MITSUBISHI
ELECTRIC

General-Purpose AC Servo

MITSUBISHI SERVO AMPLIFIERS & MOTORS
MELSERVO-J4

SSCNETIII/H Interface
Servo Amplifier Instruction Manual

-MR-J4-_B_
-MR-J4-_B_-RJ

● Safety Instructions ●

Please read the instructions carefully before using the equipment.

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

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

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

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

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

1. To prevent electric shock, note the following

⚠ WARNING

- Before wiring and inspections, turn off the power and wait for 15 minutes or more until the charge lamp turns off. 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 ⏚) of the servo amplifier to the protective earth (PE) of the cabinet.
- To avoid an electric shock, insulate the connections of the power supply terminals.

2. To prevent fire, note the following

⚠ CAUTION

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

3. To prevent injury, note the following

⚠ CAUTION

- Only the power/signal specified in the Instruction Manual should be applied to each terminal. Otherwise, it may cause an electric shock, fire, injury, etc.
- 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 the power is on and for some time after power-off. Take safety measures such as providing covers to avoid accidentally touching them by hands and parts such as cables.

4. Additional instructions

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

(1) Transportation and installation

⚠ CAUTION

- Transport the products correctly according to their mass.
- Stacking in excess of the specified number of product packages is not allowed.
- Do not hold the front cover, cables, or connectors when carrying 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 product. Otherwise, it may cause injury.
- The equipment must be installed in the specified direction.
- Maintain specified clearances between the servo amplifier and the inner surfaces of a control cabinet 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 apply heavy impact on the servo amplifiers and the servo motors. Otherwise, it may cause injury, malfunction, etc.
- Do not strike the connector. Otherwise, it may cause a connection failure, malfunction, etc.
- When you keep or use the equipment, please fulfill the following environment.

Item		Environment
Ambient temperature	Operation	0 °C to 55 °C (non-freezing)
	Storage	-20 °C to 65 °C (non-freezing)
Ambient humidity	Operation	5 %RH to 90 %RH (non-condensing)
	Storage	
Ambience		Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, and dirt
Altitude		2000 m or less above sea level (Contact your local sales office for the altitude for options.)
Vibration resistance		5.9 m/s^2, at 10 Hz to 55 Hz (X, Y, Z axes)

- When the product has been stored for an extended period of time, contact your local sales office.
- When handling the servo motor, be careful with the sharp edges of the servo motor.
- The servo amplifier must be installed in a metal cabinet.

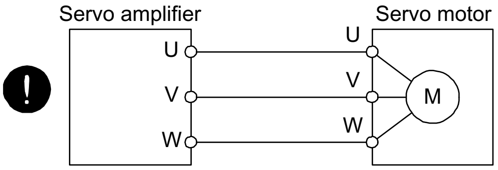
CAUTION

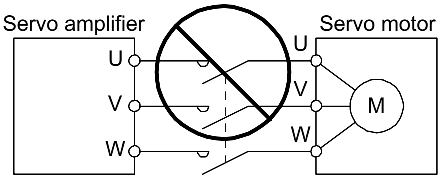
- Fumigants that are used to disinfect and protect wooden packaging from insects contain halogens (such as fluorine, chlorine, bromine, and iodine) cause damage if they enter our products. Please take necessary precautions to ensure that remaining materials from fumigant do not enter our products, or treat packaging with methods other than fumigation, such as heat treatment. Additionally, disinfect and protect wood from insects before packing the products.
- To prevent a fire or injury in case of an earthquake or other natural disasters, securely install, mount, and wire the servo motor in accordance with the Instruction Manual.

(2) Wiring

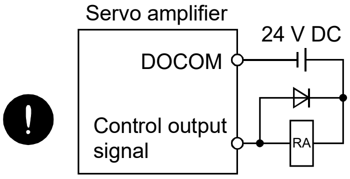
CAUTION

- Wire the equipment correctly and securely. Otherwise, the servo motor may operate unexpectedly.
- Make sure to connect the cables and connectors by using the fixing screws and the locking mechanism. Otherwise, the cables and connectors may be disconnected during operation.
- Do not install a power capacitor, surge killer, or radio noise filter (optional FR-BIF(-H)) on the servo amplifier output side.
- To avoid a malfunction, connect the wires to the correct phase terminals (U/V/W) of the servo amplifier and servo motor.
- Connect the servo amplifier power output (U/V/W) to the servo motor power input (U/V/W) directly. Do not connect a magnetic contactor and others between them. Otherwise, it may cause a malfunction.

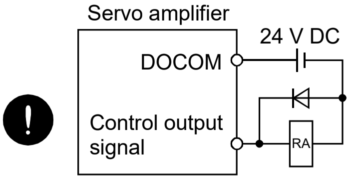




- The connection diagrams in this Instruction Manual are shown for sink interfaces, unless stated otherwise.
- The surge absorbing diode installed to the DC relay for control output should be fitted in the specified direction. Otherwise, the converter unit and the drive unit will malfunction and will not output signals, disabling the emergency stop and other protective circuits.



For sink output interface



For source output interface

- When the wires are not tightened enough to the terminal block, the wires or terminal block may generate heat because of the poor contact. Be sure to tighten the wires with specified torque.
- Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
- Configure a circuit to turn off EM2 or EM1 when the main circuit power supply is turned off to prevent an unexpected restart of the servo amplifier.
- To prevent malfunction, 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.

(3) Test run and adjustment

⚠ CAUTION

- When executing a test run, follow the notice and procedures in this instruction manual. Otherwise, it may cause a malfunction, damage to the machine, or injury.
- Before operation, check and adjust the parameter settings. Improper settings may cause some machines to operate unexpectedly.
- Never make a drastic adjustment or change to the parameter values as doing so will make the operation unstable.
- Do not get close to moving parts during the servo-on status.

(4) Usage

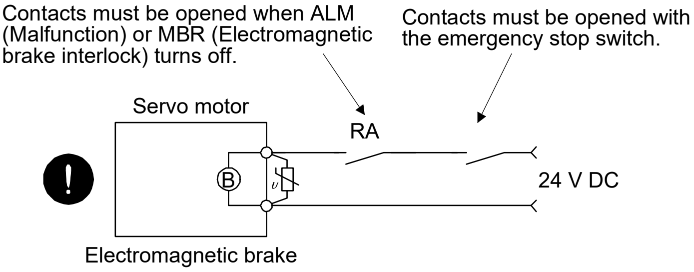
⚠ CAUTION

- Provide an external emergency stop circuit to stop the operation and shut the power off immediately.
- For equipment in which the moving part of the machine may collide against the load side, install a limit switch or stopper to the end of the moving part. The machine may be damaged due to a collision.
- Do not disassemble, repair, or modify the product. Otherwise, it may cause an electric shock, fire, injury, etc. Disassembled, repaired, and/or modified products are not covered under warranty.
- Before resetting an alarm, make sure that the run signal of the servo amplifier is off in order to prevent a sudden restart. Otherwise, it may cause an accident.
- Use a noise filter, etc., to minimize the influence of electromagnetic interference. Electromagnetic interference may affect the electronic equipment used near the servo amplifier.
- Do not burn or destroy the servo amplifier. Doing so may generate a toxic gas.
- Use the servo amplifier with the specified servo motor.
- Wire options and peripheral equipment, etc. correctly in the specified combination. Otherwise, it may cause an electric shock, fire, injury, etc.
- 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 incorrect wiring, 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.
- If the dynamic brake is activated at power-off, alarm occurrence, etc., do not rotate the servo motor by an external force. Otherwise, it may cause a malfunction of the dynamic brake or a fire.

(5) Corrective actions

⚠ CAUTION

- ●Ensure safety by confirming the power off, etc. before performing corrective actions. Otherwise, it may cause an accident.
- ●If it is assumed that a power failure, machine stoppage, or product malfunction may result in a hazardous situation, use a servo motor with an electromagnetic brake or provide an external brake system for holding purpose to prevent such hazard.
- ●Configure an electromagnetic brake circuit which is interlocked with an external emergency stop switch.



- ●Failure of MBR (Electromagnetic brake interlock) or ALM (Malfunction) may cause brake malfunction.
- ●When an alarm occurs, eliminate its cause, ensure safety, and deactivate the alarm to restart operation.
- ●If the molded-case circuit breaker or fuse is activated, be sure to remove the cause and secure safety before switching the power on. If necessary, replace the servo amplifier and recheck the wiring. Otherwise, it may cause smoke, fire, or an electric shock.
- ●Provide an adequate protection to prevent unexpected restart after an instantaneous power failure.
- ●After an earthquake or other natural disasters, ensure safety by checking the conditions of the installation, mounting, wiring, and equipment before switching the power on to prevent an electric shock, injury, or fire.

(6) Maintenance, inspection and parts replacement

⚠ CAUTION

- ●Make sure that the emergency stop circuit operates properly such that an operation can be stopped immediately and a power is shut off by the emergency stop switch.
- ●It is recommended that the servo amplifier be replaced every 10 years when it is used in general environment.
- ●When using the servo amplifier that has not been energized for an extended period of time, contact your local sales office.

(7) General instruction

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

⚠ EEP-ROM life

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

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

STO function of the servo amplifier

The servo amplifier complies with safety integrity level 3 (SIL 3) of the IEC 61508:2010 functional safety standard.
Refer to app. 14 for schedule.
When using the STO function of the servo amplifier, refer to chapter 13.
For the MR-J3-D05 safety logic unit, refer to app. 5.

Compliance with global standards

For the compliance with global standards, refer to app. 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 MR-D30 Instruction Manual (Note 5)	SH(NA)030132ENG
MELSERVO MR-CV_/MR-CR55K_/MR-J4-DU_(-RJ) Instruction Manual (Note 6)	SH(NA)030153ENG
MELSERVO-J4 Servo Amplifier Instruction Manual (Troubleshooting)	SH(NA)030109ENG
MELSERVO Servo Motor Instruction Manual (Vol. 3) (Note 1)	SH(NA)030113ENG
MELSERVO Linear Servo Motor Instruction Manual (Note 2)	SH(NA)030110ENG
MELSERVO Direct Drive Motor Instruction Manual (Note 3)	SH(NA)030112ENG
MELSERVO Linear Encoder Instruction Manual (Note 2, 4)	SH(NA)030111ENG
MELSERVO EMC Installation Guidelines	IB(NA)67310ENG

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.
5. It is necessary for using an MR-D30 functional safety unit.
6. It is necessary for using an MR-CV_ power regeneration converter unit/MR-CR_ resistance regeneration converter unit, and MR-J4-DU_B_(-RJ) drive unit.

«Wiring»

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

«U.S. customary units»

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

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

Global standards and regulations

Compliance with the indicated global standards and regulations is current as of the release date of this manual. Some standards and regulations may have been modified or withdrawn.

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MEMO

1. FUNCTIONS AND CONFIGURATION

1.1 Summary

The Mitsubishi Electric MELSERVO-J4 series general-purpose AC servo has further higher performance and higher functions compared to the previous MELSERVO-J3 series.
MR-J4-_B_ servo amplifier is connected to controllers, including a servo system controller, on the high-speed synchronous network SSCNET III/H. The servo amplifier directly receives a command from a controller to drive a servo motor.
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 MELSERVO-J3 series.
MR-J4-_B_ servo amplifier operates MELSERVO-J4 series compatible rotary servo motors, linear servo motors, and direct drive motors as standard.
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.
SSCNET III/H achieves high-speed communication of 150 Mbps full duplex with high noise tolerance due to the SSCNET III optical cables. Large amounts of data are exchanged in real-time between the controller and the servo amplifier. Servo monitor information is stored in the upper information system and is used for control.
On the SSCNET III/H network, the stations are connected with a maximum distance of 100 m between them. This allows you to create a large system.
The MR-J4-_B_ servo amplifier supports the STO (Safe Torque Off) function. When the servo amplifier is connected to a SSCNET III/H-compatible servo system controller, in addition to the STO function, the servo amplifier also supports the SS1 (Safe Stop 1), SS2 (Safe Stop 2), SOS (Safe Operating Stop), SLS (Safely-Limited Speed), SBC (Safe Brake Control) and SSM (Safe Speed Monitor) functions.
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 MELSERVO-J4 series, servo amplifiers with CN2L connector is also available as MR-J4-_B_-RJ. By using CN2L connector, an A/B/Z-phase differential output method 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 MR-J4-_B_ and MR-J4-_B_-RJ servo amplifiers.

Table 1.1 Connectors to connect external encoders

Operation mode	External encoder communication method	Connector	
		MR-J4-_B_	MR-J4-_B_-RJ
Linear servo system	Two-wire type	CN2 (Note 1)	CN2 (Note 1)
	Four-wire type		
	A/B/Z-phase differential output method		CN2L (Note 6)
Fully closed loop system	Two-wire type	CN2 (Note 2, 3, 4)	CN2L
	Four-wire type		
	A/B/Z-phase differential output method		
Scale measurement function	Two-wire type	CN2 (Note 2, 3, 5)	CN2L (Note 5)
	Four-wire type		
	A/B/Z-phase differential output method		

Note 1. The MR-J4THCBL03M branch cable is necessary.
2. The MR-J4FCCBL03M branch cable is necessary.
3. When the communication method of the servo motor encoder is four-wire type, MR-J4-_B_ cannot be used. Use an MR-J4-_B_-RJ.
4. This is used with servo amplifiers with software version A3 or later.
5. This is used with servo amplifiers with software version A8 or later.
6. Connect a thermistor to CN2.

1.2 Function block diagram

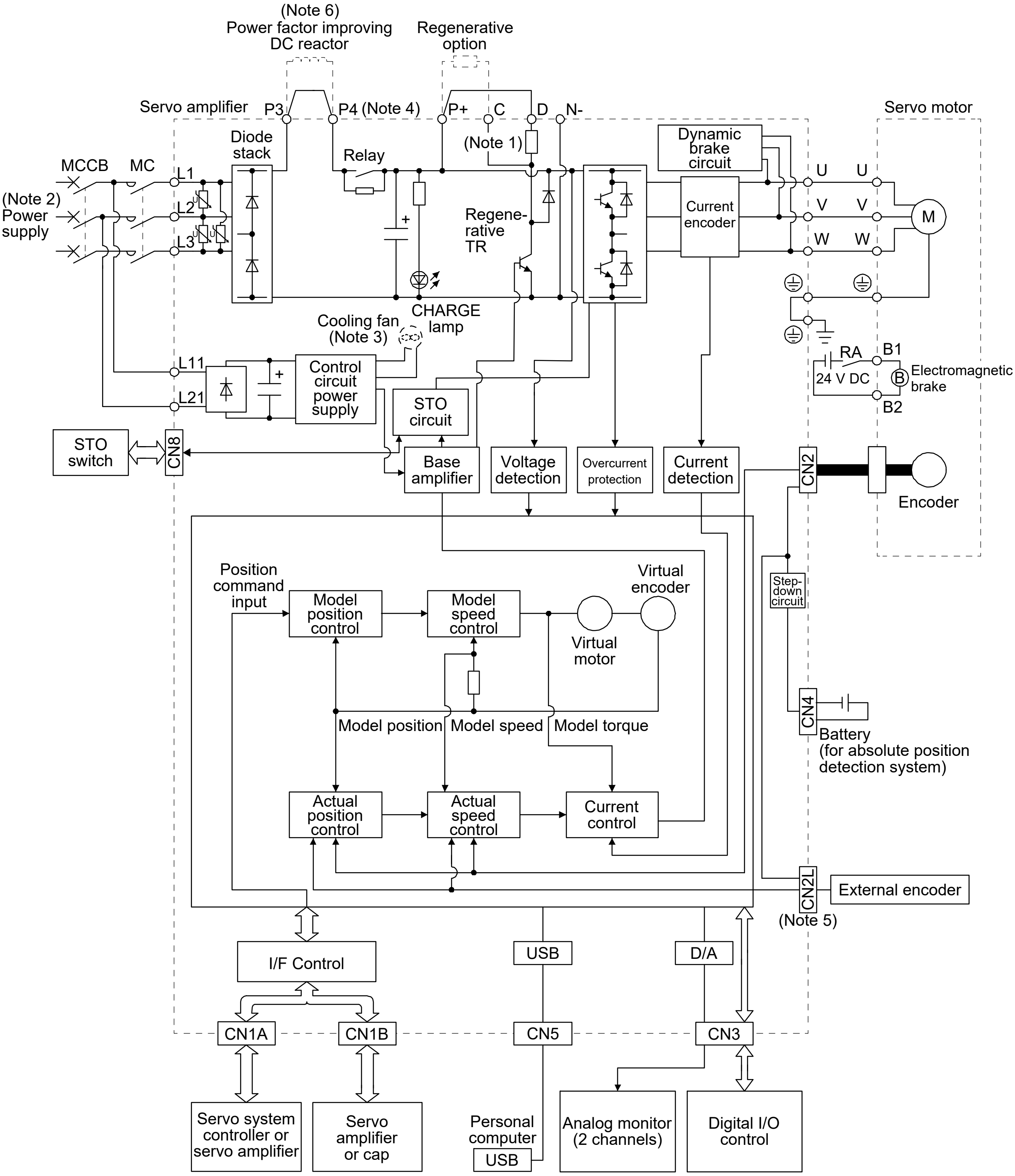
The function block diagram of this servo is shown below.

POINT

- The diagram shows for MR-J4-_B_-RJ as an example. MR-J4-_B_ servo amplifier does not have CN2L connector.

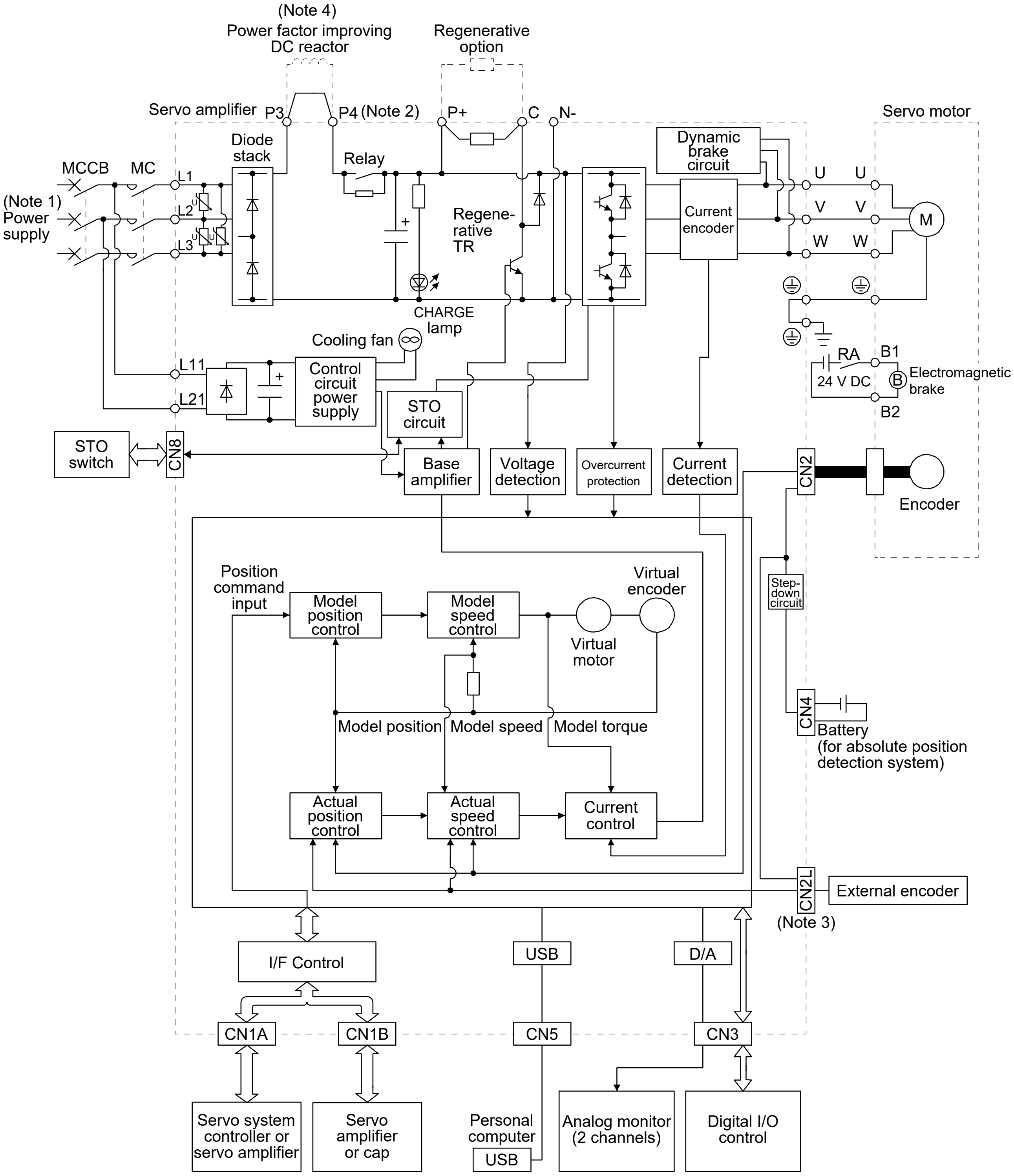
(1) 200 V class

(a) MR-J4-500B(-RJ) or less



Note 1. The built-in regenerative resistor is not provided for MR-J4-10B(-RJ).
2. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open. Refer to section 1.3 for the power supply specifications.
3. Servo amplifiers MR-J4-70B(-RJ) or more have a cooling fan.
4. 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.
5. This is for MR-J4-_B-RJ servo amplifier. MR-J4-_B servo amplifier does not have 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.

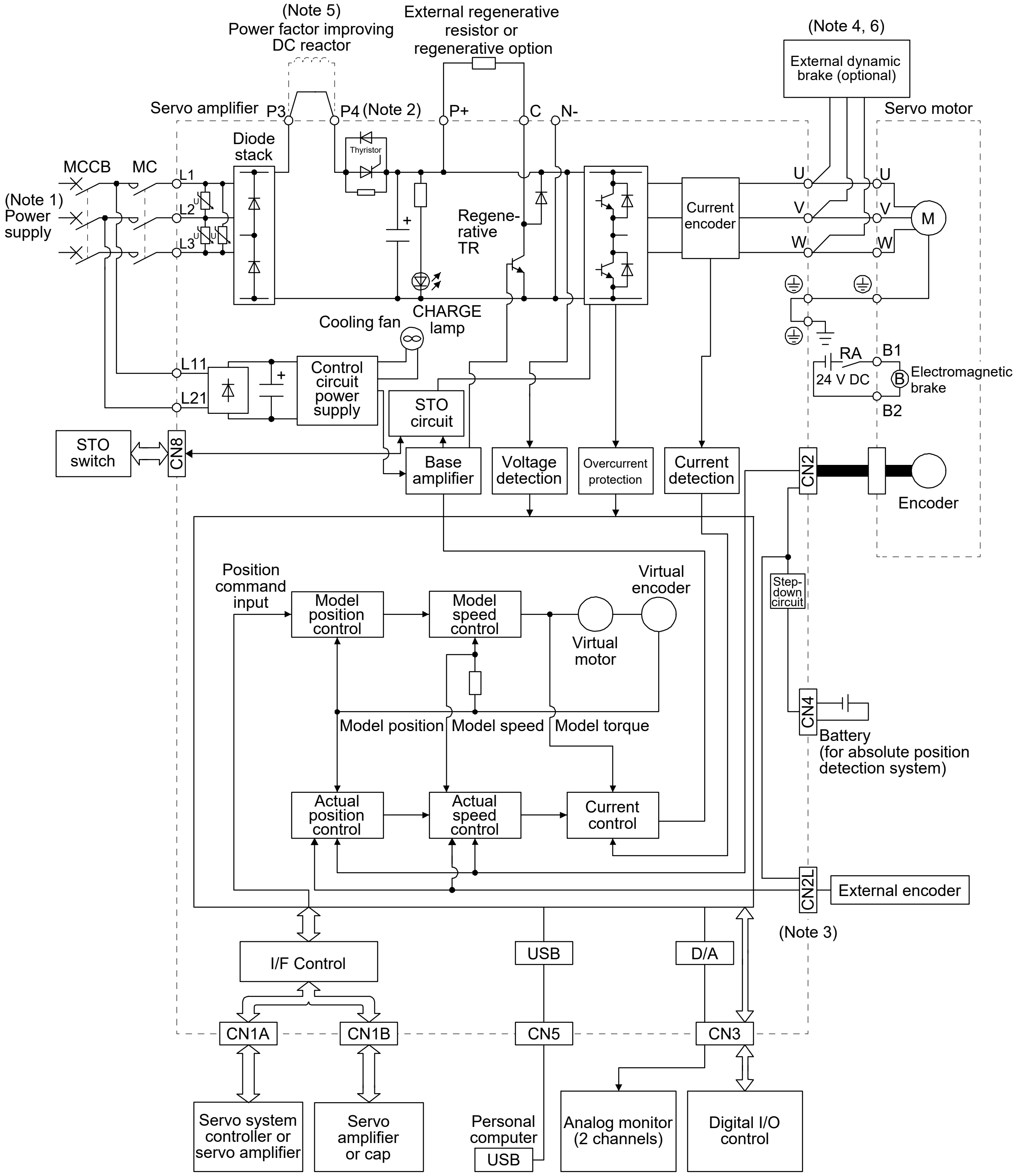
(b) MR-J4-700B(-RJ)



Note 1. Refer to section 1.3 for the power supply specifications.

2. 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.
3. This is for MR-J4-_B-RJ servo amplifier. MR-J4-_B servo amplifier does not have CN2L connector.
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.

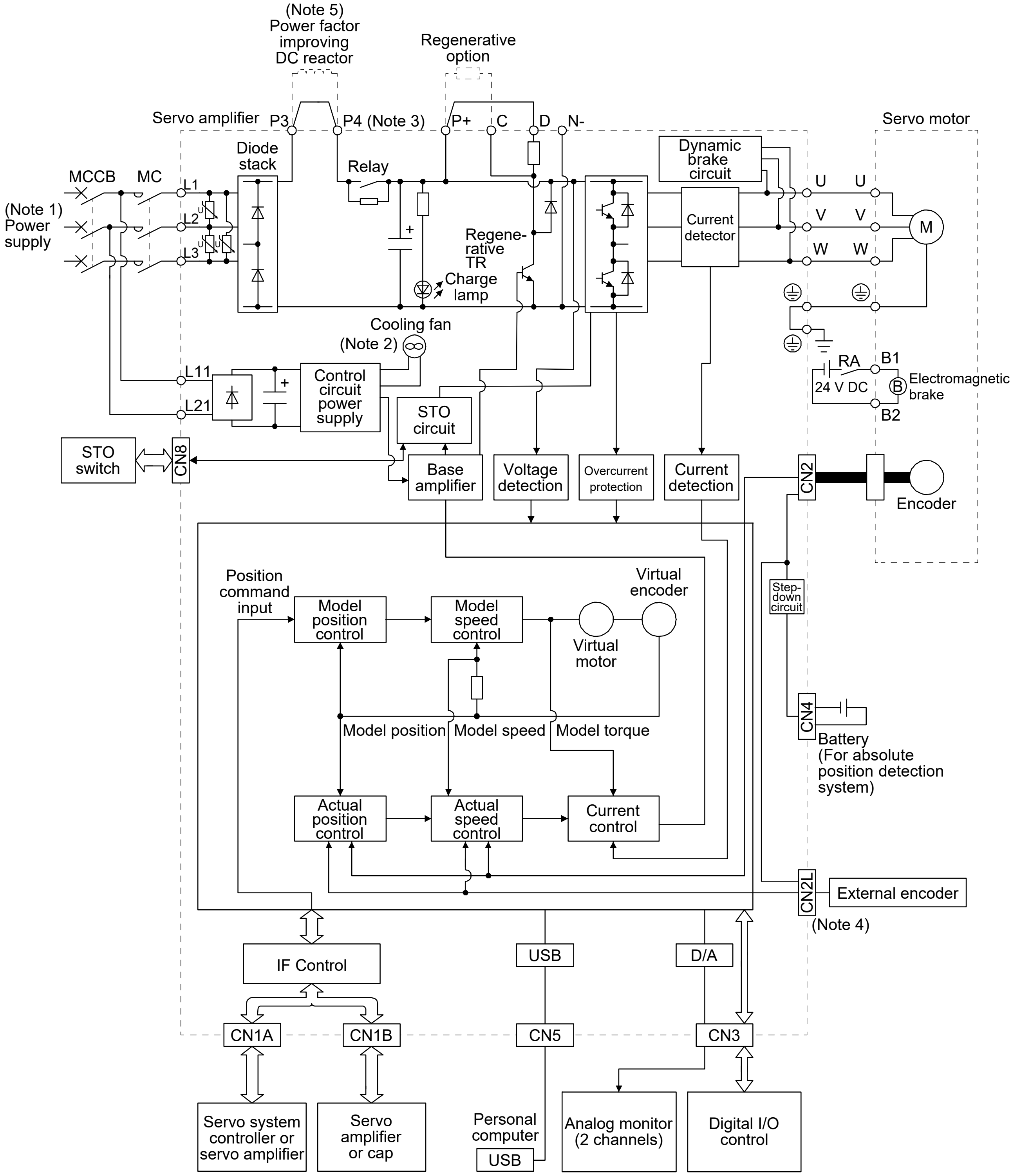
(c) MR-J4-11KB(-RJ)/MR-J4-15KB(-RJ)/MR-J4-22KB(-RJ)



Note 1. Refer to section 1.3 for the power supply specifications.
2. 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.
3. This is for MR-J4-_B-RJ servo amplifier. MR-J4-_B servo amplifier does not have CN2L connector.
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 chapter 8.
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.
6. The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD07] to [Pr. PD09]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.

(2) 400 V class

(a) MR-J4-350B4(-RJ) or less



Note 1. Refer to section 1.3 for the power supply specification.

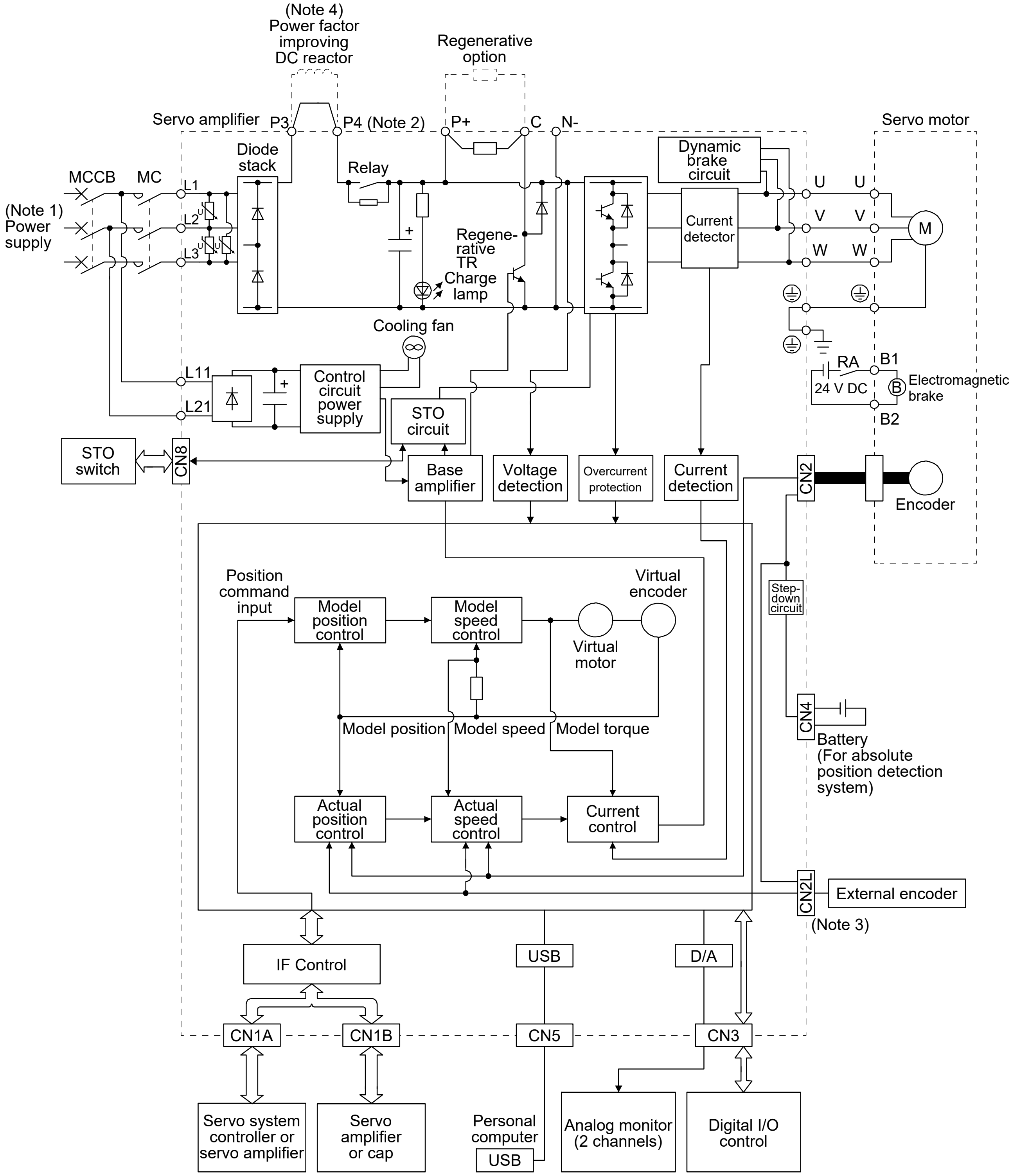
2. Servo amplifiers MR-J4-200B4(-RJ) or more have a cooling fan.

3. 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.

4. This is for MR-J4-_B4-RJ servo amplifier. MR-J4-_B4 servo amplifier does not have CN2L connector.

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.

