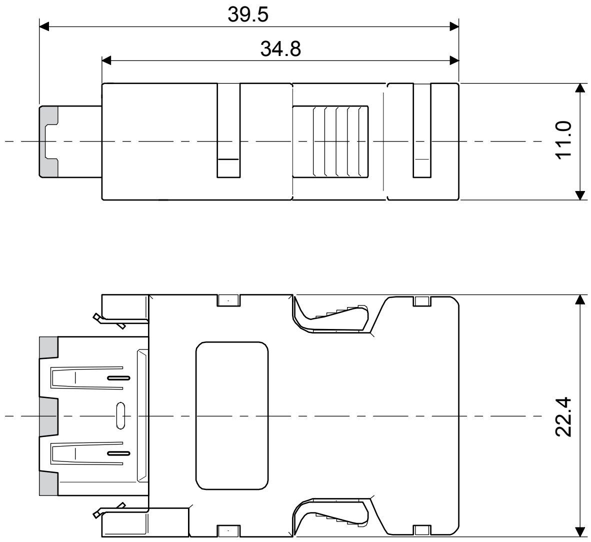
[Unit: mm]



Connector	Shell kit	Variable dimensions					
		A	B	C	D	E	F
10150-3000PE	10350-52A0-008	41.1	52.4	18.0	14.0	17.0	46.5

(2) SCR connector system (3M)
Receptacle: 36210-0100PL
Shell kit: 36310-3200-008

[Unit: mm]

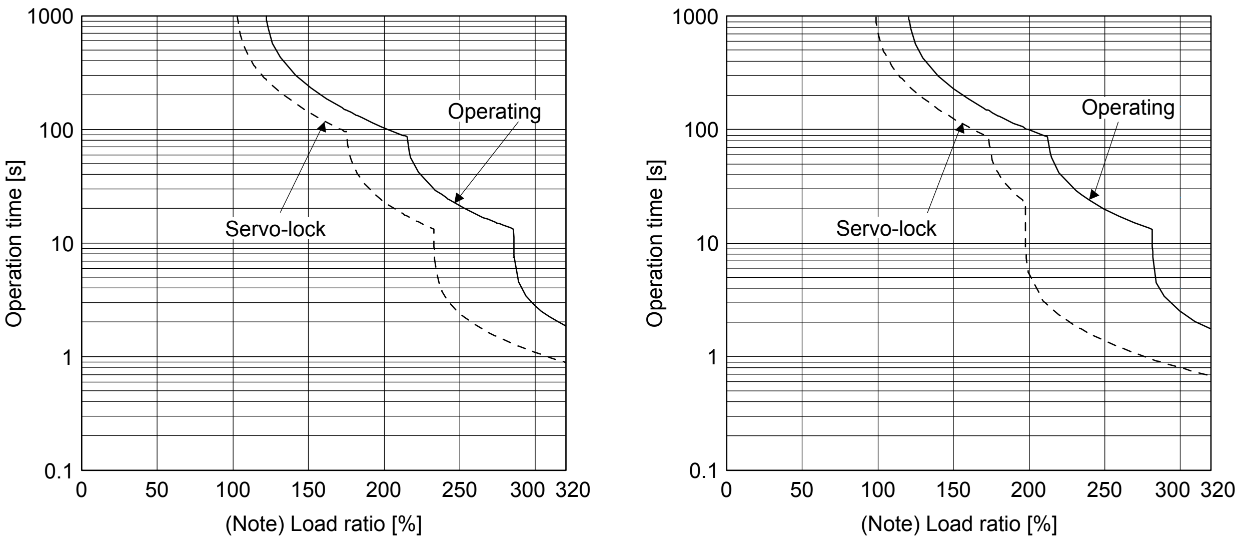


MEMO

10. CHARACTERISTICS

10.1 Overload protection characteristics

An electronic thermal is built in the servo amplifier to protect the servo motor, servo amplifier and servo motor power wires from overloads.
[AL. 50 Overload 1] occurs if overload operation performed is above the electronic thermal protection curve shown in fig. 10.1. [AL. 51 Overload 2] occurs if the maximum current is applied continuously for several seconds due to machine collision, etc. Use the equipment on the left-side area of the continuous or broken line in the graph.
For the system where the unbalanced torque occurs, such as a vertical axis system, the unbalanced torque of the machine should be kept at 70% or lower of the motor's rated torque.
This servo amplifier has servo motor overload protective function. (The servo motor overload current (full load current) is set on the basis of 120% rated current of the servo amplifier.)



HG-KN13_, HG-KN23_, HG-KN43_
HG-KN73_, HG-SN52_, HG-SN102_

HG-SN152_, HG-SN202_, HG-SN302_

Note. If operation that generates torque more than 100% of the rating is performed with an abnormally high frequency in a servo motor stop status (servo-lock status) or in a 30 r/min or less low-speed operation status, the servo amplifier may malfunction regardless of the electronic thermal protection.

Fig. 10.1 Electronic thermal protection characteristics

10.2 Power supply capacity and generated loss

(1) Amount of heat generated by the servo amplifier

Table 10.1 indicates servo amplifiers' power supply capacities and losses generated under rated load. For thermal design of an enclosed type cabinet, use the values in the table in consideration for the worst operating conditions. The actual amount of generated heat will be intermediate between values at rated torque and servo-off according to the duty used during operation. When the servo motor is run at less than the rated speed, the power supply capacity will be smaller than the value in the table, but the servo amplifier's generated heat will not change.

Table 10.1 Power supply capacity and generated loss per servo motor at rated output

Servo amplifier	Servo motor	(Note 1) Power supply capacity [kVA]	(Note 2) Servo amplifier-generated heat [W]		Area required for heat dissipation [m^2]
			At rated output	With servo-off	
MR-JE-10A	HG-KN13_	0.3	25	15	0.5
MR-JE-20A	HG-KN23_	0.5	25	15	0.5
MR-JE-40A	HG-KN43_	0.9	35	15	0.7
MR-JE-70A	HG-KN73_	1.3	50	15	1.0
	HG-SN52_	1.0	40	15	0.8
MR-JE-100A	HG-SN102_	1.7	50	15	1.0
MR-JE-200A	HG-SN152_	2.5	90	20	1.8
	HG-SN202_	3.5			
MR-JE-300A	HG-SN302_	4.8	120	20	2.4

Note 1. Note that the power supply capacity will vary according to the power supply impedance. This value is applicable when the power factor improving AC reactor is not used.

2. Heat generated during regeneration is not included in the servo amplifier-generated heat. To calculate heat generated by the regenerative option, refer to section 11.2.

(2) Heat dissipation area for an enclosed type cabinet

The enclosed type cabinet (hereafter called the cabinet) which will contain the servo amplifier should be designed to ensure that its temperature rise is within +10 ˚C at the ambient temperature of 40 ˚C. Calculate the necessary cabinet dissipation area (allowing a margin of approximately 5 °C for the ambient temperature of 55 °C maximum) with equation (10.1).

$$A = \frac{P}{K \cdot \Delta T} \quad \cdots\cdots\cdots \quad (10.1)$$

A : Heat dissipation area [m^2]
P : Loss generated in the cabinet [W]
ΔT : Difference between internal and ambient temperatures [˚C]
K : Heat dissipation coefficient [5 to 6]

When calculating the heat dissipation area with equation 10.1, assume that P is the sum of all losses generated in the cabinet. Refer to table 10.1 for heat generated by the servo amplifier. "A" indicates the effective area for heat dissipation, but if the cabinet is directly installed on an insulated wall, that extra amount must be added to the cabinet's surface area. The required heat dissipation area will vary with the conditions in the cabinet. If convection in the cabinet is poor and heat builds up, effective heat dissipation will not be possible. Therefore, arrangement of the equipment in the cabinet and the use of a cooling fan should be considered. Table 10.1 lists the cabinet dissipation area for each servo amplifier (guideline) when the servo amplifier is operated at the ambient temperature of 40 ˚C under rated load.

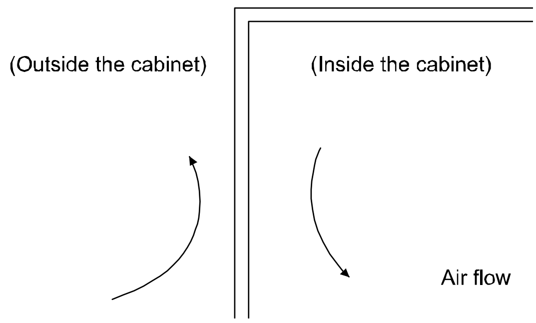


Fig. 10.2 Temperature distribution in an enclosed type cabinet

When air flows along the outer wall of the cabinet, effective heat exchange will be possible, because the temperature slope inside and outside the cabinet will be steeper.

10.3 Dynamic brake characteristics

POINT
●Do not use dynamic brake to stop in a normal operation as it is the function to stop in emergency. ●For a machine operating at the recommended load to motor inertia ratio or less, the estimated number of usage times of the dynamic brake is 1000 times while the machine decelerates from the rated speed to a stop once in 10 minutes. ●Be sure to enable EM1 (Forced stop 1) after servo motor stops when using EM1 (Forced stop 1) frequently in other than emergency. ●The coasting distance of HG-KN series and HG-SN series servo motors may be different from that of HF-KN series and HF-SN series.

10.3.1 Dynamic brake operation

(1) Calculation of coasting distance

Fig. 10.3 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use equation 10.2 to calculate an approximate coasting distance to a stop. The dynamic brake time constant τ varies with the servo motor and machine operation speeds. (Refer to (2) of this section.)

A working part generally has a friction force. Therefore, actual coasting distance will be shorter than a maximum coasting distance calculated with the following equation.

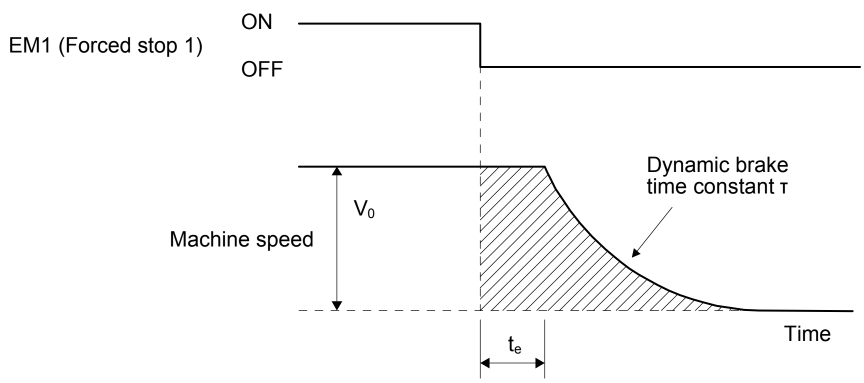


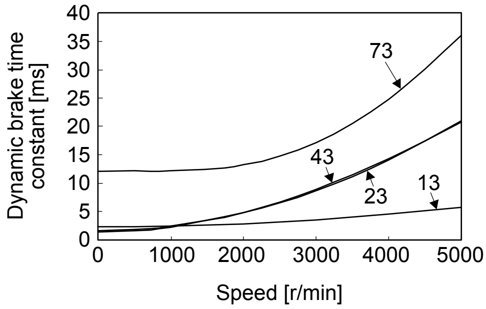
Fig. 10.3 Dynamic brake operation diagram

$$L_{max} = \frac{V_0}{60} \cdot \left\{ t_e + \tau \left(1 + \frac{J_L}{J_M} \right) \right\} \qquad (10.2)$$

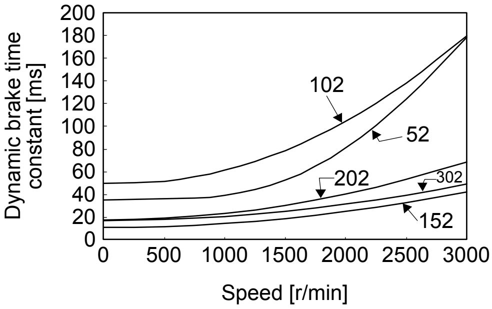
L_{max}: Maximum coasting distance ··· [mm]
V_0: Machine's fast feed speed ··· [mm/min]
J_M: Moment of inertia of the servo motor ··· [× 10^{-4} kg•m^2]
J_L: Load moment of inertia converted into equivalent value on servo motor shaft ··· [× 10^{-4} kg•m^2]
τ: Dynamic brake time constant ··· [s]
t_e: Delay time of control section ··· [s]
There is internal relay delay time of about 10 ms.

(2) Dynamic brake time constant

The following shows necessary dynamic brake time constant τ for equation 10.2.



HG-KN series



HG-SN series

10.3.2 Permissible load to motor inertia when the dynamic brake is used

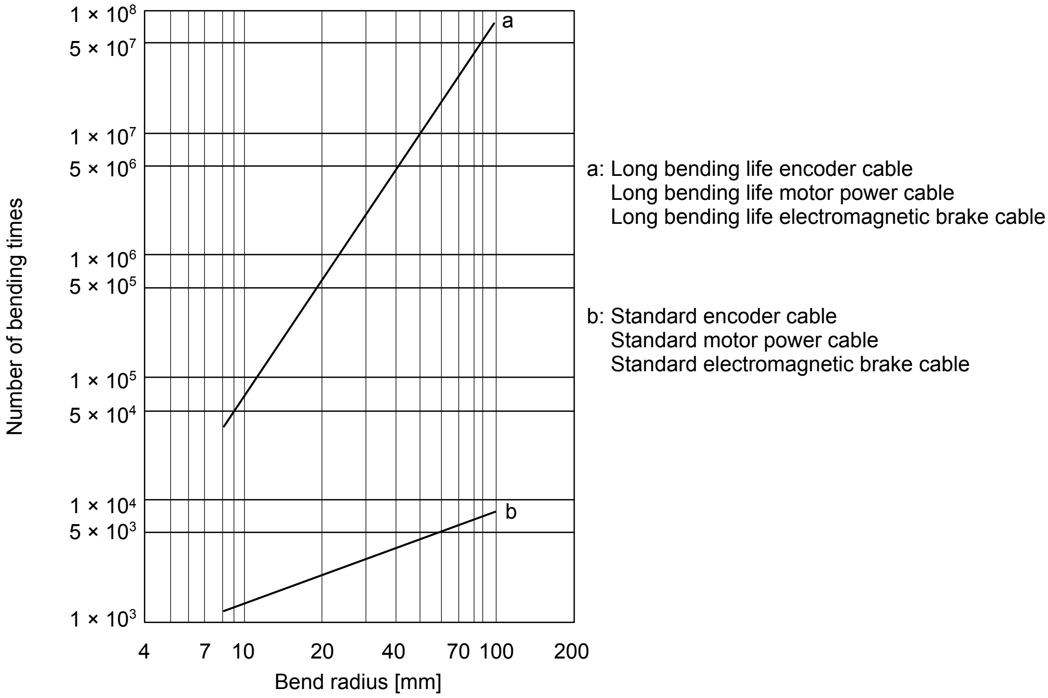
Use the dynamic brake under the load to motor inertia ratio indicated in the following table. If the ratio is higher than this value, the dynamic brake may burn. If there is a possibility that the ratio may exceed the value, contact your local sales office.

The values of the permissible load to motor inertia ratio in the table are the values at the maximum rotation speed of the servo motor.

Servo motor	Permissible load to motor inertia ratio [multiplier]
HG-KN13_	30
HG-KN23_	
HG-KN43_	
HG-KN73_	
HG-SN52_	
HG-SN102_	
HG-SN152_	
HG-SN202_	24
HG-SN302_	16

10.4 Cable bending life

The bending life of the cables is shown below. This graph calculated values. Since they are not guaranteed values, provide a little allowance for these values.



10.5 Inrush current at power-on

POINT
●The inrush current values can change depending on frequency of turning on/off the power and ambient temperature.

The following table indicates the inrush currents (reference data) that will flow when 240 V AC is applied at the power supply capacity of 2500 kVA and the wiring length of 1 m. Even when you use a 1-phase 200 V AC power supply with MR-JE-10A to MR-JE-200A, the inrush currents will be the same.

Servo amplifier	Inrush currents (A_{0-P})
MR-JE-10A, MR-JE-20A, MR-JE-40A	32 A (attenuated to approx. 3 A in 20 ms)
MR-JE-70A, MR-JE-100A	36 A (attenuated to approx. 7 A in 20 ms)
MR-JE-200A, MR-JE-300A	102 A (attenuated to approx. 12 A in 20 ms)

Since large inrush currents flow in the power supplies, always use molded-case circuit breakers and magnetic contactors. (Refer to section 11.6.)
When circuit protectors are used, it is recommended that the inertia delay type, which is not tripped by an inrush current, be used.

11. OPTIONS AND PERIPHERAL EQUIPMENT

WARNING	●Before connecting options and peripheral equipment, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Otherwise, an electric shock may occur. In addition, when confirming whether the charge lamp is off or not, always confirm it from the front of the servo amplifier.

CAUTION	●Use the specified peripheral equipment and options to prevent a malfunction or a fire.

POINT

●We recommend using HIV wires to wire the servo amplifiers, options, and peripheral equipment. Therefore, the recommended wire sizes may differ from those used for the previous servo amplifiers.

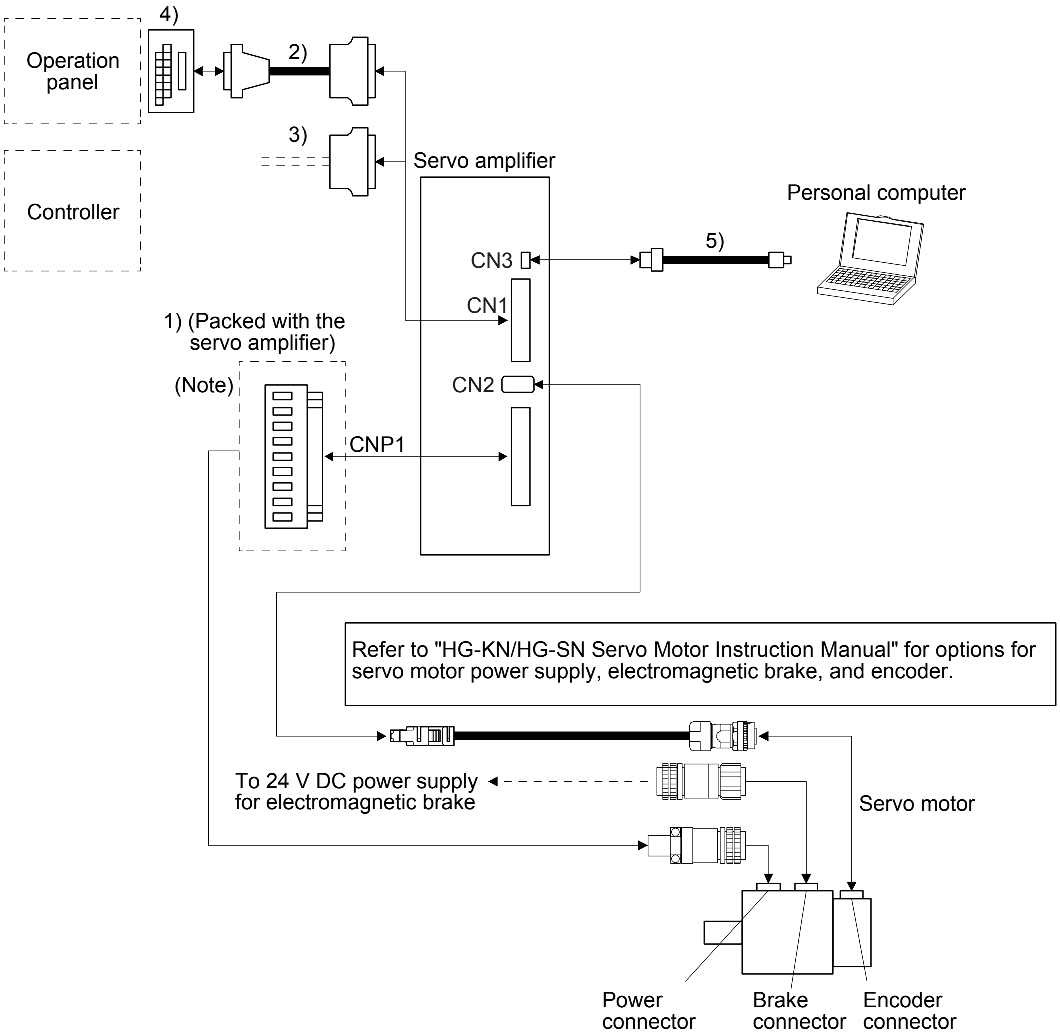
11.1 Cable/connector sets

POINT

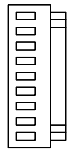
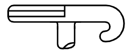
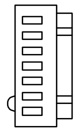
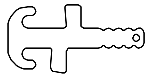
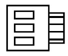
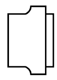
●The IP rating indicated for cables and connectors is their protection against ingress of dust and raindrops when they are connected to a servo amplifier or servo motor. If the IP rating of the cable, connector, servo amplifier and servo motor vary, the overall IP rating depends on the lowest IP rating of all components.

Please purchase the cable and connector options indicated in this section.

11.1.1 Combinations of cable/connector sets



Note. Connectors for 1 kW or less. Refer to section 3.3.3 (1) (b) for 2 kW or more.

No.	Product name	Model	Description	Application
1)	Servo amplifier CNP1 power connector	MR-JECNP1-01	CNP1 Connector: 09JFAT-SAXGDK-H5.0 (JST) Applicable wire size: AWG 18 to 14 Insulator OD: to 3.9 mm  Open tool: J-FAT-OT (JST) 	Supplied with servo amplifiers of 1 kW or less
		MR-JECNP1-02	CNP1 Connector: 07JFAT-SAXGFK-XL (JST) Applicable wire size: AWG 16 to 10 Insulator OD: to 4.7 mm  Open tool: J-FAT-OT-EXL (JST) 	Supplied with servo amplifiers of 2 kW and 3 kW
	Servo amplifier power connector	MR-JECNP2-02	CNP2 Connector: 03JFAT-SAXGFK-XL (JST) Applicable wire size: AWG 16 to 10 Insulator OD: to 4.7 mm 	
2)	Junction terminal block cable	MR-J2M-CN1TBL_M Cable length: 0.5 m, 1 m (Refer to section 11.3.)	Junction terminal block connector Connector: D7950-B500FL (3M) CN1 connector Connector: 10150-6000EL Shell kit: 10350-3210-000 (3M or equivalent) 	For junction terminal block connection
3)	CN1 connector set	MR-J3CN1	Connector: 10150-3000PE Shell kit: 10350-52F0-008 (3M or equivalent) 	
4)	Junction terminal block	MR-TB50	Refer to section 11.3.	
5)	USB cable	MR-J3USBCBL3M Cable length: 3 m	CN5 connector mini-B connector (5 pins) Personal computer connector A connector 	For connection with PC-AT compatible personal computer

11.2 Regenerative option

CAUTION	●Do not use servo amplifiers with regenerative options other than the combinations specified below. Otherwise, it may cause a fire.

11.2.1 Combination and regenerative power

The power values in the table are resistor-generated powers and not rated powers.

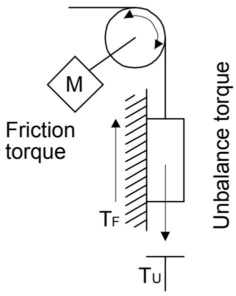
Servo amplifier	Regenerative power [W]					
	Built-in regenerative resistor	MR-RB032 [40 Ω]	MR-RB12 [40 Ω]	MR-RB30 [13 Ω]	MR-RB32 [40 Ω]	(Note) MR-RB50 [13 Ω]
MR-JE-10A		30				
MR-JE-20A		30	100			
MR-JE-40A	10	30	100			
MR-JE-70A	20	30	100		300	
MR-JE-100A	20	30	100		300	
MR-JE-200A	100			300		500
MR-JE-300A	100			300		500

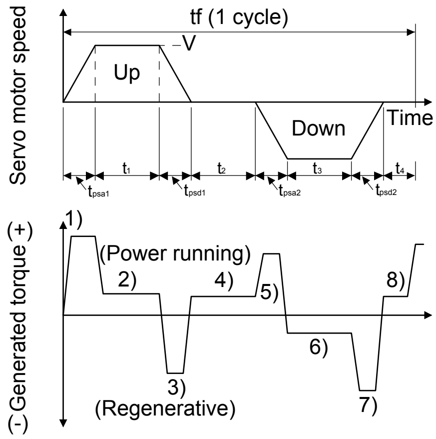
Note. Always install a cooling fan.

11.2.2 Selection of regenerative option

Use the following method when regeneration occurs continuously in vertical motion applications or when selecting the regenerative option in details.

(1) Regenerative energy calculation





Formulas for calculating torque and energy in operation

Regenerative power	Torque applied to servo motor [N•m]	Energy E [J]
1)	$T_1 = \frac{(J_L/\eta + J_M) \cdot V}{9.55 \cdot 10^4} \cdot \frac{1}{t_{psa1}} + T_U + T_F$	$E_1 = \frac{0.1047}{2} \cdot V \cdot T_1 \cdot t_{psa1}$
2)	$T_2 = T_U + T_F$	$E_2 = 0.1047 \cdot V \cdot T_2 \cdot t_1$
3)	$T_3 = \frac{-(J_L \cdot \eta + J_M) \cdot V}{9.55 \cdot 10^4} \cdot \frac{1}{t_{psa2}} + T_U + T_F$	$E_3 = \frac{0.1047}{2} \cdot V \cdot T_3 \cdot t_{psa2}$
4), 8)	T_4, $T_8 = T_U$	E_4, $E_8 \geq 0$ (No regeneration)
5)	$T_5 = \frac{(J_L/\eta + J_M) \cdot V}{9.55 \cdot 10^4} \cdot \frac{1}{t_{psd2}} - T_U + T_F$	$E_5 = \frac{0.1047}{2} \cdot V \cdot T_5 \cdot t_{psd2}$
6)	$T_6 = -T_U + T_F$	$E_6 = 0.1047 \cdot V \cdot T_6 \cdot t_3$
7)	$T_7 = \frac{-(J_L \cdot \eta + J_M) \cdot V}{9.55 \cdot 10^4} \cdot \frac{1}{t_{psd2}} - T_U + T_F$	$E_7 = \frac{0.1047}{2} \cdot V \cdot T_7 \cdot t_{psd2}$

From the calculation results in 1) to 8), find the absolute value (Es) of the sum total of negative energies.

(2) Losses of servo motor and servo amplifier in regenerative mode
The following table lists the efficiencies and other data of the servo motor and servo amplifier in the regenerative mode.

Servo amplifier	Inverse efficiency [%]	Capacitor charging [J]
MR-JE-10A	55	11
MR-JE-20A	75	11
MR-JE-40A	85	14
MR-JE-70A	85	25

Servo amplifier	Inverse efficiency [%]	Capacitor charging [J]
MR-JE-100A	85	25
MR-JE-200A	85	42
MR-JE-300A	85	42

Inverse efficiency (η): Efficiency including some efficiencies of the servo motor and servo amplifier when rated (regenerative) torque is generated at rated speed. Since the efficiency varies with the speed and generated torque, allow for about 10%.
Capacitor charging (Ec): Energy charged into the electrolytic capacitor in the servo amplifier

Subtract the capacitor charging from the result of multiplying the sum total of regenerative energies by the inverse efficiency to calculate the energy consumed by the regenerative option.

