

General-Purpose AC Servo

MITSUBISHI SERVO AMPLIFIERS & MOTORS
MELSERVO-J4

General-Purpose Interface AC Servo
MODEL

MR-J4- _A(-RJ)

SERVO AMPLIFIER
INSTRUCTION MANUAL

● 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".




Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.




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. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. 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.
- During power-on or operation, do not open the front cover of the servo amplifier. Otherwise, it may cause an electric shock.
- Do not operate the servo amplifier with the front cover removed. High-voltage terminals and charging area are exposed and you may get an electric shock.
- Except for wiring and periodic inspection, do not remove the front cover of the servo amplifier even if the power is off. The servo amplifier is charged and you may get an electric shock.
- To prevent an electric shock, always connect the protective earth (PE) terminal (marked \oplus) of the servo amplifier to the protective earth (PE) of the cabinet.
- When using a residual current device (RCD), select the type B.
- 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 it directly or close to combustibles will lead to a fire.
- Always connect a magnetic contactor 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 magnetic contactor is not connected, continuous flow of a large current may cause a fire when the servo amplifier malfunctions.
- When using the regenerative resistor, switch power off with the alarm signal. Not doing so may cause a fire when a regenerative transistor malfunctions or the like may overheat the regenerative resistor.
- Provide adequate protection to prevent screws and other conductive matter, oil and other combustible matter from entering the servo amplifier and servo motor.
- Always connect a molded-case circuit breaker to the power supply of the servo amplifier.


3. To prevent injury, note the following

 CAUTION	
<ul style="list-style-type: none"> ● 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 prevent accidental contact of hands and parts (cables, etc.) with them. 	

4. Additional instructions

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

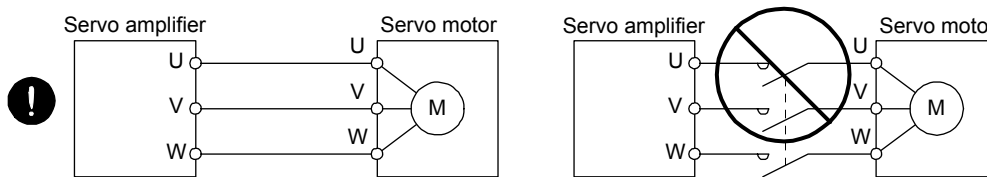
(1) Transportation and installation

 CAUTION																						
<ul style="list-style-type: none"> ● 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 front cover when transporting the servo amplifier. Otherwise, it may drop. ● 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. 																						
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: center;">Items</th> <th style="text-align: center;">Environment</th> </tr> </thead> <tbody> <tr> <td rowspan="2" style="text-align: center;">Ambient temperature</td> <td style="text-align: center;">Operation</td> <td style="text-align: center;">0 °C to 55 °C (non-freezing)</td> </tr> <tr> <td style="text-align: center;">Storage</td> <td style="text-align: center;">-20 °C to 65 °C (non-freezing)</td> </tr> <tr> <td rowspan="2" style="text-align: center;">Ambient humidity</td> <td style="text-align: center;">Operation</td> <td rowspan="2" style="text-align: center;">90 %RH or less (non-condensing)</td> </tr> <tr> <td style="text-align: center;">Storage</td> </tr> <tr> <td colspan="2" style="text-align: center;">Ambience</td> <td style="text-align: center;">Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, and dirt</td> </tr> <tr> <td colspan="2" style="text-align: center;">Altitude</td> <td style="text-align: center;">Max. 1000 m above sea level</td> </tr> <tr> <td colspan="2" style="text-align: center;">Vibration resistance</td> <td style="text-align: center;">5.9 m/s² at 10 Hz to 55 Hz (directions of X, Y, and Z axes)</td> </tr> </tbody> </table>		Items		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		Max. 1000 m above sea level	Vibration resistance		5.9 m/s ² at 10 Hz to 55 Hz (directions of X, Y, and Z axes)
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<ul style="list-style-type: none"> ● When the equipment has been stored for an extended period of time, consult 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 the metal cabinet. ● When you disinfect or protect wooden packing from insects, take measures except by fumigation. Fumigating the servo amplifier or packing the servo amplifier with fumigated wooden packing can cause a malfunction of the servo amplifier due to halogen materials (such as fluorine, chlorine, bromine, and iodine) which are contained in fumigant. ● The servo amplifier must not be used with parts which contain halogen-series flame retardant materials (such as bromine) under coexisting conditions. 																						

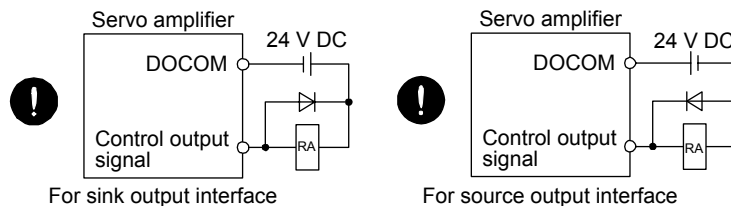
(2) Wiring

⚠ CAUTION

- 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 (FR-BIF option) 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 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.



- 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 for different axis to the U, V, W, or CN2 may cause a malfunction.

(3) Test run and adjustment

⚠ CAUTION

- Before operation, check the parameter settings. Improper settings may cause some machines to perform unexpected operation.
- Never adjust or change the parameter values extremely as it will make operation unstable.
- Do not close to moving parts at servo-on status.

(4) Usage

⚠ CAUTION

- Provide an external emergency stop circuit to ensure that operation can be stopped and power switched off immediately.
- 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.

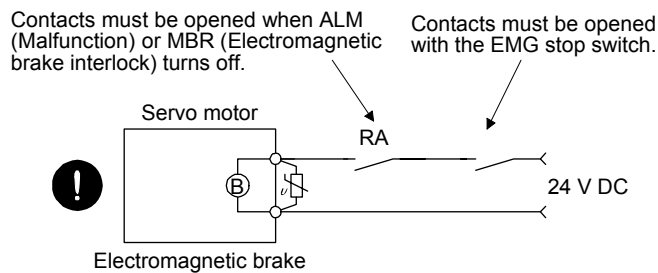
⚠ CAUTION

- 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 recommended that the electrolytic capacitor be replaced every 10 years when it is used in general environment. Please 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 Specifications and Instruction Manual.

● DISPOSAL OF WASTE ●

Please dispose a servo amplifier, battery (primary battery) and other options according to your local laws and regulations.

EEPROM life

The number of write times to the EEPROM, 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 EEPROM reaches the end of its useful life.

- Write to the EEPROM due to parameter setting changes
- Write to the EEPROM due to device changes

STO function of the servo amplifier

When using the STO function of the servo amplifier, refer to chapter 13.
For the MR-J3-D05 safety logic unit, refer to appendix 5.

Compliance with global standards

For the compliance with global standards, refer to appendix 4.

«About the manuals»

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-J4 Series Instructions and Cautions for Safe Use of AC Servos (Packed with the servo amplifier)	IB(NA)0300175
MR-J4 Servo Amplifier Instruction Manual (Troubleshooting)	SH(NA)030109
MELSERVO Servo Motor Instruction Manual (Vol. 3) (Note 1)	SH(NA)030113
MELSERVO Linear Servo Motor Instruction Manual (Note 2)	SH(NA)030110
MELSERVO Direct Drive Motor Instruction Manual (Note 3)	SH(NA)030112
MELSERVO Linear Encoder Instruction Manual (Note 2, 4)	SH(NA)030111
EMC Installation Guidelines	IB(NA)67310

- Note
1. It is necessary for using a rotary servo motor.
 2. It is necessary for using a linear servo motor.
 3. It is necessary for using a direct drive motor.
 4. It is necessary for using a fully closed loop system.

«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 [in]
Torque	1 [N•m]	141.6 [oz•in]
Moment of inertia	1 [(× 10 ⁻⁴ kg•m ²)]	5.4675 [oz•in ²]
Load (thrust load/axial load)	1 [N]	0.2248 [lbf]
Temperature	N [°C] × 9/5 + 32	N [°F]

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1.1 Summary

The Mitsubishi MELSERVO-J4 series general-purpose AC servo has further higher performance and higher functions compared to the previous MELSERVO-J3 series.

The MELSERVO-J4 series compatible rotary servo motor is equipped with 22-bit (4194304 pulses/rev) high-resolution absolute encoder. In addition, speed frequency response is increased to 2.5 kHz. Thus, faster and more accurate control is enabled as compared to the MELSERVO-J3 series.

The servo amplifier has position, speed, and torque control modes. In the position control mode, the maximum pulse train of 4 Mpps 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 and the drive recorder function, which are well-received in the MELSERVO-JN series, have been improved. The MR-J4 servo amplifier supports the improved functions. Additionally, the preventive maintenance support function detects an error in the machine parts. This function provides strong support for the machine maintenance and inspection.

The MR-J4-A servo amplifier supports the Safe Torque Off (STO) function for safety. By combining with optional MR-J3-D05, the servo amplifier supports Safe stop 1 (SS1) function.

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.

In the MELSERVO-J4 series, servo amplifiers with the CN2L connector are also available as MR-J4-_A-RJ. By using the CN2L connector, an A/B/Z-phase differential output type external encoder can be connected to the servo amplifier. In a fully closed loop system, a four-wire type external encoder is connectable as well.

The following table indicates the communication method of the external encoder compatible with the MR-J4-_A and MR-J4-_A-RJ servo amplifiers.

Operation mode	Linear encoder communication method	MR-J4-_A		MR-J4-_A-RJ	
		Software version	Connector	Software version	Connector
Linear servo motor system	Two-wire type	A5 or later	CN2	A5 or later	CN2L
	Four-wire type				
	A/B/Z-phase differential output type				
Fully closed loop system	Two-wire type	A5 or later	CN2		
	Four-wire type				
	A/B/Z-phase differential output type				

1. FUNCTIONS AND CONFIGURATION

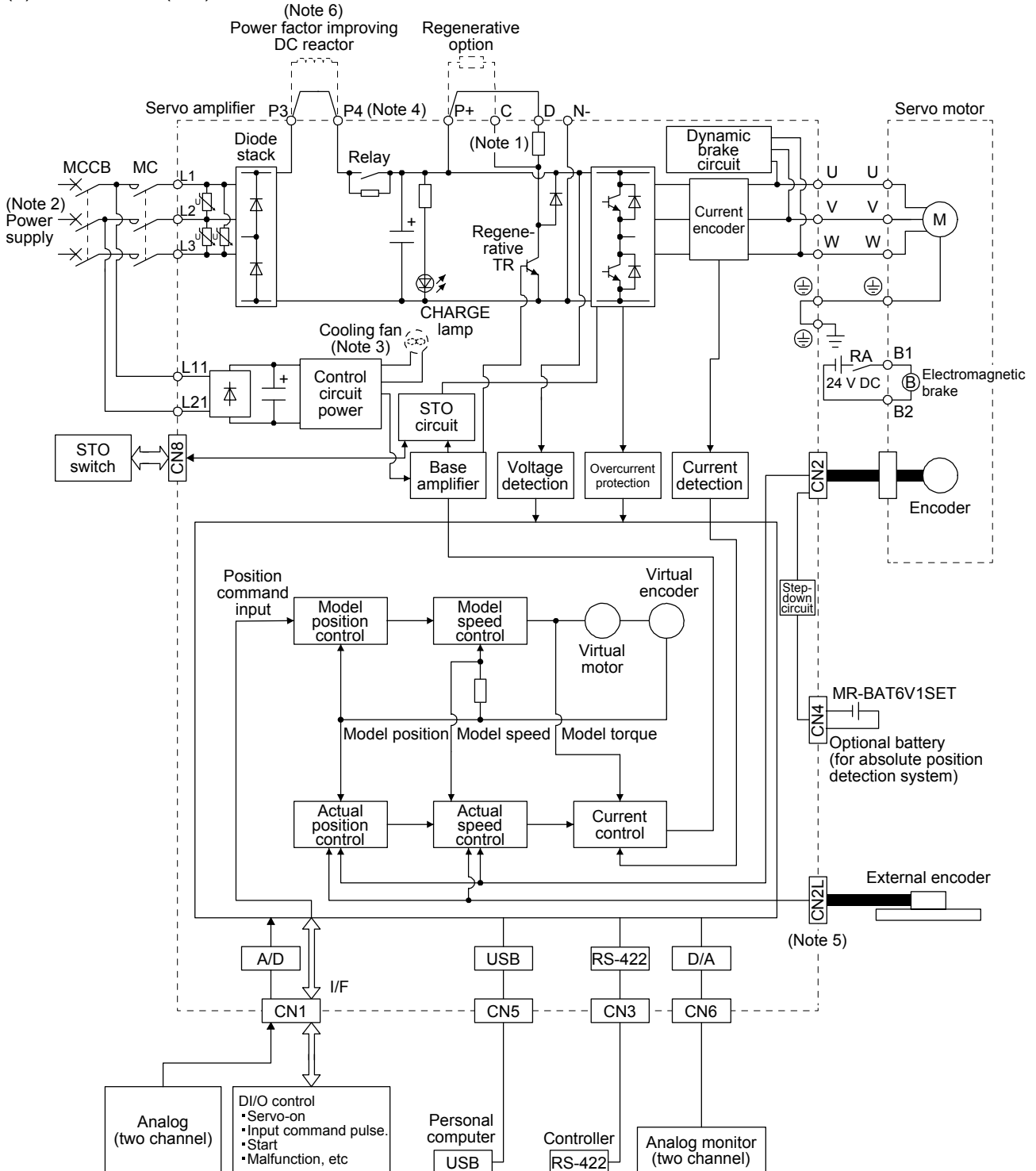
1.2 Function block diagram

The function block diagram of this servo is shown below.

POINT

● The diagram shows MR-J4-A-RJ as an example. The MR-J4-A servo amplifier does not have the CN2L connector.

(1) MR-J4-500A(-RJ) or less

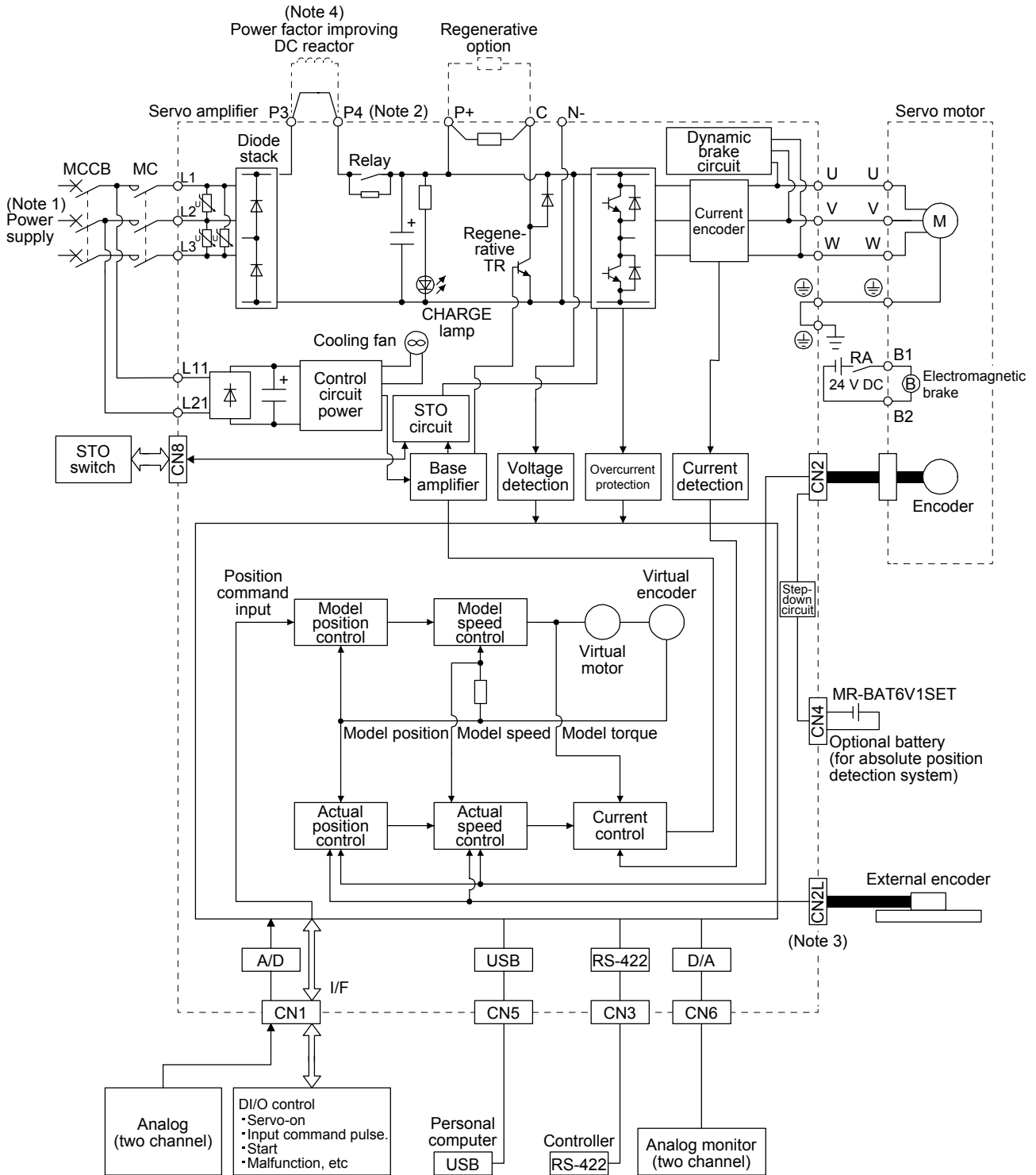


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- Note
1. The built-in regenerative resistor is not provided for MR-J4-10A(-RJ).
 2. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open.
For the power supply specifications, refer to section 1.3.
 3. Servo amplifiers MR-J4-70A(-RJ) or more have a cooling fan.
 4. The MR-J4 servo amplifier has P3 and P4 in the upstream of the inrush current suppression circuit. They are different from P1 and P2 of the MR-J3 servo amplifiers.
 5. This is for the MR-J4- A-RJ servo amplifier. The MR-J4- A servo amplifier does not have the CN2L connector.
 6. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used.
When not using the power factor improving DC reactor, short P3 and P4.

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(2) MR-J4-700A(-RJ)



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

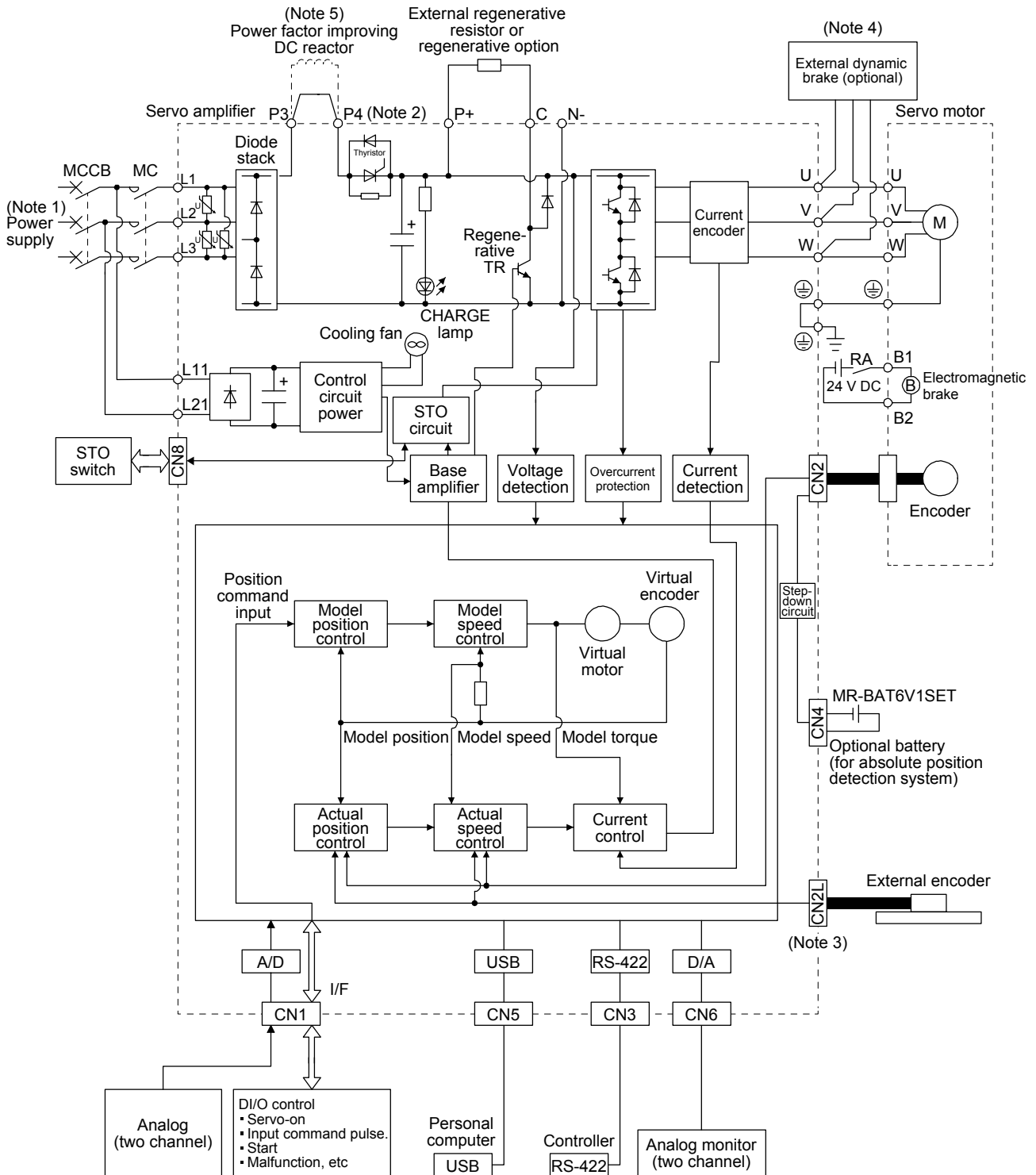
Note 2. The MR-J4 servo amplifier has P3 and P4 in the upstream of the inrush current suppression circuit. They are different from P1 and P2 of MR-J3 servo amplifiers.

Note 3. This is for the MR-J4-A-RJ servo amplifier. The MR-J4-A servo amplifier does not have the CN2L connector.

Note 4. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.

1. FUNCTIONS AND CONFIGURATION

(3) MR-J4-11KA(-RJ)/MR-J4-15KA(-RJ)/MR-J4-22KA(-RJ)



- Note 1. For the power supply specifications, refer to section 1.3.
- Note 2. The MR-J4 servo amplifier has P3 and P4 in the upstream of the inrush current suppression circuit. They are different from P1 and P2 of the MR-J3 servo amplifiers.
- Note 3. This is for the MR-J4-A-RJ servo amplifier. The MR-J4-A servo amplifier does not have the CN2L connector.
- Note 4. Use an external dynamic brake for this servo amplifier. Failure to do so will cause an accident because the servo motor does not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire equipment. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.
- Note 5. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.

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1.3 Servo amplifier standard specifications

Model: MR-J4-		10A (-RJ)	20A (-RJ)	40A (-RJ)	60A (-RJ)	70A (-RJ)	100A (-RJ)	200A (-RJ)	350A (-RJ)	500A (-RJ)	700A (-RJ)	11KA (-RJ)	15KA (-RJ)	22KA (-RJ)	
Output	Rated voltage	3-phase 170 V AC													
	Rated current [A]	1.1	1.5	2.8	3.2	5.8	6.0	11.0	17.0	28.0	37.0	68.0	87.0	126.0	
Main circuit power supply	Voltage/Frequency	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								
	Rated current [A]	0.9	1.5	2.6	3.2 (Note 5)	3.8	5.0	10.5	16.0	21.7	28.9	46.0	64.0	95.0	
	Permissible voltage fluctuation	3-phase or 1-phase 170 V AC to 264 V AC					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.													
Control circuit power supply	Voltage/Frequency	1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz													
	Rated current [A]	0.2						0.3							
	Permissible voltage fluctuation	1-phase 170 V AC to 264 V AC													
	Permissible frequency fluctuation	Within ±5%													
	Power consumption [W]	30						45							
	Inrush current [A]	Refer to section 10.5.													
Interface power supply	Voltage	24 V DC ± 10%													
	Current capacity [A]	(Note 1) 0.5 (including the CN8 connector signals)													
Control method	Sine-wave PWM control, current control method														
Dynamic brake	Built-in											External option (Note 8)			
Fully closed loop control	Available (Note 9)														
Load-side encoder interface (Note 10)	Mitsubishi high-speed serial communication														
Communication function	USB: Connection to a personal computer or others (MR Configurator2-compatible)														
	RS-422: 1:n communication (up to 32 axes) (Note 7)														
Encoder output pulses	Compatible (A/B/Z-phase pulse)														
Analog monitor	Two channels														
Position control mode	Max. input pulse frequency	4 Mpps (for differential receiver) (Note 6), 200 kpps (for open collector)													
	Positioning feedback pulse	Encoder resolution (resolution per servo motor revolution): 22 bits													
	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	Set by parameter setting or external analog input (0 V DC to +10 V DC/maximum torque)													
	Torque limit	±3 revolutions													
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)													
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, error excessive protection, magnetic pole detection protection, and linear servo control fault protection														
Safety function	STO (IEC/EN 61800-5-2)														
Safety performance	Standards certified by CB	EN ISO 13849-1 category 3 PL d, EN 61508 SIL 2, EN 62061 SIL CL 2, and EN 61800-5-2 SIL 2													
	Response performance	8 ms or less (STO input off → energy shut off)													
	(Note 3) Test pulse input (STO)	Test pulse interval: 1 Hz to 25 Hz Test pulse off time: Up to 1 ms													
	Mean time to dangerous failure (MTTFd)	100 years or longer													
	Diagnosis coverage (DC)	Medium (90% to 99%)													
	Average probability of dangerous failures per hour (PFH)	1.68 × 10 ⁻¹⁰ [1/h]													

1. FUNCTIONS AND CONFIGURATION

Model: MR-J4-		10A (-RJ)	20A (-RJ)	40A (-RJ)	60A (-RJ)	70A (-RJ)	100A (-RJ)	200A (-RJ)	350A (-RJ)	500A (-RJ)	700A (-RJ)	11KA (-RJ)	15KA (-RJ)	22KA (-RJ)	
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)			Force cooling, open (IP20) (Note 4)							
Close mounting (Note 2)		Possible							Impossible						
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	1.0	1.4	2.1	2.3	4.0	6.2	13.4	18.2					

- Note
- 0.5 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.
 - 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.
 - Test pulse is a signal which instantaneously turns off a signal to the servo amplifier at a constant period for external circuit to self-diagnose.
 - Except for the terminal block.
 - The rated current is 2.9 A when the servo amplifier is used with a UL or CSA compliant servo motor.
 - 1 Mpps or lower commands are supported in the initial setting. When inputting commands between 1 Mpps and 4 Mpps, change the setting in [Pr. PA13].
 - RS-422 communication is supported by servo amplifier with software version A3.
 - Use an external dynamic brake for this servo amplifier. Failure to do so will cause an accident because the servo motor does not stop immediately but coasts at emergency stop. Ensure the safety in the entire equipment.
 - For the compatible version for the fully closed loop system, refer to section 1.1. Check the software version of the servo amplifier using MR Configurator2.
 - The MR-J4-_A servo amplifier is compatible only with the two-wire type.
The MR-J4-_A-RJ servo amplifier is compatible with the two-wire type, four-wire type, and A/B/Z-phase differential output type. Refer to section 1.1 for details.

1. FUNCTIONS AND CONFIGURATION

1.4 Combinations of servo amplifiers and servo motors

Servo amplifier	Rotary servo motor							Linear servo motor (primary side)	Direct drive motor
	HG-KR	HG-MR	HG-SR	HG-UR	HG-RR	HG-JR	HG-JR (When the maximum torque is 400%)		
MR-J4-10A(-RJ)	053 13	053 13							
MR-J4-20A(-RJ)	23	23						LM-U2PAB-05M-0SS0 LM-U2PBB-07M-1SS0	TM-RFM002C20
MR-J4-40A(-RJ)	43	43						LM-H3P2A-07P-BSS0 LM-H3P3A-12P-CSS0 LM-K2P1A-01M-2SS1 LM-U2PAD-10M-0SS0 LM-U2PAF-15M-0SS0	TM-RFM004C20
MR-J4-60A(-RJ)			51 52				53	LM-U2PBD-15M-1SS0	TM-RFM006C20 TM-RFM006E20
MR-J4-70A(-RJ)	73	73		72			73	LM-H3P3B-24P-CSS0 LM-H3P3C-36P-CSS0 LM-H3P7A-24P-ASS0 LM-K2P2A-02M-1SS1 LM-U2PBF-22M-1SS0	TM-RFM012E20 TM-RFM012G20 TM-RFM040J10
MR-J4-100A(-RJ)			81 102				103		TM-RFM018E20
MR-J4-200A(-RJ)			121 201 152 202	152	103 153	153 203	73 103	LM-H3P3D-48P-CSS0 LM-H3P7B-48P-ASS0 LM-H3P7C-72P-ASS0 LM-FP2B-06M-1SS0 LM-K2P1C-03M-2SS1 LM-U2P2B-40M-2SS0	
MR-J4-350A(-RJ)			301 352	202	203	353	153 203	LM-H3P7D-96P-ASS0 LM-K2P2C-07M-1SS1 LM-K2P3C-14M-1SS1 LM-U2P2C-60M-2SS0	TM-RFM048G20 TM-RFM072G20 TM-RFM120J10
MR-J4-500A(-RJ)			421 502	352 502	353 503	503	353	LM-FP2D-12M-1SS0 LM-FP4B-12M-1SS0 LM-K2P2E-12M-1SS1 LM-K2P3E-24M-1SS1 LM-U2P2D-80M-2SS0	TM-RFM240J10
MR-J4-700A(-RJ)			702			703	503	LM-FP2F-18M-1SS0 LM-FP4D-24M-1SS0	
MR-J4-11KA(-RJ)						903 11K1M		LM-FP4F-36M-1SS0	
MR-J4-15KA(-RJ)						15K1M		LM-FP4F-48M-1SS0	
MR-J4-22KA(-RJ)						22K1M			

1. FUNCTIONS AND CONFIGURATION

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
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 change mode	Using an input device, control can be switched between position control and speed control.	Section 3.6.4
Speed/torque control change mode	Using an input device, control can be switched between speed control and torque control.	Section 3.6.5
Torque/position control change mode	Using an input device, control can be switched between torque control and position control.	Section 3.6.6
High-resolution encoder	High-resolution encoder of 4194304 pulses/rev is used as the encoder of the rotary servo motor compatible with the MELSERVO-J4 series.	
Absolute position detection system	Merely setting a home position once makes home position return unnecessary at every power-on.	Chapter 12
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
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
Brake unit	Used when the regenerative option cannot provide enough regenerative power. Can be used for the 5 kW or more servo amplifier.	Section 11.3
Power regenerative converter	Used when the regenerative option cannot provide enough regenerative power. Can be used for the 5 kW or more servo amplifier.	Section 11.4
Regenerative option	Used when the built-in regenerative resistor of the servo amplifier does not have sufficient regenerative capability for the large 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. PD22]
Output signal selection (device settings)	The output devices including MBR (Electromagnetic brake interlock) can be assigned to certain pins of the CN1 connector.	[Pr. PD23] 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

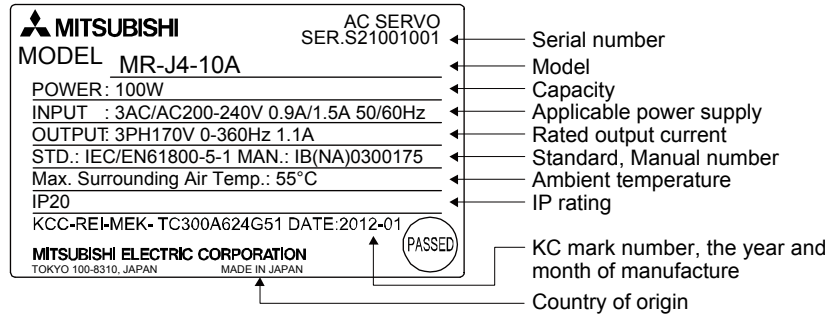
1. FUNCTIONS AND CONFIGURATION

Function	Description	Detailed explanation
Restart after instantaneous power failure	If the input power supply voltage had reduced to cause an alarm but has returned to normal, the servo motor can be restarted by merely switching on the start signal. (available in the future)	
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
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 to perform positioning operation or program operation.	Section 4.5.9
Analog monitor output	Servo status is output 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 11.7
Linear servo system	Linear servo system can be configured using a linear servo motor and liner encoder.	Chapter 15
Direct drive servo system	The direct drive servo system can be configured to drive a direct drive motor.	Chapter 16
Fully closed loop system	Fully closed loop system can be configured using the load-side encoder.	Chapter 17
One-touch tuning	Gain adjustment is performed just by one click on a certain button on MR Configurator2 or operation section.	Section 6.1
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]
STO function	This function is a safety function that complies with IEC/EN 61800-5-2. You can create a safety system for the equipment easily.	Chapter 13
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.	

1. FUNCTIONS AND CONFIGURATION

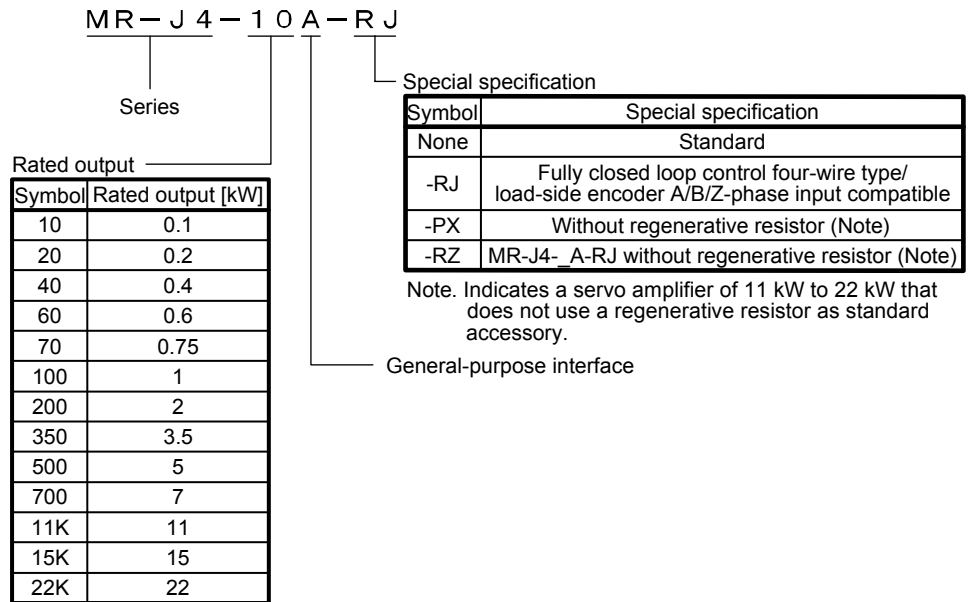
1.6 Model designation

(1) Rating plate



(2) Model

The following describes what each block of a model name indicates. Not all combinations of the symbols are available.



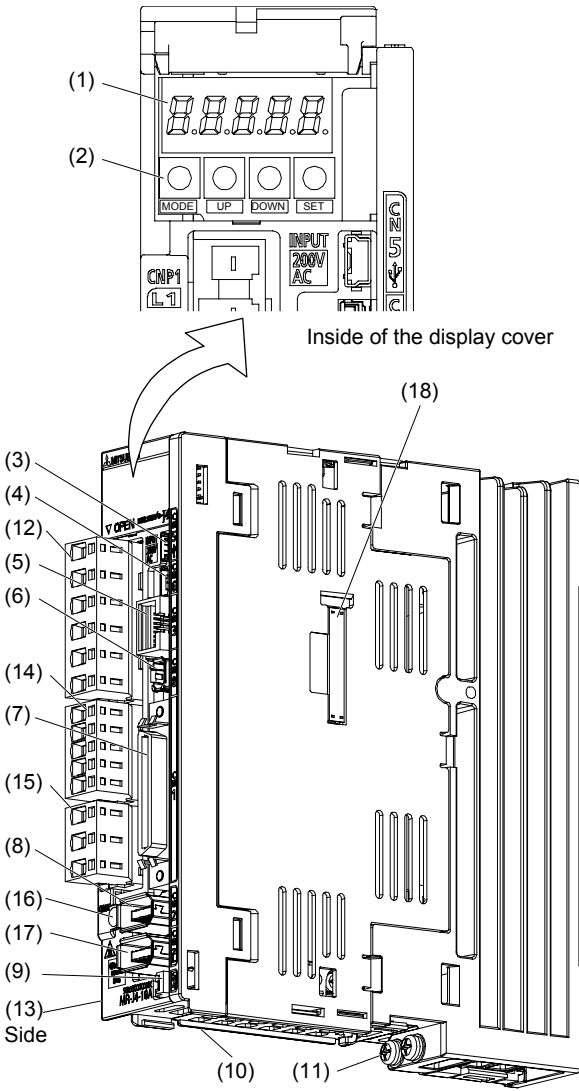
1. FUNCTIONS AND CONFIGURATION

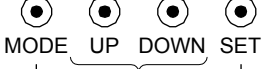
1.7 Structure

1.7.1 Parts identification

(1) MR-J4-200A(-RJ) or less

The diagram shows MR-J4-10A-RJ.



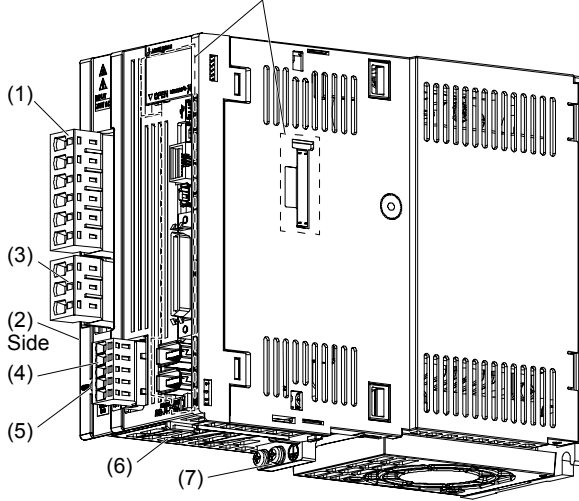
No.	Name/Application	Detailed explanation
(1)	Display The 5-digit, 7-segment LED shows the servo status and the alarm number.	Section 4.5
(2)	Operation section Used to perform status display, diagnostic, alarm, and parameter setting operations. Push the "MODE" and "SET" buttons at the same time for 3 s or more to switch to the one-touch tuning mode.  MODE UP DOWN SET Used to set data. Push this button together with the "MODE" button for 3 s or more to switch to the one-touch tuning mode. Used to change the display or data in each mode. Used to change the mode. Push this button together with the "SET" button for 3 s or more to switch to the one-touch tuning mode.	Section 4.5
(3)	USB communication connector (CN5) Connect with the personal computer.	Section 11.7
(4)	Analog monitor connector (CN6) Outputs the analog monitor.	Section 3.2
(5)	RS-422 communication connector (CN3) Connect with the personal computer, etc.	Chapter 14
(6)	STO input signal connector (CN8) Used to connect the MR-J3-D05 safety logic unit and external safety relay.	Chapter 13
(7)	I/O signal connector (CN1) Used to connect digital I/O signals.	Section 3.2 Section 3.4
(8)	Encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4
(9)	Battery connector (CN4) Used to connect the battery for absolute position data backup.	Chapter 12
(10)	Battery holder Install the the battery for absolute position data backup.	Section 12.4
(11)	Protective earth (PE) terminal Grounding terminal	Section 3.1 Section 3.3
(12)	Main circuit power supply connector (CNP1) Connect the input power supply.	Section 1.6
(13)	Rating plate	Section 1.6
(14)	Control circuit power supply connector (CNP2) Connect the control circuit power supply and regenerative option.	Section 3.1 Section 3.3
(15)	Servo motor power output connector (CNP3) Connect the servo motor.	
(16)	Charge lamp When the main circuit is charged, this will light up. While this lamp is lit, do not reconnect the cables.	
(17) (Note)	External encoder connector (CN2L) Used to connect the external encoder.	"Linear Encoder Instruction Manual"
(18)	Manufacturer setting connector (CN7) This connector is attached on the MR-J4- A-RJ servo amplifier, but not for use. The MR-J4- A servo amplifier does not have this connector.	

Note. This is for the MR-J4- A-RJ servo amplifier. The MR-J4- A servo amplifier does not have the CN2L connector.

1. FUNCTIONS AND CONFIGURATION

(2) MR-J4-350A(-RJ)

The broken line area is the same as MR-J4-200A(-RJ) or less.



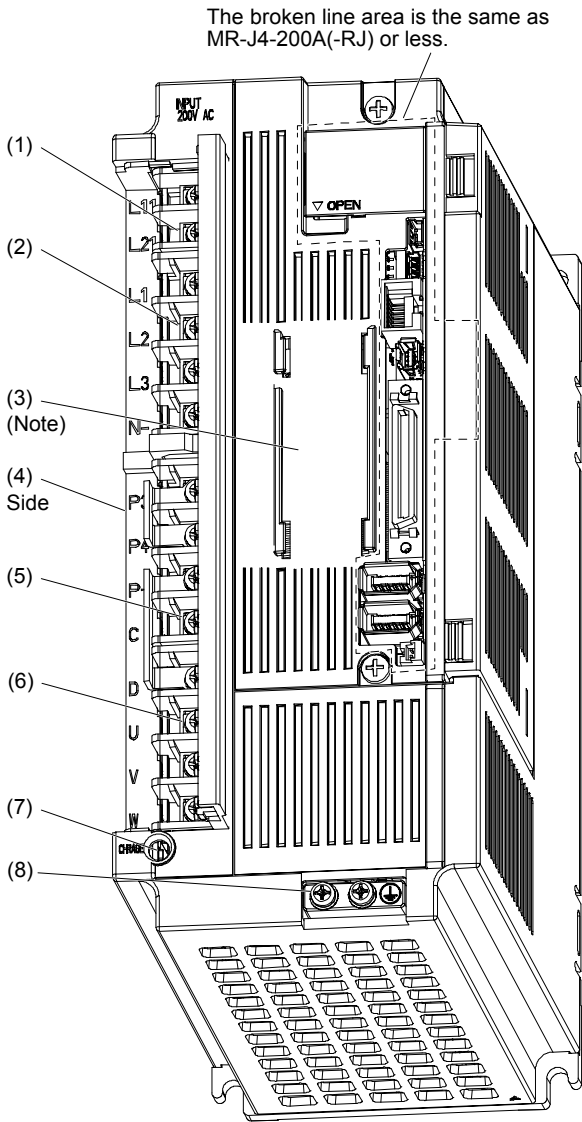
No.	Name/Application	Detailed explanation
(1)	Main circuit power supply connector (CNP1) Connect the input power supply.	Section 3.1 Section 3.3
(2)	Rating plate	Section 1.6
(3)	Servo motor power supply connector (CNP3) Connect the servo motor.	Section 3.1 Section 3.3
(4)	Control circuit power supply connector (CNP2) Connect the control circuit power supply and regenerative option.	
(5)	Charge lamp When the main circuit is charged, this will light up. While this lamp is lit, do not reconnect the cables.	
(6)	Protective earth (PE) terminal Grounding terminal	Section 3.1 Section 3.3
(7)	Battery holder Install the the battery for absolute position data backup.	Section 12.4

1. FUNCTIONS AND CONFIGURATION

(3) MR-J4-500A(-RJ)

POINT

● The servo amplifier is shown with the front cover open. The front cover cannot be removed.



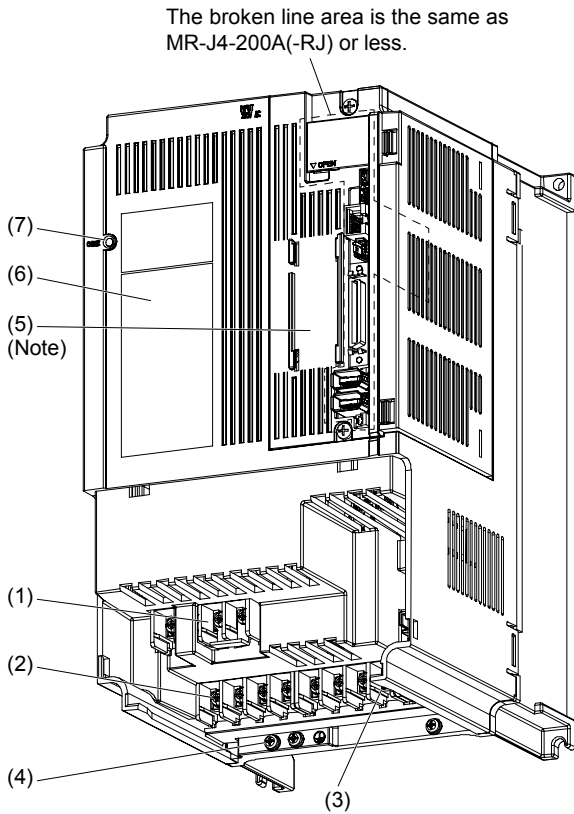
No.	Name/Application	Detailed explanation
(1)	Control circuit terminal block (TE2) Used to connect the control circuit power supply.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1) Connect the input power supply.	
(3)	Battery holder Install the the battery for absolute position data backup.	Section 12.4
(4)	Rating plate	Section 1.6
(5)	Regenerative option/power factor improving reactor terminal block (TE3) Used to connect a regenerative option or a power factor improving DC reactor.	Section 3.1 Section 3.3
(6)	Servo motor power supply terminal block (TE4) Connect the servo motor.	
(7)	Charge lamp When the main circuit is charged, this will light up. While this lamp is lit, do not reconnect the cables.	
(8)	Protective earth (PE) terminal Grounding terminal	Section 3.1 Section 3.3

Note. Lines for slots around the battery holder are omitted from the illustration.

1. FUNCTIONS AND CONFIGURATION

(4) MR-J4-700A(-RJ)

POINT
<p>● The servo amplifier is shown without the front cover. For removal of the front cover, refer to section 1.7.2.</p>



No.	Name/Application	Detailed explanation
(1)	Power factor improving reactor terminal block (TE3) Used to connect the DC reactor.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1) Used to connect the input power supply, regenerative option, and servo motor.	
(3)	Control circuit terminal block (TE2) Used to connect the control circuit power supply.	
(4)	Protective earth (PE) terminal Grounding terminal	
(5)	Battery holder Install the the battery for absolute position data backup.	Section 12.4
(6)	Rating plate	Section 1.6
(7)	Charge lamp When the main circuit is charged, this will light up. While this lamp is lit, do not reconnect the cables.	

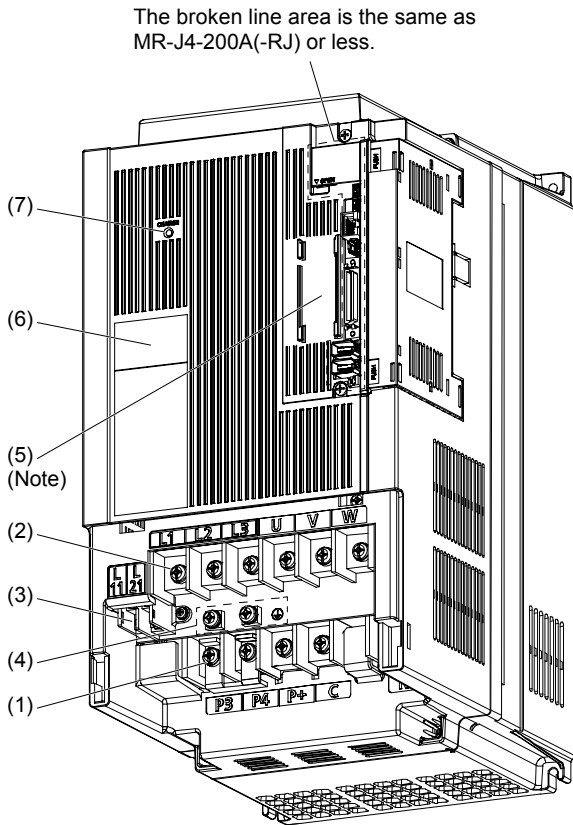
Note. Lines for slots around the battery holder are omitted from the illustration.

1. FUNCTIONS AND CONFIGURATION

(5) MR-J4-11KA(-RJ)/MR-J4-15KA(-RJ)

POINT

● The servo amplifier is shown without the front cover. For removal of the front cover, refer to section 1.7.2.



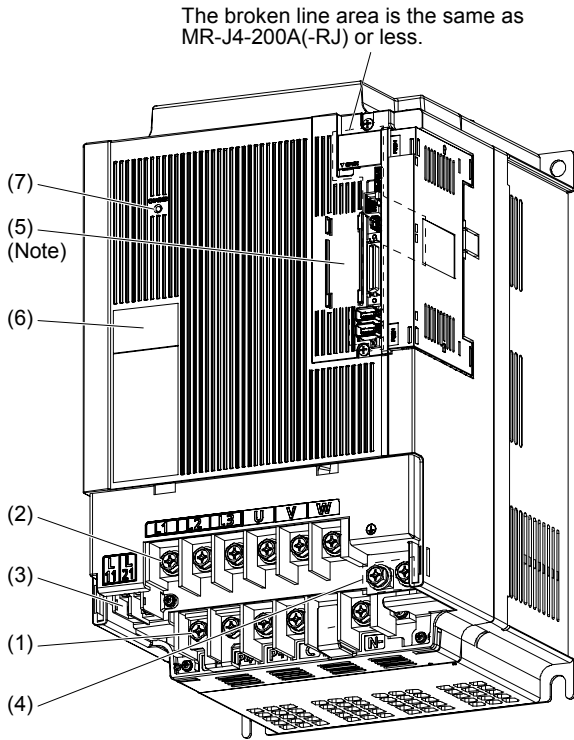
No.	Name/Application	Detailed explanation
(1)	Power factor improving reactor terminal block (TE1-2) Used to connect a power factor improving DC reactor and a regenerative option.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1-1) Used to connect the input power supply and servo motor.	
(3)	Control circuit terminal block (TE2) Used to connect the control circuit power supply.	
(4)	Protective earth (PE) terminal Grounding terminal	
(5)	Battery holder Install the the battery for absolute position data backup.	Section 12.4
(6)	Rating plate	Section 1.6
(7)	Charge lamp When the main circuit is charged, this will light up. While this lamp is lit, do not reconnect the cables.	

Note. Lines for slots around the battery holder are omitted from the illustration.

1. FUNCTIONS AND CONFIGURATION

(6) MR-J4-22KA(-RJ)

POINT
<p>● The servo amplifier is shown without the front cover. For removal of the front cover, refer to section 1.7.2.</p>



No.	Name/Application	Detailed explanation
(1)	Power factor improving reactor terminal block (TE1-2) Used to connect a power factor improving DC reactor and a regenerative option.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1-1) Used to connect the input power supply and servo motor.	
(3)	Control circuit terminal block (TE2) Used to connect the control circuit power supply.	
(4)	Protective earth (PE) terminal Grounding terminal	
(5)	Battery holder Install the the battery for absolute position data backup.	Section 12.4
(6)	Rating plate	Section 1.6
(7)	Charge lamp When the main circuit is charged, this will light up. While this lamp is lit, do not reconnect the cables.	

Note. Lines for slots around the battery holder are omitted from the illustration.

1. FUNCTIONS AND CONFIGURATION

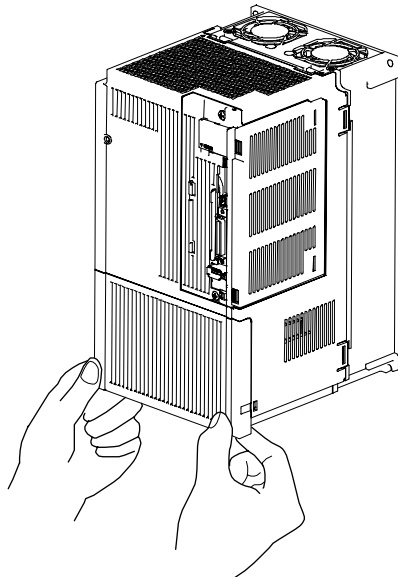
1.7.2 Removal and reinstallation of the front cover

⚠ CAUTION

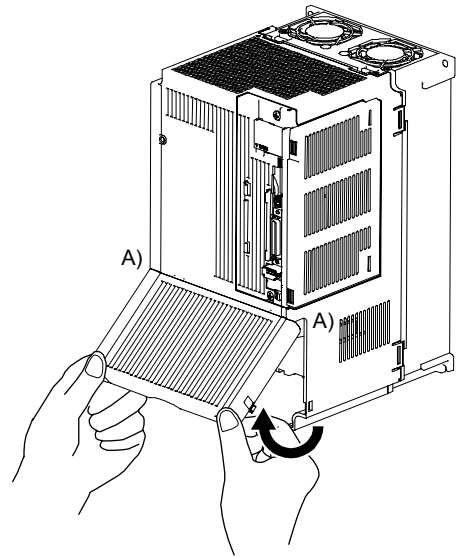
● Before removing or installing the front cover, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, when confirming whether the charge lamp is off or not, always confirm it from the front of the servo amplifier.

The following shows how to remove and reinstall the front cover of MR-J4-700A(-RJ) to MR-J4-22KA(-RJ). The diagram shows MR-J4-700A.

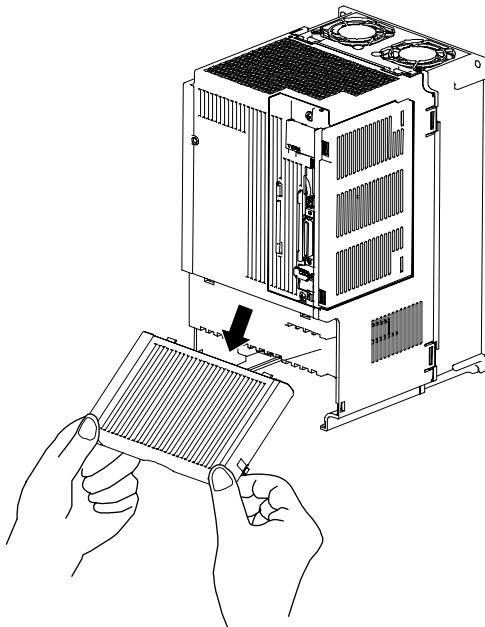
Removal of the front cover



1) Hold the ends of lower side of the front cover with both hands.



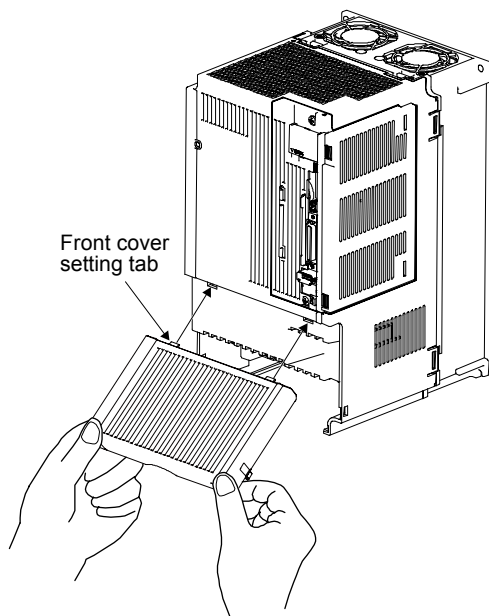
2) Pull up the cover, supporting at point A).



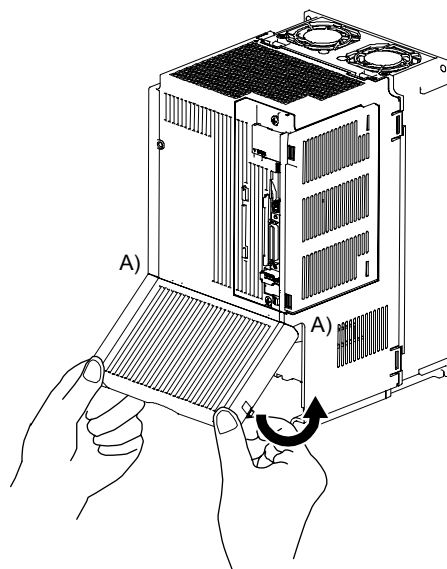
3) Pull out the front cover to remove. Hold the ends of lower side of the front cover with both hands.

1. FUNCTIONS AND CONFIGURATION

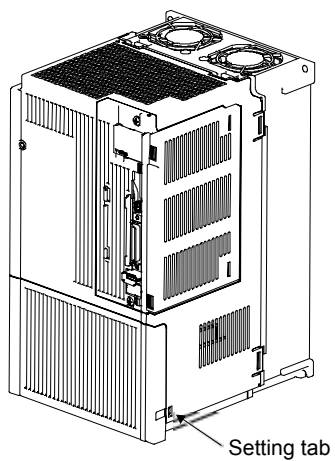
Reinstallation of the front cover



1) Insert the front cover setting tabs into the sockets of the servo amplifier (2 places).



2) Push down the cover, supporting at point A).



3) Press the cover against the terminal box until the setting tabs click.

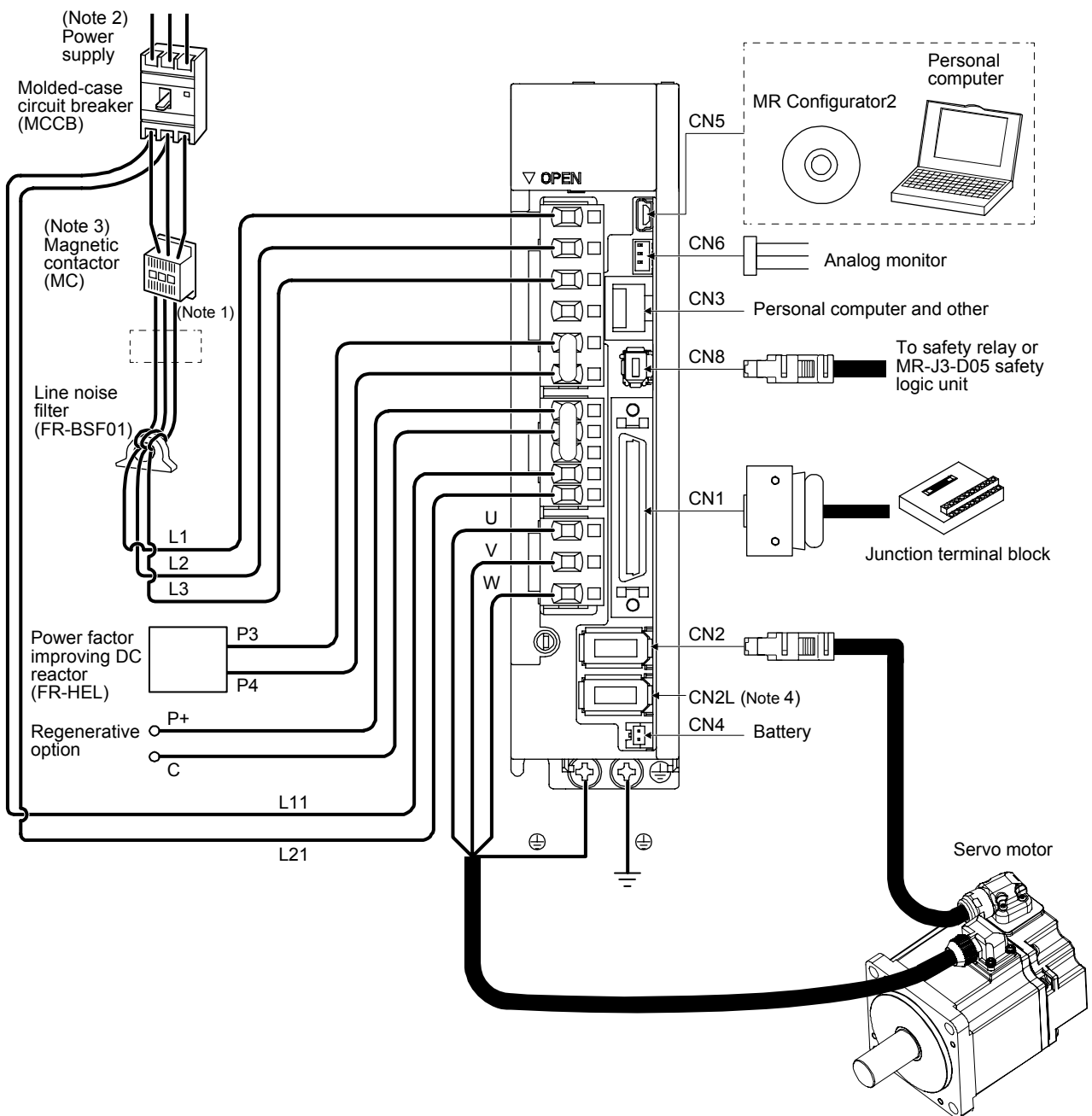
1. FUNCTIONS AND CONFIGURATION

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-J4-200A(-RJ) or less
The diagram shows MR-J4-20A-RJ.

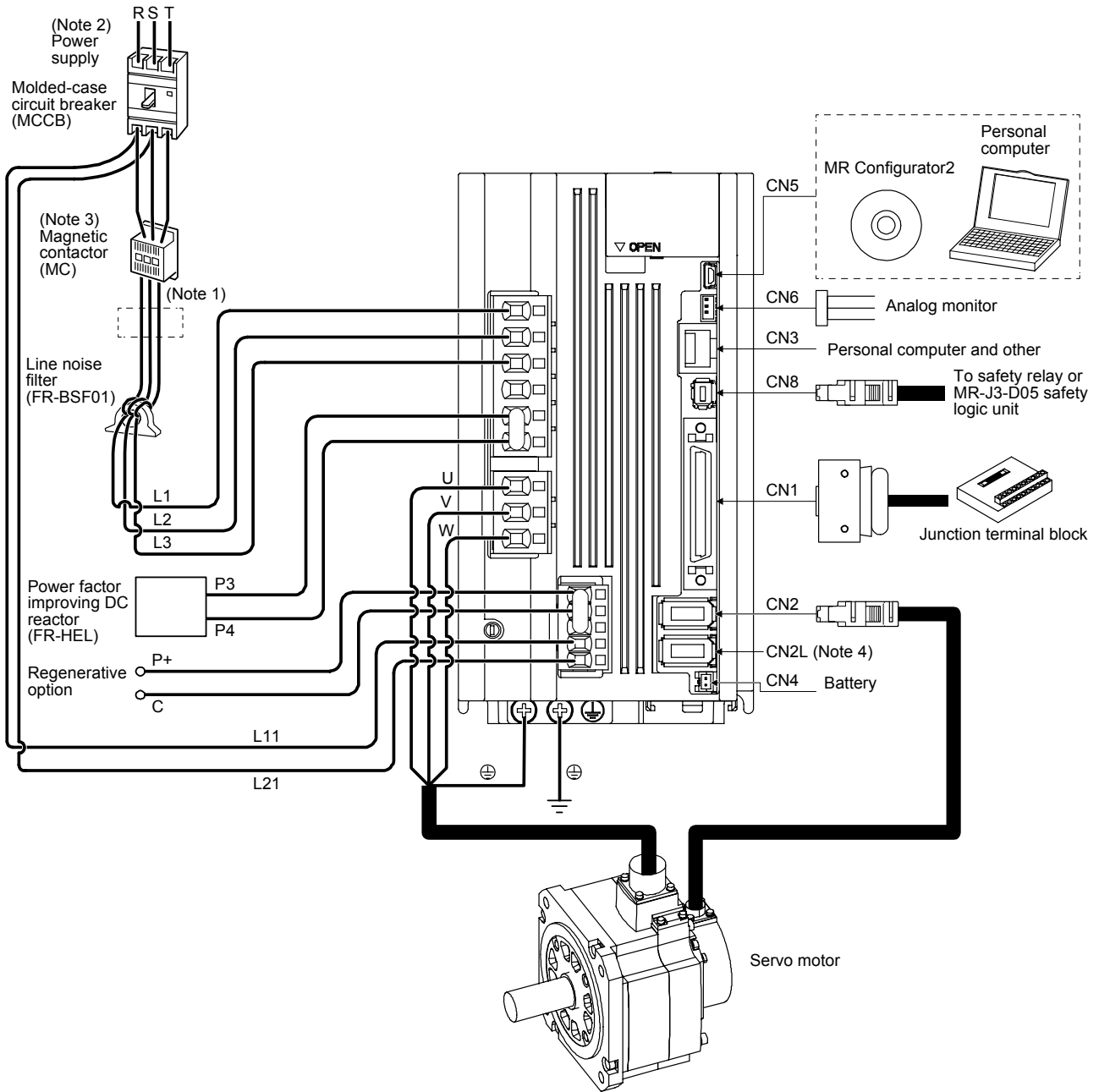


1. FUNCTIONS AND CONFIGURATION

- Note
1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
 2. A 1-phase 200 V AC to 240 V AC power supply may be used with the servo amplifier of MR-J4-70A(-RJ) 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.
 3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
 4. This is for the MR-J4-_A-RJ servo amplifier. The MR-J4-_A servo amplifier does not have the CN2L connector. When using an MR-J4-_A-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to section 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.

1. FUNCTIONS AND CONFIGURATION

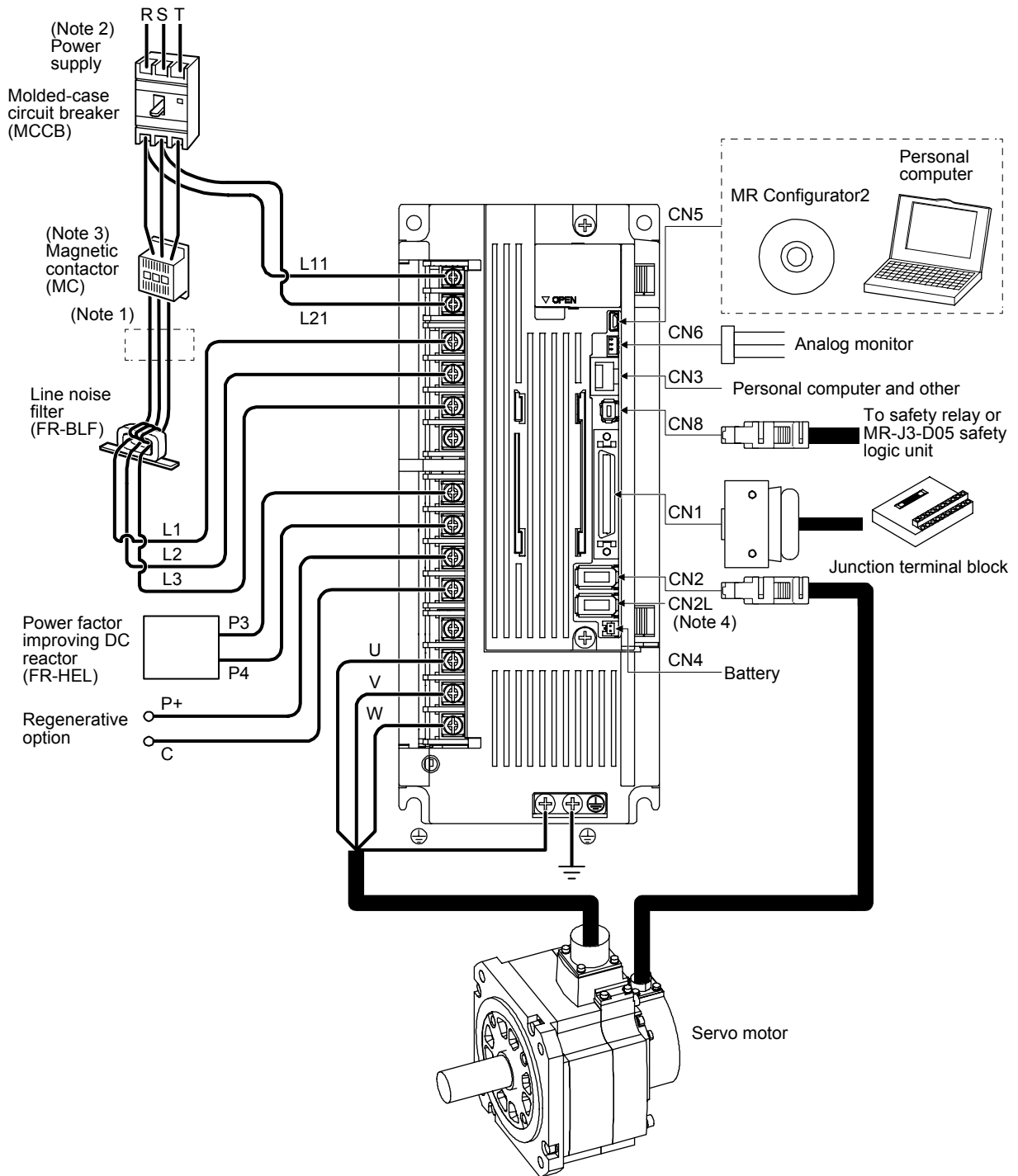
(2) MR-J4-350A(-RJ)



- Note 1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
- Note 2. For the power supply specifications, refer to section 1.3.
- Note 3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
- Note 4. This is for the MR-J4-_A-RJ servo amplifier. The MR-J4-_A servo amplifier does not have the CN2L connector. When using MR-J4-_A-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to section 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.

1. FUNCTIONS AND CONFIGURATION

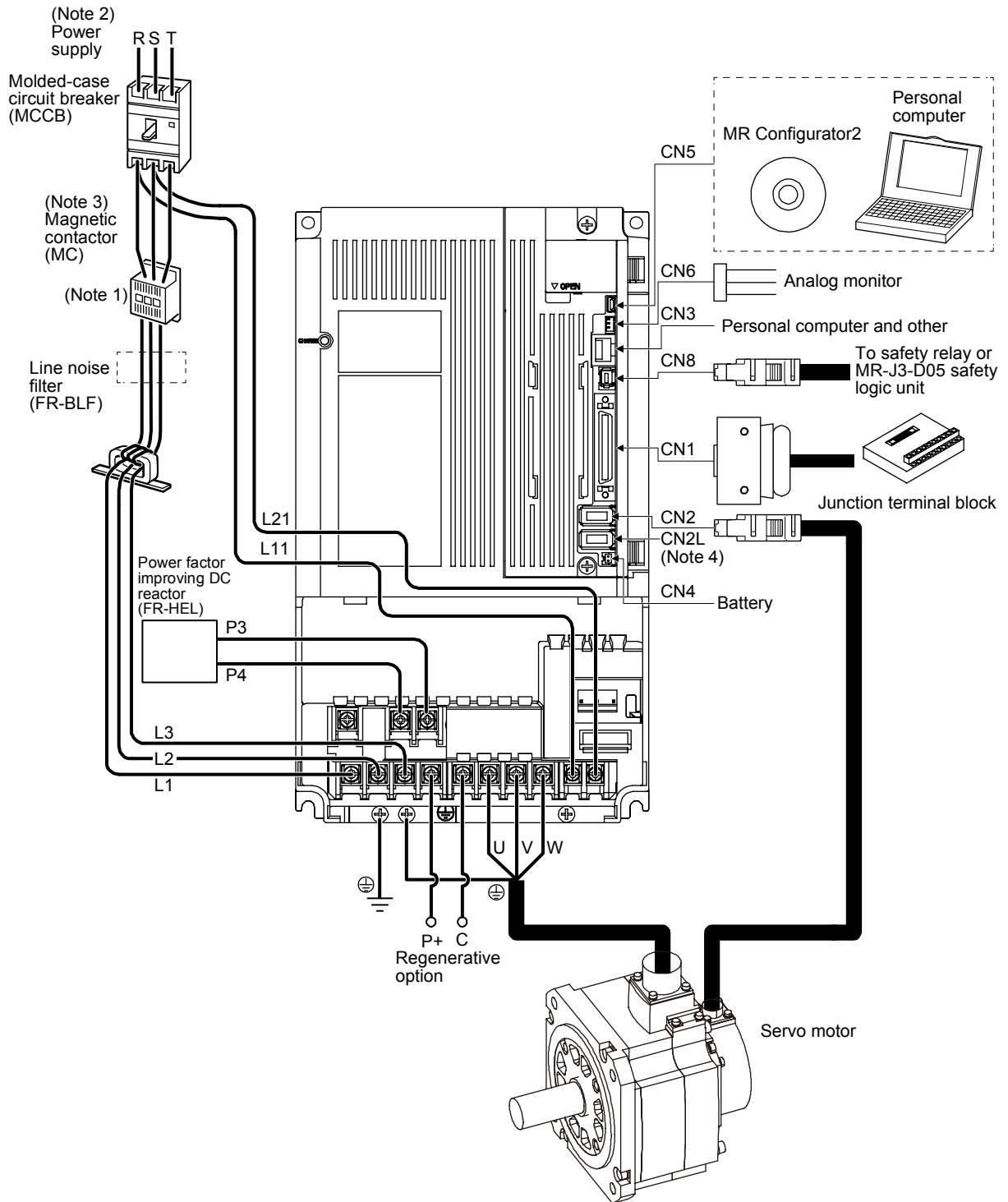
(3) MR-J4-500A(-RJ)



- Note 1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
- Note 2. For the power supply specifications, refer to section 1.3.
- Note 3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
- Note 4. This is for the MR-J4-_A-RJ servo amplifier. The MR-J4-_A servo amplifier does not have the CN2L connector. When using an MR-J4-_A-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to section 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.

1. FUNCTIONS AND CONFIGURATION

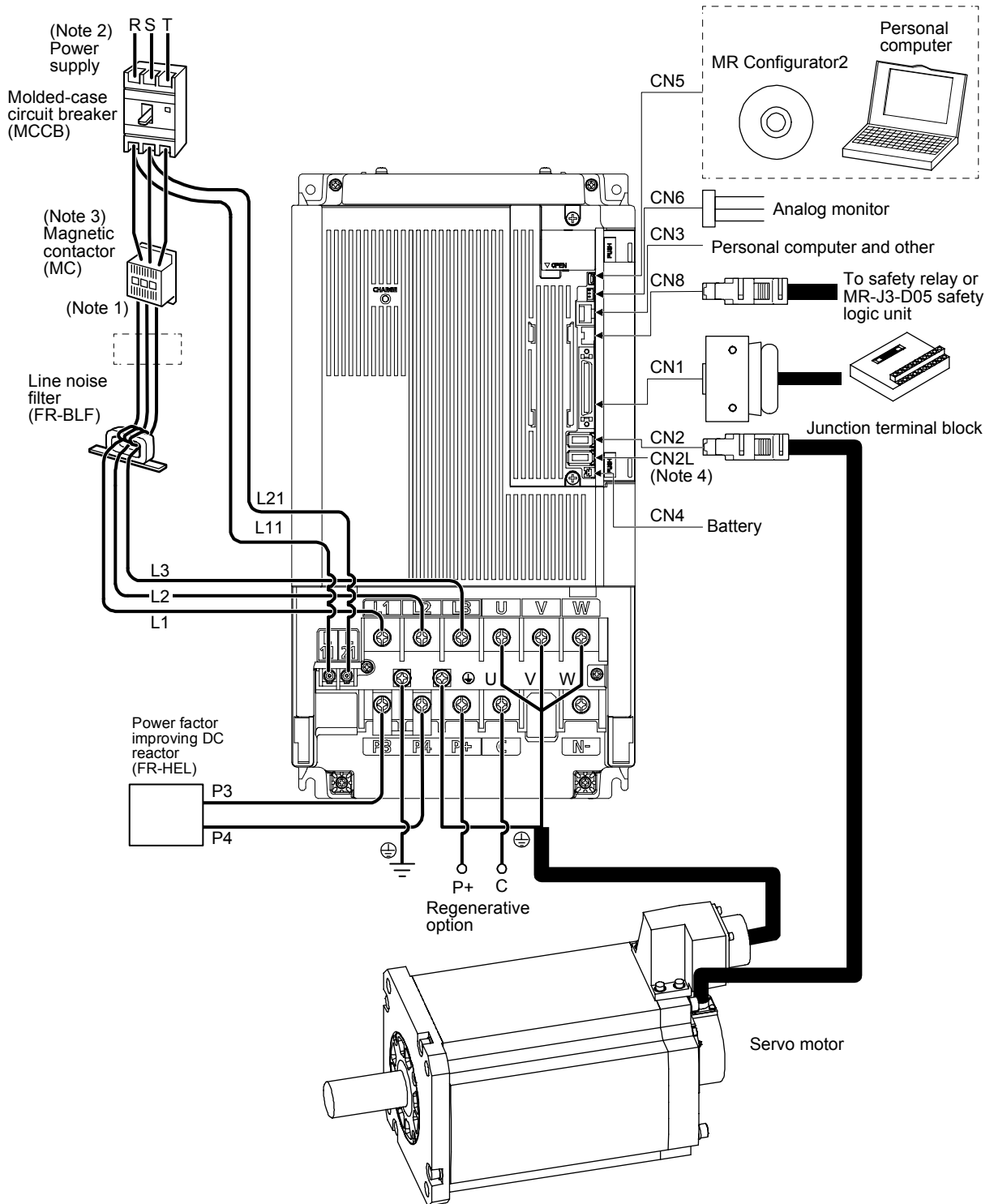
(4) MR-J4-700A(-RJ)



- Note 1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
- Note 2. For the power supply specifications, refer to section 1.3.
- Note 3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
- Note 4. This is for the MR-J4-_A-RJ servo amplifier. The MR-J4-_A servo amplifier does not have the CN2L connector. When using an MR-J4-_A-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to section 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.

1. FUNCTIONS AND CONFIGURATION

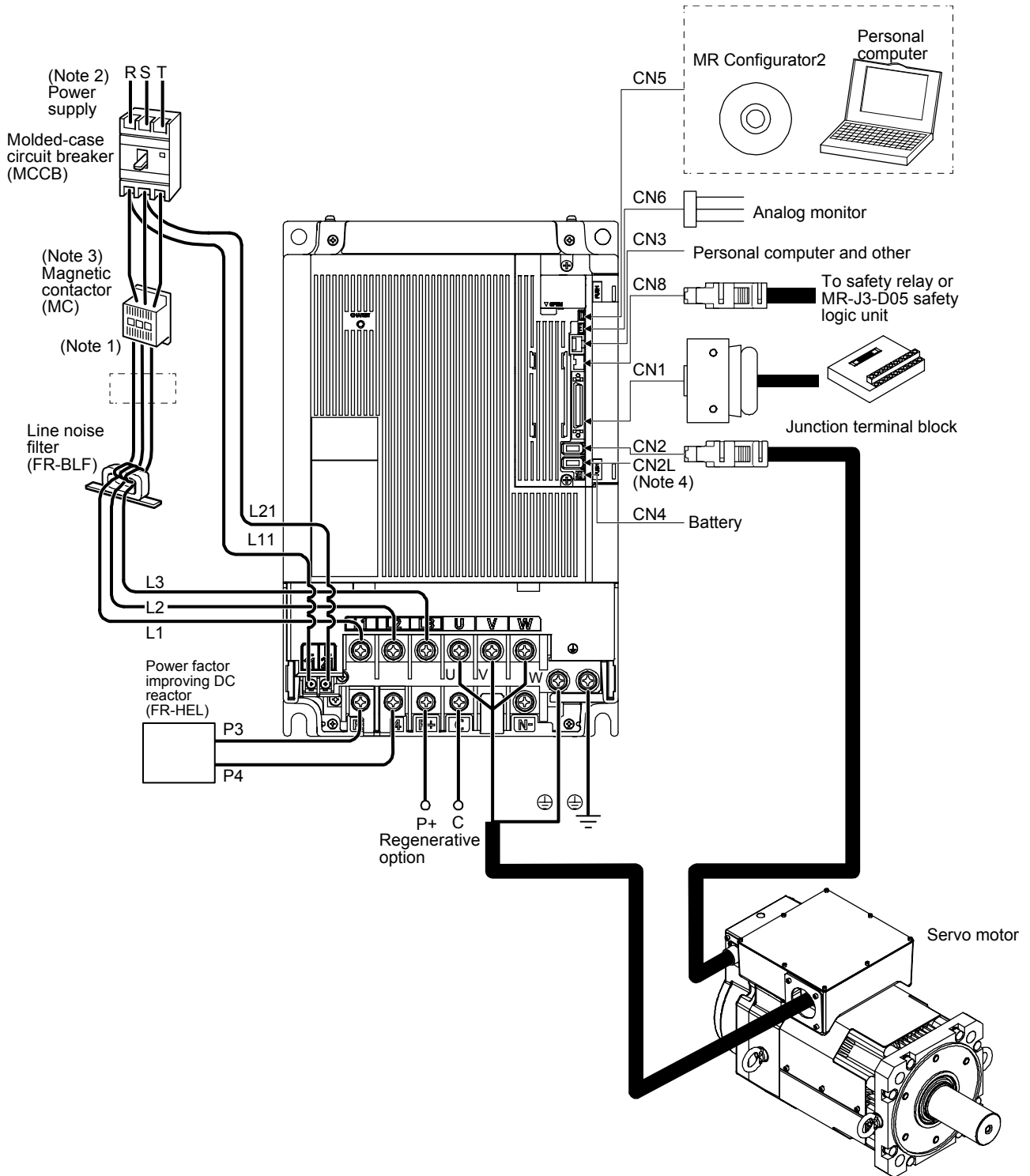
(5) MR-J4-11KA(-RJ)/MR-J4-15KA(-RJ)



- Note 1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
- Note 2. For the power supply specifications, refer to section 1.3.
- Note 3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
- Note 4. This is for the MR-J4-_A-RJ servo amplifier. The MR-J4-_A servo amplifier does not have the CN2L connector. When using an MR-J4-_A-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to section 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.

1. FUNCTIONS AND CONFIGURATION


(6) MR-J4-22KA(-RJ)



- Note 1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
- Note 2. For the power supply specifications, refer to section 1.3.
- Note 3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
- Note 4. This is for the MR-J4-_A-RJ servo amplifier. The MR-J4-_A servo amplifier does not have the CN2L connector. When using an MR-J4-_A-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to section 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.

2. INSTALLATION

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.
- Install the equipment on incombustible material. Installing it 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 have been damaged or have any parts missing.
- When the equipment 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 the metal cabinet.
- When you disinfect or protect wooden packing from insects, take measures except by fumigation. Fumigating the servo amplifier or packing the servo amplifier with fumigated wooden packing can cause a malfunction of the servo amplifier due to halogen materials (such as fluorine, chlorine, bromine, and iodine) which are contained in fumigant.
- The servo amplifier must not be used with parts which contain halogen-series flame retardant materials (such as bromine) under coexisting conditions.

POINT

- When pulling out CNP1, CNP2, and CNP3 connectors of MR-J4-40A(-RJ) or less servo amplifiers, pull out CN3 and CN8 connectors beforehand.

2. INSTALLATION

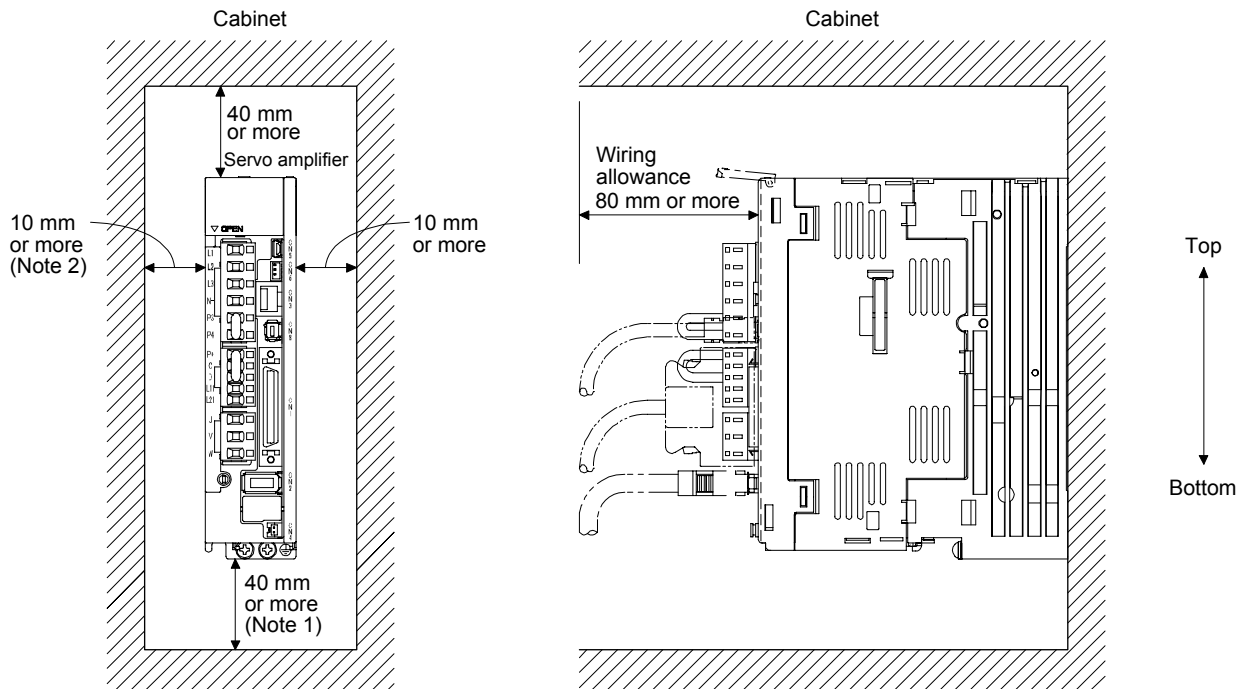
2.1 Installation direction and clearances

! 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.

(1) Installation clearances of the servo amplifier

(a) Installation of one servo amplifier



- Note 1. For 11 kW to 22 kW servo amplifiers, the clearance between the bottom and ground will be 120 mm or more.
2. For the 5 kW servo amplifier, the clearance between the left side and wall will be 25 mm or more.


2. INSTALLATION


- (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 bending radius should be made as large as possible. Refer to section 10.4 for the bending life.

2.4 Inspection items

 WARNING	<ul style="list-style-type: none">● Before starting maintenance and/or inspection, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. 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.
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 CAUTION	<ul style="list-style-type: none">● 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.
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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. INSTALLATION

2.5 Parts having service lives

Service lives of the following parts are listed below. However, the service life vary depending or 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 sales representative.

Part name	Life guideline
Smoothing capacitor	10 years
Relay	Number of power-on and forced stop by EM1 (Forced stop 1) times: 100,000 times Number of on and off for STO: 1,000,000 times
Cooling fan	10,000 hours to 30,000 hours (2 years to 3 years)
Absolute position battery	Refer to section 12.2.

(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 reach the end of their lives when the power has been turned on and forced stop by EM1 (Forced stop 1) has occurred 100,000 times in total, or when the STO has been turned on and off 1,000,000 times while the servo motor is stopped under servo-off state. However, the lives of relays may depend on the power supply capacity.

(3) Servo amplifier cooling fan

The cooling fan bearings reach the end of their life in 10,000 hours to 30,000 hours. Normally, therefore, the cooling fan must be replaced in a few 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.

3. SIGNALS AND WIRING

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. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. 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

- 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. SIGNALS AND WIRING

POINT	
●When you use a linear servo motor, replace the following left words to the right words.	
Load to motor inertia ratio	→ Load to motor mass ratio
Torque	→ Thrust
(Servo motor) speed	→ (Linear servo motor) speed

3.1 Input power supply circuit

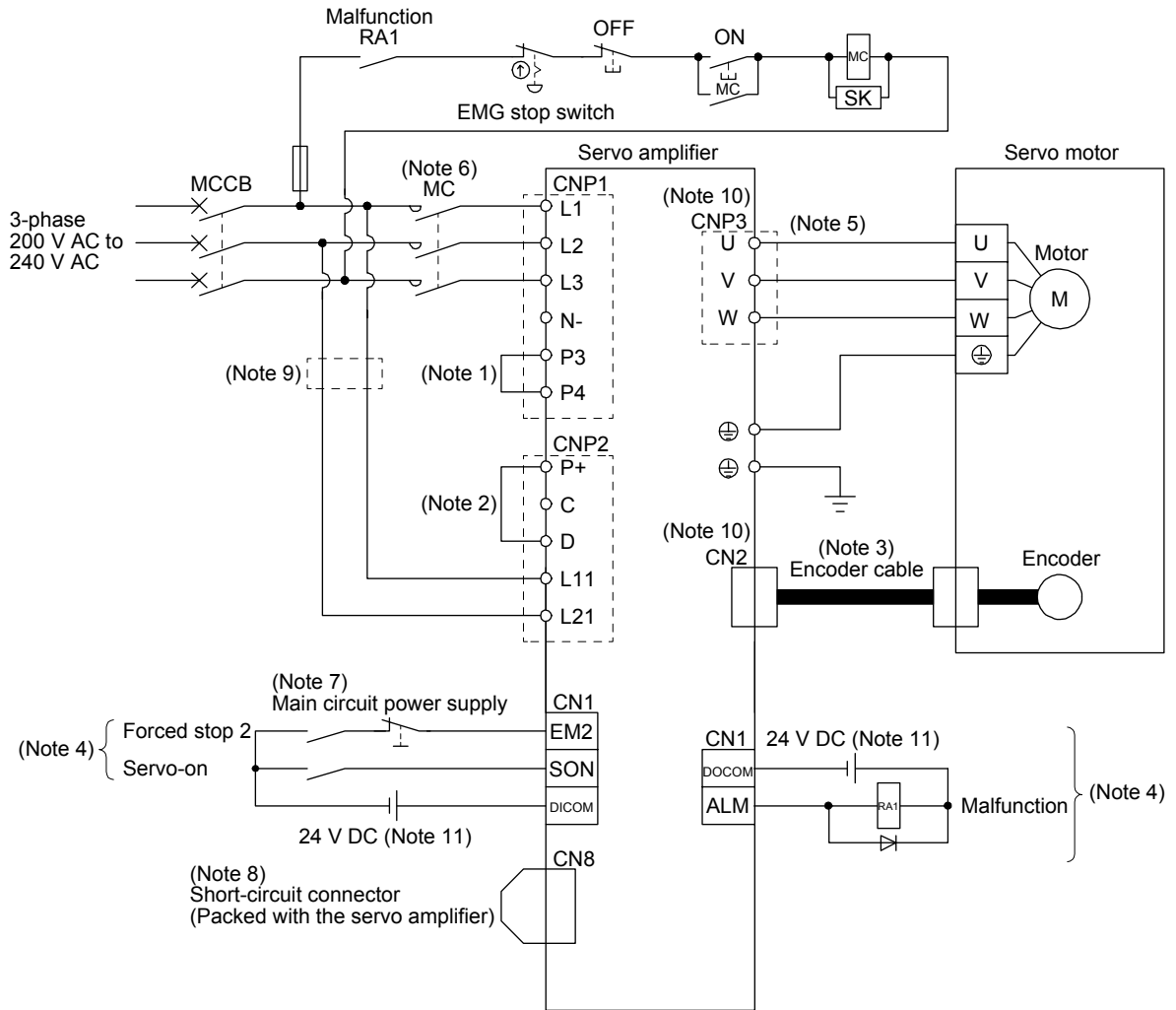
 CAUTION	●Always connect a magnetic contactor between the power supply and the main circuit power supply (L1, L2, and L3) of the servo amplifier, in order to configure a circuit that shuts down the power supply on the side of the servo amplifier's power supply. If a magnetic contactor is not connected, continuous flow of a large current may cause a fire when the servo amplifier malfunctions.
	●Use ALM (Malfunction) to switch main circuit power supply off. Not doing so may cause a fire when a regenerative transistor malfunctions or the like may overheat 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.

POINT
●EM2 has the same function as EM1 in the torque control mode.
●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-J3 Series Servo Amplifier's. When using MR-J4 as a replacement for MR-J3, be careful not to connect the power to L2.

Configure the wirings so that the main circuit 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.

3. SIGNALS AND WIRING

(1) For 3-phase 200 V AC to 240 V AC power supply of MR-J4-10A(-RJ) to MR-J4-350A(-RJ)



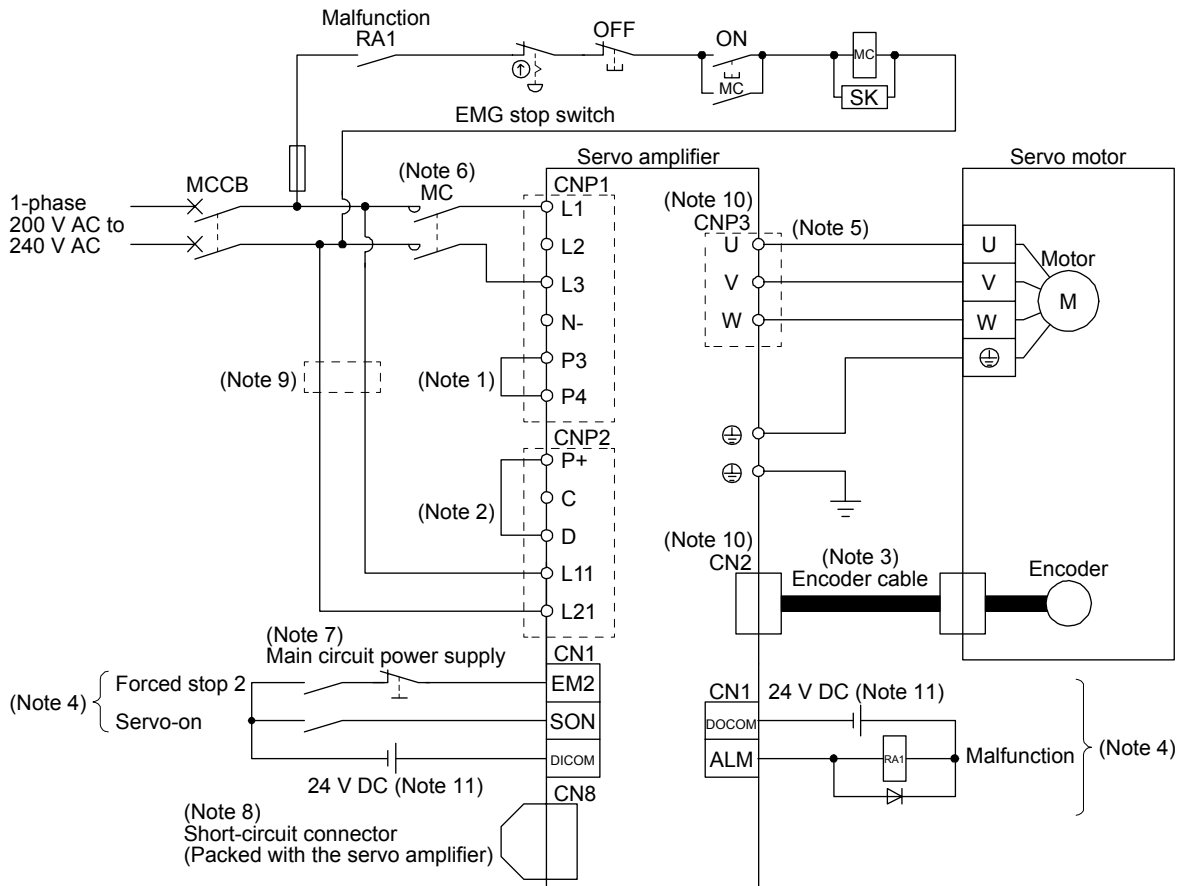
- Note
1. Always connect between P3 and P4 (factory-wired). When using the power factor improving DC reactor, refer to section 11.11. Use either the power factor improving DC reactor or the power factor improving AC reactor.
 2. Always connect between P+ and D terminals (factory-wired). When using the regenerative option, refer to section 11.2.
 3. For the encoder cable, use of the option cable is recommended. For selecting cables, refer to "Servo Motor Instruction Manual (Vol. 3)".
 4. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
 5. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
 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 main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
 7. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
 8. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
 9. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker. (Refer to section 11.10.)
 10. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
 11. 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. SIGNALS AND WIRING

(2) For 1-phase 200 V AC to 240 V AC power supply of MR-J4-10A(-RJ) to MR-J4-70A(-RJ)

POINT

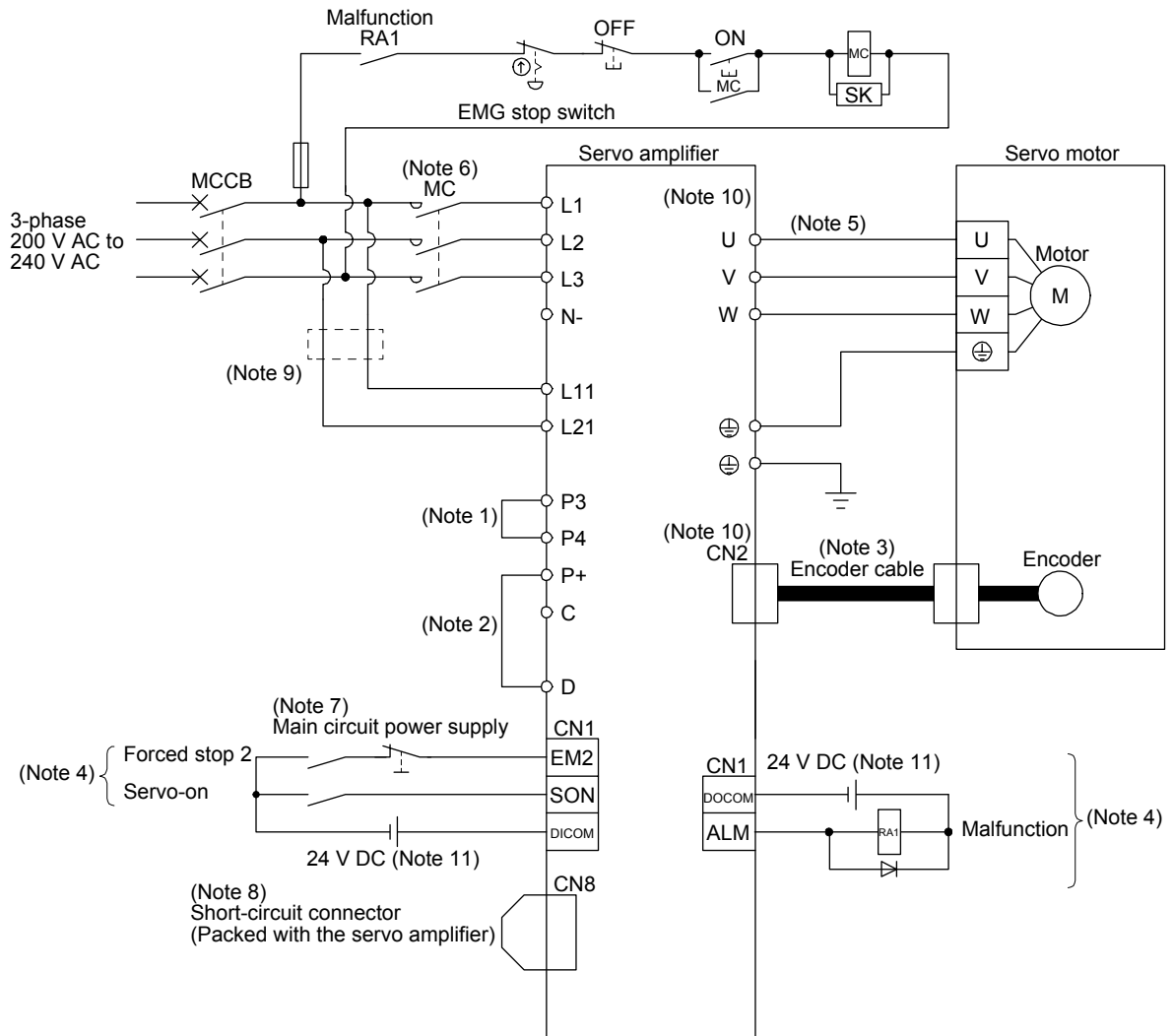
● Connect the 1-phase 200 V AC to 240 V AC power supply to L1 and L3. One of the connecting destinations is different from MR-J3 Series Servo Amplifier's. When using MR-J4 as a replacement for MR-J3, be careful not to connect the power to L2.



- Note
1. Always connect between P3 and P4 (factory-wired). When using the power factor improving DC reactor, refer to section 11.11. Use either the power factor improving DC reactor or the power factor improving AC reactor.
 2. Always connect between P+ and D terminals (factory-wired). When using the regenerative option, refer to section 11.2.
 3. For the encoder cable, use of the option cable is recommended. For selecting cables, refer to "Servo Motor Instruction Manual (Vol. 3)".
 4. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
 5. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
 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 main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
 7. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
 8. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
 9. When wires used for L11 and L21 are thinner than wires used for L1, and L3, use a molded-case circuit breaker. (Refer to section 11.10.)
 10. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
 11. 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. SIGNALS AND WIRING

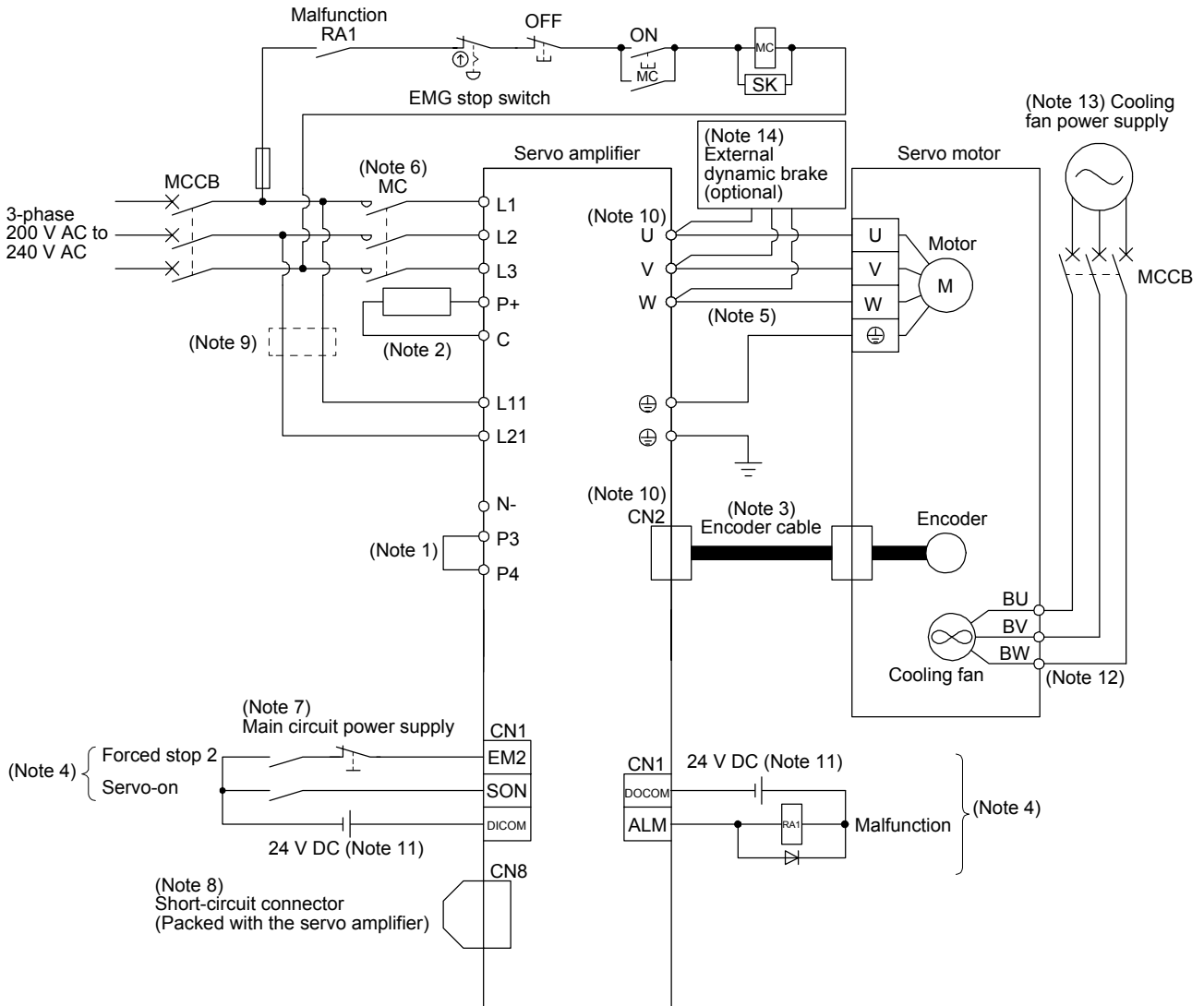
(3) MR-J4-500A(-RJ)



- Note 1. Always connect between P3 and P4 (factory-wired). When using the power factor improving DC reactor, refer to section 11.11. Use either the power factor improving DC reactor or the power factor improving AC reactor.
- Note 2. Always connect between P+ and D terminals (factory-wired). When using the regenerative option, refer to section 11.2.
- Note 3. For the encoder cable, use of the option cable is recommended. For selecting cables, refer to "Servo Motor Instruction Manual (Vol. 3)".
- Note 4. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
- Note 5. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
- Note 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 main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
- Note 7. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
- Note 8. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
- Note 9. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker. (Refer to section 11.10.)
- Note 10. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
- Note 11. 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. SIGNALS AND WIRING

(5) MR-J4-11KA(-RJ)/MR-J4-15KA(-RJ)/MR-J4-22KA(-RJ)



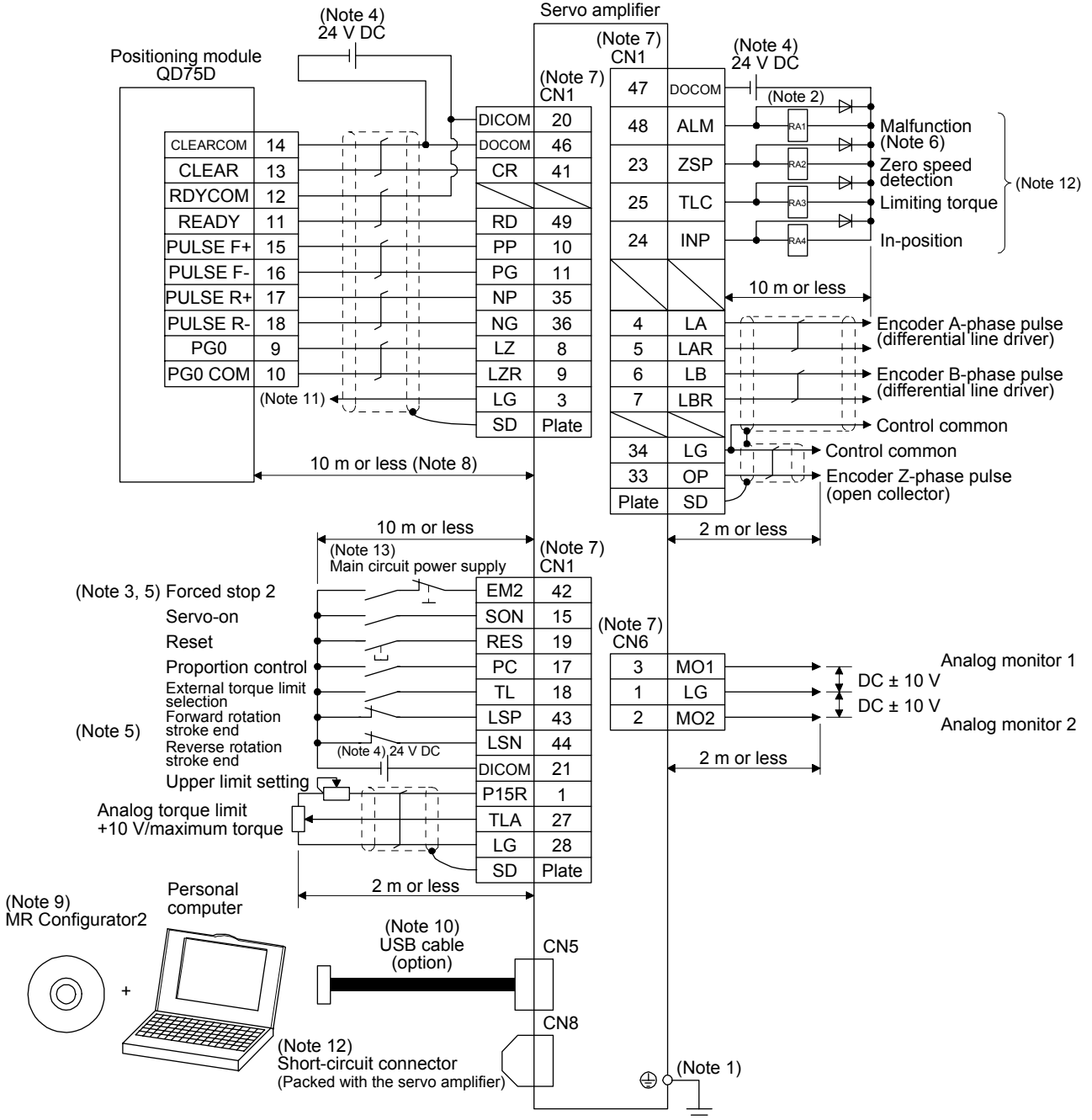
- Note 1. Always connect between P3 and P4 (factory-wired). When using the power factor improving DC reactor, refer to section 11.11. Use either the power factor improving DC reactor or the power factor improving AC reactor.
- Note 2. When using the regenerative option, refer to section 11.2.
- Note 3. For the encoder cable, use of the option cable is recommended. For selecting cables, refer to "Servo Motor Instruction Manual (Vol. 3)".
- Note 4. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
- Note 5. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
- Note 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 main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
- Note 7. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
- Note 8. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
- Note 9. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker. (Refer to section 11.10.)
- Note 10. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
- Note 11. 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.
- Note 12. Only HG-JP22K1M servo motor is equipped with a cooling fan.
- Note 13. For the cooling fan power supply, refer to "Servo Motor Instruction Manual (Vol. 3)".
- Note 14. Use an external dynamic brake for this servo amplifier. Failure to do so will cause an accident because the servo motor does not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire equipment. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.

3. SIGNALS AND WIRING

3.2 I/O signal connection example

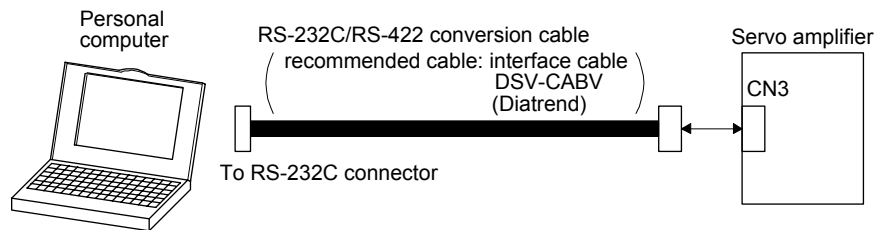
3.2.1 Position control mode

(1) Sink I/O interface



3. SIGNALS AND WIRING

- Note
1. To prevent an electric shock, always connect the protective earth (PE) terminal (marked \oplus) 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 \pm 10% to interfaces from outside. The total current capacity is up to 500 mA. 500 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. When this signal (normally closed contact) 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-J. (Refer to section 11.7.) RS-422 communication function will be available in the future.
 10. Personal computers can also be connected via the CN3 connector, enabling RS-422 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.

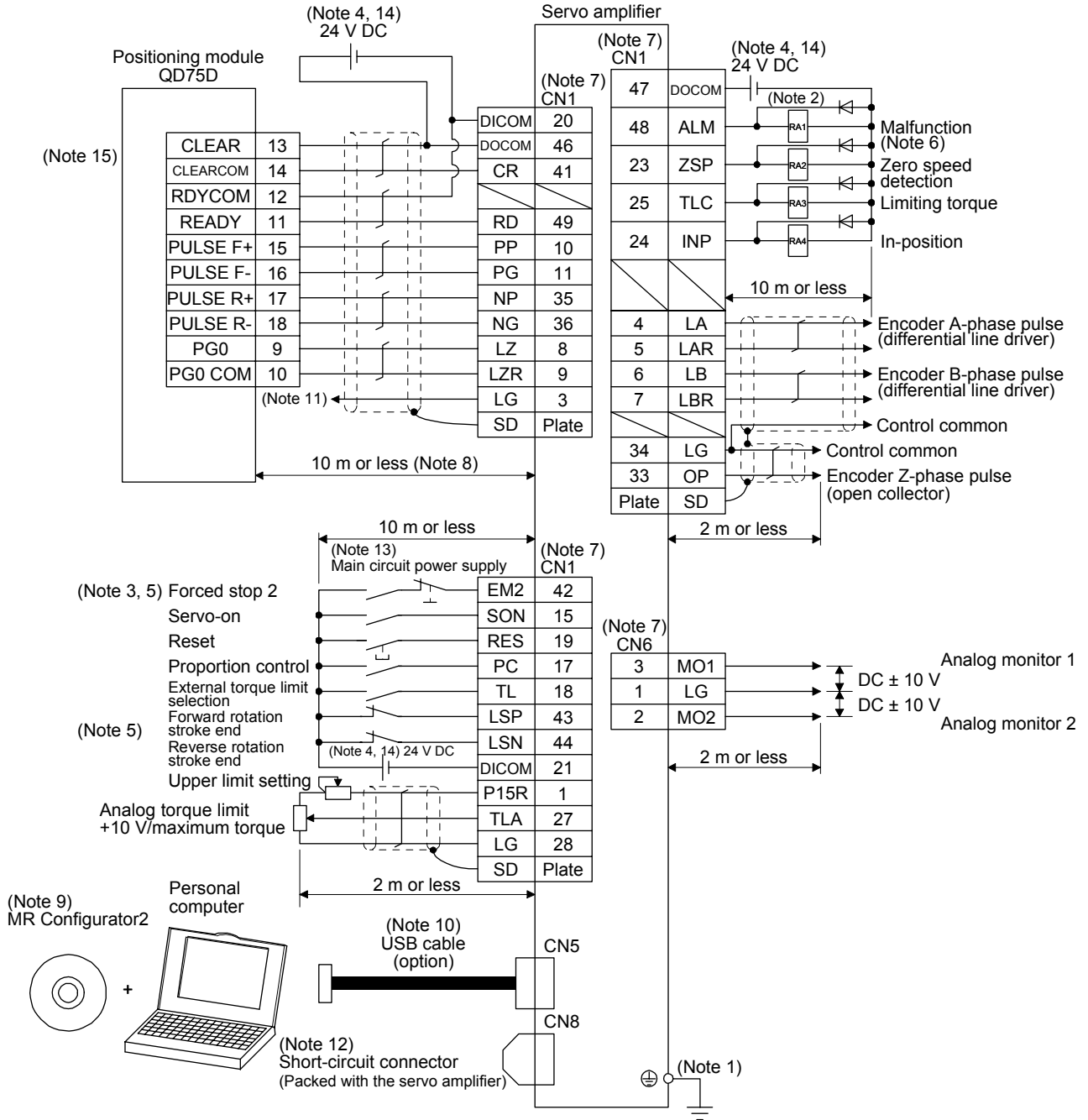


11. This connection is not required for QD75D. However, to enhance noise immunity, it is recommended to connect LG of servo amplifier and control common depending on the positioning module.
12. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
13. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
14. Plus and minus of the power of source interface are the opposite of those of sink interface.
15. CLEAR and CLEARCOM of source interface are interchanged to sink interface.

3. SIGNALS AND WIRING

(2) Source I/O interface

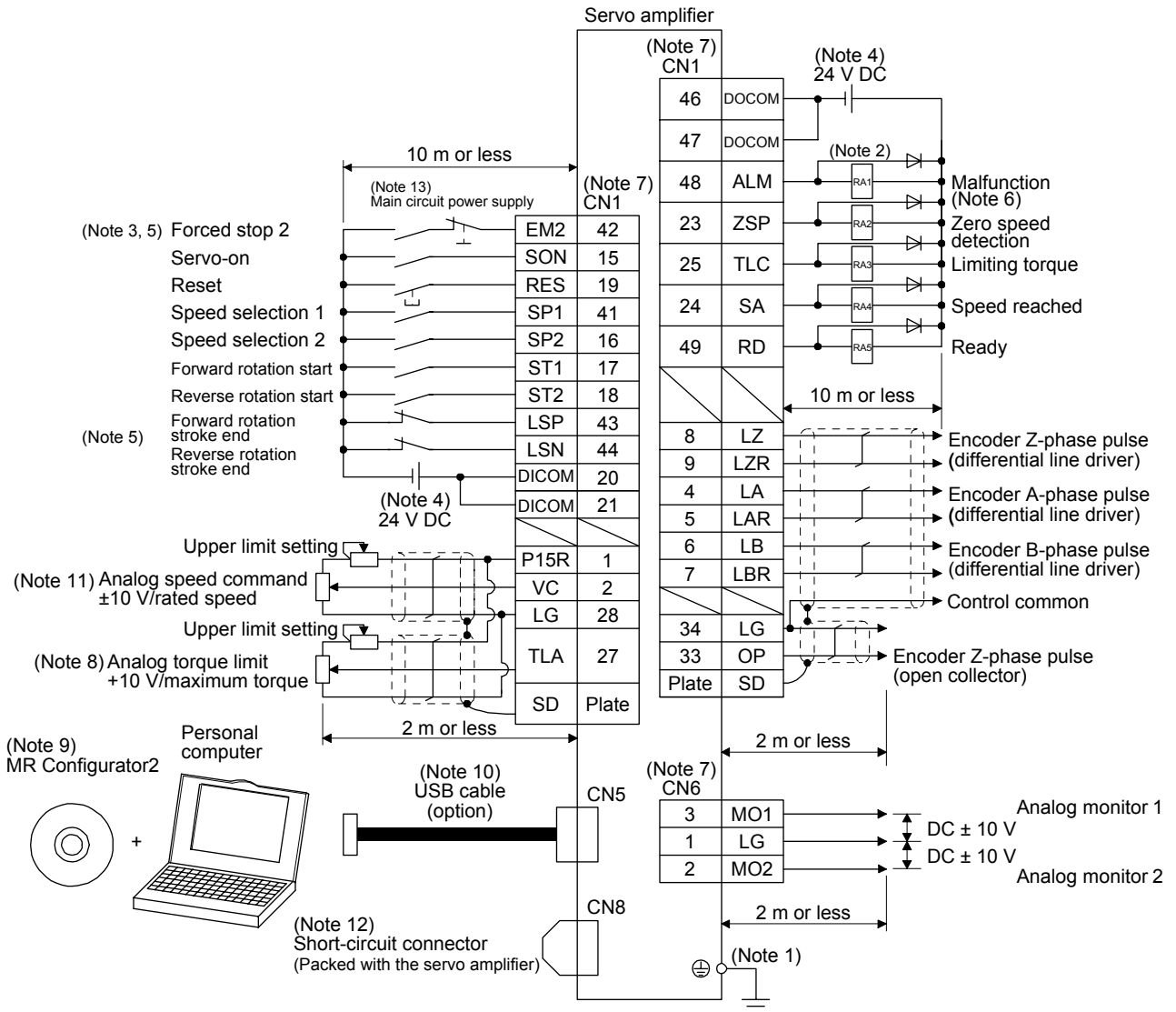
POINT
 ● For notes, refer to (1) in this section.



3. SIGNALS AND WIRING

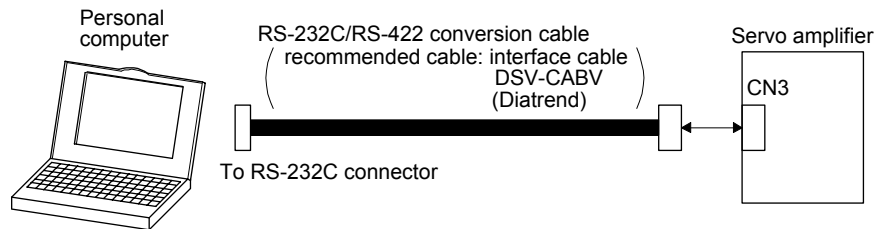
3.2.2 Speed control mode

(1) Sink I/O interface



3. SIGNALS AND WIRING

- Note
1. To prevent an electric shock, always connect the protective earth (PE) terminal (marked \oplus) 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 \pm 10% to interfaces from outside. The total current capacity is up to 500 mA. 500 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 24 V DC power supply can be used both for input signals and output signals.
 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] to [Pr. PD22]. (Refer to section 3.6.1 (5).)
 9. Use SW1DNC-MRC2-J. (Refer to section 11.7.) RS-422 communication function will be available in the future.
 10. Personal computers can also be connected via the CN3 connector, enabling RS-422 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.

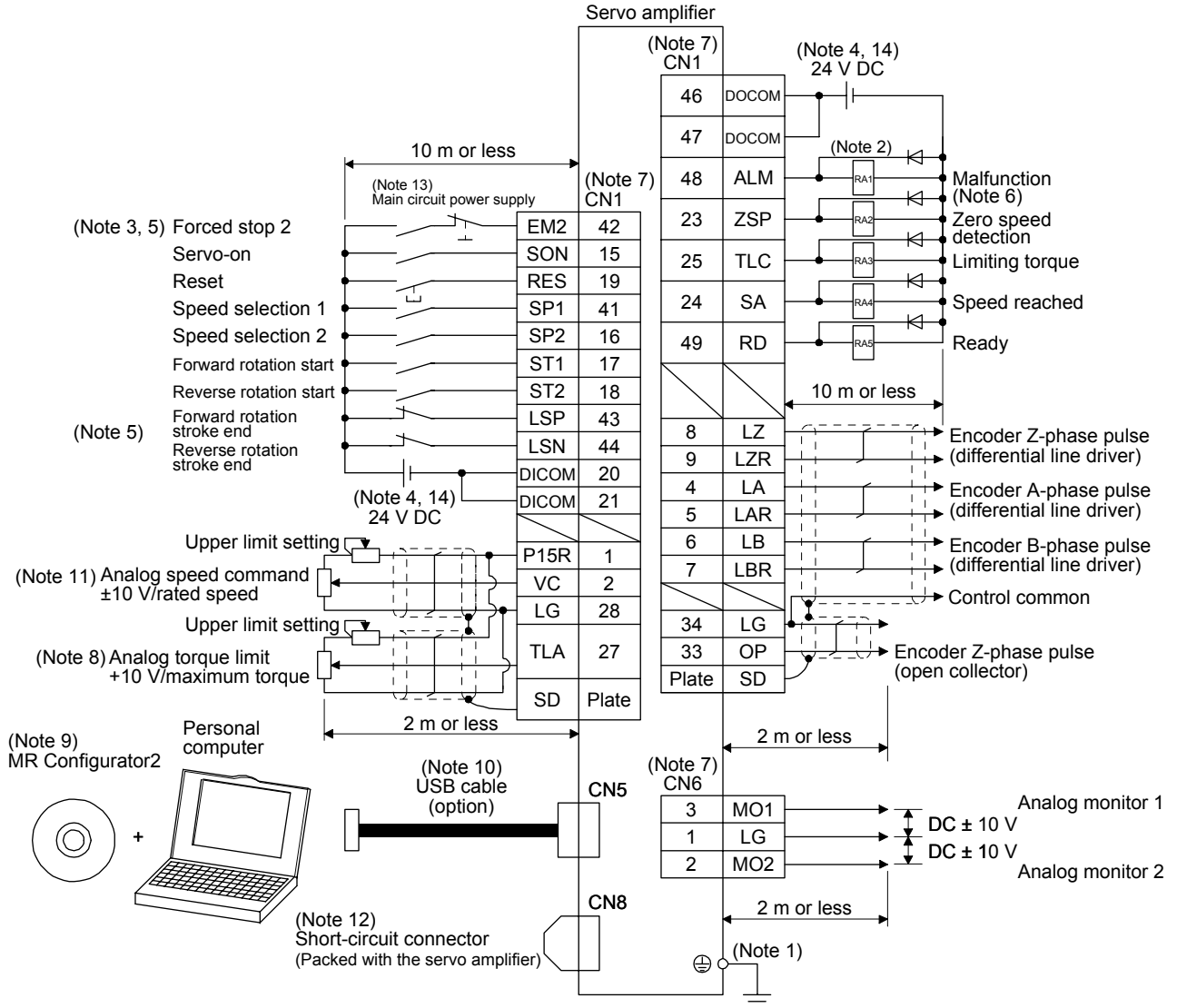


11. Use an external power supply when inputting a negative voltage.
12. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
13. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
14. Plus and minus of the power of source interface are the opposite of those of sink interface.

3. SIGNALS AND WIRING

(2) Source I/O interface

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

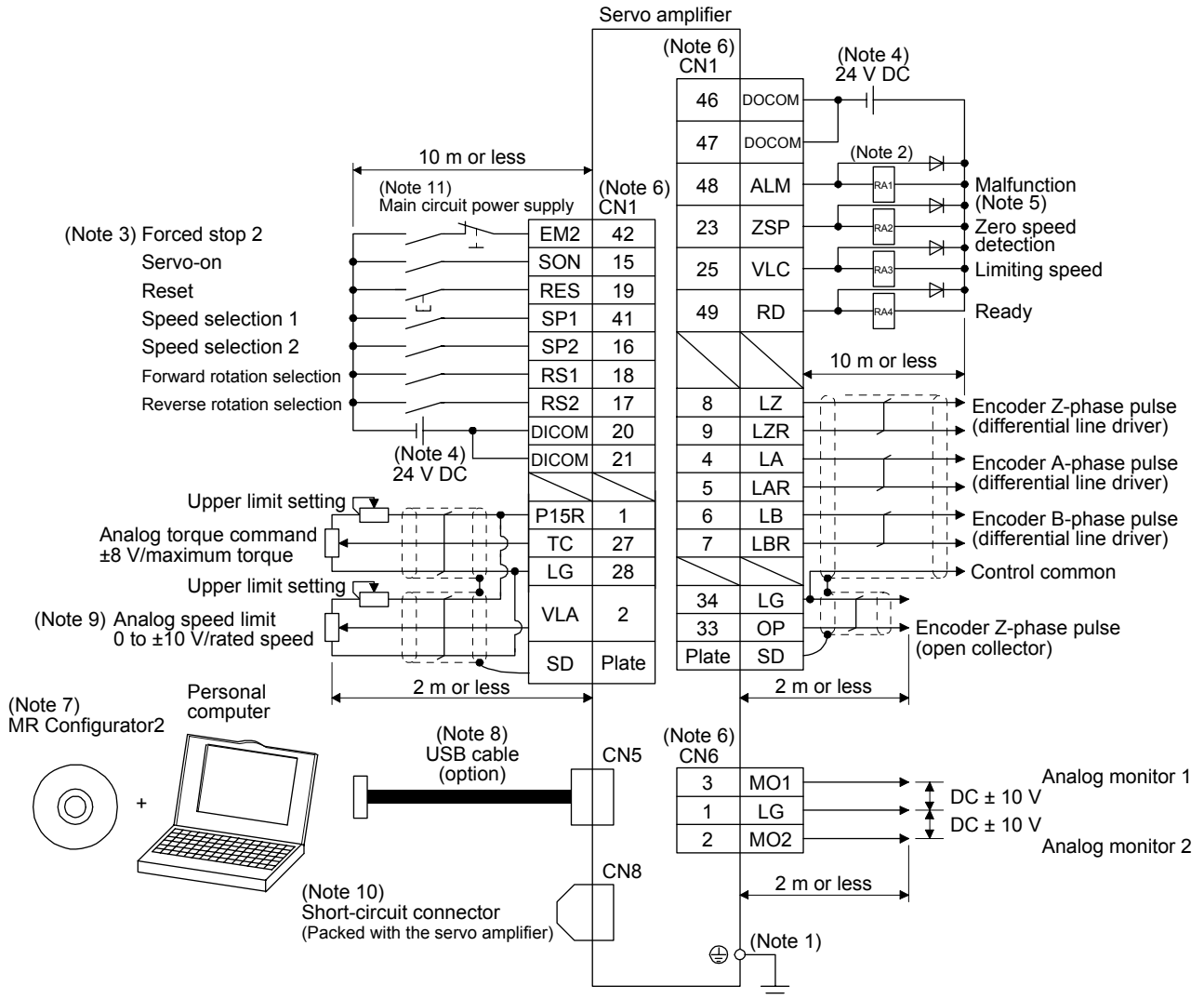


3. SIGNALS AND WIRING

3.2.3 Torque control mode

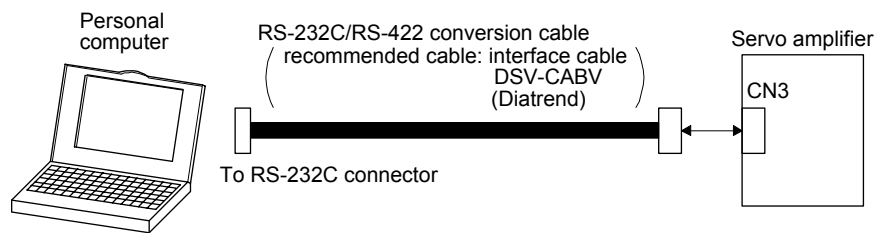
POINT
●EM2 has the same function as EM1 in the torque control mode.

(1) For sink I/O interface



3. SIGNALS AND WIRING

- Note
1. To prevent an electric shock, always connect the protective earth (PE) terminal (marked \oplus) 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 \pm 10% to interfaces from outside. The total current capacity is up to 500 mA. 500 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 24 V DC power supply can be used both for input signals and output signals.
 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-J. (Refer to section 11.7.) RS-422 communication function will be available in the future.
 8. Personal computers can also be connected via the CN3 connector, enabling RS-422 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.



9. Use an external power supply when inputting a negative voltage.
10. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
11. Configure a circuit to turn off EM2 when the main circuit 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.

3. SIGNALS AND WIRING

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.

Symbol	Connection target (application)	Description												
L1/L2/L3	Main circuit power supply	<p>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.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">Servo amplifier</td> <td style="text-align: center;">MR-J4-10A(-RJ) to MR-J4-70A(-RJ)</td> <td style="text-align: center;">MR-J4-100A(-RJ) to MR-J4-22KA(-RJ)</td> </tr> <tr> <td style="text-align: center;">Power</td> <td colspan="2" style="text-align: center;">L1/L2/L3</td> </tr> <tr> <td>3-phase 200 V AC to 240 V AC, 50 Hz/60 Hz</td> <td colspan="2"></td> </tr> <tr> <td>1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz</td> <td style="text-align: center;">L1/L3</td> <td></td> </tr> </table>	Servo amplifier	MR-J4-10A(-RJ) to MR-J4-70A(-RJ)	MR-J4-100A(-RJ) to MR-J4-22KA(-RJ)	Power	L1/L2/L3		3-phase 200 V AC to 240 V AC, 50 Hz/60 Hz			1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz	L1/L3	
Servo amplifier	MR-J4-10A(-RJ) to MR-J4-70A(-RJ)	MR-J4-100A(-RJ) to MR-J4-22KA(-RJ)												
Power	L1/L2/L3													
3-phase 200 V AC to 240 V AC, 50 Hz/60 Hz														
1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz	L1/L3													
P3/P4	Power factor improving DC reactor	<p>When not using the power factor improving DC reactor, connect P3 and P4(factory-wired).</p> <p>When using the power factor improving DC reactor, disconnect P3 and P4, and connect the power factor improving DC reactor to P3 and P4.</p> <p>Refer to section 11.11 for details.</p>												
P+/C/D	Regenerative option	<p>1) MR-J4-500A(-RJ) or less</p> <p>When using a servo amplifier built-in regenerative resistor, connect P+ and D (factory-wired).</p> <p>When using a regenerative option, disconnect P+ and D, and connect the regenerative option to P+ and C.</p> <p>2) MR-J4-700A(-RJ) to MR-J4-22KA(-RJ)</p> <p>MR-J4-700A(-RJ) to MR-J4-22KA(-RJ) do not have D.</p> <p>When using a servo amplifier built-in regenerative resistor, connect P+ and C (factory-wired).</p> <p>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.</p> <p>Refer to section 11.2 to 11.5 for details.</p>												
L11/L21	Control circuit power supply	<p>Supply the following power to L11 and L21.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">Servo amplifier</td> <td style="text-align: center;">MR-J4-10A(-RJ) to MR-J4-22KA(-RJ)</td> </tr> <tr> <td style="text-align: center;">Power</td> <td style="text-align: center;">L11/L21</td> </tr> <tr> <td>1-phase 200 V AC to 240 V AC</td> <td></td> </tr> </table>	Servo amplifier	MR-J4-10A(-RJ) to MR-J4-22KA(-RJ)	Power	L11/L21	1-phase 200 V AC to 240 V AC							
Servo amplifier	MR-J4-10A(-RJ) to MR-J4-22KA(-RJ)													
Power	L11/L21													
1-phase 200 V AC to 240 V AC														
U/V/W	Servo motor power output	<p>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.</p>												
N-	Power regenerative converter Power regenerative common converter Brake unit	<p>This terminal is used for a power regenerative converter, power regenerative common converter and brake unit.</p> <p>Refer to section 11.3 to 11.5 for details.</p>												
⊕	Protective earth (PE)	<p>Connect it to the grounding terminal of the servo motor and to the protective earth (PE) of the cabinet for grounding.</p>												

3. SIGNALS AND WIRING

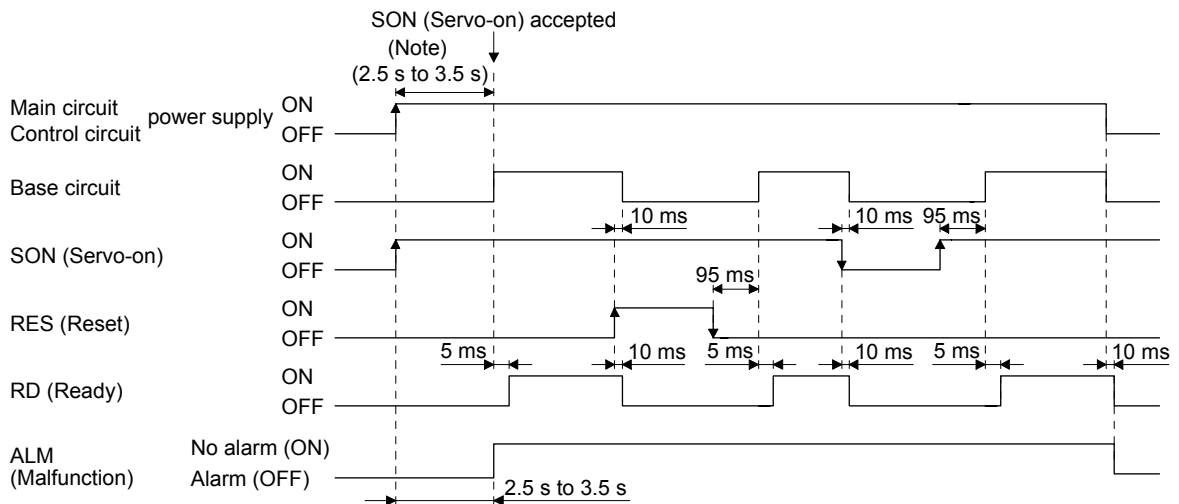
3.3.2 Power-on sequence

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

(1) Power-on procedure

- 1) Always use a magnetic contactor for the main circuit power supply wiring (3-phase: L1, L2, and L3, 1-phase: L1 and L3) as shown in above section 3.1. Configure up an external sequence to switch off the magnetic contactor as soon as an alarm occurs.
- 2) Switch on the control circuit power supply (L11 and L21) simultaneously with the main circuit power supply or before switching on the main circuit power supply. If the main circuit power supply is not on, the display shows the corresponding warning. However, by switching on the main circuit power supply, the warning disappears and the servo amplifier will operate properly.
- 3) The servo amplifier receives the SON (Servo-on) 2.5 s to 3.5 s after the main circuit power supply is switched on. Therefore, when SON (Servo-on) is switched on simultaneously with the main circuit 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.)
- 4) When RES (Reset) is switched on, the base circuit is shut off and the servo motor shaft coasts.

(2) Timing chart



Note. The time will be longer during the magnetic pole detection of a linear servo motor and direct drive motor.

3. SIGNALS AND WIRING

3.3.3 Wiring CNP1, CNP2, and CNP3

POINT
● For the wire sizes used for wiring, refer to section 11.9.
● MR-J4-500A(-RJ) or more do not have these connectors.

Use the servo amplifier power supply connector for wiring CNP1, CNP2, and CNP3.

(1) Connector

(a) MR-J4-10A(-RJ) to MR-J4-100A(-RJ)

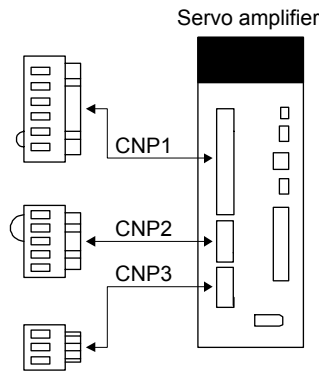


Table 3.1 Connector and applicable wire

Connector	Receptacle assembly	Applicable wire		Stripped length [mm]	Open tool	Manufacturer
		Size	Insulator OD			
CNP1	06JFAT-SAXGDK-H7.5	AWG18 to 14	3.9 mm or shorter	9	J-FAT-OT	JST
CNP2	05JFAT-SAXGDK-H5.0					
CNP3	03JFAT-SAXGDK-H7.5					

(b) MR-J4-200A(-RJ)/MR-J4-350A(-RJ)

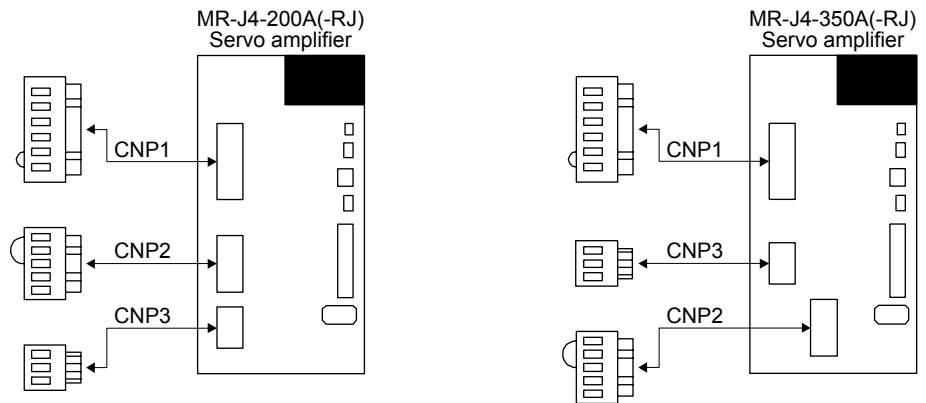


Table 3.2 Connector and applicable wire

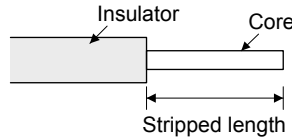
Connector	Receptacle assembly	Applicable wire		Stripped length [mm]	Open tool	Manufacturer
		Size	Insulator OD			
CNP1	06JFAT-SAXGFK-XL	AWG16 to 10	4.7 mm or shorter	11.5	J-FAT-OT-EXL	JST
CNP3	03JFAT-SAXGFK-XL					
CNP2	05JFAT-SAXGDK-H5.0	AWG18 to 14	3.9 mm or shorter	9		

3. SIGNALS AND WIRING

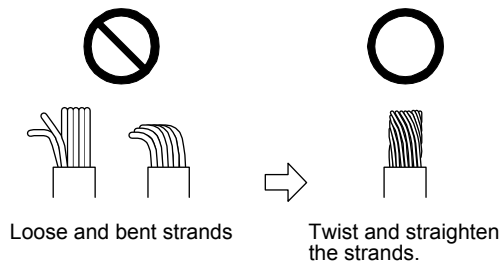
(2) Cable connection procedure

(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.



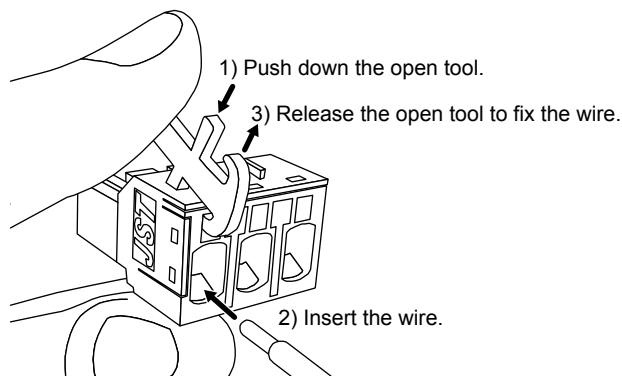
You can also use a ferrule to connect with the connectors. The following shows references to select ferrules according to wire sizes.

Servo amplifier	Wire size	Ferrule model (Phoenix Contact)		Crimp terminal (Phoenix Contact)
		For one	For two	
MR-J4-10A(-RJ) to MR-J4-100A(-RJ)	AWG16	AI1.5-10BK	AI-TWIN2×1.5-10BK	CRIMPFOX-ZA3
	AWG14	AI2.5-10BU		
MR-J4-200A(-RJ) to MR-J4-350A(-RJ)	AWG16	AI1.5-10BK	AI-TWIN2×1.5-10BK	
	AWG14	AI2.5-10BU	AI-TWIN2×2.5-10BU	
	AWG12	AI4-10GY		

(b) Inserting wire

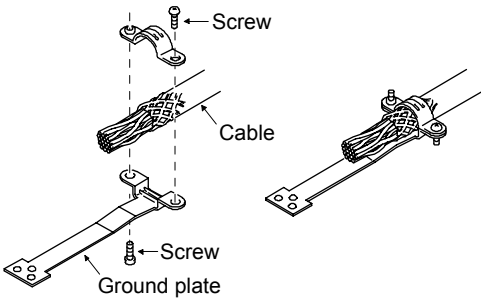
Insert the open tool as follows and push down it to open the spring. While the open tool is pushed down, insert the stripped wire into the wire insertion hole. Check the insertion depth so that the wire insulator does not get caught by the spring.

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 CNP3 connector for 2 kW and 3.5 kW.



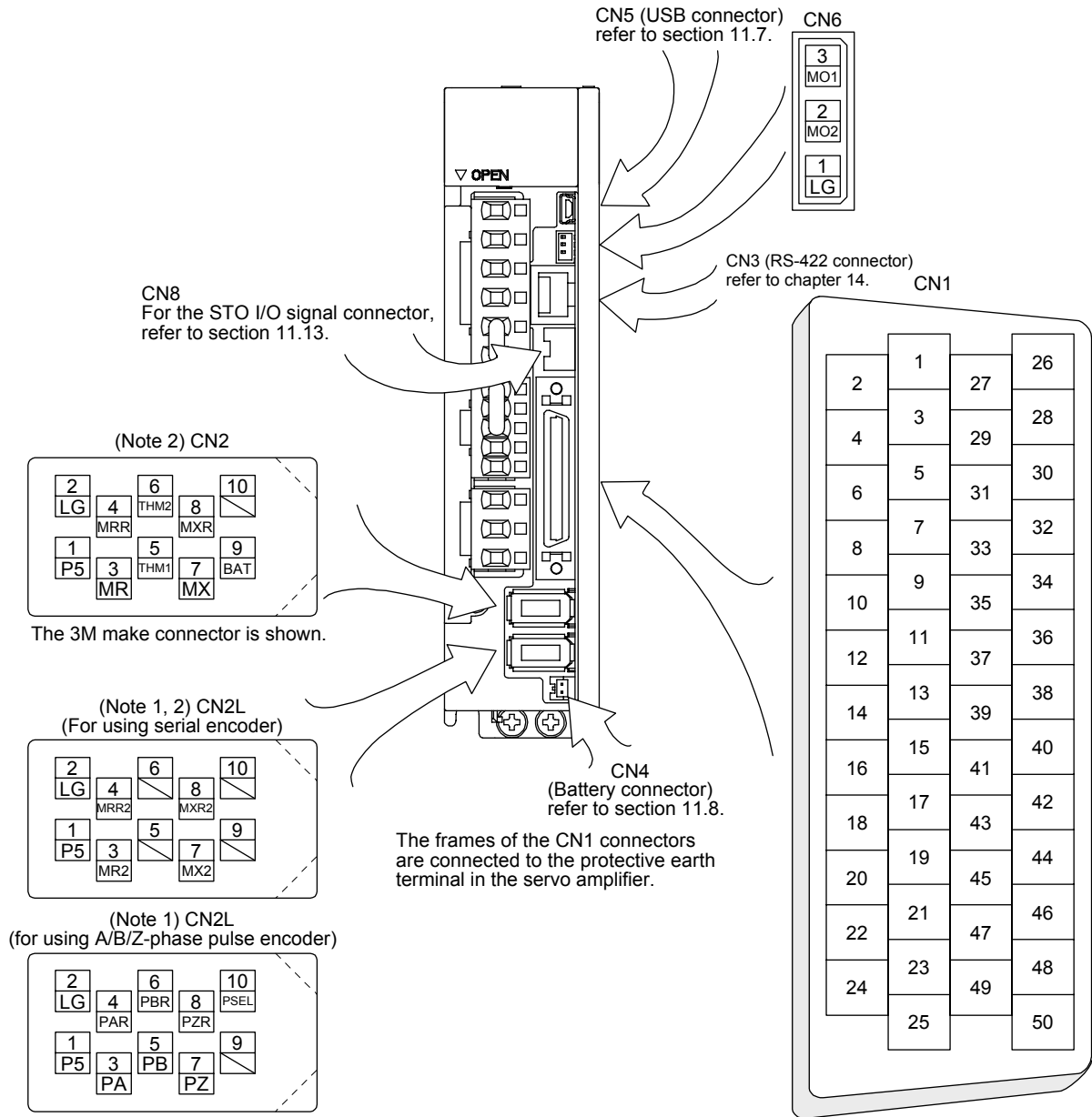
3. SIGNALS AND WIRING

3.4 Connectors and pin assignment

POINT
<ul style="list-style-type: none">● The pin assignment of the connectors are as viewed from the cable connector wiring section.● For the STO I/O signal connector (CN8), refer to chapter 13.● For the CN1 connector, securely connect the external conductive portion of the shielded cable to the ground plate and fix it to the connector shell.  <p>The diagram illustrates the assembly of a shielded cable connection. On the left, a perspective view shows a cable with a braided shield being secured to a metal ground plate. A screw is used to clamp the shield to the plate. On the right, a top-down view shows the cable's shielded portion inserted into a connector shell, with a screw securing the shield to the shell's ground contact point. Labels with arrows point to the 'Screw' at the top, the 'Cable' in the middle, and the 'Ground plate' at the bottom.</p>

3. SIGNALS AND WIRING

The servo amplifier front view shown is that of the MR-J4-20A(-RJ) or less. Refer to chapter 9 DIMENSIONS for the appearances and connector layouts of the other servo amplifiers.



- Note 1. The MR-J4-A-RJ servo amplifiers have CN2L connectors. This CN2L is a connector of 3M. When using any other connector, refer to each servo motor instruction manual.
- Note 2. An external encoder cannot be connected to the CN2 connector of the MR-J4-A-RJ servo amplifiers. When configuring the linear servo system or fully closed loop system with the MR-J4-A-RJ servo amplifier, connect an external encoder to the CN2L connector.