(b) MR-J4-500B4(-RJ)/MR-J4-700B4(-RJ)



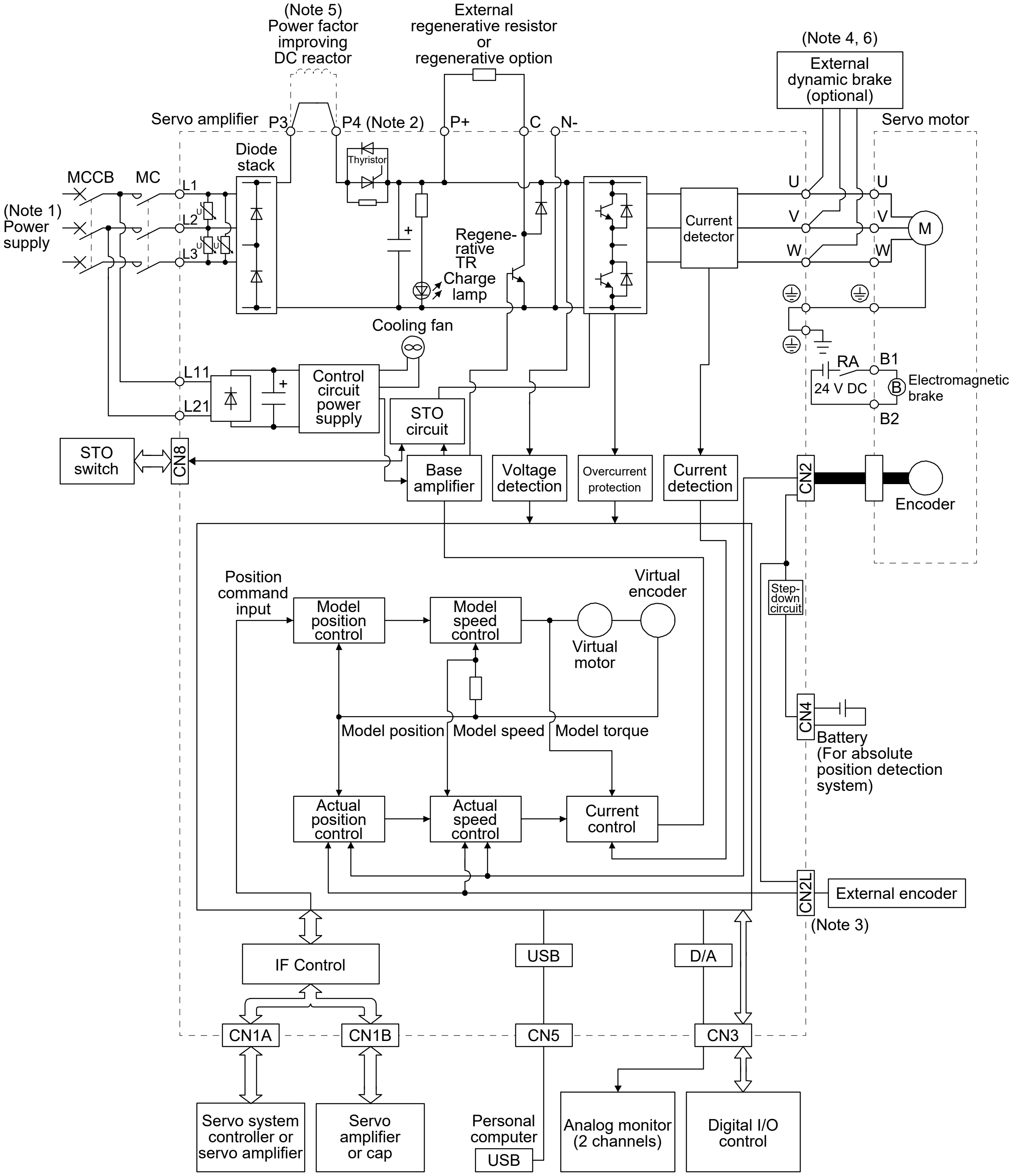
Note 1. Refer to section 1.3 for the power supply specification.

2. 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.

3. This is for MR-J4-_B4-RJ servo amplifier. MR-J4-_B4 servo amplifier does not have CN2L connector.

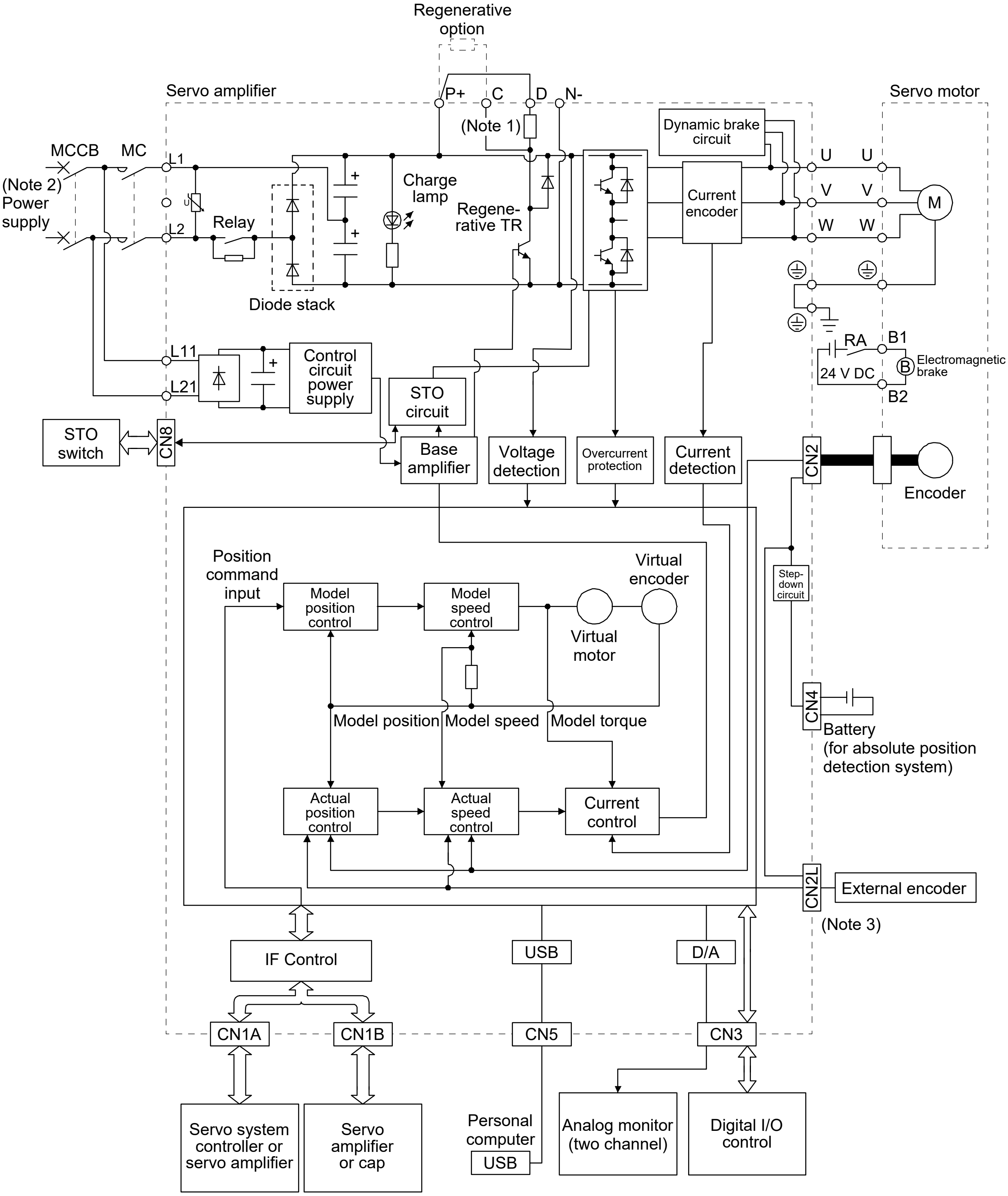
4. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.

(c) MR-J4-11KB4(-RJ)/MR-J4-15KB4(-RJ)/MR-J4-22KB4(-RJ)



Note
1. Refer to section 1.3 for the power supply specification.
2. 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.
3. This is for MR-J4-_B4-RJ servo amplifier. MR-J4-_B4 servo amplifier does not have CN2L connector.
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 chapter 8.
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.
6. The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD07] to [Pr. PD09]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.

(3) 100 V class



Note 1. The built-in regenerative resistor is not provided for MR-J4-10B1(-RJ).
2. Refer to section 1.3 for the power supply specifications.
3. This is for MR-J4-_B1-RJ servo amplifier. MR-J4-_B1 servo amplifier does not have CN2L connector.

1.3 Servo amplifier standard specifications

(1) 200 V class

Model: MR-J4-_(-RJ)			10B	20B	40B	60B	70B	100B	200B	350B	500B	700B	11KB	15KB	22KB
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 input	Voltage/ Frequency	At AC input	3-phase or 1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz					3-phase or 1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz (Note 13)		3-phase 200 V AC to 240 V AC, 50 Hz/60 Hz					
		At DC input (Note 16)	283 V DC to 340 V DC												
	Rated current (Note 11) [A]		0.9 (1.5)	1.5 (2.5)	2.6 (4.5)	3.2 (5.0) (Note 6)	3.8 (6.5)	5.0 (10.5)	10.5 (15.8)	16.0	21.7	28.9	46.0	64.0	95.0
	Permissible voltage fluctuation	At AC input	3-phase or 1-phase 170 V AC to 264 V AC					3-phase or 1-phase 170 V AC to 264 V AC (Note 13)		3-phase 170 V AC to 264 V AC					
		At DC input (Note 16)	241 V DC to 374 V DC												
	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 input	Voltage/ Frequency	At AC input	1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz												
		At DC input (Note 16)	283 V DC to 340 V DC												
	Rated current [A]		0.2								0.3				
	Permissible voltage fluctuation	At AC input	1-phase 170 V AC to 264 V AC												
		At DC input (Note 16)	241 V DC to 374 V DC												
	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]		0.3 (including CN8 connector signals) (Note 1)												
Control method			Sine-wave PWM control, current control method												
Dynamic brake			Built-in										External option (Note 9, 12)		
SSCNET III/H communication cycle (Note 8)			0.222 ms, 0.444 ms, 0.888 ms												
Fully closed loop control			Compatible (Note 7)												
Scale measurement function			Compatible (Note 10)												
Load-side encoder interface (Note 5)			Mitsubishi Electric high-speed serial communication												
Communication function			USB: connection to a personal computer or others (MR Configurator2-compatible)												
Encoder output pulses			Compatible (A/B/Z-phase pulse)												
Analog monitor			Two channels												
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												
Functional safety			STO (IEC/EN 61800-5-2)												

Model: MR-J4-_(-RJ)			10B	20B	40B	60B	70B	100B	200B	350B	500B	700B	11KB	15KB	22KB
Safety performance	Standards (Note 14)		EN ISO 13849-1:2015 Category 3 PL e, IEC 61508 SIL 3, EN IEC 62061 maximum SIL 3, EN 61800-5-2												
	Response performance		8 ms or less (STO input off → energy shut off)												
	Test pulse input (STO) (Note 3)		Test pulse interval: 1 Hz to 25 Hz Test pulse off time: Up to 1 ms												
	Mean time to dangerous failure (MTTFd)		MTTFd ≥ 100 [years] (314a)												
	Diagnostic coverage (DC)		DC = Medium, 97.6 [%]												
	Probability of dangerous failures per hour (PFH)		PFH = 6.4 × 10^{-9} [1/h]												
Global standards	CE marking		LVD: EN 61800-5-1, EMC: EN 61800-3, MD: EN ISO 13849-1:2015, EN 61800-5-2, EN IEC 62061												
	UKCA marking		LVD: BS EN 61800-5-1, EMC: BS EN IEC 61800-3, MD: BS EN ISO 13849-1:2015, BS EN 61800-5-2, BS EN IEC 62061												
	UL standard		UL 61800-5-1												
Structure (IP rating)			Natural cooling, open (IP20)				Force cooling, open (IP20)				Force cooling, open (IP20) (Note 4)				
Close mounting (Note 2)	3-phase power supply input		Possible									Impossible			
	1-phase power supply input		Possible					Impossible							
Environment	Ambient temperature	Operation	0 ˚C to 55 ˚C (non-freezing)												
		Storage	-20 ˚C to 65 ˚C (non-freezing)												
	Ambient humidity	Operation	5 %RH to 90 %RH (non-condensing)												
		Storage													
	Ambience		Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, and dirt												
	Altitude		2000 m or less above sea level (Note 15)												
	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 1. 0.3 A is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points.

2. When closely mounting the servo amplifiers, operate them at the ambient temperature of 0 ˚C to 45 ˚C or at 75% or smaller effective load ratio.

3. 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.

4. Except for the terminal block.

5. MR-J4-_B servo amplifier is compatible only with two-wire type. MR-J4-_B-RJ servo amplifier is compatible with two-wire type, four-wire type, and A/B/Z-phase differential output method. Refer to table 1.1 for details.

6 The rated current is 2.9 A when the servo amplifier is used with the 3-phase power supply and a UL or CSA compliant servo motor.

7. For the compatible version of fully closed loop system, refer to table 1.1.

8. The communication cycle depends on the controller specifications and the number of axes connected.

9. 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.

10. For the compatible version for the scale measurement function, refer to table 1.1.

11. The value in ( ) is the rated current for the 1-phase power supply input.

12. The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD07] to [Pr. PD09]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.

13. When using 1-phase 200 V AC to 240 V AC power supply, operate the servo amplifier at 75% or smaller effective load ratio.

14. The safety level depends on the setting value of [Pr. PF18 STO diagnosis error detection time] and whether STO input diagnosis by TOFB output is performed or not. For details, refer to the Function column of [Pr. PF18] in section 5.2.6.

15. Follow the restrictions in section 2.7 when using this product at altitude exceeding 1000 m and up to 2000 m above sea level.

16. The DC power supply input is available only with MR-J4-_B-RJ servo amplifiers. For parameter setting values when a DC input is used, refer to the Function column of [Pr. PC20] in section 5.2.3. For the connection example of the power circuit, refer to app. 16.

(2) 400 V class

Model: MR-J4-_(-RJ)		60B4	100B4	200B4	350B4	500B4	700B4	11KB4	15KB4	22KB4
Output	Rated voltage	3-phase 323 V AC								
	Rated current [A]	1.5	2.8	5.4	8.6	14.0	17.0	32.0	41.0	63.0
Main circuit power supply input	Voltage/Frequency	3-phase 380 V AC to 480 V AC, 50 Hz/60 Hz								
	Rated current [A]	1.4	2.5	5.1	7.9	10.8	14.4	23.1	31.8	47.6
	Permissible voltage fluctuation	3-phase 323 V AC to 528 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 input	Voltage/Frequency	1-phase 380 V AC to 480 V AC, 50 Hz/60 Hz								
	Rated current [A]	0.1			0.2					
	Permissible voltage fluctuation	1-phase 323 V AC to 528 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]	0.3 (including CN8 connector signals) (Note 1)								
Control method		Sine-wave PWM control, current control method								
Dynamic brake		Built-in						External option (Note 6, 8)		
SSCNET III/H communication cycle (Note 5)		0.222 ms, 0.444 ms, 0.888 ms								
Fully closed loop control		Compatible								
Scale measurement function		Compatible (Note 7)								
Load-side encoder interface (Note 4)		Mitsubishi Electric high-speed serial communication								
Communication function		USB: connection to a personal computer or others (MR Configurator2-compatible)								
Encoder output pulses		Compatible (A/B/Z-phase pulse)								
Analog monitor		Two channels								
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								
Functional safety		STO (IEC/EN 61800-5-2)								
Safety performance	Standards (Note 9)	EN ISO 13849-1:2015 Category 3 PL e, IEC 61508 SIL 3, EN IEC 62061 maximum SIL 3, EN 61800-5-2								
	Response performance	8 ms or less (STO input off → energy shut off)								
	Test pulse input (STO) (Note 2)	Test pulse interval: 1 Hz to 25 Hz Test pulse off time: Up to 1 ms								
	Mean time to dangerous failure (MTTFd)	MTTFd ≥ 100 [years] (314a)								
	Diagnosis converge (DC)	DC = Medium, 97.6 [%]								
	Probability of dangerous failures per hour (PFH)	PFH = 6.4×10^{-9} [1/h]								
Global standards	CE marking	LVD: EN 61800-5-1, EMC: EN 61800-3, MD: EN ISO 13849-1:2015, EN 61800-5-2, EN IEC 62061								
	UKCA marking	LVD: BS EN 61800-5-1, EMC: BS EN IEC 61800-3, MD: BS EN ISO 13849-1:2015, BS EN 61800-5-2, BS EN IEC 62061								
	UL standard	UL 61800-5-1								
Structure (IP rating)		Natural cooling, open (IP20)		Force cooling, open (IP20)		Force cooling, open (IP20) (Note 3)				
Close mounting		Impossible								

Model: MR-J4-_(-RJ)			60B4	100B4	200B4	350B4	500B4	700B4	11KB4	15KB4	22KB4
Environment	Ambient temperature	Operation	0 ˚C to 55 ˚C (non-freezing)								
		Storage	-20 ˚C to 65 ˚C (non-freezing)								
	Ambient humidity	Operation	5 %RH to 90 %RH (non-condensing)								
		Storage									
	Ambience		Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, and dirt								
	Altitude		2000 m or less above sea level (Note 10)								
	Vibration resistance		5.9 m/s^2, at 10 Hz to 55 Hz (directions of X, Y and Z axes)								
Mass		[kg]	1.7		2.1	3.6	4.3	6.5	13.4		18.2

Note 1. 0.3 A is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points.

2. 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.

3. Except for the terminal block.

4. MR-J4-B4 servo amplifier is compatible only with two-wire type. MR-J4-B4-RJ servo amplifier is compatible with two-wire type, four-wire type, and A/B/Z-phase differential output method. Refer to table 1.1 for details.

5. The communication cycle depends on the controller specifications and the number of axes connected.

6. 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.

7. For the compatible version for the scale measurement function, refer to table 1.1.

8. The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD07] to [Pr. PD09]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.

9. The safety level depends on the setting value of [Pr. PF18 STO diagnosis error detection time] and whether STO input diagnosis by TOFB output is performed or not. For details, refer to the Function column of [Pr. PF18] in section 5.2.6.

10. Follow the restrictions in section 2.7 when using this product at altitude exceeding 1000 m and up to 2000 m above sea level.

(3) 100 V class

Model: MR-J4-_(-RJ)		10B1	20B1	40B1
Output	Rated voltage	3-phase 170 V AC		
	Rated current [A]	1.1	1.5	2.8
Main circuit power supply input	Voltage/Frequency	1-phase 100 V AC to 120 V AC, 50 Hz/60 Hz		
	Rated current [A]	3.0	5.0	9.0
	Permissible voltage fluctuation	1-phase 85 V AC to 132 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 input	Voltage/Frequency	1-phase 100 V AC to 120 V AC, 50 Hz/60 Hz		
	Rated current [A]	0.4		
	Permissible voltage fluctuation	1-phase 85 V AC to 132 V AC		
	Permissible frequency fluctuation	Within ±5%		
	Power consumption [W]	30		
	Inrush current [A]	Refer to section 10.5.		
Interface power supply	Voltage	24 V DC ± 10%		
	Current capacity [A]	0.3 (including CN8 connector signals) (Note 1)		
Control method		Sine-wave PWM control, current control method		
Dynamic brake		Built-in		
SSCNET III/H communication cycle (Note 6)		0.222 ms, 0.444 ms, 0.888 ms		
Fully closed loop control		Compatible (Note 5)		
Scale measurement function		Compatible (Note 7)		
Load-side encoder interface (Note 4)		Mitsubishi Electric high-speed serial communication		
Communication function		USB: connection to a personal computer or others (MR Configurator2-compatible)		
Encoder output pulses		Compatible (A/B/Z-phase pulse)		
Analog monitor		Two channels		
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		
Functional safety		STO (IEC/EN 61800-5-2)		
Safety performance	Standards (Note 8)	EN ISO 13849-1:2015 Category 3 PL e, IEC 61508 SIL 3, EN IEC 62061 maximum SIL 3, EN 61800-5-2		
	Response performance	8 ms or less (STO input off → energy shut off)		
	Test pulse input (STO) (Note 3)	Test pulse interval: 1 Hz to 25 Hz Test pulse off time: Up to 1 ms		
	Mean time to dangerous failure (MTTFd)	MTTFd ≥ 100 [years] (314a)		
	Diagnostic coverage (DC)	DC = Medium, 97.6 [%]		
	Probability of dangerous failures per hour (PFH)	PFH = 6.4×10^{-9} [1/h]		
Global standards	CE marking	LVD: EN 61800-5-1, EMC: EN 61800-3, MD: EN ISO 13849-1:2015, EN 61800-5-2, EN IEC 62061		
	UKCA marking	LVD: BS EN 61800-5-1, EMC: BS EN IEC 61800-3, MD: BS EN ISO 13849-1:2015, BS EN 61800-5-2, BS EN IEC 62061		
	UL standard	UL 61800-5-1		
Structure (IP rating)		Natural cooling, open (IP20)		
Close mounting (Note 2)		Possible		

Model: MR-J4-_(-RJ)			10B1	20B1	40B1
Environment	Ambient temperature	Operation	0 °C to 55 °C (non-freezing)		
		Storage	-20 °C to 65 °C (non-freezing)		
	Ambient humidity	Operation	5 %RH to 90 %RH (non-condensing)		
		Storage			
	Ambience		Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, and dirt		
	Altitude		2000 m or less above sea level (Note 9)		
	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

Note 1. 0.3 A is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points.

2. When closely mounting the servo amplifiers, operate them at the ambient temperature of 0 °C to 45 °C or at 75% or smaller effective load ratio.
3. 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.
4. MR-J4-_B servo amplifier is compatible only with two-wire type. MR-J4-_B-RJ servo amplifier is compatible with two-wire type, four-wire type, and A/B/Z-phase differential output method. Refer to table 1.1 for details.
5. For the compatible version of fully closed loop system, refer to table 1.1.
6 The communication cycle depends on the controller specifications and the number of axes connected.
7. For the compatible version for the scale measurement function, refer to table 1.1.
8. The safety level depends on the setting value of [Pr. PF18 STO diagnosis error detection time] and whether STO input diagnosis by TOFB output is performed or not. For details, refer to the Function column of [Pr. PF18] in section 5.2.6.
9. Follow the restrictions in section 2.7 when using this product at altitude exceeding 1000 m and up to 2000 m above sea level.

1.4 Combinations of servo amplifiers and servo motors

POINT

- ●When a 1-phase 200 V AC input is used, the maximum torque of 400% cannot be achieved with HG-JR series servo motor.
- ●When you use the MR-J4-100B(-RJ) or MR-J4-200B(-RJ) with the 1-phase 200 V AC input, contact your local sales office for the torque characteristics of the HG-UR series, HG-RR series, and HG-JR series servo motors.

(1) 200 V class

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		
MR-J4-10B(-RJ)	053 13	053 13						
MR-J4-20B(-RJ)	23	23					LM-U2PAB-05M-0SS0 LM-U2PBB-07M-1SS0	TM-RFM002C20 TM-RG2M002C30 (Note 1) TM-RU2M002C30 (Note 1) TM-RG2M004E30 (Note 1) TM-RU2M004E30 (Note 1)
MR-J4-40B(-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 TM-RG2M004E30 (Note 1, 3) TM-RU2M004E30 (Note 1, 3) TM-RG2M009G30 (Note 1) TM-RU2M009G30 (Note 1)
MR-J4-60B(-RJ)			51 52			53	LM-U2PBD-15M-1SS0	TM-RFM006C20 TM-RFM006E20
MR-J4-70B(-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-J4-100B(-RJ)			81 102			53 (Note 2) 103		TM-RFM018E20
MR-J4-200B(-RJ)			121 201 152 202	152	103 153	73 (Note 2) 103 (Note 2) 153 203	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-J4-350B(-RJ)			301 352	202	203	153 (Note 2) 203 (Note 2) 353	LM-H3P7D-96P-ASS0 LM-K2P2C-07M-1SS1 LM-K2P3C-14M-1SS1 LM-U2P2C-60M-2SS0	TM-RFM048G20 TM-RFM072G20 TM-RFM120J10
MR-J4-500B(-RJ)			421 502	352 502	353 503	353 (Note 2) 503	LM-FP2D-12M-1SS0 LM-FP4B-12M-1SS0 LM-K2P2E-12M-1SS1 LM-K2P3E-24M-1SS1 LM-U2P2D-80M-2SS0	TM-RFM240J10
MR-J4-700B(-RJ)			702			503 (Note 2) 601 701M 703	LM-FP2F-18M-1SS0 LM-FP4D-24M-1SS0	
MR-J4-11KB(-RJ)						801 12K1 11K1M 903	LM-FP4F-36M-1SS0	
MR-J4-15KB(-RJ)						15K1 15K1M	LM-FP4F-48M-1SS0	
MR-J4-22KB(-RJ)						20K1 25K1 22K1M		

Note 1. This is available with servo amplifiers with software version C8 or later.
2. This combination increases the maximum torque of the servo motor to 400%.
3. This combination increases the rated torque and the maximum torque.

(2) 400 V class

Servo amplifier	Rotary servo motor		Linear servo motor (primary side)
	HG-SR	HG-JR	
MR-J4-60B4(-RJ)	524	534	
MR-J4-100B4(-RJ)	1024	534 (Note) 734 1034	
MR-J4-200B4(-RJ)	1524 2024	734 (Note) 1034 (Note) 1534 2034	
MR-J4-350B4(-RJ)	3524	1534 (Note) 2034 (Note) 3534	
MR-J4-500B4(-RJ)	5024	3534 (Note) 5034	
MR-J4-700B4(-RJ)	7024	5034 (Note) 6014 701M4 7034	
MR-J4-11KB4(-RJ)		8014 12K14 11K1M4 9034	
MR-J4-15KB4(-RJ)		15K14 15K1M4	
MR-J4-22KB4(-RJ)		20K14 25K14 22K1M4	LM-FP5H-60M-1SS0

Note. This combination is for increasing the maximum torque of the servo motor to 400%.

(3) 100 V class

Servo amplifier	Rotary servo motor		Linear servo motor (primary side)	Direct drive motor
	HG-KR	HG-MR		
MR-J4-10B1(-RJ)	053 13	053 13		
MR-J4-20B1(-RJ)	23	23	LM-U2PAB-05M-0SS0 LM-U2PBB-07M-1SS0	TM-RFM002C20 TM-RG2M002C30 (Note 1) TM-RU2M002C30 (Note 1) TM-RG2M004E30 (Note 1) TM-RU2M004E30 (Note 1)
MR-J4-40B1(-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 TM-RG2M004E30 (Note 1, 2) TM-RU2M004E30 (Note 1, 2) TM-RG2M009G30 (Note 1) TM-RU2M009G30 (Note 1)

Note 1. This is available with servo amplifiers with software version C8 or later.

2. This combination increases the rated torque and the maximum torque.

1.5 Function list

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

Function	Description	Detailed explanation
Model adaptive control	This realizes a high response and stable control following the ideal model. The two-degrees-of-freedom-model model adaptive control enables you to set a response to the command and response to the disturbance separately. Additionally, this function can be disabled. Refer to section 7.5 for disabling this function. This is used with servo amplifiers with software version B4 or later.	
Position control mode	This servo amplifier is used as a position control servo.	
Speed control mode	This servo amplifier is used as a speed control servo.	
Torque control mode	This servo amplifier is used as a torque control servo.	
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
Machine resonance suppression filter	This is a filter function (notch filter) which decreases the gain of the specific frequency to suppress the resonance of the mechanical system.	Section 7.1.1
Shaft resonance suppression filter	When a load is mounted to the servo motor shaft, resonance by shaft torsion during driving may generate a mechanical vibration at high frequency. The shaft resonance suppression filter suppresses the vibration.	Section 7.1.3
Adaptive filter II	Servo amplifier detects mechanical resonance and sets filter characteristics automatically to suppress mechanical vibration.	Section 7.1.2
Low-pass filter	Suppresses high-frequency resonance which occurs as servo system response is increased.	Section 7.1.4
Machine analyzer function	Analyzes the frequency characteristic of the mechanical system by simply connecting a 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]
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 regeneration 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
Multifunction regeneration converter	Use this function if the regenerative option does not have sufficient regenerative capacity.	Section 11.19
Regenerative option	Used when the built-in regenerative resistor of the servo amplifier does not have sufficient regenerative capability for the regenerative power generated.	Section 11.2
Alarm history clear	Alarm history is cleared.	[Pr. PC21]
Output signal selection (device settings)	The output devices including ALM (Malfunction) and DB (Dynamic brake interlock) can be assigned to certain pins of the CN3 connector.	[Pr. PD07] to [Pr. PD09]
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 4.5.1 (1) (d)
Test operation mode	Jog operation, positioning operation, motor-less operation, DO forced output, and program operation can be used. MR Configurator2 is necessary for this function.	Section 4.5
Analog monitor output	Servo status is output in terms of voltage in real time.	[Pr. PC09], [Pr. PC10]
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 linear encoder.	Chapter 14

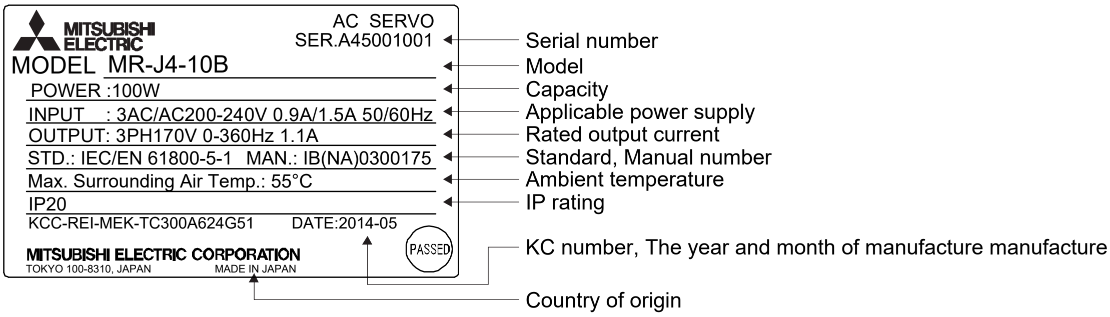
Function	Description	Detailed explanation
Direct drive servo system	Direct drive servo system can be configured to drive a direct drive motor.	Chapter 15
Fully closed loop system	Fully closed loop system can be configured using the load-side encoder. This is used with servo amplifiers with software version A3 or later.	Chapter 16
One-touch tuning	Gain adjustment is performed just by one click on a certain button on MR Configurator2. MR Configurator2 is necessary for this function.	Section 6.2
SEMI-F47 function (Note)	Enables to avoid triggering [AL. 10 Undervoltage] using the electrical energy charged in the capacitor in case that an instantaneous power failure occurs during operation. Use a 3-phase for the input power supply of the servo amplifier. Using a 1-phase 100 V AC/200 V AC for the input power supply will not comply with SEMI-F47 standard.	[Pr. PA20] [Pr. PF25] Section 7.4
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". 4. The controller is not connected (except the test operation mode). 5. An alarm related to the controller is occurring.	[Pr. PA23]
STO function	This function is a functional safety that complies with IEC/EN 61800-5-2. You can create a safety system for the equipment easily.	
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. For the SSCNET III/H system, MR Configurator2 can display the data, including the power consumption. Since the servo amplifier can send the data to a servo system controller, you can analyze the data and display the data on a display.	
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.	
Master-slave operation function	The function transmits a master axis torque to slave axes using driver communication and the torque as a command drives slave axes by torque control. This is used with servo amplifiers with software version A8 or later.	Section 17.2
Scale measurement function	The function transmits position information of a scale measurement encoder to the controller by connecting the scale measurement encoder in semi closed loop control. This is used with servo amplifiers with software version A8 or later.	Section 17.3
J3 compatibility mode	This amplifier has "J3 compatibility mode" which compatible with the previous MR-J3-B series. Refer to section 17.1 for software versions.	Section 17.1
Continuous operation to torque control mode	This enables to smoothly switch the mode from position control mode/speed control mode to torque control mode without stopping. This also enables to decrease load to the machine and high quality molding without rapid changes in speed or torque. For details of the continuous operation to torque control mode, refer to the manuals for servo system controllers.	[Pr. PB03] [Pr. PB09] Refer to the servo system controller manual used.
Lost motion compensation function	This function improves the response delay occurred when the machine moving direction is reversed. This is used with servo amplifiers with software version B4 or later.	Section 7.6
Super trace control	This function sets constant and uniform acceleration/deceleration droop pulses to almost 0.This is used with servo amplifiers with software version B4 or later.	Section 7.7

Note. For servo system controllers which are available with this, contact your local sales office.

1.6 Model designation

(1) Rating plate

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



MITSUBISHI ELECTRIC
AC SERVO
SER.A45001001
MODEL MR-J4-10B
POWER :100W
INPUT : 3AC/AC200-240V 0.9A/1.5A 50/60Hz
OUTPUT: 3PH170V 0-360Hz 1.1A
STD.: IEC/EN 61800-5-1 MAN.: IB(NA)0300175
Max. Surrounding Air Temp.: 55°C
IP20
KCC-REI-MEK-TC300A624G51 DATE:2014-05
MITSUBISHI ELECTRIC CORPORATION
TOKYO 100-8310, JAPAN MADE IN JAPAN
PASSED

(2) Model

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

MR-J4-60B4-RJ

Series: MR-J4

Rated output

Symbol	Rated output [kW]
10	0.1
20	0.2
40	0.4
60	0.6
70	0.75
100	1
200	2
350	3.5
500	5
700	7
11K	11
15K	15
22K	22

SSCNETIII/H interface: B

Power supply

Symbol	Power supply
None	3-phase or 1-phase 200 V AC to 240 V AC
1	1-phase 100 V AC to 120 V AC
4	3-phase 380 V AC to 480 V AC

Special specifications

Symbol	Special specifications
None	Standard
-RJ	Fully closed loop control four-wire type/load-side encoder A/B/Z-phase input compatible/Compatible with MR-D30 functional safety unit
-ED	MR-J4-_B_ without a dynamic brake (Note 2)
-RU	MR-J4-_B_-RJ without a dynamic brake (Note 2)
-PX	MR-J4-_B_ without regenerative resistor (Note 1)
-RZ	MR-J4-_B_-RJ without regenerative resistor (Note 1)
-EB	MR-J4-_B_ with a special coating specification (3C2) (Note 3)
-KS	MR-J4-_B_-RJ with a special coating specification (3C2) (Note 3)

Note 1. Indicates a servo amplifier of 11 kW to 22 kW that does not use a regenerative resistor as standard accessory. Refer to app. 11.2 for details.

2. Dynamic brake which is built in 7 kW or smaller servo amplifiers is removed. Refer to app. 11.1 for details.

3. Type with a specially-coated servo amplifier board (IEC 60721-3-3:1994 Class 3C2). Refer to app. 11.3 for details.

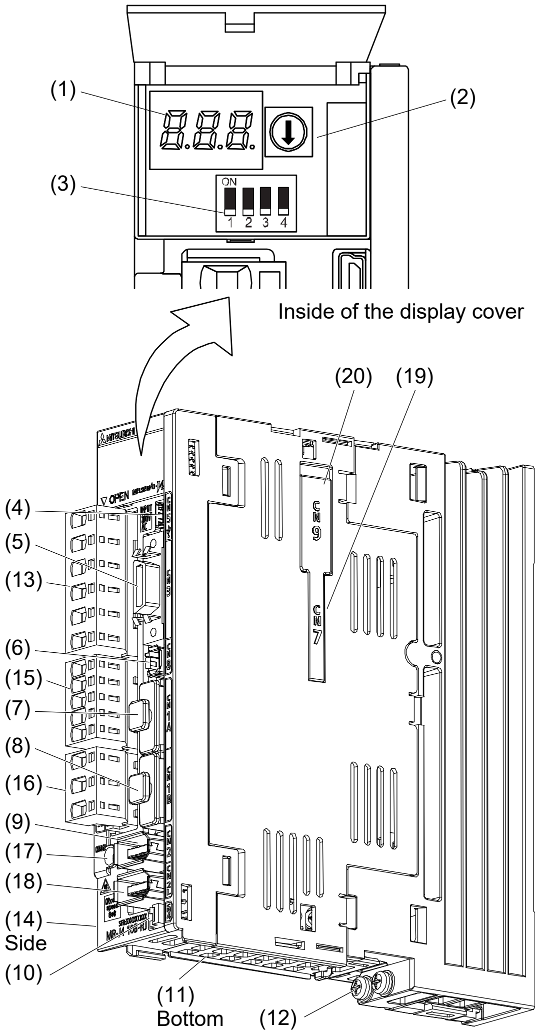
1.7 Structure

1.7.1 Parts identification

(1) 200 V class

(a) MR-J4-200B(-RJ) or less

The diagram is for MR-J4-10B-RJ.