ER [J] = η • Es - Ec

Select a necessary regenerative option by calculating the power consumption of the regenerative option on the basis of one-cycle operation period tf [s].

PR [W] = ER/tf

11.2.3 Parameter setting

Set [Pr. PA02] according to the option to be used.

[Pr. PA02]

0	0		

Regenerative option selection
00: Regenerative option is not used.
- For servo amplifier of 200 W or less, regenerative resistor is not used.
- For servo amplifier of 0.4 kW to 3 kW, built-in regenerative resistor is used.

02: MR-RB032
03: MR-RB12
04: MR-RB32
05: MR-RB30
06: MR-RB50 (Cooling fan is required)

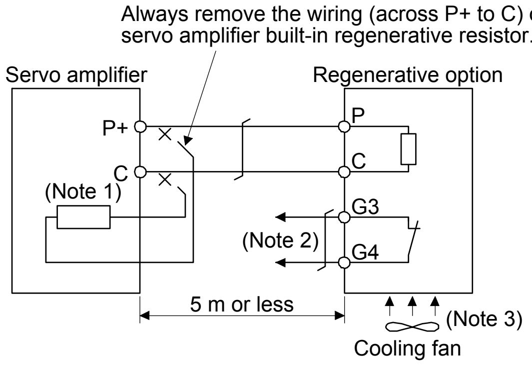
11.2.4 Selection of regenerative option

POINT
●When you use a regenerative option with an MR-JE-40A to MR-JE-100A, remove the built-in regenerative resistor and wiring from the servo amplifier. ●When MR-RB50 is used, a cooling fan is required to cool it. The cooling fan should be prepared by the customer. ●For the wire sizes used for wiring, refer to section 11.5. ●A built-in regenerative resistor should not be mounted/removed frequently. ●When you remount a built-in regenerative resistor, check the lead wires of the built-in regenerative resistor for scratches or cracks.

The regenerative option generates heat of 100 ˚C higher than the ambient temperature. Fully consider heat dissipation, installation position, wires used, etc. before installing the option. For wiring, use flame-resistant wires or make the wires flame-resistant and keep them away from the regenerative option. Always use twisted cables of max. 5 m length for connection with the servo amplifier.

(1) MR-JE-100A or less

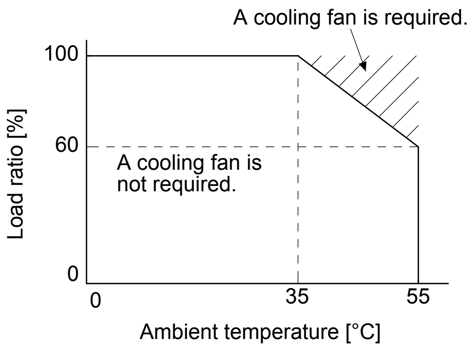
When you use a regenerative option for MR-JE-40A to MR-JE-100A, remove wirings of P+ and C, remove the built-in regenerative resistor, and then connect the regenerative option between P+ and C. G3 and G4 are terminals for thermal sensor. Between G3 and G4 is opened when the regenerative option overheats abnormally.



Note 1. The built-in regenerative resistor is not provided for MR-JE-10A and MR-JE-20A.

2. Make up a sequence which will switch off the magnetic contactor when abnormal heating occurs.
G3-G4 contact specifications
Maximum voltage: 120 V AC/DC
Maximum current: 0.5 A/4.8 V DC
Maximum capacity: 2.4 VA

3. When the ambient temperature is more than 55 °C and the regenerative load ratio is more than 60% in MR-RB32, forcefully cool the air with a cooling fan (1.0 m^3/min or more, 92 mm × 92 mm). A cooling fan is not required if the ambient temperature is 35 °C or less. (A cooling fan is required for the shaded area in the following graph.)

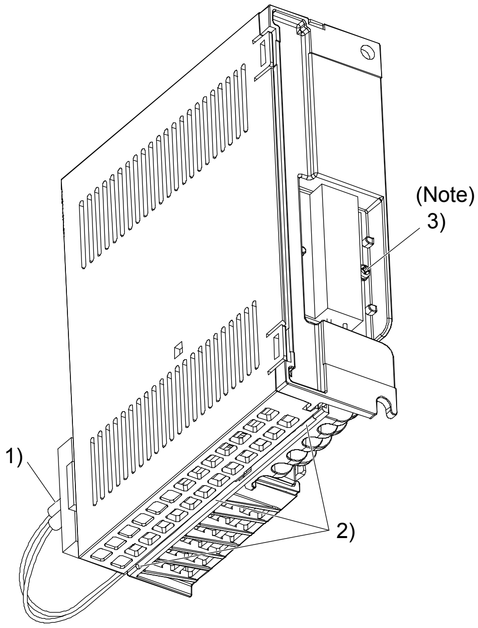


To remove the built-in regenerative resistor mounted on the back of MR-JE-40A to MR-JE-100A, follow the procedures 1) to 3) with referring the illustration.

1) Disconnect the wirings of the built-in regenerative resistor from the power connector (CNP1). (Refer to (3) (b) of 3.3.2.)

2) Remove the wirings of the built-in regenerative resistor from the closest position to the power connector (CNP1) in order. Please pay full attention not to break the wirings.

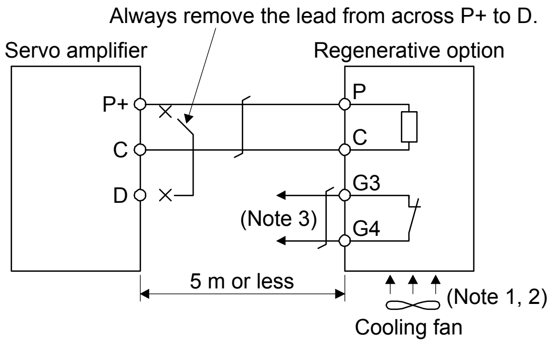
3) Remove the screw fixing the built-in regenerative resistor and dismount the built-in regenerative resistor.



Note. Screw size: M3
Tightening torque: 0.72 [N•m]

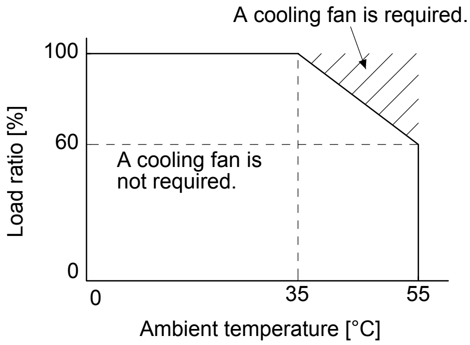
(2) MR-JE-200A or more

Always remove the wiring from across P+ to D and fit the regenerative option across P+ to C. G3 and G4 are terminals for thermal sensor. Between G3 and G4 is opened when the regenerative option overheats abnormally.



Note 1. When using the MR-RB50, forcibly cool it with a cooling fan (1.0 m^3/min or more, 92 mm × 92 mm).

2. When the ambient temperature is more than 55 °C and the regenerative load ratio is more than 60% in MR-RB30, forcefully cool the air with a cooling fan (1.0 m^3/min or more, 92 mm × 92 mm). A cooling fan is not required if the ambient temperature is 35 °C or less. (A cooling fan is required for the shaded area in the following graph.)

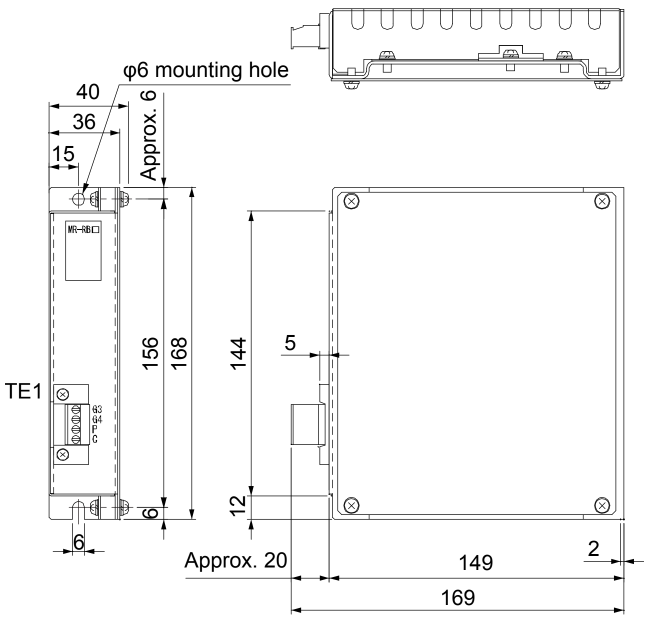


3. Make up a sequence which will switch off the magnetic contactor when abnormal heating occurs.
G3-G4 contact specifications
Maximum voltage: 120 V AC/DC
Maximum current: 0.5 A/4.8 V DC
Maximum capacity: 2.4 VA

11.2.5 Dimensions

(1) MR-RB12

[Unit: mm]



・TE1 terminal block

G3
G4
P
C

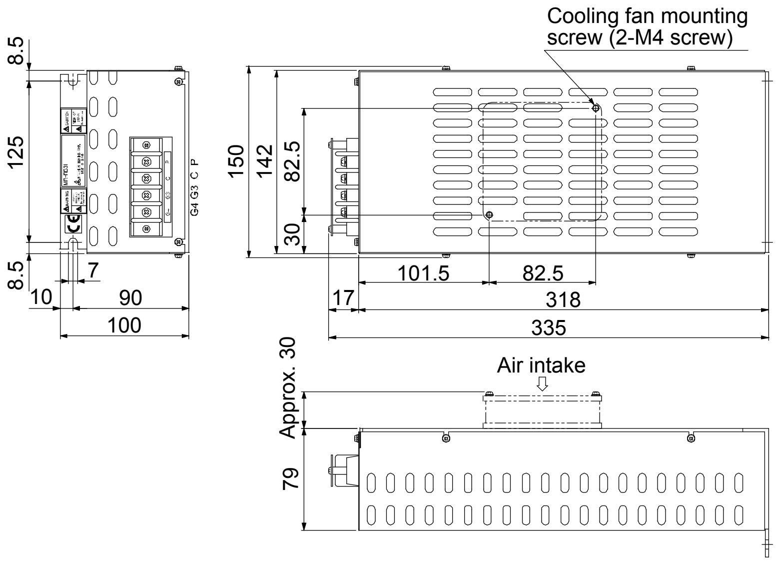
Applicable wire size: 0.2 mm^2 to 2.5 mm^2 (AWG 24 to 12)
Tightening torque: 0.5 to 0.6 [N•m]

・Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]

Mass: 1.1 [kg]

(2) MR-RB30/MR-RB32

[Unit: mm]



・Terminal block

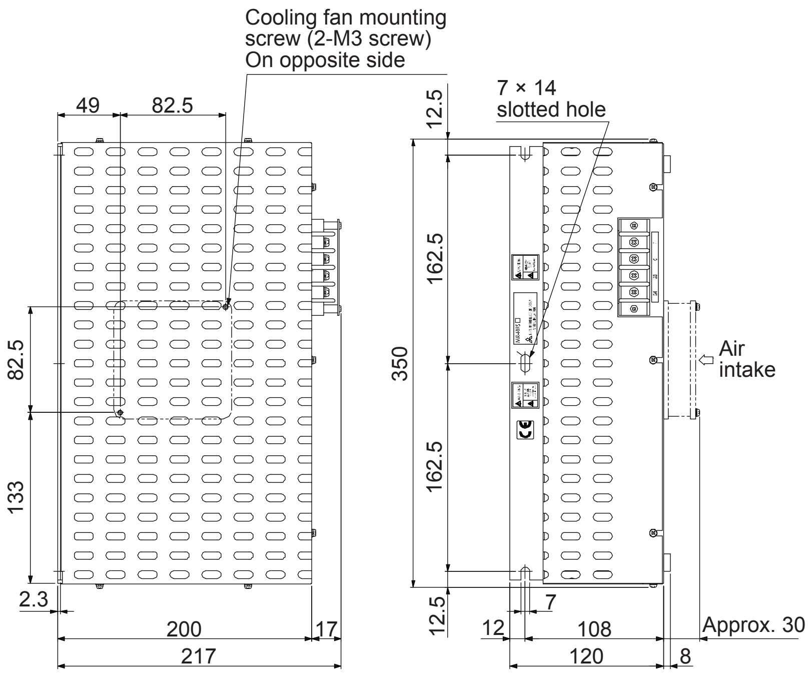
P
C
G3
G4

Terminal screw size: M4
Tightening torque: 1.2 [N•m]

・Mounting screw
Screw size: M6
Tightening torque: 5.4 [N•m]

Mass: 2.9 [kg]

(3) MR-RB50



・Terminal block

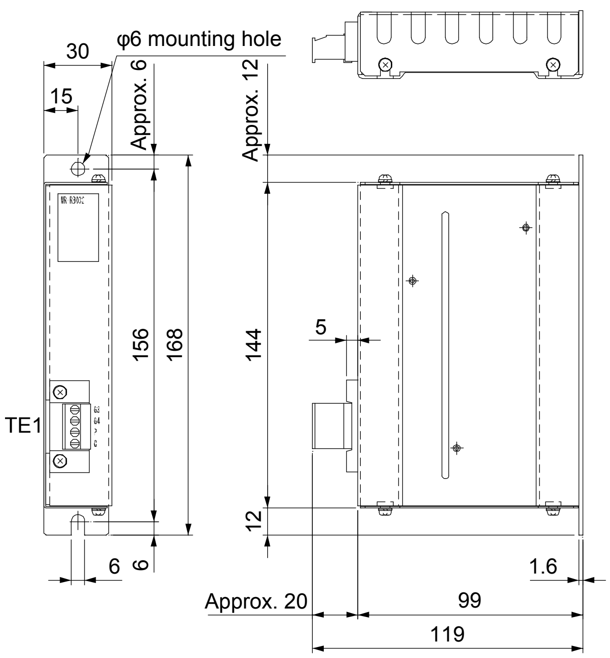
P
C
G3
G4

Terminal screw size: M4
Tightening torque: 1.2 [N•m]

・Mounting screw
Screw size: M6
Tightening torque: 5.4 [N•m]

Mass: 5.6 [kg]

(4) MR-RB032



・TE1 terminal block

G3
G4
P
C

Applicable wire size: 0.2 mm^2 to 2.5 mm^2 (AWG 24 to 12)
Tightening torque: 0.5 to 0.6 [N•m]

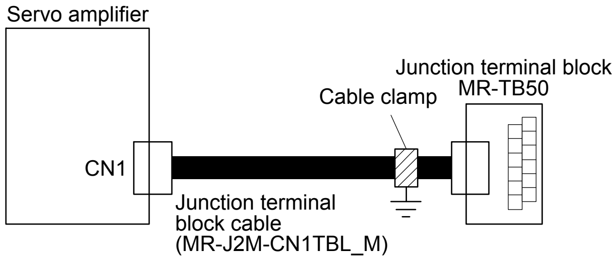
・Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]

Mass: 0.5 [kg]

11.3 Junction terminal block MR-TB50

(1) Usage

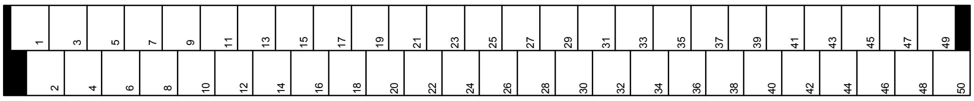
Always use the junction terminal block (MR-TB50) with the option cable (MR-J2M-CN1TBL_M) as a set.



Install the junction terminal block cable on the junction terminal block side with the supplied cable clamp fitting (AERSBAN-ESET). For the use of the cable clamp fitting, refer to section 11.9, (2) (c).

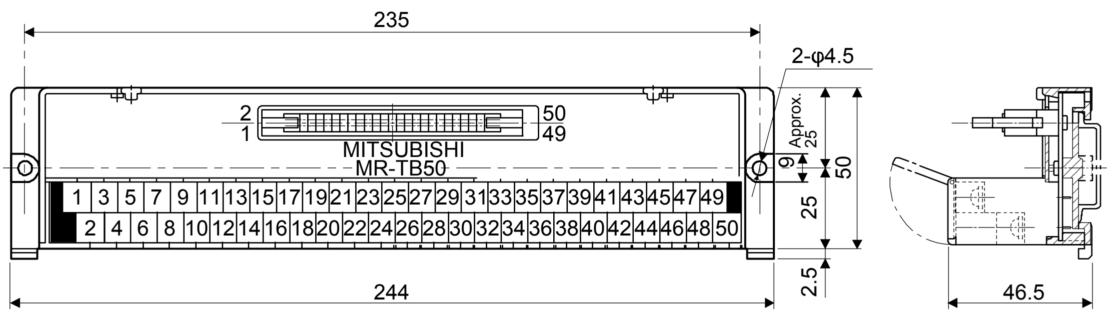
(2) Terminal block label

Use the following for the terminal label. For the input/output pin assignment in the control mode, refer to (4) (b) of this section.



(3) Dimensions

[Unit: mm]



Terminal screw: M3.5
Applicable wire: 2 mm^2
Crimp terminal width: 7.2 mm or shorter

(4) Junction terminal block cable MR-J2M-CN1TBL_M

(a) Model explanations

Model: MR−J2M−CN1TBL_M

Symbol	Cable length [m]
05	0.5
1	1

(b) Connection diagram

10150-6000EL (servo amplifier side) Signal symbol: Position	Speed	Torque	Pin No.	D7950-B500FL (junction terminal side) Pin No.
			1	1
	VC	VLA	2	2
LG	LG	LG	3	3
LA	LA	LA	4	4
LAR	LAR	LAR	5	5
LB	LB	LB	6	6
LBR	LBR	LBR	7	7
LZ	LZ	LZ	8	8
LZR	LZR	LZR	9	9
PP			10	10
PG			11	11
OPC			12	12
SDP	SDP	SDP	13	13
SDN	SDN	SDN	14	14
SON	SON	SON	15	15
			16	16
			17	17
			18	18
RES	ST1	RS2	19	19
DICOM	DICOM	DICOM	20	20
DICOM	DICOM	DICOM	21	21
			22	22
ZSP	ZSP	ZSP	23	23
INP	SA		24	24
			25	25
MO1	MO1	MO1	26	26
TLA	TLA	TC	27	27
LG	LG	LG	28	28
MO2	MO2	MO2	29	29
LG	LG	LG	30	30
TRE	TRE	TRE	31	31
			32	32
OP	OP	OP	33	33
LG	LG	LG	34	34
NP			35	35
NG			36	36
			37	37
			38	38
RDP	RDP	RDP	39	39
RDN	RDN	RDN	40	40
CR	ST2	RS1	41	41
EM2	EM2	EM2	42	42
LSP	LSP		43	43
LSN	LSN		44	44
			45	45
DOCOM	DOCOM	DOCOM	46	46
DOCOM	DOCOM	DOCOM	47	47
ALM	ALM	ALM	48	48
RD	RD	RD	49	49
			50	50
SD	SD	SD	Plate	

11.4 MR Configurator2

POINT
●For the MR-JE servo amplifier, use MR Configurator2 with software version 1.19V or later.

MR Configurator2 (SW1DNC-MRC2-_) uses the communication function of the servo amplifier to perform parameter setting changes, graph display, test operation, etc. on a personal computer.

11.4.1 Specifications

Item	Description
Project	Create/read/save/delete project, system setting, and print
Parameter	Parameter setting, axis name setting
Monitor	Display all, I/O monitor, and graph
Diagnosis	Alarm display, alarm onset data, drive recorder, no motor rotation, system configuration, life diagnosis, machine diagnosis
Test operation	Jog operation, positioning operation, motor-less operation, DO forced output, and program operation, test mode information
Adjustment	One-touch tuning, tuning, and machine analyzer
Others	Servo assistant, parameter setting range update, machine unit conversion setting, and help display

11.4.2 System requirements

(1) Configuration diagram

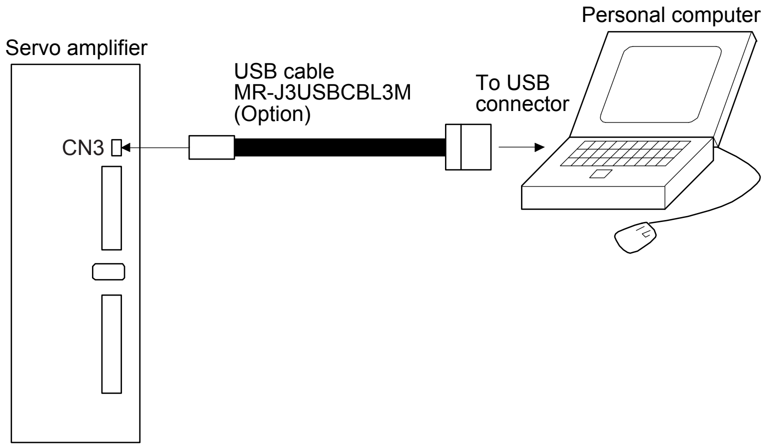
To use this software, the following components are required in addition to the servo amplifier and servo motor.

Equipment	Description	
(Note 1, 2, 3, 4, 5) Personal computer	OS	Microsoft® Windows® 8 Enterprise Operating System Microsoft® Windows® 8 Pro Operating System Microsoft® Windows® 8 Operating System Microsoft® Windows® 7 Enterprise Operating System Microsoft® Windows® 7 Ultimate Operating System Microsoft® Windows® 7 Professional Operating System Microsoft® Windows® 7 Home Premium Operating System Microsoft® Windows® 7 Starter Operating System Microsoft® Windows Vista® Enterprise Operating System Microsoft® Windows Vista® Ultimate Operating System Microsoft® Windows Vista® Business Operating System Microsoft® Windows Vista® Home Premium Operating System Microsoft® Windows Vista® Home Basic Operating System Microsoft® Windows® XP Professional Operating System, Service Pack2 or later Microsoft® Windows® XP Home Edition Operating System, Service Pack2 or later
	CPU (recommended)	Desktop personal computer: Intel® Celeron® processor 2.8 GHz or more Laptop personal computer: Intel® Pentium® M processor 1.7 GHz or more
	Memory (recommended)	512 MB or more (for 32-bit OS), 1 GB or more (for 64-bit OS)
	Free space on the hard disk:	1 GB or more
	Communication interface	USB port
Browser	Windows® Internet Explorer® 4.0 or more	
Display	One whose resolution is 1024 × 768 or more and that can provide a high color (16 bit) display. Connectable with the above personal computer.	
Keyboard	Connectable with the above personal computer.	
Mouse	Connectable with the above personal computer.	
Printer	Connectable with the above personal computer.	
USB cable	MR-J3USBCBL3M	

Note 1. On some personal computers, MR Configurator2 may not run properly.
2. When Windows® XP or later is used, the following functions cannot be used.
- Windows Program Compatibility mode
- Fast User Switching
- Remote Desktop
- Large Fonts Mode (Display property)
- DPI settings other than 96 DPI (Display property)

For 64-bit operating system, this software is compatible with Windows® 7 and Windows® 8.
3. When Windows® 7 or later is used, the following functions cannot be used.
- Windows XP Mode
- Windows touch
4. When using this software with Windows Vista® or later, log in as a user having USER authority or higher.
5. When Windows® 8 is used, the following functions cannot be used.
- Hyper-V
- Modern UI style

(2) Connection with servo amplifier



11.4.3 Precautions for using USB communication function

Note the following to prevent an electric shock and malfunction of the servo amplifier.

(1) Power connection of personal computers
Connect your personal computer with the following procedures.

(a) When you use a personal computer with AC power supply

1) When using a personal computer with a three-core power plug or power plug with grounding wire, use a three-pin socket or ground the grounding wire.

2) When your personal computer has two-core plug and has no grounding wire, connect the personal computer to the servo amplifier with the following procedures.

a) Disconnect the power plug of the personal computer from an AC power socket.

b) Check that the power plug was disconnected and connect the device to the servo amplifier.

c) Connect the power plug of the personal computer to the AC power socket.

(b) When you use a personal computer with battery
You can use as it is.

(2) Connection with other devices using servo amplifier communication function
When the servo amplifier is charged with electricity due to connection with a personal computer and the charged servo amplifier is connected with other devices, the servo amplifier or the connected devices may malfunction. Connect the servo amplifier and other devices with the following procedures.

(a) Shut off the power of the device for connecting with the servo amplifier.

(b) Shut off the power of the servo amplifier which was connected with the personal computer and check the charge lamp is off.

(c) Connect the device with the servo amplifier.

(d) Turn on the power of the servo amplifier and the device.

11.5 Selection example of wires

POINT

- To comply with the IEC/EN/UL/CSA standard, use the wires shown in appendix 2 for wiring. To comply with other standards, use a wire that is complied with each standard.
- Selection conditions of wire size is as follows.
  Construction condition: Single wire set in midair
  Wiring length: 30 m or shorter

The following diagram shows the wires used for wiring. Use the wires given in this section or equivalent.

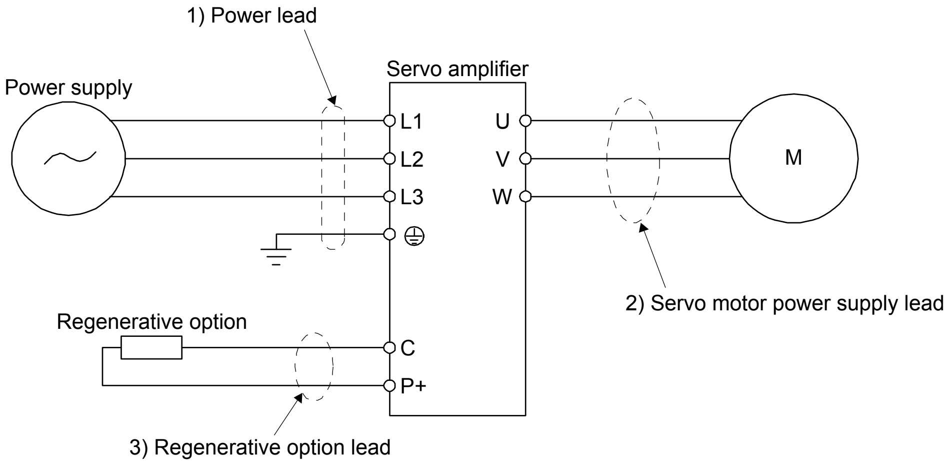


Table 11.1 shows examples for using the 600 V Grade heat-resistant polyvinyl chloride insulated wire (HIV wire).