3. SIGNALS AND WIRING

The device assignment of the 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		P15R	P15R	P15R	P15R	P15R	P15R	
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/-				-/PP	
11	I	PG	PG/-				-/PG	
12		OPC	OPC/-				-/OPC	
13								
14								
15	I	SON	SON	SON	SON	SON	SON	Pr. PD03/Pr. PD04
16	I		-/SP2	SP2	SP2/SP2	SP2	SP2/-	Pr. PD05/Pr. PD06
17	I	PC	PC/ST1	ST1	ST1/RS2	RS2	RS2/PC	Pr. PD07/Pr. PD08
18	I	TL	TL/ST2	ST2	ST2/RS1	RS1	RS1/TL	Pr. PD09/Pr. PD10
19	I	RES	RES	RES	RES	RES	RES	Pr. PD11/Pr. PD12
20		DICOM	DICOM	DICOM	DICOM	DICOM	DICOM	
21		DICOM	DICOM	DICOM	DICOM	DICOM	DICOM	
22	O	INP	INP/SA	SA	SA/-		-/INP	Pr. PD23
23	O	ZSP	ZSP	ZSP	ZSP	ZSP	ZSP	Pr. PD24
24	O	INP	INP/SA	SA	SA/-		-/INP	Pr. PD25
25	O	TLC	TLC	TLC	TLC/MLC	VLC	VLC/TLC	Pr. PD26
26								
27	I	TLA	(Note 3) TLA	(Note 3) TLA	(Note 3) TLA/TC	TC	TC/TLA	
28		LG	LG	LG	LG	LG	LG	
29								
30		LG	LG	LG	LG	LG	LG	
31								
32								
33	O	OP	OP	OP	OP	OP	OP	
34		LG	LG	LG	LG	LG	LG	
35	I	NP	NP/-				-/NP	
36	I	NG	NG/-				-/NG	
37								
38								
39								
40								
41	I	CR	CR/SP1	SP1	SP1/SP1	SP1	SP1/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	I	LOP	LOP	LOP	LOP	LOP	LOP	Pr. PD21/Pr. PD22

3. SIGNALS AND WIRING

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 change mode, S/T: Speed/torque control change mode, T/P: Torque/position control change mode

3. TLA will be available when TL (External torque limit selection) is enabled with [Pr. PD03] to [Pr. PD22].

3. SIGNALS AND WIRING

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

○: 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

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode																
					P	S	T														
Forced stop 2	EM2	CN1-42	<p>Turn off EM2 (open between commons) to decelerate the servo motor to a stop with commands.</p> <p>Turn EM2 on (short between commons) in the forced stop state to reset that state.</p> <p>The following shows the setting of [Pr. PA04].</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <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> </thead> <tbody> <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> </tbody> </table> <p>EM2 and EM1 are mutually exclusive. EM2 has the same function as EM1 in the torque control mode.</p>	[Pr. PA04] setting	EM2/EM1	Deceleration method		EM2 or EM1 is off	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.	DI-1	○	○	○
[Pr. PA04] setting	EM2/EM1	Deceleration method																			
		EM2 or EM1 is off	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.																		
Forced stop 1	EM1	(CN1-42)	<p>When using EM1, set [Pr. PA04] to "0 _ _ _" to enable EM1.</p> <p>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.</p> <p>Turn EM1 on (short between commons) in the forced stop state to reset that state.</p>	DI-1	△	△	△														
Servo-on	SON	CN1-15	<p>Turn SON on to power on the base circuit and make the servo amplifier ready to operate. (servo-on status)</p> <p>Turn it off to shut off the base circuit and coast the servo motor.</p> <p>Set "_ _ _ 4" in [Pr. PD01] to switch this signal on (keep terminals connected) automatically in the servo amplifier.</p>	DI-1	○	○	○														
Reset	RES	CN1-19	<p>Turn on RES for more than 50 ms to reset the alarm.</p> <p>Some alarms cannot be deactivated by RES (Reset). Refer to section 8.1.</p> <p>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].</p> <p>This device is not designed to make a stop. Do not turn it on during operation.</p>	DI-1	○	○	○														

3. SIGNALS AND WIRING

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode																																								
					P	S	T																																						
Forward rotation stroke end	LSP	CN1-43	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.	DI-1	○	○	△																																						
Reverse rotation stroke end	LSN	CN1-44	<table border="1" style="margin-bottom: 10px;"> <thead> <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> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>○</td> <td>○</td> </tr> <tr> <td>0</td> <td>1</td> <td style="text-align: center;">/</td> <td>○</td> </tr> <tr> <td>1</td> <td>0</td> <td>○</td> <td style="text-align: center;">/</td> </tr> <tr> <td>0</td> <td>0</td> <td style="text-align: center;">/</td> <td style="text-align: center;">/</td> </tr> </tbody> </table> <p>Note. 0: Off 1: On</p> <p>Set [Pr. PD01] as indicated below to switch on the signals (keep terminals connected) automatically in the servo amplifier.</p> <table border="1" style="margin-bottom: 10px;"> <thead> <tr> <th rowspan="2">[Pr. PD01]</th> <th colspan="2">Status</th> </tr> <tr> <th>LSP</th> <th>LSN</th> </tr> </thead> <tbody> <tr> <td>_ 4 _ _</td> <td>Automatic on</td> <td style="text-align: center;">/</td> </tr> <tr> <td>_ 8 _ _</td> <td style="text-align: center;">/</td> <td>Automatic on</td> </tr> <tr> <td>_ C _ _</td> <td>Automatic on</td> <td>Automatic on</td> </tr> </tbody> </table> <p>When LSP or LSN turns off, [AL. 99 Stroke limit warning] occurs, and WNG (Warning) turns on. When using WNG, enable it by the setting of [Pr. PD23] to [Pr. PD28].</p> <p>In the torque control mode, this device cannot be used during normal operation. It can be used during the magnetic pole detection in the linear servo motor control mode and the DD motor control mode. Also, when the magnetic pole detection in the torque control mode is completed, this signal will be disabled.</p>	(Note) Input device		Operation		LSP	LSN	CCW direction	CW direction	1	1	○	○	0	1	/	○	1	0	○	/	0	0	/	/	[Pr. PD01]	Status		LSP	LSN	_ 4 _ _	Automatic on	/	_ 8 _ _	/	Automatic on	_ C _ _	Automatic on	Automatic on	DI-1	○	○	△
(Note) Input device		Operation																																											
LSP	LSN	CCW direction	CW direction																																										
1	1	○	○																																										
0	1	/	○																																										
1	0	○	/																																										
0	0	/	/																																										
[Pr. PD01]	Status																																												
	LSP	LSN																																											
_ 4 _ _	Automatic on	/																																											
_ 8 _ _	/	Automatic on																																											
_ C _ _	Automatic on	Automatic on																																											
External torque limit selection	TL	CN1-18	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).	DI-1	○	△	/																																						
Internal torque limit selection	TL1	/	To select [Pr. PC35 Internal torque limit 2], enable TL1 with [Pr. PD03] to [Pr. PD22]. For details, refer to section 3.6.1 (5).	DI-1	△	△	△																																						
Forward rotation start	ST1	CN1-17	This is used to start the servo motor. The following shows the directions.	DI-1	/	○	/																																						
Reverse rotation start	ST2	CN1-18	<table border="1" style="margin-bottom: 10px;"> <thead> <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> </thead> <tbody> <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> </tbody> </table> <p>Note. 0: Off 1: On</p> <p>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.</p>	(Note) Input device		Servo motor starting direction	ST2	ST1	0	0	Stop (servo-lock)	0	1	CCW	1	0	CW	1	1	Stop (servo-lock)	DI-1	/	/	/																					
(Note) Input device		Servo motor starting direction																																											
ST2	ST1																																												
0	0	Stop (servo-lock)																																											
0	1	CCW																																											
1	0	CW																																											
1	1	Stop (servo-lock)																																											

3. SIGNALS AND WIRING

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode																																																																																
					P	S	T																																																																														
Forward rotation selection	RS1	CN1-18	<p>This is used to select a servo motor torque generation directions. The following shows the torque generation directions.</p> <table border="1"> <thead> <tr> <th colspan="2">(Note) Input device</th> <th rowspan="2">Torque generation direction</th> </tr> <tr> <th>RS2</th> <th>RS1</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>Note. 0: Off 1: On</p>	(Note) Input device		Torque generation direction	RS2	RS1	0	0	Torque is not generated.	0	1	Forward rotation in power running mode/reverse rotation in regenerative mode	1	0	Reverse rotation in power running mode/forward rotation in regenerative mode	1	1	Torque is not generated.	DI-1			○																																																													
(Note) Input device		Torque generation direction																																																																																			
RS2	RS1																																																																																				
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1	1	Torque is not generated.																																																																																			
Reverse rotation selection	RS2	CN1-17																																																																																			
Speed selection 1	SP1	CN1-41	<p>1. For speed control mode This is used to select the command speed for operation.</p> <table border="1"> <thead> <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> </thead> <tbody> <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> </tbody> </table> <p>Note. 0: Off 1: On</p> <p>2. For the torque control mode This is used to select the limit speed for operation.</p> <table border="1"> <thead> <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> </thead> <tbody> <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> </tbody> </table> <p>Note. 0: Off 1: On</p>	(Note) Input device			Speed command	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) 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	DI-1		○	○
(Note) Input device				Speed command																																																																																	
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																																																																																		
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1	0	0	Pr. PC08 Internal speed command 4																																																																																		
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1	1	0	Pr. PC10 Internal speed command 6																																																																																		
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SP3	SP2	SP1																																																																																			
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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																																																																																		
Speed selection 2	SP2	CN1-16		DI-1		○	○																																																																														
Speed selection 3	SP3			DI-1		△	△																																																																														

3. SIGNALS AND WIRING

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode																			
					P	S	T																	
Proportion control	PC	CN1-17	<p>Turn PC on to switch the speed amplifier from the proportional integral type to the proportional type.</p> <p>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.</p> <p>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).</p>	DI-1	○	△																		
Clear	CR	CN1-41	<p>Turn CR on to clear the position control counter droop pulse on its leading edge. The pulse width should be 10 ms or longer.</p> <p>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.</p>	DI-1	○																			
Electronic gear selection 1	CM1		<p>The combination of CM1 and CM2 enables you to select four different electronic gear numerators set in the parameters.</p> <p>CM1 and CM2 cannot be used in the absolute position detection system.</p> <table border="1" style="margin: 10px auto;"> <thead> <tr> <th colspan="2">(Note) Input device</th> <th rowspan="2">Electronic gear numerator</th> </tr> <tr> <th>CM2</th> <th>CM1</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>Note. 0: Off 1: On</p>	(Note) Input device		Electronic gear numerator	CM2	CM1	0	0	Pr. PA06	0	1	Pr. PC32	1	0	Pr. PC33	1	1	Pr. PC34	DI-1	△		
(Note) Input device		Electronic gear numerator																						
CM2	CM1																							
0	0	Pr. PA06																						
0	1	Pr. PC32																						
1	0	Pr. PC33																						
1	1	Pr. PC34																						
Electronic gear selection 2	CM2			DI-1	△																			
Gain switching	CDP		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.	DI-1	△	△	△																	

3. SIGNALS AND WIRING

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode																				
					P	S	T																		
Control switching	LOP	CN1-45	<p>«Position/speed control change mode» This is used to select the control mode in the position/speed control switching mode.</p> <table border="1"> <thead> <tr> <th>(Note) LOP</th> <th>Control mode</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Position</td> </tr> <tr> <td>1</td> <td>Speed</td> </tr> </tbody> </table> <p>Note. 0: Off 1: On</p> <p>«Speed/torque control change mode» This is used to select the control mode in the speed/torque control switching mode.</p> <table border="1"> <thead> <tr> <th>(Note) LOP</th> <th>Control mode</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Speed</td> </tr> <tr> <td>1</td> <td>Torque</td> </tr> </tbody> </table> <p>Note. 0: Off 1: On</p> <p>«Torque/position control change mode» This is used to select the control mode in the torque/position control switching mode.</p> <table border="1"> <thead> <tr> <th>(Note) LOP</th> <th>Control mode</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Torque</td> </tr> <tr> <td>1</td> <td>Position</td> </tr> </tbody> </table> <p>Note. 0: Off 1: On</p>	(Note) LOP	Control mode	0	Position	1	Speed	(Note) LOP	Control mode	0	Speed	1	Torque	(Note) LOP	Control mode	0	Torque	1	Position	DI-1			Refer to Function and application
(Note) LOP	Control mode																								
0	Position																								
1	Speed																								
(Note) LOP	Control mode																								
0	Speed																								
1	Torque																								
(Note) LOP	Control mode																								
0	Torque																								
1	Position																								
Second acceleration/deceleration selection	STAB2		<p>The device allows selection of the acceleration/deceleration time constant at servo motor rotation in the speed control mode or torque control mode. The s-pattern acceleration/deceleration time constant is always uniform.</p> <table border="1"> <thead> <tr> <th>(Note) STAB2</th> <th>Acceleration/deceleration time constant</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>Note. 0: Off 1: On</p>	(Note) STAB2	Acceleration/deceleration time constant	0	Pr. PC01 Acceleration time constant Pr. PC02 Deceleration time constant	1	Pr. PC30 Acceleration time constant 2 Pr. PC31 Deceleration time constant 2	DI-1		△	△												
(Note) STAB2	Acceleration/deceleration time constant																								
0	Pr. PC01 Acceleration time constant Pr. PC02 Deceleration time constant																								
1	Pr. PC30 Acceleration time constant 2 Pr. PC31 Deceleration time constant 2																								

3. SIGNALS AND WIRING

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
ABS transfer mode	ABSM	CN1-17	This is an ABS transfer mode request device. When "___1" is set in [Pr. PA03] and absolute position detection system by DIO is selected, CN1-17 pin will become ABSM. (Refer to chapter 12.)	DI-1	△		
ABS request	ABSR	CN1-18	This is an ABS request device. When "___1" is set in [Pr. PA03] and absolute position detection system by DIO is selected, CN1-18 pin will become ABSR. (Refer to chapter 12.)	DI-1	△		
Fully closed loop selection	CLD		This is used when the semi closed loop control/fully closed loop control switching is enabled with [Pr. PE01]. Turn off CLD to select the semi closed loop control, and turn on CLD to select the fully closed loop control.	DI-1	△		
Motor-side/load-side position deviation counter clear	MECR		Turn on MECR to clear the motor-side/load-side position deviation counter to zero. - It operates during the fully closed loop control. - It does not affect the position control droop pulses. - Turning on this device during the semi closed loop control does not affect the operation. - Turning on this device while the fully closed loop control error detection function is disabled in [Pr. PE03] does not affect the operation.	DI-1	△		

(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	○	○	○
Dynamic brake interlock	DB		When using the signal, enable it by setting [Pr. PD23] to [Pr. PD26] and [Pr. PD28]. DB turns off when the dynamic brake needs to operate. When using the external dynamic brake on the servo amplifier of 11 kW or more, this device is required. (Refer to section 12.6.) For the servo amplifier of 7 kW or less, it is not necessary to use this device.	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	CN1-22 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	CN1-25	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	○	○	

3. SIGNALS AND WIRING

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Zero speed detection	ZSP	CN1-23	<p>ZSP turns on when the servo motor speed is zero speed (50r/min) or less. Zero speed can be changed with [Pr. PC17].</p> <p>Forward rotation direction OFF level 70 r/min ON level 50 r/min</p> <p>Servo motor speed 0 r/min</p> <p>Reverse rotation direction ON level -50 r/min OFF level -70 r/min</p> <p>ZSP (Zero speed detection) ON OFF</p> <p>20 r/min (Hysteresis width) [Pr. PC17]</p> <p>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.</p>	DO-1	○	○	○
Electromagnetic brake interlock	MBR		<p>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.</p>	DO-1	△	△	△
Warning	WNG		<p>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.</p>	DO-1	△	△	△
Battery warning	BWNG		<p>BWNG turns on when [AL. 92 Battery cable disconnection warning] or [AL. 9F Battery warning] has occurred. When the battery warning is not occurring, turning on the power will turn off BWNG after 2.5 s to 3.5 s.</p>	DO-1	△	△	△
Alarm code	ACD0	(CN1-24)	<p>To use these signals, set " ___ 1" in [Pr. PD34]. This signal is outputted when an alarm occurs.</p>	DI-1	△	△	△
	ACD1	(CN1-23)	<p>When an alarm is not occurring, respective ordinary signals are outputted. For details of the alarm codes, refer to chapter 8.</p>				
	ACD2	(CN1-22)	<p>When "Enabled (absolute position detection system by DIO) (___ 1)" is selected in [Pr. PA03] and when MBR, DB, or ALM is assigned to CN1-22 pin, CN1-23 pin, or CN1-24 pin, selecting alarm code output will generate [AL. Parameter error].</p>				
Variable gain selection	CDPS		<p>CDPS turns on during gain switching.</p>	DO-1	△	△	△
Absolute position undetermined	ABSV		<p>ABSV turns on when the absolute position is undetermined.</p>	DO-1	△		
ABS transmission data bit 0	ABSB0	(CN1-22)	<p>This is used to output ABS transmission data bit 0. When "Enabled (absolute position detection system by DIO) (___ 1)" is selected in [Pr. PA03], the CN1-22 pin will become ABSB0 only during ABS transfer mode. (Refer to chapter 12.)</p>	DO-1	△		
ABS transmission data bit 1	ABSB1	(CN1-23)	<p>This is used to output ABS transmission data bit 1. When "Enabled (absolute position detection system by DIO) (___ 1)" is selected in [Pr. PA03], the CN1-23 pin will become ABSB1 only during ABS transfer mode. (Refer to chapter 12.)</p>	DO-1	△		
ABS transmission data ready	ABST	(CN1-25)	<p>This is used to output ABS transmission data ready. When "Enabled (absolute position detection system by DIO) (___ 1)" is selected in [Pr. PA03], CN1-25 pin will become ABST only during ABS transfer mode. (Refer to chapter 12.)</p>	DO-1	△		

3. SIGNALS AND WIRING

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
During tough drive	MTTR		MTTR turns on when the instantaneous power failure tough drive operates while the tough drive function selection is enabled with [Pr. PA20].	DO-1	△	△	△
During fully closed loop control	CLDS		CLDS turns on during fully closed loop control.	DO-1	△		

(2) Input signal

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Analog torque limit	TLA	CN1-27	To use the signal in the speed control mode, enable TL (External torque limit selection) with [Pr. PD23] to [Pr. PD28]. 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 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 PG NG	CN1-10 CN1-35 CN1-11 CN1-36	This is used to enter a command pulse train. • For open-collector type (max. input frequency: 200 kpps) Input the forward rotation pulse train between PP and DOCOM. Input the reverse rotation pulse train between NP and DOCOM. • For differential receiver type (max. input frequency: 4 Mpps) Input the forward rotation pulse train between PG and PP. Input the reverse rotation pulse train between NG and NP. The command input pulse train form, pulse train logic, and command input pulse train filter are changed in [Pr. PA13]. When the command pulse train is between 1 Mpps and 4 Mpps, set [Pr. PA13] to "_ 0 _ _".	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	The encoder output pulses set in [Pr. PA15] are outputted 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 $\pi/2$.	DO-2	○	○	○
Encoder B-phase pulse (differential line driver)	LB LBR	CN1-6 CN1-7	The relation between rotation direction and phase difference of the A-phase and B-phase pulses can be changed with [Pr. PC19].				

3. SIGNALS AND WIRING

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
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	CN6-3	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	CN6-2	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 I/F	SDP SDN RDP RDN	CN3-5 CN3-4 CN3-3 CN3-6	These are terminals for RS-422 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% 500 mA) to 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 power input	OPC	CN1-12	When inputting a pulse train in the open-collector type, 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.		○	○	○
15 V DC power supply	P15R	CN1-1	This outputs 15 V DC to between P15R and LG. This is available as power for TC, TLA, VC, or VLA. Permissible current: 30 mA		○	○	○
Control common	LG	CN1-3 CN1-28 CN1-30 CN1-34 CN3-1 CN3-7 CN6-1	This is a common terminal for TLA, TC, VC, VLA, FPA, FPB, OP, MO1, MO2, and P15R. Pins are connected internally.		○	○	○
Shield	SD	Plate	Connect the external conductive portion of the shielded cable.		○	○	○

3. SIGNALS AND WIRING

3.6 Detailed explanation of signals

3.6.1 Position control mode

POINT		
<p>● Adjust the logic of a positioning module and command pulse as follows.</p> <ul style="list-style-type: none"> ▪ Q series/L series positioning module 		
	Command pulse logic setting	
Signal type	Q series/L series positioning module Pr. 23 setting	MR-J4-_A(-RJ) 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 _)
<p>Note. For Q series and L series, the logic means N-side waveform. Therefore, reverse the input pulse logic of the servo amplifier.</p>		
<ul style="list-style-type: none"> ▪ F series positioning module 		
	Command pulse logic setting	
Signal type	F series positioning module (fixed)	MR-J4-_A(-RJ) servo amplifier [Pr. PA13] setting
Open-collector Differential line driver	Negative logic	Negative logic (_ _ 1 _)

(1) Pulse train input

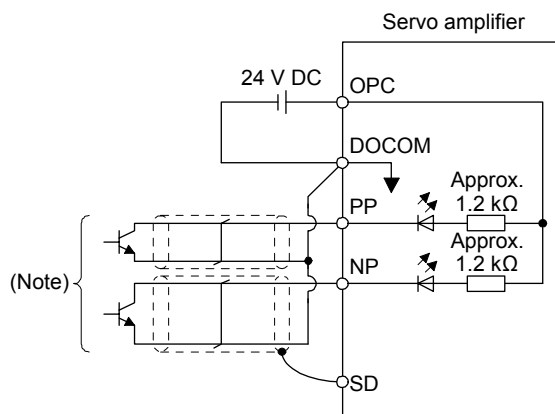
(a) Input pulse waveform selection

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.

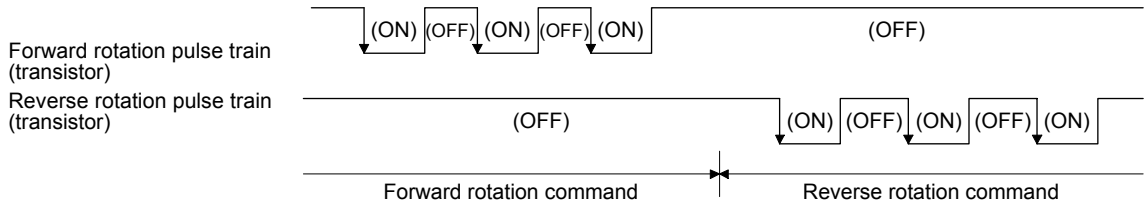


Note. Pulse train input interface is comprised of a photocoupler.

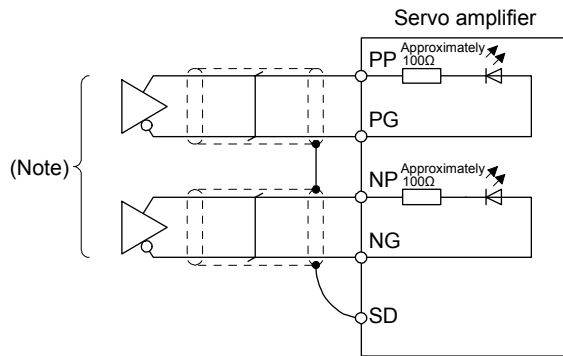
If a resistor is connected to the pulse train signal line, it may malfunction due to reduction in current.

3. SIGNALS AND WIRING

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

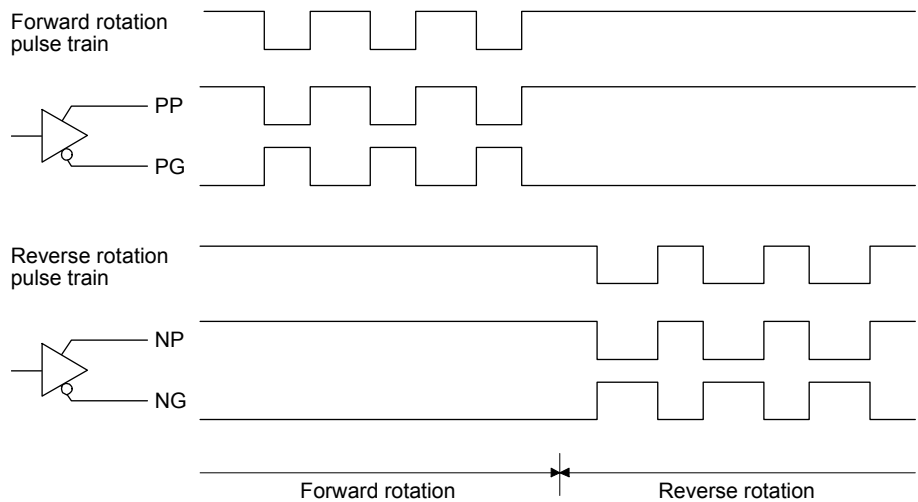


- 2) Differential line driver type
Connect as follows.



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.

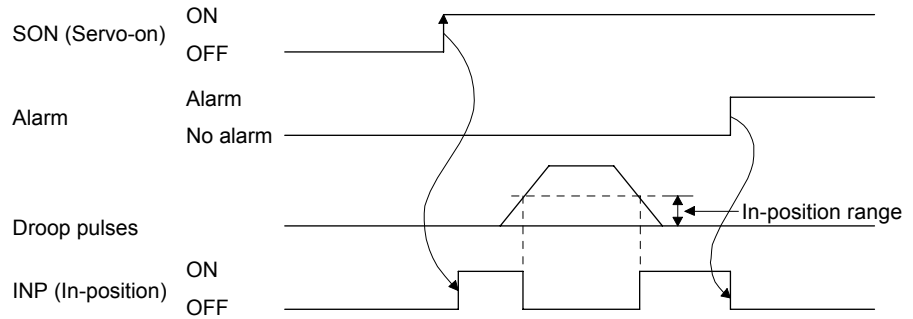
The following section explains about the case where the negative logic and the forward/reverse rotation pulse trains are set to "0 0 1 0" in [Pr. PA13]. The waveforms of PP, PG, NP, and NG are based on LG.



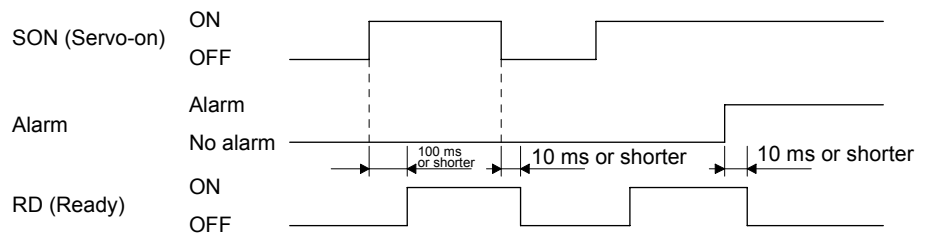
3. SIGNALS AND WIRING

(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

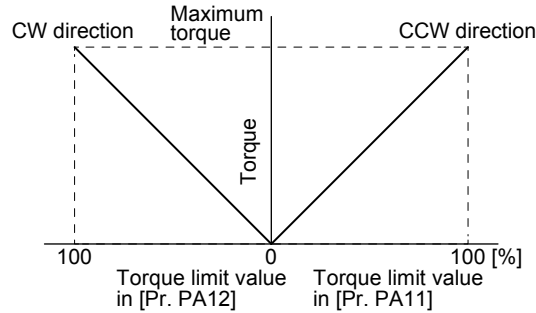
3. SIGNALS AND WIRING

(5) Torque limit

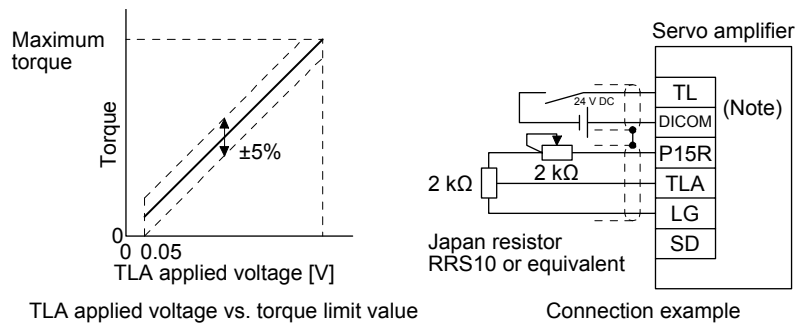
CAUTION ● If the torque limit is canceled during servo-lock, the servo motor may suddenly rotate according to position deviation in respect to the command position.

(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.



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], you can 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.

3. SIGNALS AND WIRING

(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. SIGNALS AND WIRING

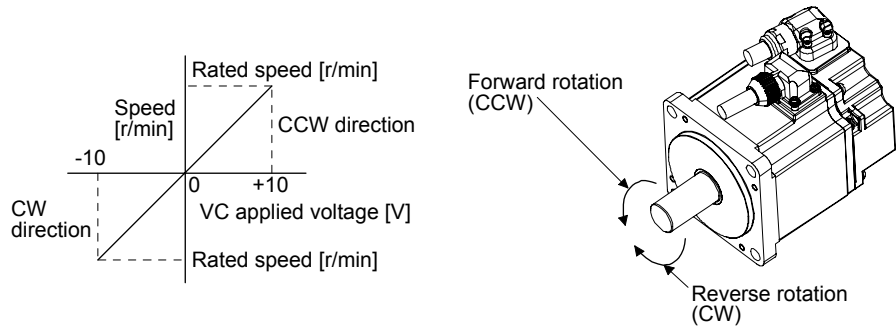
3.6.2 Speed control mode

(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].



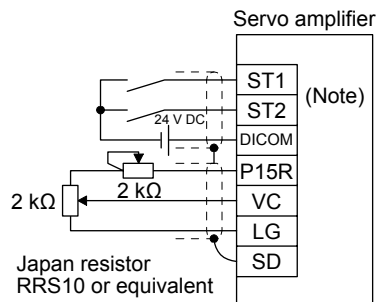
The following table indicates the rotation direction according to ST1 (Forward rotation start) and ST2 (Reverse rotation start) combination.

(Note 1) Input device		(Note 2) Rotation direction			
ST2	ST1	VC (Analog speed command)			Internal speed command
		Polarity: +	0 V	Polarity: -	
0	0	Stop (servo-lock)	Stop (servo-lock)	Stop (servo-lock)	Stop (servo-lock)
0	1	CCW	Stop (no servo-lock)	CW	CCW
1	0	CW		CCW	CW
1	1	Stop (servo-lock)	Stop (servo-lock)	Stop (servo-lock)	Stop (servo-lock)

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.

3. SIGNALS AND WIRING

- (b) SP1 (Speed selection 1), SP2 (Speed selection 2), and speed command value
 Select any of the speed settings by the internal speed commands 1 to 3 and by VC (Analog speed command) using SP1 (Speed selection 1) and SP2 (Speed selection 2) as follows.

(Note) Input device		Speed command value
SP2	SP1	
0	0	VC (Analog speed command)
0	1	Pr. PC05 Internal speed command 1
1	0	Pr. PC06 Internal speed command 2
1	1	Pr. PC07 Internal speed command 3

Note. 0: Off
 1: On

To select VC (Analog speed command) and a speed command value of internal speed commands 1 to 7, enable SP3 (Speed selection 3) with [Pr. PD03] to [Pr. PD22].

(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

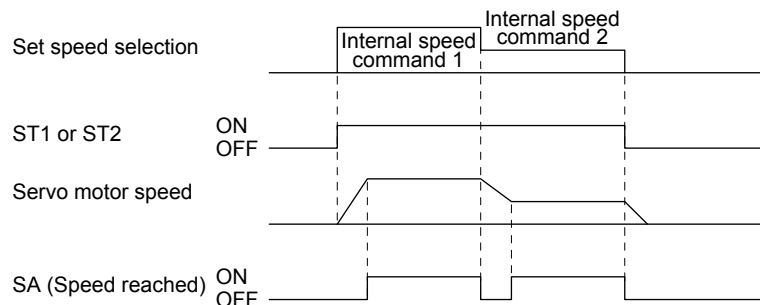
Note. 0: Off
 1: On

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. SIGNALS AND WIRING

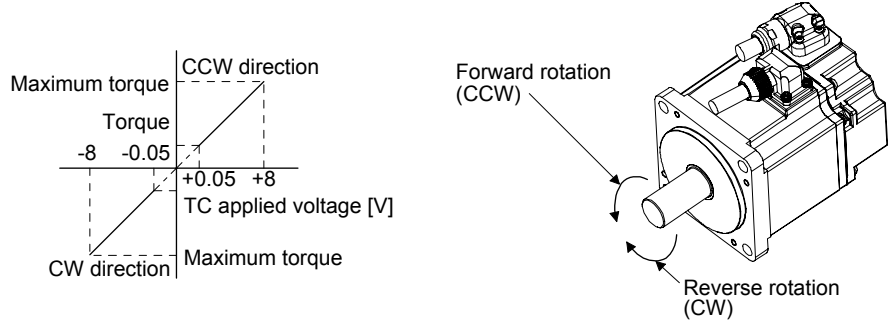
3.6.3 Torque control mode

(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].



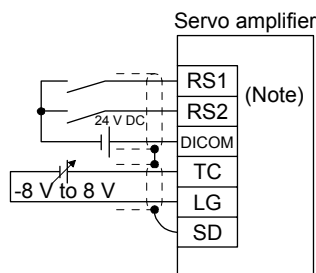
Generated torque command values will vary about 5% relative to the voltage depending on products. The torque may vary if the voltage is low (-0.05 V to 0.05 V) and the actual speed is close to the limit value. In such a case, increase the speed limit value.

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.

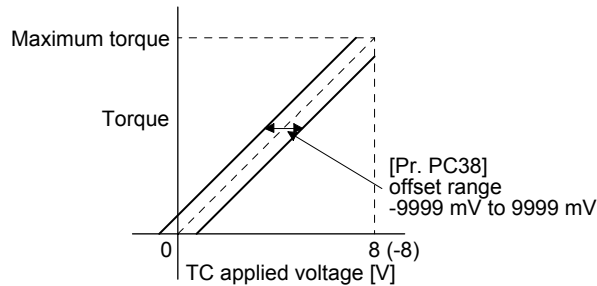


Note. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.

3. SIGNALS AND WIRING

(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.

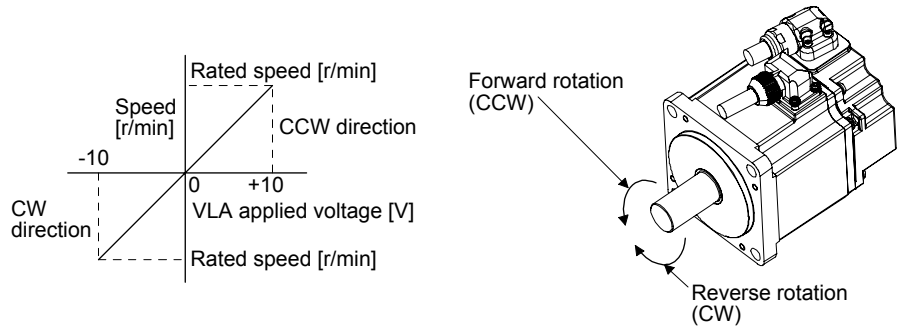
(3) Speed limit

(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.



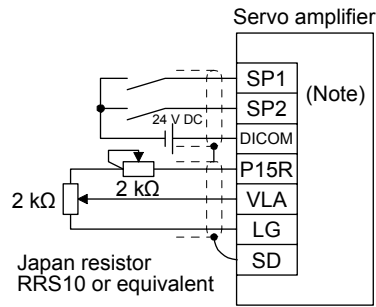
The following table indicates the limit direction according to RS1 (Forward rotation selection) and RS2 (Reverse rotation selection) combination.

(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

3. SIGNALS AND WIRING

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 limit value selection

Select any of the speed settings by the internal speed limits 1 to 7 and by VLA (Analog speed limit) using SP1 (Speed selection 1), SP2 (Speed selection 2), and SP3 (Speed selection 3) as follows.

(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. SIGNALS AND WIRING

3.6.4 Position/speed control switching mode

Set " ___ 1" in [Pr. PA01] to switch to the position/speed control switching mode. This function is not available in the absolute position detection system.

(1) LOP (control switching)

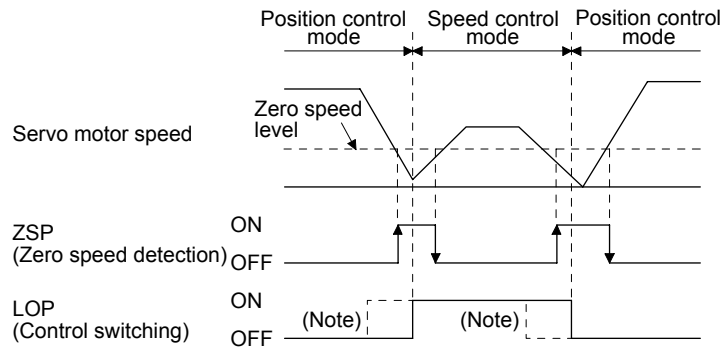
Use LOP (Control switching) to switch between the position control mode and the speed control mode with an external contact. The following shows a relation between LOP and control modes.

(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)

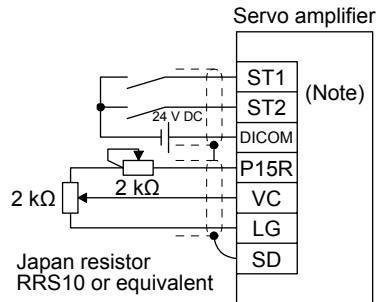
3. SIGNALS AND WIRING

(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

Select any of the speed settings by the internal speed commands 1 to 3 and by VC (Analog speed command) using SP1 (Speed selection 1) and SP2 (Speed selection 2) as follows.

(Note) Input device		Speed command value
SP2	SP1	
0	0	VC (Analog speed command)
0	1	Pr. PC05 Internal speed command 1
1	0	Pr. PC06 Internal speed command 2
1	1	Pr. PC07 Internal speed command 3

Note. 0: Off
1: On

To select VC (Analog speed command) and a speed command value of internal speed commands 1 to 7, enable SP3 (Speed selection 3) with [Pr. PD03] to [Pr. PD22].

(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.

3. SIGNALS AND WIRING

- (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.

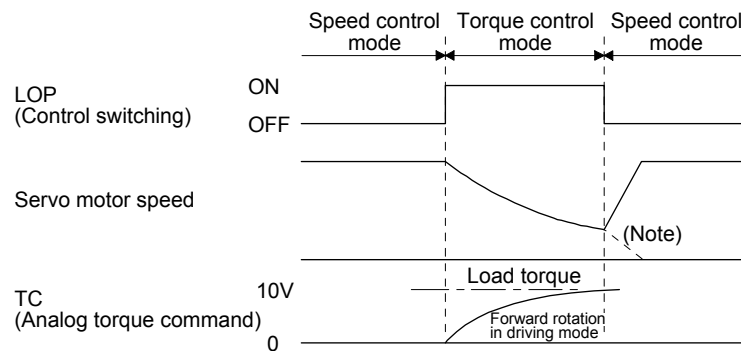
(1) LOP (control switching)

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)

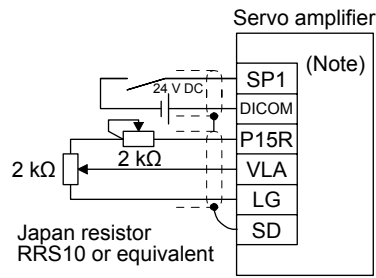
- (4) Speed limit in torque control mode
 - (a) Speed limit value and speed

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).

3. SIGNALS AND WIRING

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 limit value selection

Select any of the speed settings by the internal speed limit 1 and by VLA (Analog speed limit) using SP1 (Speed selection 1) as follows.

(Note) Input device	Speed command value
SP1	
0	VLA (Analog speed limit)
1	Pr. PC05 Internal speed limit 1

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 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. SIGNALS AND WIRING

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)

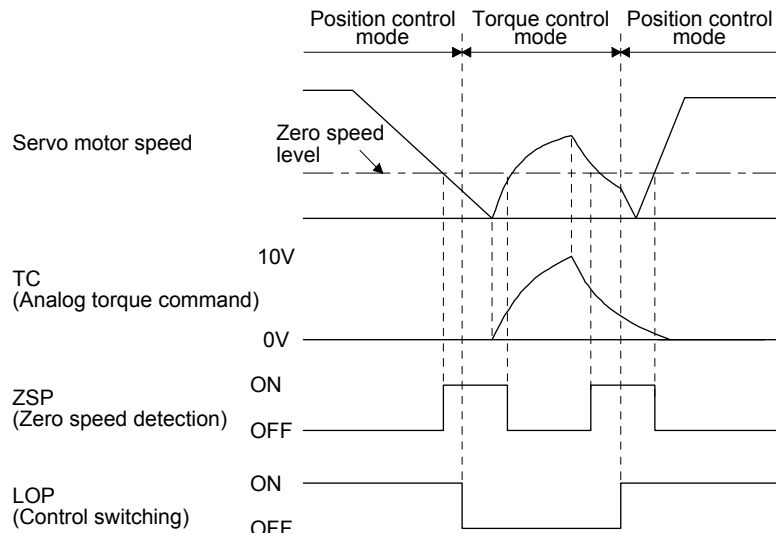
Use LOP (Control switching) to switch between the torque control mode and the position control mode with an external contact. The following shows a relation between LOP and control modes.

(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. SIGNALS AND WIRING

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.

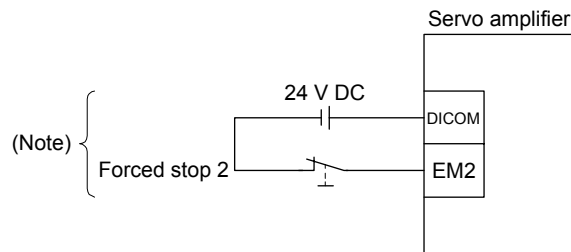
3.7.1 Forced stop deceleration function (SS1)

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



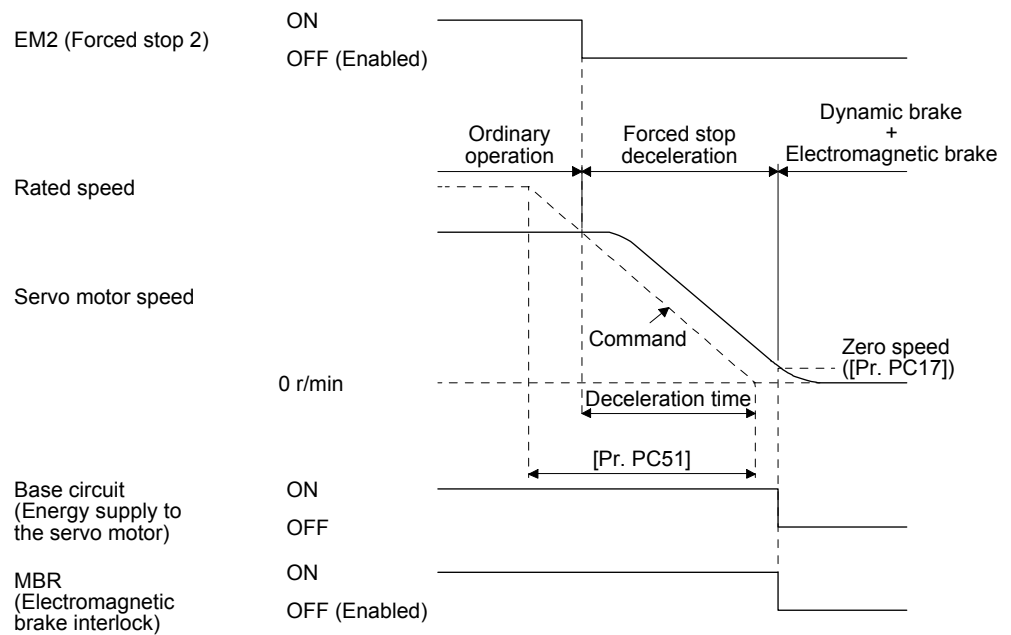
Note. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.

3. SIGNALS AND WIRING

(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.

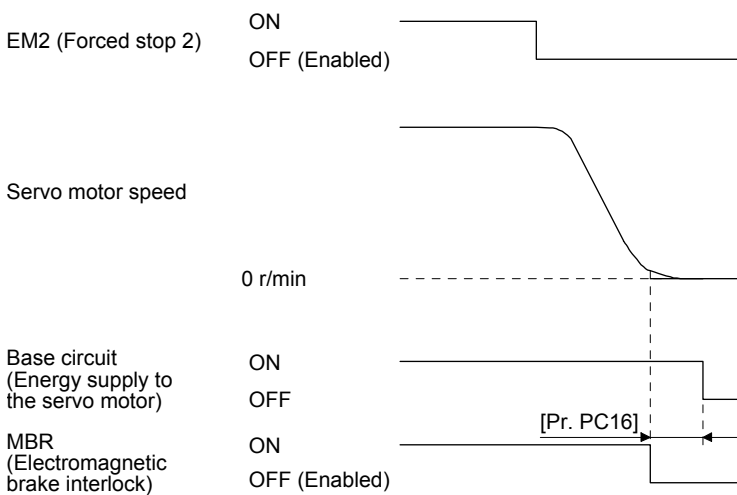


3. SIGNALS AND WIRING

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. SIGNALS AND WIRING

3.7.3 Vertical axis freefall prevention function

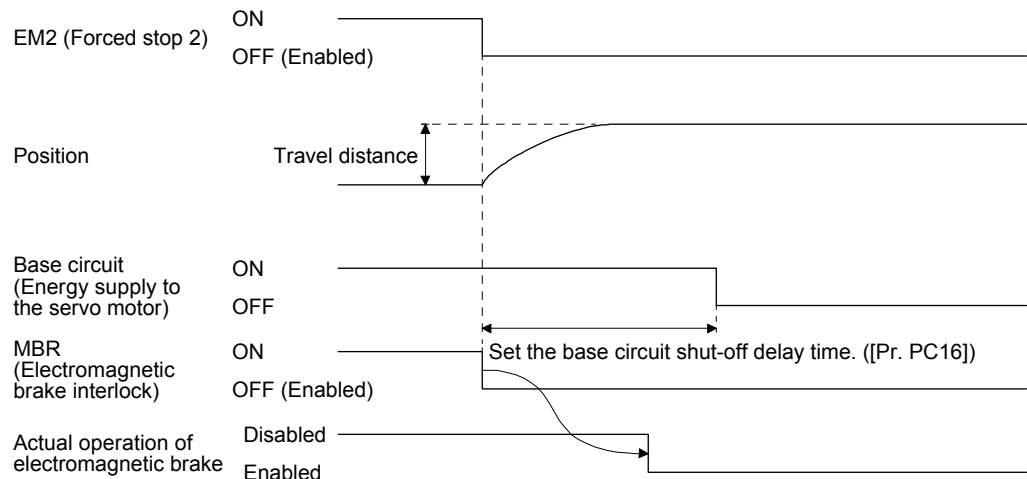
The vertical axis freefall prevention function avoids machine damage by pulling up the shaft slightly like the following case.

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, those 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) If STO is turned off during forced stop deceleration, [AL.63 STO timing error] will occur.

3. SIGNALS AND WIRING

3.8 Alarm occurrence timing chart

 CAUTION	<ul style="list-style-type: none"> 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.
--	---

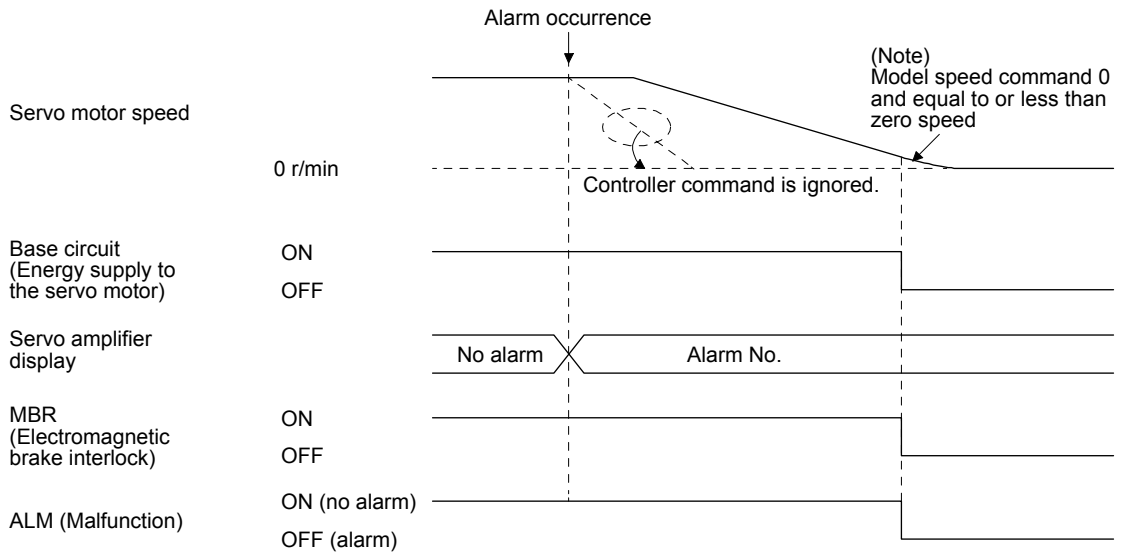
POINT	<ul style="list-style-type: none"> In the torque control mode, the forced stop deceleration function is not available.
-------	---

To deactivate an alarm, cycle the control circuit 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	<ul style="list-style-type: none"> To enable the function, set "2 _ _ _ (initial value)" in [Pr. PA04].
-------	--

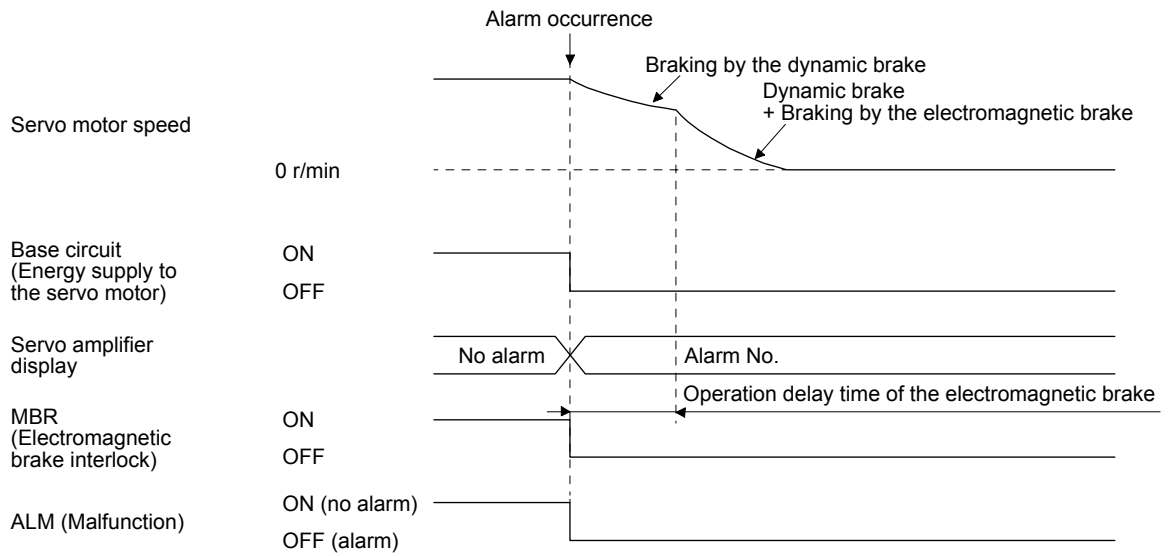
(1) When the forced stop deceleration function is enabled



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

3. SIGNALS AND WIRING

(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).

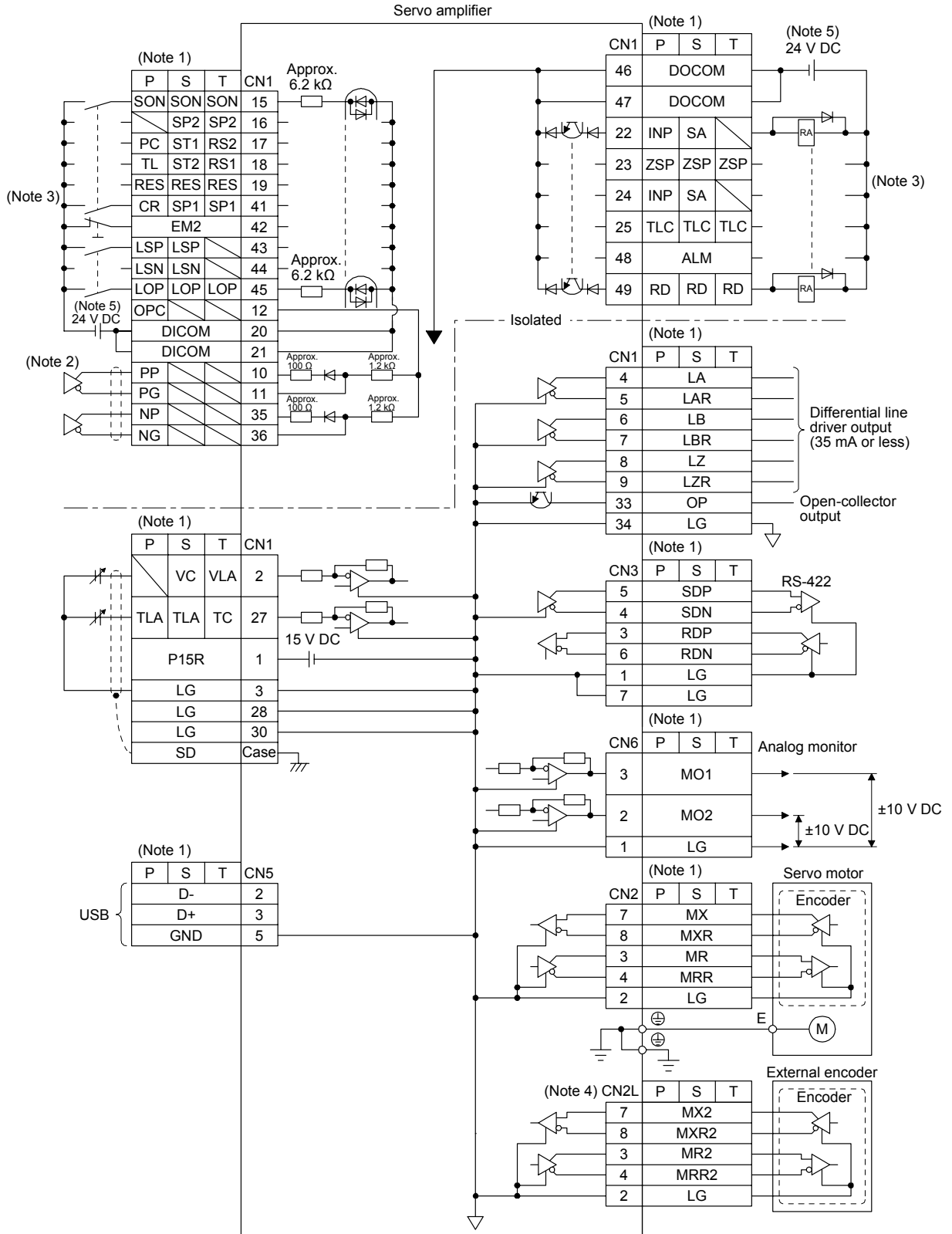
3. SIGNALS AND WIRING

3.9 Interfaces

3.9.1 Internal connection diagram

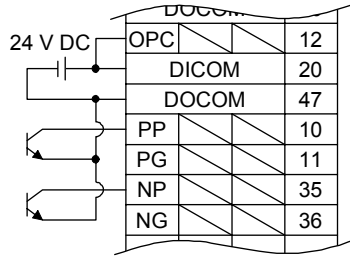
POINT

● Refer to section 13.3.1 for the CN8 connector.



3. SIGNALS AND WIRING

- 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.



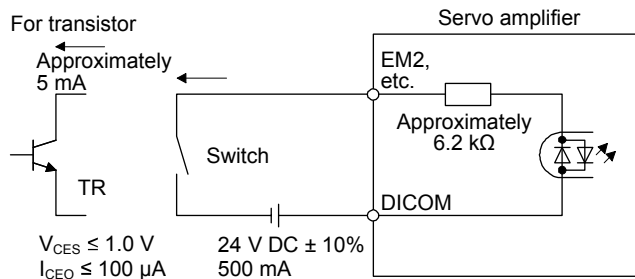
3. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
 4. This is for MR-J4-_A-RJ servo amplifier. The MR-J4-_A servo amplifier does not have the CN2L connector.
 5. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.

3.9.2 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 the 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.



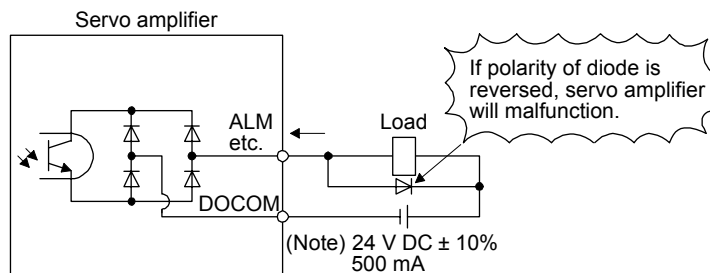
(2) Digital output interface DO-1

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.

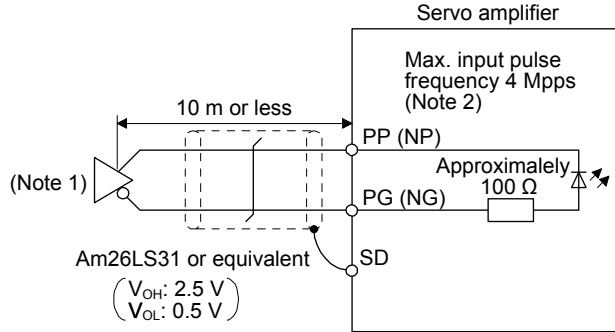
3. SIGNALS AND WIRING

(3) Pulse train input interface DI-2

Give a pulse train signal in the differential line driver type or open-collector type.

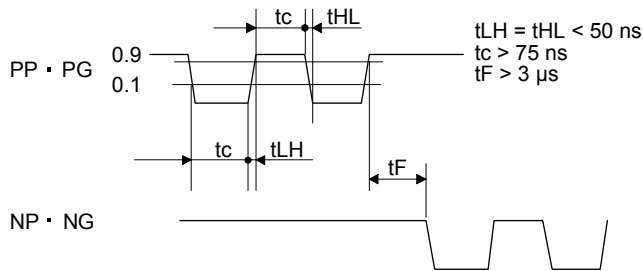
(a) Differential line driver type

1) Interface



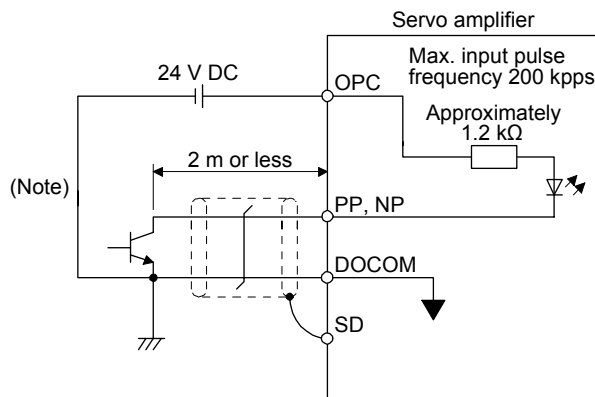
- Note 1. Pulse train input interface is comprised of a photocoupler.
If a resistor is connected to the pulse train signal line, it may malfunction due to reduction in current.
2. When the input pulse frequency is 4 Mpps, set [Pr. PA13] to "_ 0 _ _".

2) Input pulse condition



(b) Open-collector type

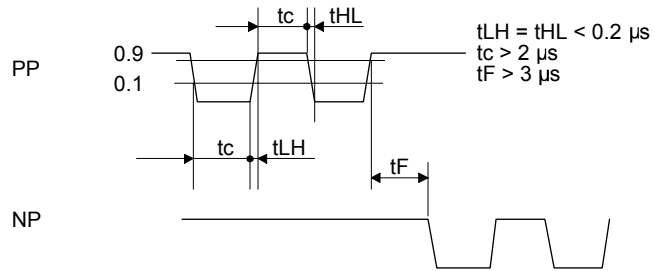
1) Interface



- 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.

3. SIGNALS AND WIRING

2) Input pulse condition

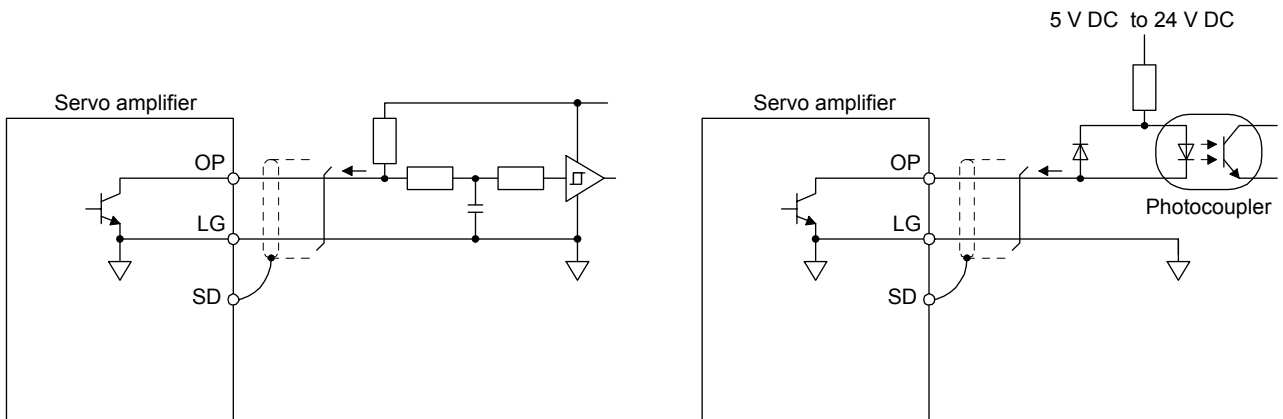


(4) Encoder output pulse DO-2

(a) Open-collector type

Interface

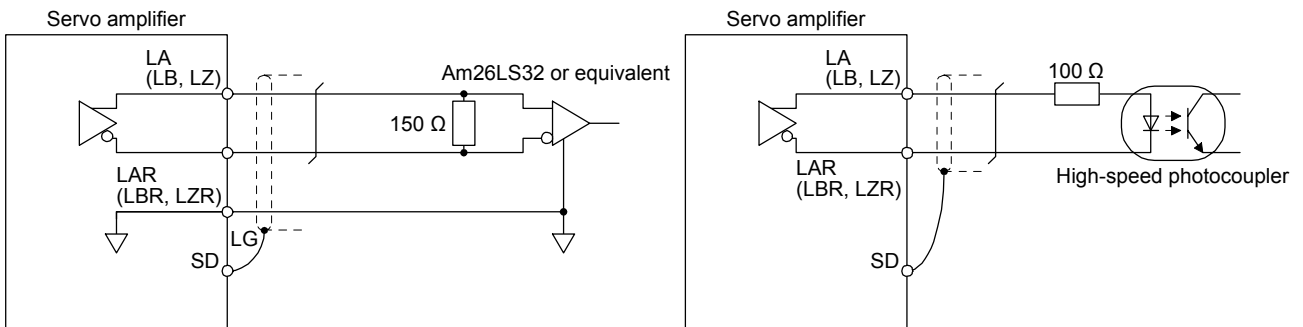
Maximum sink current: 35 mA



(b) Differential line driver type

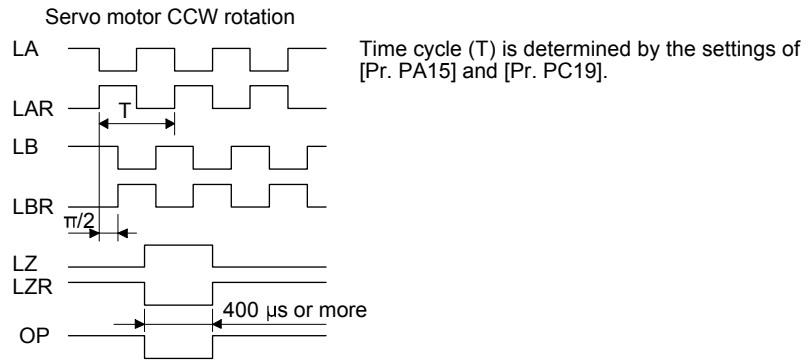
1) Interface

Maximum output current: 35 mA

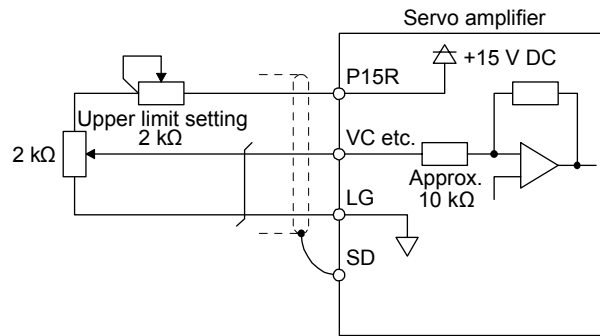


3. SIGNALS AND WIRING

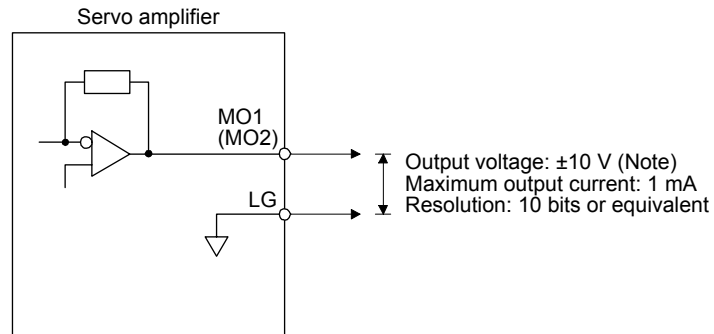
2) Output pulse



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



- (6) Analog output



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

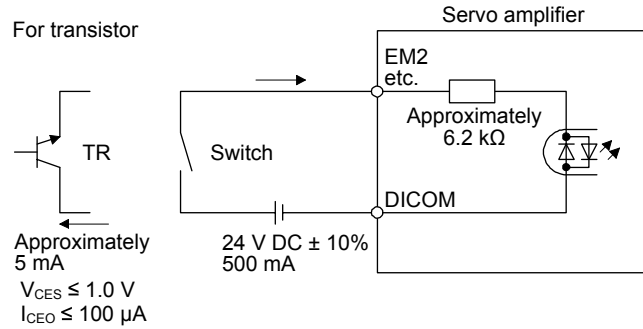
3. SIGNALS AND WIRING

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

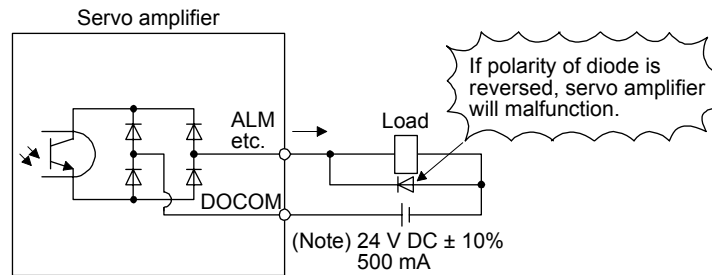
This is an input circuit whose photocoupler anode side is the input terminal. Transmit signals using source (open-collector) type transistor output, relay switch, etc.



(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. SIGNALS AND WIRING

3.10 Servo motor with an electromagnetic brake

3.10.1 Safety precautions

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

Contacts must be opened when ALM (Malfunction) or MBR (Electromagnetic brake interlock) turns off. Contacts must be opened with the EMG stop switch.

Servo motor

RA

24 V DC

Electromagnetic brake

CAUTION

- 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.

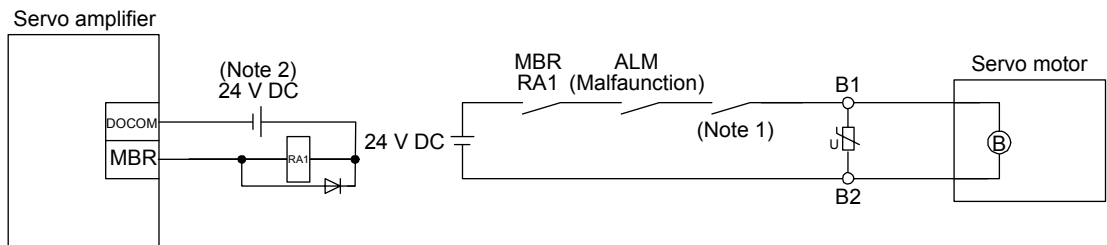
POINT

- Refer to "Servo Motor Instruction Manual (Vol. 3)" for specifications such as the power supply capacity and operation delay time of the electromagnetic brake.
- Refer to "Servo Motor Instruction Manual (Vol. 3)" 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.
- Note 2. Do not use the 24 V DC interface power supply for the electromagnetic brake.

3. SIGNALS AND WIRING

(2) Setting

- (a) Enable MBR (Electromagnetic brake interlock) with [Pr. PD03] to [Pr. PD22].
- (b) In [Pr. PC16 Electromagnetic brake sequence output], set the time delay (T_b) from electromagnetic brake operation 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

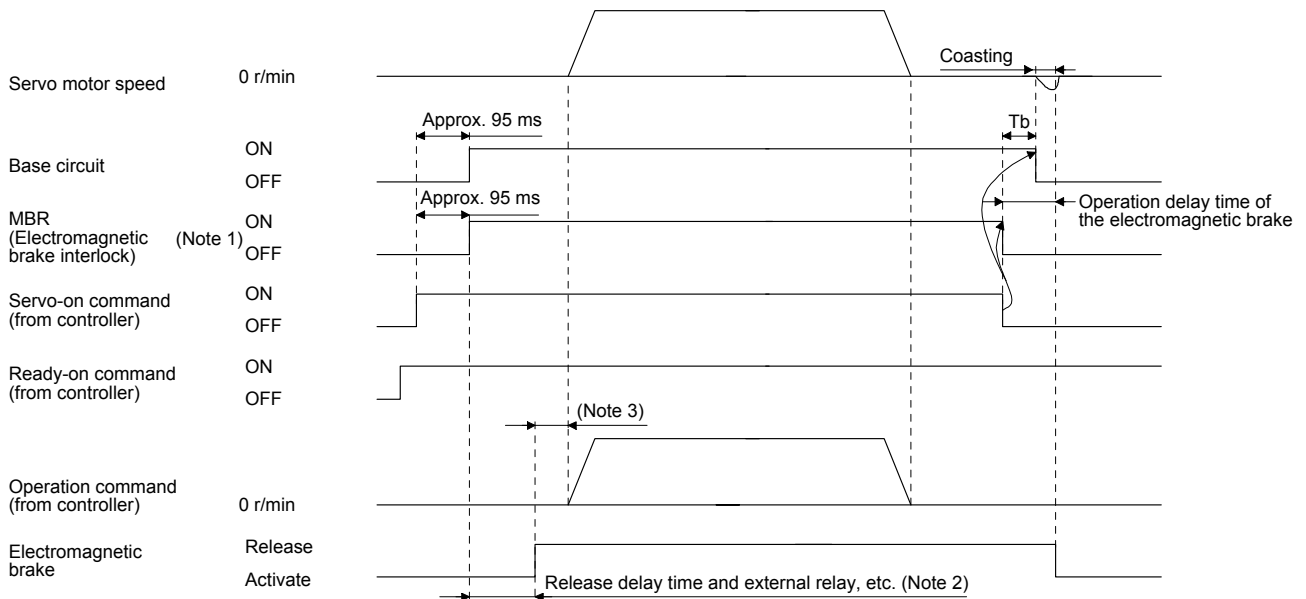
(1) When you use the forced stop deceleration function

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 T_b [ms], and the servo motor will coast. If the electromagnetic brake is enabled during servo-lock, the brake life may be shorter. Therefore, set T_b 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 delaying for the release delay time of electromagnetic brake and operation time of external circuit relay. For the release delay time of electromagnetic brake, refer to "Servo Motor Instruction Manual (Vol. 3)".

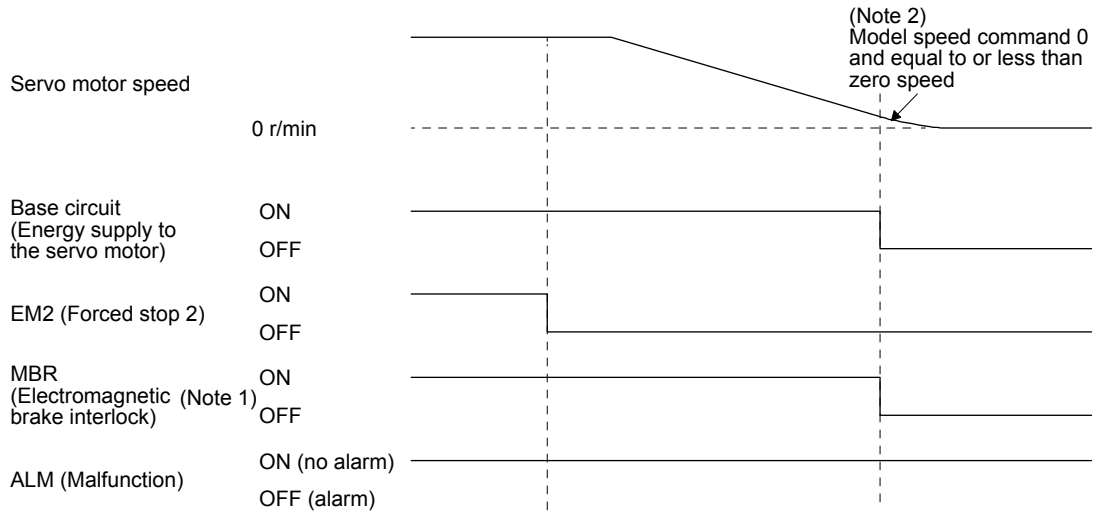
3. Give a position command after the electromagnetic brake is released.

4. This is in position control mode.

3. SIGNALS AND WIRING

(b) Forced stop 2 on/off

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

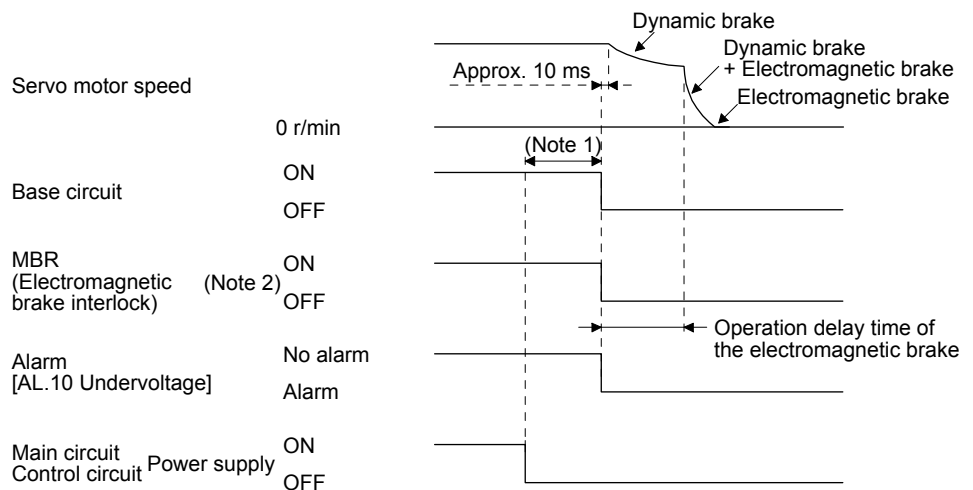


- Note 1. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake has been activated.
2. The model speed command is a speed command generated in the servo amplifier for forced stop deceleration of the servo motor.

(c) Alarm occurrence

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

(d) Both main and control circuit power supplies off



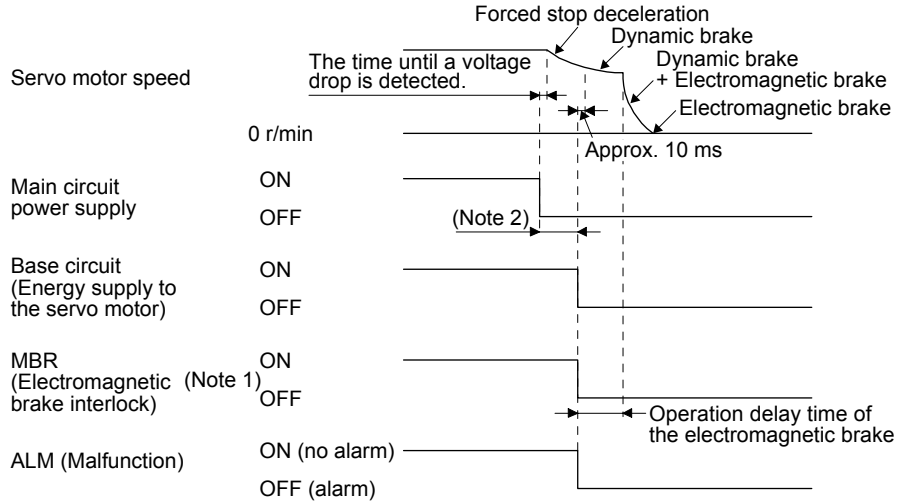
- Note 1. Variable according to the operation status.
2. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake has been activated.

3. SIGNALS AND WIRING

(e) Main circuit power supply off during control circuit power supply on

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. Variable according to the operation status.

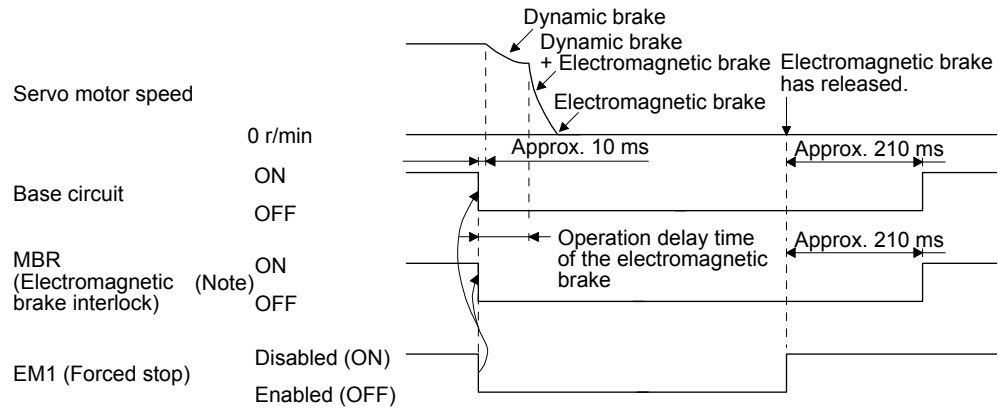
(2) When you do not use the forced stop deceleration function

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.

3. SIGNALS AND WIRING

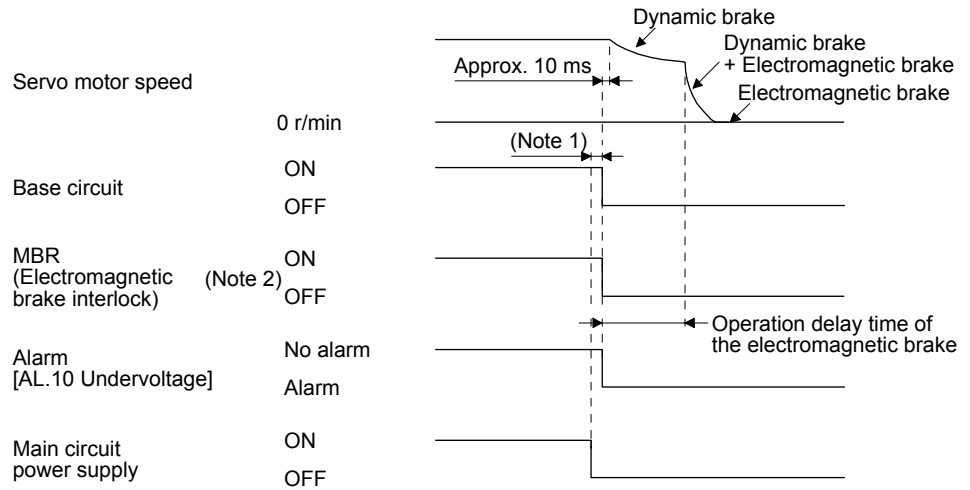
(c) Alarm occurrence

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

(d) Both main and control circuit power supplies off

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

(e) Main circuit power supply off during control circuit power supply on



Note 1. Variable according to the operation status.

2. ON: Electromagnetic brake is not activated.

OFF: Electromagnetic brake has been activated.

4. STARTUP

4. STARTUP

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

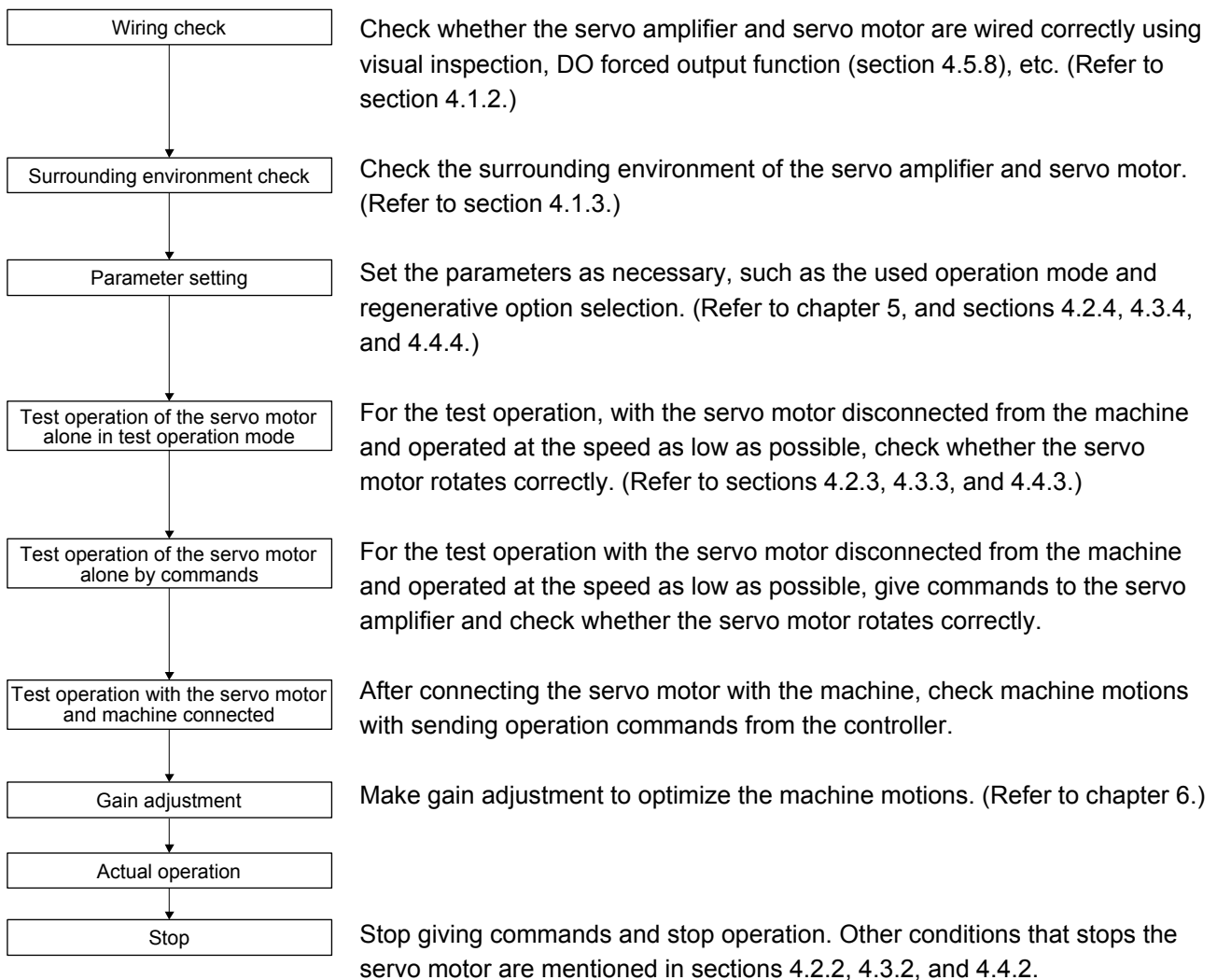
⚠ CAUTION

- 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 prevent accidental contact of hands and parts (cables, etc.) with them.
- 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



4. STARTUP

4.1.2 Wiring check

(1) Power supply system wiring

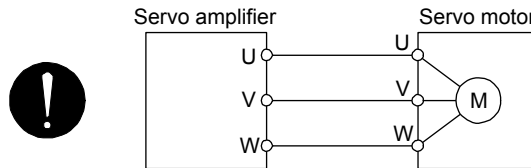
Before switching on the main circuit and control circuit power supplies, check the following items.

(a) Power supply system wiring

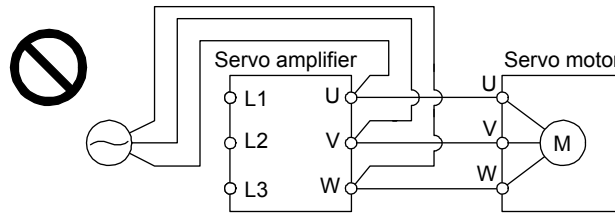
The power supplied to the power input terminals (L1, L2, L3, L11, and L21) of the servo amplifier should satisfy the defined specifications. (Refer to section 1.3.)

(b) Connection of servo amplifier and servo motor

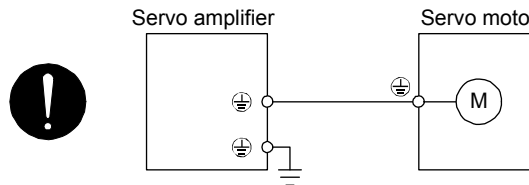
- 1) The servo amplifier power output (U, V, and W) should match in phase with the servo motor power input terminals (U, V, and W).



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

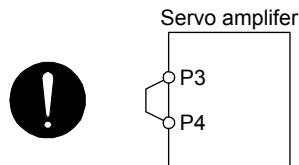


- 3) The grounding terminal of the servo motor is connected to the PE terminal of the servo amplifier.



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

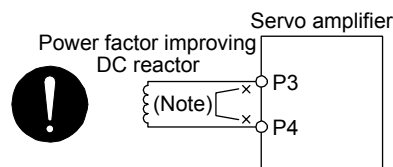
- 5) Between P3 and P4 should be connected.



4. STARTUP

(c) When option and auxiliary equipment are used

- 1) When you use a regenerative option for 200 V class 5 kW or less 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) When you use a regenerative option for 200 V class 7 kW or more servo amplifiers for 200 V class
 - 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 when wiring is over 5 m and under 10 m. (Refer to section 11.2.4.)
- 3) When you use a brake unit and power regenerative converter for 7 kW or more servo amplifiers
 - The lead wire of built-in regenerative resistor connected to P+ terminal and C terminal should not be connected.
 - Brake unit or power regenerative converter should be connected to P+ terminal and N-terminal. (Refer to section 11.3 to 11.4.)
- 4) When you use a power regenerative common converter
 - For 5 kW or less servo amplifiers, the lead wire between P+ terminal and D terminal should not be connected.
 - For 7 kW servo amplifiers, the lead wires of the built-in regenerative resistor connected to P+ terminal and C terminal should not be connected.
 - The wire of power regenerative common converter should be connected to P4 terminal and N-terminal. (Refer to section 11.5.)
- 5) The power factor improving DC reactor should be connected between P3 and P4. (Refer to section 11.11.)



Note. Always disconnect between P3 and P4 terminals.

(2) I/O signal wiring

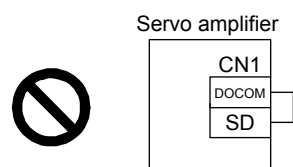
(a) The I/O signals should be connected correctly.

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. In this case, switch on the control circuit power supply only.

Refer to section 3.2 for details of I/O signal connection.

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

(c) SD and DOCOM of the CN1 connector is not shorted.



4. STARTUP

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



In the absolute position detection system, first power-on results in [AL. 25 Absolute position erased] and the servo system cannot be switched on. The alarm can be deactivated by then switching power off once and on again.

Also, if power is switched on at the servo motor speed of 3000 r/min or higher, position mismatch may occur due to external force or the like. Power must therefore be switched on when the servo motor is at a stop.

(2) Power-off

- 1) Make sure that a command pulse train is not input.
- 2) Switch off SON (Servo-on).
- 3) Switch off the main circuit power supply and control circuit power supply.

4. STARTUP

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.

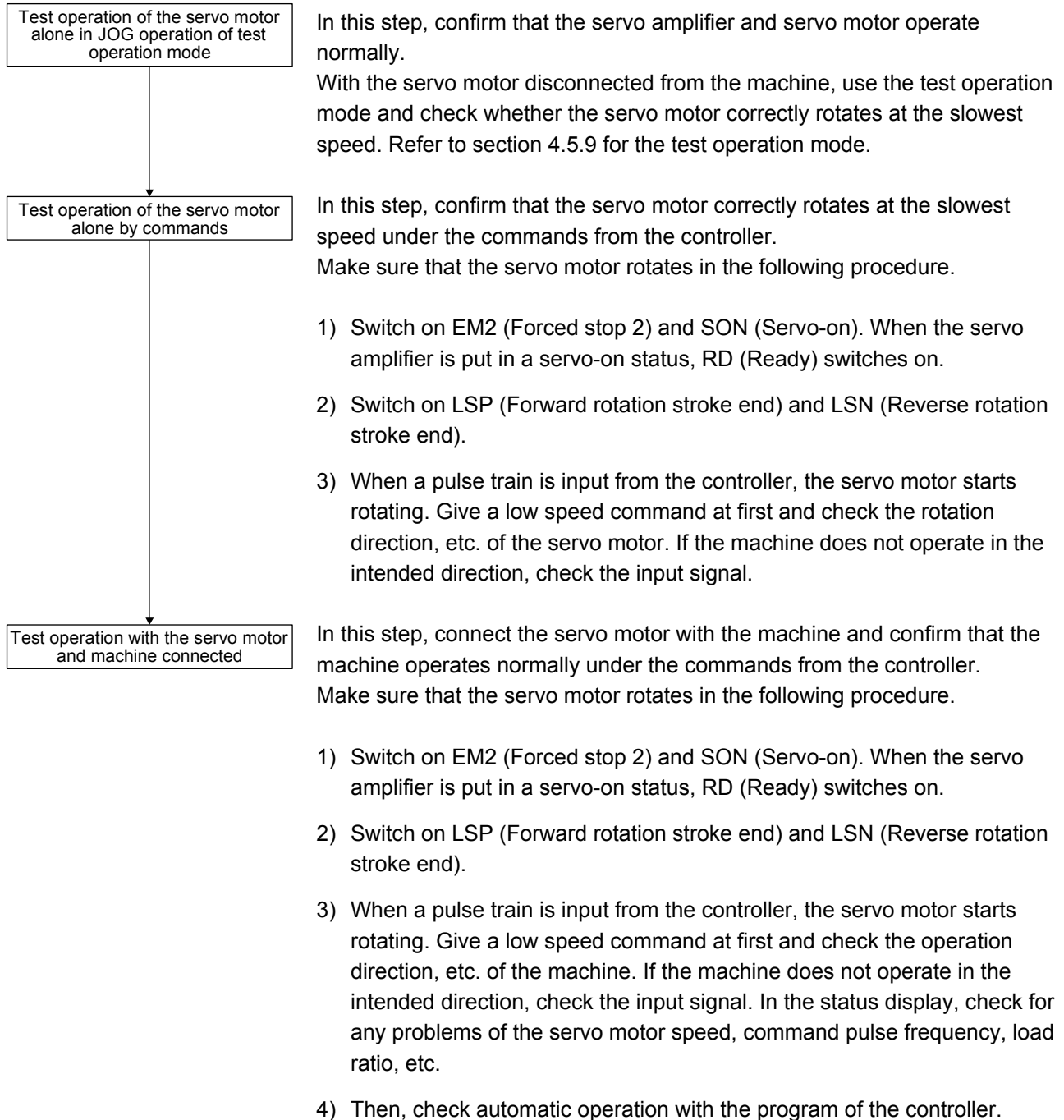
Operation/command	Stopping condition
Switch of SON (Servo-on).	The base circuit is shut off and the servo motor coasts.
Alarm occurrence	The servo motor decelerates to a stop with the command. With some alarms, however, the dynamic brake operates to bring the servo motor to a stop. (Refer to chapter 8. (Note))
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.
STO (STO1, STO2) off	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a stop.
LSP (Forward rotation stroke end) of 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.

Note. Only a list of alarms and warnings is listed in chapter 8. Refer to "MELSERVO-J4 Servo Amplifier Instruction Manual (Troubleshooting)" for details of alarms and warnings.

4. STARTUP

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 the power on and off methods of the servo amplifier.



4. STARTUP

4.2.4 Parameter setting


POINT
<p>● 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].</p> <p>MR-EKCBL30M-L MR-EKCBL30M-H MR-EKCBL40M-H MR-EKCBL50M-H</p>

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	<p>● Never adjust or change the parameter values extremely as it will make operation unstable.</p>
--	--

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

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	<ul style="list-style-type: none"> • LED is not lit. • LED flickers. 	Not improved even if CN1, CN2 and CN3 connectors are disconnected.	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 1. Power supply of encoder cabling is shorted. 2. Encoder is malfunctioning. 	
			Improved when CN3 connector is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to chapter 8 and remove cause.	Chapter 8 (Note)	

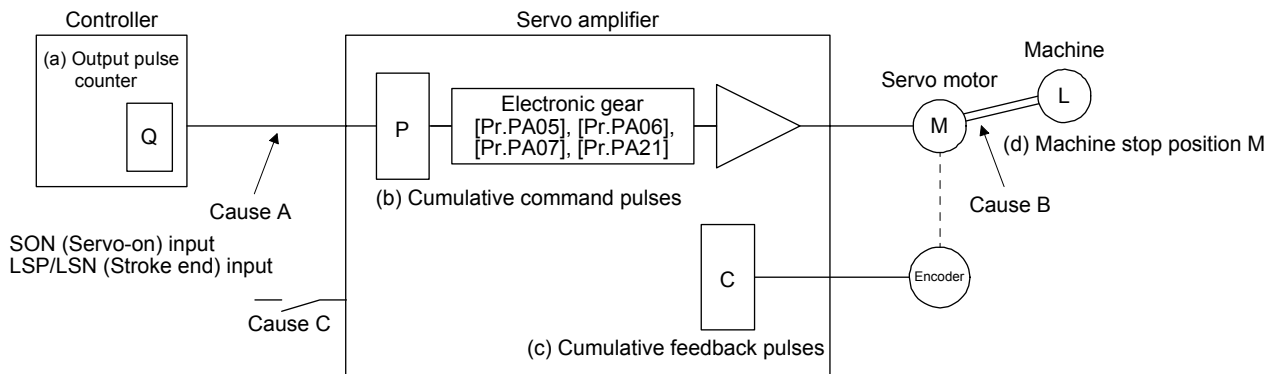
4. STARTUP

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
2	Switch on SON (Servo-on).	Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8 (Note)
		Servo motor shaft is not servo-locked. (Servo motor shaft is free.)	<ol style="list-style-type: none"> 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. 	<ol style="list-style-type: none"> 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).	<ol style="list-style-type: none"> 1. Wiring mistake <ol style="list-style-type: none"> (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
		Servo motor run in reverse direction.		Mistake in setting of [Pr. PA13]. <ol style="list-style-type: none"> 1. Mistake in wiring to controller. 2. Mistake in setting of [Pr. PA14]. 	Chapter 5
4	Gain adjustment	Rotation ripples (speed fluctuations) are large at low speed.	Make gain adjustment in the following procedure. <ol style="list-style-type: none"> 1. Increase the auto tuning response level. 2. Repeat acceleration and deceleration several 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 run with safety, repeat acceleration and deceleration several 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) in this section

Note. Only a list of alarms and warnings is listed in chapter 8. Refer to "MELSERVO-J4 Servo Amplifier Instruction Manual (Troubleshooting)" for details of alarms and warnings.

4. STARTUP

(2) How to find the cause of position shift



When a position shift occurs, check (a) output pulse counter display 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 _ _ _"

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

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

$$P \cdot \frac{4194304}{\text{FBP [Pr. PA05]}} = C$$

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

$$P \cdot \frac{\text{CMX [Pr. PA06]}}{\text{CDV [Pr. PA07]}} \times 16 = C$$

5) $C \cdot \Delta l = M$ (Cumulative feedback pulses \times Travel distance per pulse = Machine position)

Check for a position mismatch in the following sequence.

1) When $Q \neq P$

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 11.14 (2) (a).)
- Change the [Pr. PA13 Command pulse input form] setting.

4. STARTUP

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 $C \cdot \Delta t \neq M$

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) Switch on the main circuit power supply and control circuit power supply.
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) Switch off the main circuit power supply and control circuit power supply.

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.

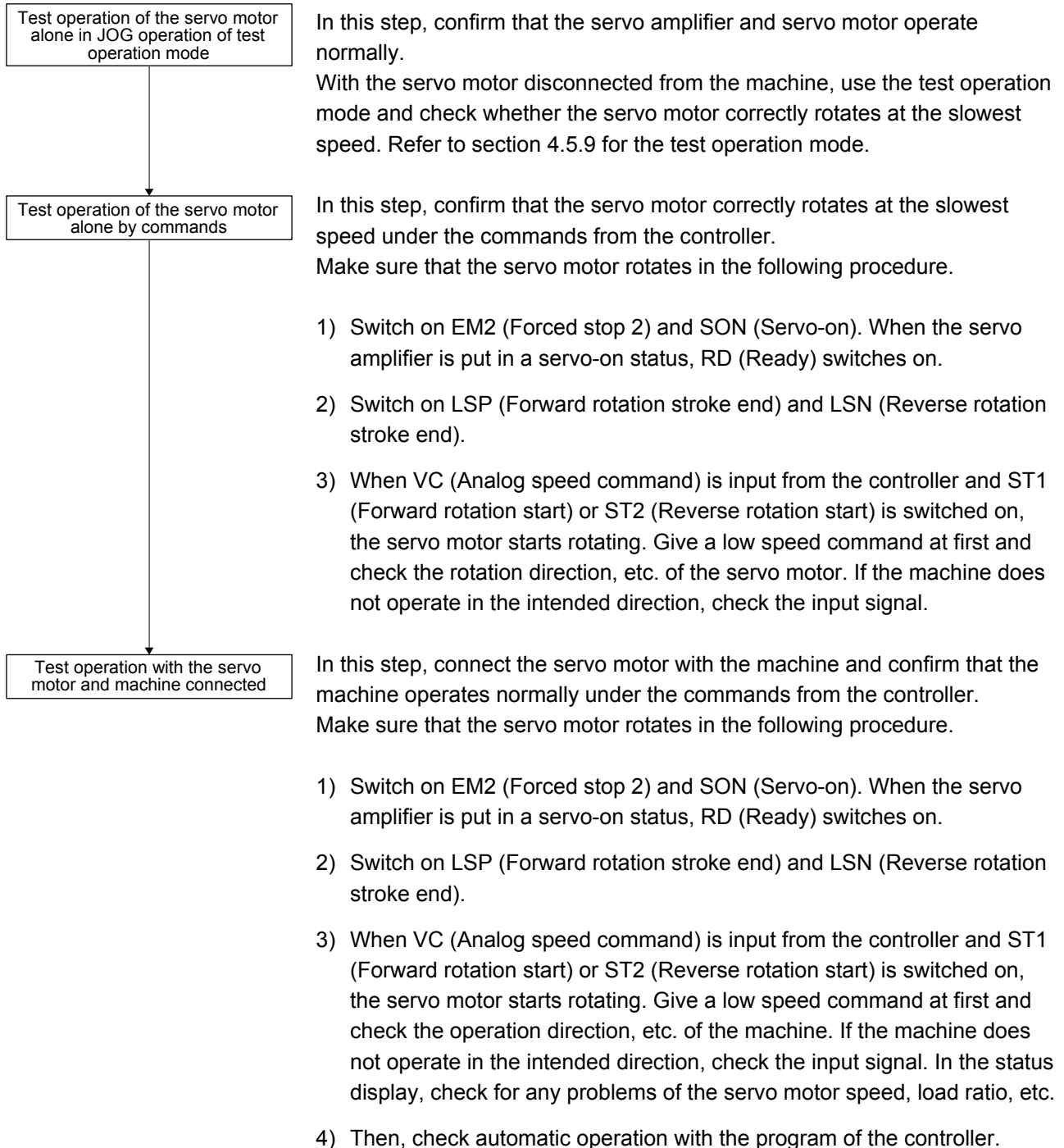
Operation/command	Stopping condition
Switch of SON (Servo-on).	The base circuit is shut off and the servo motor coasts.
Alarm occurrence	The servo motor decelerates to a stop with the command. With some alarms, however, the dynamic brake operates to bring the servo motor to a stop. (Refer to chapter 8. (Note))
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.
STO (STO1, STO2) off	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a stop.
LSP (Forward rotation stroke end) of 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.

Note. Only a list of alarms and warnings is listed in chapter 8. Refer to "MELSERVO-J4 Servo Amplifier Instruction Manual (Troubleshooting)" for details of alarms and warnings.

4. STARTUP

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 the power on and off methods of the servo amplifier.



4. STARTUP

4.3.4 Parameter setting


POINT
<p>● 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].</p> <p>MR-EKCBL30M-L MR-EKCBL30M-H MR-EKCBL40M-H MR-EKCBL50M-H</p>

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

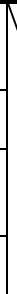
Start actual operation after confirmation of normal operation by test operation and completion of the corresponding parameter settings.

4.3.6 Trouble at start-up

 CAUTION	<p>● Never adjust or change the parameter values extremely as it will make operation unstable.</p>
--	--

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

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	<ul style="list-style-type: none"> • LED is not lit. • LED flickers. 	Not improved even if CN1, CN2, and CN3 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.	
			Improved when CN3 connector is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to chapter 8 and remove cause.	Chapter 8 (Note)	

4. STARTUP

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
2	Switch on SON (Servo-on).	Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8 (Note)
		Servo motor shaft is not servo-locked. (Servo motor shaft is free.)	<ol style="list-style-type: none"> 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. 	<ol style="list-style-type: none"> 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
4	Gain adjustment	Rotation ripples (speed fluctuations) are large at low speed.	<p>Make gain adjustment in the following procedure.</p> <ol style="list-style-type: none"> 1. Increase the auto tuning response level. 2. Repeat acceleration and deceleration several 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 run with safety, repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 6

Note. Only a list of alarms and warnings is listed in chapter 8. Refer to "MELSERVO-J4 Servo Amplifier Instruction Manual (Troubleshooting)" for details of alarms and warnings.

4. STARTUP

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) Switch on the main circuit power supply and control circuit power supply.
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) Switch off the main circuit power supply and control circuit power supply.

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.

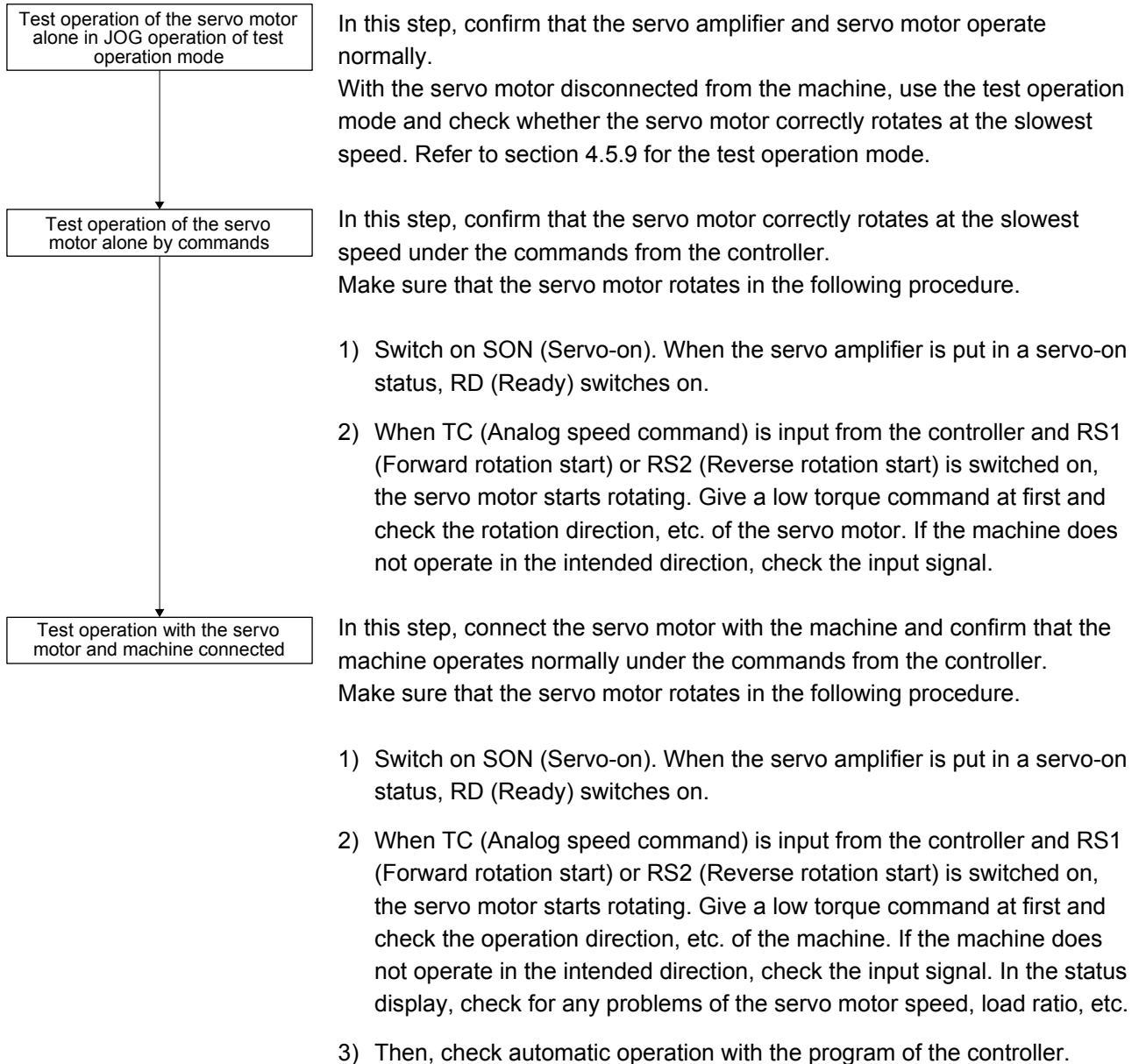
Operation/command	Stopping condition
Switch off SON (Servo-on).	The base circuit is shut off and the servo motor coasts.
Alarm occurrence	The servo motor decelerates to a stop with the command. With some alarms, however, the dynamic brake operates to bring the servo motor to a stop. (Refer to chapter 8. (Note))
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.
STO (STO1, STO2) off	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a stop.
Simultaneous on or off of RS1 (Forward rotation selection) and RS2 (Reverse rotation selection)	The servo motor coasts.

Note. Only a list of alarms and warnings is listed in chapter 8. Refer to "MELSERVO-J4 Servo Amplifier Instruction Manual (Troubleshooting)" for details of alarms and warnings.

4. STARTUP

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 the power on and off methods of the servo amplifier.



4. STARTUP

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. STARTUP

4.4.6 Trouble at start-up



CAUTION

● Never adjust or change the parameter values extremely as it will make unstable movement.

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	<ul style="list-style-type: none"> • LED is not lit. • LED flickers. 	Not improved even if CN1, CN2, and CN3 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.	
			Improved when CN3 connector is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8 (Note)
2	Switch on SON (Servo-on).	Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8 (Note)
		(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

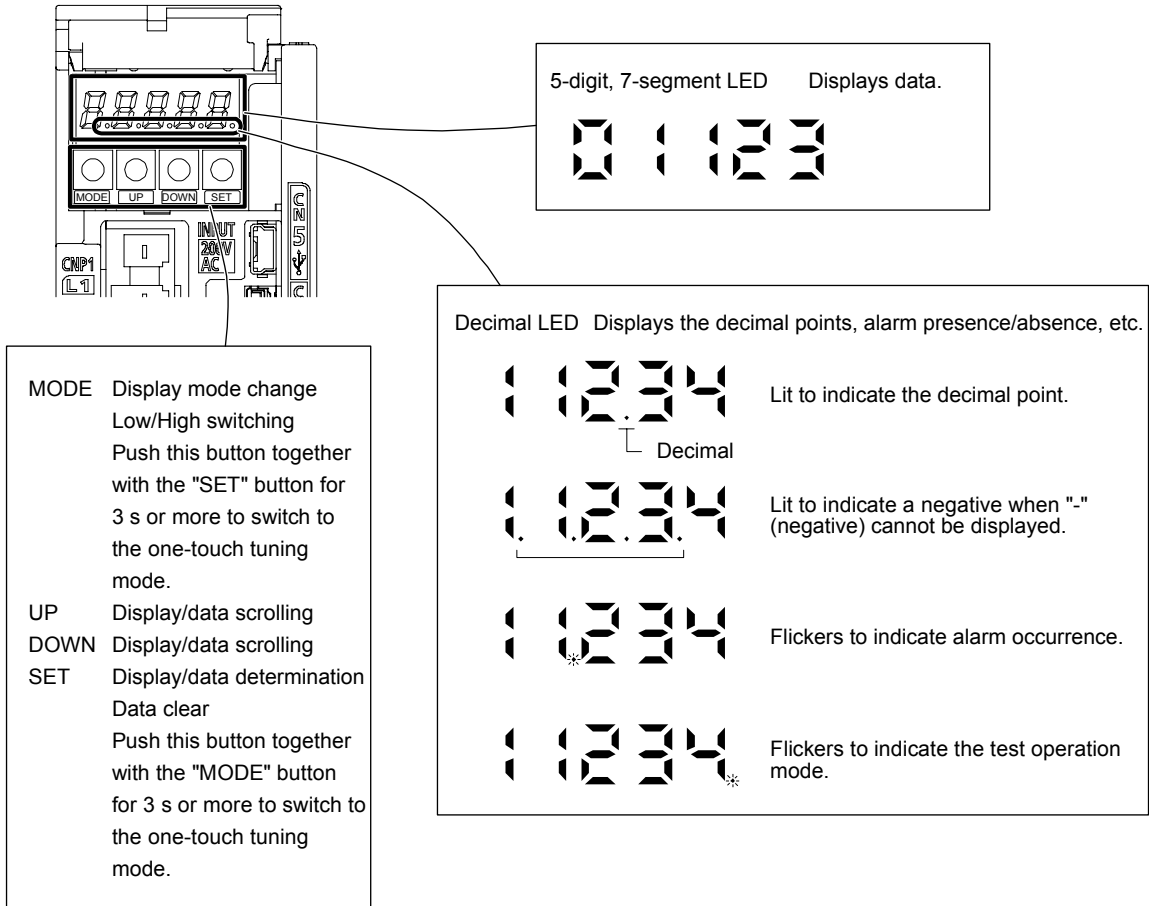
Note. Only a list of alarms and warnings is listed in chapter 8. Refer to "MELSERVO-J4 Servo Amplifier Instruction Manual (Troubleshooting)" for details of alarms and warnings.

4. STARTUP

4.5 Display and operation sections

4.5.1 Summary

The MR-J4-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. Also, press 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. STARTUP

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
<pre> graph TD A([Status display]) --> B([One-touch tuning]) B --> C([Diagnosis]) C --> D([Alarms]) D --> E([Basic setting parameters]) E --> F([Gain/filter parameters]) F --> G([Extension setting parameters]) G --> H([I/O setting parameters]) H --> I([Extension setting 2 parameters]) I --> J([Extension setting 3 parameters]) J --> K([Linear/DD motor setting parameter]) K --> A </pre>		Servo status display. [] appears at power-on. (Note)	Section 4.5.3
		One-touch tuning Select this when performing the one-touch tuning.	Section 6.2
		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
		Current alarm display, alarm history display, parameter error number display.	Section 4.5.5
		Display and setting of basic setting parameters.	Section 4.5.6
		Display and setting of gain/filter parameters.	
		Display and setting of extension setting parameters.	
		Display and setting of I/O setting parameters.	
		Display and setting of extension setting 2 parameters.	
		Display and setting of extension setting 3 parameters.	
		Display and setting of linear/DD motor setting parameters.	

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. STARTUP

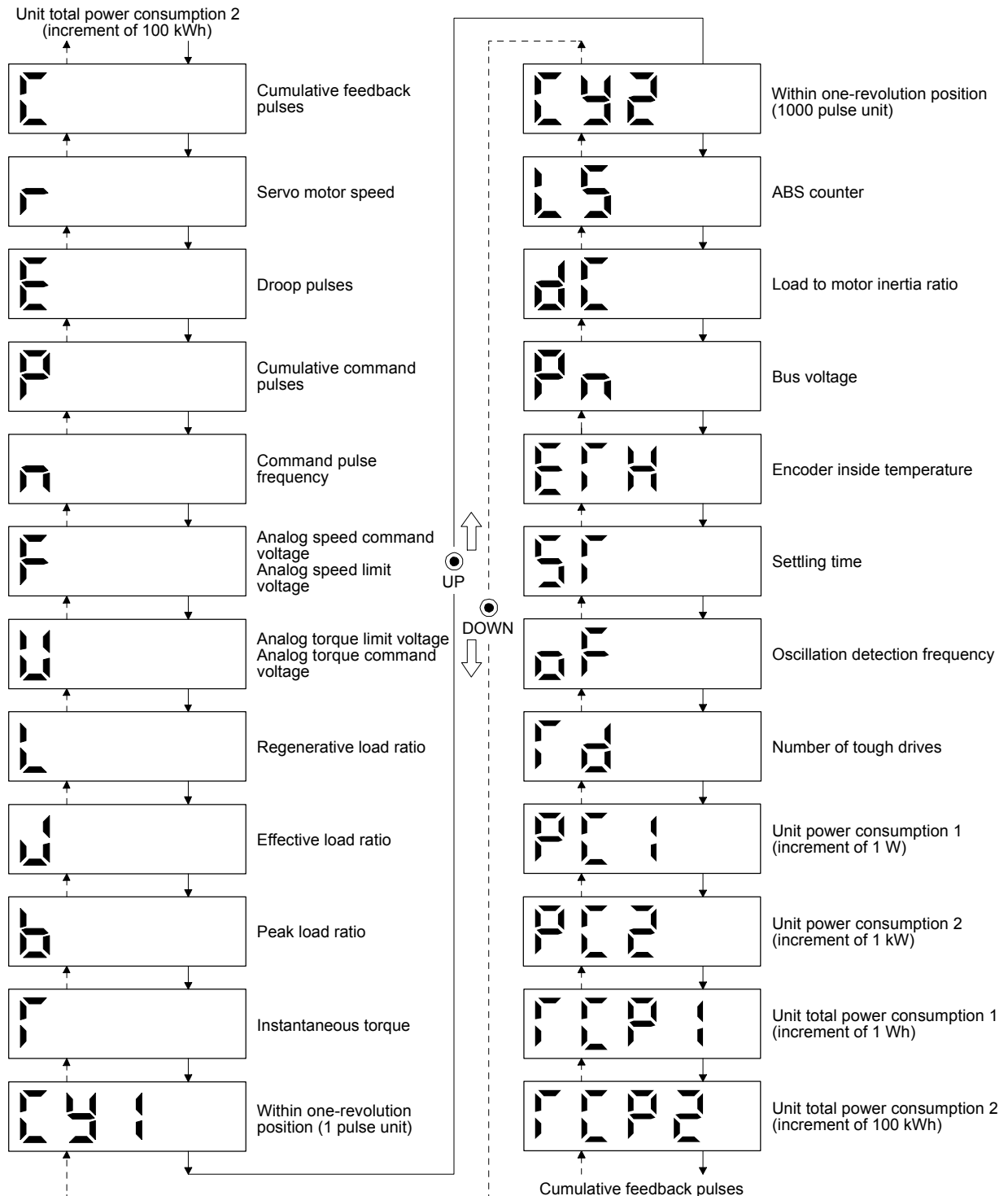
4.5.3 Status display mode

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

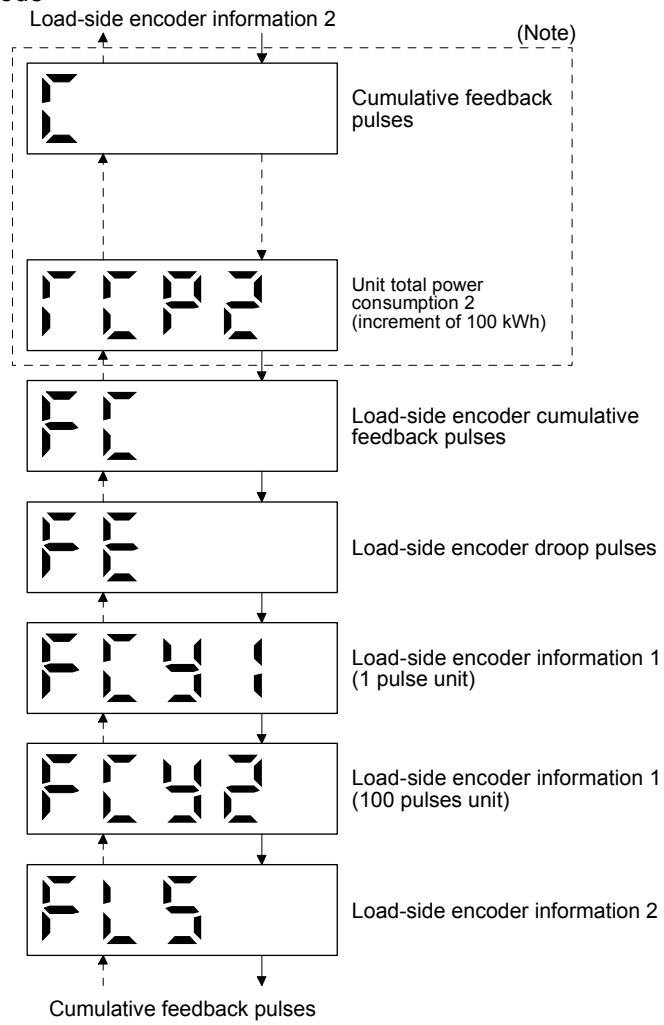
After selecting the status display mode with the "MODE" button, pressing the "UP" or "DOWN" button changes the display as shown below.

(a) Standard control mode



4. STARTUP

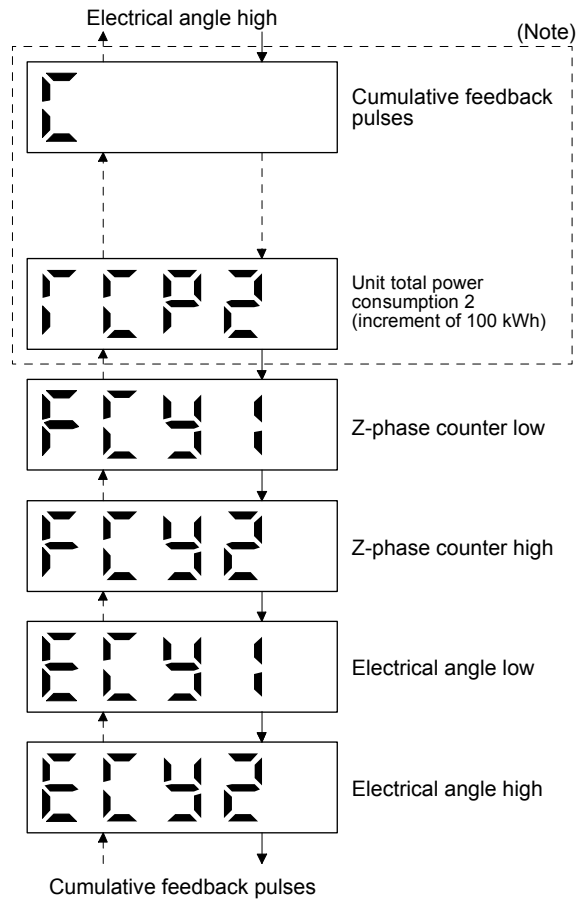
(b) Fully closed loop control mode



Note. The displays in the frames are the standard control modes in one cycle with some displays omitted.

4. STARTUP

(c) Linear servo motor control mode/DD motor control mode

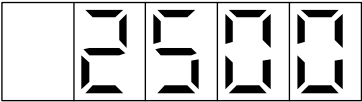
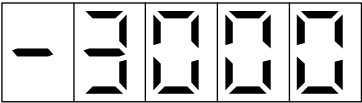

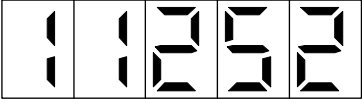
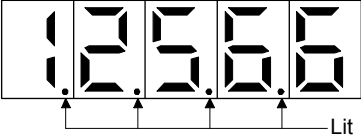


Note. The displays in the frames are the standard control modes in one cycle with some displays omitted.

4. STARTUP

(2) Display examples

The following table shows the display examples.

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

4. STARTUP

(3) Status display list

The following table lists the servo statuses that may be shown. Refer to appendix 10 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 pulse in the deviation counter is 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	kpps	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	F	V	1) Torque control mode Input voltage of VLA (Analog speed limit) voltage is displayed.
Analog speed limit voltage			2) Speed control mode Input voltage of VC (Analog speed command) voltage is displayed
Analog torque command voltage	U	V	1) Position control mode and speed control mode Voltage of TLA (Analog torque limit) voltage is displayed.
Analog torque limit voltage			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 pulse 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	The travel distance from the home position is displayed as multi-revolution counter value of the absolute position encoder in the absolute position detection system.

4. STARTUP

Status display	Symbol	Unit	Description
Load to motor inertia ratio	dC	Multiplier	The estimated ratio of the load inertia moment to the servo motor shaft inertia moment is displayed.
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 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 Wh	Unit total power consumption is displayed by increment of 100 kWh. Positive value is cumulated during power running and negative value during regeneration.
Load-side encoder Cumulative feedback pulses	FC	pulse	Feedback pulses from the load-side 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.
Load-side encoder Droop pulses	FE	pulse	Droop pulses of the deviation counter between a load-side encoder and a command are displayed. When the count exceeds ±99999, it starts from 0. Negative value is indicated by the lit decimal points in the upper four digits. The display shows the average droop pulse of 128 samplings at the rate of 444 [µs].
Load-side encoder information 1 (1 pulse unit)	FCY1	pulse	The Z-phase counter of a load-side encoder is displayed in the encoder pulse unit. For an incremental linear encoder, the Z-phase counter is displayed. The value is counted up from 0 based on the home position (reference mark). For an absolute position linear encoder, the encoder absolute position is displayed. When the count exceeds 99999, it starts from 0.
Load-side encoder information 1 (100 pulses unit)	FCY2	100 pulses	The Z-phase counter of a load-side encoder is displayed by increments of 100 pulses. For an incremental linear encoder, the Z-phase counter is displayed. The value is counted up from 0 based on the home position (reference mark). For an absolute position linear encoder, the encoder absolute position is displayed. When the count exceeds 99999, it starts from 0.
Load-side encoder information 2	FL5	rev	When an incremental linear encoder is used as the load-side encoder, the display shows 0. When an absolute position linear encoder is used as the load-side encoder, the display shows 0. When a rotary encoder is used as the load-side encoder, the display shows the value of the multi-revolution counter.
Z-phase counter low	FCY1	pulse	The Z-phase counter is displayed in the encoder pulse unit. For an incremental linear encoder, the Z-phase counter is displayed. The value is counted up from 0 based on the home position (reference mark). For an absolute position linear encoder, the encoder absolute position is displayed. When the count exceeds 99999, it starts from 0.
Z-phase counter high	FCY2	100000 pulses	The Z-phase counter is displayed by increments of 100000 pulses. For an incremental linear encoder, the Z-phase counter is displayed. The value is counted up from 0 based on the home position (reference mark). For an absolute position linear encoder, the encoder absolute position is displayed. When the count exceeds 99999, it starts from 0.
Electrical angle low	ECY1	pulse	The servo motor electrical angle is displayed.
Electrical angle high	ECY2	100000 pulses	The servo motor electrical angle is displayed by increments of 100000 pulses.

4. STARTUP

(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. STARTUP

4.5.4 Diagnostic mode

Name		Display	Description
Sequence			Not ready Indicates that the servo amplifier is being initialized or an alarm has occurred.
			Ready Indicates that the servo was switched on after completion of initialization and the servo amplifier is ready to operate.
Drive recorder enabled/disabled display			Drive recorder enabled When an alarm occurs in the status, the drive recorder will operate and write the status of occurrence.
			Drive recorder enabled 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".
External I/O signal display		Refer to section 4.5.7.	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.
Output signal (DO) forced output			This allows digital output signal to be switched on/off forcibly. For details, refer to section 4.5.8.
Test operation mode	JOG operation		JOG operation can be performed when there is no command from an external controller. For details, refer to section 4.5.9 (2).
	Positioning operation		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).
	Motor-less operation		Without connecting the servo motor, output signals or status display monitoring can be provided in response to the input device as if the servo motor is actually running. For details, refer to section 4.5.9 (4).
	Machine analyzer operation		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 11.7 for details.
	For manufacturer		This is for manufacturer.
Software version - Lower			Indicates the version of the software.

4. STARTUP

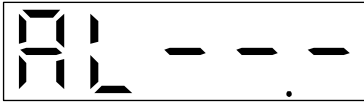
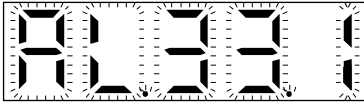



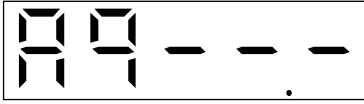
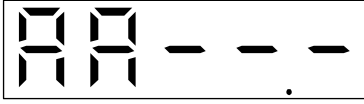
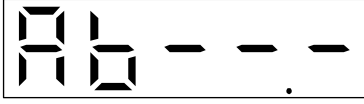
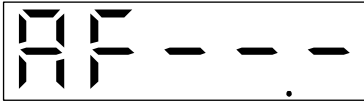
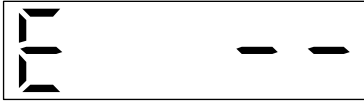

Name	Display	Description
Software version - Upper		Indicates the system number of the software.
Automatic VC offset		<p>If offset voltages in the analog circuits inside and outside the servo amplifier cause the servo motor to rotate slowly at VC (Analog speed command) or VLA (Analog speed limit) of 0 V, this function automatically makes zero-adjustment of offset voltages.</p> <p>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.</p> <ol style="list-style-type: none"> 1) Push "SET" once. 2) Set the number in the first digit to 1 with "UP"/"DOWN". 3) Push "SET". <p>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)</p>
Servo motor series ID		<p>Push the "SET" button to show the series ID of the servo motor currently connected.</p> <p>For indication details, refer to the Servo Motor Instruction Manual (Vol. 3).</p>
Servo motor type ID		<p>Push the "SET" button to show the type ID of the servo motor currently connected.</p> <p>For indication details, refer to the Servo Motor Instruction Manual (Vol. 3).</p>
Servo motor encoder ID		<p>Push the "SET" button to show the encoder ID of the servo motor currently connected.</p> <p>For indication details, refer to the Servo Motor Instruction Manual (Vol. 3).</p>
For manufacturer		This is for manufacturer.
For manufacturer		This is for manufacturer.

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. STARTUP

4.5.5 Alarm mode

The current alarm, past alarm history and parameter error are displayed. The lower 2 digits on the display indicate the alarm number that has occurred or the parameter number in error.

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

4. STARTUP

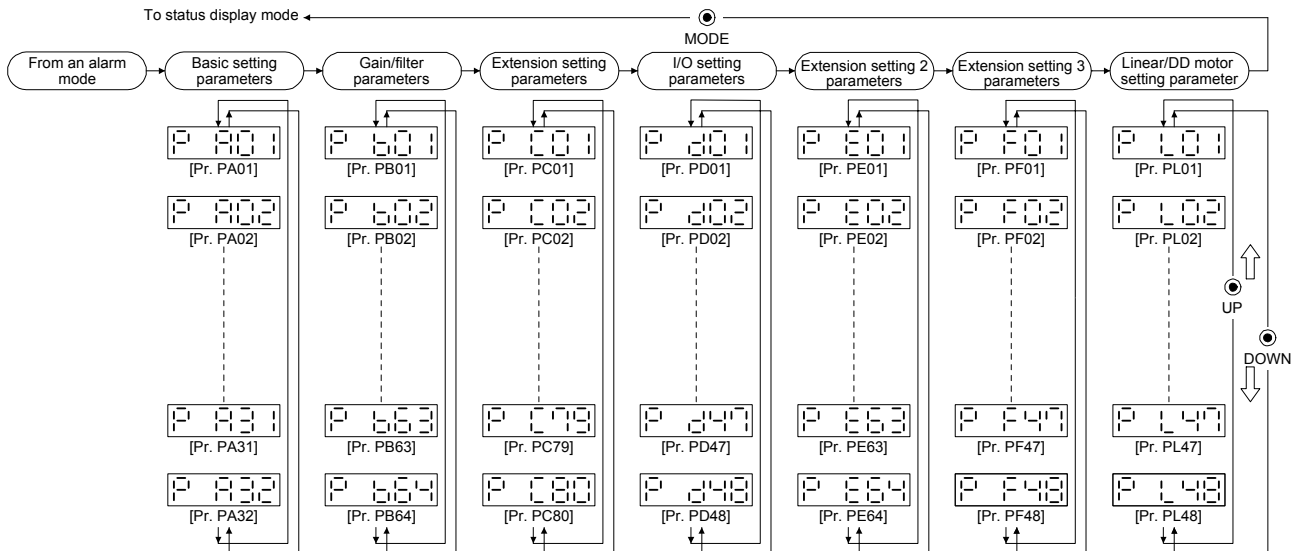
Functions at occurrence of an alarm

- (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.

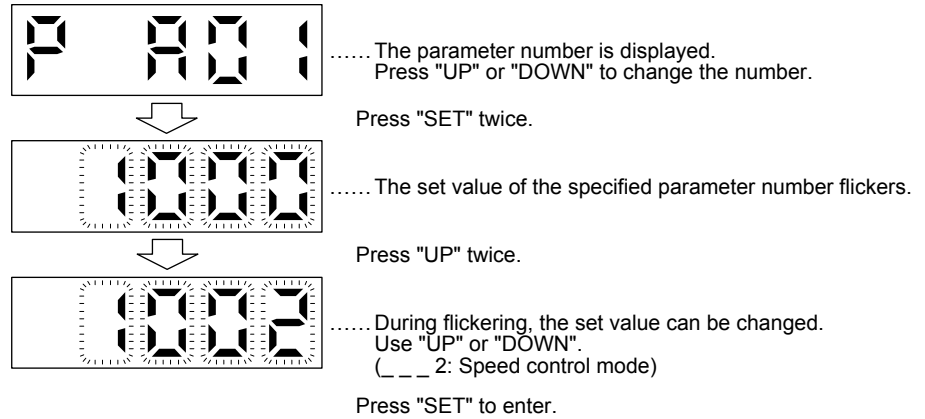


4. STARTUP

(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.

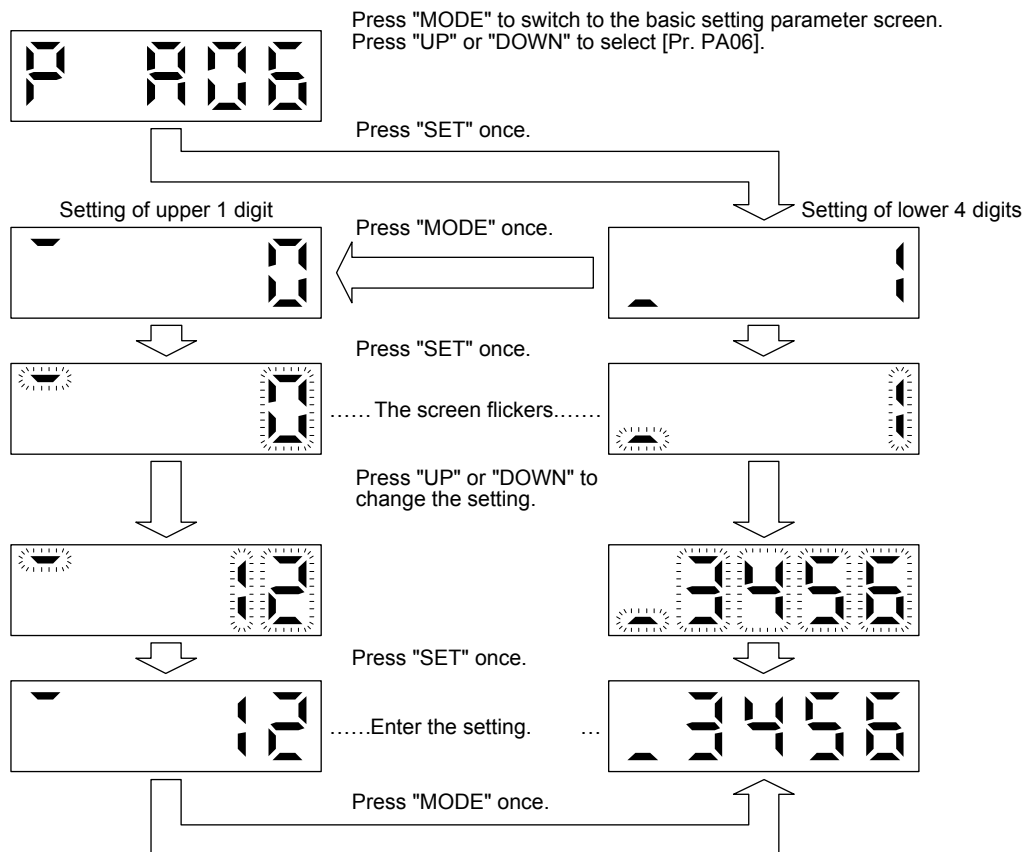


To shift to the next parameter, press the "UP" or "DOWN" button.

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. STARTUP

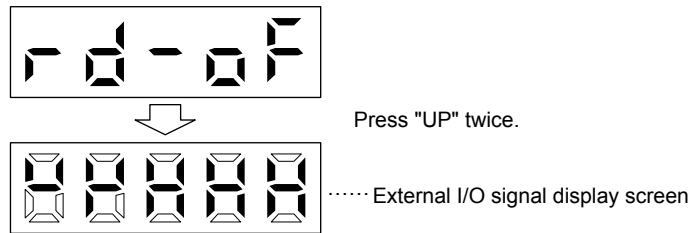
4.5.7 External I/O signal display

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

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

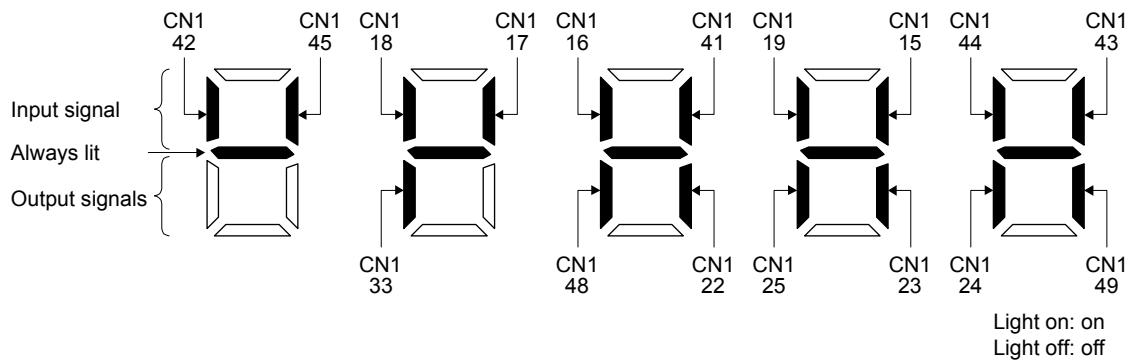
(1) Operation

Call the display screen shown after power-on. Using the "MODE" button, show the diagnostic screen.



(2) Display definition

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



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.

4. STARTUP

(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	15	I	SON	SON	SON	SON	SON	SON	Pr. PD03/Pr. PD04
	16	I	/	-/SP2	SP2	SP2/SP2	SP2	SP2/-	Pr. PD05/Pr. PD06
	17	I	PC	PC/ST1	ST1	ST1/RS2	RS2	RS2/PC	Pr. PD07/Pr. PD08
	18	I	TL	TL/ST2	ST2	ST2/RS1	RS1	RS1/TL	Pr. PD09/Pr. PD10
	19	I	RES	RES	RES	RES	RES	RES	Pr. PD11/Pr. PD12
	22	O	INP	INP/SA	SA	SA/-	/	-/INP	Pr. PD23
	23	O	ZSP	ZSP	ZSP	ZSP	ZSP	ZSP	Pr. PD24
	24	O	INP	INP/SA	SA	SA/-	/	-/INP	Pr. PD25
	25	O	TLC	TLC	TLC	TLC/VLC	VLC	VLC/TLC	Pr. PD26
	33	O	OP	OP	OP	OP	OP	OP	/
	41	I	CR	CR/SP1	SP1	SP1/SP1	SP1	SP1/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	I	LOP	LOP	LOP	LOP	LOP	LOP	Pr. PD21/Pr. PD22
	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

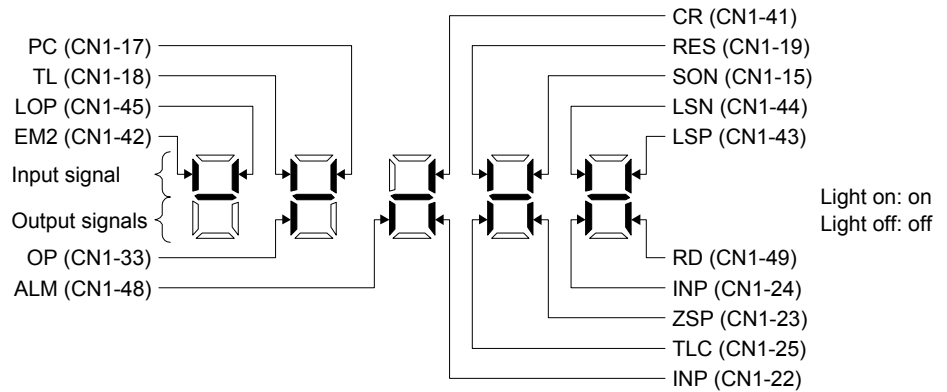
(b) Symbol and signal names

Symbol	Application	Symbol	Application
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	/	/

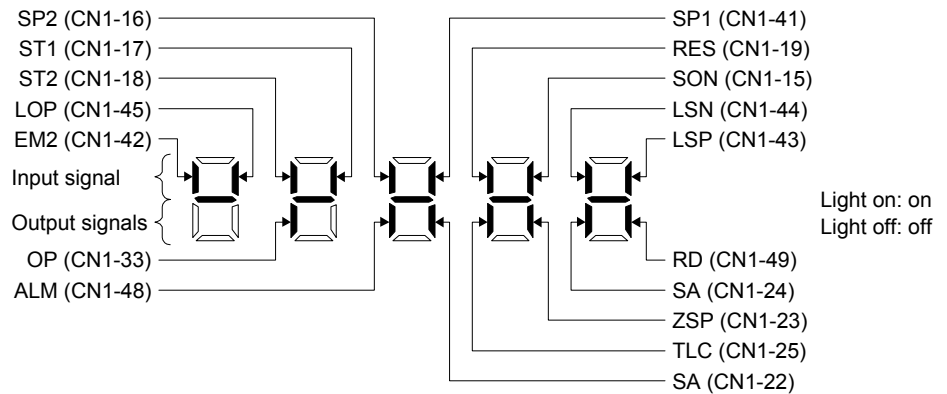
4. STARTUP

(3) Display data at initial values

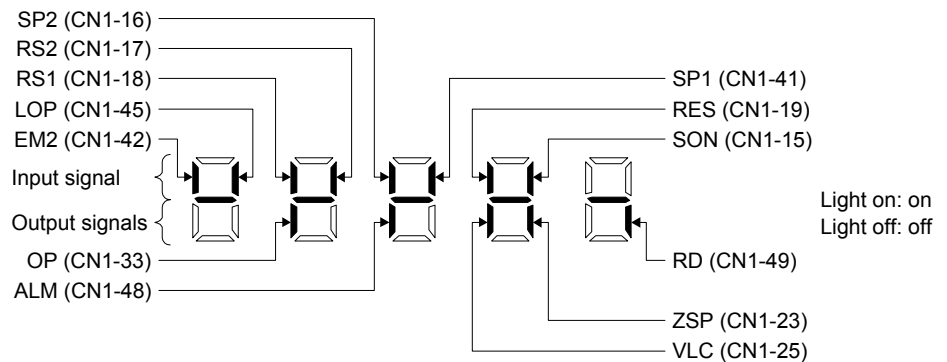
(a) Position control mode



(b) Speed control mode



(c) Torque control mode



4. STARTUP

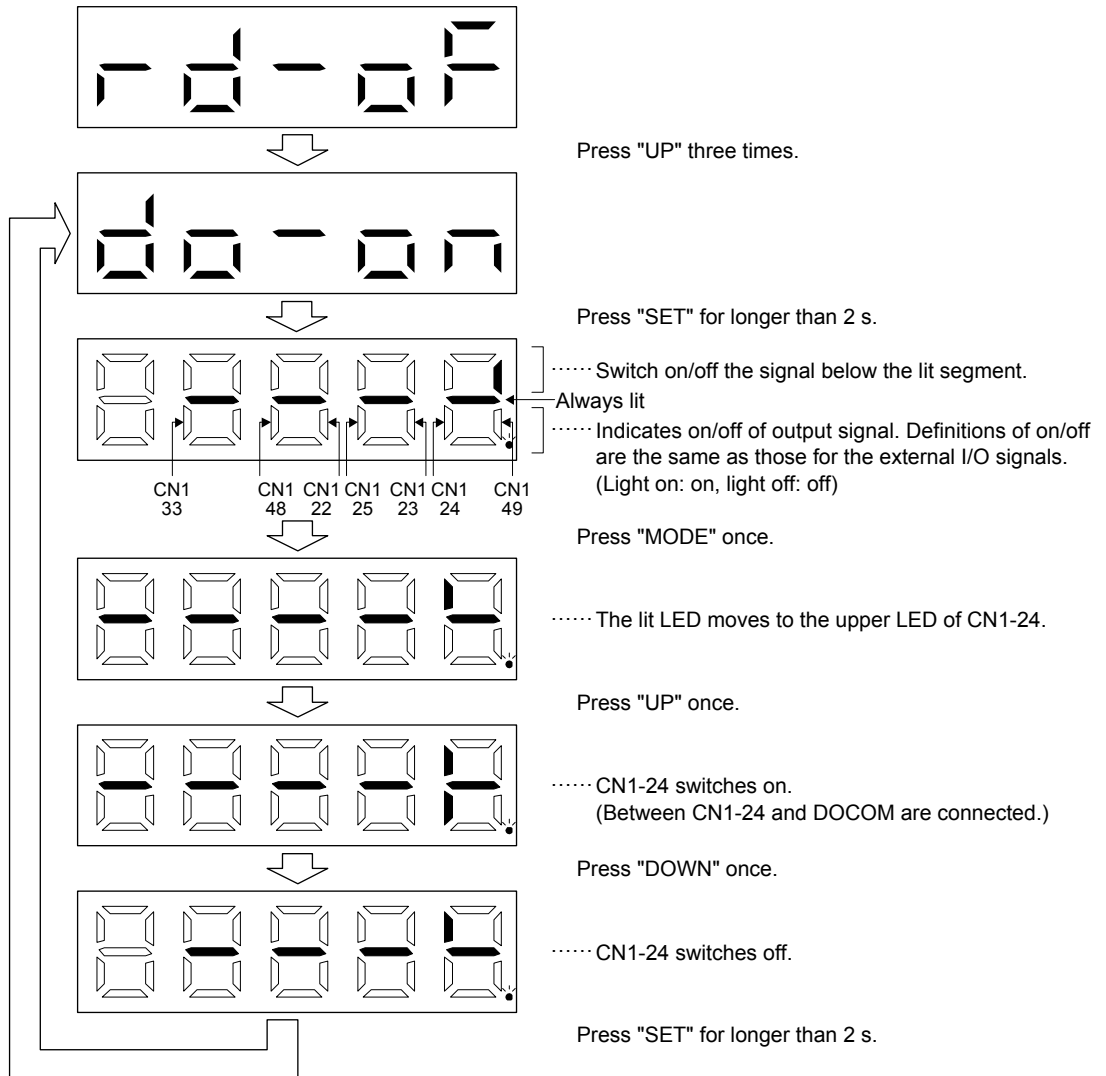
4.5.8 Output signal (DO) forced output

POINT
<p>● 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.</p>

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

Operation

Call the display screen shown after power-on. Using the "MODE" button, show the diagnostic screen.



4. STARTUP

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

- The test operation mode cannot be used in the absolute position detection system by DIO ([Pr. PA03: ___1]).
- MR Configurator2 is required to perform positioning operation.
- Test operation cannot be performed if SON (Servo-on) is not turned off.

(1) Mode switching

Call the display screen shown after power-on. Select JOG operation or motor-less operation in the following procedure. Using the "MODE" button, show the diagnostic screen.

r-d-o-f



Press "UP" four times.

TEST



Press "SET" for longer than 2 s.

d-01

..... When this screen appears,
JOG operation can be performed.

↑ Flickers in the test operation mode.

4. STARTUP

(2) JOG operation

POINT	<p>● 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 _ _".</p>
-------	--

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 instantaneous permissible 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.

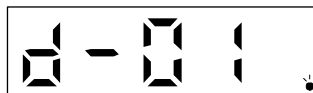
If the USB cable is disconnected during JOG operation using the MR Configurator2, the servo motor decelerates to a stop.

(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 pushed, 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.



4. STARTUP

(3) Positioning operation

POINT
<ul style="list-style-type: none"> ● 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 a 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.

4. STARTUP

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" button to rotate the servo motor in the forward rotation direction.

Click the "Reverse" 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 monitored during positioning operation.