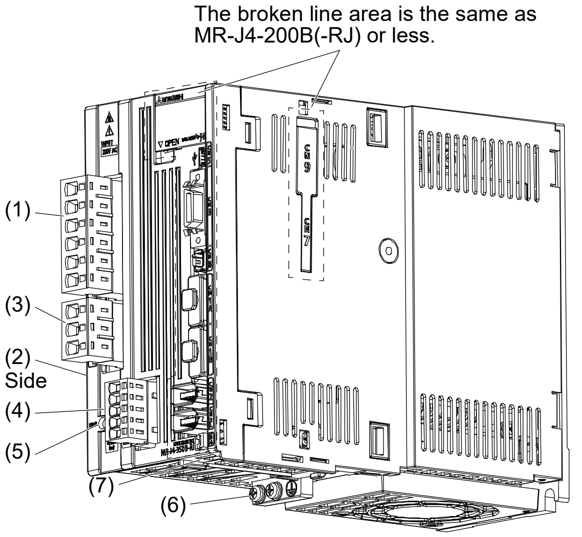


No.	Name/Application	Detailed explanation
(1)	Display The 3-digit, 7-segment LED shows the servo status and the alarm number.	Section 4.3
(2)	Axis selection rotary switch (SW1) Used to set the axis No. of servo amplifier.	
(3)	Control axis setting switch (SW2) The test operation switch, the disabling control axis switch, and the auxiliary axis number setting switch are available.	
(4)	USB communication connector (CN5) Connect with the personal computer.	Section 11.7
(5)	I/O signal connector (CN3) Used to connect digital I/O signals.	Section 3.2 Section 3.4
(6)	STO input signal connector (CN8) Used to connect MR-J3-D05 safety logic unit and external safety relay.	Chapter 13 App. 5
(7)	SSCNET III cable connector (CN1A) Used to connect the servo system controller or the previous axis servo amplifier.	Section 3.2 Section 3.4
(8)	SSCNET III cable connector (CN1B) Used to connect the next axis servo amplifier. For the final axis, put a cap.	
(9) (Note 2)	Encoder connector (CN2) Used to connect the servo motor encoder. Used to connect the servo motor encoder or external encoder. Refer to table 1.1 for the compatible external encoders.	Section 3.4 "Servo Motor Instruction Manual (Vol. 3)"
(10)	Battery connector (CN4) Used to connect the battery for absolute position data backup.	Chapter 12
(11)	Battery holder Install the battery for absolute position data backup.	Section 12.2
(12)	Protective earth (PE) terminal	Section 3.1 Section 3.3
(13)	Main circuit power connector (CNP1) Connect the input power supply.	
(14)	Rating plate	Section 1.6
(15)	Control circuit power connector (CNP2) Connect the control circuit power supply and regenerative option.	Section 3.1 Section 3.3
(16)	Servo motor power output connector (CNP3) Connect the servo motor.	
(17)	Charge lamp When the main circuit is charged, this will light. While this lamp is lit, do not reconnect the cables. The lamp may light up when only the control circuit is powered on. Before wiring or inspection, turn off the main circuit power and the control circuit power, and wait for 15 minutes or more until the charge lamp turns off. Then, check the voltage between P+ and N- using the tester, etc.	
(18) (Note 1, 2)	External encoder connector (CN2L) Refer to table 1.1 for connections of external encoders.	Section 3.4 "Linear Encoder Instruction Manual"
(19)	Optional unit connector 1 (CN7) This is for connecting the optional unit. This connector is attached only on MR-J4-_B_-RJ.	
(20)	Optional unit connector 2 (CN9) This is for connecting the optional unit. This connector is attached only on MR-J4-_B_-RJ.	

Note 1. This is for MR-J4-_B-RJ servo amplifier. MR-J4-_B servo amplifier does not have CN2L connector.

2. "External encoder" is a term for linear encoder used in the linear servo system, load-side encoder used in the fully closed loop system, and scale measurement encoder used with the scale measurement function in this manual.

(b) MR-J4-350B(-RJ)

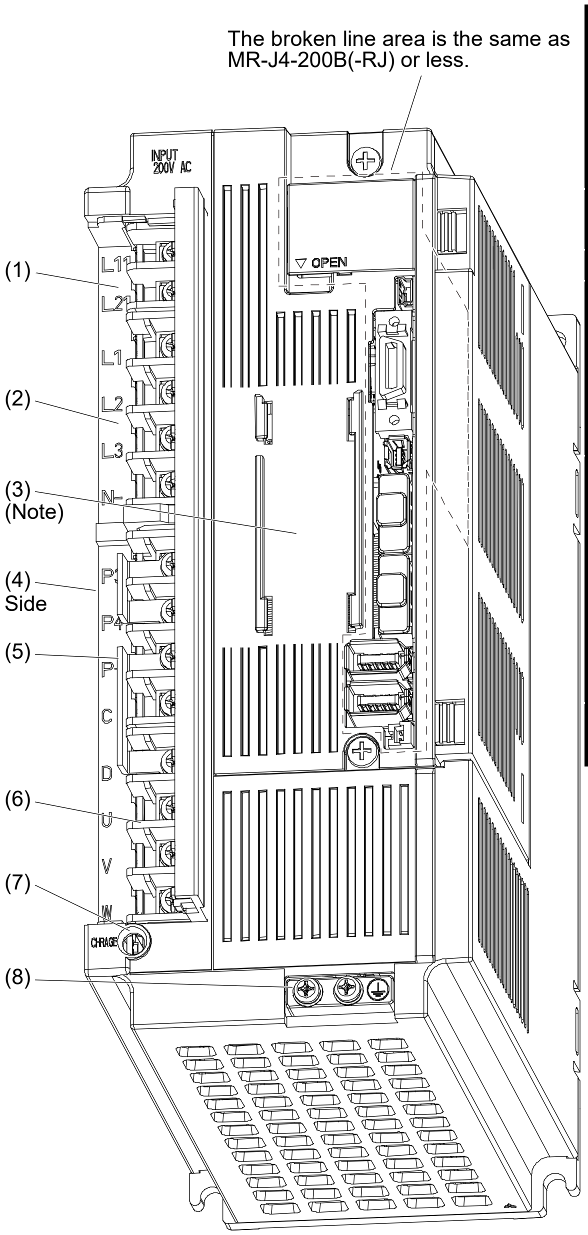


No.	Name/Application	Detailed explanation
(1)	Main circuit power connector (CNP1) Connect the input power supply.	Section 3.1 Section 3.3
(2)	Rating plate	Section 1.6
(3)	Servo motor power connector (CNP3) Connect the servo motor.	Section 3.1 Section 3.3
(4)	Control circuit power connector (CNP2) Connect the control circuit power supply and regenerative option.	
(5)	Charge lamp When the main circuit is charged, this will light. While this lamp is lit, do not reconnect the cables. The lamp may light up when only the control circuit is powered on. Before wiring or inspection, turn off the main circuit power and the control circuit power, and wait for 15 minutes or more until the charge lamp turns off. Then, check the voltage between P+ and N- using the tester, etc.	
(6)	Protective earth (PE) terminal	Section 3.1 Section 3.3
(7)	Battery holder Install the battery for absolute position data backup.	Section 12.2

(c) MR-J4-500B(-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 battery for absolute position data backup.	Section 12.2
(4)	Rating plate	Section 1.6
(5)	Regenerative option/power factor improving reactor terminal block (TE3) Used to a connect a regenerative option and 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. While this lamp is lit, do not reconnect the cables. The lamp may light up when only the control circuit is powered on. Before wiring or inspection, turn off the main circuit power and the control circuit power, and wait for 15 minutes or more until the charge lamp turns off. Then, check the voltage between P+ and N- using the tester, etc.	
(8)	Protective earth (PE) terminal	Section 3.1 Section 3.3

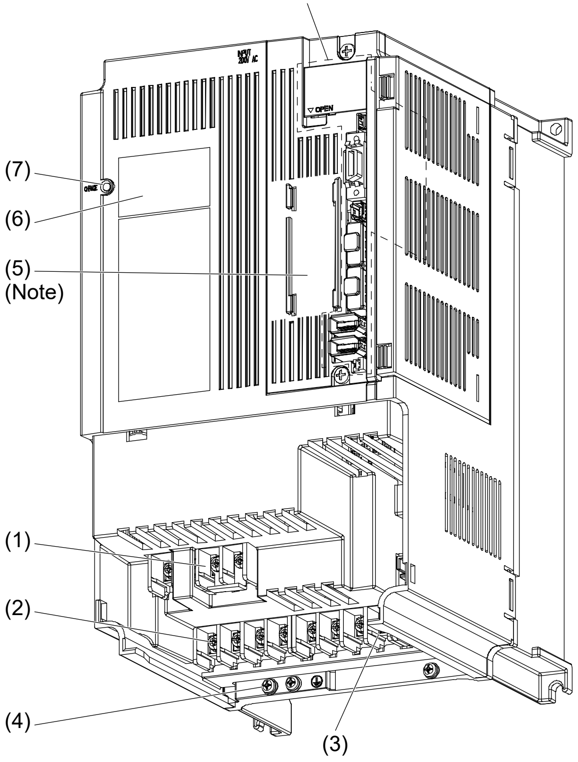
Note. Lines for slots around the battery holder are omitted from the illustration.

(d) MR-J4-700B(-RJ)

POINT

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

The broken line area is the same as MR-J4-200B4(-RJ) or less.



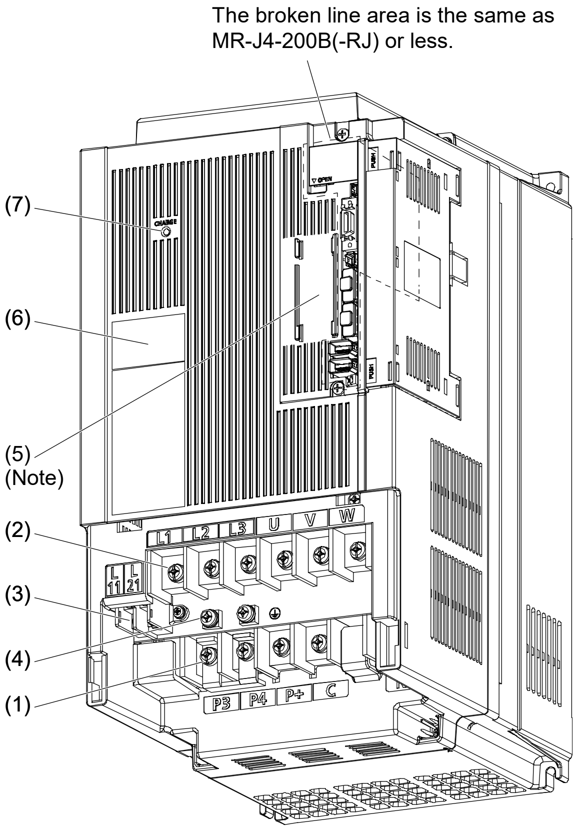
No.	Name/Application	Detailed explanation
(1)	Power factor improving reactor terminal block (TE3) Used to connect the DC reactor.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1) Used to connect the input power supply, regenerative option, and servo motor.	
(3)	Control circuit terminal block (TE2) Used to connect the control circuit power supply.	
(4)	Protective earth (PE) terminal	
(5)	Battery holder Install the battery for absolute position data backup.	Section 12.2
(6)	Rating plate	Section 1.6
(7)	Charge lamp When the main circuit is charged, this will light. While this lamp is lit, do not reconnect the cables. The lamp may light up when only the control circuit is powered on. Before wiring or inspection, turn off the main circuit power and the control circuit power, and wait for 15 minutes or more until the charge lamp turns off. Then, check the voltage between P+ and N- using the tester, etc.	

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

(e) MR-J4-11KB(-RJ)/MR-J4-15KB(-RJ)

POINT

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

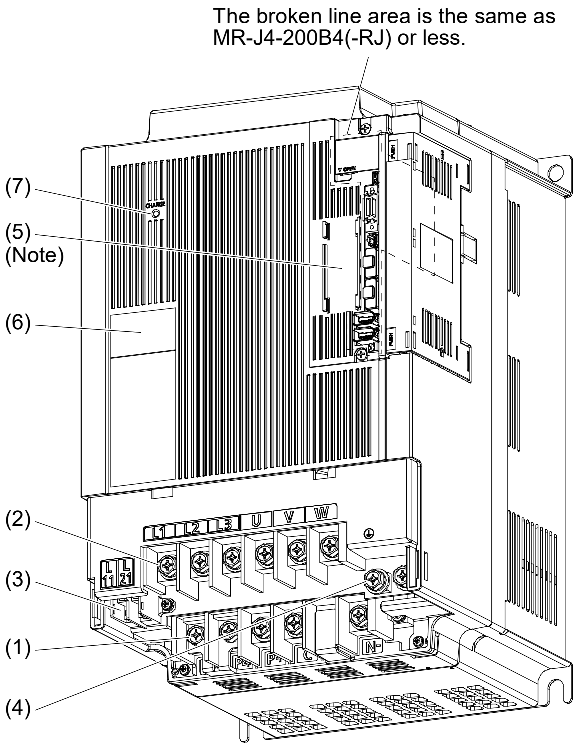


No.	Name/Application	Detailed explanation
(1)	Power factor improving reactor terminal block (TE1-2) Used to connect a power factor improving DC reactor and a regenerative option.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1-1) Used to connect the input power supply and servo motor.	
(3)	Control circuit terminal block (TE2) Used to connect the control circuit power supply.	
(4)	Protective earth (PE) terminal	
(5)	Battery holder Install the battery for absolute position data backup.	Section 12.2
(6)	Rating plate	Section 1.6
(7)	Charge lamp When the main circuit is charged, this will light. While this lamp is lit, do not reconnect the cables. The lamp may light up when only the control circuit is powered on. Before wiring or inspection, turn off the main circuit power and the control circuit power, and wait for 15 minutes or more until the charge lamp turns off. Then, check the voltage between P+ and N- using the tester, etc.	

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

(f) MR-J4-22KB(-RJ)

> **POINT**
>
> - The servo amplifier is shown without the front cover. For removal of the front cover, refer to section 1.7.2.



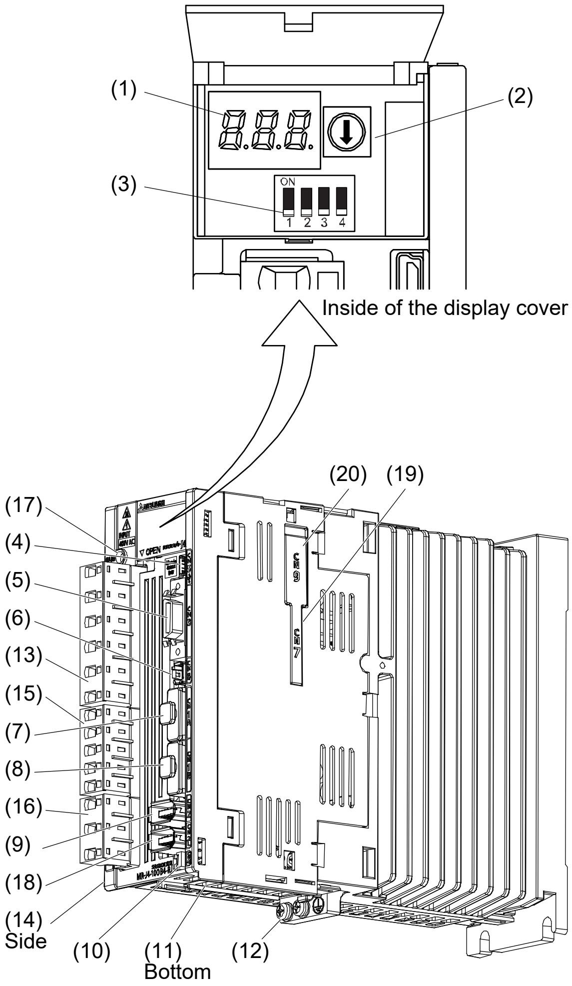
No.	Name/Application	Detailed explanation
(1)	Power factor improving reactor terminal block (TE1-2) Used to connect a power factor improving DC reactor and a regenerative option.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1-1) Used to connect the input power supply and servo motor.	
(3)	Control circuit terminal block (TE2) Used to connect the control circuit power supply.	
(4)	Protective earth (PE) terminal	
(5)	Battery holder Install the battery for absolute position data backup.	Section 12.2
(6)	Rating plate	Section 1.6
(7)	Charge lamp When the main circuit is charged, this will light. While this lamp is lit, do not reconnect the cables. The lamp may light up when only the control circuit is powered on. Before wiring or inspection, turn off the main circuit power and the control circuit power, and wait for 15 minutes or more until the charge lamp turns off. Then, check the voltage between P+ and N- using the tester, etc.	

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

(2) 400 V class

(a) MR-J4-200B4(-RJ) or less

The diagram is for MR-J4-60B4-RJ.

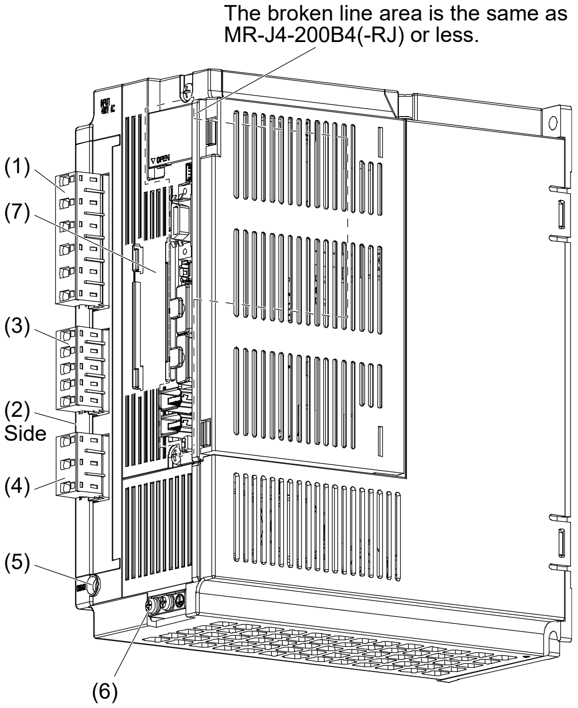


No.	Name/Application	Detailed explanation
(1)	Display The 3-digit, 7-segment LED shows the servo status and the alarm number.	Section 4.3
(2)	Axis selection rotary switch (SW1) Used to set the axis No. of servo amplifier.	
(3)	Control axis setting switch (SW2) The test operation switch, the disabling control axis switch and the auxiliary axis number setting switch are available.	
(4)	USB communication connector (CN5) Connect with the personal computer.	Section 11.7
(5)	I/O signal connector (CN3) Used to connect digital I/O signals.	Section 3.2 Section 3.4
(6)	STO input signal connector (CN8) Used to connect MR-J3-D05 safety logic unit and external safety relay.	Chapter 13 App. 5
(7)	SSCNET III cable connector (CN1A) Used to connect the servo system controller or the previous axis servo amplifier.	Section 3.2 Section 3.4
(8)	SSCNET III cable connector (CN1B) Used to connect the next axis servo amplifier. For the final axis, put a cap.	
(9) (Note 2)	Encoder connector (CN2) Used to connect the servo motor encoder or external encoder. Refer to table 1.1 for the compatible external encoders.	Section 3.4 "Servo Motor Instruction Manual (Vol. 3)"
(10)	Battery connector (CN4) Used to connect the battery for absolute position data backup.	Chapter 12
(11)	Battery holder Install the battery for absolute position data backup.	Section 12.2
(12)	Protective earth (PE) terminal	Section 3.1 Section 3.3
(13)	Main circuit power connector (CNP1) Connect the input power supply.	
(14)	Rating plate	Section 1.6
(15)	Control circuit power connector (CNP2) Connect the control circuit power supply and regenerative option.	Section 3.1 Section 3.3
(16)	Servo motor power output connector (CNP3) Connect the servo motor.	
(17)	Charge lamp When the main circuit is charged, this will light. While this lamp is lit, do not reconnect the cables. The lamp may light up when only the control circuit is powered on. Before wiring or inspection, turn off the main circuit power and the control circuit power, and wait for 15 minutes or more until the charge lamp turns off. Then, check the voltage between P+ and N- using the tester, etc.	
(18) (Note 1, 2)	External encoder connector (CN2L) Used to connect the external encoder. Refer to table 1.1 for the compatible external encoders.	Section 3.4 "Linear Encoder Instruction Manual"
(19)	Optional unit connector 1 (CN7) This is for connecting the optional unit. This connector is attached only on MR-J4-_B_-RJ.	
(20)	Optional unit connector 2 (CN9) This is for connecting the optional unit. This connector is attached only on MR-J4-_B_-RJ.	

Note 1. This is for MR-J4-_B4-RJ servo amplifier. MR-J4-_B4 servo amplifier does not have CN2L connector.

2. "External encoder" is a term for linear encoder used in the linear servo system, load-side encoder used in the fully closed loop system, and scale measurement encoder used with the scale measurement function in this manual.

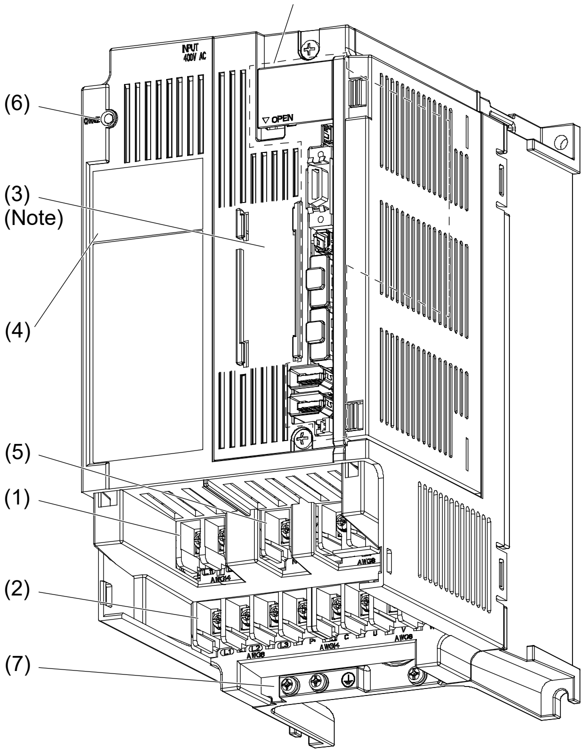
(b) MR-J4-350B4(-RJ)



No.	Name/Application	Detailed explanation
(1)	Main circuit power connector (CNP1) Connect the input power supply.	Section 3.1 Section 3.3
(2)	Rating plate	Section 1.6
(3)	Control circuit power connector (CNP2) Connect the control circuit power supply and regenerative option.	Section 3.1 Section 3.3
(4)	Servo motor power output connector (CNP3) Connect the servo motor.	
(5)	Charge lamp When the main circuit is charged, this will light. While this lamp is lit, do not reconnect the cables. The lamp may light up when only the control circuit is powered on. Before wiring or inspection, turn off the main circuit power and the control circuit power, and wait for 15 minutes or more until the charge lamp turns off. Then, check the voltage between P+ and N- using the tester, etc.	
(6)	Protective earth (PE) terminal	Section 3.1 Section 3.3
(7)	Battery holder Install the battery for absolute position data backup.	Section 12.2

(c) MR-J4-500B4(-RJ)

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



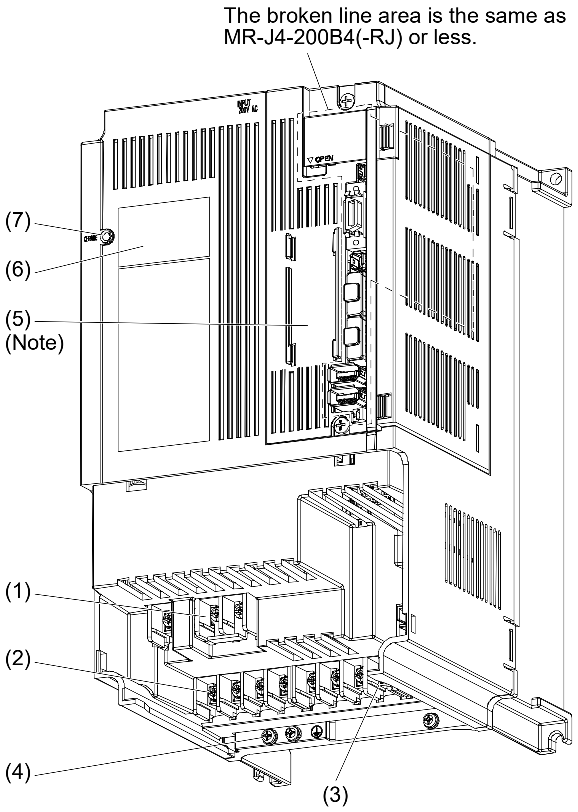
The broken line area is the same as MR-J4-200B4(-RJ) or less.

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) Used to connect the input power supply, regenerative option, and servo motor.	
(3)	Battery holder Install the battery for absolute position data backup.	Section 12.2
(4)	Rating plate	Section 1.6
(5)	Power factor improving reactor terminal block (TE3) Used to connect a power factor improving DC reactor.	Section 3.1 Section 3.3
(6)	Charge lamp When the main circuit is charged, this will light. While this lamp is lit, do not reconnect the cables. The lamp may light up when only the control circuit is powered on. Before wiring or inspection, turn off the main circuit power and the control circuit power, and wait for 15 minutes or more until the charge lamp turns off. Then, check the voltage between P+ and N- using the tester, etc.	
(7)	Protective earth (PE) terminal	Section 3.1 Section 3.3

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

(d) MR-J4-700B4(-RJ)

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



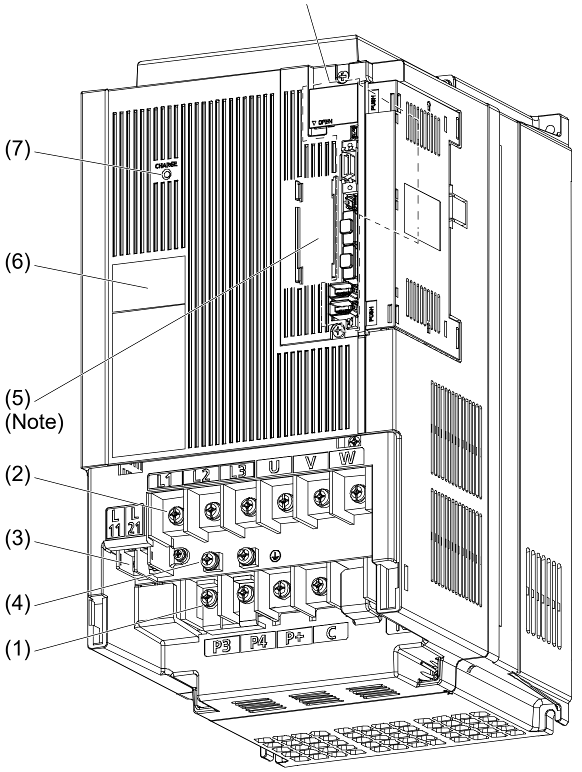
No.	Name/Application	Detailed explanation
(1)	Power factor improving reactor terminal block (TE3) Used to connect the DC reactor.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1) Used to connect the input power supply, regenerative option, and servo motor.	
(3)	Control circuit terminal block (TE2) Used to connect the control circuit power supply.	
(4)	Protective earth (PE) terminal	
(5)	Battery holder Install the battery for absolute position data backup.	Section 12.2
(6)	Rating plate	Section 1.6
(7)	Charge lamp When the main circuit is charged, this will light. While this lamp is lit, do not reconnect the cables. The lamp may light up when only the control circuit is powered on. Before wiring or inspection, turn off the main circuit power and the control circuit power, and wait for 15 minutes or more until the charge lamp turns off. Then, check the voltage between P+ and N- using the tester, etc.	

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

(e) MR-J4-11KB4(-RJ)/MR-J4-15KB4(-RJ)

POINT

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

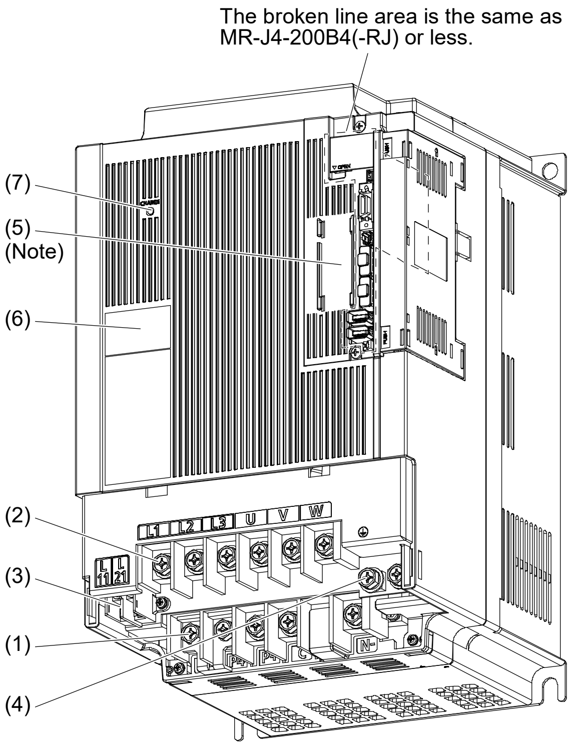

The broken line area is the same as MR-J4-200B4(-RJ) or less.

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	
(5)	Battery holder Install the battery for absolute position data backup.	Section 12.2
(6)	Rating plate	Section 1.6
(7)	Charge lamp When the main circuit is charged, this will light. While this lamp is lit, do not reconnect the cables. The lamp may light up when only the control circuit is powered on. Before wiring or inspection, turn off the main circuit power and the control circuit power, and wait for 15 minutes or more until the charge lamp turns off. Then, check the voltage between P+ and N- using the tester, etc.	

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

(f) MR-J4-22KB4(-RJ)

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

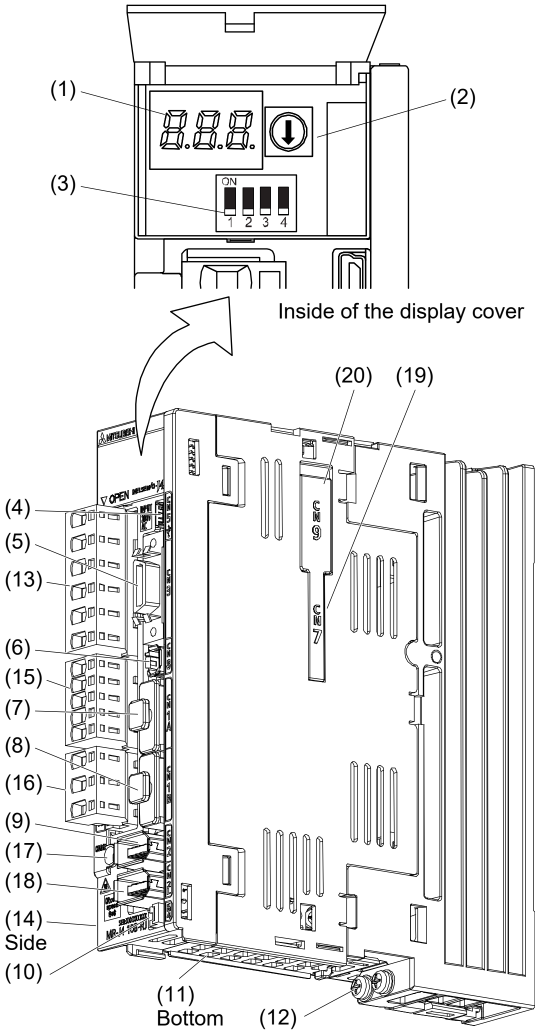


No.	Name/Application	Detailed explanation
(1)	Power factor improving reactor terminal block (TE1-2) Used to connect a power factor improving DC reactor and a regenerative option.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1-1) Used to connect the input power supply and servo motor.	
(3)	Control circuit terminal block (TE2) Used to connect the control circuit power supply.	
(4)	Protective earth (PE) terminal	
(5)	Battery holder Install the battery for absolute position data backup.	Section 12.2
(6)	Rating plate	Section 1.6
(7)	Charge lamp When the main circuit is charged, this will light. While this lamp is lit, do not reconnect the cables. The lamp may light up when only the control circuit is powered on. Before wiring or inspection, turn off the main circuit power and the control circuit power, and wait for 15 minutes or more until the charge lamp turns off. Then, check the voltage between P+ and N- using the tester, etc.	

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

(3) 100 V class

The diagram is for MR-J4-10B1-RJ.



No.	Name/Application	Detailed explanation
(1)	Display The 3-digit, 7-segment LED shows the servo status and the alarm number.	Section 4.3
(2)	Axis selection rotary switch (SW1) Used to set the axis No. of servo amplifier.	
(3)	Control axis setting switch (SW2) The test operation switch, the disabling control axis switch and the auxiliary axis number setting switch are available.	
(4)	USB communication connector (CN5) Connect with the personal computer.	Section 11.7
(5)	I/O signal connector (CN3) Used to connect digital I/O signals.	Section 3.2 Section 3.4
(6)	STO input signal connector (CN8) Used to connect MR-J3-D05 safety logic unit and external safety relay.	Chapter 13 App. 5
(7)	SSCNET III cable connector (CN1A) Used to connect the servo system controller or the previous axis servo amplifier.	Section 3.2 Section 3.4
(8)	SSCNET III cable connector (CN1B) Used to connect the next axis servo amplifier. For the final axis, put a cap.	
(9) (Note 2)	Encoder connector (CN2) Used to connect the servo motor encoder. Used to connect the servo motor encoder or external encoder. Refer to table 1.1 for the compatible external encoders.	Section 3.4 "Servo Motor Instruction Manual (Vol. 3)"
(10)	Battery connector (CN4) Used to connect the battery for absolute position data backup.	Chapter 12
(11)	Battery holder Install the battery for absolute position data backup.	Section 12.2
(12)	Protective earth (PE) terminal	Section 3.1 Section 3.3
(13)	Main circuit power connector (CNP1) Connect the input power supply.	
(14)	Rating plate	Section 1.6
(15)	Control circuit power connector (CNP2) Connect the control circuit power supply and regenerative option.	Section 3.1 Section 3.3
(16)	Servo motor power output connector (CNP3) Connect the servo motor.	
(17)	Charge lamp When the main circuit is charged, this will light. While this lamp is lit, do not reconnect the cables. The lamp may light up when only the control circuit is powered on. Before wiring or inspection, turn off the main circuit power and the control circuit power, and wait for 15 minutes or more until the charge lamp turns off. Then, check the voltage between P+ and N- using the tester, etc.	
(18) (Note 1, 2)	External encoder connector (CN2L) Refer to table 1.1 for connections of external encoders.	Section 3.4 "Linear Encoder Instruction Manual"
(19)	Optional unit connector 1 (CN7) This is for connecting the optional unit. This connector is attached only on MR-J4-_B_-RJ.	
(20)	Optional unit connector 2 (CN9) This is for connecting the optional unit. This connector is attached only on MR-J4-_B_-RJ.	