Table 11.1 Wire size selection example (HIV wire)

Servo amplifier	Wire [mm^2]		
	1) L1/L2/L3/⏚	3) P+/C	2) U/V/W/⏚ (Note 1)
MR-JE-10A	2 (AWG 14)	2 (AWG 14)	AWG 18 to 14 (Note 2)
MR-JE-20A			
MR-JE-40A			
MR-JE-70A			
MR-JE-100A			
MR-JE-200A (3-phase power supply input)			AWG 16 to 10
MR-JE-200A (1-phase power supply input)	3.5 (AWG 12)		
MR-JE-300A	2 (AWG 14)		

Note 1. The wire size shows applicable size of the servo amplifier connector. For wires connecting to the servo motor, refer to "HG-KN/HG-SN Servo Motor Instruction Manual".
2. Be sure to use the size of 2 mm^2 when corresponding to IEC/EN/UL/CSA standard.

11.6 Molded-case circuit breakers, fuses, magnetic contactors

CAUTION

- To prevent the servo amplifier from smoke and a fire, select a molded-case circuit breaker which shuts off with high speed.
- Always use one molded-case circuit breaker and one magnetic contactor with one servo amplifier.

When using a fuse instead of the molded-case circuit breaker, use the one having the specifications given in this section.

<table>
<tr><th rowspan="3">Servo amplifier</th><th colspan="3">Molded-case circuit breaker (Note 1, 4)</th><th colspan="3">Fuse</th><th rowspan="3">Magnetic contactor (Note 2)</th></tr>
<tr><th colspan="2">Frame, rated current</th><th rowspan="2">Voltage AC [V]</th><th rowspan="2">Class</th><th rowspan="2">Current [A]</th><th rowspan="2">Voltage AC [V]</th></tr>
<tr><th>Power factor improving reactor is not used</th><th>Power factor improving reactor is used</th></tr>
<tr><td>MR-JE-10A</td><td rowspan="2">30 A frame 5 A</td><td rowspan="2">30 A frame 5 A</td><td rowspan="8">240</td><td rowspan="8">T</td><td rowspan="2">10</td><td rowspan="8">300</td><td rowspan="6">S-N10
S-T10</td></tr>
<tr><td>MR-JE-20A</td></tr>
<tr><td>MR-JE-40A</td><td>30 A frame 10 A</td><td>30 A frame 5 A</td><td>15</td></tr>
<tr><td>MR-JE-70A</td><td rowspan="2">30 A frame 15 A</td><td rowspan="2">30 A frame 10 A</td><td rowspan="2">20</td></tr>
<tr><td>MR-JE-100A (3-phase power supply input)</td></tr>
<tr><td>MR-JE-100A (1-phase power supply input)</td><td>30 A frame 15 A</td><td>30 A frame 15 A</td><td>30</td></tr>
<tr><td>MR-JE-200A</td><td>30 A frame 20 A</td><td>30 A frame 20 A</td><td>40</td><td>S-N20 (Note 3)
S-T21</td></tr>
<tr><td>MR-JE-300A</td><td>30 A frame 30 A</td><td>30 A frame 30 A</td><td>70</td><td>S-N20
S-T21</td></tr>
</table>

Note 1. When having the servo amplifier comply with the IEC/EN/UL/CSA standard, refer to appendix 2.
2. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less.
3. S-N18 can be used when auxiliary contact is not required.
4. Use a molded-case circuit breaker which has the same or more operation characteristics than our lineup.

11.7 Power factor improving AC reactor

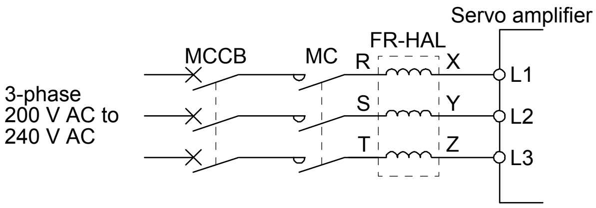
The following shows the advantages of using power factor improving AC reactor.

- It improves the power factor by increasing the form factor of the servo amplifier's input current.
- It decreases the power supply capacity.
- The input power factor is improved to about 80%.

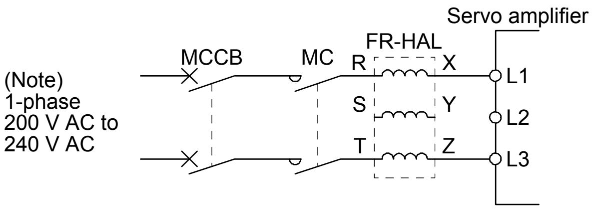
When using power factor improving reactors for two servo amplifiers or more, be sure to connect a power factor improving reactor to each servo amplifier. If using only one power factor improving reactor, enough improvement effect of phase factor cannot be obtained unless all servo amplifiers are operated.

(1) Connection example

(a) When using 3-phase 200 V AC to 240 V AC power supply

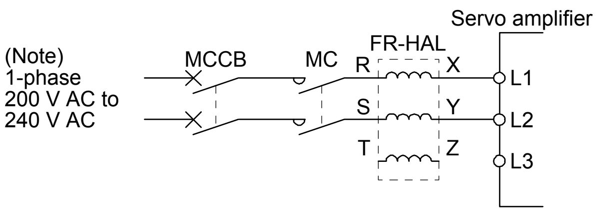


(b) When using 1-phase 200 V AC to 240 V AC power supply for MR-JE-10A to MR-JE-100A



Note. Connect the power supply to L1 and L3. Leave L2 open.

(c) When using 1-phase 200 V AC to 240 V AC power supply for MR-JE-200A



Note. Connect the power supply to L1 and L2. Leave L3 open.

(2) Dimensions

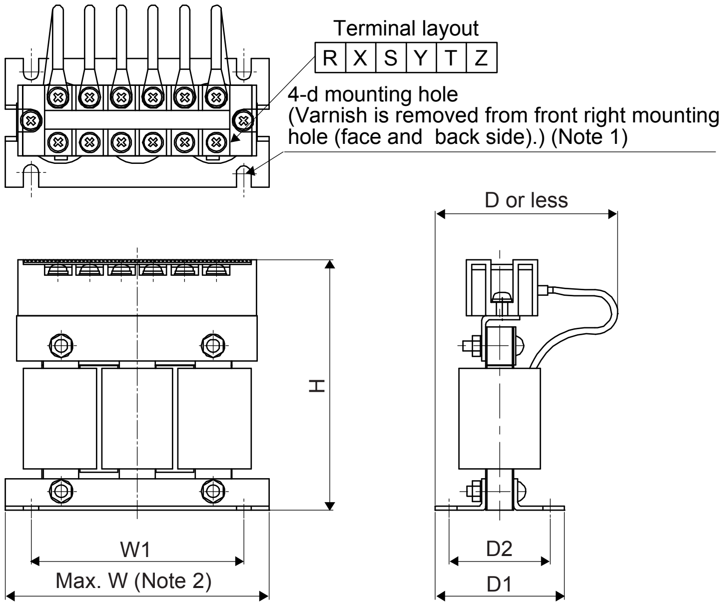


Fig. 11.1

Servo amplifier	Power factor improving AC reactor	Dimensions	Dimensions [mm]							Terminal size	Mass [kg]
			W	W1	H	D (Note 3)	D1	D2	d		
MR-JE-10A, MR-JE-20A	FR-HAL-0.4K	Fig. 11.1	104	84	99	72	51	40	M5	M4	0.6
MR-JE-40A	FR-HAL-0.75K		104	84	99	74	56	44	M5	M4	0.8
MR-JE-70A	FR-HAL-1.5K		104	84	99	77	61	50	M5	M4	1.1
MR-JE-100A (3-phase power supply input)	FR-HAL-2.2K		115 (Note 3)	40	115	77	71	57	M6	M4	1.5
MR-JE-100A (1-phase power supply input) MR-JE-200A (3-phase power supply input)	FR-HAL-3.7K		115 (Note 3)	40	115	83	81	67	M6	M4	2.2
MR-JE-200A (1-phase power supply input) MR-JE-300A	FR-HAL-5.5K		115 (Note 3)	40	115	83	81	67	M6	M4	2.3

Note 1. Use this for grounding.
2. W ± 2 is applicable for FR-HAL-0.4K to FR-HAL-1.5K.
3. Maximum dimensions. The dimension varies depending on the input/output lines.

11.8 Relay (recommended)

The following relays should be used with the interfaces.

Interface	Selection example
Digital input (interface DI-1) Relay used for digital input command signals	To prevent defective contacts, use a relay for small signal (twin contacts). (Ex.) Omron: type G2A, type MY
Digital output (interface DO-1) Relay used for digital output signals	Small relay with 12 V DC or 24 V DC of rated current 40 mA or less (Ex.) Omron: type MY

11.9 Noise reduction techniques

Noises are classified into external noises which enter the servo amplifier to cause it to malfunction and those radiated by the servo amplifier to cause peripheral equipment to malfunction. Since the servo amplifier is an electronic device which handles small signals, the following general noise reduction techniques are required. Also, the servo amplifier can be a source of noise as its outputs are chopped by high carrier frequencies. If peripheral equipment malfunction due to noises produced by the servo amplifier, take measures to suppress the noises. The measures will vary slightly with the routes of noise transmission.

(1) Noise reduction techniques

(a) General reduction techniques

- Avoid bundling power lines (input/output) and signal cables together or running them in parallel to each other. Separate the power lines from the signal cables.
- Use a shielded twisted pair cable for connection with the encoder and for control signal transmission, and connect the external conductor of the cable to the SD terminal.
- Ground the servo amplifier, servo motor, etc. together at one point. (Refer to section 3.11.)

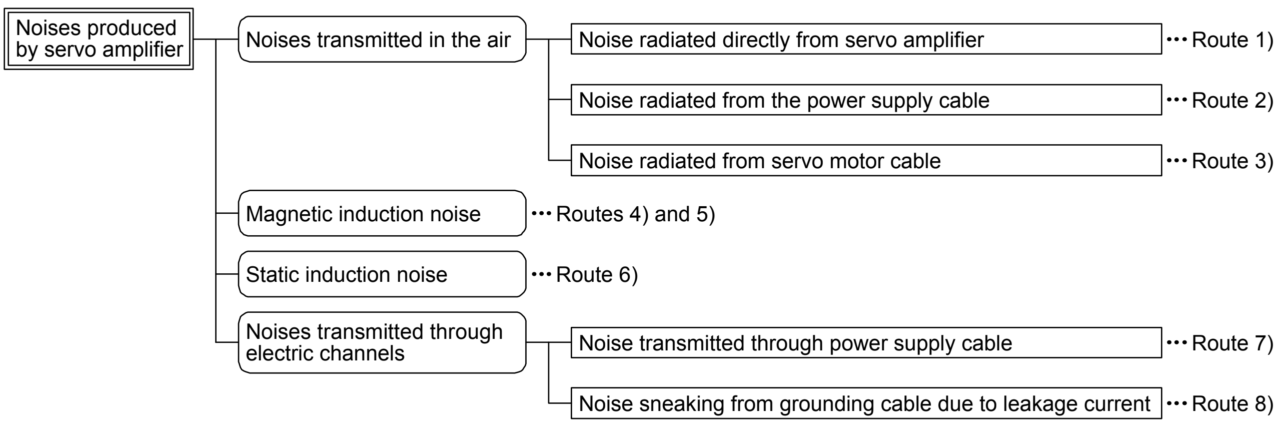
(b) Reduction techniques for external noises that cause the servo amplifier to malfunction

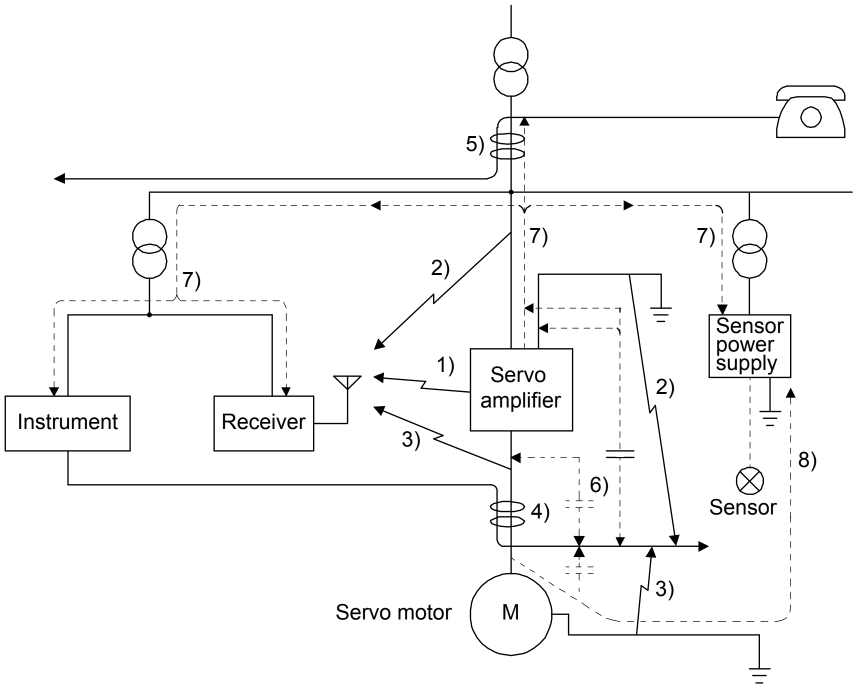
If there are noise sources (such as a magnetic contactor, an electromagnetic brake, and many relays which make a large amount of noise) near the servo amplifier and the servo amplifier may malfunction, the following countermeasures are required.

- Provide surge absorbers on the noise sources to suppress noises.
- Attach data line filters to the signal cables.
- Ground the shields of the encoder connecting cable and the control signal cables with cable clamp fittings.
- Although a surge absorber is built into the servo amplifier, to protect the servo amplifier and other equipment against large exogenous noise and lightning surge, attaching a varistor to the power input section of the equipment is recommended.

(c) Techniques for noises radiated by the servo amplifier that cause peripheral equipment to malfunction

Noises produced by the servo amplifier are classified into those radiated from the cables connected to the servo amplifier and its main circuits (input and output circuits), those induced electromagnetically or statically by the signal cables of the peripheral equipment located near the main circuit cables, and those transmitted through the power supply cables.





Noise transmission route	Suppression techniques
1) 2) 3)	When measuring instruments, receivers, sensors, etc. which handle weak signals and may malfunction due to noise and/or their signal cables are contained in a cabinet together with the servo amplifier or run near the servo amplifier, such devices may malfunction due to noises transmitted through the air. The following techniques are required. 1. Provide maximum clearance between easily affected devices and the servo amplifier. 2. Provide maximum clearance between easily affected signal cables and the I/O cables of the servo amplifier. 3. Avoid wiring the power lines (input/output lines of the servo amplifier) and signal lines side by side or bundling them together. 4. Insert a line noise filter to the I/O cables or a radio noise filter on the input line. 5. Use shielded wires for the signal and power lines, or put the lines in separate metal conduits.
4) 5) 6)	When the power lines and the signal lines are laid side by side or bundled together, magnetic induction noise and static induction noise will be transmitted through the signal cables and malfunction may occur. The following techniques are required. 1. Provide maximum clearance between easily affected devices and the servo amplifier. 2. Provide maximum clearance between easily affected signal cables and the I/O cables of the servo amplifier. 3. Avoid wiring the power lines (input/output lines of the servo amplifier) and signal lines side by side or bundling them together. 4. Use shielded wires for the signal and power lines, or put the lines in separate metal conduits.
7)	When the power supply of peripheral equipment is connected to the power supply of the servo amplifier system, noises produced by the servo amplifier may be transmitted back through the power supply cable and the devices may malfunction. The following techniques are required. 1. Install the radio noise filter (FR-BIF) on the power lines (Input lines) of the servo amplifier. 2. Install the line noise filter (FR-BSF01) on the power lines of the servo amplifier.
8)	When the cables of peripheral equipment are connected to the servo amplifier to make a closed loop circuit, leakage current may flow to malfunction the peripheral equipment. If so, malfunction may be prevented by disconnecting the grounding cable of the peripheral device.

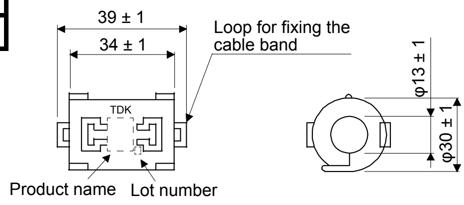
(2) Noise reduction techniques

(a) Data line filter (recommended)

Noise can be prevented by installing a data line filter onto the encoder cable, etc.
For example, ZCAT3035-1330 by TDK, ESD-SR-250 by NEC TOKIN, GRFC-13 by Kitagawa Industries, and E04SRM563218 by SEIWA ELECTRIC are available as data line filters.
As a reference example, the impedance specifications of the ZCAT3035-1330 (TDK) are indicated below. This impedances are reference values and not guaranteed values.

Impedance [Ω]	
10 MHz to 100 MHz	100 MHz to 500 MHz
80	150

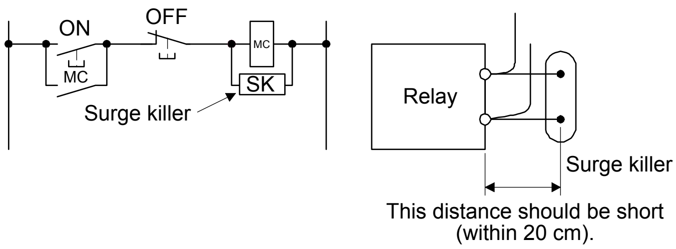
[Unit: mm]



Outline drawing (ZCAT3035-1330)

(b) Surge killer (recommended)

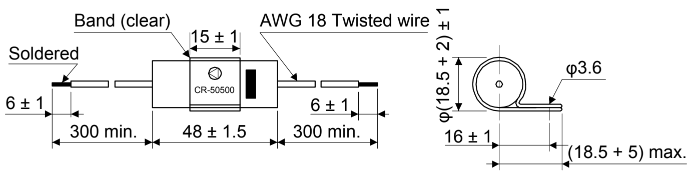
Use of a surge killer is recommended for AC relay, magnetic contactor or the like near the servo amplifier. Use the following surge killer or equivalent.



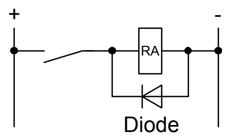
(Ex.) CR-50500 Okaya Electric Industries)

Rated voltage AC [V]	C [μF ± 20%]	R [Ω ± 30%]	Test voltage
250	0.5	50 (1/2 W)	Between terminals: 625 V AC, 50/60 Hz 60 s Between terminal and case: 2000 V AC, 50/60 Hz 60 s

Dimensions [Unit: mm]



Note that a diode should be installed to a DC relay or the like.
Maximum voltage: not less than four times the drive voltage of the relay or the like
Maximum current: not less than two times the drive current of the relay or the like



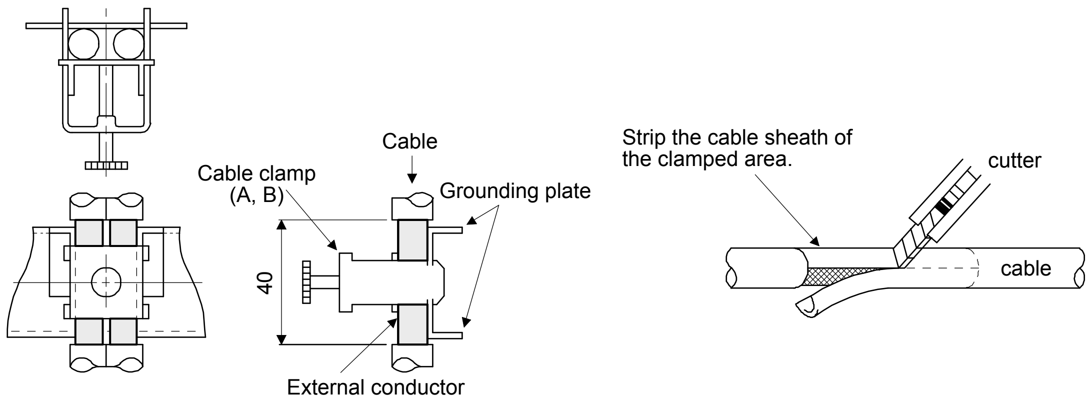
(c) Cable clamp fitting AERSBAN-_SET

Generally, the grounding of the shielded wire may only be connected to the connector's SD terminal. However, the effect can be increased by directly connecting the cable to an grounding plate as shown below.

Install the grounding plate near the servo amplifier for the encoder cable. Peel part of the cable sheath to expose the external conductor, and press that part against the grounding plate with the cable clamp. If the cable is thin, clamp several cables in a bunch.

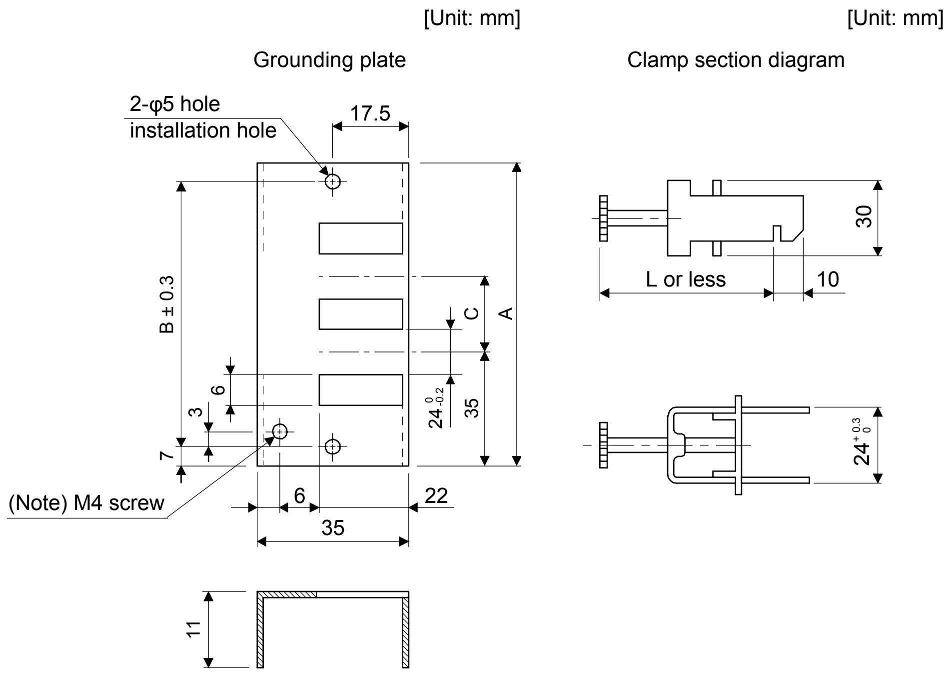
The cable clamp comes as a set with the grounding plate.

[Unit: mm]



Clamp section diagram

・Dimensions



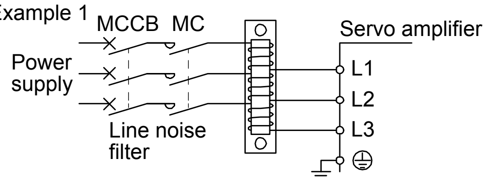
Note. Screw hole for grounding. Connect it to the grounding plate of the cabinet.

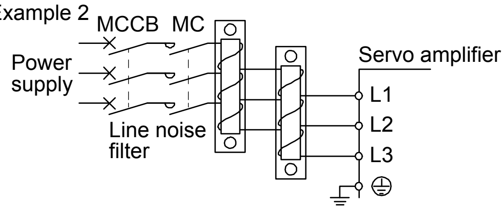
Model	A	B	C	Accessory fittings
AERSBAN-DSET	100	86	30	Clamp A: 2pcs.
AERSBAN-ESET	70	56		Clamp B: 1pc.

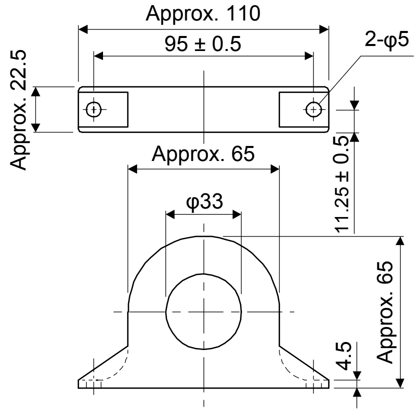
Clamp fitting	L
A	70
B	45

(d) Line noise filter (FR-BSF01)

This filter is effective in suppressing noises radiated from the power supply side and output side of the servo amplifier and also in suppressing high-frequency leakage current (0-phase current). It especially affects the noises between 0.5 MHz and 5 MHz band.

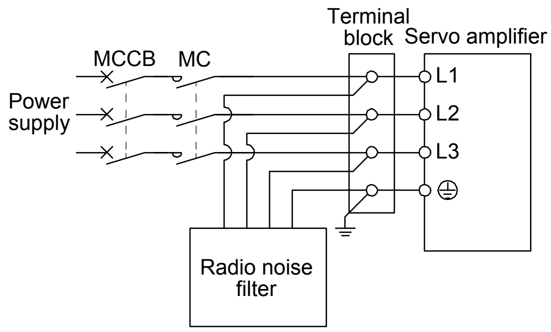
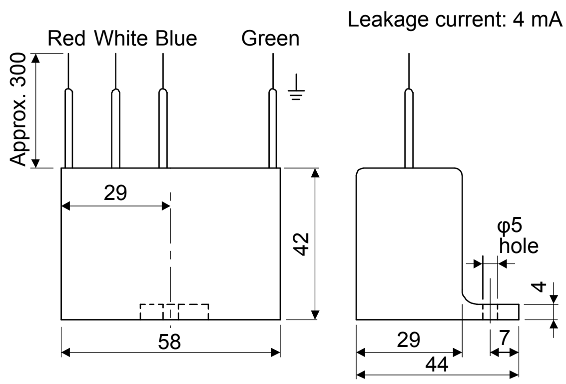
<table>
<tr><th>Connection diagram</th><th>Dimensions [Unit: mm]</th></tr>
<tr><td>
The line noise filters can be installed for lines of the power supply (L1, L2, and L3) and of the servo motor power (U, V, and W). Pass each of the wires through the line noise filter an equal number of times in the same direction. For the power supply, the effect of the filter rises as the number of passes increases, but generally four passes would be appropriate. For the servo motor power lines, passes must be four times or less. Do not pass the grounding wire through the filter. or the effect of the filter will drop.
Wind the wires by passing through the filter to satisfy the required number of passes as shown in Example 1. If the wires are too thick to wind, use two or more filters to have the required number of passes as shown in Example 2.
Place the line noise filters as close to the servo amplifier as possible for their best performance.
Example 1


(Number of passes: 4)
Example 2


Two filters are used
(Total number of passes: 4)
</td><td>
FR-BSF01 (for wire size 3.5 mm^2 (AWG 12) or less)


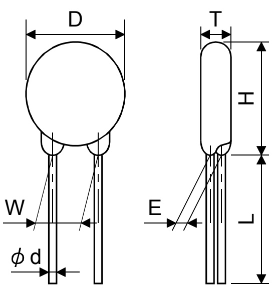
</td></tr>
</table>

(e) Radio noise filter (FR-BIF)
This filter is effective in suppressing noises radiated from the power supply side of the servo amplifier especially in 10 MHz and lower radio frequency bands. The FR-BIF is designed for the input only.
200 V class: FR-BIF

Connection diagram	Dimensions [Unit: mm]
Make the connection cables as short as possible. Grounding is always required. When using the FR-BIF with a single-phase power supply, always insulate the lead wires that are not used for wiring. 	