4. STARTUP

(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

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 *, cycle the power after setting it.
- Abbreviations of operation modes indicate the followings.
 - Standard: Standard (semi closed loop system) use of the rotary servo motor
 - Full.: Fully closed loop system use of the rotary servo motor
(The fully closed loop system is available for the MR-J4-_A servo amplifiers of which software version is A5 or later. Check the software version using MR Configurator2.)
 - Lin.: Linear servo motor use
 - DD: Direct drive (DD) motor use
- The symbols in the control mode column mean as follows.
 - P: Position control mode
 - S: Speed control mode
 - T: Torque control mode

5. PARAMETERS

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

No.	Symbol	Name	Initial value	Unit	Operation mode				Control mode		
					Standard	Full.	Lin.	D.D.	P	S	T
PA01	*STY	Operation mode	1000h		○	○	○	○	○	○	○
PA02	*REG	Regenerative option	0000h		○	○	○	○	○	○	○
PA03	*ABS	Absolute position detection system	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/positive direction thrust limit	100.0	[%]	○	○	○	○	○	○	○
PA12	TLN	Reverse rotation torque limit/negative direction thrust limit	100.0	[%]	○	○	○	○	○	○	○
PA13	*PLSS	Command pulse input form	0100h		○	○	○	○	○	○	○
PA14	*POL	Rotation direction selection/travel direction selection	0		○	○	○	○	○	○	○
PA15	*ENR	Encoder output pulses	4000	[pulse/rev]	○	○	○	○	○	○	○
PA16	*ENR2	Encoder output pulses 2	1		○	○	○	○	○	○	○
PA17	*MSR	Servo motor series setting	0000h		○	○	○	○	○	○	○
PA18	*MTY	Servo motor type setting	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		○	○	○	○	○	○	○
PA29			0000h		○	○	○	○	○	○	○
PA30			0000h		○	○	○	○	○	○	○
PA31			0000h		○	○	○	○	○	○	○
PA32			0000h		○	○	○	○	○	○	○

5. PARAMETERS

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

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

5. PARAMETERS

No.	Symbol	Name	Initial value	Unit	Operation mode				Control mode				
					Standard	Full.	Lin.	D.D.	P	S	T		
PB37		For manufacturer setting	1600										
PB38			0.00										
PB39			0.00										
PB40			0.00										
PB41			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. PARAMETERS

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

No.	Symbol	Name	Initial value	Unit	Operation mode			Control mode		
					Standard	Full.	Lin.	D.D.	P	S	T
PC01	STA	Acceleration time constant	0	[ms]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC02	STB	Deceleration time constant	0	[ms]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC03	STC	S-pattern acceleration/deceleration time constant	0	[ms]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC04	TQC	Torque command time constant/thrust command time constant	0	[ms]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC05	SC1	Internal speed command 1	100	[r/min]/ [mm/s]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Internal speed limit 1			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC06	SC2	Internal speed command 2	500	[r/min]/ [mm/s]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Internal speed limit 2			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC07	SC3	Internal speed command 3	1000	[r/min]/ [mm/s]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Internal speed limit 3			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC08	SC4	Internal speed command 4	200	[r/min]/ [mm/s]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Internal speed limit 4			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC09	SC5	Internal speed command 5	300	[r/min]/ [mm/s]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Internal speed limit 5			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC10	SC6	Internal speed command 6	500	[r/min]/ [mm/s]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Internal speed limit 6			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC11	SC7	Internal speed command 7	800	[r/min]/ [mm/s]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Internal speed limit 7			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC12	VCM	Analog speed command - Maximum speed	0	[r/min]/ [mm/s]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Analog speed limit - Maximum speed			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC13	TLC	Analog torque/thrust command maximum output	100.0	[%]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Analog torque/thrust limit maximum output			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC14	MOD1	Analog monitor 1 output	0000h		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC15	MOD2	Analog monitor 2 output	0001h		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC16	MBR	Electromagnetic brake sequence output	0	[ms]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC17	ZSP	Zero speed	50	[r/min]/ [mm/s]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC18	*BPS	Alarm history clear	0000h		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC19	*ENRS	Encoder output pulse selection	0000h		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC20	*SNO	Station No. setting	0	[station]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC21	*SOP	RS-422 communication function selection	0000h		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC22	*COP1	Function selection C-1	0000h		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC23	*COP2	Function selection C-2	0000h		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC24	*COP3	Function selection C-3	0000h		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC25		For manufacturer setting	0000h		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC26	*COP5	Function selection C-5	0000h		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC27	*COP6	Function selection C-6	0000h		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC28		For manufacturer setting	0000h		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC29			0000h		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC30	STA2	Acceleration time constant 2	0	[ms]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC31	STB2	Deceleration time constant 2	0	[ms]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC32	CMX2	Command input pulse multiplication numerator 2	1		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC33	CMX3	Command input pulse multiplication numerator 3	1		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC34	CMX4	Command input pulse multiplication numerator 4	1		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC35	TL2	Internal torque limit 2/internal thrust limit 2	100.0	[%]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC36	*DMD	Status display selection	0000h		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PC37	VCO	Analog speed command offset	0	[mV]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Analog speed limit offset			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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No.	Symbol	Name	Initial value	Unit	Operation mode				Control mode		
					Standard	Full.	Lin.	D.D.	P	S	T
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 detection level	0	[rev]/[mm]	○	○	○	○	○	○	○
PC44	*COP9	Function selection C-9	0000h		/	○	/	/	○	/	/
PC45	*COPA	Function selection C-A	0000h		/	○	○	/	○	○	○
PC46		For manufacturer setting	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]/ [0.01mm]	○	○	○	○	○	○	○
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			0000h								
PC67			0000h								
PC68			0000h								
PC69			0000h								
PC70			0000h								
PC71			0000h								
PC72			0000h								
PC73			0000h								
PC74			0000h								
PC75	0000h										
PC76	0000h										
PC77	0000h										
PC78	0000h										
PC79	0000h										
PC80	0000h										

5. PARAMETERS

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

No.	Symbol	Name	Initial value	Unit	Operation mode			Control mode			
					Standard	Full.	Lin.	D.D.	P	S	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	0002h		○	○	○	○	○	○	○
PD05	*DI2L	Input device selection 2L	2100h		○	○	○	○	○	○	○
PD06	*DI2H	Input device selection 2H	0021h		○	○	○	○	○	○	○
PD07	*DI3L	Input device selection 3L	0704h		○	○	○	○	○	○	○
PD08	*DI3H	Input device selection 3H	0007h		○	○	○	○	○	○	○
PD09	*DI4L	Input device selection 4L	0805h		○	○	○	○	○	○	○
PD10	*DI4H	Input device selection 4H	0008h		○	○	○	○	○	○	○
PD11	*DI5L	Input device selection 5L	0303h		○	○	○	○	○	○	○
PD12	*DI5H	Input device selection 5H	0003h		○	○	○	○	○	○	○
PD13	*DI6L	Input device selection 6L	2006h		○	○	○	○	○	○	○
PD14	*DI6H	Input device selection 6H	0020h		○	○	○	○	○	○	○
PD15		For manufacturer setting	0000h		○	○	○	○	○	○	○
PD16			0000h		○	○	○	○	○	○	○
PD17	*DI8L	Input device selection 8L	0A0Ah		○	○	○	○	○	○	○
PD18	*DI8H	Input device selection 8H	0000h		○	○	○	○	○	○	○
PD19	*DI9L	Input device selection 9L	0B0Bh		○	○	○	○	○	○	○
PD20	*DI9H	Input device selection 9H	0000h		○	○	○	○	○	○	○
PD21	*DI10L	Input device selection 10L	2323h		○	○	○	○	○	○	○
PD22	*DI10H	Input device selection 10H	0023h		○	○	○	○	○	○	○
PD23	*DO1	Output device selection 1	0004h		○	○	○	○	○	○	○
PD24	*DO2	Output device selection 2	000Ch		○	○	○	○	○	○	○
PD25	*DO3	Output device selection 3	0004h		○	○	○	○	○	○	○
PD26	*DO4	Output device selection 4	0007h		○	○	○	○	○	○	○
PD27		For manufacturer setting	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		○	○	○	○	○	○	○
PD39			0		○	○	○	○	○	○	○
PD40			0		○	○	○	○	○	○	○
PD41			0000h		○	○	○	○	○	○	○
PD42			0000h		○	○	○	○	○	○	○
PD43			0000h		○	○	○	○	○	○	○
PD44			0000h		○	○	○	○	○	○	○
PD45			0000h		○	○	○	○	○	○	○
PD46			0000h		○	○	○	○	○	○	○
PD47			0000h		○	○	○	○	○	○	○
PD48			0000h		○	○	○	○	○	○	○

5. PARAMETERS

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

No.	Symbol	Name	Initial value	Unit	Operation mode			Control mode			
					Standard	Full.	Lin.	D.D.	P	S	T
PE01	*FCT1	Fully closed loop function selection 1	0000h			<input type="radio"/>			<input type="radio"/>		
PE02		For manufacturer setting	0000h								
PE03	*FCT2	Fully closed loop function selection 2	0003h			<input type="radio"/>			<input type="radio"/>		
PE04	*FBN	Fully closed loop control - Feedback pulse electronic gear 1 - Numerator	1			<input type="radio"/>			<input type="radio"/>		
PE05	*FBD	Fully closed loop control - Feedback pulse electronic gear 1 - Denominator	1			<input type="radio"/>			<input type="radio"/>		
PE06	BC1	Fully closed loop control - Speed deviation error detection level	400	[r/min]		<input type="radio"/>			<input type="radio"/>		
PE07	BC2	Fully closed loop control - Position deviation error detection level	100	[kpulse]		<input type="radio"/>			<input type="radio"/>		
PE08	DUF	Fully closed loop dual feedback filter	10	[rad/s]		<input type="radio"/>			<input type="radio"/>		
PE09		For manufacturer setting	0000h								
PE10	FCT3	Fully closed loop function selection 3	0000h			<input type="radio"/>			<input type="radio"/>		
PE11		For manufacturer setting	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	*FBN2	Fully closed loop control - Feedback pulse electronic gear 2 - Numerator	1			<input type="radio"/>			<input type="radio"/>		
PE35	*FBD2	Fully closed loop control - Feedback pulse electronic gear 2 - Denominator	1			<input type="radio"/>			<input type="radio"/>		
PE36		For manufacturer setting	0.0								
PE37			0.00								
PE38			0.00								
PE39			20								
PE40			0000h								
PE41	EOP3	Function selection E-3	0000h			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. PARAMETERS

No.	Symbol	Name	Initial value	Unit	Operation mode				Control mode		
					Standard	Full.	Lin.	D.D.	P	S	T
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. PARAMETERS

5.1.6 Extension setting 3 parameters ([Pr. PF__])

No.	Symbol	Name	Initial value	Unit	Operation mode			Control mode			
					Standard	Full.	Lin.	D.D.	P	S	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		For manufacturer setting	0000h								
PF11			0000h								
PF12			10000								
PF13			100								
PF14			100								
PF15	DBT	Electronic dynamic brake operating time	2000	[ms]	○	○			○	○	○
PF16		For manufacturer setting	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	SEMI-F47 function - Instantaneous power failure detection time (instantaneous power failure tough drive - detection time)	200	[ms]	○	○	○	○	○	○	○
PF26		For manufacturer setting	0								
PF27			0								
PF28			0								
PF29			0000h								
PF30			0								
PF31	FRIC	Machine diagnosis function - Friction judgement speed	0	[r/min]/ [mm/s]	○	○	○	○	○	○	○
PF32		For manufacturer setting	50								
PF33			0000h								
PF34			0000h								
PF 35			0000h								
PF36			0000h								
PF37			0000h								
PF38			0000h								
PF39			0000h								
PF40			0000h								
PF41			0000h								
PF42			0000h								
PF43			0000h								
PF44			0000h								
PF45			0000h								
PF46			0000h								
PF47			0000h								
PF48			0000h								

5. PARAMETERS

5.1.7 Linear servo motor/DD motor setting parameters ([Pr. PL_ _])

No.	Symbol	Name	Initial value	Unit	Operation mode			Control mode			
					Standard	Full.	Lin.	D.D.	P	S	T
PL01	*LIT1	Linear servo motor/DD motor function selection 1	0301h				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PL02	*LIM	Linear encoder resolution - Numerator	1000	[μm]			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PL03	*LID	Linear encoder resolution - Denominator	1000	[μm]			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PL04	*LIT2	Linear servo motor/DD motor function selection 2	0003h				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PL05	LB1	Position deviation error detection level	0	[mm]/ [0.01rev]			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PL06	LB2	Speed deviation error detection level	0	[r/min]/ [mm/s]			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PL07	LB3	Torque/thrust deviation error detection level	100	[%]			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PL08	*LIT3	Linear servo motor/DD motor function selection 3	0010h				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PL09	LPWM	Magnetic pole detection voltage level	30	[%]			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PL10		For manufacturer setting	5								
PL11			100								
PL12			500								
PL13			0000h								
PL14			0000h								
PL15			20								
PL16			0								
PL17	LTSTS	Magnetic pole detection - Minute position detection method - Function selection	0000h				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PL18	IDLV	Magnetic pole detection - Minute position detection method - Identification signal amplitude	0	[%]			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PL19		For manufacturer setting	0								
PL20			0								
PL21			0								
PL22			0								
PL23			0000h								
PL24			0								
PL25			0000h								
PL26			0000h								
PL27			0000h								
PL28			0000h								
PL29			0000h								
PL30			0000h								
PL31			0000h								
PL32			0000h								
PL33			0000h								
PL34			0000h								
PL35			0000h								
PL36			0000h								
PL37			0000h								
PL38			0000h								
PL39			0000h								
PL40			0000h								
PL41			0000h								
PL42			0000h								
PL43			0000h								
PL44			0000h								
PL45			0000h								
PL46			0000h								
PL47			0000h								
PL48			0000h								

5. PARAMETERS

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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	__x_	Operation mode selection 0: Standard control mode 1: Fully closed loop control mode 4: Linear servo motor control mode 6: DD motor control mode Setting other than above will trigger [AL. 37 Parameter error]. The linear servo system, direct drive servo system and fully closed loop system are available for the MR-J4_A(-RJ) servo amplifiers of which software version is A5 or later.	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_x__ x___	For manufacturer setting	0h 1h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PA02 *REG Regenerative option	__xx	Regenerative option Select the 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. <ul style="list-style-type: none"> • For the servo amplifier of 100 W, a regenerative resistor is not used. • For the servo amplifier of 0.2 kW to 7 kW, the built-in regenerative resistor is used. • The supplied regenerative resistor or a regenerative option is used with the servo amplifier of 11 kW to 22 kW. 01: FR-RC/FR-CV/FR-BU2 When you use FR-RC, FR-CV, or FR-BU2, select "Mode 2 (___1)" of "Undervoltage alarm detection mode selection" in [Pr. PC27]. 02: MR-RB032 03: MR-RB12 04: MR-RB32 05: MR-RB30 06: MR-RB50 (Cooling fan is required.) 08: MR-RB31 09: MR-RB51 (Cooling fan is required.) 0B: MR-RB3N 0C: MR-RB5N (Cooling fan is required.) FA: When the supplied regenerative resistor or a regenerative option used with the servo amplifier of 11 kW to 22 kW is cooled by a cooling fan to increase regenerative ability.	00h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_x__ x___	For manufacturer setting	0h 0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode																
				P	S	T														
PA03 *ABS Absolute position detection system	___x	Absolute position detection system selection Set this parameter when using the absolute position detection system in the position control mode. 0: Disabled (incremental system) 1: Enabled (absolute position detection system by DIO) 2: Enabled (absolute position detection system by communication) (available for the software version A3 or later)	0h	○	/	/														
	__x_	For manufacturer setting	0h	/	/	/														
	_x__		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 (with EM1) 2: Forced stop deceleration function enabled (with EM2) Refer to table 5.1 for details.	2h	○	○	/														
Table 5.1 Deceleration method																				
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2">Setting value</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> </thead> <tbody> <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> </tbody> </table>							Setting value	EM2/EM1	Deceleration method		EM2 or EM1 is off	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.
Setting value	EM2/EM1	Deceleration method																		
		EM2 or EM1 is off	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.																	
PA05 *FBP Number of command input pulses per revolution	/	The servo motor rotates based on set command input pulses. To enable the parameter value, set "Electronic gear selection" to "Number of command input pulses per revolution (1 ___)" of in [Pr. PA21]. "1 ___" cannot be set in [Pr. PA21] in the linear control mode. Setting range: 1000 to 1000000	10000	○	/	/														

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode
PA06 CMX Electronic gear numerator (command pulse multiplication numerator)		<p>Set the numerator of the electronic gear.</p> <p>To enable the parameter, set "Electronic gear selection" to "Electronic gear (0 ___)" or "J3A electronic gear setting value compatibility mode (2 ___)" in [Pr. PA21].</p> <p>The following shows a standard of the setting range of the electronic gear.</p> $\frac{1}{10} < \frac{CMX}{CDV} < 4000$ <p>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.</p> <p>Number of command input pulses per revolution ([Pr. PA05] "1000" to "1000000")</p> <p>Electronic gear selection (x ___) ([Pr. PA21])</p> <p>Electronic gear ([Pr. PA06]·[Pr. PA07])</p> <p>CMX CDV</p> <p>CMX CDV</p> <p>CMX CDV</p> <p>Command pulse train</p> <p>"0" (initial value)</p> <p>"1"</p> <p>"2"</p> <p>X16</p> <p>Pt FBP</p> <p>[pulse/rev]</p> <p>Deviation counter</p> <p>Servo motor (M)</p> <p>Encoder</p> <p>Pt (servo motor resolution): 4194304 pulses/rev</p> <p>Always set the electronic gear with servo-off state to prevent unexpected operation due to improper setting.</p> <p>Setting range: 1 to 16777215</p>	1	○
PA07 CDV Electronic gear denominator (command pulse multiplication denominator)		<p>Set the denominator of the electronic gear.</p> <p>To enable the parameter, set "Electronic gear selection" to "Electronic gear (0 ___)" or "J3A electronic gear setting value compatibility mode (2 ___)" in [Pr. PA21].</p> <p>Setting range: 1 to 16777215</p>	1	○

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode																				
				P	S	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																								
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Setting value</th> <th style="width: 30%;">Gain adjustment mode</th> <th style="width: 60%;">Automatically adjusted parameter</th> </tr> </thead> <tbody> <tr> <td>___0</td> <td>2 gain adjustment mode 1 (interpolation mode)</td> <td>[Pr. PB06 Load to motor inertia ratio] [Pr. PB08 Position loop gain] [Pr. PB09 Speed loop gain] [Pr. PB10 Speed integral compensation]</td> </tr> <tr> <td>___1</td> <td>Auto tuning mode 1</td> <td>[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]</td> </tr> <tr> <td>___2</td> <td>Auto tuning mode 2</td> <td>[Pr. PB07 Model loop gain] [Pr. PB08 Position loop gain] [Pr. PB09 Speed loop gain] [Pr. PB10 Speed integral compensation]</td> </tr> <tr> <td>___3</td> <td>Manual mode</td> <td></td> </tr> <tr> <td>___4</td> <td>2 gain adjustment mode 2</td> <td>[Pr. PB08 Position loop gain] [Pr. PB09 Speed loop gain] [Pr. PB10 Speed integral compensation]</td> </tr> </tbody> </table>							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]
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]																						

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode																																																																																												
				P	S	T																																																																																										
PA09 RSP Auto tuning response		Set a response of the auto tuning.	16	<input type="radio"/>	<input type="radio"/>																																																																																											
		<table border="1"> <thead> <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> </thead> <tbody> <tr><td>1</td><td rowspan="10">Low response ↑</td><td>2.7</td><td>21</td><td rowspan="10">Middle response ↑</td><td>67.1</td></tr> <tr><td>2</td><td>3.6</td><td>22</td><td>75.6</td></tr> <tr><td>3</td><td>4.9</td><td>23</td><td>85.2</td></tr> <tr><td>4</td><td>6.6</td><td>24</td><td>95.9</td></tr> <tr><td>5</td><td>10.0</td><td>25</td><td>108.0</td></tr> <tr><td>6</td><td>11.3</td><td>26</td><td>121.7</td></tr> <tr><td>7</td><td>12.7</td><td>27</td><td>137.1</td></tr> <tr><td>8</td><td>14.3</td><td>28</td><td>154.4</td></tr> <tr><td>9</td><td>16.1</td><td>29</td><td>173.9</td></tr> <tr><td>10</td><td>18.1</td><td>30</td><td>195.9</td></tr> <tr><td>11</td><td>20.4</td><td>31</td><td>220.6</td></tr> <tr><td>12</td><td>23.0</td><td>32</td><td>248.5</td></tr> <tr><td>13</td><td>25.9</td><td>33</td><td>279.9</td></tr> <tr><td>14</td><td>29.2</td><td>34</td><td>315.3</td></tr> <tr><td>15</td><td>32.9</td><td>35</td><td>355.1</td></tr> <tr><td>16</td><td>37.0</td><td>36</td><td>400.0</td></tr> <tr><td>17</td><td>41.7</td><td>37</td><td>446.6</td></tr> <tr><td>18</td><td>47.0</td><td>38</td><td>501.2</td></tr> <tr><td>19</td><td>Middle response ↓</td><td>52.9</td><td>39</td><td>High response ↓</td><td>571.5</td></tr> <tr><td>20</td><td></td><td>59.6</td><td>40</td><td></td><td>642.7</td></tr> </tbody> </table>					Setting value	Machine characteristic		Setting value	Machine characteristic		Response	Guideline for machine resonance frequency [Hz]	Response	Guideline for machine resonance frequency [Hz]	1	Low response ↑	2.7	21	Middle response ↑	67.1	2	3.6	22	75.6	3	4.9	23	85.2	4	6.6	24	95.9	5	10.0	25	108.0	6	11.3	26	121.7	7	12.7	27	137.1	8	14.3	28	154.4	9	16.1	29	173.9	10	18.1	30	195.9	11	20.4	31	220.6	12	23.0	32	248.5	13	25.9	33	279.9	14	29.2	34	315.3	15	32.9	35	355.1	16	37.0	36	400.0	17	41.7	37	446.6	18	47.0	38	501.2	19	Middle response ↓	52.9	39	High response ↓	571.5
Setting value	Machine characteristic		Setting value	Machine characteristic																																																																																												
	Response	Guideline for machine resonance frequency [Hz]		Response	Guideline for machine resonance frequency [Hz]																																																																																											
1	Low response ↑	2.7	21	Middle response ↑	67.1																																																																																											
2		3.6	22		75.6																																																																																											
3		4.9	23		85.2																																																																																											
4		6.6	24		95.9																																																																																											
5		10.0	25		108.0																																																																																											
6		11.3	26		121.7																																																																																											
7		12.7	27		137.1																																																																																											
8		14.3	28		154.4																																																																																											
9		16.1	29		173.9																																																																																											
10		18.1	30		195.9																																																																																											
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14	29.2	34	315.3																																																																																													
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16	37.0	36	400.0																																																																																													
17	41.7	37	446.6																																																																																													
18	47.0	38	501.2																																																																																													
19	Middle response ↓	52.9	39	High response ↓	571.5																																																																																											
20		59.6	40		642.7																																																																																											
		Setting range: 1 to 40																																																																																														
PA10 INP In-position range		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	100 [pulse]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																																																																																										
PA11 TLP Forward rotation torque limit/positive direction thrust limit		You can limit the torque or thrust generated by the servo motor. Set the parameter referring section 3.6.1 (5). When you output torque or thrust as analog monitor output, the larger value of [Pr. PA11 Forward rotation torque limit/positive direction thrust limit value] or [Pr. PA12 Reverse rotation torque limit/negative direction thrust limit value] will be the maximum output voltage (8 V). Set the parameter on the assumption that the maximum torque or thrust is 100.0 [%]. The parameter is for limiting the torque of the servo motor in the CCW power running or CW regeneration, or limiting the thrust of the linear servo motor in the positive direction power running or negative direction regeneration. Set this parameter to "0.0" to generate no torque or thrust. Setting range: 0.0 to 100.0	100.0 [%]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																																																																																										
PA12 TLN Reverse rotation torque limit/negative direction thrust limit		You can limit the torque or thrust generated by the servo motor. Set the parameter referring section 3.6.1 (5). When you output torque or thrust with analog monitor output, the larger value of [Pr. PA11 Forward rotation torque limit/positive direction thrust limit value] or [Pr. PA12 Reverse rotation torque limit/negative direction thrust limit value] will be the maximum output voltage (8 V). Set the parameter on the assumption that the maximum torque or thrust is 100.0 [%]. The parameter is for limiting the torque of the servo motor in the CCW power running or CW regeneration, or limiting the thrust of the linear servo motor in the positive direction power running or negative direction regeneration. Set this parameter to "0.0" to generate no torque or thrust. Setting range: 0.0 to 100.0	100.0 [%]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																																																																																										

5. PARAMETERS

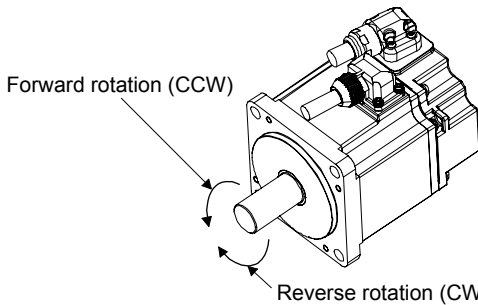
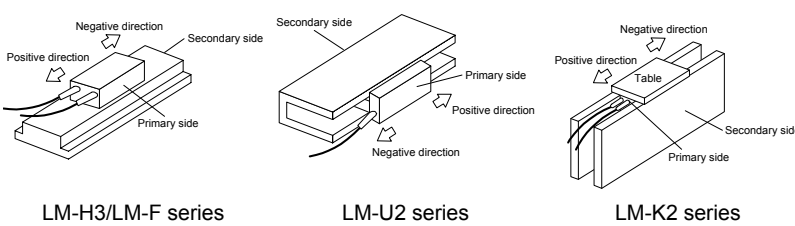
No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PA13 *PLSS Command pulse input form	__ _ x	Command input pulse train form selection 0: Forward/reverse rotation pulse train 1: Signed pulse train 2: A-phase/B-phase pulse train Refer to table 5.3 for settings.	0h	○		
	__ x _	Pulse train logic selection 0: Positive logic 1: Negative logic Refer to table 5.3 for settings.	0h	○		
	_ x _ _	Command input pulse train filter selection Selecting proper filter enables to enhance noise immunity. 0: Command input pulse train is 4 Mpps or less. 1: Command input pulse train is 1 Mpps or less. 2: Command input pulse train is 500 kpps or less. 3: Command input pulse train is 200 kpps or less (available for the software version A5 or later) 1 Mpps or lower commands are supported by "1". When inputting commands between 1 Mpps and 4 Mpps, set "0".	1h	○		
	x _ _ _	For manufacturer setting	0h			

Table 5.3 Command input pulse train form selection

Setting value		Pulse train form	Forward rotation (positive direction) command	Reverse rotation (negative direction) command
0010h	Negative logic	Forward rotation pulse train (positive direction pulse train)	PP	NP
		Reverse rotation pulse train (negative direction pulse train)	PP	NP
		Pulse train + sign	PP	NP
0012h		A-phase pulse train	PP	NP
		B-phase pulse train	PP	NP
0000h	Positive logic	Forward rotation pulse train (positive direction pulse train)	PP	NP
		Reverse rotation pulse train (negative direction pulse train)	PP	NP
		Pulse train + sign	PP	NP
0002h		A-phase pulse train	PP	NP
		B-phase pulse train	PP	NP

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

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode													
				P	S	T											
PA14 *POL Rotation direction selection/ travel direction selection		<p>Select the servo motor rotation direction or linear servo motor travel direction for the input pulse train.</p> <table border="1"> <thead> <tr> <th rowspan="2">Setting value</th> <th colspan="2">Servo motor rotation direction/ linear servo motor travel direction</th> </tr> <tr> <th>When forward rotation pulse is input</th> <th>When reverse rotation pulse is input</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>CCW or positive direction</td> <td>CW or negative direction</td> </tr> <tr> <td>1</td> <td>CW or negative direction</td> <td>CCW or positive direction</td> </tr> </tbody> </table> <p>The following shows the servo motor rotation directions.</p>  <p>The positive/negative directions of the linear servo motor are as follows.</p>  <p>LM-H3/LM-F series LM-U2 series LM-K2 series</p> <p>Setting range: 0, 1</p>	Setting value	Servo motor rotation direction/ linear servo motor travel direction		When forward rotation pulse is input	When reverse rotation pulse is input	0	CCW or positive direction	CW or negative direction	1	CW or negative direction	CCW or positive direction	0	<input type="radio"/>		
Setting value	Servo motor rotation direction/ linear servo motor travel direction																
	When forward rotation pulse is input	When reverse rotation pulse is input															
0	CCW or positive direction	CW or negative direction															
1	CW or negative direction	CCW or positive direction															
PA15 *ENR Encoder output pulses		<p>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)</p> <p>To set a numerator of the electronic gear, select "A-phase/B-phase pulse electronic gear setting (_ _ 3 _)" of "Encoder output pulse setting selection" in [Pr. PC19]. The maximum output frequency is 4.6 Mpps. Set the parameter within this range.</p> <p>Setting range: 1 to 4194304</p>	4000 [pulse/ rev]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>											
PA16 *ENR2 Encoder output pulses 2		<p>Set a denominator of the electronic gear for the A/B-phase pulse output.</p> <p>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].</p> <p>Setting range: 1 to 4194304</p>	1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>											

5. PARAMETERS

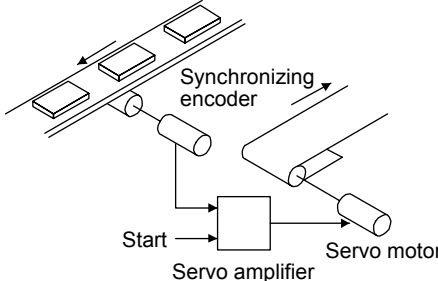
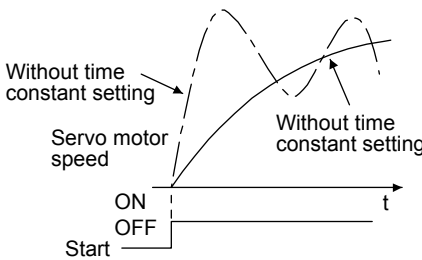
No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode																																																																																								
				P	S	T																																																																																						
PA17 *MSR Servo motor series setting		When you use a linear servo motor, select its model from [Pr. PA17] and [Pr. PA18]. Set this and [Pr. PA18] at a time. Refer to the following table for settings.	0000h	○	○	○																																																																																						
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PA18 *MTY Servo motor type setting		When you use a linear servo motor, select its model from [Pr. PA17] and [Pr. PA18]. Set this and [Pr. PA17] at a time. Refer to the table of [Pr. PA17] for settings.	0000h	○	○	○																																																																																						

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No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	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	<input type="radio"/>	<input type="radio"/>	
	__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]) 2: J3A electronic gear setting value compatibility mode (Electronic gear ([Pr. PA06] and [Pr. PA07] × 16)) Setting the parameter enables the electronic gear value set in MR-J3-A.	0h	<input type="radio"/>		
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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	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	<input type="radio"/>	<input type="radio"/>	
	__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. Setting "0" will be 50%.	0 [%]	<input type="radio"/>	<input type="radio"/>	
PA26 *AOP5 Function selection A-5	___x	Torque limit function selection at instantaneous power failure 0: Disabled 1: Enabled When an instantaneous power failure occurs during operation, the torque at acceleration is limited to save electric energy charged in the capacitor in the servo amplifier and the time until [AL. 10.2 Voltage drop in the main circuit power] occurs is extended with the instantaneous power failure tough drive function. Consequently, you can set a longer time in [Pr. PF25 Instantaneous power failure tough drive - Detection time]. The torque limit function at instantaneous power failure is enabled when "SEMI-F47 function selection (instantaneous power failure tough drive selection)" in [Pr. PA20] is "Enabled (_ 1 __)". This parameter setting is supported by servo amplifier with software version A6 or later.	0h	<input type="radio"/>	<input type="radio"/>	
	__x_	For manufacturer setting	0h			
	_x__		0h			
	x___		0h			

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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 setting of this digit, set "Vibration suppression mode selection" to "3 inertia mode (___1)" in [Pr. PA24]. Refer to section 7.1.5 for details. 0: Disabled 1: Automatic setting 2: Manual setting	0h	○		
	_x__		0h			
	x___		0h			
PB03 PST Position command acceleration/ deceleration time constant (position smoothing)		<p>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]. When the linear acceleration/deceleration is selected, the setting range 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 or linear servo motor to make a sudden stop at the time of position control mode switching or restart. (Example) When a command is given from a synchronizing encoder, synchronous operation will start smoothly even if it start during line operation.</p>   <p>Setting range: 0 to 65535</p>	0 [ms]	○		

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode												
				P	S	T										
PB04 FFC Feed forward gain		<p>Set the feed forward gain.</p> <p>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.</p> <p>Setting range: 0 to 100</p>	0 [%]	<input type="radio"/>												
PB06 GD2 Load to motor inertia ratio/ load to motor mass ratio		<p>Set the load to motor inertia ratio or load to motor mass ratio.</p> <p>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.</p> <p>Setting range: 0.00 to 300.00</p> <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Pr. PA08</th> <th>This parameter</th> </tr> </thead> <tbody> <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> </tbody> </table>	Pr. PA08	This parameter	___ 0 (2 gain adjustment mode 1 (interpolation mode))	Automatic setting	___ 1: (Auto tuning mode 1)	___ 2: (Auto tuning mode 2)	Manual setting	___ 3 (Manual mode)	___ 4: (2 gain adjustment mode 2)	7.00 [Multiplier]	<input type="radio"/>	<input type="radio"/>		
Pr. PA08	This parameter															
___ 0 (2 gain adjustment mode 1 (interpolation mode))	Automatic setting															
___ 1: (Auto tuning mode 1)																
___ 2: (Auto tuning mode 2)	Manual setting															
___ 3 (Manual mode)																
___ 4: (2 gain adjustment mode 2)																
PB07 PG1 Model loop gain		<p>Set the response gain up to the target position.</p> <p>Increasing the setting value will also increase the response level to the position command but will be liable to generate vibration and/or noise.</p> <p>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.</p> <p>Setting range: 1.0 to 2000.0</p> <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Pr. PA08</th> <th>This parameter</th> </tr> </thead> <tbody> <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> </tbody> </table>	Pr. PA08	This parameter	___ 0 (2 gain adjustment mode 1 (interpolation mode))	Manual setting	___ 1: (Auto tuning mode 1)	Automatic setting	___ 2: (Auto tuning mode 2)	___ 3 (Manual mode)	Manual setting	___ 4: (2 gain adjustment mode 2)	15.0 [rad/s]	<input type="radio"/>	<input type="radio"/>	
Pr. PA08	This parameter															
___ 0 (2 gain adjustment mode 1 (interpolation mode))	Manual setting															
___ 1: (Auto tuning mode 1)	Automatic setting															
___ 2: (Auto tuning mode 2)																
___ 3 (Manual mode)	Manual setting															
___ 4: (2 gain adjustment mode 2)																
PB08 PG2 Position loop gain		<p>Set the gain of the position loop.</p> <p>Set this parameter to increase the position response to level load disturbance.</p> <p>Increasing the setting value will also increase the response level to the load disturbance but will be liable to generate vibration and/or noise.</p> <p>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.</p> <p>Setting range: 1.0 to 2000.0</p> <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Pr. PA08</th> <th>This parameter</th> </tr> </thead> <tbody> <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> </tbody> </table>	Pr. PA08	This parameter	___ 0 (2 gain adjustment mode 1 (interpolation mode))	Automatic setting	___ 1: (Auto tuning mode 1)	___ 2: (Auto tuning mode 2)	Manual setting	___ 3 (Manual mode)	___ 4: (2 gain adjustment mode 2)	37.0 [rad/s]	<input type="radio"/>			
Pr. PA08	This parameter															
___ 0 (2 gain adjustment mode 1 (interpolation mode))	Automatic setting															
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___ 4: (2 gain adjustment mode 2)																

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	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]	<input type="radio"/>	<input type="radio"/>	
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]	<input type="radio"/>	<input type="radio"/>	
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	<input type="radio"/>	<input type="radio"/>	
PB12 OVA Overshoot amount compensation		Set a percentage of viscous friction torque against the servo motor rated value or thrust against the linear servo motor rated value. When the response level is low or when the torque/thrust is limited, the efficiency of the parameter may be lower. Setting range: 0 to 100	0 [%]	<input type="radio"/>		
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 with [Pr. PB01], this parameter will be set automatically. When "Filter tuning mode selection" is "Manual setting (_ _ _ 2)" in [Pr. PB01], the setting value is enabled. Setting range: 10 to 4500	4500 [Hz]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PB14 NHQ1 Notch shape selection 1		Set the shape of the machine resonance suppression filter 1. When "Filter tuning mode selection" is "Automatic setting (_ _ _ 1)" in [Pr. PB01], this parameter will be set 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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_ x _ _	Notch width selection 0: $\alpha = 2$ 1: $\alpha = 3$ 2: $\alpha = 4$ 3: $\alpha = 5$	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	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, set "Machine resonance suppression filter 2 selection" to "Enabled (_ _ _ 1)" in [Pr. PB16]. Setting range: 10 to 4500	4500 [Hz]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode																																																																						
				P	S	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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																																																																				
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																																																																				
	_ x _ _	Notch width selection 0: $\alpha = 2$ 1: $\alpha = 3$ 2: $\alpha = 4$ 3: $\alpha = 5$	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																																																																				
x _ _ _	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																					
PB17 NHF Shaft resonance suppression filter	Set the shaft resonance suppression filter. This is used to suppress a low-frequency machine vibration. When "Shaft resonance suppression filter selection" is "Automatic setting (_ _ _ 0)" in [Pr. PB23], the value will be calculated automatically from the servo motor you use and load to motor inertia ratio. It will not be automatically calculated for the liner servo motor. Set manually for "Manual setting (_ _ _ 1)". When "Shaft resonance suppression filter selection" is "Disabled (_ _ _ 2)" in [Pr. PB23], the setting value of this parameter is disabled. When "Machine resonance suppression filter 4 selection" is "Enabled (_ _ _ 1)" 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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																																																																				
	_ x _ _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																																																																				
	x _ _ _	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																				
<p align="center">Table 5.5 Shaft resonance suppression filter setting frequency selection</p> <table border="1"> <thead> <tr> <th>Setting value</th> <th>Frequency [Hz]</th> <th>Setting value</th> <th>Frequency [Hz]</th> </tr> </thead> <tbody> <tr><td>00</td><td>Disabled</td><td>10</td><td>562</td></tr> <tr><td>01</td><td>Disabled</td><td>11</td><td>529</td></tr> <tr><td>02</td><td>4500</td><td>12</td><td>500</td></tr> <tr><td>03</td><td>3000</td><td>13</td><td>473</td></tr> <tr><td>04</td><td>2250</td><td>14</td><td>450</td></tr> <tr><td>05</td><td>1800</td><td>15</td><td>428</td></tr> <tr><td>06</td><td>1500</td><td>16</td><td>409</td></tr> <tr><td>07</td><td>1285</td><td>17</td><td>391</td></tr> <tr><td>08</td><td>1125</td><td>18</td><td>375</td></tr> <tr><td>09</td><td>1000</td><td>19</td><td>360</td></tr> <tr><td>0A</td><td>900</td><td>1A</td><td>346</td></tr> <tr><td>0B</td><td>818</td><td>1B</td><td>333</td></tr> <tr><td>0C</td><td>750</td><td>1C</td><td>321</td></tr> <tr><td>0D</td><td>692</td><td>1D</td><td>310</td></tr> <tr><td>0E</td><td>642</td><td>1E</td><td>300</td></tr> <tr><td>0F</td><td>600</td><td>1F</td><td>290</td></tr> </tbody> </table>							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
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5. PARAMETERS

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]	○	○			
		<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>[Pr. PB23]</th> <th>[Pr. PB18]</th> </tr> </thead> <tbody> <tr> <td>__ 0 _ (Initial value)</td> <td>Automatic setting</td> </tr> <tr> <td>__ 1 _</td> <td>Setting value enabled</td> </tr> <tr> <td>__ 2 _</td> <td>Setting value disabled</td> </tr> </tbody> </table>					[Pr. PB23]	[Pr. PB18]
[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 "Machine resonance suppression filter 4 selection" is "Enabled (___ 1)" 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	0h					
	x _ _ _		0h					

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	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, set "Gain adjustment mode selection" to "Manual mode (___3)" in [Pr. PA08]. Slight vibration suppression control cannot be used in the speed control mode.	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	__x_	For manufacturer setting	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_x__		0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	x___		0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PB25 *BOP1 Function selection B-1	___x	For manufacturer setting	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	__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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_x__	For manufacturer setting	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PB26 *CDP Gain switching function	___x	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]. Gain switching selection 0: Disabled 1: Input device (gain switching (CDP)) 2: Command frequency 3: Droop pulses 4: Servo motor speed/linear servo motor speed	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	__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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_x__	For manufacturer setting	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	x___		0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PB27 CDL Gain switching condition		This is used to set the value of gain switching (command frequency, droop pulses, and servo motor speed/linear servo motor speed) selected in [Pr. PB26]. The set value unit differs depending on the switching condition item. (Refer to section 7.2.3.) The unit "r/min" will be "mm/s" for linear servo motors. Setting range: 0 to 9999	10 [kpps]/ [pulse]/ [r/min]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PB28 CDT Gain switching time constant		This is used to 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]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PB29 GD2B Load to motor inertia ratio/ load to motor mass ratio after gain switching		This is used to set the load to motor inertia ratio/load to motor mass ratio when gain switching is enabled. This parameter is enabled only when "Gain adjustment mode selection" is "Manual mode (___3)" in [Pr. PA08]. Setting range: 0.00 to 300.00	7.00 [Multiplier]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PB30 PG2B Position loop gain after gain switching		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 "Gain adjustment mode selection" is "Manual mode (___3)" in [Pr. PA08]. Setting range: 0.0 to 2000.0	0.0 [rad/s]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PB31 VG2B Speed loop gain after gain switching		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 "Gain adjustment mode selection" is "Manual mode (___ 3)" in [Pr. PA08]. Setting range: 0 to 65535	0 [rad/s]	<input type="radio"/>	<input type="radio"/>	
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 "Gain adjustment mode selection" is "Manual mode (___ 3)" in [Pr. PA08]. Setting range: 0.0 to 5000.0	0.0 [ms]	<input type="radio"/>	<input type="radio"/>	
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. <ul style="list-style-type: none"> • "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 or linear servo motor stops. Setting range: 0.0 to 300.0	0.0 [Hz]	<input type="radio"/>		
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. <ul style="list-style-type: none"> • "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 or linear servo motor stops. Setting range: 0.0 to 300.0	0.0 [Hz]	<input type="radio"/>		
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. <ul style="list-style-type: none"> • "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 or linear servo motor stops. Setting range: 0.00 to 0.30	0.00	<input type="radio"/>		
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. <ul style="list-style-type: none"> • "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 or linear servo motor stops. Setting range: 0.00 to 0.30	0.00	<input type="radio"/>		

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode																																																																																																																																																																																																								
				P	S	T																																																																																																																																																																																																						
PB45		Set the command notch filter.																																																																																																																																																																																																										
CNHF 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																																																																																																																																																																																																												
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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																																																																																																																																																																																																												
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Setting value</th> <th>Depth [dB]</th> <th>Setting value</th> <th>Depth [dB]</th> </tr> </thead> <tbody> <tr><td>0</td><td>-40.0</td><td>8</td><td>-6.0</td></tr> <tr><td>1</td><td>-24.1</td><td>9</td><td>-5.0</td></tr> <tr><td>2</td><td>-18.1</td><td>A</td><td>-4.1</td></tr> <tr><td>3</td><td>-14.5</td><td>B</td><td>-3.3</td></tr> <tr><td>4</td><td>-12.0</td><td>C</td><td>-2.5</td></tr> <tr><td>5</td><td>-10.1</td><td>D</td><td>-1.8</td></tr> <tr><td>6</td><td>-8.5</td><td>E</td><td>-1.2</td></tr> <tr><td>7</td><td>-7.2</td><td>F</td><td>-0.6</td></tr> </tbody> </table>							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																																																																																																																																																																		
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5. PARAMETERS

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

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PB51 NHQ5 Notch shape selection 5		Set the shape of the machine resonance suppression filter 5. When "Robust filter selection" is "Enabled (_ _ _ 1)" in [Pr. PE41], the machine resonance suppression filter 5 is not available.				
	___ x	Machine resonance suppression filter 5 selection 0: Disabled 1: Enabled	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	__ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_ x __	Notch width selection 0: $\alpha = 2$ 1: $\alpha = 3$ 2: $\alpha = 4$ 3: $\alpha = 5$	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	x ___	For manufacturer setting	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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 setting of this digit, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. Setting range: 0.1 to 300.0	100.0 [Hz]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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 setting of this digit, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. Setting range: 0.1 to 300.0	100.0 [Hz]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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 setting of this digit, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. Setting range: 0.00 to 0.30	0.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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 setting of this digit, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. Setting range: 0.00 to 0.30	0.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. PARAMETERS

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		<p>Set the vibration frequency for vibration suppression control 2 when the gain switching is enabled.</p> <p>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.</p> <ul style="list-style-type: none"> • "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)". <p>Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.</p> <p>Setting range: 0.0 to 300.0</p>	0.0 [Hz]	<input type="radio"/>		
PB57 VRF22B Vibration suppression control 2 - Resonance frequency after gain switching		<p>Set the resonance frequency for vibration suppression control 2 when the gain switching is enabled.</p> <p>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.</p> <ul style="list-style-type: none"> • "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)". <p>Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.</p> <p>Setting range: 0.0 to 300.0</p>	0.0 [Hz]	<input type="radio"/>		
PB58 VRF23B Vibration suppression control 2 - Vibration frequency damping after gain switching		<p>Set a damping of the vibration frequency for vibration suppression control 2 when the gain switching is enabled.</p> <p>This parameter will be enabled only when the following conditions are fulfilled.</p> <ul style="list-style-type: none"> • "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)". <p>Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.</p> <p>Setting range: 0.00 to 0.30</p>	0.00	<input type="radio"/>		
PB59 VRF24B Vibration suppression control 2 - Resonance frequency damping after gain switching		<p>Set a damping of the resonance frequency for vibration suppression control 2 when the gain switching is enabled.</p> <p>This parameter will be enabled only when the following conditions are fulfilled.</p> <ul style="list-style-type: none"> • "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)". <p>Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.</p> <p>Setting range: 0.00 to 0.30</p>	0.00	<input type="radio"/>		

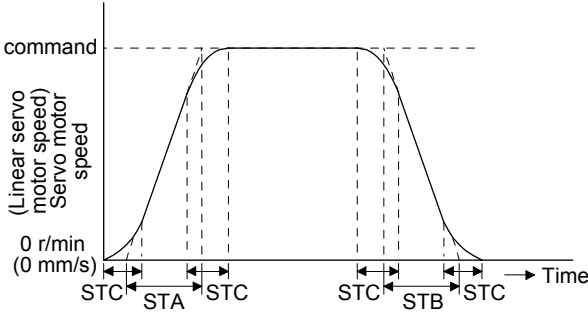
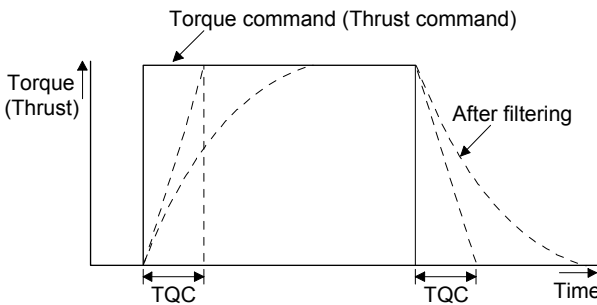
5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PB60 PG1B Model loop gain after gain switching		<p>Set the model loop gain when the gain switching is enabled.</p> <p>When you set a value less than 1.0 rad/s, the value will be the same as [Pr. PB07].</p> <p>This parameter will be enabled only when the following conditions are fulfilled.</p> <ul style="list-style-type: none"> • "Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". • "Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". <p>Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.</p> <p>Setting range: 0.0 to 2000.0</p>	0.0 [rad/s]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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		<p>Set the acceleration time required to reach the rated speed from 0 r/min or 0 mm/s for VC (Analog speed command) and [Pr. PC05 Internal speed command 1] to [Pr. PC11 Internal speed command 7].</p> <p>For example for the servo motor of 3000 r/min rated speed, set 3000 (3s) to increase the speed from 0 r/min to 1000 r/min in 1 second.</p> <p>Setting range: 0 to 50000</p>	0 [ms]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PC02 STB Deceleration time constant		<p>Set the deceleration time required to reach 0 r/min or 0 mm/s from the rated speed for VC (Analog speed command) and [Pr. PC05 Internal speed command 1] to [Pr. PC11 Internal speed command 7].</p> <p>Setting range: 0 to 50000</p>	0 [ms]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC03 STC S-pattern acceleration/ deceleration time constant		<p>Start/stop the servo motor or linear servo motor smoothly. Set the time of the arc part for S-pattern acceleration/deceleration.</p>  <p>STA: Acceleration time constant ([Pr. PC01]) STB: Deceleration time constant ([Pr. PC02]) STC: S-pattern acceleration/deceleration time constant ([Pr. PC03])</p> <p>Long setting of STA (acceleration time constant) or STB (deceleration time constant) may produce an error in the time of the arc part for the setting of the S-pattern acceleration/deceleration time constant. The upper limit value of the actual arc part time is limited by $\frac{2000000}{STA}$ for acceleration or by $\frac{2000000}{STB}$ for deceleration.</p> <p>(Example) At the setting of STA 20000, STB 5000 and STC 200, the actual arc part times are as follows.</p> <p>Acceleration: 100 ms $\frac{2000000}{20000} = 100 \text{ [ms]} < 200 \text{ [ms]}$ Therefore, it will be limited to 100 ms.</p> <p>Deceleration: 200 ms $\frac{2000000}{5000} = 400 \text{ [ms]} > 200 \text{ [ms]}$ Therefore, it will be 200 ms as you set.</p> <p>Setting range: 0 to 5000</p>	0 [ms]		<input type="radio"/>	<input type="radio"/>
PC04 TQC Torque/thrust command time constant		<p>Set the constant of a primary delay filter for the torque/thrust command.</p>  <p>TQC: Torque/thrust command time constant</p> <p>Setting range: 0 to 50000</p>	0 [ms]			<input type="radio"/>
PC05 SC1 Internal speed command 1		<p>Set the speed 1 of internal speed commands.</p> <p>Setting range: 0 to permissible instantaneous speed</p>	100 [r/min]/ [mm/s]		<input type="radio"/>	
Internal speed limit 1		<p>Set the speed 1 of internal speed limits.</p> <p>Setting range: 0 to permissible instantaneous speed</p>				<input type="radio"/>

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC06 SC2 Internal speed command 2 Internal speed limit 2		Set the speed 2 of internal speed commands. Setting range: 0 to permissible instantaneous speed	500 [r/min]/ [mm/s]		<input type="radio"/>	
		Set the speed 2 of internal speed limits. Setting range: 0 to permissible instantaneous speed				<input type="radio"/>
PC07 SC3 Internal speed command 3 Internal speed limit 3		Set the speed 3 of internal speed commands. Setting range: 0 to permissible instantaneous speed	1000 [r/min]/ [mm/s]		<input type="radio"/>	
		Set speed 3 of internal speed limits. Setting range: 0 to permissible instantaneous speed				<input type="radio"/>
PC08 SC4 Internal speed command 4 Internal speed limit 4		Set the speed 4 of internal speed commands. Setting range: 0 to permissible instantaneous speed	200 [r/min]/ [mm/s]		<input type="radio"/>	
		Set the speed 4 of internal speed limits. Setting range: 0 to permissible instantaneous speed				<input type="radio"/>
PC09 SC5 Internal speed command 5 Internal speed limit 5		Set the speed 5 of internal speed commands. Setting range: 0 to permissible instantaneous speed	300 [r/min]/ [mm/s]		<input type="radio"/>	
		Set the speed 5 of internal speed limits. Setting range: 0 to permissible instantaneous speed				<input type="radio"/>
PC10 SC6 Internal speed command 6 Internal speed limit 6		Set the speed 6 of internal speed commands. Setting range: 0 to permissible instantaneous speed	500 [r/min]/ [mm/s]		<input type="radio"/>	
		Set the speed 6 of internal speed limits. Setting range: 0 to permissible instantaneous speed				<input type="radio"/>
PC11 SC7 Internal speed command 7 Internal speed limit 7		Set the speed 7 of internal speed commands. Setting range: 0 to permissible instantaneous speed	800 [r/min]/ [mm/s]		<input type="radio"/>	
		Set the speed 7 of internal speed limits. Setting range: 0 to permissible instantaneous speed				<input type="radio"/>
PC12 VCM Analog speed command - Maximum speed Analog speed limit - Maximum speed		Set the speed of servo motor or linear servo motor at the maximum voltage (10 V) input to VC (Analog speed command). When "0" is set, the rated speed of the connected servo motor or linear servo motor is used. When you input a command value of the permissible speed or more to VC, the value is clamped at the permissible speed. Setting range: 0 to 50000	0 [r/min]/ [mm/s]		<input type="radio"/>	
		Set the speed of servo motor or linear servo motor at the maximum voltage (10 V) input to VLA (Analog speed limit). When "0" is set, the rated speed of the connected servo motor or linear servo motor is used. When you input a limit value of the permissible speed or more to VLA, the value is clamped at the permissible speed. Setting range: 0 to 50000				<input type="radio"/>

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No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC13 TLC Analog torque/thrust command maximum output Analog torque/thrust limit maximum output		<p>Set the output torque/thrust at the analog torque/thrust command voltage (TC = ±8 V) of +8 V on the assumption that the maximum torque/thrust is 100.0%. For example, set 50.0.</p> <p>The maximum torque or thrust × $\frac{50.0}{100.0}$ is outputted.</p> <p>When you input a command value of the maximum torque/thrust or more to TC, the value is clamped at the maximum torque/thrust.</p> <p>Setting range: 0.0 to 1000.0</p>	100.0 [%]			○
		<p>Set the output torque/thrust at the analog torque/thrust limit voltage (TLA = ±8 V) of +8 V on the assumption that the maximum torque/thrust is 100.0%. For example, set 50.0.</p> <p>The maximum torque or thrust × $\frac{50.0}{100.0}$ is outputted.</p> <p>When you input a limit value of the maximum torque/thrust or more to TLA, the value is clamped at the maximum torque/thrust.</p> <p>Setting range: 0.0 to 1000.0</p>			○	

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode																																																																																																																																																						
				P	S	T																																																																																																																																																				
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 10 (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																																																																																																																																																										
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<p>Note 1. Items with ○ are available for each operation mode. Standard: Standard (semi closed loop system) use of the rotary servo motor Full.: Fully closed loop system use of the rotary servo motor Lin.: Linear servo motor use DD: Direct drive (DD) motor use</p> <p>2. Encoder pulse unit</p> <p>3. 8 V is outputted at the maximum torque. However, when [Pr. PA11] and [Pr. PA12] are set to limit torque, 8 V is outputted at the torque highly limited.</p>																																																																																																																																																										

5. PARAMETERS

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 10 (3) for detection point of output selection. Refer to [Pr. PC14] for settings.	01h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																	
	_ x _ _	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																	
	x _ _ _		0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																	
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]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																	
	/	Set the output range of ZSP (Zero speed detection). ZSP (Zero speed detection) has hysteresis of 20 r/min or 20 mm/s. Setting range: 0 to 10000	50 [r/min]/ [mm/s]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																	
PC18 *BPS Alarm history clear	___ x	Alarm history clear selection 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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																	
	_ _ x _	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																	
	_ x _ _		0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																	
	x _ _ _		0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																	
PC19 *ENRS Encoder output pulse selection	___ x	Encoder output pulse phase selection Select the encoder pulse direction. 0: A-phase 90° shift in CCW or positive direction 1: A-phase 90° shift in CW or negative direction <table border="1" style="margin: 10px auto;"> <thead> <tr> <th rowspan="2">Setting value</th> <th colspan="2">Servo motor rotation direction/ linear servo motor travel direction</th> </tr> <tr> <th>CCW or positive direction</th> <th>CW or negative direction</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>A-phase </td> <td>A-phase </td> </tr> <tr> <td></td> <td>B-phase </td> <td>B-phase </td> </tr> <tr> <td>1</td> <td>A-phase </td> <td>A-phase </td> </tr> <tr> <td></td> <td>B-phase </td> <td>B-phase </td> </tr> </tbody> </table>	Setting value	Servo motor rotation direction/ linear servo motor travel direction		CCW or positive direction	CW or negative direction	0	A-phase	A-phase		B-phase	B-phase	1	A-phase	A-phase		B-phase	B-phase	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Setting value	Servo motor rotation direction/ linear servo motor travel direction																					
		CCW or positive direction	CW or negative direction																				
	0	A-phase	A-phase																				
	B-phase	B-phase																					
1	A-phase	A-phase																					
	B-phase	B-phase																					
_ _ 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 4: A/B-phase pulse through output setting When you select "1", the setting 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. Setting "4" will be enabled only when A/B/Z-phase differential output linear encoder is used. And "Encoder output pulse phase selection (_ _ _ x)" will be disabled. When another encoder is connected, [AL. 37 Parameter error] will occur. Setting "Standard control mode (_ _ 0 _)" in [Pr. PA01] will trigger [AL. 37 Parameter error].	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																		
_ x _ _	Selection of the encoders for encoder output pulse Select an encoder for servo amplifier output. 0: Servo motor encoder 1: Load-side encoder This is only for the fully closed loop system. If "1" is set other than in the fully closed loop system, [AL. 37 Parameter error] will occur.	0h	<input type="radio"/>	<input type="checkbox"/>	<input type="checkbox"/>																		
x _ _ _	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																		

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode														
				P	S	T												
PC20 *SNO Station No. setting		Set a station No. of the servo amplifier for RS-422 and USB 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]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>												
PC21 *SOP RS-422 communication function selection	Select the details of RS-422 communication function.																	
	___x	For manufacturer setting	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>												
	__x_	RS-422 communication baud rate selection 0: 9600 [bps] 1: 19200 [bps] 2: 38400 [bps] 3: 57600 [bps] 4: 115200 [bps]	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>												
	_x__	RS-422 communication response delay time selection 0: Disabled 1: Enabled (responding after 800 μs or longer delay time)	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>												
PC22 *COP1 Function selection C-1	x___	For manufacturer setting	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>												
	___x		0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>												
	__x_		0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>												
	_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. Setting "1" will trigger [AL. 37] while "Fully closed loop control mode (_ _ 1 _)" is selected in [Pr. PA01] (except MR-J4-A-RJ).	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>												
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 or 0 mm/s is performed.	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>												
	__x_	For manufacturer setting	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>												
	_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. <table border="1" data-bbox="438 1646 774 1892"> <thead> <tr> <th>Setting value</th> <th>Filtering time [ms]</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>0.444</td> </tr> <tr> <td>2</td> <td>0.888</td> </tr> <tr> <td>3</td> <td>1.777</td> </tr> <tr> <td>4</td> <td>3.555</td> </tr> <tr> <td>5</td> <td>7.111</td> </tr> </tbody> </table>	Setting value	Filtering time [ms]	0	0	1	0.444	2	0.888	3	1.777	4	3.555	5	7.111	0h	<input type="radio"/>
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0	0																	
1	0.444																	
2	0.888																	
3	1.777																	
4	3.555																	
5	7.111																	
	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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>												

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	--x_	For manufacturer setting	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_x__		0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	x---	Error excessive alarm level unit selection Select a setting unit of the error excessive alarm level set in [Pr. PC43]. 0: Per 1 rev or 1 mm 1: Per 0.1 rev or 0.1 mm 2: Per 0.01 rev or 0.01 mm 3: Per 0.001 rev or 0.001 mm	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PC26 *COP5 Function selection C-5	---x	[AL. 99 Stroke limit warning] selection Select [AL. 99 Stroke limit warning]. 0: Enabled 1: Disabled	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	--x_	For manufacturer setting	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_x__		0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	x---		0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PC27 *COP6 Function selection C-6	---x	[AL. 10 Undervoltage] detection method selection Set this parameter when [AL. 10 undervoltage] occurs due to power supply voltage distortion while using FR-RC or FR-CV. 0: When [AL. 10] does not occur 1: When [AL. 10] occurs	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	--x_	For manufacturer setting	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_x__		0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	x---		0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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 or 0 mm/s for 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]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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 or 0 mm/s from the rated speed for 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]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PC32 CMX2 Commanded pulse multiplication numerator 2		To enable the parameter, select "Electronic gear (0 ___) " or "J3A electronic gear setting value compatibility mode (2 ___) " of "Electronic gear selection" in [Pr. PA21]. Setting range: 1 to 16777215	1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PC33 CMX3 Commanded pulse multiplication numerator 3		To enable the parameter, select "Electronic gear (0 ___) " or "J3A electronic gear setting value compatibility mode (2 ___) " of "Electronic gear selection" in [Pr. PA21]. Setting range: 1 to 16777215	1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PC34 CMX4 Commanded pulse multiplication numerator 4		To enable the parameter, select "Electronic gear (0 ___) " or "J3A electronic gear setting value compatibility mode (2 ___) " of "Electronic gear selection" in [Pr. PA21]. Setting range: 1 to 16777215	1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PC35 TL2 Internal torque limit 2		Set the parameter on the assumption that the maximum torque or thrust is 100.0%. The parameter is for limiting the torque of the servo motor or the thrust of the linear servo motor. No torque or thrust 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	100.0 [%]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode																
				P	S	T														
PC36 *DMD Status display selection	-- x x	Status display selection at power-on Select a status display shown at power-on. 00: Cumulative feedback pulses 01: Servo motor speed/linear 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/thrust 0B: Within one-revolution position/within virtual one-revolution position (1 pulse unit) 0C: Within one-revolution position/within virtual one-revolution position (100 pulses unit) 0D: ABS counter/virtual ABS counter 0E: Load to motor inertia ratio/load to motor mass 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 kWh) 16: Unit total power consumption (increment of 1 Wh) 17: Unit total power consumption (increment of 100 kWh) 18: Load-side cumulative feedback pulses (Note 3) 19: Load-side droop pulses (Note 3) 1A: Load-side encoder information 1 (1 pulse unit) (Note 3) 1B: Load-side encoder information 1 (100 pulses unit) (Note 3) 1C: Load-side encoder ABS counter (Note 3) 1D: Z-phase counter (1 pulse unit) (Note 4) 1E: Z-phase counter (100 pulses unit) (Note 4) 1F: Electrical angle (1 pulse unit) (Note 4) 20: Electrical angle (100 pulses unit) (Note 4) 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. Setting "18 to 1C" will trigger [AL. 37] in the mode other than the fully closed loop control mode. 4. Setting "1D to 20" will trigger [AL. 37] in the mode other than the linear servo motor control mode.	00h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>														
	_ x _ _	Status display at power-on in corresponding control mode 0: Depends on the control mode <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Control mode</th> <th>Status display at power-on</th> </tr> </thead> <tbody> <tr> <td>Position</td> <td>Cumulative feedback pulses</td> </tr> <tr> <td>Position/speed</td> <td>Cumulative feedback pulses/servo motor speed (linear servo motor speed)</td> </tr> <tr> <td>Speed</td> <td>Servo motor speed (linear servo motor speed)</td> </tr> <tr> <td>Speed/torque</td> <td>Servo motor speed (linear servo motor speed)/analog torque (thrust) command voltage</td> </tr> <tr> <td>Torque</td> <td>Analog torque (thrust) command voltage</td> </tr> <tr> <td>Torque/position</td> <td>Analog torque (thrust) command voltage/cumulative feedback pulses</td> </tr> </tbody> </table> 1: Depends on the last 2 digits settings of the parameter	Control mode	Status display at power-on	Position	Cumulative feedback pulses	Position/speed	Cumulative feedback pulses/servo motor speed (linear servo motor speed)	Speed	Servo motor speed (linear servo motor speed)	Speed/torque	Servo motor speed (linear servo motor speed)/analog torque (thrust) command voltage	Torque	Analog torque (thrust) command voltage	Torque/position	Analog torque (thrust) command voltage/cumulative feedback pulses	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Control mode	Status display at power-on																			
Position	Cumulative feedback pulses																			
Position/speed	Cumulative feedback pulses/servo motor speed (linear servo motor speed)																			
Speed	Servo motor speed (linear servo motor speed)																			
Speed/torque	Servo motor speed (linear servo motor speed)/analog torque (thrust) command voltage																			
Torque	Analog torque (thrust) command voltage																			
Torque/position	Analog torque (thrust) command voltage/cumulative feedback pulses																			
	x _ _ _	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														

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No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	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 or positive direction travel is provided by switching on ST1 (Forward rotation start) while 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]		<input type="radio"/>	
		Set the offset voltage of VLA (Analog speed limit). For example, if CCW rotation or positive direction travel is provided by switching on RS1 (Forward rotation selection) while 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				<input type="radio"/>
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]			<input type="radio"/>
		Set the offset voltage of TLA (Analog torque limit). Setting range: -9999 to 9999			<input type="radio"/>	
PC39 MO1 Analog monitor 1 offset		Set the offset voltage of MO1 (Analog monitor 1). Setting range: -9999 to 9999	0 [mV]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PC40 MO2 Analog monitor 2 offset		Set the offset voltage of MO2 (Analog monitor 2). Setting range: -9999 to 9999	0 [mV]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PC43 ERZ Error excessive alarm level		Set an error excessive alarm level. You can change the setting unit with "Error excessive alarm level" in [Pr. PC24]. Set this per revolution for rotary servo motors and direct drive motors. Set this per mm for linear servo motors. Setting "0" will be "3 rev" for rotary servo motors and direct drive motors and "100 mm" for linear servo motors. A setting over 200 rev will be clamped at 200 rev. Setting range: 0 to 1000	0 [rev]/ [mm]	<input type="radio"/>		
PC44 *COP9 Function selection C-9	__ _ x	For manufacturer setting	0h			
	_ _ x _					
	_ x _ _					
	x _ _ _	Load-side encoder cable communication method selection Select the communication method of the encoder cable to be connected to the CN2L connector of MR-J4-A-RJ. 0: Two-wire type 1: Four-wire type Incorrect setting will trigger [AL. 70] and [AL. 71]. Setting "1" while using a servo amplifier other than MR-J4-A-RJ will trigger [AL. 37].	0h	<input type="radio"/>		

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode															
				P	S	T													
PC45 *COPA Function selection C-A	___X	Encoder pulse count polarity selection Select a polarity of the linear encoder or load-side encoder. 0: Encoder pulse increases in the servo motor CCW or positive direction. 1: Encoder pulse decreases in the servo motor CCW or positive direction.	0h																
	__X_	For manufacturer setting	0h																
	_X__	Selection of A/B/Z-phase input interface encoder Z-phase connection judgement function Select the non-signal detection status for the pulse train signal from the A/B/Z-phase input interface encoder used as a linear encoder or load-side encoder. This function is enabled only when you use an A/B/Z-phase input interface encoder.	0h	○	○	○													
		<table border="1"> <thead> <tr> <th rowspan="2">Setting value</th> <th>Detection of disconnection</th> <th colspan="2">Alarm status</th> </tr> <tr> <th>Z-phase-side non- signal</th> <th>Fully closed loop system</th> <th>Linear servo system Direct drive servo system</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Enabled</td> <td>[AL. 71.6] (Z-phase)</td> <td>[AL. 20.6] (Z-phase)</td> </tr> <tr> <td>1</td> <td>Disabled</td> <td></td> <td></td> </tr> </tbody> </table>	Setting value	Detection of disconnection	Alarm status		Z-phase-side non- signal	Fully closed loop system	Linear servo system Direct drive servo system	0	Enabled	[AL. 71.6] (Z-phase)	[AL. 20.6] (Z-phase)	1	Disabled				
Setting value	Detection of disconnection	Alarm status																	
	Z-phase-side non- signal	Fully closed loop system	Linear servo system Direct drive servo system																
0	Enabled	[AL. 71.6] (Z-phase)	[AL. 20.6] (Z-phase)																
1	Disabled																		
	X___	For manufacturer setting	0h																
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 or 0 mm/s. [Precautions] <ul style="list-style-type: none"> • If the servo motor torque or linear servo motor thrust is saturated at the maximum value 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 control circuit power supply is cut, dynamic braking will start regardless of the deceleration time constant setting. Setting range: 0 to 20000	100 [ms]	○	○														

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No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC54 RSUP1 Vertical axis freefall prevention compensation amount		<p>Set the compensation amount of the vertical axis freefall prevention function. Set it per servo motor rotation amount or linear servo motor travel distance. When setting a positive value, the servo motor or linear servo motor moves in the direction set with [Pr. PA14] for the forward rotation pulse input. When setting a negative value, the servo motor or linear servo motor moves in the direction set with [Pr. PA14] for the reverse rotation pulse input. For example, if a positive compensation amount is set when the [Pr. PA14 Rotation direction selection/travel 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.</p> <ol style="list-style-type: none"> 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 (linear) servo motor speed is zero speed or less. 5) MBR (Electromagnetic brake interlock) is enabled with [Pr. PD23] to [Pr. PD28], and the base circuit shut-off delay time is set in [Pr. PC16]. <p>Setting range: -25000 to 25000</p>	0 [0.0001 rev]/ [0.01 mm]	○		
PC60 *COPD Function selection C-D	___x	<p>Motor-less operation selection This is used to select the motor-less operation. This is not used in the linear servo motor control mode, fully closed loop control, and DD motor control mode. 0: Disabled 1: Enabled</p>	0h	○	○	○
	___x_	For manufacturer setting	0h			
	_x__		0h			
	x___		0h			

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

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode																																		
				P	S	T																																
PD01		Select input devices to turn on them automatically.																																				
*DIA1 Input signal automatic on selection 1	___x (HEX)	___x (BIN): For manufacturer setting __x_ (BIN): For manufacturer setting _x__ (BIN): SON (Servo-on) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																
	x___	x___ (BIN): For manufacturer setting		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																
	__x_	___x (BIN): PC (Proportional control) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																
	__x_	__x_ (BIN): TL (External torque limit selection) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																
	_x__	_x__ (BIN): For manufacturer setting		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																
	x___	x___ (BIN): For manufacturer setting		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																
	_x__	___x (BIN): For manufacturer setting __x_ (BIN): For manufacturer setting _x__ (BIN): LSP (Forward rotation stroke end) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																
	x___	x___ (BIN): LSN (Reverse rotation stroke end) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																
	x___	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																
Convert the setting value into hexadecimal as follows.																																						
<table border="1"> <thead> <tr> <th rowspan="2">Signal name</th> <th colspan="2">Initial value</th> </tr> <tr> <th>BIN</th> <th>HEX</th> </tr> </thead> <tbody> <tr> <td>SON (Servo-on)</td> <td>0</td> <td rowspan="4">0</td> </tr> <tr> <td></td> <td>0</td> </tr> <tr> <td></td> <td>0</td> </tr> <tr> <td></td> <td>0</td> </tr> <tr> <td>PC (Proportional control)</td> <td>0</td> <td rowspan="4">0</td> </tr> <tr> <td>TL (External torque limit selection)</td> <td>0</td> </tr> <tr> <td></td> <td>0</td> </tr> <tr> <td></td> <td>0</td> </tr> <tr> <td>LSP (Forward rotation stroke end)</td> <td>0</td> <td rowspan="4">0</td> </tr> <tr> <td>LSN (Reverse rotation stroke end)</td> <td>0</td> </tr> <tr> <td></td> <td>0</td> </tr> <tr> <td></td> <td>0</td> </tr> </tbody> </table>							Signal name	Initial value		BIN	HEX	SON (Servo-on)	0	0		0		0		0	PC (Proportional control)	0	0	TL (External torque limit selection)	0		0		0	LSP (Forward rotation stroke end)	0	0	LSN (Reverse rotation stroke end)	0		0		0
Signal name	Initial value																																					
	BIN	HEX																																				
SON (Servo-on)	0	0																																				
	0																																					
	0																																					
	0																																					
PC (Proportional control)	0	0																																				
TL (External torque limit selection)	0																																					
	0																																					
	0																																					
LSP (Forward rotation stroke end)	0	0																																				
LSN (Reverse rotation stroke end)	0																																					
	0																																					
	0																																					
BIN 0: Use for an external input signal. BIN 1: Automatic on																																						

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode																																																																																									
				P	S	T																																																																																							
PD03	Any input device can be assigned to the CN1-15 pin.																																																																																												
*DI1L Input device selection 1L	-- x x	Position control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	02h	○	/	/																																																																																							
	x x --	Speed control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	02h	/	○	/																																																																																							
Table 5.9 Selectable input devices																																																																																													
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2">Setting value</th> <th colspan="3">Input device (Note 1)</th> </tr> <tr> <th>P</th> <th>S</th> <th>T</th> </tr> </thead> <tbody> <tr><td>02</td><td>SON</td><td>SON</td><td>SON</td></tr> <tr><td>03</td><td>RES</td><td>RES</td><td>RES</td></tr> <tr><td>04</td><td>PC</td><td>PC</td><td>/</td></tr> <tr><td>05</td><td>TL</td><td>TL</td><td>/</td></tr> <tr><td>06</td><td>CR</td><td>/</td><td>/</td></tr> <tr><td>07</td><td>/</td><td>ST1</td><td>RS2</td></tr> <tr><td>08</td><td>/</td><td>ST2</td><td>RS1</td></tr> <tr><td>09</td><td>TL1</td><td>TL1</td><td>/</td></tr> <tr><td>0A</td><td>LSP</td><td>LSP</td><td>LSP (Note 3)</td></tr> <tr><td>0B</td><td>LSN</td><td>LSN</td><td>LSN (Note 3)</td></tr> <tr><td>0D</td><td>CDP</td><td>CDP</td><td>/</td></tr> <tr><td>0E</td><td>CLD</td><td>/</td><td>/</td></tr> <tr><td>0F</td><td>MECR</td><td>/</td><td>/</td></tr> <tr><td>20</td><td>/</td><td>SP1</td><td>SP1</td></tr> <tr><td>21</td><td>/</td><td>SP2</td><td>SP2</td></tr> <tr><td>22</td><td>/</td><td>SP3</td><td>SP3</td></tr> <tr><td>23</td><td>LOP (Note 2)</td><td>LOP (Note 2)</td><td>LOP (Note 2)</td></tr> <tr><td>24</td><td>CM1</td><td>/</td><td>/</td></tr> <tr><td>25</td><td>CM2</td><td>/</td><td>/</td></tr> <tr><td>26</td><td>/</td><td>STAB2</td><td>STAB2</td></tr> </tbody> </table>							Setting value	Input device (Note 1)			P	S	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	LSP (Note 3)	0B	LSN	LSN	LSN (Note 3)	0D	CDP	CDP	/	0E	CLD	/	/	0F	MECR	/	/	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
Setting value	Input device (Note 1)																																																																																												
	P	S	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	LSP (Note 3)																																																																																										
0B	LSN	LSN	LSN (Note 3)																																																																																										
0D	CDP	CDP	/																																																																																										
0E	CLD	/	/																																																																																										
0F	MECR	/	/																																																																																										
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																																																																																										
<p>Note 1. P: Position control mode, S: Speed control mode, T: Torque control mode The diagonal lines indicate manufacturer settings. Never change the setting.</p> <p>2. When assigning LOP (Control switching), assign it to the same pin in all control modes.</p> <p>3. In the torque control mode, this device cannot be used during normal operation. It can be used during the magnetic pole detection in the linear servo motor control mode and the DD motor control mode. Also, when the magnetic pole detection in the torque control mode is completed, this signal will be disabled.</p>																																																																																													
PD04	Any input device can be assigned to the CN1-15 pin.																																																																																												
*DI1H Input device selection 1H	-- x x	Torque control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	02h	/	/	○																																																																																							
	_ x _ _	For manufacturer setting	0h	/	/	/																																																																																							
	x _ _ _		0h	/	/	/																																																																																							
PD05	Any input device can be assigned to the CN1-16 pin.																																																																																												
*DI2L Input device selection 2L	-- x x	Position control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	00h	○	/	/																																																																																							
	x x _ _	Speed control mode - Device selection Refer to table 5.9 for settings.	21h	/	○	/																																																																																							
PD06	Any input device can be assigned to the CN1-16 pin.																																																																																												
*DI2H Input device selection 2H	-- x x	Torque control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	21h	/	/	○																																																																																							
	_ x _ _	For manufacturer setting	0h	/	/	/																																																																																							
	x _ _ _		0h	/	/	/																																																																																							

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No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PD07 *DI3L Input device selection 3L	Any input device can be assigned to the CN1-17 pin. When "___ 1" is set in [Pr. PA03] and absolute position detection system by DIO is selected, the CN1-17 pin will become ABSM (ABS transfer mode).					
	__ x x	Position control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	04h	○	△	△
	x x __	Speed control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	07h	△	○	△
PD08 *DI3H Input device selection 3H	Any input device can be assigned to the CN1-17 pin.					
	__ x x	Torque control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	07h	△	△	○
	_ x __	For manufacturer setting	0h	△	△	△
	x _ _ _		0h	△	△	△
PD09 *DI4L Input device selection 4L	Any input device can be assigned to the CN1-18 pin. When "___ 1" is set in [Pr. PA03] and absolute position detection system by DIO is selected, the CN1-18 pin will become ABSR (ABS transfer request).					
	__ x x	Position control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	05h	○	△	△
	x x __	Speed control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	08h	△	○	△
PD10 *DI4H Input device selection 4H	Any input device can be assigned to the CN1-18 pin.					
	__ x x	Torque control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	08h	△	△	○
	_ x __	For manufacturer setting	0h	△	△	△
	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.	03h	△	○	△
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.	03h	△	△	○
	_ x __	For manufacturer setting	0h	△	△	△
	x _ _ _		0h	△	△	△
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.	20h	△	○	△
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.	20h	△	△	○
	_ x __	For manufacturer setting	0h	△	△	△
	x _ _ _		0h	△	△	△
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	0h	△	△	△
	x _ _ _		0h	△	△	△

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode																																																																									
				P	S	T																																																																							
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	0h	△	△	△																																																																							
	x __ __		0h	△	△	△																																																																							
PD21 *DI10L Input device selection 10L	Any input device can be assigned to the CN1-45 pin.																																																																												
	__ x x	Position control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	23h	○	△	△																																																																							
	x x __	Speed control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	23h	△	○	△																																																																							
PD22 *DI10H Input device selection 10H	Any input device can be assigned to the CN1-45 pin.																																																																												
	__ x x	Torque control mode - Device selection Refer to table 5.9 in [Pr. PD03] for settings.	23h	△	△	○																																																																							
	__ x __	For manufacturer setting	0h	△	△	△																																																																							
	x __ __		0h	△	△	△																																																																							
PD23 *DO1 Output device selection 1	Any input device can be assigned to the CN1-45 pin.																																																																												
	__ x x	Device selection Any output device can be assigned to the CN1-22 pin. When "Enabled (absolute position detection system by DIO) (_ _ _ 1)" is selected in [Pr. PA03], the CN1-22 pin will become ABSB0 (ABS send data bit 0) only during ABS transfer mode. Refer to table 5.10 for settings.	04h	○	○	○																																																																							
	__ x __	For manufacturer setting	0h	△	△	△																																																																							
	x __ __		0h	△	△	△																																																																							
Table 5.10 Selectable output devices																																																																													
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2">Setting value</th> <th colspan="3">Output device (Note)</th> </tr> <tr> <th>P</th> <th>S</th> <th>T</th> </tr> </thead> <tbody> <tr><td>00</td><td>Always off</td><td>Always off</td><td>Always off</td></tr> <tr><td>02</td><td>RD</td><td>RD</td><td>RD</td></tr> <tr><td>03</td><td>ALM</td><td>ALM</td><td>ALM</td></tr> <tr><td>04</td><td>INP</td><td>SA</td><td>Always off</td></tr> <tr><td>05</td><td>MBR</td><td>MBR</td><td>MBR</td></tr> <tr><td>06</td><td>DB</td><td>DB</td><td>DB</td></tr> <tr><td>07</td><td>TLC</td><td>TLC</td><td>VLC</td></tr> <tr><td>08</td><td>WNG</td><td>WNG</td><td>WNG</td></tr> <tr><td>09</td><td>BWNG</td><td>BWNG</td><td>BWNG</td></tr> <tr><td>0A</td><td>Always off</td><td>SA</td><td>Always off</td></tr> <tr><td>0B</td><td>Always off</td><td>Always off</td><td>VLC</td></tr> <tr><td>0C</td><td>ZSP</td><td>ZSP</td><td>ZSP</td></tr> <tr><td>0D</td><td>MTTR</td><td>MTTR</td><td>MTTR</td></tr> <tr><td>0F</td><td>CDPS</td><td>Always off</td><td>Always off</td></tr> <tr><td>10</td><td>CLDS</td><td>Always off</td><td>Always off</td></tr> <tr><td>11</td><td>ABSV</td><td>Always off</td><td>Always off</td></tr> </tbody> </table>							Setting value	Output device (Note)			P	S	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	06	DB	DB	DB	07	TLC	TLC	VLC	08	WNG	WNG	WNG	09	BWNG	BWNG	BWNG	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	10	CLDS	Always off	Always off	11	ABSV	Always off	Always off
Setting value	Output device (Note)																																																																												
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00	Always off	Always off	Always off																																																																										
02	RD	RD	RD																																																																										
03	ALM	ALM	ALM																																																																										
04	INP	SA	Always off																																																																										
05	MBR	MBR	MBR																																																																										
06	DB	DB	DB																																																																										
07	TLC	TLC	VLC																																																																										
08	WNG	WNG	WNG																																																																										
09	BWNG	BWNG	BWNG																																																																										
0A	Always off	SA	Always off																																																																										
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11	ABSV	Always off	Always off																																																																										
<p>Note. P: Position control mode, S: Speed control mode, T: Torque control mode</p>																																																																													

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No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PD24 *DO2 Output device selection 2	__ x x	Device selection Any output device can be assigned to the CN1-23 pin. When "Enabled (absolute position detection system by DIO) (___ 1)" is selected in [Pr. PA03], the CN1-23 pin will become ABSB1 (ABS send data bit 1) only during ABS transfer mode. Refer to table 5.10 in [Pr. PD23] for settings.	0Ch	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_ x _ _	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	x _ _ _		0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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. PD23] for settings.	04h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_ x _ _	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	x _ _ _		0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PD26 *DO4 Output device selection 4	__ x x	Device selection Any output device can be assigned to the CN1-25 pin. When "Enabled (absolute position detection system by DIO) (___ 1)" is selected in [Pr. PA03], the CN1-25 pin will become ABST (ABS send data ready) only during ABS transfer mode. Refer to table 5.10 in [Pr. PD23] for settings.	07h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_ x _ _	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	x _ _ _		0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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. PD23] for settings.	02h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_ x _ _	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	x _ _ _		0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	__ x _	RES (Reset) dedicated filter selection 0: Disabled 1: Enabled (50 [ms])	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_ x _ _	CR (Clear) dedicated filter selection 0: Disabled 1: Enabled (50 [ms])	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	x _ _ _	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>
	__ x _	Base circuit status selection for RES (Reset) on 0: Base circuit shut-off 1: No base circuit shut-off	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_ x _ _	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	x _ _ _	Enabled/disabled selection for a thermistor of servo motor or linear servo motor (supported by software version A5 or later) 0: Enabled 1: Disabled The setting in this digit will be disabled when using a servo motor or linear servo motor without thermistor.	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode						
				P	S	T				
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	/	/					
PD34 *DOP5 Function selection D-5	___x	Alarm code output Select output status of alarm codes. Alarm codes are outputted to the pins CN1-22, CN1-23, and CN1-24. 0: Disabled 1: Enabled For details of the alarm codes, refer to chapter 8. When "Enabled (absolute position detection system by DIO) (___1)" is selected in [Pr. PA03] and when MBR (Electromagnetic brake interlock) or ALM (Malfunction) is assigned to the CN1-22 pin, CN1-23 pin, or CN1-24 pin, selecting alarm code output will generate [AL. Parameter error].	0h	○	○	○				
	__x_	Selection of output device at warning occurrence Select ALM (Malfunction) output status at warning occurrence.	0h	○	○	○				
		<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Setting value</th> <th>Device status</th> </tr> </thead> <tbody> <tr> <td>0</td> <td> <div style="display: flex; flex-direction: column; align-items: flex-start;"> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="text-align: center;">WNG</div> <div style="text-align: center;">ON OFF</div> </div> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="text-align: center;">ALM</div> <div style="text-align: center;">ON OFF</div> </div> </div> </td> </tr> <tr> <td>1</td> <td> <div style="display: flex; flex-direction: column; align-items: flex-start;"> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="text-align: center;">WNG</div> <div style="text-align: center;">ON OFF</div> </div> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="text-align: center;">ALM</div> <div style="text-align: center;">ON OFF</div> </div> </div> </td> </tr> </tbody> </table>	Setting value	Device status	0	<div style="display: flex; flex-direction: column; align-items: flex-start;"> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="text-align: center;">WNG</div> <div style="text-align: center;">ON OFF</div> </div> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="text-align: center;">ALM</div> <div style="text-align: center;">ON OFF</div> </div> </div>	1	<div style="display: flex; flex-direction: column; align-items: flex-start;"> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="text-align: center;">WNG</div> <div style="text-align: center;">ON OFF</div> </div> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="text-align: center;">ALM</div> <div style="text-align: center;">ON OFF</div> </div> </div>		
Setting value	Device status									
0	<div style="display: flex; flex-direction: column; align-items: flex-start;"> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="text-align: center;">WNG</div> <div style="text-align: center;">ON OFF</div> </div> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="text-align: center;">ALM</div> <div style="text-align: center;">ON OFF</div> </div> </div>									
1	<div style="display: flex; flex-direction: column; align-items: flex-start;"> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="text-align: center;">WNG</div> <div style="text-align: center;">ON OFF</div> </div> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="text-align: center;">ALM</div> <div style="text-align: center;">ON OFF</div> </div> </div>									
	For manufacturer setting	0h	/	/	/					
		0h	/	/	/					

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5.2.5 Extension setting 2 parameters ([Pr. PE__])

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode																																																																								
				P	S	T																																																																						
PE01 *FCT1 Fully closed loop function selection 1	___x	Fully closed loop function selection The fully closed loop function is selected. 0: Always enabled 1: Switching with CLD (Fully closed loop control selection) <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Selection using the fully closed loop control selection (CLD)</th> <th>Control method</th> </tr> </thead> <tbody> <tr> <td>Off</td> <td>Semi closed loop control</td> </tr> <tr> <td>On</td> <td>Fully closed loop control</td> </tr> </tbody> </table> To enable the setting, select "Fully closed loop control mode (__ 1 __)" of "operation mode selection" in [Pr. PA01]. Selecting the "switching with CLD (Fully closed loop control selection)" will trigger [AL. 37] while "absolute position detection system selection" is "Enabled (absolute position detection system by DIO) (__ 1)" in [Pr. PA03] .	Selection using the fully closed loop control selection (CLD)	Control method	Off	Semi closed loop control	On	Fully closed loop control	0h	○																																																																		
	Selection using the fully closed loop control selection (CLD)	Control method																																																																										
	Off	Semi closed loop control																																																																										
	On	Fully closed loop control																																																																										
__x__	For manufacturer setting	0h																																																																										
__x__		0h																																																																										
x__			0h																																																																									
PE03 *FCT2 Fully closed loop function selection 2	__xx	Fully closed loop control error detection function selection Select the fully closed loop control error detection function. ○: Error detection enabled - -: Error detection disabled <table border="1" style="margin: 10px auto;"> <thead> <tr> <th rowspan="3">Setting value</th> <th rowspan="3">Speed deviation error</th> <th colspan="3">Position deviation error</th> </tr> <tr> <th colspan="2">During servo-on</th> <th rowspan="2">During servo- off</th> </tr> <tr> <th>With command</th> <th>Command 0</th> </tr> </thead> <tbody> <tr><td>__ 0 0</td><td>-</td><td>-</td><td>-</td><td>-</td></tr> <tr><td>__ 0 1</td><td>○</td><td>-</td><td>-</td><td>-</td></tr> <tr><td>__ 0 2</td><td>-</td><td>○</td><td>○</td><td>○</td></tr> <tr><td>__ 0 3</td><td>○</td><td>○</td><td>○</td><td>○</td></tr> <tr><td>__ 1 0</td><td>-</td><td>-</td><td>-</td><td>-</td></tr> <tr><td>__ 1 1</td><td>○</td><td>-</td><td>-</td><td>-</td></tr> <tr><td>__ 1 2</td><td>-</td><td>-</td><td>○</td><td>-</td></tr> <tr><td>__ 1 3</td><td>○</td><td>-</td><td>○</td><td>-</td></tr> <tr><td>__ 2 0</td><td>-</td><td>-</td><td>-</td><td>-</td></tr> <tr><td>__ 2 1</td><td>○</td><td>-</td><td>-</td><td>-</td></tr> <tr><td>__ 2 2</td><td>-</td><td>-</td><td>○</td><td>○</td></tr> <tr><td>__ 2 3</td><td>○</td><td>-</td><td>○</td><td>○</td></tr> </tbody> </table>	Setting value	Speed deviation error	Position deviation error			During servo-on		During servo- off	With command	Command 0	__ 0 0	-	-	-	-	__ 0 1	○	-	-	-	__ 0 2	-	○	○	○	__ 0 3	○	○	○	○	__ 1 0	-	-	-	-	__ 1 1	○	-	-	-	__ 1 2	-	-	○	-	__ 1 3	○	-	○	-	__ 2 0	-	-	-	-	__ 2 1	○	-	-	-	__ 2 2	-	-	○	○	__ 2 3	○	-	○	○	03h	○		
	Setting value	Speed deviation error			Position deviation error																																																																							
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With command			Command 0																																																																									
__ 0 0	-	-	-	-																																																																								
__ 0 1	○	-	-	-																																																																								
__ 0 2	-	○	○	○																																																																								
__ 0 3	○	○	○	○																																																																								
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__ 2 3	○	-	○	○																																																																								
__x__	For manufacturer setting	0h																																																																										
x__	Fully closed loop control error reset selection 0: Reset disabled (reset by powering off/on enabled) 1: Reset enabled	0h	○																																																																									
PE04 *FBN Fully closed loop control - Feedback pulse electronic gear 1 - Numerator		Set a numerator of electronic gear for the servo motor encoder pulse at the fully closed loop control. Set the electronic gear so that the number of servo motor encoder pulses for one servo motor revolution is converted to the resolution of the load-side encoder. Setting range: 1 to 65535	1	○																																																																								
PE05 *FBD Fully closed loop control - Feedback pulse electronic gear 1 - Denominator		Set a denominator of electronic gear for the servo motor encoder pulse at the fully closed loop control. Set the electronic gear so that the number of servo motor encoder pulses for one servo motor revolution is converted to the resolution of the load-side encoder. Setting range: 1 to 65535	1	○																																																																								

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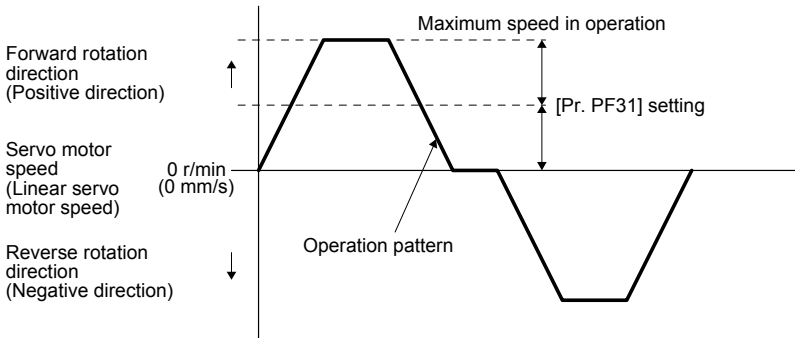
No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PE06 BC1 Fully closed loop control - Speed deviation error detection level		Set [AL. 42.9 Fully closed loop control error by speed deviation] of the fully closed loop control error detection. When the speed deviation between the servo motor encoder and load-side encoder becomes larger than the setting value, the alarm will occur. Setting range: 1 to 50000	400 [r/min]/ [mm/s]	<input type="radio"/>		
PE07 BC2 Fully closed loop control - Position deviation error detection level		Set [AL. 42.8 Fully closed loop control error by position deviation] of the fully closed loop control error detection. When the position deviation between the servo motor encoder and load-side encoder becomes larger than the setting value, the alarm will occur. Setting range: 1 to 20000	100 [kpulse]	<input type="radio"/>		
PE08 DUF Fully closed loop dual feedback filter		Set a dual feedback filter band. Refer to section 17.3.1 (5) for details. Setting range: 1 to 4500	10 [rad/s]	<input type="radio"/>		
PE10 FCT3 Fully closed loop function selection 3	___ x	For manufacturer setting	0h	<input type="radio"/>		
	__ x _	Fully closed loop control - Position deviation error detection level - Unit selection 0: 1 kpulse unit 1: 1 pulse unit	0h	<input type="radio"/>		
	_ x _ _	For manufacturer setting	0h	<input type="radio"/>		
	x _ _ _	For manufacturer setting	0h	<input type="radio"/>		
PE34 *FBN2 Fully closed loop control - Feedback pulse electronic gear 2 - Numerator		Set a numerator of electronic gear for the servo motor encoder pulse at the fully closed loop control. Set the electronic gear so that the number of servo motor encoder pulses for one servo motor revolution is converted to the resolution of the load-side encoder. Refer to section 17.3.1 (3) for details. Setting range: 1 to 65535	1	<input type="radio"/>		
PE35 *FBD2 Fully closed loop control - Feedback pulse electronic gear 2 - Denominator		Set a denominator of electronic gear for the servo motor encoder pulse at the fully closed loop control. Set the electronic gear so that the number of servo motor encoder pulses for one servo motor revolution is converted to the resolution of the load-side encoder. Refer to section 17.3.1 (3) for details. Setting range: 1 to 65535	1	<input type="radio"/>		
PE39 BT1 Fully closed loop control - Speed deviation error detection time		Set the time period until the occurrence of an alarm after the occurrence of a speed deviation error while the error detection function is enabled for the fully closed loop control. The minimum detection time is 20 ms. This parameter is enabled when the speed deviation error detection is enabled in [Pr. PE03] "Fully closed loop control error detection function selection". Setting range: 20 to 32767	20 [ms]	<input type="radio"/>		
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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	__ x _	For manufacturer setting	0h			
	_ x _ _	For manufacturer setting	0h			
	x _ _ _	For manufacturer setting	0h			

5. PARAMETERS

5.2.6 Extension setting 3 parameters ([Pr. PF__])

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PF09 *FOP5 Function selection F-5	___x	Electronic dynamic brake selection 0: Automatic (enabled only for specified servo motors) 2: Disabled Refer to the following table for the specified servo motors.	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	__x_	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	_x__		0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	x___		0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PF15 DBT Electronic dynamic brake operating time		Set an operating time for the electronic dynamic brake. Setting range: 0 to 10000	2000 [ms]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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 settling 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]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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. 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 [%]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	__x_	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	_x__		0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	x___		0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PF25 CVAT SEMI-F47 function - Instantaneous power failure detection time (instantaneous power failure tough drive - detection time)		<p>Set the time of the [AL. 10.1 Voltage drop in the control circuit power] occurrence. To disable the parameter, set "Disabled (_ 0 _)" of "SEMI-F47 function selection (instantaneous power failure tough drive selection)" in [Pr. PA20].</p> <p>Setting range: 30 to 200</p>	200 [ms]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PF31 FRIC Machine diagnosis function - Friction judgement speed		<p>Set a (linear) servo motor speed that divides a friction estimation area into high and low during the friction estimation process of the machine diagnosis. Setting "0" will set a value half of the rated speed. When your operation pattern is under the rated speed, we recommend that you set a half value of the maximum speed.</p>  <p>Setting range: 0 to permissible speed</p>	0 [r/min]/ [mm/s]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. PARAMETERS

5.2.7 Linear servo motor/DD motor setting parameters ([Pr. PL__])

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode																																	
				P	S	T																															
PL01 *LIT1 Linear servo motor/DD motor function selection 1	___x	Linear servo motor/DD motor magnetic pole detection selection The setting value "0" will be enabled only with absolute position linear encoders. 0: Magnetic pole detection disabled 1: Magnetic pole detection at first servo-on 5: Magnetic pole detection at every servo-on	1h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																															
	__x_	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																															
	_x__	Stop interval selection at the home position return Set a stop interval of the home position returning. The digit is enabled only for linear servo motors. 0: 2^{13} (= 8192) pulses 1: 2^{17} (= 131072) pulses 2: 2^{18} (= 262144) pulses 3: 2^{20} (= 1048576) pulses 4: 2^{22} (= 4194304) pulses 5: 2^{24} (= 16777216) pulses 6: 2^{26} (= 67108864) pulses	3h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																															
	x___	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																															
PL02 *LIM Linear encoder resolution - Numerator	/	Set a linear encoder resolution per μm with [Pr. PL02] and [Pr. PL03]. Set the numerator in [Pr. PL02]. This is enabled only for linear servo motors. Setting range: 1 to 65535	1000 [μm]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																															
PL03 *LID Linear encoder resolution - Denominator	/	Set a linear encoder resolution per μm with [Pr. PL02] and [Pr. PL03]. Set the denominator in [Pr. PL03]. This is enabled only for linear servo motors. Setting range: 1 to 65535	1000 [μm]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																															
PL04 *LIT2 Linear servo motor/DD motor function selection 2	___x	[AL. 42 Servo control error] detection function selection Refer to the following table. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Setting value</th> <th>Torque/thrust deviation error (Note)</th> <th>Speed deviation error (Note)</th> <th>Position deviation error (Note)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td rowspan="3">Disabled</td> <td>Disabled</td> <td>Disabled</td> </tr> <tr> <td>1</td> <td>Enabled</td> <td>Enabled</td> </tr> <tr> <td>2</td> <td>Enabled</td> <td>Disabled</td> </tr> <tr> <td>3</td> <td rowspan="4">Enabled</td> <td>Disabled</td> <td>Disabled</td> </tr> <tr> <td>4</td> <td>Disabled</td> <td>Enabled</td> </tr> <tr> <td>5</td> <td>Enabled</td> <td>Disabled</td> </tr> <tr> <td>6</td> <td>Enabled</td> <td>Enabled</td> </tr> <tr> <td>7</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> Note. Refer to chapter 15 and 16 for details of each deviation error.	Setting value	Torque/thrust deviation error (Note)	Speed deviation error (Note)	Position deviation error (Note)	0	Disabled	Disabled	Disabled	1	Enabled	Enabled	2	Enabled	Disabled	3	Enabled	Disabled	Disabled	4	Disabled	Enabled	5	Enabled	Disabled	6	Enabled	Enabled	7				3h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Setting value	Torque/thrust deviation error (Note)	Speed deviation error (Note)	Position deviation error (Note)																																	
	0	Disabled	Disabled	Disabled																																	
	1		Enabled	Enabled																																	
2	Enabled		Disabled																																		
3	Enabled	Disabled	Disabled																																		
4		Disabled	Enabled																																		
5		Enabled	Disabled																																		
6		Enabled	Enabled																																		
7																																					
__x_	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																
_x__	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																
x___	[AL. 42 Servo control error] detection function controller reset condition selection 0: Reset disabled (reset by powering off/on enabled) 1: Reset enabled	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																																

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PL05 LB1 Position deviation error detection level		Set the position deviation error detection level of the servo control error detection. When the deviation between a model feedback position and actual feedback position is larger than the setting value, [AL. 42 Servo control error] will occur. However, when "0" is set, the level vary depending on the operation mode in [Pr. PA01]. Linear servo motor: 50 mm Direct drive motor: 0.09 rev Setting range: 0 to 1000	0 [mm]/ [0.01 rev]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PL06 LB2 Speed deviation error detection level		Set the speed deviation error detection level of the servo control error detection. When the deviation between a model feedback speed and actual feedback speed is larger than the setting value, [AL. 42 Servo control error] will occur. However, when "0" is set, the level vary depending on the operation mode in [Pr. PA01]. Linear servo motor: 1000 mm/s Direct drive motor: 100 r/min Setting range: 0 to 5000	0 [mm/s]/ [r/min]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PL07 LB3 Torque/thrust deviation error detection level		Set the torque/thrust deviation error detection level of the servo control error detection. When the deviation between a current command and current feedback is larger than the setting value, [AL. 42.3 Servo control error by torque/thrust deviation] will occur. Setting range: 0 to 1000	100 [%]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PL08 *LIT3 Linear servo motor/DD motor function selection 3	___ x	Magnetic pole detection method selection 0: Position detection method 4: Minute position detection method	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	__ x _	For manufacturer setting	1h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	_ x _ _	Magnetic pole detection - Stroke limit enabled/disabled selection 0: Enabled 1: Disabled	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	x _ _ _	For manufacturer setting	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PL09 LPWM Magnetic pole detection voltage level		Set a direct current exciting voltage level during the magnetic pole detection. If [AL. 32 Overcurrent], [AL. 50 Overload 1], or [AL. 51 Overload 2] occurs during the magnetic pole detection, decrease the setting value. If [AL. 27 Initial magnetic pole detection error] occurs during the magnetic pole detection, increase the setting value. Setting range: 0 to 100	30 [%]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. PARAMETERS

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode																																																								
				P	S	T																																																						
PL17 LTSTS Magnetic pole detection - Minute position detection method - Function selection	___x	Response selection Set a response of the minute position detection method. When reducing a travel distance at the magnetic pole detection, increase the setting value. Refer to table 5.11 for settings.	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																																																						
	__x_	Load to motor mass ratio/load to motor inertia ratio selection Select a load to mass of the linear servo motor primary-side ratio or load to mass of the direct drive motor inertia ratio used at the minute position detection method. Set a closest value to the actual load. Refer to table 5.12 for settings.	0h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																																																						
	_x__	For manufacturer setting	0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																						
	x___		0h	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																						
		<p align="center">Table 5.11 Response of minute position detection method at magnetic pole detection</p> <table border="1"> <thead> <tr> <th>Setting value</th> <th>Response</th> <th>Setting value</th> <th>Response</th> </tr> </thead> <tbody> <tr> <td>0</td> <td rowspan="7">Low response ↑ ↓ Middle response</td> <td>8</td> <td rowspan="7">Middle response ↑ ↓ High response</td> </tr> <tr><td>1</td></tr> <tr><td>2</td></tr> <tr><td>3</td></tr> <tr><td>4</td></tr> <tr><td>5</td></tr> <tr><td>6</td></tr> <tr> <td>7</td> <td>Middle response</td> <td>F</td> <td>High response</td> </tr> </tbody> </table> <p align="center">Table 5.12 Load to motor mass ratio/load to motor inertia ratio</p> <table border="1"> <thead> <tr> <th>Setting value</th> <th>Load to motor mass ratio/load to motor inertia ratio</th> <th>Setting value</th> <th>Load to motor mass ratio/load to motor inertia ratio</th> </tr> </thead> <tbody> <tr><td>0</td><td>10 times or less</td><td>8</td><td>80 times</td></tr> <tr><td>1</td><td>10 times</td><td>9</td><td>90 times</td></tr> <tr><td>2</td><td>20 times</td><td>A</td><td>100 times</td></tr> <tr><td>3</td><td>30 times</td><td>B</td><td>110 times</td></tr> <tr><td>4</td><td>40 times</td><td>C</td><td>120 times</td></tr> <tr><td>5</td><td>50 times</td><td>D</td><td>130 times</td></tr> <tr><td>6</td><td>60 times</td><td>E</td><td>140 times</td></tr> <tr><td>7</td><td>70 times</td><td>F</td><td>150 times or more</td></tr> </tbody> </table>		Setting value	Response	Setting value	Response	0	Low response ↑ ↓ Middle response	8	Middle response ↑ ↓ High response	1	2	3	4	5	6	7	Middle response	F	High response	Setting value	Load to motor mass ratio/load to motor inertia ratio	Setting value	Load to motor mass ratio/load to motor inertia ratio	0	10 times or less	8	80 times	1	10 times	9	90 times	2	20 times	A	100 times	3	30 times	B	110 times	4	40 times	C	120 times	5	50 times	D	130 times	6	60 times	E	140 times	7	70 times	F	150 times or more		<input type="radio"/>	<input type="radio"/>
Setting value	Response	Setting value	Response																																																									
0	Low response ↑ ↓ Middle response	8	Middle response ↑ ↓ High response																																																									
1																																																												
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6																																																												
7	Middle response	F	High response																																																									
Setting value	Load to motor mass ratio/load to motor inertia ratio	Setting value	Load to motor mass ratio/load to motor inertia ratio																																																									
0	10 times or less	8	80 times																																																									
1	10 times	9	90 times																																																									
2	20 times	A	100 times																																																									
3	30 times	B	110 times																																																									
4	40 times	C	120 times																																																									
5	50 times	D	130 times																																																									
6	60 times	E	140 times																																																									
7	70 times	F	150 times or more																																																									
PL18 IDLV Magnetic pole detection - Minute position detection method - Identification signal amplitude		Set an identification signal amplitude used in the minute position detection method. This parameter is enabled only when the magnetic pole detection is the minute position detection method. Setting "0" will be 100% amplitude. Setting range: 0 to 100	0 [%]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																																																						

6. NORMAL GAIN ADJUSTMENT

6. NORMAL GAIN ADJUSTMENT

POINT
<ul style="list-style-type: none"> ● 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

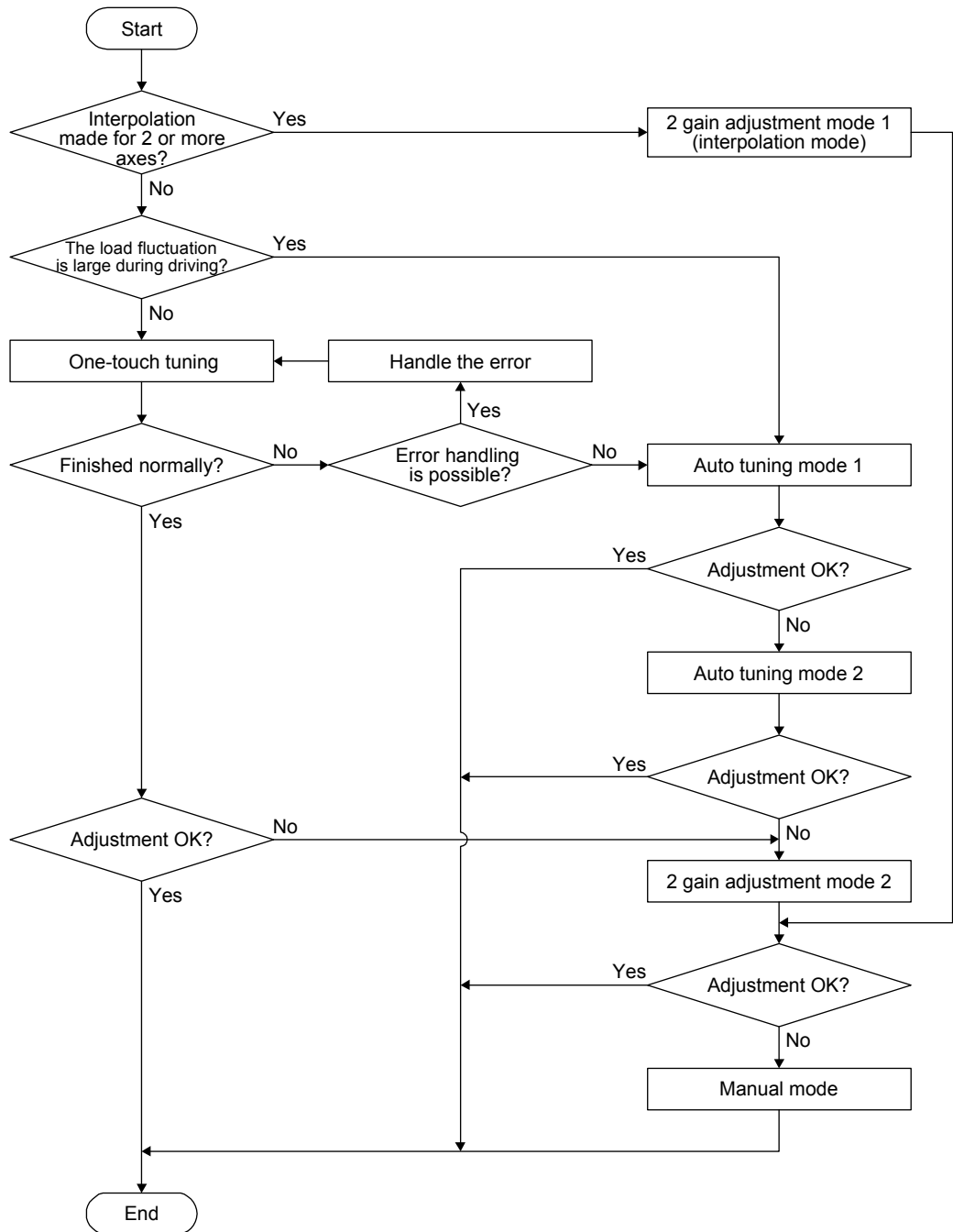
The following table shows the gain adjustment modes that can be set on a single servo amplifier. For gain adjustment, first execute "Auto tuning mode 1". If you are not satisfied with the result of the adjustment, execute "Auto tuning mode 2" and "Manual mode" in this order.

(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])

6. NORMAL GAIN ADJUSTMENT

(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. NORMAL GAIN ADJUSTMENT

6.2 One-touch tuning

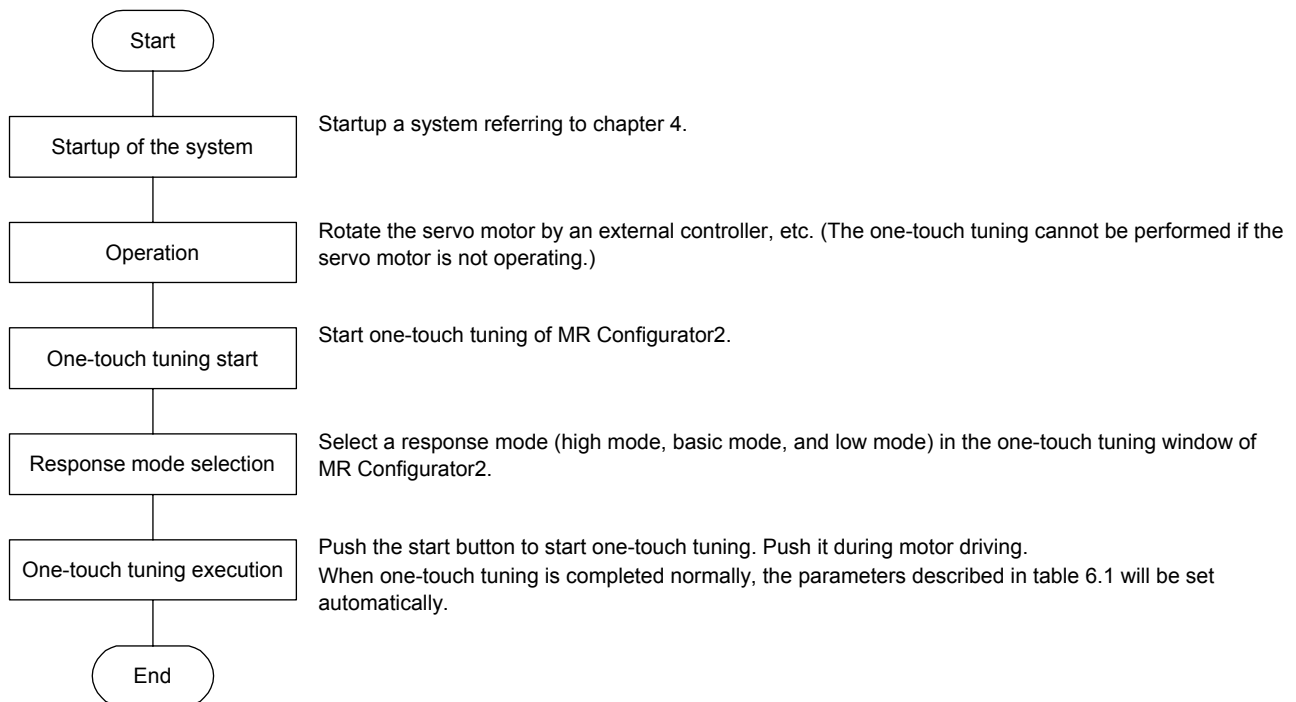
You can execute the one-touch tuning with MR Configurator2 or push buttons. The following parameters are set automatically with one-touch tuning.

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

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

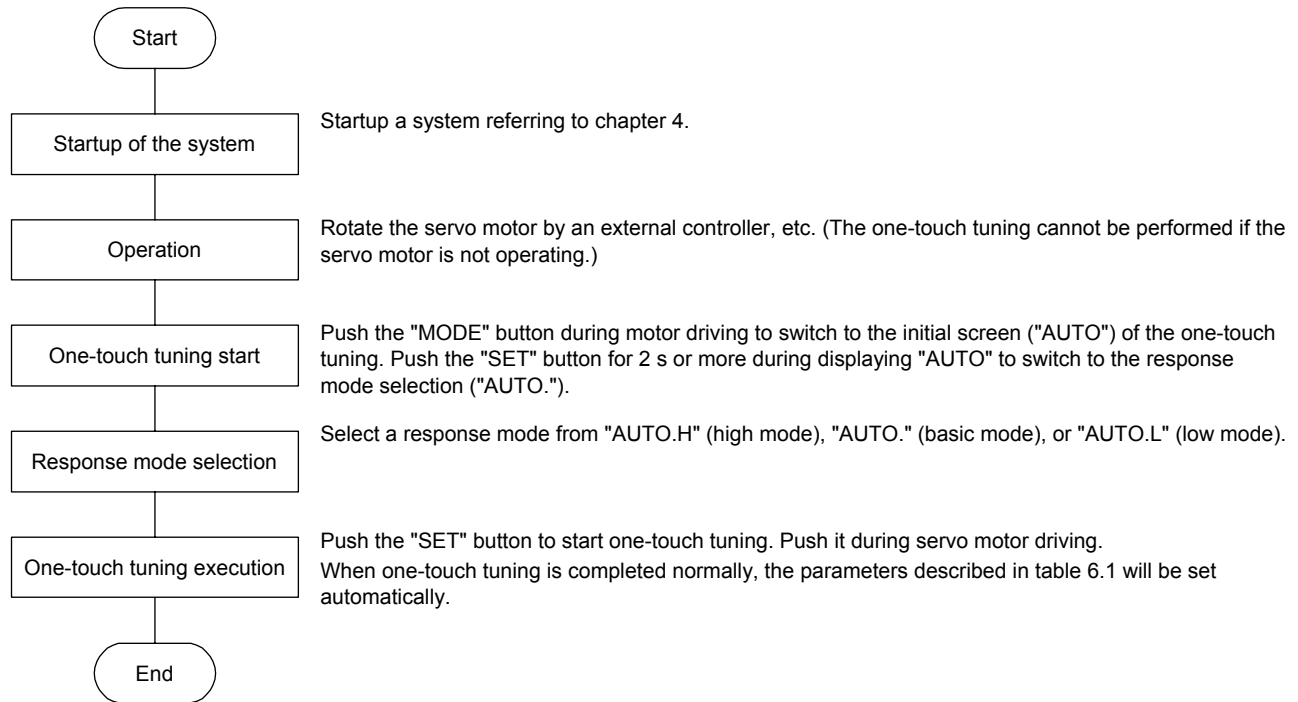
6.2.1 One-touch tuning flowchart

- (1) When you use MR Configurator2
Make one-touch tuning as follows.



6. NORMAL GAIN ADJUSTMENT

- (2) When you use push buttons
Make one-touch tuning as follows.



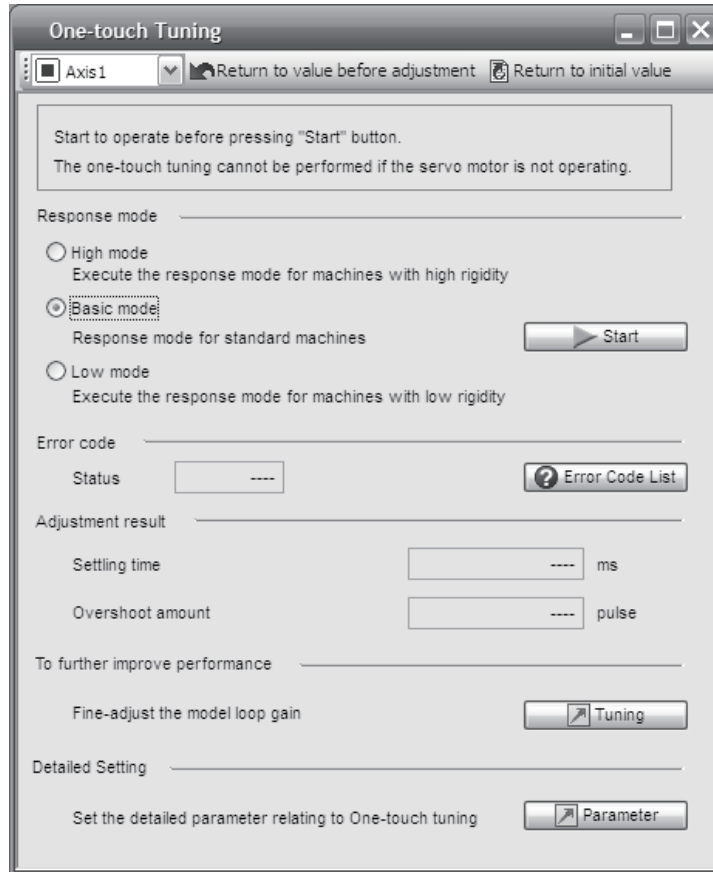
6. NORMAL GAIN ADJUSTMENT

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 3 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.

6. NORMAL GAIN ADJUSTMENT

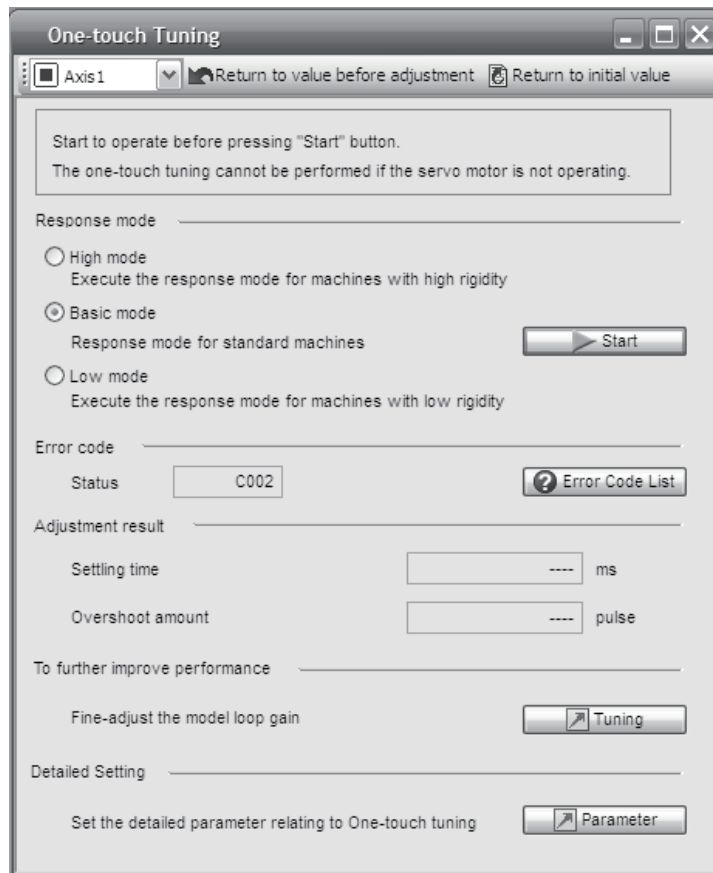
Response mode			Response	Machine characteristic
Low mode	Basic mode	High mode		Guideline of corresponding machine
↑ ↓	↑ ↓	↑ ↓	Low response ↑ ↓ High response	<p>Arm robot</p> <p>General machine tool conveyor</p> <p>Precision working machine</p> <p>Inserter Mounter Bonder</p>

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(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 (1), pushing the start button during driving will start one-touch tuning. If the start button is pushed while the 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.

6. NORMAL GAIN ADJUSTMENT

(c) One-touch tuning execution

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) If an error occur

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 List of error code with 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 larger 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. 1 cycle time during the operation has been over 30 s.	Set the 1 cycle time during the operation to 30 s or less.
		2. The command speed is low.	Set the servo motor speed to 100 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. <ul style="list-style-type: none"> • The acceleration/deceleration time constant to reach 2000 r/min (mm/s) is 5 s or less. • Speed is 150 r/min (mm/s) or higher. • The load to servo motor (mass of linear servo motor's primary side or direct drive 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. <ul style="list-style-type: none"> • 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 occur

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 occur

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.

6. NORMAL GAIN ADJUSTMENT

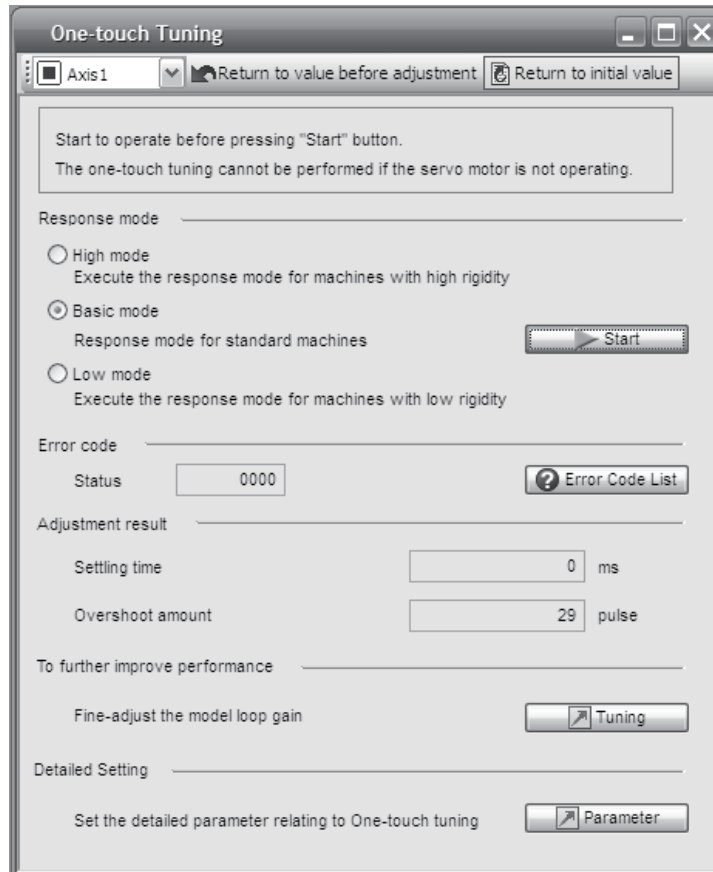
(g) Clearing one-touch tuning

You can clear the parameter values set with one-touch tuning.

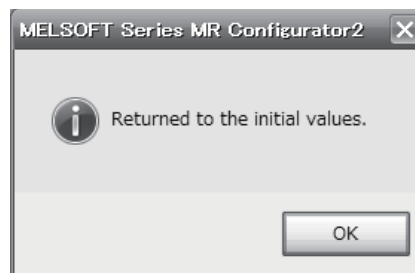
Refer to table 6.1 for the parameters which you can clear.

Pushing "Return to value before adjustment" 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.



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



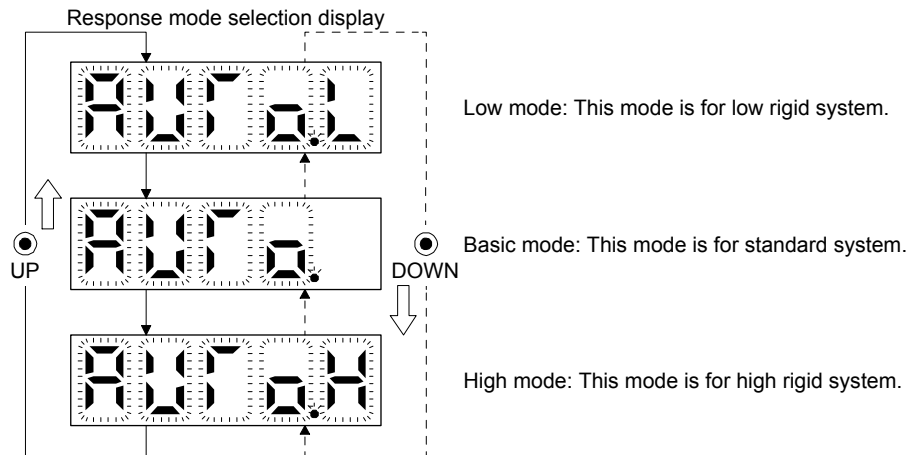
6. NORMAL GAIN ADJUSTMENT

(2) When you use push buttons

POINT
<ul style="list-style-type: none"> ● 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

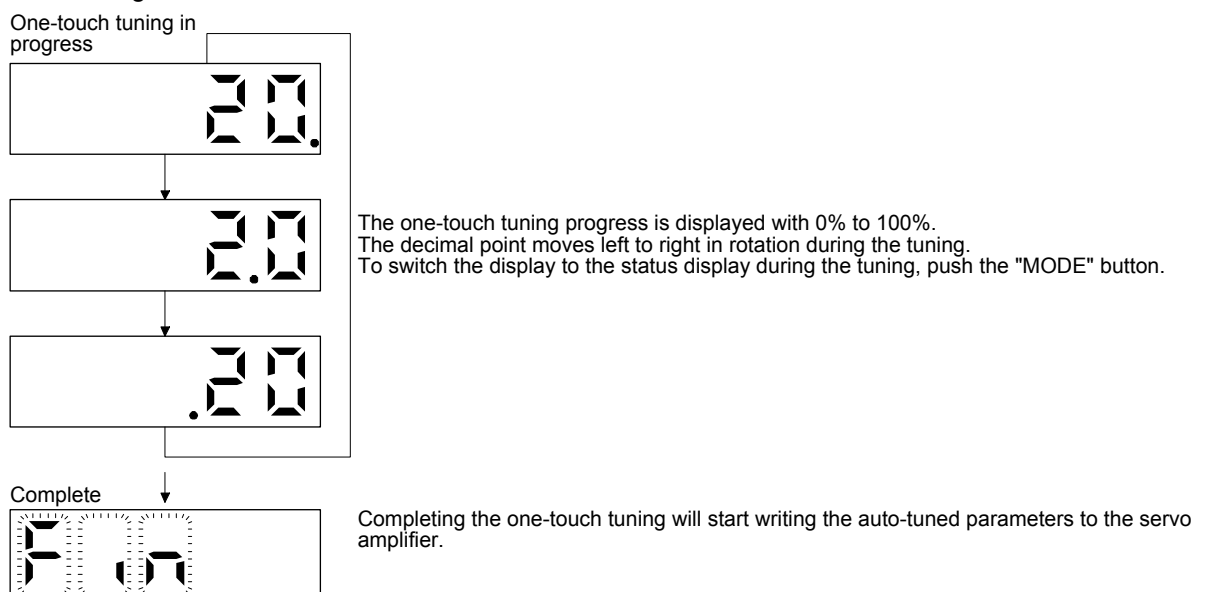
Select a response mode of the one-touch tuning from 3 modes with "UP" or "DOWN".



(b) One-touch tuning execution

POINT
<ul style="list-style-type: none"> ● 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.

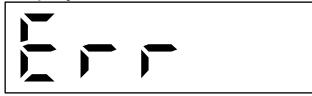
After the response mode is selected in (a), pushing the "SET" button during driving will start one-touch tuning.



6. NORMAL GAIN ADJUSTMENT

(c) One-touch tuning execution

Stop symbol



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

↕ 2 s interval

Error code



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

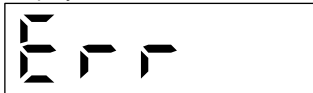
↓ Pushing the "SET" button will switch to the initial screen.

Initial screen



(d) If an error occur

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.

?



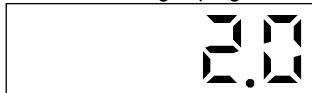
↓ Pushing the "SET" button will switch to the initial screen.

Initial screen



(e) If an alarm occur

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



6. NORMAL GAIN ADJUSTMENT

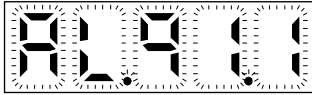
(f) If a warning occur

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)

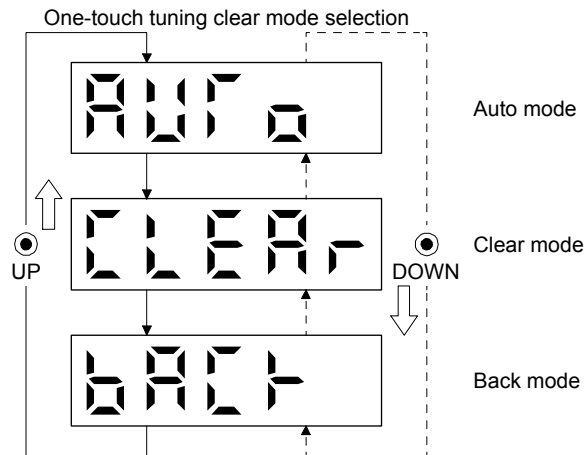


(g) Clearing one-touch tuning

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) Push the "MODE" button to switch to the initial screen ("AUTO") of the one-touch tuning.
- 2) Select the clear mode or back mode with the "UP" or "DOWN" button.



↓ To clear the one-touch tuning, push the "SET" button for 2 s.

One-touch tuning clear mode display (initializing)



The one-touch tuning clear mode is in progress. The clear mode symbol flickers for 3 s.

↓ Clearing one-touch tuning is completed, the initial screen will be displayed.

Initial screen



6. NORMAL GAIN ADJUSTMENT

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 does not continue 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. NORMAL GAIN ADJUSTMENT

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
<ul style="list-style-type: none">● The auto tuning mode 1 may not be performed properly if all of the following conditions are not satisfied.<ul style="list-style-type: none">▪ The acceleration/deceleration time constant to reach 2000 r/min (mm/s) is 5 s or less.▪ Speed is 150 r/min (mm/s) or higher.▪ The load to servo motor (mass of linear servo motor's primary side or direct drive 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].

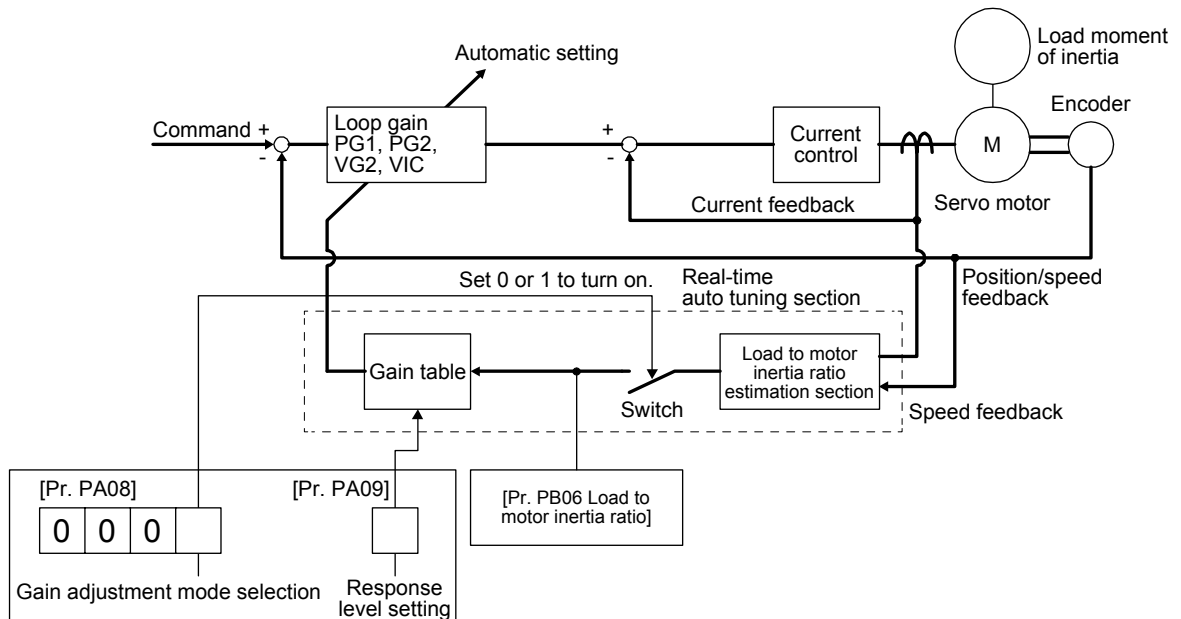
The following parameters are automatically adjusted in the auto tuning mode 2.

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

6. NORMAL GAIN ADJUSTMENT

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.

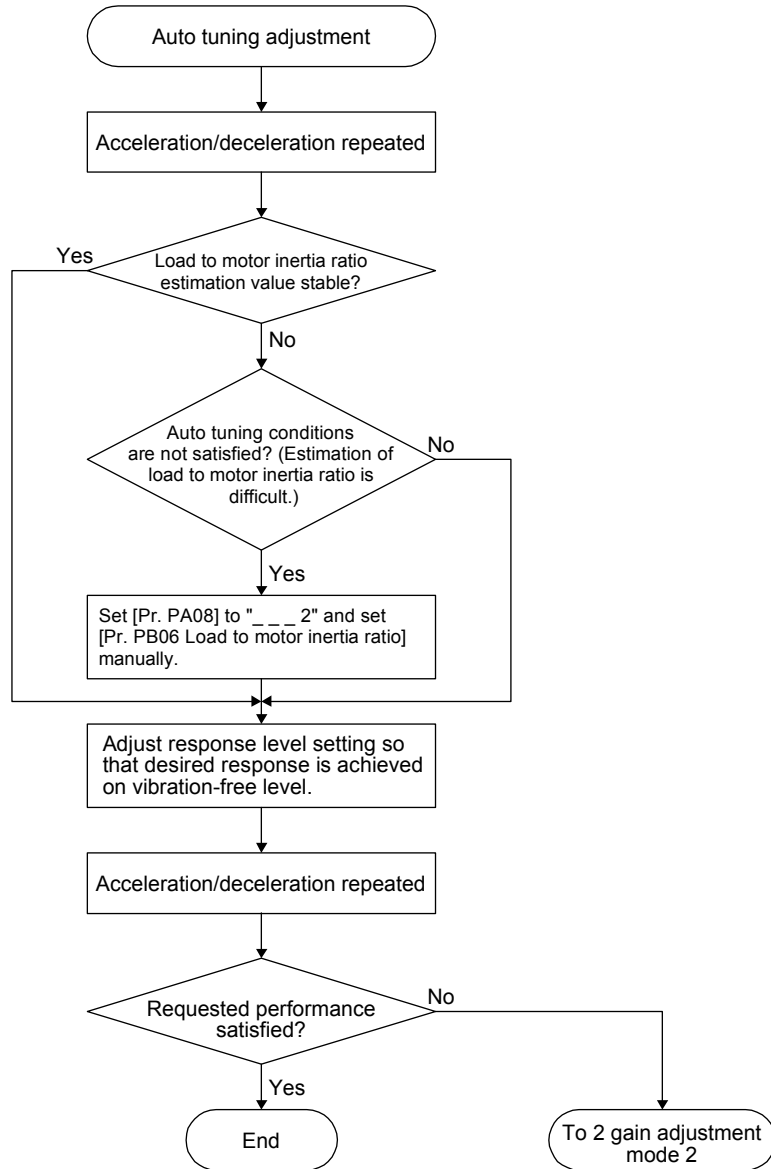
The auto tuning results are saved in the EEPROM of the servo amplifier every 60 minutes since power-on. At power-on, auto tuning is performed with the value of each loop gain saved in the EEPROM being used as an initial value.

POINT
<ul style="list-style-type: none"> ● 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 EEPROM.

6. NORMAL GAIN ADJUSTMENT

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. NORMAL GAIN ADJUSTMENT

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], [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 7.2 and 7.3 for settings of the adaptive tuning mode and machine resonance suppression filter.

[Pr. PA09]

Setting value	Machine characteristic		Reference (setting value of MR-J3)
	Response	Guideline for machine resonance frequency [Hz]	
1	Low response	2.7	
2		3.6	
3		4.9	
4		6.6	
5		10.0	1
6		11.3	2
7		12.7	3
8		14.3	4
9		16.1	5
10		18.1	6
11	20.4	7	
12	23.0	8	
13	25.9	9	
14	29.2	10	
15	32.9	11	
16	37.0	12	
17	41.7	13	
18	47.0	14	
19	Middle response	52.9	15
20		59.6	16

Setting value	Machine characteristic		Reference (setting value of MR-J3)
	Response	Guideline for machine resonance frequency [Hz]	
21	Middle response	67.1	17
22		75.6	18
23		85.2	19
24		95.9	20
25		108.0	21
26		121.7	22
27		137.1	23
28		154.4	24
29		173.9	25
30		195.9	26
31	220.6	27	
32	248.5	28	
33	279.9	29	
34	315.3	30	
35	355.1	31	
36	400.0	32	
37	446.6		
38	501.2		
39	High response	571.5	
40		642.7	

6. NORMAL GAIN ADJUSTMENT

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
<p>● 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. (Refer to section 7.2 to 7.3.)</p>

(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 6.2.3.	
2	Change the setting of auto tuning to the manual mode ([Pr. PA08]: ___ 3).	
3	Set the 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 7.2 and 7.3.
9	While checking the motor status, fine-adjust each gain.	Fine adjustment

6. NORMAL GAIN ADJUSTMENT

(c) Parameter adjustment

1) [Pr. PB09 Speed loop gain]

This parameter determines the response level of the speed control loop. Increasing this value enhances response but a too high value will make the mechanical system 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. 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.

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

(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

6. NORMAL GAIN ADJUSTMENT

(b) Adjustment procedure

Step	Operation	Description
1	Brief-adjust with auto tuning. Refer to section 6.2.3.	
2	Change the setting of auto tuning to the manual mode ([Pr. PA08]: __ _ 3).	
3	Set the 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 Refer to section 7.2 and 7.3.
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 this value enhances response but a too high value will make the mechanical system 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.

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

6. NORMAL GAIN ADJUSTMENT

3) [Pr. PB08 Position loop gain]

This parameter determines the response level to a disturbance to the position control loop. Increasing the value increases the response level to the disturbance, but a too high value will increase vibration of the mechanical system.

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

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.

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

6.5 2 gain adjustment mode

The 2 gain adjustment mode is used 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 (interpolation mode)

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

6. NORMAL GAIN ADJUSTMENT

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

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

6. NORMAL GAIN 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.

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

Position command frequency differs depending on the operation mode.

Position command frequency

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

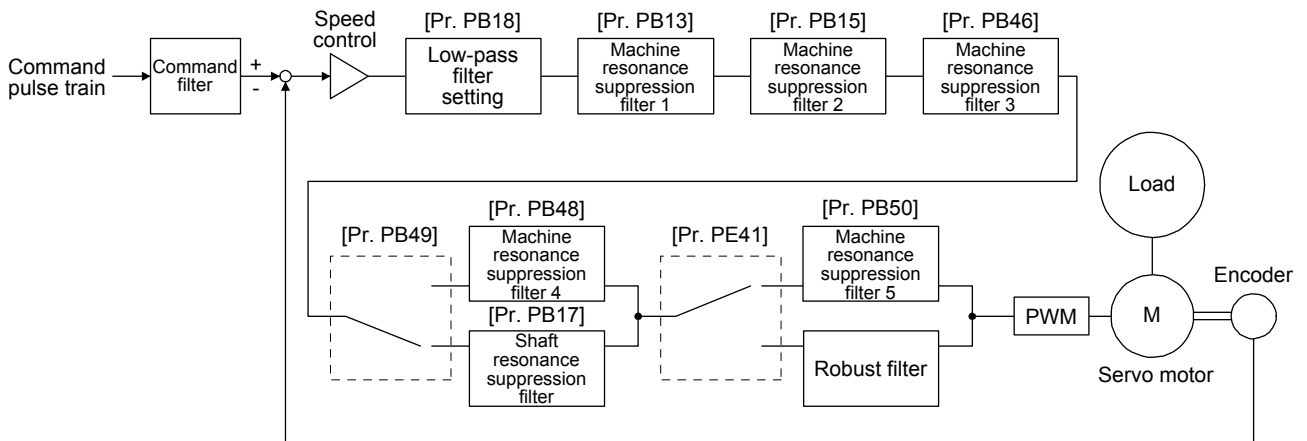
7. SPECIAL ADJUSTMENT FUNCTIONS

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-J4 servo amplifiers.



7. SPECIAL ADJUSTMENT FUNCTIONS

7.1.1 Machine resonance suppression filter

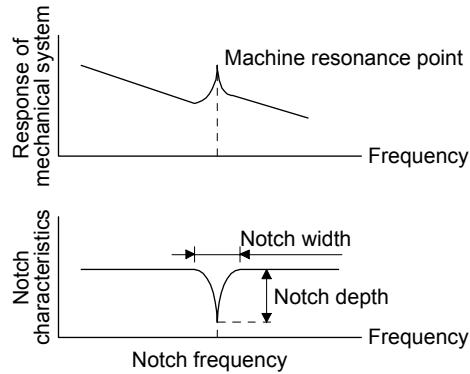
POINT
<ul style="list-style-type: none">● The machine resonance suppression filter is a delay factor for the servo system. Therefore, vibration may increase if you set an incorrect resonance frequency or set notch characteristics too deep or too wide.● If the frequency of machine resonance is unknown, 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.

7. SPECIAL ADJUSTMENT FUNCTIONS

(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 filter disables the shaft resonance suppression filter. The shaft resonance suppression filter is enabled for the initial setting.		PB48/PB49
Machine resonance suppression filter 5	PB50/PB51	The setting of this filter is disabled while you use the robust filter. The robust filter is disabled for the initial setting.		PB51

7. SPECIAL ADJUSTMENT FUNCTIONS

(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]).

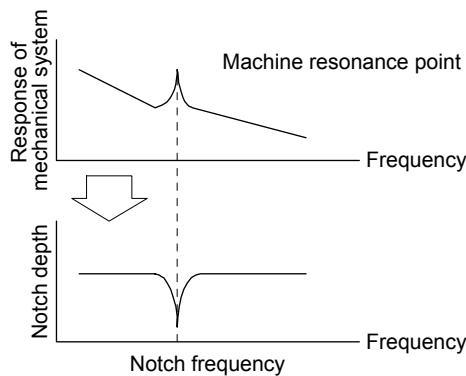
7. SPECIAL ADJUSTMENT FUNCTIONS

7.1.2 Adaptive filter II

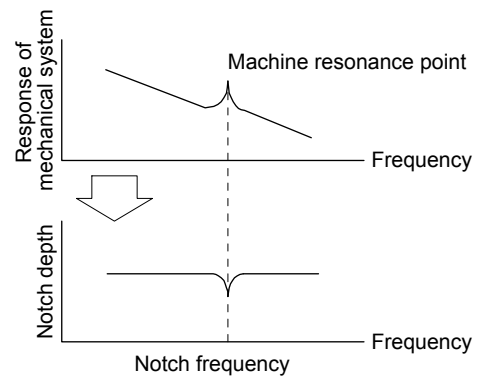
POINT
<ul style="list-style-type: none"> ● The machine resonance frequency which adaptive filter II (adaptive tuning) can respond to is about 100 Hz to 2.25 kHz. As for the resonance frequency out of the range, set manually. ● When adaptive tuning is executed, vibration sound increases as an excitation signal is forcibly applied for several seconds. ● When adaptive tuning is executed, machine resonance is detected for a maximum of 10 seconds 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]

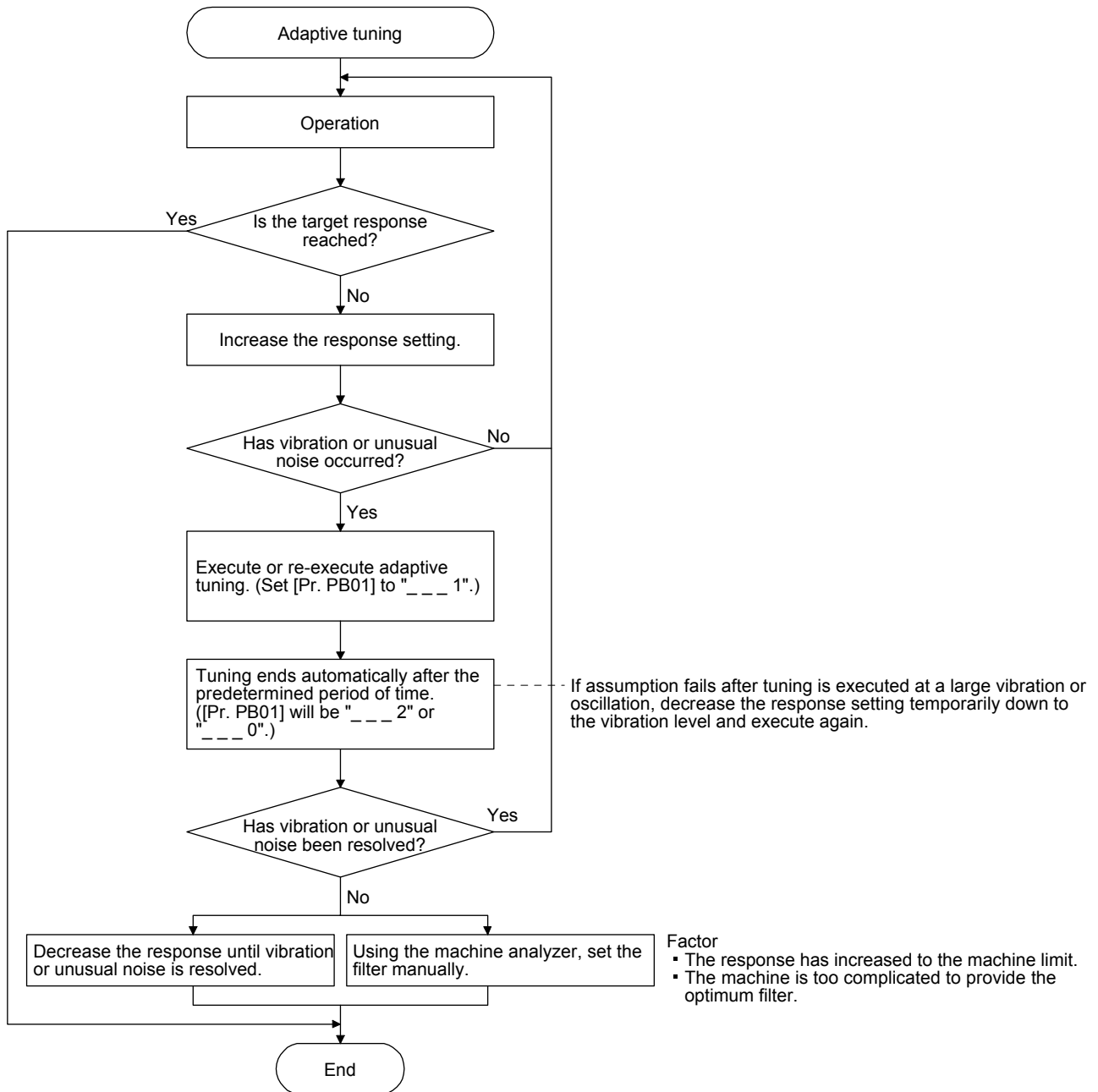
0	0	0	
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Filter tuning mode selection

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

7. SPECIAL ADJUSTMENT FUNCTIONS

(3) Adaptive tuning mode procedure



7. SPECIAL ADJUSTMENT FUNCTIONS

7.1.3 Shaft resonance suppression filter

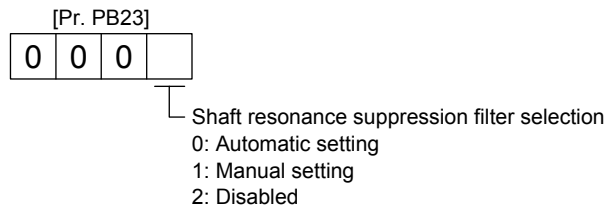
(1) Function

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 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].



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. SPECIAL ADJUSTMENT FUNCTIONS

7.1.4 Low-pass filter

(1) Function

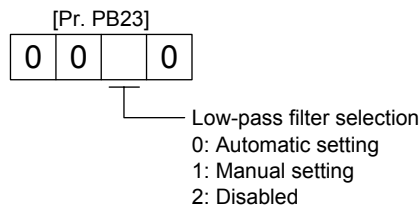
When a ball screw or the like is used, resonance of high frequency may occur as the response level of the servo system is increased. To prevent this, the low-pass filter is enabled for a torque command as a default. The filter frequency of the low-pass filter is automatically adjusted to the value in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

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

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].



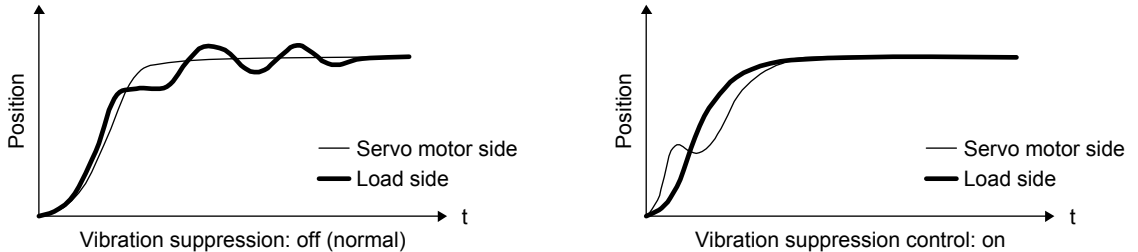
7.1.5 Advanced vibration suppression control II

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].

7. SPECIAL ADJUSTMENT FUNCTIONS

(1) Function

Vibration suppression control is used 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.



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	

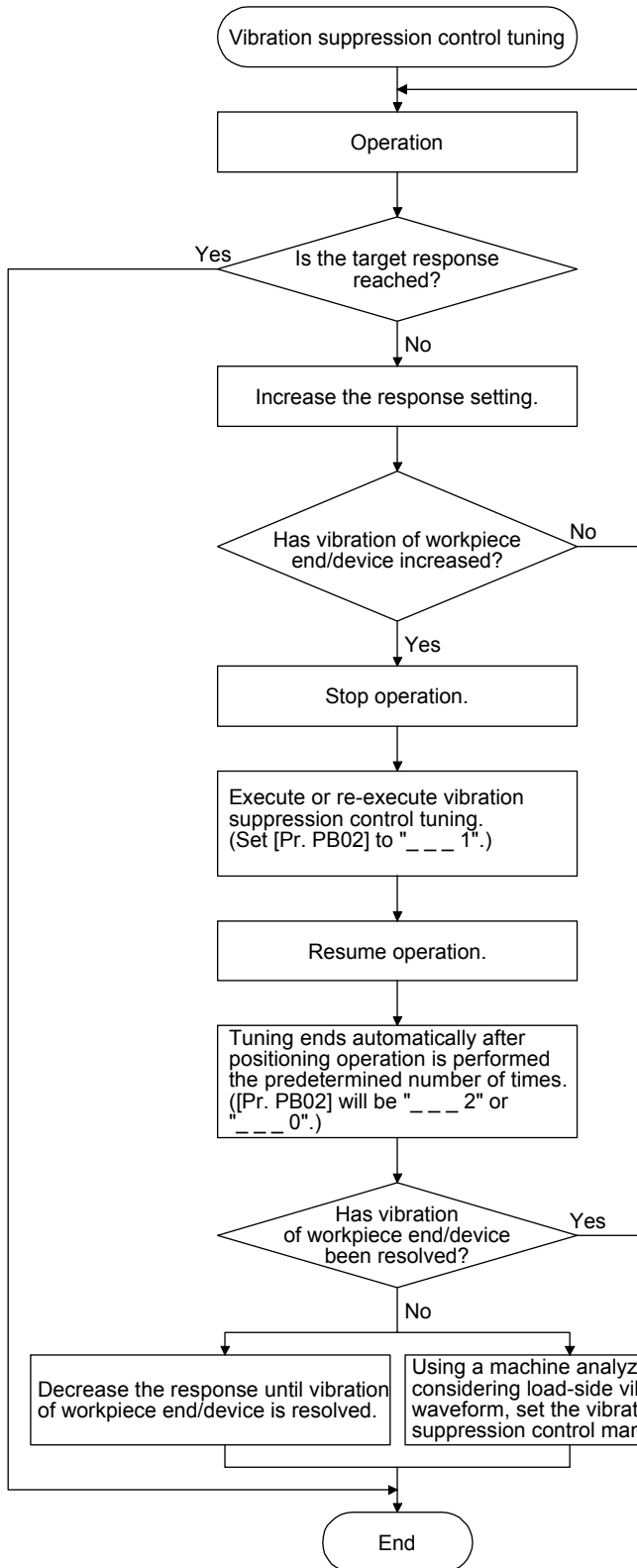
Vibration suppression control 2 tuning mode

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

7. SPECIAL ADJUSTMENT FUNCTIONS

(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).

7. SPECIAL ADJUSTMENT FUNCTIONS

(4) Vibration suppression control manual mode

POINT	
	<ul style="list-style-type: none"> ● 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. ● A vibration suppression control effect is not produced if the relation between the [Pr. PB07 Model loop gain] value and vibration frequency is as follows. Vibration suppression control 1: $[\text{Pr. PB19}] < \frac{1}{2\pi} (0.9 \times [\text{Pr. PB07}])$ $[\text{Pr. PB20}] < \frac{1}{2\pi} (0.9 \times [\text{Pr. PB07}])$ Vibration suppression control 2: $[\text{Pr. PB19}] < [\text{Pr. PB52}]$ $[\text{Pr. PB52}] < 5.0 + 0.1 \times [\text{Pr. PB07}]$ $[\text{Pr. PB53}] < 5.0 + 0.1 \times [\text{Pr. PB07}]$ $[\text{Pr. PB07}] < 2\pi (0.3 \times [\text{Pr. PB19}] + \frac{1}{8} \times [\text{Pr. PB52}])$ $1.1 < [\text{Pr. PB52}] / [\text{Pr. PB19}] < 5.5$

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.

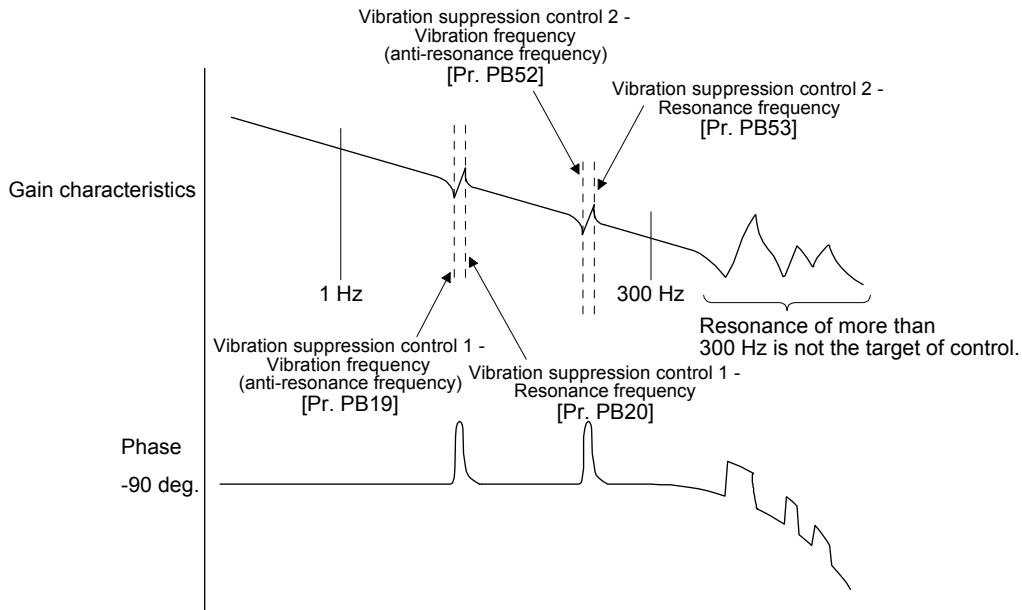
Setting item	Vibration suppression control 1	Vibration suppression control 2
Vibration suppression control - Vibration frequency	[Pr. PB19]	[Pr. PB52]
Vibration suppression control - Resonance frequency	[Pr. PB20]	[Pr. PB53]
Vibration suppression control - Vibration frequency damping	[Pr. PB21]	[Pr.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

7. SPECIAL ADJUSTMENT FUNCTIONS

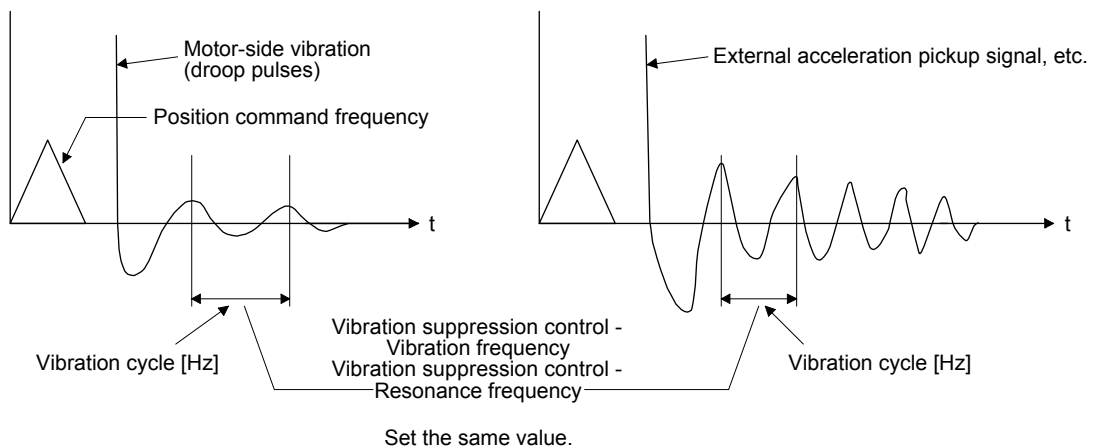
Step 1 Select "Manual setting (_ _ 2)" of "Vibration suppression control 1 tuning mode selection" or "Manual setting (_ _ 2 _)" of "Vibration suppression control 2 tuning mode selection" in [Pr. PB02].

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

(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".

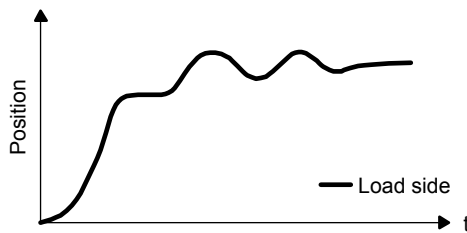
7. SPECIAL ADJUSTMENT FUNCTIONS

7.1.6 Command notch filter

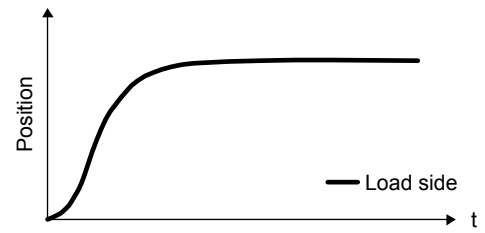
POINT
<ul style="list-style-type: none">● By using the advanced vibration suppression control II and the command notch filter, the load-side vibration of three frequencies can be suppressed.● The frequency range of machine vibration, which can be supported by the command notch filter, is between 4.5 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

7. SPECIAL ADJUSTMENT FUNCTIONS

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

7. SPECIAL ADJUSTMENT FUNCTIONS

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

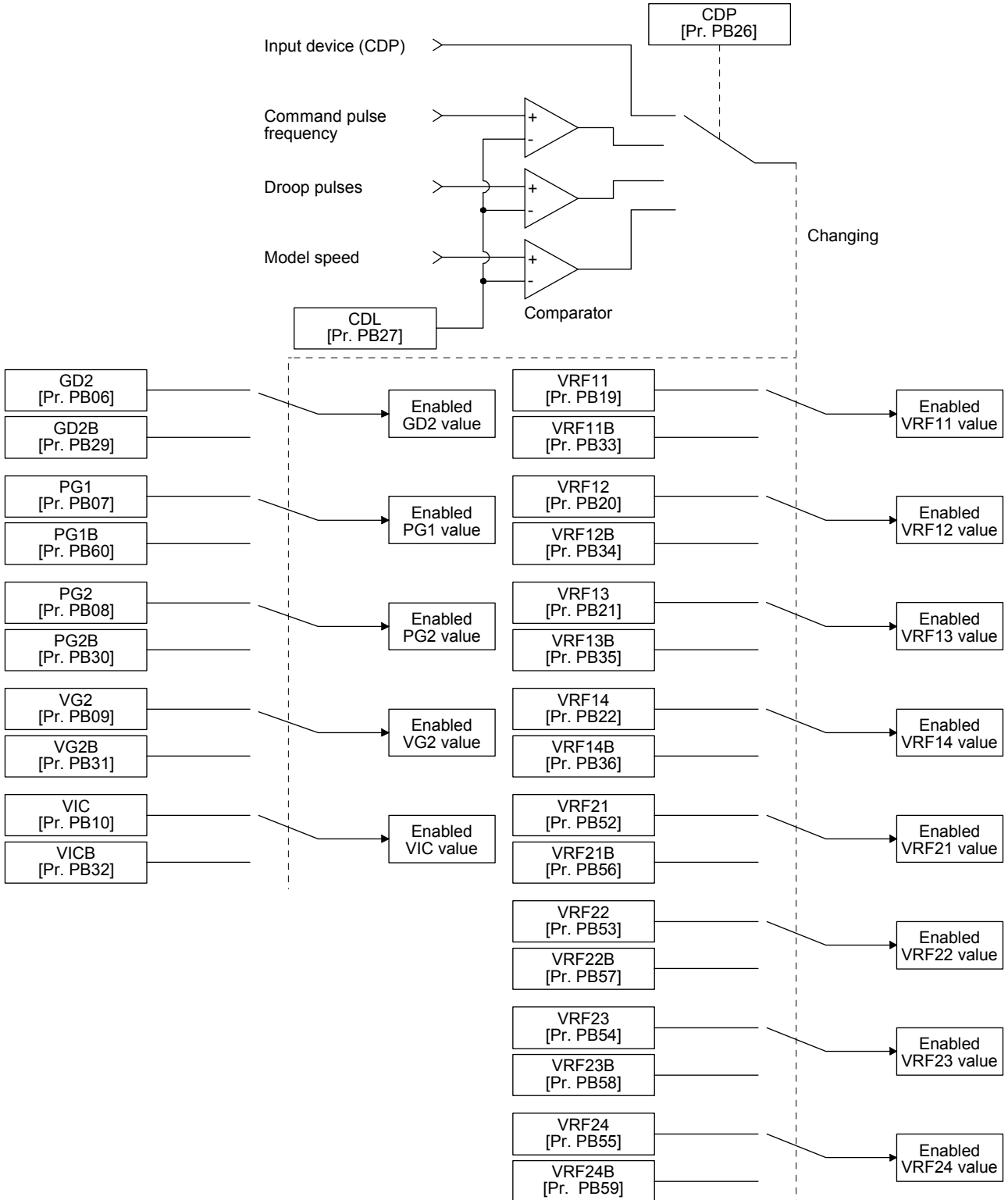
The following shows when you use the function.

- (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. SPECIAL ADJUSTMENT FUNCTIONS

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. SPECIAL ADJUSTMENT FUNCTIONS

7.2.3 Parameter

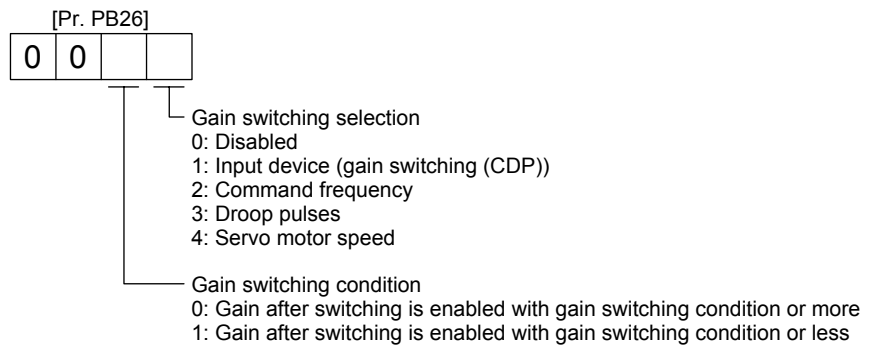
When using the gain switching function, always select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08 Auto tuning mode]. The gain switching function cannot be used in the auto tuning mode.

(1) Variable gain operation setting parameter

Parameter	Symbol	Name	Unit	Description
PB26	CDP	Gain switching selection		Used to select the changing condition.
PB27	CDL	Gain switching condition	[kpps] /[pulse] /[r/min]	Used to 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]

Used to set the gain switching condition. Select the switching condition in the first digit and second digit.



(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	[kpps]
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. This parameter is used to suppress shock given to the machine if the gain difference is large at gain switching, for example.

7. SPECIAL ADJUSTMENT FUNCTIONS

(2) Switchable gain parameter

Loop gain	Before switching			After switching		
	Parameter	Symbol	Name	Parameter	Symbol	Name
Load to motor inertia ratio/ load to motor mass ratio	PB06	GD2	Load to motor inertia ratio/ load to motor mass ratio	PB29	GD2B	Load to motor inertia ratio/ load to motor mass ratio
Model loop gain	PB07	PG1	Model loop gain	PB60	PG1B	Model loop gain after gain switching
Position loop gain	PB08	PG2	Position loop gain	PB30	PG2B	Position loop gain after gain switching
Speed loop gain	PB09	VG2	Speed loop gain	PB31	VG2B	Speed loop gain after gain switching
Speed integral compensation	PB10	VIC	Speed integral compensation	PB32	VICB	Speed integral compensation after gain switching
Vibration suppression control 1 - Vibration frequency	PB19	VRF11	Vibration suppression control 1 - Vibration frequency	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. Executing gain switching while the servo motor stops, You can change vibration frequency, resonance frequency, vibration frequency damping, and resonance frequency damping.

7. SPECIAL ADJUSTMENT FUNCTIONS

- (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]), and [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. SPECIAL ADJUSTMENT FUNCTIONS

7.2.4 Gain switching procedure

This operation will be described by way of setting examples.

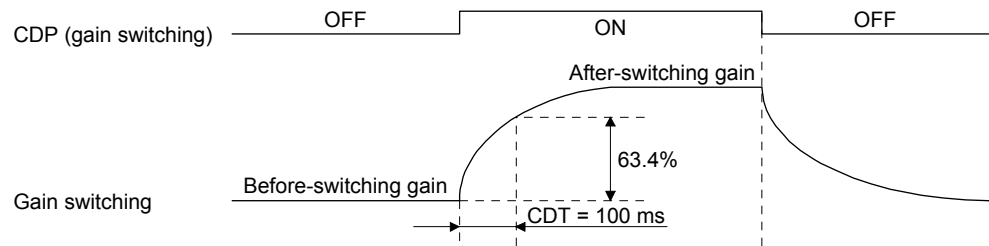
(1) When you choose switching by input device (CDP)

(a) Setting

Parameter	Symbol	Name	Setting value	Unit
PB06	GD2	Load to motor inertia ratio/load to motor mass 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/load to motor mass ratio after gain switching	10.00	[Multiplier]
PB60	PG1B	Model loop gain after gain switching	50	[rad/s]
PB30	PG2B	Position loop gain after gain switching	84	[rad/s]
PB31	VG2B	Speed loop gain after gain switching	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.)	
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	

7. SPECIAL ADJUSTMENT FUNCTIONS

(b) Switching timing chart



Model loop gain	100	→	50	→	100
Load to motor inertia ratio/load to motor mass 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

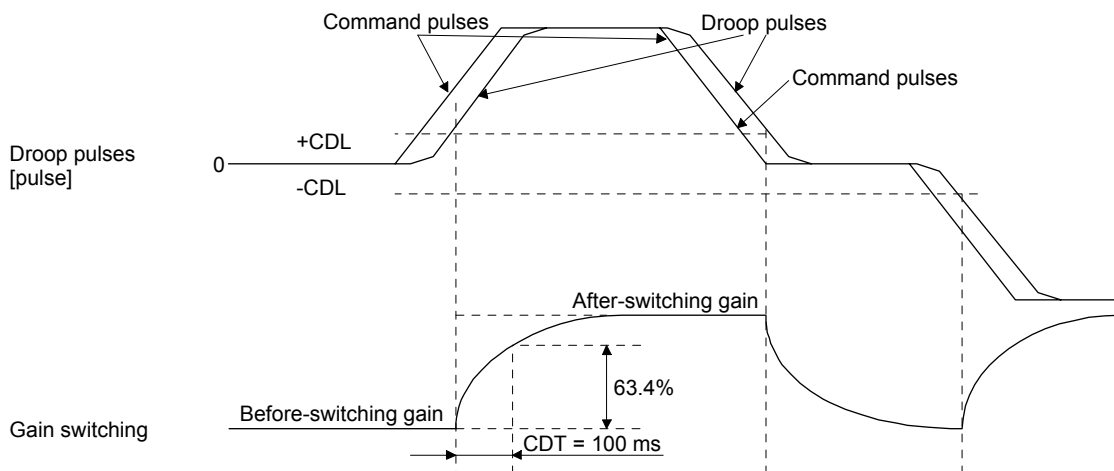
In this case, the vibration suppression control after gain switching and model loop gain after gain switching cannot be used.

(a) Setting

Parameter	Symbol	Name	Setting value	Unit
PB06	GD2	Load to motor inertia ratio/load to motor mass 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/load to motor mass ratio after gain switching	10.00	[Multiplier]
PB30	PG2B	Position loop gain after gain switching	84	[rad/s]
PB31	VG2B	Speed loop gain after gain switching	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]

7. SPECIAL ADJUSTMENT FUNCTIONS

(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

7. SPECIAL ADJUSTMENT FUNCTIONS

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.

7.3.1 Vibration tough drive function

This function prevent from vibrating by resetting a filter instantaneously when machine resonance occurs due to varied vibration frequency caused 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 6.1)
- (2) Manual setting (section 4.2.2)

The vibration tough drive function operates when a detected machine resonance frequency is within $\pm 30\%$ 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].