Note 1. This is for MR-J4-_B1-RJ servo amplifier. MR-J4-_B1 servo amplifier does not have CN2L connector.

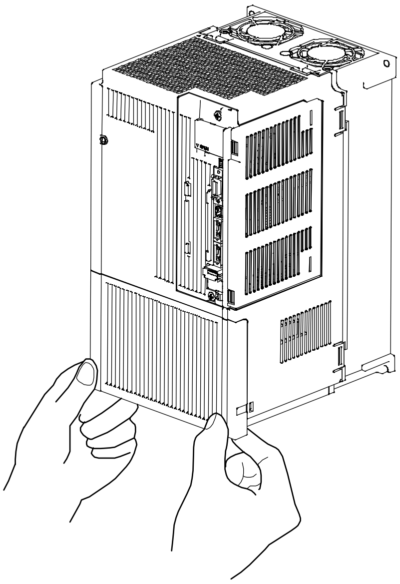
2. "External encoder" is a term for linear encoder used in the linear servo system, load-side encoder used in the fully closed loop system, and scale measurement encoder used with the scale measurement function in this manual.

1.7.2 Removal and reinstallation of the front cover

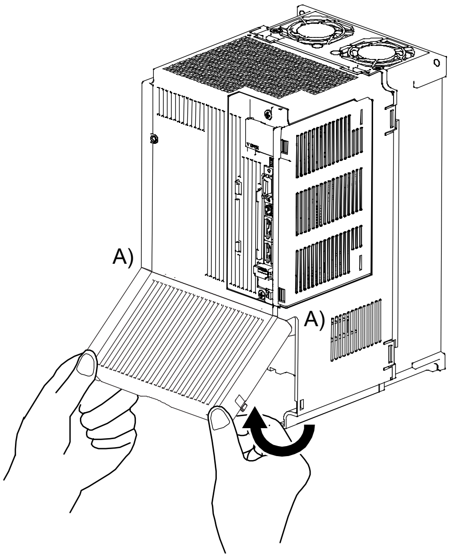
⚠WARNING	●Before removing or installing the front cover, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, when confirming 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-J4-700B(-RJ) to MR-J4-22KB(-RJ) and MR-J4-500B4(-RJ) to MR-J4-22KB4(-RJ).
The diagram is for MR-J4-700B.

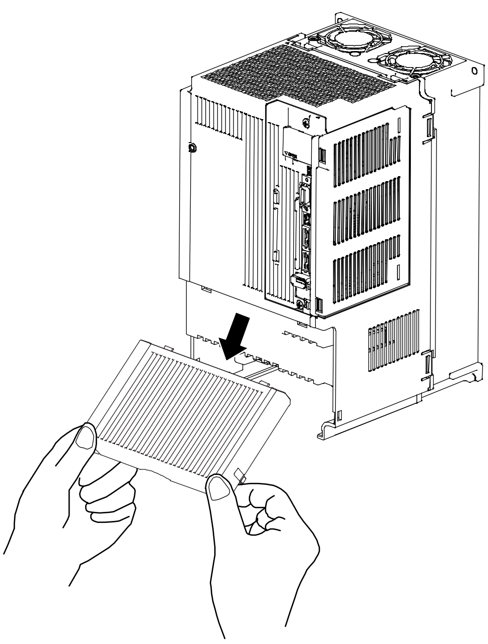
(1) Removal of the front cover



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

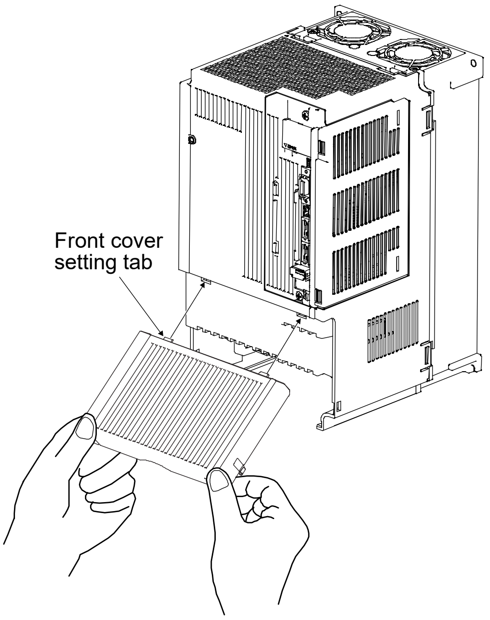


2) Pull up the cover, supporting at point A).

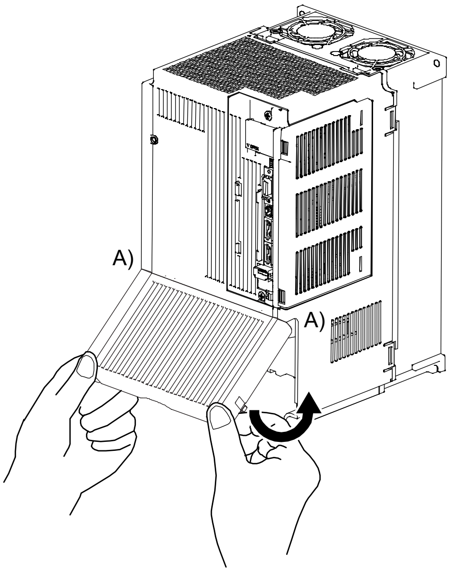


3) Pull out the front cover to remove.

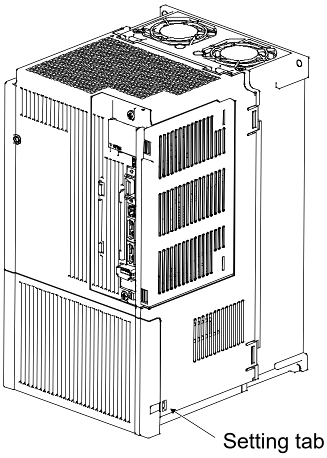
(2) Reinstallation of the front cover



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



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



3) Press the cover against the terminal box until the installing knobs click.

1.8 Configuration including peripheral equipment

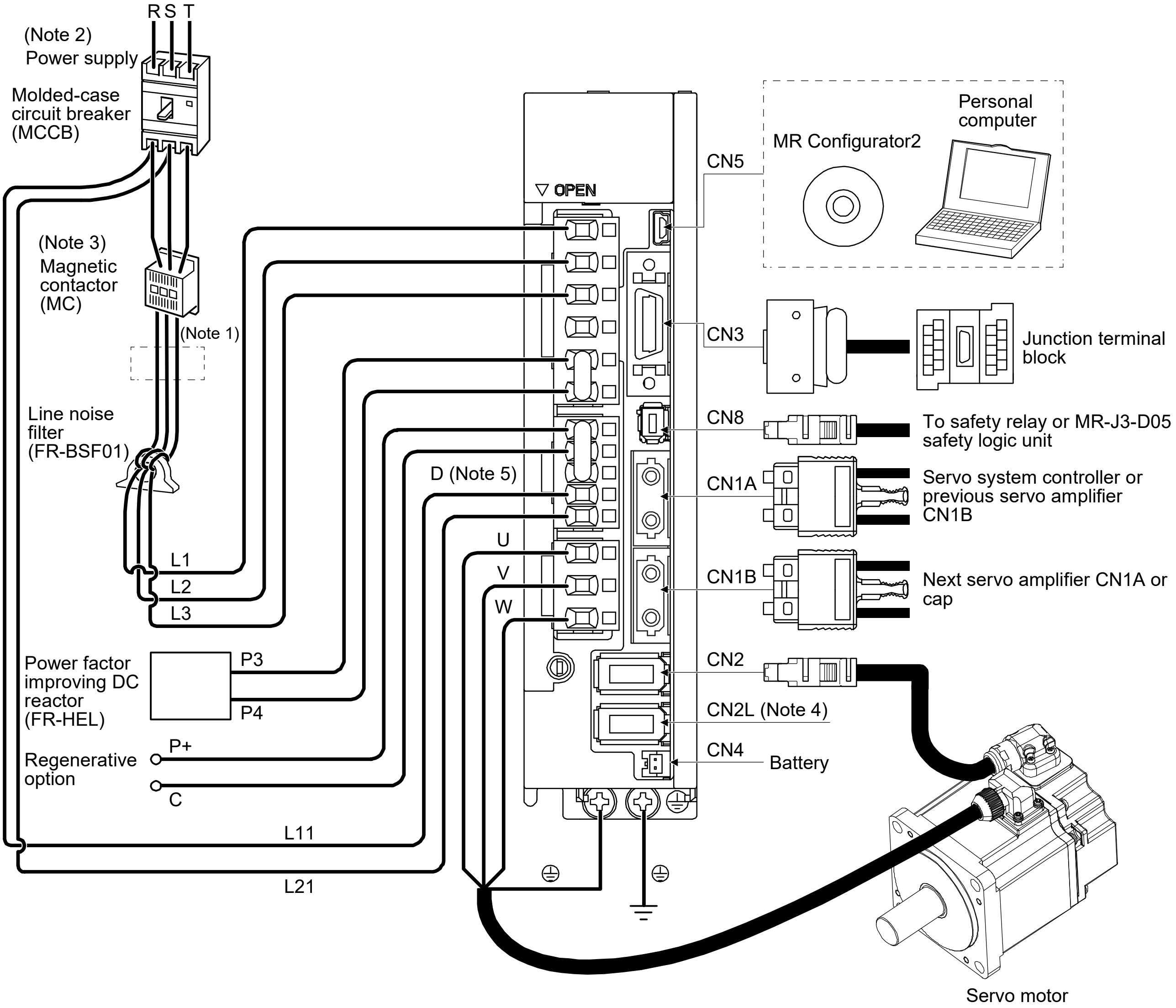
⚠CAUTION
- Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.

POINT
- Equipment other than the servo amplifier and servo motor are optional or recommended products.
- When using the MR-J4-_B-RJ servo amplifier with the DC power supply input, refer to app. 15.

(1) 200 V class

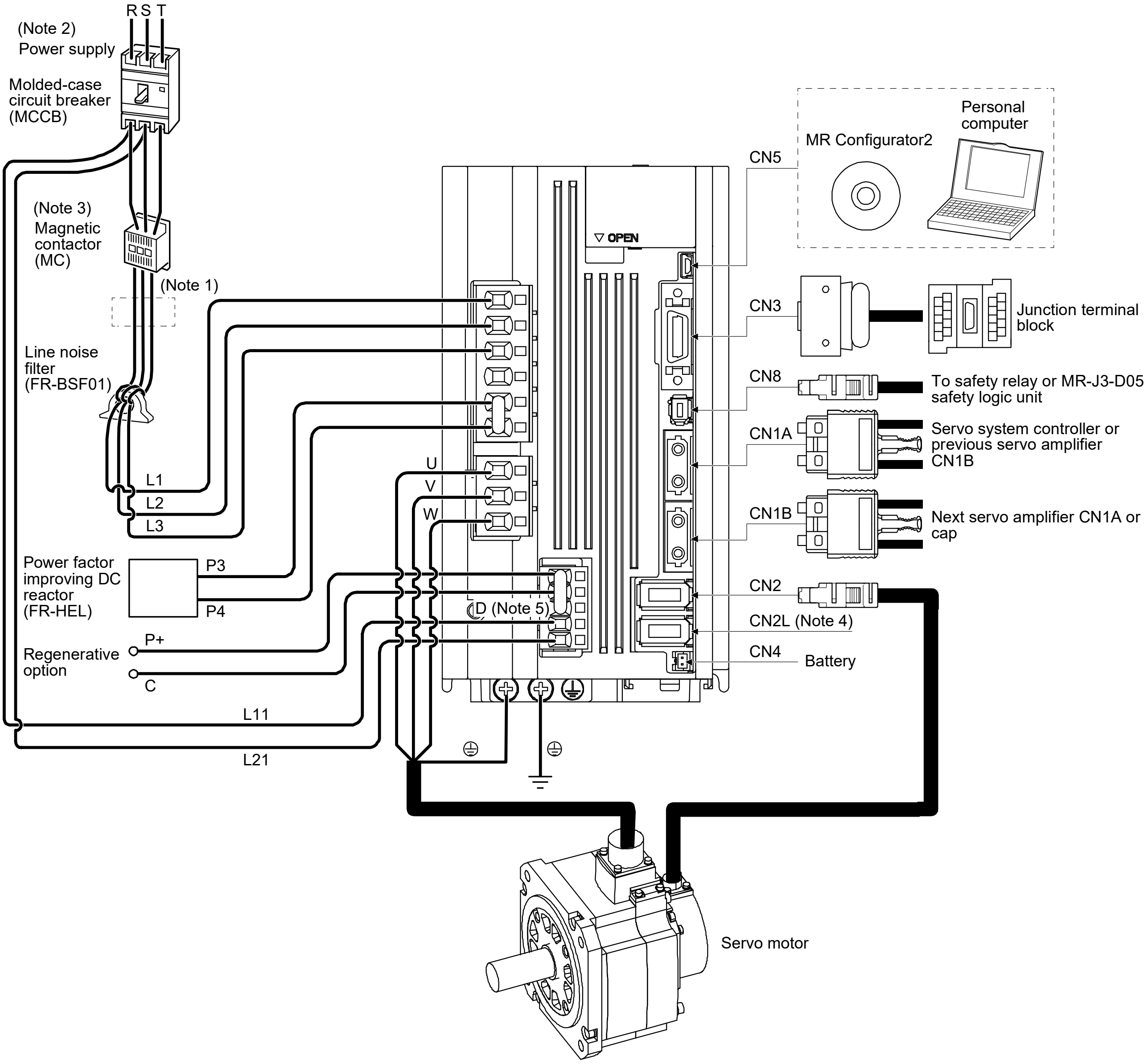
(a) MR-J4-200B(-RJ) or less

The diagram is for MR-J4-20B-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.
2. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open. Refer to section 1.3 for the power supply specifications.
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 MR-J4-_B-RJ servo amplifier. MR-J4-_B servo amplifier does not have CN2L connector. When using MR-J4-_B-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to table 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.
5. Always connect between P+ and D terminals. When using the regenerative option, refer to section 11.2.

(b) MR-J4-350B(-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.

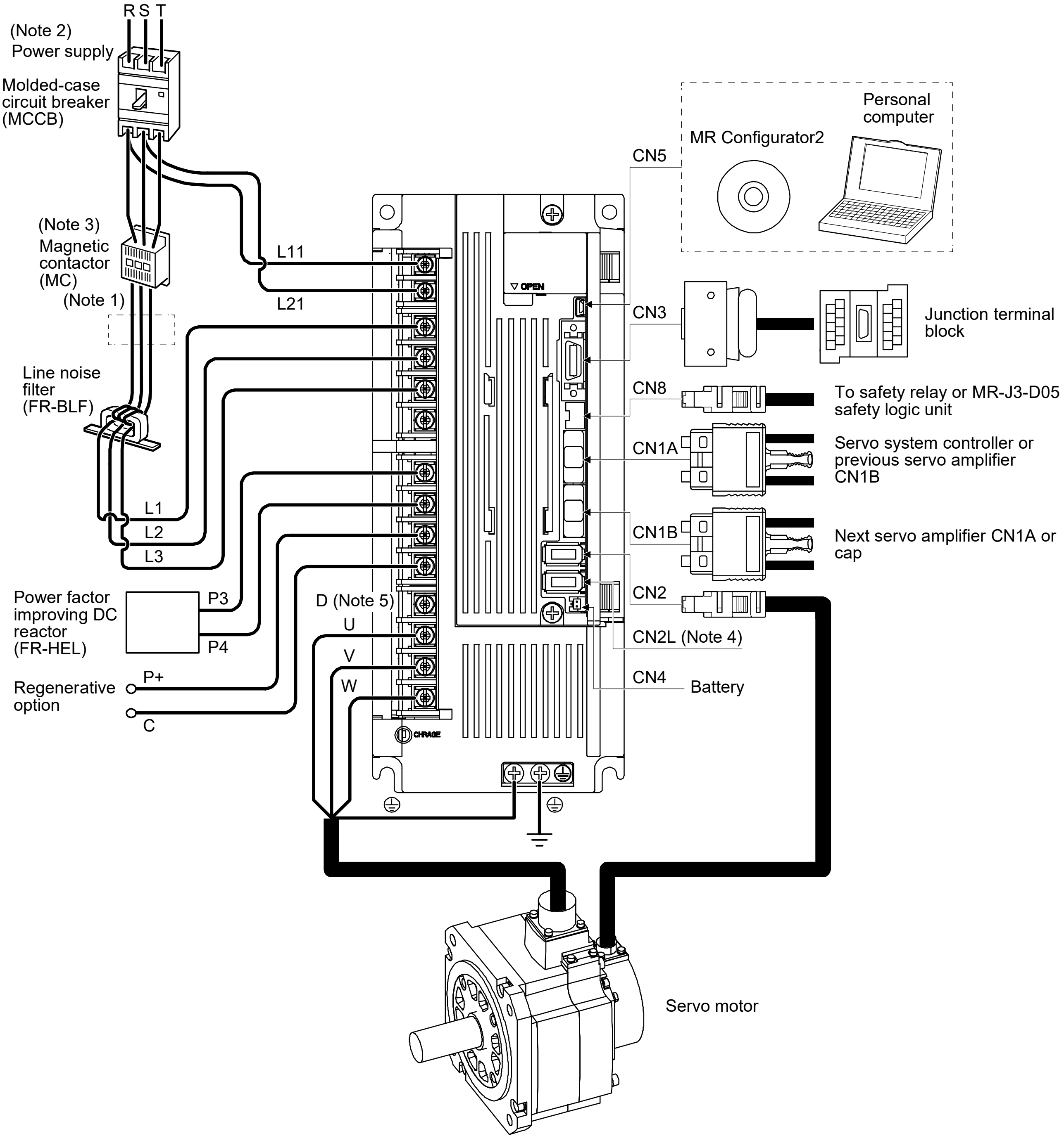
2. Refer to section 1.3 for the power supply specifications.

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 MR-J4-_B-RJ servo amplifier. MR-J4-_B servo amplifier does not have CN2L connector. When using MR-J4-_B-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to table 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.

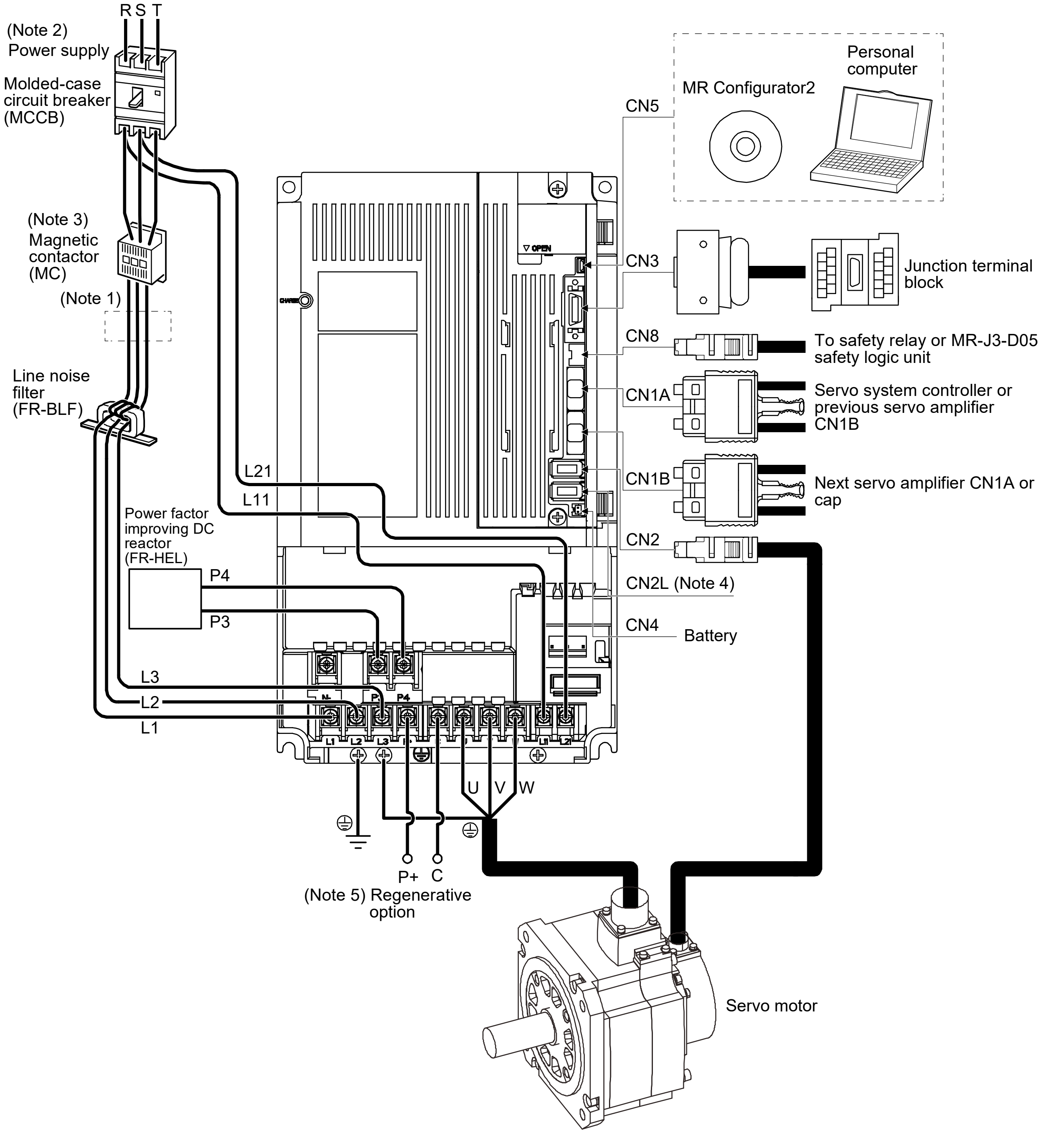
5. Always connect between P+ and D terminals. When using the regenerative option, refer to section 11.2.

(c) MR-J4-500B(-RJ)



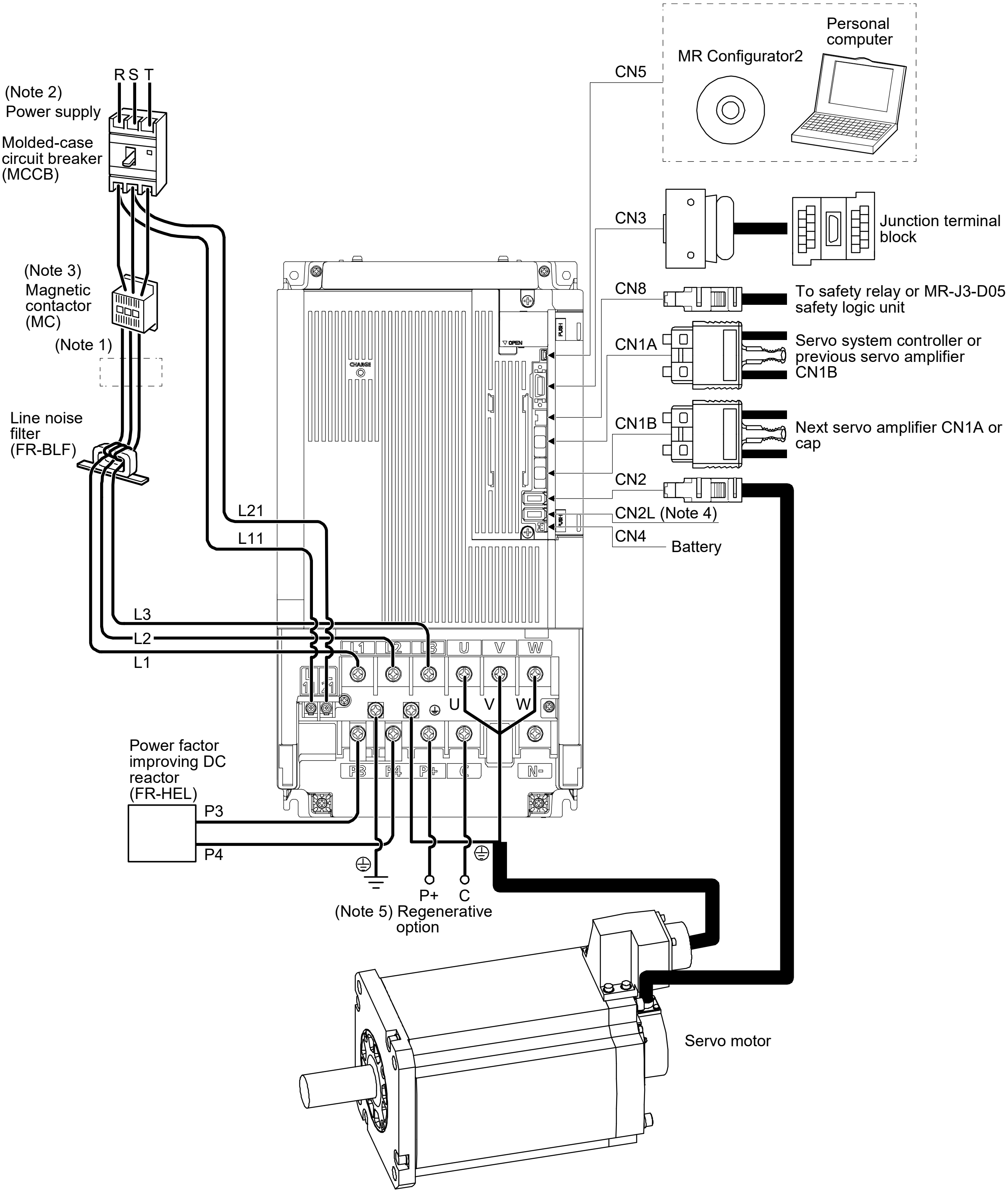
Note 1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
2. Refer to section 1.3 for the power supply specifications.
3. Depending on the main circuit voltage 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 MR-J4-_B-RJ servo amplifier. MR-J4-_B servo amplifier does not have CN2L connector. When using MR-J4-_B-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to table 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.
5. Always connect between P+ and D terminals. When using the regenerative option, refer to section 11.2.

(d) MR-J4-700B(-RJ)



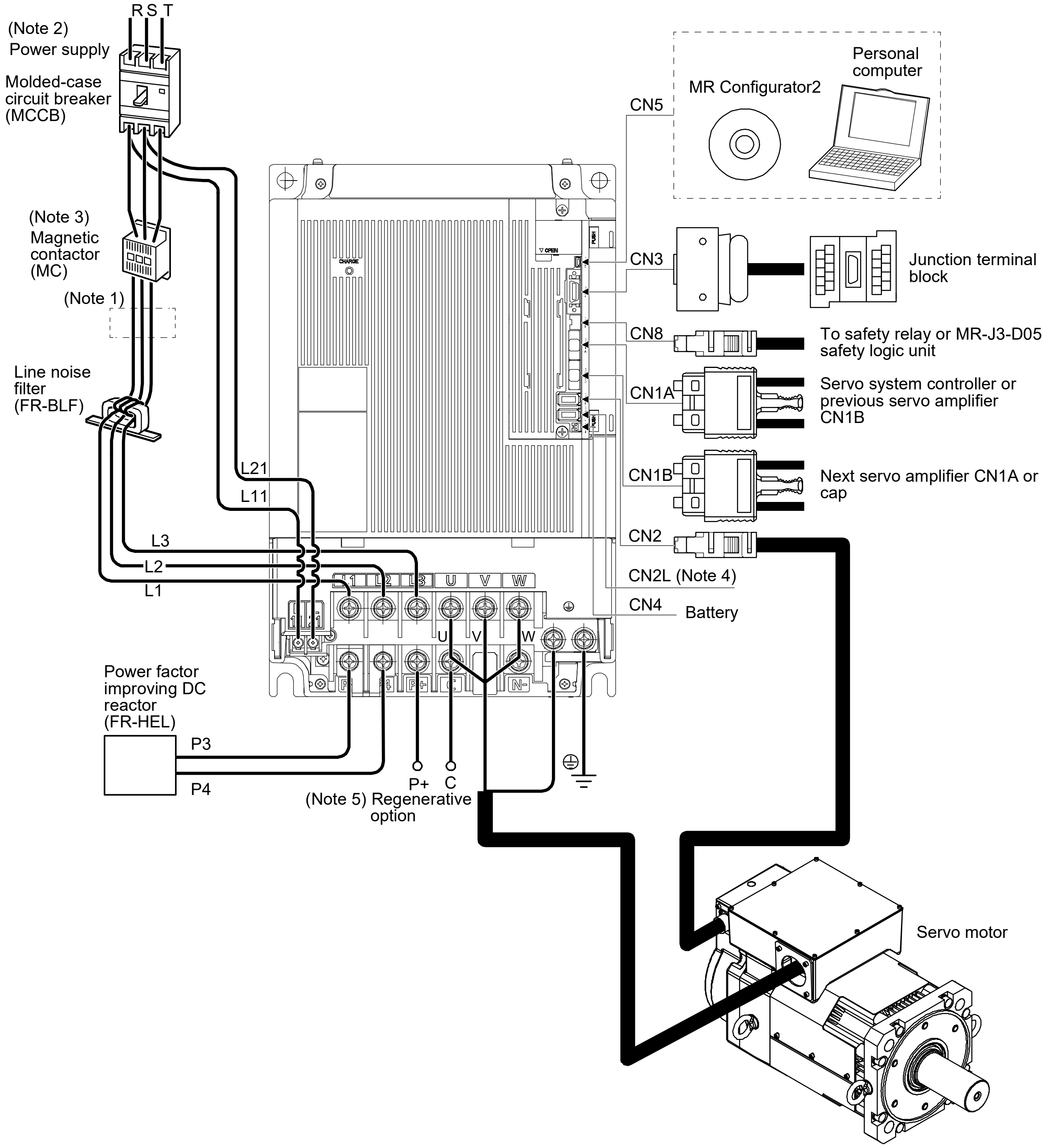
Note
1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
2. Refer to section 1.3 for the power supply specifications.
3. Depending on the main circuit voltage 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 MR-J4-_B-RJ servo amplifier. MR-J4-_B servo amplifier does not have CN2L connector. When using MR-J4-_B-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to table 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.
5. When using the regenerative option, refer to section 11.2.

(e) MR-J4-11KB(-RJ)/MR-J4-15KB(-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.
2. Refer to section 1.3 for the power supply specifications.
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 MR-J4-_B-RJ servo amplifier. MR-J4-_B servo amplifier does not have CN2L connector. When using MR-J4-_B-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to table 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.
5. When using the regenerative option, refer to section 11.2.

(f) MR-J4-22KB(-RJ)

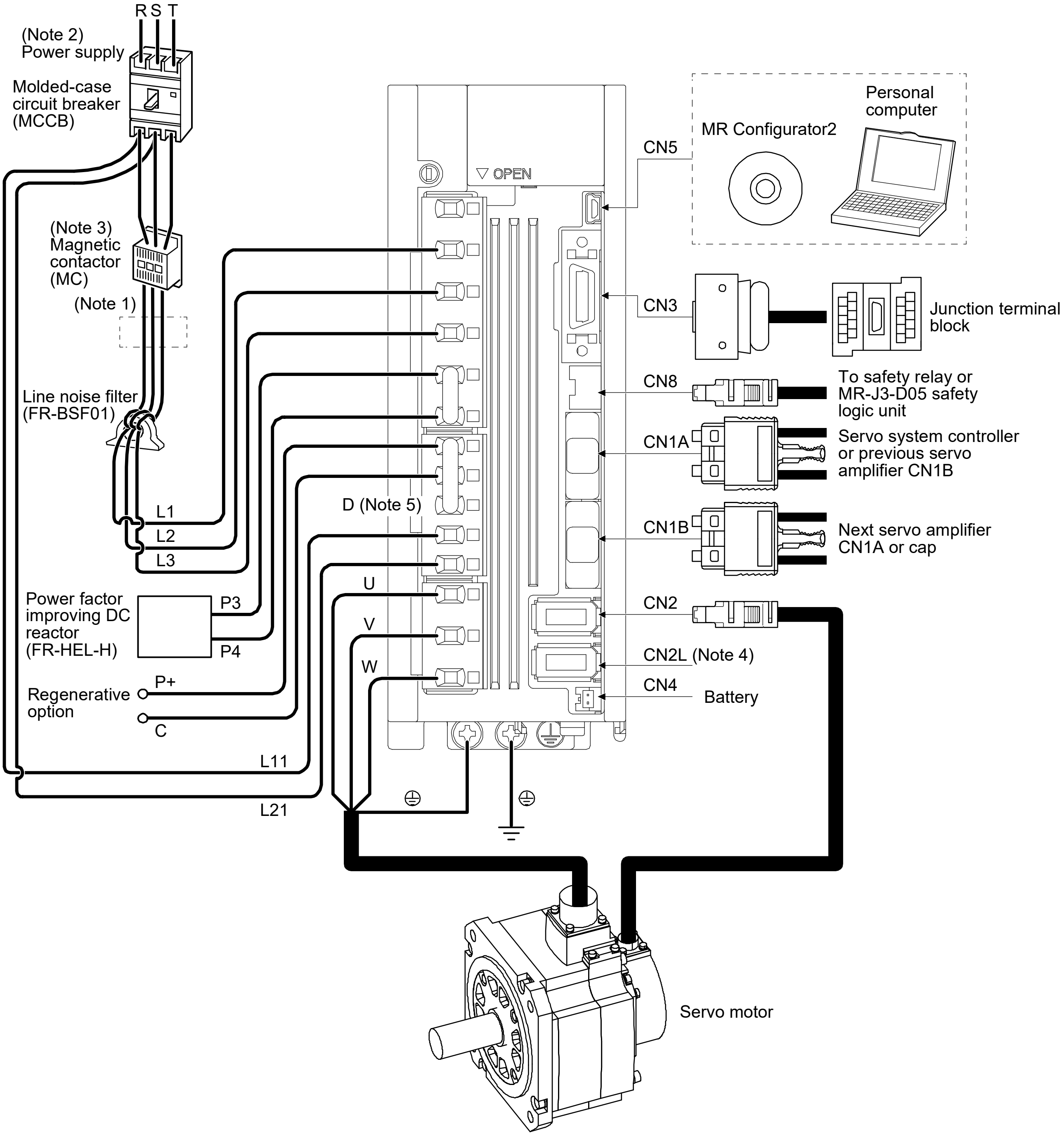


Note
1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
2. Refer to section 1.3 for the power supply specifications.
3. Depending on the main circuit voltage 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 MR-J4-_B-RJ servo amplifier. MR-J4-_B servo amplifier does not have CN2L connector. When using MR-J4-_B-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to table 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.
5. When using the regenerative option, refer to section 11.2.