(f) Varistor for input power supply (recommended)
Varistors are effective to prevent exogenous noise and lightning surge from entering the servo amplifier. When using a varistor, connect it between each phase of the input power supply of the equipment. For varistors, the TND20V-431K and TND20V-471K, manufactured by NIPPON CHEMI-CON, are recommended. For detailed specification and usage of the varistors, refer to the manufacturer catalog.

Power supply voltage	Varistor	Maximum rating					Maximum limit voltage		Static capacity (reference value)	Varistor voltage rating (range) V1 mA
		Permissible circuit voltage		Surge current immunity	Energy immunity	Rated pulse power	[A]	[V]		
		AC [Vrms]	DC [V]	8/20 μs [A]	2 ms [J]	[W]			[pF]	[V]
200 V class	TND20V-431K	275	350	10000/1 times	195	1.0	100	710	1300	430 (387 to 473)
	TND20V-471K	300	385	7000/2 times	215			775	1200	470 (423 to 517)



[Unit: mm]

Model	D Max.	H Max.	T Max.	E ±1.0	(Note) L min.	φd ±0.05	W ±1.0
TND20V-431K	21.5	24.5	6.4	3.3	20	0.8	10.0
TND20V-471K			6.6	3.5			

Note. For special purpose items for lead length (L), contact the manufacturer.

11.10 Earth-leakage current breaker

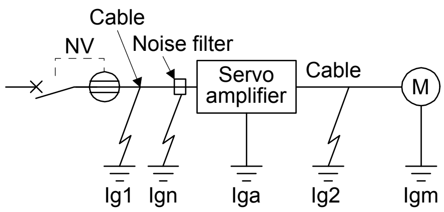
(1) Selection method

High-frequency chopper currents controlled by pulse width modulation flow in the AC servo circuits. Leakage currents containing harmonic contents are larger than those of the motor which is run with a commercial power supply.

Select an earth-leakage current breaker according to the following formula, and ground the servo amplifier, servo motor, etc. securely.

To minimize leakage currents, make the input and output cables as short as possible, and make the grounding cable longer than 30 cm.

Rated sensitivity current ≥ 10 • {Ig1 + Ign + Iga + K • (Ig2 + Igm)} [mA] ·································· (11.1)



Earth-leakage current breaker		K
Type	Mitsubishi products	
Models provided with harmonic and surge reduction techniques	NV-SP NV-SW NV-CP NV-CW NV-HW	1
General models	BV-C1 NFB NV-L	3

Ig1: Leakage current on the electric channel from the earth-leakage current breaker to the input terminals of the servo amplifier (Found from Fig. 11.2.)

Ig2: Leakage current on the electric channel from the output terminals of the servo amplifier to the servo motor (found from Fig. 11.2.)

Ign: Leakage current when a filter is connected to the input side (4.4 mA per one FR-BIF)

Iga: Leakage current of the servo amplifier (Found from table 11.3.)

Igm: Leakage current of the servo motor (Found from table 11.2.)

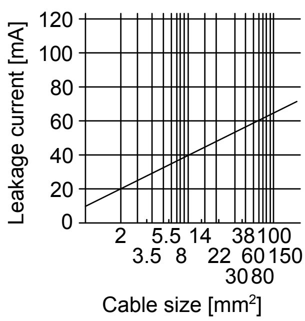


Fig. 11.2 Example of leakage current per km (Ig1, Ig2) for CV cable run in metal conduit

Table 11.2 Servo motor leakage current example (Igm)

Servo motor power [kW]	Leakage current [mA]
0.1 to 1	0.1
1.5 to 2	0.2
3	0.3

Table 11.3 Servo amplifier leakage current example (Iga)

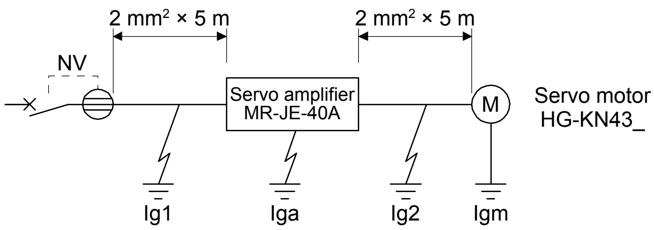
Servo amplifier capacity [kW]	Leakage current [mA]
0.1 to 0.4	0.1
0.75 to 3	0.15

Table 11.4 Earth-leakage current breaker selection example

Servo amplifier capacity [kW]	Rated sensitivity current of earth-leakage current breaker [mA]
MR-JE-10A to MR-JE-300A	15

(2) Selection example

Indicated below is an example of selecting an earth-leakage current breaker under the following conditions.



Use an earth-leakage current breaker designed for suppressing harmonics/surges.
Find the terms of equation (11.1) from the diagram.

$$Ig1 = 20 \cdot \frac{5}{1000} = 0.1 \text{ [mA]}$$

$$Ig2 = 20 \cdot \frac{5}{1000} = 0.1 \text{ [mA]}$$

Ign = 0 (not used)

Iga = 0.1 [mA]

Igm = 0.1 [mA]

Insert these values in equation (11.1).

$$Ig \geq 10 \cdot \{0.1 + 0 + 0.1 + 1 \cdot (0.1 + 0.1)\}$$
$$\geq 4 \text{ [mA]}$$

According to the result of calculation, use an earth-leakage current breaker having the rated sensitivity current (Ig) of 4.0 mA or more.
Use an earth-leakage current breaker having Ig of 15 mA with the NV-SP/SW/CP/CW/HW series.

11.11 EMC filter (recommended)

It is recommended that one of the following filters be used to comply with EN EMC directive. Some EMC filters have large in leakage current. When using an EMC filter, always use one for each servo amplifier.

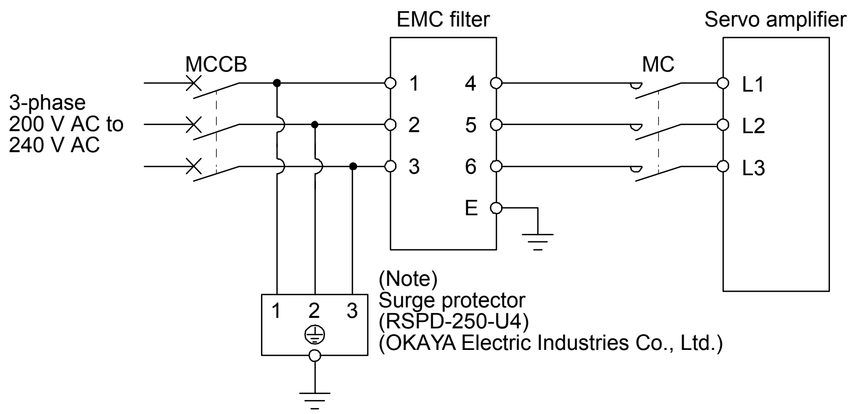
(1) Combination with the servo amplifier

Servo amplifier	Recommended filter (Soshin Electric)				Mass [kg]
	Model	Rated current [A]	Rated voltage [V AC]	Leakage current [mA]	
MR-JE-10A to MR-JE-100A	(Note) HF3010A-UN	10	250	5	3.5
MR-JE-200A, MR-JE-300A	(Note) HF3030A-UN	30	250	5	5.5

Note. A surge protector is separately required to use any of these EMC filters.

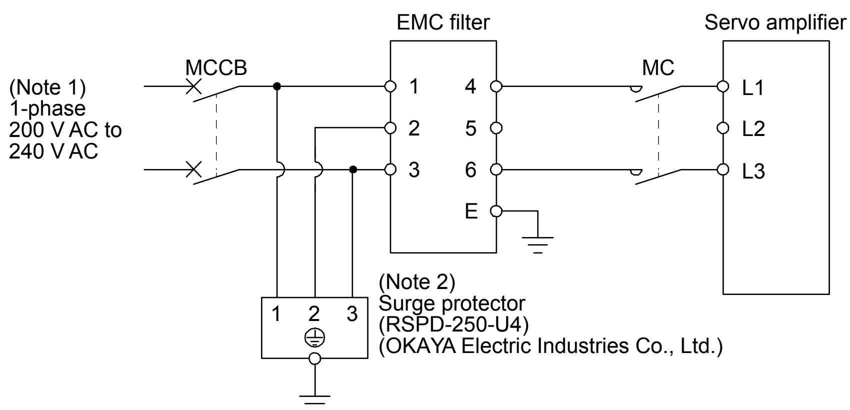
(2) Connection example

(a) When using 3-phase 200 V AC to 240 V AC power supply



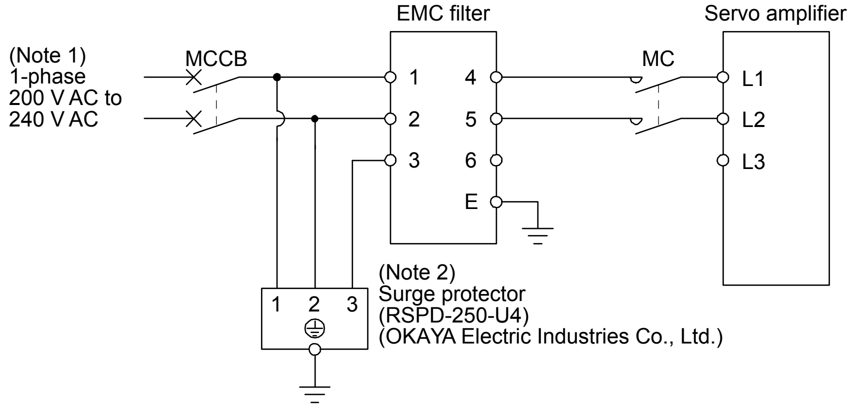
Note. The example is when a surge protector is connected.

(b) When using 1-phase 200 V AC to 240 V AC power supply for MR-JE-10A to MR-JE-100A



Note 1. Connect the power supply to L1 and L3. Leave L2 open.
2. The example is when a surge protector is connected.

(c) When using 1-phase 200 V AC to 240 V AC power supply for MR-JE-200A



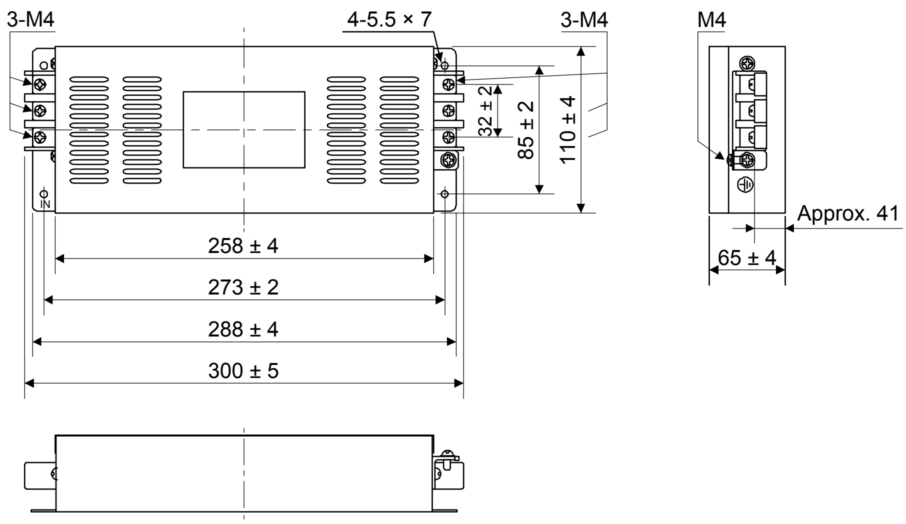
Note 1. Connect the power supply to L1 and L2. Leave L3 open.
2. The example is when a surge protector is connected.

(3) Dimensions

(a) EMC filter

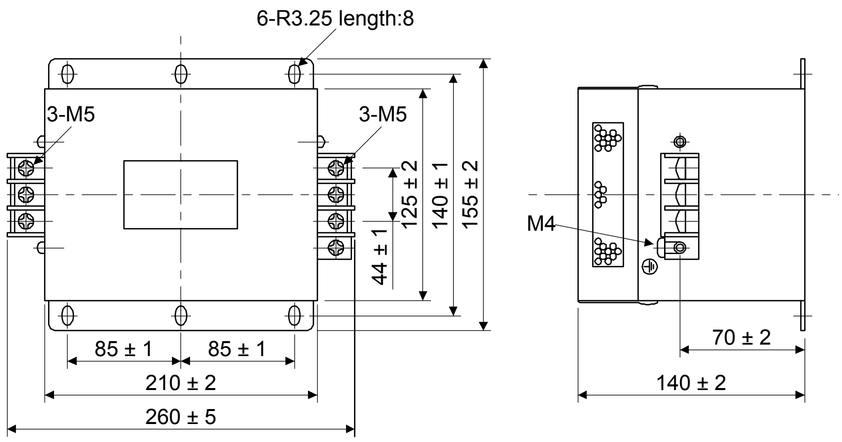
HF3010A-UN

[Unit: mm]



HF3030A-UN

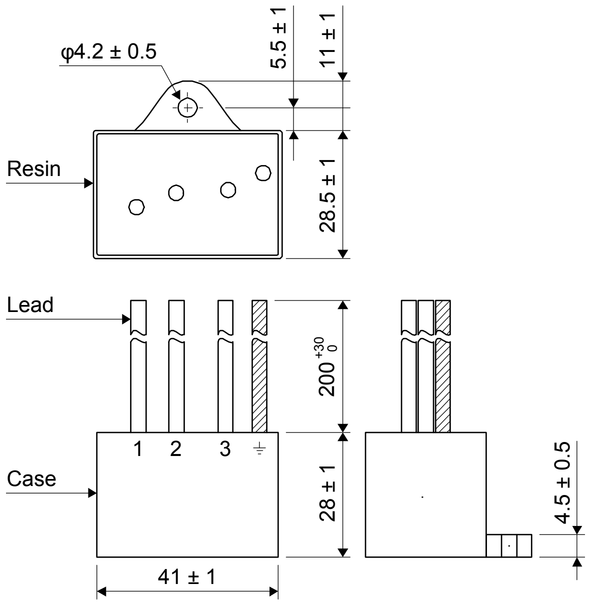
[Unit: mm]

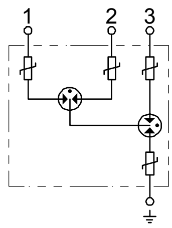


(b) Surge protector

RSPD-250-U4

[Unit: mm]





12. COMMUNICATION FUNCTION (MITSUBISHI GENERAL-PURPOSE AC SERVO PROTOCOL)

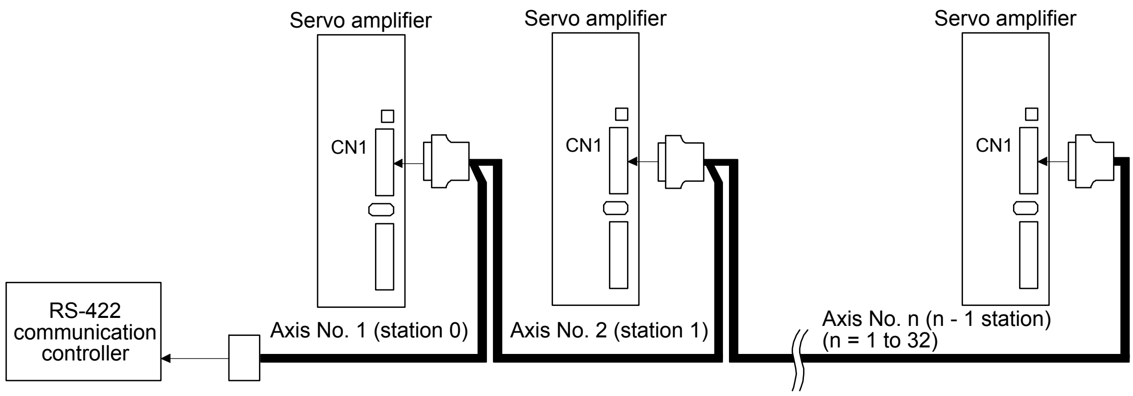
POINT
●The RS-422 serial communication function is supported by servo amplifier manufactured in December 2013 or later. Refer to section 1.6 (1) for the year and month of manufacture. ●The USB communication function and RS-422 communication function are mutually exclusive. They cannot be used together.

You can operate servo driving, parameter change, monitor function, etc. using Mitsubishi general-purpose AC servo protocol (RS-422 communication) with the servo amplifier.

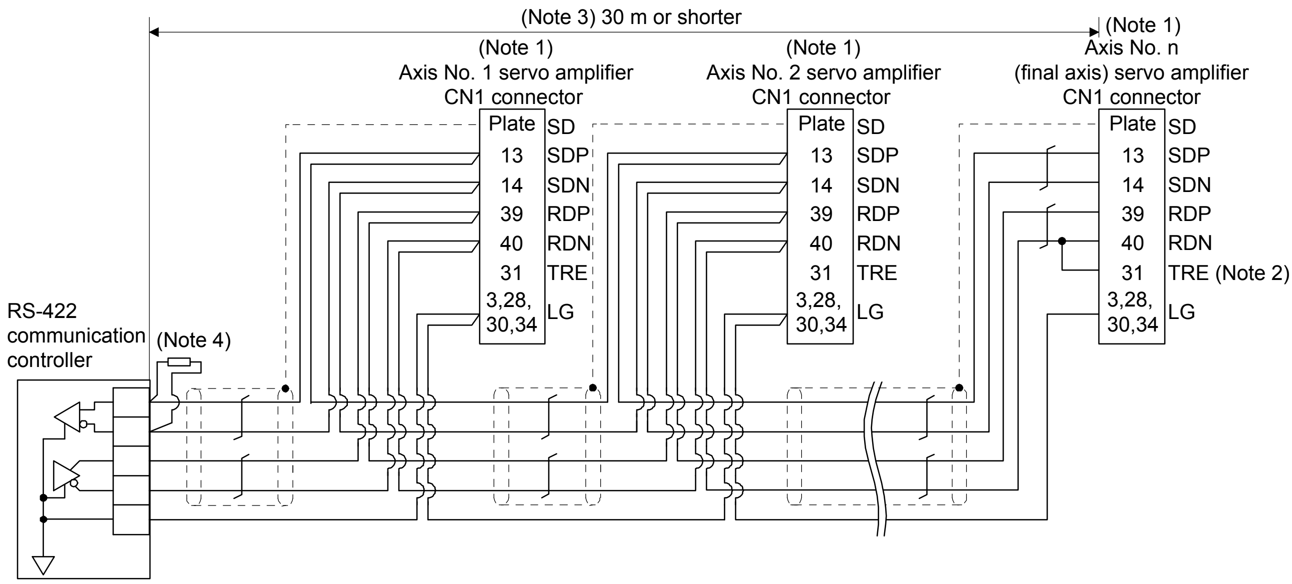
12.1 Structure

12.1.1 Configuration diagram

(1) Diagrammatic sketch
Up to 32 axes of servo amplifiers from stations 0 to 31 can be operated on the same bus.



(2) Cable connection diagram
Wire the cables as follows.



Note 1. Connector set MR-J3CN1 (3M or equivalent)
Connector: 10150-3000PE
Shell kit: 10350-52F0-008
2. Connect between TRE and RDN of the final axis servo amplifier.
3. The overall length is 30 m or less in low-noise environment.
4. If the RS-422 communication controller does not have a termination resistor, terminate it with a 150 Ω resistor.

12.1.2 Precautions for using RS422/USB communication function

Note the following to prevent an electric shock and malfunction of the servo amplifier.

(1) Power connection of personal computers
Connect your personal computer with the following procedures.

(a) When you use a personal computer with AC power supply

1) When using a personal computer with a three-core power plug or power plug with grounding wire, use a three-pin socket or ground the grounding wire.

2) When your personal computer has two-core plug and has no grounding wire, connect the personal computer to the servo amplifier with the following procedures.

a) Disconnect the power plug of the personal computer from an AC power socket.

b) Check that the power plug was disconnected and connect the device to the servo amplifier.

c) Connect the power plug of the personal computer to the AC power socket.

(b) When you use a personal computer with battery
You can use as it is.

(2) Connection with other devices using servo amplifier communication function
When the servo amplifier is charged with electricity due to connection with a personal computer and the charged servo amplifier is connected with other devices, the servo amplifier or the connected devices may malfunction. Connect the servo amplifier and other devices with the following procedures.

(a) Shut off the power of the device for connecting with the servo amplifier.

(b) Shut off the power of the servo amplifier which was connected with the personal computer and check the charge lamp is off.

(c) Connect the device with the servo amplifier.

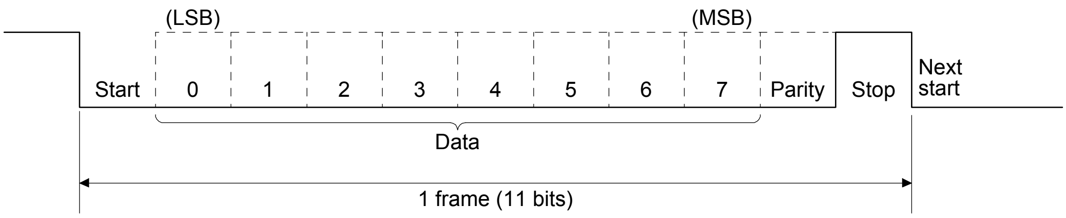
(d) Turn on the power of the servo amplifier and the device.

12.2 Communication specifications

12.2.1 Outline of communication

Receiving a command, this servo amplifier returns data. The device which gives the command (e.g. personal computer) is called a master station and the device (servo amplifier) which returns data in response to the command is called a slave station. When fetching data successively, the master station repeatedly commands the slave station to send data.

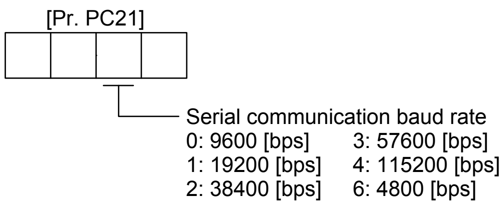
Item	Description	
Baud rate [bps]	4800/9600/19200/38400/57600/115200 asynchronous system	
Transfer code	Start bit Data bit Parity bit Stop bit	1 bit 8 bits 1 bit (even) 1 bit
Transfer method	Character method	Half-duplex communication method



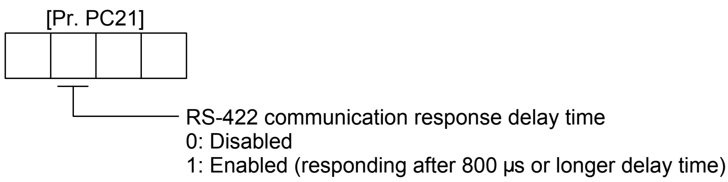
12.2.2 Parameter setting

When the RS-422 communication function is used to operate the servo, set the communication specifications of the servo amplifier with the parameters.
To enable the parameter values, cycle the power after setting.

(1) Serial communication baud rate
Select the communication speed. Match this value to the communication speed of the sending end (master station).



(2) RS-422 communication response delay time
Set the time from when the servo amplifier (slave station) receives communication data to when it returns data. Set "0" to return data in less than 800 μs or "1" to return data in 800 μs or longer.



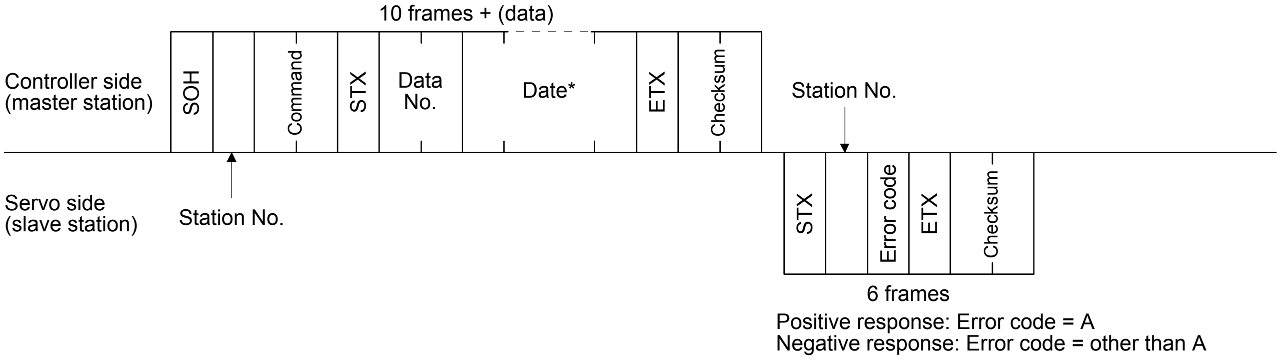
(3) Station No. setting
Set the station No. of the servo amplifier to [Pr. PC20]. The setting range is station No. 0 to 31.

12.3 Protocol

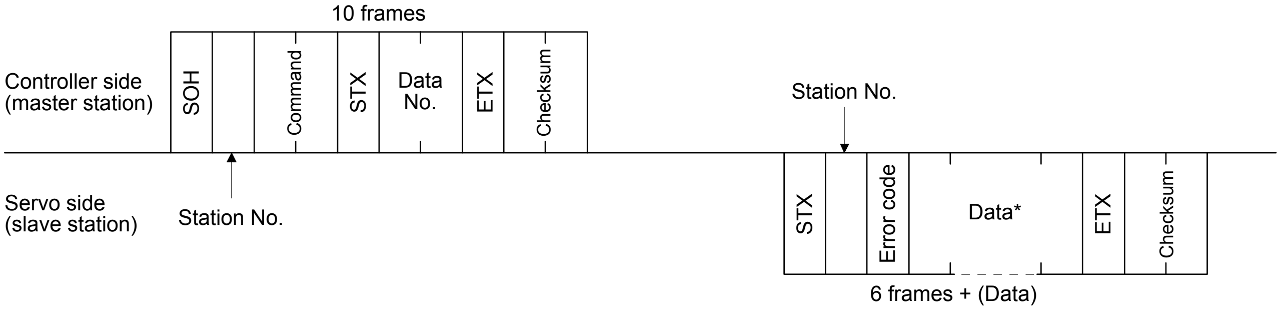
12.3.1 Transmission data configuration

Since up to 32 axes may be connected to the bus, add a station No. to the command, data No., etc. to determine the destination servo amplifier of data communication. Set the station No. to each servo amplifier using the parameters. Transmission data is enabled for the servo amplifier of the specified station No. When "*" is set as the station No. added to the transmission data, the transmission data is enabled for all servo amplifiers connected. However, when return data is required from the servo amplifier in response to the transmission data, set "0" to the station No. of the servo amplifier which must provide the return data.