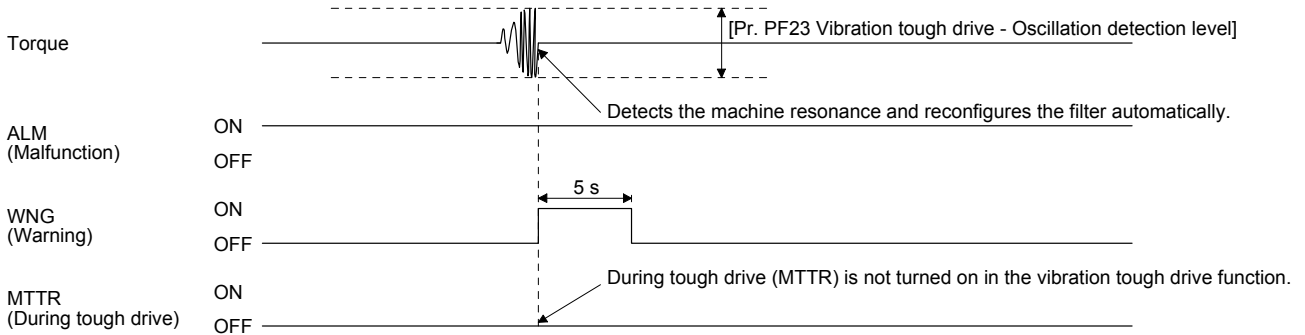
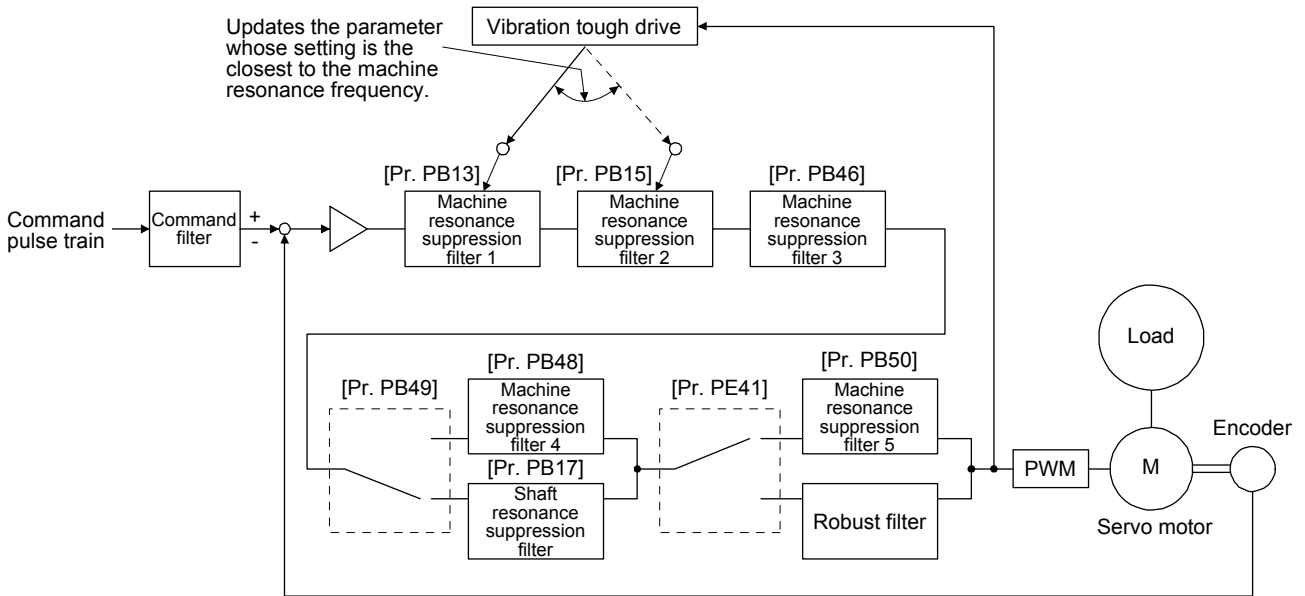
POINT
●Resetting [Pr. PB13] and [Pr. PB15] by the vibration tough drive function is performed constantly. However, the number of write times to the EEPROM is limited to once per hour.
●The vibration tough drive function does not reset [Pr. PB46 Machine resonance suppression filter 3], [Pr. PB48 Machine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

7. SPECIAL ADJUSTMENT FUNCTIONS

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 filter disables the shaft resonance suppression filter. The shaft resonance suppression filter is enabled for the initial setting.	
Machine resonance suppression filter 5	PB50/PB51	The setting of this filter is disabled while you use the robust filter. The robust filter is disabled for the initial setting.	



7. SPECIAL ADJUSTMENT FUNCTIONS

7.3.2 Instantaneous power failure tough drive function

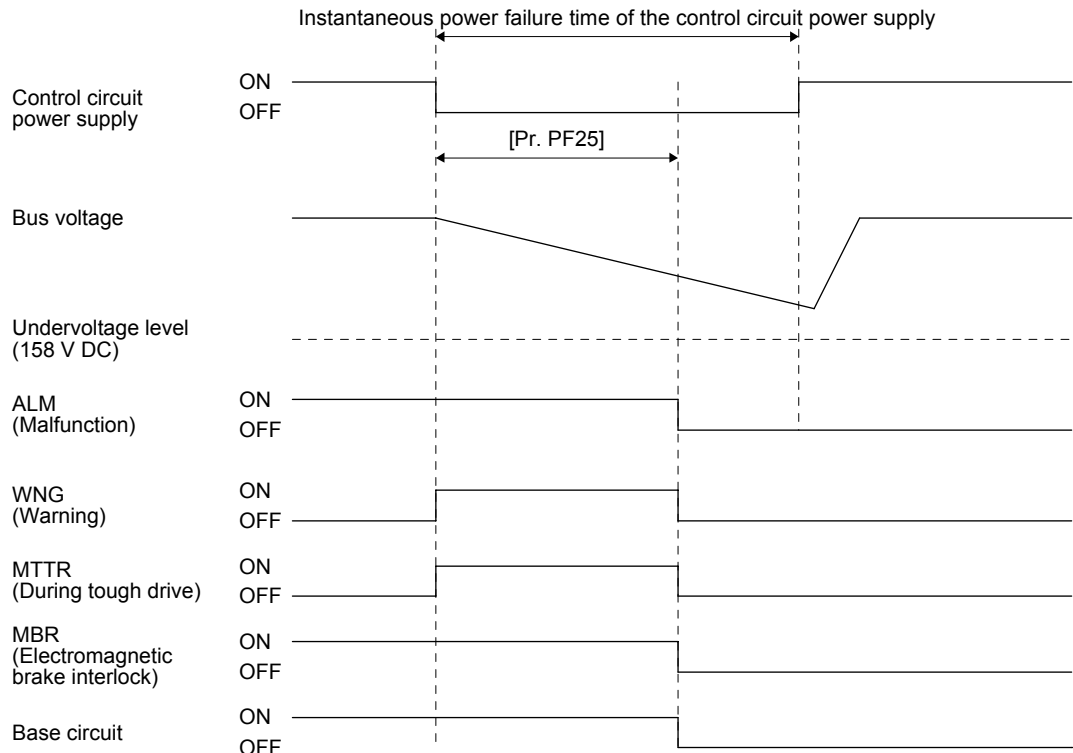
The instantaneous power failure tough drive function avoids [AL. 10 Undervoltage] even when an instantaneous power failure occurs during operation. When the instantaneous power failure tough drive activates, the function will increase the immunity to instantaneous power failures using the electrical 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 control circuit power] detection time for the control circuit power supply can be changed by [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time (instantaneous power failure tough drive - detection time)]. In addition, [AL. 10.2 Voltage drop in the main circuit power] detection level for the bus voltage is changed automatically.

POINT
<ul style="list-style-type: none"> ● MBR (Electromagnetic brake interlock) will not turn off during the instantaneous power failure tough drive. ● 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 SEMI-F47 function - Instantaneous power failure detection time (instantaneous power failure tough drive - detection time)].

- (1) Instantaneous power failure time of the control circuit power supply > [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time (instantaneous power failure tough drive - detection time)]
 The alarm occurs when the instantaneous power failure time of the control circuit power supply exceeds [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time (instantaneous power failure tough drive - detection time)].

MTTR (During tough drive) turns on after detecting the instantaneous power failure.

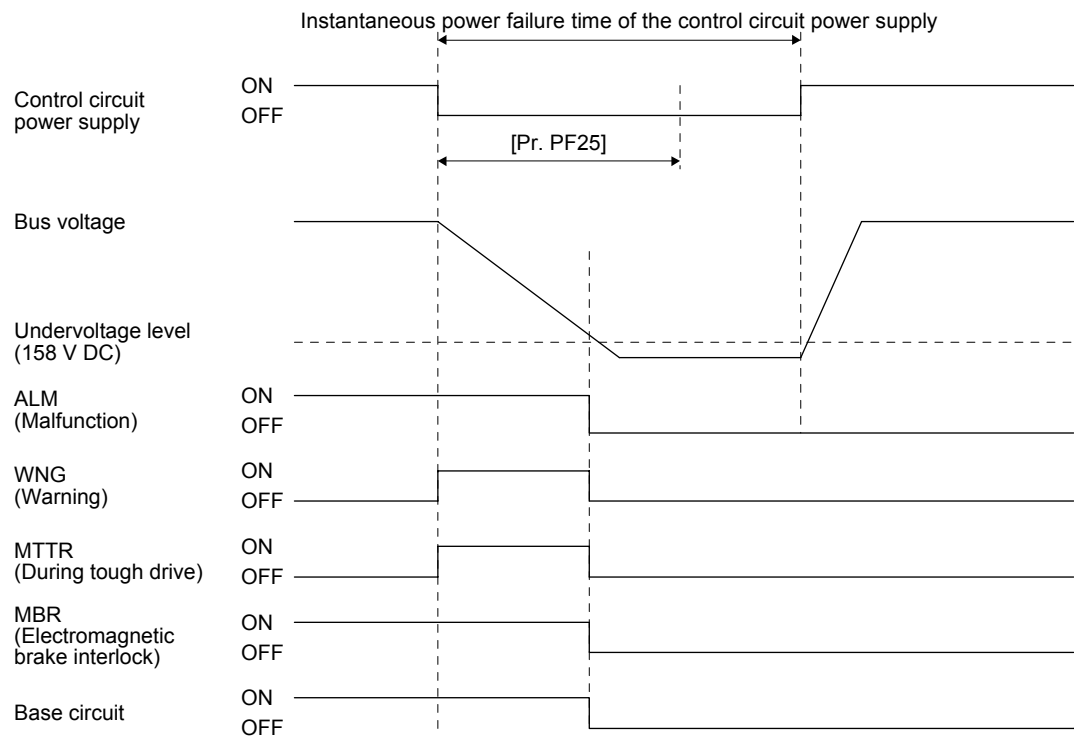
MBR (Electromagnetic brake interlock) turns off when the alarm occurs.



7. SPECIAL ADJUSTMENT FUNCTIONS

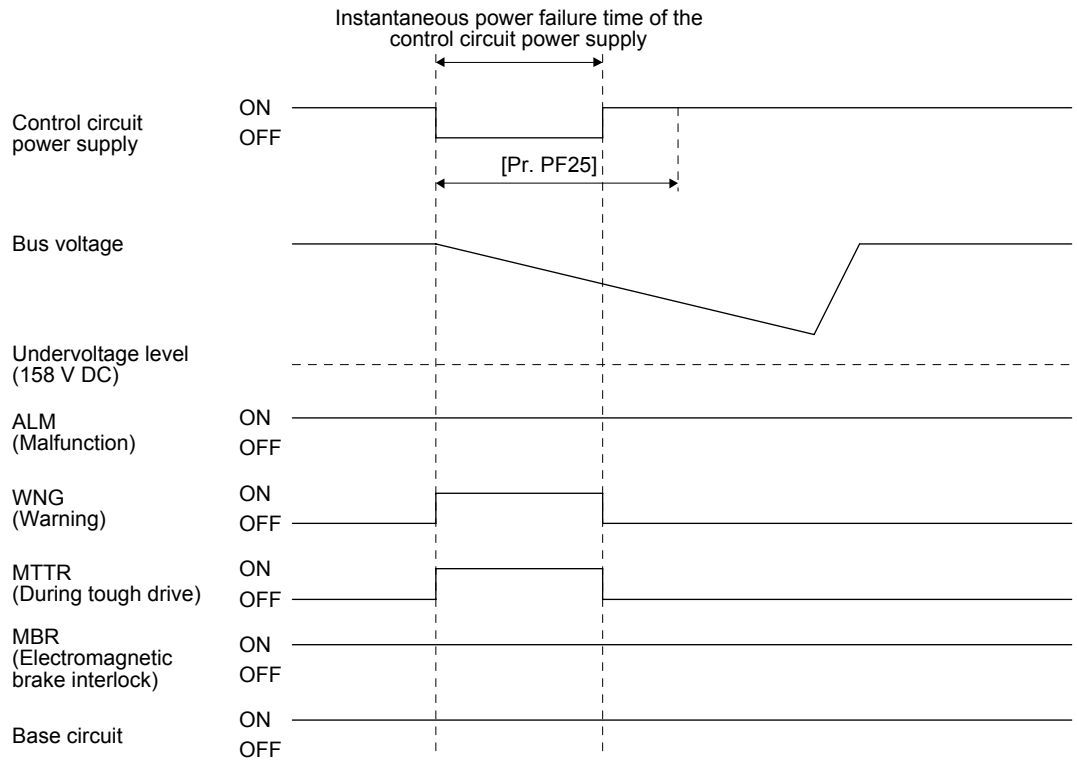
(2) Instantaneous power failure time of the control circuit power supply < [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time (instantaneous power failure tough drive - detection time)]
 Operation status differs depending on how bus voltage decrease.

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



7. SPECIAL ADJUSTMENT FUNCTIONS

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



7. SPECIAL ADJUSTMENT FUNCTIONS

7.4 Compliance with SEMI-F47 standard

POINT
<ul style="list-style-type: none"> ● The control circuit power supply of the servo amplifier can comply with SEMI-F47. However, a back-up capacitor may be necessary for instantaneous power failure in the main circuit power supply depending on the power supply impedance and operating situation. Be sure to check them by testing the entire equipment using actual machines. ● Use a 3-phase for the input power supply of the servo amplifier.

The following explains the compliance with "SEMI-F47 semiconductor process equipment voltage sag immunity test" of MR-J4 series.

(1) Parameter setting

Setting [Pr. PA20] and [Pr. PF25] as follows will enable SEMI-F47.

Parameter	Setting value	Description
PA20	_ 1 _ _	SEMI-F47 selection
PF25	200	Set the time [ms] of the [AL. 10.1 Voltage drop in the control circuit power] occurrence.

Enabling SEMI-F47 will change operation as follows.

- (a) The voltage will drop in the control circuit power at "Rated voltage × 50% or less". After 200 ms, [AL. 10.1 Voltage drop in the control circuit power] will occur.
- (b) [AL. 10.2 Voltage drop in the main circuit power] will occur when bus voltage is as follows.

Servo amplifier	Bus voltage which triggers alarm
MR-J4-10A(-RJ) to MR-J4-700A(-RJ)	158 V DC
MR-J4-11KA(-RJ) to MR-J4-22KA(-RJ)	200 V DC
MR-J4-60A4(-RJ) to MR-J4-22KA4(-RJ)	380 V DC

- (c) MBR (Electromagnetic brake interlock) will turn off when [AL. 10.1 Voltage drop in the control circuit power] occurs.

(2) Requirements and recommended conditions of SEMI-F47 standard

Table 7.1 shows the permissible time of instantaneous power failure for instantaneous power failure of SEMI-F47 standard.

Table 7.1 Requirements and recommended conditions of SEMI-F47 standard

Instantaneous power failure voltage	Permissible time of instantaneous power failure [s]	
	Requirement	Recommended condition
Rated voltage × 90%	—	10 to 100
Rated voltage × 80%	0.5 to 1	0.5 to 10
Rated voltage × 70%	0.2 to 0.5	0.2 to 0.5
Rated voltage × 50%	0.05 to 0.2	0.02 to 0.2
Rated voltage × 0%	—	0.02 or less

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POINT
<ul style="list-style-type: none"> ● Refer to "MELSERVO-J4 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.

When an error occurs during operation, the corresponding alarm or warning is displayed. When the alarm or the warning occurs, refer to "MELSERVO-J4 Servo Amplifier Instruction Manual (Troubleshooting)" to remove the failure. When an alarm occurs, ALM will turn off.

To output alarm codes, set [Pr. PD34] to "___ 1". Alarm codes are outputted by on/off of bit 0 to bit 2. Warnings ([AL. 91] 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.

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. For the alarms and warnings in which "SD" is written in the stop method column, the axis 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.

Table 8.1 Alarm list

	No.	Alarm code			Name	Detailed display	Detail name	Stop System (Note 2, 3)	Alarm deactivation			Operation mode				
		CN1 22 (Bit 2)	CN1 23 (Bit 1)	CN1 24 (Bit 0)					Alarm reset (RES)	Press the "SEL" button on the current alarm screen.	Power off to on	Standard	Full.	Lin.	DDM	
Alarm	10	0	1	0	Undervoltage	10.1	Voltage drop in the control circuit power	EDB	○	○	○	○	○	○	○	○
						10.2	Voltage drop in the main circuit power	SD	○	○	○	○	○	○	○	○
	12	0	0	0	Memory error 1 (RAM)	12.1	RAM error 1	DB	△	△	○	○	○	○	○	○
						12.2	RAM error 2	DB	△	△	○	○	○	○	○	
						12.4	RAM error 4	DB	△	△	○	○	○	○	○	
						12.5	RAM error 5	DB	△	△	○	○	○	○	○	
	13	0	0	0	Clock error	13.1	Clock error 1	DB	△	△	○	○	○	○	○	
						13.2	Clock error 2	DB	△	△	○	○	○	○	○	
	14	0	0	0	Control process error	14.1	Control process error 1	DB	△	△	○	○	○	○	○	
						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	0	0	0	Memory error 2 (EEP-ROM)	15.1	EEP-ROM error at power on	DB	△	△	○	○	○	○	○	
15.2						EEP-ROM error during operation	DB	△	△	○	○	○	○	○		

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Alarm	No.	Alarm code			Name	Detailed display	Detail name	Stop System (Note 2, 3)	Alarm deactivation			Operation mode			
		CN1 22 (Bit 2)	CN1 23 (Bit 1)	CN1 24 (Bit 0)					Alarm reset (RES)	Press the "SET" button on the current alarm screen.	Power off to on	Standard	Full.	Lin.	DDM
16	1	1	1	0	Encoder initial communication error 1	16.1	Encoder initial communication - Receive data error 1	DB			○	○	○	○	○
						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	0	0	0	Board error	17.1	Board error 1	DB			○	○	○	○	○	
					17.3	Board error 2	DB			○	○	○	○	○	
					17.4	Board error 3	DB			○	○	○	○	○	
19	0	0	0	Memory error 3 (FLASH-ROM)	19.1	FLASH-ROM error 1	DB			○	○	○	○	○	
					19.2	FLASH-ROM error 2	DB			○	○	○	○	○	
1A	1	1	0	Servo motor combination error	1A.1	Servo motor combination error	DB			○	○	○	○	○	
					1A.2	Servo motor control mode combination error	DB			○	○	○	○	○	
1E	1	1	0	Encoder initial communication error 2	1E.1	Encoder malfunction	DB			○	○	○	△	○	
					1E.2	Load-side encoder malfunction	DB			○	○	○	△	○	
1F	1	1	0	Encoder initial communication error 3	1F.1	Incompatible encoder	DB			○	○	○	○	○	
					1F.2	Incompatible load-side encoder	DB			○	○	○	△	○	
20	1	1	0	Encoder normal communication error 1	20.1	Encoder normal communication - Receive data error 1	EDB			○	○	○	○	○	
					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	1	1	0	Encoder normal communication error 2	21.1	Encoder data error 1	EDB			○	○	○	△	○	
					21.2	Encoder data update error	EDB			○	○	○	△	○	
					21.3	Encoder data waveform error	EDB			○	○	○	△	○	
					21.4	Encoder non-signal error	EDB			○	○	○	△	○	
					21.5	Encoder hardware error 1	EDB			○	○	○	△	○	
					21.6	Encoder hardware error 2	EDB			○	○	○	△	○	
24	1	0	0	Main circuit error	24.1	Ground fault detected by hardware detection circuit	DB			○	○	○	○	○	
					24.2	Ground fault detected by software detection function	DB	○	○	○	○	○	○	○	
25	1	1	0	Absolute position erased	25.1	Servo motor encoder - Absolute position erased	DB			○	○	○	○	○	

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	No.	Alarm code			Name	Detailed display	Detail name	Stop System (Note 2, 3)	Alarm deactivation			Operation mode			
		CN1 22 (Bit 2)	CN1 23 (Bit 1)	CN1 24 (Bit 0)					Alarm reset (RES)	Press the "SET" button on the current alarm screen.	Power off to on	Standard	Full.	Lin.	DDM
Alarm	27	1	1	0	Initial magnetic pole detection error	27.1	Initial magnetic pole detection - Abnormal termination	DB	○	○	○	/	/	○	○
						27.2	Initial magnetic pole detection - Time out error	DB	○	○	○	/	/	○	○
						27.3	Initial magnetic pole detection - Limit switch error	DB	○	○	○	/	/	○	○
						27.4	Initial magnetic pole detection - Estimated error	DB	○	○	○	/	/	○	○
						27.5	Initial magnetic pole detection - Position deviation error	DB	○	○	○	/	/	○	○
						27.6	Initial magnetic pole detection - Speed deviation error	DB	○	○	○	/	/	○	○
						27.7	Initial magnetic pole detection - Current error	DB	○	○	○	/	/	○	○
	28	1	1	0	Linear encoder error 2	28.1	Linear encoder - Environment error	EDB	/	/	○	/	/	○	○
	2A	1	1	0	Linear encoder error 1	2A.1	Linear encoder error 1-1	EDB	/	/	○	/	/	○	○
						2A.2	Linear encoder error 1-2	EDB	/	/	○	/	/	○	○
						2A.3	Linear encoder error 1-3	EDB	/	/	○	/	/	○	○
						2A.4	Linear encoder error 1-4	EDB	/	/	○	/	/	○	○
						2A.5	Linear encoder error 1-5	EDB	/	/	○	/	/	○	○
						2A.6	Linear encoder error 1-6	EDB	/	/	○	/	/	○	○
						2A.7	Linear encoder error 1-7	EDB	/	/	○	/	/	○	○
						2A.8	Linear encoder error 1-8	EDB	/	/	○	/	/	○	○
						2B	1	1	0	Encoder counter error	2B.1	Encoder counter error 1	EDB	/	/
	2B.2	Encoder counter error 2	EDB	/	/						○	/	/	○	○
	30	0	0	1	Regenerative error (Note 1)	30.1	Regeneration heat error	DB	○ (Note 1)	○ (Note 1)	○ (Note 1)	○	○	○	○
						30.2	Regeneration signal error	DB	○ (Note 1)	○ (Note 1)	○ (Note 1)	○	○	○	○
						30.3	Regeneration feedback signal error	DB	○ (Note 1)	○ (Note 1)	○ (Note 1)	○	○	○	○
	31	1	0	1	Overspeed	31.1	Abnormal motor speed	SD	○	○	○	○	○	○	
	32	1	0	0	Overcurrent	32.1	Overcurrent detected at hardware detection circuit (during operation)	DB	/	/	○	○	○	○	
						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	0	0	1	Overvoltage	33.1	Main circuit voltage error	EDB	○	○	○	○	○	○	
	35	1	0	1	Command frequency error	35.1	Command frequency error	SD	○	○	○	○	○	○	
	37	0	0	0	Parameter error	37.1	Parameter setting range error	DB	/	/	○	○	○	○	
						37.2	Parameter combination error	DB	/	/	○	○	○	○	
	3A	0	0	0	Inrush current suppression circuit error	3A.1	Inrush current suppression circuit error	EDB	/	/	○	○	○	○	
	42	1	1	0	Servo control error	42.1	Servo control error by position deviation	EDB	△ (Note 4)	△ (Note 4)	○	/	/	○	○
						42.2	Servo control error by speed deviation	EDB	△ (Note 4)	△ (Note 4)	○	/	/	○	○
						42.3	Servo control error by torque/thrust deviation	EDB	△ (Note 4)	△ (Note 4)	○	/	/	○	○
					Fully closed loop control error	42.8	Fully closed loop control error by position deviation	EDB	△ (Note 4)	△ (Note 4)	○	/	/	○	○
						42.9	Fully closed loop control error by speed deviation	EDB	△ (Note 4)	△ (Note 4)	○	/	/	○	○
						42.A	Fully closed loop control error by position deviation during command stop	EDB	△ (Note 4)	△ (Note 4)	○	/	/	○	○
	45	0	1	1	Main circuit device overheat (Note 1)	45.1	Main circuit device overheat error	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)	○	○	○	

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Alarm	No.	Alarm code			Name	Detailed display	Detail name	Stop System (Note 2, 3)	Alarm deactivation			Operation mode			
		CN1 22 (Bit 2)	CN1 23 (Bit 1)	CN1 24 (Bit 0)					Alarm reset (RES)	Press the "SET" button on the current alarm screen.	Power off to on	Standard	Full.	Lin.	DDM
46	0	1	1	Servo motor overheat (Note 1)	46.1	Abnormal temperature of servo motor 1	SD	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					46.2	Abnormal temperature of servo motor 2	SD	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
					46.3	Thermistor disconnected	SD	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
					46.5	Abnormal temperature of servo motor 3	DB	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
					46.6	Abnormal temperature of servo motor 4	DB	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
47	0	1	1	Cooling fan error	47.1	Cooling fan stop error	SD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					47.2	Cooling fan speed reduction error	SD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
50	0	1	1	Overload 1 (Note 1)	50.1	Thermal overload error 1 during operation	SD	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					50.2	Thermal overload error 2 during operation	SD	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					50.3	Thermal overload error 4 during operation	SD	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					50.4	Thermal overload error 1 during a stop	SD	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					50.5	Thermal overload error 2 during a stop	SD	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					50.6	Thermal overload error 4 during a stop	SD	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
51	0	1	1	Overload 2 (Note 1)	51.1	Thermal overload error 3 during operation	DB	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					51.2	Thermal overload error 3 during a stop	DB	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/> (Note 1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
52	1	0	1	Error excessive	52.1	Excess droop pulse 1	SD	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					52.3	Excess droop pulse 2	SD	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					52.4	Error excessive during 0 torque limit	SD	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					52.5	Excess droop pulse 3	EDB	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
54	0	1	1	Oscillation detection	54.1	Oscillation detection error	EDB	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
56	1	1	0	Forced stop error	56.2	Over speed during forced stop	EDB	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					56.3	Estimated distance over during forced stop	EDB	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
63	1	1	0	STO timing error	63.1	STO1 off	DB	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					63.2	STO2 off	DB	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
70	1	1	0	Load-side encoder initial communication error 1	70.1	Load-side encoder initial communication - Receive data error 1	DB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					70.2	Load-side encoder initial communication - Receive data error 2	DB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					70.3	Load-side encoder initial communication - Receive data error 3	DB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					70.5	Load-side encoder initial communication - Transmission data error 1	DB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					70.6	Load-side encoder initial communication - Transmission data error 2	DB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					70.7	Load-side encoder initial communication - Transmission data error 3	DB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					70.A	Load-side encoder initial communication - Process error 1	DB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					70.B	Load-side encoder initial communication - Process error 2	DB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					70.C	Load-side encoder initial communication - Process error 3	DB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					70.D	Load-side encoder initial communication - Process error 4	DB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					70.E	Load-side encoder initial communication - Process error 5	DB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
					70.F	Load-side encoder initial communication - Process error 6	DB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	

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	No.	Alarm code			Name	Detailed display	Detail name	Stop System (Note 2, 3)	Alarm deactivation			Operation mode				
		CN1 22 (Bit 2)	CN1 23 (Bit 1)	CN1 24 (Bit 0)					Alarm reset (RES)	Press the "SET" button on the current alarm screen.	Power off to on	Standard	Full.	Lin.	DDM	
Alarm	71	1	1	0	Load-side encoder normal communication error 1	71.1	Load-side encoder communication - Receive data error 1	EDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
						71.2	Load-side encoder communication - Receive data error 2	EDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
						71.3	Load-side encoder communication - Receive data error 3	EDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
						71.5	Load-side encoder communication - Transmission data error 1	EDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
						71.6	Load-side encoder communication - Transmission data error 2	EDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
						71.7	Load-side encoder communication - Transmission data error 3	EDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
						71.9	Load-side encoder communication - Transmission data error 4	EDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
						71.A	Load-side encoder communication - Transmission data error 5	EDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	72	1	1	0	Load-side encoder normal communication error 2	72.1	Load-side encoder data error 1	EDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
						72.2	Load-side encoder data update error	EDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
						72.3	Load-side encoder data waveform error	EDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
						72.4	Load-side encoder non-signal error	EDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
						72.5	Load-side encoder hardware error 1	EDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
						72.6	Load-side encoder hardware error 2	EDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	8E	0	0	0	USB communication error/serial communication error	8A.1	USB communication time-out error/serial communication time-out error	SD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
						8E.1	USB communication receive error/serial communication receive error	SD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
						8E.2	USB communication checksum error/serial communication checksum error	SD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
						8E.3	USB communication character error/serial communication character error	SD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
						8E.4	USB communication command error/serial communication command error	SD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
8E.5	USB communication data number error/serial communication data number error	SD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
88888				Watchdog	8888_	Watchdog	SD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

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

2. Stop method indicates as follows:

- DB: Stops with dynamic brake. (Coasts for the servo amplifier without dynamic brake.)
- EDB: 600 W or less servo amplifiers stops with electronic dynamic brake
700 W or more servo amplifiers stops with dynamic brake
- SD: Forced stop deceleration

3. This is applicable when [Pr. PA04] is set to the initial value. The stop system of SD can be changed to DB using [Pr. PA04].

4. Reset enable or disable can be selected using [Pr. PE03].

8. TROUBLESHOOTING

Table 8.2 Warning list

	No.	Name	Detail display	Detail name	Stop method (Note 2, 3)	Operation mode			
						Standard	Full.	Lin.	DDM
Warning	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		○	○	○	○
	93	ABS data transfer warning	93.1	ABS data transfer requirement warning during magnetic pole detection				○	○
	95	STO warning	95.1	STO1 off detection	DB	○	○	○	○
			95.2	STO2 off detection	DB	○	○	○	○
	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		○	○	○	○
			96.4	Home positioning warning during magnetic pole detection					○
	99	Stroke limit warning	99.1	Forward rotation stroke end off	(Note 4)	○			
			99.2	Reverse rotation stroke end off	(Note 4)	○			
	9F	Battery warning	9F.1	Low battery		○	○	○	○
			9F.2	Battery degradation warning					○
	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 error 1 during a stop		○	○	○	○
			E1.6	Thermal overload error 2 during a stop		○	○	○	○
			E1.7	Thermal overload error 3 during a stop		○	○	○	○
			E1.8	Thermal overload error 4 during a stop		○	○	○	○
	E2	Servo motor overheat warning	E2.1	Servo motor temperature warning		○	○	○	○
	E3	Absolute position counter warning	E3.1	Multi-revolution counter travel distance excess warning		○			
			E3.2	Absolute position counter warning		○	○		○
			E3.5	Encoder absolute positioning counter warning		○			○
	E5	ABS time-out warning	E5.1	Time-out during ABS data transfer		○			
			E5.2	ABSM off during ABS data transfer		○			
			E5.3	SON off during ABS data transfer		○			
	E6	Servo forced stop warning	E6.1	Forced stop warning	SD	○	○	○	○
	E8	Cooling fan speed reduction warning	E8.1	Decreased cooling fan speed warning		○	○	○	○
			E8.2	Cooling fan stop		○	○	○	○
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	○	○	○	○	
EA	ABS servo-on warning	EA.1	ABS servo-on warning		○				
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		○	○	○	○	

8. TROUBLESHOOTING

- Note
1. Leave for about 30 minutes of cooling time after removing the cause of occurrence.
 2. Stop method indicates as follows:
 - DB: Stops with dynamic brake. (Coasts for the servo amplifier without dynamic brake.)
 - SD: Forced stop deceleration
 3. This is applicable when [Pr. PA04] is set to the initial value. The stop system of SD can be changed to DB using [Pr. PA04].
 4. Quick stop or slow stop can be selected using [Pr. PD30].

9 OUTLINE DRAWINGS

9. OUTLINE DRAWINGS

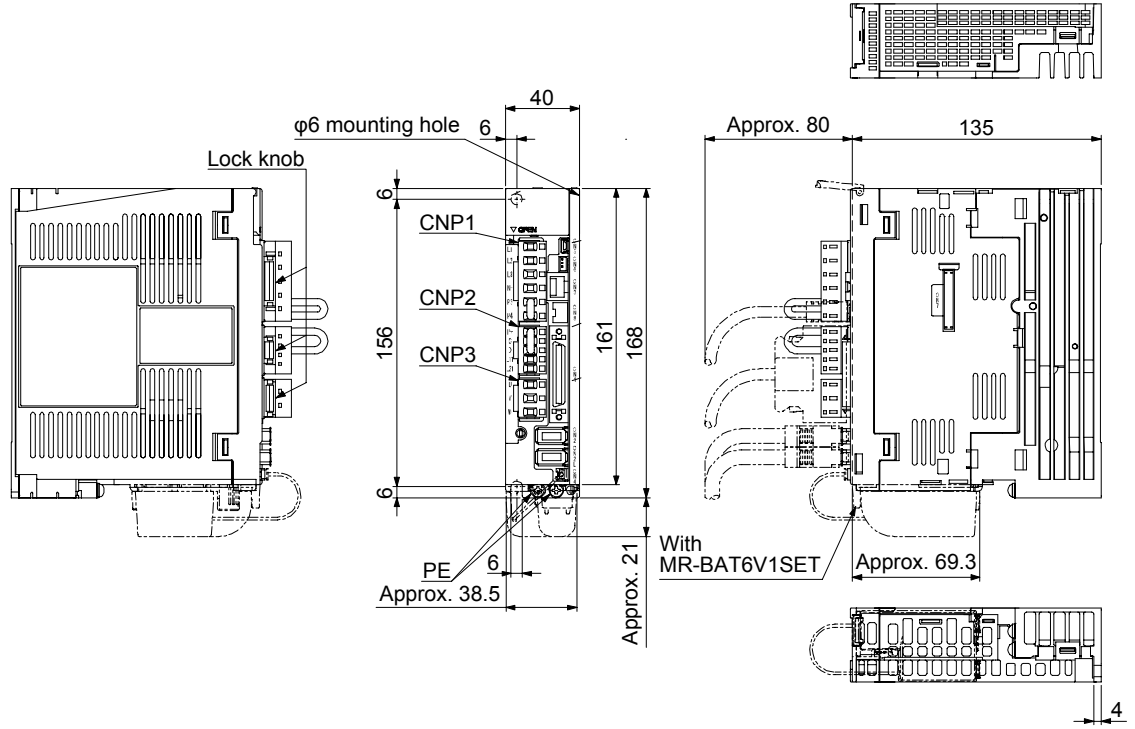
9.1 Servo amplifier

POINT
● Only MR-J4-_A-RJ are shown for dimensions. MR-J4-_A does not have CN2L and CN7 connectors. The dimensions of MR-J4-_A are the same as those of MR-J4-_A-RJ except CN2L and CN7 connectors.

9 OUTLINE DRAWINGS

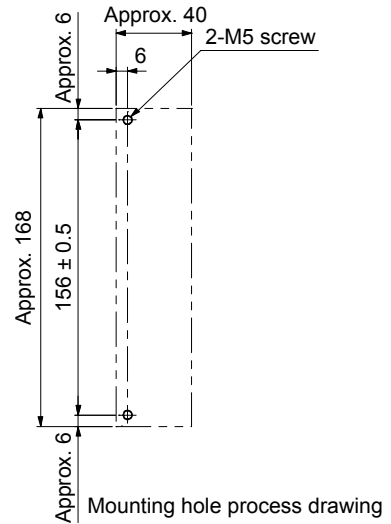
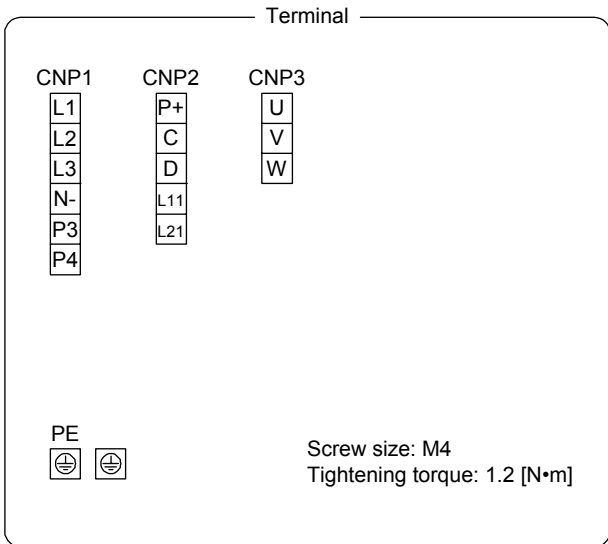
(1) MR-J4-10A(-RJ)/MR-J4-20A(-RJ)

[Unit: mm]



Mass: 0.8 [kg]

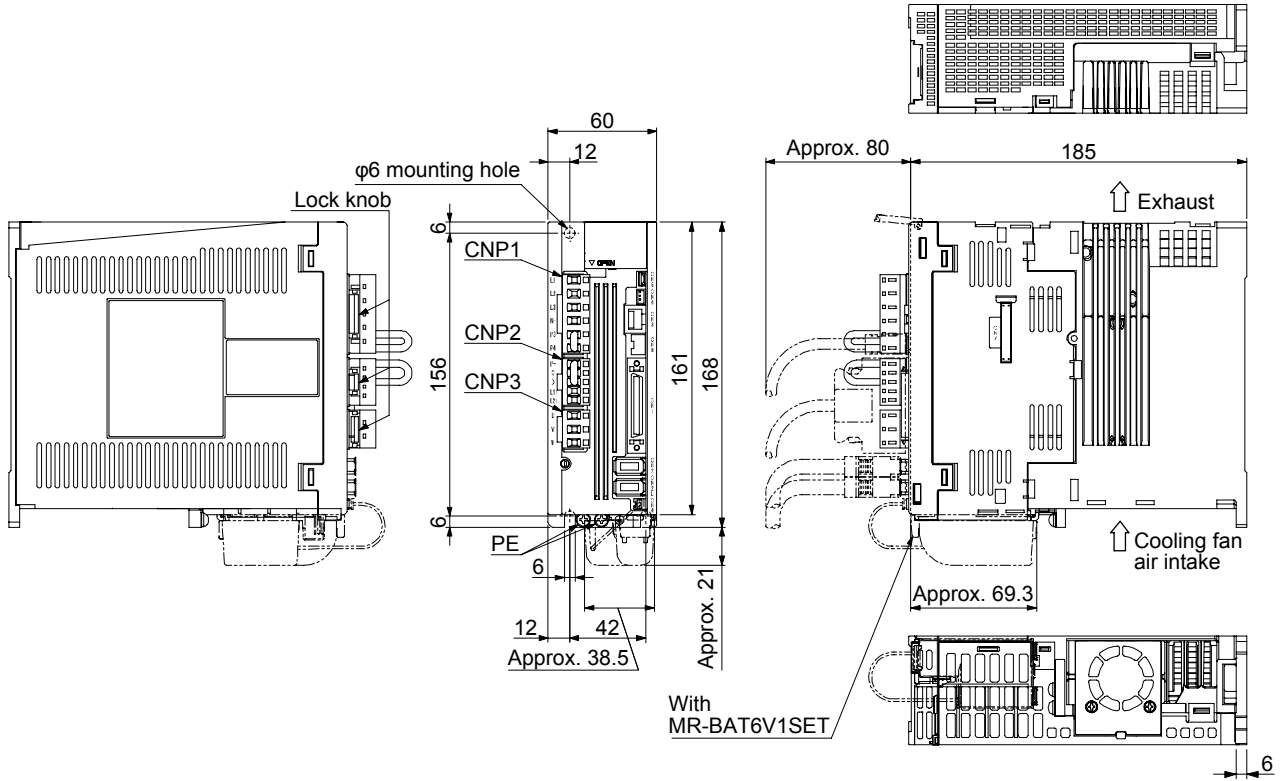
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N·m]



9 OUTLINE DRAWINGS

(3) MR-J4-70A(-RJ)/MR-J4-100A(-RJ)

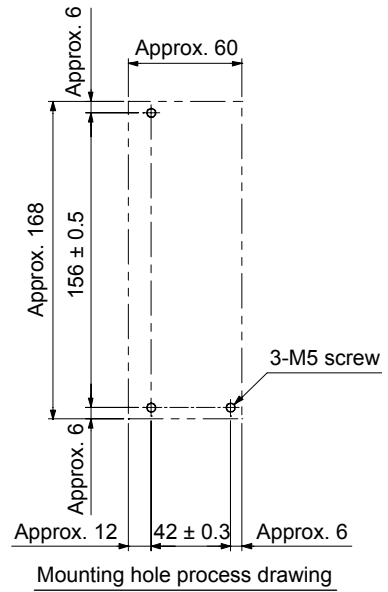
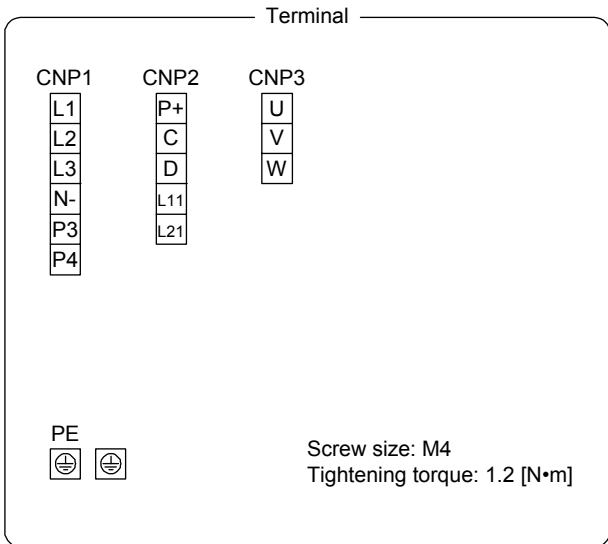
[Unit: mm]



With MR-BAT6V1SET

Mass: 1.4 [kg]

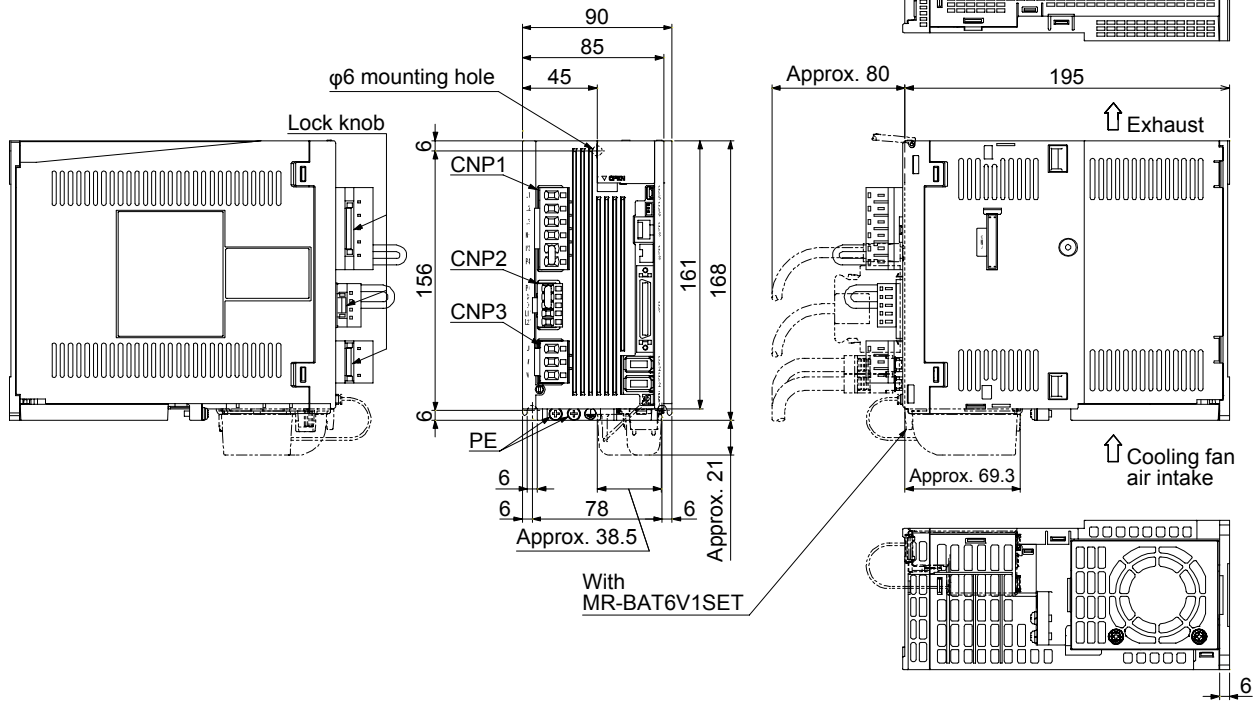
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]



9 OUTLINE DRAWINGS

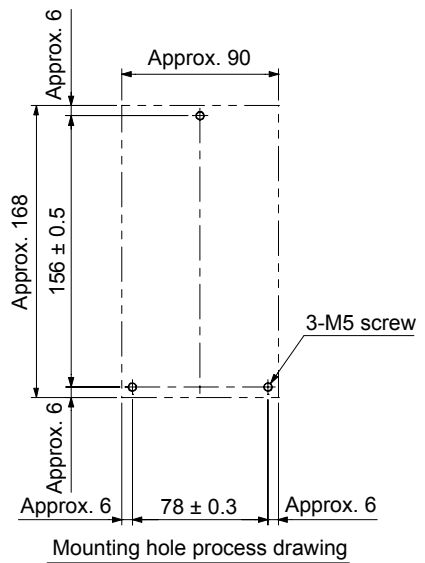
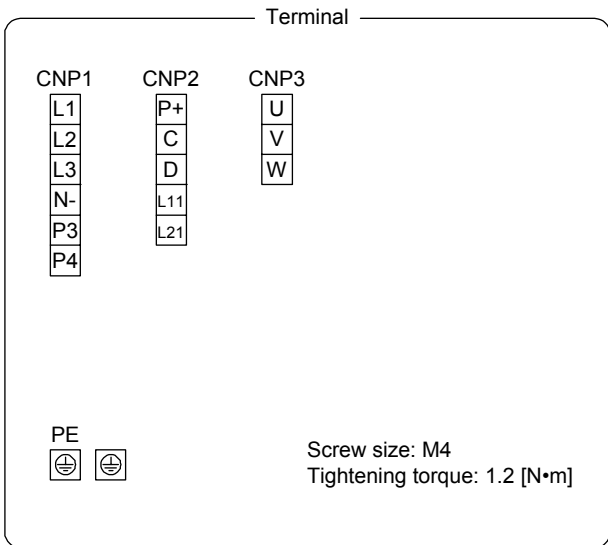
(4) MR-J4-200A(-RJ)

[Unit: mm]



Mass: 2.1 [kg]

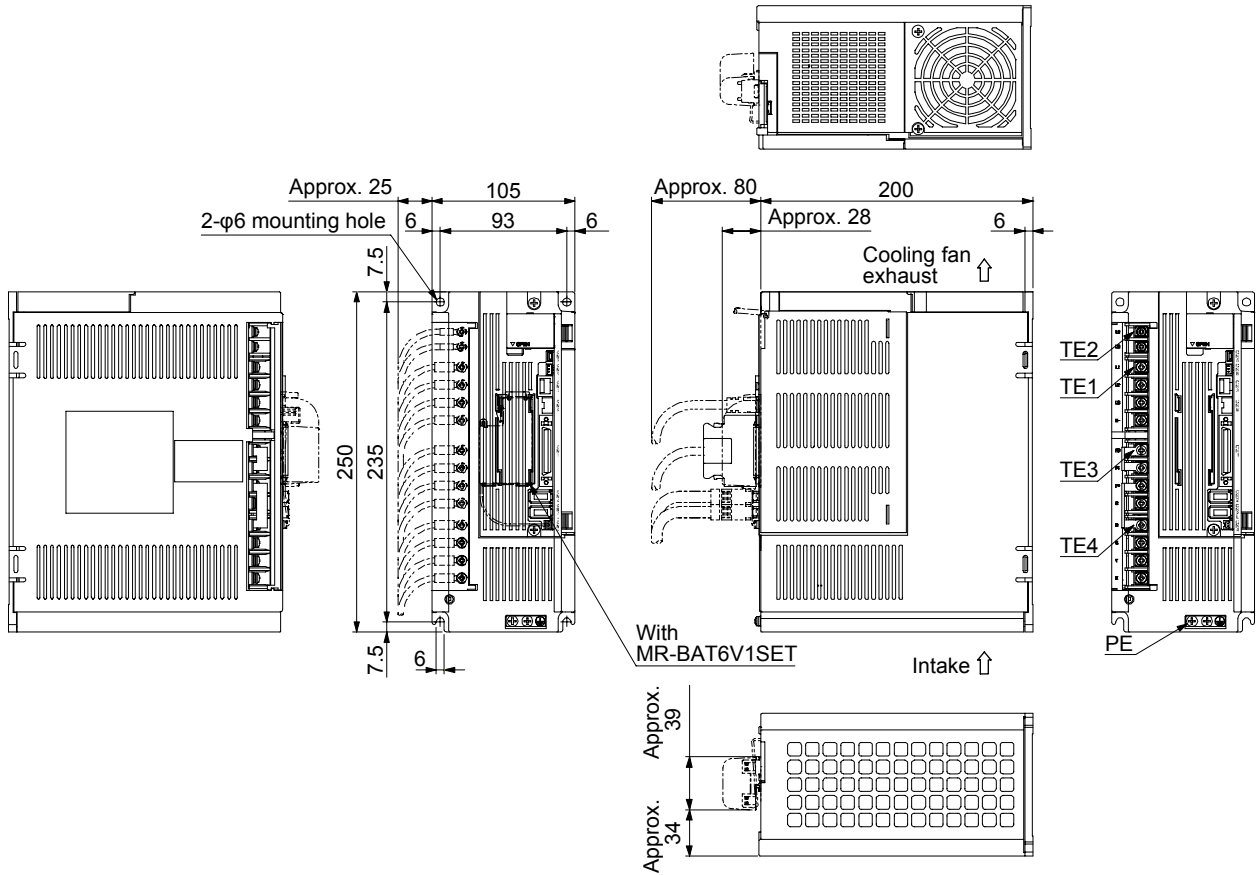
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N·m]



9 OUTLINE DRAWINGS

(6) MR-J4-500A(-RJ)

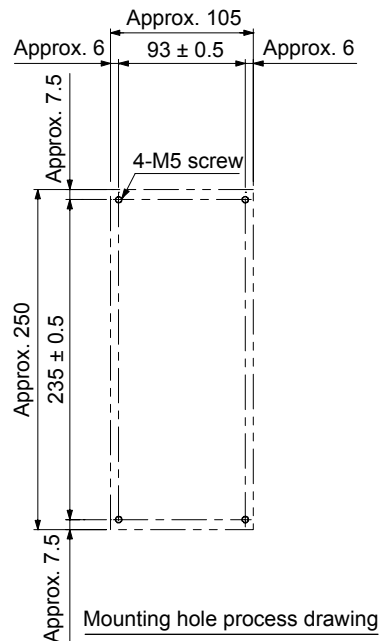
[Unit: mm]



Mass: 4.0 [kg]

Terminal		
TE2	L11 L21	TE2 Screw size: M3.5 Tightening torque: 0.8 [N•m]
TE1	L1 L2 L3 N-	TE1 Screw size: M4 Tightening torque: 1.2 [N•m]
TE3	P3 P4 P+ C	TE3 Screw size: M4 Tightening torque: 1.2 [N•m]
TE4	D U V W	TE4 Screw size: M4 Tightening torque: 1.2 [N•m]
	PE ⊕ ⊕	PE Screw size: M4 Tightening torque: 1.2 [N•m]

Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]

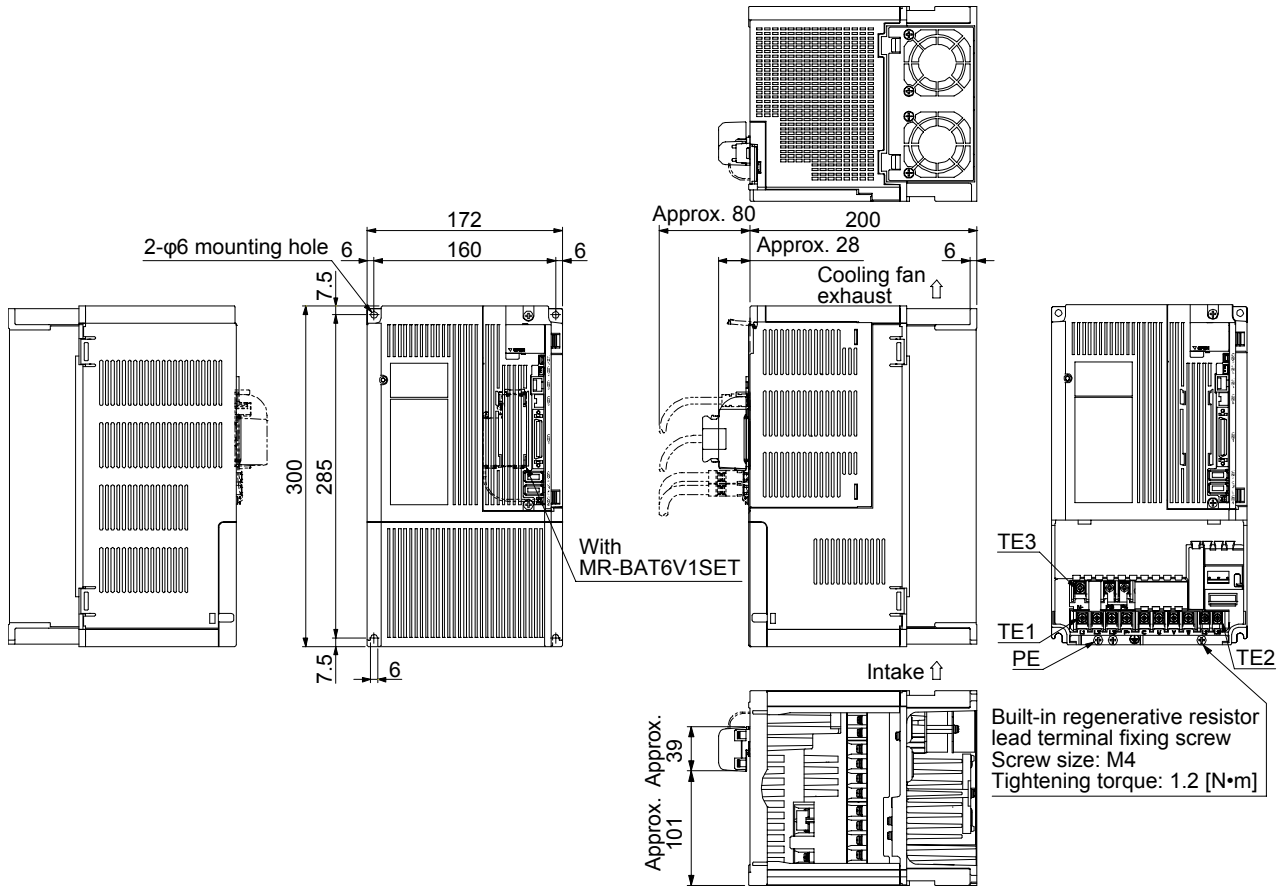


Mounting hole process drawing

9 OUTLINE DRAWINGS

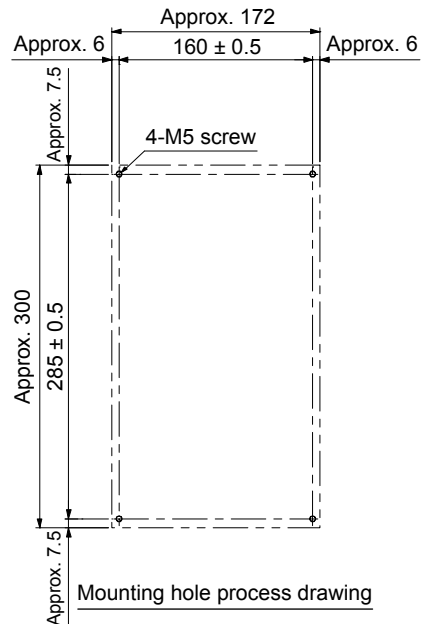
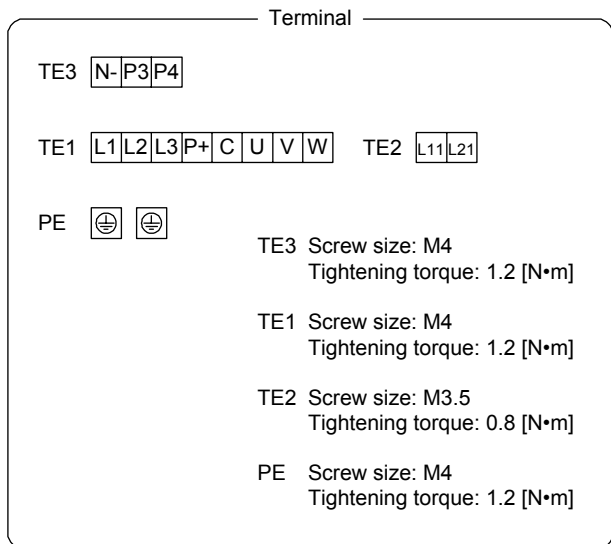
(7) MR-J4-700A(-RJ)

[Unit: mm]



Mass: 6.2 [kg]

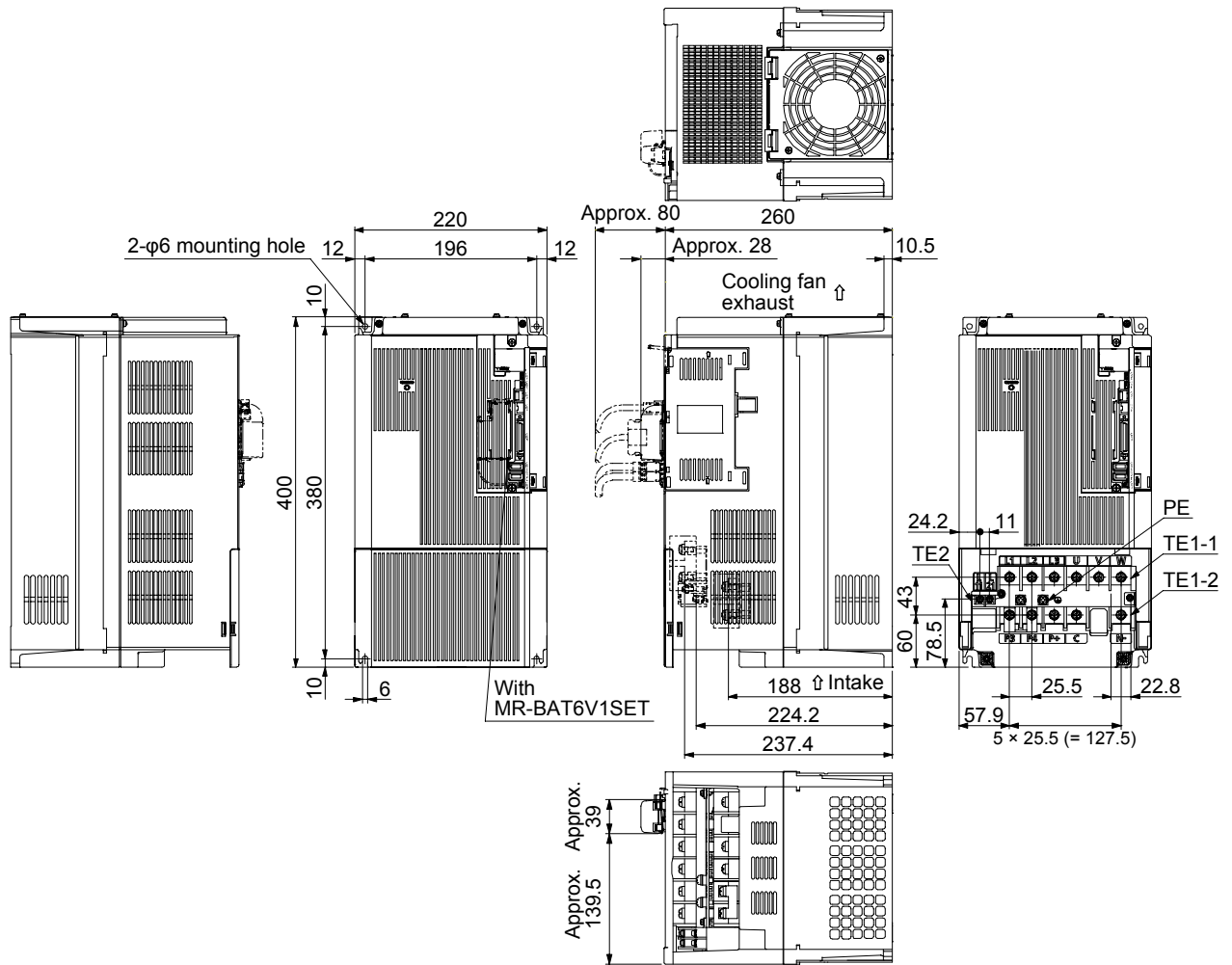
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]



9 OUTLINE DRAWINGS

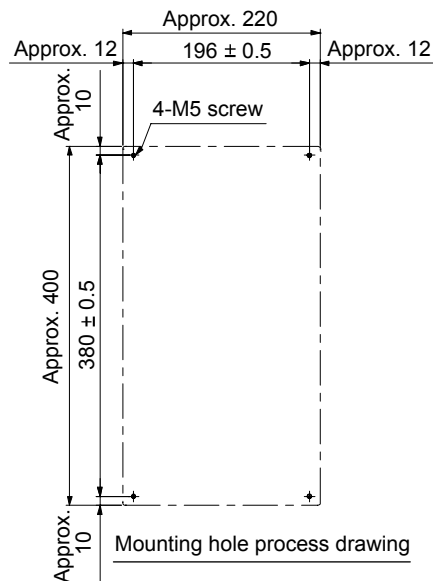
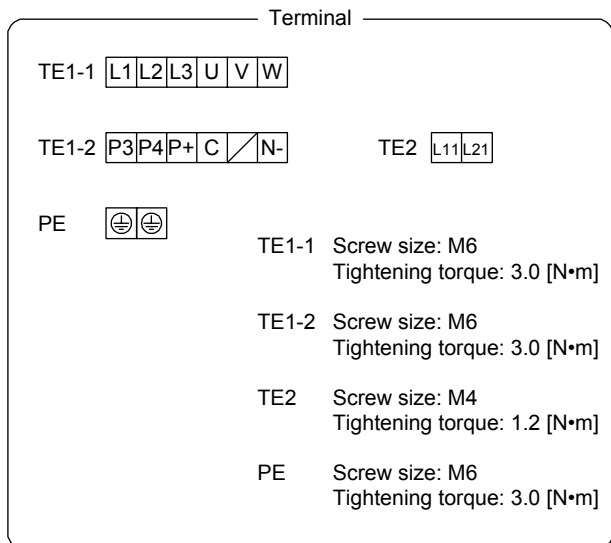
(8) MR-J4-11KA(-RJ)/MR-J4-15KA(-RJ)

[Unit: mm]



Mass: 13.4 [kg]

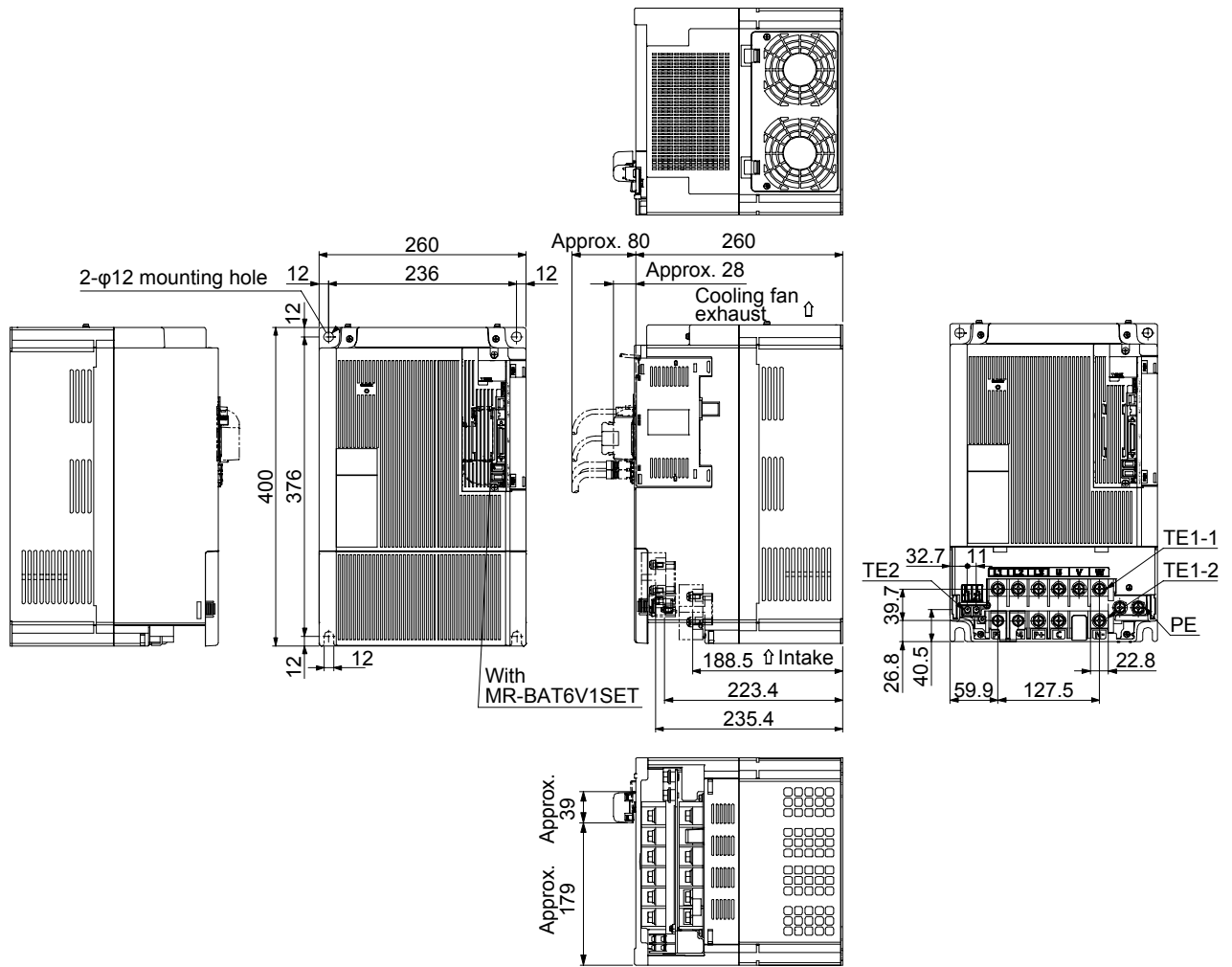
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N·m]



9 OUTLINE DRAWINGS

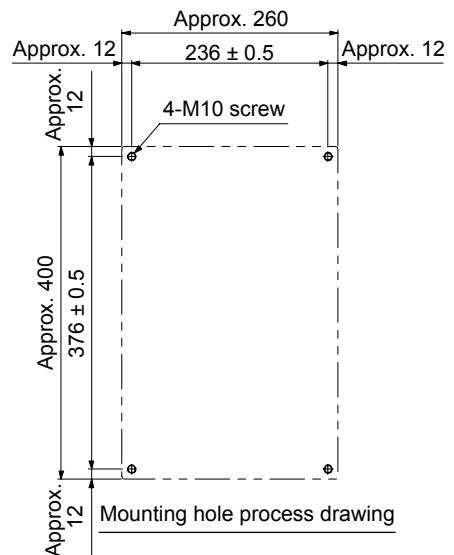
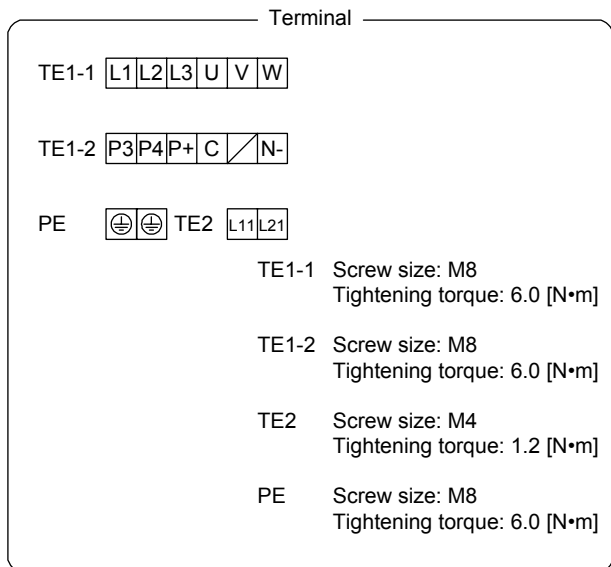
(9) MR-J4-22KA(-RJ)

[Unit: mm]



Mass: 18.2 [kg]

Mounting screw
Screw size: M10
Tightening torque: 3.24 [N·m]

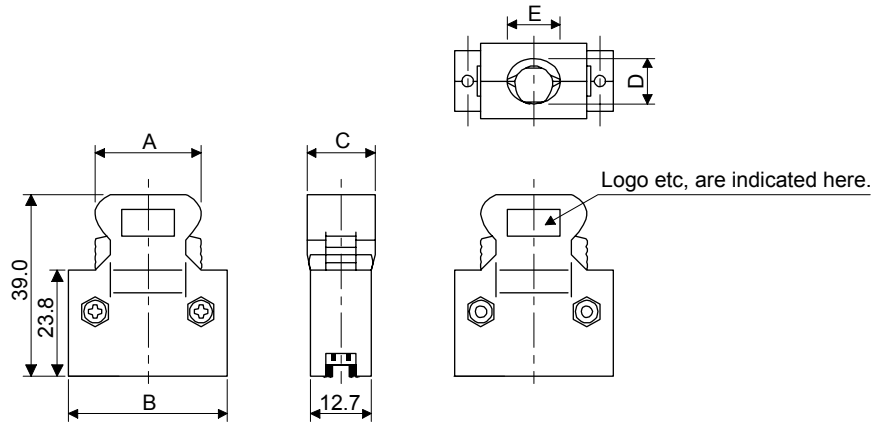


9 OUTLINE DRAWINGS

9.2 Connector

- (1) Miniature delta ribbon (MDR) system (3M)
- (2) One-touch lock type

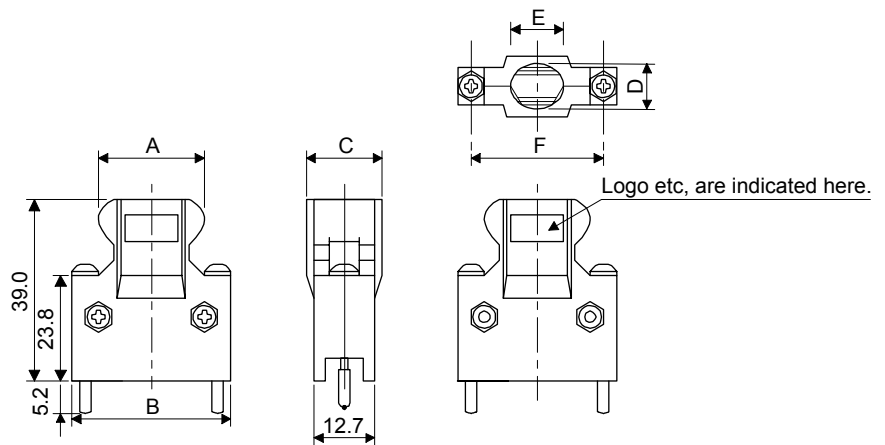
[Unit: mm]



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]

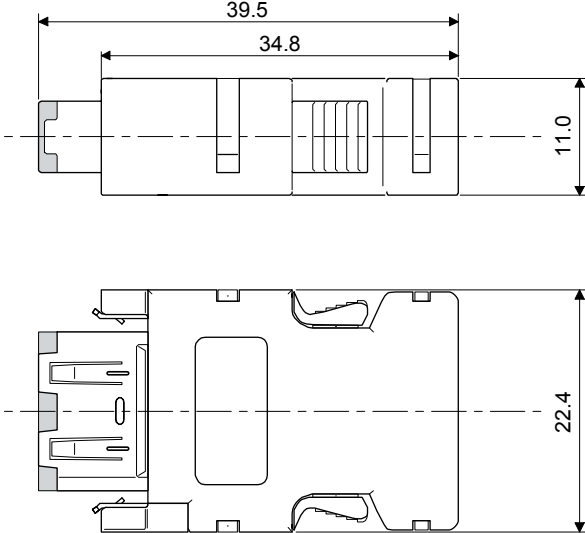


Connector	Shell kit	Variable dimensions					
		A	B	C	D	E	F
10150-3000PE	10350-52A0-008	41.1	52.4	18.0	14.0	17.0	46.5

9 OUTLINE DRAWINGS

(2) SCR connector system (3M)
Receptacle: 36210-0100PL
Shell kit: 36310-3200-008

[Unit: mm]



10. CHARACTERISTICS

10. CHARACTERISTICS

POINT	
	● For the characteristics of the linear servo motor and the direct drive motor, refer to sections 14.4 and 15.4.

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-hand side area of the continuous or broken line in the graph.

When unbalanced torque is generated, such as in a vertical lift machine, it is recommended that the unbalanced torque of the machine be kept at 70% or less of the motor's rated torque.

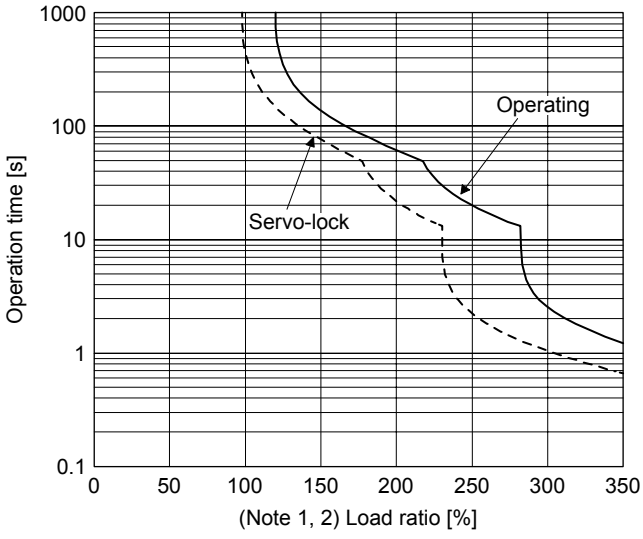
This servo amplifier has solid-state servo motor overload protection. (The servo motor overload current (full load current) is set on the basis of 120% rated current of the servo amplifier.)

The following table shows combinations of each servo motor and graph of overload protection characteristics.

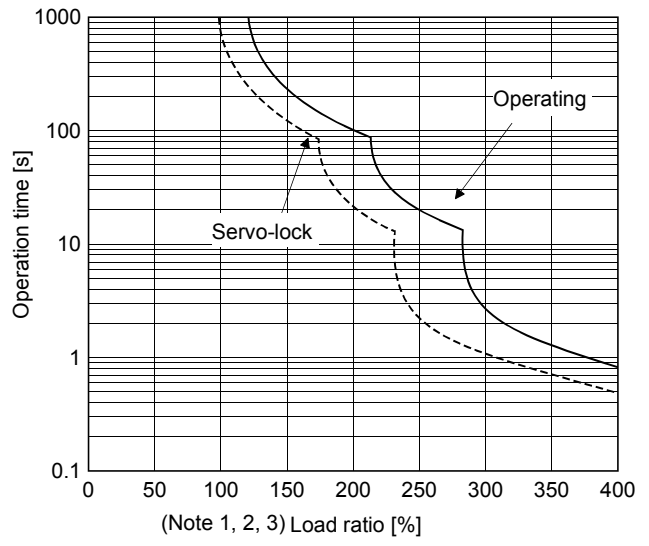
Rotary servo motor							Graph of overload protection characteristics
HG-KR	HG-MR	HG-SR	HG-UR	HG-RR	HG-JR	HG-JR (at maximum torque 400%)	
053 13	053 13		72				Characteristics a
23 43 73	23 43 73	51 81 52 102			53 73 103	53	Characteristics b
		121 201 152 202 301 352	152 202	103 153 203	153 203 353	73 103 153 203	Characteristics c
		421 502 702	352 502	353 503	503 703	353 503	Characteristics d
					903 11K1M 15K1M 22K1M		Characteristics e

10. CHARACTERISTICS

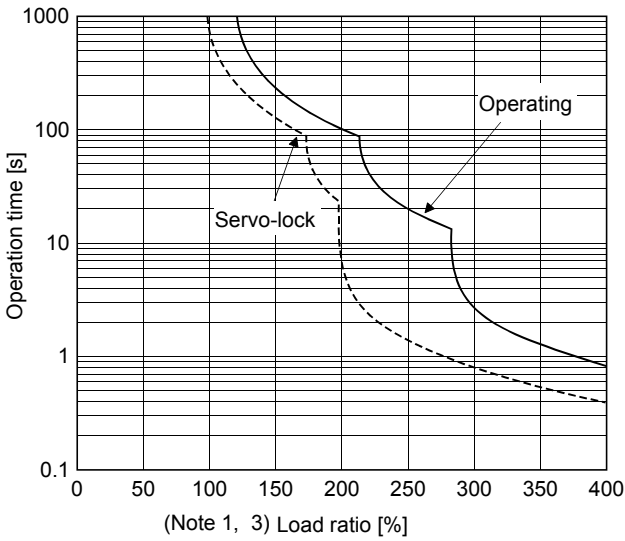
The following graphs show overload protection characteristics.



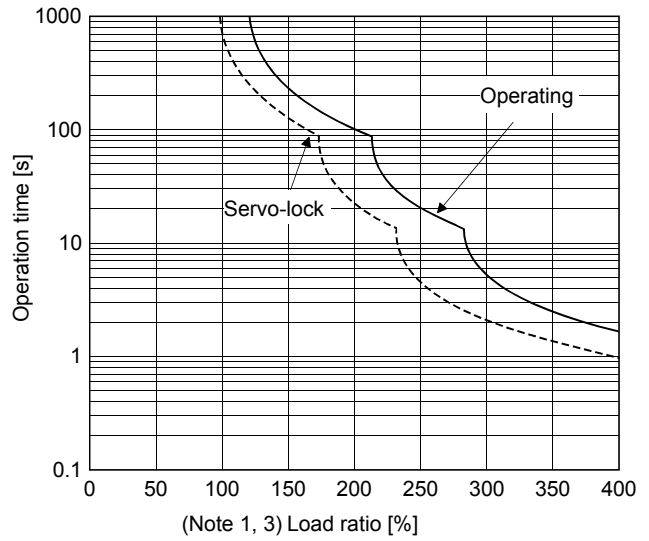
Characteristics a



Characteristics b

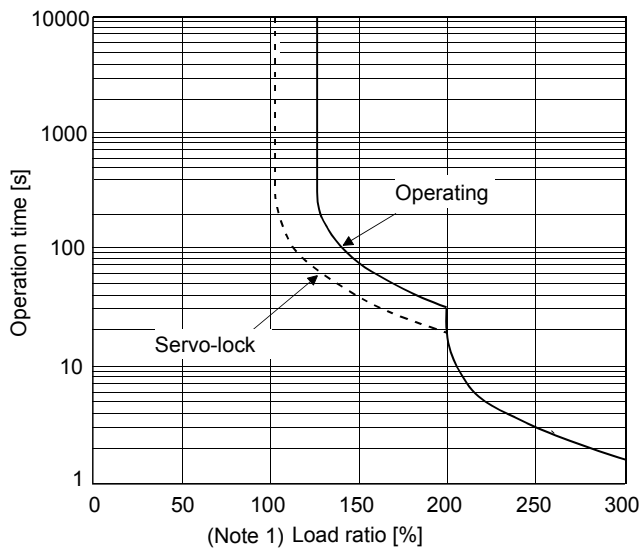


Characteristics c



Characteristics d

10. CHARACTERISTICS



Characteristics e

- Note 1. 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.
2. The load ratio ranging from 300% to 350% applies to the HG-KR servo motor.
 3. The operation time at the load ratio of 300% to 400% applies when the maximum torque of HG-JR servo motor is increased to 400% of rated torque.

Fig. 10.1 Electronic thermal protection characteristics

10. 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	At rated output [Generated heat in the cabinet when cooled outside the cabinet] (Note 3)	With servo-off	
MR-J4-10A(-RJ)	HG-MR053	0.3	25		15	0.5
	HG-MR13	0.3	25		15	0.5
	HG-KR053	0.3	25		15	0.5
	HG-KR13	0.3	25		15	0.5
MR-J4-20A(-RJ)	HG-MR23	0.5	25		15	0.5
	HG-KR23	0.5	25		15	0.5
MR-J4-40A(-RJ)	HG-MR43	0.9	35		15	0.7
	HG-KR43	0.9	35		15	0.7
MR-J4-60A(-RJ)	HG-SR52	1.0	40		15	0.8
	HG-SR51	1.0	40		15	0.8
	HG-JR53	1.0	40		15	0.8
MR-J4-70A(-RJ)	HG-MR73	1.3	50		15	1.0
	HG-KR73	1.3	50		15	1.0
	HG-UR72	1.3	50		15	1.0
	HG-JR73	1.3	50		15	1.0
MR-J4-100A(-RJ)	HG-SR102	1.7	50		15	1.0
	HG-SR81	1.5	50		15	1.0
	HG-JR734	1.3	50		15	1.0
	HG-JR103	1.7	50		15	1.0
MR-J4-200A(-RJ)	HG-SR152	2.5	90		20	1.8
	HG-SR202	3.5	90	20	1.8	
	HG-SR121	2.1	90	20	1.8	
	HG-SR201	3.5	90	20	1.8	
	HG-RR103	1.7	50	15	1.0	
	HG-RR153	2.5	90	20	1.8	
	HG-UR152	2.5	90	20	1.8	
	HG-JR153	2.5	90	20	1.8	
MR-J4-350A(-RJ)	HG-SR203	3.5	90	20	1.8	
	HG-SR352	5.5	130	20	2.6	
	HG-SR301	4.8	120	20	2.4	
	HG-UR202	3.5	90	20	1.8	
	HG-JR353	5.5	160	20	2.7	
MR-J4-500A(-RJ)	HG-SR502	7.5	195	25	3.9	
	HG-SR421	6.3	160	25	3.2	
	HG-RR353	5.5	135	25	2.7	
	HG-RR503	7.5	195	25	3.9	
	HG-UR352	5.5	195	25	3.9	
	HG-UR502	7.5	195	25	3.9	
MR-J4-700A(-RJ)	HG-JR503	7.5	195	25	3.9	
	HG-SR702	10	300	25	6.0	
	HG-JR703	10	300	25	6.0	

10. CHARACTERISTICS

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	At rated output [Generated heat in the cabinet when cooled outside the cabinet] (Note 3)	With servo-off	
MR-J4-11KB(-RJ)	HG-JR903	13	435	130	45	8.7
	HG-JR11K1M	16	530	160	45	11.0
MR-J4-15KB(-RJ)	HG-JR15K1M	22	640	195	45	13.0
MR-J4-22KB(-RJ)	HG-JR22K1M	33	850	260	55	17.0

- 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 or power factor improving DC reactor are 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.
3. This value is applicable when the servo amplifier is cooled by using the heat sink outside mounting attachment.

(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. (With an approximately 5 °C safety margin, the system should operate within a maximum 55 °C limit.) The necessary cabinet heat dissipation area can be calculated by equation 10.1.

$$A = \frac{P}{K \cdot \Delta T} \dots\dots\dots (10.1)$$

- A : Heat dissipation area [m²]
- 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.

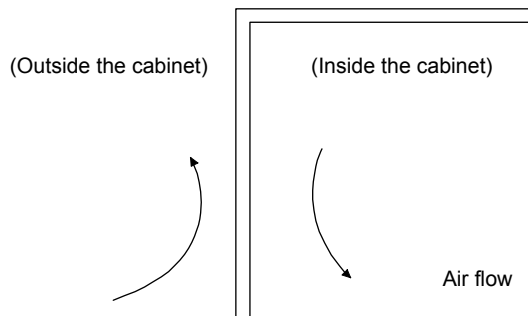


Fig. 10.2 Temperature distribution in an enclosed type cabinet

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. CHARACTERISTICS

10.3 Dynamic brake characteristics

POINT
<ul style="list-style-type: none"> ● 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. ● Servo motors for MR-J4 may have the different coasting distance from that of the previous model. ● The electronic dynamic brake operates in the initial state for the HG series servo motors of 600 W or smaller capacity. The time constant "τ" for the electronic dynamic brake will be shorter than that of normal dynamic brake. Therefore, coasting distance will be longer than that of normal dynamic brake. For how to set the electronic dynamic brake, refer to [Pr. PF06] and [Pr. PF12].

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)(a), (b) 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.

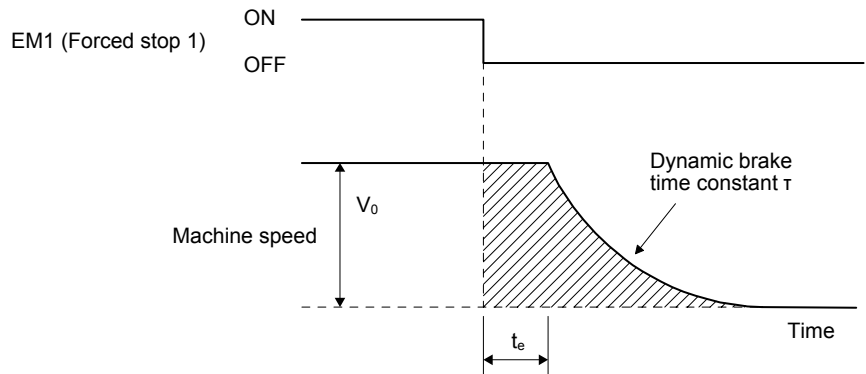


Fig. 10.3 Dynamic brake operation diagram

$$L_{\max} = \frac{V_0}{60} \cdot \left\{ t_e + \tau \left(1 + \frac{J_L}{J_M} \right) \right\} \dots \dots \dots (10.2)$$

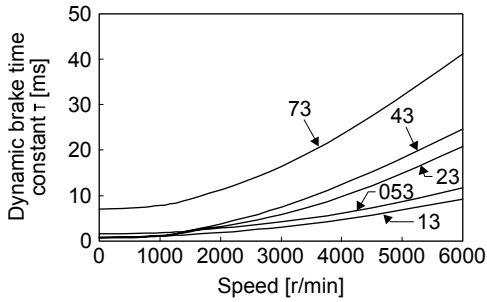
- L_{\max} : Maximum coasting distance [mm]
- V_0 : Machine's fast feed speed [mm/min]
- J_M : Moment of inertia of the servo motor [$\times 10^{-4}$ kg·m²]
- J_L : Load moment of inertia converted into equivalent value on servo motor shaft [$\times 10^{-4}$ kg·m²]
- τ : Dynamic brake time constant [s]
- t_e : Delay time of control section [s]

For 7 kW or lower servo, there is internal relay delay time of about 10 ms. For 11 kW to 22 kW servo, there is delay caused by magnetic contactor built into the external dynamic brake (about 50 ms) and delay caused by the external relay.

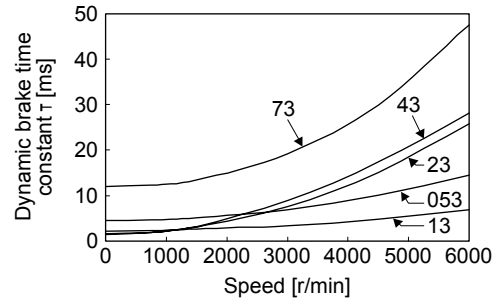
10. CHARACTERISTICS

(2) Dynamic brake time constant

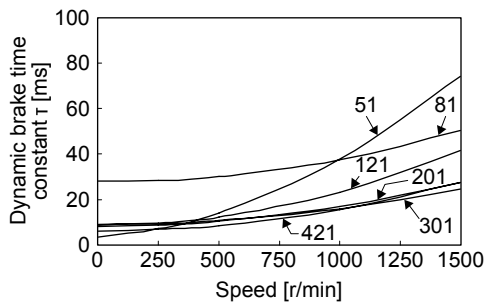
The following shows necessary dynamic brake time constant τ for equation 10.2.



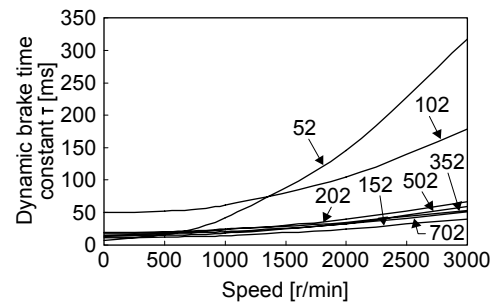
HG-MR series



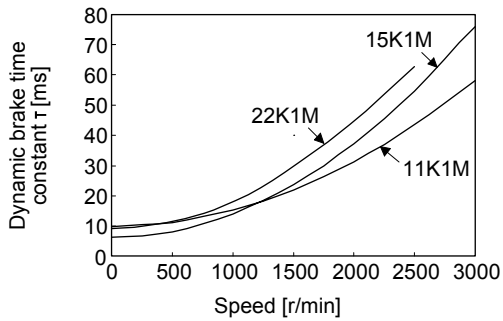
HG-KR series



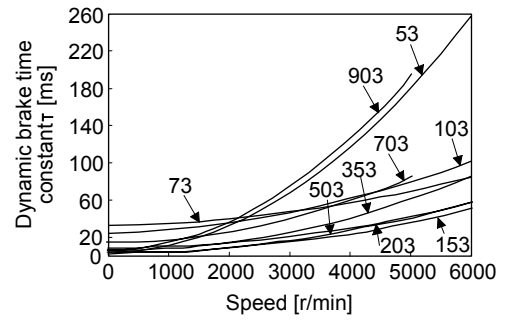
HG-SR 1000 r/min series



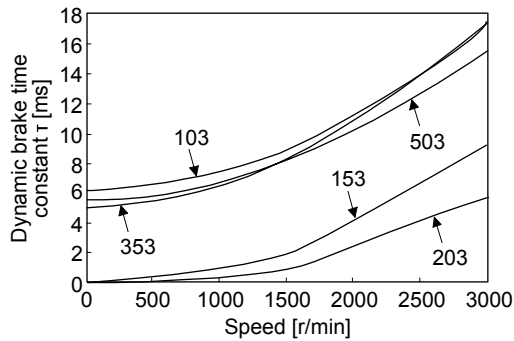
HG-SR 2000 r/min series



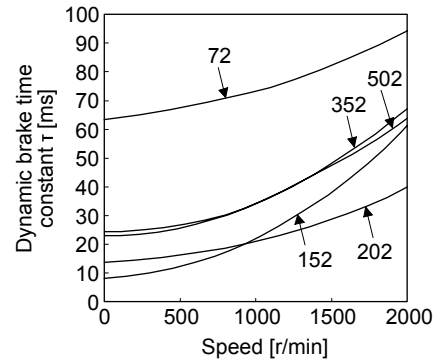
HG-JR1500 r/min series



HG-JR3000 r/min series



HG-RR series



HG-UR series

10. CHARACTERISTICS

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 load inertia moment is higher than this value, the dynamic brake may burn. If the load to motor inertia ratio exceeds the indicated 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.

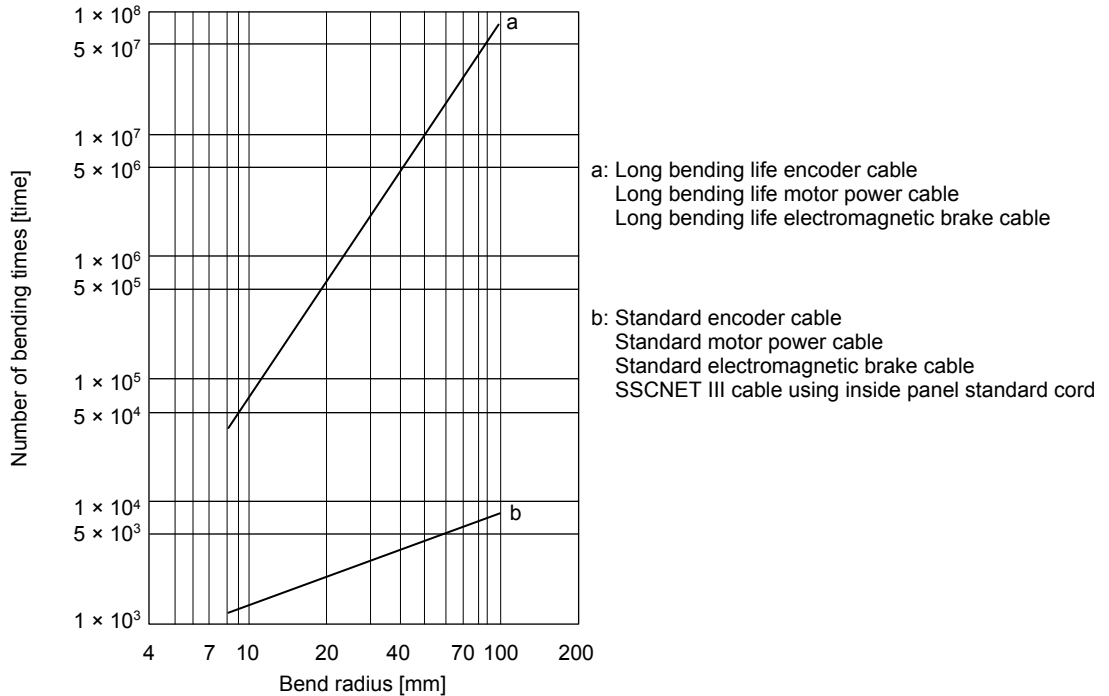
Servo motor	Permissible load to motor inertia ratio [multiplier]	Servo motor	Permissible load to motor inertia ratio [multiplier]
HG-KR053	30	HG-UR72	30
HG-KR13		HG-UR152	
HG-KR23		16	
HG-KR43			
HG-KR73		15	
HG-MR053	35	HG-RR103	30
HG-MR13	32	HG-RR153	
HG-MR23		16	
HG-MR43		15	
HG-MR73			
HG-SR51	30	HG-JR53	30
HG-SR81		HG-JR73	
HG-SR121		HG-JR103	
HG-SR201		HG-JR203	
HG-SR301		16	HG-JR353	16 (Note 2)
HG-SR421	15	HG-JR503	15 (Note 2)
HG-SR52	30	HG-JR703	11 (Note 2)
HG-SR102		HG-JR903	18 (Note 2)
HG-SR152	21	HG-JR11K1M	10 (Note 2)
HG-SR202		HG-JR15K1M	
HG-SR352	13 (Note 1)	HG-JR25K1M	20 (Note 2)
HG-SR502			
HG-SR702		5 (Note 1)	

- Note 1. The permissible load to motor inertia ratio is 15 at the rated rotation speed.
 Note 2. The permissible load to motor inertia ratio is 30 at the rated rotation speed.

10. CHARACTERISTICS

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 currents at power-on of main circuit and control circuit

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. When you use a 1-phase 200 V AC power supply with MR-J4-10A(-RJ) to MR-J4-70A(-RJ), the inrush currents of the main circuit power supply are the same.


Servo amplifier	Inrush currents (A_{0-P})	
	Main circuit power supply (L1, L2 and L3)	Control circuit power supply (L11 and L21)
MR-J4-10A(-RJ), MR-J4-20A(-RJ), MR-J4-40A(-RJ), MR-J4-60A(-RJ)	30 A (attenuated to approx. 3 A in 20 ms)	20 A to 30 A (attenuated to approx. 1 A in 20 ms)
MR-J4-70A(-RJ), MR-J4-100A(-RJ)	34 A (attenuated to approx. 7 A in 20 ms)	
MR-J4-200A(-RJ), MR-J4-350A(-RJ)	113 A (attenuated to approx. 12 A in 20 ms)	
MR-J4-500A(-RJ)	42 A (attenuated to approx. 20 A in 20 ms)	34 A (attenuated to approx. 2 A in 20 ms)
MR-J4-700A(-RJ)	85 A (attenuated to approx. 20 A in 30 ms)	
MR-J4-11KA(-RJ)	226 A (attenuated to approx. 30 A in 30 ms)	42 A (attenuated to approx. 2 A in 30 ms)
MR-J4-15KA(-RJ)	226 A (attenuated to approx. 50 A in 30 ms)	
MR-J4-22KA(-RJ)	226 A (attenuated to approx. 70 A in 30 ms)	


Since large inrush currents flow in the power supplies, always use molded-case circuit breakers and magnetic contactors. (Refer to section 11.10.)

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 AUXILIARY EQUIPMENT

11. OPTIONS AND AUXILIARY EQUIPMENT

	WARNING	● Before connecting any option or peripheral equipment, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. 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.
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	CAUTION	● Use the specified auxiliary equipment and options to prevent a malfunction or a fire.
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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.
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11.1 Cable/connector sets

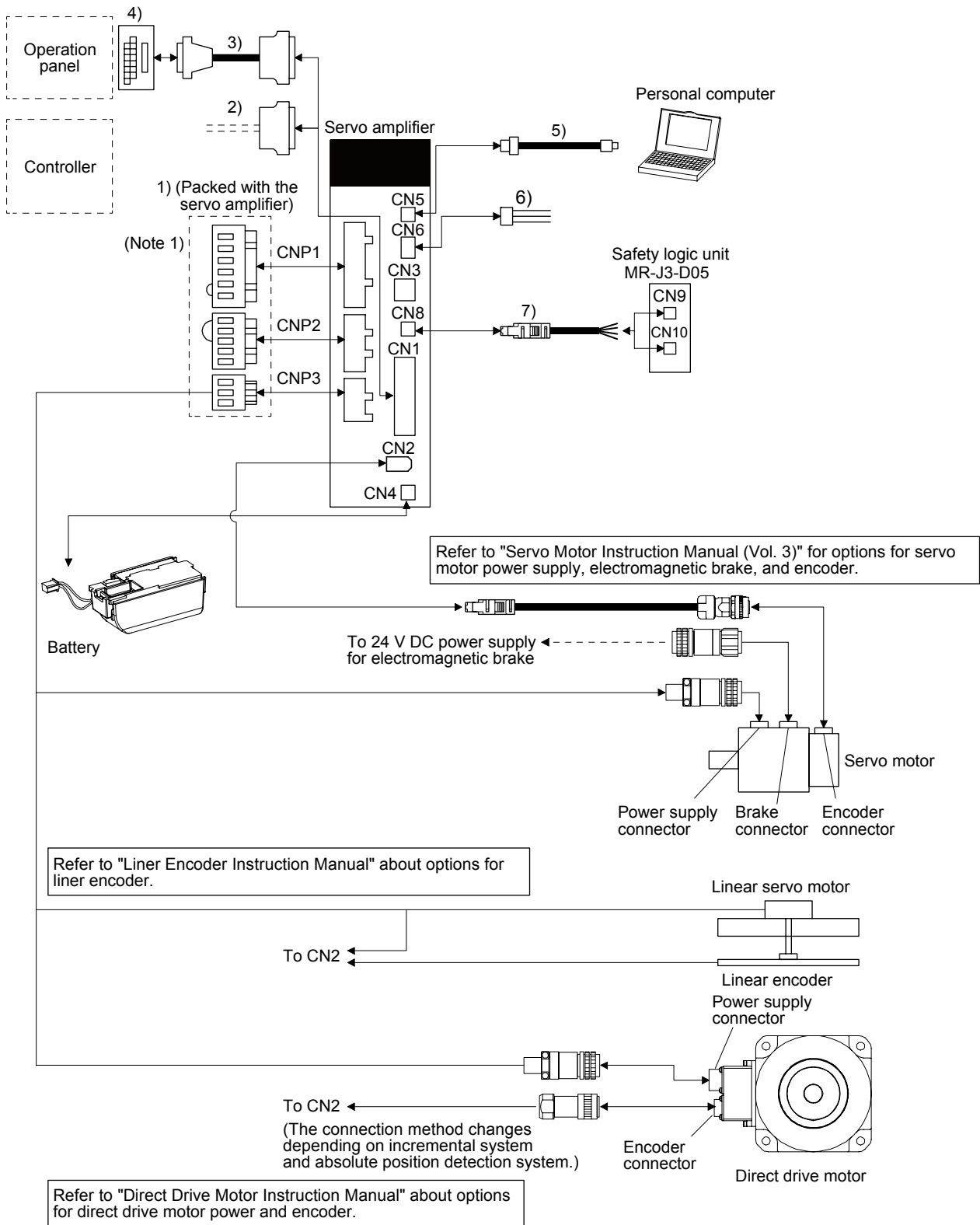
POINT	● The IP rating indicated for cables and connectors is their protection against ingress of dust and raindrops when they are connected to a servo amplifier or servo motor. If the IP rating of the cable, connector, servo amplifier and servo motor vary, the overall IP rating depends on the lowest IP rating of all components.
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Purchase the cable and connector options indicated in this section.

11. OPTIONS AND AUXILIARY EQUIPMENT

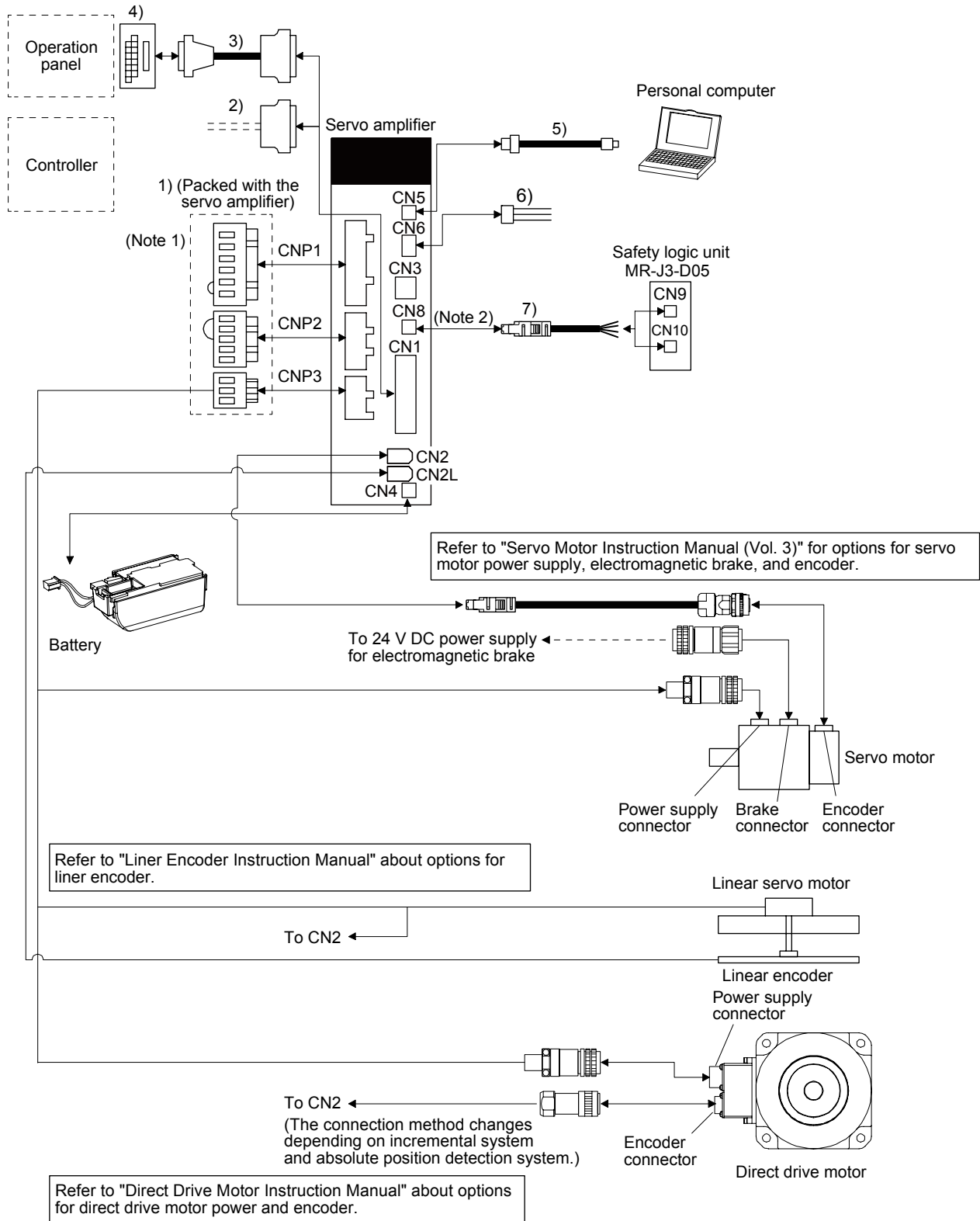
11.1.1 Combinations of cable/connector sets

For MR-J4-_A servo amplifier



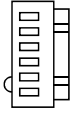

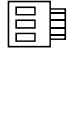
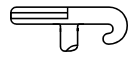
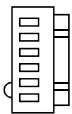

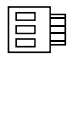




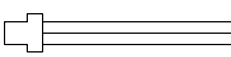


11. OPTIONS AND AUXILIARY EQUIPMENT

For MR-J4_A-RJ servo amplifier



- Note 1. Connectors for 3.5 kW or less. For 5 kW or more, it is a terminal block.
 Note 2. When not using the STO function, attach a short-circuit connector (8) supplied with a servo amplifier.

11. OPTIONS AND AUXILIARY EQUIPMENT

No.	Name	Model	Description	Application
1)	Servo amplifier power connector set		   CNP1 Connector: 06JFAT-SAXGDK-H7.5 (JST) CNP2 Connector: 05JFAT-SAXGDK-H5.0 (JST) CNP3 Connector: 03JFAT-SAXGDK-H7.5 (JST) Applicable wire size: 0.8 mm ² to 2.1 mm ² (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.
			   CNP1 Connector: 06JFAT-SAXGFK-XL (JST) CNP2 Connector: 05JFAT-SAXGDK-H5.0 (JST) CNP3 Connector: 03JFAT-SAXGFK-XL (JST) Applicable wire size: 1.25 mm ² to 5.5 mm ² (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 3.5 kW.
2)	Junction terminal block cable	MR-J2M-CN1TBL_M Cable length: 0.5 m, 1 m (Refer to section 11.6.)	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 11.6.	
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
6)	Monitor cable	MR-J3CN6CBL1M Cable length: 1 m	 3 (Red) 2 (White) 1 (Black) CN6 connector Housing: 51004-0300 Terminal: 50011-8100 (Molex)	
7)	STO cable	MR-D05UDL3M-B	Connector set: 2069250-1 (TE Connectivity) 	Connection cable for the CN8 connector
8)	Short-circuit connector			Supplied with servo amplifier

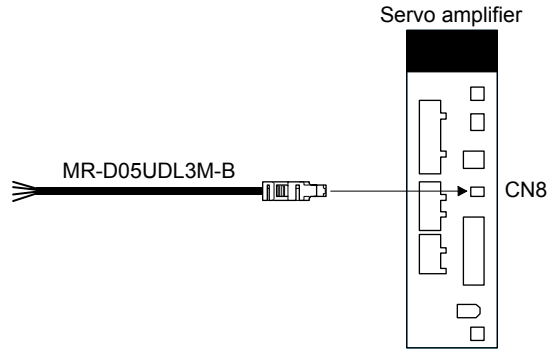
11. OPTIONS AND AUXILIARY EQUIPMENT

11.1.2 MR-D05UDL3M-B STO cable

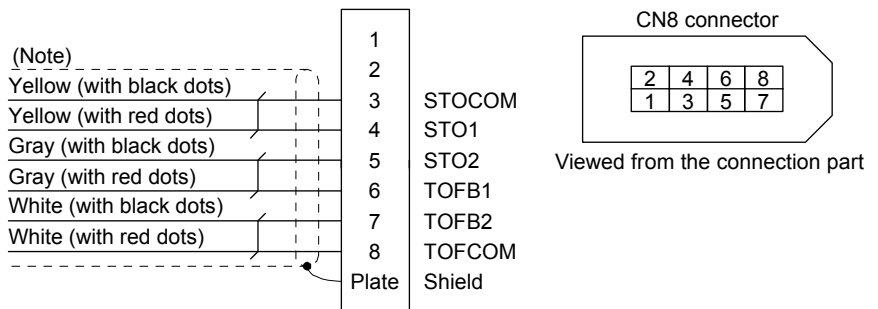
This cable is for connecting an external device to the CN8 connector.

Cable model	Cable length	Application
MR-D05UDL3M-B	3 m	Connection cable for the CN8 connector

(1) Configuration diagram




(2) Internal wiring diagram



Note. Do not use the two core wires with orange sheath (with red or black dots).

11. OPTIONS AND AUXILIARY EQUIPMENT

11.2 Regenerative options

 CAUTION	<p>● Do not use servo amplifiers with regenerative options other than the combinations specified below. Otherwise, it may cause a fire.</p>
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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-RB3N [9 Ω]	MR-RB31 [6.7 Ω]	MR-RB32 [40 Ω]	(Note 1) MR-RB50 [13 Ω]	(Note 1) MR-RB5N [9 Ω]	(Note 1) MR-RB51 [6.7 Ω]
MR-J4-10A (-RJ)		30								
MR-J4-20A (-RJ)	10	30	100							
MR-J4-40A (-RJ)	10	30	100							
MR-J4-60A (-RJ)	10	30	100							
MR-J4-70A (-RJ)	20	30	100				300			
MR-J4-100A (-RJ)	20	30	100				300			
MR-J4-200A (-RJ)	100			300				500		
MR-J4-350A (-RJ)	100				300				500	
MR-J4-500A (-RJ)	130					300				500
MR-J4-700A (-RJ)	170					300				500

Servo amplifier	(Note 2) Regenerative power [W]			
	External regenerative resistor (accessory)	MR-RB5R [3.2 Ω]	MR-RB9F [3 Ω]	MR-RB9T [2.5 Ω]
MR-J4-11KA (-RJ)	500 (800)	500 (800)		
MR-J4-15KA (-RJ)	850 (1300)		850 (1300)	
MR-J4-22KA (-RJ)	850 (1300)			850 (1300)

- Note 1. Always install a cooling fan.
 2. Values in parentheses assume the installation of a cooling fan.

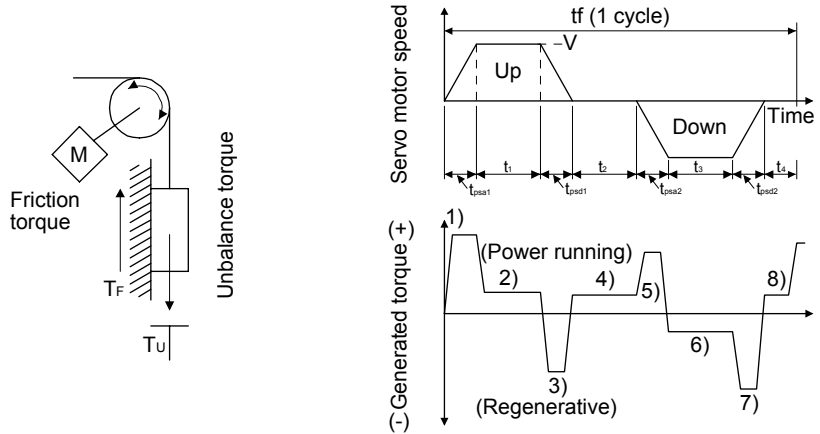
11. OPTIONS AND AUXILIARY EQUIPMENT

11.2.2 Selection of regenerative option

(1) Rotary servo motor and direct drive motor

Use the following method when regeneration occurs continuously in vertical motion applications or when it is desired to make an in-depth selection of the regenerative option.

(a) 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)	$T_4, T_8 = T_U$	$E_4, E_8 = 0$ (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.

11. OPTIONS AND AUXILIARY EQUIPMENT

(b) 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]	Servo amplifier	Inverse efficiency [%]	Capacitor charging [J]
MR-J4-10A(-RJ)	55	9	MR-J4-350A(-RJ)	85	40
MR-J4-20A(-RJ)	75	9	MR-J4-500A(-RJ)	90	45
MR-J4-40A(-RJ)	85	11	MR-J4-700A(-RJ)	90	70
MR-J4-60A(-RJ)	85	11	MR-J4-11KA(-RJ)	90	120
MR-J4-70A(-RJ)	85	18	MR-J4-15KA(-RJ)	90	170
MR-J4-100A(-RJ)	85	18	MR-J4-22KA(-RJ)	90	250
MR-J4-200A(-RJ)	85	36			

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 (E_c): 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.

$$ER[J] = \eta \cdot E_s - E_c$$

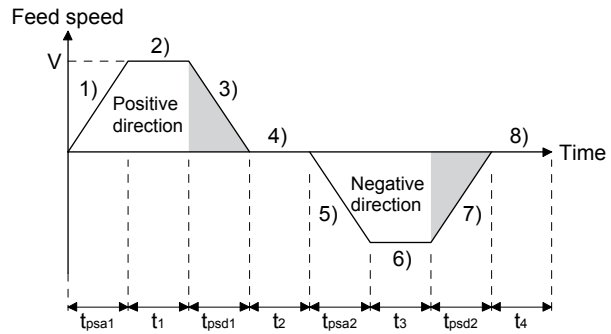
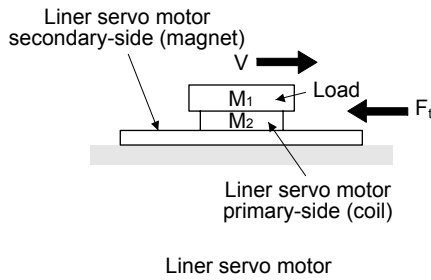
Calculate the power consumption of the regenerative option on the basis of single-cycle operation period t_f [s] to select the necessary regenerative option.

$$PR[W] = ER/t_f$$

11. OPTIONS AND AUXILIARY EQUIPMENT

(2) Linear servo motor

(a) Thrust and energy calculation



The following shows equations of the linear servo motor thrust and energy at the driving pattern above.

Section	Thrust F of linear servo motor [N]	Energy E [J]
1)	$F_1 = (M_1 + M_2) \cdot V/t_{psa1} + F_t$	$E_1 = V/2 \cdot F_1 \cdot t_{psa1}$
2)	$F_2 = F_1$	$E_2 = V \cdot F_2 \cdot t_1$
3)	$F_3 = -(M_1 + M_2) \cdot V/t_{psd1} + F_t$	$E_3 = V/2 \cdot F_3 \cdot t_{psd1}$
4), 8)	$F_4, F_8 = 0$	$E_4, E_8 = 0$ (No regeneration)
5)	$F_5 = (M_1 + M_2) \cdot V/t_{psa2} + F_t$	$E_5 = V/2 \cdot F_5 \cdot t_{psa2}$
6)	$F_6 = F_t$	$E_6 = V \cdot F_6 \cdot t_3$
7)	$F_7 = -(M_1 + M_2) \cdot V/t_{psd2} + F_t$	$E_7 = V/2 \cdot F_7 \cdot t_{psd2}$

From the calculation results in 1) to 8), find the absolute value (E_s) of the sum total of negative energies.

(b) Losses of servo motor and servo amplifier in regenerative mode

For inverse efficiency and capacitor charging energy, refer to (1) (b) of this section.

(c) Regenerative energy calculation

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 resistor.

$$ER [J] = \eta \cdot E_s - E_c$$

From the total of ER's whose subtraction results are positive and one-cycle period, the power consumption PR [W] of the regenerative option can be calculated with the following equation.

$$PR [W] = \text{total of positive ER's} / \text{one-cycle operation period (tf)}$$

Select a regenerative option from the PR value. Regenerative option is not required when the energy consumption is equal to or less than the built-in regenerative energy.

11. OPTIONS AND AUXILIARY EQUIPMENT

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 100 W, regenerative resistor is not used.
- For servo amplifier of 0.2 kW to 7 kW, built-in regenerative resistor is used.
- Supplied regenerative resistors or regenerative option is used with the servo amplifier of 11 kW to 22 kW.

01: FR-BU2/FR-RC/FR-CV

02: MR-RB032

03: MR-RB12

04: MR-RB32

05: MR-RB30

06: MR-RB50 (Cooling fan is required)

08: MR-RB31

09: MR-RB51 (Cooling fan is required)

0B: MR-RB3N

0C: MR-RB5N (Cooling fan is required)

FA: Indicates a servo amplifier of 11 kW to 22 kW that does not use a regenerative resistor as standard accessory.

11.2.4 Connection of regenerative option

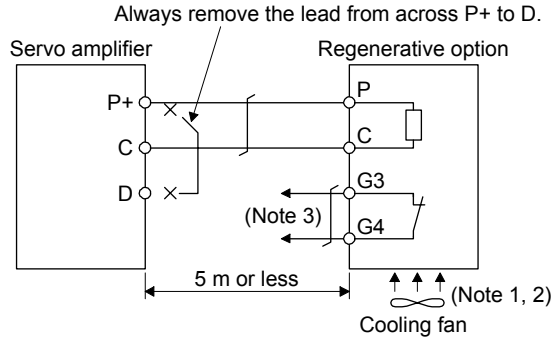
POINT
●When the MR-RB50, MR-RB51, or MR-RB5N is used, a cooling fan is required to cool it. The cooling fan should be prepared by the customer.
●For the sizes of wires used for wiring, refer to section 11.9.

The regenerative option generates heat of 100 °C higher than the ambient temperature. Fully consider heat dissipation, installation position, used wires, etc. to place 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.

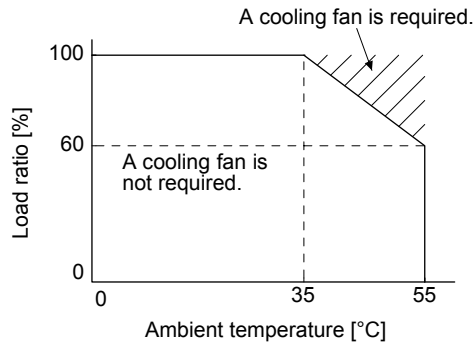
11. OPTIONS AND AUXILIARY EQUIPMENT

(1) MR-J4-500A(-RJ) or less

Always remove the wiring from across P+ to D and fit the regenerative option across P+ to C. G3 and G4 are thermal sensor's terminals. Between G3 and G4 is opened when the regenerative option overheats abnormally.



- Note 1. When using the MR-RB50, MR-RB5N, or MR-RB51, forcibly cool it with a cooling fan (92 mm × 92 mm, minimum air flow: 1.0 m³).
2. When the ambient temperature is more than 55 °C and the regenerative load ratio is more than 60% in MR-RB30, MR-RB-31, MR-RB32 and MR-RB3N, forcibly cool the air with a cooling fan (1.0 m³/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.

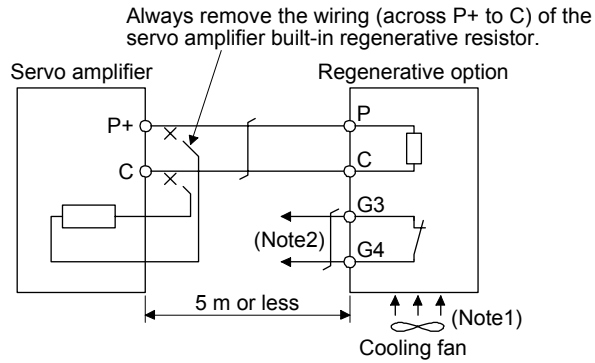
G3-G4 contact specifications

- Maximum voltage: 120 V AC/DC
- Maximum current: 0.5 A/4.8 V DC
- Maximum capacity: 2.4 VA

11. OPTIONS AND AUXILIARY EQUIPMENT

(2) MR-J4-700A(-RJ)

Always remove the wiring (across P+ to C) of the servo amplifier built-in regenerative resistor and fit the regenerative option across P+ to C. G3 and G4 are thermal sensor's terminals. Between G3 and G4 is opened when the regenerative option overheats abnormally.



- Note 1. When using the MR-RB51, forcibly cool it with a cooling fan (92 mm × 92 mm, minimum air flow: 1.0 m³).
- Note 2. Make up a sequence which will switch off the magnetic contactor when abnormal heating occurs.

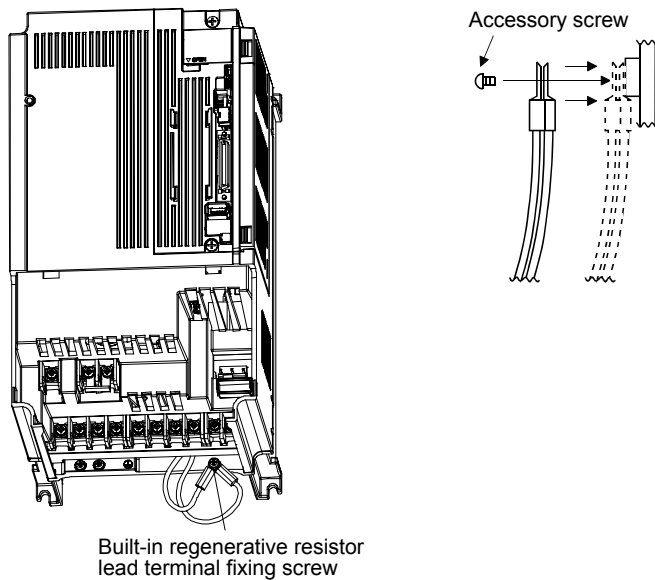
G3-G4 contact specifications

Maximum voltage: 120 V AC/DC

Maximum current: 0.5 A/4.8 V DC

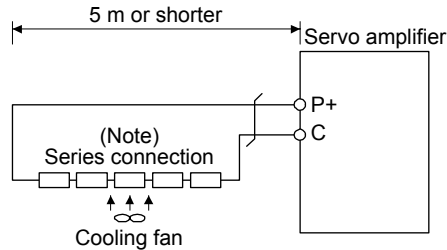
Maximum capacity: 2.4 VA

When using the regenerative option, remove the servo amplifier's built-in regenerative resistor wires (across P+ to C), fit them back to back, and secure them to the frame with the accessory screw as shown below.



11. OPTIONS AND AUXILIARY EQUIPMENT

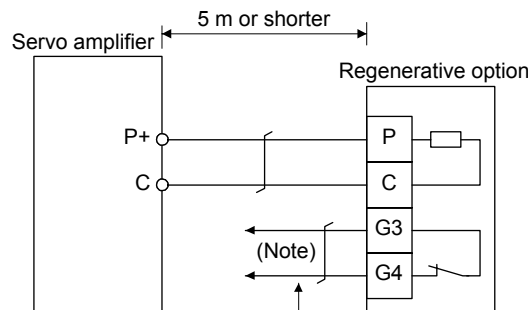
- (3) MR-J4-11KA(-RJ)/MR-J4-15KA(-RJ)/MR-J4-22KA(-RJ) (when using the supplied regenerative resistor)
 When using the regenerative resistors supplied to the servo amplifier, the specified number of resistors (4 or 5 resistors) must be connected in series. If they are connected in parallel or in less than the specified number, the servo amplifier may become faulty and/or the regenerative resistors burn. Install the resistors at intervals of about 70 mm. Cooling the resistors with two cooling fans (1.0 m³/min or more, 92 mm × 92 mm) improves the regeneration capability. In this case, set " __ F A" in [Pr. PA02].



Note. The number of resistors connected in series depends on the resistor type. The thermal sensor is not mounted on the attached regenerative resistor. An abnormal heating of resistor may be generated at a regenerative circuit failure. Install a thermal sensor near the resistor and establish a protective circuit to shut off the main circuit power supply when abnormal heating occurs. The detection level of the thermal sensor varies according to the settings of the resistor. Set the thermal sensor in the most appropriate position on your design basis, or use the thermal sensor built-in regenerative option. (MR-RB5R or 9F)

Servo amplifier	Regenerative resistor	Regenerative power [W]		Resultant resistance [Ω]	Number of resistors
		Normal	Cooling		
MR-J4-11KA(-RJ)	GRZG400-0.8Ω	500	800	3.2	4
MR-J4-15KA(-RJ)	GRZG400-0.6Ω	850	1300	3	5
MR-J4-22KA(-RJ)	GRZG400-0.5Ω			2.5	

- (4) MR-J4-11KA-PX to MR-J4-22KA-PX, and MR-J4-11KA-RZ to MR-J4-22KA-RZ (when using the regenerative option)
 The MR-J4-11KA-PX to MR-J4-22KA-PX and MR-J4-11KA-RZ to MR-J4-22KA-RZ servo amplifiers are not supplied with regenerative resistors. When using any of these servo amplifiers, always use the MR-RB5R, 9F, or 9T regenerative option.
 Cooling the regenerative option with cooling fans improves regenerative capability. G3 and G4 are thermal sensor's terminals. Between G3 and G4 is opened when the regenerative option overheats abnormally.



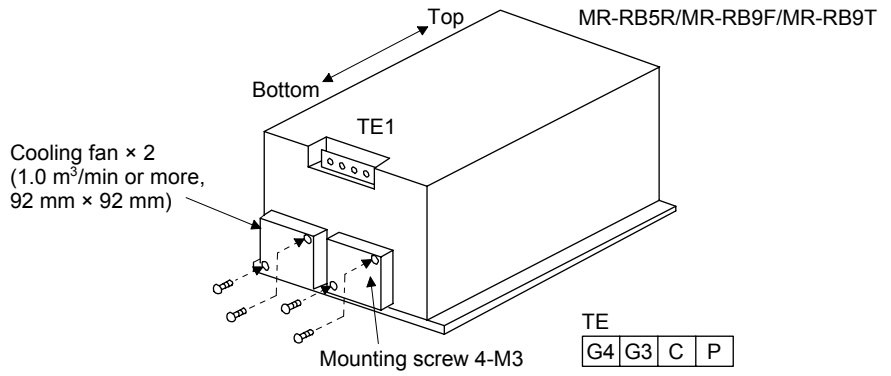
Configure up a circuit which shuts off main circuit power when thermal protector operates.

Note. 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. OPTIONS AND AUXILIARY EQUIPMENT

Servo amplifier	Regenerative option	Resistance [Ω]	Regenerative power [W]	
			Without cooling fans	With cooling fans
MR-J4-11KA-PX MR-J4-11KA-RZ	MR-RB5R	3.2	500	800
MR-J4-15KA-PX MR-J4-15KA-RZ	MR-RB9F	3	850	1300
MR-J4-22KA-PX MR-J4-22KA-RZ	MR-RB9T	2.5	850	1300

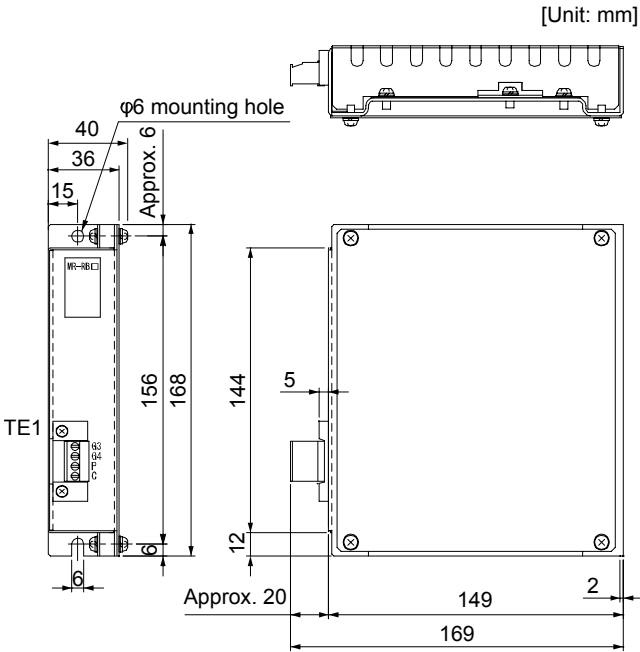
When using cooling fans, install them using the mounting holes provided in the bottom of the regenerative option.



11. OPTIONS AND AUXILIARY EQUIPMENT

11.2.5 Dimensions

(1) MR-RB12



TE1 terminal block

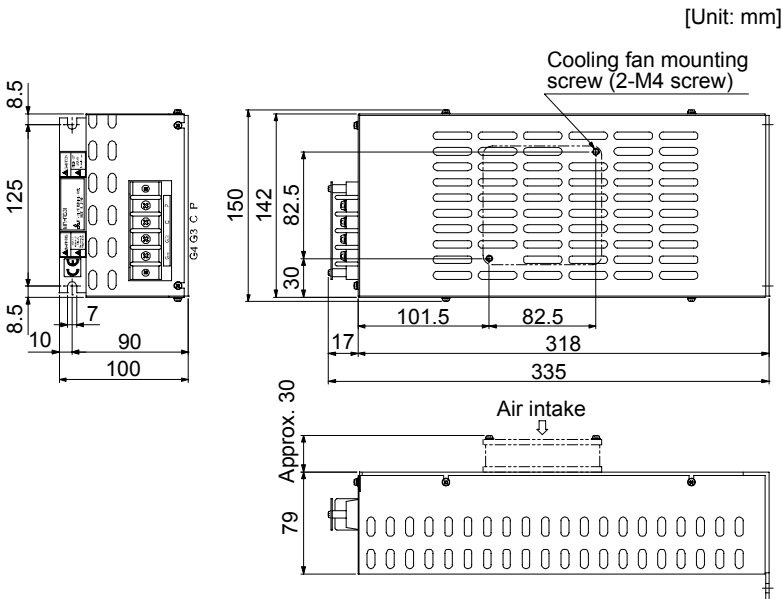
G3
G4
P
C

Applicable wire size: 0.2 mm² to 2.5 mm² (AWG 14 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-RB31/MR-RB32/MR-RB3N



Terminal block

P
C
G3
G4

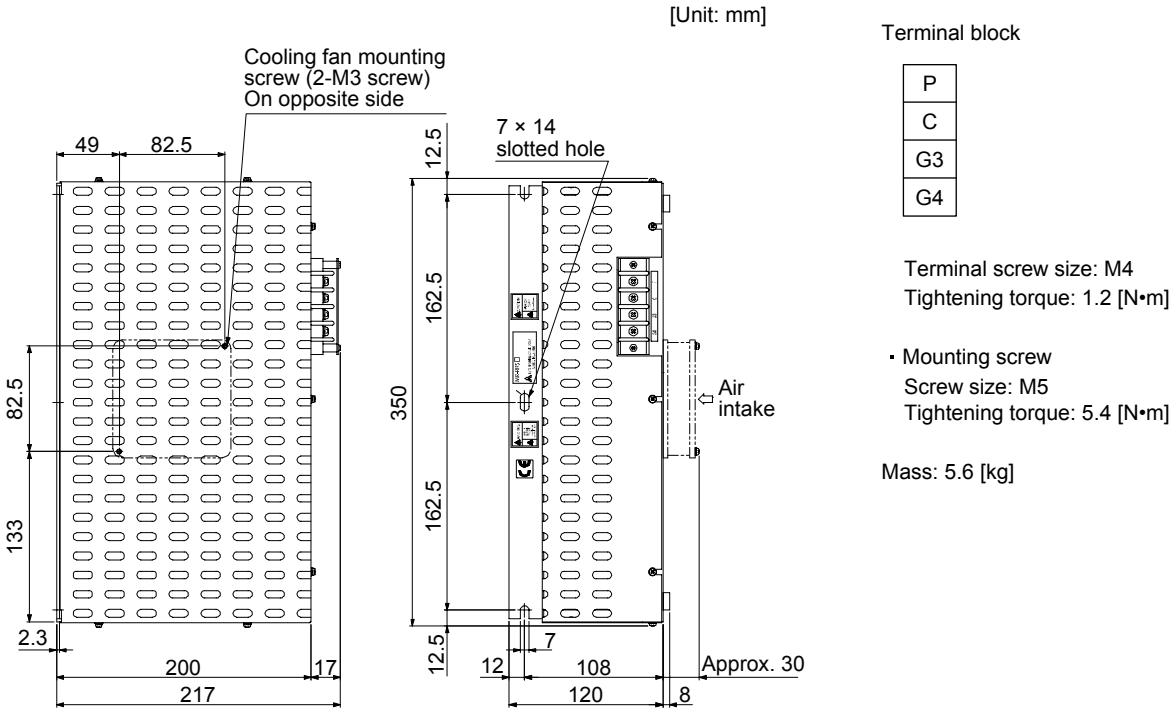
Terminal screw size: M4
Tightening torque: 1.2 [N•m]

- Mounting screw
Screw size: M5
Tightening torque: 5.4 [N•m]

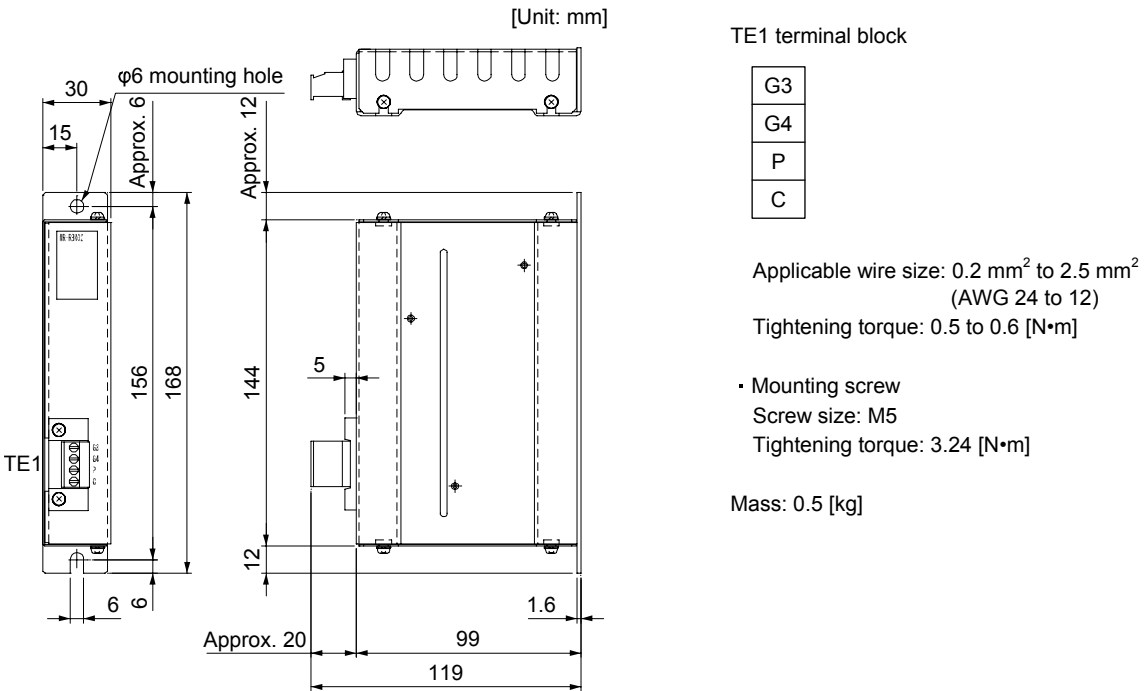
Mass: 2.9 [kg]

11. OPTIONS AND AUXILIARY EQUIPMENT

(3) MR-RB50/MR-RB51/MR-RB5N



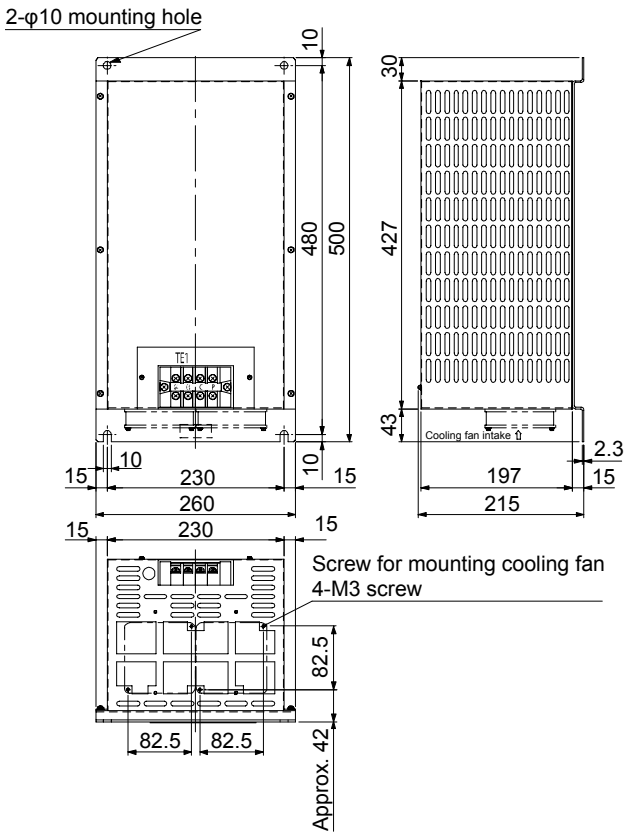
(4) MR-RB032



11. OPTIONS AND AUXILIARY EQUIPMENT

(5) MR-RB5R/MR-RB9F/MR-RB9T

[Unit: mm]



• Terminal block

G4	G3	C	P
----	----	---	---

Terminal screw size: M5
Tightening torque: 2.0 [N•m]

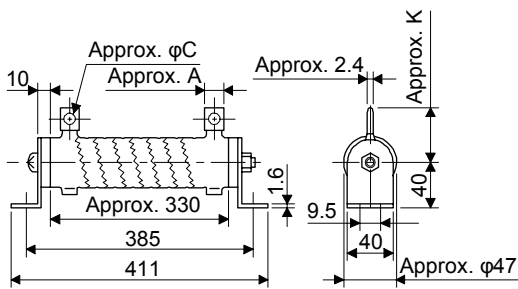
• Mounting screw

Screw size: M8
Tightening torque: 13.2 [N•m]

Regenerative option	Mass [kg]
MR-RB5R	10
MR-RB9F	11
MR-RB9T	

(6) GRZG400-0.8Ω/GRZG400-0.6Ω/GRZG400-0.5Ω (standard accessories)

[Unit: mm]



Regenerative resistor	Variable dimensions			Mounting screw size	Tightening torque [N•m]	Mass [kg]
	A	C	K			
GRZG400-0.8Ω	10	5.5	39	M8	13.2	0.8
GRZG400-0.6Ω	16	8.2	46			
GRZG400-0.5Ω						

11. OPTIONS AND AUXILIARY EQUIPMENT

11.3 FR-BU2 Brake unit

POINT
<ul style="list-style-type: none"> ● When a brake unit and a resistor unit are installed horizontally or diagonally, the heat dissipation effect diminishes. Install them on a flat surface vertically. ● Temperature of the resistor unit case rises to higher than +100 °C. Keep cables and flammable materials away from the case. ● Ambient temperature condition of the brake unit is between -10 °C to 50 °C. Note that the condition is different from the ambient temperature condition of the servo amplifier (between 0 °C and 55 °C). ● Configure the circuit to shut down the power-supply with the alarm output of the brake unit and the resistor unit under abnormal condition. ● Use the brake unit with a combination indicated in section 11.3.1. ● For executing a continuous regenerative operation, use FR-RC power regenerative converter or FR-CV power regenerative common converter. ● Brake unit and regenerative options (Regenerative resistor) cannot be used simultaneously.

Connect the brake unit to the bus of the servo amplifier. As compared to the MR-RB regenerative option, the brake unit can return larger power. Use the brake unit when the regenerative option cannot provide sufficient regenerative capability.

When using the brake unit, set [Pr. PA02] of the servo amplifier to "_ _ 0 1".

When using the brake unit, always refer to the FR-BU2-(H) Brake Unit Instruction Manual.

11.3.1 Selection

Use a combination of servo amplifier, brake unit and resistor unit listed below.

	Brake unit	Resistor unit	Number of connected units	Permissible continuous power [kW]	Resultant resistance [Ω]	Applicable servo amplifier (Note 2)
200 V class	FR-BU2-15K	FR-BR-15K	1	0.99	8	MR-J4-500A(-RJ) (Note 1)
			2 (parallel)	1.98	4	MR-J4-500A(-RJ) MR-J4-700A(-RJ) MR-J4-11KA(-RJ) MR-J4-15KA(-RJ)
	FR-BU2-30K	FR-BR-30K	1	1.99	4	MR-J4-500A(-RJ) MR-J4-700A(-RJ) MR-J4-11KA(-RJ) MR-J4-15KA(-RJ)
	FR-BU2-55K	FR-BR-55K	1	3.91	2	MR-J4-11KA(-RJ) MR-J4-15KA(-RJ) MR-J4-22KA(-RJ)
MT-BR5-55K		1	5.5	2	MR-J4-22KA(-RJ)	

Note 1. Only when using servo motor HG-RR353/HG-UR352

2. When the brake unit is selected by using the capacity selection software, a brake unit other than the combinations listed may be shown. Refer to the combinations displayed on the capacity selection software for detailed combinations.

11. OPTIONS AND AUXILIARY EQUIPMENT

11.3.2 Brake unit parameter setting

Whether a parameter can be changed or not is listed below.

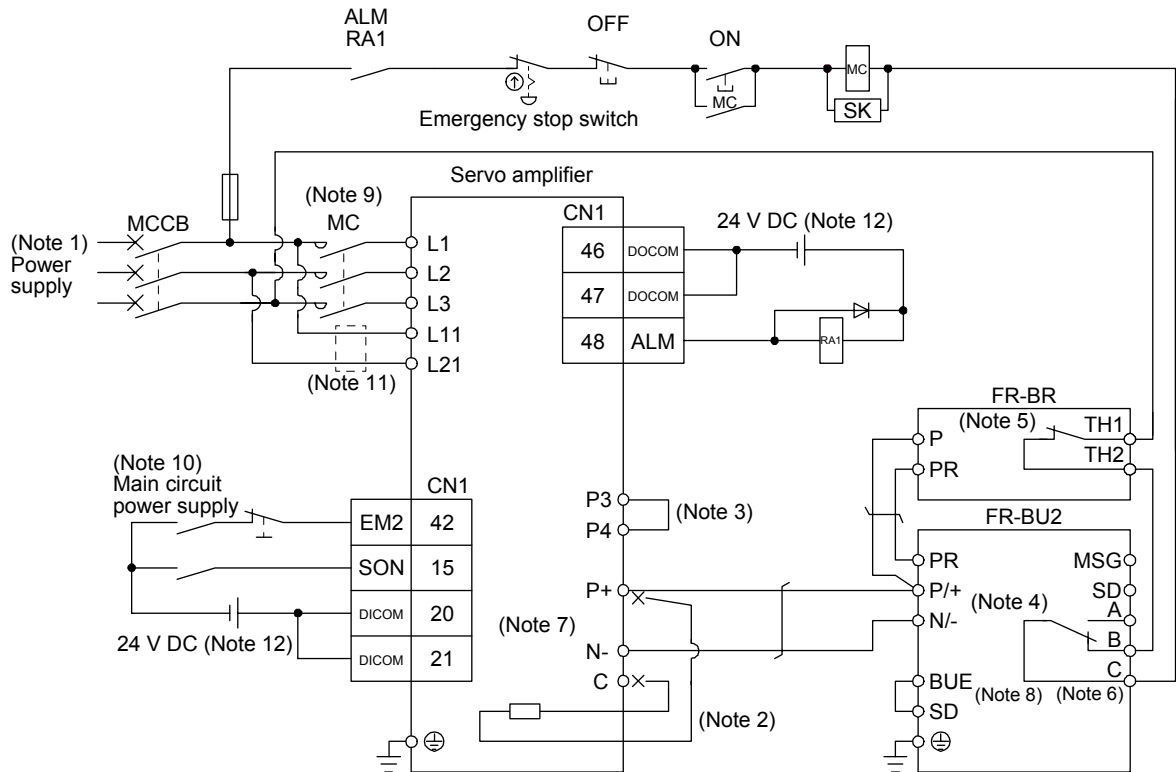
Parameter		Change possible/ impossible	Remarks
No.	Name		
0	Brake mode switchover	Impossible	Do not change the parameter
1	Monitor display data selection	Possible	Refer to the FR-BU2-(H) Brake Unit Instruction Manual.
2	Input terminal function selection 1	Impossible	Do not change the parameter
3	Input terminal function selection 2		
77	Parameter write selection		
78	Cumulative energization time carrying-over times		
CLr	Parameter clear		
ECL	Alarm history clear		
C1	For manufacturer setting		

11. OPTIONS AND AUXILIARY EQUIPMENT

11.3.3 Connection example

POINT
<ul style="list-style-type: none"> ● EM2 has the same function as EM1 in the torque control mode. ● Connecting PR terminal of the brake unit to P+ terminal of the servo amplifier results in brake unit malfunction. Always connect the PR terminal of the brake unit to the PR terminal of the resistor unit.

- (1) Combination with FR-BR resistor unit
 (a) When connecting a brake unit to a servo amplifier



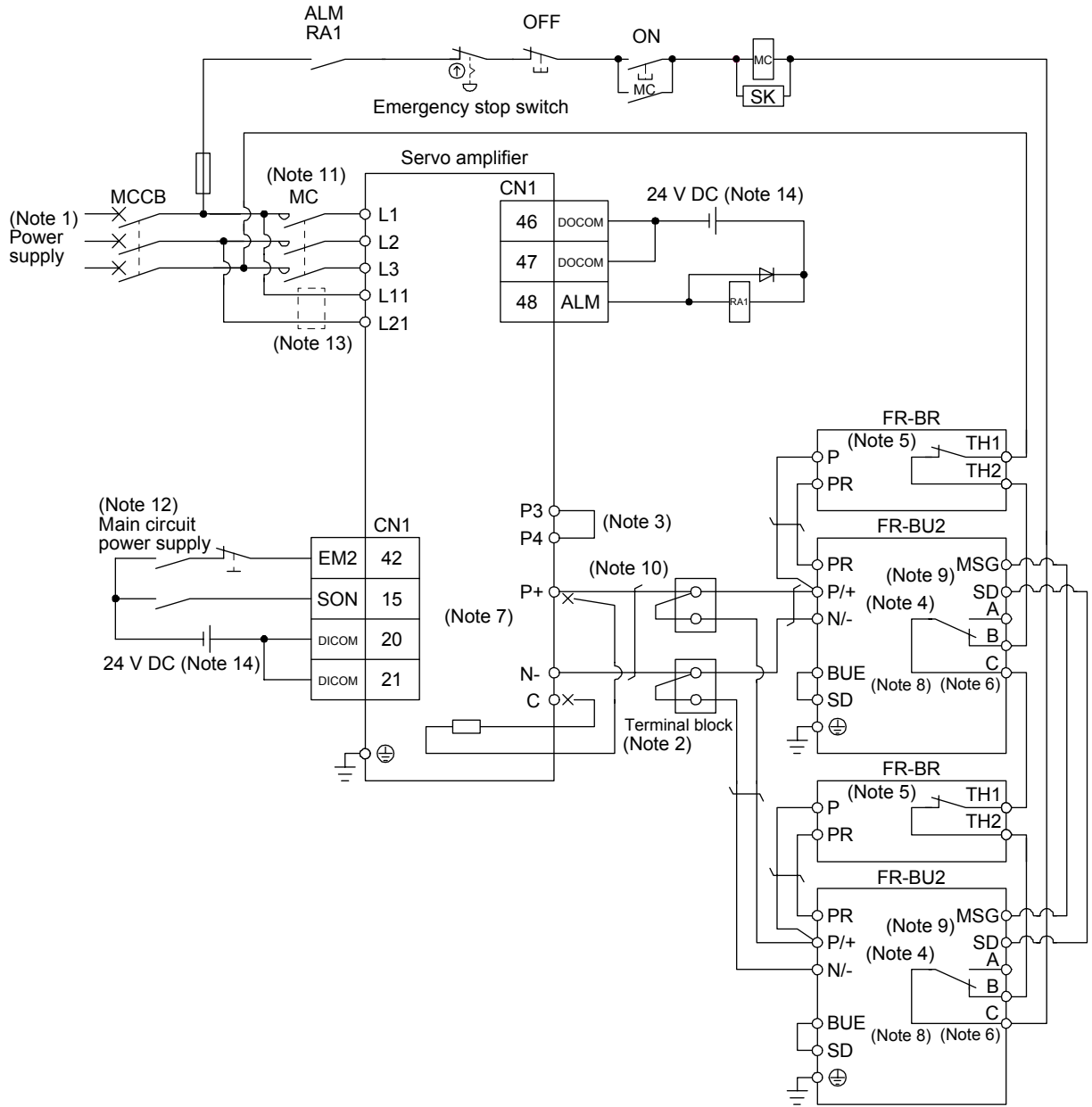
- Note 1. For power supply specifications, refer to section 1.3.
- Note 2. For the servo amplifier of 7 kW, always disconnect the lead wire of built-in regenerative resistor, which is connected to the P+ and C terminals. For the servo amplifier of 11 kW to 22 kW, do not connect a supplied regenerative resistor to the P+ and C terminals.
- Note 3. Always connect between P3 and P4 terminals. (factory-wired) Use either the power factor improving DC reactor or the power factor improving AC reactor. When using the power factor improving DC reactor, refer to section 11.11.
- Note 4. Connect P/+ and N/- terminals of the brake unit to a correct destination. Incorrect connection destination results in servo amplifier and brake unit malfunction.
- Note 5. Contact rating: 1b contact, 110 V AC_5 A/220 V AC_3 A
 Normal condition: TH1-TH2 is conducting. Abnormal condition: TH1-TH2 is not conducting.
- Note 6. Contact rating: 230 V AC_0.3 A/30 V DC_0.3 A
 Normal condition: B-C is conducting/A-C is not conducting. Abnormal condition: B-C is not conducting/A-C is conducting.
- Note 7. Do not connect more than one cable to each P+ to N- terminals of the servo amplifier.
- Note 8. Always connect BUE and SD terminals. (factory-wired)
- Note 9. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
- Note 10. Configure up a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
- Note 11. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker.
- Note 12. 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.

11. OPTIONS AND AUXILIARY EQUIPMENT

(b) When connecting two brake units to a servo amplifier

POINT
<ul style="list-style-type: none">● To use brake units with a parallel connection, use two sets of FR-BU2 brake unit. Combination with other brake unit results in alarm occurrence or malfunction.● Always connect the terminals for master/slave (MSG to MSG, SD to SD) between the two brake units.● Do not connect the converter unit and brake units as below. Connect the cables with a terminal block to distribute as indicated in this section.
<div data-bbox="462 627 917 873"><p>Connecting two cables to P+ and N- terminals</p></div> <div data-bbox="957 627 1420 873"><p>Passing wiring</p></div>

11. OPTIONS AND AUXILIARY EQUIPMENT

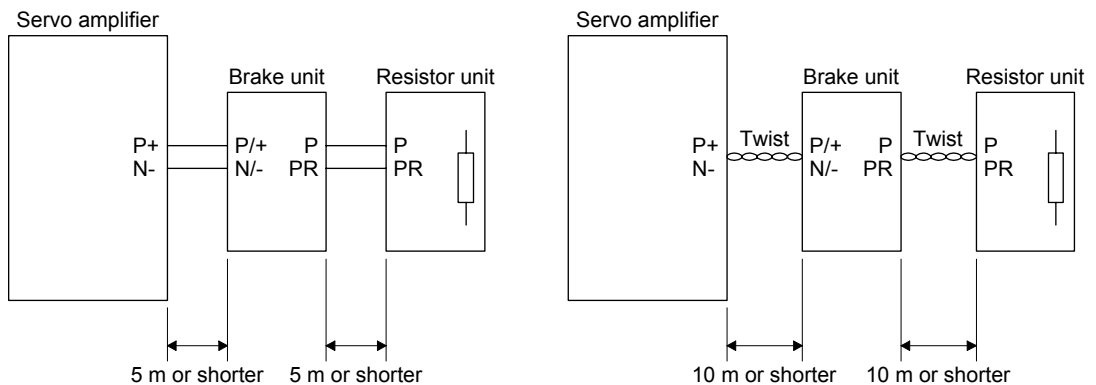


11. OPTIONS AND AUXILIARY EQUIPMENT

- Note
1. For the power supply specifications, refer to section 1.3.
 2. Do not connect a supplied regenerative resistor to the P+ and C terminals.
 3. Always connect between P3 and P4 terminals. (factory-wired) Use either the power factor improving DC reactor or the power factor improving AC reactor. When using the power factor improving DC reactor, refer to section 11.11.
 4. Connect P/+ and N/- terminals of the brake unit to a correct destination. Incorrect connection destination results in servo amplifier and brake unit malfunction.
 5. Contact rating: 1a contact, 110 V AC, 5 A/220 V AC, 3 A
Normal condition: TH1-TH2 is not conducting. Abnormal condition: TH1-TH2 is conducting.
 6. Contact rating: 230 V AC, 0.3 A/30 V DC, 0.3 A
Normal condition: B-C is conducting./A-C is not conducting. Abnormal condition: B-C is not conducting./A-C is conducting.
 7. Do not connect more than one cable to each P+ to N- terminals of the servo amplifier.
 8. Always connect BUE and SD terminals. (factory-wired)
 9. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
 10. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
 11. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker.
 12. 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) Connection instructions

The cables between the servo amplifier and the brake unit, and between the resistor unit and the brake unit should be as short as possible. Always twist the cable longer than 5 m (twist five times or more per one meter). Even when the cable is twisted, the cable should be less than 10 m. Using cables longer than 5 m without twisting or twisted cables longer than 10 m, may result in the brake unit malfunction.



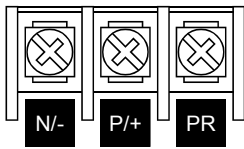
11. OPTIONS AND AUXILIARY EQUIPMENT

(4) Cables

(a) Cables for the brake unit

For the brake unit, HIV cable (600 V grade heat-resistant PVC insulated wire) is recommended.

1) Main circuit terminal



Terminal block

200 V class	Brake unit	Main circuit terminal screw size	Crimp terminal N/-, P/+, PR, ⊕	Tightening torque [N•m]	Wire size	
					N/-, P/+, PR, ⊕	
					HIV wire [mm ²]	AWG
	FR-BU2-15K	M4	5.5-4	1.5	3.5	12
	FR-BU2-30K	M5	5.5-5	2.5	5.5	10
	FR-BU2-55K	M6	14-6	4.4	14	6

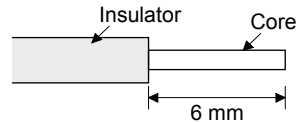
2) Control circuit terminal

POINT

- Under tightening can cause a cable disconnection or malfunction. Over tightening can cause a short circuit or malfunction due to damage to the screw or the brake unit.



Terminal block



Wire the stripped cable after twisting to prevent the cable from becoming loose. In addition, do not solder it.

Screw size: M3

Tightening torque: 0.5 N•m to 0.6 N•m

Wire size: 0.3 mm² to 0.75 mm²

Screw driver: Small flat-blade screw driver

(Tip thickness: 0.4 mm/Tip width 2.5 mm)

(b) Cables for connecting the servo amplifier and a distribution terminal block when connecting two sets of the brake unit

Brake unit	Wire size	
	HIV wire [mm ²]	AWG
FR-BU2-15K	8	8

11. OPTIONS AND AUXILIARY EQUIPMENT

- (5) Crimp terminals for P+ and N- terminals of servo amplifier
 (a) Recommended crimp terminals

POINT

● Always use recommended crimp terminals or equivalent since some crimp terminals cannot be installed depending on the size.