(2) 400 V class

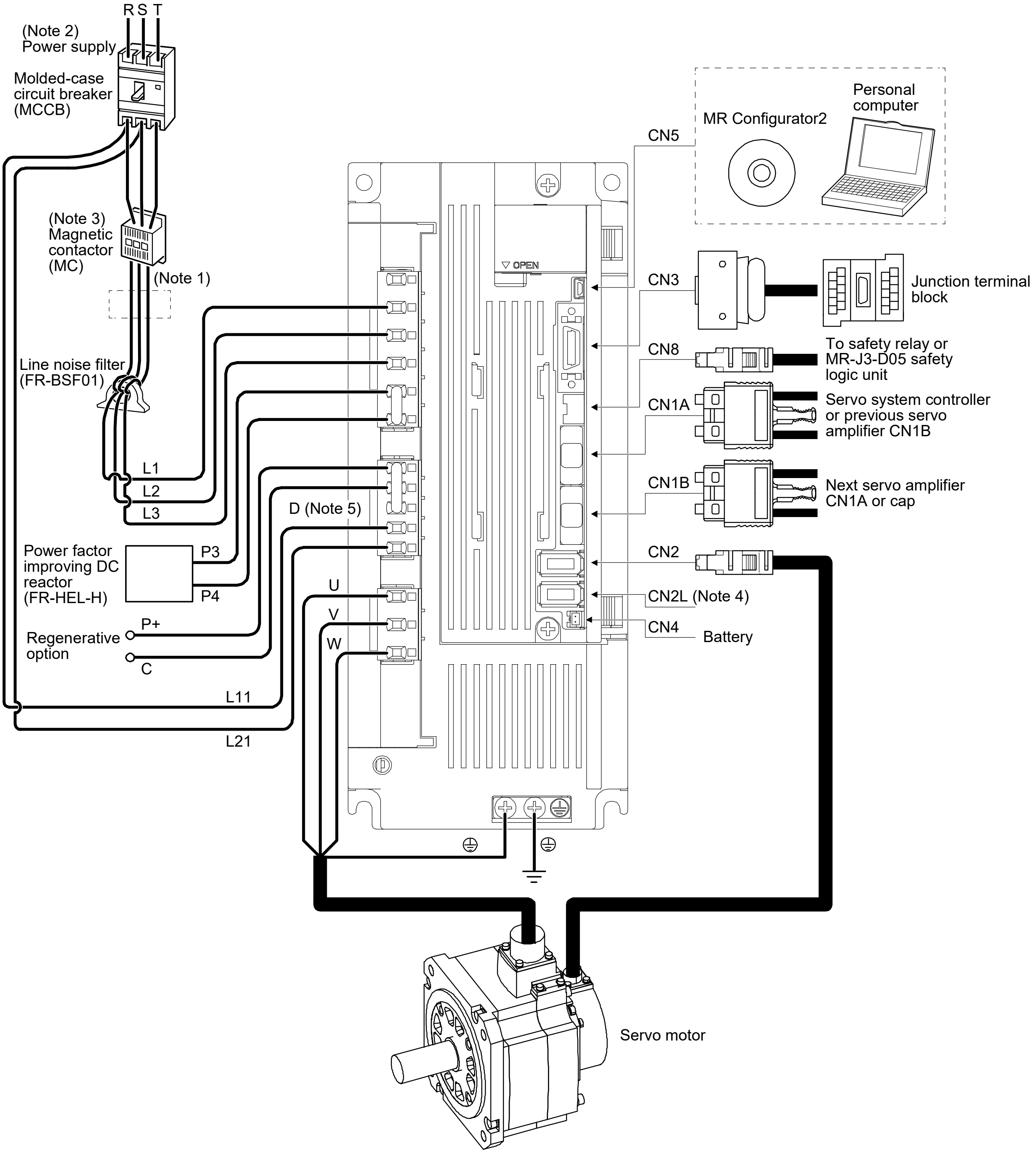
(a) MR-J4-200B4(-RJ) or less

The diagram is for MR-J4-60B4-RJ and MR-J4-100B4-RJ.



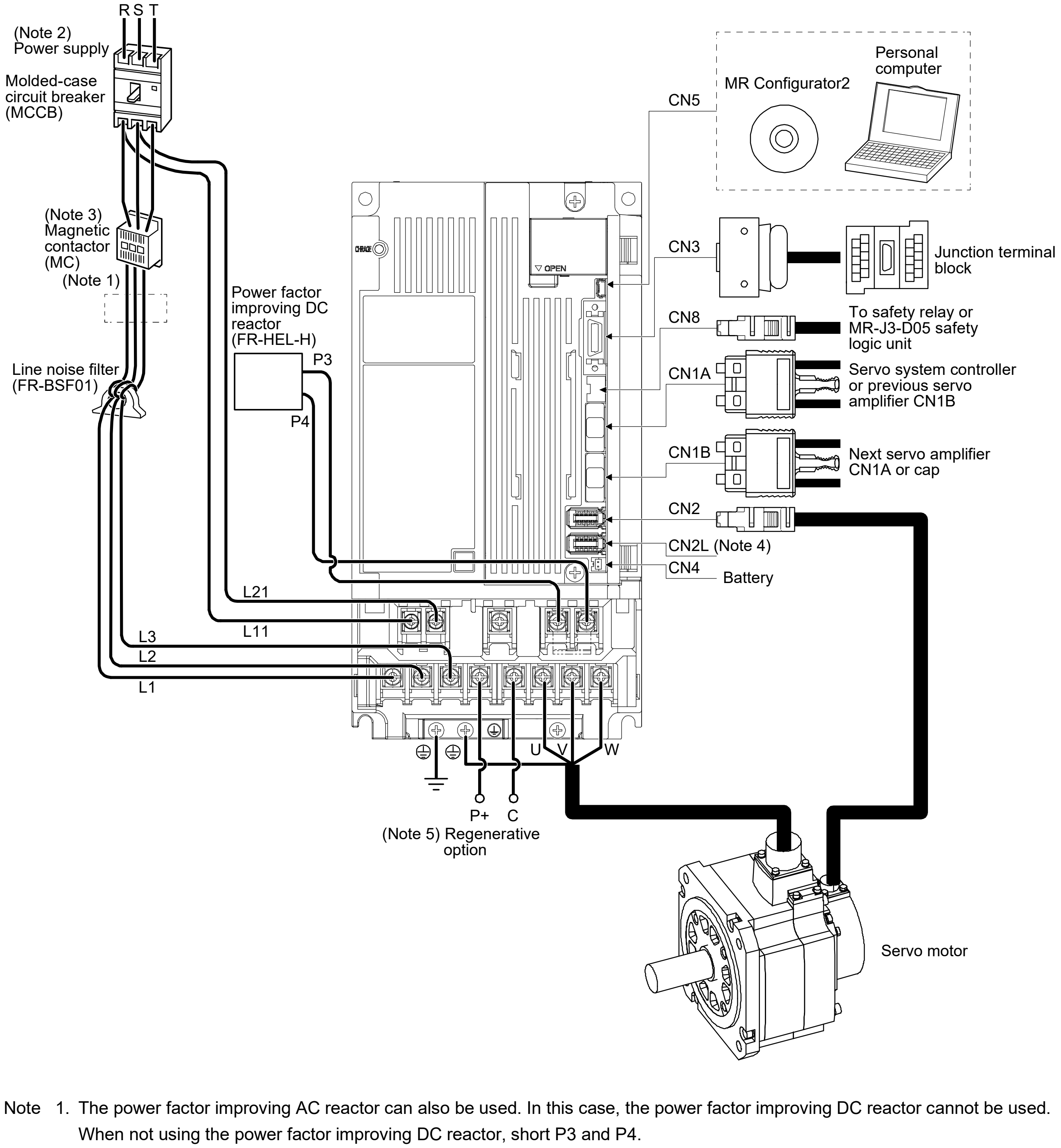
Note
1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
2. Refer to section 1.3 for the power supply specification.
3. Depending on the main circuit voltage 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 MR-J4-_B4-RJ servo amplifier. MR-J4-_B4 servo amplifier does not have CN2L connector. When using MR-J4-_B4-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to Table 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.
5. Always connect between P+ and D terminals. When using the regenerative option, refer to section 11.2.

(b) MR-J4-350B4(-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.
2. Refer to section 1.3 for the power supply specification.
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 MR-J4-_B4-RJ servo amplifier. MR-J4-_B4 servo amplifier does not have CN2L connector. When using MR-J4-_B4-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to Table 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.
5. Always connect between P+ and D terminals. When using the regenerative option, refer to section 11.2.

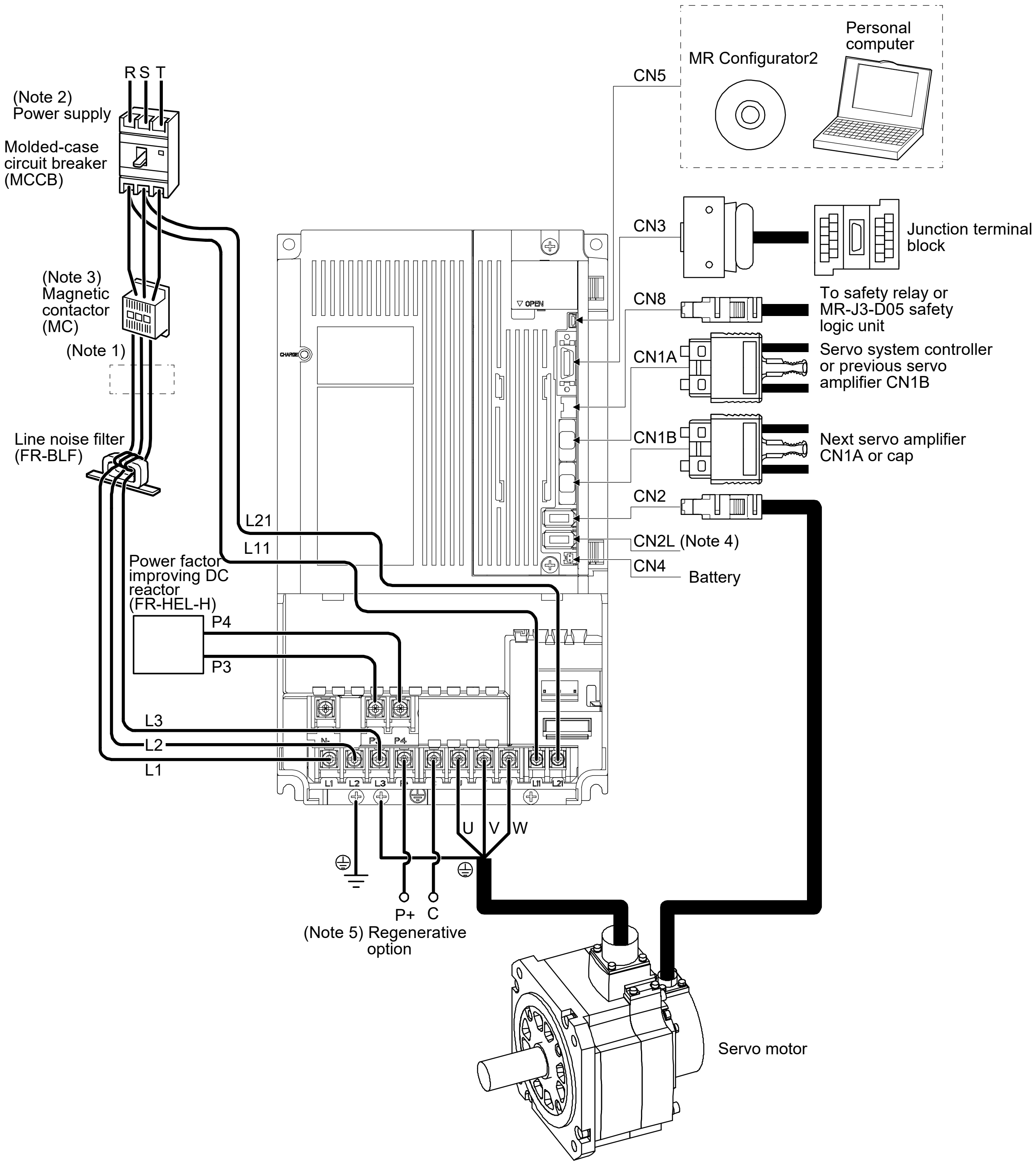
(c) MR-J4-500B4(-RJ)



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.

2. Refer to section 1.3 for the power supply specification.
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 MR-J4-_B4-RJ servo amplifier. MR-J4-_B4 servo amplifier does not have CN2L connector. When using MR-J4-_B4-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to Table 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.
5. When using the regenerative option, refer to section 11.2.

(d) MR-J4-700B4(-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.

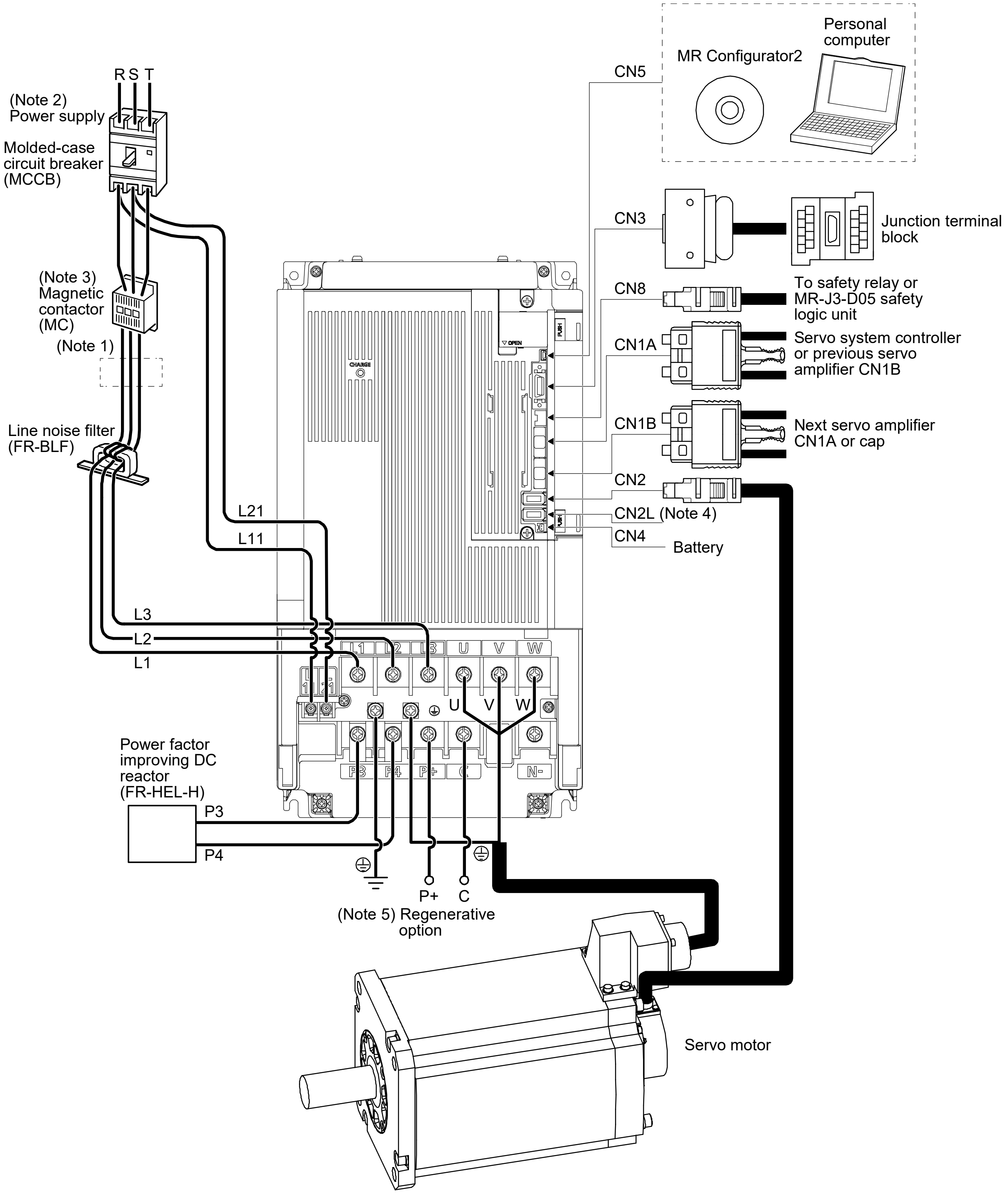
2. Refer to section 1.3 for the power supply specification.

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 MR-J4-_B4-RJ servo amplifier. MR-J4-_B4 servo amplifier does not have CN2L connector. When using MR-J4-_B4-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to Table 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.

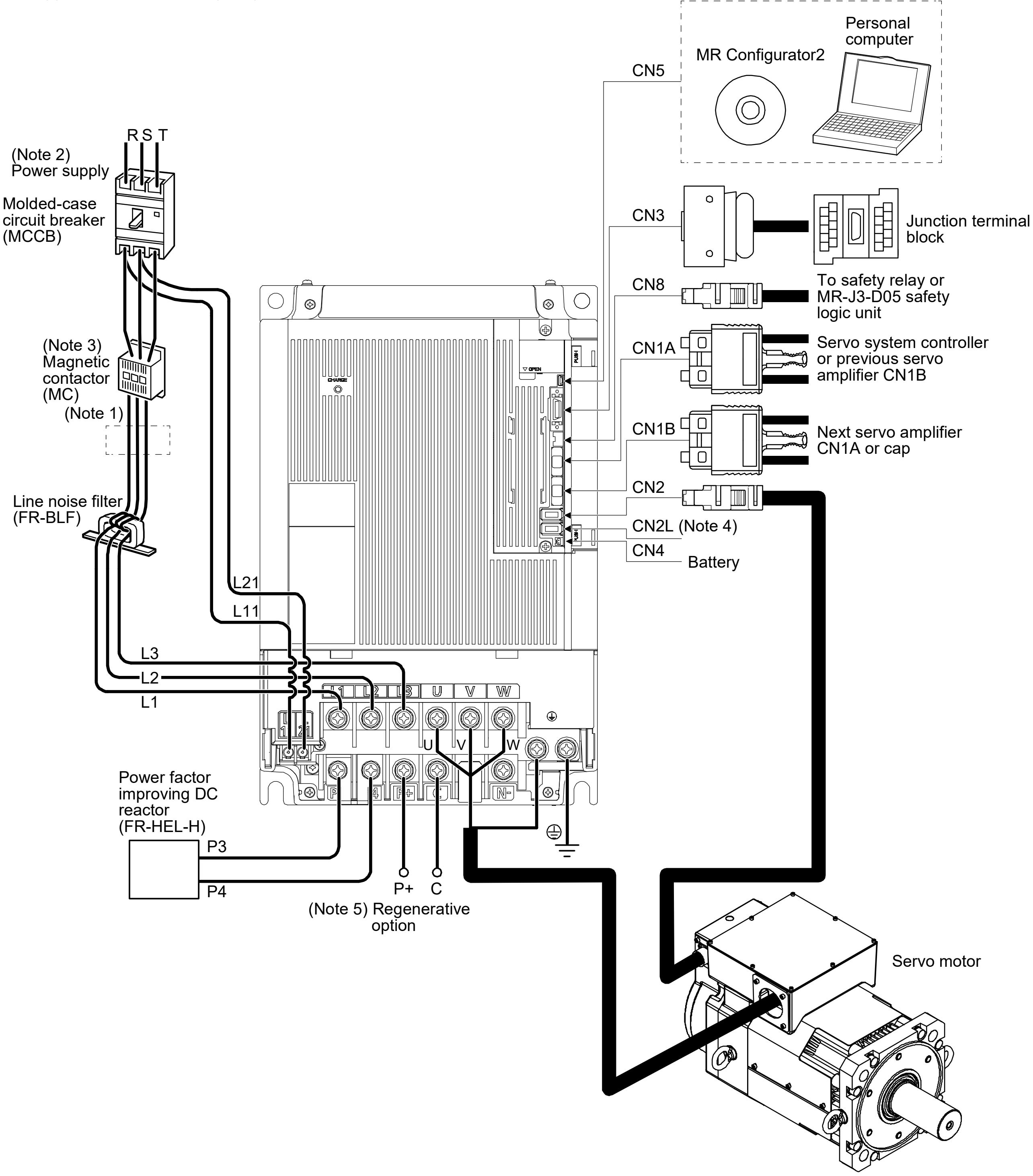
5. When using the regenerative option, refer to section 11.2.

(e) MR-J4-11K4B(-RJ)/MR-J4-15K4B(-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.
2. Refer to section 1.3 for the power supply specification.
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 MR-J4-_B4-RJ servo amplifier. MR-J4-_B4 servo amplifier does not have CN2L connector. When using MR-J4-_B4-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to Table 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.
5. When using the regenerative option, refer to section 11.2.

(f) MR-J4-22K4B(-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.

2. Refer to section 1.3 for the power supply specification.

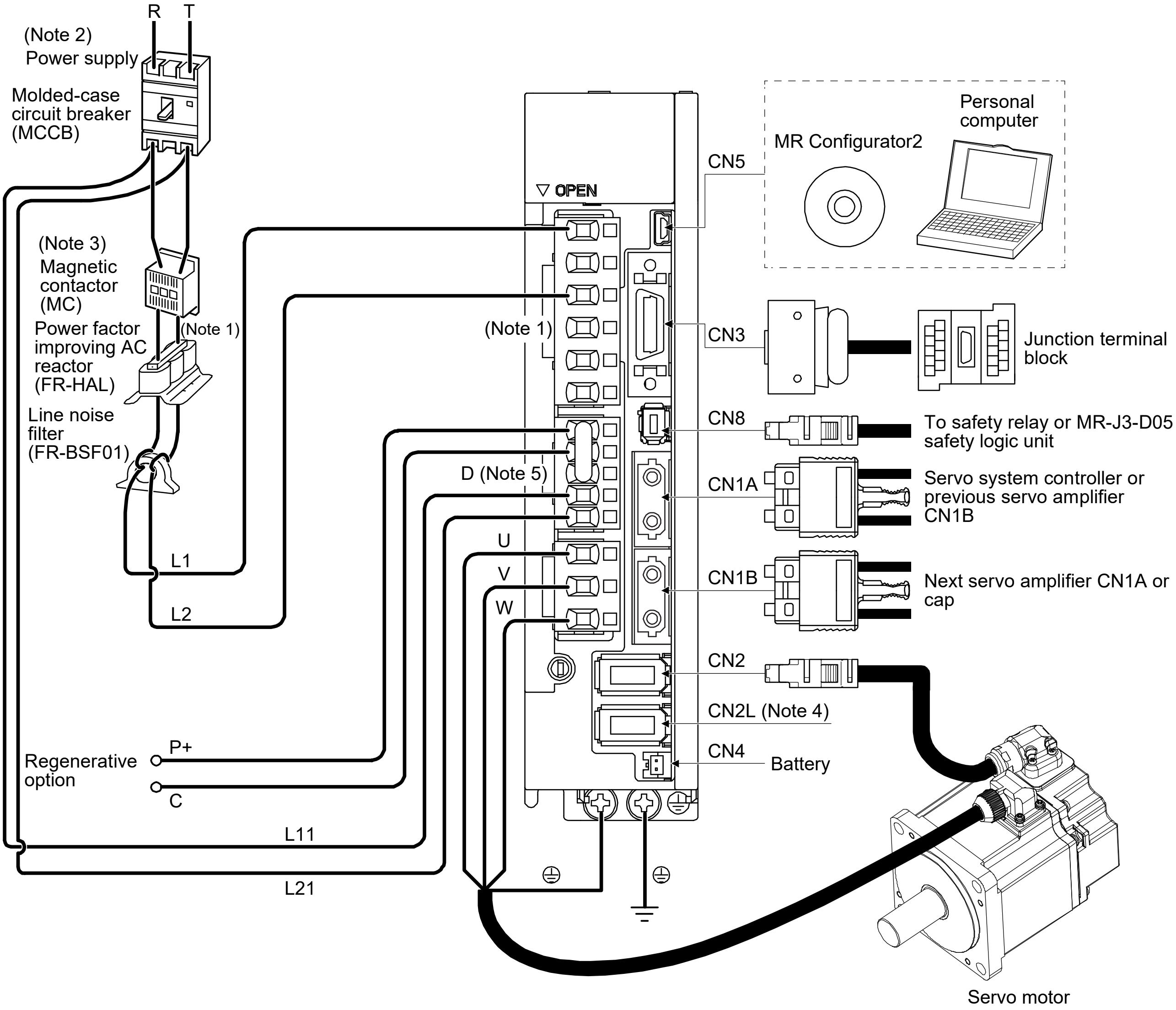
3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

4. This is for MR-J4-_B4-RJ servo amplifier. MR-J4-_B4 servo amplifier does not have CN2L connector. When using MR-J4-_B4-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to Table 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.

5. When using the regenerative option, refer to section 11.2.

(3) 100 V class

The diagram is for MR-J4-20B1-RJ.



Note
1. The power factor improving DC reactor cannot be used.
2. For 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 MR-J4-_B1-RJ servo amplifier. MR-J4-_B1 servo amplifier does not have CN2L connector. Refer to Table 1.1 and Linear Encoder Instruction Manual for the compatible external encoders.
5. Always connect between P+ and D terminals. When using the regenerative option, refer to section 11.2.

2. INSTALLATION

⚠WARNING

- To prevent electric shock, ground each equipment securely.

⚠CAUTION

- Stacking in excess of the specified number of product packages is not allowed.
- Do not hold the front cover, cables, or connectors when carrying the servo amplifier. Otherwise, it may drop.
- 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 product. 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 apply heavy impact on the servo amplifiers and the servo motors. Otherwise, injury, malfunction, etc. may occur.
- Do not install or operate the servo amplifier which have been damaged or have any parts missing.
- When the product has been stored for an extended period of time, contact your local sales office.
- When handling the servo amplifier, be careful about the edged parts such as corners of the servo amplifier.
- The servo amplifier must be installed in the metal cabinet.
- Fumigants that are used to disinfect and protect wooden packaging from insects contain halogens (such as fluorine, chlorine, bromine, and iodine) cause damage if they enter our products. Please take necessary precautions to ensure that remaining materials from fumigant do not enter our products, or treat packaging with methods other than fumigation (heat method).Additionally, disinfect and protect wood from insects before packing products.

POINT

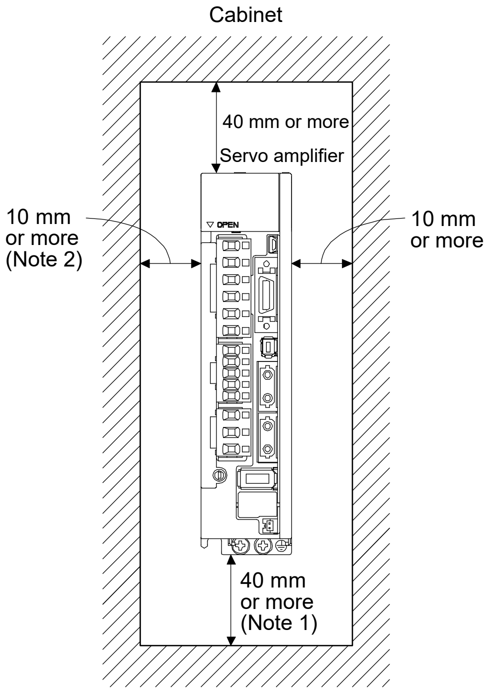
- When pulling out CNP1, CNP2, and CNP3 connectors of 100 V class/600 W or lower 200 V class servo amplifier, pull out CN3 and CN8 connectors beforehand.

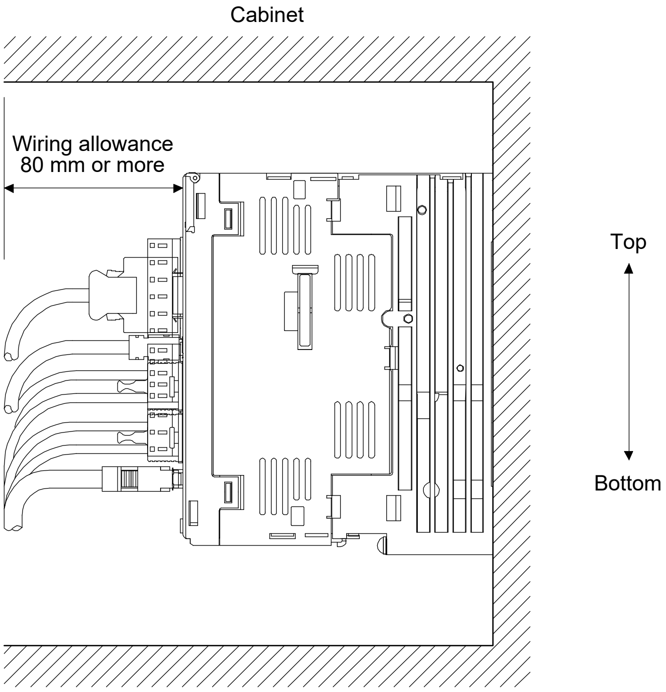
2.1 Installation direction and clearances

⚠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



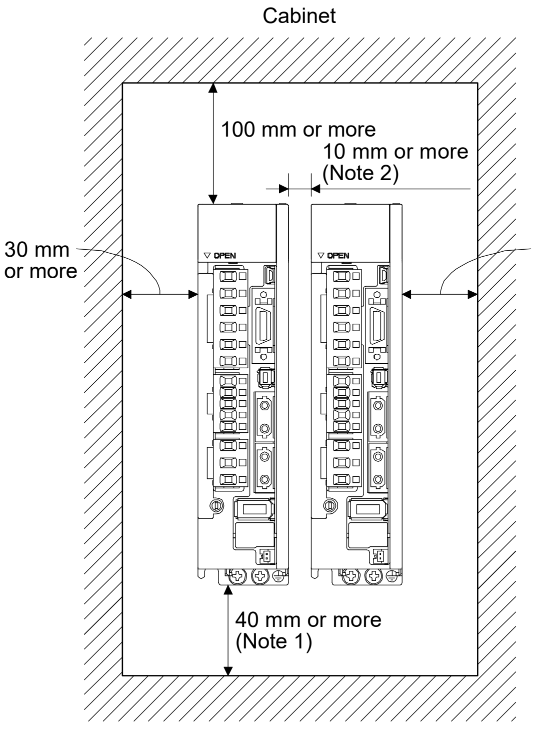


Note 1. For 11 kW to 22 kW servo amplifiers, the clearance between the bottom and ground will be 120 mm or more.
2. When mounting MR-J4-500B(-RJ), maintain a minimum clearance of 25 mm on the left side.

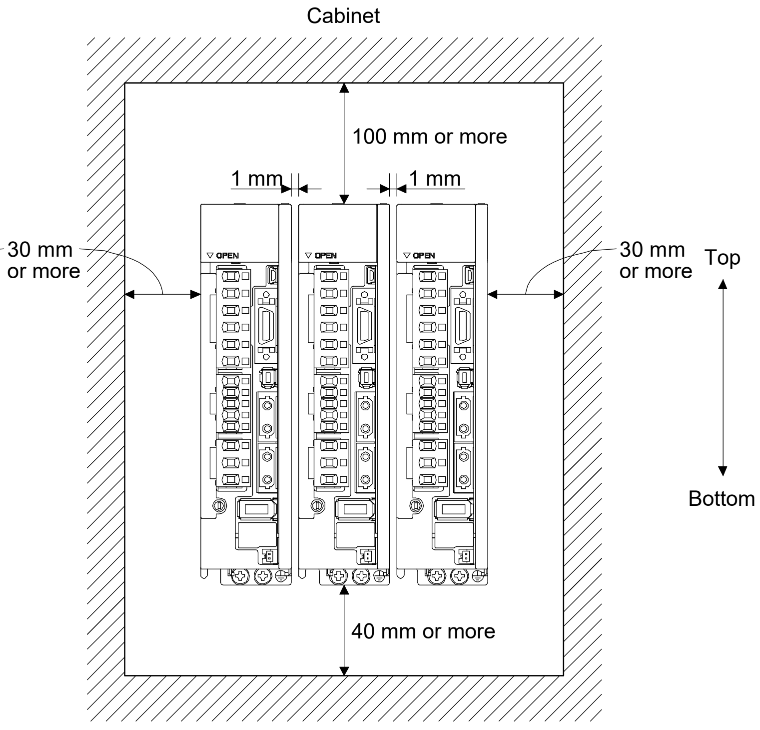
(b) Installation of two or more servo amplifiers

POINT
●Close mounting is possible depending on the capacity of the servo amplifier. Refer to section 1.3 for availability of close mounting. ●When closely mounting multiple servo amplifiers, the servo amplifier on the right must have a larger depth than that on the left. Otherwise, the CNP1, CNP2, and CNP3 connectors cannot be removed.

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



Leaving clearance



Mounting closely

Note 1. For 11 kW to 22 kW servo amplifiers, the clearance between the bottom and ground will be 120 mm or more.

2. When mounting MR-J4-500B(-RJ), maintain a minimum clearance of 25 mm between the MR-J4-500B(-RJ) and a servo amplifier mounted on the left side.

(2) Others

When using heat generating equipment such as the regenerative option, install them with full consideration of heat generation so that the servo amplifier is not affected.

Install the servo amplifier on a perpendicular wall in the correct vertical direction.

2.2 Keeping out of foreign materials

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

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

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

2.3 Encoder cable stress

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

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

(3) Avoid any probability that the cable insulator 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.

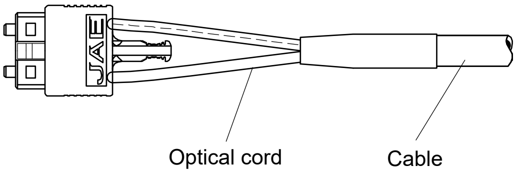
2.4 SSCNET III cable laying

SSCNET III cable is made from optical fiber. If optical fiber is added a power such as a major shock, lateral pressure, haul, sudden bending or twist, its inside distorts or breaks, and optical transmission will not be available. Especially, as optical fiber for MR-J3BUS_M/MR-J3BUS_M-A is made of synthetic resin, it melts down if being left near the fire or high temperature. Therefore, do not make it touched the part, which can become hot, such as heat sink or regenerative option of servo amplifier.
Read described item in this section carefully and handle it with caution.

(1) Minimum bend radius
Make sure to lay the cable with greater radius than the minimum bend radius. Do not press the cable to edges of equipment or others. For SSCNET III cable, the appropriate length should be selected with due consideration for the dimensions and arrangement of servo amplifier. When closing the door of cabinet, pay careful attention for avoiding the case that SSCNET III cable is hold down by the door and the cable bend becomes smaller than the minimum bend radius. For the minimum bend radius, refer to section 11.1.3.

(2) Prohibition of vinyl tape use

Migrating plasticizer is used for vinyl tape. Keep the MR-J3BUS_M, and MR-J3BUS_M-A cables away from vinyl tape because the optical characteristic may be affected.



SSCNET III cable	Cord	Cable
MR-J3BUS_M	△	
MR-J3BUS_M-A	△	△
MR-J3BUS_M-B	○	○

△: Phthalate ester plasticizer such as DBP and DOP may affect optical characteristic of cable.

○: Cord and cable are not basically affected by plasticizer.

(3) Precautions for migrating plasticizer added materials

Generally, soft polyvinyl chloride (PVC), polyethylene resin (PE) and fluorine resin contain non-migrating plasticizer and they do not affect the optical characteristic of SSCNET III cable. However, some wire sheaths and cable ties, which contain migrating plasticizer (phthalate ester), may affect MR-J3BUS_M and MR-J3BUS_M-A cables (plastic).