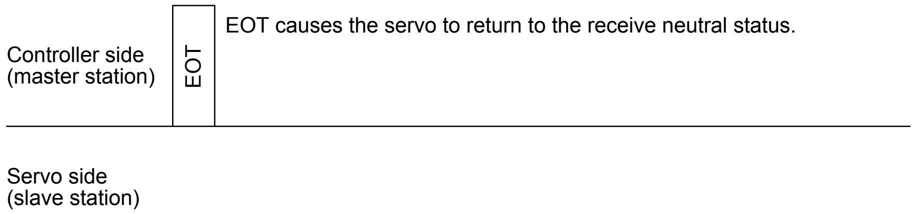
(1) Transmission of data from the controller to the servo



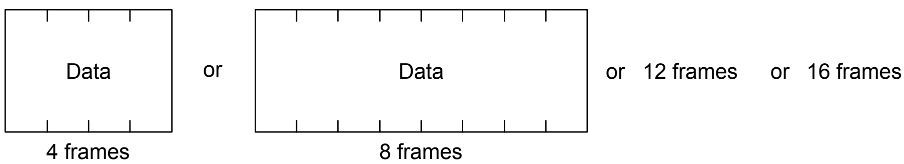
(2) Transmission of data request from the controller to the servo



(3) Recovery of communication status by time-out



(4) Data frames
The data length depends on the command.



12.3.2 Character codes

(1) Control codes

Code name	Hexadecimal (ASCII code)	Description	Personal computer terminal key operation (general)
SOH	01H	start of head	ctrl + A
STX	02H	start of text	ctrl + B
ETX	03H	end of text	ctrl + C
EOT	04H	end of transmission	ctrl + D

(2) Codes for data
Use ASCII unit codes.

b8	0	0	0	0	0	0	0	0
b7	0	0	0	0	1	1	1	1
b6	0	0	1	1	0	0	1	1
b5	0	1	0	1	0	1	0	1

b8 to b5	b4	b3	b2	b1	R \ C	0	1	2	3	4	5	6	7
	0	0	0	0	0	NUL	DLE	Space	0	@	P	`	p
	0	0	0	1	1	SOH	DC$_1$	!	1	A	Q	a	q
	0	0	1	0	2	STX	DC$_2$	“	2	B	R	b	r
	0	0	1	1	3	ETX	DC$_3$	#	3	C	S	c	s
	0	1	0	0	4			$	4	D	T	d	t
	0	1	0	1	5			%	5	E	U	e	u
	0	1	1	0	6			&	6	F	V	f	v
	0	1	1	1	7			‘	7	G	W	g	w
	1	0	0	0	8			(	8	H	X	h	x
	1	0	0	1	9			)	9	I	Y	i	y
	1	0	1	0	10			∗	:	J	Z	j	z
	1	0	1	1	11			+	;	K	[	k	{
	1	1	0	0	12			,	<	L	¥	l	|
	1	1	0	1	13			-	=	M	]	m	}
	1	1	1	0	14			.	>	N	^	n	‾
	1	1	1	1	15			/	?	O	_	o	DEL

(3) Station numbers
Set the station Nos. from station 0 to 31 in total of 32 stations, and use the ASCII unit codes to specify the stations.

Station No.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ASCII code	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Station No.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ASCII code	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V

For example, "30H" is transmitted in hexadecimal for the station No. "0" (axis 1).

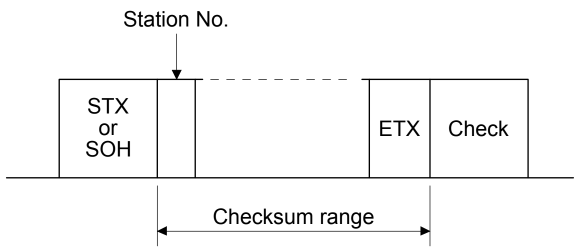
12.3.3 Error codes

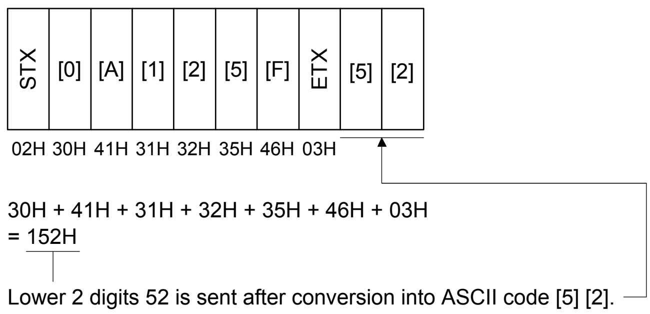
Error codes are used in the following cases and an error code of single-code length is transmitted.
Receiving data from the master station, the slave station sends the error code corresponding to that data to the master station. The error code sent in upper case indicates that the servo is normal and the one in lower case indicates that an alarm occurred.

Error code		Error name	Explanation	Remark
Servo: normal	Servo: alarm			
[A]	[a]	Normal	Data transmitted was processed normally.	Positive response
[B]	[b]	Parity error	Parity error occurred in the transmitted data.	Negative response
[C]	[c]	Checksum error	Checksum error occurred in the transmitted data.	
[D]	[d]	Character error	The transmitted character is out of specifications.	
[E]	[e]	Command error	The transmitted command is out of specifications.	
[F]	[f]	Data No. error	The transmitted data No. is out of specifications.	

12.3.4 Checksum

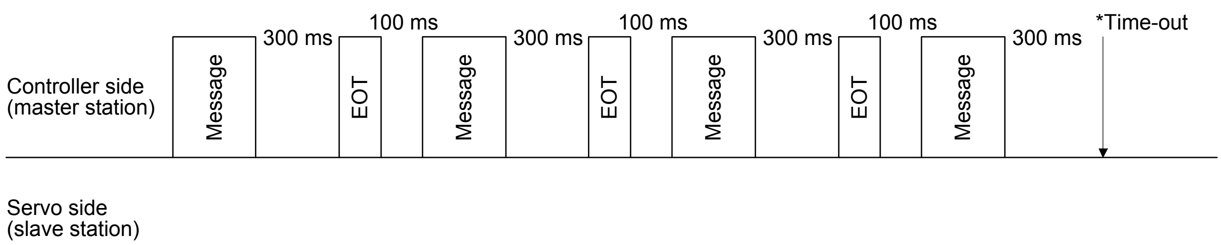
The checksum is an ASCII-coded hexadecimal representing the lower two digits of the sum of ASCII-coded hexadecimal numbers up to ETX, with the exception of the first control code (STX or SOH).





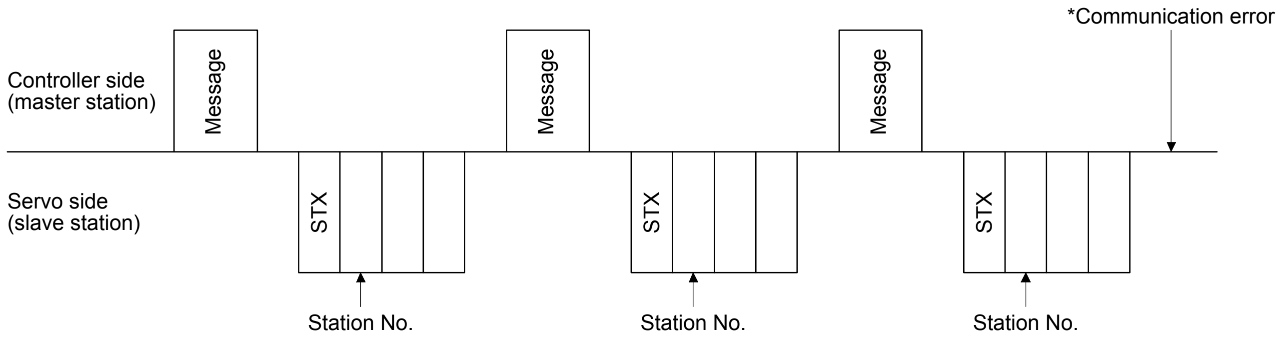
12.3.5 Time-out processing

The master station transmits EOT when the slave station does not start return processing (STX is not received) 300 [ms] after the master station has ended communication processing. 100 ms after that, the master station retransmits the message. Time-out occurs if the slave station does not answer after the master station has performed the above communication processing three times. (communication error)



12.3.6 Retry processing

When a fault occurs in communication between the master and slave stations, the error code in the response data from the slave station is a negative response code ([B] to [F], [b] to [f]). In this case, the master station retransmits the message which was sent at the occurrence of the fault (retry processing). A communication error occurs if the above processing is repeated and results in the error three or more consecutive times.



Similarly, when the master station detects a fault (e.g. checksum, parity) in the response data from the slave station, the master station retransmits the message which was sent at the occurrence of the fault. A communication error occurs if the retry processing is performed three times.

12.3.7 Initialization

After the slave station is switched on, it cannot return to communication until the internal initialization processing terminates. Hence, at power-on, ordinary communication should be started after.

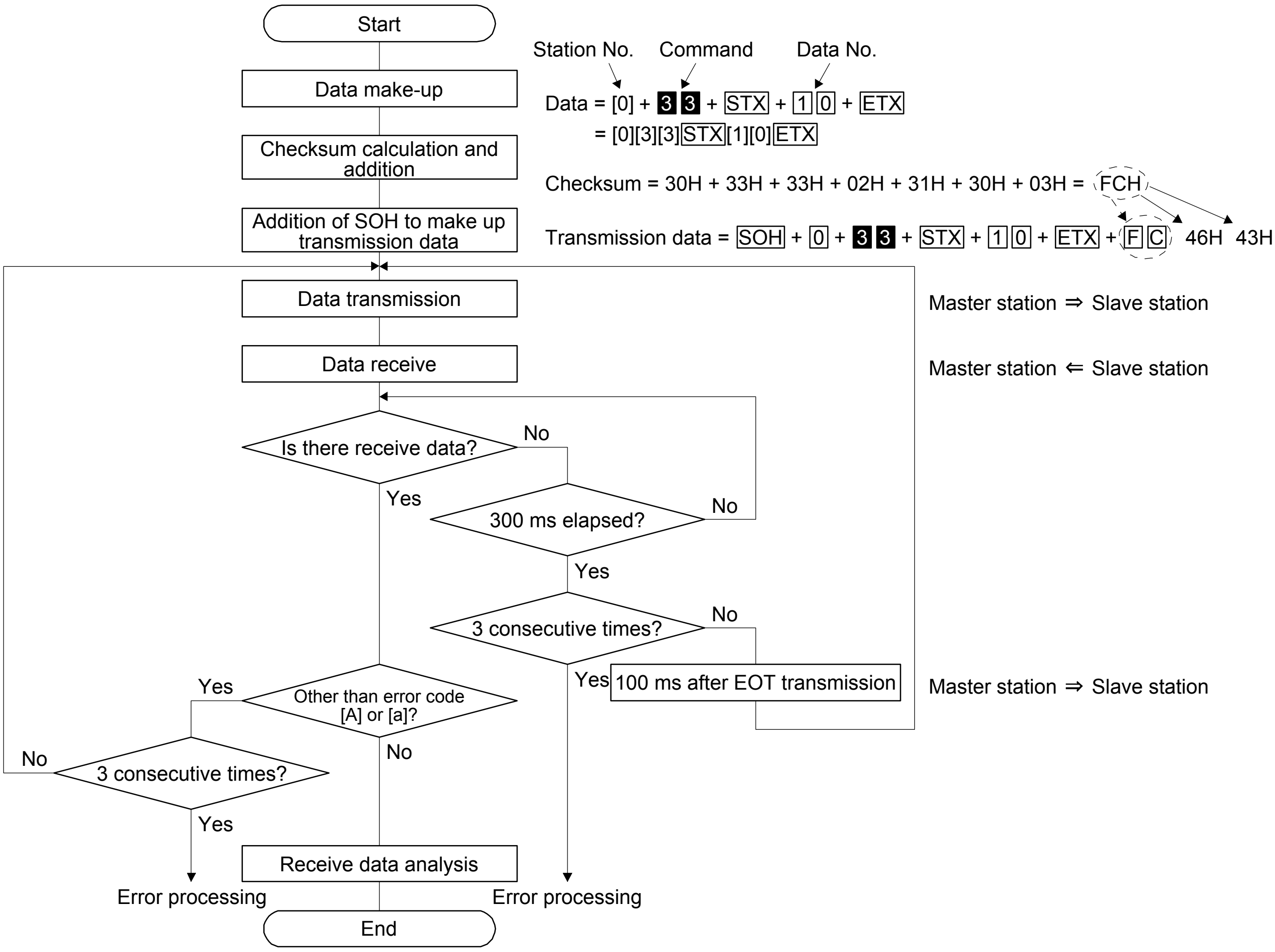
(1) Wait for 3.5 s or longer after the slave station is switched on.

(2) Check that normal communication can be made by reading the parameter or other data which does not pose any safety problems.

12.3.8 Communication procedure example

The following example reads the set value of alarm history (last alarm) from the servo amplifier of station 0.

Data item	Value	Description
Station No.	0	Servo amplifier station 0
Command	3 3	Reading command
Data No.	1 0	Alarm history (last alarm)



12.4 Command and data No. list

POINT

- Even if a command or data No. is the same between different model servo amplifiers, its description may differ.

12.4.1 Reading command

(1) Status display (command [0] [1])

Command	Data No.	Description	Status display	Frame length
[0] [1]	[0] [0]	Status display symbol and unit	Cumulative feedback pulses	16
	[0] [1]		Servo motor speed	
	[0] [2]		Droop pulses	
	[0] [3]		Cumulative command pulses	
	[0] [4]		Command pulse frequency	
	[0] [5]		Analog speed command voltage Analog speed limit voltage	
	[0] [6]		Analog torque limit voltage Analog torque command voltage	
	[0] [7]		Regenerative load ratio	
	[0] [8]		Effective load ratio	
	[0] [9]		Peak load ratio	
	[0] [A]		Instantaneous torque	
	[0] [B]		Position within one-revolution	
	[0] [C]		ABS counter (Note)	
	[0] [D]		Load to motor inertia ratio	
	[0] [E]		Bus voltage	
	[2] [0]		Encoder inside temperature	
	[2] [1]		Settling time	
	[2] [2]		Oscillation detection frequency	
	[2] [3]		Number of tough drive operations	
	[2] [8]		Unit power consumption	
	[2] [9]		Unit total power consumption	
	[8] [0]	Status display data value and processing information	Cumulative feedback pulses	12
	[8] [1]		Servo motor speed	
	[8] [2]		Droop pulses	
	[8] [3]		Cumulative command pulses	
	[8] [4]		Command pulse frequency	
	[8] [5]		Analog speed command voltage Analog speed limit voltage	
	[8] [6]		Analog torque limit voltage Analog torque command voltage	
	[8] [7]		Regenerative load ratio	
	[8] [8]		Effective load ratio	
	[8] [9]		Peak load ratio	
	[8] [A]		Instantaneous torque	
	[8] [B]		Position within one-revolution	
	[8] [C]		ABS counter (Note)	
	[8] [D]		Load to motor inertia ratio	
	[8] [E]		Bus voltage	
	[A] [0]		Encoder inside temperature	
	[A] [1]		Settling time	
	[A] [2]		Oscillation detection frequency	
	[A] [3]		Number of tough drive operations	
	[A] [8]		Unit power consumption	
	[A] [9]		Unit total power consumption	

Note. Travel distance from power on is displayed by counter value.

(2) Parameters (command [0] [4], [1] [5], [1] [6], [1] [7], [0] [8], and [0] [9])

Command	Data No.	Description	Frame length
[0] [4]	[0] [1]	Parameter group reading 0000: Basic setting parameters ([Pr. PA_ _]) 0001: Gain/filter parameters ([Pr. PB_ _]) 0002: Extension setting parameters ([Pr. PC_ _]) 0003: I/O setting parameters ([Pr. PD_ _]) 0004: Extension setting 2 parameters ([Pr. PE_ _]) 0005: Extension setting 3 parameters ([Pr. PF_ _])	4
[1] [5]	[0] [1] to [F] [F]	Current values of parameters Reads the current values of the parameters in the parameter group specified with the command [8] [5] + data No. [0] [0]. Before reading the current values, therefore, always specify the parameter group with the command [8] [5] + data No. [0] [0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter No.	12
[1] [6]	[0] [1] to [F] [F]	Upper limit values of parameter setting ranges Reads the permissible upper limit values of the parameters in the parameter group specified with the command [8] [5] + data No. [0] [0]. Before reading the upper limit values, therefore, always specify the parameter group with the command [8] [5] + data No. [0] [0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter No.	12
[1] [7]	[0] [1] to [F] [F]	Lower limit values of parameter setting ranges Reads the permissible lower limit values of the parameters in the parameter group specified with the command [8] [5] + data No. [0] [0]. Before reading the lower limit values, therefore, always specify the parameter group with the command [8] [5] + data No. [0] [0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter No.	12
[0] [8]	[0] [1] to [F] [F]	Parameter symbols Reads the symbols of the parameters in the parameter group specified with the command [8] [5] + data No. [0] [0]. Before reading the symbols, therefore, always specify the parameter group with the command [8] [5] + data No. [0] [0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter No.	12
[0] [9]	[0] [1] to [F] [F]	Writing enable/disable of parameters Reads writing enable/disable of the parameters in the parameter group specified with the command [8] [5] + data No. [0] [0]. Before reading the lower limit values, therefore, always specify the parameter group with the command [8] [5] + data No. [0] [0]. 0000: Writing enabled 0001: Writing disabled	4

(3) External I/O signals (command [1] [2])

Command	Data No.	Description	Frame length
[1] [2]	[0] [0]	Input device status	8
	[4] [0]	External input pin status	
	[6] [0]	Status of input device turned on by communication	
	[8] [0]	Output device status	
	[C] [0]	External output pin status	

(4) Alarm history (command [3] [3])

Command	Data No.	Description	Alarm occurrence sequence	Frame length
[3] [3]	[1] [0]	Alarm No. in alarm history	Most recent alarm	4
	[1] [1]		First alarm in past	
	[1] [2]		Second alarm in past	
	[1] [3]		Third alarm in past	
	[1] [4]		Fourth alarm in past	
	[1] [5]		Fifth alarm in past	
	[1] [6]		Sixth alarm in past	
	[1] [7]		Seventh alarm in past	
	[1] [8]		Eighth alarm in past	
	[1] [9]		Ninth alarm in past	
	[1] [A]		Tenth alarm in past	
	[1] [B]		Eleventh alarm in past	
	[1] [C]		Twelfth alarm in past	
	[1] [D]		Thirteenth alarm in past	
	[1] [E]		Fourteenth alarm in past	
	[1] [F]		Fifteenth alarm in past	
	[2] [0]	Alarm occurrence time in alarm history	Most recent alarm	8
	[2] [1]		First alarm in past	
	[2] [2]		Second alarm in past	
	[2] [3]		Third alarm in past	
	[2] [4]		Fourth alarm in past	
	[2] [5]		Fifth alarm in past	
	[2] [6]		Sixth alarm in past	
	[2] [7]		Seventh alarm in past	
	[2] [8]		Eighth alarm in past	
	[2] [9]		Ninth alarm in past	
	[2] [A]		Tenth alarm in past	
	[2] [B]		Eleventh alarm in past	
	[2] [C]		Twelfth alarm in past	
	[2] [D]		Thirteenth alarm in past	
	[2] [E]		Fourteenth alarm in past	
	[2] [F]		Fifteenth alarm in past	

(5) Current alarm (command [0] [2])

Command	Data No.	Description	Frame length
[0] [2]	[0] [0]	Current alarm No.	4

(6) Status display at alarm occurrence (command [3] [5])

Command	Data No.	Description	Status display	Frame length
[3] [5]	[0] [0]	Status display symbol and unit	Cumulative feedback pulses	16
	[0] [1]		Servo motor speed	
	[0] [2]		Droop pulses	
	[0] [3]		Cumulative command pulses	
	[0] [4]		Command pulse frequency	
	[0] [5]		Analog speed command voltage Analog speed limit voltage	
	[0] [6]		Analog torque limit voltage Analog torque command voltage	
	[0] [7]		Regenerative load ratio	
	[0] [8]		Effective load ratio	
	[0] [9]		Peak load ratio	

Command	Data No.	Description	Status display	Frame length
[3] [5]	[0] [A]	Status display symbol and unit	Instantaneous torque	16
	[0] [B]		Position within one-revolution	
	[0] [C]		ABS counter (Note)	
	[0] [D]		Load to motor inertia ratio	
	[0] [E]		Bus voltage	
	[2] [0]		Encoder inside temperature	
	[2] [1]		Settling time	
	[2] [2]		Oscillation detection frequency	
	[2] [3]		Number of tough drive operations	
	[2] [8]		Unit power consumption	
	[2] [9]		Unit total power consumption	
	[8] [0]	Status display data value and processing information	Cumulative feedback pulses	12
	[8] [1]		Servo motor speed	
	[8] [2]		Droop pulses	
	[8] [3]		Cumulative command pulses	
	[8] [4]		Command pulse frequency	
	[8] [5]		Analog speed command voltage Analog speed limit voltage	
	[8] [6]		Analog torque limit voltage Analog torque command voltage	
	[8] [7]		Regenerative load ratio	
	[8] [8]		Effective load ratio	
	[8] [9]		Peak load ratio	
	[8] [A]		Instantaneous torque	
	[8] [B]		Position within one-revolution	
	[8] [C]		ABS counter (Note)	
	[8] [D]		Load to motor inertia ratio	
	[8] [E]		Bus voltage	
	[A] [0]		Encoder inside temperature	
	[A] [1]		Settling time	
	[A] [2]		Oscillation detection frequency	
	[A] [3]		Number of tough drive operations	
	[A] [8]		Unit power consumption	
	[A] [9]		Unit total power consumption	

Note. Travel distance from power on is displayed by counter value.

(7) Test operation mode (command [0] [0])

Command	Data No.	Description	Frame length
[0] [0]	[1] [2]	Test operation mode reading 0000: Normal mode (not test operation mode) 0001: JOG operation 0002: Positioning operation 0004: Output signal (DO) forced output	4

(8) Software version (command [0] [2])

Command	Data No.	Description	Frame length
[0] [2]	[7] [0]	Software version	16

12.4.2 Writing commands

(1) Status display (command [8] [1])

Command	Data No.	Description	Setting range	Frame length
[8] [1]	[0] [0]	Status display data deletion	1EA5	4

(2) Parameters (command [9] [4], [8] [5])

Command	Data No.	Description	Setting range	Frame length
[9] [4]	[0] [1] to [F] [F]	Writing each parameter Writes the values of the parameters in the parameter group specified with the command [8] [5] + data No. [0] [0]. Before writing the values, therefore, always specify the parameter group with the command [8] [5] + data No. [0] [0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter No.	Depending on the parameter	12
[8] [5]	[0] [0]	Parameter group writing 0000: Basic setting parameters ([Pr. PA_ _]) 0001: Gain/filter parameters ([Pr. PB_ _]) 0002: Extension setting parameters ([Pr. PC_ _]) 0003: I/O setting parameters ([Pr. PD_ _]) 0004: Extension setting 2 parameters ([Pr. PE_ _]) 0005: Extension setting 3 parameters ([Pr. PF_ _])	0000 to 0005	4

(3) External I/O signals (command [9] [2])

Command	Data No.	Description	Setting range	Frame length
[9] [2]	[6] [0]	Communication input device signal	Refer to section 12.5.5.	8

(4) Alarm history (command [8] [2])

Command	Data No.	Description	Setting range	Frame length
[8] [2]	[2] [0]	Alarm history clear	1EA5	4

(5) Current alarm (command [8] [2])

Command	Data No.	Description	Setting range	Frame length
[8] [2]	[0] [0]	Alarm clear	1EA5	4

(6) I/O device prohibition (command [9] [0])

Command	Data No.	Description	Setting range	Frame length
[9] [0]	[0] [0]	Turns off the input device, external analog input signal or pulse train input, except EM2, LSP and LSN, independently of the external on/off status.	1EA5	4
	[0] [3]	Disables all output devices (DO).	1EA5	4
	[1] [0]	Cancels the prohibition of the input device, external analog input signal or pulse train input, except EM2, LSP and LSN.	1EA5	4
	[1] [3]	Cancels the prohibition of the output device.	1EA5	4

(7) Operation mode selection (command [8] [B])

Command	Data No.	Description	Setting range	Frame length
[8] [B]	[0] [0]	Selection of test operation mode 0000: Test operation mode cancel 0001: JOG operation 0002: Positioning operation 0004: Output signal (DO) forced output	0000 to 0002, 0004	4

(8) Test operation mode data (command [9] [2], [A] [0])

Command	Data No.	Description	Setting range	Frame length
[9] [2]	[0] [0]	Input signal for test operation	Refer to section 12.5.7.	8
	[A] [0]	Forced output of signal pin	Refer to section 12.5.9.	8
[A] [0]	[1] [0]	Write the servo motor speed in the test operation mode (JOG operation and positioning operation).	0000 to 7FFF	4
	[1] [1]	Write the acceleration/deceleration time constant in the test operation mode (JOG operation and positioning operation).	00000000 to 7FFFFFFF	8
	[2] [0]	Set the travel distance in the test operation mode (positioning operation).	00000000 to 7FFFFFFF	8
	[2] [1]	Select the positioning direction of test operation (positioning operation). 0 □ 0 □ 0: Forward rotation direction 1: Reverse rotation direction 0: Command pulse unit 1: Encoder pulse unit	0000 to 0101	4
	[4] [0]	This is a start command for test operation (positioning operation).	1EA5	4
	[4] [1]	Use this to make a temporary stop during test operation (positioning operation). "□" in the data indicates a blank. STOP: Temporary stop GO□□: Restart for remaining distance CLR□: Remaining distance clear	STOP GO□□ CLR□	4

12.5 Detailed explanations of commands

12.5.1 Data processing

When the master station transmits a command data No. or a command + data No. + data to a slave station, the servo amplifier returns a response or data in accordance with the purpose.
When numerical values are represented in these send data and receive data, they are represented in decimal, hexadecimal, etc.
Therefore, data must be processed in accordance with the application.
Since whether data must be processed or not and how to process data depend on the monitoring, parameters, etc., follow the detailed explanation of the corresponding command.
The following methods are how to process send and receive data when reading and writing data.

(1) Processing a read data
When the display type is 0, convert the eight-character data from hexadecimal to decimal, and place a decimal point according to the decimal point information.
When the display type is 1, use the eight-character data unchanged.

The following example indicates how to process the receive data "003000000929" given to show.
The receive data is as follows.

0	0	3	0	0	0	0	0	0	9	2	9

Data 32-bit length (hexadecimal representation)
(Data conversion is required as indicated in the display type.)

Display type
0: Data must be converted into decimal.
1: Data is used unchanged in hexadecimal.

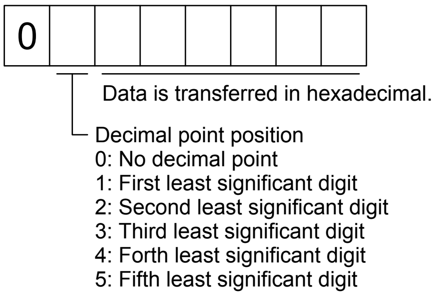
Decimal point position
0: No decimal point
1: First least significant digit (normally not used)
2: Second least significant digit
3: Third least significant digit
4: Forth least significant digit
5: Fifth least significant digit
6: Sixth least significant digit

Since the display type is "0" in this case, convert the hexadecimal data to decimal.
00000929H → 2345
As the decimal point position is "3", place a decimal point in the lower third digit.
Hence, "23.45" is displayed.