Servo amplifier		Brake unit	Number of connected units	Crimp terminal (Manufacturer)	(Note 1) Applicable tool
200 V class	MR-J4-500A(-RJ)	FR-BU2-15K	1	FVD5.5-S4 (JST)	a
			2	8-4NS (JST) (Note 2)	b
		FR-BU2-30K	1	FVD5.5-S4 (JST)	a
			2	8-4NS (JST) (Note 2)	b
	MR-J4-700A(-RJ)	FR-BU2-15K	2	8-4NS (JST) (Note 2)	b
			1	FVD5.5-S4 (JST)	a
			2	FVD8-6 (JST)	c
	MR-J4-11KA(-RJ)	FR-BU2-30K	1	FVD5.5-6 (JST)	a
			1	FVD14-6 (JST)	d
			1	FVD8-6 (JST)	c
	MR-J4-15KA(-RJ)	FR-BU2-15K	2	FVD8-6 (JST)	c
			1	FVD5.5-6 (JST)	a
1			FVD14-6 (JST)	d	
MR-J4-22KA(-RJ)	FR-BU2-55K	1	FVD14-8 (JST)	d	

- Note 1. Symbols in the applicable tool field indicate applicable tools in (4) (b) of this section.
 2. Coat the crimping part with an insulation tube.

(b) Applicable tool

Symbol	Servo amplifier-side crimp terminals				Manufacturer
	Crimp terminal	Applicable tool			
		Body	Head	Dice	
a	FVD5.5-S4 FVD5.5-6	YNT-1210S	/	/	JST
b	8-4NS	YHT-8S			
c	FVD8-6	YF-1 E-4	YNE-38	DH-111 DH-121	
d	FVD14-6 FVD14-8	YF-1 E-4	YNE-38	DH-112 DH-122	

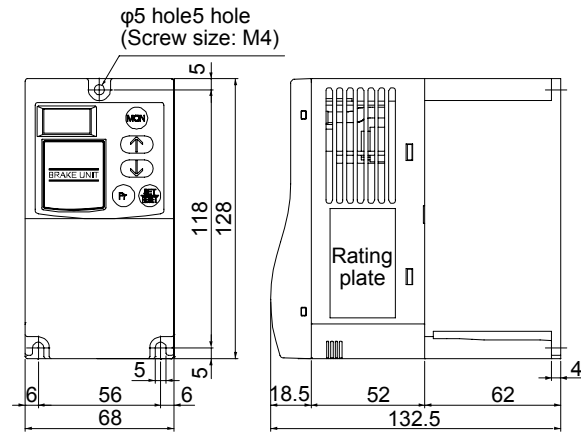
11. OPTIONS AND AUXILIARY EQUIPMENT

11.3.4 Dimensions

(1) FR-BU2 Brake unit

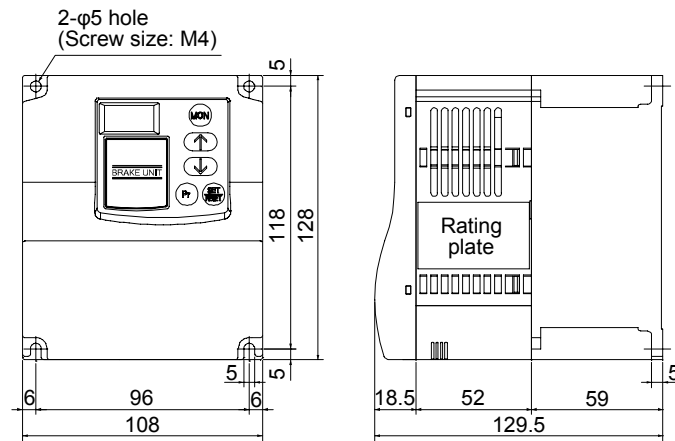
[Unit: mm]

FR-BU2-15K



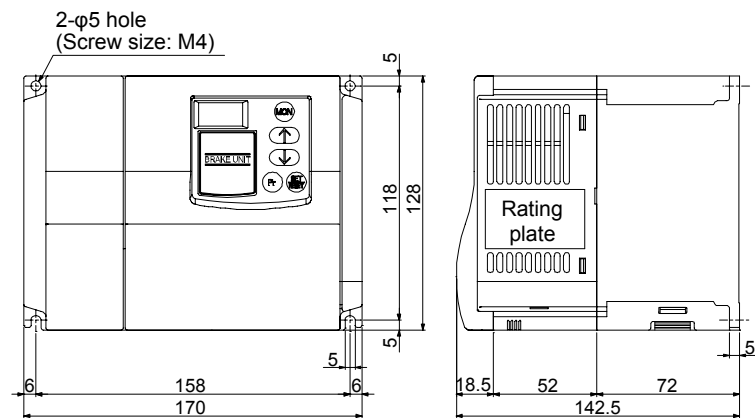
[Unit: mm]

FR-BU2-30K



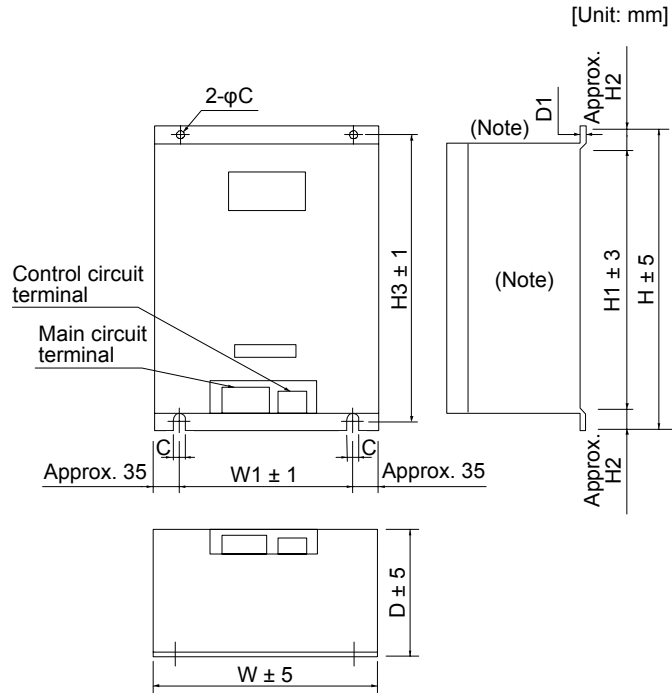
[Unit: mm]

FR-BU2-55K



11. OPTIONS AND AUXILIARY EQUIPMENT

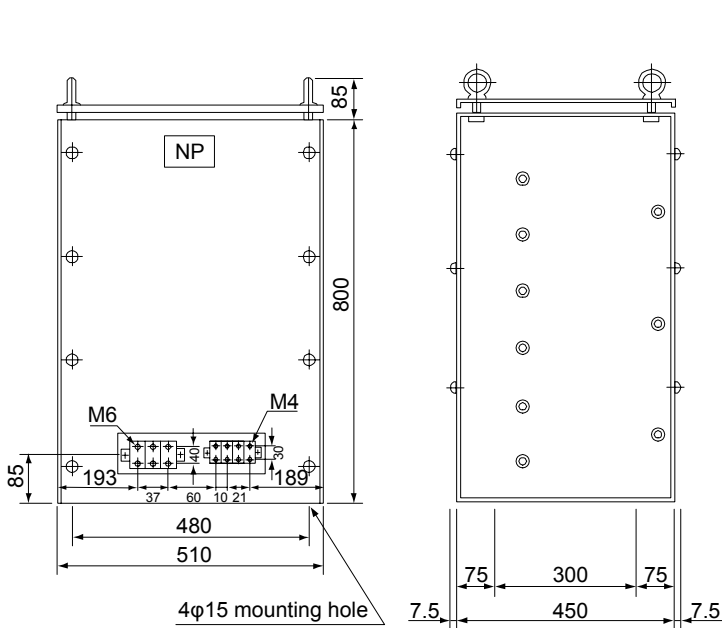
(2) FR-BR Resistor unit



Note. Ventilation ports are provided on both sides and the top. The bottom is open.

Resistor unit		W	W1	H	H1	H2	H3	D	D1	C	Approximate mass [kg]
200 V class	FR-BR-15K	170	100	450	410	20	432	220	3.2	6	15
	FR-BR-30K	340	270	600	560	20	582	220	4	10	30
	FR-BR-55K	480	410	700	620	40	670	450	3.2	12	70

(3) MT-BR5 resistor unit



Resistor unit		Resistance	Approximate mass [kg]
200 V class	MT-BR5-55K	2.0 Ω	50

11. OPTIONS AND AUXILIARY EQUIPMENT

11.4 FR-RC Power regenerative converter

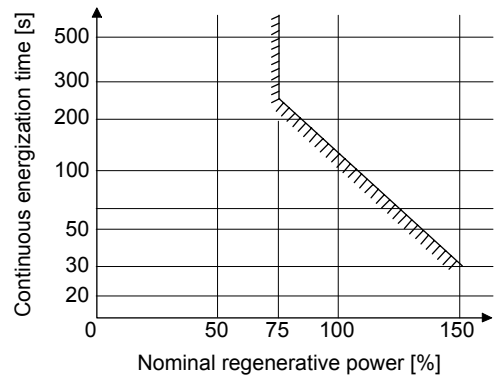
POINT
●When using FR-RC, set [Pr. PA04] to "0 0 __" to enable EM1 (Forced stop 1).

When using the power regenerative converter, set [Pr. PA02] to "__ 0 1" and set [Pr. PC27] to "__ __ 1".

(1) Selection example

The converters can continuously return 75% of the nominal regenerative power. They are applied to the servo amplifiers of the 5 kW to 22 kW.

Power regenerative converter	Nominal regenerative power [kW]	Servo amplifier
FR-RC-15K	15	MR-J4-500A(-RJ) MR-J4-700A(-RJ)
FR-RC-30K	30	MR-J4-11KA(-RJ) MR-J4-15KA(-RJ)
FR-RC-55K	55	MR-J4-22A(-RJ)

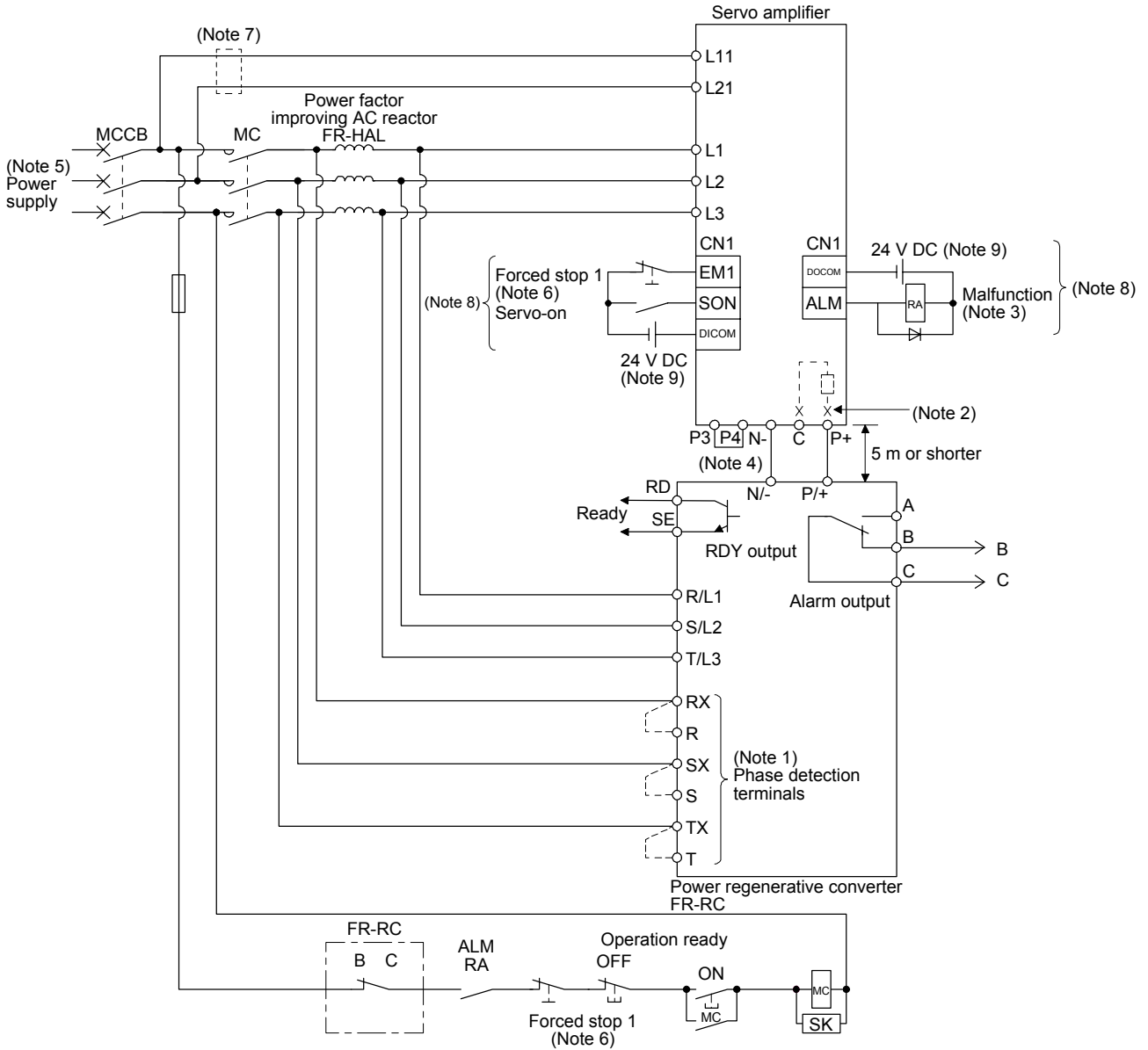


11. OPTIONS AND AUXILIARY EQUIPMENT

(2) Connection example

POINT

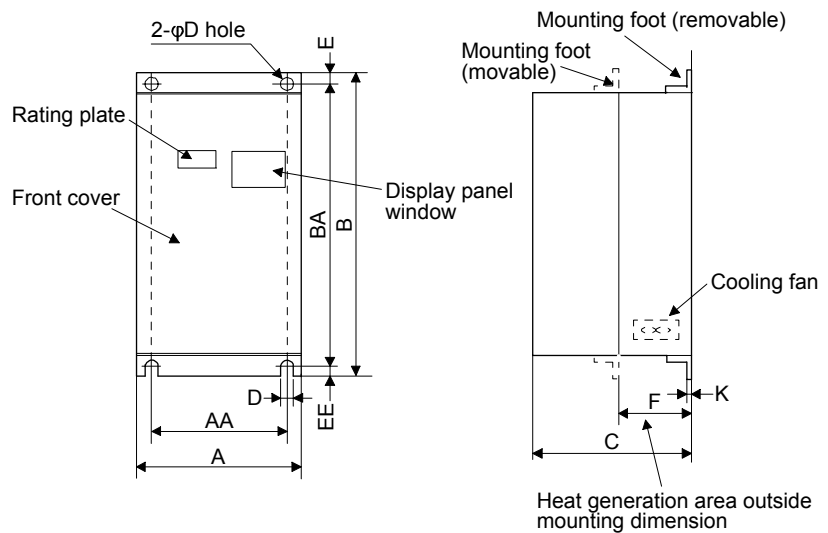
● In this configuration, only the STO function is supported. The forced stop deceleration function is not available.



11. OPTIONS AND AUXILIARY EQUIPMENT

- Note
1. When not using the phase detection terminals, fit the jumpers across RX-R, SX-S and TX-T. If the jumpers remain removed, the FR-RC will not operate.
 2. For the servo amplifier of 7 kW, always disconnect the lead wire of built-in regenerative resistor, which is connected to the P+ and C terminals. For the servo amplifier of 11 kW to 22 kW, do not connect a supplied regenerative resistor to the P+ and C terminals.
 3. If disabling ALM (Malfunction) output with the parameter, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
 4. Always connect between P3 and P4 terminals. (factory-wired) Use either the power factor improving DC reactor or the power factor improving AC reactor. When using the power factor improving DC reactor, refer to section 11.11.
 5. For power supply specifications, refer to section 1.3.
 6. Set [Pr. PA04] to "0 0 __" to enable EM1 (Forced stop 1). Configure up the circuit which shuts off main circuit power with external circuit at EM1 (Forced stop 1) off.
 7. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker.
 8. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.9.3.
 9. 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) Dimensions



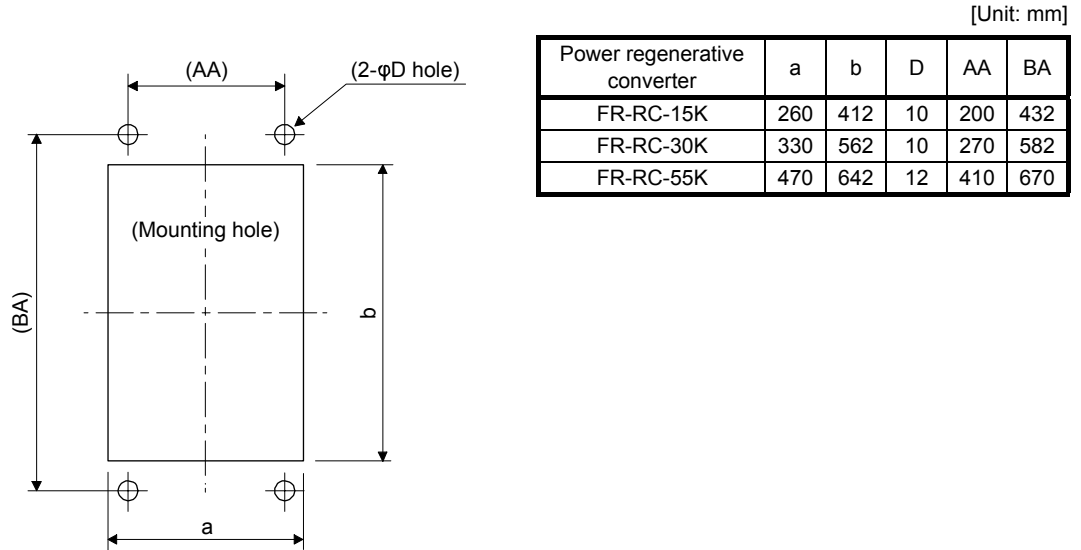
[Unit: mm]

Power regenerative converter	A	AA	B	BA	C	D	E	EE	K	F	Approximate mass [kg]
FR-RC-15K	270	200	450	432	195	10	10	8	3.2	87	19
FR-RC-30K	340	270	600	582	195	10	10	8	3.2	90	31
FR-RC-55K	480	410	700	670	250	12	15	15	3.2	135	55

11. OPTIONS AND AUXILIARY EQUIPMENT

(4) Mounting hole machining dimensions

When the power regenerative converter is installed to an enclosed type cabinet, mount the heat generating area of the converter outside the box to provide heat generation measures. At this time, the mounting hole having the following dimensions is machined in the box.



11.5 FR-CV Power regenerative common converter

POINT
<ul style="list-style-type: none"> ● For details of the power regenerative common converter FR-CV, refer to the FR-CV-(H) Installation Guide (IB(NA)0600075). ● Do not supply power to the main circuit power supply terminals (L1, L2, and L3) of the servo amplifier. Doing so will fail the servo amplifier and FR-CV. ● Connect the DC power supply between the FR-CV and servo amplifier with correct polarity. Connection with incorrect polarity will fail the FR-CV and servo amplifier. ● Two or more FR-CV's cannot be installed to improve regeneration capability. Two or more FR-CV's cannot be connected to the same DC power supply line. ● When using FR-CV, set [Pr. PA04] to "0 0 _ _" to enable EM1 (Forced stop 1).

When using the power regenerative common converter, set [Pr. PA02] to "_ _ 0 1" and set [Pr. PC27] to "_ _ _ 1".

(1) Model

FR-CV-7.5K

Capacity

Symbol	Capacity [kW]
7.5K	7.5
11K	11
15K	15
22K	22
30K	30
37K	37
55K	55

11. OPTIONS AND AUXILIARY EQUIPMENT

(2) Selection example

FR-CV power regenerative common converter can be used for the 200 V class servo amplifier of 100 W to 22 kW. The following shows the restrictions on using the FR-CV.

- (a) Up to six servo amplifiers can be connected to one FR-CV.
- (b) FR-CV capacity [W] \geq Total of rated capacities [W] \times 2 of servo amplifiers connected to FR-CV.
- (c) The total of used servo motor rated currents should be equal to or less than the applicable current [A] of the FR-CV.
- (d) Among the servo amplifiers connected to the FR-CV, the servo amplifier of the maximum capacity should be equal to or less than the maximum connectable capacity [W].

The following table lists the restrictions.

Item	FR-CV-__						
	7.5K	11K	15K	22K	30K	37K	55K
Maximum number of connected servo amplifiers	6						
Total of connectable servo amplifier capacities [kW]	3.75	5.5	7.5	11	15	18.5	27.5
Total of connectable servo motor rated currents [A]	33	46	61	90	115	145	215
Maximum servo amplifier capacity [kW]	3.5	5	7	11	15	15	22

When using the FR-CV, always install the dedicated stand-alone reactor (FR-CVL).

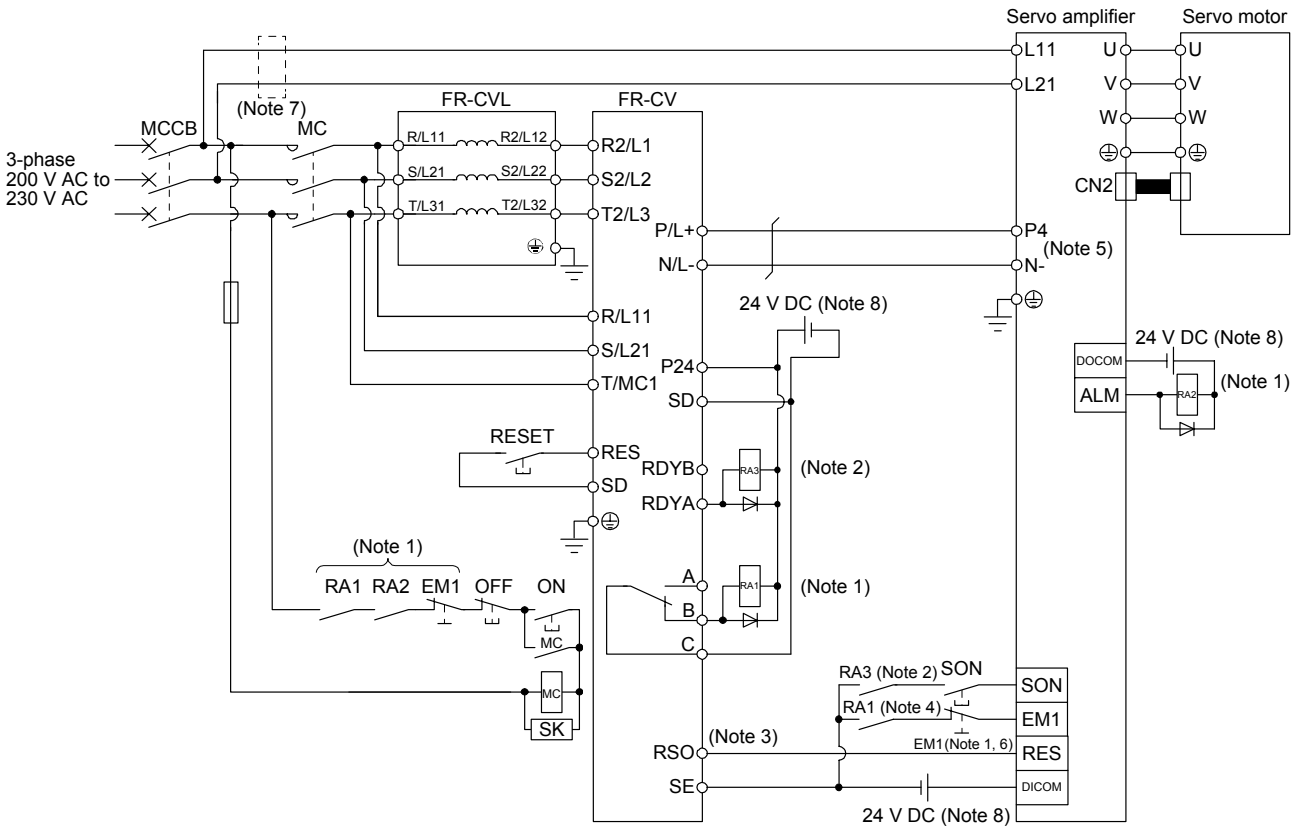
Power regenerative common converter	Dedicated stand-alone reactor
FR-CV-7.5K(-AT)	FR-CVL-7.5K
FR-CV-11K(-AT)	FR-CVL-11K
FR-CV-15K(-AT)	FR-CVL-15K
FR-CV-22K(-AT)	FR-CVL-22K
FR-CV-30K(-AT)	FR-CVL-30K
FR-CV-37K	FR-CVL-37K
FR-CV-55K	FR-CVL-55K

11. OPTIONS AND AUXILIARY EQUIPMENT

(3) Connection diagram

POINT

● In this configuration, only the STO function is supported. The forced stop deceleration function is not available.



- Note 1. Configure a sequence that will shut off main circuit power at the follow cases.
- FR-CV or servo amplifier alarm occurs.
 - EM1 (forced stop 1) turns off.
- Note 2. For the servo amplifier, configure a sequence that will switch the servo-on after the FR-CV is ready.
- Note 3. For the FR-CV, the RSO signal turns off when it is put in a ready-to-operate status where the reset signal is input. Configure a sequence that will make the servo inoperative when the RSO signal is on.
- Note 4. Configure a sequence that will make a stop with the emergency stop input of the servo system controller if an alarm occurs in the FR-CV.
- Note 5. When using FR-CV, always disconnect wiring between P3 and P4 terminals.
- Note 6. Set [Pr. PA04] to "0 0 __" to enable EM1 (Forced stop 1).
- Note 7. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker.
- Note 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.

11. OPTIONS AND AUXILIARY EQUIPMENT

(4) Selection example of wires used for wiring

POINT
<p>● Selection condition of wire size is as follows.</p> <p>Wire type: 600 V grade heat-resistant polyvinyl chloride insulated wire (HIV wire)</p> <p>Construction condition: One wire is constructed in the air.</p>

(a) Wire sizes

1) Across P to P4, N to N

The following table indicates the connection wire sizes of the DC power supply (P4, N- terminals) between the FR-CV and servo amplifier.

Total of servo amplifier capacities [kW]	Wire [mm ²]
1 or less	2 (AWG 14)
2	3.5 (AWG 12)
5	5.5 (AWG 10)
7	8 (AWG 8)
11	14 (AWG 6)
15	22 (AWG 4)
22	50 (AWG 2)

2) Grounding

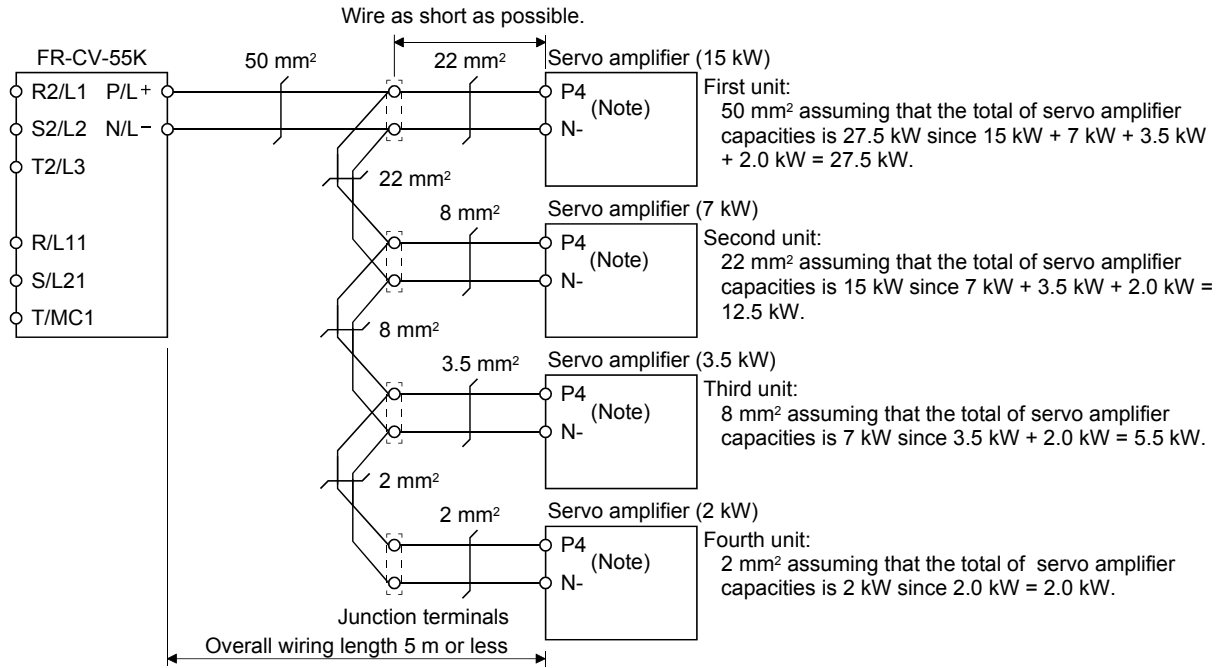
For grounding, use the wire of the size equal to or greater than that indicated in the following table, and make it as short as possible.

Power regenerative common converter	Grounding wire size [mm ²]
FR-CV-7.5K to FR-CV-15K	8 (AWG 8)
FR-CV-22K/FR-CV-30K	22 (AWG 4)
FR-CV-37K/FR-CV-55K	38 (AWG 2)

11. OPTIONS AND AUXILIARY EQUIPMENT

(b) Example of selecting the wire sizes

When connecting multiple servo amplifiers, always use junction terminals for wiring the servo amplifier terminals P4, N-. Also, connect the servo amplifiers in the order of larger to smaller capacities.



Note. When using the servo amplifier of 7 kW or less, make sure to disconnect the wiring of built-in regenerative resistor (5 kW or less: P+ and D, 7 kW: P+ and C).

11. OPTIONS AND AUXILIARY EQUIPMENT

(5) Other precautions

- (a) Always use the dedicated stand-alone reactor (FR-CVL) as the power factor improving reactor. Do not use the power factor improving AC reactor (FR-HAL) or Power factor improving DC reactor (FR-HEL).
- (b) The inputs/outputs (main circuits) of the FR-CV and servo amplifiers include high-frequency components and may provide electromagnetic wave interference to communication equipment (such as AM radios) used near them. In this case, interference can be reduced by installing the radio noise filter (FR-BIF) or line noise filter (FR-BSF01, FR-BLF).
- (c) The overall wiring length for connection of the DC power supply between the FR-CV and servo amplifiers should be 5 m or less, and the wiring must be twisted.

(6) Specifications

Item		Power regenerative common converter FR-CV- <u> </u>						
		7.5K	11K	15K	22K	30K	37K	55K
Total of connectable servo amplifier capacities [kW]		3.75	5.5	7.5	11	15	18.5	27.5
Maximum servo amplifier capacity [kW]		3.5	5	7	11	15	15	22
Output	Total of connectable servo motor rated currents [A]	33	46	61	90	115	145	215
	Regenerative braking torque	Short-time rating	Total capacity of applicable servo motors, 300% torque, 60s (Note 1)					
		Continuous rating	100% torque					
Power supply	Rated input AC voltage/frequency	3-phase 200 V AC to 220 V AC, 50 Hz, 200 V AC to 230 V AC, 60 Hz						
	Permissible AC voltage fluctuation	3-phase 170 V AC to 242 V AC, 50 Hz, 170 V AC to 253 V AC, 60 Hz						
	Permissible frequency fluctuation	±5%						
	Power supply capacity (Note 2) [kVA]	17	20	28	41	52	66	100
IP rating (JEM 1030), cooling method		Open type (IP00), forced cooling						
Environment	Ambient temperature	-10 °C to 50 °C (non-freezing)						
	Ambient humidity	90 %RH or less (non-condensing)						
	Ambience	Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, and dirt						
Altitude, vibration resistance		1000 m or less above sea level, 5.9 m/s ²						
Molded-case circuit breaker or earth-leakage current breaker		30 AF 30 A	50 AF 50 A	100 AF 75 A	100 AF 100 A	125AF 125 A	125AF 125 A	225 AF 175 A
Magnetic contactor		S-N20	S-N35	S-N50	S-N65	S-N80	S-N95	S-N125

Note 1. This is the time when the protective function of the FR-CV is activated. The protective function of the servo amplifier is activated in the time indicated in section 10.1.

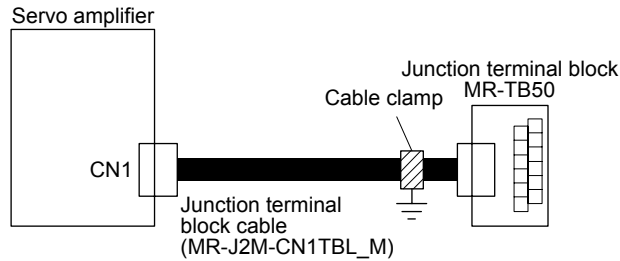
2. The specified value is the power supply capacity of FR-CV. The total power supply capacities of the connected servo amplifiers are actually required.

11. OPTIONS AND AUXILIARY EQUIPMENT

11.6 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.



Ground the option cable on the junction terminal block side with the cable clamp fitting (AERSBAN-ESET). For the use of the cable clamp fitting, refer to section 11.14, (2) (c).

(2) Terminal labels

Use the following junction terminal block labels. This label is supplied with the junction terminal block MR-TB50.

Position control mode

P15R	LG	LAR	LBR	LZR	PG	SON	PC	RES	DICOM	ZSP	TLC	TLA	OP	NP	CR	LSP	LOP	DCCOM	RD					
1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49
2	LA	LB	LZ	PP	OPC	TL	DICOM	INP	INP	LG	LG	LG	NG	EMG	LSN	DCCOM	ALM	SD						

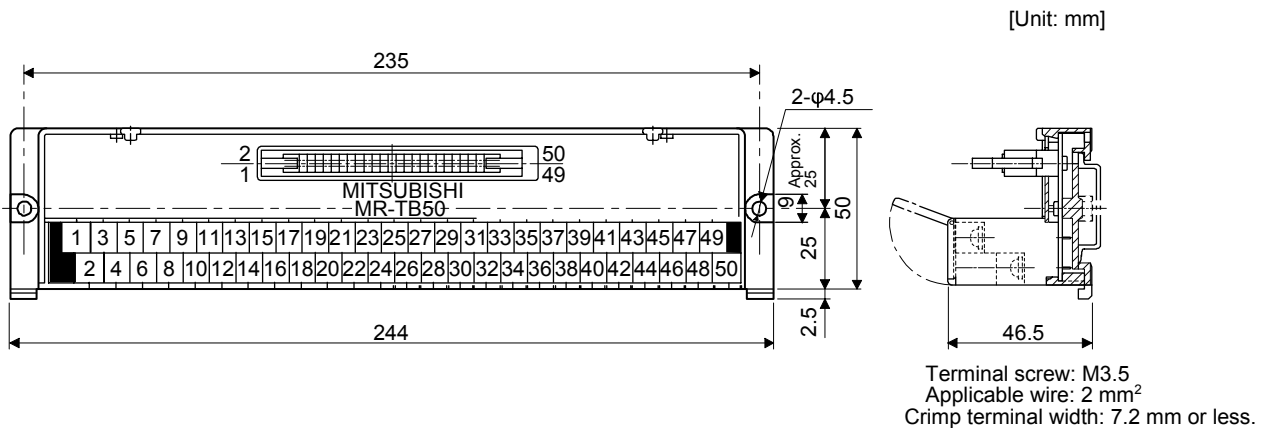
Speed control mode

P15R	LG	LAR	LBR	LZR	SON	ST1	RES	DICOM	ZSP	TLC	TLA	OP	SP1	LSP	LOP	DCCOM	RD							
1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49
2	VC	LA	LB	LZ	SP2	ST2	DICOM	SA	SA	LG	LG	LG	EMG	LSN	DCCOM	ALM	SD							

Torque control mode

P15R	LG	LAR	LBR	LZR	SON	SR2	RES	DICOM	ZSP	VLC	TC	OP	SP1	LOP	DCCOM	RD								
1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49
2	VLA	LA	LB	LZ	SP2	RS1	DICOM			LG	LG	LG	EMG	DCCOM	ALM	SD								

(3) Dimensions



11. OPTIONS AND AUXILIARY EQUIPMENT

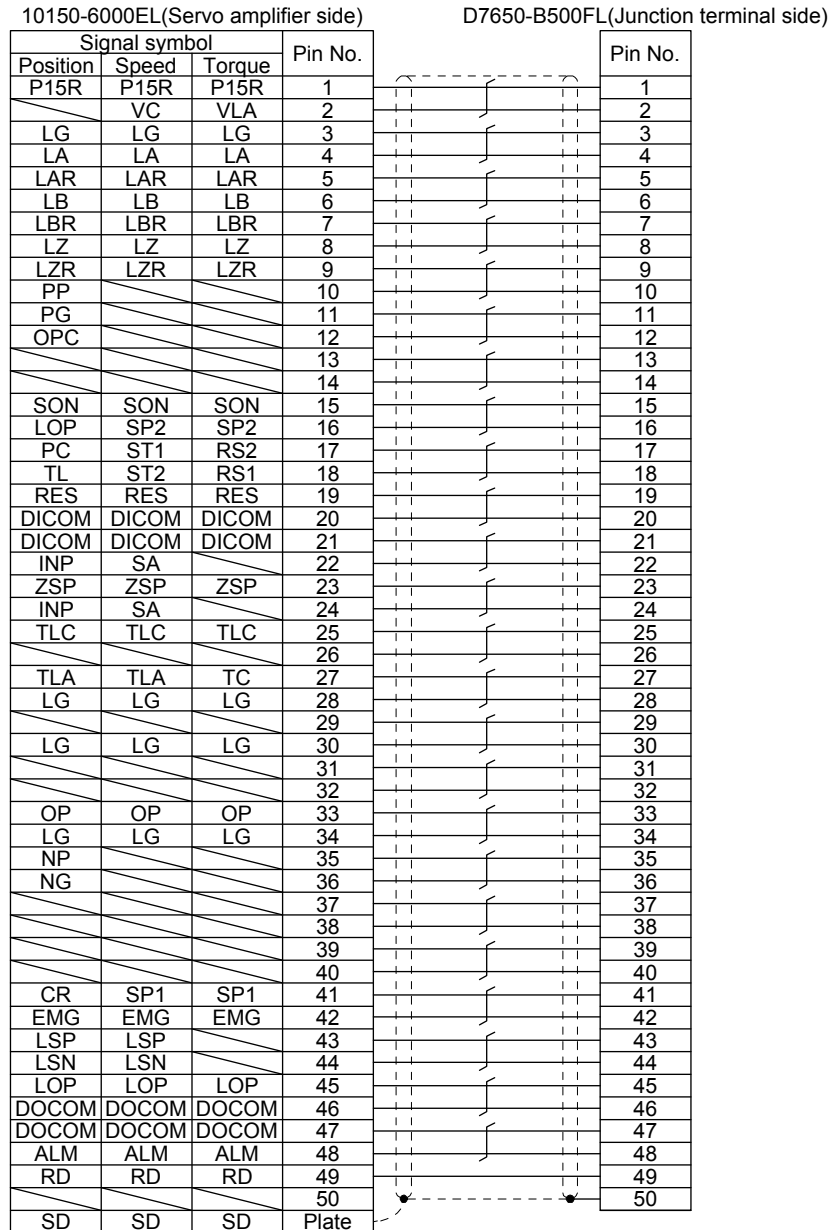
(4) Junction terminal block cable MR-J2M-CN1TBL_M

(a) Model explanations

Model: MR - J 2 M - C N 1 T B L _ M

Symbol	Cable length [m]
05	0.5
1	1

(b) Connection diagram



11. OPTIONS AND AUXILIARY EQUIPMENT

11.7 MR Configurator2

POINT
●MR-J4-A-RJ servo amplifier is supported with software version 1.19V or later.

MR Configurator2 (SW1DNC-MRC2-E) uses the communication function of the servo amplifier to perform parameter setting changes, graph display, test operation, etc. on a personal computer.

(1) Specifications

Item	Description
Project	Create/read/save/delete project, system setting, and print
Parameter	Parameter setting, axis name setting, parameter converter (Note 1)
Monitor	Display all, I/O monitor, graph, and ABS data display
Diagnosis	Alarm display, alarm onset data, drive recorder, no motor rotation, system configuration, life diagnosis, machine diagnosis, fully closed loop diagnosis (Note 2), and linear diagnosis (Note 3)
Test operation	Jog operation (Note 4), positioning operation, motor-less operation (Note 5), DO forced output, and program operation, test mode information
Adjustment	One-touch tuning, tuning, and machine analyzer
Others	Servo assistant, parameter setting range update, help display

- Note
1. This is available only in the standard control mode.
 2. This is available only in the fully closed loop control mode.
 3. This is available only in the linear servo motor control mode.
 4. This is available in the standard control mode, fully closed loop control mode, and DD motor control mode.
 5. This is available only in the standard control mode. This will be available in the fully closed loop control mode, linear servo motor control mode, and DD motor control mode in the future.

11. OPTIONS AND AUXILIARY EQUIPMENT

(2) System configuration

(a) Components

To use this software, the following components are required in addition to the servo amplifier and servo motor.

Equipment	(Note 1) Description	
(Note 2, 3, 4, 5) Personal computer	OS	Microsoft® Windows® 7 Enterprise [Service Pack none/1] Microsoft® Windows® 7 Ultimate [Service Pack none/1] Microsoft® Windows® 7 Professional [Service Pack none/1] Microsoft® Windows® 7 Home Premium [Service Pack none/1] Microsoft® Windows® 7 Starter [Service Pack none/1] Microsoft® Windows Vista® Enterprise [Service Pack none /1/2] Microsoft® Windows Vista® Ultimate [Service Pack none/1/2] Microsoft® Windows Vista® Business [Service Pack none/1/2] Microsoft® Windows Vista® Home Premium [Service Pack none/1/2] Microsoft® Windows Vista® Home Basic [Service Pack none/1/2] Microsoft® Windows® XP Professional [Service Pack 2/3] Microsoft® Windows® XP Home Edition [Service Pack 2/3] Microsoft® Windows® 2000 Professional [Service Pack 4]
	CPU	Desktop personal computer: Intel® Celeron® processor 2.8GHz or more is recommended. Laptop personal computer: Intel® Pentium® M processor 1.7GHz or more is recommended.
	Memory	512 MB or more (for 32-bit OS) and 1GB or more (for 64-bit OS)
	Hard Disk	1GB or more of free space
	Communication interface	USB port (Note 6)
Browser	Windows® Internet Explorer® 4.0 or more (Note 1)	
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. Microsoft, Windows, Internet Explorer and Windows Vista are registered trademarks of Microsoft Corporation in the United States and other countries.

Celeron and Pentium are the registered trademarks of Intel Corporation.

2. On some personal computers, MR Configurator2 may not run properly.

3. When Microsoft® Windows®7, Microsoft® Windows Vista®, or Microsoft® Windows® XP 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 96DPI (Display property)

For 64-bit operating system, this software is compatible with Windows® 7.

4. When Windows® 7 is used, the following functions cannot be used.

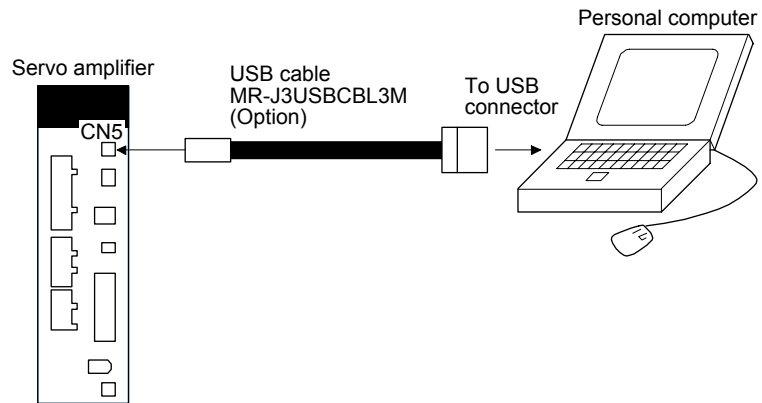
- Windows XP Mode
- Windows touch

5. When using this software with Windows Vista® and Windows® 7, log in as a user having USER authority or higher.

6. RS-422 interface will be available in the future.

11. OPTIONS AND AUXILIARY EQUIPMENT

(b) Connection with servo amplifier

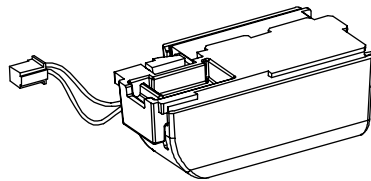


11.8 Battery

POINT
<ul style="list-style-type: none"> ● Refer to appendix 2 and 3 for battery transportation and the new EU Battery Directive.

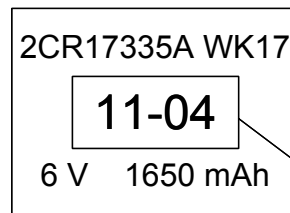
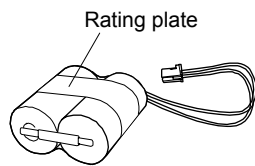
(1) Purpose of use for MR-BAT6V1SET

This battery is used to construct an absolute position detection system. Refer to section 12.3 for the fitting method, etc.



(2) Year and month when MR-BAT6V1SET is manufactured

The manufacturing years of MR-BAT6V1SET have been described to the rating plate put on a built-in MR-BAT6V1 battery.



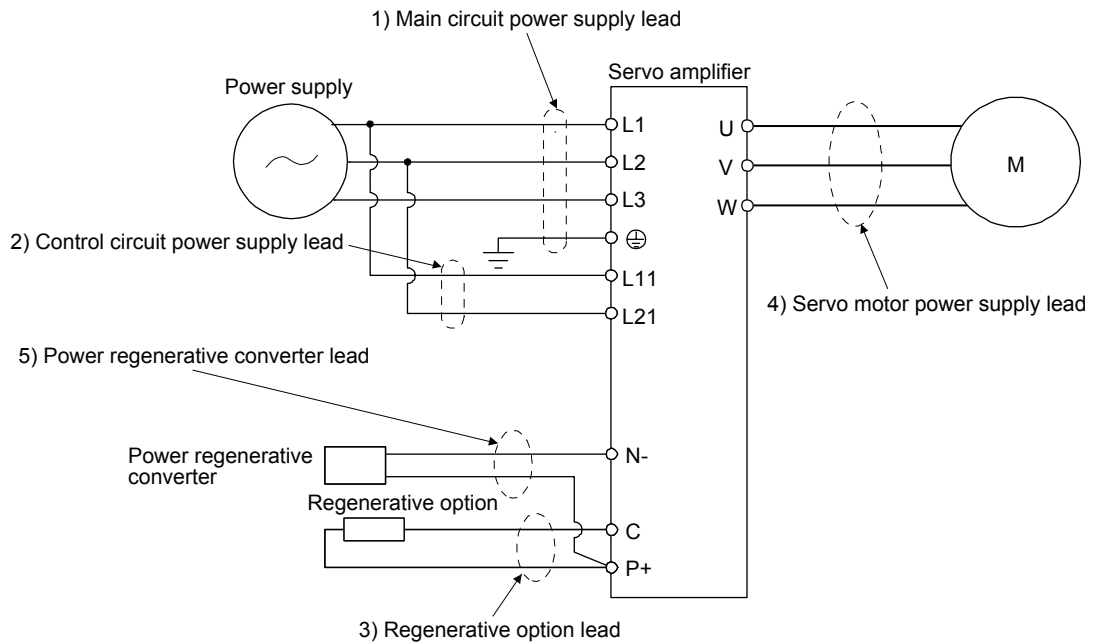
The year and month of manufacture

11. OPTIONS AND AUXILIARY EQUIPMENT

11.9 Selection example of wires

POINT
<ul style="list-style-type: none"> ● To comply with the UL/CSA standard, use the wires shown in appendix 4 for wiring. To comply with other standards, use a wire that is complied with each standard. ● Selection condition of wire size is as follows. <ul style="list-style-type: none"> Construction condition: One wire is constructed in the air. Wire length: 30 m or less

The following diagram shows the wires used for wiring. Use the wires given in this section or equivalent.



11. OPTIONS AND AUXILIARY EQUIPMENT

(1) Example of selecting the wire sizes

Use the 600 V Grade heat-resistant polyvinyl chloride insulated wire (HIV wire) for wiring. The following shows the wire size selection example.

Table 11.1 Wire size selection example 1 (HIV wire)

Servo amplifier	Wire [mm ²] (Note 1)			
	1) L1/L2/L3/⊕	2) L11/L21	3) P+/C	4) U/V/W/⊕ (Note 3)
MR-J4-10A(-RJ)	2 (AWG 14)	1.25 to 2 (AWG 16 to 14) (Note 4)	2 (AWG 14)	AWG 18 to 14 (Note 4)
MR-J4-20A(-RJ)				
MR-J4-40A(-RJ)				
MR-J4-60A(-RJ)				
MR-J4-70A(-RJ)				
MR-J4-100A(-RJ)				
MR-J4-200A(-RJ)				AWG 16 to 10
MR-J4-350A(-RJ)	3.5 (AWG 12)			
MR-J4-500A(-RJ) (Note 2)	5.5 (AWG 10): a	1.25 (AWG 16): a 2 (AWG 14): d (Note 4)	2 (AWG 14): c	2 (AWG 14): c 3.5 (AWG 12): a 5.5 (AWG 10): a
MR-J4-700A(-RJ) (Note 2)	8 (AWG 8): b			2 (AWG 14): c 3.5 (AWG 12): a 5.5 (AWG 10): a 8 (AWG 8): b
MR-J4-11KA(-RJ) (Note 2)	14 (AWG 6): f	1.25 (AWG 16): c 2 (AWG 14): c	3.5 (AWG 12): g	14 (AWG 6): f (Note 5) 55 (AWG 10): g 8 (AWG 8): k
MR-J4-15KA(-RJ) (Note 2)	22 (AWG 4): h		5.5 (AWG 10): g	22 (AWG 4): h (Note 5) 8 (AWG 8): k
MR-J4-22KA(-RJ) (Note 2)	38 (AWG 2): i		5.5 (AWG 10): j	38 (AWG 2): i

- Note
1. Alphabets in the table indicate crimping tools. For crimp terminals and applicable tools, refer to (2) in this section.
 2. To connect these models to a terminal block, be sure to use the screws that come with the terminal block.
 3. The wire size shows applicable size of the servo amplifier connector and terminal block. For wires connecting to the servo motor, refer to each servo amplifier instruction manual.
 4. Be sure to use the size of 2 mm² when corresponding to UL/CSA standard.
 5. This is for connecting to the linear servo motor with natural cooling method.

Use wires 5) of the following sizes with the power regenerative converter (FR-RC).

Model	Wires [mm ²]
FR-RC-15K	14 (AWG 6)
FR-RC-30K	14 (AWG 6)
FR-RC-55K	22 (AWG 4)

11. OPTIONS AND AUXILIARY EQUIPMENT

(2) Selection example of crimp terminals

The table below shows a selection example of crimp terminals for the servo amplifier terminal block.

Symbol	Servo amplifier-side crimp terminals				Manufacturer
	(Note 2) Crimp terminal	Applicable tool			
		Body	Head	Dice	
a	FVD5.5-4	YNT-1210S			JST
b (Note 1)	8-4NS	YHT-8S			
c	FVD2-4	YNT-1614			
d	FVD2-M3				
e	FVD1.25-M3	YNT-2216			
f	FVD14-6	YF-1	YNE-38	DH-122 DH-112	
g	FVD5.5-6	YNT-1210S			
h	FVD22-6	YF-1	YNE-38	DH-123 DH-113	
i	FVD38-8	YF-1	YNE-38	DH-124 DH-114	
j	FVD5.5-8	YNT-1210S			
k	FVD8-6	YF-1/E-4	YNE-38	DH-121 DH-111	

- Note 1. Coat the crimping part with an insulation tube.
 Note 2. Some crimp terminals may not be mounted depending on the size. Make sure to use the recommended ones or equivalent ones.

11.10 Molded-case circuit breakers, fuses, magnetic contactors (recommended)

(1) For main circuit power supply

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.

Servo amplifier	Molded-case circuit breaker (Note 1)		Fuse			Magnetic contactor (Note 2)
	Frame, rated current	Voltage AC [V]	Class	Current [A]	Voltage AC [V]	
MR-J4-10A(-RJ)	30 A frame 5 A	240	T	10	300	S-N10
MR-J4-20A(-RJ)						
MR-J4-40A(-RJ)	15					
MR-J4-60A(-RJ)	20			S-N20 (Note 3)		
MR-J4-70A(-RJ)						
MR-J4-100A(-RJ)	40			S-N20		
MR-J4-200A(-RJ)	70			S-N35		
MR-J4-350A(-RJ)	125			S-N50		
MR-J4-500A(-RJ)	150					
MR-J4-700A(-RJ)	200					
MR-J4-11KA(-RJ)	250			S-N65		
MR-J4-15KA(-RJ)	250					
MR-J4-22KA(-RJ)	350			S-N95		

- Note 1. When having the servo amplifier comply with the UL/CSA standard, refer to appendix 5.
 Note 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.
 Note 3. S-N18 can be used when auxiliary contact is not required.

11. OPTIONS AND AUXILIARY EQUIPMENT

(2) For control circuit power supply

When the wiring for the control circuit power supply (L11, L21) is thinner than that for the main circuit power supply (L1, L2, L3), install an overcurrent protection device (molded-case circuit breaker or fuse) to protect the branch circuit.

Servo amplifier	Molded-case circuit breaker (Note)		Fuse (Class T)		Fuse (Class K5)	
	Frame, rated current	Voltage AC [V]	Current [A]	Voltage AC [V]	Current [A]	Voltage AC [V]
MR-J4-10A(-RJ)	30 A frame 5 A	240	1	300	1	250
MR-J4-20A(-RJ)						
MR-J4-40A(-RJ)						
MR-J4-60A(-RJ)						
MR-J4-70A(-RJ)						
MR-J4-100A(-RJ)						
MR-J4-200A(-RJ)						
MR-J4-350A(-RJ)						
MR-J4-500A(-RJ)						
MR-J4-700A(-RJ)						
MR-J4-11KA(-RJ)						
MR-J4-15KA(-RJ)						
MR-J4-22KA(-RJ)						

Note. When having the servo amplifier comply with the UL/CSA standard, refer to appendix 5.

11. OPTIONS AND AUXILIARY EQUIPMENT

11.11 Power factor improving DC reactors

The following shows the advantages of using power factor improving DC 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 be about 85%.
- As compared to the power factor improving AC reactor (FR-HAL), it decreases the loss.

When connecting the power factor improving DC reactor to the servo amplifier, always disconnect P3 and P4. If it remains connected, the effect of the power factor improving DC reactor is not produced.

When used, the power factor improving DC reactor generates heat. To release heat, therefore, leave a 10 cm or more clearance at each of the top and bottom, and a 5 cm or more clearance on each side.

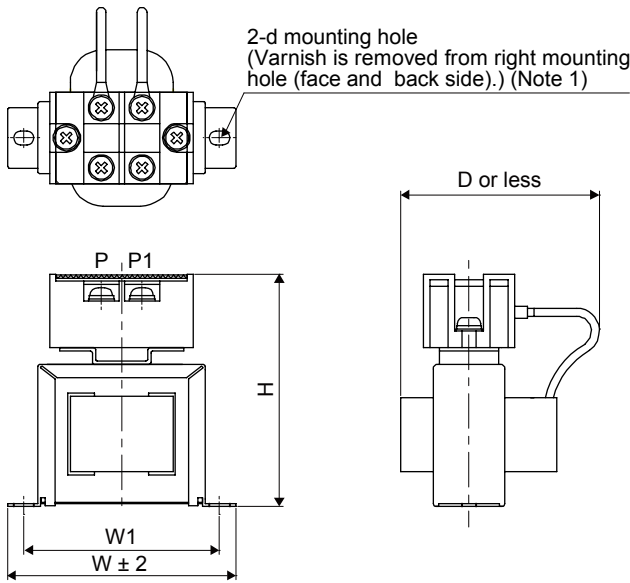


Fig. 11.1

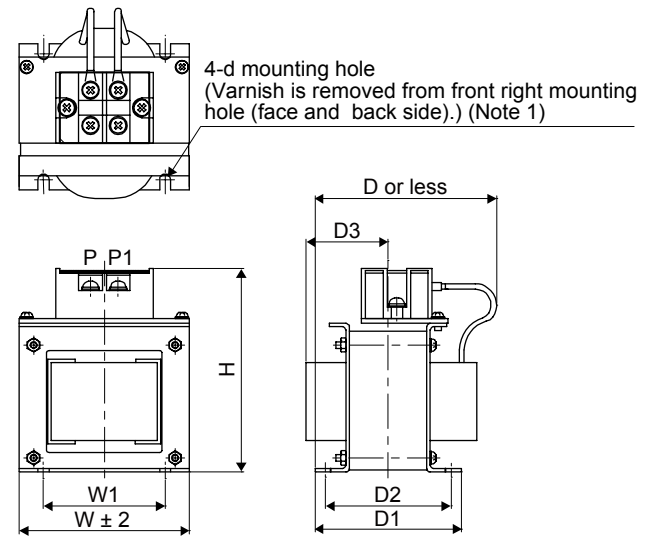


Fig. 11.2

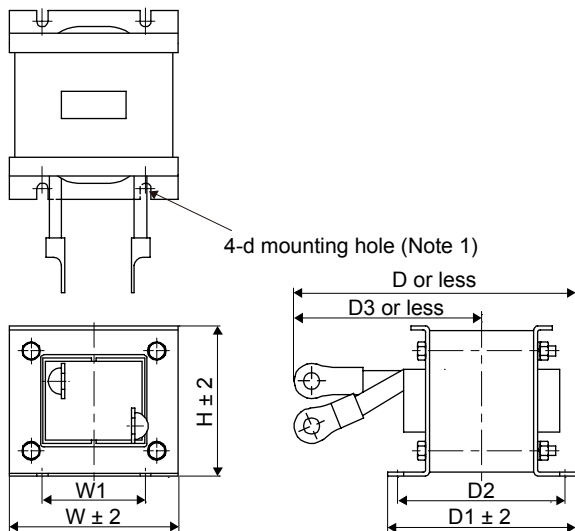
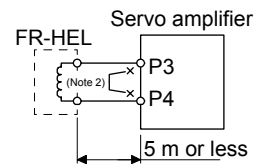


Fig. 11.3



Note 1. Use this for grounding.

Note 2. When using the Power factor improving DC reactor, remove the short bar across P3-P4.

11. OPTIONS AND AUXILIARY EQUIPMENT

Servo amplifier	Power factor improving DC reactor	Dimensions	Dimensions [mm]								Terminal size	Mass [kg]	Wire [mm ²] (Note 2)
			W	W1	H	D (Note 1)	D1	D2	D3	d			
MR-J4-10A(-RJ), MR-J4-20A(-RJ)	FR-HEL-0.4K	Fig. 11.1	70	60	71	61		21		M4	M4	0.4	2 (AWG 14)
MR-J4-40A(-RJ)	FR-HEL-0.75K		85	74	81	61		21		M4	M4	0.5	
MR-J4-60A(-RJ), MR-J4-70A(-RJ)	FR-HEL-1.5K		85	74	81	70		30		M4	M4	0.8	
MR-J4-100A(-RJ)	FR-HEL-2.2K		85	74	81	70		30		M4	M4	0.9	
MR-J4-200A(-RJ)	FR-HEL-3.7K	Fig. 11.2	77	55	92	82	66	57	37	M4	M4	1.5	
MR-J4-350A(-RJ)	FR-HEL-7.5K		86	60	113	98	81	72	43	M4	M5	2.5	3.5 (AWG 12)
MR-J4-500A(-RJ)	FR-HEL-11K		105	64	133	112	92	79	47	M6	M6	3.3	5.5 (AWG 10)
MR-J4-700A(-RJ)	FR-HEL-15K		105	64	133	115	97	84	48.5	M6	M6	4.1	8 (AWG 8)
MR-J4-11KA(-RJ)	FR-HEL-15K		105	64	133	115	97	84	48.5	M6	M6	4.1	14 (AWG 6)
MR-J4-15KA(-RJ)	FR-HEL-22K		105	64	93	175	117	104	115 (Note 1)	M6	M10	5.6	22 (AWG 4)
MR-J4-22KA(-RJ)	FR-HEL-30K	Fig. 11.3	114	72	100	200	125	101	135 (Note 1)	M6	M10	7.8	38 (AWG 2)

Note 1. Maximum dimensions. The dimension varies depending on the input/output lines.

2. Selection conditions of wire size is as follows.

Wire type: 600 V grade heat-resistant polyvinyl chloride insulated wire (HIV wire)

Construction condition: One wire is constructed in the air.

11. OPTIONS AND AUXILIARY EQUIPMENT

11.12 Power factor improving AC reactors

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 be 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.

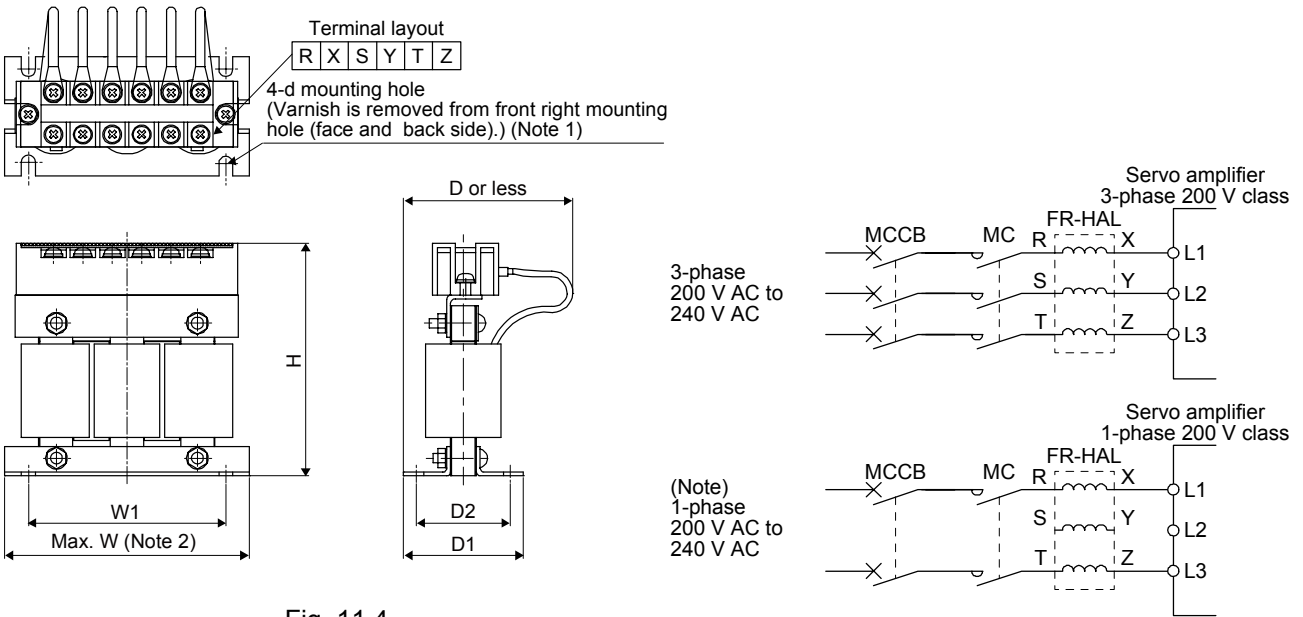


Fig. 11.4

- Note 1. Use this hole for grounding.
 2. $W \pm 2$ is applicable for FR-HAL-0.4K to FR-HAL-1.5K.

Note. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open.

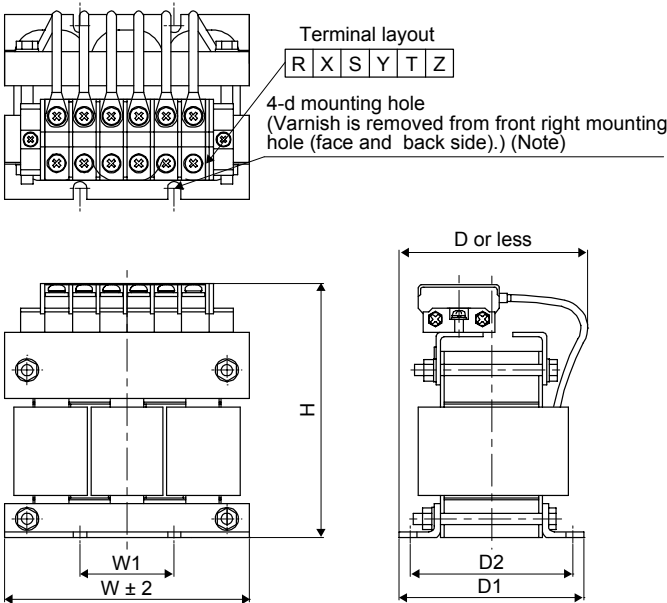


Fig. 11.5

Note. Use this hole for grounding.

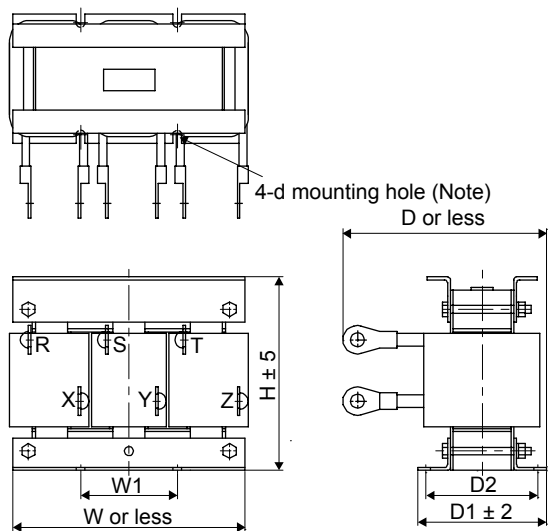


Fig. 11.6

Note. Use this for grounding.

11. OPTIONS AND AUXILIARY EQUIPMENT

Servo amplifier	Power factor improving AC reactor	Dimensions	Dimensions [mm]							Terminal size	Mass [kg]
			W	W1	H	D (Note)	D1	D2	d		
MR-J4-10A(-RJ), MR-J4-20A(-RJ)	FR-HAL-0.4K	Fig. 11.4	104	84	99	72	51	40	M5	M4	0.6
MR-J4-40A(-RJ)	FR-HAL-0.75K		104	84	99	74	56	44	M5	M4	0.8
MR-J4-60A(-RJ), MR-J4-70A(-RJ)	FR-HAL-1.5K		104	84	99	77	61	50	M5	M4	1.1
MR-J4-100A(-RJ)	FR-HAL-2.2K		115 (Note)	40	115	77	71	57	M6	M4	1.5
MR-J4-200A(-RJ)	FR-HAL-3.7K		115 (Note)	40	115	83	81	67	M6	M4	2.2
MR-J4-350A(-RJ)	FR-HAL-7.5K	Fig. 11.5	130	50	135	100	98	86	M6	M5	4.2
MR-J4-500A(-RJ)	FR-HAL-11K		160	75	164	111	109	92	M6	M6	5.2
MR-J4-700A(-RJ)	FR-HAL-15K		160	75	167	126	124	107	M6	M6	7.0
MR-J4-11KA(-RJ)	FR-HAL-15K		160	75	167	126	124	107	M6	M6	7.0
MR-J4-15KA(-RJ)	FR-HAL-22K		185 (Note)	75	150	158	100	87	M6	M8	9.0
MR-J4-22KA(-RJ)	FR-HAL-30K	Fig. 11.6	185 (Note)	75	150	168	100	87	M6	M10	9.7

Note. Maximum dimensions. The dimension varies depending on the input/output lines.

11.13 Relays (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 , 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. OPTIONS AND AUXILIARY EQUIPMENT

11.14 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 devices 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 devices malfunction due to noises produced by the servo amplifier, noise suppression measures must be taken. 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.)

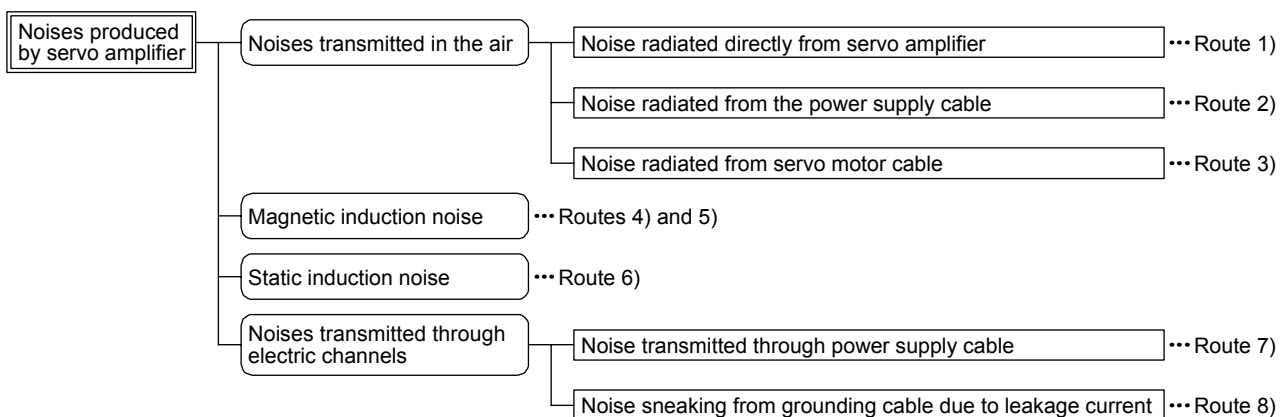
(b) Reduction techniques for external noises that cause the servo amplifier to malfunction

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.

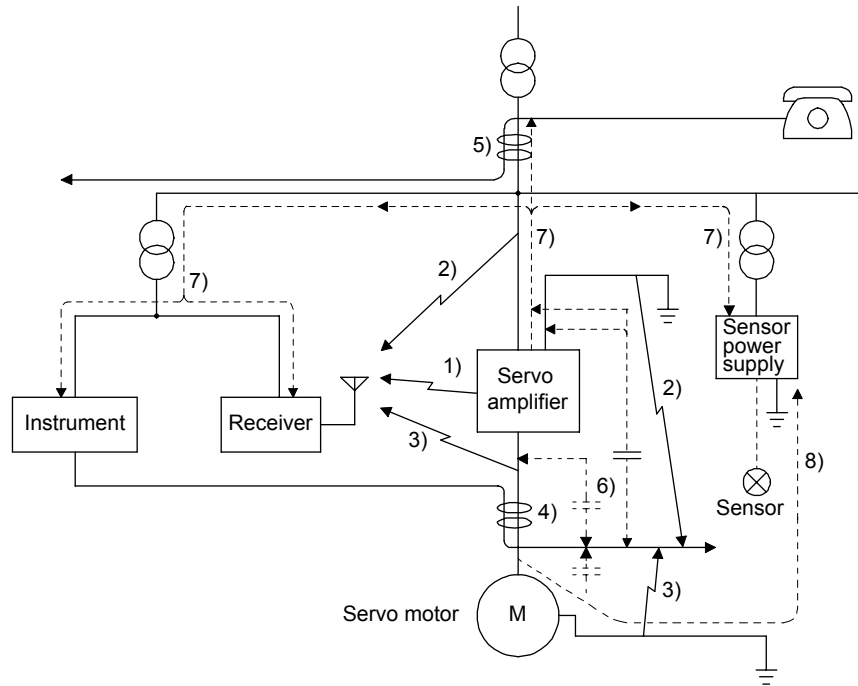
- Provide surge absorbers on the noise sources to suppress noises.
- Attach data line filters to the signal cables.
- Ground the shields of the encoder connecting cable and the control signal cables with cable clamp fittings.
- Although a surge absorber is built into the servo amplifier, to protect the 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 devices 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 devices located near the main circuit cables, and those transmitted through the power supply cables.



11. OPTIONS AND AUXILIARY EQUIPMENT



Noise transmission route	Suppression techniques
1) 2) 3)	<p>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.</p> <ol style="list-style-type: none"> 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)	<p>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.</p> <ol style="list-style-type: none"> 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)	<p>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.</p> <ol style="list-style-type: none"> 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/FR-BLF) on the power lines of the servo amplifier.
8)	<p>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.</p>

11. OPTIONS AND AUXILIARY EQUIPMENT

(2) Noise reduction techniques

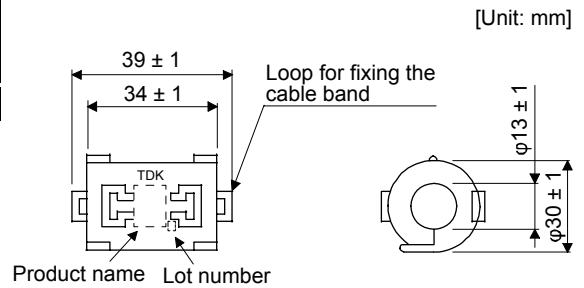
(a) Data line filter (recommended)

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, and GRFC-13 by Kitagawa Industries 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.

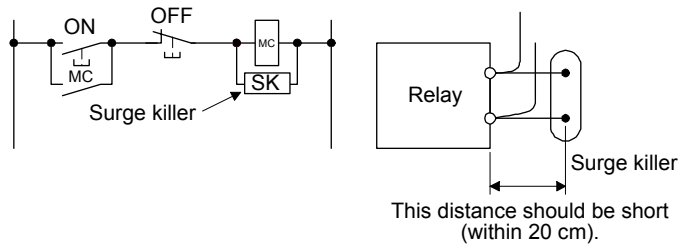
Impedance [Ω]	
10 MHz to 100 MHz	100 MHz to 500 MHz
80	150



Outline drawing (ZCAT3035-1330)

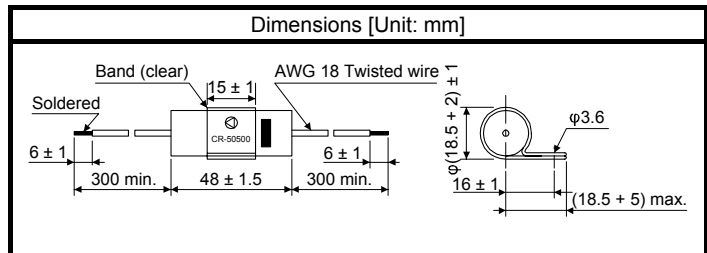
(b) Surge killer (recommended)

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

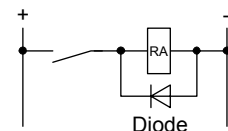
Rated voltage AC [V]	C [$\mu\text{F} \pm 20\%$]	R [$\Omega \pm 30\%$]	Test voltage
250	0.5	50 (1/2 W)	Between terminals: 625 V AC, 50/60 Hz 60 s Between terminal and case: 2000 V AC, 50/60 Hz 60 s



Note that a diode should be installed to a DC relay or the like.

Maximum voltage: Not less than 4 times the drive voltage of the relay or the like

Maximum current: Not less than twice the drive current of the relay or the like



11. OPTIONS AND AUXILIARY EQUIPMENT

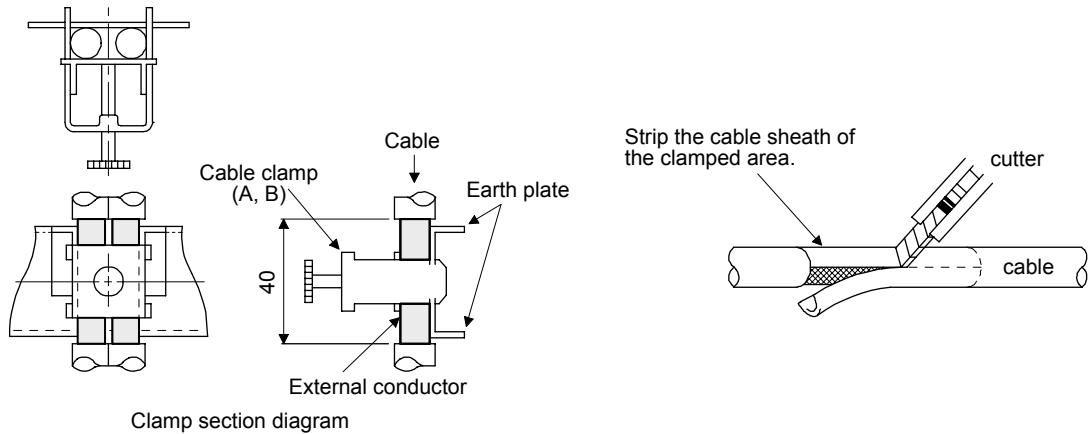
(c) Cable clamp fitting AERSBAN-_SET

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 clamp comes as a set with the grounding plate.

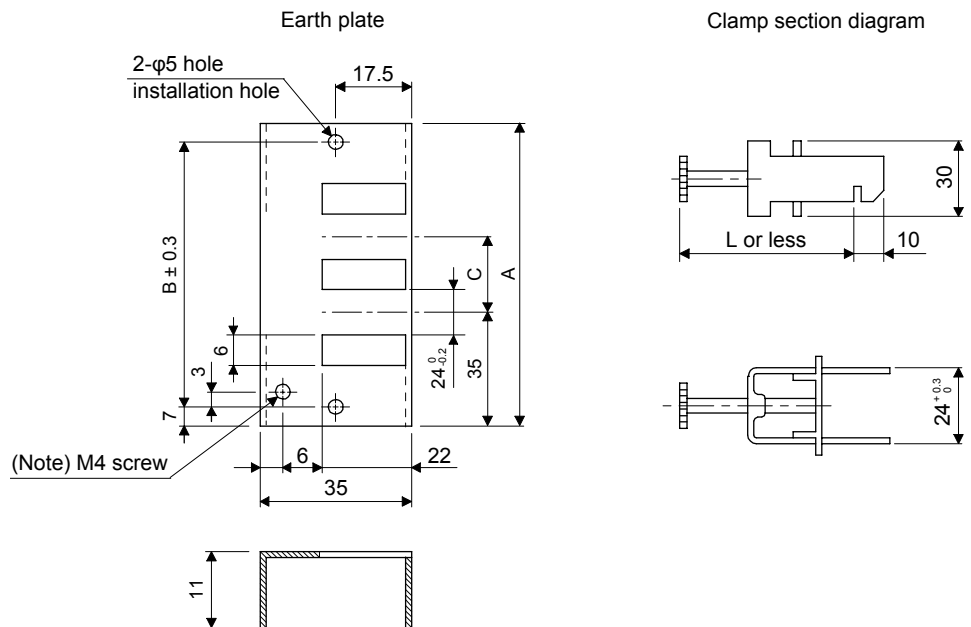
[Unit: mm]



• Dimensions

[Unit: mm]

[Unit: mm]



Note. Screw hole for grounding. Connect it to the grounding plate of the cabinet.

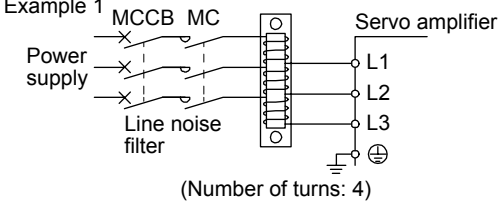
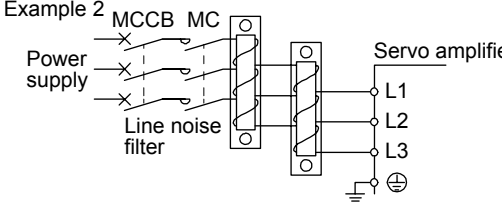
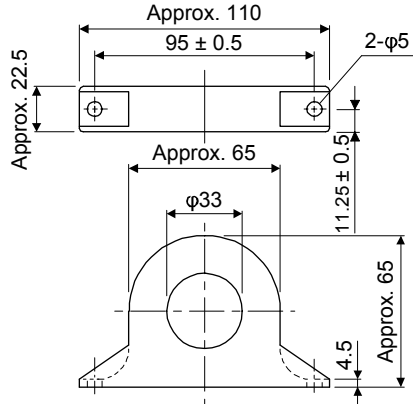
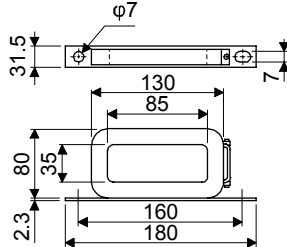
Model	A	B	C	Accessory fittings
AERSBAN-DSET	100	86	30	Clamp A: 2 pcs.
AERSBAN-ESET	70	56		Clamp B: 1 pc.

Clamp fitting	L
A	70
B	45

11. OPTIONS AND AUXILIARY EQUIPMENT

(d) Line noise filter (FR-BSF01/ FR-BLF)

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.

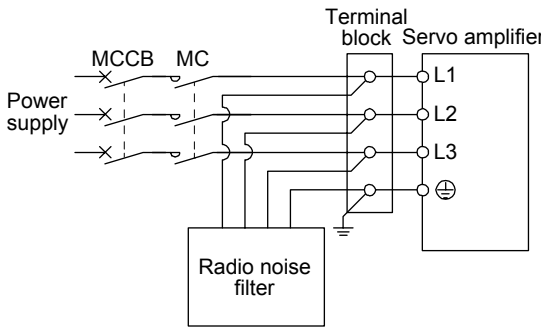
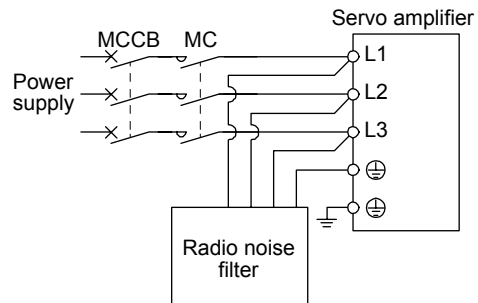
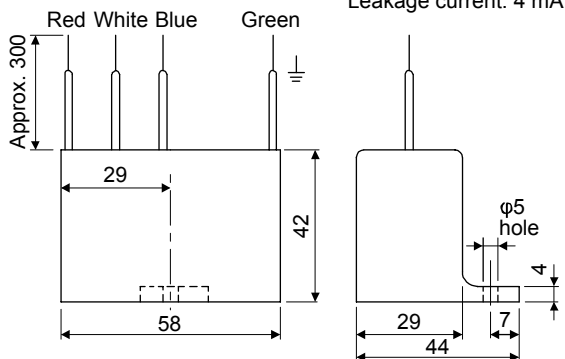
Connection diagram	Dimensions [Unit: mm]
<p>Use the line noise filters for wires of the main power supply (L1, L2, and L3) and of the servo motor power (U, V, and W). Pass each of the wires through the line noise filter an equal number of times in the same direction. For the main power supply, the effect 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.</p> <p>Place the line noise filters as close to the servo amplifier as possible for their best performance.</p> <p>Example 1</p>  <p>(Number of turns: 4)</p> <p>Example 2</p>  <p>Two filters are used (Total number of turns: 4)</p>	<p>FR-BSF01 (for wire size 3.5 mm² (AWG 12) or less)</p>  <p>FR-BLF (for wire size 5.5 mm² (AWG 10) or more))</p> 

11. OPTIONS AND AUXILIARY EQUIPMENT

(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

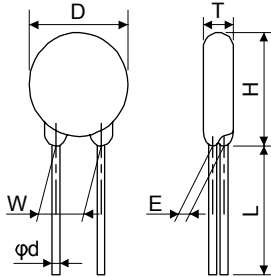
Connection diagram	Dimensions [Unit: mm]
<p>Make the connection cables as short as possible. Grounding is always required.</p> <p>When using the FR-BIF with a single-phase power supply, always insulate the lead wires that are not used for wiring.</p> <ul style="list-style-type: none"> • MR-J4-350A(-RJ) or less  <ul style="list-style-type: none"> • MR-J4-500A(-RJ) or more 	<p>Leakage current: 4 mA</p> 

11. OPTIONS AND AUXILIARY EQUIPMENT

(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 rated					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 μ s [A]	2 ms [J]	[W]			[pF]	[V]
200 V class	TND20V-431K	275	350	10000/1 time	195	1.0	100	710	1300	430 (387 to 473)
	TND20V-471K	300	385	7000/2 time	215			775	1200	470 (423 to 517)



[Unit: mm]

Model	D Max.	H Max.	T Max.	E \pm 1.0	(Note) L min.	ϕ d \pm 0.05 or less	W 1.0 or less
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. OPTIONS AND AUXILIARY EQUIPMENT

11.15 Earth-leakage current breaker

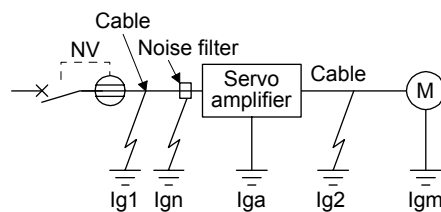
(1) Selection method

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.

$$\text{Rated sensitivity current} \geq 10 \cdot \{I_{g1} + I_{gn} + I_{ga} + K \cdot (I_{g2} + I_{gm})\} \text{ [mA]} \dots \dots \dots (11.1)$$



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

I_{g1}: Leakage current on the electric channel from the earth-leakage current breaker to the input terminals of the servo amplifier (Found from Fig. 11.5.)

I_{g2}: Leakage current on the electric channel from the output terminals of the servo amplifier to the servo motor (Found from Fig. 11.5.)

I_{gn}: Leakage current when a filter is connected to the input side (4.4 mA per one FR-BIF)

I_{ga}: Leakage current of the servo amplifier (Found from table 11.3.)

I_{gm}: Leakage current of the servo motor (Found from table 11.2.)

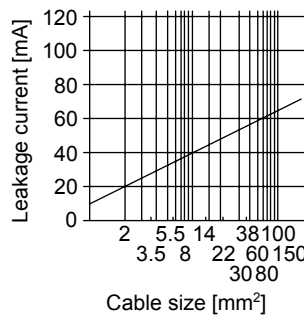


Fig. 11.7 Leakage current example (I_{g1}, I_{g2}) for CV cable run in metal conduit

11. OPTIONS AND AUXILIARY EQUIPMENT

Table 11.2 Servo motor leakage current example (I_{gm})

Servo motor power [kW]	Leakage current [mA]
0.05 to 1	0.1
1.2 to 2	0.2
3 to 3.5	0.3
4.2 to 5	0.5
7	0.7
9 to 11	1.0
15	1.3
22	2.3

Table 11.3 Servo amplifier leakage current example (I_{ga})

Servo amplifier capacity [kW]	Leakage current [mA]
0.1 to 0.6	0.1
0.75 to 3.5	0.15
5/7	2
11/15	5.5
22	7

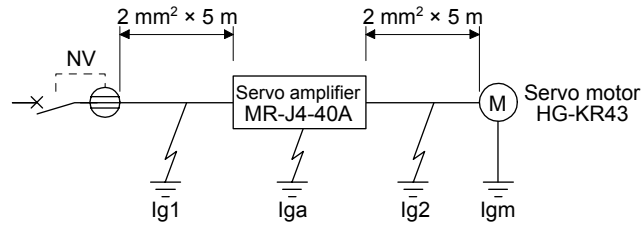
Table 11.4 Earth-leakage current breaker selection example

Servo amplifier	Rated sensitivity current of earth-leakage current breaker [mA]
MR-J4-10A(-RJ) to MR-J4-350A(-RJ)	15
MR-J4-500A(-RJ)	30
MR-J4-700A(-RJ)	50
MR-J4-11KA(-RJ) to MR-J4-22KA(-RJ)	100

11. OPTIONS AND AUXILIARY EQUIPMENT

(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.

$$I_{g1} = 20 \cdot \frac{5}{1000} = 0.1 \text{ [mA]}$$

$$I_{g2} = 20 \cdot \frac{5}{1000} = 0.1 \text{ [mA]}$$

$$I_{gn} = 0 \text{ (not used)}$$

$$I_{ga} = 0.1 \text{ [mA]}$$

$$I_{gm} = 0.1 \text{ [mA]}$$

Insert these values in equation (11.1).

$$I_g \geq 10 \cdot \{0.1 + 0 + 0.1 + 1 \cdot (0.1 + 0.1)\} \\ \geq 4 \text{ [mA]}$$

According to the result of calculation, use an earth-leakage current breaker having the rated sensitivity current (I_g) of 4.0 [mA] or more.

An earth-leakage current breaker having I_g of 15 [mA] is used with the NV-SP/SW/CP/CW/HW series.

11. OPTIONS AND AUXILIARY EQUIPMENT

11.16 EMC filter (recommended)

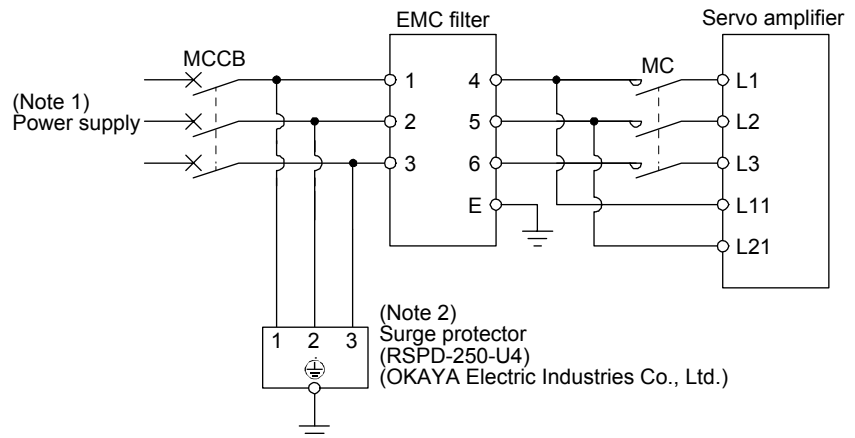
It is recommended that one of the following filters be used to comply with EN standard's EMC directive. Some EMC filters have large in leakage current.

(1) Combination with the servo amplifier

Servo amplifier	Recommended filter (Soshin Electric)			Mass [kg]
	Model	Rated current [A]	Rated voltage [V AC]	
MR-J4-10A(-RJ) to MR-J4-100A(-RJ)	(Note) HF3010A-UN	10	250	5
MR-J4-200A(-RJ), MR-J4-350A(-RJ)	(Note) HF3030A-UN	30		5
MR-J4-500A(-RJ), MR-J4-700A(-RJ)	(Note) HF3040A-UN	40		6.5
MR-J4-11KA(-RJ), MR-J4-15KA(-RJ), MR-J4-22KA(-RJ)	(Note) HF3100A-UN	100			6.5

Note. A surge protector is separately required to use any of these EMC filters.

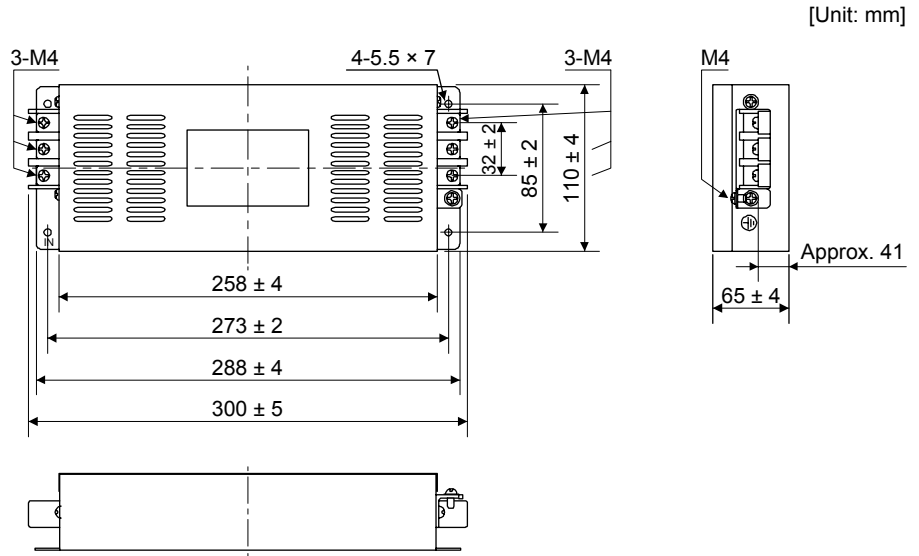
(2) Connection example



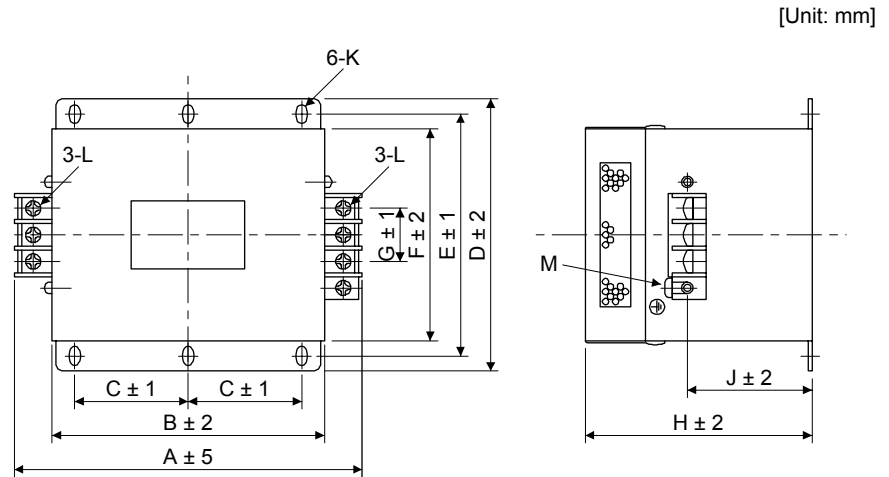
- Note 1. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open.
- Note 2. The example is when a surge protector is connected.

11. OPTIONS AND AUXILIARY EQUIPMENT

- (3) Dimensions
 - (a) EMC filter
 - HF3010A-UN



HF3030A-UN/HF-3040A-UN

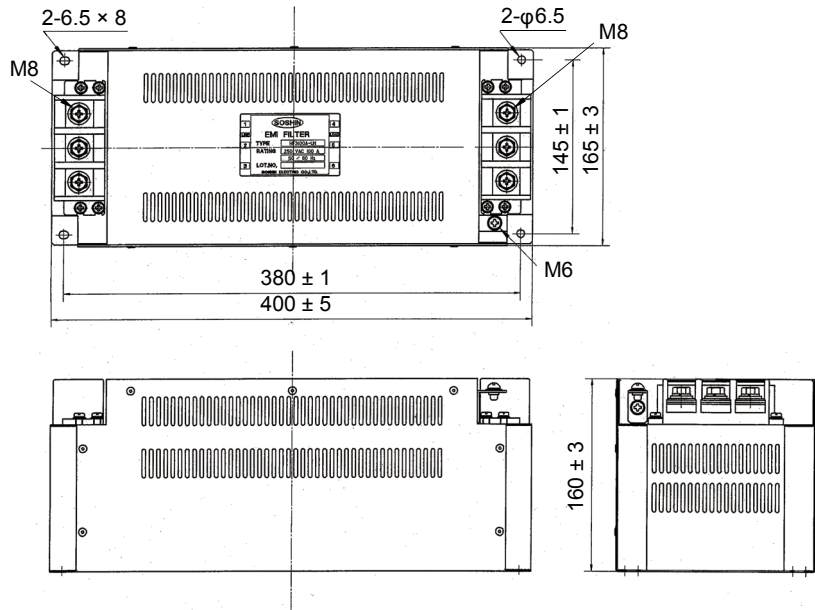


Model	Dimensions [mm]											
	A	B	C	D	E	F	G	H	J	K	L	M
HF3030A-UN	260	210	85	155	140	125	44	140	70	R3.25	M5	M4
HF3040A-UN										length: 8		

11. OPTIONS AND AUXILIARY EQUIPMENT

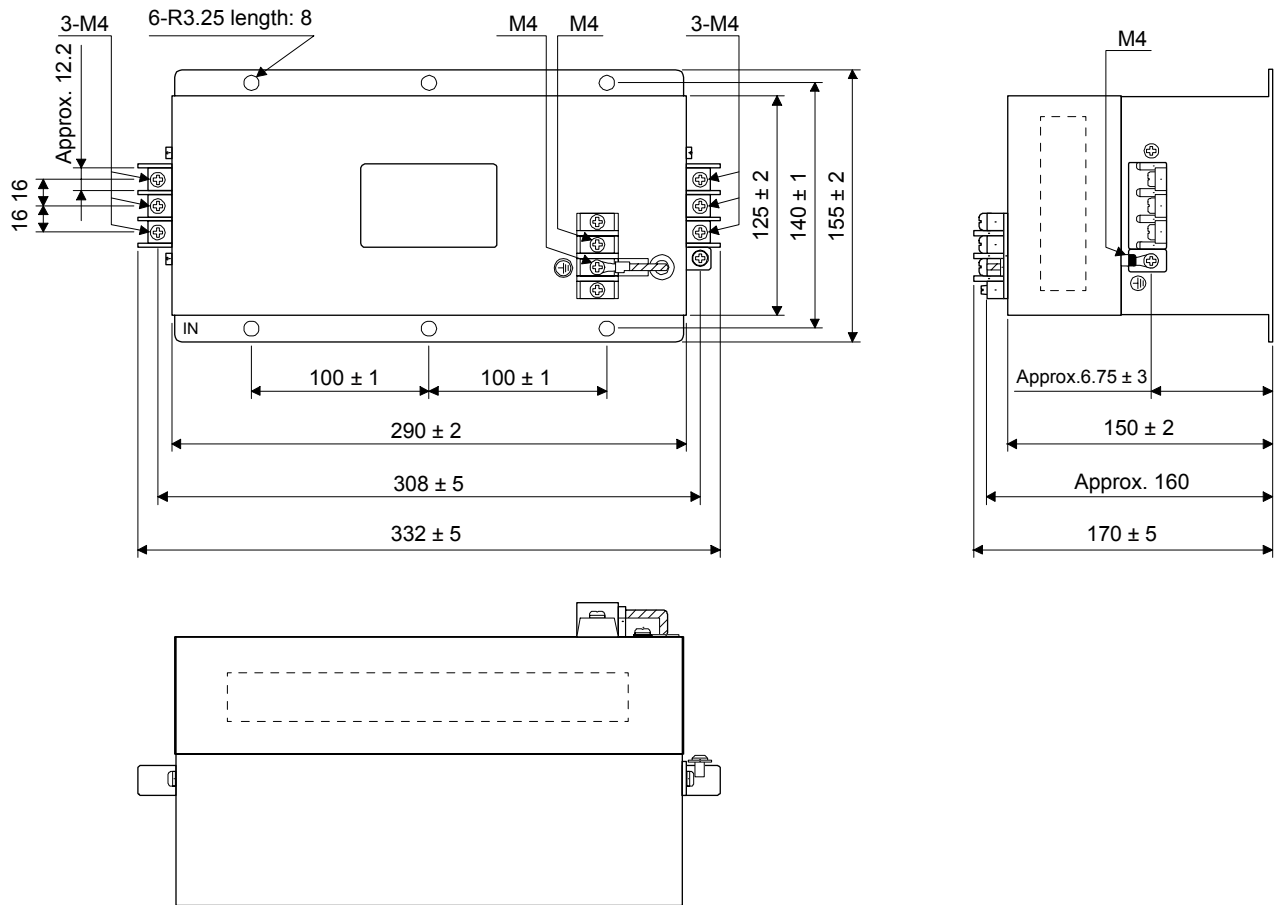
HF3100A-UN

[Unit: mm]



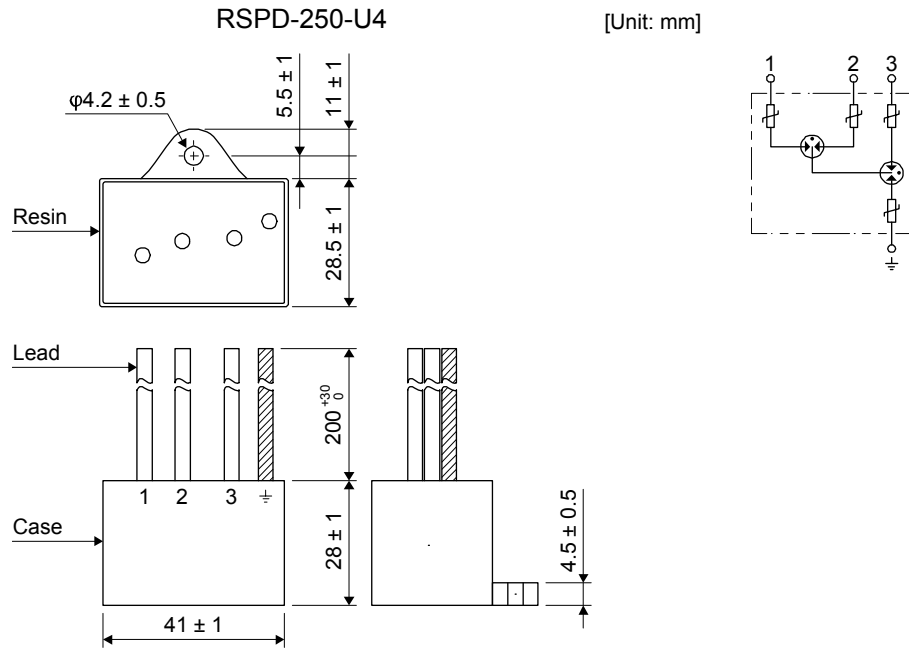
TF3005C-TX/TX3020C-TX/TF3030C-TX

[Unit: mm]



11. OPTIONS AND AUXILIARY EQUIPMENT

(b) Surge protector



11. OPTIONS AND AUXILIARY EQUIPMENT

11.17 External dynamic brake

CAUTION

- Use an external dynamic brake for a servo amplifier of MR-J4-11KA(-RJ) to MR-J4-22KA(-RJ). Failure to do so will cause an accident because the servo motor does not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire equipment. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.

POINT

- EM2 has the same function as EM1 in the torque control mode.
- Configure up a sequence which switches off the magnetic contactor of the brake unit after (or as soon as) SON (Servo-on) has been turned off at a power failure or a malfunction.
- For the braking time taken when the dynamic brake is operated, refer to section 10.3.
- The brake unit is rated for a short duration. Do not use it very frequently.
- Dynamic brake operates at occurrence of alarm, [AL. E6 Servo forced stop warning], and when power is turned off. 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.

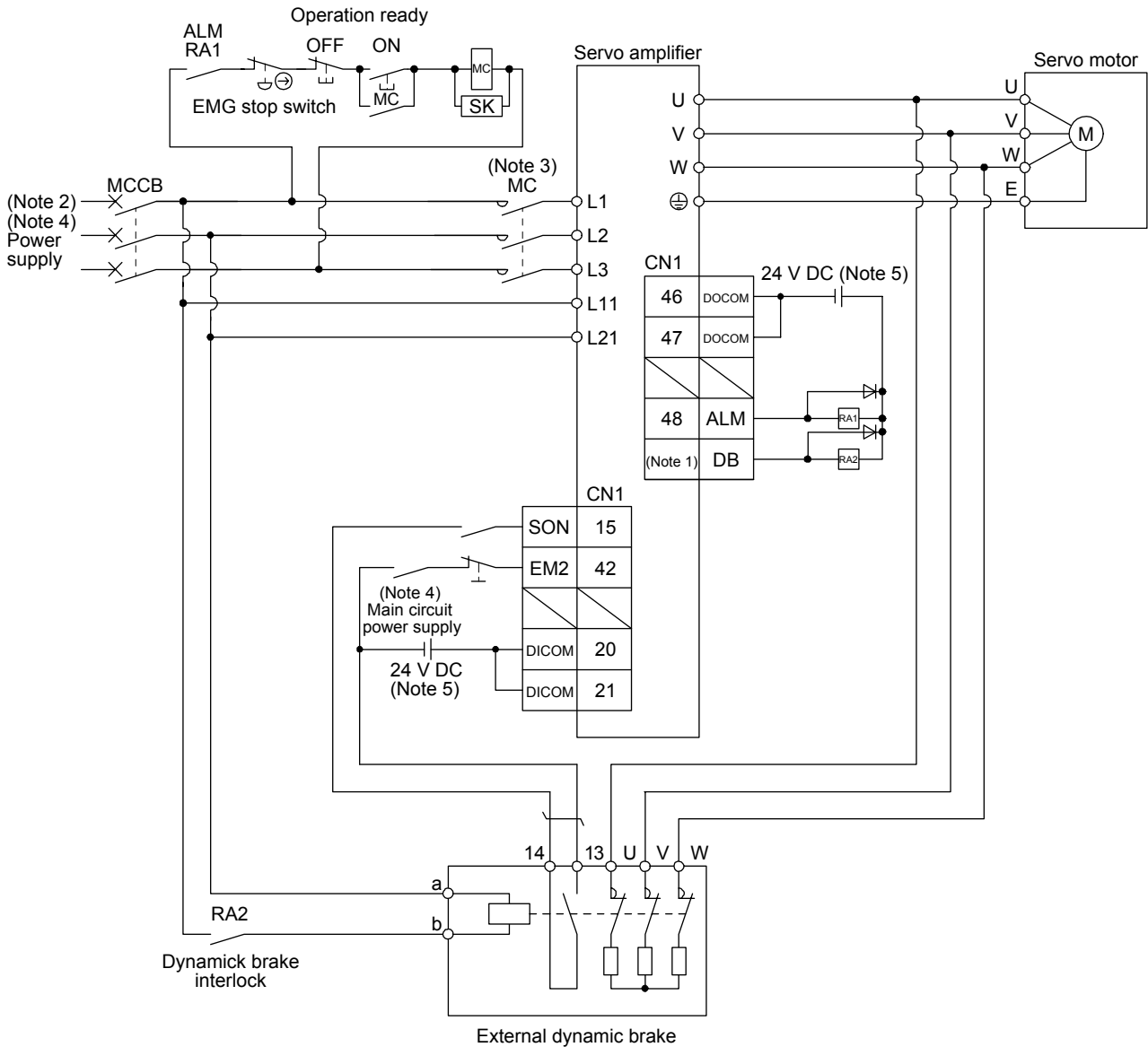
(1) Selection of dynamic brake

The dynamic brake is designed to bring the servo motor to a sudden stop when a power failure occurs or the protective circuit is activated, and is built in the 7 kW or less servo amplifier. Since it is not built in the 11 kW or more servo amplifier, purchase it separately. Assign DB (Dynamic brake interlock) to any of CN1-22 to CN1-25 and CN1-49 pins in [Pr. PD23] to [Pr. PD26] and [Pr. PD28].

Servo amplifier	Dynamic brake
MR-J4-11KA(-RJ)	DBU-11K
MR-J4-15KA(-RJ)	DBU-15K
MR-J4-22KA(-RJ)	DBU-22K-R1

11. OPTIONS AND AUXILIARY EQUIPMENT

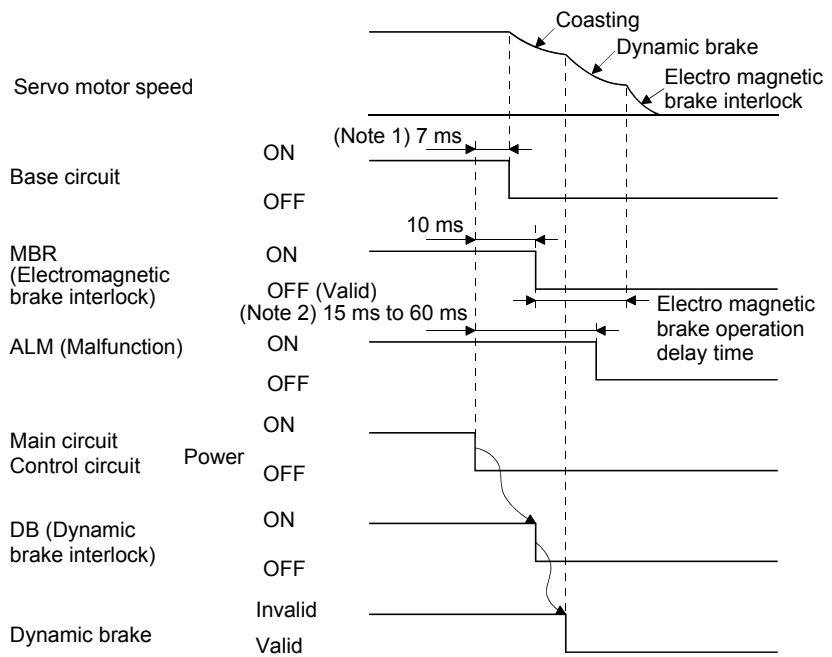
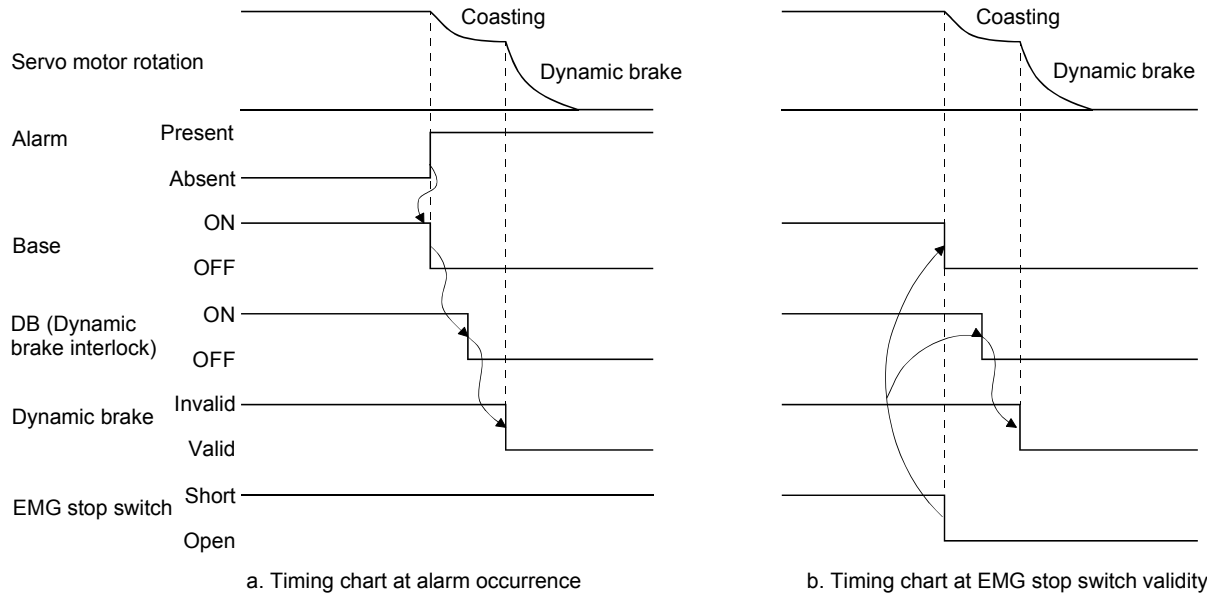
(2) Connection example



- Note 1. Assign DB (Dynamic brake interlock) in [Pr. PD23] to [Pr. PD26] and [Pr. PD28].
- Note 2. Refer to section 1.3 for the power supply specifications.
- Note 3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
- Note 4. Turn off EM2 when the main power circuit power supply is off.
- Note 5. 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.

11. OPTIONS AND AUXILIARY EQUIPMENT

(3) Timing chart



- Note 1. When powering off, DB (Dynamic brake interlock) will be turned off, and the base circuit is turned off earlier than usual before an output shortage occurs.
(Only when assigning the DB as the output signal in [Pr. PD23] to [Pr. PD26], or [Pr. PD028])
- Note 2. Variable according to the operation status.

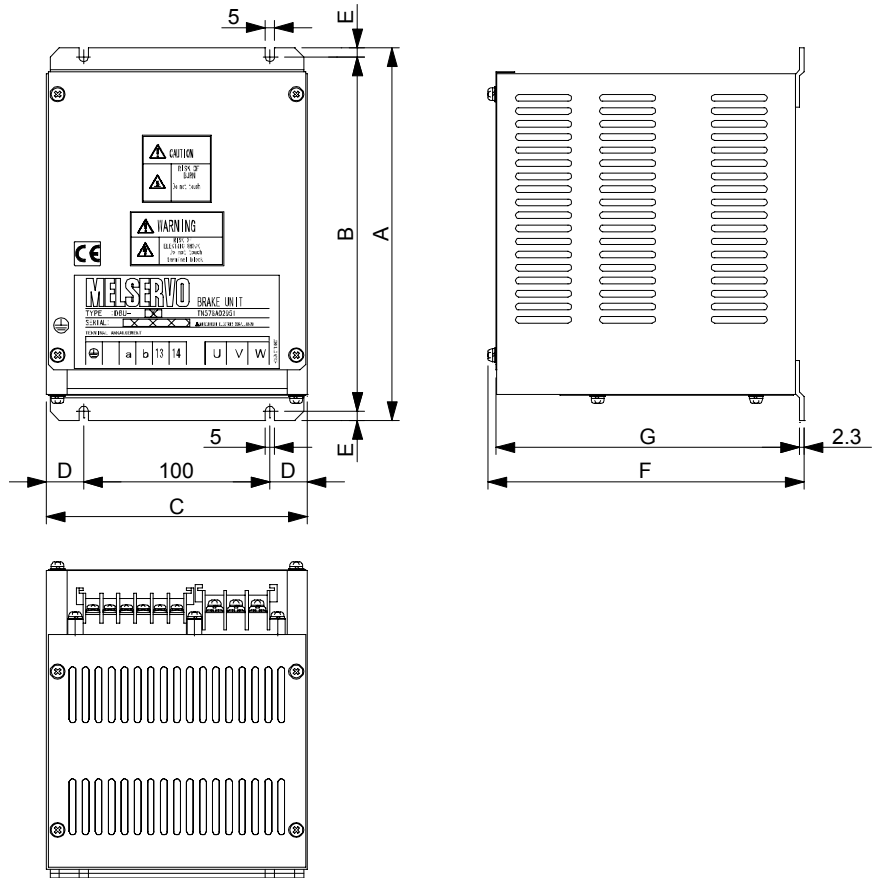
c. Timing chart when both of the main and control circuit power are off

11. OPTIONS AND AUXILIARY EQUIPMENT

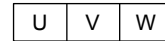
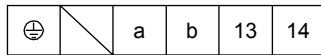
(4) Dimensions

(a) DBU-11K/DBU-15K/DBU-22K-R1

[Unit: mm]



Terminal block



Screw: M3.5
Tightening torque: 0.8 [N•m]

Screw: M4
Tightening torque: 1.2 [N•m]

Dynamic brake	A	B	C	D	E	F	G	Mass [kg]	(Note) Connection wire [mm ²]	
									U/V/W	Except U/V/W
DBU-11K	200	190	140	20	5	170	163.5	2	5.5 (AWG 10)	2 (AWG 14)
DBU-15K/DBU-22K-R1	250	238	150	25	6	235	228	6	5.5 (AWG 10)	2 (AWG 14)

Note. Selection conditions of wire size is as follows.

Wire type: 600 V grade heat-resistant polyvinyl chloride insulated wire (HIV wire)

Construction condition: One wire is constructed in the air.

11. OPTIONS AND AUXILIARY EQUIPMENT

11.18 Heat sink outside mounting attachment (MR-J4ACN15K/MR-J3ACN)

Use the heat sink outside mounting attachment to mount the heat generation area of the servo amplifier in the outside of the cabinet to dissipate servo amplifier-generated heat to the outside of the cabinet and reduce the amount of heat generated in the cabinet. In addition, designing a compact cabinet is allowed. In the cabinet, machine a hole having the panel cut dimensions, fit the heat sink outside mounting attachment to the servo amplifier with the fitting screws (4 screws supplied), and install the servo amplifier to the cabinet.

Please prepare screws for mounting. They do not come with.

The environment outside the cabinet when using the heat sink outside mounting attachment should be within the range of the servo amplifier operating environment.

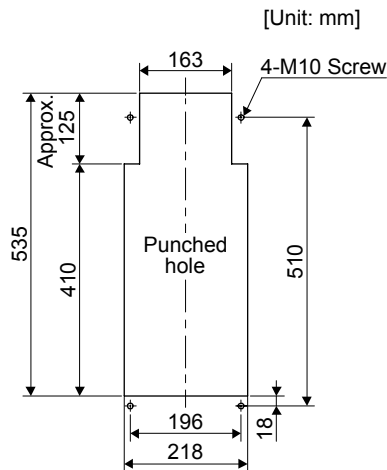
The heat sink outside mounting attachments are used for MR-J4-11KB(-RJ) to MR-J4-22KB(-RJ).

The following shows the combinations.

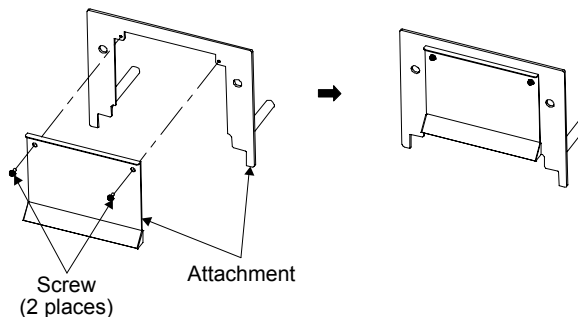
Servo amplifier	Heat sink outside mounting attachment
MR-J4-11KA, MR-J4-15KA	MR-J4ACN15K
MR-J4-22KA	MR-J3ACN

(1) MR-J4ACN15K

(a) Panel cut dimensions

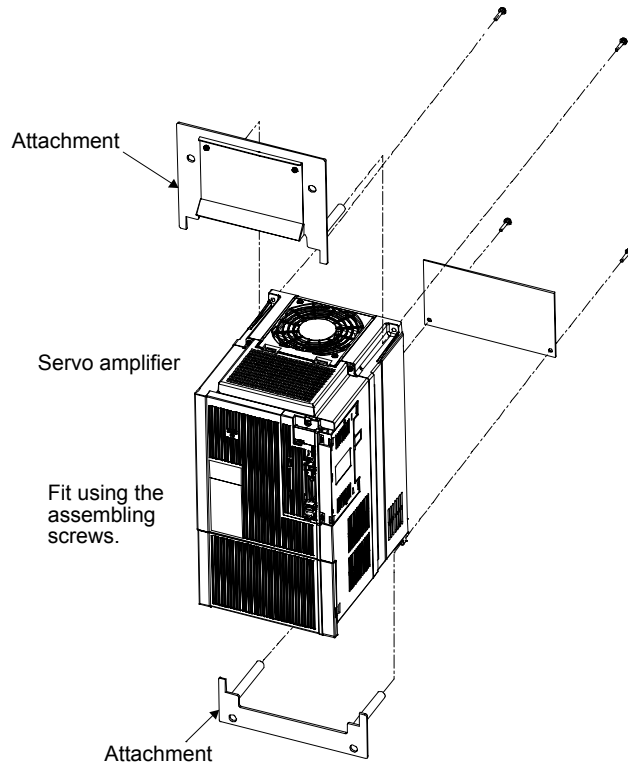


(b) How to assemble the attachment for heat sink outside mounting attachment

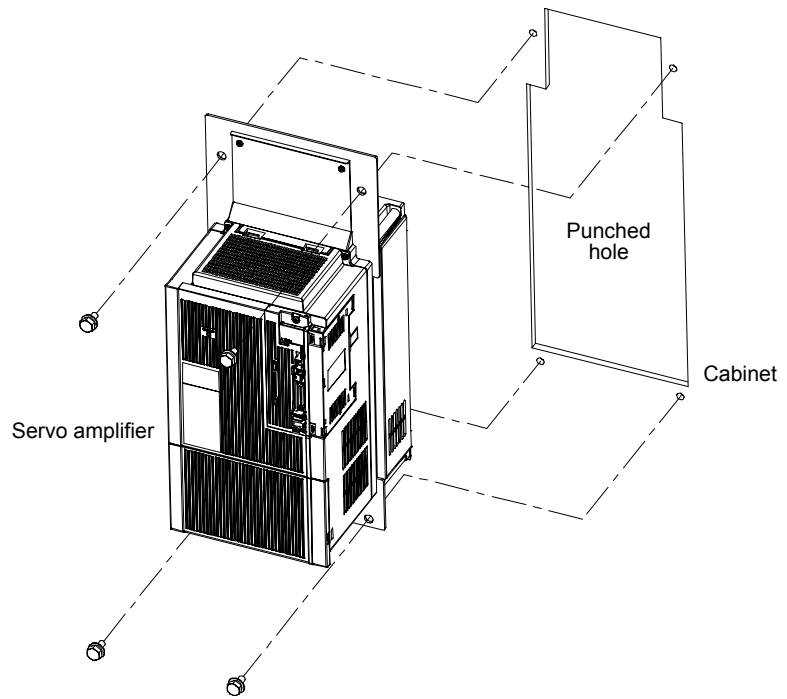


11. OPTIONS AND AUXILIARY EQUIPMENT

(c) Mounting method



a. Assembling the heat sink outside mounting attachment

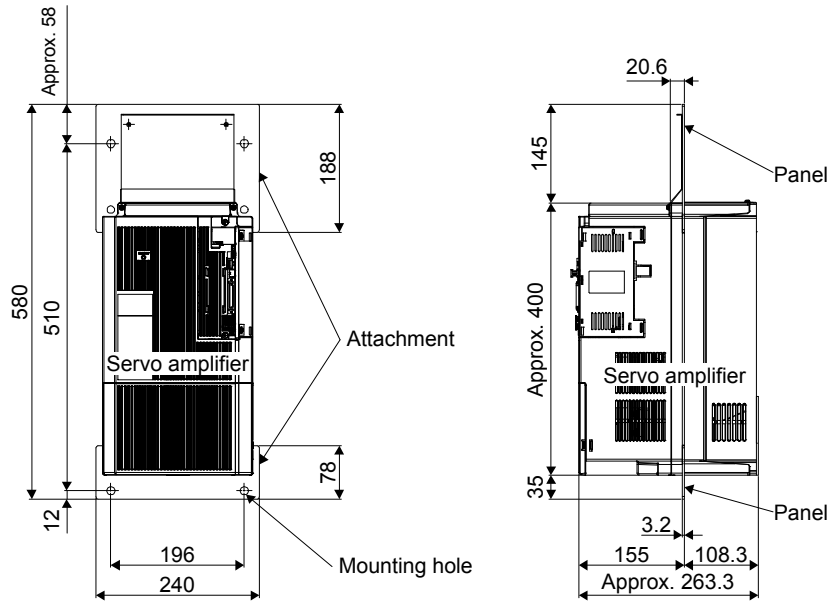


b. Mounting it to inside cabinet

11. OPTIONS AND AUXILIARY EQUIPMENT

(d) Mounting dimensional diagram

[Unit: mm]

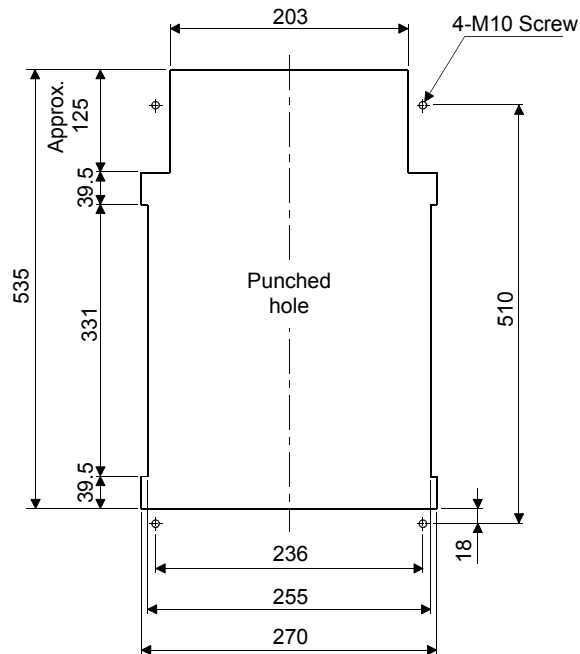


(2) MR-J3ACN

(a) Panel cut dimensions

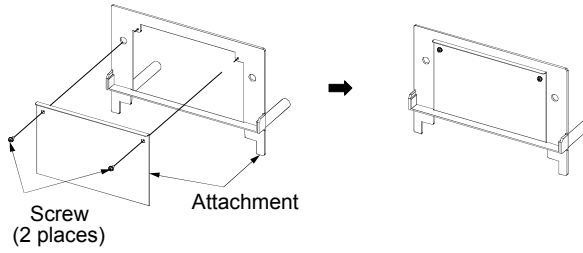
[Unit: mm]

[Unit : mm]

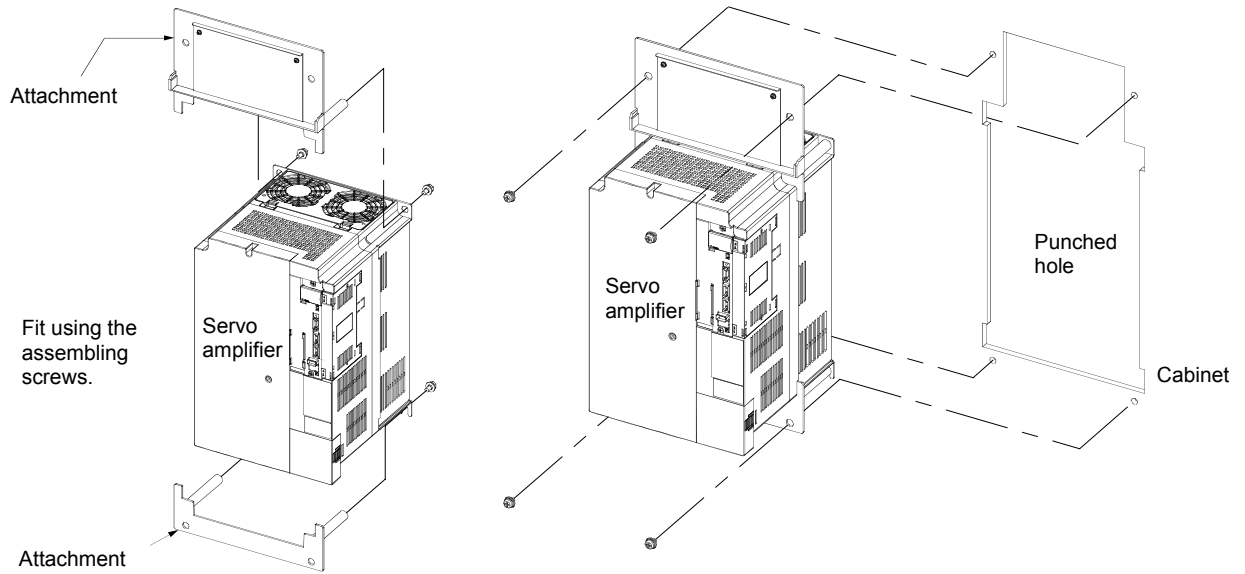


11. OPTIONS AND AUXILIARY EQUIPMENT

(b) How to assemble the attachment for heat sink outside mounting attachment



(c) Mounting method



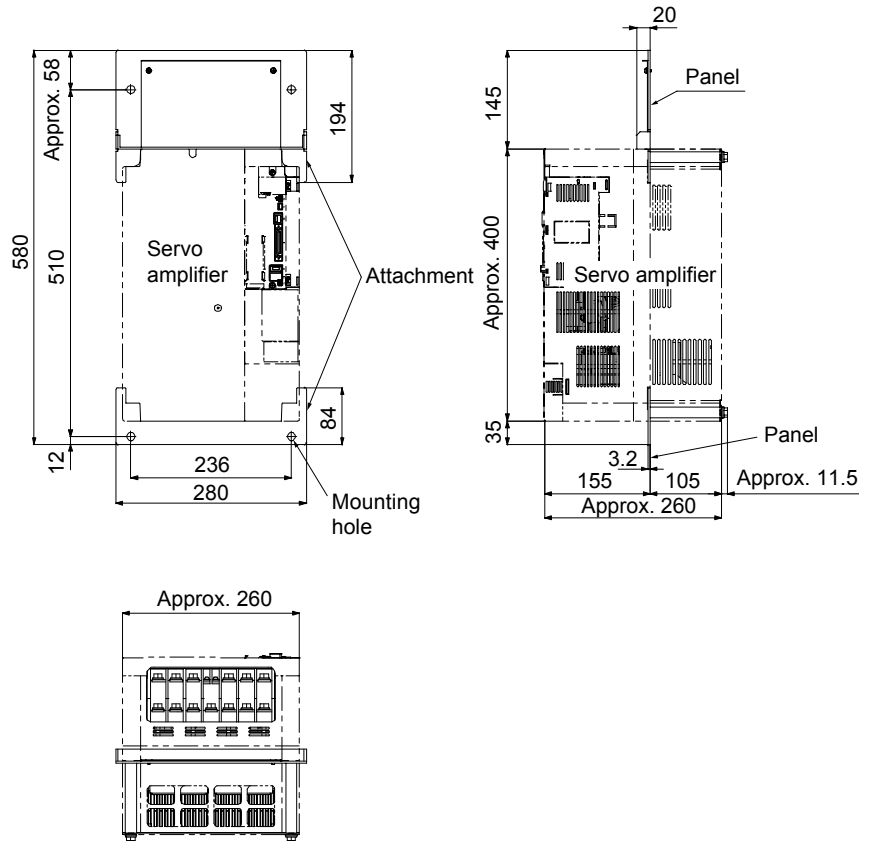
a. Assembling the heat sink outside mounting attachment

b. Mounting it to inside cabinet

11. OPTIONS AND AUXILIARY EQUIPMENT

(d) Mounting dimensional diagram

[Unit: mm]



12. ABSOLUTE POSITION DETECTION SYSTEM

12. ABSOLUTE POSITION DETECTION SYSTEM

! CAUTION

- If [AL. 25 Absolute position erased] or [AL. E3 Absolute position counter warning] has occurred, always perform home position setting again. Otherwise, it may cause an unexpected operation.
- Refer to appendix 2 and 3 for battery transportation and the new EU Battery Directive.
- If [AL. 25], [AL. 92], or [AL. 9F] occur due to such as short circuit of the battery, the MR-BAT6V1 battery can become hot. Use the MR-BAT6V1 battery with care to prevent getting burnt.

POINT

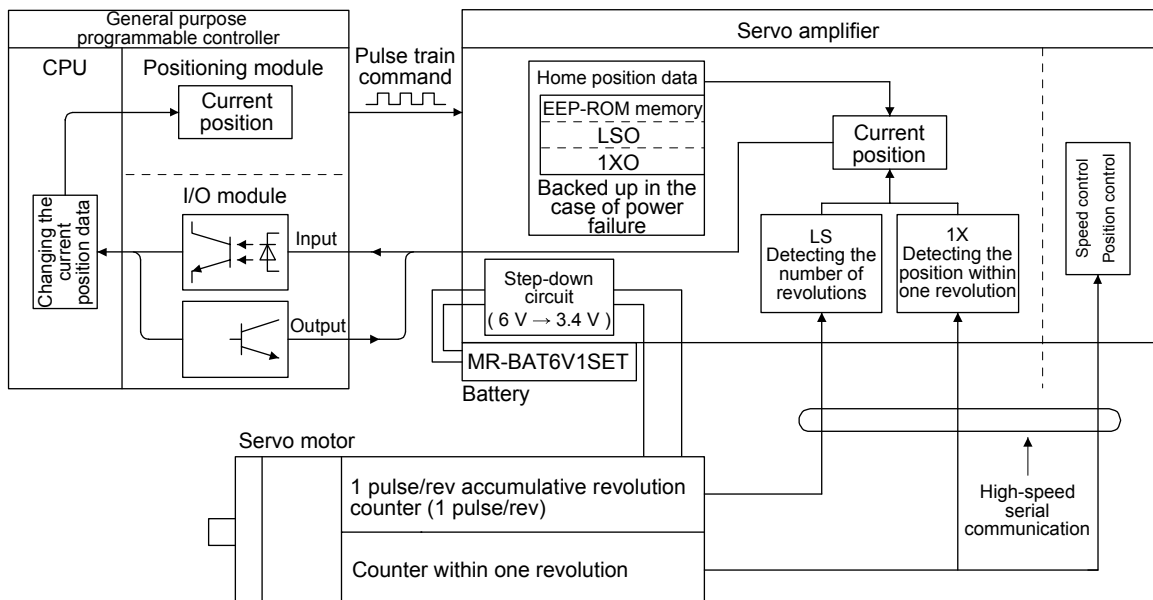
- Disconnecting the encoder cable will erase the absolute position data. After disconnecting the encoder cable, always execute home position setting and then positioning operation.

12.1 Summary

12.1.1 Features

For normal operation, as shown below, the encoder consists of a detector designed to detect a position within one revolution and a cumulative revolution counter designed to detect the number of revolutions. The absolute position detection system always detects the absolute position of the machine and keeps it battery-backed, independently of whether the programming controller power is on or off. Therefore, once home position return is made at the time of machine installation, home position return is not needed when power is switched on thereafter.

Even at a power failure or a malfunction, the system can be easily restored.



12. ABSOLUTE POSITION DETECTION SYSTEM

12.1.2 Restrictions

The absolute position detection system cannot be configured under the following conditions. Test operation cannot be performed in the absolute position detection system, either. To perform test operation, select incremental system in [Pr. PA03].

- (1) Speed control mode and torque control mode.
- (2) Control switch-over mode (position/speed, speed/torque, and torque/position).
- (3) Stroke-less coordinate system, e.g. rotary shaft, infinitely long positioning.
- (4) Changing of electronic gear after home position setting.
- (5) Use of alarm code output.

12. ABSOLUTE POSITION DETECTION SYSTEM

12.2 Specifications

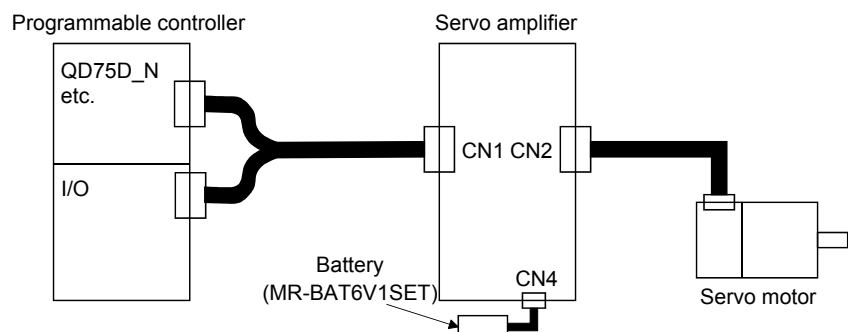
(1) Specification list

Item		Description
System		Electronic battery backup type
Battery	Model	MR-BAT6V1SET
	Battery pack	2CR17335A (Primary lithium battery)
	Nominal voltage [V]	6
	Nominal capacity [mAh]	1650
	Operating temperature [°C]	0 to 55
	Operating temperature [°C]	0 to 55
	Amount of lithium metal [g]	1.2
	Mercury content	Less than 1 ppm
	Dangerous goods class	Inapplicable to Class 9 (Battery pack containing 2 g or less lithium)
	Operating humidity and storage humidity	90% RH or less (non-condensing)
	Mass [g]	34
Maximum revolution range		Home position ±32767 rev.
(Note 1) Maximum speed at power failure [r/min]	Rotary servo motor	6000 (However, it is only when the acceleration time up to 6000 r/min is 0.2 s or longer.)
(Note 2) Battery backup time	Rotary servo motor	Approximately 20,000 hours (equipment power supply: off, ambient temperature: 20 °C)
(Note 3) Battery life		5 years from date of manufacture

- Note 1. Maximum speed available when the shaft is rotated by external force at the time of power failure or the like.
2. The data-holding time using a battery of MR-BAT6V1SET on condition that the power supply of the servo amplifier is off. Replace the batteries within 3 years since the operation start whether the power supply of the servo amplifier is on/off. If the battery is used out of specification, [AL. 25 absolute position lost] may occur.
3. Quality of the batteries degrades by the storage condition. The battery life is 5 years from the production date regardless of the connection status.

(2) Configuration

Positioning module	I/O module
QD70P_ , QD70D_	
QD75P_N, QD75D_N	QX40, QX41, QX42 QY40, QY41, QY42, QY50
LD75P4, LD75D4	LY40NT5P, LY41NT1P, LY42NT1P LY40PT5P, LY41PT1P, LY42PT1P
FX2N-_GM, FX2N-_PG	FX2N series, FX0N series



12. ABSOLUTE POSITION DETECTION SYSTEM

(3) Parameter setting

POINT
●Set "___ 2" in [Pr. PA03] when using the absolute position detection system by communication. This parameter setting is supported by servo amplifier with software version A3 or later.


Set "___ 1" in [Pr. PA03] to enable the absolute position detection system. Set "___ 2" when using the communication-based ABS transfer system. Refer to section 12.10 for the communication-based ABS transfer system.


[Pr. PA03]

			1
--	--	--	---

Absolute position detection system selection
0: Disabled (incremental system)
1: Enabled (absolute position detection system by DIO)
2: Enabled (absolute position detection system by communication-based)
(available for the software version A3 or later)

12.3 Battery replacement procedure

 WARNING	●Before installing a battery, turn off the main circuit power and wait for 15 minutes or longer until the charge lamp turns off. Then, check the voltage between P+ and N- with a voltage tester or others. 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	●The internal circuits of the servo amplifier may be damaged by static electricity. Always take the following precautions. <ul style="list-style-type: none">▪ Ground human body and work bench.▪ Do not touch the conductive areas, such as connector pins and electrical parts, directly by hand.
--	--

POINT
●Replacing battery with the control circuit power off will erase the absolute position data.
●Before replacing batteries, check that the new batteries are within battery life.

Replace the battery with only the control circuit power on. Replacing battery with the control circuit power on will not erase the absolute position data.

Refer to section 12.4 for installation procedure of battery to the servo amplifier.

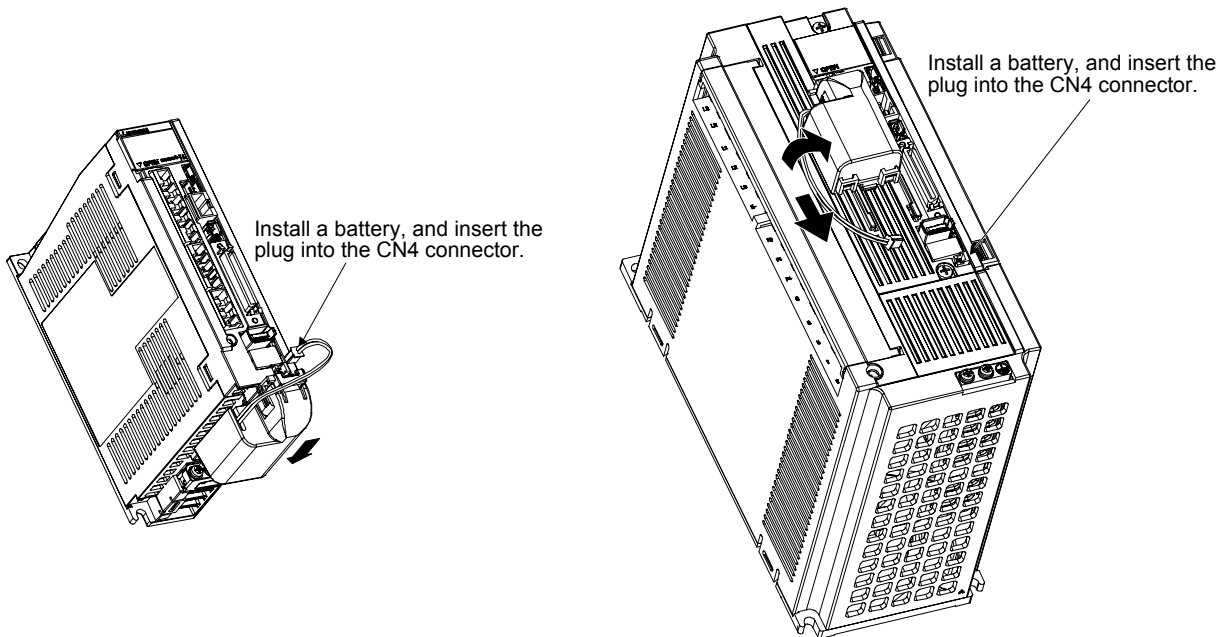
12. ABSOLUTE POSITION DETECTION SYSTEM

12.4 Battery installation and removal procedure

(1) Installation procedure

POINT

- For the servo amplifier with a battery holder on the bottom, it is not possible to wire for the earth with the battery installed. Insert the battery after executing the earth wiring of the servo amplifier.



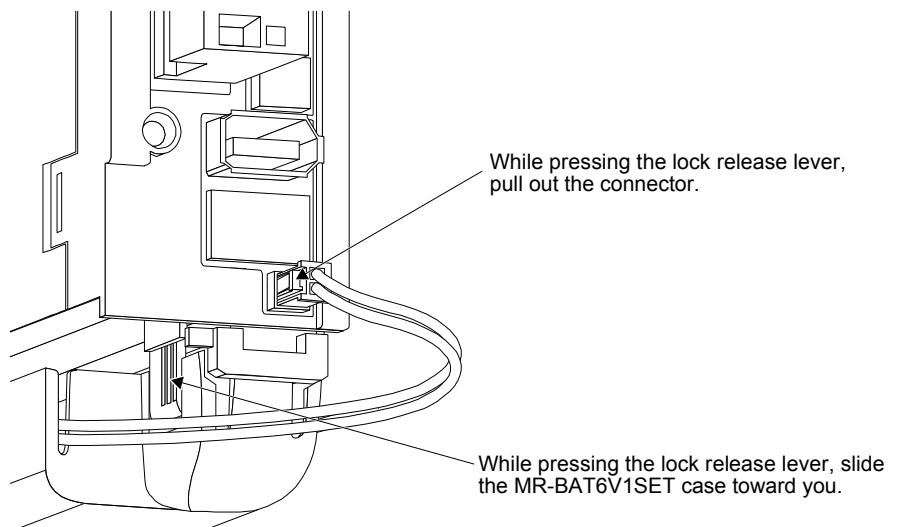
MR-J4-350A(-RJ) or smaller capacity models

MR-J4-500A(-RJ) or larger capacity models

(2) Removal procedure

! CAUTION

- Pulling out the connector of the MR-BAT6V1SET without the lock release lever pressed may damage the CN4 connector of the servo amplifier or the connector of the MR-BAT6V1SET.

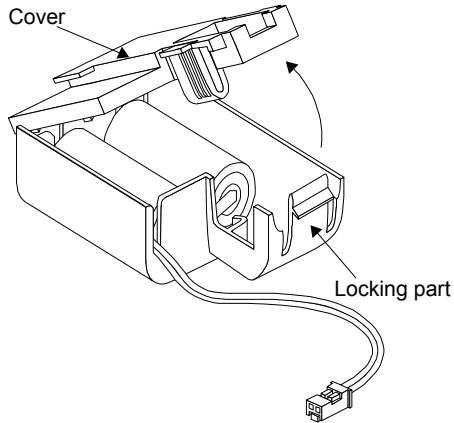


12. ABSOLUTE POSITION DETECTION SYSTEM

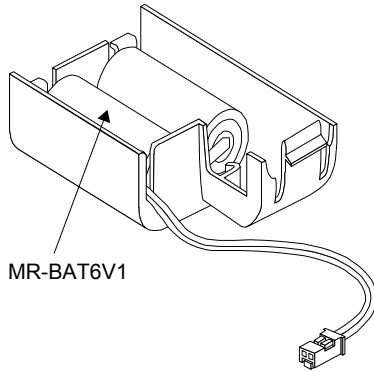
(3) Replacement procedure of the battery in the MR-BAT6V1SET

When the MR-BAT6V1SET reaches the end of its life, replace the MR-BAT6V1 battery in the MR-BAT6V1SET.

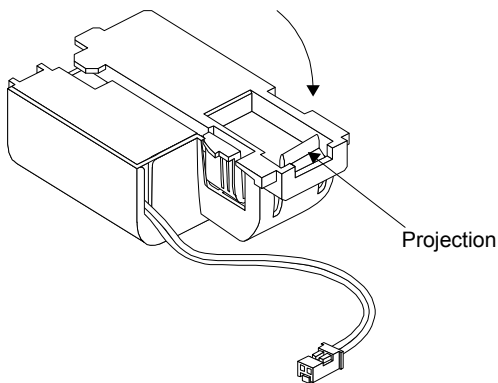
While pressing the locking part, open the cover.



Replace the battery with a new MR-BAT6V1 battery.

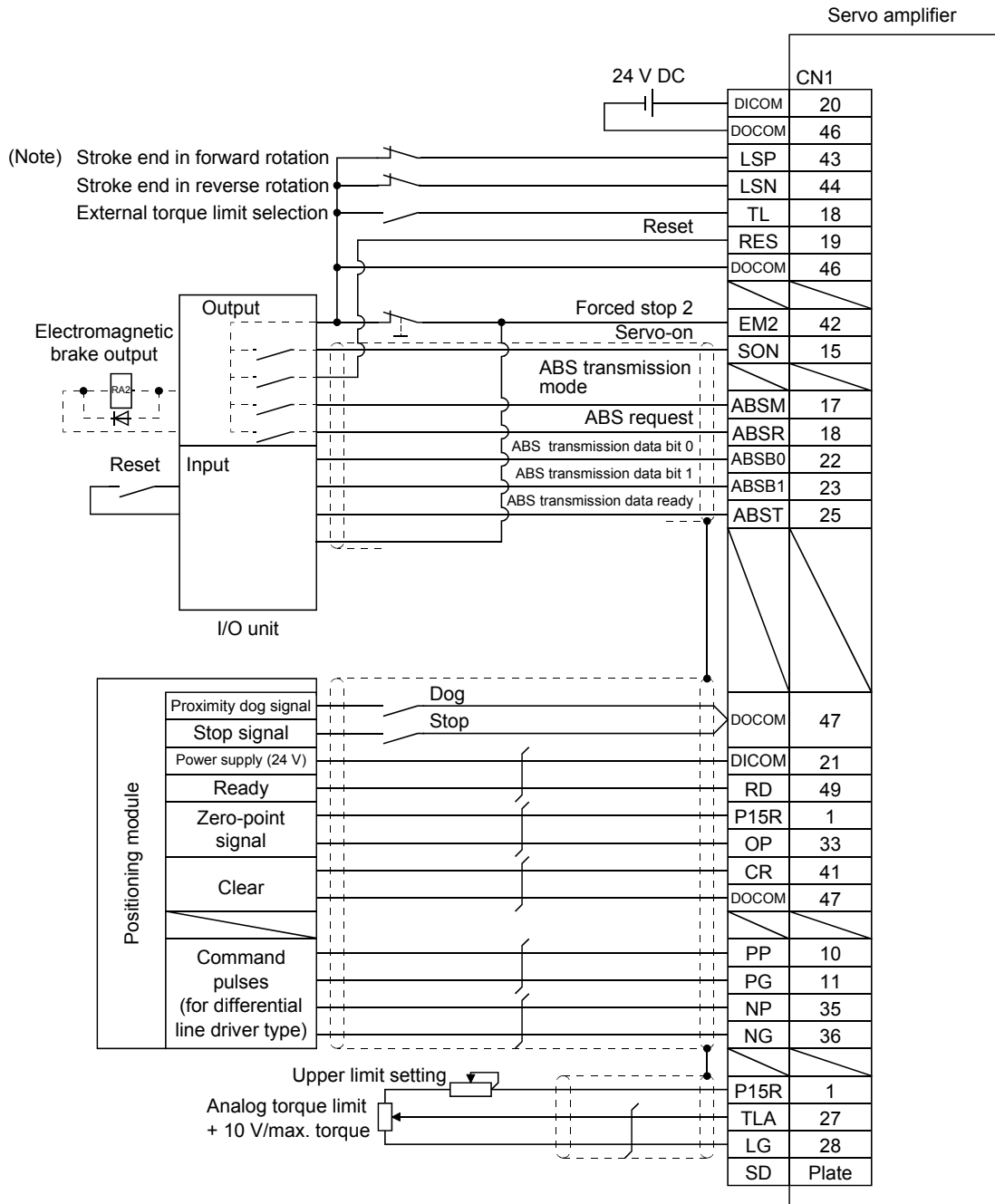


Press the cover until it is fixed with the projection of the locking part to close the cover.



12. ABSOLUTE POSITION DETECTION SYSTEM

12.5 Standard connection example



Note. For operation, always turn on LSP and LSN.

12. ABSOLUTE POSITION DETECTION SYSTEM

12.6 Signal explanation

When the absolute position data is transferred, the signals of connector CN1 change as described in this section. They return to the previous status on completion of data transfer. The other signals are as described in section 3.5.

For the I/O interfaces (symbols in the I/O Category column in the table), refer to section 3.8.2.

Signal name	Code	CN1 connector pin No.	Function/Application	I/O category	Control mode
ABS transfer mode	ABSM	(Note) 17	While ABSM is on, the servo amplifier is in the ABS transfer mode, and the functions of CN1-22, CN1-23, and CN1-25 are as indicated in this table.	DI-1	P (Position control)
ABS request	ABSR	(Note) 18	Turn on ABSR to request the absolute position data in the ABS transfer mode.	DI-1	
ABS transmission data bit 0	ABSB0	22	Indicates the lower bit of the absolute position data (2 bits) which is sent from the servo to the programmable controller in the ABS transfer mode. If there is a signal, D01 turns on.	DO-1	
ABS transmission data bit 1	ABSB1	23	Indicates the upper bit of the absolute position data (2 bits) which is sent from the servo to the programmable controller in the ABS transfer mode.	DO-1	
ABS transmission data ready	ABST	25	Indicates that the data to be sent is being prepared in the ABS transfer mode. At the completion of the ready state, ABST turns on.	DO-1	
Home position setting	CR	41	When CR is turned on, the position control counter is cleared and the home position data is stored into the non-volatile memory (backup memory).	DI-1	

Note. When "Used in absolute position detection system" is selected in [Pr. PA03], pin 17 acts as ABSM and pin 18 as ABSR. They do not return to the original signals if data transfer ends.

12. ABSOLUTE POSITION DETECTION SYSTEM

12.7 Startup procedure

- (1) Battery installation.
Refer to section 12.4.
- (2) Parameter setting
Set " _ _ _ 1" in [Pr. PA03] of the servo amplifier and switch power off, then on.
- (3) Resetting of [AL. 25 Absolute position erased]
After connecting the encoder cable, [AL. 25] occurs at first power-on. Turn off the power, then on to reset the alarm.
- (4) Confirmation of absolute position data transfer
When SON is turned on, the absolute position data is transferred to the programmable controller. Transferring the proper absolute position data will trigger the followings.
 - (a) RD (Ready) turns on.
 - (b) The absolute position data ready contact of programmable controller turns on.
 - (c) The MR Configurator2 ABS data display window (refer to section 12.11) and programmable controller side ABS data registers show the same value (at the home position address of 0).
If any warning such as [AL. E5 ABS time-out warning] or programmable controller side transfer error occurs, refer to section 12.9 or chapter 8 and take corrective action.
- (5) Home position setting
The home position must be set if.
 - (a) System set-up is performed;
 - (b) The servo amplifier has been changed;
 - (c) The servo motor has been changed; or
 - (d) [AL. 25 Absolute position erased] occurred.

In the absolute position detection system, the absolute position coordinates are made up by making home position setting at the time of system set-up. The motor shaft may operate unexpectedly if positioning operation is performed without home position setting.

Always make home position setting before starting.

For the home position setting method and types, refer to section 12.8.3.

12. ABSOLUTE POSITION DETECTION SYSTEM

12.8 Absolute position data transfer protocol

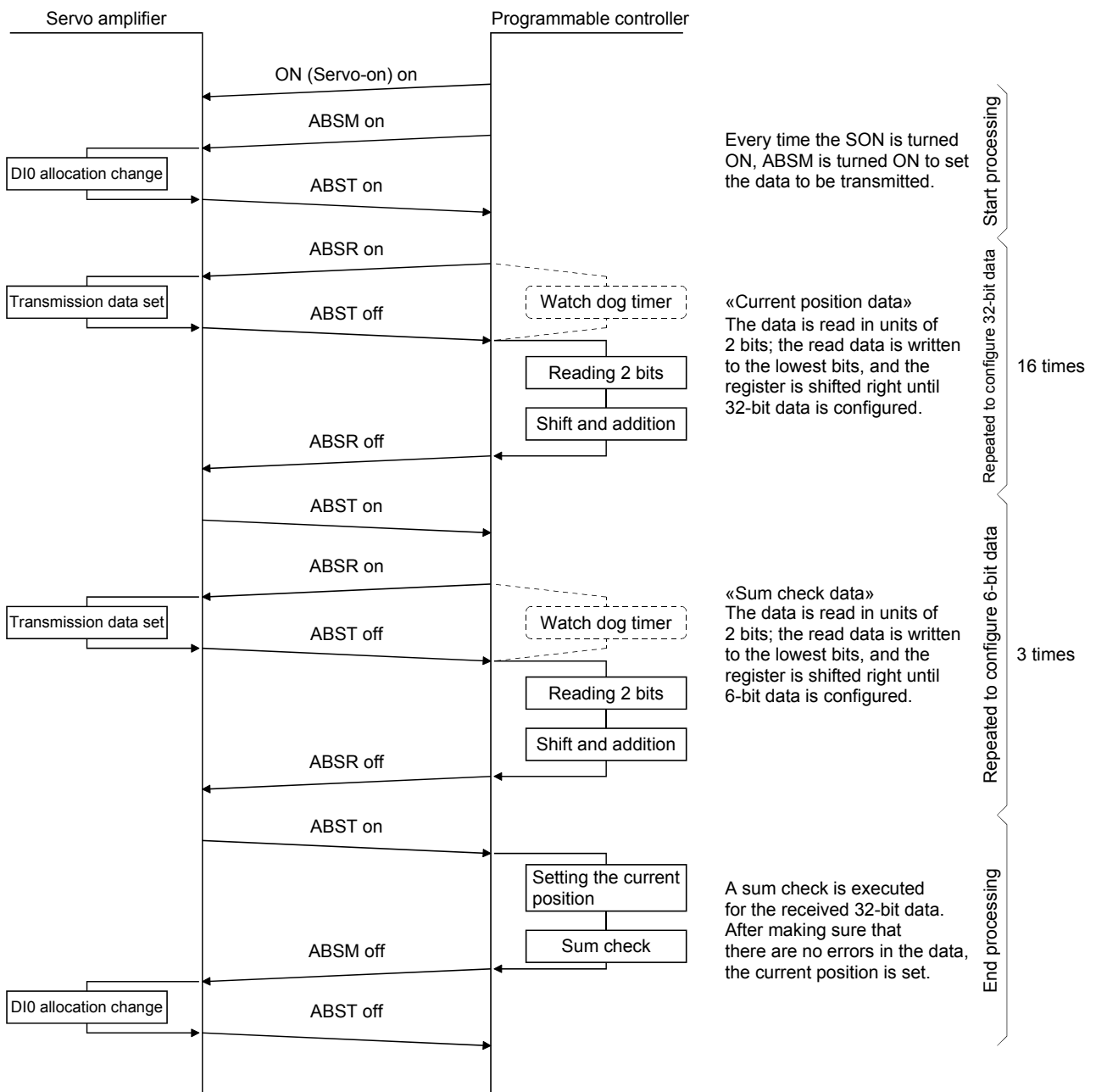
POINT

● After switching on ABSM, turn on SON. When the ABS transfer mode is off, turning on SON does not switch on the base circuit.