In addition, MR-J3BUS_M-B cable (silica glass) is not affected by plasticizer.

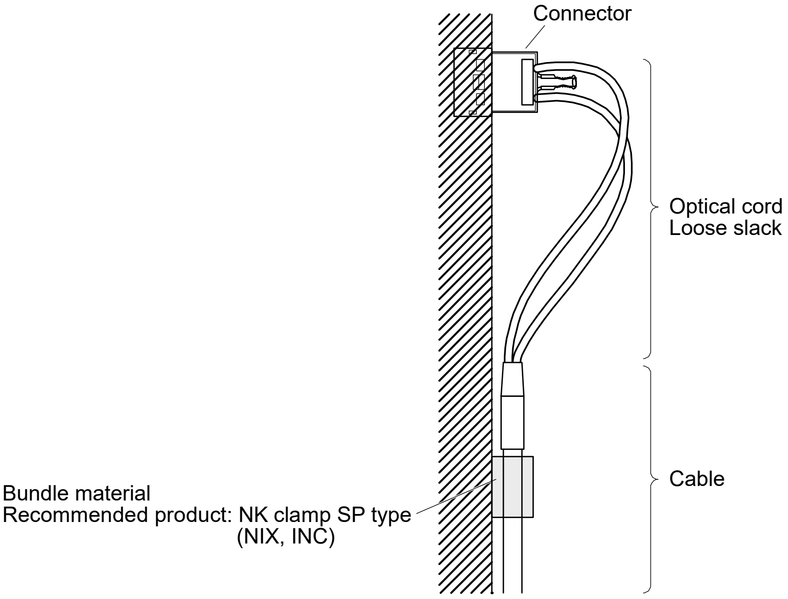
A chemical substance may affect its optical characteristic. Therefore, previously check that the cable is not affected by the environment.

(4) Bundle fixing

Fix the cable at the closest part to the connector with bundle material in order to prevent SSCNET III cable from putting its own weight on CN1A/CN1B connector of servo amplifier. Optical cord should be given loose slack to avoid from becoming smaller than the minimum bend radius, and it should not be twisted.

When bundling the cable, fix and hold it in position by using cushioning such as sponge or rubber which does not contain migratable plasticizers.

If adhesive tape for bundling the cable is used, fire resistant acetate cloth adhesive tape 570F (Teraoka Seisakusho Co., Ltd) is recommended.



(5) Tension
If tension is added on optical cable, the increase of transmission loss occurs because of external force which concentrates on the fixing part of optical fiber or the connecting part of optical connector. Doing so may cause the breakage of the optical fiber or damage of the optical connector. For cable laying, handle without putting forced tension. For the tension strength, refer to section 11.1.3.

(6) Lateral pressure
If lateral pressure is added on optical cable, the optical cable itself distorts, internal optical fiber gets stressed, and then transmission loss will increase. Doing so may cause the breakage of the optical cable. As the same condition also occurs at cable laying, do not tighten up optical cable with a thing such as nylon band (cable tie).
Do not trample it down or tuck it down with the door of cabinet or others.

(7) Twisting
If optical fiber is twisted, it will become the same stress added condition as when local lateral pressure or bend is added. Consequently, transmission loss increases, and the breakage of optical fiber may occur.

(8) Disposal
When incinerating optical cable (cord) used for SSCNET III, hydrogen fluoride gas or hydrogen chloride gas which is corrosive and harmful may be generated. For disposal of optical fiber, request for specialized industrial waste disposal services who has incineration facility for disposing hydrogen fluoride gas or hydrogen chloride gas.

2.5 Inspection items

⚠WARNING	●Before starting maintenance and/or inspection, turn off the power and wait for 15 minutes or more until the charge lamp turns off. 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.

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

It is recommended that the following points periodically be checked.

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

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

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

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

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

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

(7) Make sure that the emergency stop circuit operates properly such that an operation can be stopped immediately and a power is shut off by the emergency stop switch.

2.6 Parts having service life

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

Part name	Life guideline
Smoothing capacitor	10 years
Relay	Power-on, dynamic brake stop, and forced stop 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 air-conditioned environment (ambient temperature of 40 °C or less).

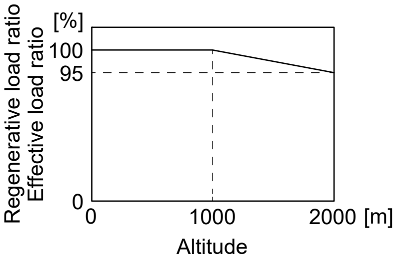
(2) Relays
Contact faults occur due to contact wear arisen from switching currents. A relay will reach the end of its service life if the following actions are performed a total of 100,000 times: powering on the servo amplifier, inputting the dynamic brake stop, and inputting the forced stop; or if the following action is performed a total of 1,000,000 times: turning on or off STO during servo-off and servo motor stop. In addition, the service life of a relay may vary depending 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. If unusual noise or vibration is found during inspection, the cooling fan must also be replaced.
The life indicates under the yearly average ambient temperature of 40 ˚C, free from corrosive gas, flammable gas, oil mist, dust and dirt.

2.7 Restrictions when using this product at altitude exceeding 1000 m and up to 2000 m above sea level

(1) Effective load ratio and regenerative load ratio

As heat dissipation effects decrease in proportion to the decrease in air density, use the product within the effective load ratio and regenerative load ratio shown in the following figure.



When closely mounting the servo amplifiers, operate them at the ambient temperature of 0 °C to 45 °C or at 75% or smaller effective load ratio. (Refer to section 2.1.)

(2) Input voltage

Generally, a withstand voltage decreases as increasing altitude; however, there is no restriction on the withstand voltage. Use in the same manner as in 1000 m or less. (Refer to section 1.3.)

(3) Parts having service life

(a) Smoothing capacitor

The capacitor will reach the end of its life in 10 years of continuous operation in air-conditioned environment (ambient temperature of 30 °C or less).

(b) Relay

There is no restriction. Use in the same manner as in 1000 m or less. (Refer to section 2.6.)

(c) Servo amplifier cooling fan

There is no restriction. Use in the same manner as in 1000 m or less. (Refer to section 2.6.)

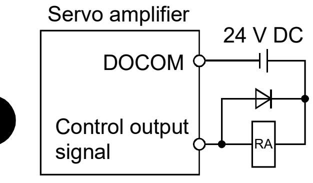
3. SIGNALS AND WIRING

⚠WARNING

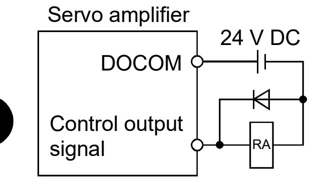
- Any person who is involved in wiring should be fully competent to do the work.
- Before wiring, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. Otherwise, an electric shock 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

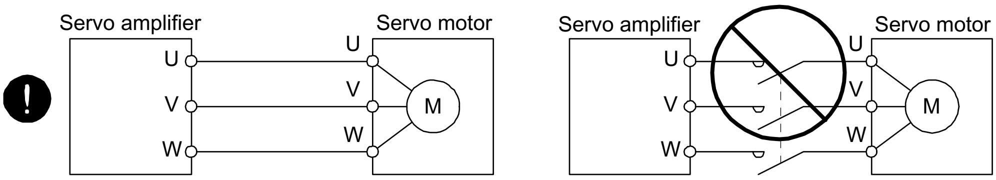


For source output interface

- 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(-H)) 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.

⚠CAUTION

- Connect the servo amplifier power output (U/V/W) to the servo motor power input (U/V/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.
- Before wiring, switch operation, etc., eliminate static electricity. Otherwise, it may cause a malfunction.

POINT

- When you use a linear servo motor, replace the following words in the left to the words in the right.

Load to motor inertia ratio	→ Load mass
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/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, the servo amplifier will break down.
- ●The servo amplifier has a built-in surge absorber (varistor) to reduce exogenous noise and to suppress lightning surge. Exogenous noise or lightning surge deteriorates the varistor characteristics, and the varistor may be damaged. To prevent a fire, use a molded-case circuit breaker or fuse for input power supply.
- ●Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
- ●The N- terminal is not a neutral point of the power supply. Incorrect wiring will cause a burst, damage, etc.
- ●When insulating the main circuit power supply (L1/L2/L3) and the control circuit power supply (L11/L21) of the servo amplifier using an isolation transformer, etc., connect between L1 and L11 and between L2 and L21 at equipotential.

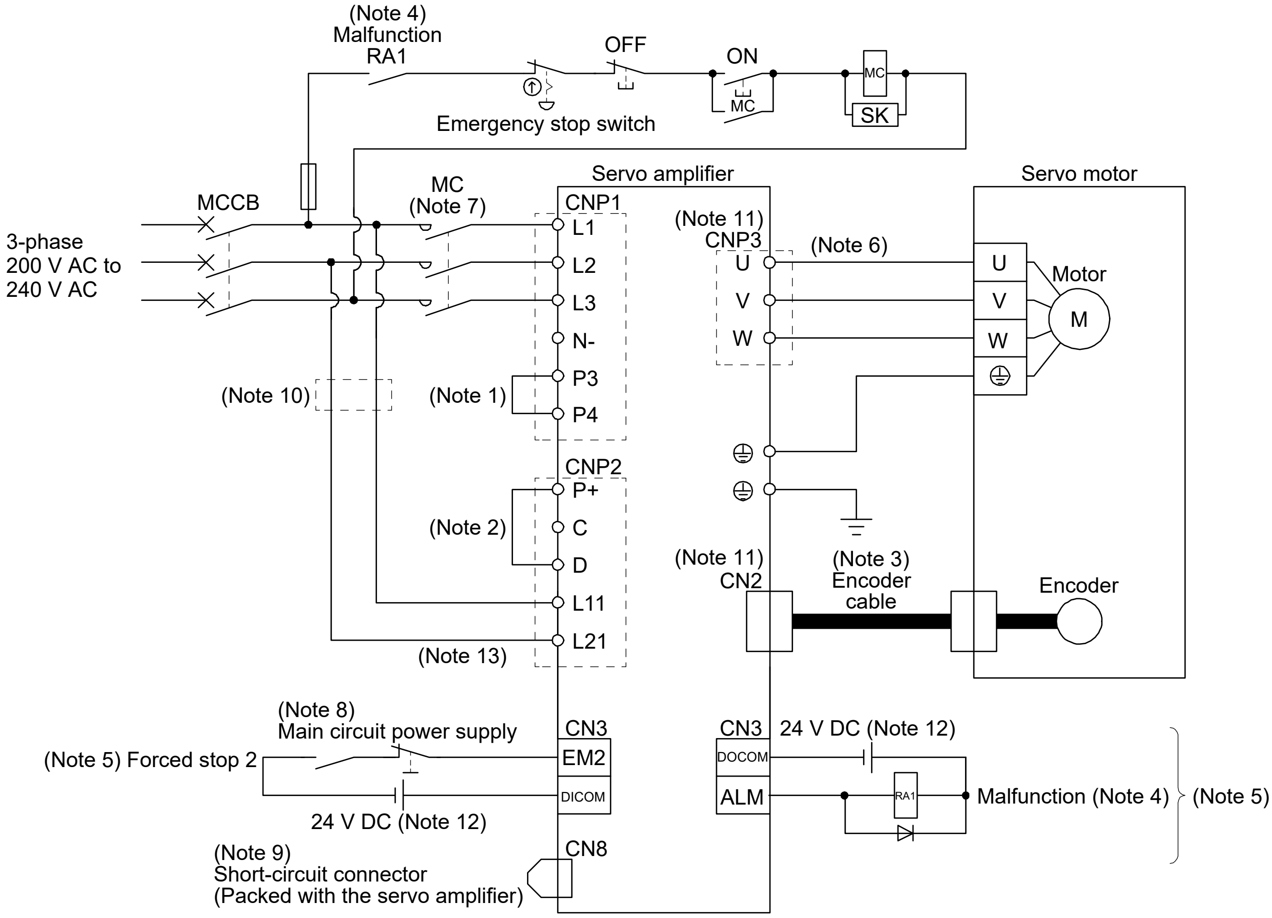
POINT

- ●Even if alarm has occurred, do not switch off the control circuit power supply. When the control circuit power supply has been switched off, optical module does not operate, and optical transmission of SSCNET III/H communication is interrupted. Therefore, the next axis servo amplifier displays "AA" at the indicator and turns into base circuit shut-off. The servo motor stops with starting dynamic brake.
- ●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.
- ●When using the MR-J4-_B-RJ servo amplifier with the DC power supply input, refer to app. 15.

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

3.1.1 200 V class

(1) Using 3-phase 200 V AC to 240 V AC power supply for MR-J4-10B(-RJ) to MR-J4-350B(-RJ)

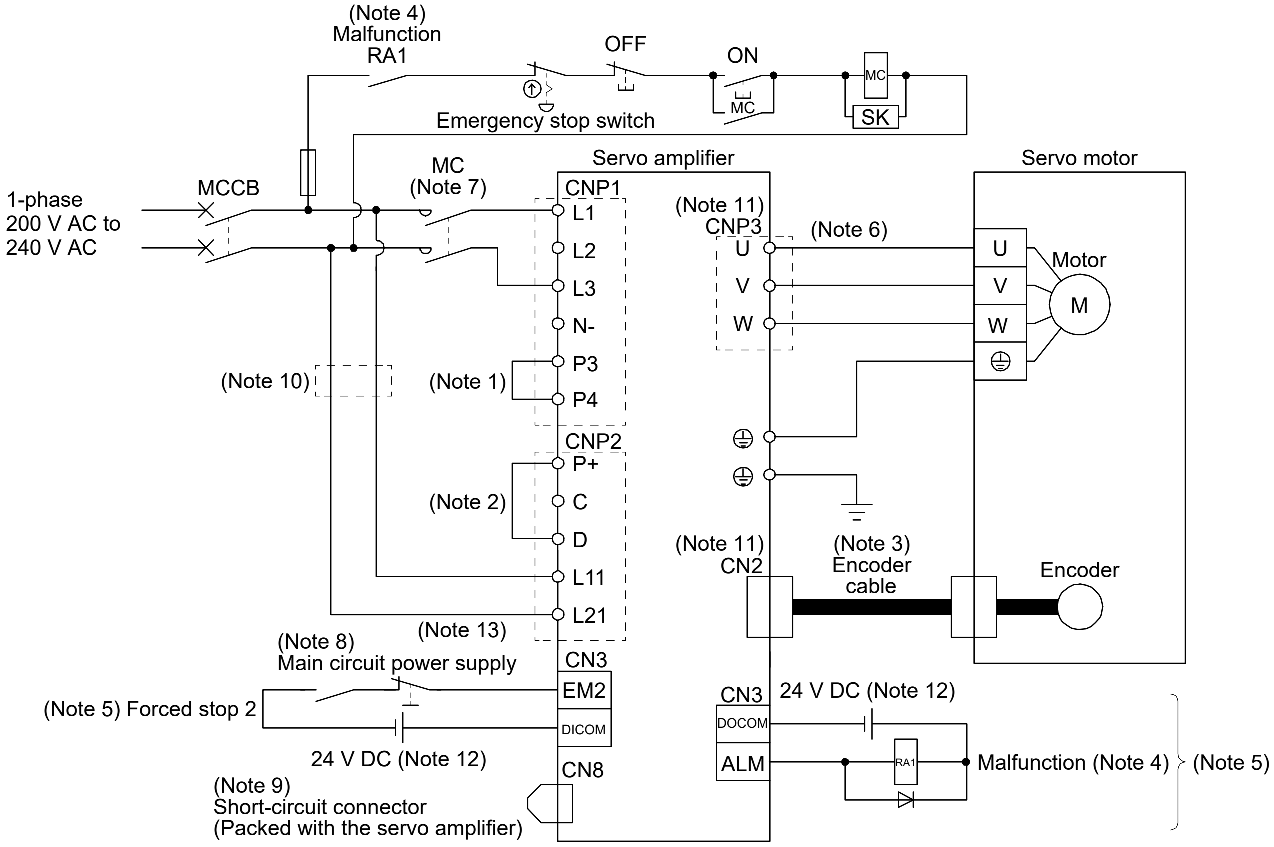


Note
1. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
2. Always 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. If ALM (Malfunction) output is disabled with the parameter, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.8.3.
6. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
7. 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.
8. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
9. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
10. 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.)
11. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
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.
13. Do not ground L11 and L21.

(2) Using 1-phase 200 V AC to 240 V AC power supply for MR-J4-10B(-RJ) to MR-J4-200B(-RJ)

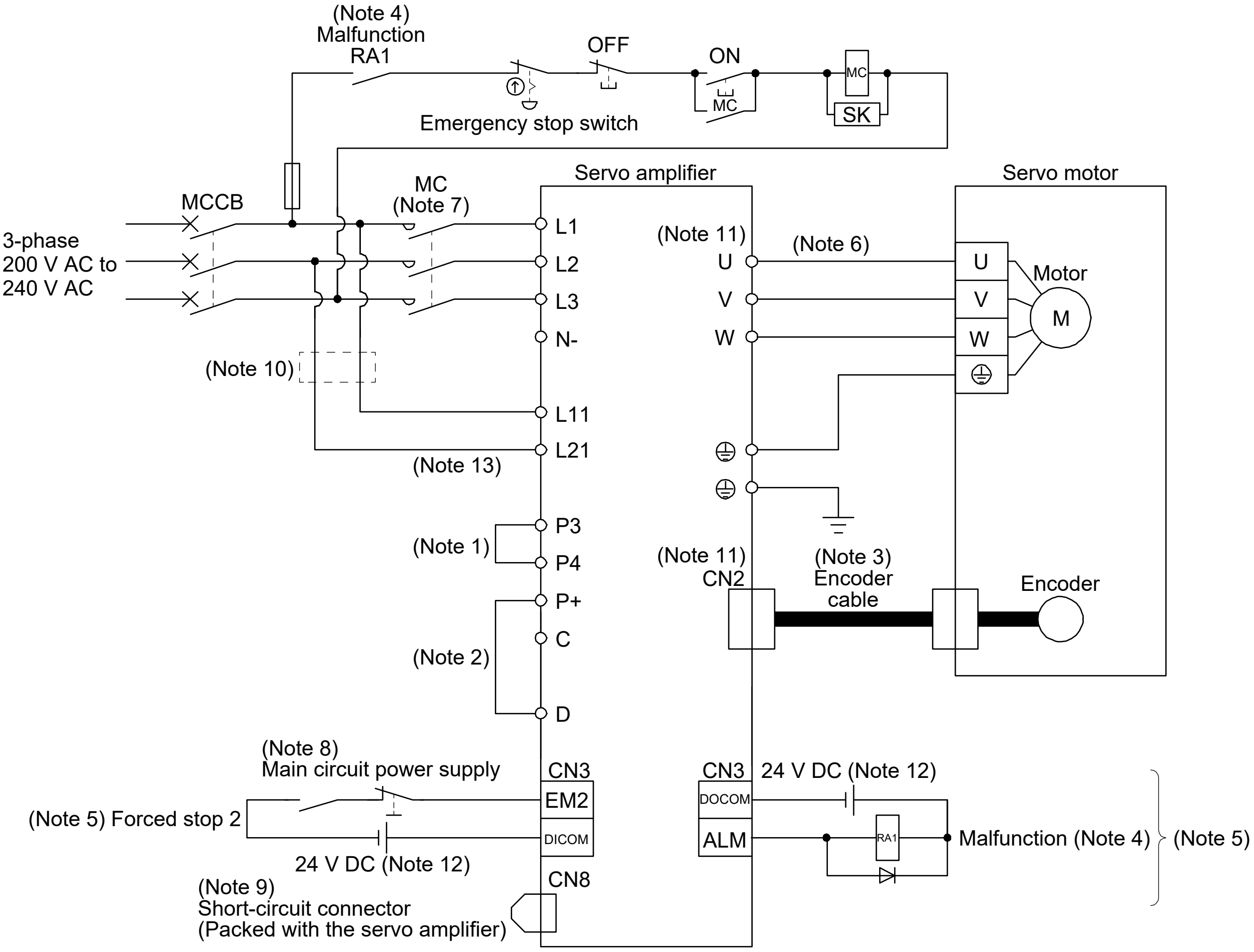
POINT

- 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.



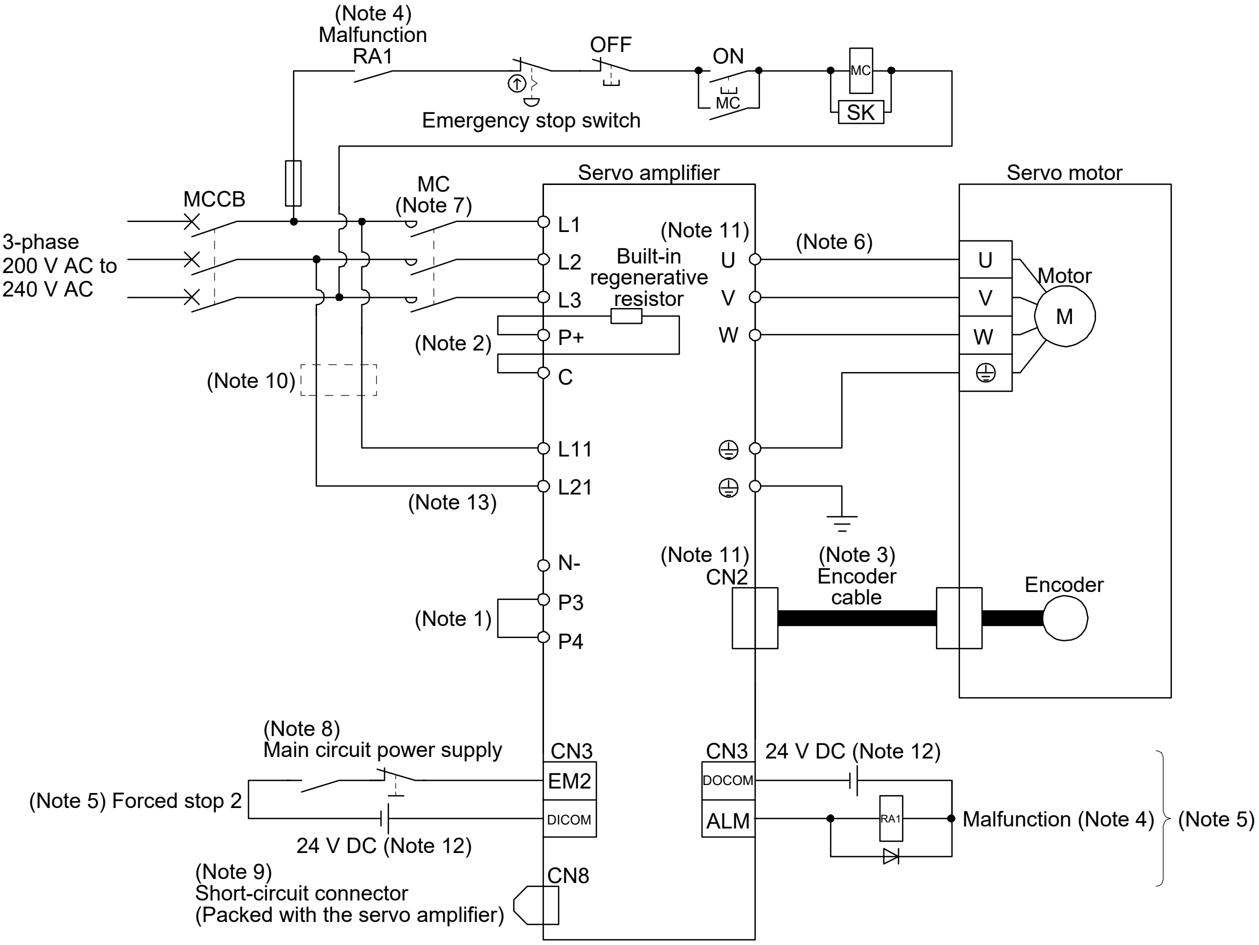
Note
1. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
2. Always 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. If ALM (Malfunction) output is disabled with the parameter, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.8.3.
6. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
7. 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.
8. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
9. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
10. 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.)
11. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
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.
13. Do not ground L11 and L21.

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



Note
1. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
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. If ALM (Malfunction) output is disabled with the parameter, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.8.3.
6. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
7. 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.
8. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
9. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
10. 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.)
11. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
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.
13. Do not ground L11 and L21.

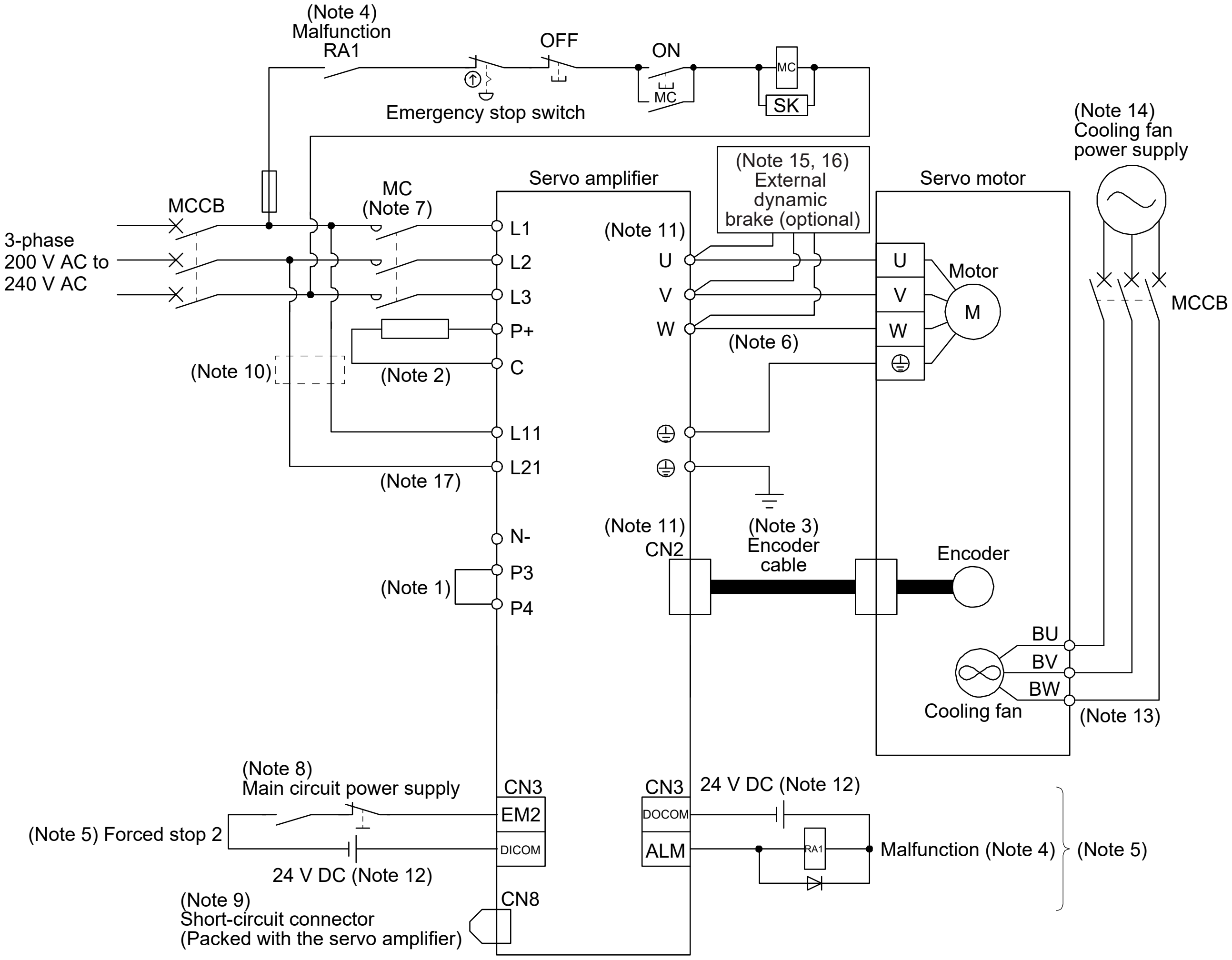
(4) MR-J4-700B(-RJ)



Note 1. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.

2. 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. If ALM (Malfunction) output is disabled with the parameter, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.8.3.
6. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
7. 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.
8. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
9. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
10. 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.)
11. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
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.
13. Do not ground L11 and L21.

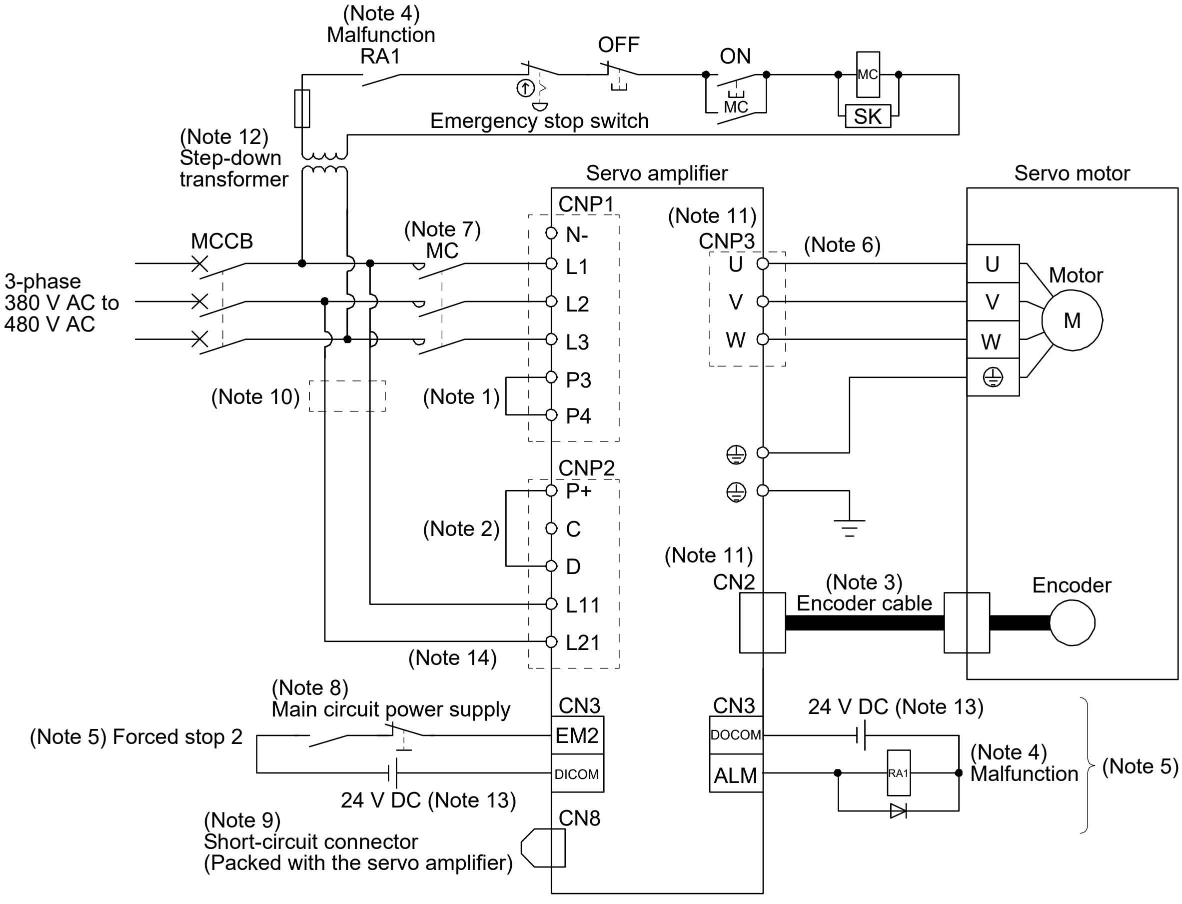
(5) MR-J4-11KB(-RJ)/MR-J4-15KB(-RJ)/MR-J4-22KB(-RJ)



Note 1. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
2. 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. If ALM (Malfunction) output is disabled with the parameter, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.8.3.
6. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
7. 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.
8. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
9. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
10. 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.)
11. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
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.
13. For the servo motor with a cooling fan.
14. For the cooling fan power supply, refer to "Servo Motor Instruction Manual (Vol. 3)".
15. 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 chapter 8. For wiring of the external dynamic brake, refer to section 11.17.
16. The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD07] to [Pr. PD09]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.
17. Do not ground L11 and L21.