(2) Writing processed data

When the data to be written is handled as decimal, the decimal point position must be specified. If it is not specified, the data cannot be written. When the data is handled as hexadecimal, specify "0" as the decimal point position.

The data to be sent is the following value.



For example, here is described how to process the set data when a value of "15.5" is sent.

Since the decimal point position is the second least significant digit, the decimal point position data is "2".

As the data to be sent is hexadecimal, convert the decimal data into hexadecimal.

155 → 9B

Hence, "0200009B" is transmitted.

12.5.2 Status display mode

(1) Reading the status display name and unit

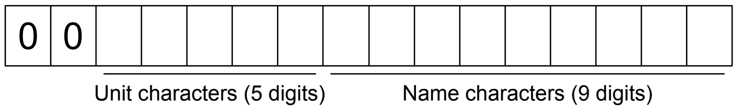
The following shows how to read the status display name and unit.

(a) Transmission

Transmit the command [0] [1] and the data No. corresponding to the status display item to be read, [0] [0] to [0] [E] and [2] [0] to [2] [9]. (Refer to section 12.4.1.)

(b) Return

The slave station returns the status display name and unit requested.



(2) Status display data reading

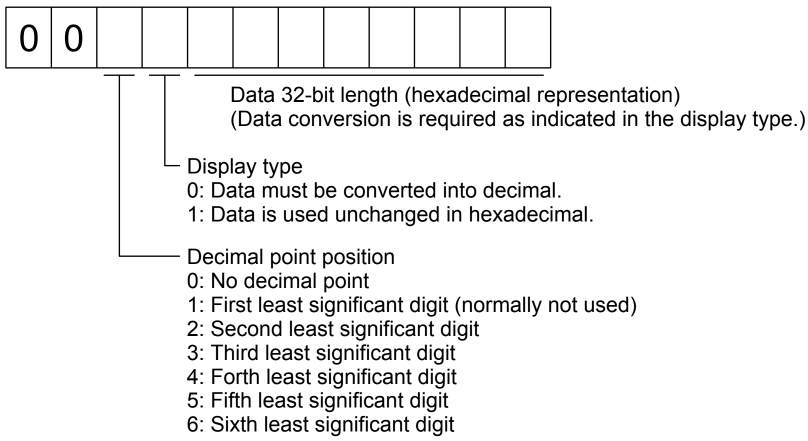
The following shows how to read the status display data and processing information.

(a) Transmission

Transmit the command [0] [1] and the data No. corresponding to the status display item to be read, [8] [0] to [8] [E] and [A] [0] to [A] [9]. (Refer to section 12.4.1.)

(b) Return

The slave station returns the status display data requested.



(3) Status display data clear

To clear the cumulative feedback pulse data of the status display, send this command immediately after reading the status display item. The data of the status display item transmitted is cleared to "0".

Command	Data No.	Data
[8] [1]	[0] [0]	1EA5

For example, after sending command [0] [1] and data No. [8] [0] and receiving the status display data, send command [8] [1], data No. [0] [0] and data [1EA5] to clear the cumulative feedback pulse value to "0".

12.5.3 Parameter

(1) Specification of the parameter group

To read or write the parameter settings, etc., the group of the parameters to be operated must be specified in advance. Write data to the servo amplifier as follows to specify the parameter group.

Command	Data No.	Transmission data	Parameter group
[8] [5]	[0] [0]	0000	Basic setting parameters ([Pr. PA_ _])
		0001	Gain/filter parameters ([Pr. PB_ _])
		0002	Extension setting parameters ([Pr. PC_ _])
		0003	I/O setting parameters ([Pr. PD_ _])
		0004	Extension setting 2 parameters ([Pr. PE_ _])
		0005	Extension setting 3 parameters ([Pr. PF_ _])

(2) Parameter group reading

The following shows how to read the parameter group set with slave station.

(a) Transmission

Transmit command [0] [4] and data No. [0] [1].

Command	Data No.
[0] [4]	[0] [1]

(b) Return

The slave station returns the preset parameter group.

0	0	0	

Parameter group
0: Basic setting parameters ([Pr. PA_ _])
1: Gain/filter parameters ([Pr. PB_ _])
2: Extension setting parameters ([Pr. PC_ _])
3: I/O setting parameters ([Pr. PD_ _])
4: Extension setting 2 parameters ([Pr. PE_ _])
5: Extension setting 3 parameters ([Pr. PF_ _])

(3) Reading symbols

The following shows how to read symbols of parameters. Specify a parameter group in advance. (Refer to (1) of this section.)

(a) Transmission

Transmit the command [0] [8] and the data No. [0] [1] to [F] [F] corresponding to the parameter No. (Refer to section 12.4.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter No.

(b) Return

The slave station returns the symbol of the parameter requested.

0	0	0									

Symbol characters (9 digits)

(4) Reading the setting

The following shows how to read the parameter setting. Specify a parameter group in advance. (Refer to (1) of this section.)

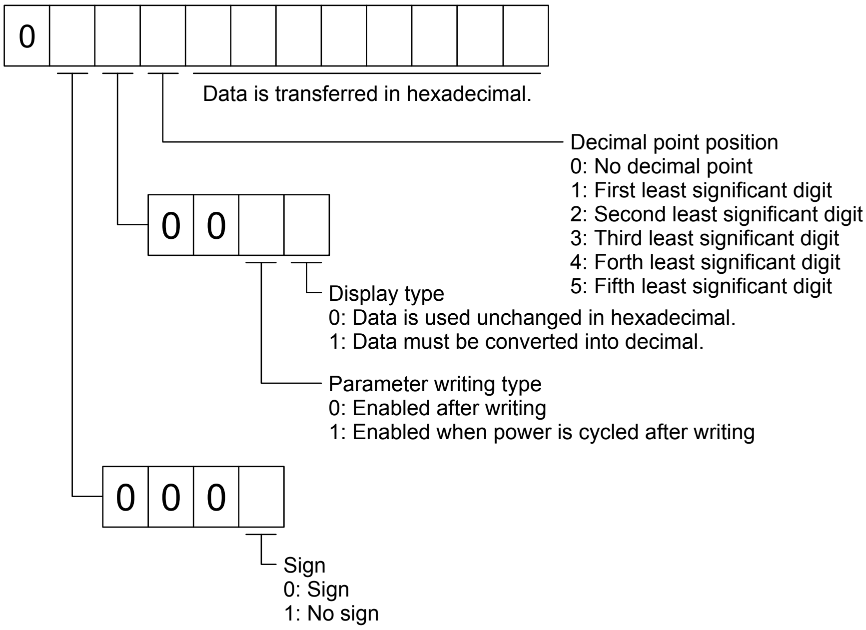
(a) Transmission

Transmit the command [1] [5] and the data No. corresponding to the parameter No [0] [1] to [F] [F]. (Refer to section 12.4.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter No.

(b) Return

The slave station returns the data and processing information of the parameter No. requested.



For example, data "00120000270F" means 999.9 (decimal display format) and data "000000003ABC" means 3ABC (hexadecimal display format).

When the display type is "0" (hexadecimal) and the decimal point position is other than 0, the display type is a special hexadecimal display format and "F" of the data value is handled as a blank. Data "0001FFFFF053" means 053 (special hexadecimal display format).

"000000000000" is transferred when the parameter that was read is the one inaccessible for writing/reference in the parameter writing inhibit setting of [Pr. PA19].

(5) Reading the setting range

The following shows how to read the parameter setting range. Specify a parameter group in advance. (Refer to (1) of this section.)

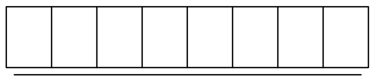
(a) Transmission

When reading an upper limit value, transmit the command [1] [6] and the data No. [0] [1] to [F] [F] corresponding to the parameter No. When reading an lower limit value, transmit the command [1] [7] and the data No. [0] [1] to [F] [F] corresponding to the parameter No. (Refer to section 12.4.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter No.

(b) Return

The slave station returns the data and processing information of the parameter No. requested.



Data is transferred in hexadecimal.

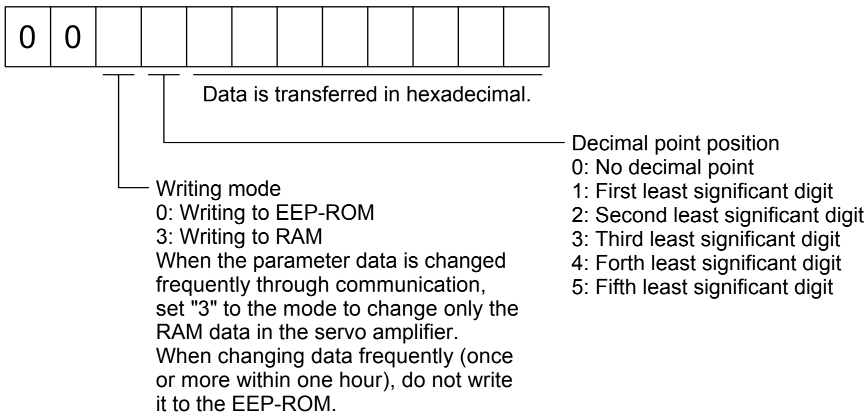
For example, data "FFFFFFEC" means "-20".

(6) Writing setting values

POINT
● If setting values need to be changed with a high frequency (i.e. one time or more per one hour), write the setting values to the RAM, not to the EEP-ROM. The EEPROM has a limitation in the number of write times and exceeding this limitation causes the servo amplifier to malfunction. Note that the number of write times to the EEP-ROM is limited to approximately 100, 000.

Write the parameter setting into EEP-ROM of the servo amplifier. Specify a parameter group in advance. (Refer to (1) of this section.)
Write any value within the setting enabled range. For the setting enabled range, refer to chapter 5 or read the setting range by performing operation in (4) of this section.
Transmit command [9] [4], the data No. , and the set data.
The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter No.
When the data to be written is handled as decimal, the decimal point position must be specified. If it is not specified, the data cannot be written. When the data is handled as hexadecimal, specify "0" as the decimal point position.
Check the writing data is within the upper/lower limit value before writing. To prevent an error, read the parameter data to be written, confirm the decimal point position, and create transmission data.
On completion of writing, read the same parameter data to verify that data has been written correctly.

Command	Data No.	Data
[9] [4]	[0] [1] to [F] [F]	See below.



12.5.4 External I/O signal status (DIO diagnosis)

(1) Reading input device status

The following shows how to read the status of the input devices.

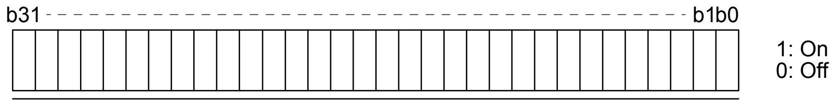
(a) Transmission

Transmit command [1] [2] and data No. [0] [0].

Command	Data No.
[1] [2]	[0] [0]

(b) Return

The slave station returns the status of the input devices.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol	Bit	Symbol	Bit	Symbol	Bit	Symbol
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1/RS2	19		27	CDP
4	TL1	12	ST2/RS1	20	STAB2	28	
5	PC	13	CM1	21		29	
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

(2) Reading external input pin status

The following shows how to read the on/off status of the external input pins.

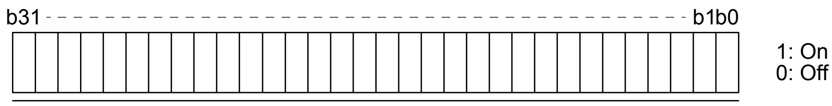
(a) Transmission

Transmit command [1] [2] and data No. [4] [0].

Command	Data No.
[1] [2]	[4] [0]

(b) Return

The on/off status of the input pins are returned.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	CN1 connector pin	Bit	CN1 connector pin	Bit	CN1 connector pin	Bit	CN1 connector pin
0	43	8		16		24	
1	44	9		17		25	
2	42	10		18		26	
3	15	11		19		27	
4	19	12		20		28	
5	41	13		21		29	
6		14		22		30	
7		15		23		31	

(3) Reading the status of input devices switched on with communication
The following shows how to read the on/off status of the input devices switched on with communication.

(a) Transmission
Transmit command [1] [2] and data No. [6] [0].

Command	Data No.
[1] [2]	[6] [0]

(b) Return
The slave station returns the status of the input devices.

b31 - - - - - - - - b1b0

1: On
0: Off

Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol	Bit	Symbol	Bit	Symbol	Bit	Symbol
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1/RS2	19		27	CDP
4	TL1	12	ST2/RS1	20	STAB2	28	
5	PC	13	CM1	21		29	
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

(4) Reading output device status
The following shows how to read the on/off status of the output devices.

(a) Transmission
Transmit command [1] [2] and data No. [8] [0].

Command	Data No.
[1] [2]	[8] [0]

(b) Return
The slave station returns the status of the input/output devices.

b31 - - - - - - - - b1b0

1: On
0: Off

Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol	Bit	Symbol	Bit	Symbol	Bit	Symbol
0	RD	8	ALM	16		24	
1	SA	9	OP	17		25	CDPS
2	ZSP	10	MBR	18		26	
3	TLC	11		19		27	
4	VLC	12	ACD0	20		28	
5	INP	13	ACD1	21		29	
6		14	ACD2	22		30	
7	WNG	15		23		31	MTTR

(5) Reading external output pin status

The following shows how to read the on/off status of the external output pins.

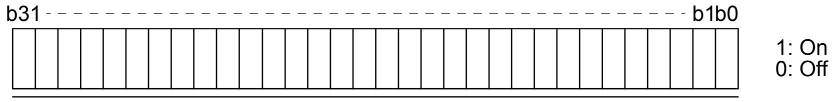
(a) Transmission

Transmit command [1] [2] and data No. [C] [0].

Command	Data No.
[1] [2]	[C] [0]

(b) Return

The slave station returns the status of the output devices.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	CN1 connector pin	Bit	CN1 connector pin	Bit	CN1 connector pin	Bit	CN1 connector pin
0	49	8		16		24	
1	24	9		17		25	
2	23	10		18		26	
3		11		19		27	
4		12		20		28	
5	48	13		21		29	
6	33	14		22		30	
7		15		23		31	

12.5.5 Input device on/off

> **POINT**
>
> The on/off status of all devices in the servo amplifier are the status of the data received at last. Therefore, when there is a device which must be kept on, transmit data which turns the device on every time.

Each input device can be switched on/off. However, when the device to be switched off is in the external input signal, also switch off the input signal.

Transmit command [9] [2], data No. [6] [0], and data.

Command	Data No.	Set data
[9] [2]	[6] [0]	See below.

b31 .... b1b0

1: On
0: Off

Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol	Bit	Symbol	Bit	Symbol	Bit	Symbol
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1/RS2	19		27	CDP
4	TL1	12	ST2/RS1	20	STAB2	28	
5	PC	13	CM1	21		29	
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

12.5.6 Disabling/enabling I/O devices (DIO)

You can disable inputs regardless of the I/O device status. When inputs are disabled, the input signals (devices) are recognized as follows. However, EM2 (Forced stop 2), LSP (Forward rotation stroke end), and LSN (Reverse rotation stroke end) cannot be disabled.

Signal	Status
Input device (DI)	Off
External analog input signal	0 V
Pulse train input	None

(1) Disabling/enabling the input devices (DI), external analog input signals and pulse train inputs except EM2 (Forced stop 2), LSP (Forward rotation stroke end), and LSN (Reverse rotation stroke end). Transmit the following communication commands.

(a) Disabling

Command	Data No.	Data
[9] [0]	[0] [0]	1EA5

(b) Enabling

Command	Data No.	Data
[9] [0]	[1] [0]	1EA5

(2) Disabling/enabling the output devices (DO)
Transmit the following communication commands.

(a) Disabling

Command	Data No.	Data
[9] [0]	[0] [3]	1EA5

(b) Enabling

Command	Data No.	Data
[9] [0]	[1] [3]	1EA5

12.5.7 Input devices on/off (test operation)

Each input devices can be turned on/off for test operation. However, when the device to be switched off is in the external input signal, also switch off the input signal.

Transmit command [9] [2], data No. [0] [0], and data.

Command	Data No.	Set data
[9] [2]	[0] [0]	See below.

b31 - - - - - - - - b1b0

1: On
0: Off

Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol	Bit	Symbol	Bit	Symbol	Bit	Symbol
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1	19		27	CDP
4	TL1	12	ST2	20	STAB2	28	
5	PC	13	CM1	21		29	
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

12.5.8 Test operation mode

POINT

- The test operation mode is used to check operation. Do not use it for actual operation.
- If communication stops for longer than 0.5 s during test operation, the servo amplifier decelerates to a stop, resulting in servo-lock. To prevent this, continue communication all the time by monitoring the status display, etc.
- Even during operation, you can switch the servo amplifier to the test operation mode. In this case, switching to the test operation mode will shut off the base circuit to coast the motor.

(1) How to prepare and cancel the test operation mode

(a) Preparing the test operation mode

Set the test operation mode type with the following procedure.

1) Selection of test operation mode

Send the command [8] [B] + data No. [0] [0] + data to select the test operation mode.

Command	Data No.	Transmission data	Selection of test operation mode
[8] [B]	[0] [0]	0001	JOG operation
		0002	Positioning operation
		0004	Output signal (DO) forced output (Note)

Note. Refer to section 12.5.9 for the output signal (DO) forced output.

2) Check of test operation mode

Read the test operation mode set for the slave station, and check that it is set correctly.

a) Transmission

Transmit command [0] [0] and data No. [1] [2].

Command	Data No.
[0] [0]	[1] [2]

b) Reply

The slave station returns the preset operation mode.

0	0	0	

Test operation mode reading
0: Normal mode (not test operation mode)
1: JOG operation
2: Positioning operation
4: Output signal (DO) forced output

(b) Cancel of test operation mode

To terminate the test operation mode, send the command [8] [B] + data No. [0] [0] + data.

Command	Data No.	Transmission data	Selection of test operation mode
[8] [B]	[0] [0]	0000	Test operation mode cancel

(2) JOG operation

Transmit the command, data No., and data as follows to execute JOG operation.

Start

Command : [8] [B]
Data No. : [0] [0]
Data : 0001 (JOG operation)

Select the JOG operation in the test operation mode.

Servo motor speed setting

Command : [A] [0]
Data No. : [1] [0]
Data : Write the servo motor speed [r/min] in hexadecimal.

Acceleration/deceleration time constant setting

Command : [A] [0]
Data No. : [1] [1]
Data : Write the acceleration/ deceleration time constant [ms] in hexadecimal.

Set the operation pattern.

When LSP and LSN are turned off with an external input signal...

Start

Command : [9] [2]
Data No. : [0] [0]
Data :
- Forward rotation direction 00000807 (Turn on SON, LSP, LSN, and ST1.)
- Reverse rotation direction 00001007 (Turn on SON, LSP, LSN, and ST2.)

Stop

Command : [9] [2]
Data No. : [0] [0]
Data : 00000007 (Turn on SON, LSP, and LSN.)

When LSP and LSN are turned on or automatically turned on...

Start

Command : [9] [2]
Data No. : [0] [0]
Data :
- Forward rotation direction 00000801 (Turn on SON and ST1.)
- Reverse rotation direction 00001001 (Turn on SON and ST2.)

Stop

Command : [9] [2]
Data No. : [0] [0]
Data : 00000001 (Turn on SON.)

Start

Stop

End

Command : [8] [B]
Data No. : [0] [0]
Data : 0000 (Test operation mode is canceled.)

Test operation mode is canceled.

(3) Positioning operation

(a) Operation procedure

Transmit the command, data No., and data as follows to execute positioning operation.

Start

Command : [8] [B]
Data No. : [0] [0]
Data : 0002 (positioning operation)

Select the positioning operation in the test operation mode.

Servo motor speed setting

Command : [A] [0]
Data No. : [1] [0]
Data : Write the speed [r/min] in hexadecimal.

Acceleration/deceleration time constant setting

Command : [A] [0]
Data No. : [1] [1]
Data : Write the acceleration/ deceleration time constant [ms] in hexadecimal.

Travel distance setting

Command : [A] [0]
Data No. : [2] [0]
Data : Write the travel distance [pulse] in hexadecimal.

Rotation direction selection

Command : [A] [0]
Data No. : [2] [1]
Data : 0000 (forward rotation)
0001 (reverse rotation direction)

Set the operation pattern.

When LSP and LSN are turned off with an external input signal...

Enable input device.

Command : [9] [2]
Data No. : [0] [0]
Data : 00000007 (Turn on SON, LSP, and LSN.)

When LSP and LSN are turned on or automatically turned on...

Enable input device.

Command : [9] [2]
Data No. : [0] [0]
Data : 00000001 (Turn on SON.)

Turn on SON (Servo-on) to make the servo amplifier ready.

(Note)

Start positioning operation

Command : [A] [0]
Data No. : [4] [0]
Data : 1EA5

Start

End

Command : [8] [B]
Data No. : [0] [0]
Data : 0000 (Test operation mode is canceled.)

Test operation mode is canceled.

Note. It has 100 ms delay.

(b) Temporary stop/restart/remaining distance clear

Transmit the following command, data No., and data during positioning operation to make deceleration to a stop.

Command	Data No.	Data
[A] [0]	[4] [1]	STOP

Transmit the following command, data No., and data during a temporary stop to restart.

Command	Data No.	(Note) Data
[A] [0]	[4] [1]	GO□□

Note. "□" indicates a blank.

Transmit the following command, data No., and data during a temporary stop to stop positioning operation and erase the remaining travel distance.

Command	Data No.	(Note) Data
[A] [0]	[4] [1]	CLR□

Note. "□" indicates a blank.

12.5.9 Output signal pin on/off (output signal (DO) forced output)

In the test operation mode, the output signal pins can be turned on/off regardless of the servo status. Using command [9] [0], disable the external input signals in advance.

(1) Selecting the output signal (DO) forced output in the test operation mode

Transmit command + [8] [B] + data No. [0] [0] + data "0004" to select the output signal (DO) forced output.

0	0	0	4

Selection of test operation mode
4: Output signal (DO) forced output

(2) External output signal on/off

Transmit the following communication commands.

Command	Data No.	Set data
[9] [2]	[A] [0]	See below.

b31 -- b1b0

1: On
0: Off

Command of each bit is transmitted to the master station as hexadecimal data.

Bit	CN1 connector pin
0	49
1	24
2	23
3	
4	
5	48
6	33
7	

Bit	CN1 connector pin
8	
9	
10	
11	
12	
13	
14	
15	

Bit	CN1 connector pin
16	
17	
18	
19	
20	
21	
22	
23	

Bit	CN1 connector pin
24	
25	
26	
27	
28	
29	
30	
31	

(3) Output signal (DO) forced output
Transmit command [8] [B] + data No. [0] [0] + data to stop the output signal (DO) forced output.

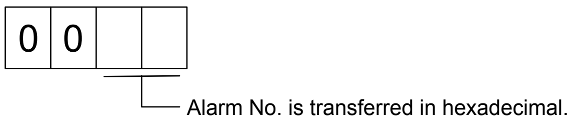
Command	Data No.	Transmission data	Selection of test operation mode
[8] [B]	[0] [0]	0000	Test operation mode cancel

12.5.10 Alarm history

(1) Alarm No. reading
The following shows how to read alarm Nos. which occurred in the past. Alarm Nos. and occurrence times of No. 0 (last alarm) to No. 15 (sixteenth alarm in the past) are read.

(a) Transmission
Transmit command [3] [3] + data No. [1] [0] to [1] [F]. Refer to section 12.4.1.

(b) Return
Alarm Nos. corresponding to the data No. is provided.

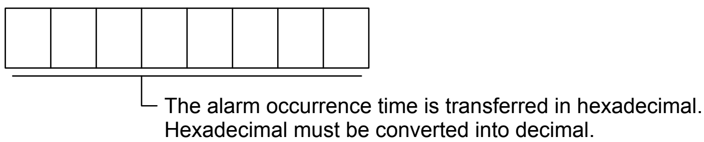


For example, "0032" means [AL. 32] and "00FF" means [AL. _ _] (no alarm).

(2) Alarm occurrence time reading
The following shows how to read alarm occurrence times which occurred in the past.
Alarm occurrence time corresponding to the data No. is provided in terms of the total time beginning with operation start, with the minute unit omitted.

(a) Transmission
Transmit command [3] [3] + data No. [2] [0] to [2] [F].
Refer to section 12.4.1.

(b) Return



For example, data "01F5" means that the alarm occurred in 501 hours after starting operation.

(3) Clearing the alarm history
Alarm history is cleared.
Transmit command [8] [2] and data No. [2] [0].

Command	Data No.	Data
[8] [2]	[2] [0]	1EA5

12.5.11 Current alarm

(1) Current alarm reading

The following shows how to read the alarm No. which is occurring currently.

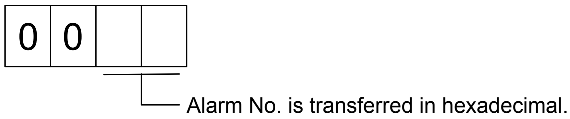
(a) Transmission

Transmit command [0] [2] and data No. [0] [0].

Command	Data No.
[0] [2]	[0] [0]

(b) Return

The slave station returns the alarm currently occurring.



For example, "0032" means [AL. 32] and "00FF" means [AL. _ _] (no alarm).

(2) Reading status display at alarm occurrence

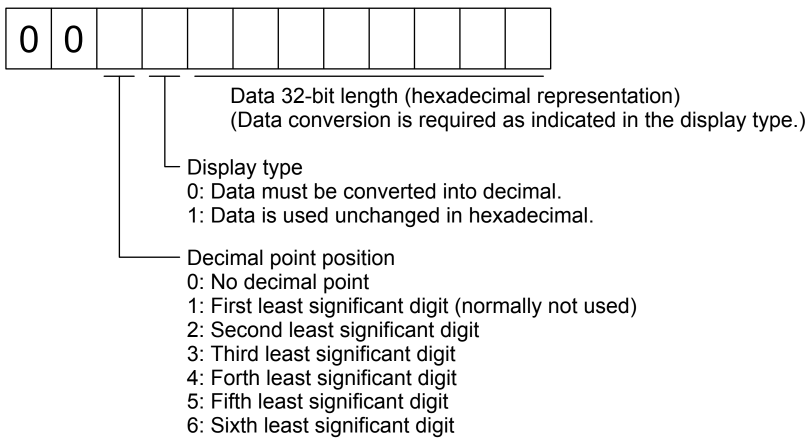
The following shows how to read the status display data at alarm occurrence. When the data No. corresponding to the status display item is transmitted, the data value and data processing information will be returned.

(a) Transmission

Transmit the command [3] [5] + the data No. corresponding to the status display item to read, [8] [0] to [8] [E] and [A] [0] to [A] [9]. Refer to section 12.4.1.

(b) Return

The slave station returns the status display data of requested alarm at occurrence.