12.8.1 Data transfer procedure

Each time SON is turned on (when the power is switched on for example), the programmable controller reads the position data (present position) of the servo amplifier.

Time-out monitoring is performed by the programmable controller.

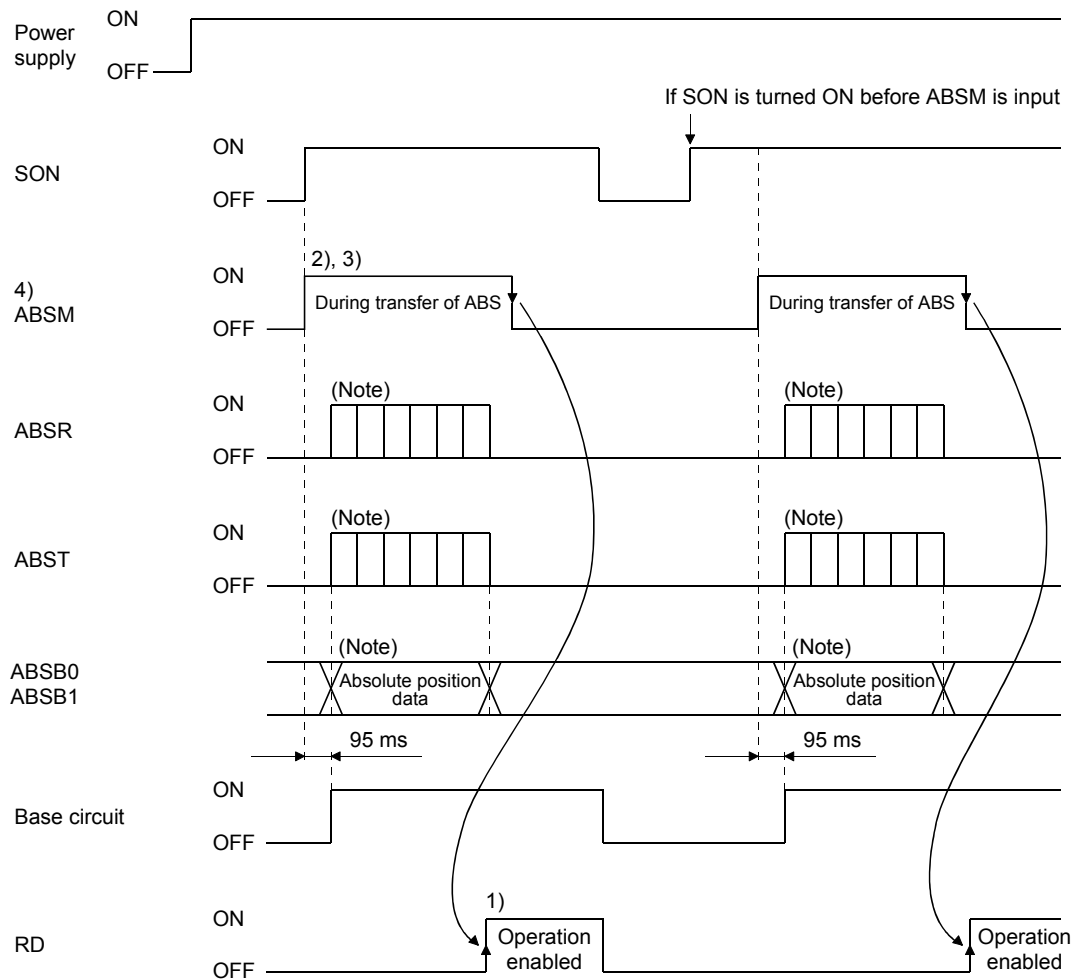


12. ABSOLUTE POSITION DETECTION SYSTEM

12.8.2 Transfer method

The following shows a sequence how to turn on the base circuit while it is off state because SON is off, EM2 is off, or an alarm is occurring. In the absolute position detection system, every time SON is turned on, ABSM should always be turned on to read the current position in the servo amplifier to the controller. The servo amplifier transmits to the controller the current position latched when ABSM switches from off to on. At the same time, this data is set as a position command value inside the servo amplifier. Unless ABSM (ABS transfer mode) is turned on, the base circuit cannot be turned on.

- (1) At power-on
 (a) Timing chart



Note. For details, refer to (1) (b) of this section.

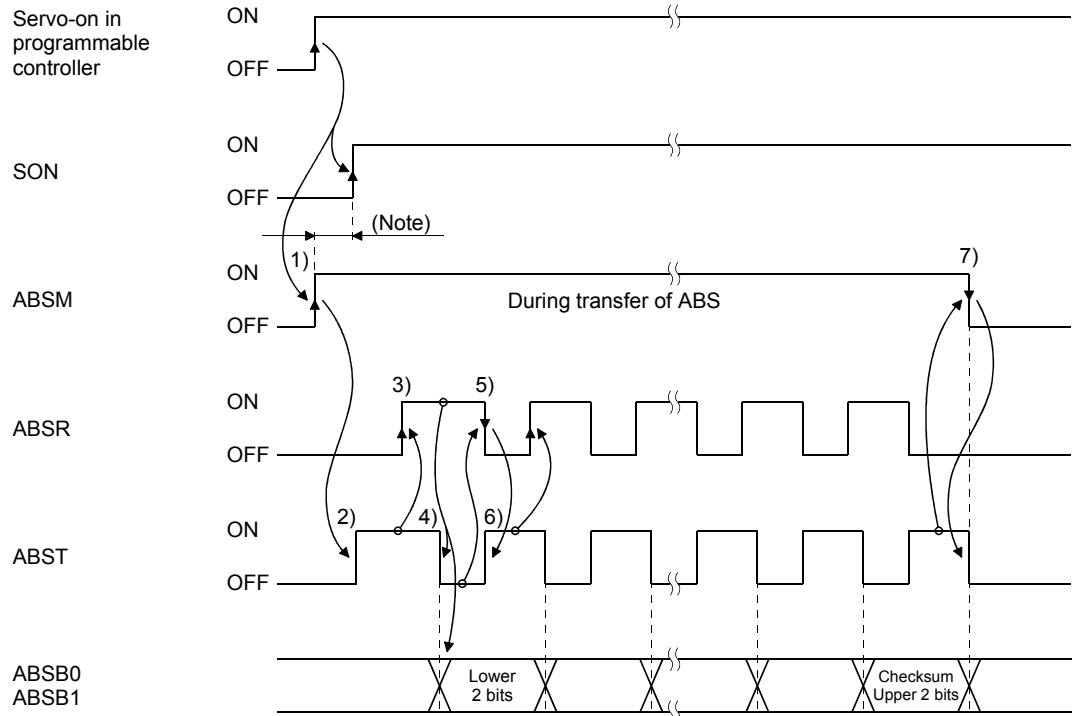
12. ABSOLUTE POSITION DETECTION SYSTEM

- 1) After the absolute position data is transmitted, RD turns on by ABSM-off. When RD is on, ABSM-on is not received.
- 2) Even if SON is turned on before ABSM is turned on, the base circuit is not turned on until ABSM is turned on.
If a servo alarm has occurred, ABSM is not received. ABSM allows data transmission even while a servo warning is occurring.
- 3) If ABSM is turned off during the ABS transfer mode, the ABS transfer mode is interrupted and [AL. E5 ABS time-out warning] occurs.
If SON is turned off, RES is turned on, and EM2 is turned off during the ABS transfer mode, [AL. E5 ABS time-out warning] occurs.
- 4) Note that if ABSM is turned on for a purpose other than absolute position data transmission, the output signals will be assigned the functions of absolute position data transmission.

CN1 Pin No.	Output signal	
	ABSM (ABS transfer mode): off	ABSM (ABS transfer mode): on
22	Positioning completion	transmission data bit 03
23	Zero speed detection	transmission data bit 1
25	During torque limit control	transmission data ready

- 5) ABSM is not accepted while the base circuit is on. For re-transferring, turn off SON signal and keep the base circuit in the off state for 20 ms or longer.

(b) Detailed description of absolute position data transfer



Note. If SON does not turn on within 1 s after ABSM off, [AL. EA ABS servo-on warning] will occur. But it will not influence the transfer. SON on will cancel [AL. EA] automatically.

12. ABSOLUTE POSITION DETECTION SYSTEM

(2) Transmission error

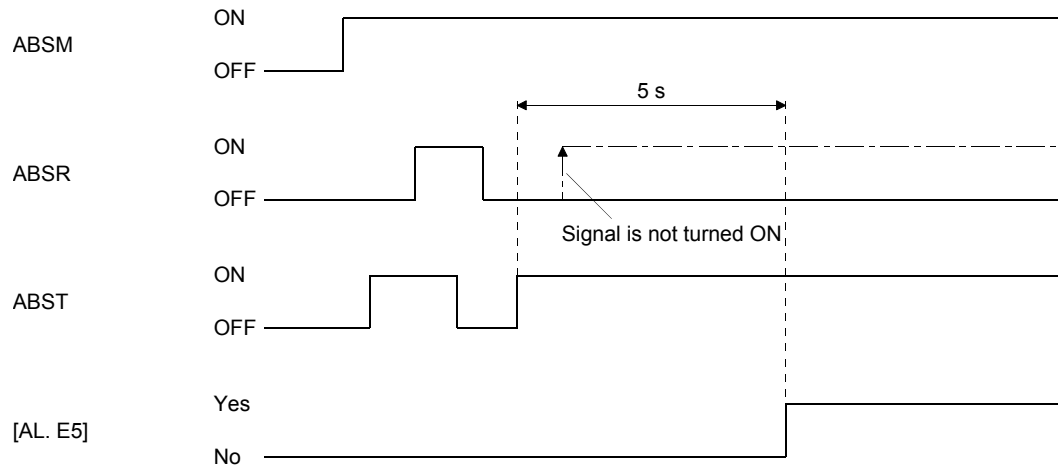
(a) [AL. E5 ABS time-out warning]

In the ABS transfer mode, the servo amplifier processes time-out below, and displays [AL. E5] when a time-out error occurs.

[AL. E5 ABS time-out warning] is cleared when ABSM changes from off to on.

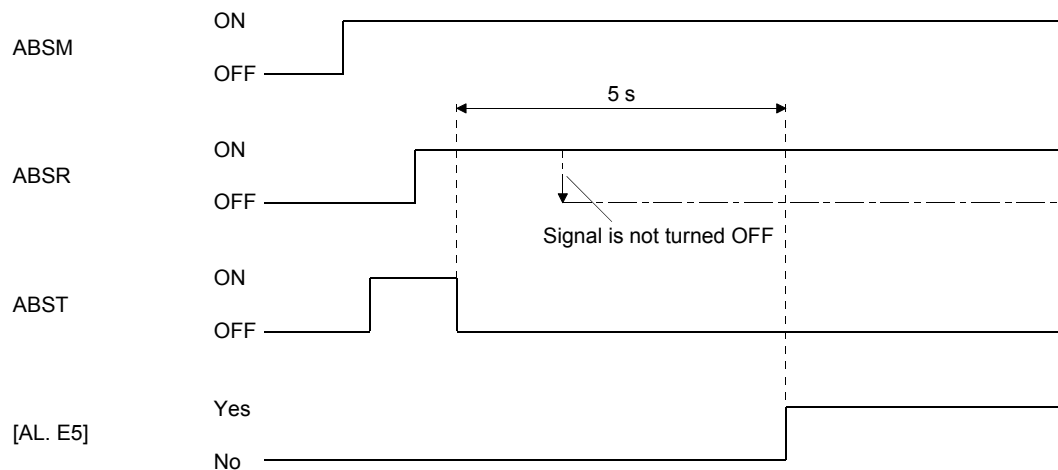
1) ABS request off-time time-out check (applied to 32-bit absolute position data in 2-bit units checksum)

If the ABS request signal is not turned on by the programmable controller within 5 s after ABST is turned on, this is regarded as a transmission error and [AL. E5 ABS time-out warning] is output.



2) ABS request on-time time-out check (applied to 32-bit absolute position data in 2-bit units checksum)

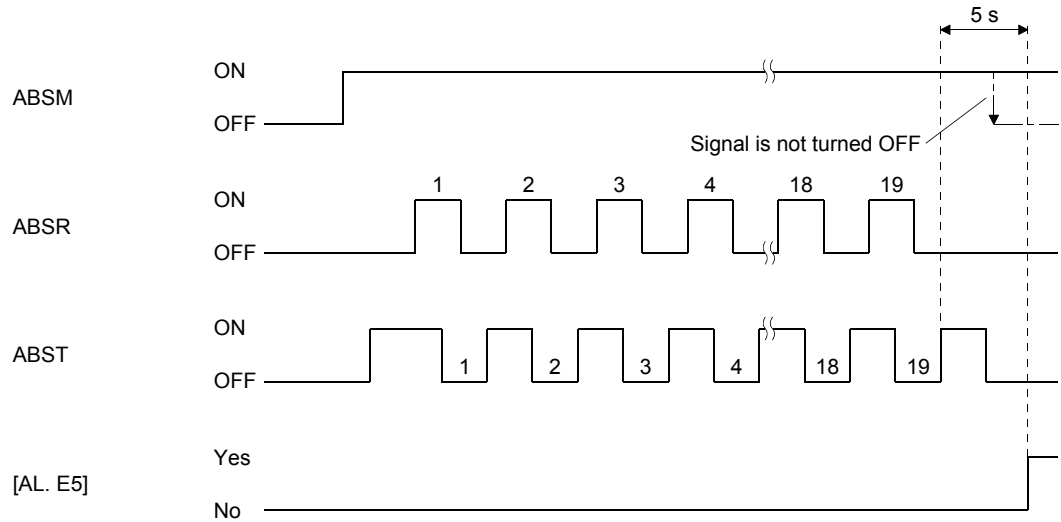
If the ABSR is not turned off by the programmable controller within 5 s after ABST is turned off, this is regarded as the transmission error and [AL. E5 ABS time-out warning] is output.



12. ABSOLUTE POSITION DETECTION SYSTEM

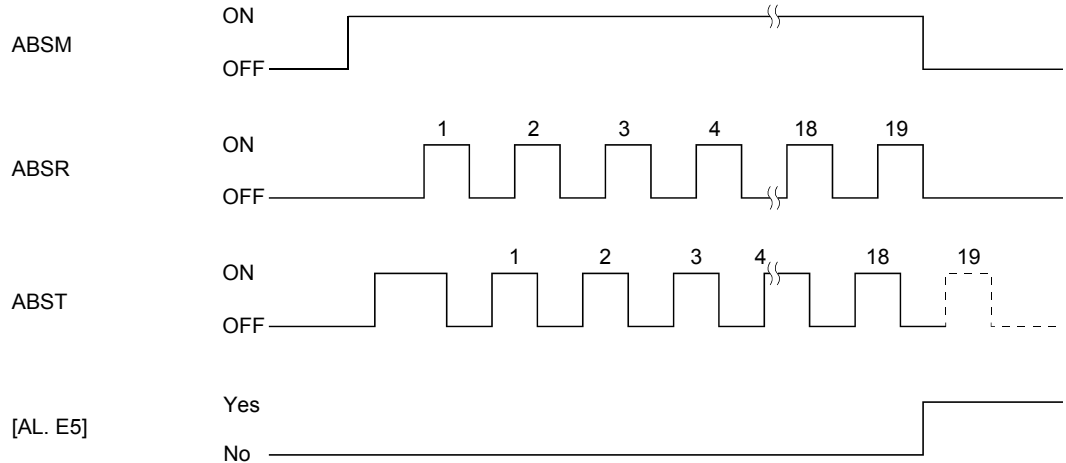
3) ABS transfer mode finish-time time-out check

If ABSM is not turned off within 5 s after the last ABS transmission data ready (19th signal for absolute position data transmission) is turned on, it is regarded as the transmission error and the [AL. E5 ABS time-out warning] is output.



4) ABSM-off check during the ABS transfer

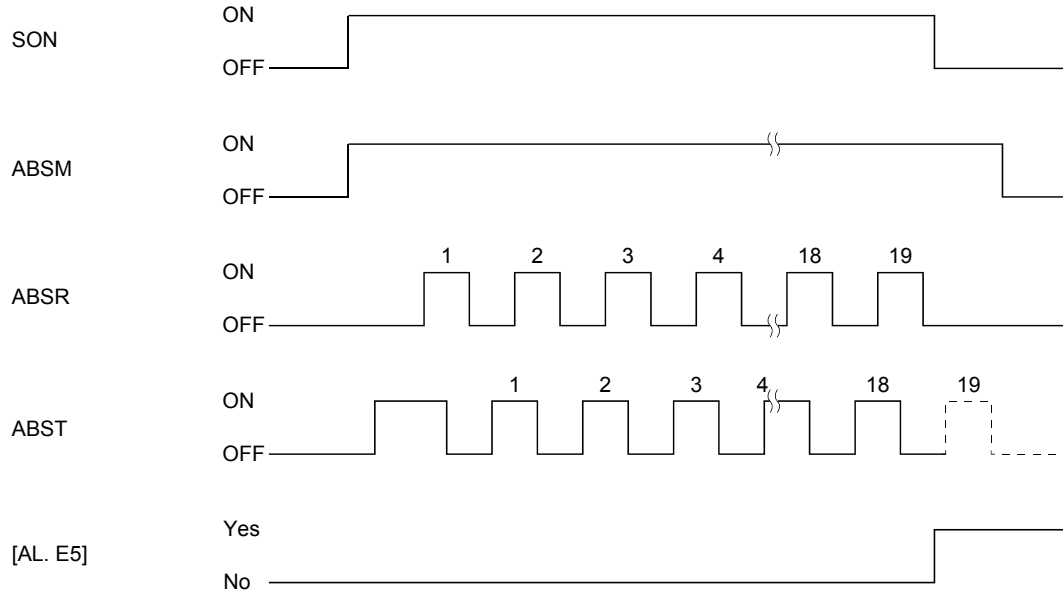
When the ABSM is turned on to start transferring and then the ABS transfer mode is turned off before the 19th ABS transmission data ready is turned on, [AL. E5 ABS time-out warning] occurs, regarding it as a transfer error.



12. ABSOLUTE POSITION DETECTION SYSTEM

5) SON off, RES on, and EM2 off check during the ABS transfer

When the ABS transfer mode is turned on to start transferring and then SON is turned off, RES is turned on, or EM2 is turned on before the 19th ABST is turned on, [AL. E5 ABS time-out warning] occurs, regarding it as a transfer error.



(b) Checksum error

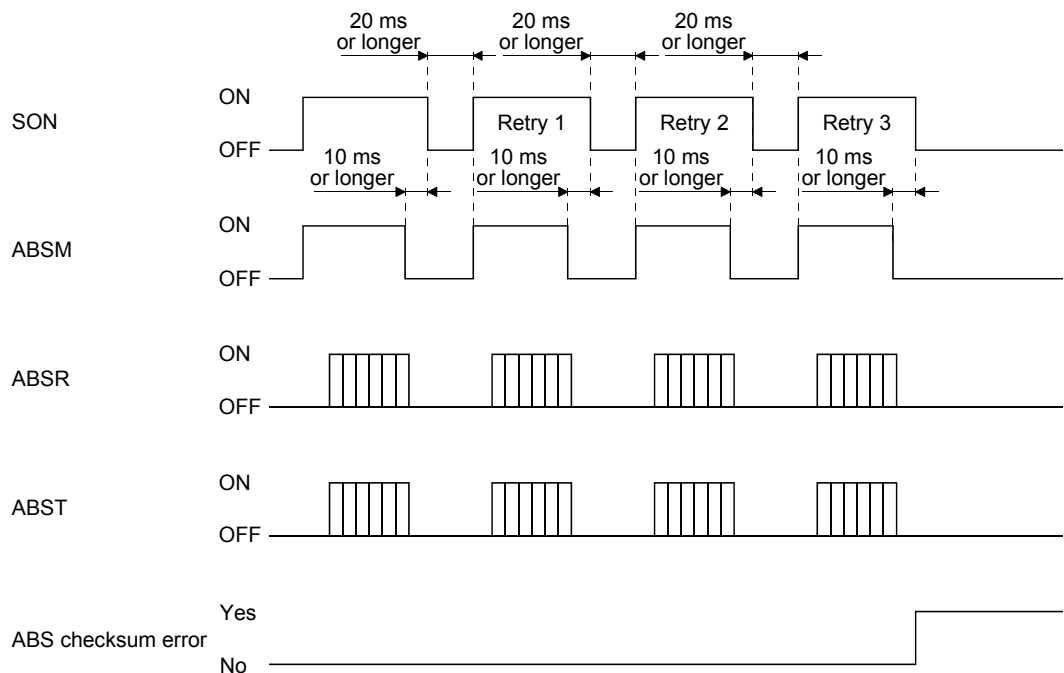
If the checksum error occurs, the programmable controller should retry transmission of the absolute position data.

Using the ladder check program of the programmable controller, turn off ABSM. After a lapse of 10 ms or longer, turn off SON (off time should be longer than 20 ms) and then turn it on again.

If the absolute position data transmission fails even after retry, process the ABS checksum error.

The start command should be interlocked with ABST to disable positioning operation when an checksum error occurs.

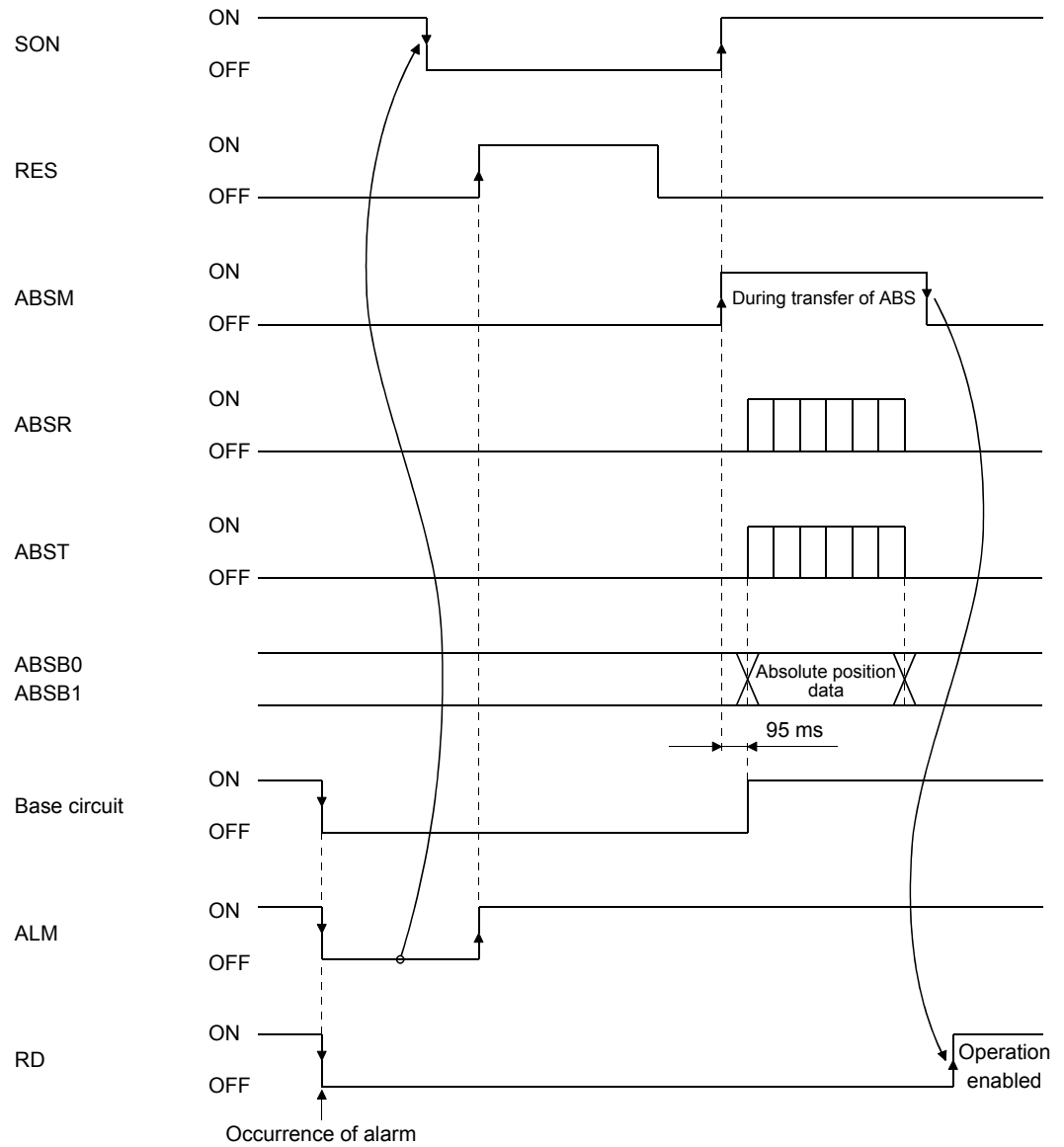
The following shows an example of three retries.



12. ABSOLUTE POSITION DETECTION SYSTEM

(3) At the time of alarm reset

If an alarm occurs, turn off SON by detecting ALM. If an alarm has occurred, ABSM cannot be accepted. In the reset state, ABSM can be input.

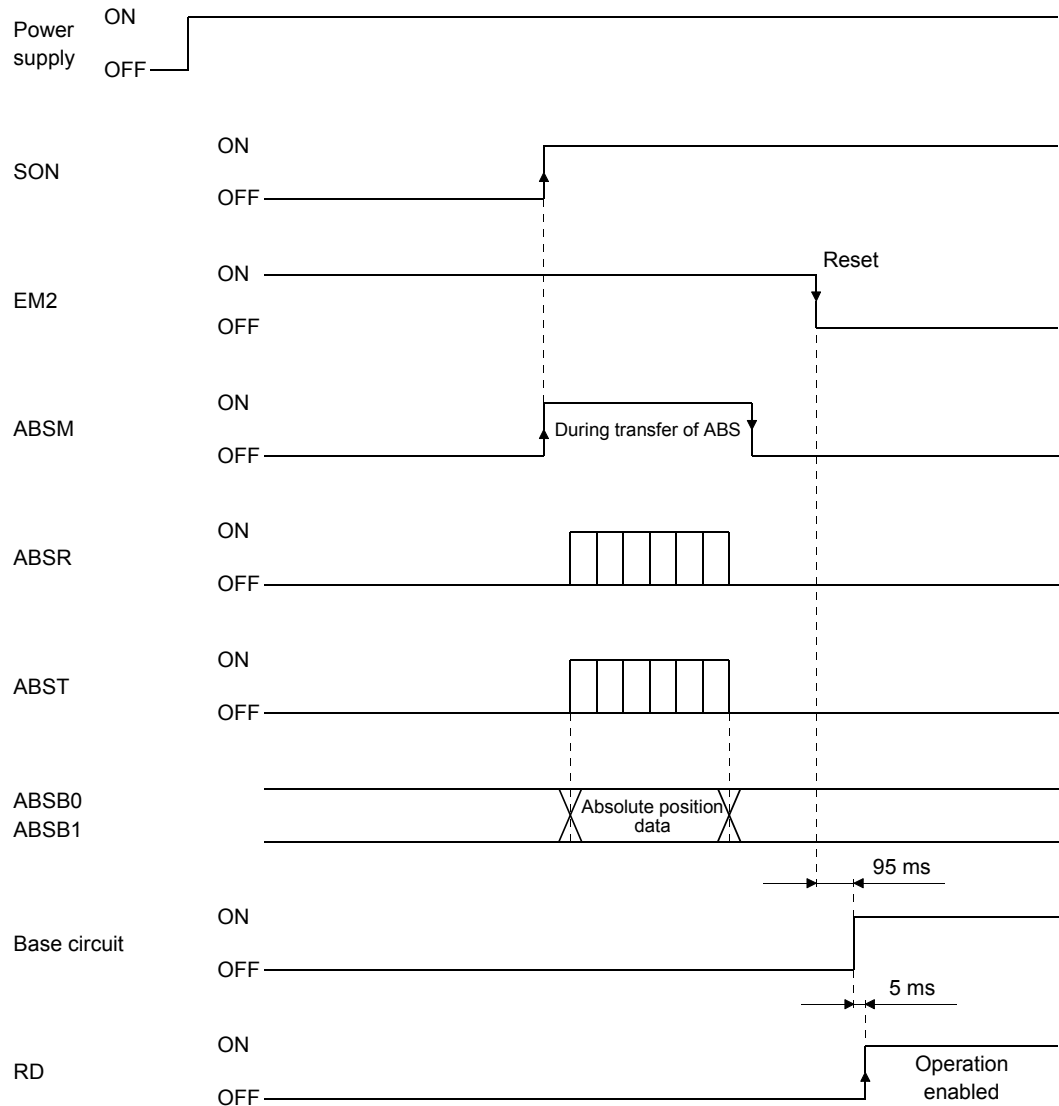


12. ABSOLUTE POSITION DETECTION SYSTEM

- (4) At the time of forced stop reset
 (a) If the power is switched on in the forced stop state

The forced stop state can be reset while the absolute position data is being transferred. If the forced stop state is reset while the absolute position data is transmitted, the base circuit is turned on 95 ms after resetting. If ABSM is off when the base circuit is turned on, RD is turned on 5 ms after the turning on of the base circuit. If ABSM is on when the base circuit is turned on, it is turned off and then RES is turned on. The absolute position data can be transmitted after the forced stop state is reset.

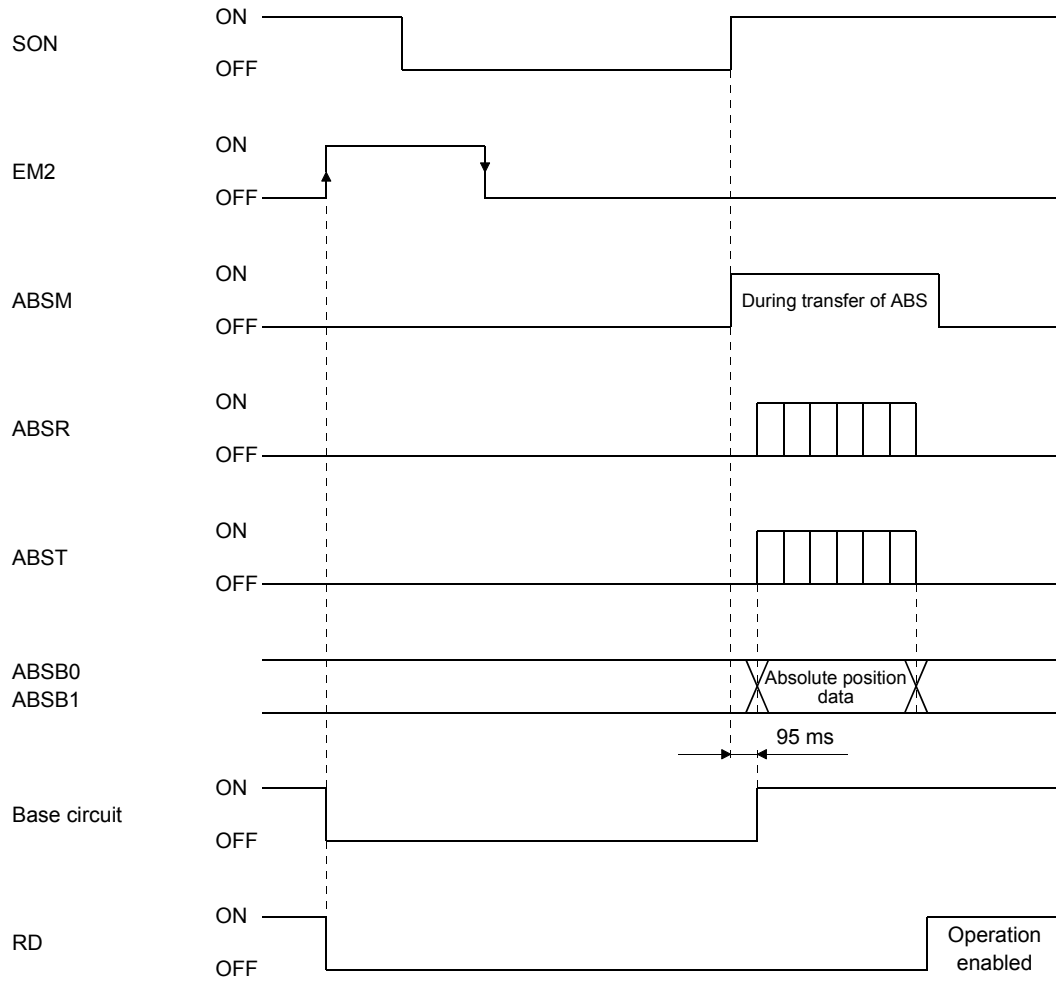
The current position in the servo amplifier is updated even during an forced stop. When SON or ABSM are turned on during an forced stop as shown below, the servo amplifier transmits to the controller the current position latched when ABSM switches from off to on, and at the same time, the servo amplifier sets this data as a position command value. However, since the base circuit is off during a forced stop, the servo-lock status is not encountered. Therefore, if the servo motor is rotated by external force or the like after ABSM is turned on, this travel distance is accumulated in the servo amplifier as droop pulses. If the forced stop is cleared in this status, the base circuit turns on and the motor returns to the original position rapidly to compensate for the droop pulses. To avoid this status, reread the absolute position data before clearing the forced stop.



12. ABSOLUTE POSITION DETECTION SYSTEM

(b) If forced stop is activated during servo-on

ABSM is permissible while in the forced stop state. In this case, the base circuit and RD are turned on after the forced stop state is reset.



12. ABSOLUTE POSITION DETECTION SYSTEM

12.8.3 Home position setting

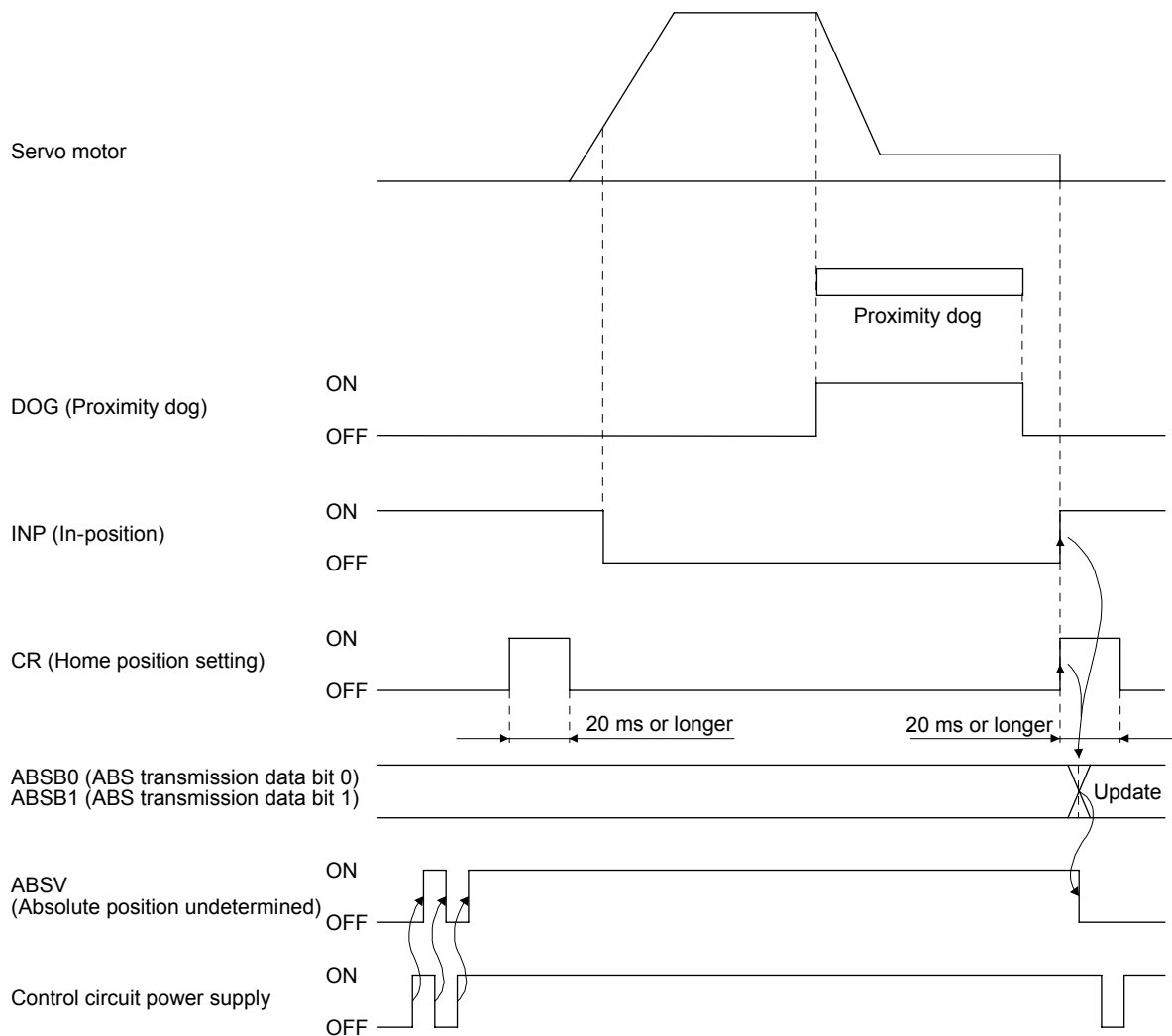
(1) Dog type home position return

Preset a home position return creep speed at which the machine will not be given impact.

On detection of a zero pulse, CR is turned from off to on. At the same time, the servo amplifier clears the droop pulses, comes to a sudden stop, and stores the stop position into the non-volatile memory as the home position absolute position data.

CR should be turned on after it has been confirmed that INP is on. If this condition is not satisfied, [AL. 96 Home position setting warning] will occur, but that warning will be reset automatically by making home position return correctly.

The number of home position setting times is limited to 1,000,000 times.



12. ABSOLUTE POSITION DETECTION SYSTEM

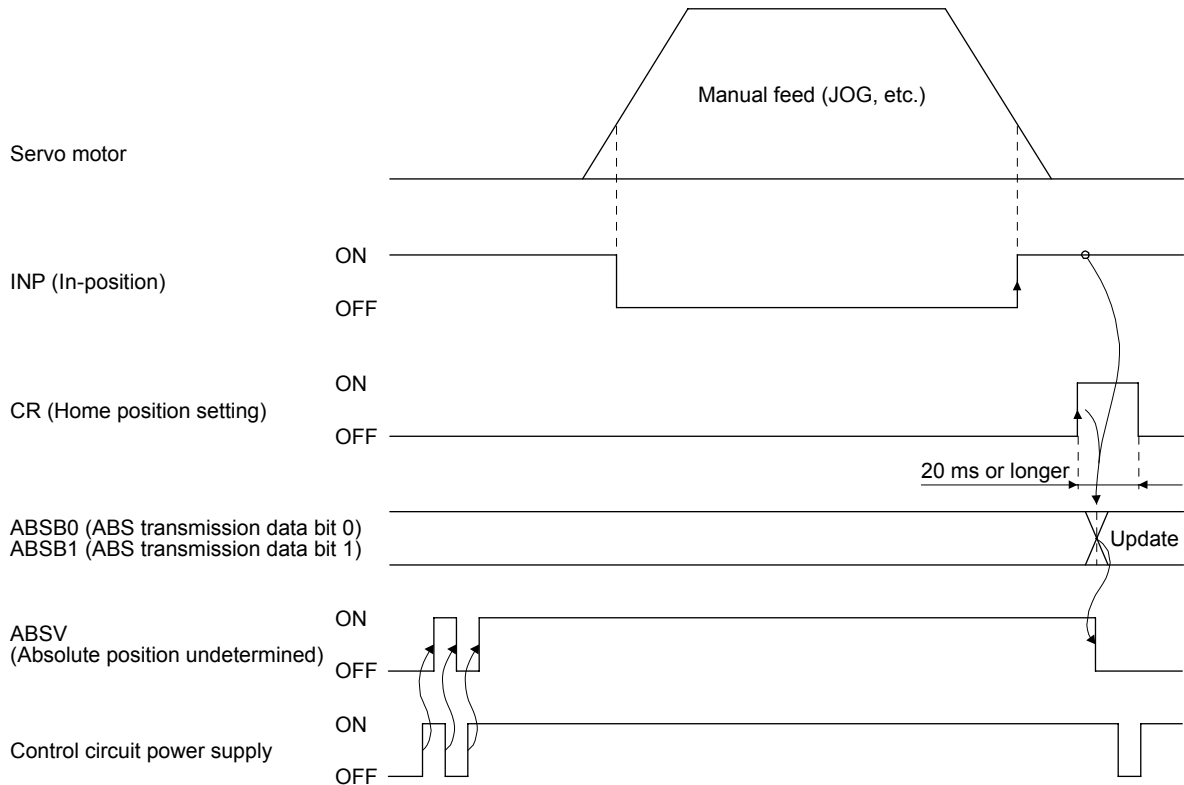
(2) Data set type home position return

POINT
<ul style="list-style-type: none"> ● Never make home position setting during command operation or servo motor rotation. It may cause home position shift. ● It is possible to execute data set type home position return during the servo off.

Move the machine to the position where the home position is to be set by performing manual operation such as JOG operation. When CR is on for longer than 20 ms, the stop position is stored into the non-volatile memory as the home position absolute position data.

When the servo on, set CR to on after confirming that INP is on. If this condition is not satisfied, [AL. 96 Home position setting warning] will occur, but that warning will be reset automatically by making home position return correctly.

The number of home position setting times is limited to 100,000 times.

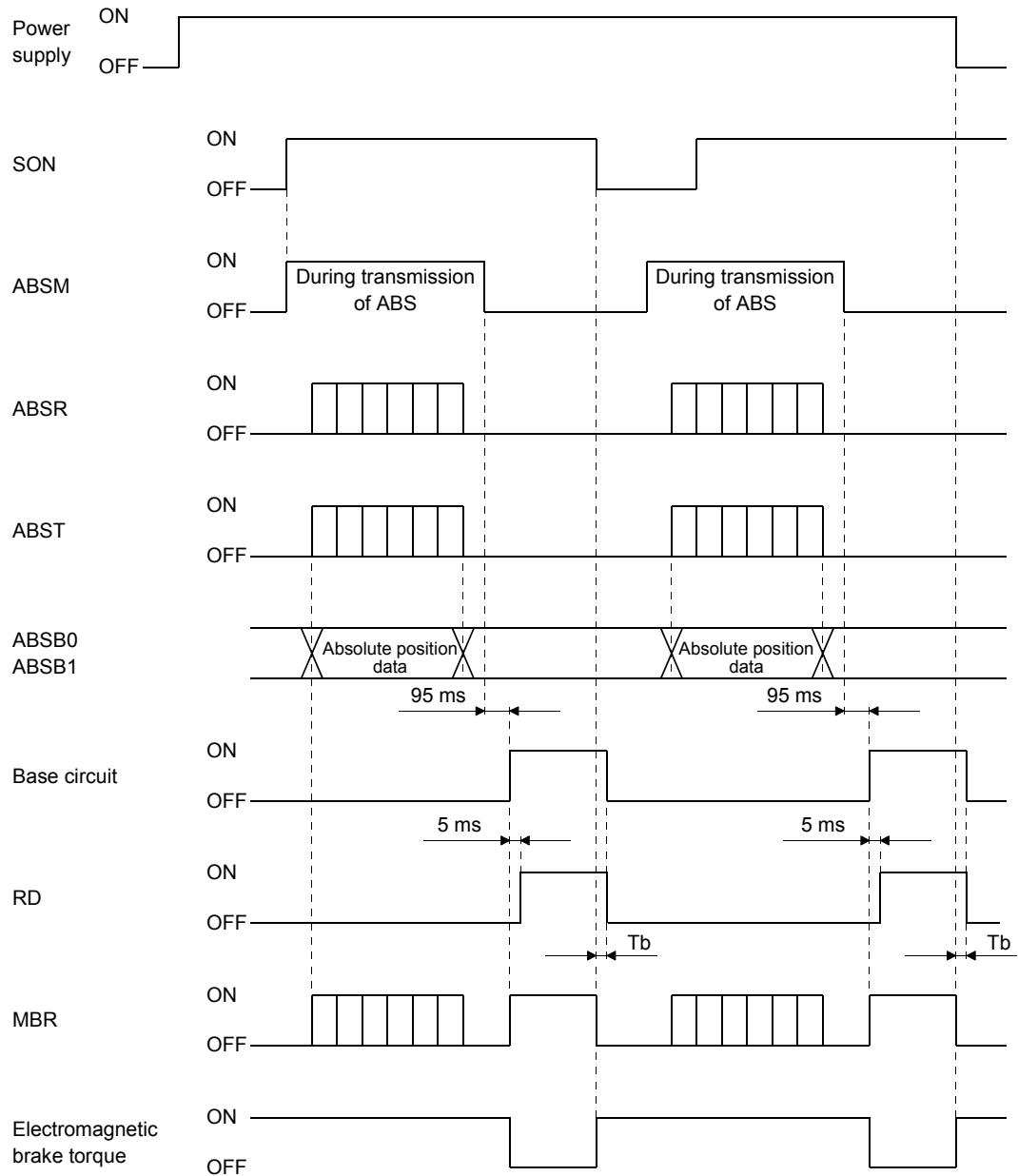


12. ABSOLUTE POSITION DETECTION SYSTEM

12.8.4 Use of servo motor with an electromagnetic brake

The timing charts at power on/off and SON on/off are given below.

Preset [Pr. PD03] to [Pr. PD22] of the servo amplifier to enable MBR. When MBR is set for the CN1-23 pin, turning ABSM on will change the CN1-23 pin to ABSB1 (ABS transmission data bit 1). Therefore, configure an external sequence to generate the electromagnetic brake torque as soon as ABSM and MBR turn off.



12. ABSOLUTE POSITION DETECTION SYSTEM

12.8.5 How to process the absolute position data at detection of stroke end

The servo amplifier stops the acceptance of the command pulse when off of LSP or LSN are detected, clears the droop pulses to 0 at the same time, and stops the servo motor. At this time, the programmable controller keeps outputting the command pulse. Since this causes a discrepancy between the absolute position data of the servo amplifier and the programmable controller, position mismatch will occur if the operation is continued. To prevent this difference in position data from occurring, do as described below. When the servo amplifier has detected the stroke end, perform JOG operation or the like to clear the stroke end.

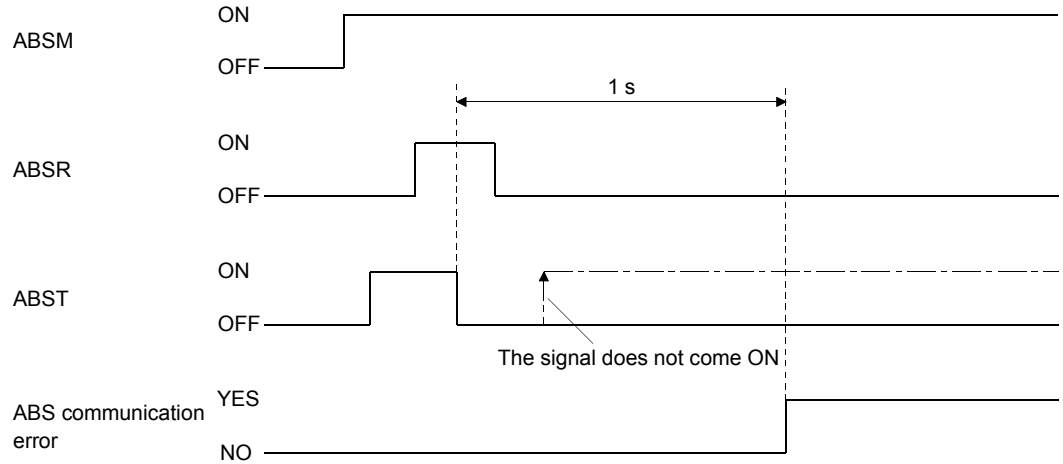
After that, switch SON off once, then on again, or switch the power off once, then on again. This causes the absolute position data of the servo amplifier to be transferred to the programmable controller, restoring the normal data.

12.9 Absolute position data transfer errors

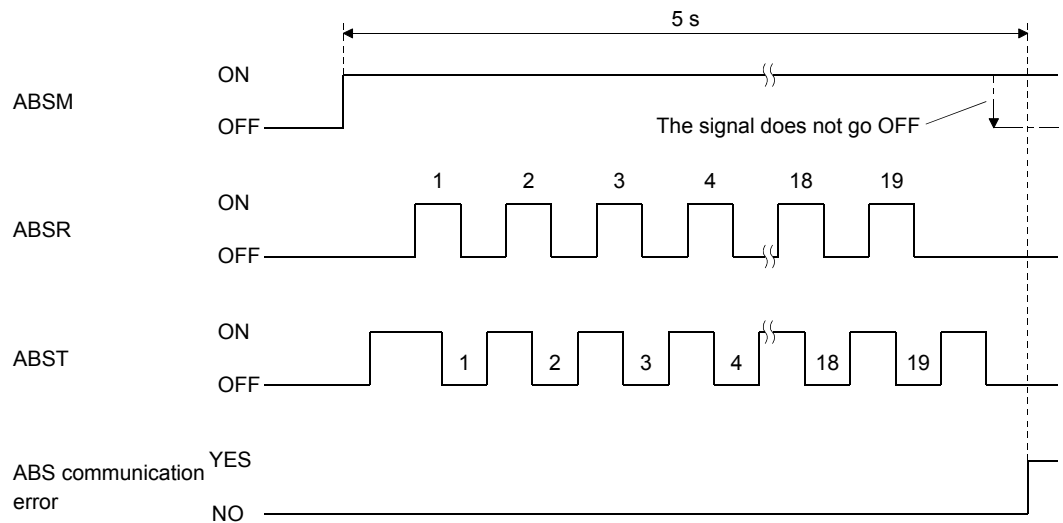
POINT
●When the following alarm or warning occurs, refer to "MELSERVO-J4 Servo Amplifier Instruction Manual (Troubleshooting)" to remove the failure. [AL. 25 Absolute position erased] [AL. 96 Home position setting warning] [AL. E3 Absolute position counter warning] [AL. E5 ABS time-out warning] [AL. EA ABS servo-on warning]

12. ABSOLUTE POSITION DETECTION SYSTEM

- (1) The off period of the ABS transmission data ready signal output from the servo amplifier is checked. If the off period is 1 s or longer, regard as a transfer fault and generate the ABS communication error. Generate the ABS communication error if [AL. E5 ABS time-out warning] is generated at the servo amplifier due to an ABS request on time time-out.



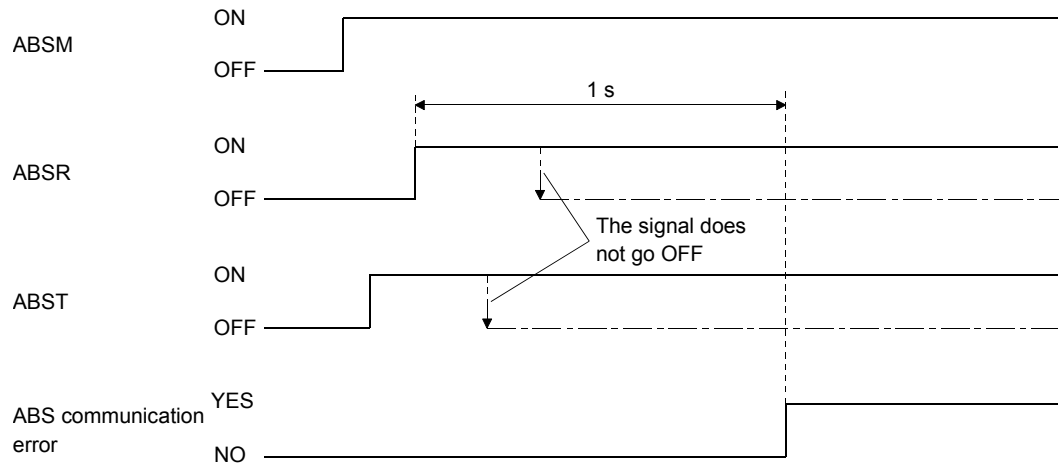
- (2) The time required for the ABS transfer mode signal to go off after it has been turned on (ABS transfer time) is checked. If the ABS transfer time is longer than 5 s, regard that a transfer fault has occurred, and generate the ABS communication error. Generate the ABS communication error if [AL. E5 ABS time-out warning] is generated at the servo amplifier due to an ABS transfer mode completion time time-out.



12. ABSOLUTE POSITION DETECTION SYSTEM

- (3) The time required for the ABS request signal to go off after it has been turned on (ABS transfer time) is checked. To detect [AL. E5 ABS time-out warning] at the servo amplifier. If the ABS request remains on for longer than 1 s, regard that a fault relating to the ABS request signal or the ABST has occurred and generate the ABS communication error.

Generate the ABS communication error if [AL. E5 ABS time-out warning] is generated at the servo amplifier due to an ABS request off time time-out.



12. ABSOLUTE POSITION DETECTION SYSTEM

12.10 Communication-based absolute position transfer system

12.10.1 Serial communication command

The following commands are available for reading absolute position data using the serial communication function. When reading data, take care to specify the correct station number of the servo amplifier from where the data will be read.

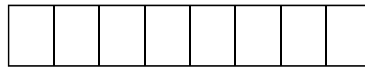
When the master station sends the data No. to the slave station (servo amplifier), the slave station returns the data value to the master station.

(1) Transmission

Transmit command [0] [2] and data No. [9] [1].

(2) Reply

The absolute position data in the command pulse unit is returned in hexadecimal.



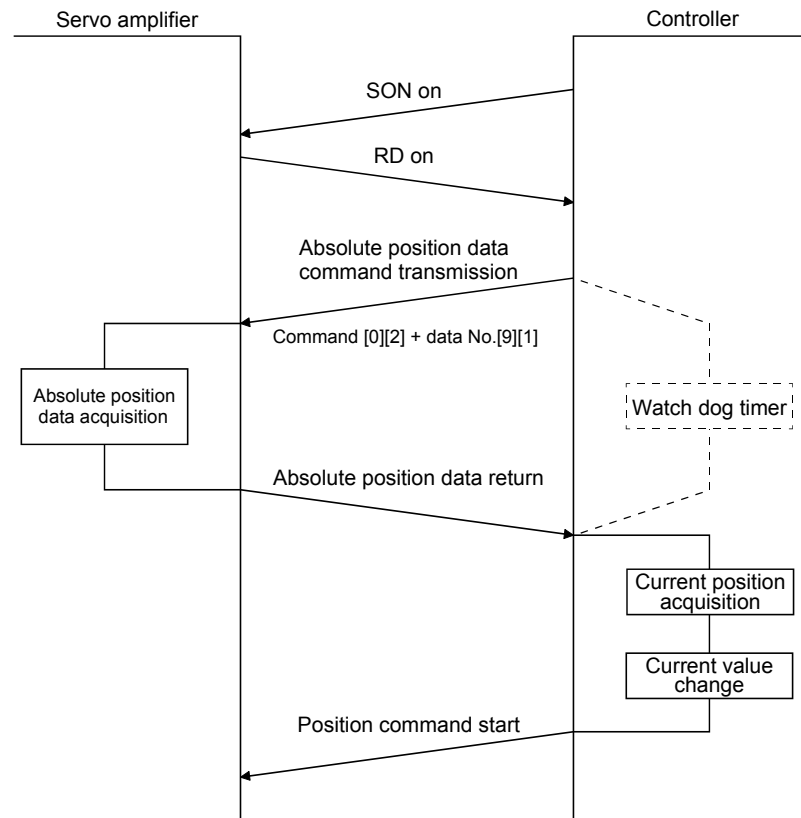
Data 32-bit length (hexadecimal representation)

12.10.2 Absolute position data transfer protocol

(1) Data transfer procedure

Every time SON turns on at power-on or like, the controller must read the current position data in the servo amplifier. Not performing this operation will cause a position shift.

Time-out monitoring should be performed by the controller.

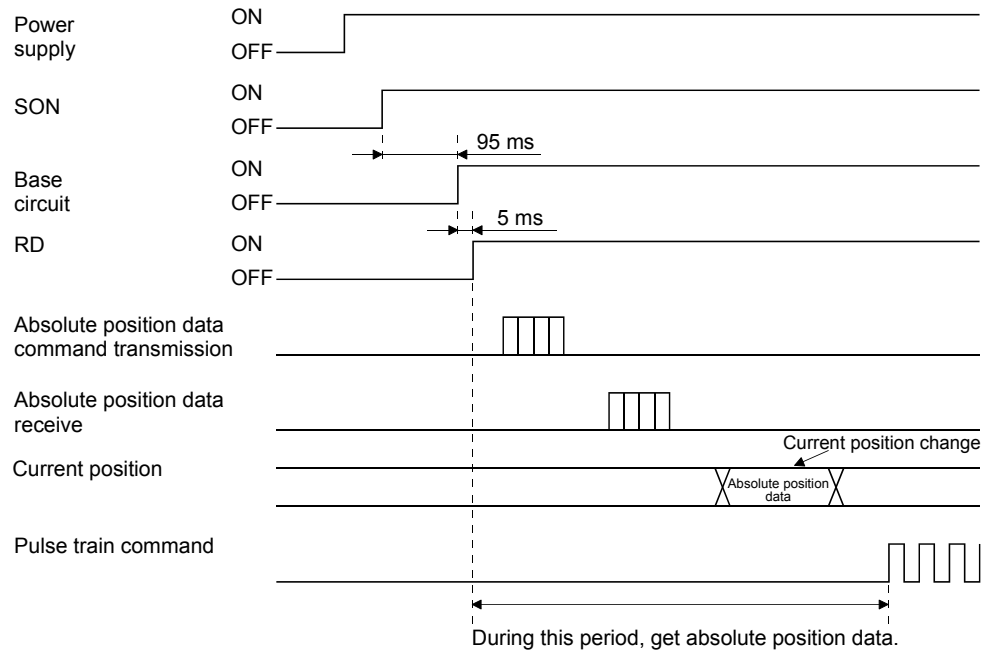


12. ABSOLUTE POSITION DETECTION SYSTEM

(2) Transfer method

The following shows a sequence how to turn on the base circuit while it is off state because SON is off, EM2 is off, or an alarm is occurring. In the absolute position detection system, always give the serial communication command to read the current position in the servo amplifier to the controller every time RD turns on. The servo amplifier sends the current position to the controller on receipt of the command. At the same time, this data is set as a position command value in the servo amplifier.

(a) Sequence processing at power-on



- 1) The base circuit turns on after 95 ms.
- 2) After the base circuit is turned on, RD turns on.
- 3) After RD turned on and the controller acquired the absolute position data, give command pulses to the servo amplifier. If the controller gives command pulses before acquiring the absolute position data, a position shift can occur.

(b) Communication error

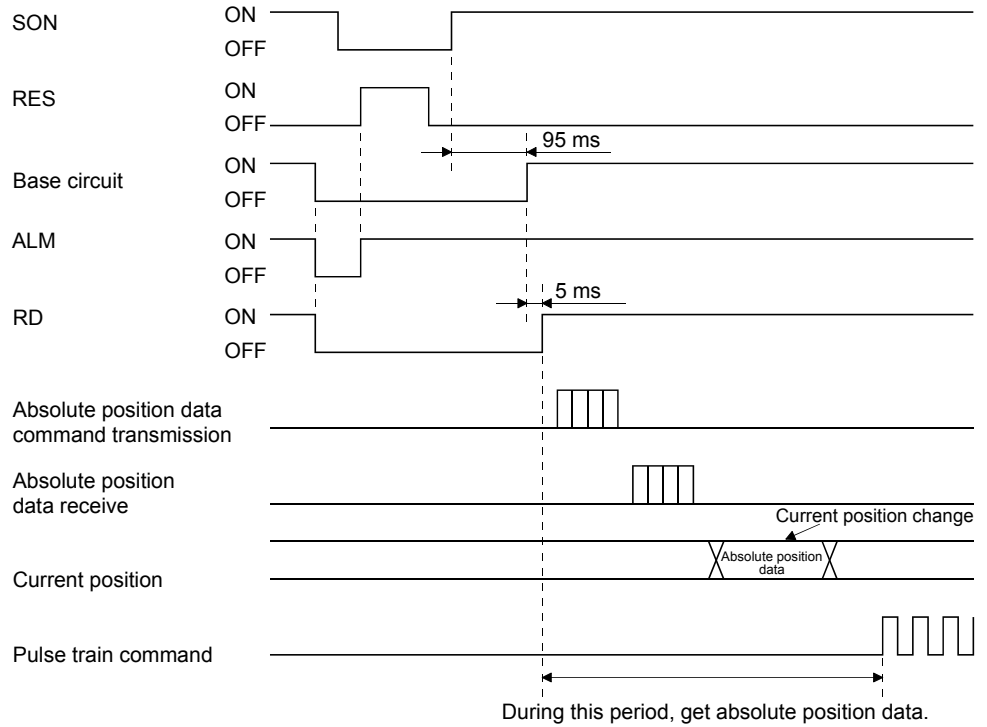
If a communication error occurs between the controller and servo amplifier, the servo amplifier sends the error code. The definition of the error code is the same as that of the communication function. Refer to section 14.3.3 for details.

If a communication error has occurred, perform retry operation. If several retries do not result in a normal termination, perform error processing.

12. ABSOLUTE POSITION DETECTION SYSTEM

(c) At the time of alarm reset

If an alarm has occurred, detect ALM and turn off SON. After removing the alarm occurrence factor and deactivating the alarm, get the absolute position data again from the servo amplifier in accordance with the procedure in (a) of this section.

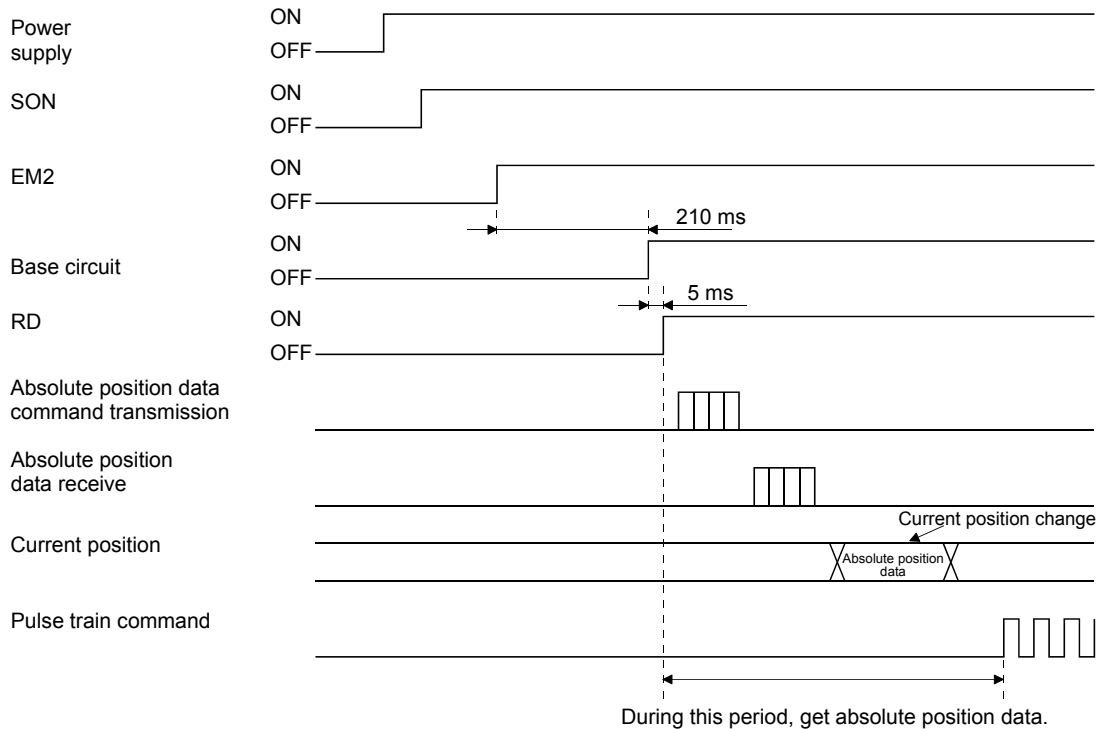


12. ABSOLUTE POSITION DETECTION SYSTEM

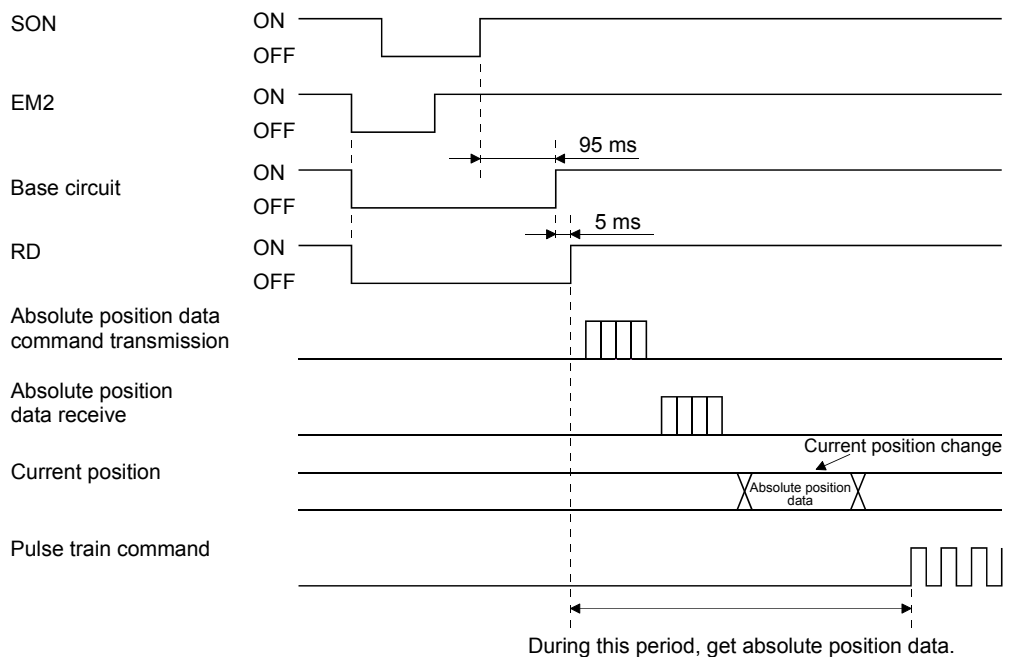
(d) At the time of forced stop reset

210 ms after the forced stop is deactivated, the base circuit turns on, and RD turns on further 5 ms after that, turns on. Always get the current position data using RD as the trigger before the position command is issued.

1) When power is switched on in a forced stop status



2) When a forced stop is activated during servo on

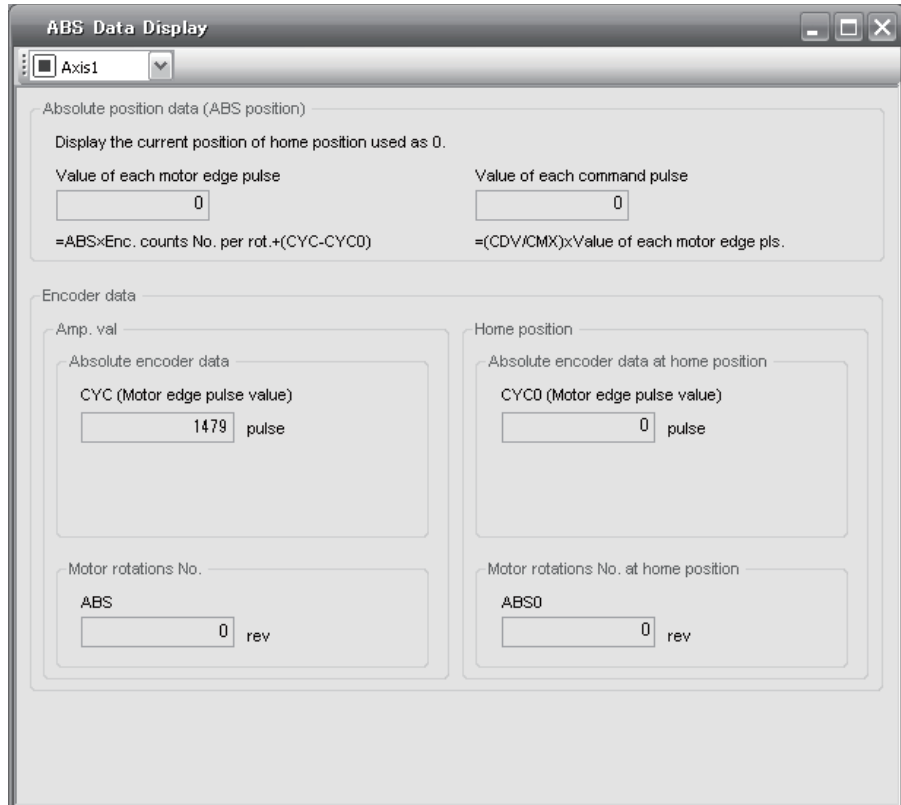


12. ABSOLUTE POSITION DETECTION SYSTEM

12.11 Confirmation of absolute position detection data

You can check the absolute position data with MR Configurator2.

Choose "Monitor" and "ABS Data Display" to open the absolute position data display screen.



13. USING STO FUNCTION

13. USING STO FUNCTION

POINT

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

13.1 Introduction

This section provides the cautions of the STO function.

13.1.1 Summary

This servo amplifier complies with the following safety standards.

- ISO/EN ISO 13849-1 category 3 PL d
- IEC/EN 61508 SIL 2
- IEC/EN 61800-5-2 SIL 2

13.1.2 Terms related to safety

The STO function shuts down energy to servo motors, thus removing torque. This function electronically cuts off power supply in the servo amplifier.

The purpose of this safety function is as follows.

- (1) Uncontrolled stop according to stop category 0 of IEC/EN 60204-1
- (2) Preventing unexpected start-up

13.1.3 Cautions

The following basic safety notes must be read carefully and fully in order to prevent injury to persons or damage to property.

Only qualified personnel are authorized to install, start-up, repair, or service the machines in which these components are installed.

They must be familiar with all applicable local regulations and laws in which machines with these components are installed, particularly the standards mentioned in this manual.

The staff responsible for this work must be given express permission from the company to perform start-up, programming, configuration, and maintenance of the machine in accordance with the safety standards.



● Improper installation of the safety related components or systems may cause improper operation in which safety is not assured, and may result in severe injuries or even death.

Protective Measures

- This servo amplifier satisfies the Safe Torque Off (STO) function described in IEC/EN 61800-5-2 by preventing the energy supply from the servo amplifier to the servo motor. If an external force acts upon the drive axis, additional safety measures, such as brakes or counterbalances must be used.

13. USING STO FUNCTION

13.1.4 Residual risks of the STO function

Machine manufacturers are responsible for all risk evaluations and all associated residual risks. Below are residual risks associated with the STO function. Mitsubishi is not liable for any damages or injuries caused by these risks.

- (1) The STO function disables energy supply to the servo motor by electrical shut-off. The function does not mechanically disconnect electricity from the motor. Therefore, it cannot prevent exposure to electric shock. To prevent an electric shock, install a magnetic contactor or a molded-case circuit breaker to the main circuit power supply (L1, L2, and L3) of the servo amplifier.
- (2) The STO function disables energy supply to the servo motor by electrical shut-off. It does not guarantee the stop control or the deceleration control of the servo motor.
- (3) For proper installation, wiring, and adjustment, thoroughly read the manual of each individual safety related component.
- (4) In the safety circuit, use components that are confirmed safe or meet the required safety standards.
- (5) The STO function does not guarantee that the drive part of the servo motor will not rotate due to external or other forces.
- (6) Safety is not assured until safety-related components of the system are completely installed or adjusted.
- (7) When replacing this servo amplifier, confirm that the model name of servo amplifiers are exactly the same as those being replaced. Once installed, make sure to verify the performance of the safety functions before commissioning the system.
- (8) Perform all risk assessments to the machine or the whole system.
- (9) To prevent accumulation of malfunctions, perform malfunction checks at regular intervals based on the risk assessments of the machine or the system. Regardless of the system safety level, malfunction checks should be performed at least once per year.
- (10) If the upper and lower power module in the servo amplifier are shorted and damaged simultaneously, the servo motor may make a half revolution at a maximum.
- (11) The STO input signals (STO1 and STO2) must be supplied from one power source. Otherwise, the STO function may not function properly due to a sneak current, failing to bring the STO shut-off state.
- (12) For the STO I/O signals of the STO function, supply power by using a safety extra low voltage (SELV) power supply with the reinforced insulation.

13. USING STO FUNCTION

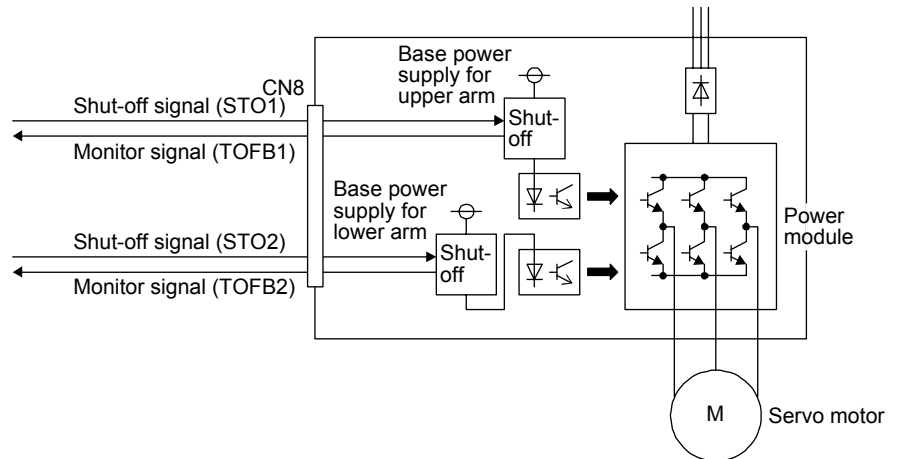
13.1.5 Specifications

(1) Specifications

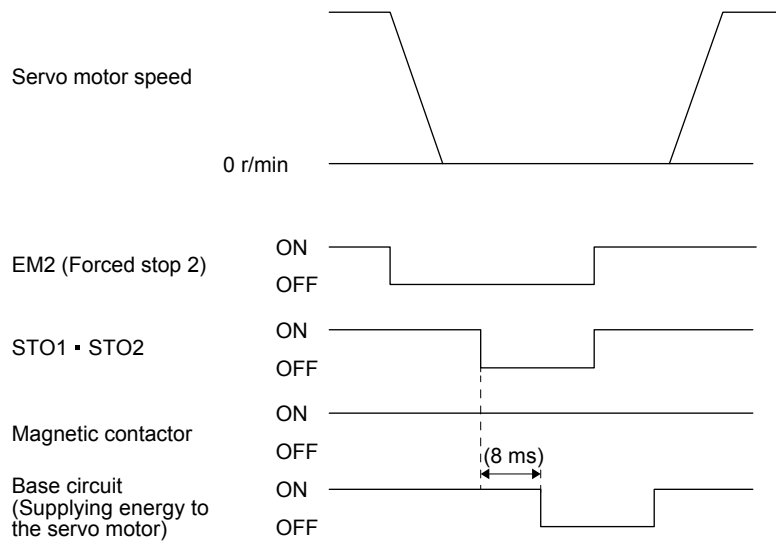
Item	Specifications
Safety function	STO (IEC/EN 61800-5-2)
Safety performance	ISO/EN ISO 13849-1 category 3 PL d, IEC/EN 61508 SIL 2, EN 62061 SIL CL2, EN 61800-5-2 SIL 2
Mean time to dangerous failure (MTTFd)	100 years or more (Note)
Diagnostic converge (DC)	Medium (90% to 99%) (Note)
Average probability of dangerous failures per hour (PFH) [1/h]	1.68×10^{-10}
Number of on/off times of STO	1,000,000 times
CE marking	LVD: EN 61800-5-1 EMC: EN 61800-3 MD: EN ISO 13849-1, EN 61800-5-2, EN 62061

Note. This is the value required by safety standards.

(2) Function block diagram (STO function)



(3) Operation sequence (STO function)



13. USING STO FUNCTION

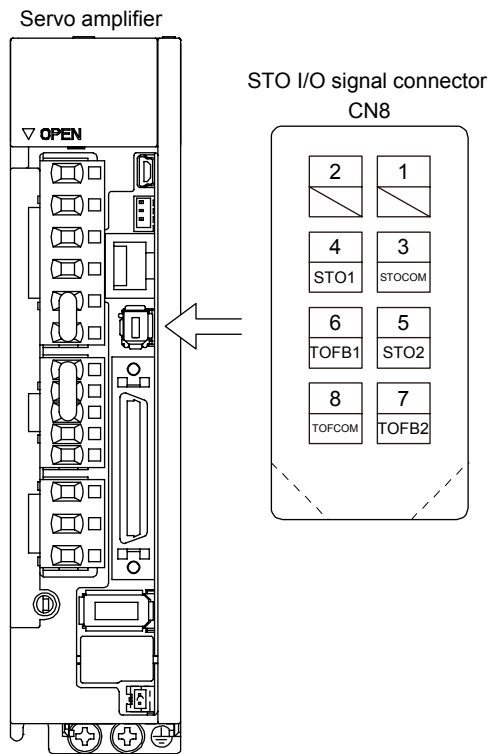
13.1.6 Maintenance

This servo amplifier has alarms and warnings for maintenance that supports the Mitsubishi drive safety function. (Refer to chapter 8.)

13.2 STO I/O signal connector (CN8) and signal layouts

13.2.1 Signal layouts

POINT
● The pin configurations of the connectors are as viewed from the cable connector wiring section.



13. USING STO FUNCTION

13.2.2 Signal (device) explanations

(1) I/O device

Signal name	Connector pin No.	Description	I/O division
STOCOM	CN8-3	Common terminal for input signal of STO1 and STO2	DI-1
STO1	CN8-4	Inputs STO state 1. STO state (base shut-off): Open between STO1 and STOCOM. STO release state (in driving): Close between STO1 and STOCOM. Be sure to turn off STO1 after the servo motor stops by the servo-off state or with forced stop deceleration by turning off EM2 (Forced stop 2).	DI-1
STO2	CN8-5	Inputs STO state 2. STO state (base shut-off): Open between STO2 and STOCOM. STO release state (in driving): Close between STO2 and STOCOM. Be sure to turn off STO2 after the servo motor stops by the servo-off state or with forced stop deceleration by turning off EM2 (Forced stop 2).	DI-1
TOFCOM	CN8-8	Common terminal for monitor output signal in STO state	DO-1
TOFB1	CN8-6	Monitor output signal in STO1 state STO state (base shut-off): Between TOFB1 and TOFCOM is closed. STO release state (in driving): Between TOFB1 and TOFCOM is opened.	DO-1
TOFB2	CN8-7	Monitor output signal in STO2 state STO state (base shut-off): Between TOFB2 and TOFCOM is closed. STO release state (in driving): Between TOFB2 and TOFCOM is opened.	DO-1

(2) Signals and STO state

The following table shows the TOFB and STO states when the power is on in normal state and STO1 and STO2 are on (closed) or off (opened).

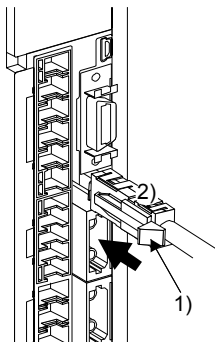
Input signal		State		
STO1	STO2	Between TOFB1 and TOFCOM (Monitoring STO1 state)	Between TOFB2 and TOFCOM (Monitoring STO2 state)	Between TOFB1 and TOFB2 (Monitoring STO state of servo amplifier)
Off	Off	On: STO state (base circuit shut-off)	On: STO state (base circuit shut-off)	On: STO state (base circuit shut-off)
Off	On	On: STO state (base circuit shut-off)	Off: STO release state	Off: STO state (base circuit shut-off)
On	Off	Off: STO release state	On: STO state (base circuit shut-off)	Off: STO state (base circuit shut-off)
On	On	Off: STO release state	Off: STO release state	Off: STO release state

(3) Test pulse of STO input signal

Set the test pulse off time inputted from outside to 1 ms or less.

13.2.3 How to pull out the STO cable

The following shows how to pull out the STO cable from the CN8 connector of the servo amplifier.



While pressing knob 1) of the STO cable plug in the direction of the arrow, pull out the plug 2).
(This figure shows the MR-J4-B servo amplifier. This procedure also applies to the MR-J4-A servo amplifier.)

13. USING STO FUNCTION

13.3 Connection example

POINT	
●	Turn off STO (STO1 and STO2) after the servo motor stops by the servo off state or with forced stop deceleration by turning off EM2 (Forced stop 2). Configure an external sequence that has the timings shown as below using an external device such as the MR-J3-D05 safety logic unit.

The diagram shows three waveforms over time. The top waveform is labeled 'STO1 + STO2' and has levels 'ON' and 'OFF'. The middle waveform is labeled 'EM2' and also has levels 'ON' and 'OFF'. The bottom waveform is labeled 'Servo motor speed' and has a level '0 r/min'. A vertical dashed line indicates the point where the servo motor speed reaches 0 r/min. At this point, both STO1 + STO2 and EM2 transition from ON to OFF.

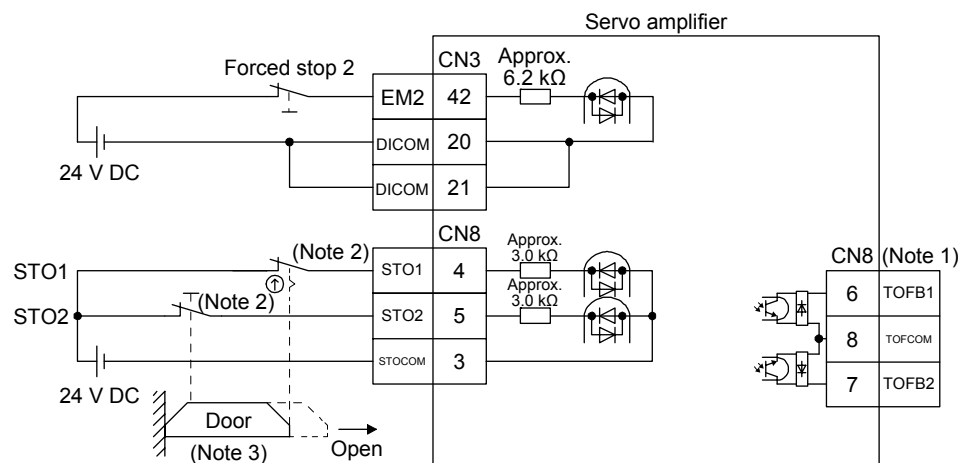
●	If STO is turned off during operation, the servo motor is in dynamic brake stop (stop category 0), and [AL.63 STO timing error] will occur.
---	---

13.3.1 Connection example for CN8 connector

This servo amplifier is equipped with the connector (CN8) in accordance with the STO function. When this connector is used with a certified external safety relay, power to the motor can be safely removed and unexpected restart can be prevented. The safety relay used should meet the applicable safety standards and have forcibly guided or mirror contacts for the purpose of error detection.

In addition, the MR-J3-D05 safety logic unit can be used instead of a safety relay for implementation of various safety standards. Refer to Appendix 5 for details.

The following diagram is for source interface. For sink interface, refer to section 13.4.1.



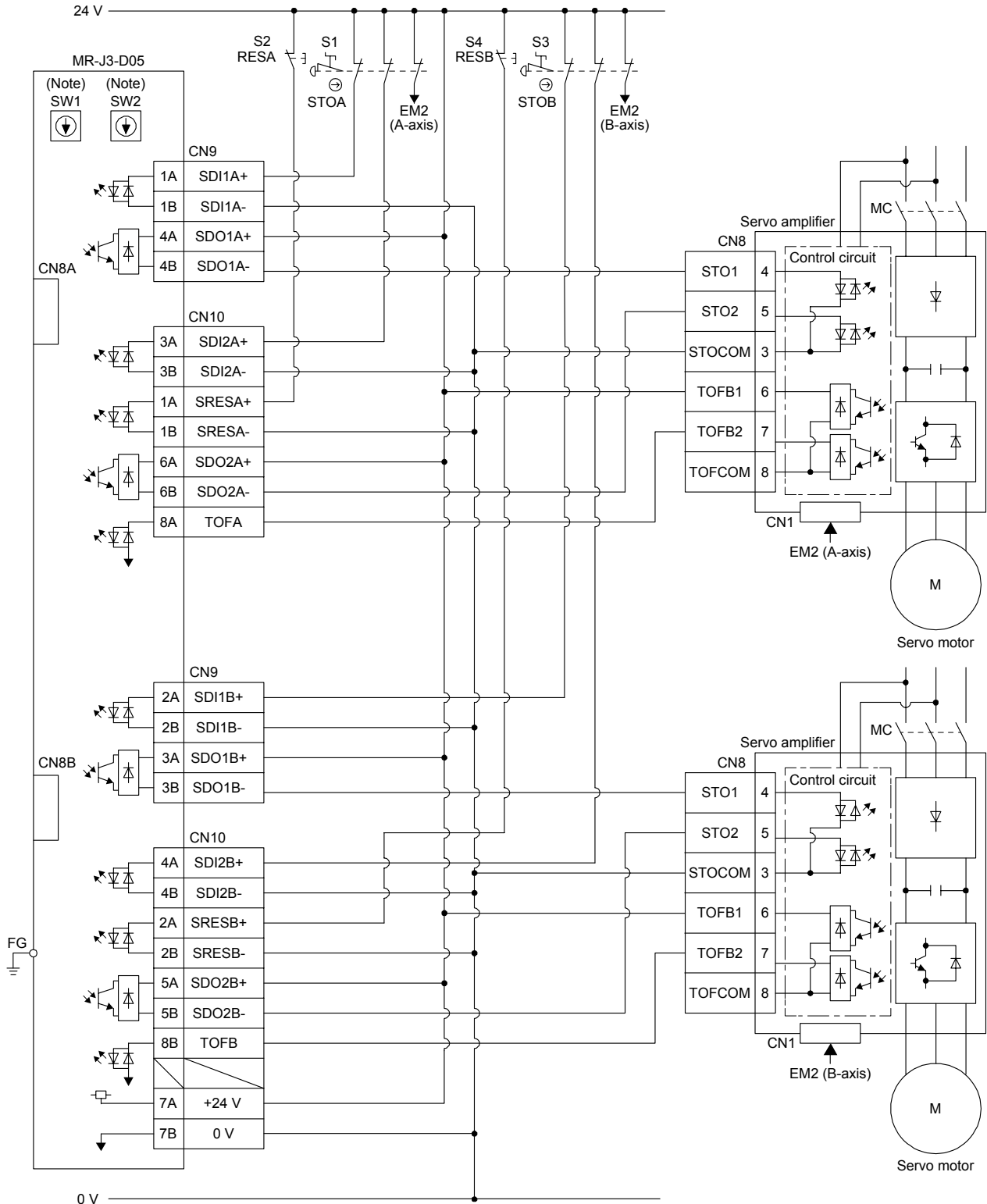
- Note 1. By using TOFB, whether the servo is in the STO state can be confirmed. For connection examples, refer to section 13.3.2 to 13.3.4.
- Note 2. When using the STO function, turn off STO1 and STO2 at the same time. Turn off STO1 and STO2 after the servo motor stops by the servo off state or with forced stop deceleration by turning off EM2 (Forced stop 2).
- Note 3. Configure the interlock circuit so that the door is open after the servo motor is stopped.

13. USING STO FUNCTION

13.3.2 External I/O signal connection example using an MR-J3-D05 safety logic unit

POINT
 ● This connection is for the source interface. For the other I/O signals, refer to the connection examples in section 3.2.

(1) Connection example



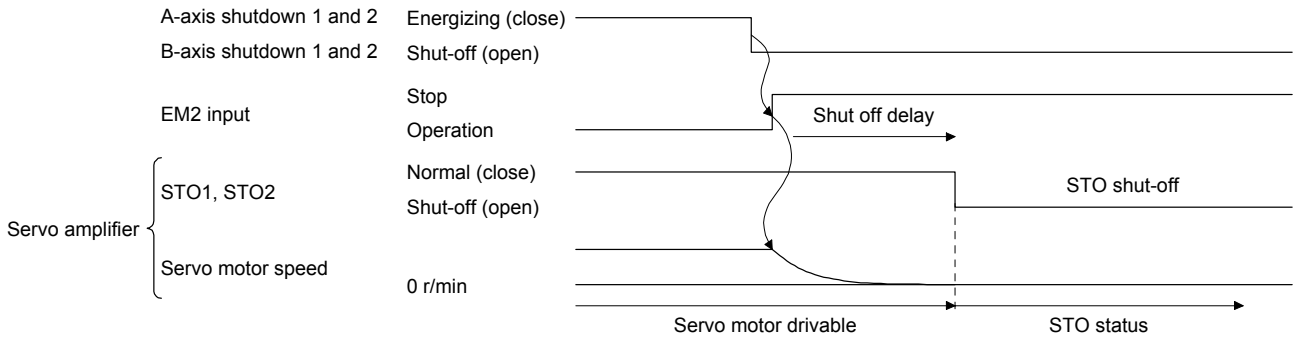
Note. Set the delay time of STO output with SW1 and SW2. These switches for MR-J3-D05 are located where dented from the front panel.

13. USING STO FUNCTION

(2) Basic operation example

The switch status of STOA is input to SDI2A+ of MR-J3-D05, and then it will be input to STO1 and STO2 of the servo amplifier via SDO1A and SDO2A of MR-J3-D05.

The switch status of STOB is input to SDI2B+ of MR-J3-D05, and then it will be input to STO1 and STO2 of the servo amplifier via SDO1B and SDO2B of MR-J3-D05.

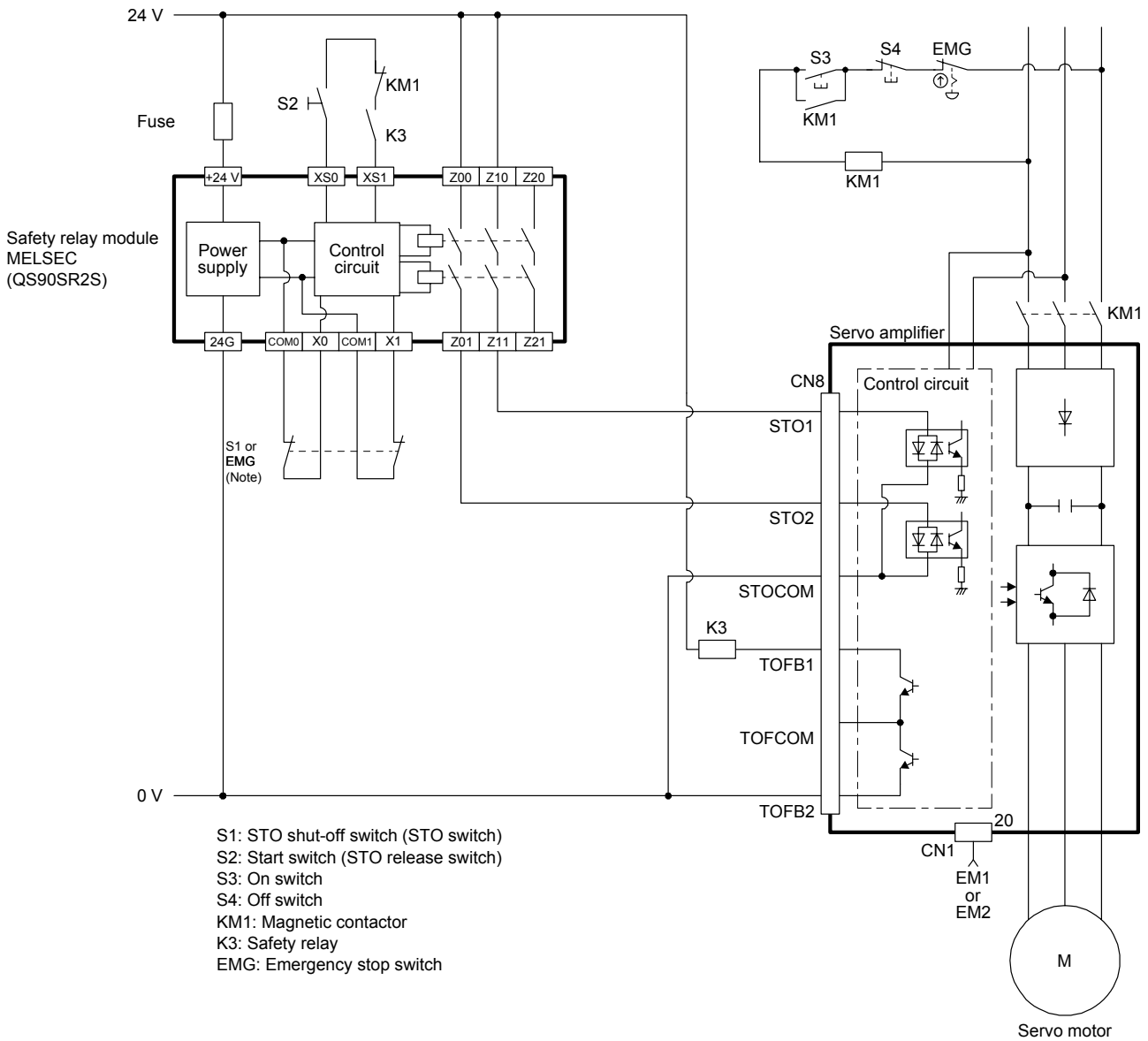


13. USING STO FUNCTION

13.3.3 External I/O signal connection example using an external safety relay unit

POINT
<ul style="list-style-type: none"> ● This connection is for the source interface. For the other I/O signals, refer to the connection examples in section 3.2.

This connection example complies with the requirement of ISO/EN ISO 13849-1 category 3 PL d. For details, refer to the safety relay module user's manual.



Note. To enable the STO function of the servo amplifier by using "Emergency switching off", change S1 to EMG. The stop category at this time is "0". If STO is turned off while the servo motor is rotating, [AL. 63 STO timing error] will occur.

13. USING STO FUNCTION

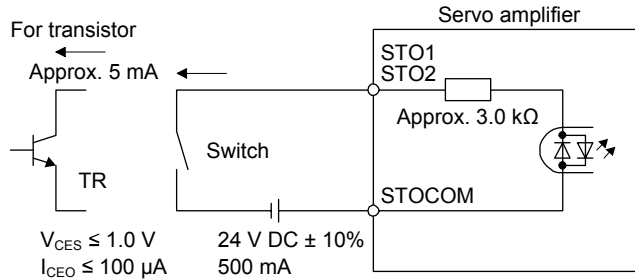
13.4 Detailed description of interfaces

This section provides the details of the I/O signal interfaces (refer to the I/O division in the table) given in section 13.2. Refer to this section and make connection with the external device.

13.4.1 Sink I/O interface

(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.



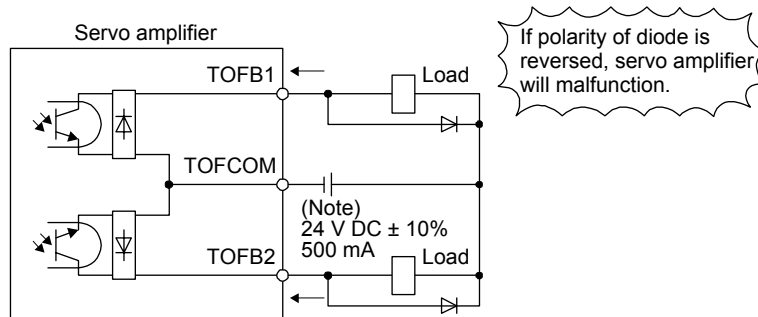
(2) Digital output interface DO-1

This is a circuit of collector output terminal of the output transistor. When the output transistor is turned on, collector terminal current will be applied for the output.

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 5.2 V voltage drop occurs in the servo amplifier.

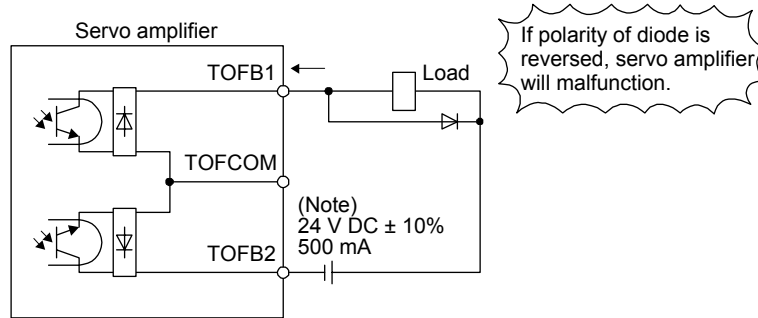
(a) When outputting two STO states by using each TOFB



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.

13. USING STO FUNCTION

(b) When outputting two STO states by using one TOFB



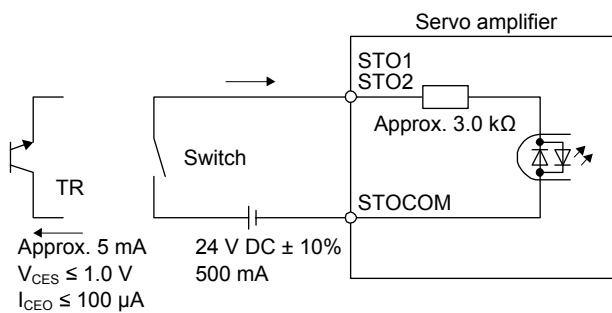
Note. If the voltage drop (maximum of 5.2 V) interferes with the relay operation, apply high voltage (maximum of 26.4 V) from external source.

13.4.2 Source I/O interface

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 input terminal. Transmit signals from source (open-collector) type transistor output, relay switch, etc.

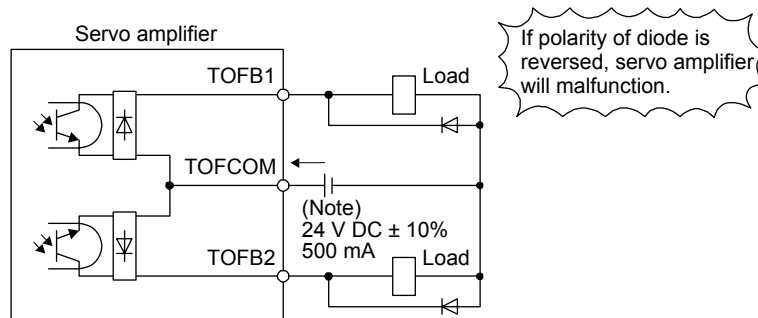


(2) Digital output interface DO-1

This is a circuit of emitter output terminal of the output transistor. When the output transistor is turned on, current will be applied from the output to a load.

A maximum of 5.2 V voltage drop occurs in the servo amplifier.

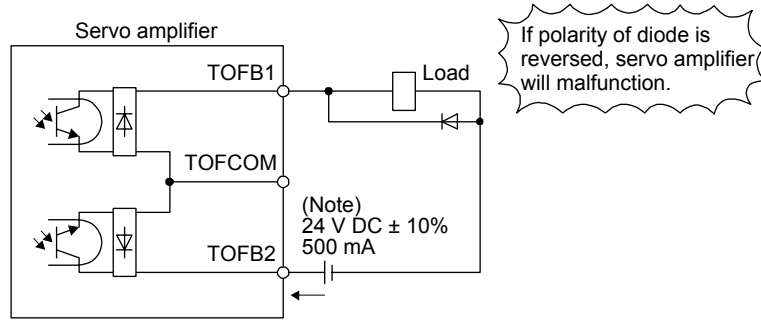
(a) When outputting two STO states by using each TOFB



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.

13. USING STO FUNCTION

(b) When outputting two STO states by using one TOFB



Note. If the voltage drop (maximum of 5.2 V) interferes with the relay operation, apply high voltage (maximum of 26.4 V) from external source.

14. COMMUNICATION FUNCTION

14. Communication function

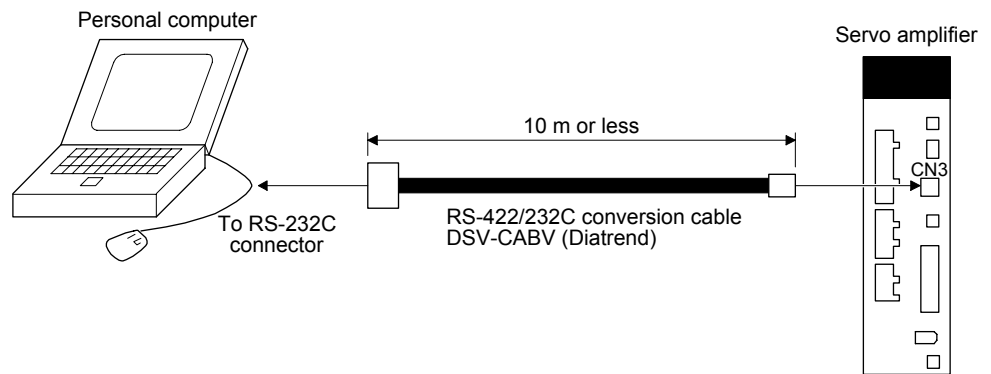
POINT
<ul style="list-style-type: none"> ● RS-422 serial communication function is supported by servo amplifier with software version A3. ● The USB communication function (CN5 connector) and the RS-422 communication function (CN3 connector) are mutually exclusive functions. They cannot be used together.

You can operate servo driving, parameter change, monitor function, etc. using RS-422 serial communication function with the servo amplifier.

14.1 Structure

(1) Single axis

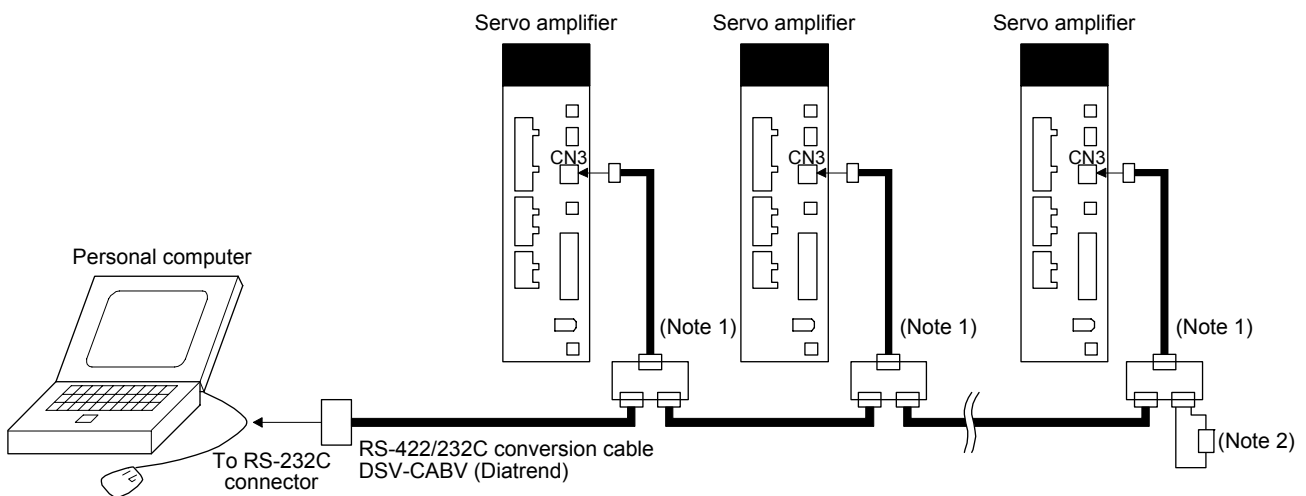
Operate the single-axis servo amplifier. It is recommended to use the following cable.



(2) Multi-drop connection

(a) Diagrammatic sketch

Up to 32 axes of servo amplifiers from stations 0 to 31 can be operated on the same bus.

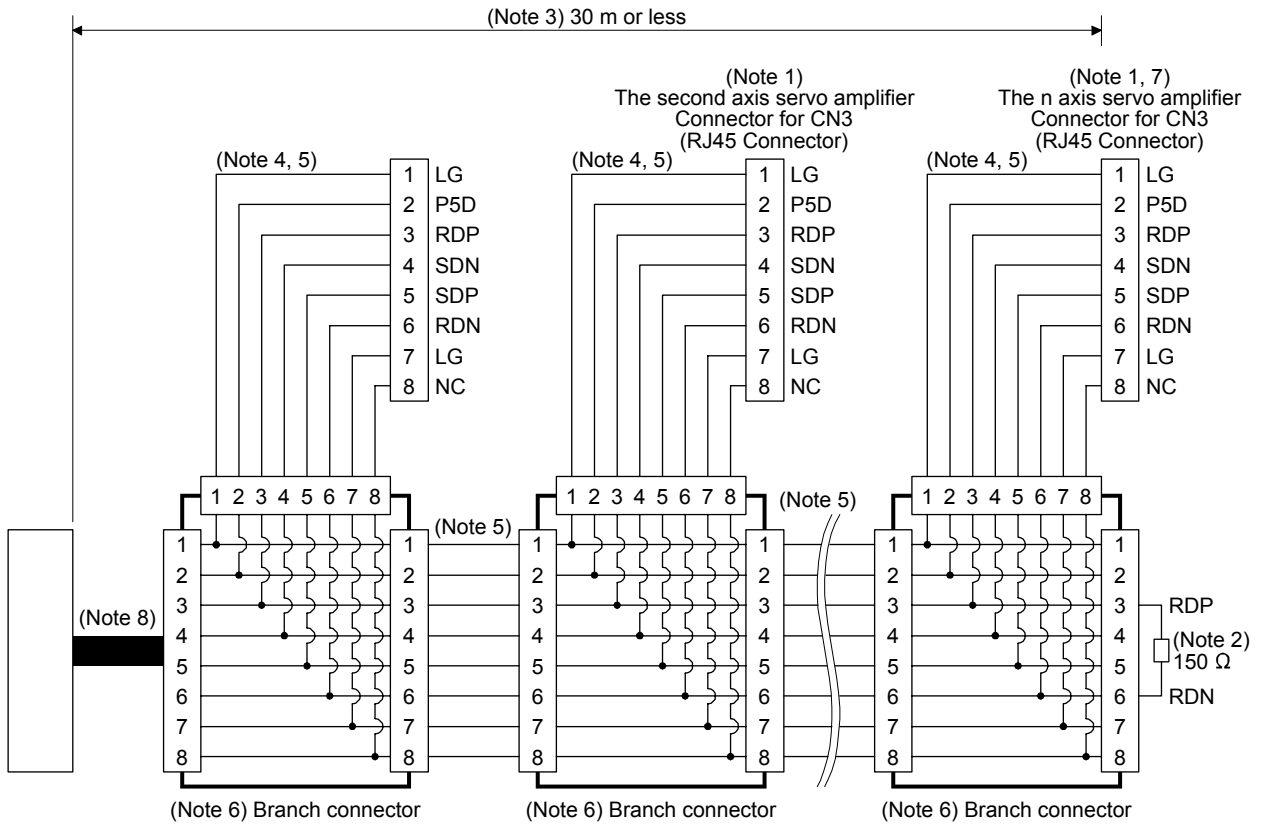


Note 1. The BMJ-8 (Hachiko Electric) is recommended as the branch connector.

Note 2. The final axis must be terminated between RDP (pin No.3) and RDN (pin No.6) on the receiving side (servo amplifier) with a 150 Ω resistor.

14. COMMUNICATION FUNCTION

(b) Cable connection diagram
Wire the cables as follows.



- Note 1. Recommended connector (Hirose Electric)
Plug: TM10P-88P
Connection tool: CL250-0228-1
2. The final axis must be terminated between RDP (pin No.3) and RDN (pin No.6) on the receiving side (servo amplifier) with a 150 Ω resistor.
3. The overall length is 30 m or less in low-noise environment.
4. The wiring between the branch connector and servo amplifier should be as short as possible.
5. Use the EIA568-compliant cable (10BASE-T cable, etc.).
6. Recommended branch connector: BMJ-8 (Hachiko Electric)
7. $n \leq 32$ (Up to 32 axes can be connected.)
8. RS-422/232C conversion cable DSV-CABV (Diatrend)

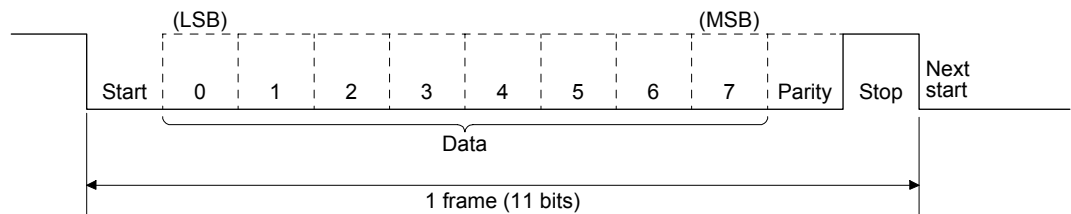
14. COMMUNICATION FUNCTION

14.2 Communication specifications

14.2.1 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	Definition	
Baud rate [bps]	9600/19200/38400/57600/115200 asynchronous system	
Transfer code	Start bit	1 bit
	Data bit	8 bits
	Parity bit	1 bit (even)
	Stop bit	1 bit
Transfer method	Character method	Half-duplex communication method



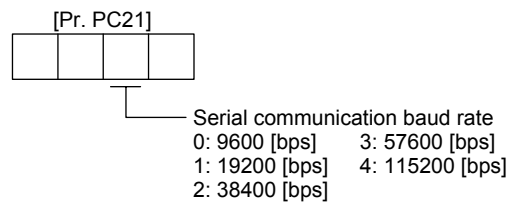
14.2.2 Parameter setting

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.

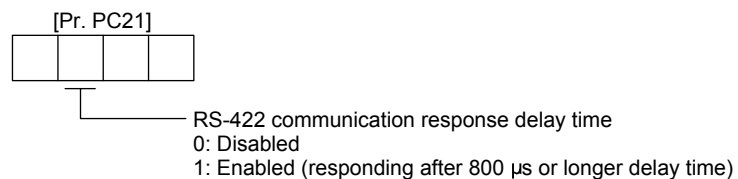
(1) Serial communication baud rate

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.

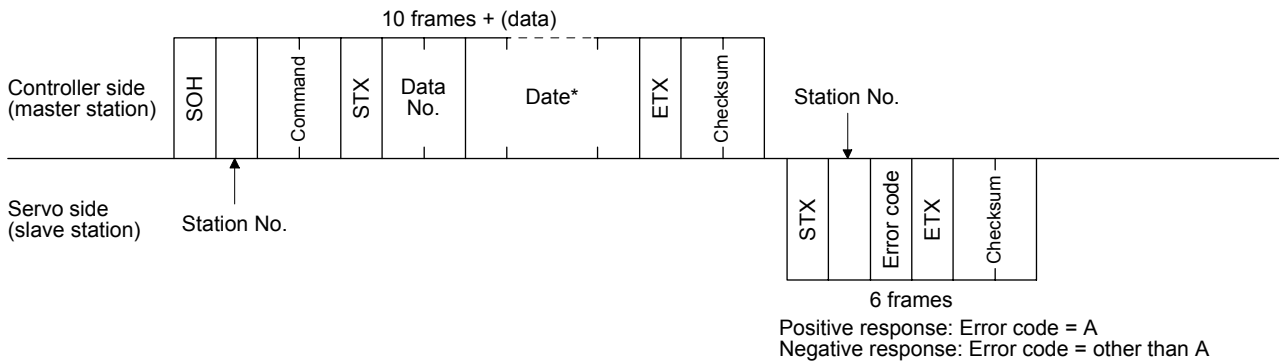
14. COMMUNICATION FUNCTION

14.3 Protocol

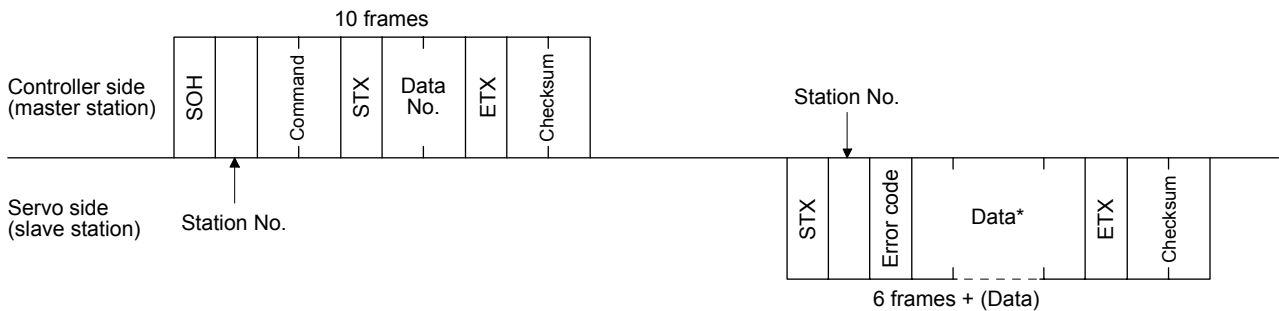
14.3.1 Transmission data configuration

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. When the command pulse train is between 1 Mpps and 4 Mpps, set [Pr. PA13] to "_ 0 _ _".

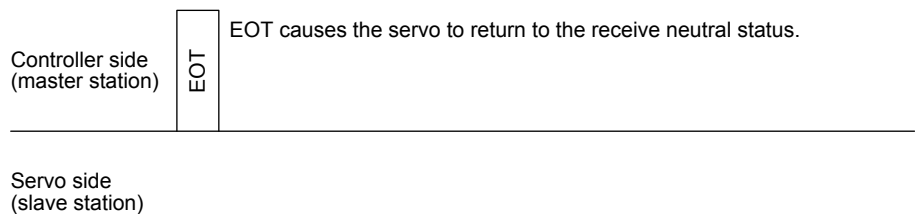
(1) Transmission of data from the controller to the servo



(2) Transmission of data request from the controller to the servo

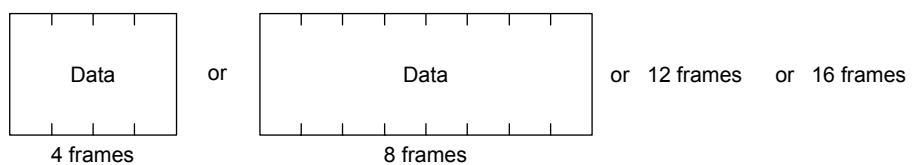


(3) Recovery of communication status by time-out



(4) Data frames

The data length depends on the command.



14. COMMUNICATION FUNCTION

14.3.2 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

ASCII unit codes are used.

	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
	0	0	0	0
	0	0	0	1
	0	0	1	0
	0	0	1	1
	0	1	0	0
	0	1	0	1
	0	1	1	0
	0	1	1	1
	1	0	0	0
	1	0	0	1
	1	0	1	0
	1	0	1	1
	1	1	0	0
	1	1	0	1
	1	1	1	0
	1	1	1	1

R \ C	0	1	2	3	4	5	6	7
0	NUL	DLE	Space	0	@	P	`	p
1	SOH	DC ₁	!	1	A	Q	a	q
2	STX	DC ₂	"	2	B	R	b	r
3	ETX	DC ₃	#	3	C	S	c	s
4			\$	4	D	T	d	t
5			%	5	E	U	e	u
6			&	6	F	V	f	v
7			'	7	G	W	g	w
8			(	8	H	X	h	x
9			)	9	I	Y	i	y
10			*	:	J	Z	j	z
11			+	;	K	[	k	{
12			,	<	L	¥	l	|
13			-	=	M	]	m	}
14			.	>	N	^	n	~
15			/	?	O	_	o	DEL

(3) Station numbers

You may set 32 station Nos. from station 0 to station 31 and the ASCII unit codes are used 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).

14. COMMUNICATION FUNCTION

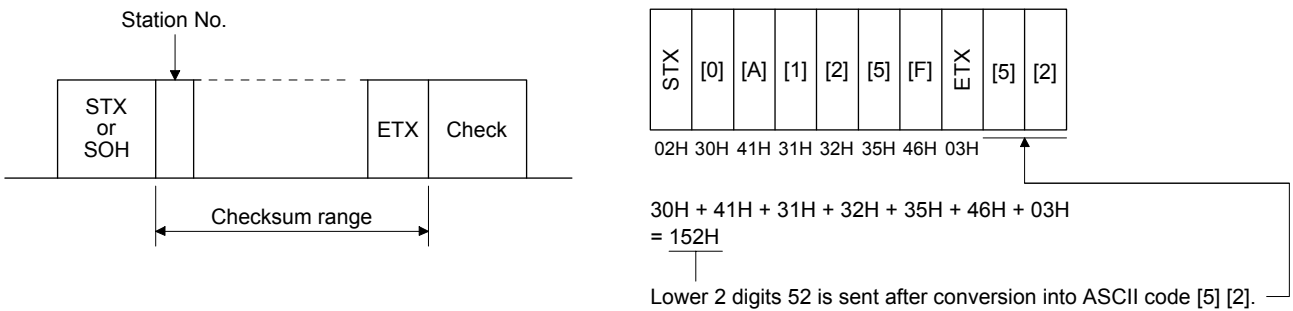
14.3.3 Error codes

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	Remarks
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.	

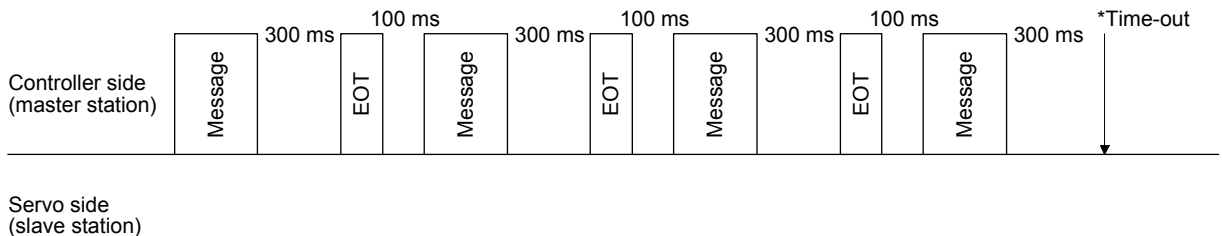
14.3.4 Checksum

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).



14.3.5 Time-out processing

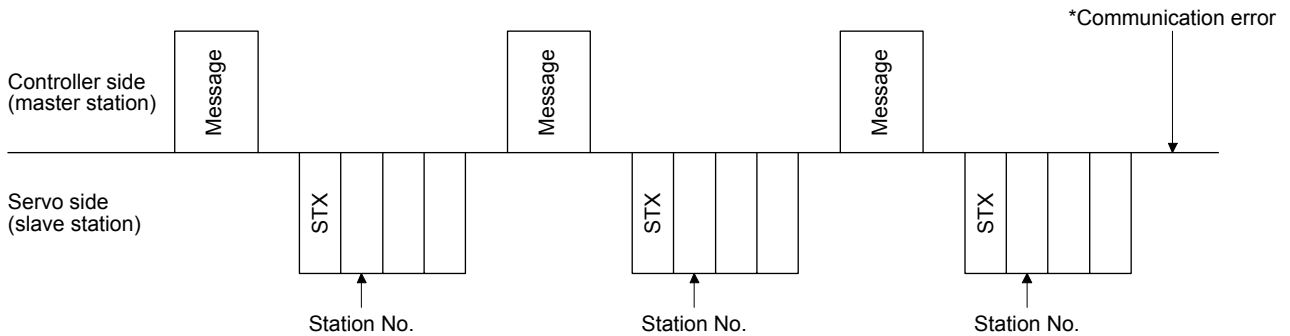
The master station transmits EOT when the slave station does not start return processing (STX is not received) 300 [ms] after the master station has ended communication processing. 100 ms after that, the master station retransmits the message. Time-out occurs if the slave station does not answer after the master station has performed the above communication processing three times. (communication error)



14. COMMUNICATION FUNCTION

14.3.6 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.

14.3.7 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.

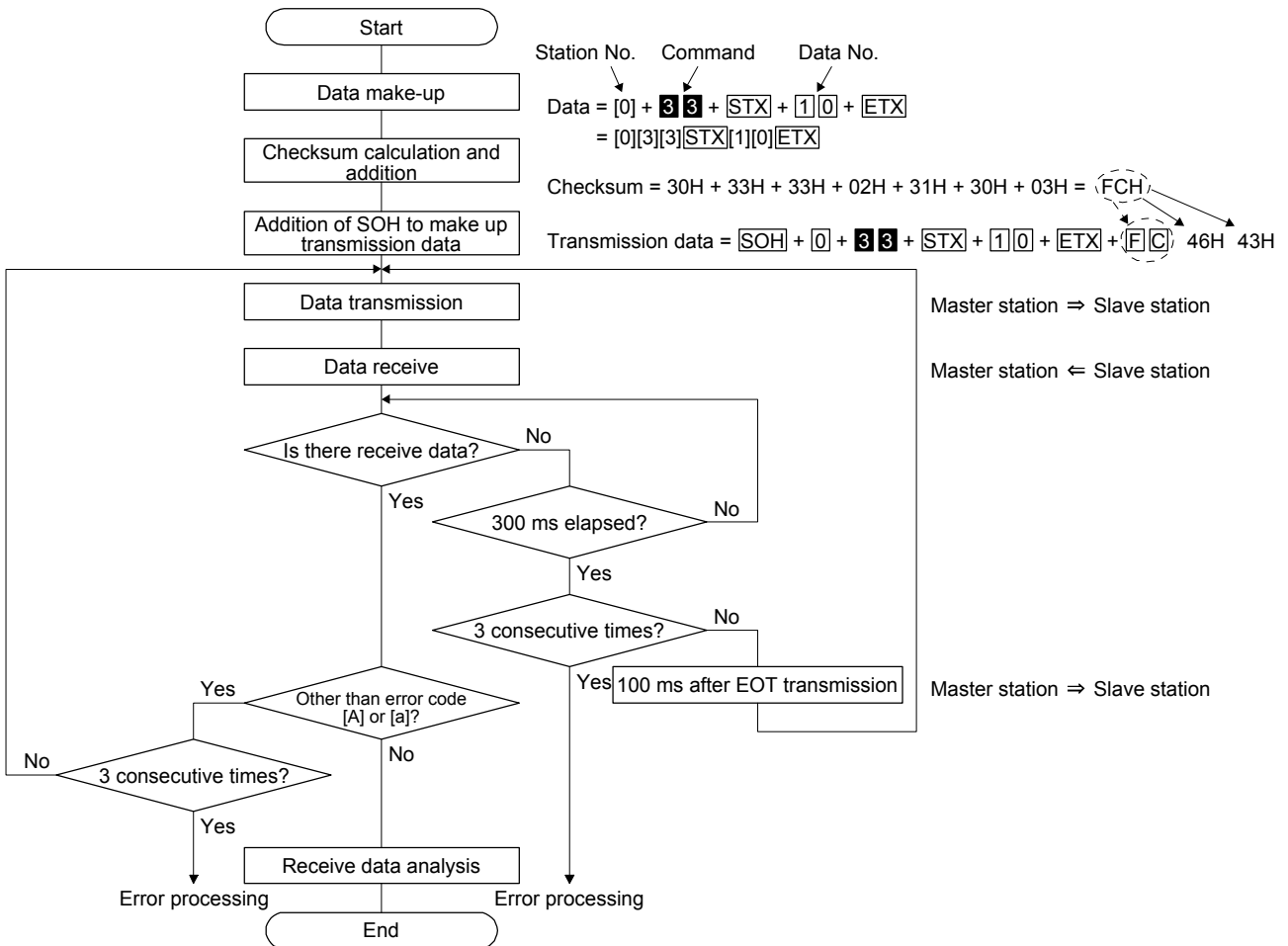
- (1) Wait for 3.5 s or longer after the slave station is switched on.
- (2) Check that normal communication can be made by reading the parameter or other data which does not pose any safety problems.

14. COMMUNICATION FUNCTION

14.3.8 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)



14. COMMUNICATION FUNCTION

14.4 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.

14.4.1 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 Motor-side cumu. feedback pulses (after gear)	16
	[0] [1]		Servo motor speed Servo motor speed	
	[0] [2]		Droop pulses Motor-side 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 Instantaneous thrust	
	[0] [B]		Position within one-revolution Motor encoder position within one-revolution Virtual position within one-revolution	
	[0] [C]		ABS counter Motor encoder ABS counter Virtual ABS counter	
	[0] [D]		Load to motor inertia ratio Load to motor mass ratio	
	[0] [E]		Bus voltage	
	[0] [F]		Load-side cumulative feedback pulses	
	[1] [0]		Load-side droop pulses	
	[1] [1]		Load-side encoder information 1 Z-phase counter	
	[1] [2]		Load-side encoder information 2	
	[1] [6]		Temperature of motor thermistor	
	[1] [7]		Motor-side cumu. feedback pulses (before gear)	
	[1] [8]		Electrical angle	
	[1] [E]		Motor-side/load-side position deviation	
	[1] [F]		Motor-side/load-side speed deviation	
	[2] [0]		Encoder inside temperature	
	[2] [1]		Settling time	
	[2] [2]		Oscillation detection frequency	
	[2] [3]		Number of tough operations	
	[2] [8]		Unit power consumption	
	[2] [9]		Unit total power consumption	

14. COMMUNICATION FUNCTION

Command	Data No.	Description	Status display	Frame length
[0] [1]	[8] [0]	Status display data value and processing information	Cumulative feedback pulses Motor-side cumu. feedback pulses (after gear)	12
	[8] [1]		Servo motor speed Servo motor speed	
	[8] [2]		Droop pulses Motor-side 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 Instantaneous thrust	
	[8] [B]		Position within one-revolution Motor encoder position within one-revolution Virtual position within one-revolution	
	[8] [C]		ABS counter Motor encoder ABS counter Virtual ABS counter	
	[8] [D]		Load to motor inertia ratio Load to motor mass ratio	
	[8] [E]		Bus voltage	
	[8] [F]		Load-side cumulative feedback pulses	
	[9] [0]		Load-side droop pulses	
	[9] [1]		Load-side encoder information 1 Z-phase counter	
	[9] [2]		Load-side encoder information 2	
	[9] [6]		Temperature of motor thermistor	
	[9] [7]		Motor-side cumu. feedback pulses (before gear)	
	[9] [8]		Electrical angle	
	[9] [E]		Motor-side/load-side position deviation	
	[9] [F]		Motor-side/load-side speed deviation	
	[A] [0]		Encoder inside temperature	
	[A] [1]		Settling time	
	[A] [2]		Oscillation detection frequency	
	[A] [3]		Number of tough operations	
	[A] [8]		Unit power consumption	
	[A] [9]		Unit total power consumption	

14. COMMUNICATION FUNCTION

(2) Parameters (command [0] [4], [0] [5], [0] [6], [0] [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_ _]) 000B: Linear servo motor/DD motor setting parameters ([Pr. PL_ _])	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	

14. COMMUNICATION FUNCTION

(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

14. COMMUNICATION FUNCTION

(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
			Motor-side cumu. feedback pulses (after gear)	
	[0] [1]		Servo motor speed	
			Servo motor speed	
	[0] [2]		Drop pulses	
			Motor-side 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	
			Instantaneous thrust	
	[0] [B]		Position within one-revolution	
			Motor encoder position within one-revolution	
			Virtual position within one-revolution	
	[0] [C]		ABS counter	
			Motor encoder ABS counter	
			Virtual ABS counter	
	[0] [D]		Load to motor inertia ratio	
			Load to motor mass ratio	
	[0] [E]		Bus voltage	
	[0] [F]		Load-side cumulative feedback pulses	
	[1] [0]		Load-side droop pulses	
	[1] [1]		Load-side encoder information 1	
			Z-phase counter	
	[1] [2]		Load-side encoder information 2	
	[1] [6]		Temperature of motor thermistor	
[1] [7]	Motor-side cumu. feedback pulses (before gear)			
[1] [8]	Electrical angle			
[1] [E]	Motor-side/load-side position deviation			
[1] [F]	Motor-side/load-side speed deviation			
[2] [0]	Encoder inside temperature			
[2] [1]	Settling time			
[2] [2]	Oscillation detection frequency			
[2] [3]	Number of tough operations			
[2] [8]	Unit power consumption			
[2] [9]	Unit total power consumption			

14. COMMUNICATION FUNCTION

Command	Data No.	Description	Status display	Frame length
[3] [5]	[8] [0]	Status display data value and processing information	Cumulative feedback pulses Motor-side cumu. feedback pulses (after gear)	12
	[8] [1]		Servo motor speed Servo motor speed	
	[8] [2]		Droop pulses Motor-side 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 Instantaneous thrust	
	[8] [B]		Position within one-revolution Motor encoder position within one-revolution Virtual position within one-revolution	
	[8] [C]		ABS counter Motor encoder ABS counter Virtual ABS counter	
	[8] [D]		Load to motor inertia ratio Load to motor mass ratio	
	[8] [E]		Bus voltage	
	[8] [F]		Load-side cumulative feedback pulses	
	[9] [0]		Load-side droop pulses	
	[9] [1]		Load-side encoder information 1 Z-phase counter	
	[9] [2]		Load-side encoder information 2	
	[9] [6]		Temperature of motor thermistor	
	[9] [7]		Motor-side cumu. feedback pulses (before gear)	
	[9] [8]		Electrical angle	
	[9] [E]		Motor-side/load-side position deviation	
	[9] [F]		Motor-side/load-side speed deviation	
	[A] [0]		Encoder inside temperature	
	[A] [1]		Settling time	
	[A] [2]		Oscillation detection frequency	
	[A] [3]		Number of tough operations	
	[A] [8]		Unit power consumption	
	[A] [9]		Unit total power consumption	

(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 0003: Motor-less operation 0004: Output signal (DO) forced output	4

(8) Others

Command	Data No.	Description	Frame length
[0] [2]	[9] [0]	Servo motor-side pulse unit absolute position	8
	[9] [1]	Command unit absolute position	8
	[7] [0]	Software version	16

14. COMMUNICATION FUNCTION

14.4.2 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_ _]) 000B: Linear servo motor/DD motor setting parameters ([Pr. PL_ _])	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 14.5.5.	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])

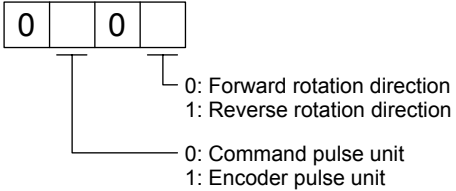
Command	Data No.	Description	Setting range	Frame length
[9] [0]	[0] [0]	Turns off the input device, external analog input signal or pulse train input, except EMG, LSP and LSN, independently of the external on/off status.	1EA5	4
	[0] [3]	Disables all output devices (DO).	1EA5	4
	[1] [0]	Cancels the prohibition of the input device, external analog input signal or pulse train input, except EMG, 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]	Operation mode switching 0000: Test operation mode cancel 0001: JOG operation 0002: Positioning operation 0004: Output signal (DO) forced output	0000 to 0002, 0004	4

14. COMMUNICATION FUNCTION

(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 14.5.7.	8
	[A] [0]	Forced output of signal pin	Refer to section 14.5.9.	8
[A] [0]	[1] [0]	Writes the speed in the test operation mode (JOG operation and positioning operation).	0000 to 7FFF	4
	[1] [1]	Writes the acceleration/deceleration time constant in the test operation mode (JOG operation and positioning operation).	00000000 to 7FFFFFFF	8
	[2] [0]	Sets the travel distance in the test operation mode (JOG operation, positioning operation).	00000000 to 7FFFFFFF	8
	[2] [1]	Selects the positioning direction of test operation (positioning operation). 	0000 to 0101	4
	[4] [0]	This is a start command for test operation (positioning operation).	1EA5	4
[4] [1]	This is used 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	

14. COMMUNICATION FUNCTION

14.5 Detailed explanations of commands

14.5.1 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.

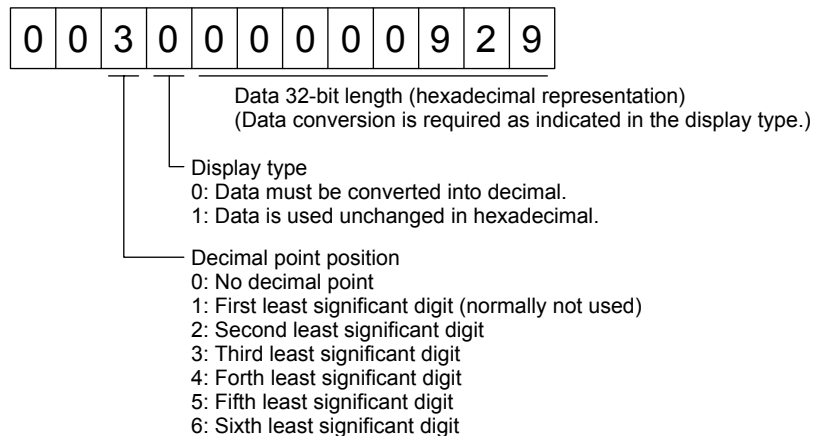
(1) Processing a read data

When the display type is 0, the eight-character data is converted from hexadecimal to decimal and a decimal point is placed according to the decimal point position information.

When the display type is 1, the eight-character data is used unchanged.

The following example indicates how to process the receive data "00300000929" given to show.

The receive data is as follows.



Since the display type is "0" in this case, the hexadecimal data is converted into decimal.

00000929H → 2345

As the decimal point position is "3", a decimal point is placed in the third least significant digit.

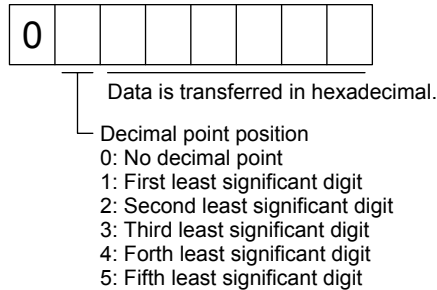
Hence, "23.45" is displayed.

14. COMMUNICATION FUNCTION

(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 digit, the decimal point position data is "2".

As the data to be sent is hexadecimal, the decimal data is converted into hexadecimal.

155 → 9B

Hence, "0200009B" is transmitted.

14. COMMUNICATION FUNCTION

14.5.2 Status display mode

(1) Reading the status display name and unit

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 14.4.1.)

(b) Return

The slave station returns the status display name and unit requested.



(2) Status display data reading

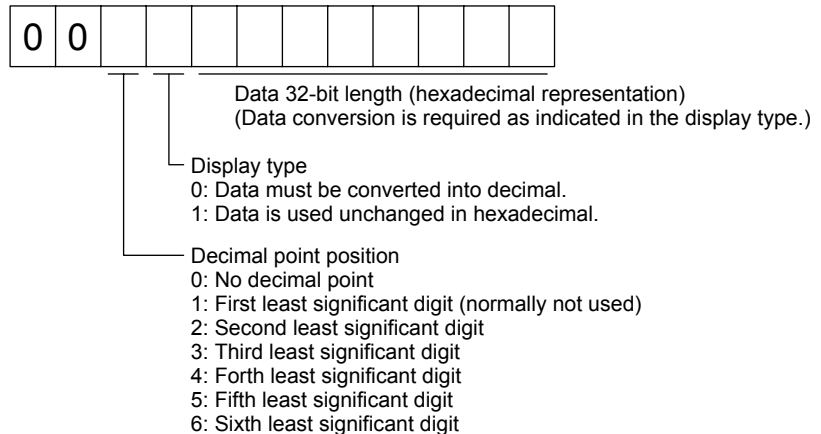
Read the status display data and processing information.

(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 14.4.1.)

(b) Return

The slave station returns the status display data requested.



(3) Status display data clear

The cumulative feedback pulse data of the status display is cleared. 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".

14. COMMUNICATION FUNCTION

14.5.3 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__])
		000B	Linear servo motor/DD motor setting parameters ([Pr. PL__])

(2) Parameter group reading

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__])
 B: Linear servo motor/DD motor setting parameters ([Pr. PL__])

(3) Reading symbols

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 14.4.1.)

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)

14. COMMUNICATION FUNCTION

(4) Reading the setting

Read the parameter setting. Specify a parameter group in advance. (Refer to (1) of this section.)

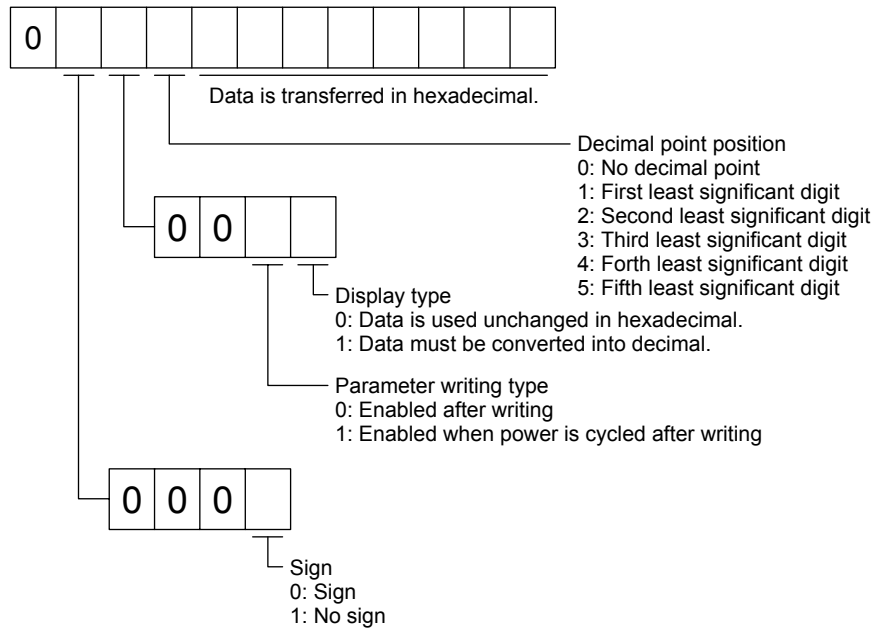
(a) Transmission

Transmit the command [1] [5] and the data No. corresponding to the parameter No [0] [1] to [F] [F]. (Refer to section 14.4.1.)

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

"0001FFFF053" 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].

14. COMMUNICATION FUNCTION

(5) Reading the setting range

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] [0] to [F] [F] corresponding to the parameter No. When reading an lower limit value, transmit the command [1] [7] and the data No. [0] [0] to [F] [F] corresponding to the parameter No. (Refer to section 14.4.1.)

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".

14. COMMUNICATION FUNCTION

(6) Writing setting values

POINT
<p>● 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 the EEPROM. 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 EEPROM is limited to approximately 100,000.</p>

Write the parameter setting into EEPROM 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.

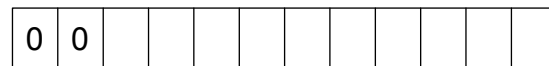
The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter No.

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] [0] to [F] [F]	See below.



- Writing mode
 - 0: Writing to EEPROM
 - 3: Writing to RAM

When the parameter data is changed frequently through communication, set "3" to the mode to change only the RAM data in the servo amplifier.
When changing data frequently (once or more within one hour), do not write it to the EEPROM.
- Decimal point position
 - 0: No decimal point
 - 1: First least significant digit
 - 2: Second least significant digit
 - 3: Third least significant digit
 - 4: Fourth least significant digit
 - 5: Fifth least significant digit

14. COMMUNICATION FUNCTION

14.5.4 External I/O signal status (DIO diagnosis)

(1) Reading input device status

Read the status of the input devices.

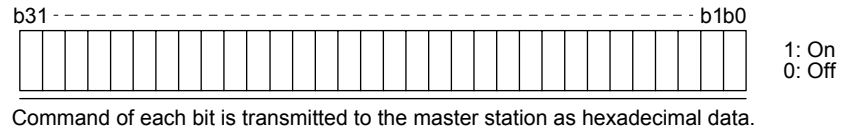
(a) Transmission

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.



Bit	Symbol
0	SON
1	LSP
2	LSN
3	TL
4	TL1
5	PC
6	RES
7	CR

Bit	Symbol
8	SP1
9	SP2
10	SP3
11	ST1/RS2
12	ST2/RS1
13	CM1
14	CM2
15	LOP

Bit	Symbol
16	
17	
18	
19	
20	STAB2
21	
22	
23	

Bit	Symbol
24	
25	
26	
27	CDP
28	CLD
29	MECR
30	
31	

(2) Reading external input pin status

Read the on/off status of the external input pins.

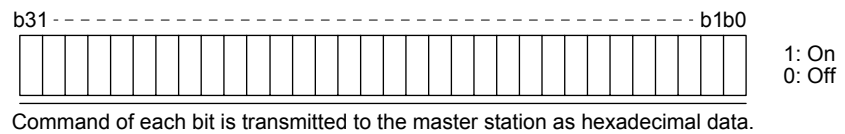
(a) Transmission

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.



Bit	CN1 connector pin
0	43
1	44
2	42
3	15
4	19
5	41
6	16
7	17

Bit	CN1 connector pin
8	18
9	45
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	

14. COMMUNICATION FUNCTION

- (3) Reading the status of input devices switched on with communication
 Read the on/off status of the input devices switched on with communication.

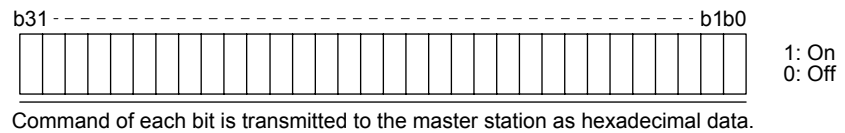
- (a) Transmission

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.



Bit	Symbol
0	SON
1	LSP
2	LSN
3	TL
4	TL1
5	PC
6	RES
7	CR

Bit	Symbol
8	SP1
9	SP2
10	SP3
11	ST1/RS2
12	ST2/RS1
13	CM1
14	CM2
15	LOP

Bit	Symbol
16	
17	
18	
19	
20	STAB2
21	
22	
23	

Bit	Symbol
24	
25	
26	
27	CDP
28	CLD
29	MECR
30	
31	

- (4) Reading external output pin status
 Read the on/off status of the external output pins.

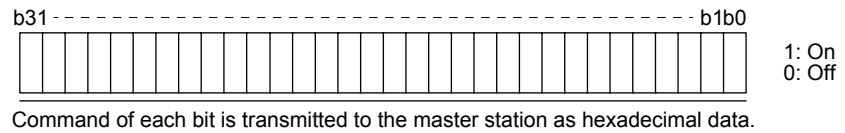
- (a) Transmission

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.



Bit	CN1 connector pin
0	49
1	24
2	23
3	25
4	22
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	

14. COMMUNICATION FUNCTION

(5) Reading output device status

Read the on/off status of the output devices.

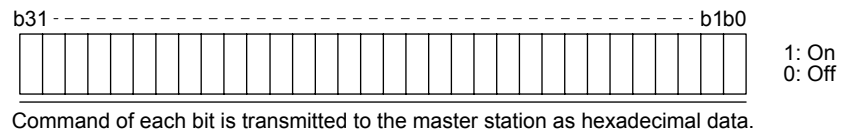
(a) Transmission

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.



Bit	Symbol
0	RD
1	SA
2	ZSP
3	TLC
4	VLC
5	INP
6	
7	WNG

Bit	Symbol
8	ALM
9	OP
10	MBR
11	DB
12	ACD0
13	ACD1
14	ACD2
15	BWNG

Bit	Symbol
16	
17	
18	
19	
20	
21	
22	
23	

Bit	Symbol
24	
25	CDPS
26	CLDS
27	ABSV
28	
29	
30	
31	MTTR

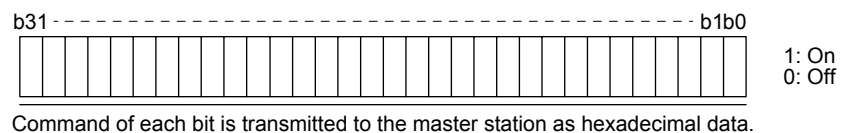
14.5.5 Input device on/off

POINT
<ul style="list-style-type: none"> 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.



Bit	Symbol
0	SON
1	LSP
2	LSN
3	TL
4	TL1
5	PC
6	RES
7	CR

Bit	Symbol
8	SP1
9	SP2
10	SP3
11	ST1/RS2
12	ST2/RS1
13	CM1
14	CM2
15	LOP

Bit	Symbol
16	
17	
18	
19	
20	STAB2
21	
22	
23	

Bit	Symbol
24	
25	
26	
27	CDP
28	CLD
29	MECR
30	
31	

14. COMMUNICATION FUNCTION

14.5.6 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

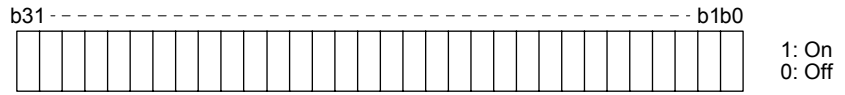
14. COMMUNICATION FUNCTION

14.5.7 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.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol
0	SON
1	LSP
2	LSN
3	TL
4	TL1
5	PC
6	RES
7	CR

Bit	Symbol
8	SP1
9	SP2
10	SP3
11	ST1
12	ST2
13	CM1
14	CM2
15	LOP

Bit	Symbol
16	/
17	/
18	/
19	/
20	STAB2
21	/
22	/
23	/

Bit	Symbol
24	/
25	/
26	/
27	CDP
28	CLD
29	MECR
30	/
31	/

14. COMMUNICATION FUNCTION

14.5.8 Test operation mode

POINT
<ul style="list-style-type: none"> ● 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	DO forced output (Note)

Note. Refer to section 14.5.9 for 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
 3: Motor-less operation
 4: DO forced output

(b) Cancel of test operation mode

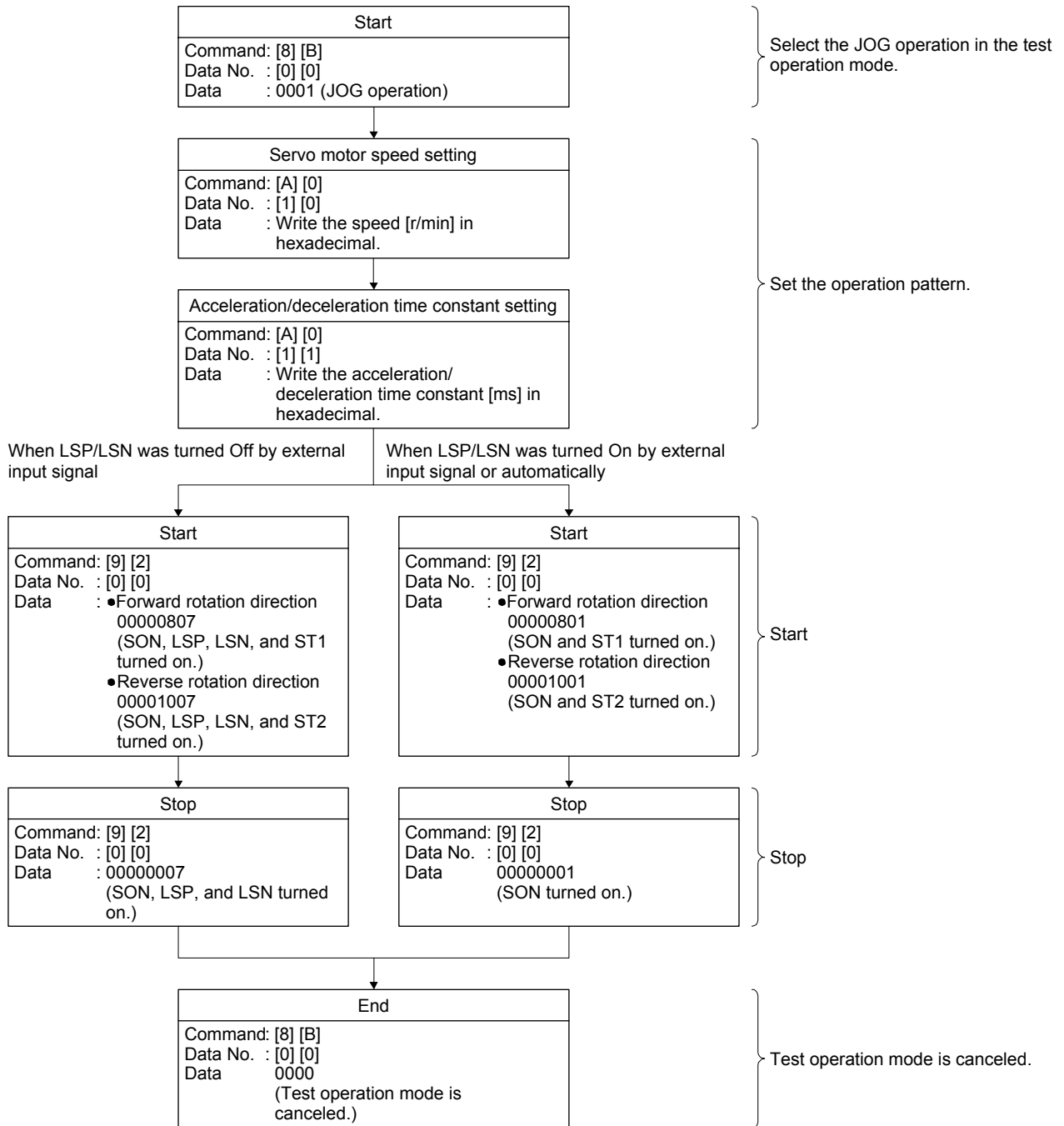
To terminate the test operation mode, send the command [8] [B] + data No. [0] [0] + data.

Command	Data No.	Transmission data	Selection of test operation mode
[8] [B]	[0] [0]	0000	Test operation mode cancel

14. COMMUNICATION FUNCTION

(2) JOG operation

Transmit the command, data No., and data as follows to execute JOG operation.

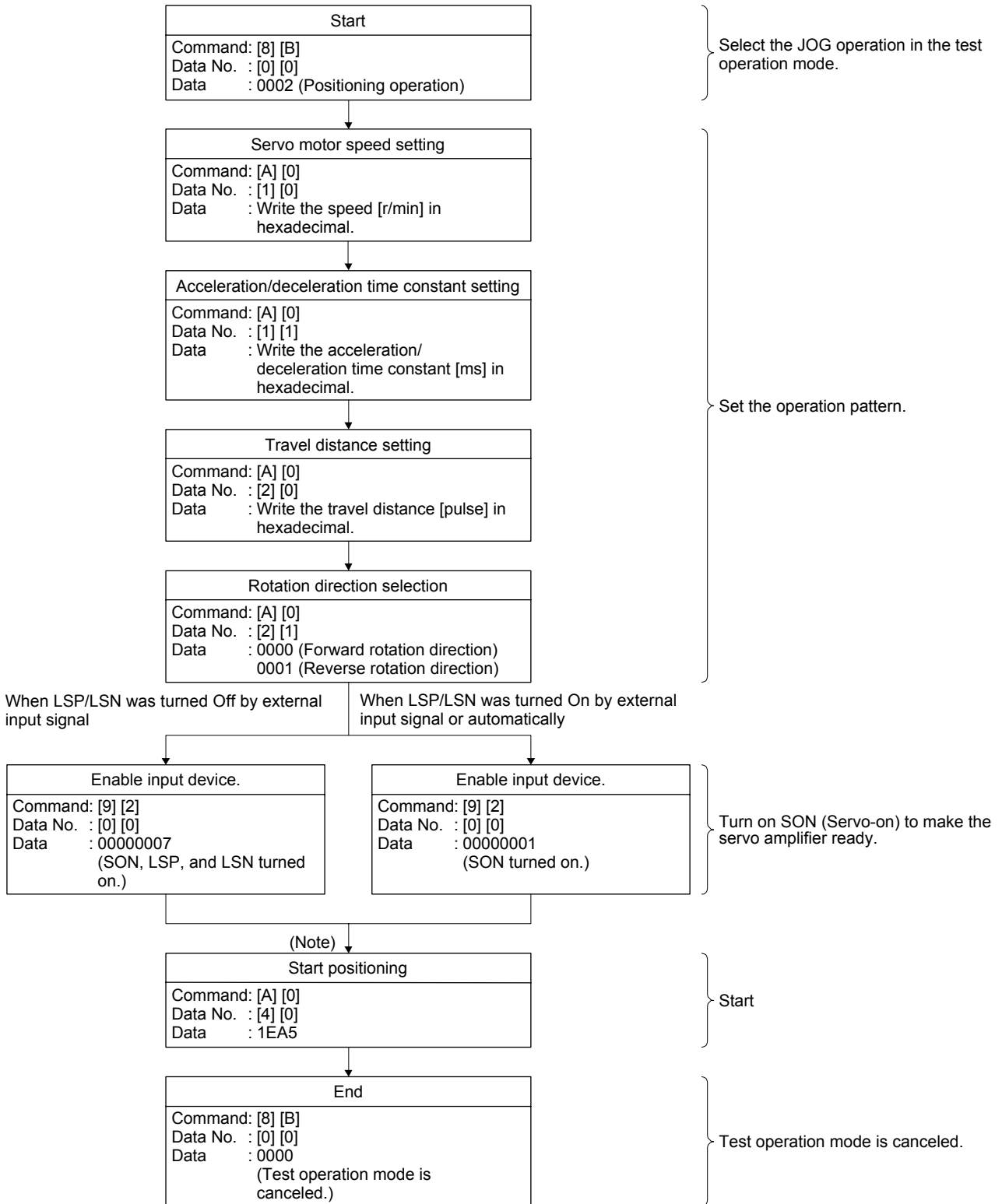


14. COMMUNICATION FUNCTION

(3) Positioning operation

(a) Operation procedure

Transmit the command, data No., and data as follows to execute positioning operation.



Note. It has 100 ms delay.

14. COMMUNICATION FUNCTION

(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.

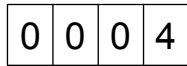
14. COMMUNICATION FUNCTION

14.5.9 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 DO forced output in the test operation mode

Transmit command + [8] [B] + data No. [0] [0] + data "0004" to select DO forced output.

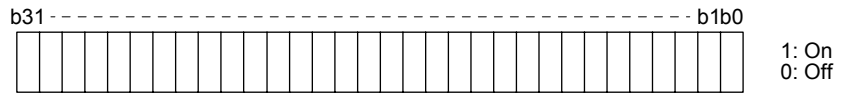


Selection of test operation mode
4: DO forced output (output signal forced output)

(2) External output signal on/off

Transmit the following communication commands.

Command	Data No.	Set data
[9] [2]	[A] [0]	See below.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	CN1 connector pin
0	49
1	24
2	23
3	25
4	22
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) DO forced output

Transmit command [8] [B] + data No. [0] [0] + data to stop DO forced output.