3.1.2 400 V class

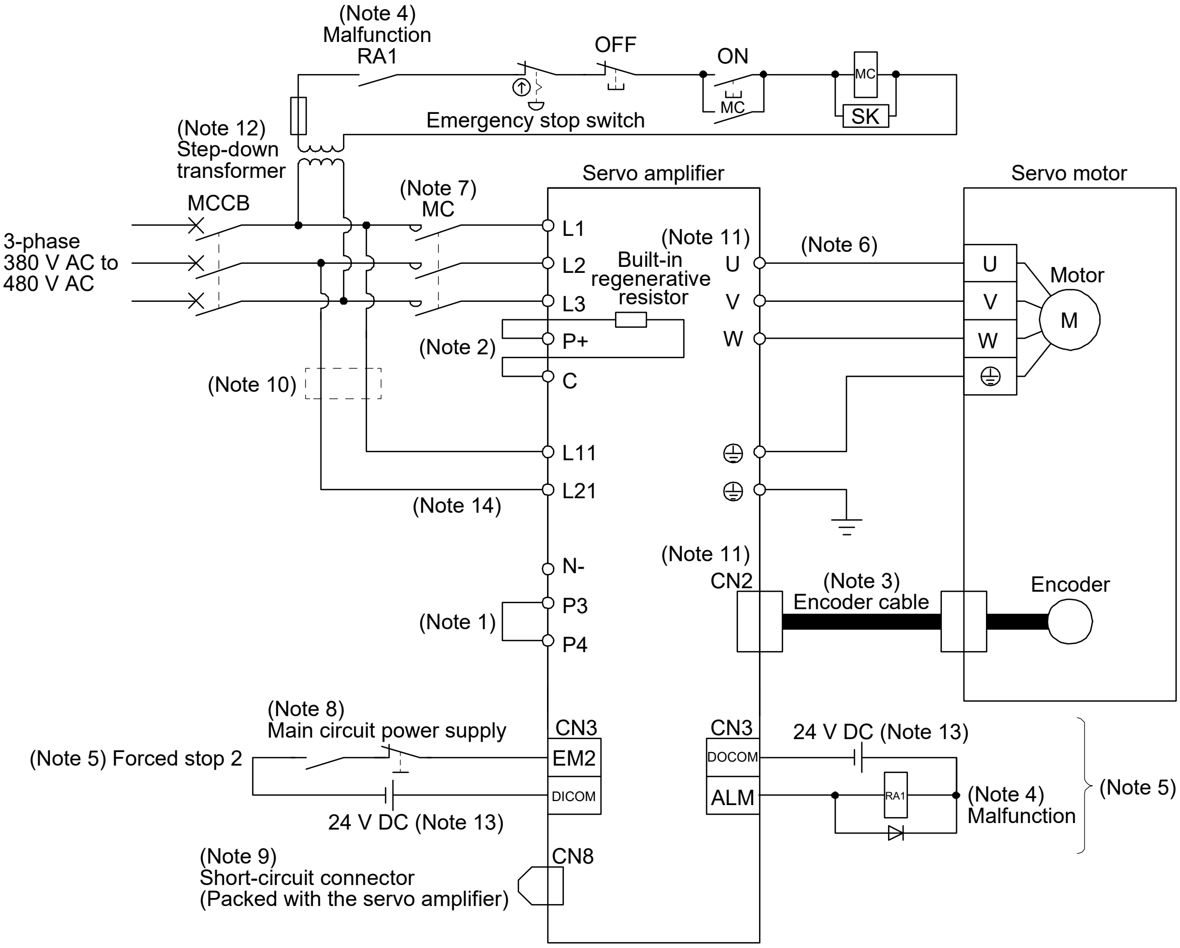
(1) MR-J4-60B4(-RJ) to MR-J4-350B4(-RJ)



Note

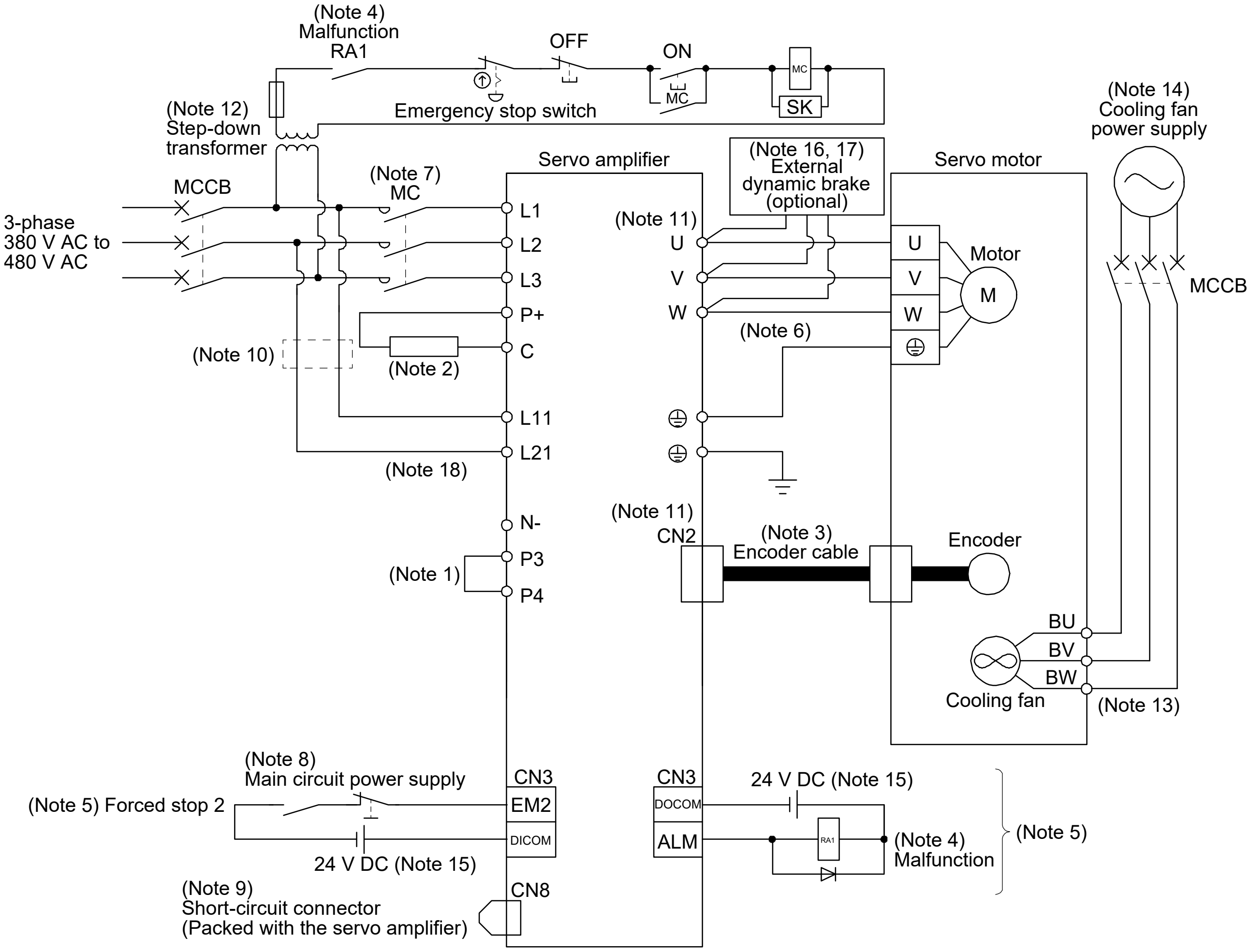
1. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
2. Always 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. If ALM (Malfunction) output is disabled with the parameter, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.8.3.
6. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
7. 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.
8. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
9. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
10. 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.)
11. Connecting a servo motor for different axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
12. Stepdown transformer is required when the coil voltage of the magnetic contactor is 200 V class.
13. 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.
14. Do not ground L11 and L21.

(2) MR-J4-500B4(-RJ)/MR-J4-700B4(-RJ)



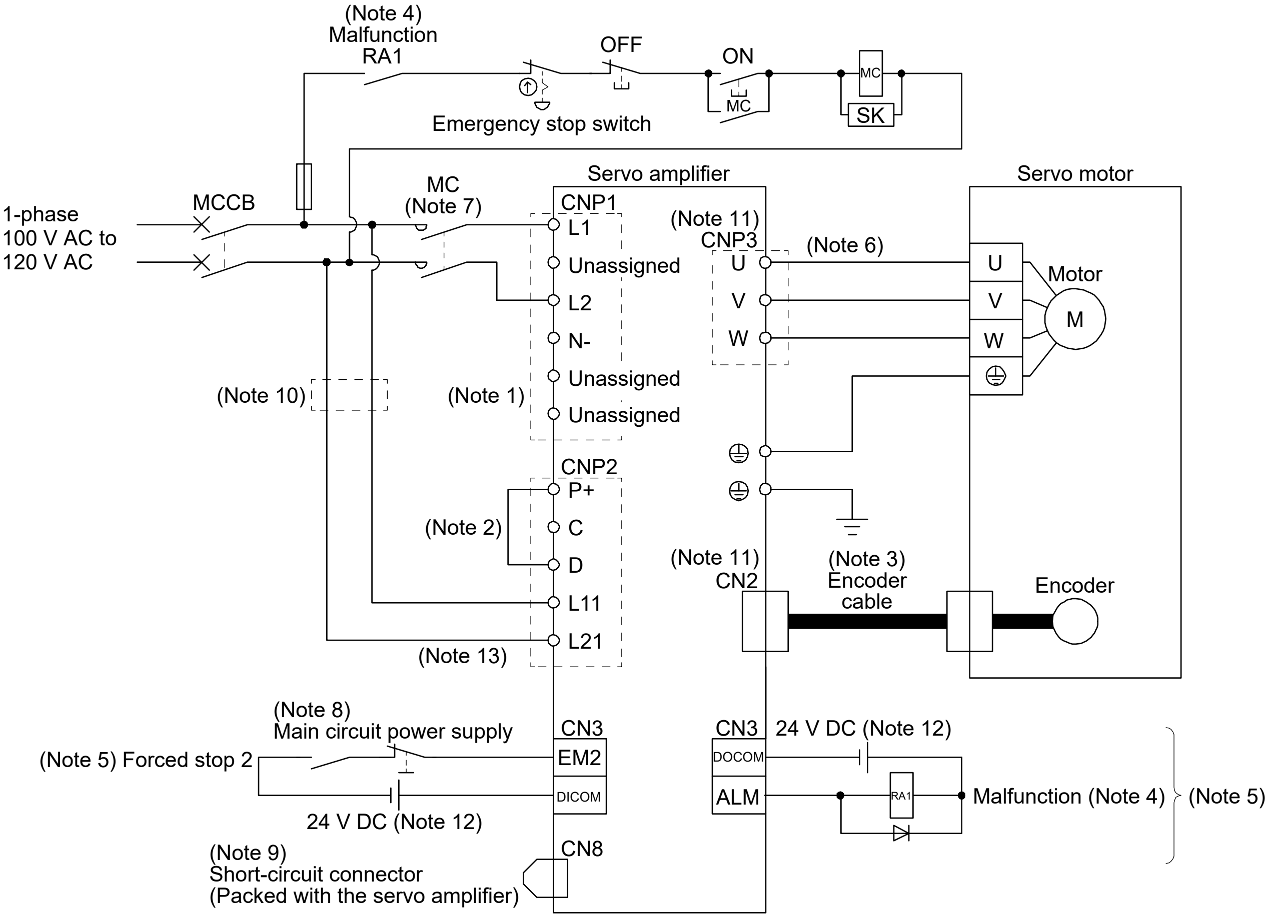
Note
1. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
2. When 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. If ALM (Malfunction) output is disabled with the parameter, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.8.3.
6. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
7. 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.
8. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
9. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
10. 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.)
11. Connecting a servo motor for different axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
12. Stepdown transformer is required when the coil voltage of the magnetic contactor is 200 V class.
13. 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.
14. Do not ground L11 and L21.

(3) MR-J4-11KB4(-RJ) to MR-J4-22KB4(-RJ)



Note
1. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
2. 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. If ALM (Malfunction) output is disabled with the parameter, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.8.3 in MR-J4-_B(-RJ) Servo Amplifier Instruction Manual.
6. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
7. 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.
8. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
9. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
10. 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.)
11. Connecting a servo motor for different axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
12. Stepdown transformer is required for coil voltage of magnetic contactor more than 200 V class servo amplifiers.
13. For the servo motor with a cooling fan.
14. For the cooling fan power supply, refer to "Servo Motor Instruction Manual (Vol. 3)".
15. 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.
16. 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 chapter 8. For wiring of the external dynamic brake, refer to section 11.17.
17. The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD07] to [Pr. PD09]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.
18. Do not ground L11 and L21.

3.1.3 100 V class

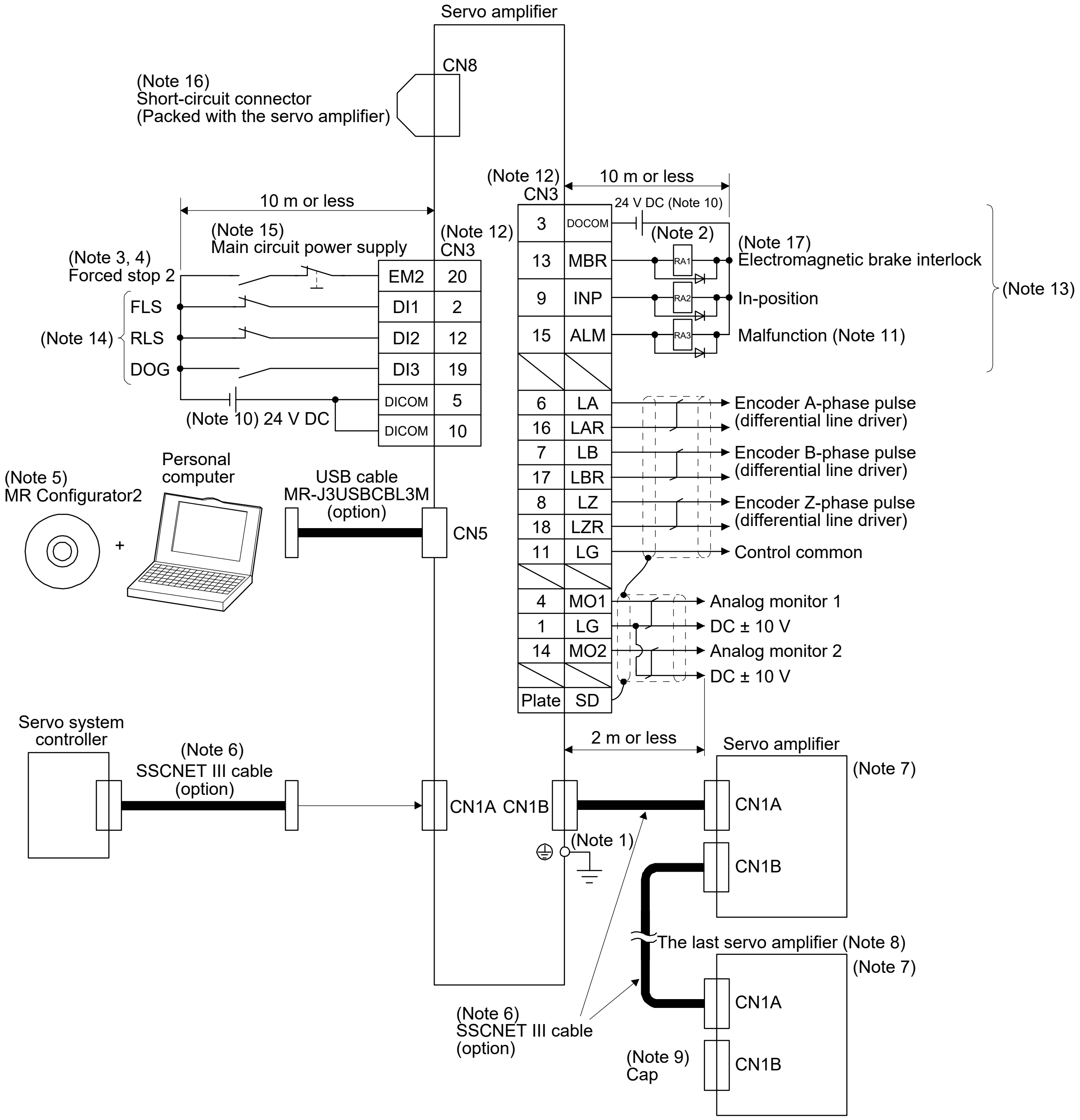


Note
1. The power factor improving DC reactor cannot be used.
2. Always connect between P+ and D terminals (factory-wired). When using the regenerative option, refer to section 11.2.
3. For the encoder cable, use of the option cable is recommended. For selecting cables, refer to "Servo Motor Instruction Manual (Vol. 3)".
4. If ALM (Malfunction) output is disabled with the parameter, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.8.3.
6. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
7. 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.
8. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
9. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
10. When wires used for L11 and L21 are thinner than wires used for L1 and L2, use a molded-case circuit breaker. (Refer to section 11.10.)
11. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
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.
13. Do not ground L11 and L21.

3.2 I/O signal connection example

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

3.2.1 For sink I/O interface



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

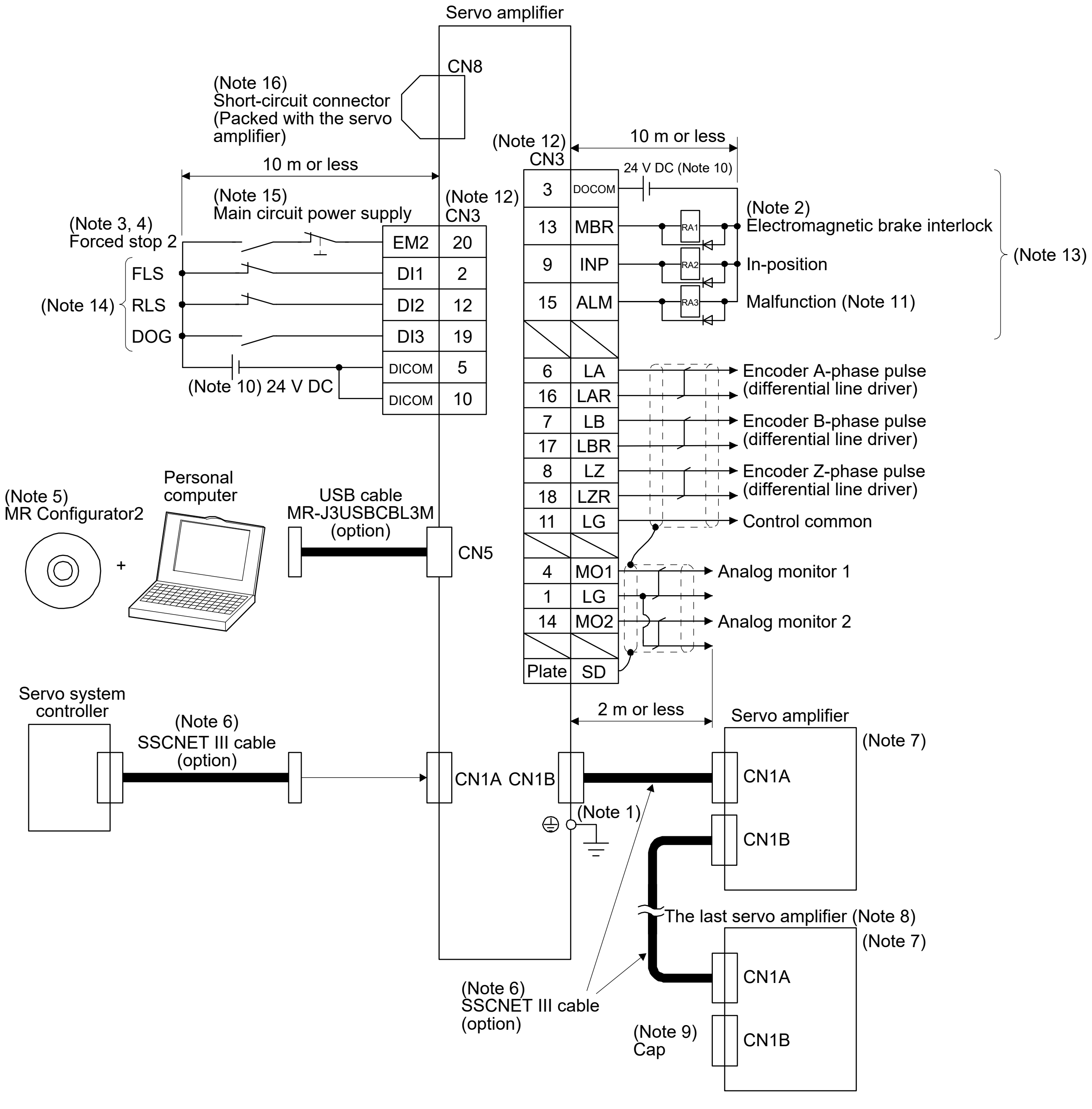
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. If the controller does not have forced stop function, always install the forced stop 2 switch (normally closed contact).
4. When starting operation, always turn on EM2 (Forced stop 2). (Normally closed contact)
5. Use SW1DNC-MRC2-_. (Refer to section 11.7.)
6. Use SSCNET III cables listed in the following table.

Cable	Cable model	Cable length
Standard cord inside cabinet	MR-J3BUS_M	0.15 m to 3 m
Standard cable outside cabinet	MR-J3BUS_M-A	5 m to 20 m
Long-distance cable	MR-J3BUS_M-B	30 m to 50 m

7. The wiring after the second servo amplifier is omitted.
8. Up to 64 axes of servo amplifiers can be connected. The number of connectable axes depends on the controller you use. Refer to section 4.3.1 for setting of axis selection.
9. Make sure to cap the unused CN1B connector.
10. Supply 24 V DC ± 10% for interfaces from outside. Set the total current capacity to 300 mA. 300 mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.8.2 (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.
11. ALM (Malfunction) turns on in normal alarm-free condition. (Normally closed contact)
12. The pins with the same signal name are connected in the servo amplifier.
13. You can change devices of these pins with [Pr. PD07], [Pr. PD08], and [Pr. PD09].
14. Devices can be assigned for these signals with controller setting. For devices that can be assigned, refer to the controller instruction manual. The following devices can be assigned for R_MTCPU, Q17_DSCPU, RD77MS_ and QD77MS_.
    FLS: Upper stroke limit
    RLS: Lower stroke limit
    DOG: Proximity dog
15. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
16. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
17. When you use a linear servo motor or direct drive motor, use MBR (Electromagnetic brake interlock) for an external brake mechanism.

3.2.2 For source I/O interface

POINT
●For notes, refer to section 3.2.1.



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.
> - ●When using the MR-J4-_B-RJ servo amplifier with the DC power supply input, refer to app. 15.

<table>
<tr><th>Symbol</th><th>Connection target (application)</th><th>Description</th></tr>
<tr><td>L1/L2/L3</td><td>Main circuit power supply</td><td>Supply the following power to L1, L2, and L3. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open.
<table>
<tr><th>Servo amplifier
Power</th><th>MR-J4-10B (-RJ) to MR-J4-200B (-RJ)</th><th>MR-J4-350B (-RJ) to MR-J4-22KB (-RJ)</th><th>MR-J4-60B4 (-RJ) to MR-J4-22KB4 (-RJ)</th><th>MR-J4-10B1 to MR-J4-40B1</th></tr>
<tr><td>3-phase 200 V AC to 240 V AC, 50 Hz/60 Hz</td><td colspan="2">L1/L2/L3</td><td></td><td></td></tr>
<tr><td>1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz</td><td>L1/L3</td><td></td><td></td><td></td></tr>
<tr><td>3-phase 380 V AC to 480 V AC, 50 Hz/60 Hz</td><td></td><td></td><td>L1/L2/L3</td><td></td></tr>
<tr><td>1-phase 100 V AC to 120 V AC, 50 Hz/60 Hz</td><td></td><td></td><td></td><td>L1/L2</td></tr>
</table>
</td></tr>
<tr><td>P3/P4</td><td>Power factor improving DC reactor</td><td>When not using the power factor improving DC reactor, connect P3 and P4. (factory-wired)
When using the power factor improving DC reactor, disconnect P3 and P4, and connect the power factor improving DC reactor to P3 and P4. Additionally, the power factor improving DC reactor cannot be used for the 100 V class servo amplifiers.
Refer to section 11.11 for details.</td></tr>
<tr><td>P+/C/D</td><td>Regenerative option</td><td>(1) 200 V class/100 V class
1) MR-J4-500B(-RJ) or less and MR-J4-40B1(-RJ) or less
When using a servo amplifier built-in regenerative resistor, connect P+ and D. (factory-wired)
When using a regenerative option, disconnect P+ and D, and connect the regenerative option to P+ and C.
2) MR-J4-700B(-RJ) to MR-J4-22KB(-RJ)
MR-J4-700B(-RJ) to MR-J4-22KB(-RJ) do not have D.
When using a servo amplifier built-in regenerative resistor, connect P+ and C. (factory-wired)
When using a regenerative option, disconnect wires of P+ and C for the built-in regenerative resistor. And then connect wires of the regenerative option to P+ and C.
(2) 400 V class
1) MR-J4-350B4(-RJ) or less
When using a servo amplifier built-in regenerative resistor, connect P+ and D. (factory-wired)
When using a regenerative option, disconnect P+ and D, and connect the regenerative option to P+ and C.
2) MR-J4-500B4(-RJ) to MR-J4-22KB4(-RJ)
MR-J4-500B4(-RJ) to MR-J4-22KB4(-RJ) do not have D.
When using a servo amplifier built-in regenerative resistor, connect P+ and C. (factory-wired)
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.
Refer to section 11.2 for details.</td></tr>
</table>

<table>
<tr><th>Symbol</th><th>Connection target (application)</th><th>Description</th></tr>
<tr><td>L11/L21</td><td>Control circuit power supply</td><td>Supply the following power to L11 and L21.
<table>
<tr><th>Servo amplifier
Power</th><th>MR-J4-10B(-RJ) to MR-J4-22KB(-RJ)</th><th>MR-J4-60B4(-RJ) to MR-J4-22KB4(-RJ)</th><th>MR-J4-10B1 to MR-J4-40B1</th></tr>
<tr><td>1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz</td><td>L11/L21</td><td></td><td></td></tr>
<tr><td>1-phase 380 V AC to 480 V AC, 50 Hz/60 Hz</td><td></td><td>L11/L21</td><td></td></tr>
<tr><td>1-phase 100 V AC to 120 V AC, 50 Hz/60 Hz</td><td></td><td></td><td>L11/L21</td></tr>
</table></td></tr>
<tr><td>U/V/W</td><td>Servo motor power input</td><td>Connect the servo amplifier power output (U/V/W) to the servo motor power input (U/V/W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.</td></tr>
<tr><td>N-</td><td>Power regeneration converter
Power regeneration common converter
Brake unit
Multifunction regeneration converter</td><td>This terminal is used for a power regeneration converter, power regeneration common converter, brake unit, and multifunction regeneration converter.
For details, refer to sections 11.3 through 11.5 and 11.19.</td></tr>
<tr><td>⏚</td><td>Protective earth (PE)</td><td>Connect it to the grounding terminal of the servo motor and to the protective earth (PE) of the cabinet for grounding.</td></tr>
</table>

3.3.2 Power-on sequence

POINT

●The output signal, etc. may be unstable at power-on.

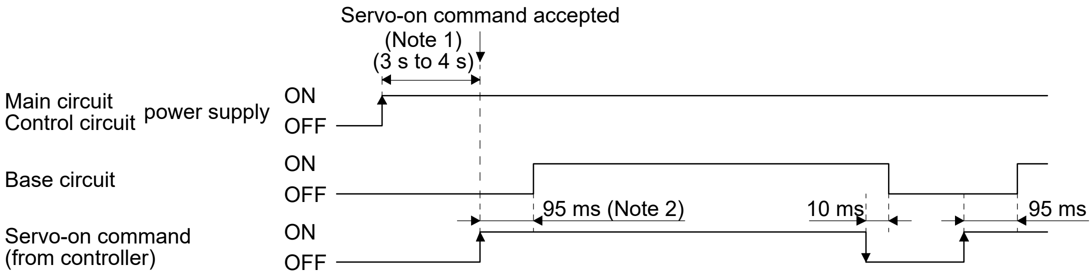
(1) Power-on procedure

1) Always wire the power supply as shown in above section 3.1 using the magnetic contactor with the main circuit power supply (L1/L2/L3). 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/L21) simultaneously with the main circuit power supply or before switching on the main circuit power supply. If the control circuit power supply is turned on with the main circuit power supply off, and then the servo-on command is transmitted, [AL. E9 Main circuit off warning] will occur. Turning on the main circuit power supply stops the warning and starts the normal operation.

3) The servo amplifier receives the servo-on command within 3 s to 4 s after the main circuit power supply is switched on.
(Refer to (2) in this section.)

(2) Timing chart



Note 1. This range will be "5 s to 6 s" for the linear servo system and fully closed loop system.
2. The time will be longer during the magnetic pole detection of a linear servo motor and direct drive motor.

3.3.3 Wiring CNP1, CNP2, and CNP3

POINT

- ●For the wire sizes used for wiring, refer to section 11.9.
- ●When wiring, remove the power connectors from the servo amplifier.
- ●Insert only one wire or ferrule to each wire insertion hole.
- ●MR-J4-500B(-RJ) or more and MR-J4-500B4(-RJ) or more do not have these connectors.

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

(1) Connector

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

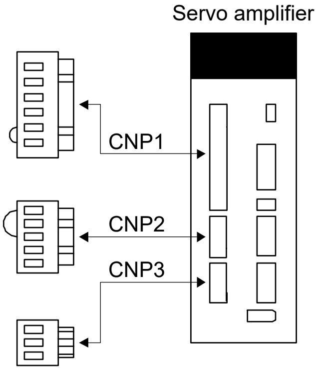


Table 3.1 Connector and applicable wire

Connector	Receptacle assembly	Applicable wire		Stripped length [mm]	Open tool	Manufacturer
		Size	Insulator OD			
CNP1	06JFAT-SAXGDK-H7.5	AWG 18 to 14	3.9 mm or shorter	9	J-FAT-OT (N) or J-FAT-OT	JST
CNP2	05JFAT-SAXGDK-H5.0					
CNP3	03JFAT-SAXGDK-H7.5					

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

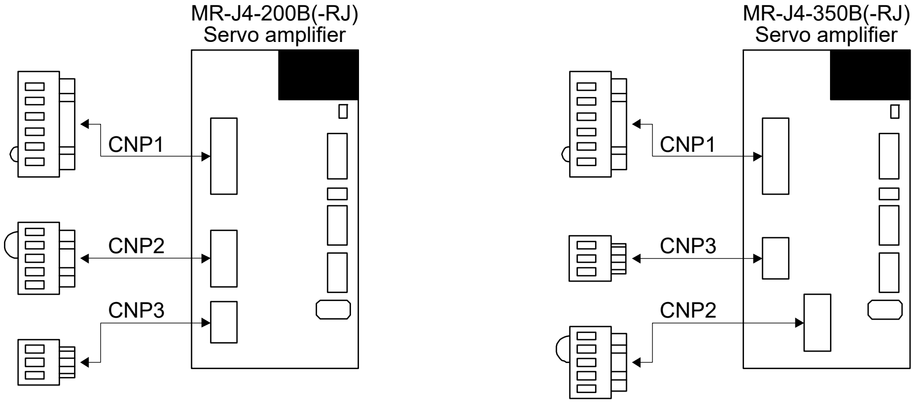
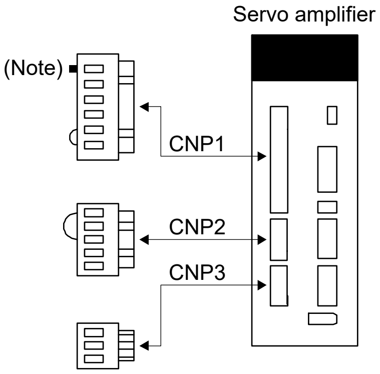


Table 3.2 Connector and applicable wire

Connector	Receptacle assembly	Applicable wire		Stripped length [mm]	Open tool	Manufacturer
		Size	Insulator OD			
CNP1	06JFAT-SAXGFK-XL	AWG 16 to 10	4.7 mm or shorter	11.5	J-FAT-OT-EXL	JST
CNP3	03JFAT-SAXGFK-XL					
CNP2	05JFAT-SAXGDK-H5.0	AWG 18 to 14	3.9 mm or shorter	9		

(c) MR-J4-60B4(-RJ) to MR-J4-350B4(-RJ)



Note. A pin for preventing improper connection is inserted to N- of CNP1 connector.

Table 3.3 Connector and applicable wire

Connector	Receptacle assembly	Applicable wire		Stripped length [mm]	Open tool	Manufacturer
		Size	Insulator OD			
CNP1	06JFAT-SAXGDK-HT10.5	AWG 16 to 14	3.9 mm or shorter	10	J-FAT-OT-XL	JST
CNP2	05JFAT-SAXGDK-HT7.5					
CNP3	03JFAT-SAXGDK-HT10.5					

(d) MR-J4-10B1(-RJ) to MR-J4-40B1(-RJ)

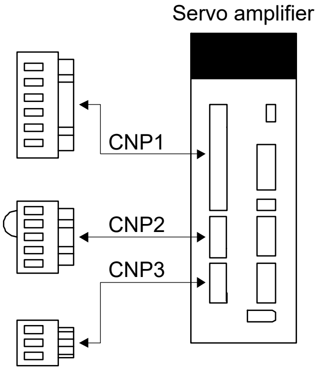


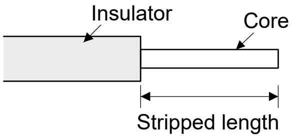
Table 3.4 Connector and applicable wire

Connector	Receptacle assembly	Applicable wire		Stripped length [mm]	Open tool	Manufacturer
		Size	Insulator OD			
CNP1	06JFAT-SAXGDK-H7.5	AWG 18 to 14	3.9 mm or shorter	9	J-FAT-OT (N) or J-FAT-OT	JST
CNP2	05JFAT-SAXGDK-H5.0					
CNP3	03JFAT-SAXGDK-H7.5					

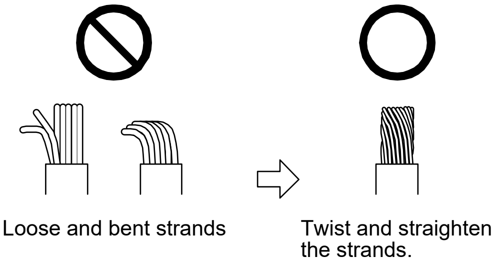
(2) Cable connection procedure

(a) Fabrication on cable insulator

Refer to table 3.1 to 3.4 for stripped length of cable insulator. The appropriate stripped length of cables depends on their type, etc. Set the length considering their status.



Twist strands lightly and straighten them as follows.



You can also use a ferrule to connect with the connectors. When using a ferrule, select a ferrule and crimping tool listed in the table below.

Servo amplifier	Wire size	Ferrule model (Phoenix Contact)		Crimping tool (Phoenix Contact)
		For one	For two	
MR-J4-10B(-RJ) to MR-J4-100B(-RJ)	AWG 16	AI1.5-10BK	AI-TWIN2×1.5-10BK	CRIMPFOX-ZA3
	AWG 14	AI2.5-10BU		
MR-J4-200B(-RJ) to MR-J4-350B(-RJ)	AWG 16	AI1.5-10BK	AI-TWIN2×1.5-10BK	
	AWG 14	AI2.5-10BU	AI-TWIN2×2.5-10BU	
	AWG 12	AI4-10GY		
MR-J4-60B4(-RJ) to MR-J4-350B4(-RJ)	AWG 16	AI1.5-10BK	AI-TWIN2×1.5-10BK	
	AWG 14	AI2.5-10BU		
MR-J4-10B1(-RJ) to MR-J4-40B1(-RJ)	AWG 16	AI1.5-10BK	AI-TWIN2×1.5-10BK	
	AWG 14	AI2.5-10BU		

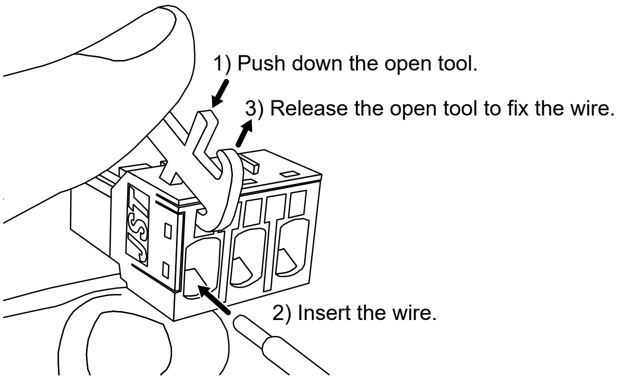
(b) Inserting wire

Insert only one wire or ferrule to each wire insertion hole.

Insert the open tool as follows and push it down to open the spring. While the open tool is pushed down, insert the stripped wire into the wire insertion hole. Check the wire insertion depth, and make sure that the cable insulator will not be caught by the spring and that the conductive part of the stripped wire will not be exposed.

Release the open tool to fix the wire. Pull the wire lightly to confirm that the wire is surely connected. In addition, make sure that no conductor wire sticks out of the connector.

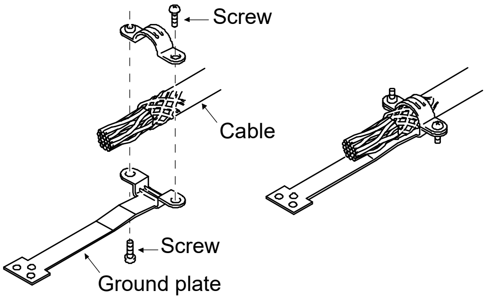
The following shows a connection example of the CNP3 connector for MR-J4-200B(-RJ) and MR-J4-350B(-RJ).