(3) Current alarm reset

As by the reset (RES) on, reset the servo amplifier alarm to make the servo amplifier ready to operate. After removing the cause of the alarm, reset the alarm with no command entered.

Command	Data No.	Data
[8] [2]	[0] [0]	1EA5

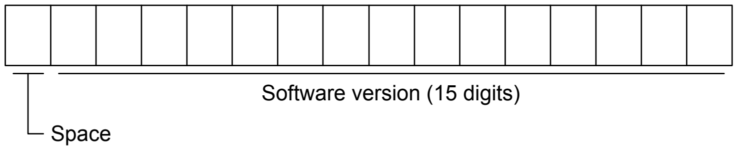
12.5.12 Software version

The following shows how to read the software version of the servo amplifier.

(a) Transmission
Transmit command [0] [2] and data No. [7] [0].

Command	Data No.
[0] [2]	[7] [0]

(b) Return
The slave station returns the requested software version.



MEMO

App. 1 Peripheral equipment manufacturer (for reference)

Names given in the table are as of Apr. 2015.

Manufacturer	Contact information
JST	J.S.T. Mfg. Co., Ltd.
3M	3M
Soshin Electric	Soshin Electric Co., Ltd.

App. 2 Compliance with global standards

App. 2.1 About safety

This section explains safety of users and machine operators. Please read the section carefully before mounting the equipment.

App. 2.1.1 Professional engineer

Only professional engineers should mount MR-JE servo amplifiers.
Here, professional engineers are persons who took a proper engineering training or qualified persons who are engaged in electrical equipment.
Check if applicable technical training is available at your local Mitsubishi Electric office. Contact your local sales office for schedules and locations.

App. 2.1.2 Applications of the devices

MR-JE servo amplifiers comply with the following standards.
IEC/EN 61800-5-1, IEC/EN 61800-3

App. 2.1.3 Correct use

Always use the MR-JE servo amplifiers within specifications (voltage, temperature, etc. Refer to section 1.3 for details.). Mitsubishi Electric Co. accepts no claims for liability if the equipment is used in any other way or if modifications are made to the device, even in the context of mounting and installation.

⚠WARNING	●It takes 15 minutes for capacitor discharging. Do not touch the unit and terminals immediately after power off.

(1) Peripheral device and power wiring
The followings are selected based on IEC/EN 61800-5-1, UL 508C, and CSA C22.2 No.14.

(a) Local wiring
The following table shows the stranded wire sizes [AWG] symbols rated at 75 °C/60 °C.

Table. Recommended wires

Servo amplifier (Note 3)	75 °C/60 °C stranded wire [AWG]		
	L1/L2/L3/⏚ (Note 2)	P+/C	U/V/W/⏚ (Note 1, 2)
MR-JE-10_/MR-JE-20_/MR-JE-40_/MR-JE-70_/MR-JE-100_ (T)/ MR-JE-200_/MR-JE-300_	14/14	14/14	14/14
MR-JE-200_ (S)	12/12		

Note 1. Select wire sizes depending on the rated output of the servo motors. The values in the table are sizes based on rated output of the servo amplifiers.
2. The following shows the PE terminal specifications of the servo amplifier.
Screw size: M4
Tightening torque: 1.2 [N•m]
Recommended crimp terminals: R2-4 (Manufactured by JST)
Crimping tool: YPT-60-21 (Manufactured by JST)
3. "(S)" means 1-phase 200 V AC power input and "(T)" means 3-phase 200 V AC power input in the table.

(b) Selection example of MCCB and fuse
Use T class fuses or molded-case circuit breaker (UL489 Listed MCCB) as the following table. The T class fuses and molded-case circuit breakers in the table are selected examples based on rated I/O of the servo amplifiers. When you select a smaller capacity servo motor to connect it to the servo amplifier, you can also use smaller capacity T class fuses or molded-case circuit breaker than ones in the table. For selecting ones other than Class T fuses and molded-case circuit breakers below, refer to section 11.6.

Servo amplifier (Note)	Molded-case circuit breaker (240 V AC)	Fuse (300 V)
MR-JE-10_/MR-JE-20_/MR-JE-40_/MR-JE-70_ (T)	NF50-SWU-5A (50 A frame 5 A)	10 A
MR-JE-70_ (S)/MR-JE-100_ (T)	NF50-SWU-10A (50 A frame 10 A)	15 A
MR-JE-200_ (T)/MR-JE-300_	NF50-SWU-15A (50 A frame 15 A)	30 A
MR-JE-100_ (S)	NF50-SVFU-15A (50 A frame 15 A)	30 A
MR-JE-200_ (S)	NF50-SVFU-20A (50 A frame 20 A)	40 A

Note. "(S)" means 1-phase 200 V AC power input and "(T)" means 3-phase 200 V AC power input in the table.

(c) Power supply

This servo amplifier can be supplied from star-connected supply with grounded neutral point of overvoltage category III set forth in IEC/EN 60664-1. However, when you use the neutral point for single phase supply, a reinforced insulating transformer is required in the power input section. For the interface power supply, use an external 24 V DC power supply with reinforced insulation on I/O terminals.

(d) Grounding

To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the servo amplifier to the protective earth (PE) of the cabinet. Do not connect two grounding cables to the same protective earth (PE) terminal. Always connect cables to the terminals one-to-one.
If using a leakage circuit breaker, always ground the protective earth (PE) terminal of the servo amplifier to prevent an electric shock. This product can cause a d.c. current in the protective earthing conductor. Where a residual current-operated protective (RCD: earth-leakage current breaker) device is used for protection in case of direct or indirect contact, only an RCD of Type B is allowed on the supply side of this product.

(2) EU compliance

The MR-JE servo amplifiers are designed to comply with the following directions to meet requirements for mounting, using, and periodic technical inspections: EMC directive (2004/108/EC), and Low-voltage directive (2006/95/EC).

(a) EMC requirement

MR-JE servo amplifiers comply with category C3 in accordance with IEC/EN 61800-3. Install an EMC filter and surge protector on the primary side of the servo amplifier. As for I/O signal wires (max. length 10 m) and encoder cables (max. length 50 m), use shielded wires and ground the shields. However, when the encoder cable length is longer than 30 m for MR-JE-70_ and MR-JE-100_, set a radio noise filter (FR-BIF) to the input power supply side of the servo amplifier. The following shows recommended products.

EMC filter: Soshin Electric HF3000A-UN series

Surge protector: Okaya Electric Industries RSPD-250-U4 series

Radio noise filter: Mitsubishi Electric FR-BIF

MR-JE Series are not intended to be used on a low-voltage public network which supplies domestic premises; radio frequency interference is expected if used on such a network. The installer shall provide a guide for Installation and use, including recommended mitigation devices.

(b) For Declaration of Conformity (DoC)

Hereby, MITSUBISHI ELECTRIC EUROPE B.V., declares that the servo amplifiers are in compliance with the necessary requirements and standards (2004/108/EC and 2006/95/EC). For the copy of Declaration of Conformity, contact your local sales office.

(3) USA/Canada compliance
This servo amplifier is designed in compliance with UL 508C and CSA C22.2 No.14.

(a) Installation
The minimum cabinet size is 150% of MR-JE servo amplifier's volume. Also, design the cabinet so that the ambient temperature in the cabinet is 55 °C or less. The servo amplifier must be installed in the metal cabinet. Additionally, mount the servo amplifier on a cabinet that the protective earth based on the standard of IEC/EN 60204-1 is correctly connected. For environment, the units should be used in open type (UL 50) and overvoltage category shown in table in section 8.1. The servo amplifier needs to be installed at or below of pollution degree 2. For connection, use copper wires.

(b) Short-circuit current rating (SCCR)
Suitable For Use On A Circuit Capable Of Delivering Not More Than 100 kA rms Symmetrical Amperes, 500 Volts Maximum.

(c) Overload protection characteristics
The MR-JE servo amplifiers have solid-state servo motor overload protection. (It is set on the basis (full load current) of 120% rated current of the servo amplifier.)

(d) Over-temperature protection for motor
Motor Over temperature sensing is not provided by the drive.
Integral thermal protection(s) is necessary for motor and refer to appendix. 4.3 for the proper connection.

(e) Branch circuit protection
For installation in United States, branch circuit protection must be provided, in accordance with the National Electrical Code and any applicable local codes.
For installation in Canada, branch circuit protection must be provided, in accordance with the Canada Electrical Code and any applicable provincial codes.

(4) South Korea compliance
This product complies with the Radio Wave Law (KC mark). Please note the following to use the product.
이 기기는 업무용 (A급) 전자파적합기기로서 판 매자 또는 사용자는 이 점을 주의하시기 바라며,
가정외의 지역에서 사용하는 것을 목적으 로 합니다.
(The product is for business use (Class A) and meets the electromagnetic compatibility requirements. The seller and the user must note the above point, and use the product in a place except for home.)

App. 2.1.4 General cautions for safety protection and protective measures

Observe the following items to ensure proper use of the MELSERVO MR-JE servo amplifiers.

(1) For installing systems, only qualified personnel and professional engineers should perform.

(2) When mounting, installing, and using the MR-JE servo amplifier, always observe standards and directives applicable in the country.

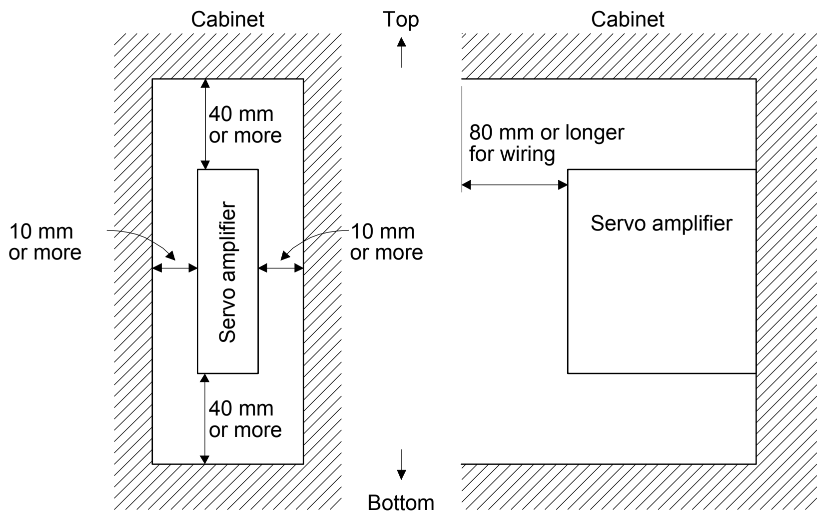
App. 2.1.5 Disposal

Disposal of unusable or irreparable devices should always occur in accordance with the applicable country-specific waste disposal regulations. (Example: European Waste 16 02 14)

App. 2.2 Mounting/dismounting

Installation direction and clearances

⚠CAUTION	●The devices must be installed in the specified direction. Not doing so may cause a malfunction. ●Mount the servo amplifier on a cabinet which meets IP54 in the correct vertical direction to maintain pollution degree 2.



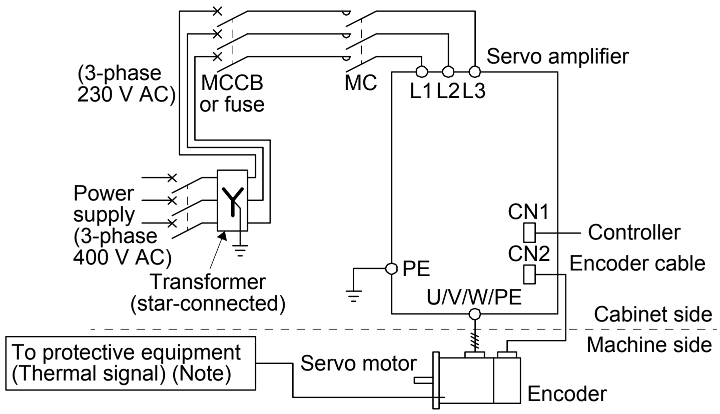
App. 2.3 Electrical Installation and configuration diagram

⚠WARNING	●Turn off the molded-case circuit breaker (MCCB) to avoid electrical shocks or damages to the product before starting the installation or wiring.

⚠CAUTION	●Connecting a servo motor for different axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.

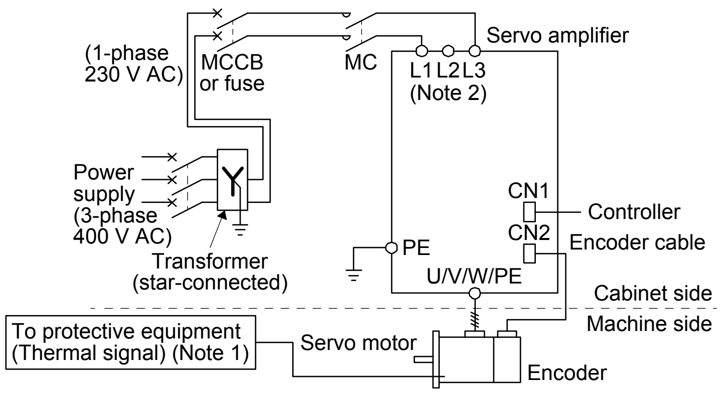
The following shows representative configuration examples to conform to the IEC/EN/UL/CSA standards.

(1) 3-phase input



Note. Please use a thermal sensor, etc. for thermal protection of the servo motor.

(2) 1-phase input



Note 1. Please use a thermal sensor, etc. for thermal protection of the servo motor.
2. For the MR-JE-200_ servo amplifiers, connect the power supply to L1 and L2. Leave L3 open.

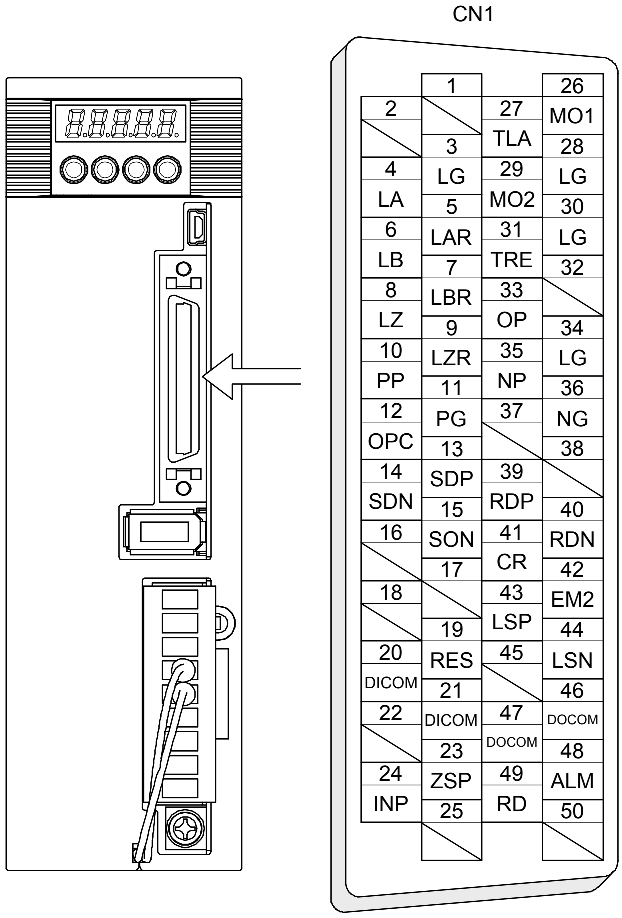
The control circuit connectors described by rectangles are safely separated from the main circuits described by circles.
The connected motors will be limited as follows.

HG-KN/HG-SN series servo motors (Mfg.: Mitsubishi Electric)

App. 2.4 Signals

App. 2.4.1 Signal

The following shows CN1 connector signals of MR-JE-10A as a typical example.



This is in position control mode.

App. 2.4.2 I/O device

The following shows typical I/O devices of MR-JE-_A. For the other devices, refer to each servo amplifier instruction manual.

Input device

Symbol	Device	Connector	Pin No.
SON	Servo-on	CN1	15
RES	Reset		19
CR	Clear		41
EM2	Forced stop 2		42
LSP	Forward rotation stroke end		43
LSN	Reverse rotation stroke end		44

Output device

Symbol	Device	Connector	Pin No.
ZSP	Zero speed detection	CN1	23
INP	In-position		24
ALM	Malfunction		48
RD	Ready		49

Power supply

Symbol	Device	Connector	Pin No.
DICOM	Digital I/F power supply input	CN1	20, 21
DOCOM	Digital I/F common		46, 47
SD	Shield		Plate

App. 2.5 Maintenance and service

WARNING	●To avoid an electric shock, only qualified personnel should attempt inspections. For repair and parts replacement, contact your local sales office.

App. 2.5.1 Inspection items

It is recommended that the following points periodically be checked.

(1) Check for loose screws on the protective earth (PE) terminal. Retighten any loose screws. (tightening torque: 1.2 N•m)

(2) Servo motor bearings, brake section, etc. for unusual noise.

(3) Check the cables and the like for scratches or cracks. Perform periodic inspection according to operating conditions.

(4) Check that the connectors are securely connected to the servo motor.

(5) Check that the wires are not coming out from the connector.

(6) Check for dust accumulation on the servo amplifier.

(7) Check for unusual noise generated from the servo amplifier.

(8) Check the servo motor shaft and coupling for connection.

App. 2.5.2 Parts having service lives

Service lives of the following parts are listed below. However, the service lives vary depending on operation and environment. If any fault is found in the parts, they must be replaced immediately regardless of their service lives. For parts replacement, please contact your local sales office.

Part name	Life guideline
Smoothing capacitor	(Note) 10 years
Relay	Number of power-on, forced stop, and controller forced stop times: 100 000 times
Cooling fan	50,000 hours to 70,000 hours (7 years to 8 years)

Note. The characteristic of smoothing capacitor is deteriorated due to ripple currents, etc. The life of the capacitor greatly depends on ambient temperature and operating conditions. The capacitor will reach the end of its life in 10 years of continuous operation in normal air-conditioned environment (40 °C surrounding air temperature or less).

App. 2.6 Transportation and storage

⚠CAUTION

- Transport the products correctly according to their mass.
- Stacking in excess of the limited number of product packages is not allowed.
- Install the product in a load-bearing place of servo amplifier and servo motor in accordance with instruction manual.
- Do not get on or put heavy load on the equipment.
- Do not hold the lead of the built-in regenerative resistor when carrying the servo amplifier.

When you keep or use it, please fulfill the following environment.

Item		Environment
Ambient temperature	Operation [°C]	0 to 55 Class 3K3 (IEC/EN 60721-3-3)
	Transportation (Note) [°C]	-20 to 65 Class 2K4 (IEC/EN 60721-3-2)
	Storage (Note) [°C]	-20 to 65 Class 1K4 (IEC/EN 60721-3-1)
Ambient humidity	Operation, transportation, storage	5 %RH to 90 %RH
Vibration resistance	Test condition	10 Hz to 57 Hz with constant amplitude of 0.075 mm 57 Hz to 150 Hz with constant acceleration of 9.8 m/s^2 to IEC/EN 61800-5-1 (Test Fc of IEC 60068-2-6)
	Operation	5.9 m/s^2
	Transportation (Note)	Class 2M3 (IEC/EN 60721-3-2)
	Storage	Class 1M2 (IEC/EN 60721-3-2)
Pollution degree		2
IP rating		IP20 (IEC/EN 60529)
		Open type (UL 50)
Altitude	Operation, storage	Max. 1000 m above sea level
	Transportation	Max. 10000 m above sea level

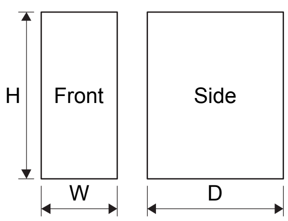
Note. In regular transport packaging

App. 2.7 Technical data

App. 2.7.1 MR-JE servo amplifier

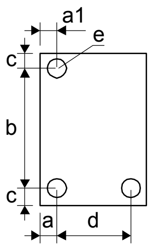
Item		MR-JE-10_/MR-JE-20_/MR-JE-40_/ MR-JE-70_/MR-JE-100_/MR-JE-200_	MR-JE-300_
Power supply	Line voltage	3-phase or 1-phase 200 V AC to 240 V AC, 50 Hz /60 Hz	3-phase 200 V AC to 240 V AC, 50 Hz/60 Hz
	Interface (SELV)	24 V DC, (required current capacity: MR-JE-_A, 300 mA; MR-JE-_B, 100 mA)	
Control method		Sine-wave PWM control, current control method	
Pollution degree		2 (IEC/EN 60664-1)	
Overvoltage category		1-phase 200 V AC: II (IEC/EN 60664-1), 3-phase 200 V AC: III (IEC/EN 60664-1)	
Protective class		I (IEC/EN 61800-5-1)	
Short-circuit current rating (SCCR)		100 kA	

App. 2.7.2 Servo amplifier dimensions



Servo amplifier	Variable dimension table [mm]			Mass [kg]
	W	H	D	
MR-JE-10_/MR-JE-20_/MR-JE-40_	50	168	135	0.8
MR-JE-70_/MR-JE-100_	70	168	185	1.5
MR-JE-200_/MR-JE-300_	90	168	195	2.1

App. 2.7.3 Mounting hole



Servo amplifier	Variable dimensions [mm]					Screw size
	a	a1	b	c	d	e
MR-JE-10_/MR-JE-20_/MR-JE-40_	6	6	156 ± 0.5	6		M5
MR-JE-70_/MR-JE-100_	22	22	156 ± 0.5	6	42 ± 0.3	M5
MR-JE-200_/MR-JE-300_	6	45	156 ± 0.5	6	78 ± 0.3	M5

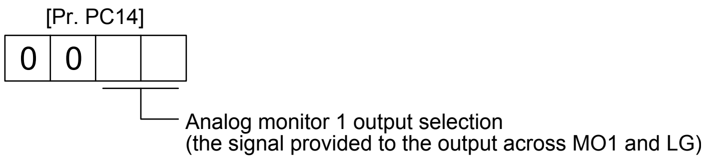
App. 3 Analog monitor

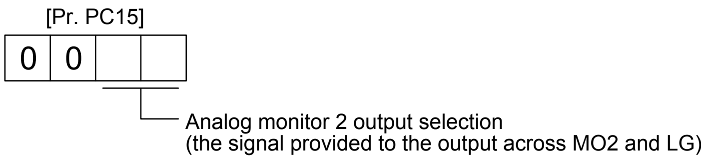
POINT
●A voltage of analog monitor output may be irregular at power-on.

The servo status can be outputted to two channels in terms of voltage.

(1) Setting

Change the following digits of [Pr. PC14] and [Pr. PC15].





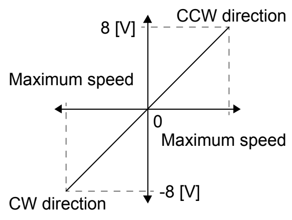
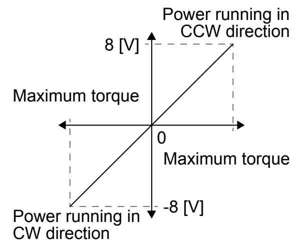
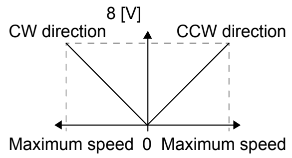
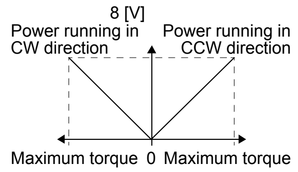
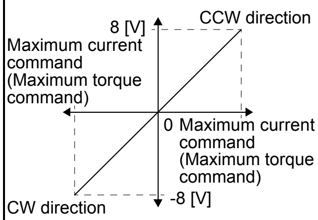
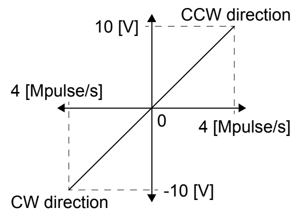
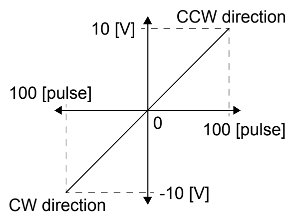
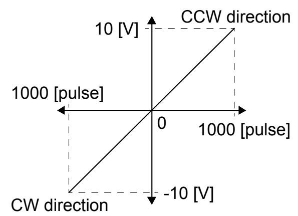
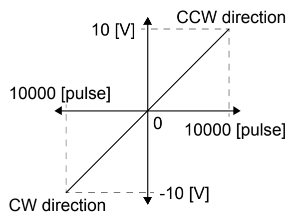
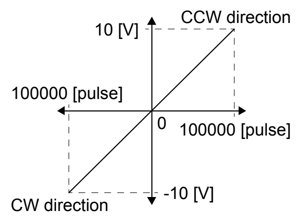
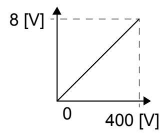
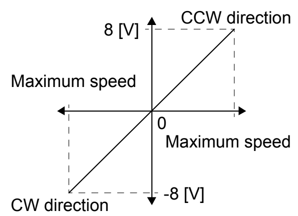
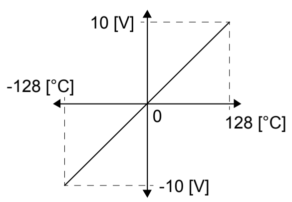
[Pr. PC39] and [Pr. PC40] can be used to set the offset voltages to the analog output voltages. Setting value is -9999 mV to 9999 mV.

Parameter	Description	Setting range [mV]
PC39	Set the offset voltage of MO1 (Analog monitor 1).	-9999 to 9999
PC40	Set the offset voltage of MO2 (Analog monitor 2).	

(2) Setting

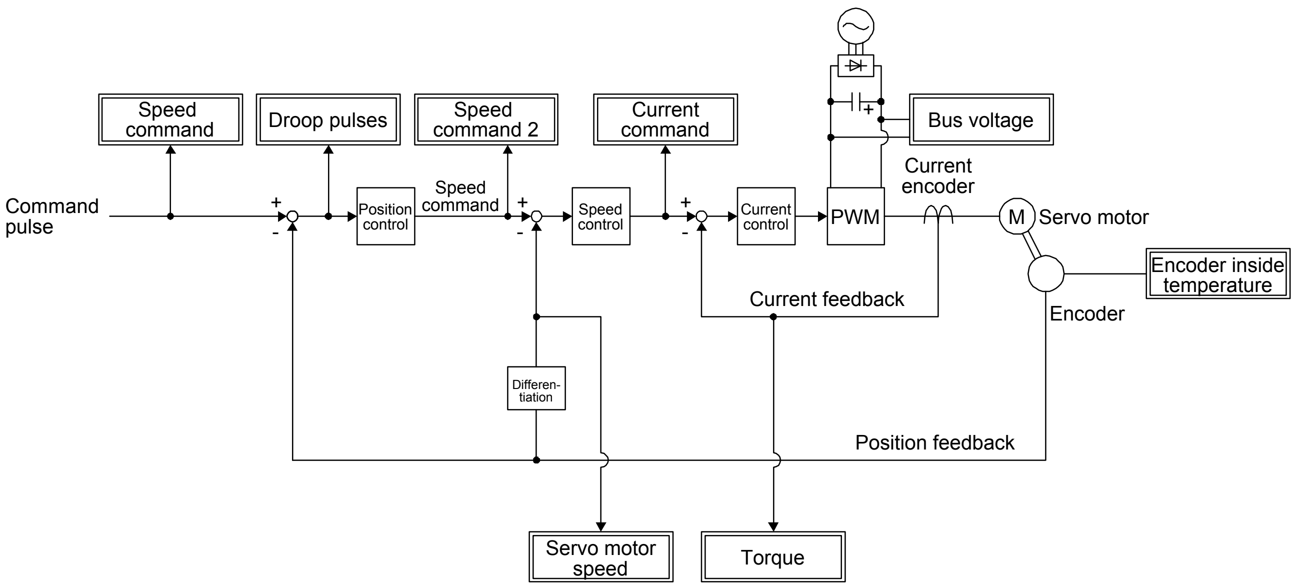
The servo amplifier is factory-set to output the servo motor speed to MO1 (Analog monitor 1) and the torque to MO2 (Analog monitor 2). The setting can be changed as listed below by setting the [Pr. PC14] and [Pr. PC15] value.