Command	Data No.	Transmission data	Selection of test operation mode
[8] [B]	[0] [0]	0000	Test operation mode cancel

14. COMMUNICATION FUNCTION

14.5.10 Alarm history

(1) Alarm No. reading

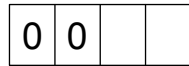
Read alarm Nos. which occurred in the past. Alarm Nos. and occurrence times of No. 0 (last alarm) to No. 15 (sixteenth alarm in the past) are read.

(a) Transmission

Transmit command [3] [3] + data No. [1] [0] to [1] [F]. Refer to section 14.4.1.

(b) Return

Alarm Nos. corresponding to the data No. is provided.



Alarm No. is transferred in hexadecimal.

For example, "0032" means [AL. 32] and "00FF" means [AL. _ _] (no alarm).

(2) Alarm occurrence time reading

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 14.4.1.

(b) Return



The alarm occurrence time is transferred in hexadecimal.
Hexadecimal must be converted into decimal.

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

14. COMMUNICATION FUNCTION

14.5.11 Current alarm

(1) Current alarm reading

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.

0	0		
---	---	--	--

Alarm No. is transferred in hexadecimal.

For example, "0032" means [AL. 32] and "00FF" means [AL. __] (no alarm).

(2) Reading status display at alarm occurrence

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 14.4.1.

(b) Return

The slave station returns the status display data of requested alarm at occurrence.

0	0																		
---	---	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

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

(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

15. USING A LINEAR SERVO MOTOR

15. USING A LINEAR SERVO MOTOR

⚠ WARNING ●When using the linear servo motor, read "Linear Servo Motor Instruction Manual" and "Linear Encoder Instruction Manual".

POINT

●The linear servo system is available for the MR-J4-_A(-RJ) servo amplifiers of which software version is A5 or later. Check the software version using MR Configurator2.

15.1 Functions and configuration

15.1.1 Summary

The fields of semiconductor/LCD manufacturing systems, mounters, and others have strong demands for high accuracy, high speed, and efficiency. Therefore, the number of systems using a linear servo motor for a drive axis has been increasing. Since the linear servo system can obtain the characteristics of the high speed and the high acceleration/deceleration greater than the ball screw drive system. The linear servo system also does not have a ball screw wear which is a weak point in the ball screw drive system. This will extend the life of the equipment. In addition, since a response error due to backlash and friction does not occur, you can establish a high-accuracy system.

The following shows the differences between the linear servo motor and the rotary servo motor.

Category	Item	Differences		Remarks	
		Linear servo motor	Rotary servo motor		
Motor pole adjustment	Magnetic pole detection	Required	Not required (default setting)	Automatically executed at the first servo-on after the power is turned on. For the absolute position linear encoder, [Pr. PL01] can disable the magnetic pole detection. The timing of the magnetic pole detection can be changed with [Pr. PL01]. (Refer to (2) (b) of section 15.3.3.)	
Home position return	Reference home position	1048576 pulses unit (initial value)	One servo motor revolution unit	Home position return pitch can be changed with parameter setting. (Refer to section 15.3.3.)	
Absolute position detection system	Absolute position encoder battery (MR-BAT6V1SET)	Not required	Required	The following alarms and warnings are not provided for the linear servo motor. <ul style="list-style-type: none"> ▪ [AL. 25 Absolute position erased] ▪ [AL. 92 Battery cable disconnection warning] ▪ [AL. 9F Battery warning] ▪ [AL. E3 Absolute position counter warning] 	
Auto tuning	Load to motor inertia ratio (J)	Load to motor mass ratio	Load to motor inertia ratio		
MR Configurator2 (SW1DNC-MRC2-J) (software version 1.19V or later)	Motor speed (Data display and setting)	mm/s unit	r/min unit		
	Test operation function	Positioning operation	Supported	Supported	
		Motor-less operation	Not supported	Supported	
		JOG operation	Not supported	Supported	
Program operation		Supported	Supported		

15. USING A LINEAR SERVO MOTOR

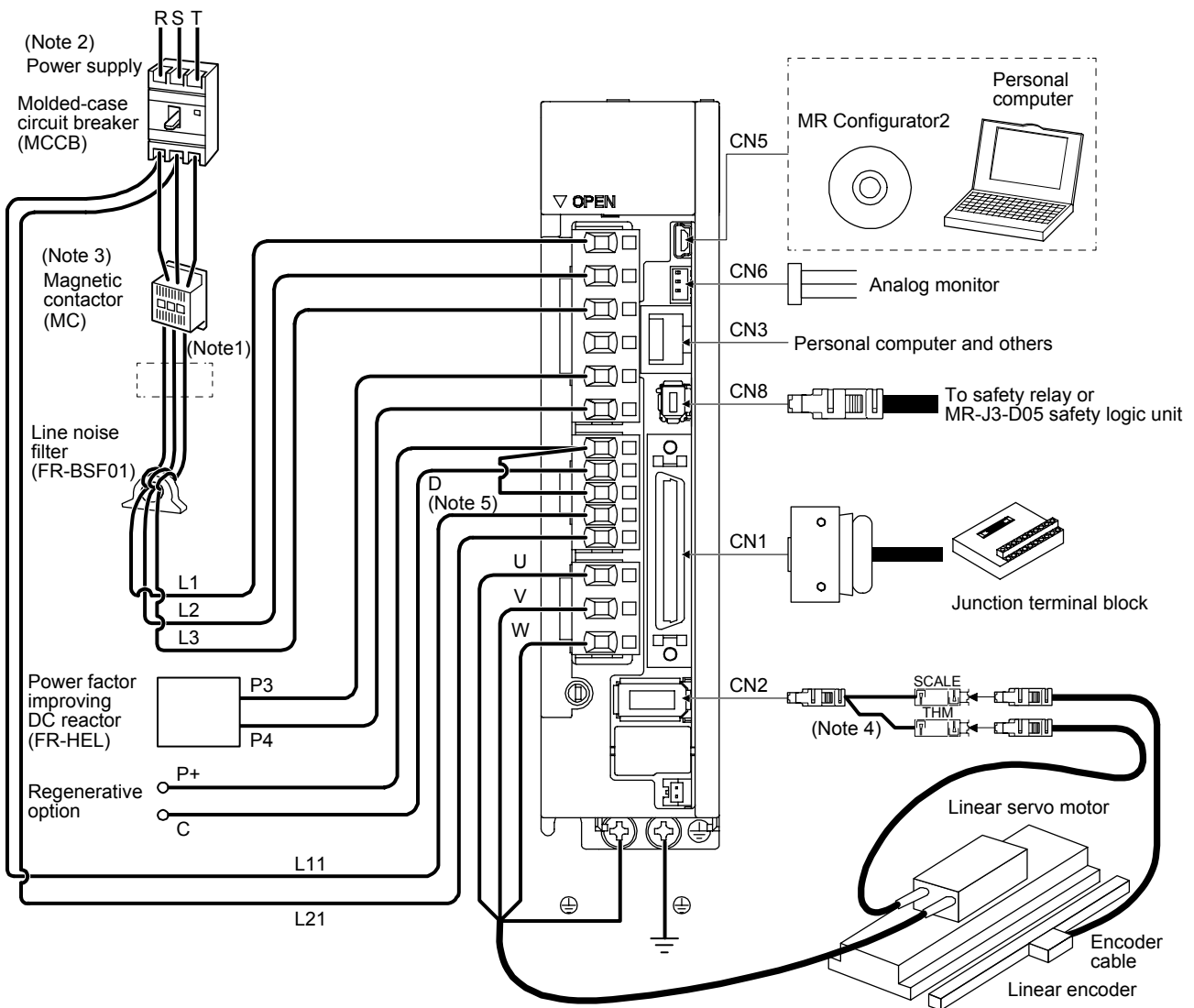
15.1.2 Configuration including peripheral equipment

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

POINT

- Equipment other than the servo amplifier and linear servo motor are optional or recommended products.
- When using the linear servo motor, set [Pr. PA01] to " _ _ 4 _".

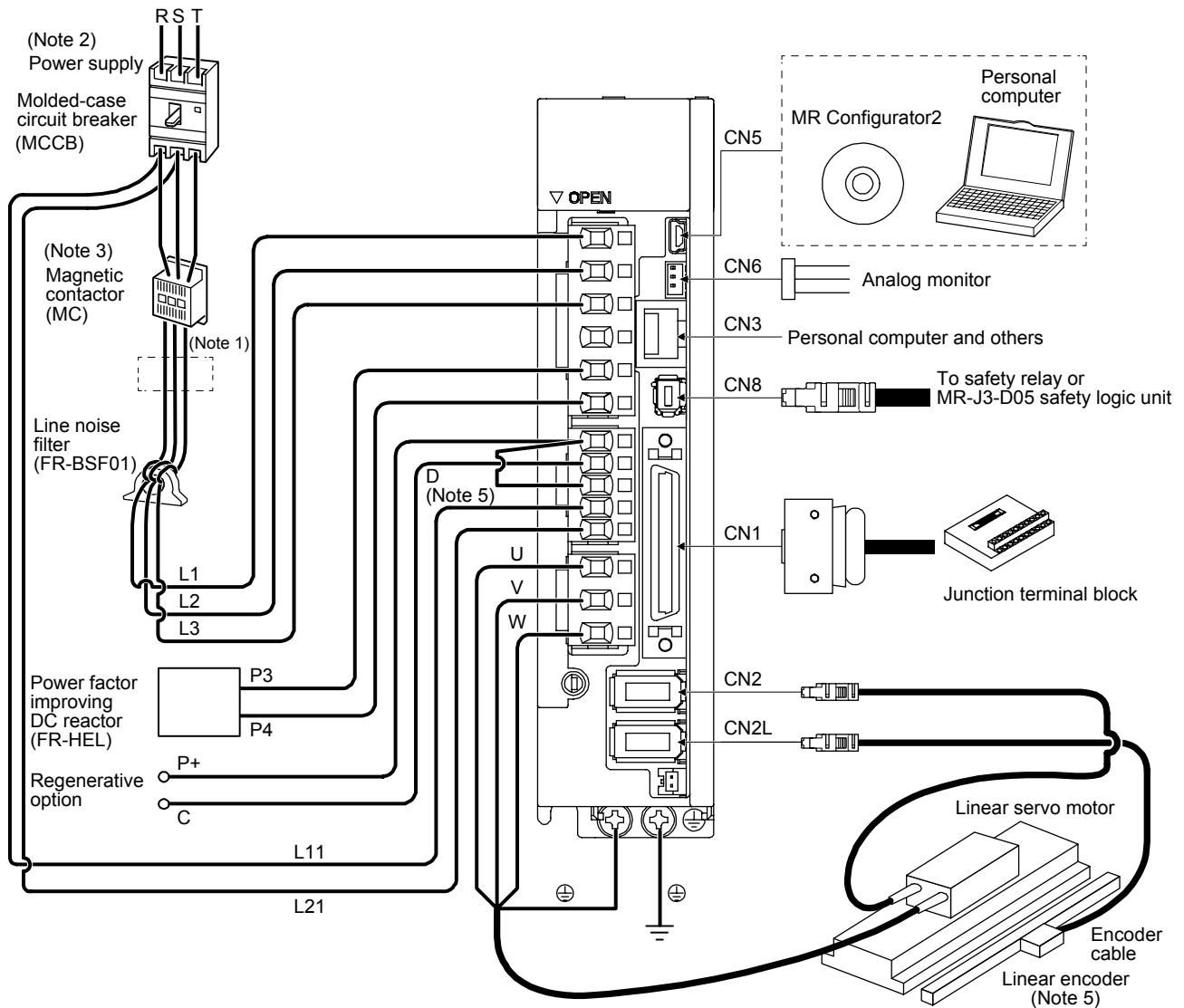
(1) MR-J4- _A



- Note
1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
 2. A 1-phase 200 V AC to 240 V AC power supply may be used with the servo amplifier of MR-J4-70A 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.
 3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
 4. For the branch cable, use the MR-J4THCBL03M (optional).
 5. Always connect between P+ and D terminals. When using the regenerative option, refer to section 11.2.

15. USING A LINEAR SERVO MOTOR

(2) MR-J4-_A-RJ



- Note 1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
- Note 2. A 1-phase 200 V AC to 240 V AC power supply may be used with the servo amplifier of MR-J4-J4-70B-RJ 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.
- Note 3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
- Note 4. Always connect between P+ and D terminals. When using the regenerative option, refer to section 11.2.
- Note 5. A/B/Z-phase differential output linear encoder also be used.

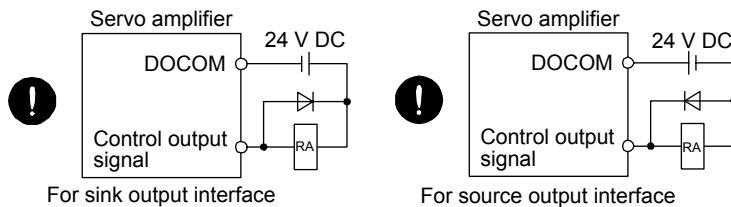
15. USING A LINEAR SERVO MOTOR

15.2 Signals and wiring

! WARNING

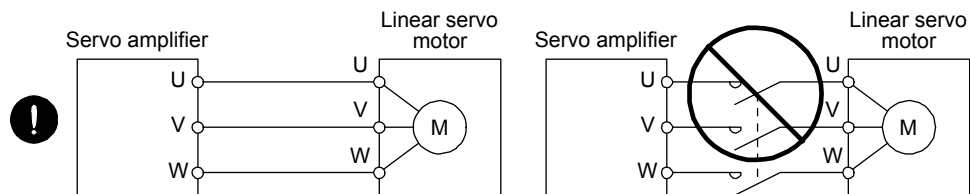
- Any person who is involved in wiring should be fully competent to do the work.
- Before wiring, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. Otherwise, an electric shock 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 the linear servo motor securely.
- Do not attempt to wire the servo amplifier and the linear 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.

- Wire the equipment correctly and securely. Otherwise, the linear 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.



! CAUTION

- 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 wire of the linear 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.
- Connect the servo amplifier power output (U, V, and W) to the linear 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 linear servo motor of the wrong axis to the U, V, W, or CN2 may cause a malfunction.

15. USING A LINEAR SERVO MOTOR



CAUTION

- Do not modify the equipment.
- The cables such as power wires deriving from the primary side cannot stand the long-term bending action. Avoid the bending action by fixing the cables to the moving part, etc. Also, use the cable that stands the long-term bending action for the wiring to the servo amplifier.

This section does not describe the following items. For details of the items, refer to each section of the detailed description field.

Item	Detailed explanation
Input power supply circuit	Section 3.1
Explanation of power supply system	Section 3.3
Signal (device) explanations	Section 3.5
Alarm occurrence timing chart	Section 3.8
Interface	Section 3.9
Grounding	Section 3.11
Display and operation sections	Section 4.5

15.3 Operation and functions

15.3.1 Startup

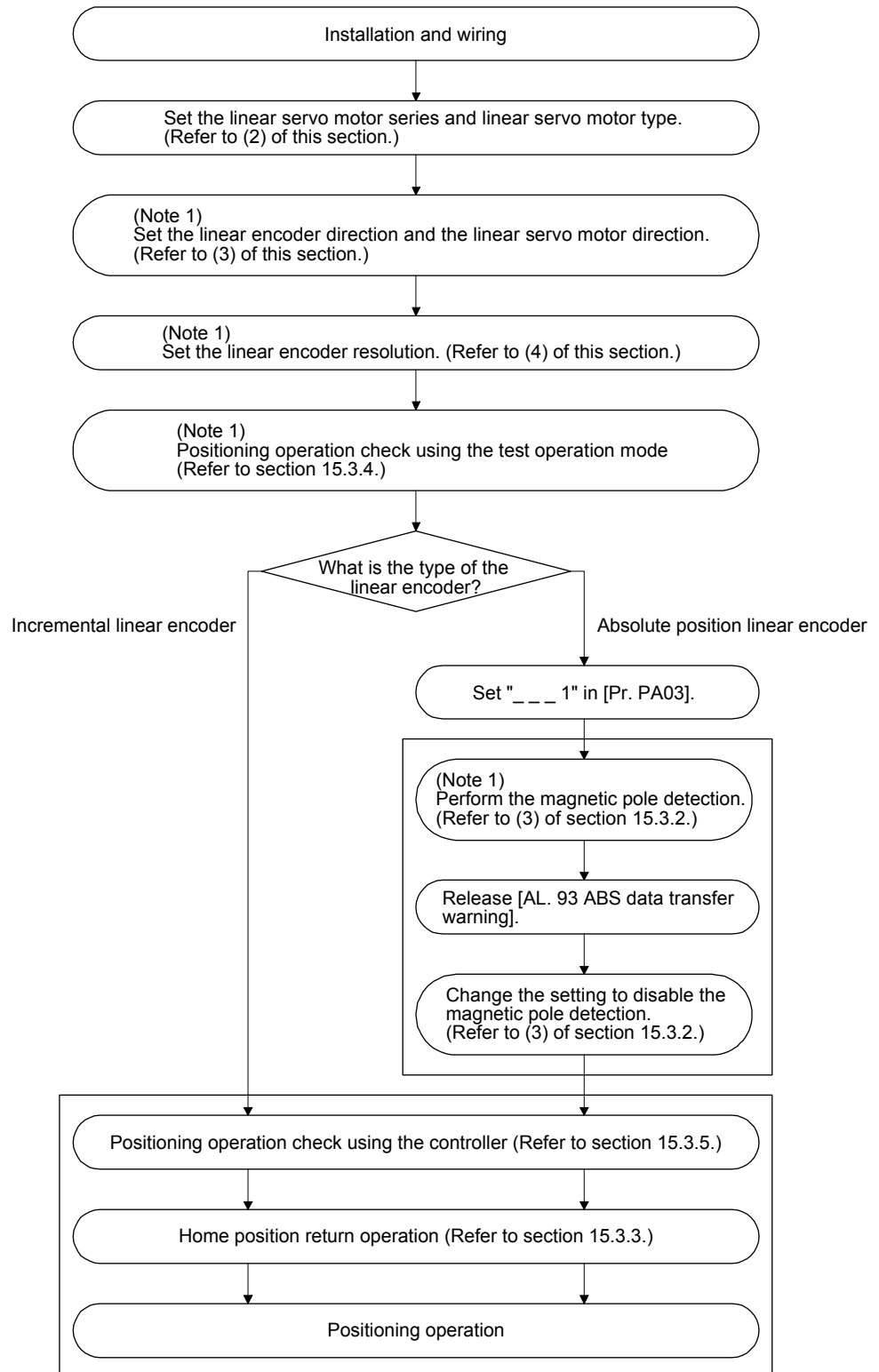
POINT

- | |
|--|
| ● When using the linear servo motor, set [Pr. PA01] to "__ 4 _". |
|--|

15. USING A LINEAR SERVO MOTOR

(1) Startup procedure

Start up the linear servo in the following procedure.



Note 1. Use MR Configurator2.

2. To cancel [AL. 93 ABS data transfer warning], cycle SON (Servo-on) or set a home position.

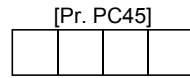
(2) Setting of linear servo motor series and linear servo motor type

To use the linear servo motor, set the linear servo motor series and linear servo motor type with [Pr. PA17 Servo motor series setting] and [Pr. PA18 Servo motor type setting]. (Refer to section 5.2.1.)

15. USING A LINEAR SERVO MOTOR

(3) Setting of linear encoder direction and linear servo motor direction

Set the first digit of [Pr. PC45] (Encoder pulse count polarity selection) so that the positive direction of the linear servo motor matches with the increasing direction of the linear encoder feedback.



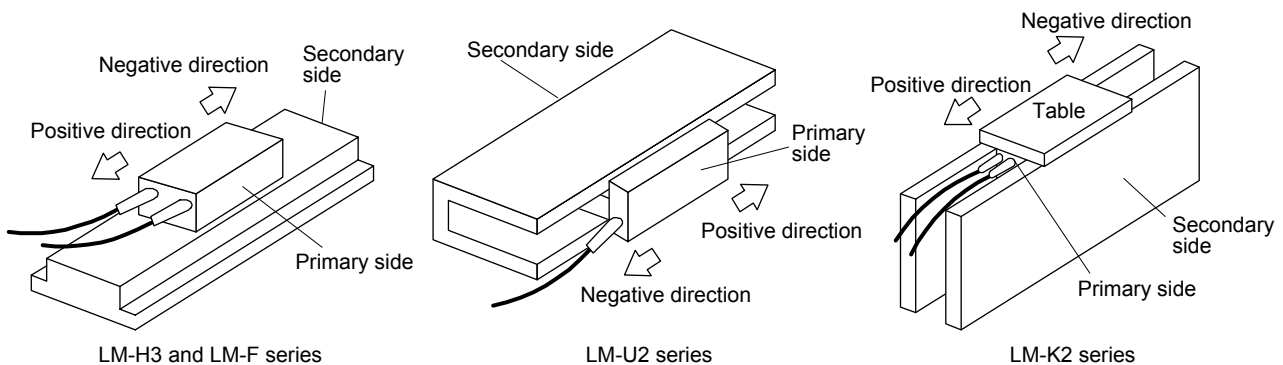
Encoder pulse count polarity selection
 0: Linear servo motor positive direction and linear encoder increasing direction
 1: Linear servo motor positive direction and linear encoder decreasing direction

(a) Parameter setting method

- 1) Confirm the positive direction of the linear servo motor. [Pr. PA14] determines the relation of the travel direction of the linear servo motor under commands as shown below.

[Pr. PA14] setting	Travel direction of linear servo motor	
	Address increasing command	Address decreasing command
0	Positive direction	Negative direction
1	Negative direction	Positive direction

The positive/negative directions of the linear servo motor are as follows.



- 2) Confirm the increasing direction of the linear encoder.

- 3) If the positive direction of the linear servo motor matches with the increasing direction of the linear encoder, set [Pr. PC45] to "___0". If the positive direction of the linear servo motor does not match with the increasing direction of the linear encoder, set [Pr. PC45] to "___1".

(b) Confirmation method

Confirm the positive direction of the linear servo motor and the increasing direction of the linear encoder in the following procedure.

- 1) In servo-off status, move the linear servo motor in the positive direction manually.
- 2) Confirm the motor speed (in the positive and negative directions) at that time with MR Configurator2.
- 3) When [Pr. PC45] is set to "___0" and the positive direction of the linear servo motor matches with the increasing direction of the linear encoder, if the linear servo motor operates in the positive direction, the motor speed will be a positive value. If the positive direction of the linear servo motor does not match with the increasing direction of the linear encoder, the motor speed will be a negative value. When [Pr. PC45] is set to "___1" and the positive direction of the linear servo motor matches with the increasing direction of the linear encoder, if the linear servo motor operates in the positive direction, the motor speed will be a negative value.

15. USING A LINEAR SERVO MOTOR

(4) Linear encoder resolution setting

Set the ratio of the electronic gear to the linear encoder resolution with [Pr. PL02 Linear encoder resolution - Numerator] and [Pr. PL03 Linear encoder resolution - Denominator].

POINT
● To enable the parameter values, cycle the power after setting.

(a) Parameter setting

Set the values that apply to the following equation.

$$\frac{[\text{Pr. PL02 Linear encoder resolution - Numerator}]}{[\text{Pr. PL03 Linear encoder resolution - Denominator}]} = \text{Linear encoder resolution } [\mu\text{m}]$$

(b) Parameter setting example

When the linear encoder resolution is 0.5 μm

$$\frac{[\text{Pr. PL02}]}{[\text{Pr. PL03}]} = \text{Linear encoder resolution} = 0.5 \mu\text{m} = \frac{1}{2}$$

The following shows the simplified chart for the setting values of [Pr. PL02] and [Pr. PL03].

		Linear encoder resolution [μm]							
		0.01	0.02	0.05	0.1	0.2	0.5	1.0	2.0
Setting value	[Pr. PL02]	1	1	1	1	1	1	1	2
	[Pr. PL03]	100	50	20	10	5	2	1	1

POINT
● If an incorrect value is set for [Pr. PL02] or [Pr. PL03], the linear servo motor may not operate properly, or [AL. 27] or [AL. 42] may occur at the positioning operation or the magnetic pole detection.

15.3.2 Magnetic pole detection

Before the positioning operation of the linear servo motor, make sure to perform the magnetic pole detection. When [Pr. PL01] is set to the initial value, perform the magnetic pole detection only at the first servo-on after the power is turned on.

The magnetic pole detection includes the following two methods. Each method has advantages and disadvantages. Select a magnetic pole detection method suitable for your usage.

The position detection method is selected the initial value.

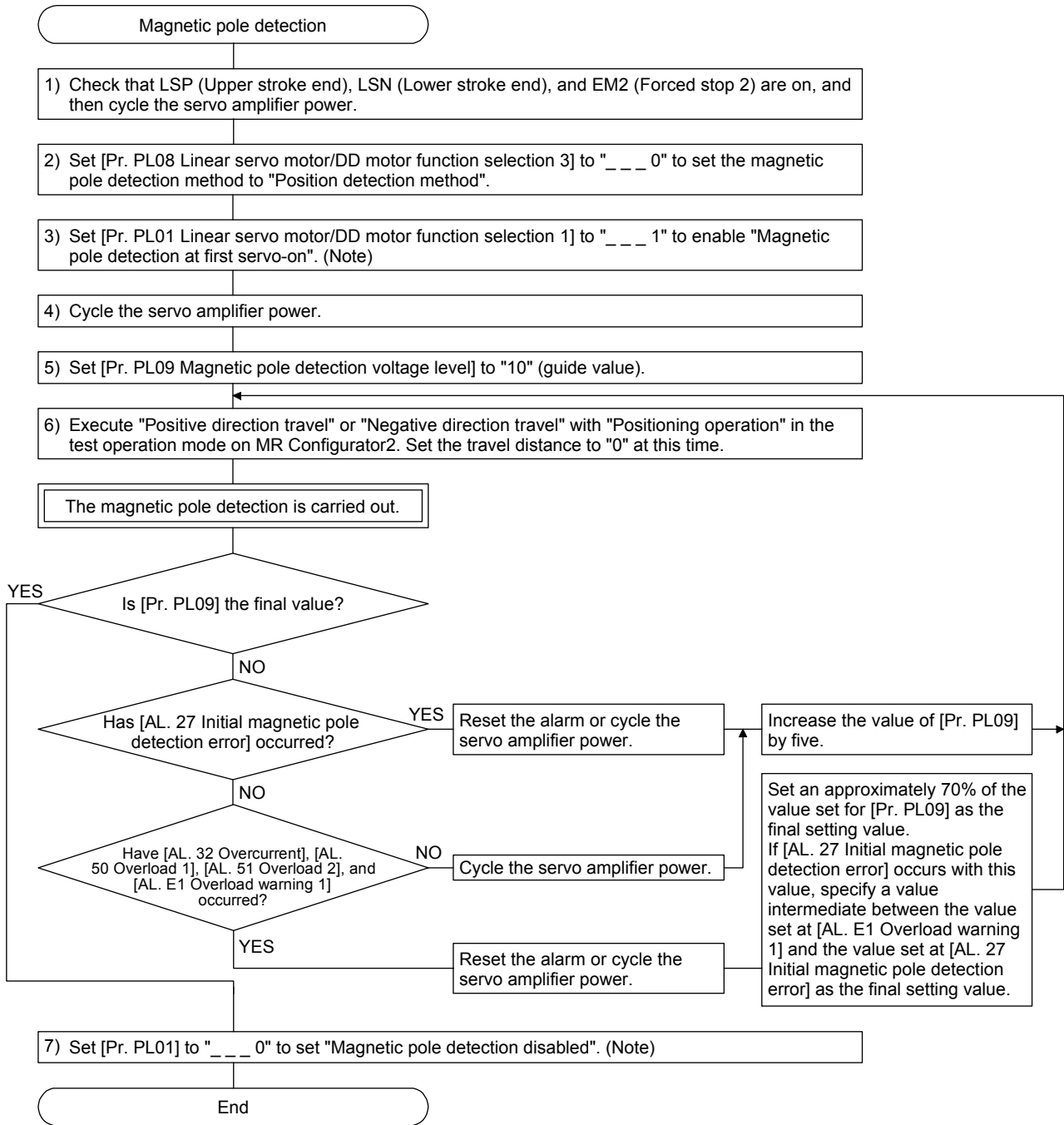
Magnetic pole detection	Advantage	Disadvantage
Position detection method	<ol style="list-style-type: none"> The magnetic pole detection has a high degree of accuracy. The adjustment procedure at the magnetic pole detection is simple. 	<ol style="list-style-type: none"> The travel distance at the magnetic pole detection is long. For equipment with small friction, the initial magnetic pole detection error may occur.
Minute position detection method	<ol style="list-style-type: none"> The travel distance at the magnetic pole detection is short. Even for equipment with small friction, the magnetic pole detection is available. 	<ol style="list-style-type: none"> The adjustment procedure at the magnetic pole detection is complex. If a disturbance occurs during the magnetic pole detection, [AL. 27 Initial magnetic pole detection error] may occur.

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(1) Magnetic pole detection method by using MR Configurator2

The following shows the magnetic pole detection procedure by using MR Configurator2.

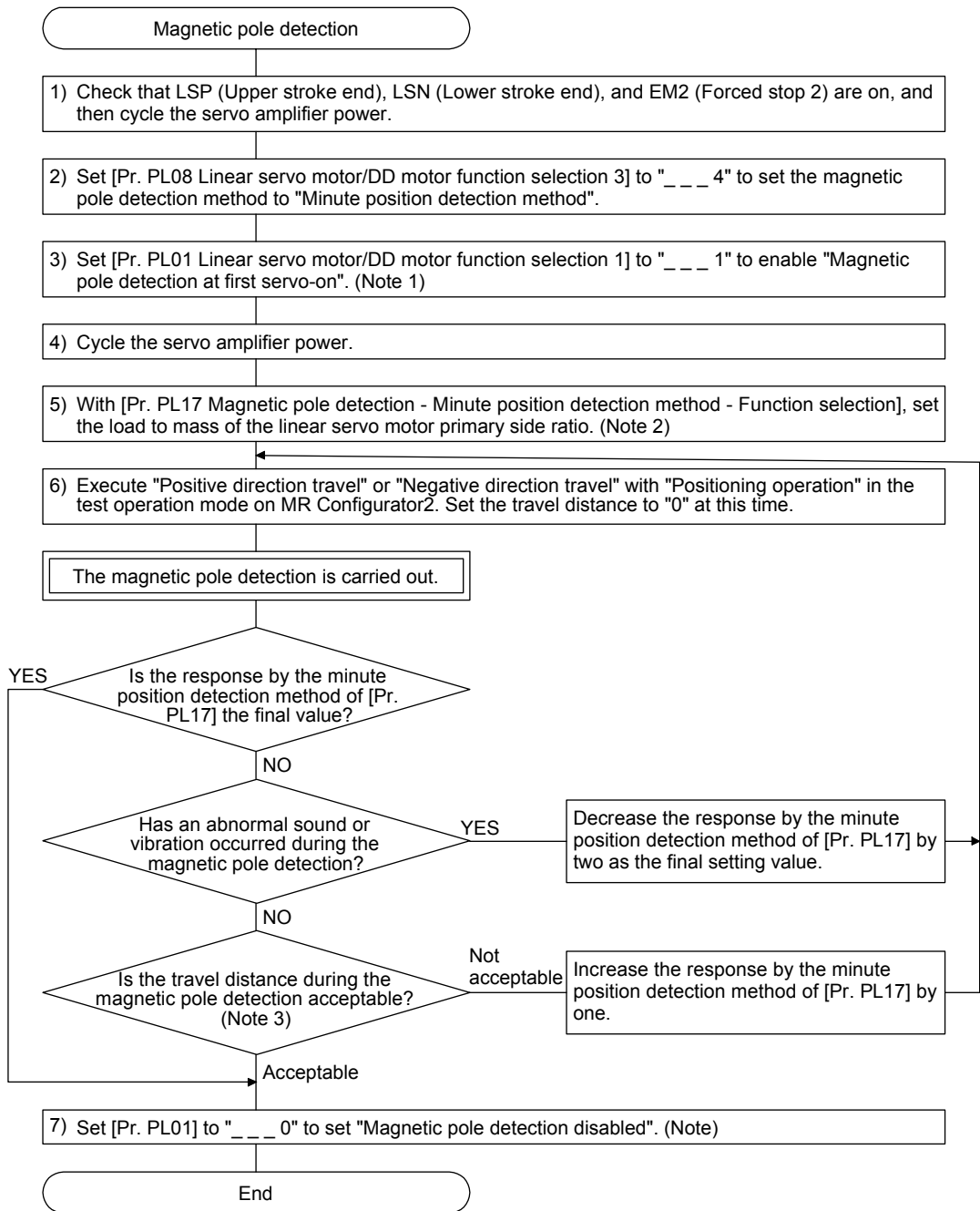
(a) Magnetic pole detection by the position detection method



Note. For the incremental system, the [Pr. PL01] setting is not required.

15. USING A LINEAR SERVO MOTOR

(b) Magnetic pole detection by the minute position detection method



- Note 1. For the incremental system, the [Pr. PL01] setting is not required.
- Note 2. If the load to primary-side linear servo motor mass ratio is unknown, perform the magnetic pole detection by the position detection method, and then perform the auto tuning to set an estimated value.
- Note 3. For the magnetic pole detection by the minute position detection method, the maximum travel distance at the magnetic pole detection must be 0.5 mm or less. To shorten the travel distance, increase the response by the minute position detection method in [Pr. PL17].

15. USING A LINEAR SERVO MOTOR

(2) Operation at the magnetic pole detection

⚠ WARNING ● Note that the magnetic pole detection automatically starts simultaneously with the turning-on of the servo-on command.

⚠ CAUTION ● If the magnetic pole detection is not executed properly, the linear servo motor may operate unexpectedly.

POINT

- Establish the machine configuration to use LSP (Upper stroke end) and LSN (Lower stroke end). The machine may be damaged due to a collision without LSP and LSN.
- Assign LSP and LSN and perform the magnetic pole detection also in the torque control mode.
- At the magnetic pole detection, whether the linear servo motor moves in the positive or negative direction is unpredictable.
- Depending on the setting value of [Pr. PL09 Magnetic pole detection voltage level], an overload, overcurrent, magnetic pole detection alarm, or others may occur.
- After the magnetic pole detection, check the positioning accuracy with the test operation (positioning operation function) of MR Configurator2.
- When the absolute position linear encoder is used, if a gap is generated to the positional relation between the linear encoder and the linear servo motor, perform the magnetic pole detection again.
- The accuracy of the magnetic pole detection improves with no load.
- A servo alarm may occur when the linear encoder is not mounted properly, or when the linear encoder resolution setting ([Pr. PL02] and [Pr. PL03]) or the setting value of [Pr. PL09 Magnetic pole detection voltage level] is incorrect.
- For the machine that its friction becomes 30% or more of the continuous thrust, the linear servo motor may not operate properly after the magnetic pole detection.
- For the horizontal shaft of the machine that its unbalanced thrust becomes 20% or more of the continuous thrust, the linear servo motor may not operate properly after the magnetic pole detection.
- For the machine that multiple axes are connected like a tandem configuration, if you try to perform the magnetic pole detection simultaneously for multiple axes, the magnetic pole detection may not be executed. Perform the magnetic pole detection for each axis. At this time, set the axes that the magnetic pole detection is not performed for to servo-off.

15. USING A LINEAR SERVO MOTOR

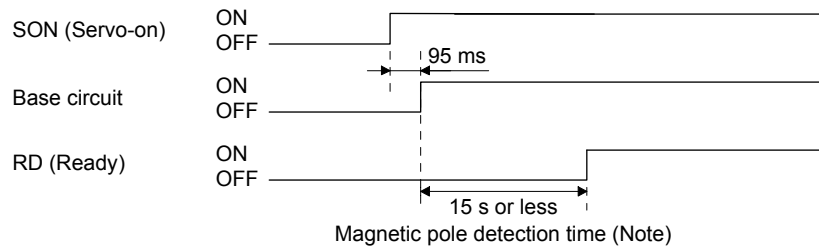
(a) For the incremental linear encoder

POINT

● For the incremental linear encoder, the magnetic pole detection is required every time the power is turned on.

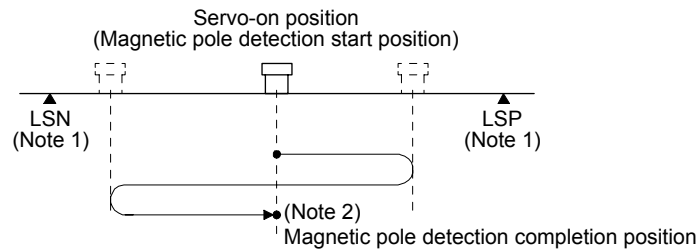
By turning on SON (Servo-on) after power-on, the magnetic pole detection is automatically carried out. Therefore, there is not need to set the parameter (first digit of [Pr. PL01]) for executing the magnetic pole detection.

1) Timing chart



Note. The magnetic pole detection time indicates the operation time when LSP (Upper stroke end) and LSN (Lower stroke end) are on.

2) Linear servo motor movement (when LSP (Upper stroke end) and LSN (Lower stroke end) are on)



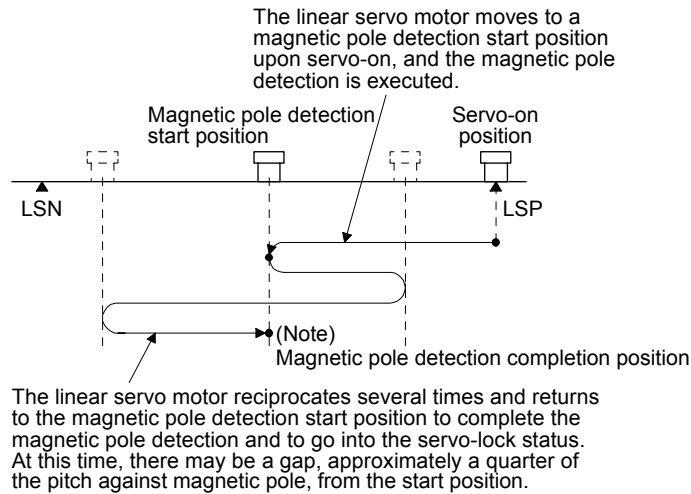
Note 1. When LSP (Upper stroke end) or LSN (Lower stroke end) turns off during the magnetic pole detection, the operation of the magnetic pole detection is carried on to the opposite direction. When both LSP and LSN are off, [AL. 27 Initial magnetic pole detection error] occurs.

The following shows the pitch against the magnetic pole.

Linear servo motor series	LM-H3 LM-F	LM-U2		LM-K2
		Medium thrust (Continuous thrust: Less than 400 N)	Large thrust (Continuous thrust: 400 N or more)	
Pitch against magnetic pole [mm]	48	30	60	48

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- 3) Linear servo motor movement (when LSP (Upper stroke end) or LSN (Lower stroke end) is off)
When LSP or LSN is off at servo-on, the magnetic pole detection is carried out as follows.



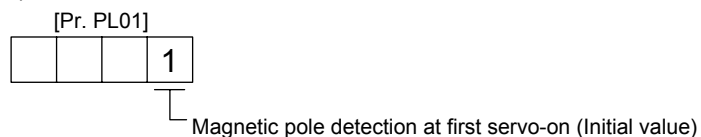
Note. For the pitch against magnetic pole, refer to (3) (a) 2) Note 2 of this section.

- (b) For the absolute position linear encoder

POINT
<ul style="list-style-type: none"> ● When you use an absolute position linear encoder with the following timings, the magnetic pole detection will be required. <ul style="list-style-type: none"> ▪ When the system is set up (at the first startup of equipment) ▪ After a servo amplifier is replaced ▪ After a linear servo motor (primary-side or secondary-side) is replaced ▪ After a linear encoder (scale or head) is replaced or its position is adjusted ● When the absolute position linear encoder is used, if a gap is generated to the positional relation between the linear encoder and the linear servo motor, perform the magnetic pole detection again.

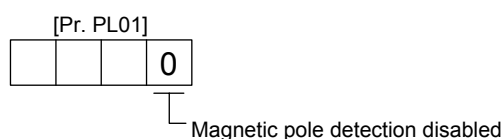
Perform the magnetic pole detection in the following procedure.

- 1) Set [Pr. PL01 Linear servo motor/DD motor function selection 1] to "___ 1" (Magnetic pole detection at first servo-on).



- 2) Execute the magnetic pole detection. (Refer to (3) (a) 1), 2) of this section.)

- 3) After the completion of the magnetic pole detection, change [Pr. PL01] to "___ 0" (Magnetic pole detection disabled).



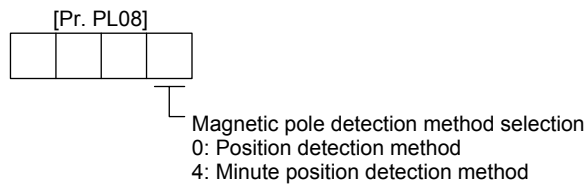
After the magnetic pole detection, by disabling the magnetic pole detection function with [Pr. PL01], the magnetic pole detection after each power-on is not required.

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(3) Magnetic pole detection method setting

POINT
<ul style="list-style-type: none"> ● In the following cases, set the magnetic pole detection method to the minute position detection method. <ul style="list-style-type: none"> ▪ When a shorten travel distance at the magnetic pole detection is required ▪ When the magnetic pole detection by the position detection method is not completed

Set the magnetic pole detection method using the first digit of [Pr. PL08] (Magnetic pole detection method selection).



(4) Setting of the magnetic pole detection voltage level by the position detection method

For the magnetic pole detection by the position detection method, set the voltage level with [Pr. PL09 Magnetic pole detection voltage level]. For the magnetic pole detection by the minute position detection method, the voltage level setting is not required.

(a) Guideline of parameter settings

Set the parameters by referring to the following table.

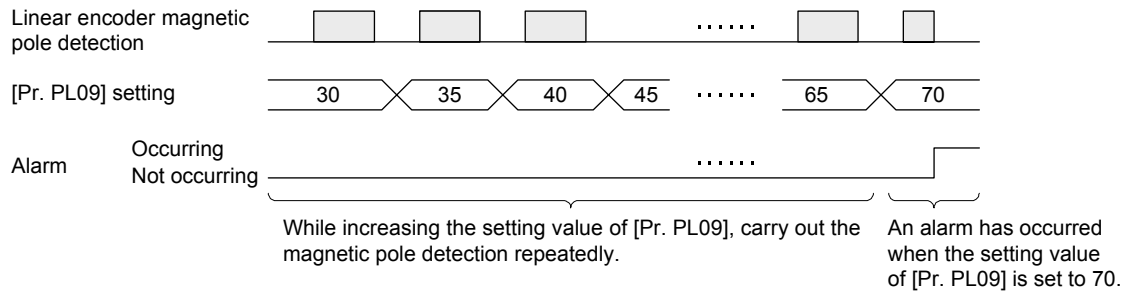
[Pr. PL09] setting (guide value)	Small ← Medium → Large (10 or less (initial value) 50 or more)	
Servo status		
Thrust at operation	Small	Large
Overload, overcurrent alarm	Seldom occurs	Frequently occurs
Magnetic pole detection alarm	Frequently occurs	Seldom occurs
Magnetic pole detection accuracy	Low	High

(b) Setting procedure

- 1) Perform the magnetic pole detection, and increase the setting value of [Pr. PL09 Magnetic pole detection voltage level] until [AL. 50 Overload 1], [AL. 51 Overload 2], [AL. 33 Overvoltage], [AL. E1 Overload warning 1], and [AL. EC Overload warning 2] occur. Increase the setting value by five as a guide value. When these alarms and warnings occur during the magnetic pole detection by using MR Configurator2, the test operation of MR Configurator2 automatically completes and the servo-off status is established.
- 2) Specify the setting value that is an approximately 70% of the value set when [AL. 50 Overload 1], [AL. 51 Overload 2], [AL. 33 Overvoltage], [AL. E1 Overload warning 1], and [AL. EC Overload warning 2] occurred as the final setting value. However, if [AL. 27 Initial magnetic pole detection error] occurs with this value, specify a value intermediate between the value set at [AL. 50 Overload 1], [AL. 51 Overload 2], [AL. 33 Overvoltage], [AL. E1 Overload warning 1], and [AL. EC Overload warning 2] and the value set at the magnetic pole detection alarm as the final setting value.
- 3) Perform the magnetic pole detection again with the final setting value to check there is no problem.

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(c) Setting example



In this example, the final setting value of [Pr. PL09] is 49 (Setting value at the alarm occurrence = 70×0.7).

15.3.3 Home position return

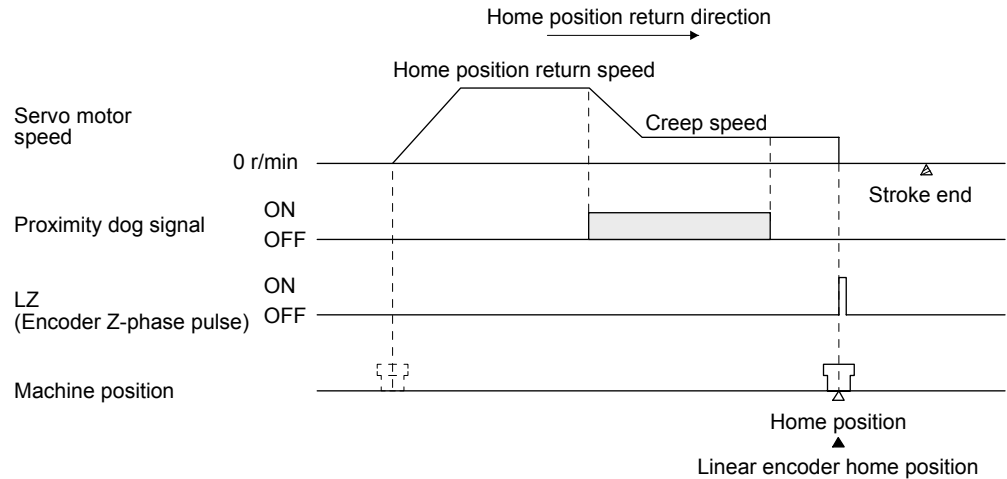
POINT
<ul style="list-style-type: none"> ● Change the third digit value of [Pr. PL01] according to the linear encoder resolution. ● The incremental linear encoder and the absolute position linear encoder have different reference home positions at the home position return. ● For the linear encoder, a home position (reference mark) of the linear encoder is necessary in the home position return direction. In addition, install a dog so that the mover passes the dog, decelerates to the creep speed, and passes the home position (reference mark). ● When you configure as follows, move the mover to LSN with JOG operation and perform home position to perform it in safe.
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>Returnable area: Home position return can be performed when started from this area.</p> </div> <div style="width: 45%;"> <p>Non-returnable area: Home position return cannot be performed when started from this area.</p> </div> </div>

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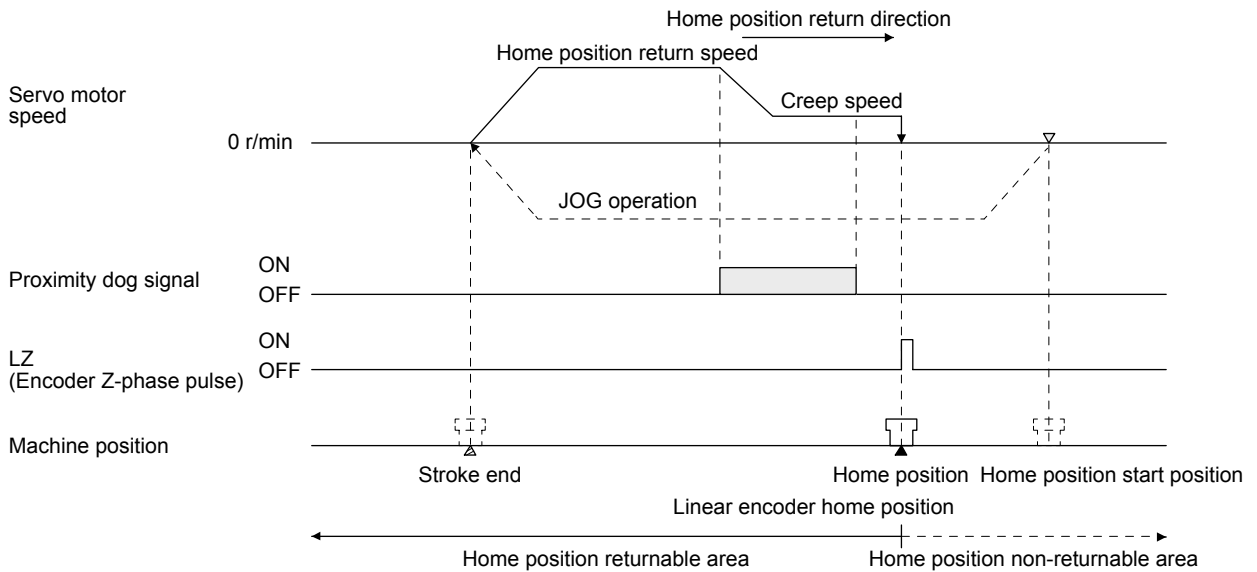
(1) Incremental linear encoder

! CAUTION ● If the resolution or the stop interval (the third digit of [Pr. PL01]) of the linear encoder is large, it is very dangerous since the linear servo motor may crash into the stroke end.

(a) When the linear encoder home position (reference mark) exists in the home position return direction
 When you use an incremental linear encoder, LZ (Encoder Z-phase pulse) from the servo amplifier will be the home position (reference mark) of the linear encoder.



(b) When the linear encoder home position (reference mark) does not exist in the home position return direction
 The home position return cannot be performed from the position which the home position of the linear encoder does not exist in the home position return direction. Move the mover to the stroke end on the opposite side of the home position return direction with the JOG operation from the controller and others, and then perform a home position return.

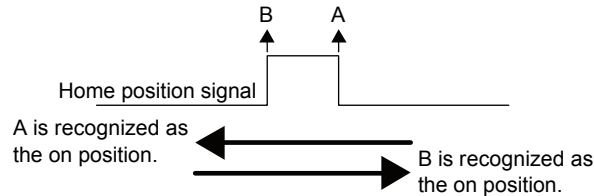


15. USING A LINEAR SERVO MOTOR

(c) Caution for passing the home position (reference mark)

An interval for turning on home position (reference mark) signal of the linear encoder has a certain width. (Specifications differ depending on the linear encoders. For details, refer to "Linear Encoder Instruction Manual".)

Example: When Z-phase is recognized at startup



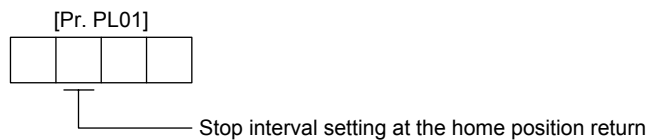
The position which turns on LZ (Encoder Z-phase pulse) differs depending on the directions of home position passing. When you need to set the home position return completion to the same position each time such as dog type home position return, always start home position return with the same direction.

(d) Caution for linear encoder which does not have the home position (reference mark)

The linear encoder which does not have the home position (reference mark), LZ (Encoder Z-phase pulse) of the servo amplifier does not be outputted. It is depending on positioning controllers to use whether LZ (Encoder Z-phase pulse) is necessary or not for home position return. Check the specifications of controllers.

(2) Absolute position linear encoder

The home position reference position using an absolute type linear encoder will be per 1048576 pulses based on the linear encoder home position (absolute position data = 0). You can change the stop interval at home position return with the third digit of [Pr. PL01].



Setting value	Stop interval [pulse]
0	8192
1	131072
2	262144
3	1048576 (initial value)
4	4194304
5	16777216
6	67108864

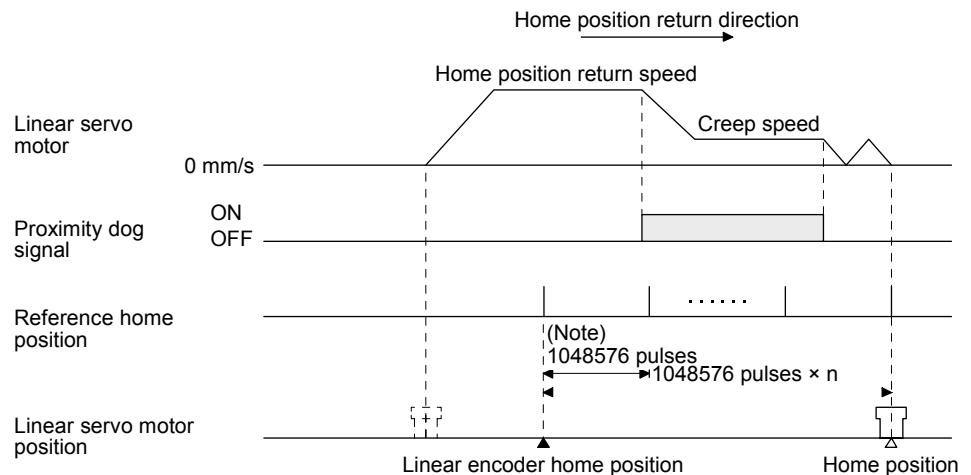
15. USING A LINEAR SERVO MOTOR

The following shows the relation between the stop interval at the home position return and the linear encoder resolution. For example, when the linear encoder resolution is 0.001 μm and the parameter for the stop interval at the home position return, [Pr.PL01], is set to "_ 5 _" (16777216 pulses), the stop interval is 16.777 mm. The value inside a bold box indicates the recommended stop interval for each linear encoder resolution.

[Unit: mm]

Pr. PL01	Linear encoder resolution [μm] Stop interval [pulse]	0.001	0.005	0.01	0.02	0.05	0.1	0.2	0.5	1	2
_ 0 _	8192	0.008	0.041	0.082	0.164	0.410	0.819	1.638	4.096	8.192	16.384
_ 1 _	131072	0.131	0.655	1.311	2.621	6.554	13.107	26.214	65.536	131.072	262.144
_ 2 _	262144	0.262	1.311	2.621	5.243	13.107	26.214	52.429	131.072	262.144	524.288
_ 3 _	1048576	1.049	5.243	10.486	20.972	52.429	104.858	209.715	524.288	1048.576	2097.152
_ 4 _	4194304	4.194	20.972	41.943	83.886	209.715	419.430	838.861	2097.152	4194.304	8388.608
_ 5 _	16777216	16.777	83.886	167.772	335.544	838.861	1677.722	3355.443	8388.608	16777.216	33554.432
_ 6 _	67108864	67.109	335.544	671.089	1342.177	3355.443	6710.886	13421.773	33554.432	67108.864	134217.728

In the case of a proximity dog type home position return, the nearest reference home position after proximity dog off is the home position. The linear encoder home position can be set in any position. LZ (Encoder Z-phase pulse) is outputted based on "Stop interval selection at the home position return" in [Pr. PL01].

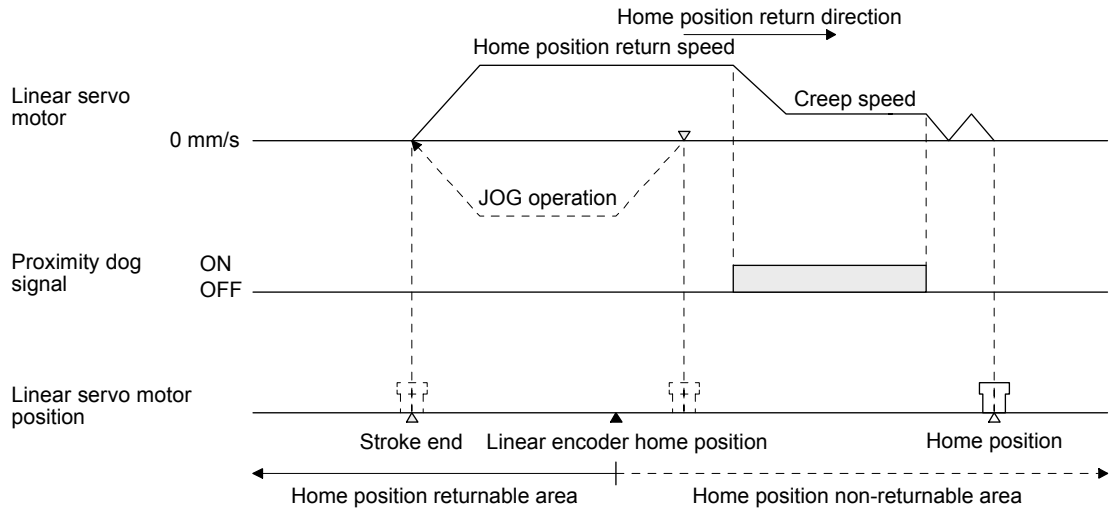


Note. Changeable with [Pr. PL01].

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(b) When the linear encoder home position does not exist in the home position return direction

If the home position return is performed from the position where the linear encoder does not exist in the home position return direction, a home position return error occurs on the controller. The error contents differ according to the controller type. Move the linear servo motor to the stroke end on the opposite side of the home position return direction with the JOG operation from the controller and others, and then perform a home position return.



POINT

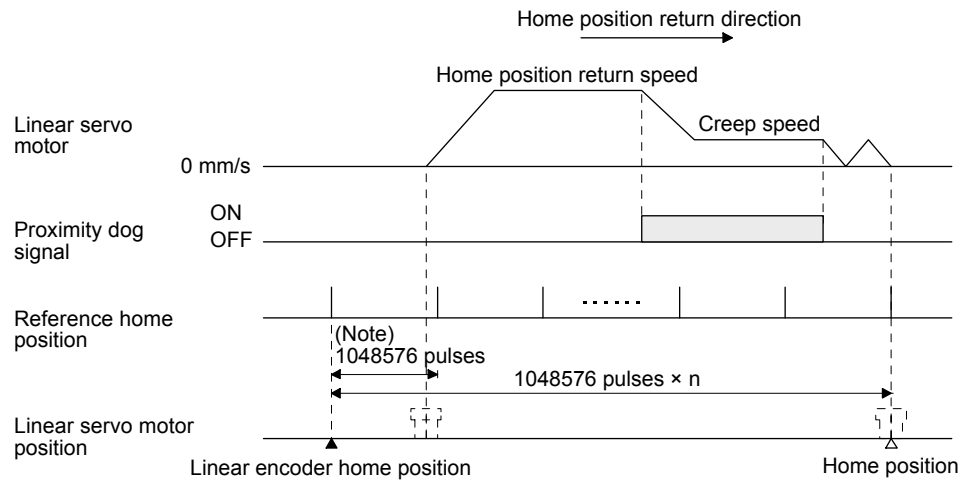
- To execute a home position return securely, start a home position return after moving the linear servo motor to the opposite stroke end with JOG operation and others.
- Change the third digit value of [Pr. PL01] according to the linear encoder resolution.

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(2) Absolute position linear encoder

When an absolute linear encoder is used, the reference home position is the position per 1048576 pulses (changeable with the third digit of [Pr. PL01]) with reference to the linear encoder home position (absolute position data = 0).

In the case of a proximity dog type home position return, the nearest reference home position after proximity dog off is the home position. The linear encoder home position can be set in any position. LZ (Encoder Z-phase pulse) is outputted based on "Stop interval selection at the home position return" in [Pr. PL01].




Note. Changeable with [Pr. PL01].

POINT

- The data set type home position return can also be carried out.

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15.3.4 Test operation mode in MR Configurator2



CAUTION

- The test operation mode is designed for checking servo operation. It is not for checking machine operation. Do not use this mode with the machine. Always use the linear servo motor alone.
- If the servo motor operates abnormally, use EM2 (Forced stop 2) to stop it.

POINT	<ul style="list-style-type: none"> ● The content described in this section indicates the environment where the servo amplifier and a personal computer are directly connected.
--------------	---

By using a personal computer and MR Configurator2, you can execute the positioning operation, the output signal (DO) forced output, and the program operation without connecting the controller.

(1) Positioning operation

Positioning operation can be performed when there is no command from the controller. Use this operation with the forced stop reset. This operation may be used independently of whether servo-on, servo-off, or whether a controller is connected or not.

Exercise control on the positioning operation screen of MR Configurator2.

(a) Operation pattern

Item	Initial value	Setting range
Travel distance [pulse]	1048576	0 to 99999999
Speed [mm/s]	10	0 to Maximum speed
Acceleration/deceleration time constant [ms]	1000	0 to 50000
Repeat pattern	Positive direction travel → Negative direction travel	Positive direction travel → Negative direction travel Positive direction travel → Positive direction travel Negative direction travel → Positive direction travel Negative direction travel → Negative direction travel
Dwell time [s]	2.0	0.1 to 50.0
Number of repeats [time]	1	1 to 9999

(b) Operation method

Operation	Screen control
Positive direction travel	Click the "Positive Direction Movement" button.
Negative direction travel	Click the "Reverse Direction Movement" button.
Pause	Click the "Pause" button.
Stop	Click the "Stop" button.
Forced stop	Click the "Forced Stop" button.

(2) 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.

15. USING A LINEAR SERVO MOTOR

(3) 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, servo-off, or 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.
Pause	Click the "Pause" button.
Stop	Click the "Stop" button.
Forced stop	Click the "Forced Stop" button.

15.3.5 Function

(1) Linear servo control error detection function

POINT
<ul style="list-style-type: none"> ● For the linear servo control error detection function, the position and speed deviation error detections are enabled by default. ([Pr. PL04]: ___ 3)

If the linear servo control gets unstable for some reasons, the linear servo motor may not operate properly. To detect this state and to stop operation, the linear servo control error detection function is used as a protective function.

The linear servo control error detection function has three different detection methods: the position deviation, speed deviation, and thrust deviation. An error is detected when each method is enabled with [Pr. PL04 Linear servo motor/DD motor function selection 2]. The detection level can be changed with [Pr. PL05], [Pr. PL06], and [Pr. PL07].

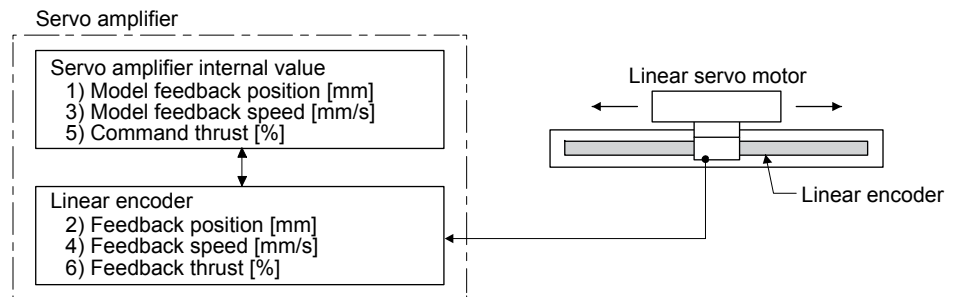
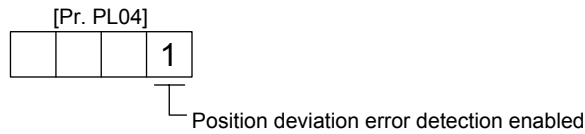


Figure 15.1 Outline of linear servo control error detection function

15. USING A LINEAR SERVO MOTOR

(a) Position deviation error detection

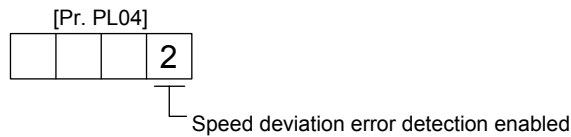
Set [Pr. PL04] to "___ 1" to enable the position deviation error detection.



When you compare the model feedback position (1)) and the feedback position (2)) in figure 15.1, if the deviation is more than the value of [Pr. PL05 Position deviation error detection level] (1 mm to 1000 mm), [AL. 42.1 Servo control error by position deviation] will occur and the linear servo motor will stop. The initial value of this detection level is 50 mm. Change the set value as necessary.

(b) Speed deviation error detection

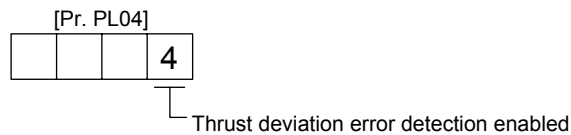
Set [Pr. PL04] to "___ 2" to enable the speed deviation error detection.



When you compare the model feedback speed (3)) and the feedback speed (4)) in figure 15.1, if the deviation is more than the value of [Pr. PL06 Speed deviation error detection level] (1 mm/s to 5000 mm/s), [AL. 42.2 Servo control error by speed deviation] will occur and the linear servo motor will stop. The initial value of this detection level is 1000 mm/s. Change the set value as necessary.

(c) Thrust deviation error detection level

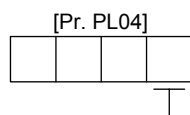
Set [Pr. PL04] to "___ 4" to enable the thrust deviation error detection.



When you compare the command thrust (5)) and the feedback thrust (6)) in figure 15.1, if the deviation is more than the value of [Pr. PL07 Torque/thrust deviation error detection level] (1% to 1000%), [AL. 42.3 Servo control error by torque/thrust deviation] will occur and the linear servo motor will stop. The initial value of this detection level is 100%. Change the set value as necessary.

(d) Detecting multiple deviation errors

When [Pr. PL04] is set as follows, multiple deviation errors can be detected. For the error detection methods, refer to (1) (a), (b), (c) of this section.



Setting value	Position deviation error detection	Speed deviation error detection	Thrust deviation error detection
1	○	/	/
2	/	○	/
3	○	○	/
4	/	/	○
5	○	/	○
6	/	○	○
7	○	○	○

15. USING A LINEAR SERVO MOTOR

(2) Auto tuning function

The auto tuning function during the linear servo motor operation is the same as that of the rotary servo motor. However, the calculation method of the load to motor mass ratio (J ratio) differs. The load to motor mass ratio (J ratio) on the linear servo motor is calculated by dividing the load mass by the mass of the linear servo motor primary side.

Example) Mass of linear servo motor primary side = 2 kg
Load mass (excluding the mass of the linear servo motor primary side) = 4 kg
Mass ratio = $4/2 = 2$ times

For the parameters set by the auto tuning function, refer to chapter 6.

POINT
<ul style="list-style-type: none">● The auto tuning mode 1 may not be performed properly if the following conditions are not satisfied.<ul style="list-style-type: none">▪ Time to reach 2000 mm/s is the acceleration/deceleration time constant of 5 s or less.▪ The linear servo motor speed is 150 mm/s or higher.▪ The load to mass of the linear servo motor primary-side ratio is 100 times or less.▪ The acceleration/deceleration thrust is 10% or less of the continuous thrust.

(3) Machine analyzer function

POINT
<ul style="list-style-type: none">● Make sure to perform the machine analyzer function after the magnetic pole detection. If the magnetic pole detection is not performed, the machine analyze function may not operate properly.● The stop position at the completion of the machine analyzer function can be any position.

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15.3.6 Absolute position detection system

When the linear servo motor is used with the absolute position detection system, an absolute position linear encoder is required.

- (1) Operating conditions of absolute position detection system
 - (a) Use an absolute type linear encoder.
 - (b) Perform the magnetic pole detection in the incremental system and disable the magnetic pole detection after the detection.
 - (c) Enable the absolute position detection system with [Pr. PA03 Absolute position detection system].
- (2) Alarm detection
[AL. 25 Absolute position erased], [AL. 92 Battery cable disconnection warning], [AL. 9F Battery warning], and [AL. E3 Absolute position counter warning] are not provided for the linear servo motor.
- (3) Backup
The linear encoder backs up the absolute position data. Therefore, the encoder battery MR-BAT6V1SET need not be installed to the servo amplifier.
- (4) Absolute position data transfer to controller
Refer to section 12.8 for absolute position data transfer to the controller.

15. USING A LINEAR SERVO MOTOR

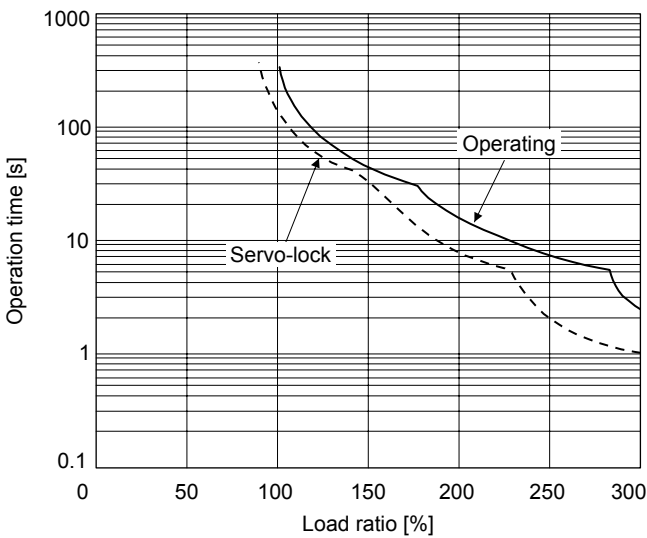
15.4 Characteristics

15.4.1 Overload protection characteristics

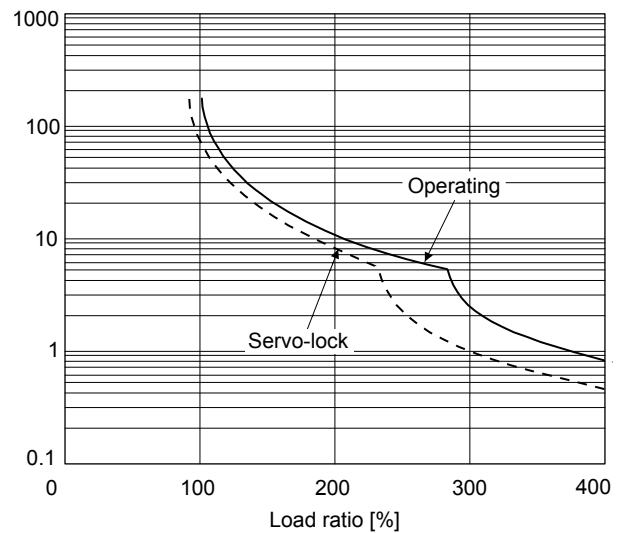
An electronic thermal is built in the servo amplifier to protect the linear servo motor, servo amplifier and linear servo motor power wires from overloads.

[AL. 50 Overload 1] occurs if overload operation performed is above the electronic thermal protection curve shown in fig. 15.2. [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.

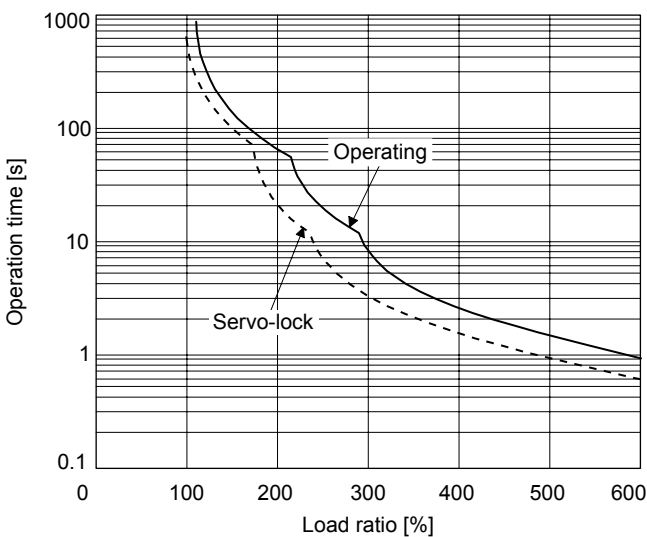
This servo amplifier has solid-state linear servo motor overload protection. (The servo motor overload current (full load current) is set on the basis of 120% rated current of the servo amplifier.)



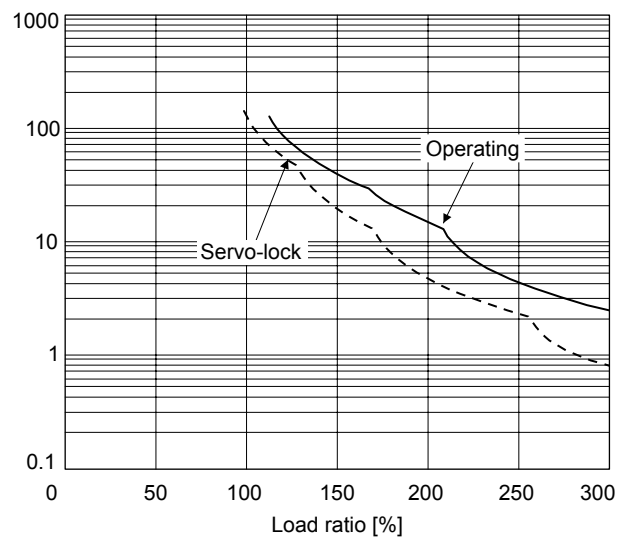
a. LM-H3 series
LM-K2 series



b. LM-U2 series



c. LM-F (natural cooling)



d. LM-F (liquid cooling)

Fig. 15.2 Electronic thermal protection characteristics

15. USING A LINEAR SERVO MOTOR

15.4.2 Power supply capacity and generated loss

Table 15.1 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 linear 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.

Mounting a heat sink outside of the cabinet enables to reduce heat in the cabinet and design a compact enclosed type cabinet.

Table 15.1 Power supply capacity and generated loss per linear servo motor at rated output

Linear servo motor	Servo amplifier	Power supply capacity [kVA] (Note 1)	Servo amplifier-generated heat [W] (Note 2)		Area required for heat dissipation [m ²]
			At rated output	With servo-off	
LM-H3P2A-07P-BSS0	MR-J4-40A(-RJ)	0.9	35	15	0.7
LM-H3P3A-12P-CSS0		0.9	35	15	0.7
LM-H3P3B-24P-CSS0	MR-J4-70A(-RJ)	1.3	50	15	1.0
LM-H3P3C-36P-CSS0		1.9	75	15	1.5
LM-H3P3D-48P-CSS0	MR-J4-200A(-RJ)	3.5	90	20	1.8
LM-H3P7A-24P-ASS0	MR-J4-70A(-RJ)	1.3	50	15	1.0
LM-H3P7B-48P-ASS0	MR-J4-200A(-RJ)	3.5	90	20	1.8
LM-H3P7C-72P-ASS0		3.8	100	20	1.1
LM-H3P7D-96P-ASS0	MR-J4-350A(-RJ)	5.5	130	20	2.7
LM-U2PAB-05M-0SS0	MR-J4-20A(-RJ)	0.5	25	15	0.5
LM-U2PAD-10M-0SS0	MR-J4-40A(-RJ)	0.9	35	15	0.7
LM-U2PAF-15M-0SS0		0.9	35	15	0.7
LM-U2PBB-07M-1SS0	MR-J4-20A(-RJ)	0.5	25	15	0.5
LM-U2PBD-15M-1SS0	MR-J4-60A(-RJ)	1.0	40	15	0.8
LM-U2PBF-22M-1SS0	MR-J4-70A(-RJ)	1.3	50	15	1.0
LM-U2P2B-40M-2SS0	MR-J4-200A(-RJ)	3.5	90	20	1.8
LM-U2P2C-60M-2SS0	MR-J4-350A(-RJ)	5.5	130	20	2.7
LM-U2P2D-80M-2SS0	MR-J4-500A(-RJ)	7.5	195	25	3.9
LM-FP2B-06M-1SS0	MR-J4-200A(-RJ)	3.5	90	20	1.8
LM-FP2D-12M-1SS0	MR-J4-500A(-RJ)	7.5	195	25	3.9
LM-FP2F-18M-1SS0	MR-J4-700A(-RJ)	10	300	25	6.0
LM-FP4B-12M-1SS0	MR-J4-500A(-RJ)	7.5	195	25	3.9
LM-FP4D-24M-1SS0	MR-J4-700A(-RJ)	10	300	25	6.0
LM-FP4F-36M-1SS0	MR-J4-11KA(-RJ)	14	460	45	9.2
LM-FP4H-48M-1SS0	MR-J4-15KA(-RJ)	18	580	45	11.6
LM-K2P1A-01M-2SS1	MR-J4-40A(-RJ)	0.9	35	15	0.7
LM-K2P1C-03M-2SS1	MR-J4-200A(-RJ)	3.5	90	20	1.8
LM-K2P2A-02M-1SS1	MR-J4-70A(-RJ)	1.3	50	15	1.0
LM-K2P2C-07M-1SS1	MR-J4-350A(-RJ)	5.5	130	20	2.7
LM-K2P2E-12M-1SS1	MR-J4-500A(-RJ)	7.5	195	25	3.9
LM-K2P3C-14M-1SS1	MR-J4-350A(-RJ)	5.5	130	20	2.7
LM-K2P3E-24M-1SS1	MR-J4-500A(-RJ)	7.5	195	25	3.9

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 or power factor improving DC reactor are 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.

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15.4.3 Dynamic brake characteristics

POINT
<ul style="list-style-type: none"> ● 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 mass 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 the linear servo motor stops when using EM1 (Forced stop 1) frequently in other than emergency.

The approximate coasting distance from when the dynamic brake is activated until when the linear servo motor stops can be calculated with the equation below.

$$L_{max} = V_0 \cdot (0.03 + M \cdot (A + B \cdot V_0^2))$$

Lmax: Coasting distance of the machine [m]

V₀: Speed when the brake is activated [m/s]

M: Full mass of the moving part [kg]

A: Coefficient (Refer to the following tables.)

B: Coefficient (Refer to the following tables.)

Linear servo motor	Coefficient A	Coefficient B
LM-H3P2A-07P-BSS0	7.15E-03	2.94E-03
LM-H3P3A-12P-CSS0	2.81E-03	1.47E-03
LM-H3P3B-24P-CSS0	7.69E-03	2.27E-04
LM-H3P3C-36P-CSS0	7.22E-03	1.13E-04
LM-H3P3D-48P-CSS0	1.02E-03	2.54E-04
LM-H3P7A-24P-ASS0	7.69E-03	2.14E-04
LM-H3P7B-48P-ASS0	9.14E-04	2.59E-04
LM-H3P7C-72P-ASS0	7.19E-04	1.47E-04
LM-H3P7D-96P-ASS0	6.18E-04	9.59E-05

Linear servo motor	Coefficient A	Coefficient B
LM-U2PAB-05M-0SS0	5.72×10^{-2}	1.72×10^{-4}
LM-U2PAD-10M-0SS0	2.82×10^{-2}	8.60×10^{-5}
LM-U2PAF-15M-0SS0	1.87×10^{-2}	5.93×10^{-5}
LM-U2PBB-07M-1SS0	3.13×10^{-2}	1.04×10^{-4}
LM-U2PBD-15M-1SS0	1.56×10^{-2}	5.18×10^{-5}
LM-U2PBF-22M-1SS0	4.58×10^{-2}	1.33×10^{-5}
LM-U2P2B-40M-2SS0	1.47×10^{-3}	1.27×10^{-5}
LM-U2P2C-60M-2SS0	1.07×10^{-3}	7.66×10^{-6}
LM-U2P2D-80M-2SS0	9.14×10^{-4}	5.38×10^{-6}

Linear servo motor	Coefficient A	Coefficient B
LM-FP2B-06M-1SS0	8.96×10^{-4}	1.19×10^{-3}
LM-FP2D-12M-1SS0	5.55×10^{-4}	4.81×10^{-4}
LM-FP2F-18M-1SS0	4.41×10^{-4}	2.69×10^{-4}
LM-FP4B-12M-1SS0	5.02×10^{-4}	4.36×10^{-4}
LM-FP4D-24M-1SS0	3.55×10^{-4}	1.54×10^{-4}
LM-FP4F-36M-1SS0	1.79×10^{-4}	1.36×10^{-4}
LM-FP4H-48M-1SS0	1.15×10^{-4}	1.19×10^{-4}

Linear servo motor	Coefficient A	Coefficient B
LM-K2P1A-01M-2SS1	5.36×10^{-3}	6.56×10^{-3}
LM-K2P1C-03M-2SS1	1.17×10^{-3}	3.75×10^{-4}
LM-K2P2A-02M-1SS1	2.49×10^{-2}	1.02×10^{-3}
LM-K2P2C-07M-1SS1	6.85×10^{-4}	2.80×10^{-4}
LM-K2P2E-12M-1SS1	5.53×10^{-4}	1.14×10^{-4}
LM-K2P3C-14M-1SS1	2.92×10^{-4}	1.16×10^{-4}
LM-K2P3E-24M-1SS1	2.53×10^{-4}	5.52×10^{-5}

CAUTION

● The coasting distance is a theoretically calculated value which ignores the running load such as friction. The calculated value is considered to be longer than the actual distance. However, if an enough breaking distance is not obtained, the linear servo motor may crash into the stroke end, which is very dangerous. Install the anti-crash mechanism such as an air brake or an electric/mechanical stopper such as a shock absorber to reduce the shock of moving parts. No linear servo motor with an electromagnetic brake is available.

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15.4.4 Permissible load to motor mass ratio when the dynamic brake is used

Use the dynamic brake under the load to motor mass 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 mass ratio in the table are the values when the linear servo motor is used at the maximum speed.

Linear servo motor	Permissible load to motor mass ratio [Multiplier]
LM-H3 series	40
LM-U2 series	100
LM-F series	
LM-K2 series	50

When actual speed does not reach the maximum speed of the servo motor, calculate the permissible load to motor mass ratio at the time of using the dynamic brake by the following equation. (The upper limit is 300 times.)

Permissible load to motor mass ratio of the dynamic brake = Value in the table × (Servo motor maximum speed²/Actual using speed²)

For example, when an actual using speed is 2 m/s or less for the LM-H3P2A-07P motor (maximum speed: 3.0 m/s), the equation will be as follows.

Permissible load to motor mass ratio of dynamic brake = $40 \times 3^2/2^2 = 90$ [times]

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16. USING A DIRECT DRIVE MOTOR

CAUTION ●When using the direct drive motor, read "Direct Drive Motor Instruction Manual".

POINT

- The direct drive servo system is available for the MR-J4-_A(-RJ) servo amplifiers of which software version is A5 or later. Check the software version using MR Configurator2.

16.1 Functions and configuration

16.1.1 Summary

The fields of semiconductor/LCD manufacturing systems, mounters, and others have strong demands for high accuracy and efficiency. Therefore, the number of systems using a direct drive motor for a drive axis has been increasing. The direct drive servo system includes the following features.

(1) Performance

- The direct drive servo system ensures the high-rigidity and the high-torque. A high-resolution encoder enables the high-accuracy control.
- The high-resolution encoder contributes to the high-accuracy indexing.
- Since transmission mechanism is no longer required, no backlash occurs. In addition, the settling time is reduced, and the high-frequency operation is enabled.
- Since transmission mechanism is no longer required, the direct drive motor does not deteriorate with time.

(2) Mechanism

- The motor's low profile design contributes to compact moving part of the machine and a low center of gravity for enhanced equipment stability.
- The motor has an inner rotor with hollow shaft which enables cables and pipes to be passed through.
- Lubrication and the maintenance due to abrasion are not required.

The following shows the differences between the direct drive motor and the rotary servo motor.

Category	Item	Differences		Remarks
		Direct drive motor	Rotary servo motor	
Motor pole adjustment	Magnetic pole detection	Required	Not required (default setting)	Automatically executed at the first servo-on after the power is turned on. For the absolute position detection system, [Pr. PL01] can disable the magnetic pole detection. (Refer to (2) (b) of 16.3.3.)
Absolute position detection system	Absolute position encoder battery (MR-BAT6V1SET)	Required	Required	
	Absolute position storage unit (MR-BTAS01)	Required	Not required	

16. USING A DIRECT DRIVE MOTOR

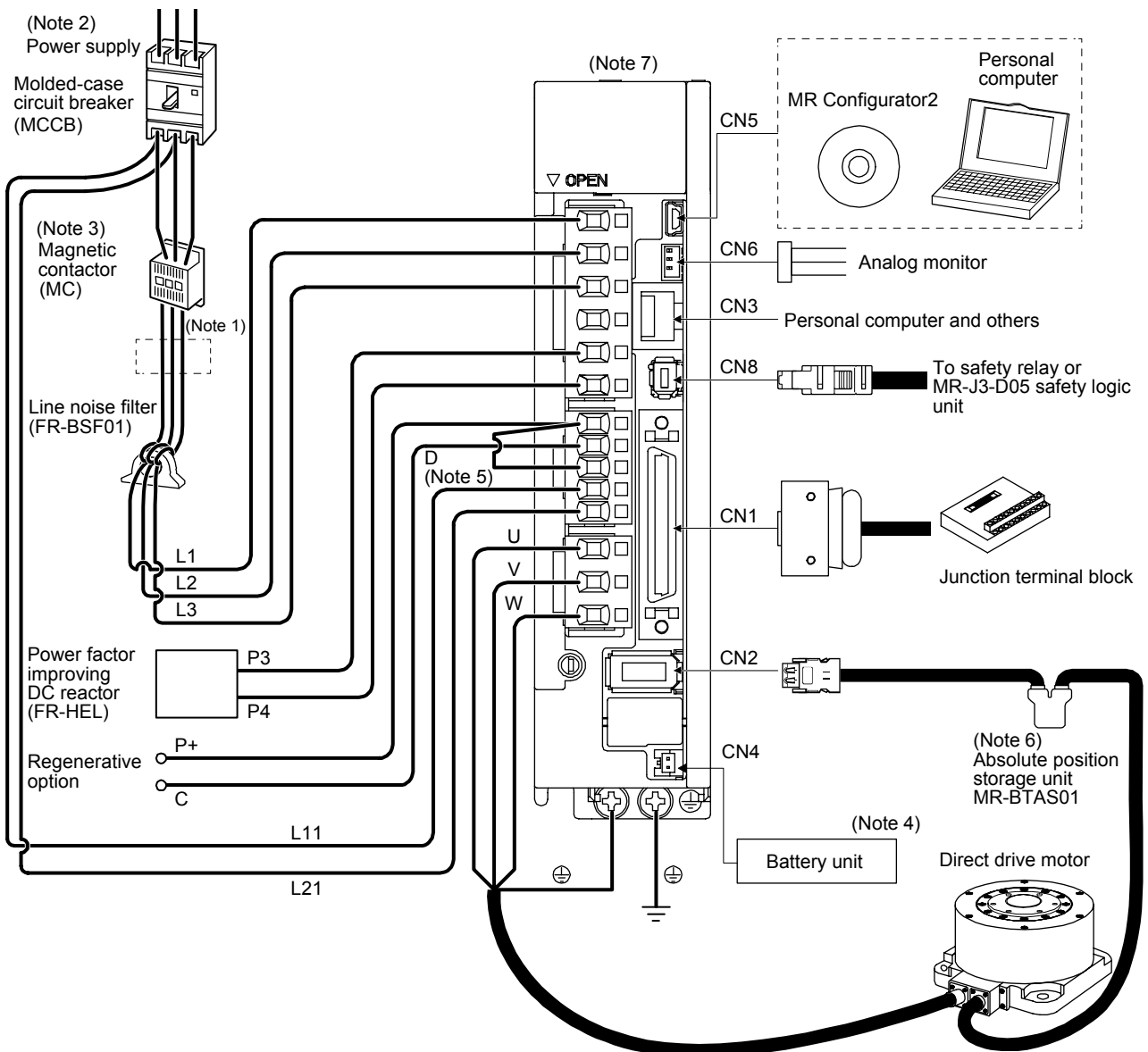
16.1.2 Configuration including peripheral equipment



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

POINT


- Equipment other than the servo amplifier and direct drive motor are optional or recommended products.
- When using the direct drive motor, set [Pr. PA01] to " __ 6 __".



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- Note
1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
 2. A 1-phase 200 V AC to 240 V AC power supply may be used with the servo amplifier of MR-J4-70A(-RJ) 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.
 3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
 4. The battery unit (MR-BAT6V1SET) is used for the absolute position detection system. (Refer to chapter 12.)
 5. Always connect between P+ and D terminals. When using the regenerative option, refer to section 11.2.
 6. The absolute position storage unit is used for the absolute position detection system.
 7. This is for MR-J4-_A. MR-J4-_A-RJ has a CN2L connector. However, CN2L is not used for the direct drive servo system.

16.2 Signals and wiring



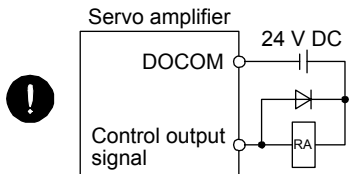
WARNING

- 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. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. 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 the direct drive motor securely.
- Do not attempt to wire the servo amplifier and direct drive 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.

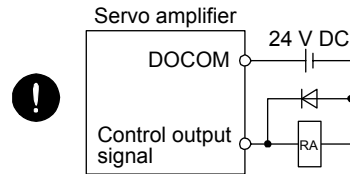


CAUTION

- Wire the equipment correctly and securely. Otherwise, the direct drive 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 (FR-BIF option) on the power wire of the direct drive 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.
- During power-on, do not open or close the power line of the direct drive motor. Otherwise, it may cause a malfunction.

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CAUTION !

- Connect the servo amplifier power output (U, V, and W) to the direct drive 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.

This section does not describe the following items. For details of the items, refer to each section of the detailed description field.

Item	Detailed explanation
Input power supply circuit	Section 3.1
Explanation of power supply system	Section 3.3
Signal (device) explanations	Section 3.5
Alarm occurrence timing chart	Section 3.8
Interface	Section 3.9
Grounding	Section 3.11
Display and operation sections	Section 4.5
Parameter	Chapter 5
Troubleshooting	Chapter 8

16.3 Operation and functions

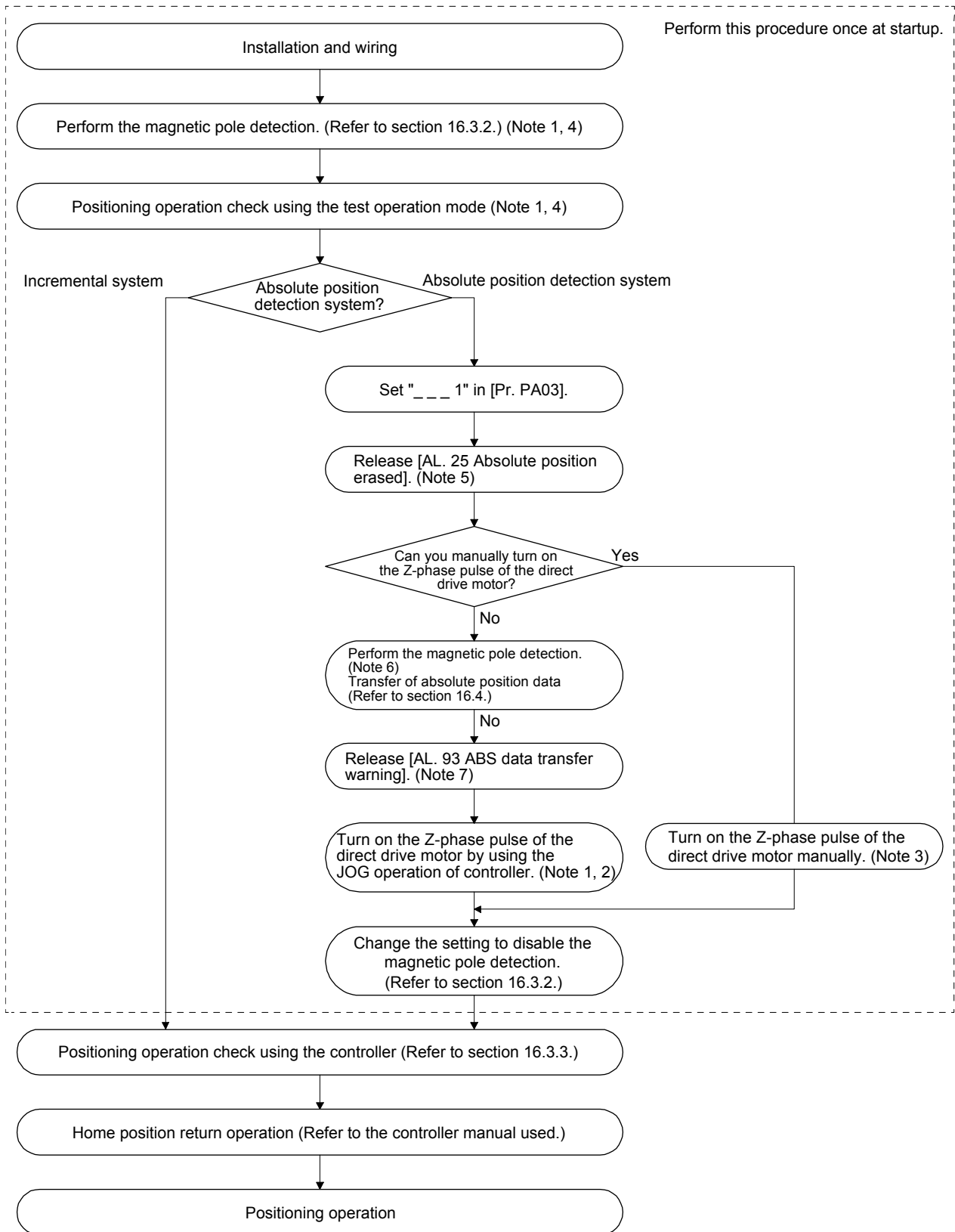
POINT

- When using the direct drive motor, set [Pr. PA01] to " __ 6 __".
- For the test operation, refer to section 4.2.3, 4.3.3, 4.4.3, and 4.5.9.
- After power on, the Z-phase mark of the direct drive motor must pass the connector area once. In a system which prevents the direct drive motor from making a full rotation, install the direct drive motor in a position where the Z-phase mark can pass over the connector area.

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16.3.1 Startup procedure

Start up the direct drive servo in the following procedure.



16. USING A DIRECT DRIVE MOTOR

- Note
1. Use MR Configurator2.
 2. For the absolute position detection system, always turn on the Z-phase pulse of the direct drive motor while the servo amplifier power is on, and then turn the servo amplifier power supply off and on again. By turning off and on the power supply, the absolute position becomes confirmed. Without this operation, the absolute position will not be regained properly, and a warning will occur at the controller.
 3. If the Z-phase pulse of the direct drive motor can be turned on manually, the Z-phase pulse does not have to be turned on by the magnetic pole detection or the JOG operation.
For this operation, always connect the direct drive motor encoder and the servo amplifier, and turn on only the control circuit power supply of the servo amplifier (L11 and L21) (turn off the main circuit power supply L1, L2, and L3). Perform this operation by considering the safety.
 4. Test operation cannot be performed in the absolute position detection system, either. To perform test operation, select "Disabled (incremental system) (_ _ _ 0)" in [Pr. PA03]. Refer to section 16.3.2 (1) for details.
 5. After the servo amplifier is connected to the direct drive motor with an encoder cable, [AL. 25 Absolute position erased] will occur at the first power on. Cancel the alarm by turning on/off the power.
 6. When the magnetic pole detection is performed with absolute position detection system by DIO transfer, [AL. 93 ABS data transfer warning] will occur. Refer to section 16.4 for details.
 7. To cancel [AL. 93 ABS data transfer warning], cycle SON (Servo-on) or set a home position.

16.3.2 Magnetic pole detection

POINT
<ul style="list-style-type: none">● The magnetic pole detection is not required for the configured absolute position detection system where the Z-phase pulse of the direct drive motor can be turned on manually. For this operation, always connect the direct drive motor encoder and the servo amplifier and turn on the control power supply of the servo amplifier. Perform this operation by considering the safety.

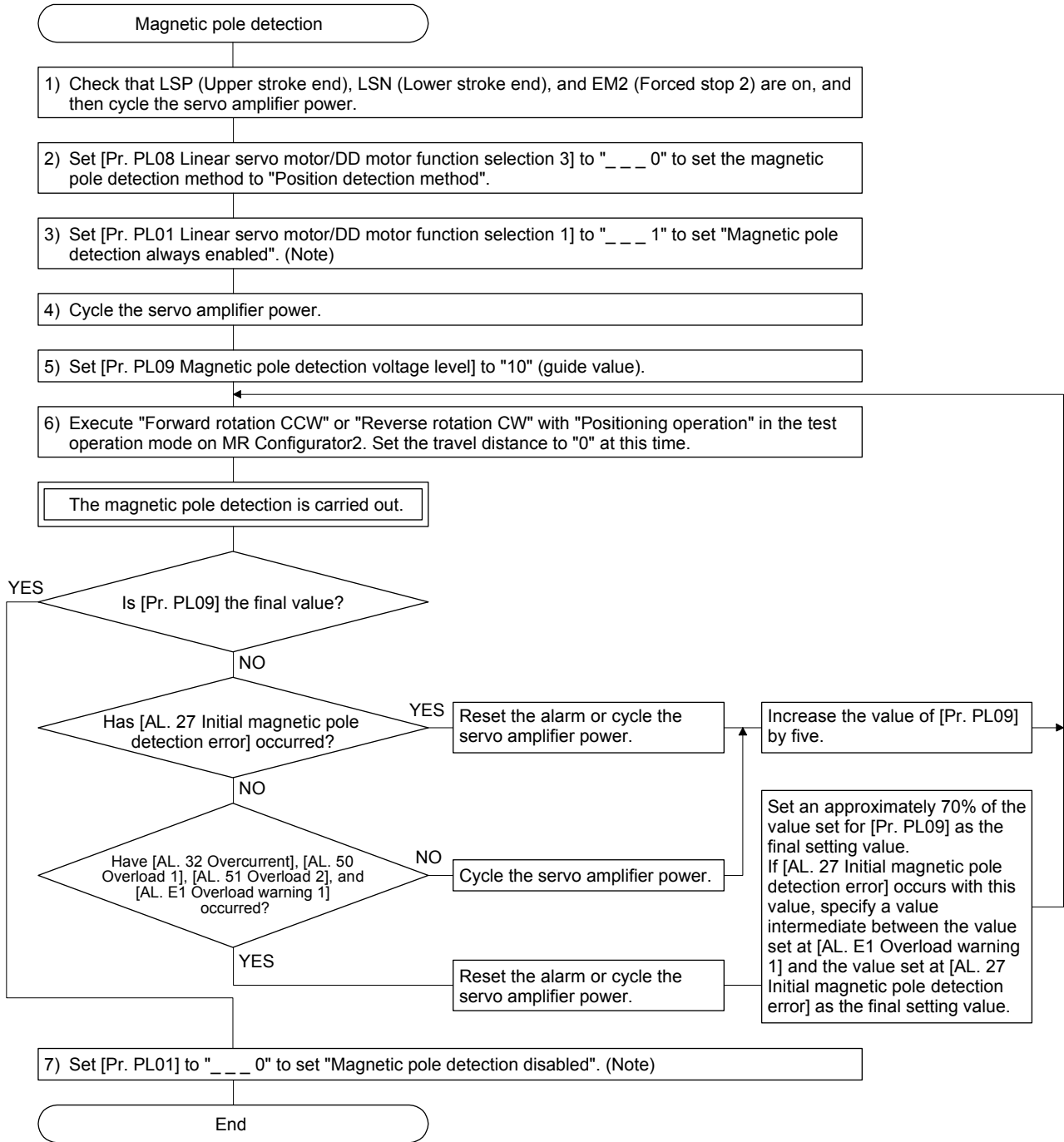
Before the positioning operation of the direct drive motor, make sure to perform the magnetic pole detection. Before starting up the equipment, perform the test operation (positioning operation) of MR Configurator2.

16. USING A DIRECT DRIVE MOTOR

(1) Magnetic pole detection method by using MR Configurator2

The following shows the magnetic pole detection procedure by using MR Configurator2.

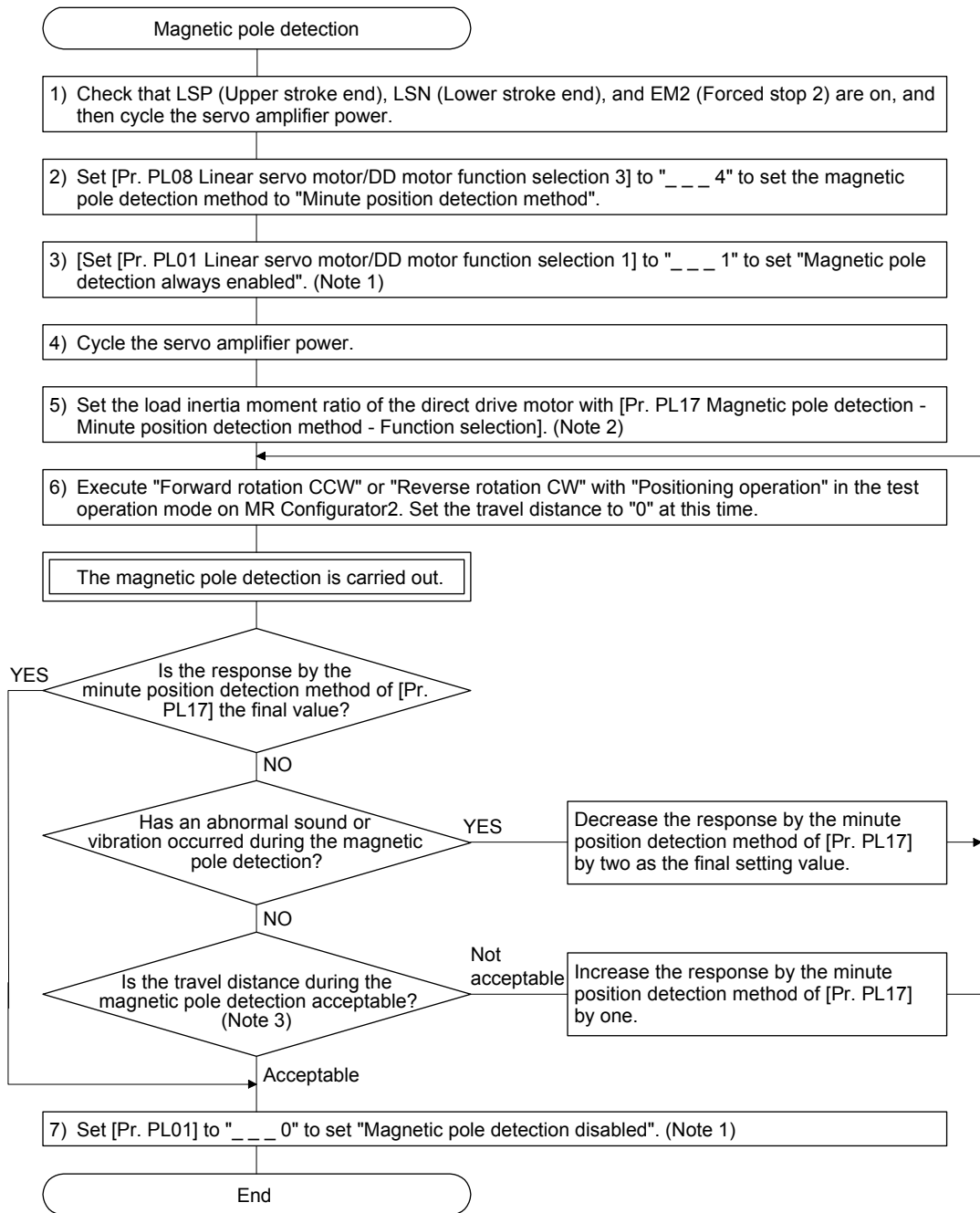
(a) Magnetic pole detection by the position detection method



Note. For the incremental system, the [Pr. PL01] setting is not required.

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(b) Magnetic pole detection by the minute position detection method



- Note 1. For the incremental system, the [Pr. PL01] setting is not required.
- Note 2. If the load to direct drive motor inertia ratio is unknown, perform the magnetic pole detection by the position detection method, and then perform the auto tuning to set an estimated value.
- Note 3. For the magnetic pole detection by the minute position detection method, the maximum rotation angle at the magnetic pole detection must be five degrees or less. To shorten the travel distance, increase the response by the minute position detection method in [Pr. PL17].

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(2) Operation at the magnetic pole detection

! WARNING ● Note that the magnetic pole detection automatically starts simultaneously with the turning-on of the servo-on command.

! CAUTION ● If the magnetic pole detection is not executed properly, the direct drive motor may operate unexpectedly.

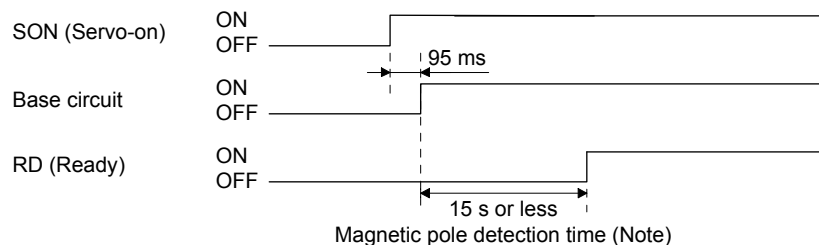
POINT
<ul style="list-style-type: none"> ● Establish the machine configuration to use LSP (Upper stroke end) and LSN (Lower stroke end). The machine may be damaged due to a collision without LSP and LSN. ● Assign LSP and LSN and perform the magnetic pole detection also in the torque control mode. ● At the magnetic pole detection, whether the motor rotates in the forward or reverse direction is unpredictable. ● Depending on the setting value of [Pr. PL09 Magnetic pole detection voltage level], an overload, overcurrent, magnetic pole detection alarm, or others may occur. ● After the magnetic pole detection, check the positioning accuracy with the test operation (positioning operation function) of MR Configurator2. ● The accuracy of the magnetic pole detection improves with no load.

(a) Incremental system

POINT
<ul style="list-style-type: none"> ● For the incremental system, the magnetic pole detection is required every time the power is turned on.

By turning on SON (Servo-on) after power-on, the magnetic pole detection is automatically carried out. Therefore, there is not need to set the parameter (first digit of [Pr. PL01]) for executing the magnetic pole detection.

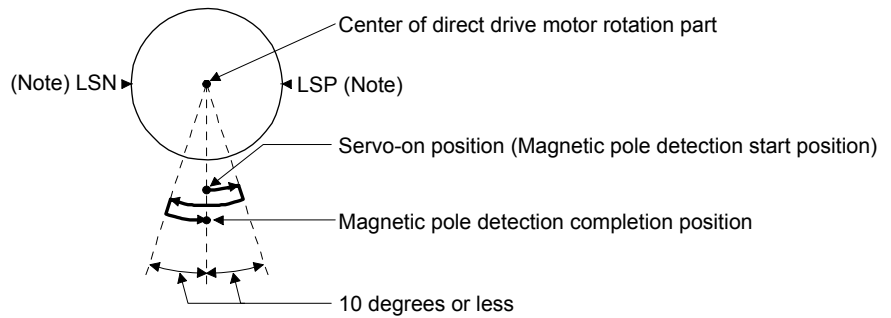
1) Timing chart



Note. The magnetic pole detection time indicates the operation time when LSP (Upper stroke end) and LSN (Lower stroke end) are on.

16. USING A DIRECT DRIVE MOTOR

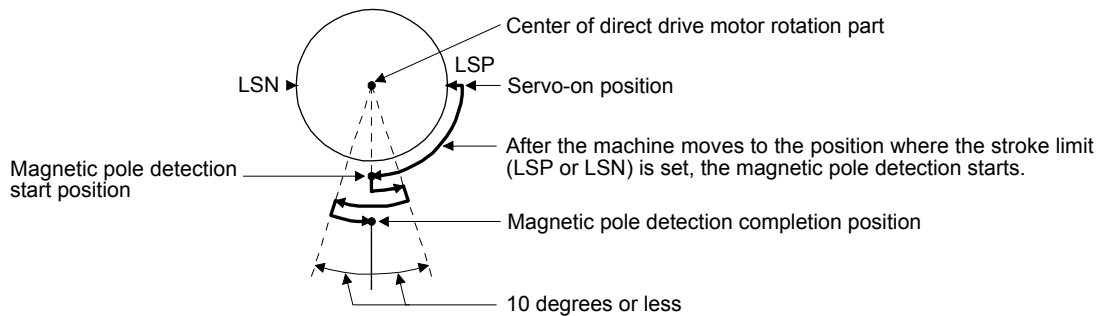
2) Direct drive motor movement (when LSP and LSN are on)



Note. When the stroke limit (LSP or LSN) turns off during the magnetic pole detection, the magnetic pole detection is carried on to the opposite direction. When both LSP and LSN are off, [AL. 27 Initial magnetic pole detection error] occurs.

3) Direct drive motor movement (when LSP or LSN is off)

When LSP or LSN is off at servo-on, the magnetic pole detection is carried out as follows.

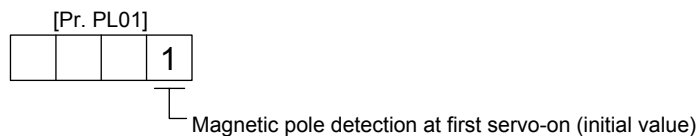


(b) Absolute position detection system

POINT
<ul style="list-style-type: none"> ● When the absolute position detection system is used with the following timing, the magnetic pole detection is required. <ul style="list-style-type: none"> ▪ System set-up (at the first startup of equipment) ▪ When the Z-phase pulse of the direct drive motor is not turned on at the system setup (When the Z-phase pulse of the direct drive motor can be turned on manually, the magnetic pole detection is not required.) ▪ After a direct drive motor is replaced ▪ When [AL. 25 Absolute position erased] has occurred ● Turn on the Z-phase pulse of the direct drive motor in JOG operation from the controller after the magnetic pole detection.

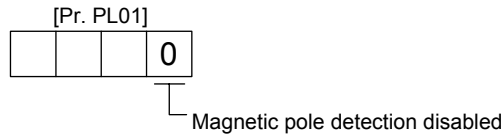
Perform the magnetic pole detection in the following procedure.

- 1) Set [Pr. PL01 Linear servo motor/DD motor function selection 1] to "___ 1" (Magnetic pole detection at first servo-on).



16. USING A DIRECT DRIVE MOTOR

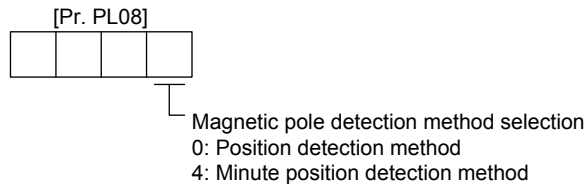
- 2) Execute the magnetic pole detection. (Refer to (2) (a) 1), 2) of this section.)
- 3) After the completion of the magnetic pole detection, change [Pr. PL01] to "___0" (Magnetic pole detection disabled).



After the magnetic pole detection, by turning on the Z-phase pulse of the direct drive motor in JOG operation and by disabling the magnetic pole detection function with [Pr. PL01], the magnetic pole detection after each power-on is not required.

(3) Magnetic pole detection method setting

Set the magnetic pole detection method using the first digit of [Pr. PL08] (Magnetic pole detection method selection).



(4) Setting of the magnetic pole detection voltage level by the position detection method

For the magnetic pole detection by the position detection method, set the voltage level with [Pr. PL09 Magnetic pole detection voltage level]. For the magnetic pole detection by the minute position detection method, the voltage level setting is not required.

(a) Guideline of parameter settings

Set the parameters by referring to the following table.

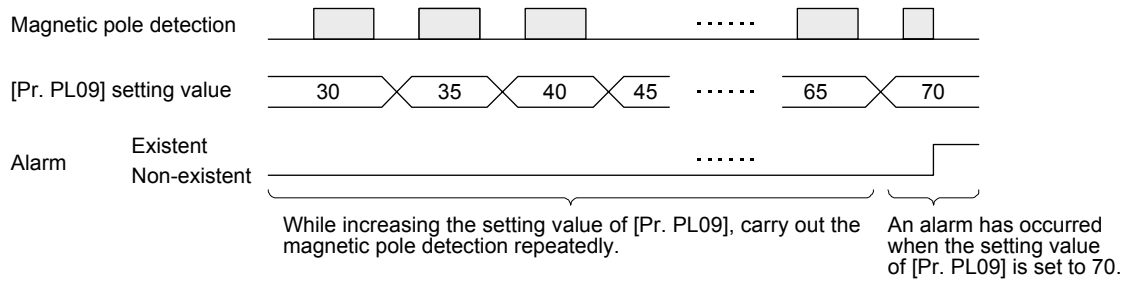
Servo status	[Pr. PL09] setting (guide value)	Small ← Medium → Large (10 or less (initial value) 50 or more)	
		Small	Large
Torques required for operation		Small	Large
Overload, overcurrent alarm		Seldom occurs	Frequently occurs
Magnetic pole detection alarm		Frequently occurs	Seldom occurs
Magnetic pole detection accuracy		Low	High

(b) Setting procedure

- 1) Perform the magnetic pole detection, and increase the setting value of [Pr. PL09 Magnetic pole detection voltage level] until [AL. 50 Overload 1], [AL. 51 Overload 2], [AL. E1 Overload warning 1], and [AL. EC Overload warning 2] occur. Increase the setting value by five as a guide value. When these alarms and warnings occur during the magnetic pole detection by using MR Configurator2, the test operation of MR Configurator2 automatically completes and the servo-off status is established.
- 2) Specify the setting value that is an approximately 70% of the value set when [AL. 50 Overload 1], [AL. 51 Overload 2], [AL. E1 Overload warning 1], and [AL. EC Overload warning 2] occurred as the final setting value. However, if [AL. 27 Initial magnetic pole detection error] occurs with this value, specify a value intermediate between the value set at [AL. 50 Overload 1], [AL. 51 Overload 2], [AL. E1 Overload warning 1], or [AL. EC Overload warning 2] and the value set at the magnetic pole detection alarm as the final setting value.
- 3) Perform the magnetic pole detection again with the final setting value.

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(c) Setting example



In this example, the final setting value of [Pr. PL09] is 49 (Setting value at the alarm occurrence = 70 × 0.7).

16.3.3 Function

(1) Servo control error detection function

POINT
<ul style="list-style-type: none"> ● For the servo control error detection function, the position and speed deviation error detections are enabled by default. ([Pr. PL04]: __ __ 3)

If the servo control gets unstable for some reasons, the direct drive motor may not operate properly. To detect this state and to stop operation, the servo control error detection function is used as a protective function.

The servo control error detection function has three different detection methods: the position deviation, speed deviation, and torque deviation. An error is detected when each method is enabled with [Pr. PL04 Linear servo motor/DD motor function selection 2]. The detection level can be changed with [Pr. PL05], [Pr. PL06], and [Pr. PL07].

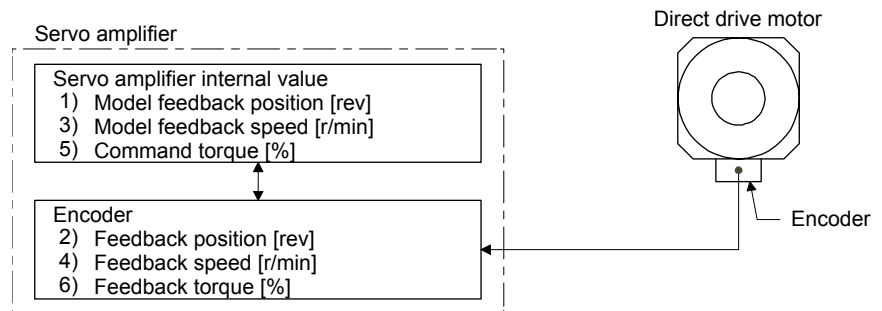
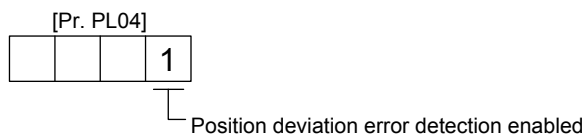


Figure 16.1 Outline of servo control error detection function

(a) Position deviation error detection

Set [Pr. PL04] to "__ __ 1" to enable the position deviation error detection.

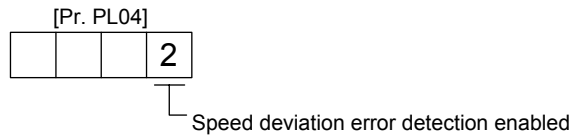


When you compare the model feedback position (1)) and the feedback position (2)) in figure 16.1, if the deviation is more than the value of [Pr. PL05 Position deviation error detection level] (1 (0.01 rev) to 1000 (10 rev)), [AL. 42.1 Servo control error by position deviation] will occur and the linear servo motor will stop. The initial value of this detection level is 0.09 rev. Change the set value as necessary.

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(b) Speed deviation error detection

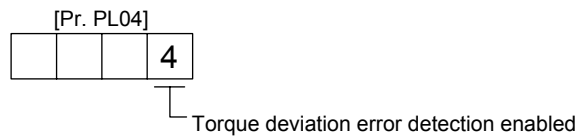
Set [Pr. PL04] to "___2" to enable the speed deviation error detection.



When you compare the model feedback speed (3) and the feedback speed (4) in figure 16.1, if the deviation is more than the value of [Pr. PL06 Speed deviation error detection level] (1 r/min to 2000 r/min), [AL. 42.2 Servo control error by speed deviation] will occur and the linear servo motor will stop. The initial value of this detection level is 100 r/min. Change the set value as necessary.

(c) Torque deviation error detection level

Set [Pr. PL04] to "___4" to enable the torque deviation error detection.



When you compare the command torque (5) and the feedback torque (6) in figure 16.1, if the deviation is more than the value of [Pr. PL07 Torque/thrust deviation error detection level] (1% to 1000%), [AL. 42.3 Servo control error by torque/thrust deviation] will occur and the linear servo motor will stop. The initial value of this detection level is 100%. Change the set value as necessary.

(d) Detecting multiple deviation errors

When [Pr. PL04] is set as follows, multiple deviation errors can be detected. For the error detection methods, refer to (1) (a), (b), (c) of this section.

[Pr. PL04]

--	--	--	--

Setting value	Position deviation error detection	Speed deviation error detection	Torque deviation error detection
1	○	○	○
2	○	○	○
3	○	○	○
4	○	○	○
5	○	○	○
6	○	○	○
7	○	○	○

16. USING A DIRECT DRIVE MOTOR

16.4 Absolute position detection system

POINT
●To configure the absolute position detection system by using the direct drive motor, the battery (MR-BAT6V1SET) and the absolute position storage unit (MR-BTAS01) are required.
●For encoder cables and absolute position storage units, refer to "Direct Drive Motor Instruction Manual".
●Replacing the absolute position storage unit (MR-BTAS01) will erase the absolute position. Start up the direct drive motor again and perform home positioning.
●Replace the battery (MR-BAT6V1SET) while the control circuit power is on. Replacing the unit during control circuit power supply off will cause [AL. 25 Absolute position erased]. A battery cannot be replaced using battery connection cable (MR-J3BTCBL03M).
●[AL. 25 Absolute position erased] will occur if the encoder cable is disconnected.

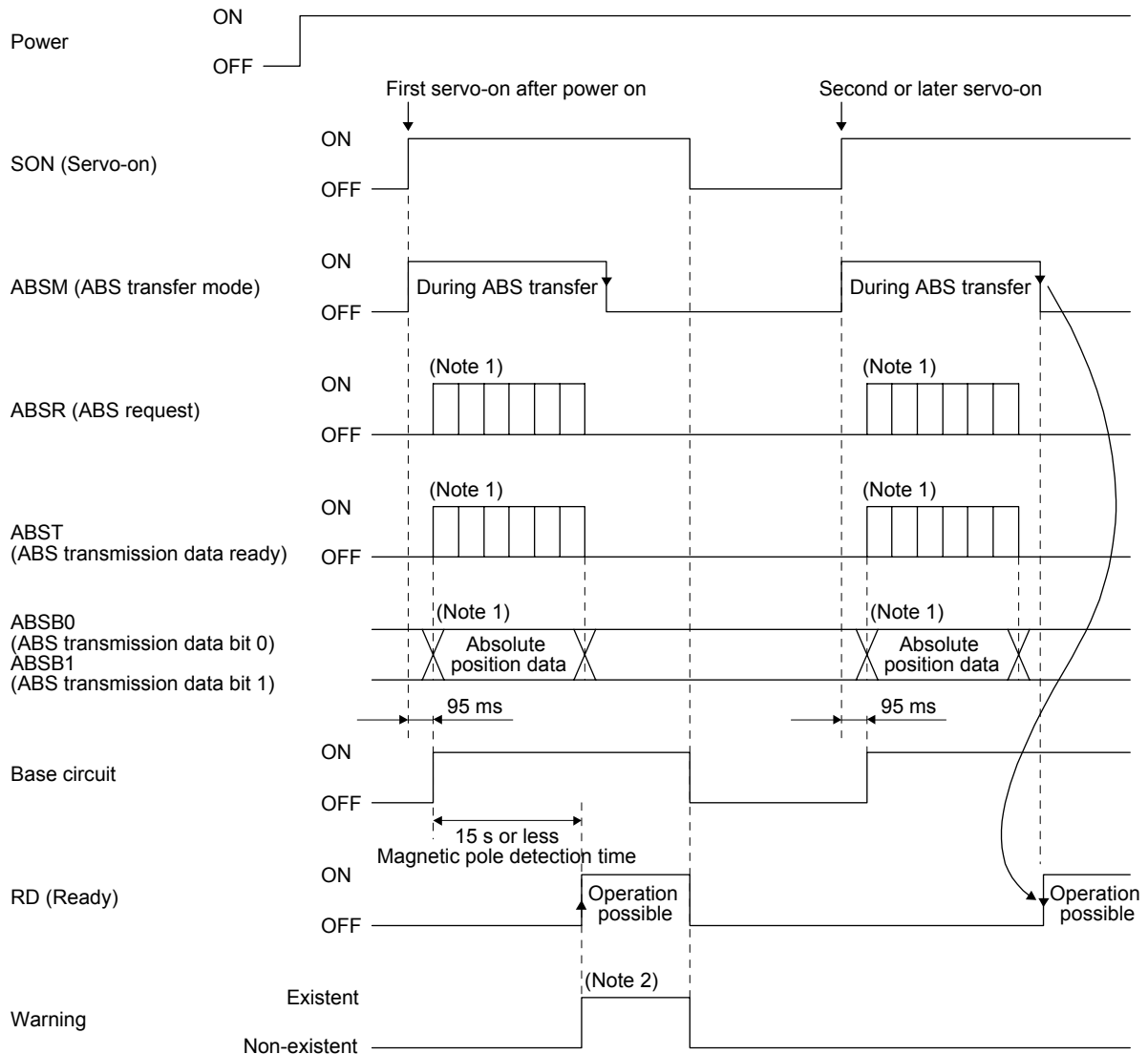
When you use the system with absolute position detection system by DIO transfer (set [Pr. PA03] to "___ 1") with the following conditions, the first servo-on after power on will trigger the magnetic pole detection and [AL. 93 ABS data transfer warning] will occur.

- Magnetic pole detection always enabled (Set [Pr. PL03] to "___ 1".)
- The Z-phase pulse of the direct drive motor has not turned on.

When the magnetic pole detection is performed with absolute position detection system by DIO transfer, a deviation occurs between absolute position data of the servo amplifier side and controller side. If the operation is continued, positions will be mismatched. Therefore, [AL. 93 ABS data transfer warning] will occur on the servo amplifier side. To cancel [AL. 93 ABS data transfer warning], cycle SON (Servo-on) or set a home position.

16. USING A DIRECT DRIVE MOTOR

Timing chart at power on under the condition of performing magnetic pole detection



Note 1. Refer to section 12.8.2 (1) (b) for details.

Note 2. Performing the magnetic pole detection triggers [AL. 93 ABS data transfer warning].

For transferring absolute position data to the controller, refer to section 12.8.

16.5 Characteristics

16.5.1 Overload protection characteristics

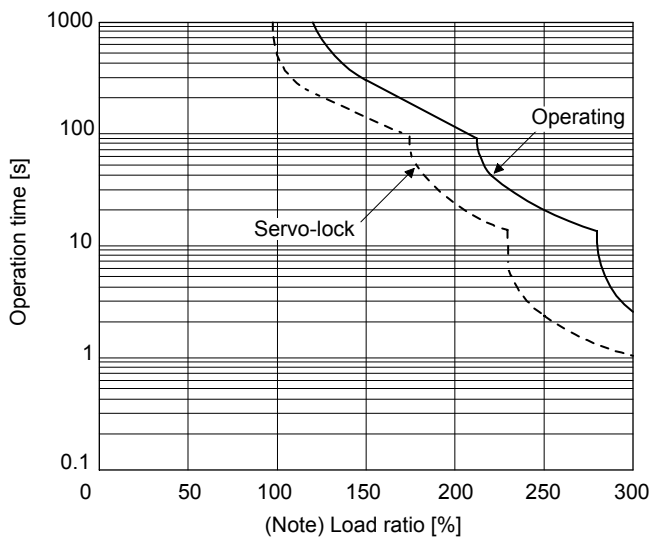
An electronic thermal is built in the servo amplifier to protect the servo amplifier, the direct drive motor, and direct drive motor power wires from overloads.

[AL. 50 Overload 1] occurs if overload operation performed is above the electronic thermal protection curve shown in fig. 16.2. [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.

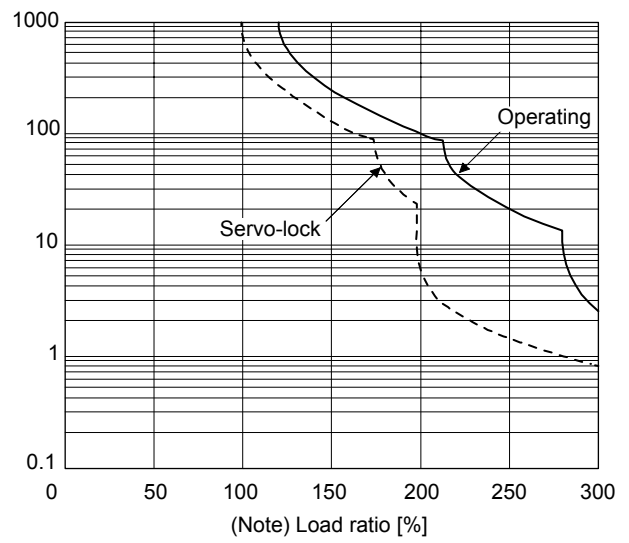
For the system where the unbalanced torque occurs, such as a vertical axis system, it is recommended that the unbalanced torque of the machine be kept at 70% or less of the motor's rated torque.

This servo amplifier has solid-state direct drive motor overload protection for each axis. (The direct drive motor overload current (full load current) is set on the basis of 120% rated current of the servo amplifier.)

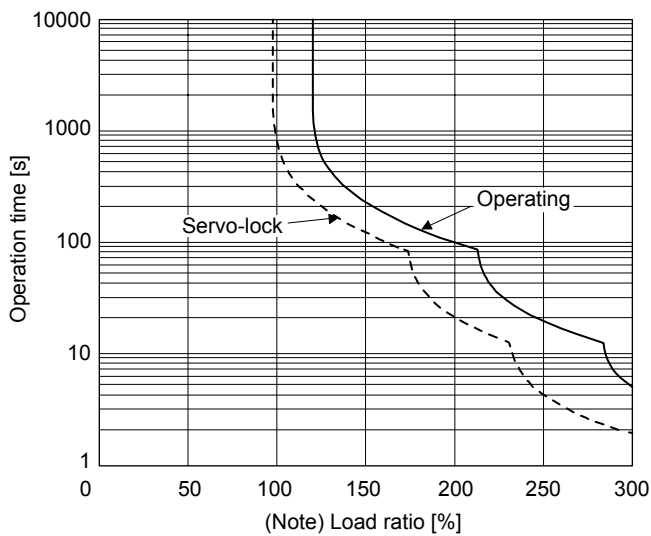
16. USING A DIRECT DRIVE MOTOR



TM-RFM002C20/TM-RFM004C20/
 TM-RFM006C20/TM-RFM006E20/
 TM-RFM012E20/TM-RFM018E20/
 TM-RFM012G20/TM-RFM040J10



TM-RFM048G20/TM-RFM072G20/
 TM-RFM120J10



TM-RFM240J10

Note. If operation that generates torque more than 100% of the rating is performed with an abnormally high frequency in a direct drive 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. 16.2 Electronic thermal protection characteristics

16. USING A DIRECT DRIVE MOTOR

16.5.2 Power supply capacity and generated loss

Table 16.1 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 16.1 Power supply capacity and generated loss per direct drive motor at rated output

Servo motor	Power supply capacity [kVA]	Servo amplifier-generated heat [W]		Area required for heat dissipation [m ²]
		At rated output	With servo-off	
TM-RFM002C20	0.25	25	15	0.5
TM-RFM004C20	0.38	35	15	0.7
TM-RFM006C20	0.53	40	15	0.8
TM-RFM006E20	0.46	40	15	0.8
TM-RFM012E20	0.81	50	15	1.0
TM-RFM018E20	1.3	50	15	1.0
TM-RFM012G20	0.71	50	15	1.0
TM-RFM048G20	2.7	90	20	1.8
TM-RFM072G20	3.8	110	20	2.2
TM-RFM040J10	1.2	50	15	1.0
TM-RFM120J10	3.4	90	20	1.8
TM-RFM240J10	6.6	160	25	3.2

16. USING A DIRECT DRIVE MOTOR

16.5.3 Dynamic brake characteristics

POINT
<ul style="list-style-type: none"> ● 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 the direct drive motor stops when using EM1 (Forced stop 1) frequently in other than emergency.

(1) Dynamic brake operation

(a) Calculation of coasting distance

Fig. 16.3 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use equation 16.1 to calculate an approximate coasting distance to a stop. The dynamic brake time constant τ varies with the direct drive motor and machine operation speeds. (Refer to (1) (b) of this section.)

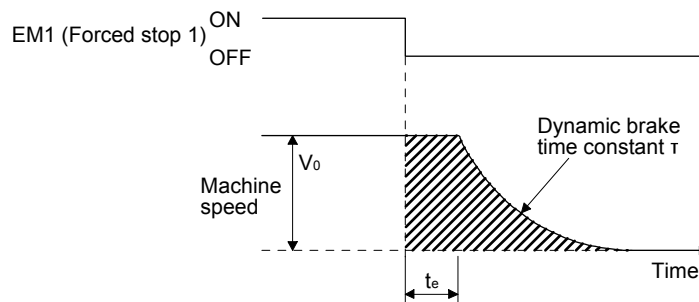


Fig. 16.3 Dynamic brake operation diagram

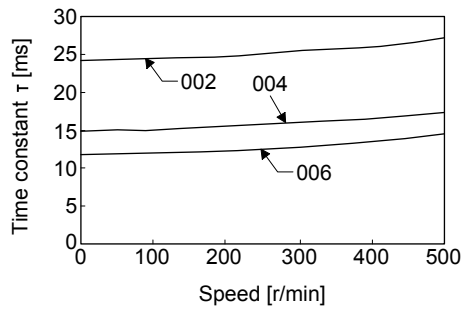
$$L_{\max} = \frac{V_0}{60} \cdot \left\{ t_e + \tau \left(1 + \frac{J_L}{J_M} \right) \right\} \dots\dots\dots (16.1)$$

- L_{\max} : Maximum coasting distance [mm]
 - V_0 : Machine's fast feed speed [mm/min]
 - J_M : Moment of inertia of direct drive motor [kg·cm²]
 - J_L : Load moment of inertia converted into equivalent value on direct drive motor rotor [kg·cm²]
 - τ : Dynamic brake time constant [s]
 - t_e : Delay time of control section [s]
- There is internal relay delay time of about 10 ms.

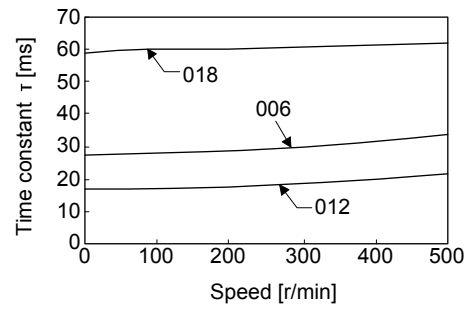
16. USING A DIRECT DRIVE MOTOR

(b) Dynamic brake time constant

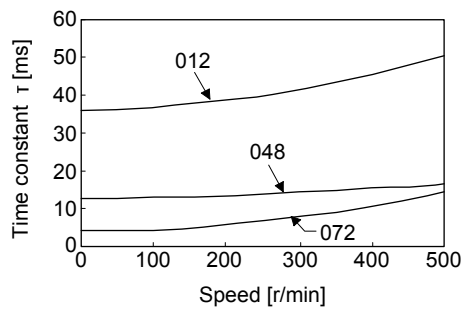
The following shows necessary dynamic brake time constant τ for equation 16.1.



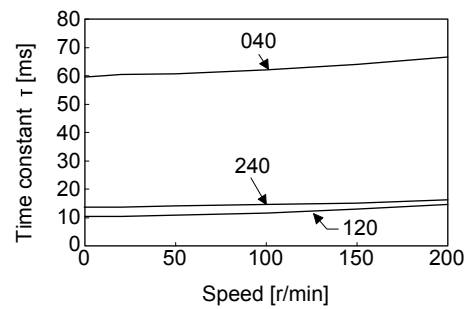
TM-RFM_C20



TM-RFM_E20



TM-RFM_G20



TM-RFM_J10

(2) Permissible load to motor inertia ratio 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 direct drive motor.

The value in the parenthesis shows the value at the rated speed of the direct drive motor.

Direct drive motor	Permissible load to motor inertia ratio [multiplier]
TM-RFM_C20	100 (300)
TM-RFM_E20	
TM-RFM_G20	50 (300)
TM-RFM_J10	50 (200)

17. FULLY CLOSED LOOP SYSTEM

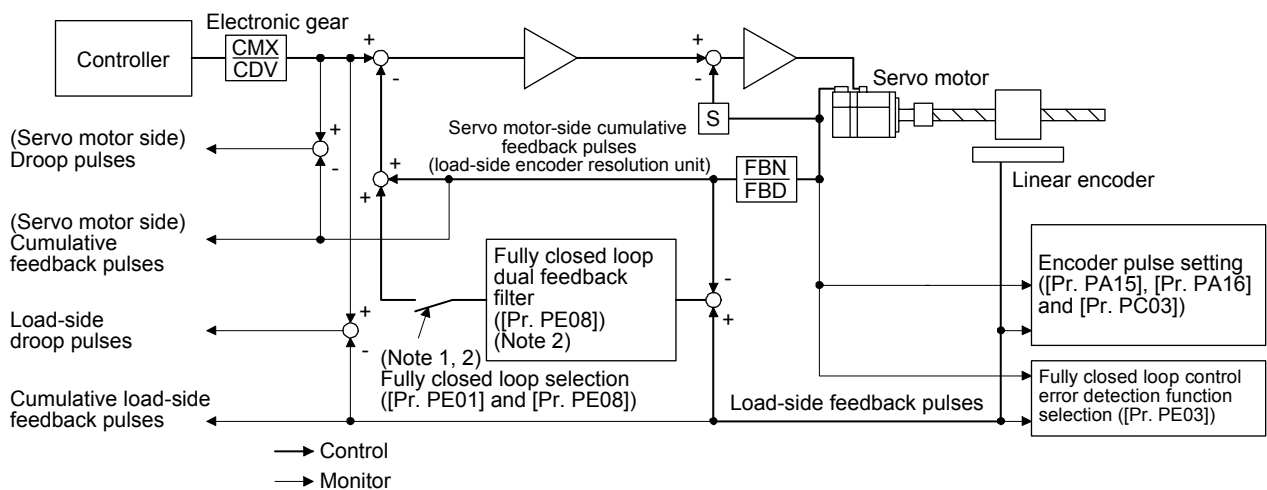
17. FULLY CLOSED LOOP SYSTEM

POINT
<ul style="list-style-type: none"> ● The fully closed loop system is available for the MR-J4-_A(-RJ) servo amplifiers of which software version is A5 or above. Check the software version using MR Configurator2. ● When fully closed loop control system is used with this servo amplifier, "Linear Encoder Instruction Manual" is needed. ● Fully closed loop control system is available with position control mode. ● When fully closed loop control system is configured with MR-J4-_A servo amplifier, the following restrictions will be applied. However, these restrictions will not be applied for MR-J4-_A-RJ servo amplifiers. <ul style="list-style-type: none"> ▪ A/B/Z-phase differential output type encoder cannot be used. ▪ The load-side encoder and servo motor encoder is compatible with only the two-wire type. The four-wire type load-side encoder and servo motor encoder cannot be used. ▪ When you use the KG-KR and HG-MR series for driving and load-side encoder, the optional four-wire type encoder cables (MR-EKCBL30M-L, MR-EKCBL30M-H, MR-EKCBL40M-H, and MR-EKCBL50M-H) cannot be used. When an encoder cable of 30 m to 50 m is needed, fabricate the encoder cable according to appendix 11.

17.1 Functions and configuration

17.1.1 Function block diagram

A fully closed loop control block diagram is shown below. The fully closed loop system is controlled in the load-side encoder unit.



- Note 1. Switching between semi closed loop control and fully closed loop control can be performed by changing the setting of [Pr. PE01].
 When semi closed loop control is selected, a control is always performed on the bases of the position data of the servo motor encoder independently of whether the servo motor is at a stop or running.
- Note 2. When the fully closed loop system is enabled in [Pr. PE01], dual feedback control in which the servo motor feedback signal and load-side encoder feedback signal are combined by the dual feedback filter in [Pr. PE08] is performed.
 In this case, fully closed loop control is performed when the servo motor is at a stop, and semi closed loop control is performed when the servo motor is operating to improve control performance. When "4500" is set as the filter value of [Pr. PE08 Fully closed loop dual feedback filter], fully closed loop control is always performed.

17. FULLY CLOSED LOOP SYSTEM

The following table shows the functions of each control mode.

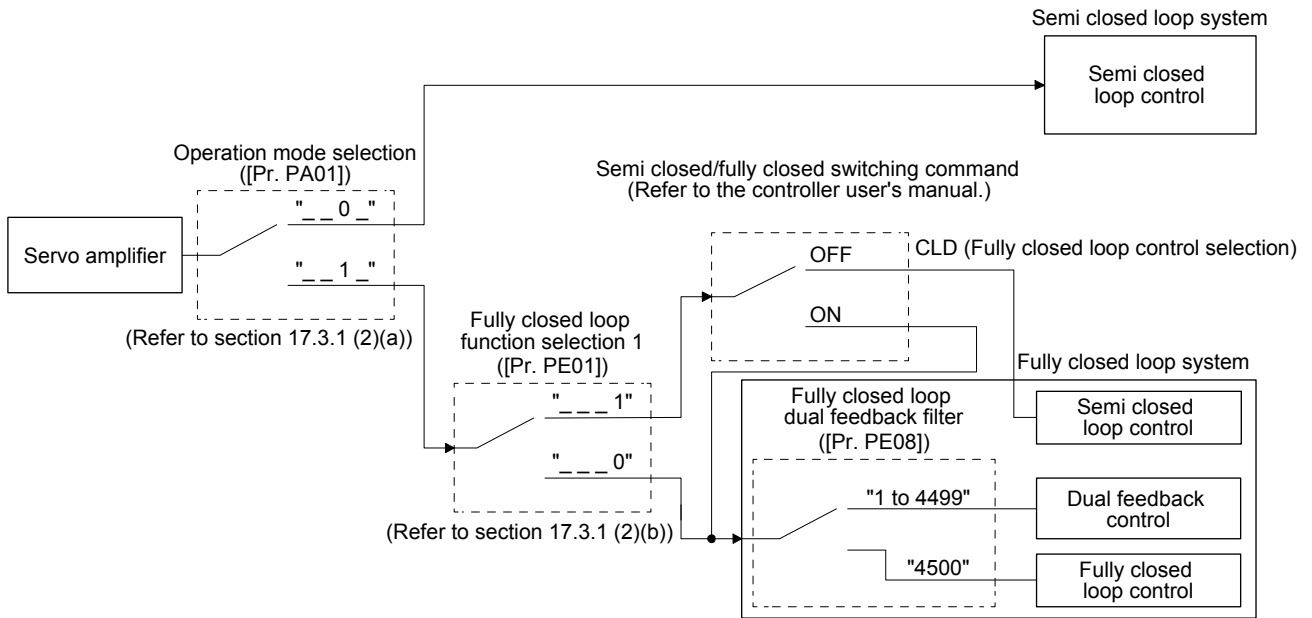
Control	Description	
Semi closed loop control	Feature	Position is controlled according to the servo motor-side data.
	Advantage	Since this control is insusceptible to machine influence (such as machine resonance), the gains of the servo amplifier can be raised and the settling time shortened.
	Disadvantage	If the servo motor side is at a stop, the side may be vibrating or the load-side accuracy not obtained.
Dual feedback control	Feature	Position is controlled according to the servo motor-side data and load-side data.
	Advantage	Control is performed according to the servo motor-side data during operation, and according to the load side-data at a stop in sequence to raise the gains during operation and shorten the settling time. A stop is made with the load-side accuracy.
Fully closed loop control	Feature	Position is controlled according to the load-side data.
	Advantage	The load-side accuracy is obtained not only at a stop but also during operation.
	Disadvantage	Since this control is susceptible to machine resonance or other influences, the gains of the servo amplifier may not rise.

17. FULLY CLOSED LOOP SYSTEM

17.1.2 Selecting procedure of control mode

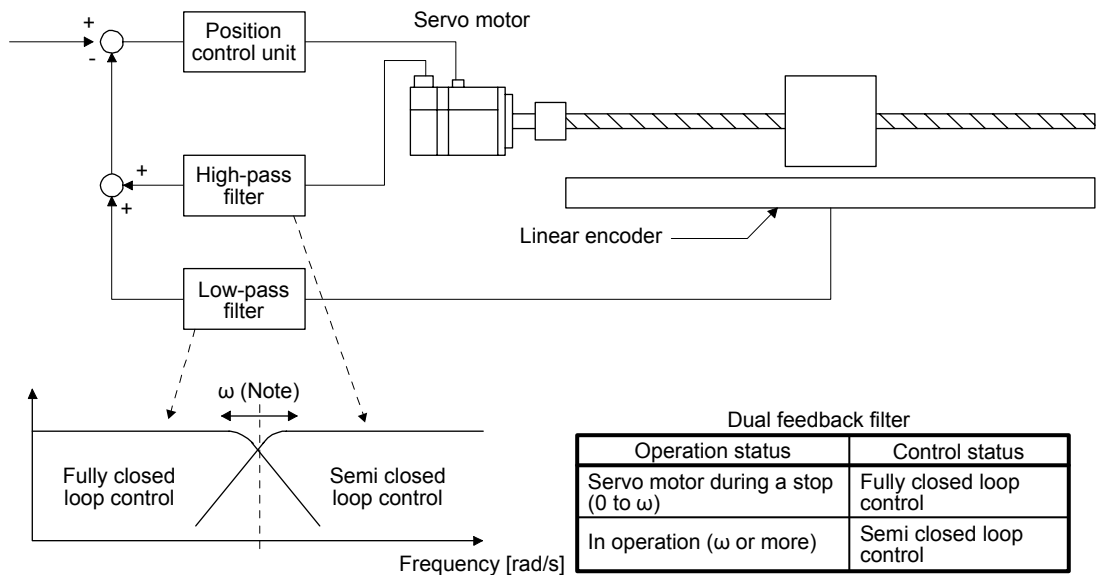
(1) Control mode configuration

In this servo, a semi closed loop system or fully closed loop system can be selected as a control system. In addition, the fully closed loop control and dual feedback control can be selected by the [Pr. PE08] settings on the fully closed loop system.



(2) Dual feedback filter equivalent block diagram

A dual feedback filter equivalent block diagram on the dual feedback control is shown below.



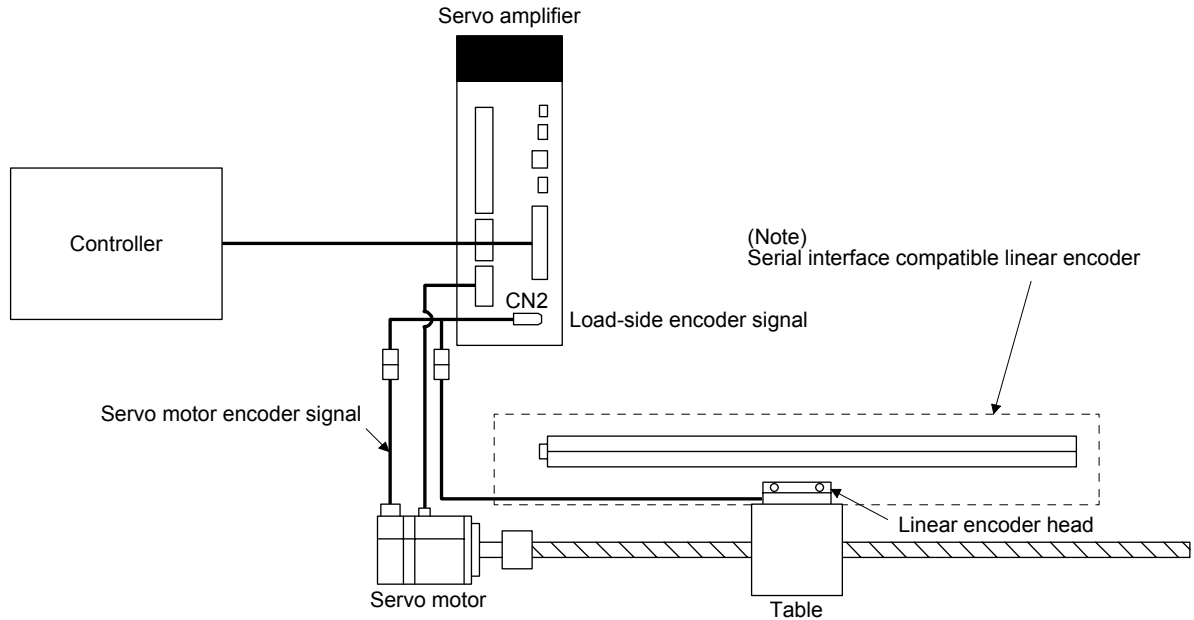
Note. " ω " (a dual feedback filter band) is set by [Pr. PE08].

17. FULLY CLOSED LOOP SYSTEM

17.1.3 System configuration

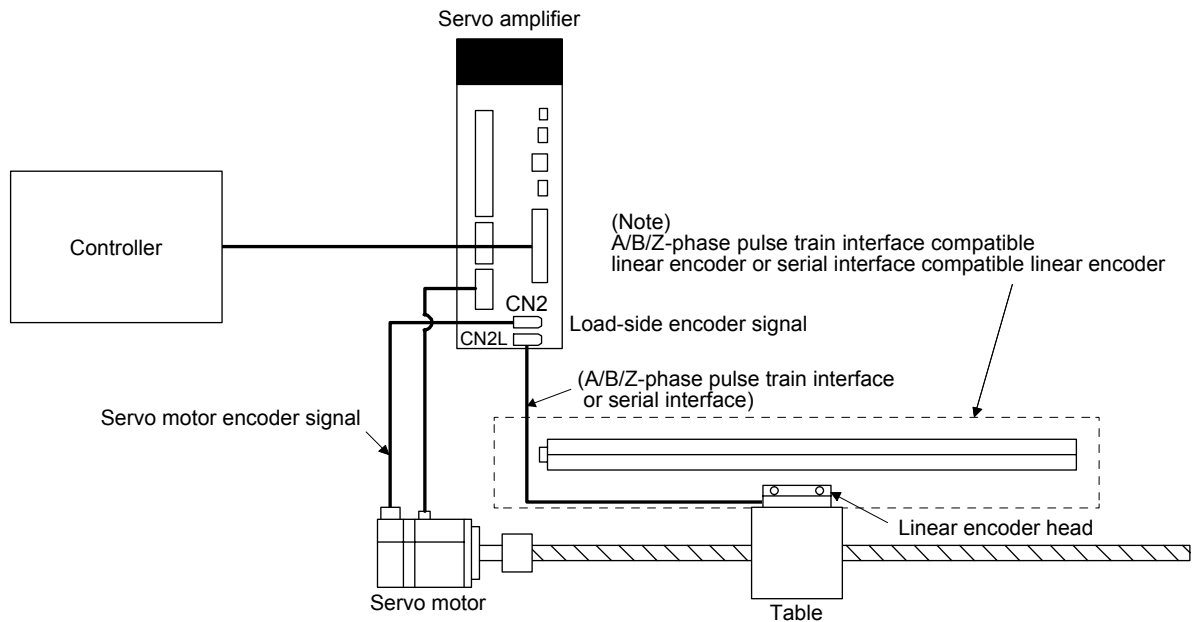
(1) For a linear encoder

(a) MR-J4-_A servo amplifier



Note. Applicable for the absolute position detection system when an absolute position linear encoder is used.
In that case, a battery (MR-BAT6V1SET) is not required.

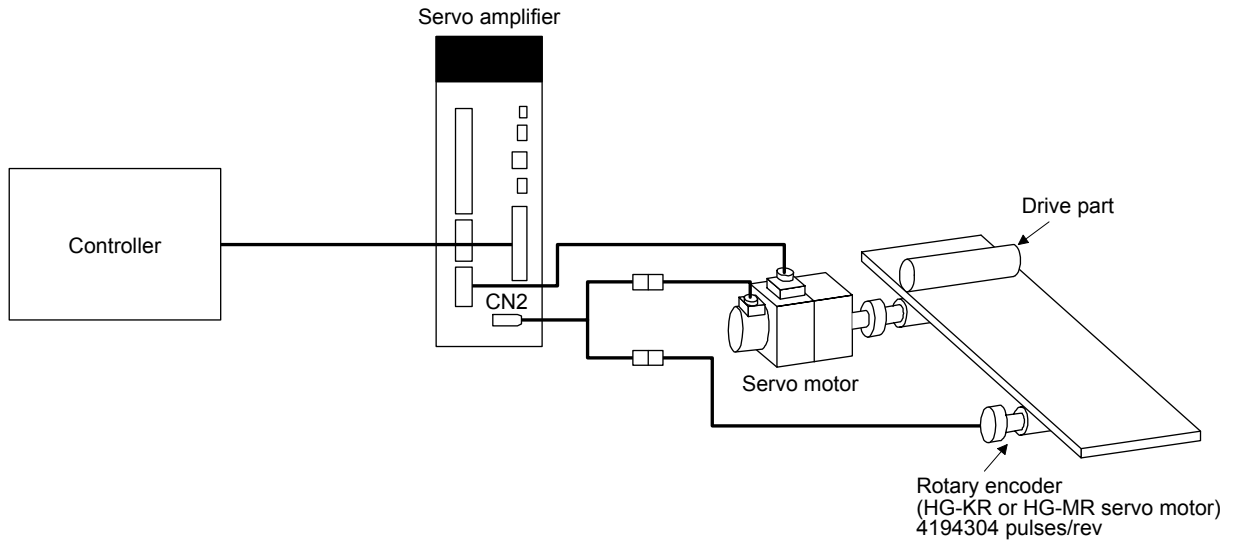
(b) MR-J4-_A-RJ servo amplifier



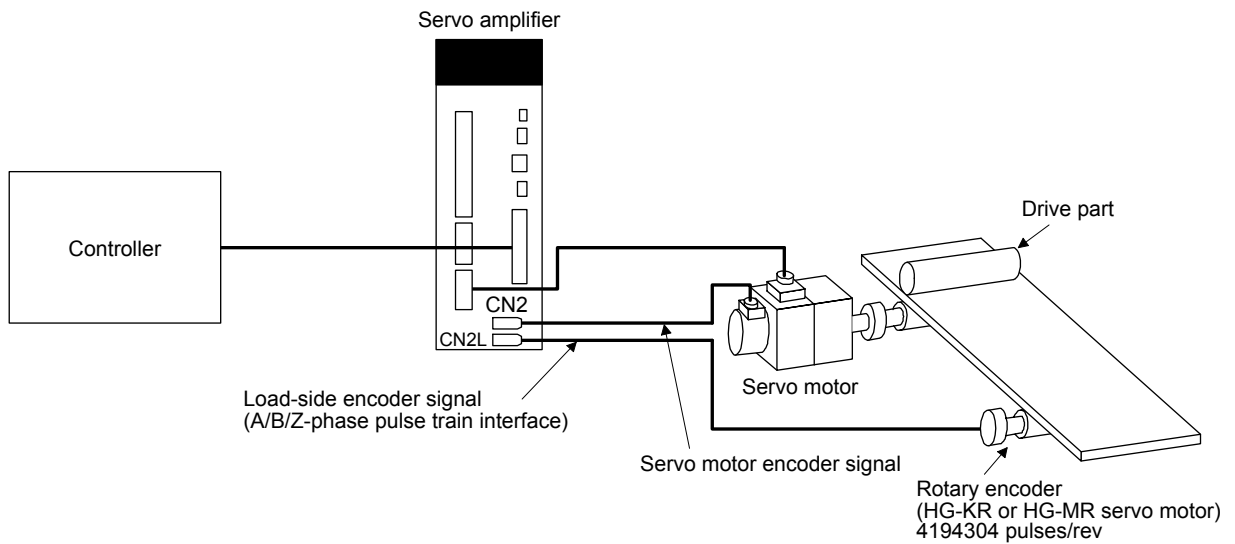
Note. Applicable for the absolute position detection system when an absolute position linear encoder is used.
In that case, a battery (MR-BAT6V1SET) is not required.

17. FULLY CLOSED LOOP SYSTEM

- (2) For a rotary encoder
 - (a) MR-J4-_A servo amplifier



- (b) MR-J4-_A-RJ servo amplifier



17. FULLY CLOSED LOOP SYSTEM

17.2 Load-side encoder

POINT
<ul style="list-style-type: none">● Always use the load-side encoder cable introduced in this section. Using other products may cause a malfunction.● For details of the load-side encoder specifications, performance and assurance, contact each encoder manufacturer.

17.2.1 LINEAR ENCODER

Refer to "Linear Encoder Instruction Manual" for usable linear encoders.

17.2.2 Rotary encoder

When a rotary encoder is used for the load-side encoder, use HG-KR or HG-MR servo motor as an encoder. Use a two-wire type encoder cable for MR-J4-_A servo amplifiers. Do not use MR-EKCBL30M-L, MR-EKCBL30M-H, MR-EKCBL40M-H, or MR-EKCBL50M-H as they are four-wire type.

17. FULLY CLOSED LOOP SYSTEM

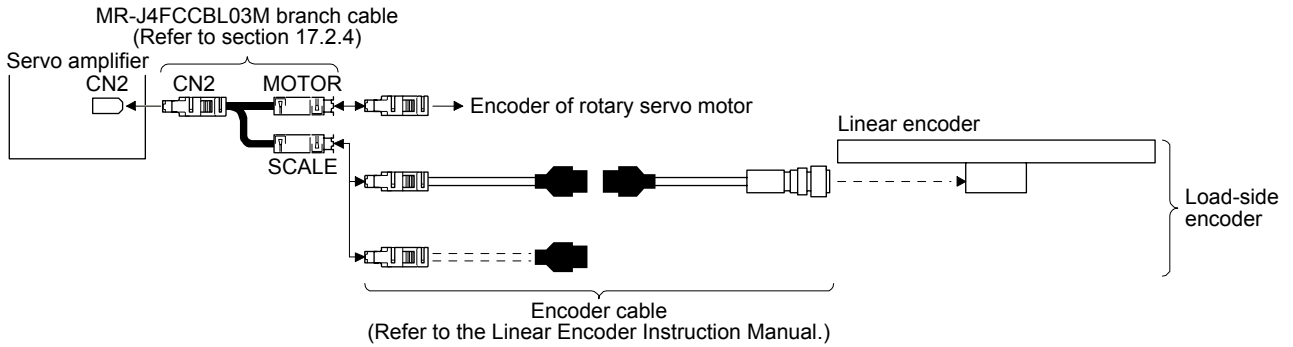
17.2.3 Configuration diagram of encoder cable

Configuration diagram for servo amplifier and load-side encoder is shown below. Cables used vary, depending on the load-side encoder.

(1) Linear encoder

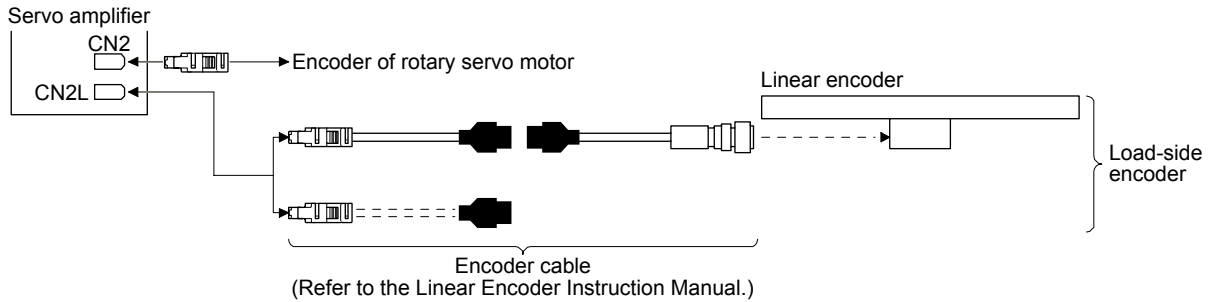
Refer to Linear Encoder Instruction Manual for encoder cables for linear encoder.

(a) MR-J4-_A servo amplifier



(b) MR-J4-_A-RJ servo amplifier

You can connect the linear encoder without using a branch cable shown in (a) for MR-J4-A-RJ servo amplifier. You can also use a four-wire type linear encoder.

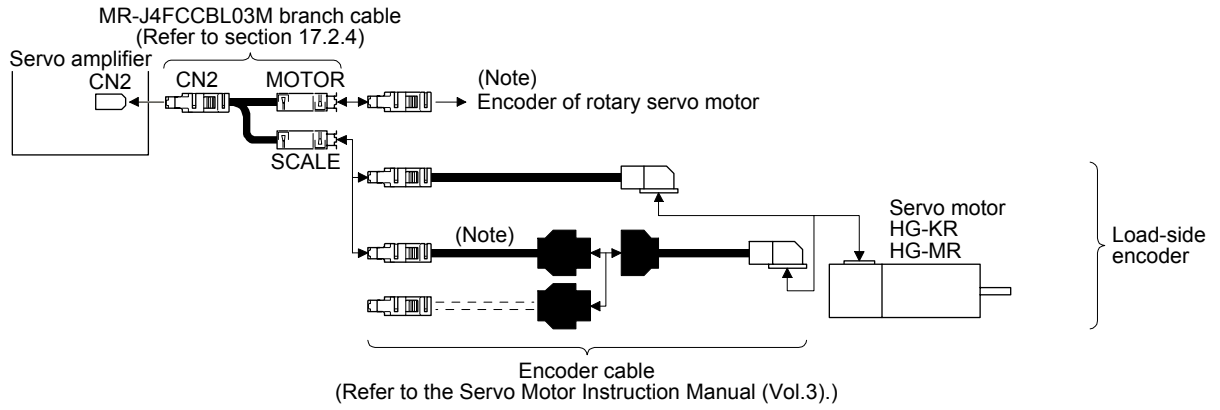


17. FULLY CLOSED LOOP SYSTEM

(2) Rotary encoder

Refer to "Servo Motor Instruction Manual (Vol. 3)" for encoder cables for rotary encoders.

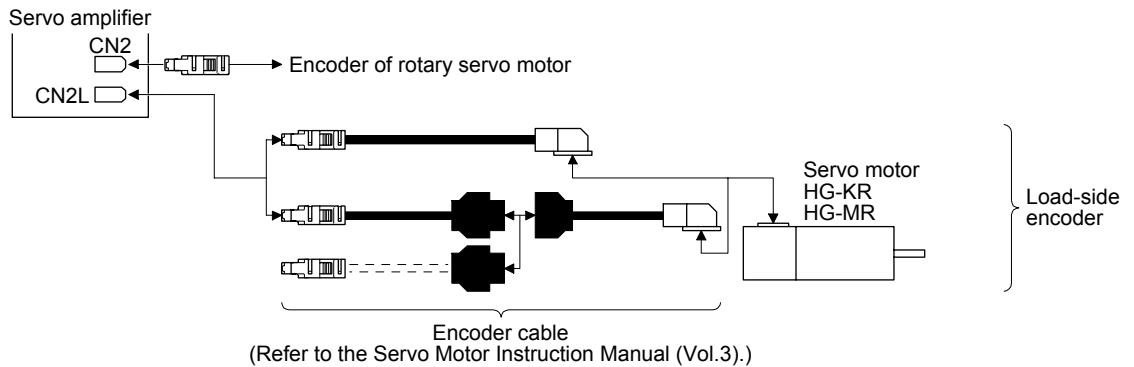
(a) MR-J4-_A servo amplifier



Note. Use a two-wire type encoder cable. A four-wire type linear encoder cable cannot be used.

(b) MR-J4-_A-RJ servo amplifier

You can connect the linear encoder without using a branch cable shown in (a) for MR-J4-A-RJ servo amplifier. You can also use a four-wire type linear encoder.

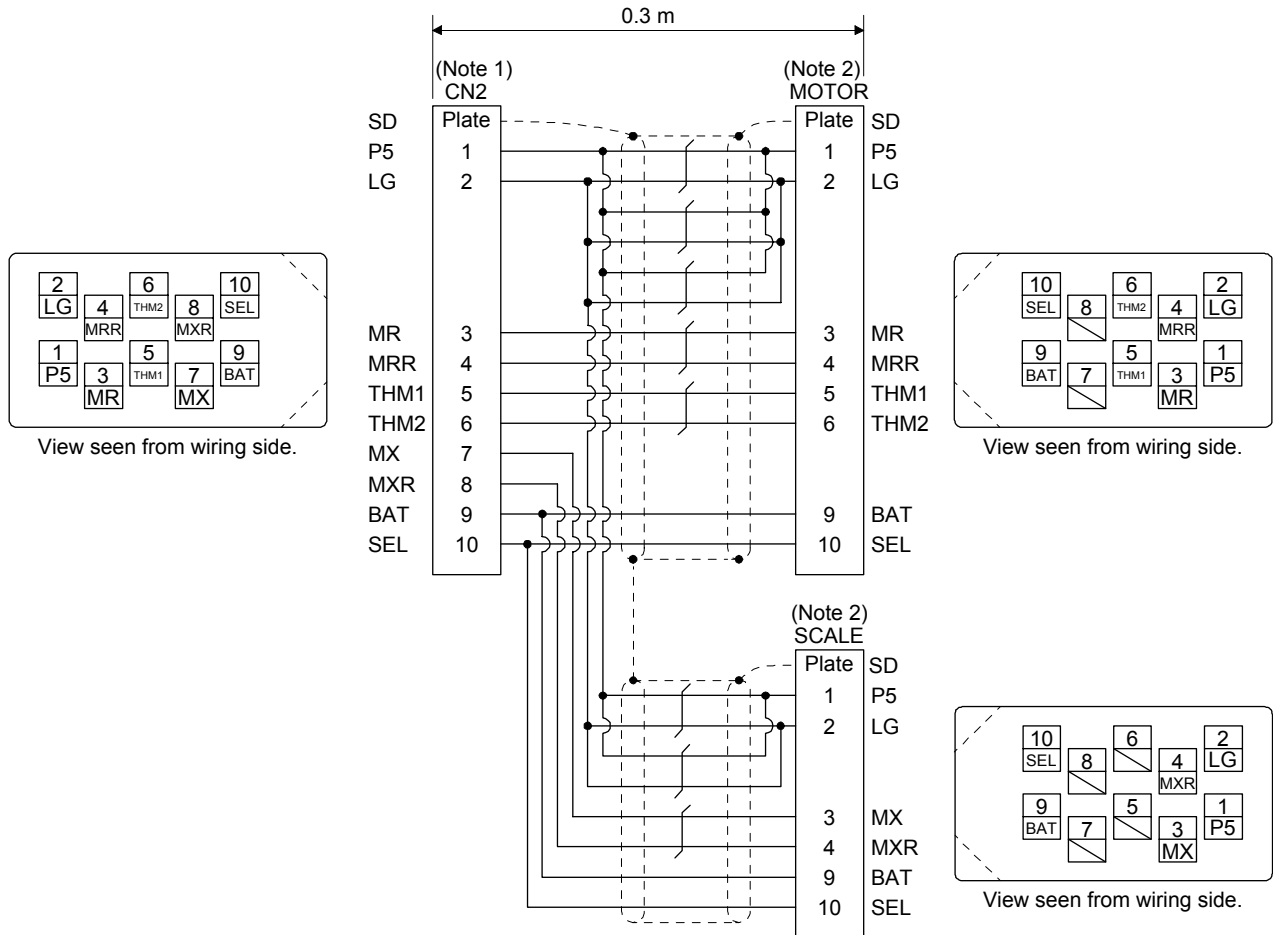


17. FULLY CLOSED LOOP SYSTEM

17.2.4 MR-J4FCCBL03M branch cable

Use MR-J4FCCBL03M branch cable to connect the rotary encoder and the load-side encoder to CN2 connector.

When fabricating the branch cable using MR-J3THMCN2 connector set, refer to "Linear Encoder Instruction Manual".



- Note 1. Receptacle: 36210-0100PL, shell kit: 36310-3200-008 (3M)
 Note 2. Plug: 36110-3000FD, shell kit: 36310-F200-008 (3M)

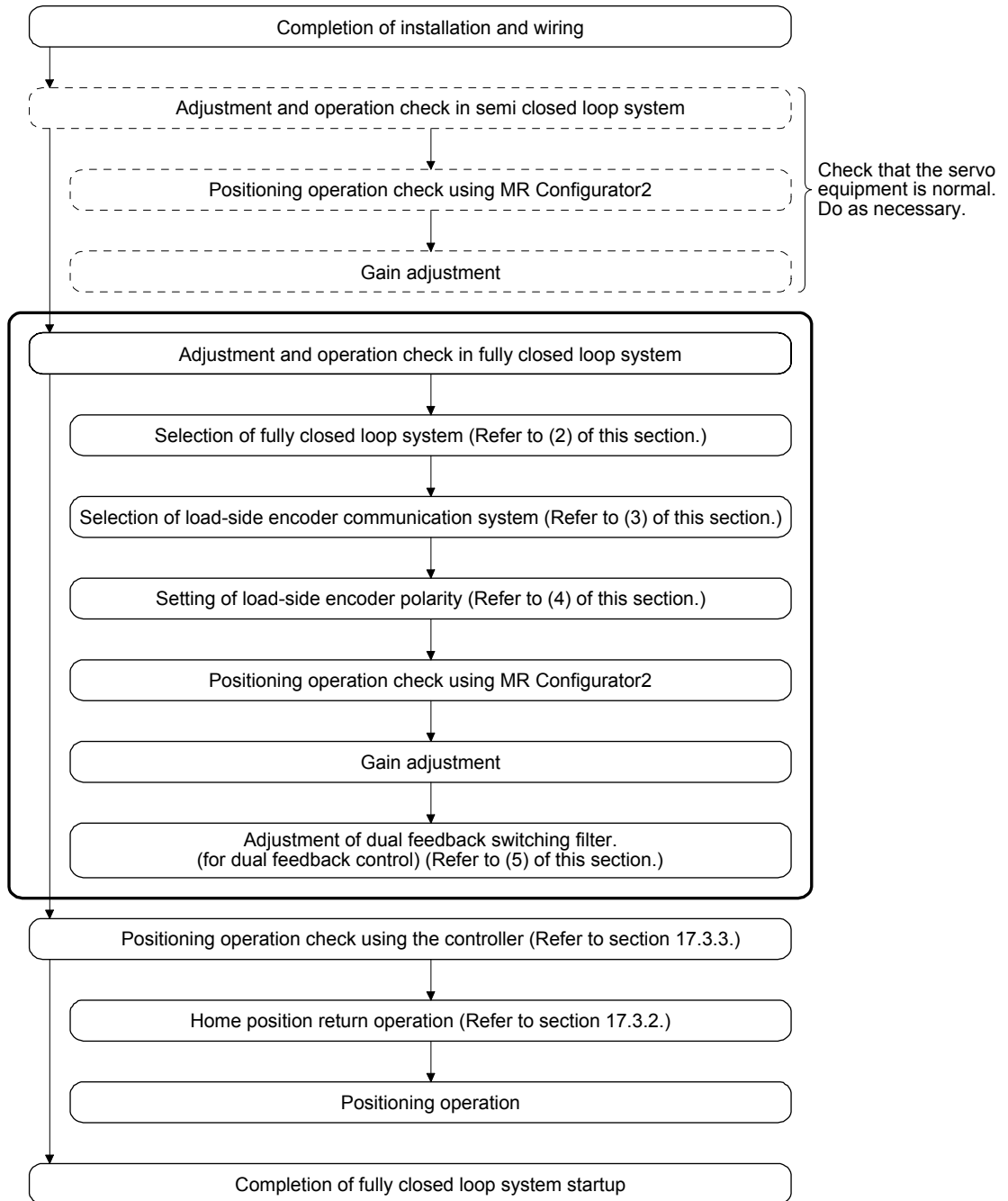
17. FULLY CLOSED LOOP SYSTEM

17.3 Operation and functions

17.3.1 Startup

(1) Startup procedure

Start up the fully closed loop system in the following procedure.



17. FULLY CLOSED LOOP SYSTEM

(2) Selection of fully closed loop system

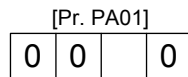
By setting [Pr. PA01], [Pr. PE01] and the control command of controller, the control method can be selected as shown in the following table.

[Pr. PA01]	[Pr. PE01]	Semi closed loop control/fully closed loop control switching signal	Command unit	Control method	Absolute position detection system
"__0_" Semi closed loop system (standard control mode)	/	/	Servo motor encoder unit	Semi closed loop control	○
"__1_" Fully closed loop system (fully closed loop control mode)			Load-side encoder unit	Dual feedback control (fully closed loop control)	○ (Note)
	"___0"	Off		Semi closed loop control	×
	"___1"	On		Dual feedback control (fully closed loop control)	×

Note. Applicable when the load-side encoder is set as the absolute position encoder.

(1) Operation mode selection

Select a operation mode.

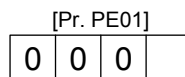


Operation mode selection

Set value	Operation mode	Control unit
0	Semi closed loop system (Standard control mode)	Servo motor-side resolution unit
1	Fully closed loop system (Fully closed loop control mode)	Load-side encoder resolution unit

(b) Semi closed loop control/fully closed loop control selection

Select the semi closed loop control/fully closed loop control.



Fully closed loop control selection

0: Always enabled

1: Switching using the control command of controller (switching between semi closed/fully closed)

Selection using the control command of controller	Control method
OFF	Semi closed loop control
ON	Fully closed loop control

When the operation mode selection in [Pr. PA01] is set to "__1_" (fully closed loop system), this setting is enabled.

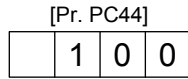
17. FULLY CLOSED LOOP SYSTEM

(3) Selection of load-side encoder communication method

The communication method changes depending on the load-side encoder type.

Refer to section 1.1 and "Linear Encoder Instruction Manual" for the communication method for each load-side encoder.

Select the cable to be connected to CN2L connector in [Pr. PC44].



Load-side encoder cable communication method selection

0: Two-wire type

1: Four-wire type

Incorrect setting will trigger [AL. 70] and [AL. 71]. Setting "1" while using a servo amplifier other than MR-J4-_A-RJ will trigger [AL. 37].

(4) Setting of load-side encoder polarity



CAUTION

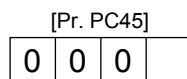
- Do not set an incorrect direction to "Encoder pulse count polarity selection" in [Pr. PC45]. An abnormal operation and a machine collision may occur if an incorrect direction is set, which cause a fault and parts damaged.

POINT

- "Encoder pulse count polarity selection" in [Pr. PC45] is not related to [Pr. PA14 Rotation direction selection]. Make sure to set the parameter according to the relationships between servo motor and linear encoder/rotary encoder.
- Do not set an incorrect direction to "Encoder pulse count polarity selection" in [Pr. PC45]. Doing so may cause [AL. 42 Fully closed loop control error] during the positioning operation.

(a) Parameter setting method

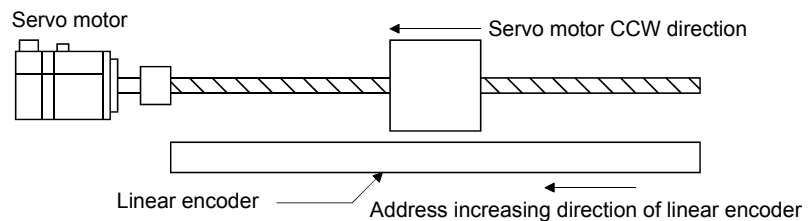
Set the load-side encoder polarity to be connected to CN2L connector in order to match the CCW direction of servo motor and the increasing direction of load-side encoder feedback.



Load-side encoder pulse count polarity selection

0: Load-side encoder pulse increasing direction in the servo motor CCW

1: Load-side encoder pulse decreasing direction in the servo motor CCW



(b) How to confirm the load-side encoder feedback direction

For the way of confirming the load-side encoder feedback direction, refer to (6) in this section.

17. FULLY CLOSED LOOP SYSTEM

(5) Setting of feedback pulse electronic gear

POINT
<p>● If an incorrect value is set in the feedback pulse electronic gear ([Pr. PE04], [Pr. PE05], [Pr. PE34], and [Pr. PE35]), [AL. 37 Parameter error] and an abnormal operation may occur. Also, it may cause [AL. 42.8 Fully closed loop control error by position deviation] during the positioning operation.</p>

The numerator ([Pr. PE04] and [Pr. PE34]) and denominator ([Pr. PE05] and [Pr. PE35]) of the electronic gear are set to the servo motor-side encoder pulse. Set the electronic gear so that the number of servo motor encoder pulses per servo motor revolution is converted to the number of load-side encoder pulses. The relational expression is shown below.

$$\frac{[\text{Pr. PE04}] \times [\text{Pr. PE34}]}{[\text{Pr. PE05}] \times [\text{Pr. PE35}]} = \frac{\text{Number of motor encoder pulses per servo motor revolution}}{\text{Number of load side encoder pulses per servo motor revolution}}$$

Select the load-side encoder so that the number of load-side encoder pulses per servo motor revolution is within the following range.

$$4096(2^{12}) \leq \text{Number of load-side encoder pulses per servo motor revolution} \leq 67108864 (2^{26})$$

(a) When the servo motor is directly coupled with a ball screw and the linear encoder resolution is 0.05 μm

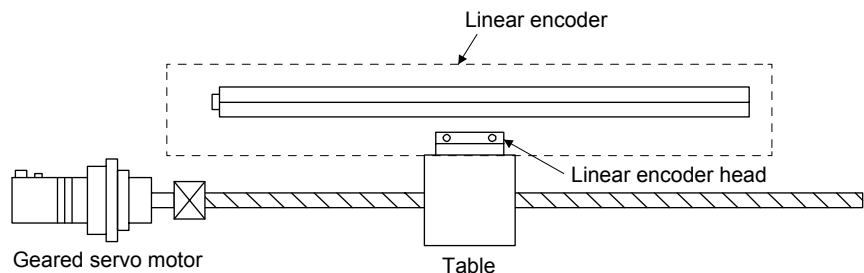
Conditions

Servo motor resolution: 4194304 pulses/rev

Servo motor reduction ratio: 1/11

Ball screw lead: 20 mm

Linear encoder resolution: 0.05 μm



Calculate the number of linear encoder pulses per ball screw revolution.

Number of linear encoder pulses per ball screw revolution
 = Ball screw lead/linear encoder resolution
 = 20 mm/0.05 μm = 400000 pulses

$$\frac{[\text{Pr. PE04}] \times [\text{Pr. PE34}]}{[\text{Pr. PE05}] \times [\text{Pr. PE35}]} = \frac{400000}{4194304} \times \frac{1}{11} = \frac{3125}{32768} \times \frac{1}{11}$$

17. FULLY CLOSED LOOP SYSTEM

(b) Setting example when using the rotary encoder for the load-side encoder of roll feeder

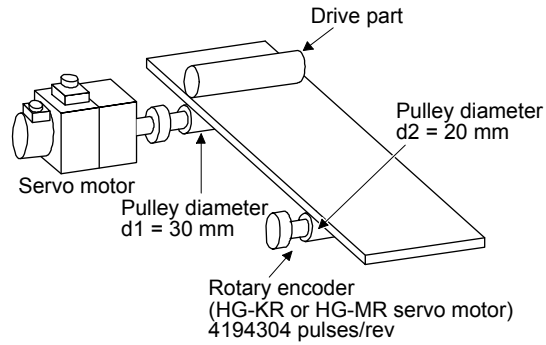
Conditions

Servo motor resolution: 4194304 pulses/rev

Pulley diameter on the servo motor side: 30 mm

Pulley diameter on the rotary encoder side: 20 mm

Rotary encoder resolution: 4194304 pulses/rev



When the pulley diameters or reduction ratios differ, consider that in calculation.

$$\frac{[\text{Pr. PE04}] \times [\text{Pr. PE34}]}{[\text{Pr. PE05}] \times [\text{Pr. PE35}]} = \frac{4194304 \times 30}{4194304 \times 20} = \frac{1}{1} \times \frac{3}{2}$$

17. FULLY CLOSED LOOP SYSTEM

(6) Confirmation of load-side encoder position data

Check the load-side encoder mounting and parameter settings for any problems.

POINT
<ul style="list-style-type: none"> ● Depending on the check items, MR Configurator2 may be used. Refer to section 17.3.6 for the data displayed on the MR Configurator2.

When checking the following items, the fully closed loop control mode must be set. For the setting of control mode, refer to (2) in this section.

No.	Check item	Confirmation method and description
1	Read of load-side encoder position data	<p>With the load-side encoder in a normal state (mounting, connection, etc.), the load-side cumulative feedback pulses value is counted normally when the load-side encoder is moved. When it is not counted normally, the following factors can be considered.</p> <ol style="list-style-type: none"> 1. An alarm occurred. 2. The installation of the load-side encoder was not correct. 3. The encoder cable was not wired correctly.
2	Read of load-side encoder scale home position (reference mark, Z-phase)	<p>With the home position (reference mark, or Z-phase) of the load-side encoder in a normal condition (mounting, connection, etc.), the value of load-side encoder information 1 is cleared to 0 when the home position (reference mark, or Z-phase) is passed through by moving the load-side encoder. When it is not cleared, the following factors can be considered.</p> <ol style="list-style-type: none"> 1. The installation of the load-side encoder was not correct. 2. The encoder cable was not wired correctly.
3	Confirmation of load-side encoder feedback direction (Setting of load-side encoder polarity)	<p>Confirm that the directions of the cumulative feedback pulses of servo motor encoder (after gear) and the load-side cumulative feedback pulses are matched by moving the device (load-side encoder) manually in the servo-off status. If mismatched, reverse the polarity.</p>
4	Setting of load-side encoder electronic gear	<p>When the servo motor and load-side encoder operate synchronously, the servo motor-side cumulative feedback pulses (after gear) and load-side cumulative feedback pulses are matched and increased.</p> <p>If mismatched, review the setting of fully closed loop control feedback electronic gear ([Pr. PE04], [Pr. PE05], [Pr. PE34], and [Pr. PE35]) with the following method.</p> <ol style="list-style-type: none"> 1) Check the servo motor-side cumulative feedback pulses (before gear). 2) Check the load-side cumulative feedback pulses. 3) Check that the ratio of above 1) and 2) has been that of the feedback electronic gear.

17. FULLY CLOSED LOOP SYSTEM

(7) Setting of fully closed loop dual feedback filter

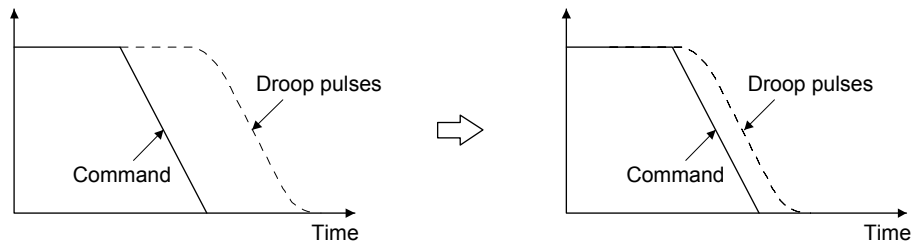
With the initial value (setting = 10) set in [Pr. PE08 Fully closed loop dual feedback filter the dual feedback filter], make gain adjustment by auto tuning, etc. as in semi closed loop control. While observing the servo operation waveform with the graph function, etc. of MR Configurator2, adjust the dual feedback filter.

The dual feedback filter operates as described below depending on the setting.

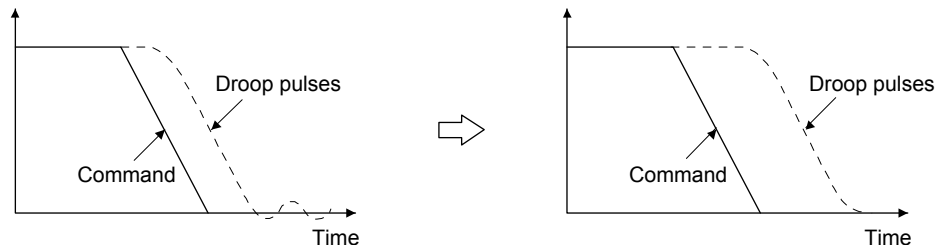
[Pr. PE08] setting	Control mode	Vibration	Settling time
1 to 4499	Dual feedback	Seldom occurs to Frequently occurs	Long time to Short time
4500	Fully closed loop		

Increasing the dual feedback filter setting shortens the settling time, but increases servo motor vibration since the motor is more likely to be influenced by the load-side encoder vibration. The maximum setting of the dual feedback filter should be less than half of the PG2 setting.

Reduction of settling time: Increase the dual feedback filter setting.



Suppression of vibration: Decrease the dual feedback filter setting.



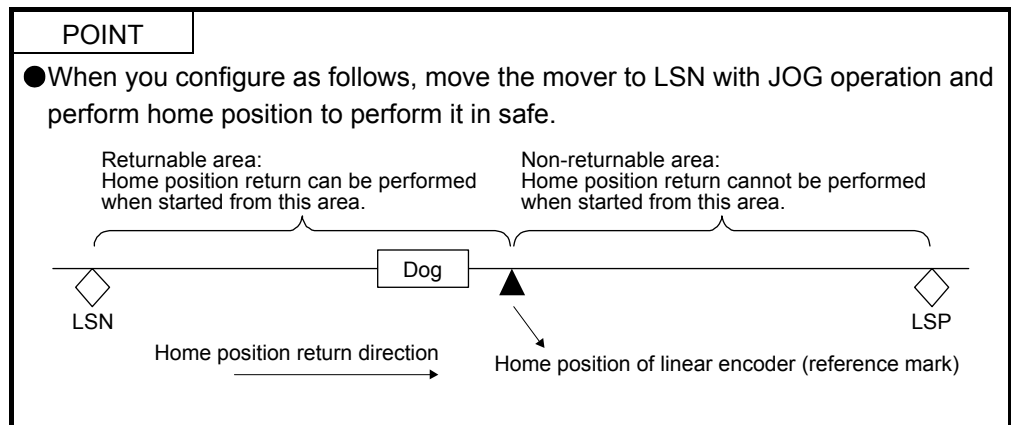
17. FULLY CLOSED LOOP SYSTEM

17.3.2 Home position return

(1) General instruction

Home position return is all performed according to the load-side encoder feedback data, independently of the load-side encoder type. It is irrelevant to the Z-phase position of the servo motor encoder. In the case of a home position return using a dog signal, the scale home position (reference mark) must be passed through when an incremental type linear encoder is used, or the Z-phase be passed through when a rotary encoder is used, during a period from a home position return start until the dog signal turns off.

For the linear encoder, a home position (reference mark) of the linear encoder is necessary in the home position return direction. In addition, set the position of the dog 1/2 rotation or more short of the reference mark.



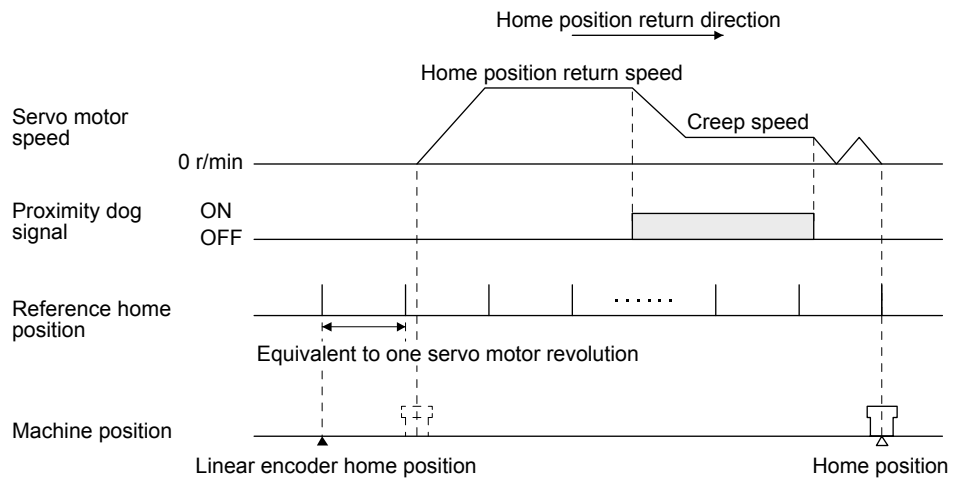
(2) Load-side encoder types and home position return methods

(a) About proximity dog type home position return using absolute type linear encoder

When an absolute type linear encoder is used, the home position standard position is the position per servo motor revolution to the linear encoder home position (absolute position data = 0).

In the case of a proximity dog type home position return, the nearest position after proximity dog off is the home position.

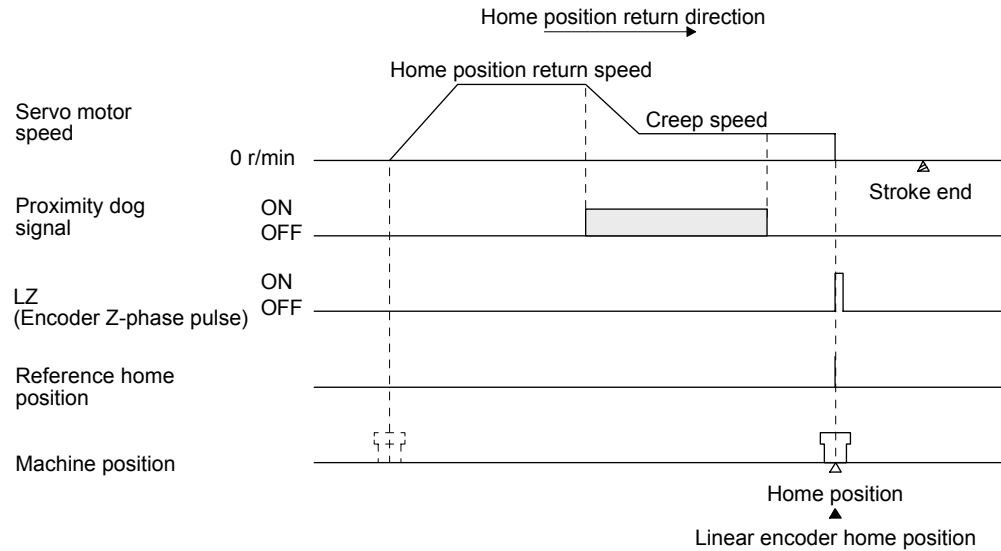
The linear encoder home position may be set in any position.



17. FULLY CLOSED LOOP SYSTEM

(b) Home position return using incremental linear encoder

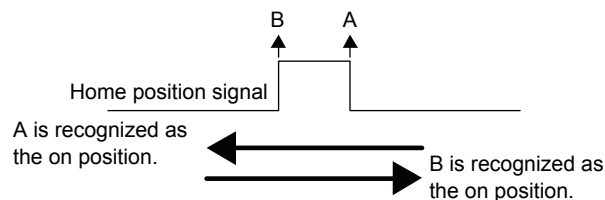
When you use an incremental linear encoder, LZ (Encoder Z-phase pulse) from the servo amplifier will be the home position (reference mark) of the linear encoder. Two or more home positions (reference marks) should not be set. In addition, the home position return cannot be executed without home position (reference mark).



1) Caution for passing the home position (reference mark)

An interval for turning on home position (reference mark) signal of the linear encoder has a certain width. (Specifications differ depending on the linear encoders. For details, refer to "Linear Encoder Instruction Manual".)

Example: When Z-phase is recognized at startup



The position which turns on a signal differs depending on the directions of home position passing. When you need to set the home position return completion to the same position each time such as dog type home position return, always start home position return with the same direction.

2) Caution for linear encoder which does not have the home position (Z-phase)

The linear encoder which does not have the home position (Z-phase), LZ (Encoder Z-phase pulse) of the servo amplifier does not be outputted. The home position return can be performed depending on specifications of controllers even if LZ (Encoder Z-phase pulse) is not outputted. Check the controller specifications of the home position return.

17. FULLY CLOSED LOOP SYSTEM

17.3.3 Fully closed loop control error detection functions

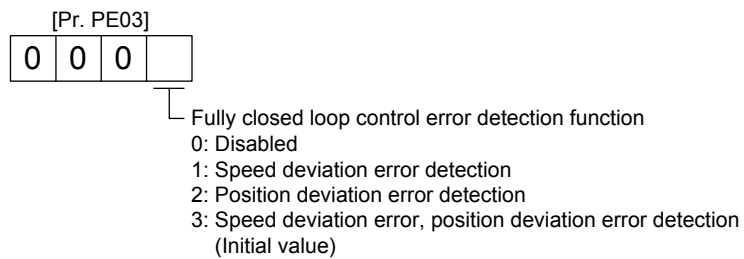
If fully closed loop control becomes unstable for some reason, the speed at servo motor side may increase abnormally. The fully closed loop control error detection function is a protective function designed to pre-detect it and stop operation.

The fully closed loop control error detection function has two different detection methods, speed deviation and position deviation, and errors are detected only when the corresponding functions are enabled by setting [Pr. PE03 Fully closed loop function selection 2].

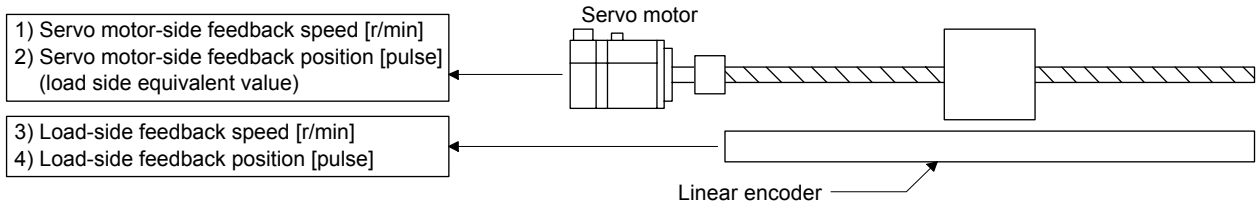
The detection level setting can be changed using [Pr. PE06] and [Pr. PE07].

(1) Parameter

The fully closed loop control error detection function is selected.

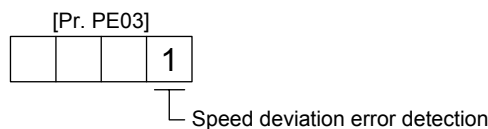


(2) Fully closed loop control error detection functions



(a) Speed deviation error detection

Set [Pr. PE03] to " __ _ 1" to enable the speed deviation error detection.

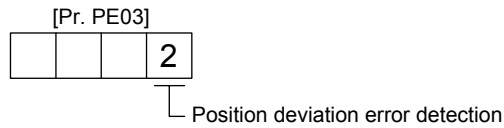


The function compares the servo motor-side feedback speed (1)) and load-side feedback speed (3)). If the deviation is not less than the set value (1 r/min to the permissible speed) of [Pr. PE06 Fully closed loop control speed deviation error detection level], the function generates [AL. 42.2 Servo control error by speed deviation] and stops the motor. The initial value of [Pr. PE06] is 400 r/min. Change the set value as necessary.

17. FULLY CLOSED LOOP SYSTEM

(b) Position deviation error detection

Set [Pr. PE03] to "___2" to enable the position deviation error detection.



Comparing the servo motor-side feedback position (2)) and load-side feedback position (4)), if the deviation is not less than the set value (1 kpulses to 20000 kpulses) of [Pr. PE07 Fully closed loop control position deviation error detection level], the function generates [AL. 42.1 Servo control error by position deviation] and stops the motor. The initial value of [Pr. PE07] is 100 kpulses. Change the set value as necessary.

(c) Detecting multiple deviation errors

When setting [Pr. PE03] as shown below, multiple deviation errors can be detected. For the error detection method, refer to (2) (a), (b) in this section.

[Pr. PE03]

--	--	--	--

Setting value	Speed deviation error detection	Position deviation error detection
1	○	/
2	/	○
3	○	○

17.3.4 Auto tuning function

Refer to section 6.3 for the auto tuning function.

17.3.5 Machine analyzer function

Refer to Help of MR Configurator2 for the machine analyzer function of MR Configurator2.

17.3.6 Test operation mode

Test operation mode is enabled by MR Configurator2.

For details on the test operation, refer to section 4.5.9.

Function	Item	Usability	Remarks
Test operation mode	JOG operation	○	It drives in the load-side encoder resolution unit
	Positioning operation	○	The fully closed loop system is operated in the load-side encoder resolution unit. For details, refer to section 4.5.9 (5).
	Program operation	○	
	Output signal (DO) forced output	○	Refer to section 4.5.9 (6).
	Motor-less operation	/	

17. FULLY CLOSED LOOP SYSTEM

17.3.7 Absolute position detection system under fully closed loop system

An absolute type linear encoder is necessary to configure an absolute position detection system under fully closed loop control using a linear encoder. In this case, the encoder battery (MR-BAT6V1SET) need not be installed to the servo amplifier. When a rotary encoder is used, an absolute position detection system can be configured by installing the encoder battery (MR-BAT6V1SET) to the servo amplifier. In this case, the battery life will be shorter because the power consumption is increased as the power is supplied to the two encoders of motor side and load side.

For the absolute position detection system with linear encoder, the restrictions mentioned in this section apply. Enable the absolute position detection system with [Pr. PA03 Absolute position detection system] and use this servo within the following restrictions.

(1) Using conditions

- (a) Use an absolute type linear encoder with the load-side encoder.
- (b) Select Always fully closed loop ([Pr. PA01] = __ 1 __ and [Pr. PE01] = ___ 0).

(2) Absolute position detection range using encoder

Encoder type	Absolute position detection enabled range
Linear encoder (serial interface)	Movable distance range of scale (within 32-bit absolute position data)

(3) Alarm detection

The absolute position-related alarm ([AL. 25]) and warnings (AL. 92] and [AL. 9F]) are not detected.

(4) Absolute position data transfer to controller

It is the same process as rotary servo motors. (Refer to section 12.8.)

17. FULLY CLOSED LOOP SYSTEM

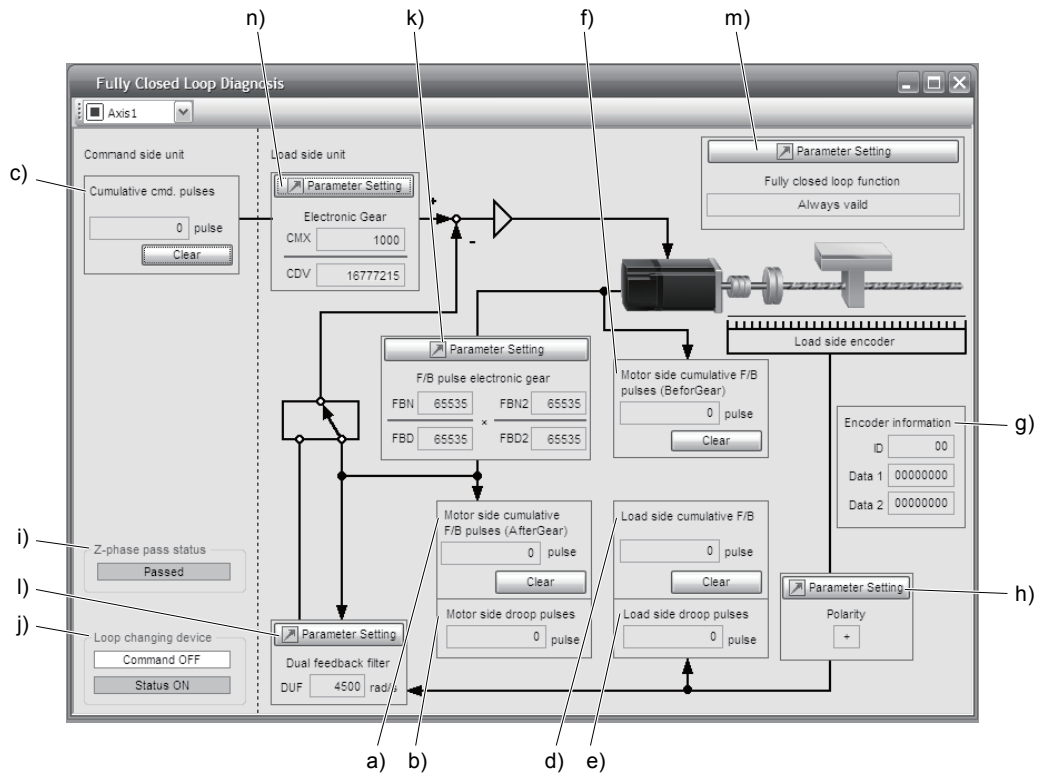
17.3.8 About MR Configurator2

Using MR Configurator2 can confirm if the parameter setting is normal or if the servo motor and the load-side encoder operate properly.

This section explains the fully closed diagnosis screen.

Click "Monitor start" to constantly read the monitor display items from the servo amplifier.

Then, click "Monitor stop" to stop reading. Click "Parameter read" to read the parameter items from the servo amplifier, and then click "Parameter write" to write them.



Symbol	Name	Explanation	Unit
a)	Motor-side cumu. feedback pulses (after gear)	Feedback pulses from the servo motor encoder are counted and displayed. (load-side encoder unit) When the set value exceeds 999999999, it starts with 0. Click "Clear" to reset the value to 0. The "-" symbol is indicated for reverse.	pulse
b)	Motor-side droop pulses	Droop pulses of the deviation counter between a servo motor-side position and a command are displayed. The "-" symbol is indicated for reverse.	pulse
c)	Cumulative command pulses	Position command input pulses are counted and displayed. Click "Clear" to reset the value to 0. The "-" symbol is indicated for reverse command.	pulse
d)	Load-side cumulative feedback pulses	Feedback pulses from the load-side encoder are counted and displayed. When the set value exceeds 999999999, it starts with 0. Click "Clear" to reset the value to 0. The "-" symbol is indicated for reverse.	pulse
e)	Load-side droop pulses	Droop pulses of the deviation counter between a load-side position and a command are displayed. The "-" symbol is indicated for reverse.	pulse
f)	Motor-side cumu. feedback pulses (Before Gear)	Feedback pulses from the servo motor encoder are counted and displayed. (Servo motor encoder unit) When the set value exceeds 999999999, it starts with 0. Click "Clear" to reset the value to 0. The "-" symbol is indicated for reverse.	pulse

17. FULLY CLOSED LOOP SYSTEM

Symbol	Name	Explanation	Unit
g)	Encoder information	The load-side encoder information is displayed. The display contents differ depending on the load-side encoder type. <ul style="list-style-type: none"> • ID: The ID No. of the load-side encoder is displayed. • Data 1: For the incremental type linear encoder, the counter from powering on is displayed. For the absolute position type linear encoder, the absolute position data is displayed. • Data 2: For the incremental type linear encoder, the distance (number of pulses) from the reference mark (Z-phase) is displayed. For the absolute position type linear encoder, "00000000" is displayed. 	
h)	Polarity	For address increasing direction in the servo motor CCW, it is indicated as "+" and for address decreasing direction in the servo motor CCW, as "-".	
i)	Z-phase pass status	If the fully closed loop system is "disabled", the Z-phase pass status of the servo motor encoder is displayed. If the fully closed loop system is "Enabled" or "Semi closed loop control/fully closed loop control switching", the Z-phase pass status of the load-side encoder is displayed.	
j)	Fully closed loop changing device	Only if the fully closed loop system is "Semi closed loop control/fully closed loop control switching", the device is displayed. The state of the semi closed loop control/fully closed loop control switching signal and the inside state during selection are displayed.	
k)	Parameter (Feedback pulse electronic gear)	The feedback pulse electronic gears ([Pr. PE04], [Pr. PE05], [Pr. PE34], and [Pr. PE35]) are displayed/set for servo motor encoder pulses in this parameter. (Refer to section 17.3.1 (3).)	
l)	Parameter (Dual feedback filter)	The band of [Pr. PE08 Fully closed loop dual feedback filter] is displayed/set in this parameter.	
m)	Parameter (fully closed loop function)	The parameter for the fully closed loop control is displayed or set. Click "Parameter setting" button to display the "Fully closed loop control-Basic" window. <ol style="list-style-type: none"> 1) Fully closed loop function selection ([Pr. PE01]) "Always valid" or "Changing by input signal (CLD)" is selected here. 2) Setting of feedback pulse electronic gear ([Pr. PE04], [Pr. PE05], [Pr. PE34], [Pr. PE35]) Setting of feedback pulse electronic gear 3) Load-side encoder cable communication method selection ([Pr. PC44]) This is used to select a load-side encoder cable to be connected to the CN2L connector. 4) Encoder pulse count polarity selection ([Pr. PC45]) Polarity of the load-side encoder cable information is selected. 5) Selection of A/B/Z-phase input interface encoder Z-phase connection judgement function ([Pr. PC45]) Select the non-signal detection status for the pulse train signal from the A/B/Z-phase input interface encoder used as a linear encoder or load-side encoder. This function is enabled only when you use an A/B/Z-phase input interface encoder. 	
n)	Parameter (electronic gear)	Electronic gear ([Pr. PA05], [Pr. PA06], [Pr. PA07], [Pr. PA13], [Pr. PA21]) This is used to set parameters for the electronic gear.	

APPENDIX

App. 1 Peripheral equipment manufacturer (for reference)

Names given in the table are as of February 2013.

Manufacturer	Reference
JST	J.S.T. Mfg. Co., Ltd.
Junkosha	Purchase from Toa Electric Industry Co. Ltd., Nagoya Branch
3M	3M
Soshin Electric	Soshin Electric Co., Ltd.
TE Connectivity	TE Connectivity Ltd. Company
Molex	Molex

App. 2 Handling of AC servo amplifier batteries for the United Nations Recommendations on the Transport of Dangerous Goods

United Nations Recommendations on the Transport of Dangerous Goods Rev. 15 (hereinafter Recommendations of the United Nations) has been issued. To reflect this, transport regulations for lithium metal batteries are partially revised in the Technical Instruction (ICAO-TI) by the International Civil Aviation Organization (ICAO) and the International Maritime Dangerous Goods Code (IMDG Code) by the International Maritime Organization (IMO).

To comply the instruction and code, we have modified the indication on the package for general-purpose AC servo batteries.

The above change will not affect the function and performance of the product.

- (1) Target model
 - (a) Battery (cell)

Model	Option model
ER6	MR-J3BAT
ER17330	MR-BAT, A6BAT

- (b) Battery unit (assembled)

Model	Option model
ER17330	MR-J2M-BT
CR17335A	MR-BAT6V1
	MR-BAT6V1SET

- (2) Purpose
 - Safer transportation of lithium metal batteries.

- (3) Change in regulations

The following points are changed for lithium metal batteries transportation by sea or air due to Recommendations of the United Nations Rev. 15 and ICAO-TI 2009-2010 edition. For lithium metal batteries, cells are classified as UN3090, and batteries contained in or packed with equipment are classified as UN3091.

- (a) A package containing 24 cells or 12 batteries or less that are not contained in equipment are no longer exempt from the following: attachment of a handling label, submission of the Shipper's Declaration for Dangerous Goods, and a 1.2 m drop test.
- (b) A battery handling label (size: 120 mm × 110 mm) is required. Emergency telephone number must be filled out in the additional handling information of the Shipper's Declaration for Dangerous Goods.

APPENDIX

(c) New handling label design containing battery illustration must be used. (only air transportation)



Figure. Example of Mitsubishi Label with Battery Illustration

(4) Action taken by Mitsubishi

The following caution will be added to the packages of the target batteries.
"Containing lithium metal battery. Regulations apply for transportation."

(5) Transportation precaution for customers

For sea or air transportation, attaching the handling label (figure) and the Shipper's Declaration for Dangerous Goods are required to the package of a Mitsubishi cell or battery. In addition, attaching them to the outer package containing several packages of Mitsubishi cells or batteries are also required. Please attach the documentations in the specified design to the packages and the outer packages.

APPENDIX

App. 3 Symbol for the new EU Battery Directive

Symbol for the new EU Battery Directive (2006/66/EC) that is plastered to general-purpose AC servo battery is explained here.



Note. This symbol mark is for EU countries only.

This symbol mark is according to the directive 2006/66/EC Article 20 Information for end-users and Annex II. Your MITSUBISHI ELECTRIC product is designed and manufactured with high quality materials and components which can be recycled and/or reused.

This symbol means that batteries and accumulators, at their end-of-life, should be disposed of separately from your household waste.

If a chemical symbol is printed beneath the symbol shown above, this chemical symbol means that the battery or accumulator contains a heavy metal at a certain concentration.

This will be indicated as follows.

Hg: mercury (0.0005%), Cd: cadmium (0.002%), Pb: lead (0.004%)

In the European Union there are separate collection systems for used batteries and accumulators. Please, dispose of batteries and accumulators correctly at your local community waste collection/recycling centre. Please, help us to conserve the environment we live in!

App. 4 Compliance with global standards

App. 4.1 Terms related to safety (IEC/EN 61800-5-2 Stop function)

STO function (Refer to IEC/EN 61800-5-2: 2007 4.2.2.2 STO.)

MR-J4 servo amplifiers have the STO function. The STO function shuts down energy to servo motors, thus removing torque. This function electronically cuts off power supply in the servo amplifier.

App. 4.2 About safety

This section explains safety of users and machine operators. Please read the section carefully before mounting the equipment.

APPENDIX

App. 4.2.1 Professional engineer

Only professional engineers should mount MR-J4 servo amplifiers. Here, professional engineers should meet the all conditions below.


- (1) A person who took a proper engineering training
Please note if you can take proper engineering training at your local Mitsubishi Electric office. Contact your local sales office for schedules and locations.
- (2) A person who can access to operating manuals for the protective devices (e.g. light curtain) connected to the safety control system. A person who have read and familiarized himself/herself with the manuals.

App. 4.2.2 Applications of the devices

MR-J4 servo amplifiers comply with the following safety standards.
ISO/EN ISO 13849-1 Category 3 PL d, IEC/EN 62061 SIL CL 2, IEC/EN 61800-5-2 SIL 2 (STO), IEC/EN 61800-5-1, IEC/EN 61800-3, IEC/EN 60204-1
In addition, MR-J4 servo amplifiers can be used with the MR-J3-D05 safety logic unit or safety PLCs.

App. 4.2.3 Correct use

Always use the MR-J4 servo amplifiers within specifications (voltage, temperature, etc. Refer to each instruction manual 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
 - (a) Local wiring and crimping tool
Use only copper wires rated at 60 °C/75 °C for wiring. The following table shows the wire sizes [AWG] and the crimp terminal symbols rated at 75 °C.

Servo amplifier	Wire [AWG] (Note 2)					
	L1/L2/L3 ⊕	L11/L21	P+/C	U/V/W/⊕ (Note 3)		
MR-J4-10_/MR-J4-20_/MR-J4-40_/MR-J4-60_/MR-J4-70_/MR-J4-100_	14	14	14	14		
MR-J4-200_	12					
MR-J4-350_	10					
MR-J4-500_ (Note 1)	8: b	14: c	14: c	8: b		
MR-J4-700_ (Note 1)			12: a			
MR-J4-11K_ (Note 1)			6: d		12: e	4: f
MR-J4-15K_ (Note 1)			4: f		10: e	2: g
MR-J4-22K_ (Note 1)			1/0: h		10: i	2/0: j
MR-J4W_-B	14 (Note 4)	14	14	14		

- Note
1. To connect these models to a terminal block, be sure to use the screws that come with the terminal block.
 2. Alphabets in the table indicate crimping tools. Refer to the following table for the crimp terminals and crimping tools.
 3. 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.
 4. Use the crimp terminal c for the PE terminal of the servo amplifier.

APPENDIX

Table: Recommended crimp terminals

Symbol	Servo amplifier-side crimp terminals				Manufacturer
	Crimp terminal (Note 2)	Applicable tool			
		Body	Head	Dice	
a	FVD5.5-4	YNT-1210S	/	/	JST
b (Note 1)	8-4NS	YHT-8S			
c	FVD2-4	YNT-1614			
d	FVD14-6	YF-1	YNE-38	DH-122 DH-112	
e	FVD5.5-6	YNT-1210S	/	/	
f	FVD22-6	YF-1				YNE-38	DH-123 DH-113
g	FVD38-6	YF-1	YNE-38	DH-124 DH-114	
h	R60-8	YF-1	YET-60-1	TD-125 TD-113	
i	FVD5.5-8	YNT-1210S	/	/	
j	CB70-S8	YF-1				YET-150-1	TD-226 TD-213

- Note 1. Coat the crimping part with an insulation tube.
 2. Some crimp terminals may not be mounted depending on the size. Make sure to use the recommended ones or equivalent ones.

(b) Selection example of MCCB and fuse

When a servo amplifier is protected by T class fuses or circuit breaker having an interrupting rating not less than 300 A effective value and 240 V maximum, 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 11.10.

Servo amplifier	Molded-case circuit breaker (240 V AC)	Fuse (300 V)
MR-J4-10_/MR-J4-20_/MR-J4-40_/MR-J4-60_/MR-J4-70_/MR-J4W2-22B	NF50-SVFU-5A (50 A frame 5 A)	10 A
MR-J4-60_ (Note)/MR-J4-70_ (Note)/MR-J4-100_/MR-J4W2-22B (Note)/MR-J4W2-44B/MR-J4W2-77B/MR-J4W3-222B/MR-J4W3-444B	NF50-SVFU-10A (50 A frame 10 A)	15 A
MR-J4-200_/MR-J4W2-44B (Note)/MR-J4W2-1010B	NF50-SVFU-15A (50 A frame 15 A)	30 A
MR-J4-350_/MR-J4W2-77B (Note)/MR-J4W3-444B (Note)	NF50-SVFU-20A (50 A frame 20 A)	40 A
MR-J4-500_	NF50-SVFU-30A (50 A frame 30 A)	60 A
MR-J4-700_	NF50-SVFU-40A (50 A frame 40 A)	80 A
MR-J4-11K_	NF100-CVFU-60A (100 A frame 60 A)	125 A
MR-J4-15K_	NF100-CVFU-80A (100 A frame 80 A)	150 A
MR-J4-22K_	NF225-CWU-125A (225 A frame 125 A)	300 A

Note. For 1-phase 200 V AC power input

(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.

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(d) Grounding

To prevent an electric shock, always connect the protective earth (PE) terminal (marked \oplus) 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 an earth-leakage current breaker, always ground the protective earth (PE) terminal of the servo amplifier to prevent an electric shock. Only an RCD (earth-leakage current breaker) of type B can be used for the power supply side of the product.



(2) EU compliance

The MR-J4 servo amplifiers are designed to comply with the following directions to meet requirements for mounting, using, and periodic technical inspections: Machinery directive (2006/42/EC), EMC directive (2004/108/EC), and Low-voltage directive (2006/95/EC).

(a) EMC requirement

MR-J4 servo amplifiers comply with category C3 in accordance with IEC/EN 61800-3. As for I/O wires (max. length 10 m. However, 3 m for STO cable for CN8.) and encoder cables (max. length 50 m), connect them to a shielded grounding. Use an EMC filter and surge protector on the primary side. The following shows recommended products.

EMC filter: Soshin Electric HF3000A-UN series

Surge protector: Okaya Electric Industries RSPD-250-U4 series

- MR-J4 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 (2006/42/EC, 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 standards. Refer to MR-J4 Servo Amplifier Instruction Manuals for details of UL/CSA standards.

(a) Installation

The minimum cabinet size is 150% of each MR-J4 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 a metal cabinet. Environment is open type (UL 50) and overvoltage category III. The servo amplifier needs to be installed at or below of pollution degree 2. Use copper conductors only.

(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.

APPENDIX

(c) Overload protection characteristics

The MR-J4 servo amplifiers have servo motor overload protective function. (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.

(e) Capacitor discharge

It takes 15 minutes for capacitor discharging. Do not touch the unit and terminals immediately after power off.

(f) 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 목적으로 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. In addition, use an EMC filter, surge protector, and line noise filter on the primary side for inputs. Use a line noise filter for outputs.)

App. 4.2.4 General cautions for safety protection and protective measures

Observe the following items to ensure proper use of the MELSERVO MR-J4 servo amplifiers.

- (1) For safety components and installing systems, only qualified personnel and professional engineers should perform.
- (2) When mounting, installing, and using the MELSERVO MR-J4 servo amplifier, always observe standards and directives applicable in the country.
- (3) The item about noises of the test notices in the manuals should be observed.
- (4) The MR-J4 servo amplifiers fulfill the requirements to conducted emissions at the main connections in the frequency range from 150 kHz to 30 MHz. (Bases for the evaluation: Product standard IEC/EN 61800, adjustable speed electrical power drive systems, Part 3: EMC)

App. 4.2.5 Residual risk

- (1) Be sure that all safety related switches, relays, sensors, etc., meet the required safety standards.
- (2) Perform all risk assessments and safety level certification to the machine or the system as a whole.
- (3) If the upper and lower power modules in the servo amplifier are shorted and damaged simultaneously, the servo motor may make a half revolution at a maximum.

APPENDIX

- (4) Only qualified personnel are authorized to install, start-up, repair or service the machines in which these components are installed. Only trained engineers should install and operate the equipment. (ISO 13849-1 Table F.1 No.5)
- (5) Separate the wiring for safety function from other signal wirings. (ISO 13849-1 Table F.1 No.1)
- (6) Protect the cables with appropriate ways (routing them in a cabinet, using a cable guard, etc.).
- (7) Keep the required clearance/creepage distance depending on voltage you use.

App. 4.2.6 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. 4.2.7 Lithium battery transportation

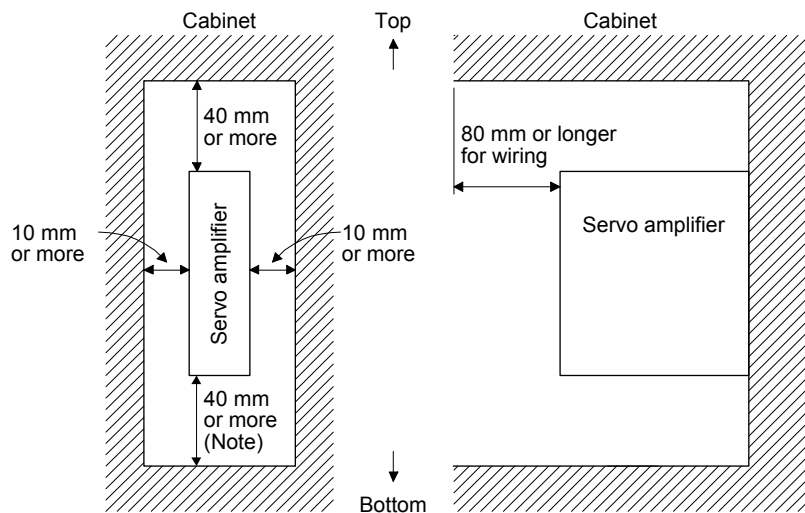
To transport lithium batteries, take actions to comply with the instructions and regulations such as the United Nations (UN), the International Civil Aviation Organization (ICAO), and the International Maritime Organization (IMO).

The battery options (MR-BAT6V1SET and MR-BAT6V1) are assembled batteries from lithium metal battery CR17335A which are not subject to the dangerous goods (Class 9) of the UN Recommendations.

App. 4.3 Mounting/dismounting

Installation direction and clearances

 CAUTION	<ul style="list-style-type: none">● 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.
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Note. For 11 kW to 22 kW servo amplifiers, the clearance between the bottom and ground will be 120 mm or more.

APPENDIX

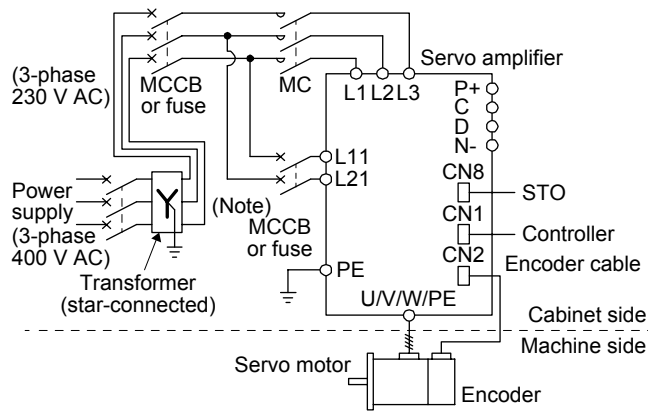
App. 4.4 Electrical Installation and configuration diagram

⚠ WARNING ● Turn off the molded-case circuit breaker (MCCB) to avoid electrical shocks or damages to the product before starting the installation or wiring.

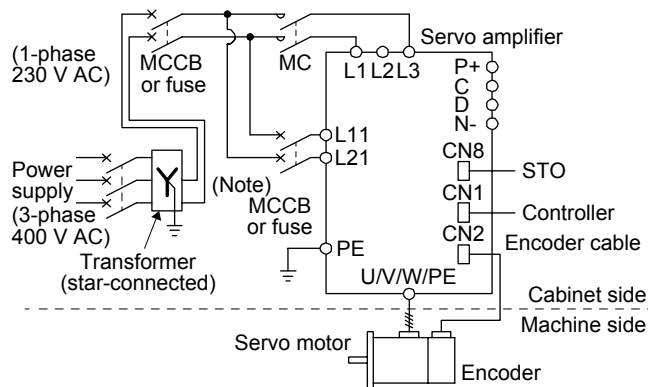
⚠ CAUTION ● The installation complies with IEC/EN 60204-1. The voltage supply to machines must be 20 ms of immunity to instantaneous power failures as specified in IEC/EN 60204-1.

The following shows representative configuration diagram examples to conform to the IEC/EN/UL/CSA standards.

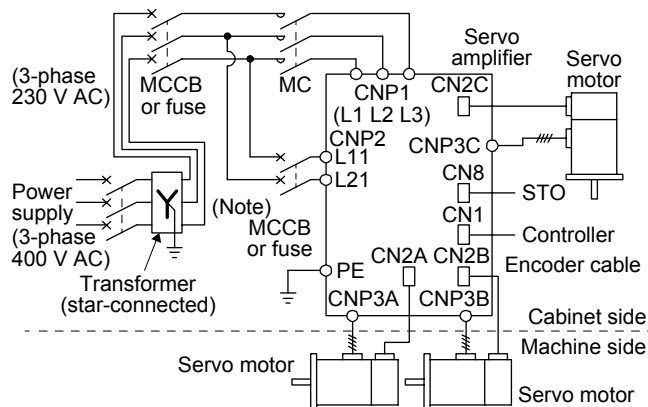
(1) 3-phase input for MR-J4 1-axis servo amplifier



(2) 1-phase input for MR-J4 1-axis servo amplifier

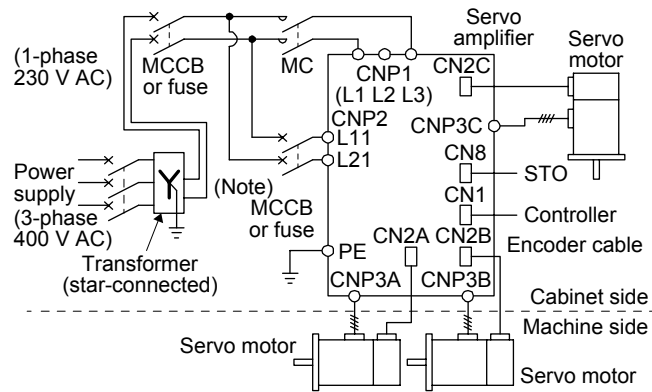


(3) 3-phase input for MR-J4 multi-axis servo amplifier



APPENDIX

(4) 1-phase input for MR-J4 multi-axis servo amplifier



Note. When the wire sizes of L1 and L11 are the same, MCCB or fuse is not required.

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.

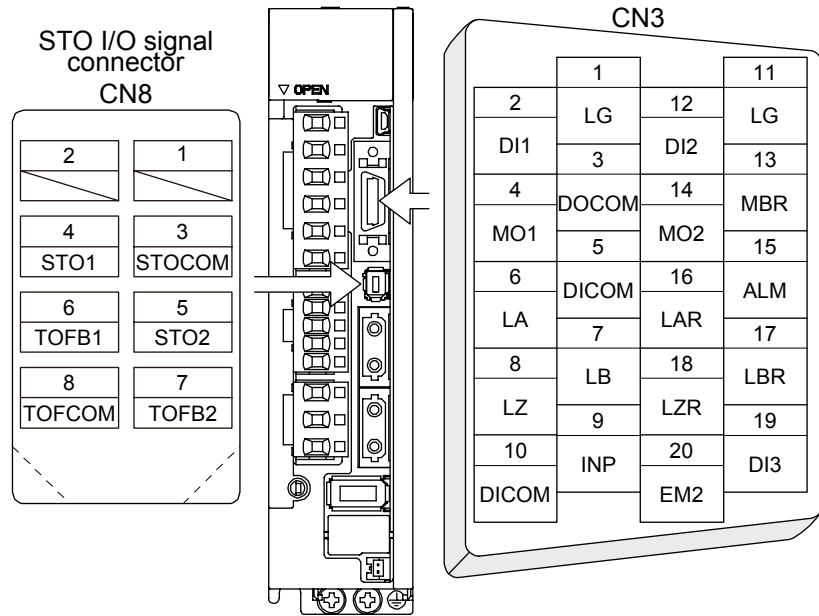
- (1) HG/HF/HC/HA series servo motors (Mfg.: Mitsubishi Electric)
- (2) Using a servo motor complied with IEC60034-1 and Mitsubishi Electric encoder (OBA, OSA)

APPENDIX

App. 4.5 Signal

App. 4.5.1 Signal

The following shows MR-J4-10B signals as a typical example. Refer to section 3.4 for the MR-J4-_A servo amplifiers.



App. 4.5.2 Input device

Input device

Symbol	Device	Connector	Pin No.
EM2	Forced stop 2	CN3	20
STOCOM	Common terminal for input signals STO1/STO2	CN8	3
STO1	STO1 state input		4
STO2	STO2 state input		5

Output device


Symbol	Device	Connector	Pin No.
TOFCOM	Common terminal for monitor output signal in STO state	CN8	8
TOFB1	Monitor output signal in STO1 state		6
TOFB2	Monitor output signal in STO2 state		7


Power

Symbol	Device	Connector	Pin No.
DICOM	Digital I/F power supply input	CN3	5, 10
DOCOM	Digital I/F common		3
SD	Shield		Plate

APPENDIX

App. 4.6 Maintenance and service

 WARNING	<ul style="list-style-type: none"> ● To avoid an electric shock, only qualified personnel should attempt inspections. For repair and parts replacement, contact your local sales office.
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 CAUTION	<ul style="list-style-type: none"> ● 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.
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App. 4.6.1 Inspection items

It is recommended that the following points periodically be checked.

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

Servo amplifier	Tightening torque [N•m]															
	L1	L2	L3	N-	P3	P4	P+	C	D	L11	L21	U	V	W	PE	
MR-J4-10_/MR-J4-20_/MR-J4-40_/MR-J4-60_/MR-J4-70_/MR-J4-100_/MR-J4-200_/MR-J4-350_																1.2
MR-J4-500_	1.2										0.8	1.2				
MR-J4-700_	1.2								/		0.8	1.2				
MR-J4-11K_•MR-J4-15K_	3.0								/		1.2	3.0				
MR-J4-22K_	6.0								/		1.2	6.0				
MR-J4W_-B																1.2

- (2) Check 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.

APPENDIX

App. 4.6.2 Parts having service lives


Service lives of the following parts are listed below. However, the service life vary depending or 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		(Note 4) 10 years	
Relay		Number of power-on, forced stop and controller forced stop times: 100 000 times Number of on and off for STO: 1,000,000 times	
Cooling fan		10,000 hours to 30,000 hours (2 years to 3 years)	
Battery backup time	(Note 1) MR-J4 1-axis servo amplifier	Rotary servo motor	Approximately 20,000 hours (equipment power supply: off, ambient temperature: 20 °C)
		Direct drive motor	Approximately 5,000 hours (equipment power supply: off, ambient temperature: 20 °C)
	(Note 2) MR-J4 multi-axis servo amplifier	Rotary servo motor	Approximately 40,000 hours for 2-axis, 30,000 hours for 3-axis, or 10,000 hours for 8-axis, (equipment power supply: off, ambient temperature: 20 °C)
		Direct drive motor	Approximately 10,000 hours for 2-axis, 7,000 hours for 3-axis, or 2,000 hours for 8-axis, (equipment power supply: off, ambient temperature: 20 °C)
(Note 3) Battery life		5 years from date of manufacture	

- Note 1. The data-holding time using a battery of MR-BAT6V1SET on condition that the power supply of the servo amplifier is off
Replace the batteries within three years since the operation start whether the power supply of the servo amplifier is on/off. If the battery is used out of specification, [AL. 25 Absolute position erased] may occur.
2. The data-holding time using 5 batteries of MR-BAT6V1 on condition that the power supply of the servo amplifier is off
Replace the batteries within three years since the operation start whether the power supply of the servo amplifier is on/off. If the battery is used out of specification, [AL. 25 Absolute position erased] may occur.
3. Quality of the batteries degrades by the storage condition. The battery life is 5 years from the production date regardless of the connection status.
4. 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).

APPENDIX

App. 4.7 Transportation and storage

	<h3>CAUTION</h3>	<ul style="list-style-type: none"> ● Transport the products correctly according to their mass. ● Stacking in excess of the limited number of product packages is not allowed. ● Do not hold the front cover to transport the servo amplifier. Otherwise, it may drop. ● Install the servo amplifier and servo motor in a load-bearing place in accordance with the Instruction Manual. ● Do not get on or put heavy load on the equipment. ● For detailed information on the option battery's transportation and handing, refer to app. 2.
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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% to 90 %RH
Vibration load	Test values	10 Hz to 57 Hz with constant deviation of 0.075 mm 57 Hz to 150 Hz with constant acceleration of 9.8 m/s ² (1 g) to IEC/EN 61800-5-1 (Test Fc of IEC 60068-2-6)
	Operation	5.9 m/s ² (0.6 g)
	Transportation (Note)	Class 2M3 (IEC/EN 60721-3-2)
	Storage	Class 1M2 (IEC/EN 60721-3-2)
Pollution degree		2
IP rating		Except terminal block IP20 (IEC/EN 60529) and fan finger guard Open type (UL 50)
Altitude	Operation, storage	1000 m or less above sea level
	Transportation	10000 m or less above sea level

Note. In regular transport packaging

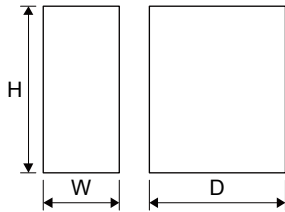
APPENDIX

App. 4.8 Technical data

App. 4.8.1 MR-J4 servo amplifier

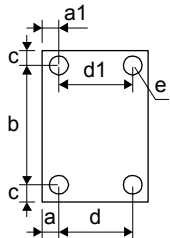
Item		MR-J4-10_/MR-J4-20_/MR-J4-40_/MR-J4-60_/MR-J4-70_/MR-J4W2-22B/MR-J4W2-44B/MR-J4W2-77B/MR-J4W3-222B/MR-J4W3-444B	MR-J4-100_/MR-J4-200_/MR-J4-350_/MR-J4-500_/MR-J4-700_/MR-J4W2-1010B/MR-J4-11K_/MR-J4-15K_/MR-J4-22K_
Power	Main circuit (line voltage)	3-phase or 1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz	
	Control circuit (line voltage)	1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz	
	Interface (SELV)	24 V DC, (required current capacity: MR-J4-_A, 500 mA; MR-J4-_B, 300 mA; MR-J4W2-_B, 350 mA; MR-J4W3-_B, 450 mA)	
Control method		Sine-wave PWM control, current control method	
Safety function (STO) IEC/EN 61800-5-2		EN ISO 13849-1 category 3 PL d, EN 61508 SIL 2, EN 62061 SIL CL 2, and EN 61800-5-2 SIL 2	
Mean time to dangerous failure		MTTFd ≥ 100 [years]	
Effectiveness of fault monitoring of a system or subsystem		DC = 90 [%]	
Average probability of dangerous failures per hour		PFH = 1.68 × 10 ⁻¹⁰ [1/h]	
Mission time		TM = 20 [years]	
Response performance		8 ms or less (STO input off → energy shut off)	
Pollution degree		2 (IEC/EN 60664-1)	
Overvoltage category		III (IEC/EN 60664-1)	
Protection class		I (IEC/EN 61800-5-1)	
Short-circuit current rating (SCCR)		100 kA	

App. 4.8.2 Servo amplifier dimensions



Servo amplifier	Variable dimension table [mm]			Mass [kg]
	W	H	D	
MR-J4-10_/MR-J4-20_	40	168	135	0.8
MR-J4-40_/MR-J4-60_	40	168	170	1.0
MR-J4-70_/MR-J4-100_	60	168	185	1.4
MR-J4-200_	90	168	195	2.1
MR-J4-350_	90	168	195	2.3
MR-J4-500_	105	250	200	4.0
MR-J4-700_	172	300	200	6.2
MR-J4-11K_/MR-J4-15K_	220	400	260	13.4
MR-J4-22K_	260	400	260	18.2
MR-J4W2-22B/MR-J4W2-44B	60	168	195	1.4
MR-J4W2-77B/MR-J4W2-1010B	85	168	195	2.3
MR-J4W3-222B/MR-J4W3-444B	85	168	195	2.3

App. 4.8.3 Mounting hole



Servo amplifier	Variable dimensions [mm]						Screw size
	a	a1	b	c	d	d1	
MR-J4-10_/MR-J4-20_/MR-J4-40_/MR-J4-60_	6	6	156 ± 0.5	6			M5
MR-J4-70_/MR-J4-100_	12	12	156 ± 0.5	6	42 ± 0.3		M5
MR-J4-200_/MR-J4-350_	6	45	156 ± 0.5	6	78 ± 0.3		M5
MR-J4-500_	6	6	235 ± 0.5	7.5	93 ± 0.3	93 ± 0.3	M5
MR-J4-700_	6	6	285 ± 0.5	7.5	160 ± 0.5	160 ± 0.5	M5
MR-J4-11K_/MR-J4-15K_	12	12	380 ± 0.5	10	196 ± 0.5	196 ± 0.5	M5
MR-J4-22K_	12	12	376 ± 0.5	12	236 ± 0.5	236 ± 0.5	M10
MR-J4W2-22B/MR-J4W2-44B	6	6	156 ± 0.5	6			M5
MR-J4W2-77B/MR-J4W2-1010B	6	6	156 ± 0.5	6	73 ± 0.3		M5
MR-J4W3-222B/MR-J4W3-444B	6	6	156 ± 0.5	6	73 ± 0.3		M5

APPENDIX

App. 4.9 Check list for user documentation



MR-J4 installation checklist for manufacturer/installer

The following items must be satisfied by the initial test operation at least. The manufacturer/installer must be responsible for checking the standards in the items.

Maintain and keep this checklist with related documents of machines to use this for periodic inspection.

1. Is it based on directive/standard applied to the machine? Yes [], No []
2. Is directive/standard contained in Declaration of Conformity (DoC)? Yes [], No []
3. Does the protection instrument conform to the category required? Yes [], No []
4. Are electric shock protective measures (protection class) effective? Yes [], No []
5. Is the STO function checked (test of all the shut-off wiring)? Yes [], No []

Checking the items will not be instead of the first test operation or periodic inspection by professional engineers.

APPENDIX

App. 5 MR-J3-D05 Safety logic unit

App. 5.1 Contents of the package

Open packing, and confirm the content of packing.

Contents	Quantity
MR-J3-D05 Safety logic unit	1
Connector for CN9 1-1871940-4 (TE Connectivity)	1
Connector for CN10 1-1871940-8 (TE Connectivity)	1
MR-J3-D05 Safety Logic Unit Installation Guide	1

App. 5.2 Terms related to safety

App. 5.2.1 Stop function for IEC/EN 61800-5-2

(1) STO function (Refer to IEC/EN 61800-5-2: 2007 4.2.2.2 STO.)

This function is integrated into the MR-J4 series servo amplifiers.

The STO function shuts down energy to servo motors, thus removing torque. This function electronically cuts off power supply in servo amplifiers for MR-J4 series servo amplifiers.

The purpose of this safety function is as follows.

- 1) Uncontrolled stop according to stop category 0 of IEC/EN 60204-1
- 2) Preventing unexpected start-up

(2) SS1 function (Refer to IEC/EN 61800-5-2: 2007 4.2.2.3C Safe stop 1 temporal delay.)

SS1 is a function which initiates the STO function when the previously set delay time has passed after the servo motor starts decelerating. The delay time can be set with MR-J3-D05.

The purpose of this safety function is as follows. This function is available by using an MR-J4 series servo amplifier with MR-J3-D05.

- Controlled stop according to stop category 1 of IEC/EN 60204-1

App. 5.2.2 Emergency operation for IEC/EN 60204-1

(1) Emergency stop (Refer to IEC/EN 60204-1: 2005 9.2.5.4.2 Emergency Stop.)

Emergency stop must override all other functions and actuation in all operation modes. Power to the machine driving part which may cause a hazardous state must be either removed immediately (stop category 0) or must be controlled to stop such hazardous state as soon as possible (stop category 1). Restart must not be allowed even after the cause of the emergency state has been removed.

(2) Emergency switching off (Refer to IEC/EN 60204-1: 2005 9.2.5.4.3 Emergency Switching OFF.)

Removal of input power to driving device to remove electrical risk and to meet above mentioned safety standards.

APPENDIX


App. 5.3 Cautions

The following basic safety notes must be read carefully and fully in order to prevent injury to persons or damage to property.

Only qualified personnel are authorized to install, start-up, repair or service the machines in which these components are installed.

They must be familiar with all applicable local safety regulations and laws in which machines with these components are installed, particularly the standards and guidelines mentioned in this Instruction Manual and the requirements mentioned in ISO/EN ISO 13849-1, IEC/EN 61508, IEC/EN 61800-5-2, and IEC/EN 60204-1.

The staff responsible for this work must be given express permission from the company to perform start-up, programming, configuration, and maintenance of the machine in accordance with the safety standards.

	WARNING	● Improper installation of the safety related components or systems may cause improper operation in which safety is not assured, and may result in severe injuries or even death.
---	----------------	---

Protective Measures

- As described in IEC/EN 61800-5-2, the Safe Torque Off (STO) function only prevents the servo amplifier from supplying energy to the servo motor. Therefore, if an external force acts upon the drive axis, additional safety measures, such as brakes or counter-weights must be used.

App. 5.4 Residual risk

Machine manufacturers are responsible for all risk evaluations and all associated residual risks. Below are residual risks associated with the STO/EMG function. Mitsubishi is not liable for any damages or injuries caused by the residual risks.

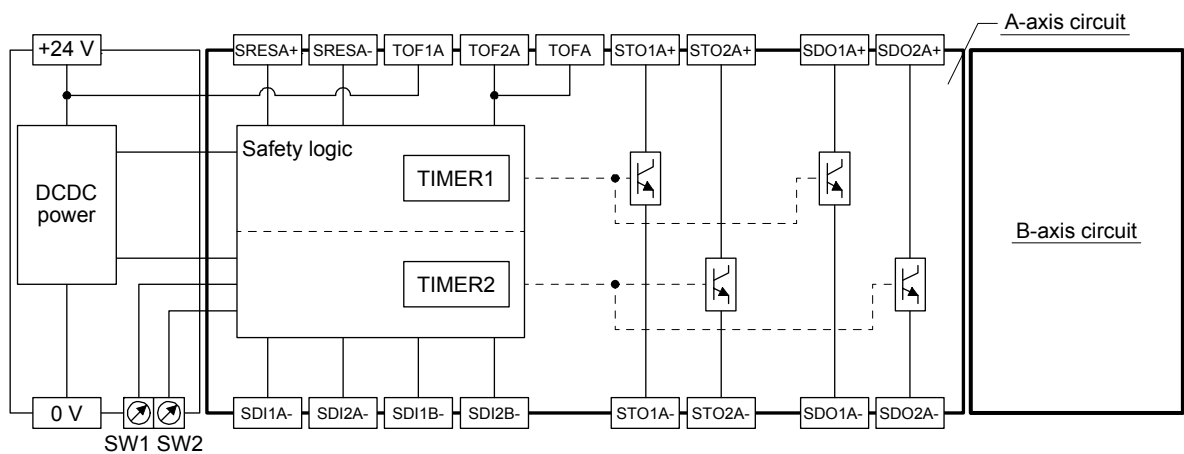
- (1) The SS1 function only guarantees the delay time before STO/EMG is engaged. Proper setting of this delay time is the full responsibility of the company and/or individuals responsible for installation and commissioning of the safety related system. The system, as a whole, must pass safety standards certification.
- (2) When the SS1 delay time is shorter than the required servo motor deceleration time, if the forced stop function is malfunctioning, or if STO/EMG is engaged while the servo motor is still rotating; the servo motor will stop with the dynamic brake or freewheeling.
- (3) For proper installation, wiring, and adjustment, thoroughly read the manual of each individual safety related component.
- (4) Be sure that all safety related switches, relays, sensors, etc., meet the required safety standards. The Mitsubishi Electric safety related components mentioned in this manual are certified by Certification Body as meeting the requirements of ISO/EN ISO 13849-1 Category 3, PL d and IEC/EN 61508 SIL 2.
- (5) Safety is not assured until safety-related components of the system are completely installed or adjusted.
- (6) When replacing a servo amplifier etc. or MR-J3-D05, confirm that the new equipment is exactly the same as those being replaced. Once installed, be sure to verify the performance of the safety functions before commissioning the system.

APPENDIX

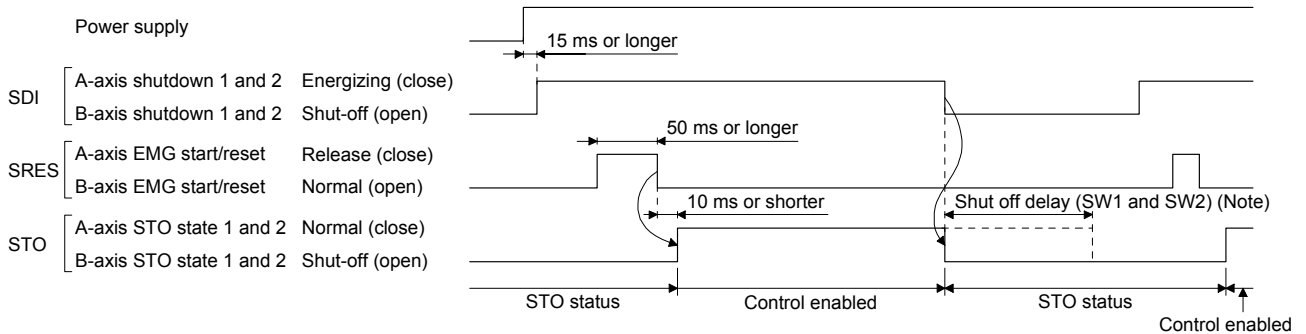
- (7) Perform all risk assessments and safety level certification to the machine or the system as a whole. It is recommended that a Certification Body final safety certification of the system be used.
- (8) To prevent accumulation of multiple malfunctions, perform a malfunction check at regular intervals as deemed necessary by the applicable safety standard. Regardless of the system safety level, malfunction checks should be performed at least once per year.
- (9) If the upper and lower power module in the servo amplifier are shorted and damaged simultaneously, the servo motor may make a half revolution at a maximum.

App. 5.5 Block diagram and timing chart

(1) Function block diagram



(2) Operation sequence



Note. Refer to App. 5.10.

App. 5.6 Maintenance and disposal

MR-J3-D05 is equipped with LED displays to check errors for maintenance. Please dispose this unit according to your local laws and regulations.

App. 5.7 Functions and configuration

App. 5.7.1 Summary

MR-J3-D05 has two systems in which the each system has SS1 function (delay time) and output of STO function.

APPENDIX

App. 5.7.2 Specifications

Safety logic unit model		MR-J3-D05
Control circuit power supply	Voltage	24 V DC
	Permissible voltage fluctuation	24 V DC \pm 10%
	Power supply capacity [A]	0.5 (Note 1, 2)
Compatible system		2 systems (A-axis, B-axis independent)
Shut-off input		4 points (2 point \times 2 systems) SDI_: (source/sink compatible) (Note 3)
Shut-off release input		2 points (1 point \times 2 systems) SRES_: (source/sink compatible) (Note 3)
Feedback input		2 points (1 point \times 2 systems) TOF_: (source compatible) (Note 3)
Input type		Photocoupler insulation, 24 V DC (external supply), internal limited resistance 5.4 k Ω
Shut-off output		8 points (4 point \times 2 systems) STO_: (source compatible) (Note 3) SDO_: (source/sink compatible) (Note 3)
Output type		Photocoupler insulation, open-collector type Permissible current: 40 mA/1 output, Inrush current: 100 mA/1 output
Delay time setting		A-axis: Select from 0 s, 1.4 s, 2.8 s, 5.6 s, 9.8 s, or 30.8 s. B-axis: Select from 0 s, 1.4 s, 2.8 s, 9.8 s, or 30.8 s. Accuracy: \pm 2%
Safety function		STO, SS1 (IEC/EN 61800-5-2) EMG STOP, EMG OFF IEC/EN 60204-1)
Safety performance	Standards certified by CB	EN ISO 13849-1 category 3 PL d, EN 61508 SIL 2, EN 62061 SIL CL 2, and EN 61800-5-2 SIL 2
	Response performance (when delay time is set to 0s) (Note 4)	10 ms or less (STO input off \rightarrow shut-off output off)
	Mean time to dangerous failure (MTTFd)	516 years
	Diagnosis converge (DC avg)	93.1%
	Average probability of dangerous failures per hour (PFH)	4.75×10^{-9} [1/h]
	CE marking	LVD: EN 61800-5-1 EMC: EN 61800-3 MD: EN ISO 13849-1, EN 61800-5-2, EN 62061
Compliance to standards		Natural-cooling, open (IP rating: IP 00)
Structure	Ambient temperature	0 °C to 55 °C (non-freezing), storage: -20 °C to 65 °C (non-freezing)
Environment	Ambient humidity	90 %RH or less (non-condensing), storage: 90 %RH or less (non-condensing)
	Ambience	Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, and dirt
	Altitude	Max. 1000 m 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]	0.2 (including CN9 and CN10 connectors)

- Note 1. Inrush current of approximately 1.5 A flows instantaneously when turning the control circuit power supply on. Select an appropriate capacity of power supply considering the inrush current.
2. Power-on duration of the safety logic unit is 100,000 times.
3. _: in signal name indicates a number or axis name.
4. For the test pulse input, contact your local sales office.

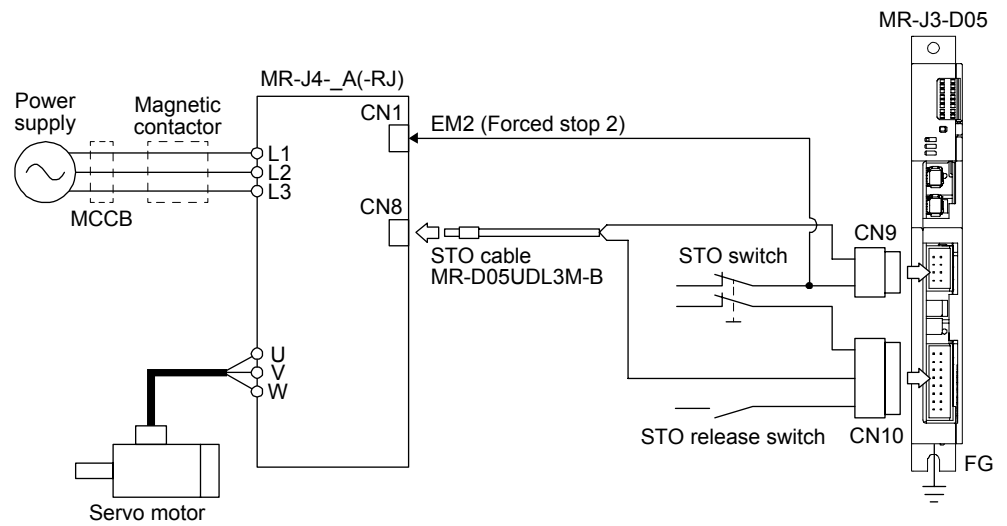
APPENDIX

App. 5.7.3 When using MR-J3-D05 with an MR-J4 series servo amplifier

(1) System configuration diagram

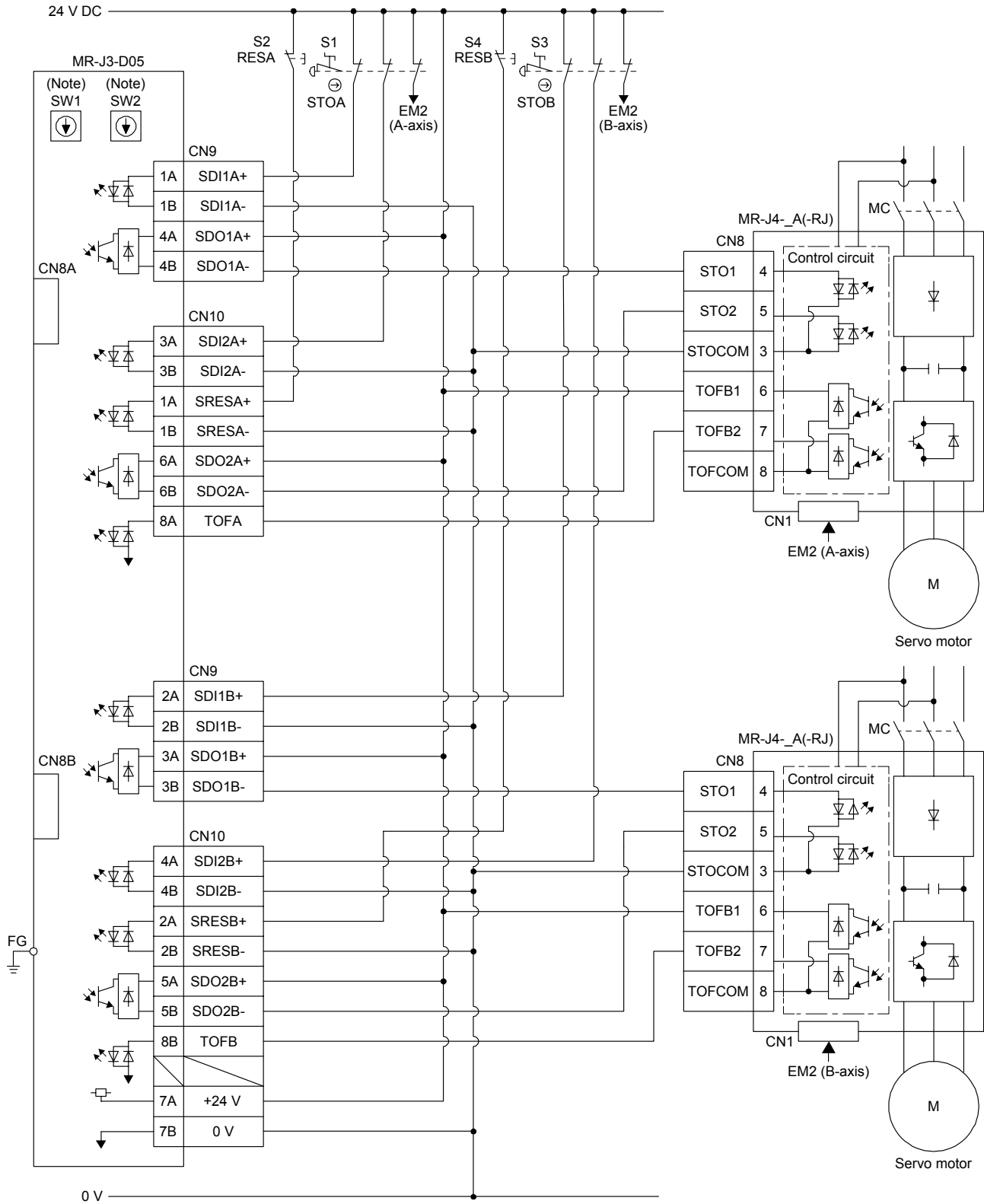
The following shows the connection targets of the STO switch and STO release switch.

POINT
●MR-D05UDL_M (STO cable) for MR-J3 series cannot be used.



APPENDIX

(2) Connection example



Note. Set the delay time of STO output with SW1 and SW2. These switches are located where denoted from the front panel.

APPENDIX

App. 5.8 Signal

App. 5.8.1 Connector/pin assignment

(1) CN8A

Device	Symbol	Pin No.	Function/application	I/O division
A-axis STO1	STO1A- STO1A+	1	Outputs STO1 to A-axis driving device.	O
		4	Outputs the same signal as A-axis STO2. STO state (base shutdown): Between STO1A+ and STO1A- is opened. STO release state (in driving): Between STO1A+ and STO1A- is closed.	
A-axis STO2	STO2A- STO2A+	5	Outputs STO2 to A-axis driving device.	O
		6	Outputs the same signal as A-axis STO1. STO state (base shutdown): Between STO2A+ and STO2A- is opened. STO release state (in driving): Between STO2A+ and STO2A- is closed.	
A-axis STO state	TOF2A TOF1A	7	Inputs STO state of A-axis driving device.	I
		8	STO state (base shutdown): Open between TOF2A and TOF1A. STO release state (in driving): Close between TOF2A and TOF1A.	

(2) CN8B

Device	Symbol	Pin No.	Function/application	I/O division
B-axis STO1	STO1B- STO1B+	1	Outputs STO1 to B-axis driving device.	O
		4	Outputs the same signal as B-axis STO2. STO state (base shutdown): Between STO1B+ and STO1B- is opened. STO release state (in driving): Between STO1B+ and STO1B- is closed.	
B-axis STO2	STO2B- STO2B+	5	Outputs STO2 to B-axis driving device.	O
		6	Outputs the same signal as B-axis STO1. STO state (base shutdown): Between STO2B+ and STO2B- is opened. STO release state (in driving): Between STO2B+ and STO2B- is closed.	
B-axis STO state	TOF2B TOF1B	7	Inputs STO state of B-axis driving device.	I
		8	STO state (base shutdown): Open between TOF2B and TOF1B. STO release state (in driving): Close between TOF2B and TOF1B.	

(3) CN9

Device	Symbol	Pin No.	Function/application	I/O division
A-axis shutdown 1	SDI1A+ SDI1A-	1A	Connect this device to a safety switch for A-axis driving device.	DI-1
		1B	Input the same signal as A-axis shutdown 2. STO state (base shutdown): Open between SDI1A+ and SDI1A-. STO release state (in driving): Close between SDI1A+ and SDI1A-.	
B-axis shutdown 1	SDI1B+ SDI1B-	2A	Connect this device to a safety switch for B-axis driving device.	DI-1
		2B	Input the same signal as B-axis shutdown 2. STO state (base shutdown): Open between SDI1B+ and SDI1B-. STO release state (in driving): Close between SDI1B+ and SDI1B-.	
A-axis SDO1	SDO1A+ SDO1A-	4A	Outputs STO1 to A-axis driving device.	DO-1
		4B	Outputs the same signal as A-axis SDO2. STO state (base shutdown): Between SDO1A+ and SDO1A- is opened. STO release state (in driving): Between SDO1A+ and SDO1A- is closed.	
B-axis SDO1	SDO1B+ SDO1B-	3A	Outputs STO1 to B-axis driving device.	DO-1
		3B	Outputs the same signal as B-axis SDO2. STO state (base shutdown): Between SDO1B+ and SDO1B- is opened. STO release state (in driving): Between SDO1B+ and SDO1B- is closed.	

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(4) CN10

Device	Symbol	Pin No.	Function/application	I/O division
A-axis shutdown 2	SDI2A+ SDI2A-	3A 3B	Connect this device to a safety switch for A-axis driving device. Input the same signal as A-axis shutdown 1. STO state (base shutdown): Open between SDI2A+ and SDI2A-. STO release state (in driving): Close between SDI2A+ and SDI2A-.	DI-1
B-axis shutdown 2	SDI2B+ SDI2B-	4A 4B	Connect this device to a safety switch for B-axis driving device. Input the same signal as B-axis shutdown 1. STO state (base shutdown): Open between SDI2B+ and SDI2B-. STO release state (in driving): Close between SDI2B+ and SDI2B-.	DI-1
A-axis EMG start/reset	SRESA+ SRESA-	1A 1B	Signal for releasing STO state (base shutdown) on A-axis driving device. Releases STO state (base shutdown) on A-axis driving device by switching between SRESA+ and SRESA- from on (connected) to off (opened).	DI-1
B-axis EMG start/reset	SRESB+ SRESB-	2A 2B	Signal for releasing STO state (base shutdown) on B-axis driving device. Releases STO state (base shutdown) on B-axis driving device by switching between SRESB+ and SRESB- from on (connected) to off (opened).	DI-1
A-axis SDO2	SDO2A+ SDO2A-	6A 6B	Outputs STO2 to A-axis driving device. Outputs the same signal as A-axis STO1. STO state (base shutdown): Between SDO2A+ and SDO2A- is opened. STO release state (in driving): Between SDO2A+ and SDO2A- is closed.	DO-1
B-axis SDO2	SDO2B+ SDO2B-	5A 5B	Outputs STO2 to B-axis driving device. Outputs the same signal as B-axis SDO1. STO state (base shutdown): Between SDO2B+ and SDO2B- is opened. STO release state (in driving): Between SDO2B+ and SDO2B- is closed.	DO-1
Control circuit power supply	+24V	7A	Connect + side of 24 V DC.	
Control circuit power GND	0V	7B	Connect - side of 24 V DC.	
A-axis STO state	TOFA	8A	TOFA is internally connected with TOF2A.	
B-axis STO state	TOFB	8B	TOFB is internally connected with TOF2B.	

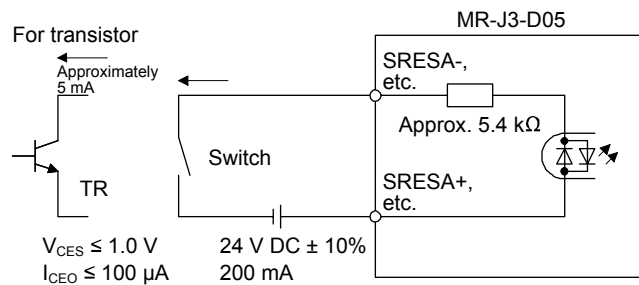
App. 5.8.2 Interfaces

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

(1) Sink I/O interface (CN9, CN10 connector)

(a) Digital input interface DI-1

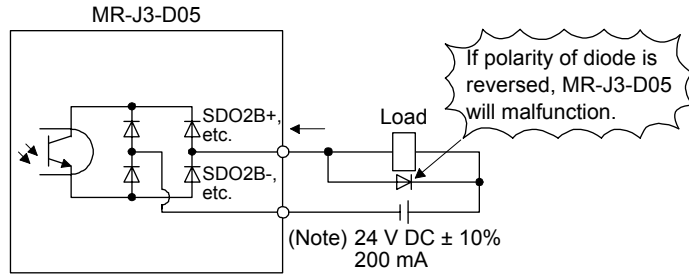
This is an input circuit whose photocoupler cathode side is input terminal. Transmit signals from sink (open-collector) type transistor output, relay switch, etc.



APPENDIX

(b) Digital output interface DO-1

This is a circuit of collector output terminal of the output transistor. When the output transistor is turned on, collector terminal current will be applied for the output. 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 MR-J3-D05.

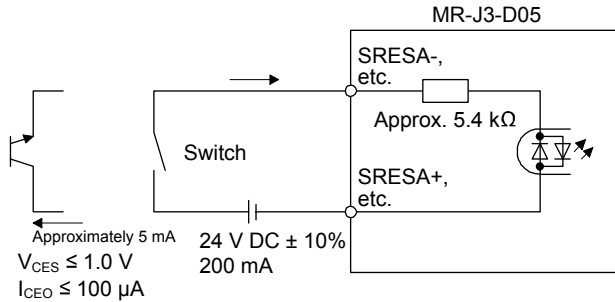


Note. If the voltage drop (maximum of 2.6 V) interferes with the relay operation, apply high voltage (maximum of 26.4 V) from external source.

(2) Source I/O interfaces (CN9, CN10 connector)

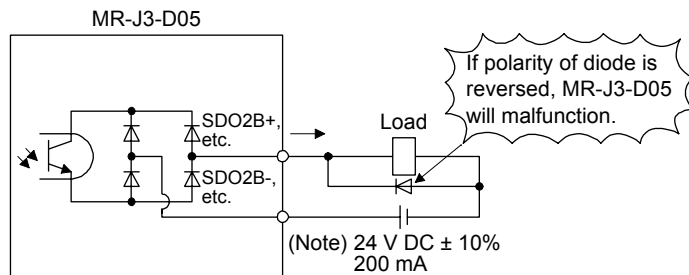
(a) Digital input interface DI-1

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



(b) Digital output interface DO-1

This is a circuit of emitter output terminal of the output transistor. When the output transistor is turned on, current will be applied from the output to a load. A maximum of 2.6 V voltage drop occurs in the MR-J3-D05.



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.

APPENDIX

App. 5.8.3 Wiring CN9 and CN10 connectors

Handle with the tool with care when connecting wires.

(1) Wire strip

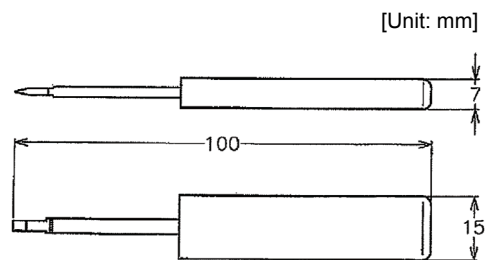
- (a) Use wires with size of AWG 24 to 20 (0.22 mm^2 to 0.5 mm^2) (recommended electric wire: UL1007) and strip the wires to make the stripped length $7.0 \text{ mm} \pm 0.3 \text{ mm}$. Confirm the stripped length with gauge, etc. before using the wires.
- (b) If the stripped wires are bent, feazed or too thick due to twisting too much, fix the wires by twisting lightly, etc. Then, confirm the stripped length before using the wires. Do not use excessively deformed wires.
- (c) Smooth out the wire surface and stripped insulator surface.

(2) Connecting wires

Before connecting wires, be sure to pull out the receptacle assembly from the header connector. If wires are connected with inserted connector, the connector and the printed board may malfunction.

(a) Using extraction tool (1891348-1 or 2040798-1)

1) Dimensions and mass

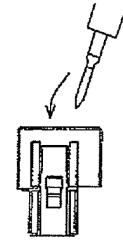


Mass : Approx. 20 g

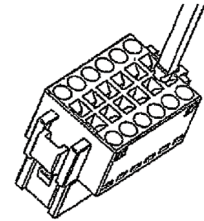
APPENDIX

2) Connecting wires

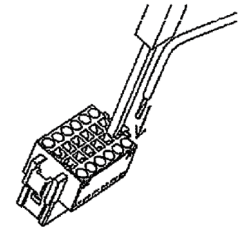
- a) Confirm the model number of the housing, contact and tool to be used.
- b) Insert the tool diagonally into the receptacle assembly.



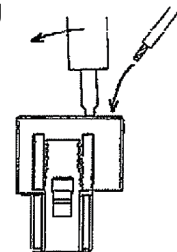
- c) Insert the tool until it hits the surface of the receptacle assembly. At this stage, the tool is vertical to the receptacle assembly.



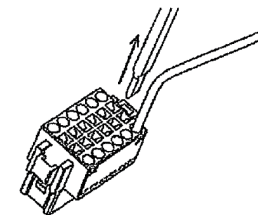
- d) Insert wires in the wiring hole till the end. The wires should be slightly twisted in advance to prevent it from being feazed.



It is easy to insert the wire if the wire is inserted diagonally while twisting the tool.



- e) Remove the tool.



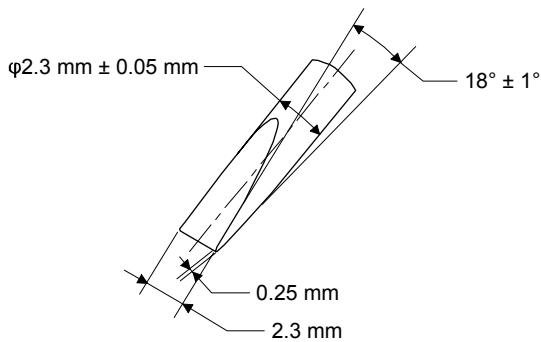
APPENDIX

(b) Using a screwdriver

To avoid damaging housings and springs when wiring with screwdriver, do not put excessive force. Be cautious when connecting.

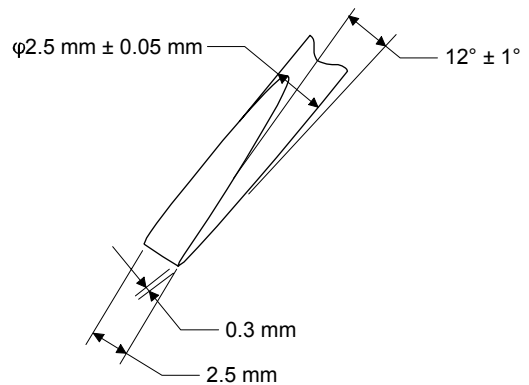
1) Adjusting screw driver

Diameter: 2.3 mm \pm 0.05 mm
Length: 120 mm or less
Width: 2.3 mm
Thickness: 0.25 mm
Angle in tip of the blade: 18 ± 1 degrees



Screwdriver diameter: ϕ 2.3 mm

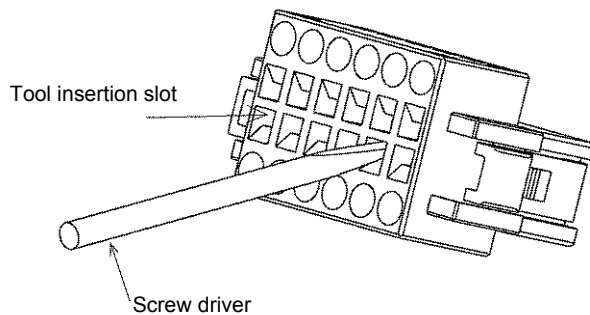
Diameter: 2.5 mm \pm 0.05 mm
Length: 120 mm or less
Width: 2.5 mm
Thickness: 0.3 mm
Angle in tip of the blade: 12 ± 1 degrees



Screwdriver diameter: ϕ 2.5 mm

2) Connecting wires

- a) Insert a screwdriver in the front slot a little diagonally, and depress the spring. While depressing the spring, insert the wires until they hit the end. Note that the housing and spring may be damaged if the screwdriver is inserted strongly. Never insert the screwdriver in the wire hole. Otherwise, the connector will be damaged.
- b) Pull the screwdriver out while pressing the wires. Connecting wires is completed.
- c) Pull the wire lightly to confirm that the wire is surely connected.
- d) To remove the wires, depress the spring by the screwdriver in the same way as connecting wires, and then pull the wires out.



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(3) Connector insertion

Insert the connector all the way straight until you hear or feel clicking. When removing the connector, depress the lock part completely before pulling out. If the connector is pulled out without depressing the lock part completely, the housing, contact and/or wires may be damaged.

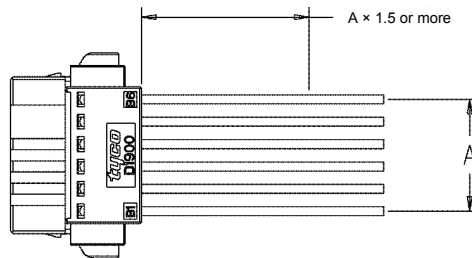
(4) Compatible wire

Compatible wire size is listed below.

Wire size	
mm ²	AWG
0.22	24
0.34	22
0.50	20

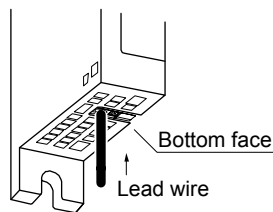
(5) Others

(a) Fix a wire tie at least distance of "A" × 1.5 away from the end of the connector.



(b) Be sure that wires are not pulled excessively when the connector is inserted.

App. 5.8.4 Wiring FG



Wire range

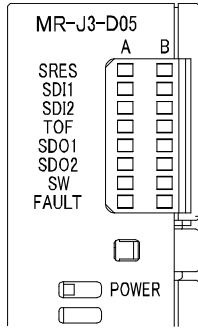
Single wire: φ 0.4 mm to 1.2 mm (AWG 26 to AWG 16)

Stranded wire: 0.2 mm² to 1.25 mm² (AWG 24 to AWG 16),
wire φ 0.18 mm or more

APPENDIX

App. 5.9 LED display

I/O status, malfunction and power on/off are displayed with LED for each A-axis and B-axis.



LED	Description	LED	
		Column A	Column B
SRES	Monitor LED for start/reset Off: The start/reset is off. (The switch contact is opened.) On: The start/reset is on. (The switch contact is closed.)	A-axis	B-axis
SDI1	Monitor LED for shut-off 1 Off: The shut-off 1 is off. (The switch contact is closed.) On: The shut-off 1 is on. (The switch contact is opened.)		
SDI2	Monitor LED for shut-off 2 Off: The shut-off 2 is off. (The switch contact is closed.) On: The shut-off 2 is on. (The switch contact is opened.)		
TOF	Monitor LED for STO state Off: Not in STO state On: In STO state		
SDO1	Monitor LED for SDO1 Off: Not in STO state On: In STO state		
SDO2	Monitor LED for SDO2 Off: Not in STO state On: In STO state		
SW	Monitor LED for confirming shutdown delay setting Off: The settings of SW1 and SW2 do not match. On: The settings of SW1 and SW2 match.		
FAULT	FAULT LED Off: Normal operation (STO monitoring state) On: Fault has occurred.		
POWER	Power supply Off: Power is not supplied to MR-J3-D05. On: Power is being supplied to MR-J3-D05.	/	

App. 5.10 Rotary switch setting

Rotary switch is used to shut off the power after control stop by SS1 function.

Set the delay time for STO output after STO shut off switch is pressed. Set same setting for SW1 and SW2, and set the rotary switch setting according to the delay time in the table below.

Setting cannot be changed while power is on. Notify users that setting cannot be changed by putting a seal or by another method so that end users will not change the setting after the shipment.

0 to F in the following table is the set value of the rotary switches (SW1 and SW2).

Rotary switch setting and delay time at A/B-axis [s]

		B-axis					
		0 s	1.4 s	2.8 s	5.6 s	9.8 s	30.8 s
A-axis	0 s	0	1	2	-	3	4
	1.4 s		-	5	-	6	7
	2.8 s			8	-	9	A
	5.6 s				-	B	C
	9.8 s					D	E
	30.8 s						F

APPENDIX

App. 5.11 Troubleshooting

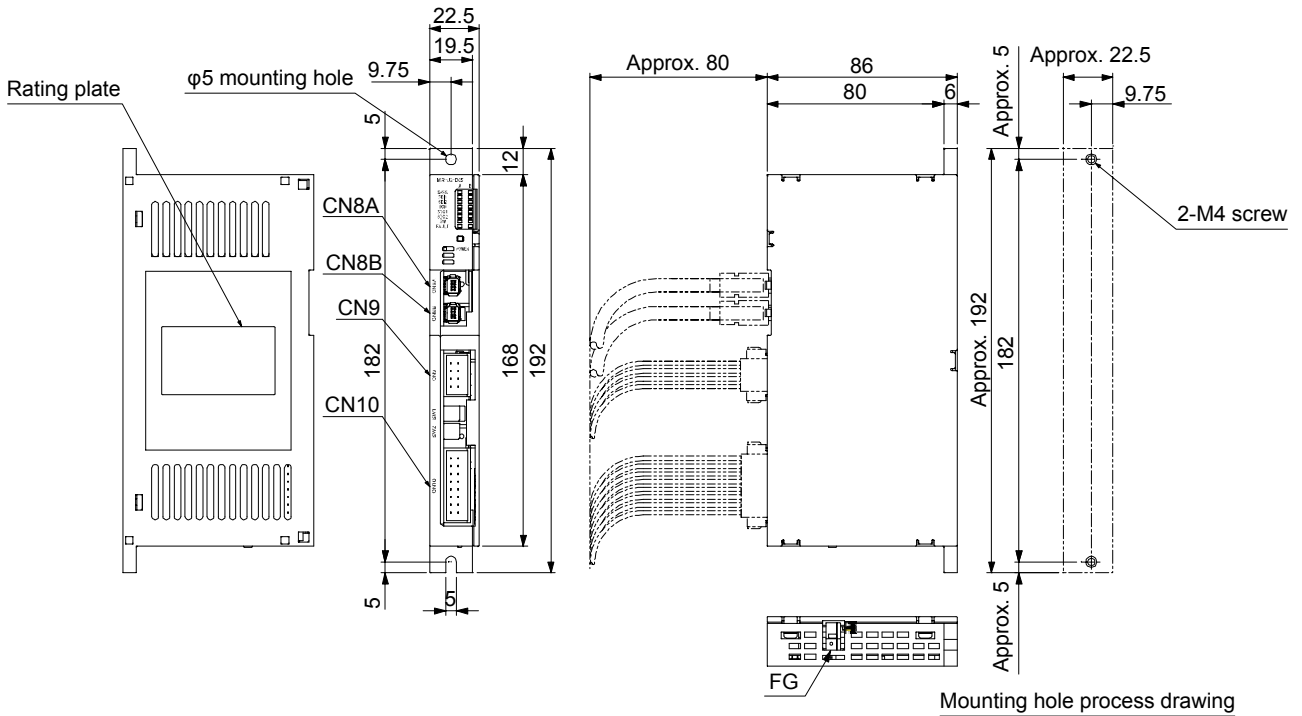
When power is not supplied or FAULT LED turns on, refer the following table and take the appropriate action.

Event	Description	Cause	Action
Power is not supplied.	Power LED does not turn on although power is supplied.	1. 24 V DC power supply is malfunctioning.	Replace the 24 V DC power supply.
		2. Wires between MR-J3-D05 and 24 V DC power supply are disconnected or are in contact with other wires.	Check the wiring.
		3. MR-J3-D05 is malfunctioning.	Replace the MR-J3-D05.
FAULT LED is on.	FAULT LED of A-axis or B-axis is on, and will not turn off.	1. The delay time settings are not matched.	Check the settings of the rotary switch.
		2. Switch input error	Check the wiring or sequence of the input signals.
		3. TOF signal error	Check the connection with the servo amplifier.
		4. MR-J3-D05 is malfunctioning.	Replace the MR-J3-D05.

APPENDIX

App. 5.12 Dimensions

[Unit: mm]



Pin assignment

CN8A		CN8B	
7	8	7	8
TOF2A	TOF1A	TOF2B	TOF1B
5	6	5	6
STO2A-	STO2A+	STO2B-	STO2B+
3	4	3	4
	STO1A+		STO1B+
1	2	1	2
STO1A-		STO1B-	

CN9		CN10	
1A	1B	1A	1B
SDI1A+	SDI1A-	SRESA+	SRESA-
2A	2B	2A	2B
SDI1B+	SDI1B-	SRESB+	SRESB-
3A	3B	3A	3B
SDO1B+	SDO1B-	SDI2A+	SDI2A-
4A	4B	4A	4B
SDO1A+	SDO1A-	SDI2B+	SDI2B-
		5A	5B
		SDO2B+	SDO2B-
		6A	6B
		SDO2A+	SDO2A-
		7A	7B
		+24 V	0 V
		8A	8B
		TOFA	TOFB

Mounting screw

Screw size: M4

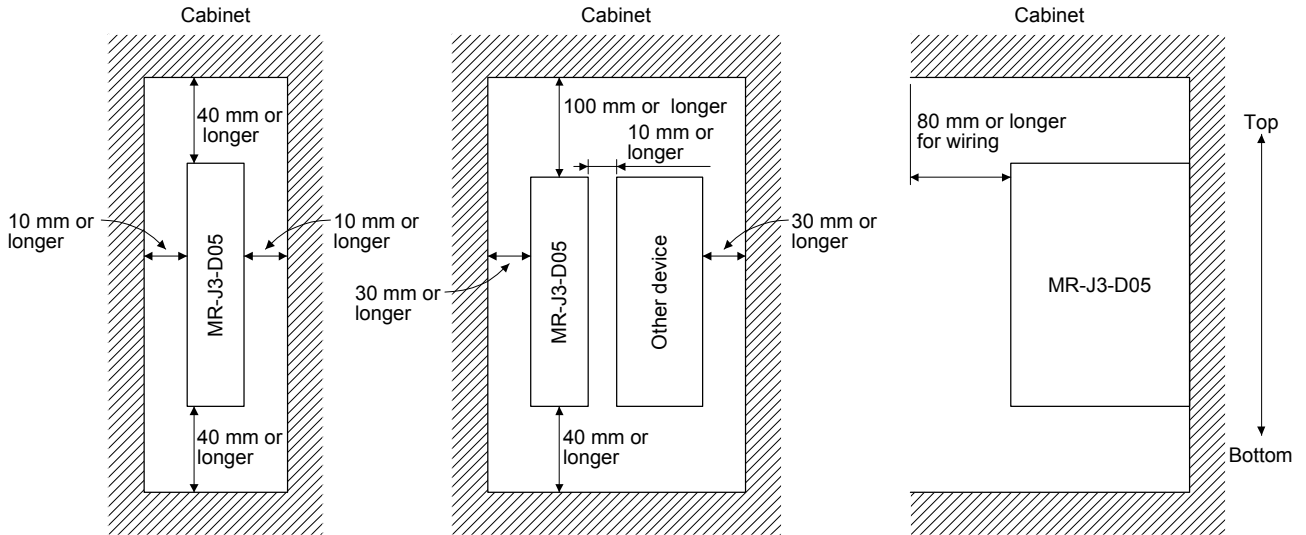
Tightening torque: 1.2 N•m

Mass: 0.2 [kg]

APPENDIX

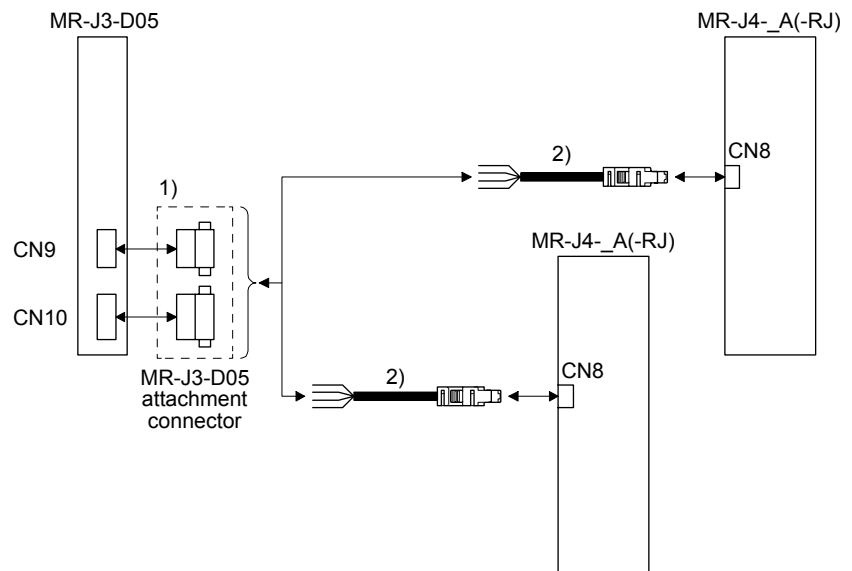
App. 5.13 Installation

Follow the instructions in this section and install MR-J3-D05 in the specified direction. Leave clearances between MR-J3-D05 and other equipment including the cabinet.






App. 5.14 Combinations of cable/connector

POINT
● MR-D05UDL_M (STO cable) for MR-J3 series cannot be used.



APPENDIX


No.	Name	Model	Description
1)	Connector	MR-J3-D05 attachment connector	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>Connector for CN9: 1-1871940-4 (TE Connectivity)</p> </div> <div style="text-align: center;">  <p>Connector for CN10: 1-1871940-8 (TE Connectivity)</p> </div> </div>
2)	STO cable	MR-D05UDL3M-B Cable length: 3 m	<p>Connector set: 2069250-1 (TE Connectivity)</p> <div style="text-align: center;">  </div>

COMPLIANCE WITH THE MACHINERY DIRECTIVES

The MR-J3-D05 complies with the safety components laid down in the directive 2006/42/EC (Machinery).

App. 6 EC declaration of conformity

The MR-J4 series servo amplifiers and MR-J3-D05 safety logic unit complies with the safety component laid down in the Machinery directive.




ZERTIFIKAT

CERTIFICATE

EC Type-Examination Certificate


Reg.-No.: 01/205/5196/12


Product tested	AC Servo Drive with integrated safety function "Safe Torque Off (STO)"	Certificate holder	Mitsubishi Electric Corporation Nagoya Works 1-14 Yada-Minami 5-chome Higashi-ku Nagoya 461-8670 Japan
Type designation	MR-J4-*A* MR-J4-*B* MR-J4W2-*B* MR-J4W3-*B*	Manufacturer	see certificate holder
Codes and standards forming the basis of testing	EN 61800-5-2:2007 EN 61800-5-1:2007 (in extracts) EN 61800-3:2004 EN ISO 13849-1:2008 + AC:2009		EN 62061:2005 + AC:2010 EN 60204-1:2006 + A1:2009 + AC:2010 (in extracts) IEC 61508 Parts 1-7:2010
Intended application	The safety function "Safe Torque Off" complies with the requirements of the relevant standards (PL d acc. to EN ISO 13849-1, SIL CL 2 acc. to EN 61800-5-2/ EN 62061/ IEC 61508) and can be used in applications up to PL d acc. to EN ISO 13849-1 and SIL 2 acc. to EN 62061/ IEC 61508.		
Specific requirements	The instructions of the associated Installation and Operating Manual shall be considered.		
It is confirmed, that the product under test complies with the requirements for machines defined in Annex I of the EC Directive 2006/42/EC.			
This certificate is valid until 2017-02-28.			



The test report-no.: 968/M 342.00/12 dated 2012-02-28 is an integral part of this certificate.

The holder of a valid licence certificate for the product tested is authorized to affix the test mark shown opposite to products, which are identical with the product tested.





Berlin, 2012-02-28

Certification Body for Machinery, NB 0035

Dipl.-Ing. Eberhard Frejno



ZERTIFIKAT
CERTIFICATE

Nr./No. 968/EL 612.00/09

Prüfgegenstand Product tested	Safety Logic Module for usage in combination with MR-J3-□S Servo Drives	Inhaber Holder	Mitsubishi Electric Corporation Nagoya Works 1-14 Yada-Minami 5-chome, Higashi-ku Nagoya 461-8670 Japan
Typbezeichnung Type designation	MR-J3-D05	Verwendungszweck Intended application	Drive Applications STO / SS1 acc. to EN 61800-5-2 Safe Stop / Safe Off Stop Category 0 / Stop Category 1 acc. to EN 60204-1
Prüfgrundlagen Codes and standards forming the basis of testing	EN ISO 13849-1:2008 EN 62061:2005 EN 61800-5-2:2007 EN 61800-5-1:2007	EN 61800-3:2004 EN 60204-1:2006 EN 50178:1997 EN 61508-1 to -7:2000-2002	
Prüfungsergebnis Test results	The MR-J3-D05 Safety Logic Module in combination with the MR-J3 series servo drives is suitable for the basic safety functions "STO" and "SS1" (Type C) according to EN 61800-5-2 as well as "Safe Stop" (Stop category 0 and Stop category 1) and "Safe Off" according to EN 60204-1. It can be used within safety related applications up to Safety Category 3 / PL d and SIL 2 / SIL CL 2 according to EN ISO 13849-1 and EN 62061.		
Besondere Bedingungen Specific requirements	For a safe usage of the product the instructions in the user documentation must be observed. For "Safe Off" two suitable additional magnetic contactors must be used additionally.		

Der Prüfbericht-Nr.: 968/EL 612.00/09 vom 21.04.2009 ist Bestandteil dieses Zertifikates.

Dieses Zertifikat ist nur gültig für Erzeugnisse, die mit dem Prüfgegenstand übereinstimmen. Es wird ungültig bei jeglicher Änderung der Prüfgrundlagen für den angegebenen Verwendungszweck.

The test report-no.: 968/EL 612.00/09 dated 2009-04-21 is an integral part of this certificate.

This certificate is valid only for products which are identical with the product tested. It becomes invalid at any change of the codes and standards forming the basis of testing for the intended application.

TÜV Rheinland Industrie Service GmbH
Geschäftsfeld ASI
Automation, Software und Informationstechnologie
Am Grauen Stein, 51105 Köln
Postfach 91 09 51, 51101 Köln

2009-04-21
Datum/Date

Firmenstempel/Company stamp

Dipl.-Ing. Heinz Gall

APPENDIX

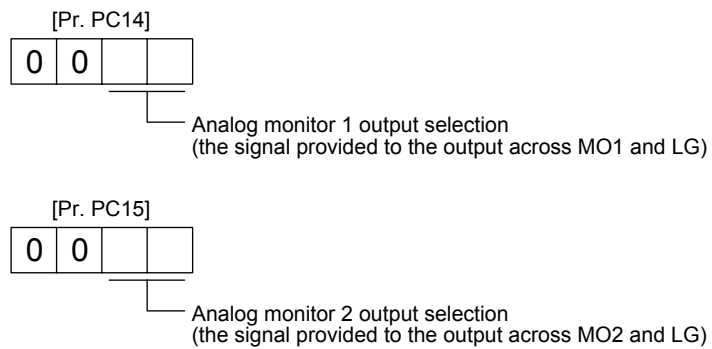
App. 7 Analog monitor

POINT
●A voltage of analog monitor output may be irregular at power-on.

The servo status can be output 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. The setting range is between -9999 mV and 9999 mV.

Parameter	Description	Setting range [mV]
PC39	This is used to set the offset voltage of MO1 (Analog monitor 1).	-9999 to 9999
PC40	This is used to set the offset voltage of MO2 (Analog monitor 2).	

APPENDIX

(2) Set content

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		01	Torque	
02	Servo motor speed		03	Torque	
04	Current command		05	Command pulse frequency	
06	Servo motor-side droop pulses (Note 1, 3, 5, 6) (±10 V/100 pulses)		07	Servo motor-side droop pulses (Note 1, 3, 5, 6) (±10 V/1000 pulses)	
08	Servo motor-side droop pulses (Note 1, 3, 5, 6) (±10 V/10000 pulses)		09	Servo motor-side droop pulses (Note 1, 3, 5, 6) (±10 V/100000 pulses)	
0A	Feedback position (Note 1, 2, 3) (±10 V/1 Mpulse)		0B	Feedback position (Note 1, 2, 3) (±10 V/10 Mpulse)	
0C	Feedback position (Note 1, 2, 3) (±10 V/100 Mpulse)		0D	Bus voltage	

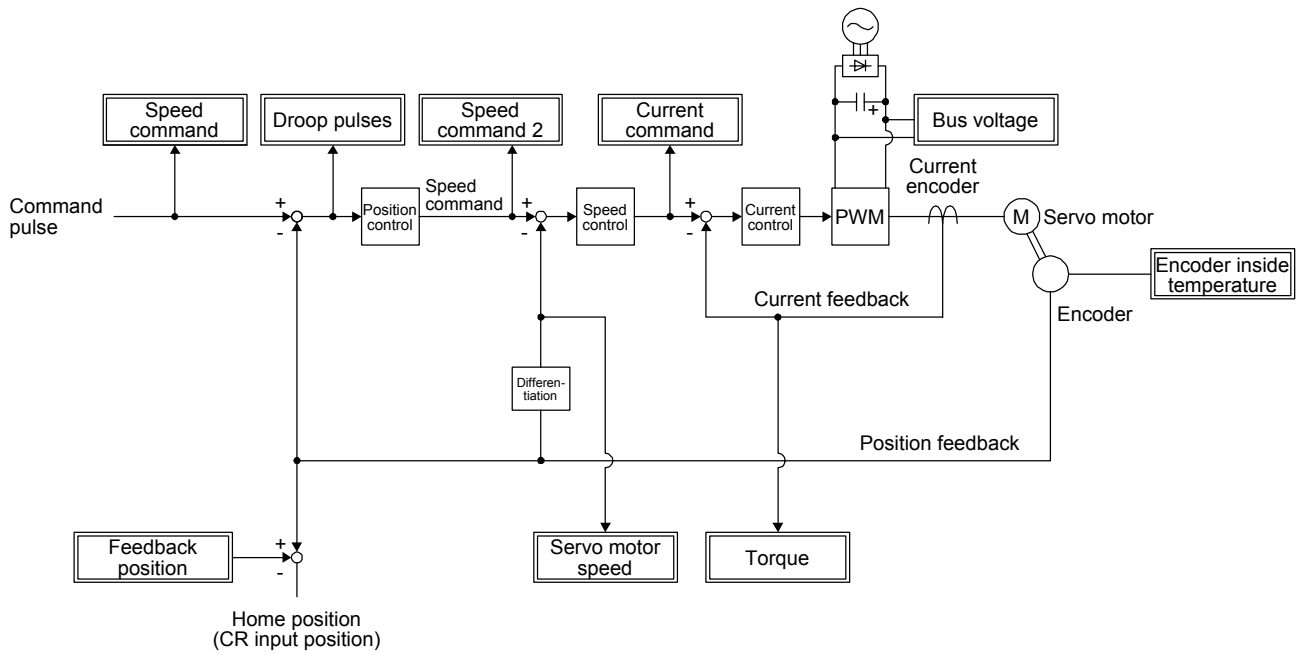
APPENDIX

Setting value	Output item	Description	Setting value	Output item	Description
0E	Speed command 2 (Note 3)		10	Load-side droop pulses (Note 3, 4, 5, 6) (± 10 V/100 pulses)	
11	Load-side droop pulses (Note 3, 4, 5, 6) (± 10 V/1000 pulses)		12	Load-side droop pulses (Note 3, 4, 5, 6) (± 10 V/10000 pulses)	
13	Load-side droop pulses (Note 3, 4, 5, 6) (± 10 V/100000 pulses)		14	Load-side droop pulses (Note 3, 4, 5, 6) (± 10 V/1 Mpulses)	
15	Motor-side/load-side position deviation (Note 3, 4, 5, 6) (± 10 V/100000 pulses)		16	Servo motor-side/load-side speed deviation (Note 4)	
17	Encoder inside temperature (± 10 V/ ± 128 °C)				

- Note
1. Encoder pulse unit.
 2. Available in position control mode
 3. This cannot be used in the torque control mode.
 4. This can be used with MR Configurator2 with software version 1.19V or later.
 5. This cannot be used in the speed control mode.
 6. Output in the load-side encoder unit for the fully closed loop control. Output in the servo motor encoder unit for the semi closed loop control.

APPENDIX

(3) Analog monitor block diagram

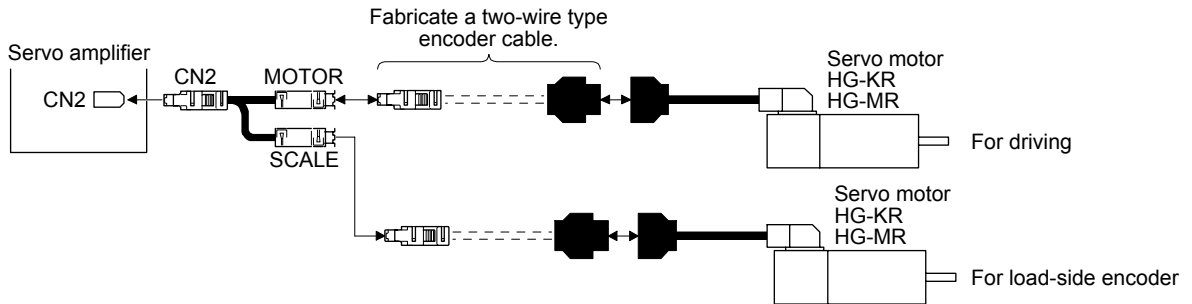


APPENDIX

App. 8 Two-wire type encoder cable for HG-MR/HG-KR

Use a two-wire type encoder cable for the fully closed loop control by the MR-J4-_A servo amplifiers. For MR-EKCBL_M-_ encoder cables for HG-MR and HG-KR, up to 20 m cables are two-wire type. Therefore, when you need a longer encoder cable of two-wire type than 20 m, fabricate one using MR-ECNM connector set. Use the internal wiring diagram in the section to fabricate a cable up to 50 m.

App. 8.1 Configuration diagram

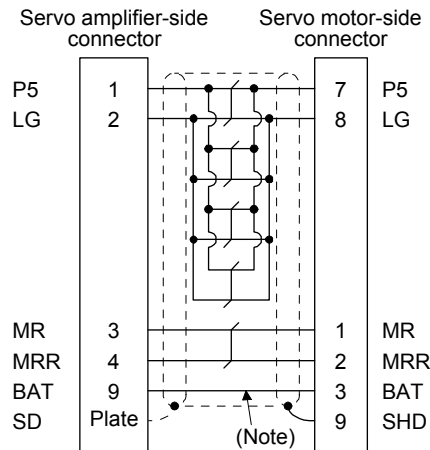


App. 8.2 Connector set

Connector set	1) Servo amplifier-side connector	2) Servo motor-side connector																																																					
MR-ECNM	<p>Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M)</p> <p>Connector set: 54599-1019 (Molex)</p> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 5px;"> <table border="1" style="border-collapse: collapse; text-align: center;"> <tr><td>2</td><td>6</td><td>10</td></tr> <tr><td>LG</td><td>MRR</td><td></td></tr> <tr><td>1</td><td>5</td><td>9</td></tr> <tr><td>P5</td><td>MR</td><td>BAT</td></tr> <tr><td>3</td><td>7</td><td></td></tr> </table> <p>View seen from wiring side. (Note)</p> </div> <div style="border: 1px solid black; padding: 5px;"> <table border="1" style="border-collapse: collapse; text-align: center;"> <tr><td>2</td><td>4</td><td>6</td><td>8</td><td>10</td></tr> <tr><td>LG</td><td>MRR</td><td></td><td></td><td></td></tr> <tr><td>1</td><td>3</td><td>5</td><td>7</td><td>9</td></tr> <tr><td>P5</td><td>MR</td><td></td><td></td><td>BAT</td></tr> </table> <p>View seen from wiring side. (Note)</p> </div> </div> <p>or</p> <p>Note. Do not connect anything to the pins shown as . Especially, pin 10 is provided for manufacturer adjustment. If it is connected with any other pin, the servo amplifier cannot operate normally.</p>	2	6	10	LG	MRR		1	5	9	P5	MR	BAT	3	7		2	4	6	8	10	LG	MRR				1	3	5	7	9	P5	MR			BAT	<p>Housing: 1-172161-9 Connector pin: 170359-1 (TE Connectivity or equivalent) Cable clamp: MTI-0002 (Toa Electric Industry)</p> <div style="border: 1px solid black; padding: 5px;"> <table border="1" style="border-collapse: collapse; text-align: center;"> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>MR</td><td>MRR</td><td>BAT</td></tr> <tr><td>4</td><td>5</td><td>6</td></tr> <tr><td></td><td></td><td>CONT</td></tr> <tr><td>7</td><td>8</td><td>9</td></tr> <tr><td>P5</td><td>LG</td><td>SHD</td></tr> </table> <p>View seen from wiring side.</p> </div>	1	2	3	MR	MRR	BAT	4	5	6			CONT	7	8	9	P5	LG	SHD
2	6	10																																																					
LG	MRR																																																						
1	5	9																																																					
P5	MR	BAT																																																					
3	7																																																						
2	4	6	8	10																																																			
LG	MRR																																																						
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4	5	6																																																					
		CONT																																																					
7	8	9																																																					
P5	LG	SHD																																																					

APPENDIX

App. 8.3 Internal wiring diagram



Note. Always make connection for use in an absolute position detection system. Wiring is not necessary for use in an incremental system.

App. 9 How to replace servo amplifier without magnetic pole detection

CAUTION

● Be sure to write the magnetic pole information of the servo amplifier before the replacement to the servo amplifier after the replacement. If the information before and after replacement are not the same, the servo motor may operate unexpectedly.

When replacing the servo amplifier, carry out the magnetic pole detection again. If the magnetic pole detection cannot be performed unavoidably, write the magnetic pole information from the servo amplifier before the replacement to the one after the replacement using MR Configurator2.

(1) Procedures

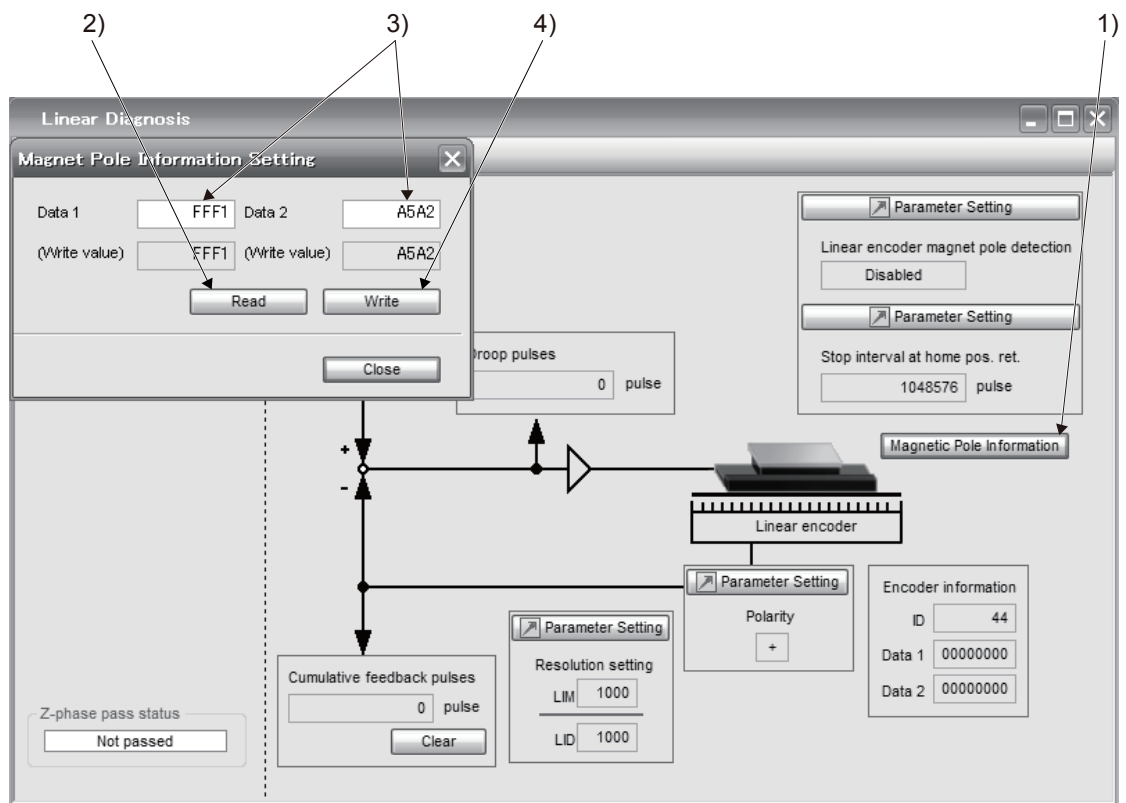
- Read the magnetic pole information of the servo amplifier before the replacement.
- Write the read magnetic pole information to the servo amplifier after the replacement.
- Perform the test operation with the torque limit for ensuring the safety, and confirm that there is no trouble.

(2) Migration method of the magnetic pole information

- How to read the magnetic pole information from the servo amplifier before the replacement
 - Open the project in MR Configurator2, select "MR-J4-A" for model, and select "Linear" for operation mode.
 - Check that the personal computer is connected with the servo amplifier, and select "Diagnosis" and then "Linear diagnosis".

APPENDIX

- 3) Click the "Magnetic pole information" button (1) in figure) to open the magnetic pole information window.
 - 4) Click "Read All" of the magnetic pole information window. (2) in figure)
 - 5) Confirm the data 1 and data 2 (3) in figure) of the magnetic pole information window and take notes.
- (b) How to write the magnetic pole information to the servo amplifier after the replacement
- 1) Open the project in MR Configurator2, select "MR-J4-B" for model, and select "Linear" for operation mode.
 - 2) Check that the personal computer is connected with the servo amplifier, and select "Diagnosis" and then "Linear diagnosis".
 - 3) Click the "Magnetic pole information" button (1) in figure) to open the magnetic pole information window.
 - 4) Input the value of the magnetic pole information taken notes to the data 1 and data 2 (3) in figure) of the magnetic pole information window.
 - 5) Click "Write All" (4) in figure) of the magnetic pole information window.
 - 6) Cycle the power of the servo amplifier.



REVISIONS

*The manual number is given on the bottom left of the back cover.

Print Data	*Manual Number	Revision
Mar. 2012	SH(NA)030107-A	First edition
Jun. 2012	SH(NA)030107-B	<p>4. Additional instructions (2) Wiring The sentences are added.</p> <p>4. Additional instructions (3) Test run and adjustment The sentences are added.</p> <p>COMPLIANCE WITH CE MARKING The reference is changed.</p> <p>COMPLIANCE WITH UL/CSA STANDARD The reference is changed.</p> <p>COMPLIANCE WITH KC MARK Added.</p> <p>Section 1.2 (1) The diagram is changed.</p> <p>Section 1.2 (2) The diagram is changed.</p> <p>Section 1.3 The table and Note are changed.</p> <p>Section 1.5 The item of detailed explanation is changed.</p> <p>Section 1.8 Note is changed.</p> <p>Chapter 2 CAUTION is changed.</p> <p>Section 2.4 POINT is changed to CAUTION.</p> <p>Section 2.5 The explanation of relay lifetime is changed.</p> <p>Chapter 3 The sentences are added to CAUTION.</p> <p>Section 3.1 The sentences are added to CAUTION.</p> <p>The sentences are changed.</p> <p>Section 3.1 (1) Note 10 is added.</p> <p>Section 3.1 (2) Note 10 is added.</p> <p>Section 3.1 (3) Note 10 is added.</p> <p>Section 3.1 (4) Note 10 is added.</p> <p>Section 3.2.1 (1) Note 9, 12, 13, 14, and 15 are changed and added.</p> <p>Section 3.2.1 (2) The diagram is added.</p> <p>Section 3.2.2 (1) Note 9, 12, 13, and 14 are changed and added.</p> <p>Section 3.2.2 (2) Added.</p> <p>Section 3.2.3 (1) Note 7, 10, 11, and 12 are changed and added.</p> <p>Section 3.2.3 (2) Added.</p> <p>Section 3.3.1 The sentences of N- are changed.</p> <p>Section 3.3.3 (2) (a) The ferrule is added.</p> <p>Section 3.5 (2) The sentences are added to TLA, TC, VC, VLA, PP, NP, PG, and NG.</p> <p>Section 3.5 (4) "Available in the future" is deleted.</p> <p>Section 3.9.1 The part of diagram is changed.</p> <p>Section 3.9.2 (1) The sentences are changed.</p> <p>Section 3.9.2 (2) The sentences are added.</p> <p>Section 3.9.3 (1) The sentences are added.</p> <p>Section 3.9.3 (2) The sentences are added.</p> <p>Section 4.1.2 (1) (b) 4) Added.</p> <p>Section 4.2.2 Note is added.</p> <p>Section 4.3.2 Note is added.</p> <p>Section 4.4.2 "EM2 (Forced stop 2) off" in the table is changed. Note is added.</p> <p>Section 4.5.6 POINT is deleted.</p> <p>Section 4.5.9 (4) (a) is deleted</p> <p>Section 5.1.1 PA25 is changed from "For manufacturer setting".</p> <p>Section 5.1.3 PC21 is changed from "For manufacturer setting".</p> <p>Section 5.1.6 PF09 and PF15 are changed from "For manufacturer setting".</p> <p>Section 5.2.1 The setting value is added to PA03, the diagram of PA06 is changed, and PA25 is added.</p>

Print Data	*Manual Number	Revision	
Jun. 2012	SH(NA)030107-B	Section 5.2.3 Section 5.2.6 Section 7.3.1 Chapter 8 Section 10.3 Section 10.3.2 Section 11.3 Section 11.4 Section 11.5 Section 11.5 (3) Section 11.5 (4) Section 11.7 (1) Section 11.7 (2) Section 12.3 Section 12.8.4 Section 13.1.5 Section 13.3.2 (1) Section 13.3.2 (2) Section 13.3.3 Section 13.4.1 (1) Section 13.4.1 (2) Section 13.4.1 (2) (a) Section 13.4.2 (1) Section 13.4.2 (2) Chapter 14 Appendix. 4 Appendix. 5 Appendix. 6 Appendix. 7.7.3 (1) Appendix. 7.7.3 (2) Appendix. 7.7.3 (3) Appendix. 7.7.3 (4) Appendix. 7.8.1 (1) Appendix. 7.8.1 (2) Appendix. 7.8.2 Appendix. 7.12 Appendix. 7.14 Appendix. 8	The sentences are added to PC12 and PC13, PC21 is added, and the sentences are added to the initial value in PC37. PF09 and PF15 are added. The sentences are added to POINT. The sentences of the electronic dynamic brake are added. The serial communication is added to [AL. 8A] and [AL. 8E]. The name of [AL. E1] is changed. POINT is added. The table is changed. The sentences are changed. The sentences are changed. The sentences are changed. The diagram is changed. The connection destination of the servo amplifier is changed. CAUTION is changed. Note is added. The sentences are added to POINT. The sentences are changed. The value in table is changed. The diagram is changed. Added. The part of diagram is changed. The sentences are changed. The sentences are added. Note is changed. The sentences are added. The sentences are added. Added. The sentences are changed. The sentences are changed. The sentences are changed. POINT and diagram are changed. The diagram is changed. Deleted. Deleted. The pin number is changed and Note is deleted. CAUTION is deleted. The sentences are changed. The diagram is added. POINT is changed. TUV certificate of MR-J4 series is added.
Jul. 2012	SH(NA)030107-C	Section 3.2.1 (2) Section 3.2.2 (2) Section 3.2.3 (2)	The part of diagram is changed. The part of diagram is changed. The part of diagram is changed.
Sep. 2012	SH(NA)030107-D	Section 3.2.1 Section 3.2.2 Section 3.10.2 (1) (b) Section 13.3.1 Section 13.4.1 (1) Section 13.4.2 (1)	The diagram is changed. The diagram is changed. The diagram is changed. The sentences are changed. The diagram is changed. The diagram is changed.
Feb. 2013	SH(NA)030107-E	HG-JR, HG-UR, HG-RR servo motor, 11 kW to 22 kW servo amplifier, and MR-J4- _A-RJ servo amplifier are added. Safety 4 (1) Safety Instructions 4 (2) COMPLIANCE WITH CE MARKING	Two items are added to CAUTION. The diagram in CAUTION is changed. The reference is changed.

Print Data	*Manual Number	Revision	
Feb. 2013	SH(NA)030107-E	<p>COMPLIANCE WITH UL/CSA STANDARD COMPLIANCE WITH KC MARK</p> <p>Section 1.1 Section 1.2 Section 1.2 (1) Section 1.2 (2) Section 1.2 (3) Section 1.3</p> <p>Section 1.4 Section 1.5 Section 1.6 (2) Section 1.7.1 (1) Section 1.7.1 (1) to (4) Section 1.7.1 (5), (6) Section 1.7.2 Section 1.8 (1) to (4) Section 1.8 (5), (4) Chapter 2 Section 2.1 (1) (a), (b) Section 2.4 (1) to (6) Chapter 3 Section 3.1 Section 3.1 (1) to (4) Section 3.1 (5) Section 3.2.1 (1) Section 3.2.1 (2) Section 3.2.2 (1) Section 3.2.2 (2) Section 3.2.3 (1) Section 3.2.3 (2) Section 3.3.1 Section 3.3.2 Section 3.3.2 (2) Section 3.4 Section 3.5 (1) (a) Section 3.5 (1) (b) Section 3.6.1 (5) Section 3.6.2 (1) Section 3.6.3 (1), (3) Section 3.6.4 (3) (a) Section 3.6.5 (4) (a) Section 3.6.6 (1) Section 3.7.3 Section 3.9.1 Section 3.10.1 (1) Section 3.10.2 (1) (b) Section 4.1.2 (1) (b) 5) Section 4.1.2 (1) (c) Section 4.5.1 Section 4.5.2 Section 4.5.3 (1) Section 4.5.3 (3) Section 4.5.4 Section 4.5.6 Section 4.5.9 (2) (b) Section 4.5.9 (3) Section 4.5.9 (3) (a) d) Section 4.5.9 (4) Chapter 5</p>	<p>The reference is changed.</p> <p>The reference is changed.</p> <p>The sentences and table of combination are added. POINT is added. CN2L connector, Note 5 and 6 are added. CN2L connector, Note 3 and 4 are added. 11 kW to 22 kW and Note 5 are added. Note 3 is changed. Note 10 and 11 kW to 22 kW are added. A part of specifications is added and changed. POINT is added. The table of combination is changed. Function item is added. Table is changed and added. Table item (17), (18), and Note are added. The diagram is changed. The diagram is changed. 11 kW to 22 kW are added. The sentences are added. CN2L connector and Note 4 are added. 11 kW to 22 kW are added. Two items are added to CAUTION. Note 1 and 2 are added. Note 5 is added. The diagram of CAUTION is changed. POINT is added. CAUTION is added. The connection diagram is changed. Note 11 is added. Newly added. The connection diagram is changed. Note 3 and 4 are changed. The connection diagram is changed. The connection diagram is changed. Note 3 and 4 are changed. The connection diagram is changed. The connection diagram is changed. Note 3 and 4 are changed. The connection diagram is changed. The table is changed. POINT is added. Note is added. Note 1, 2, and CN2L are added. The content is added. The sentences are added. The item is added. The connection diagram is changed. The connection diagram is changed. The connection diagram is changed. The connection diagram is changed. The connection diagram is changed. Note is added. The content is added. Note 4 and 5 are added. The connection diagram is changed. The connection diagram is changed. The content is changed. Newly added. 4) is added. The explanation is added. The display content is added. The display content is added. The display content is added. Note is added. The display content is added. The sentences are changed. The sentences are changed. The sentences are changed. The sentences are changed. CAUTION is added. POINT is added.</p>

Print Data	*Manual Number	Revision	
Feb. 2013	SH(NA)030107-E	Section 5.1.1	[Pr. PA17], [Pr. PA18], and [Pr. PA26] are added. [Pr. PA27] is changed. The operation mode is added.
		Section 5.1.3	[Pr. PC44] and [Pr. PC45] are added. The operation mode is added.
		Section 5.1.1 to 5.1.6	The operation mode is added.
		Section 5.1.6	The name of [Pr. PF25] is changed.
		Section 5.2.1	The content of [Pr. PA01] is added. The sentences of [Pr. PA05] are added. [Pr. PA02], [Pr. PA13] and [Pr. PA19] are changed. The name of [Pr. PA20] is changed.
		Section 5.2.2	The sentences of [Pr. PB17] is changed.
		Section 5.2.3	The setting of [Pr. PC19] is changed. The sentences of [Pr. PC20] is changed. The explanation of [Pr. PC22] is changed. The sentences of [Pr. PC35], [Pr. PC43], and [Pr. PC60] are added. [Pr. PC36] and [Pr. PC27] are changed. [Pr. PC44] and [Pr. PC45] are added. The contents of Note 3 and 4 are added.
		Section 5.2.4	The content of [Pr. PD01] is added. [Pr. PD03], Note 3, and content are added. The content of [Pr. PD23] is added. The content of [Pr. PD30] is changed.
		Section 5.2.5	[Pr. PE01], [Pr. PE03] to [Pr. PE08], [Pr. PE10], [Pr. PE34], [Pr. PE35], and [Pr. PE39] are added.
		Section 5.2.6	The name of [Pr. PF25] is changed.
		Section 5.2.7	Newly added.
		Section 6.2.2	The display of MR Configurator2 is changed.
		Section 6.2.2 (1) (b)	POINT is added.
		Section 6.2.2 (1) (d)	The table is changed.
		Section 6.2.2 (1) (e)	The sentences are added.
		Section 6.2.2 (2)	POINT is added.
		Section 6.2.2 (2) (b)	POINT is added.
		Section 6.3.1 (1)	The content of POINT is changed.
		Section 6.3.4	The table is changed.
		Section 7.1.5 (4)	The content of POINT is changed.
		Section 7.3.2	CAUTION is deleted.
		Section 7.4	Newly added.
		Chapter 8	The operation mode is added. [AL. 93] and [AL. 96.4] are added.
		Section 8.1	The name of [AL. F0.1] is changed.
		Section 9.1	POINT is added.
		Section 9.1 (1) to (7)	The connection diagram is changed.
		Section 9.1 (8), (9)	Newly added.
		Chapter 10	POINT is added.
		Section 10.1	The table is added. The graph is changed and added. Note 3 is added.
		Section 10.2 (1)	Note 3 and content are added to the table. Partially changed.
		Section 10.3.1 (1)	The appended sentence is added.
		Section 10.3.1 (2)	The content is added.
		Section 10.3.2	Note 2 and content are added to the table.
		Section 10.5	The sentences are added. The content of the table is added.
		Chapter 11	POINT is added.
		Section 11.1.1	The diagram is changed and added.
		Section 11.2.1	The content of the table is added. Note 2 is added.
		Section 11.2.2 (1) (b)	The content of the table is added.
		Section 11.2.3	[Pr. PA02] is changed.
		Section 11.2.4 (3), (4)	Newly added.
		Section 11.2.5 (5), (6)	Newly added.

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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-J4-A INSTRUCTIONMANUAL
MODEL CODE	1CW804

mitsubishi electric corporation

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