Refer to (3) for the detection point.

Setting value	Output item	Description	Setting value	Output item	Description
00	Servo motor speed (Note 4)		01	Torque	
02	Servo motor speed (Note 4)		03	Torque	
04	Current command		05	The command pulse frequency (±10 V/±4 Mpulses/s)	
06	Servo motor-side droop pulses (Note 1, 2, 3) (±10 V/100 pulses)		07	Servo motor-side droop pulses (Note 1, 2, 3) (±10 V/1000 pulses)	
08	Servo motor-side droop pulses (Note 1, 2, 3) (±10 V/10000 pulses)		09	Servo motor-side droop pulses (Note 1, 2, 3) (±10 V/100000 pulses)	
0D	Bus voltage		0E	Speed command 2 (Note 2, 4)	
17	Encoder inside temperature (±10 V/±128 ˚C)				

Note 1. Encoder pulse unit
2. This cannot be used in the torque control mode.
3. This cannot be used in the speed control mode.
4. The maximum speed of the HF-KN series servo motor is 4500 r/min and that of the HG-KN series is 5000 r/min. Please watch out when using an HG-KN series servo motor as a replacement for the HF-KN series servo motor because HG-KN series output 8 V at 5000 r/min.

(3) Analog monitor block diagram



App. 4 Low-voltage directive

MR-JE series servo amplifiers are certificated in compliance with Low-voltage directive. The following shows a certificate by the Certification Body.

Zertifikat ***Certificate***

TÜVRheinland®

Zertifikat Nr. ***Certificate No.*** R 50244051

Blatt ***Page*** 0001

Ihr Zeichen *Client Reference*	Unser Zeichen *Our Reference*	Ausstellungsdatum *Date of Issue (day/mo/yr)*
T.E.	ZO-HIM- 12311510 001	11.01.2013

Genehmigungsinhaber ***License Holder***
Mitsubishi Electric Corp.
Nagoya Works
1-14, Yada-minami 5-chome
Higashi-ku, Nagoya-shi, Aichi
461-8670 JAPAN

Fertigungsstätte Manufacturing Plant
Mitsubishi Electric Corp.
Nagoya Works
1-14, Yada-minami 5-chome
Higashi-ku, Nagoya-shi, Aichi
461-8670 JAPAN

Prüfzeichen ***Test Mark***

TÜVRheinland CERTIFIED
Type Approved
Safety
Regular
Production
Surveillance
www.tuv.com
ID 2000000000

Geprüft nach ***Tested acc. to***
EN 61800-5-1:2007
IEC 61800-5-1:2007

Zertifiziertes Produkt (Geräteidentifikation)
Certified Product (Product Identification)

Lizenzentgelte - Einheit
License Fee - Unit

Control Unit Servo Drive Unit

```
Type Designation     :  MR-JE-uvw-xyz                              5
                        u, v, w, x, y, z = (see Appendix 1)        6

Rated Voltage        :  3AC 200-240V, 50/60Hz or
                        AC 200-240V, 50/60Hz
Rated Current        :  (see Appendix 1)
Protection Class     :  I
Rated Output Values  :  3AC 170V 360Hz
Ambient Temperature  :  0°C to 55°C
Overvoltage Category:   III (3AC200-240V) or II (AC200-240V)
Pollution Degree     :  2

Remark:  Power circuits and secondary control circuits
         provide protective separation.
         The unit must be installed in accordance with
         the manufacturer's instructions.
                                                                    11
```

ANLAGE (Appendix): 1

Dem Zertifikat liegt unsere Prüf- und Zertifizierungsordnung zugrunde und es bestätigt die Konformität des Produktes mit den oben genannten Standards und Prüfgrundlagen. Zusätzliche Anforderungen in Ländern, in denen das Produkt in Verkehr gebracht werden soll, müssen zusätzlich betrachtet werden. Die Herstellung des zertifizierten Produktes wird überwacht.
This certificate is based on our Testing and Certification Regulation and states the conformity of the product with the standards and testing requirements as indicated above. Any additional requirements in countries where the product is going to be marketed have to be considered additionally. The manufacturing of the certified product is subject to surveillance.

TÜV Rheinland LGA Products GmbH Zertifizierungsstelle

Zertifizierungsstelle

Dipl.-Ing. (FH) M. Geiser

TÜV Rheinland LGA Products GmbH - Tillystraße 2 - 90431 Nürnberg
Tel.: (+49/221)8 06 - 13 71 e-mail: cert-validity@de.tuv.com
Fax: (+49/221)8 06 - 39 35 http://www.tuv.com/safety

Supplementation: Refer to section 1.6 (2) for the models shown in "(see Appendix 1)".

App. 5 Using HF-KN series and HF-SN series servo motors

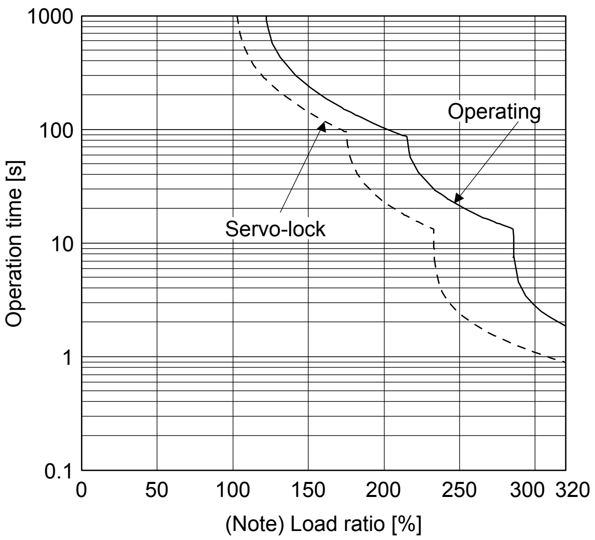
> POINT
>
> ●For HF-KN series and HF-SN series servo motors, refer to "HF-KN/HF-SN Servo Motor Instruction Manual" (SH(NA)030123).

App.5.1 Combinations of servo amplifiers and servo motors

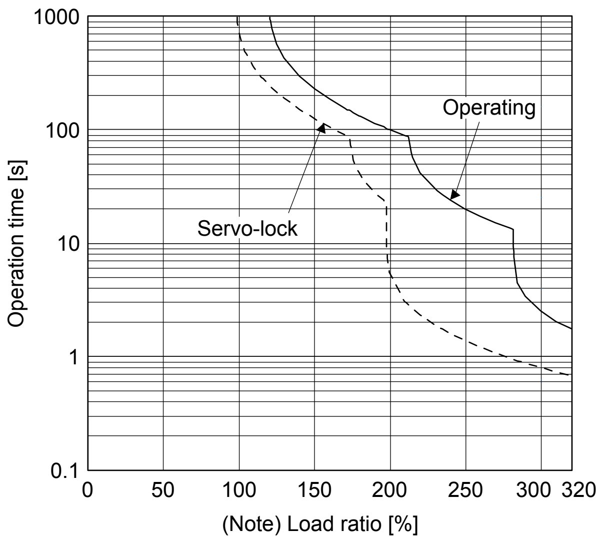
Servo amplifier	Servo motor
MR-JE-10A	HF-KN13_
MR-JE-20A	HF-KN23_
MR-JE-40A	HF-KN43_
MR-JE-70A	HF-KN73_ HF-SN52_
MR-JE-100A	HF-SN102_
MR-JE-200A	HF-SN152_ HF-SN202_
MR-JE-300A	HF-SN302_

App.5.2 Characteristics

App.5.2.1 Overload protection characteristics



HF-KN13_, HF-KN23_, HF-KN43_
HF-KN73_, HF-SN52_, HF-SN102_



HF-SN152_, HF-SN202_, HF-SN302_

Note. If operation that generates torque more than 100% of the rating is performed with an abnormally high frequency in a servo motor stop status (servo-lock status) or in a 30 r/min or less low-speed operation status, the servo amplifier may malfunction regardless of the electronic thermal protection.

App.5.2.2 Power supply capacity and generated loss

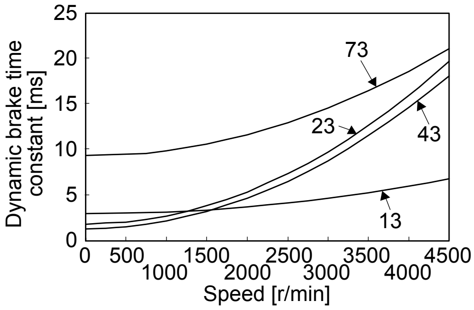
Servo amplifier	Servo motor	(Note 1) Power supply capacity [kVA]	(Note 2) Servo amplifier-generated heat [W]		Area required for heat dissipation [m^2]
			At rated output	With servo-off	
MR-JE-10A	HF-KN13_	0.3	25	15	0.5
MR-JE-20A	HF-KN23_	0.5	25	15	0.5
MR-JE-40A	HF-KN43_	0.9	35	15	0.7
MR-JE-70A	HF-KN73_	1.3	50	15	1.0
	HF-SN52_	1.0	40	15	0.8
MR-JE-100A	HF-SN102_	1.7	50	15	1.0
MR-JE-200A	HF-SN152_	2.5	90	20	1.8
	HF-SN202_	3.5			
MR-JE-300A	HF-SN302_	4.8	120	20	2.4

Note 1. Note that the power supply capacity will vary according to the power supply impedance. This value is applicable when the power factor improving AC reactor is not used.

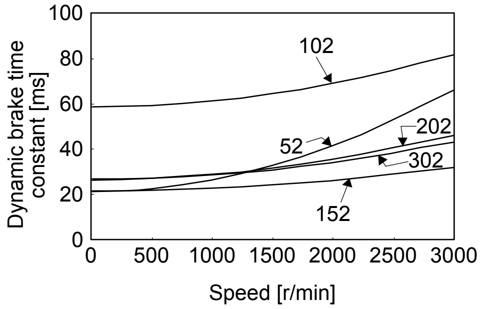
2. Heat generated during regeneration is not included in the servo amplifier-generated heat. To calculate heat generated by the regenerative option, refer to section 11.2.

App.5.2.3 Dynamic brake characteristics

(1) Dynamic brake time constant



HF-KN series



HF-SN series

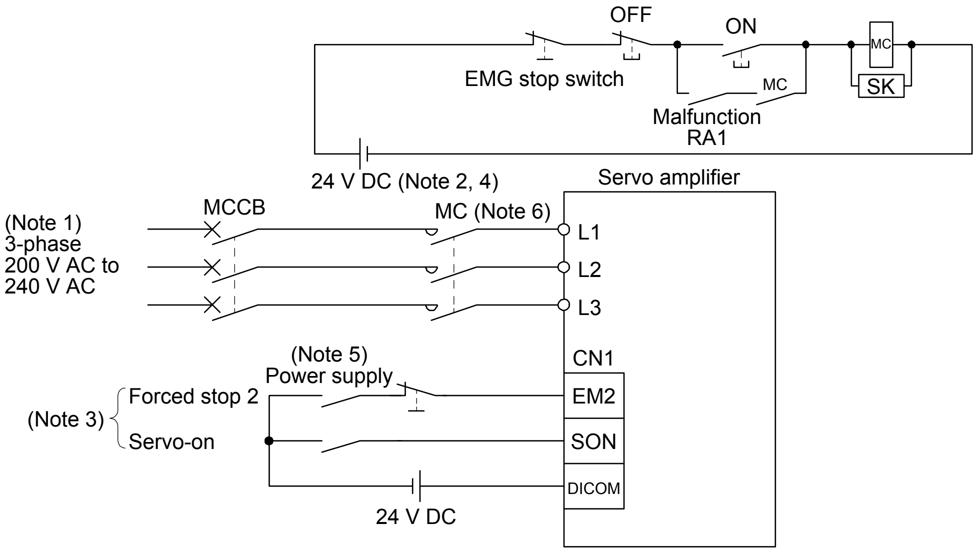
(2) Permissible load to motor inertia when the dynamic brake is used

Servo motor	Permissible load to motor inertia ratio [multiplier]
HF-KN13_	30
HF-KN23_	
HF-KN43_	
HF-KN73_	
HF-SN52_	
HF-SN102_	
HF-SN152_	
HF-SN202_	
HF-SN302_	16

App. 6 When turning on or off the input power supply with DC power supply

App. 6.1 Connection example

For the signals or wiring that are not described in this section, refer to section 3.1.



Note 1. When using a power supply of 1-phase 200 V AC to 240 V AC for MR-JE-10A to MR-JE-100A, connect the power supply to L1 and L3. Leave L2 open. When using a power supply of 1-phase 200 V AC to 240 V AC for MR-JE-200A, connect the power supply to L1 and L2. Leave L3 open. MR-JE-300A cannot be used with 1-phase 200 V AC to 240 V AC power supply.

2. Do not use the 24 V DC interface power supply for magnetic contactor. Always use the power supply designed exclusively for the magnetic contactor.
3. This is for the sink I/O interface. For source I/O interface, refer to section 3.9.3.
4. Controlling the on switch or off switch with DC power supply satisfies the requirements of IEC/EN 60204-1.
5. Configure a circuit to turn off EM2 when the power is turned off to prevent an unexpected restart of the servo amplifier.
6. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. Depending on the power supply voltage and operation pattern, bus voltage can decrease. This can shift the mode to the dynamic brake deceleration during forced stop deceleration. When dynamic brake deceleration is not required, delay the time to turn off the magnetic contactor.

App. 6.2 Magnetic contactor

Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less.

Servo amplifier	Magnetic contactor
MR-JE-10A	SD-N11
MR-JE-20A	
MR-JE-40A	
MR-JE-70A	
MR-JE-100A	
MR-JE-200A	SD-N21
MR-JE-300A	

REVISIONS

*The manual number is given on the bottom left of the back cover.

Print Data	*Manual Number	Revision	
May. 2013	SH(NA)030128-A	First edition	
Jul. 2013	SH(NA)030128-B	4. Additional instructions (3) Transportation and installation	Partially changed.
		Section 1.3	Partially changed.
		Section 1.6	Partially changed.
		Chapter 2	CAUTION is partially changed.
		Chapter 3	CAUTION is partially changed.
		Section 3.2.1	Partially changed.
		Section 3.4	Partially changed.
		Section 3.5	Partially changed.
		Section 3.6.1	Partially changed.
		Section 3.9.1	Partially changed.
		Section 3.9.2	Partially changed.
		Section 3.9.3	Partially deleted.
		Section 5.2.1	Partially added and partially changed in Pr. PA13.
		Section 11.3	Partially changed.
		Section 11.6	Partially changed.
		App. 2	Partially changed.
Jan. 2014	SH(NA)030128-C	RS-422 function is added.	
		Section 1.2	The diagram is partially changed.
		Section 1.3	Partially changed.
		Section 1.5	Added.
		Section 1.7.1	Partially changed.
		Section 3.2.1	Note is added.
		Section 3.2.2	Note is added.
		Section 3.2.3	Note is added.
		Section 3.3.2	Partially changed.
		Section 3.4	The table is partially changed.
		Section 3.5	RS-422 communication is added.
		Section 3.9.1	The diagram is partially changed.
		Section 3.10.1	Partially changed.
		Section 3.10.2	Partially changed.
		Section 5.1.3	PC20 and PC21 are added.
		Section 5.2.1	Partially changed.
		Section 6.2	POINT is added.
		Section 7.1.1	Partially changed.
		Section 7.1.3	Partially changed.
		Section 7.1.4	The sentence is added.
		Section 7.2.3	Partially changed.
		Section 7.3	The sentence is added.
		Chapter 8	POINT is added.
		Section 8.1	Partially changed.
		Section 8.2	POINT is added. Partially changed.
		Section 8.3	POINT is added.
		Section 11.3	The diagram is partially changed.
		Section 11.4.1	Partially changed.
		Section 11.4.2	Partially changed.
		Section 11.4.3	Added.
		Section 11.6	The table is changed.
		Section 11.9	Partially changed.
		Section 11.11	Partially changed.

Print Data	*Manual Number	Revision	
Jan. 2014	SH(NA)030128-C	Chapter 12	Added.
		App. 2.1.3	Partially changed.
		App. 2.1.4	Partially changed.
		App. 2.7.1	Partially changed.
Oct. 2014	SH(NA)030128-D	Compatible with HG-KN series/HG-SN series servo motors	
		Safety Instructions	
		2.To prevent fire, note the following	Partially changed.
		4. Additional instructions	Partially changed.
		(6) Maintenance, inspection and parts replacement	Partially added.
		«About the manual»	Partially changed.
		Section 1.3	Note 5 is added.
		Section 1.4	Servo motor series are changed to HG-KN/HG-SN.
		Section 1.6	Partially changed.
		Section 3.1	Partially changed.
		Section 3.2.1 (1)	Partially changed.
		Section 3.2.1 (2)	Partially changed.
		Section 3.2.2	Partially changed.
		Section 3.2.3	Partially changed.
		Section 3.3.3	Partially added.
		Section 3.10.1	CAUTION is partially added. POINT is partially changed.
		Section 3.10.2	Partially changed.
		Section 4.5.4	Partially changed.
		Section 4.5.5	Partially changed.
		Section 5.2.3	[Pr. PC14] is partially changed.
		Section 7.1.1	Partially changed.
		Section 7.1.3	POINT is added.
		Section 7.1.5	Partially added and partially changed.
		Section 7.2.3	Partially changed.
		Section 7.2.4	Partially changed.
		Section 7.3.1	Partially changed.
		Chapter 8	POINT is partially added.
		Section 8.2	Partially changed.
		Section 8.3	POINT is partially changed.
		Section 10.3	POINT is partially added.
		Section 10.3.1	Partially changed.
		Section 10.3.2	Partially changed.
		Section 10.5	POINT is added.
		Section 11.1.1	Partially changed.
		Section 11.4.2	Partially changed.
		Section 11.5	Partially changed.
		Section 11.6	CAUTION is newly added.
		Section 11.10	Partially changed.
		Section 12.1.1	Partially changed.
		App. 1	Partially changed.
		App. 2	Partially changed.
		App. 3	Partially added.
		App. 5	Newly added.
Apr. 2015	SH(NA)030128-E	1-phase 200 V AC (to 2 kW) is added.	
		Source pulse input is added.	
		RS-422 is changed to RS-422/RS-485.	
		1. To prevent electric shock, note the following.	An item is deleted.

Print Data	*Manual Number	Revision	
Apr. 2015	SH(NA)030128-E	2. To prevent fire, note the following.	The content is changed.
		4. Additional instructions	The sentences are changed.
		4. Additional instructions (6) General instruction	An item is added.
		Relevant manuals	The content is added.
		Section 1.3	The content of the table is changed and added. Note is added.
		Section 1.4	The content of the table is changed.
		Section 1.5	The content of the table is changed and added.
		Section 1.6 (1)	The diagram is changed.
		Section 2.1 (2)	The content of POINT is changed.
		Section 3.1	CAUTION is added. The content of POINT is changed.
		Section 3.1 (1)	The diagram is changed.
		Section 3.1 (2)	The content of POINT is changed.
		Section 3.1 (3)	The title is changed.
		Section 3.1 (4)	Newly added.
		Section 3.2.2 (1)	The diagram is changed. Note is deleted.
		Section 3.2.2 (2)	The diagram is changed.
		Section 3.2.3 (1)	The diagram is changed. Note is deleted.
		Section 3.2.3 (2)	The diagram is changed.
		Section 3.3.1	The content of the table is changed.
		Section 3.3.3 (2) (a)	The sentences are changed.
		Section 3.4	The content of the table is changed. Note is added. POINT is added.
		Section 3.5 (2)	The content of the table is changed.
		Section 3.5 (4)	The title is changed.
		Section 3.6.1 (1) (b) 1)	The diagram is changed.
		Section 3.9.1	The diagram is changed. The diagram of Note 2 is changed.
		Section 3.9.2	The diagram is added.
		Section 3.9.3 (1)	The diagram is added.
		Section 3.9.3 (3)	Newly added.
		Section 3.10.1	The sentences of CAUTION are changed.
		Section 4.5.4	The table is changed.
		Section 4.5.7 (2)	The diagram is changed. Note is added.
		Section 4.5.7 (2) (a)	The content of the table is changed.
		Section 5.1	Sentences of POINT is changed. Note is added.
		Section 5.1.3	[Pr. PC73] is added.
		Section 5.1.4	[Pr. PD43] to [Pr. PD46] are added.
		Section 5.1.6	The name of [Pr. PF25] is changed.
		Section 5.2.1	The sentences of [Pr. PA20] and [Pr. PA26] are changed.
		Section 5.2.2	The contents of [Pr. PB25] and [Pr. PB26] are changed.
		Section 5.2.3	[Pr. PC27] and [Pr. PC73] are added. Sentences of [Pr. PC43] is changed. The content of [Pr. PC60] is added.
		Section 5.2.4	[Pr. PD43] to [Pr. PC46] are added.
		Section 5.2.6	[Pr. PF09] is added. The content of [Pr. PF25] is changed.
		Section 7.2.3 (1) (a)	The diagram is changed.
		Section 7.2.4 (3)	Newly added.
		Section 7.3.2	Sentences are changed. Sentences of POINT are changed.
		Section 7.4	Newly added.
		Chapter 8	The content is changed.
		Section 10.1	The sentences are changed.
		Section 11.2.4 (1)	The diagram is changed. Note is added.
		Section 11.4.2 (1)	The content is changed.
		Section 11.5	The content of table 11.1 is changed.
		Section 11.6	CAUTION is added. Table is changed. Note is added. The sentences are deleted.

Print Data	*Manual Number	Revision	
Apr. 2015	SH(NA)030128-E	Section 11.7 (1)	The diagram is changed.
		Section 11.7 (2)	The table is changed.
		Section 11.11 (2)	The diagram is changed.
		App. 2	The content is changed.
		App. 5	POINT is added.
		App. 6	Newly added.

MEMO

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Warranty

1. Warranty period and coverage

We will repair any failure or defect hereinafter referred to as "failure" in our FA equipment hereinafter referred to as the "Product" arisen during warranty period at no charge due to causes for which we are responsible through the distributor from which you purchased the Product or our service provider. However, we will charge the actual cost of dispatching our engineer for an on-site repair work on request by customer in Japan or overseas countries. We are not responsible for any on-site readjustment and/or trial run that may be required after a defective unit are repaired or replaced.

[Term]

The term of warranty for Product is twelve (12) months after your purchase or delivery of the Product to a place designated by you or eighteen (18) months from the date of manufacture whichever comes first ("Warranty Period"). Warranty period for repaired Product cannot exceed beyond the original warranty period before any repair work.

[Limitations]

(1) You are requested to conduct an initial failure diagnosis by yourself, as a general rule.
It can also be carried out by us or our service company upon your request and the actual cost will be charged. However, it will not be charged if we are responsible for the cause of the failure.

(2) This limited warranty applies only when the condition, method, environment, etc. of use are in compliance with the terms and conditions and instructions that are set forth in the instruction manual and user manual for the Product and the caution label affixed to the Product.

(3) Even during the term of warranty, the repair cost will be charged on you in the following cases;
- (i) a failure caused by your improper storing or handling, carelessness or negligence, etc., and a failure caused by your hardware or software problem
- (ii) a failure caused by any alteration, etc. to the Product made on your side without our approval
- (iii) a failure which may be regarded as avoidable, if your equipment in which the Product is incorporated is equipped with a safety device required by applicable laws and has any function or structure considered to be indispensable according to a common sense in the industry
- (iv) a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
- (v) any replacement of consumable parts (battery, fan, smoothing capacitor, etc.)
- (vi) a failure caused by external factors such as inevitable accidents, including without limitation fire and abnormal fluctuation of voltage, and acts of God, including without limitation earthquake, lightning and natural disasters
- (vii) a failure generated by an unforeseeable cause with a scientific technology that was not available at the time of the shipment of the Product from our company
- (viii) any other failures which we are not responsible for or which you acknowledge we are not responsible for

2. Term of warranty after the stop of production

(1) We may accept the repair at charge for another seven (7) years after the production of the product is discontinued. The announcement of the stop of production for each model can be seen in our Sales and Service, etc.

(2) Please note that the Product (including its spare parts) cannot be ordered after its stop of production.

3. Service in overseas countries

Our regional FA Center in overseas countries will accept the repair work of the Product. However, the terms and conditions of the repair work may differ depending on each FA Center. Please ask your local FA center for details.

4. Exclusion of responsibility for compensation against loss of opportunity, secondary loss, etc.

Whether under or after the term of warranty, we assume no responsibility for any damages arisen from causes for which we are not responsible, any losses of opportunity and/or profit incurred by you due to a failure of the Product, any damages, secondary damages or compensation for accidents arisen under a specific circumstance that are foreseen or unforeseen by our company, any damages to products other than the Product, and also compensation for any replacement work, readjustment, start-up test run of local machines and the Product and any other operations conducted by you.

5. Change of Product specifications

Specifications listed in our catalogs, manuals or technical documents may be changed without notice.

6. Application and use of the Product

(1) For the use of our General-Purpose AC Servo, its applications should be those that may not result in a serious damage even if any failure or malfunction occurs in General-Purpose AC Servo, and a backup or fail-safe function should operate on an external system to General-Purpose AC Servo when any failure or malfunction occurs.

(2) Our General-Purpose AC Servo is designed and manufactured as a general purpose product for use at general industries.
Therefore, applications substantially influential on the public interest for such as atomic power plants and other power plants of electric power companies, and also which require a special quality assurance system, including applications for railway companies and government or public offices are not recommended, and we assume no responsibility for any failure caused by these applications when used
In addition, applications which may be substantially influential to human lives or properties for such as airlines, medical treatments, railway service, incineration and fuel systems, man-operated material handling equipment, entertainment machines, safety machines, etc. are not recommended, and we assume no responsibility for any failure caused by these applications when used.
We will review the acceptability of the abovementioned applications, if you agree not to require a specific quality for a specific application. Please contact us for consultation.

MODEL	MR-JE-A SERVOAMPLIFIER INSTRUCTIONMANUAL
MODEL CODE	1CW706

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