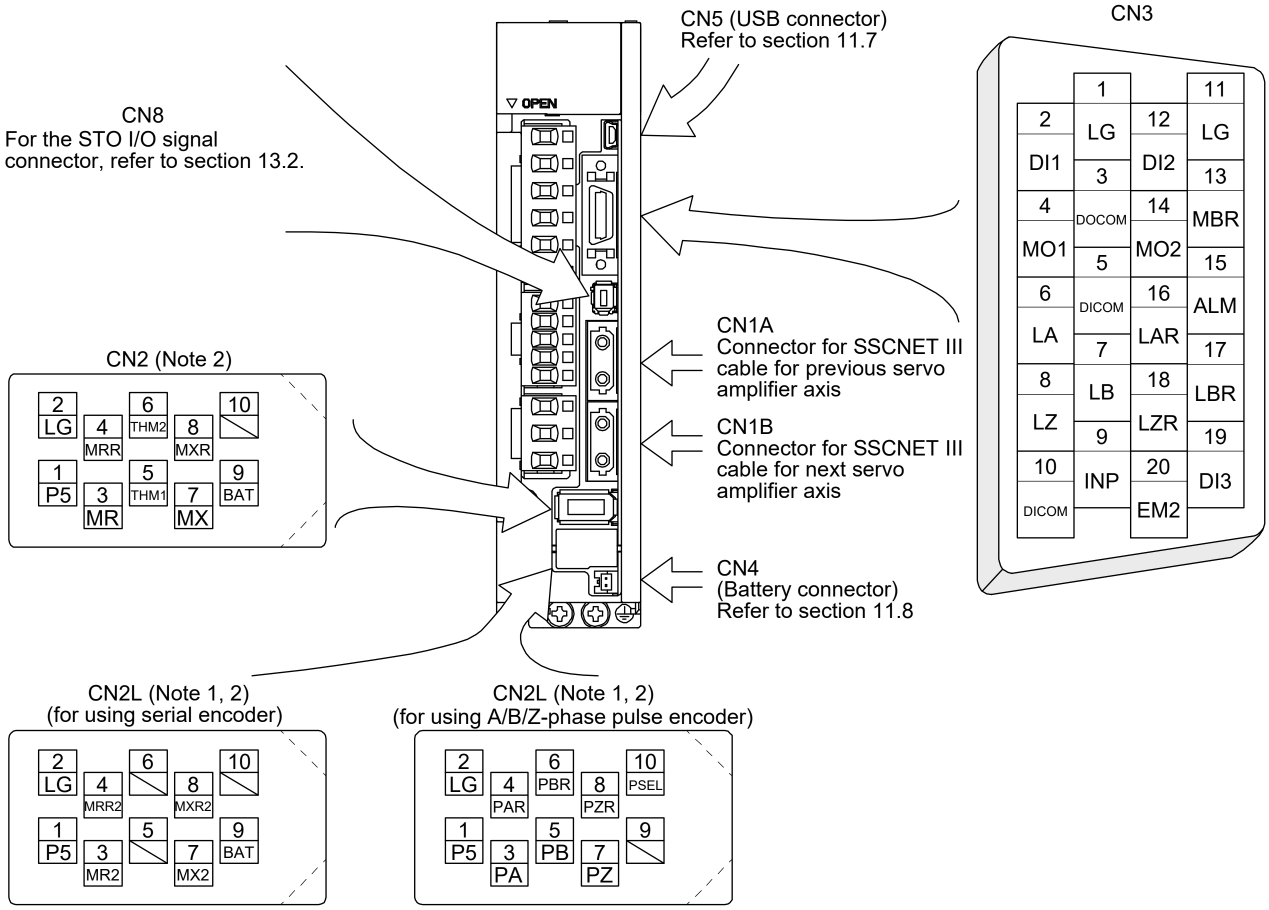
3.4 Connectors and pin assignment

POINT

- ●The pin assignment of the connectors is as viewed from the cable connector wiring section.
- ●For the STO I/O signal connector (CN8), refer to chapter 13.
- ●For the CN3 connector, securely connect the external conductor of the shielded cable to the ground plate and fix it to the connector shell.



The servo amplifier front view shown is that of the MR-J4-20B or less. Refer to chapter 9 DIMENSIONS for the appearances and connector layouts of the other servo amplifiers.
The frames of the CN2 and CN3 connectors are connected to the protective earth terminal in the servo amplifier.



Note 1. The MR-J4-_B_ servo amplifiers have CN2L connectors. This CN2L is a connector of 3M.
When using any other connector, refer to each servo motor instruction manual.
2. Refer to table 1.1 and "Linear Encoder Instruction Manual" for connections of external encoders.

3.5 Signal (device) explanations

For the I/O interfaces (symbols in I/O division column in the table), refer to section 3.8.2.
The pin numbers in the connector pin No. column are those in the initial status.

3.5.1 Input device

<table>
<tr><th>Device</th><th>Symbol</th><th>Connector pin No.</th><th>Function and application</th><th>I/O division</th></tr>
<tr><td>Forced stop 2</td><td>EM2</td><td>CN3-20</td><td>Turn off EM2 (open between commons) to decelerate the servo motor to a stop with commands.
Turn EM2 on (short between commons) in the forced stop state to reset that state.
Set [Pr. PA04] to "2 1 _ _" to disable EM2.
The following shows the setting of [Pr. PA04].
<table>
<tr><th rowspan="2">[Pr. PA04] setting</th><th rowspan="2">EM2/EM1</th><th colspan="2">Deceleration method</th></tr>
<tr><th>EM2 or EM1 is off</th><th>Alarm occurred</th></tr>
<tr><td>0 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 0 _ _</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>
<tr><td>0 1 _ _</td><td>Not using EM2 and EM1</td><td></td><td>MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.</td></tr>
<tr><td>2 1 _ _</td><td>Not using EM2 and EM1</td><td></td><td>MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.</td></tr>
</table>
EM2 and EM1 are mutually exclusive.
EM2 has the same function as EM1 in the torque control mode.</td><td>DI-1</td></tr>
<tr><td>Forced stop 1</td><td>EM1</td><td>(CN3-20)</td><td>When using EM1, set [Pr. PA04] to "0 0 _ _" to enable EM1.
When EM1 is turned off (open between commons), the base circuit shuts off, and the dynamic brake operates to decelerate the servo motor to a stop.
The forced stop will be reset when EM1 is turned on (short between commons).
Set [Pr. PA04] to "0 1 _ _" to disable EM1.</td><td>DI-1</td></tr>
<tr><td></td><td>DI1</td><td>CN3-2</td><td rowspan="3">Devices can be assigned for these signals with controller setting. For devices that can be assigned, refer to the controller instruction manual. The following devices can be assigned for MR-J4 compatible controller (R_MTCPU, Q17_DSCPU, RD77MS_ and QD77MS_).</td><td>DI-1</td></tr>
<tr><td></td><td>DI2</td><td>CN3-12</td><td>DI-1</td></tr>
<tr><td></td><td>DI3</td><td>CN3-19</td><td>DI-1</td></tr>
</table>

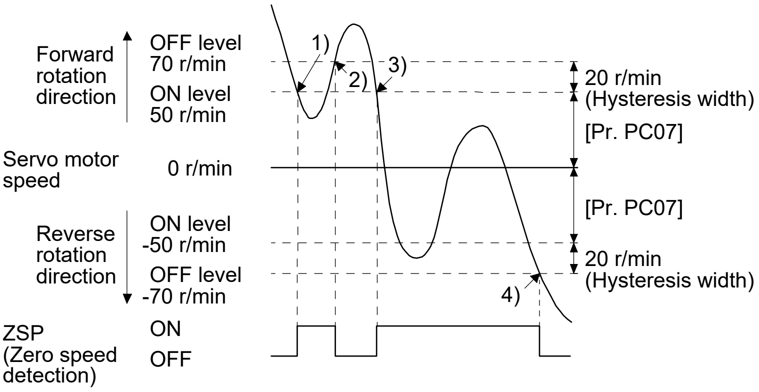
3.5.2 Output device

(1) Output device pin

The following shows the output device pins and parameters for assigning devices.

Connector pin No.	Parameter	Initial device	I/O division
CN3-13	[Pr. PD07]	MBR	DO-1
CN3-9	[Pr. PD08]	INP	
CN3-15	[Pr. PD09]	ALM	

(2) Output device explanations

Device	Symbol	Function and application
Electromagnetic brake interlock	MBR	When using the device, set operation delay time of the electromagnetic brake in [Pr. PC02]. When a servo-off status or alarm occurs, MBR will turn off.
Malfunction	ALM	When the protective circuit is activated to shut off the base circuit, 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.
In-position	INP	When the number of droop pulses is in the 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. The device cannot be used in the speed control mode, torque control mode, and for continuous operation to torque control mode.
Dynamic brake interlock	DB	When using the signal, enable it by the setting of [Pr. PD07] to [Pr. PD09]. 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 11.17.) For the servo amplifier of 7 kW or less, it is not necessary to use this device. The external dynamic brake cannot be used with 11 kW or more servo amplifier for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD07] to [Pr. PD09]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.
Ready	RD	Enabling servo-on to make the servo amplifier ready to operate will turn on RD.
Speed reached	SA	SA will turn off during servo-off. 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. The device cannot be used in the position control mode and torque control mode.
Limiting speed	VLC	When the speed reaches the speed limit value in the torque control mode, VLC will turn on. When the servo is off, TLC will be turned off. The device cannot be used in the position control mode and speed control mode.
Zero speed detection	ZSP	ZSP turns on when the servo motor speed is zero speed (50 r/min) or less. Zero speed can be changed with [Pr. PC07].  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. When you use a linear servo motor, [r/min] explained above will be [mm/s].

Device	Symbol	Function and application
Limiting torque	TLC	When the torque reaches the torque limit value during torque generation, TLC will turn on. When the servo is off, TLC will be turned off. This device cannot be used in the torque control mode.
Warning	WNG	When warning has occurred, WNG turns on. When a warning is not occurring, WNG will turn off in 2.5 s to 3.5 s after power-on.
Battery warning	BWNG	BWNG turns on when [AL. 92 Battery cable disconnection warning] or [AL. 9F Battery warning] has occurred. When the battery warning is not occurring, BWNG will turn off in 2.5 s to 3.5 s after power-on.
Variable gain selection	CDPS	CDPS will turn on during variable gain.
Absolute position undetermined	ABSV	ABSV turns on when the absolute position is undetermined. The device cannot be used in the speed control mode and torque control mode.
During tough drive	MTTR	When a tough drive is enabled in [Pr. PA20], activating the instantaneous power failure tough drive will turn on MTTR.
During fully closed loop control	CLDS	CLDS turns on during fully closed loop control.

3.5.3 Output signal

Signal name	Symbol	Connector pin No.	Function and application
Encoder A-phase pulse (differential line driver)	LA LAR	CN3-6 CN3-16	These devices output pulses of encoder output set in [Pr. PA15] and [Pr. PA16] in the differential line driver type. In CCW rotation of the servo motor, the encoder B-phase pulse lags the encoder A-phase pulse by a phase angle of π/2. The relation between rotation direction and phase difference of the A-phase and B-phase pulses can be changed with [Pr. PC03]. Output pulse specification, dividing ratio setting, and electronic gear setting can be selected. Depending on the servo motor stop position, the encoder output pulse may turn on and off repeatedly even if the servo motor is stopped.
Encoder B-phase pulse (differential line driver)	LB LBR	CN3-7 CN3-17	
Encoder Z-phase pulse (differential line driver)	LZ LZR	CN3-8 CN3-18	The encoder zero-point signal is output in the differential line driver type. One pulse is output 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.
Analog monitor 1	MO1	CN3-4	This is used to output the data set in [Pr. PC09] to between MO1 and LG in terms of voltage. Resolution: 10 bits or equivalent
Analog monitor 2	MO2	CN3-14	This signal output the data set in [Pr. PC10] to between MO2 and LG in terms of voltage. Resolution: 10 bits or equivalent

3.5.4 Power supply

Signal name	Symbol	Connector pin No.	Function and application
Digital I/F power supply input	DICOM	CN3-5 CN3-10	Input 24 V DC (24 V DC ± 10% 300 mA) for I/O interface. The power supply capacity changes depending on the number of I/O interface points to be used. For sink interface, connect + of 24 V DC external power supply. For source interface, connect - of 24 V DC external power supply.
Digital I/F common	DOCOM	CN3-3	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.
Monitor common	LG	CN3-1 CN3-11	Common terminal of MO1 and MO2. Pins are connected internally.
Shield	SD	Plate	Connect the external conductor of the shielded wire.

3.6 Forced stop deceleration function

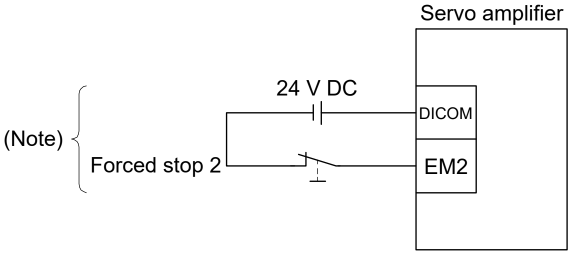
POINT

- ●When alarms not related to the forced stop function occur, control of motor deceleration cannot be guaranteed. (Refer to chapter 8.)
- ●When SSCNET III/H communication shut-off occurs, forced stop deceleration will operate. (Refer to section 3.7.1 (3).)
- ●In the torque control mode, the forced stop deceleration function is not available.
- ●Disable the forced stop deceleration function for a machine in which multiple axes are connected together, such as a tandem structure. If an alarm occurs with the forced stop deceleration function disabled, the servo motor will stop with the dynamic brake.
- ●Keep the servo-on command (from controller) and ready-on command (from controller) on while EM2 (Forced stop 2) is off. When the servo-on command (from controller) or ready-on command (from controller) is off, forced stop deceleration, base circuit shut-off delay time, and vertical axis freefall prevention do not function.

3.6.1 Forced stop deceleration function

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

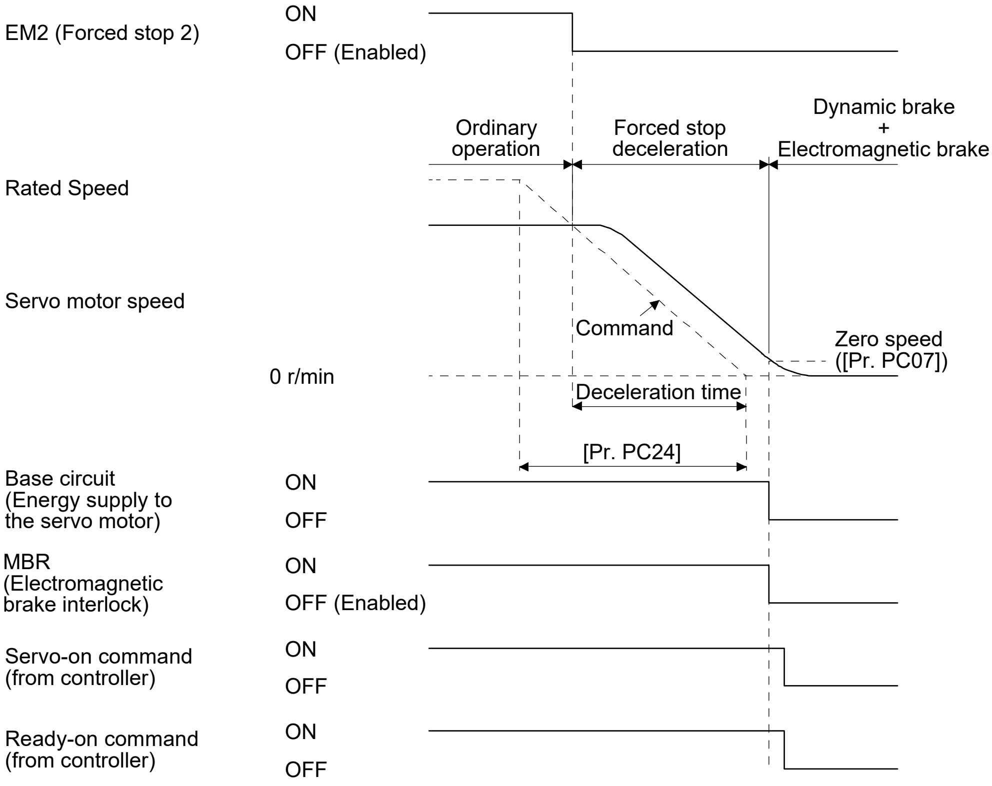
(1) Connection diagram



Note. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.8.3.

(2) Timing chart

When EM2 (Forced stop 2) is turned off, the motor will decelerate according to [Pr. PC24 Forced stop deceleration time constant]. Once the motor speed is below [Pr. PC07 Zero speed], base power is cut and the dynamic brake activates.

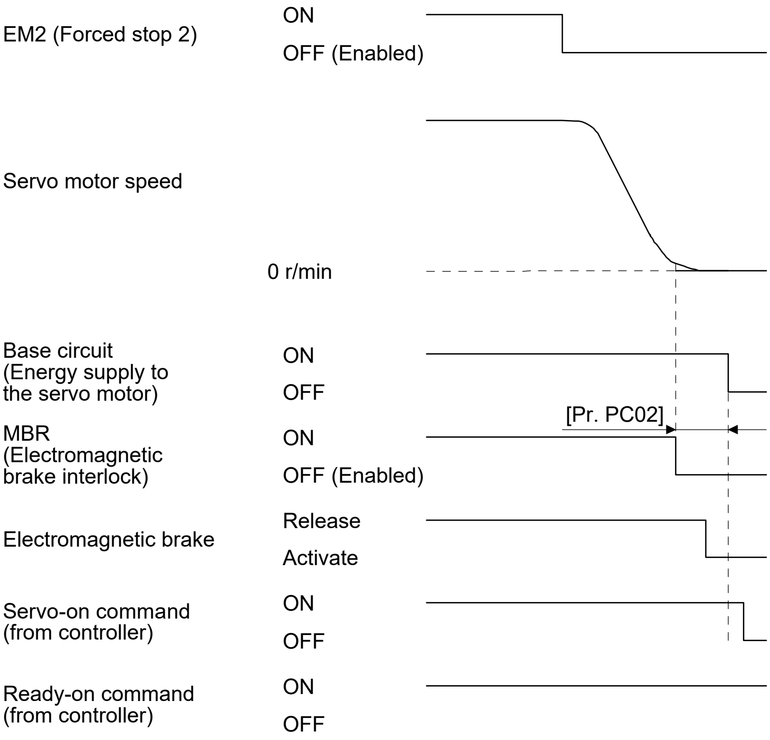


3.6.2 Base circuit shut-off delay time function

The base circuit shut-off delay time function is used to prevent vertical axis from dropping at a forced stop (EM2 goes off), alarm occurrence, or SSCNET III/H communication shut-off due to delay time of the electromagnetic brake. Set the time from MBR (Electromagnetic brake interlock) off to base circuit shut-off with [Pr. PC02].

(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. PC02], the servo amplifier will be base circuit shut-off status.



(2) Adjustment

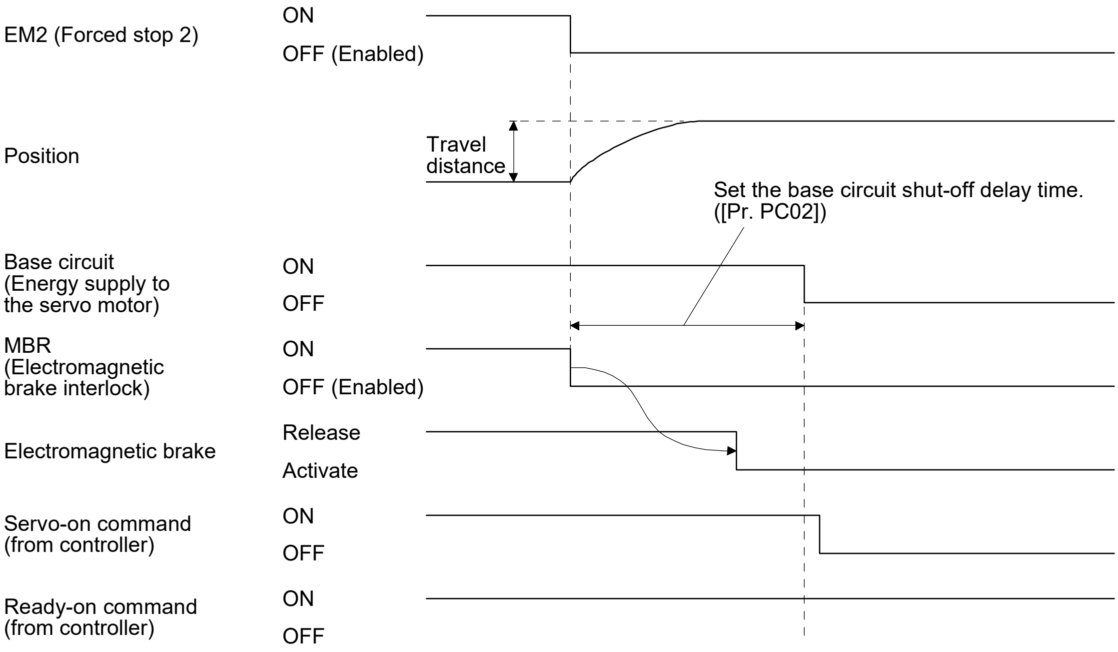
While the servo motor is stopped, turn off EM2 (Forced stop 2), adjust the base circuit shut-off delay time in [Pr. PC02], and set the value to approximately 1.5 times of the smallest delay time in which the servo motor shaft does not freefall.

3.6.3 Vertical axis freefall prevention function

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

- The control mode is set to the position control mode.
- A value other than "0" is set in [Pr. PC31 Vertical axis freefall prevention compensation amount].
- "Forced stop deceleration function selection" of [Pr. PA04] is set to "Forced stop deceleration function enabled (2 _ _ _)".
- EM2 (Forced stop 2) turned off, an alarm occurred, or SSCNET III/H communication shut-off occurred while the servo motor speed is zero speed or less.
- MBR (Electromagnetic brake interlock) is enabled in [Pr. PD07] to [Pr. PD09] while the base circuit shut-off delay time is set in [Pr. PC02].

(1) Timing chart



(2) Adjustment

- Set the freefall prevention compensation amount in [Pr. PC31].
- While the servo motor is stopped, turn off the EM2 (Forced stop 2). Adjust the base circuit shut-off delay time in [Pr. PC02] in accordance with the travel distance ([Pr. PC31). Adjust it considering the freefall prevention compensation amount by checking the servo motor speed, torque ripple, etc.

3.6.4 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.

3.7 Alarm occurrence timing chart

⚠CAUTION

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

POINT

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

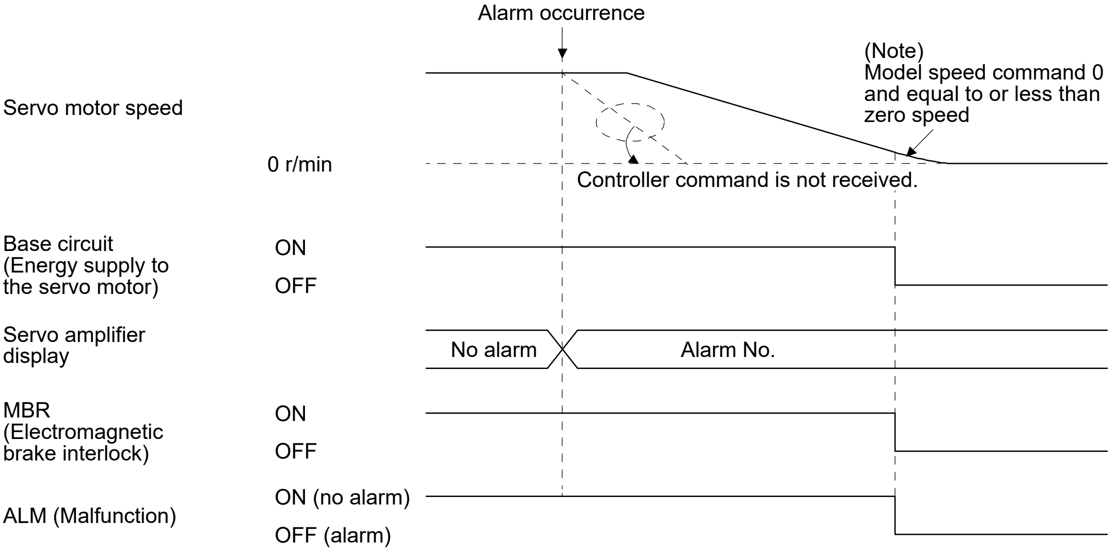
To deactivate the alarm, cycle the control circuit power or give the error reset or CPU reset command from the servo system controller. However, the alarm cannot be deactivated unless its cause is removed.

3.7.1 When you use the forced stop deceleration function

POINT

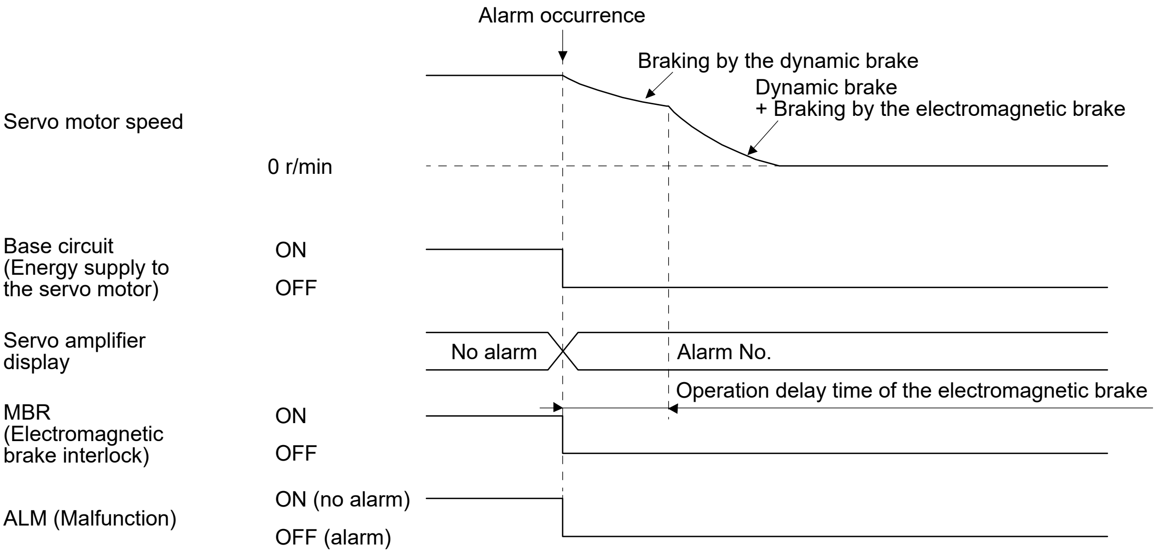
- To enable the function, set "2 _ _ _ (initial value)" in [Pr. PA04].
- Disable the forced stop deceleration function for a machine in which multiple axes are connected together, such as a tandem structure. If an alarm occurs with the forced stop deceleration function disabled, the servo motor will stop with the dynamic brake.

(1) When the forced stop deceleration function is enabled

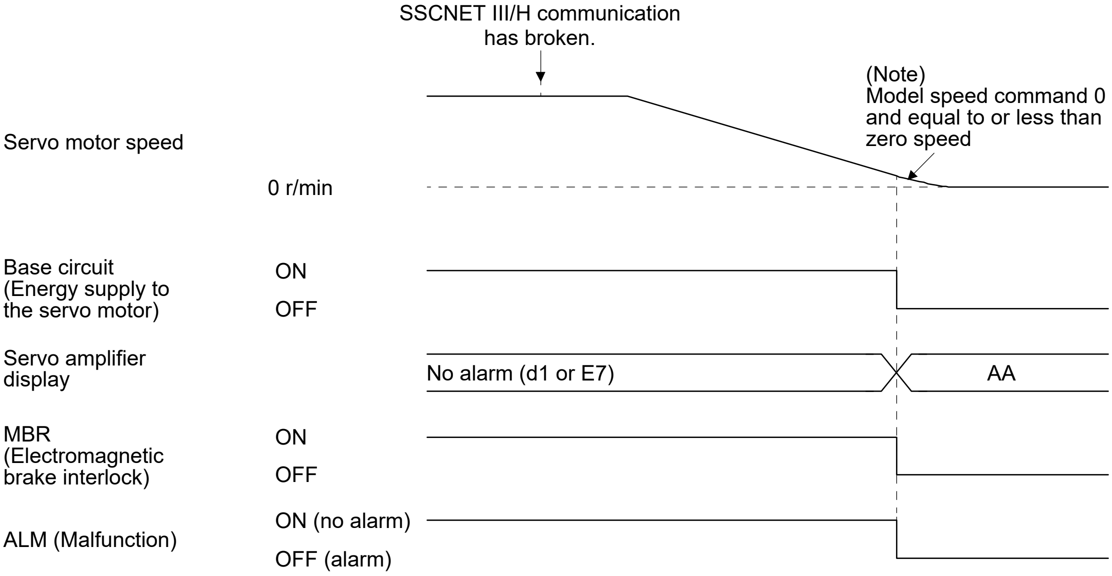


Note. The model speed command is a speed command generated in the servo amplifier for forced stop deceleration of the servo motor.

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



(3) When SSCNET III/H communication shut-off occurs
The dynamic brake may operate depending on the communication shut-off status.



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

3.7.2 When you do not use the forced stop deceleration function

POINT

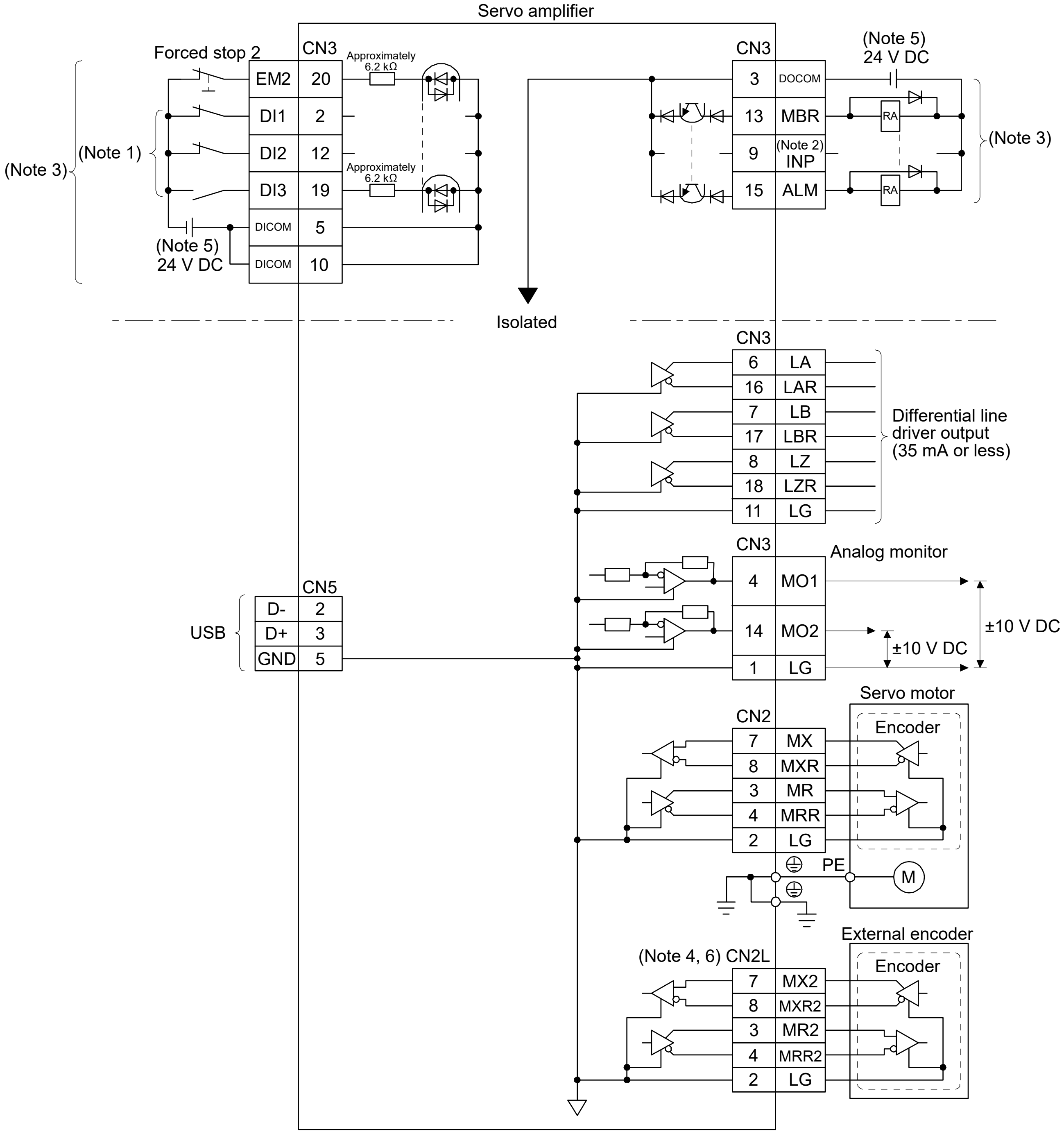
- ●To disable the function, set "0 _ _ _" in [Pr. PA04].

The timing chart that shows the servo motor condition when an alarm or SSCNET III/H communication shut-off occurs is the same as section 3.7.1 (2).

3.8 Interfaces

3.8.1 Internal connection diagram

POINT
●Refer to section 13.3.1 for the CN8 connector.



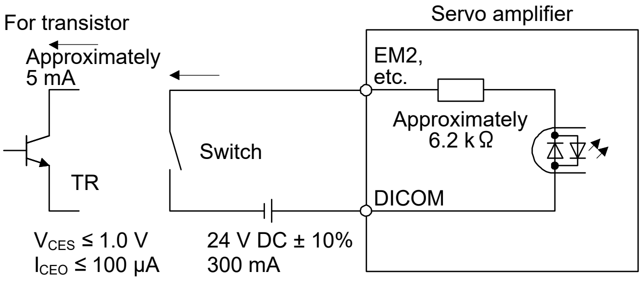
Note
1. Signal can be assigned for these pins with the controller setting.
   For contents of signals, refer to the instruction manual of the controller.
2. The signal cannot be used in the speed control mode and torque control mode.
3. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.8.3.
4. This is for MR-J4-_B_-RJ servo amplifier. MR-J4-_B_ servo amplifier does not have 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.
6. Refer to table 1.1 for connections of external encoders.

3.8.2 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 3.8.3 for source input.



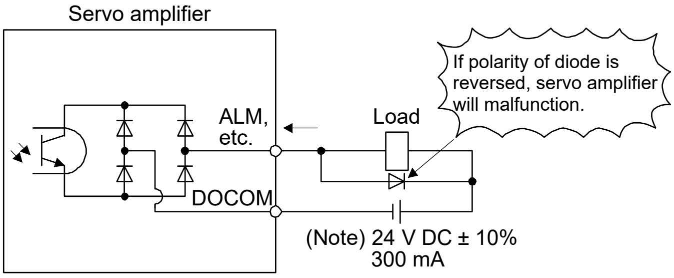
(2) Digital output interface DO-1

This is a circuit in which the collector of the output transistor is the output terminal. When the output transistor is turned on, the current will flow to 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 3.8.3 for source output.

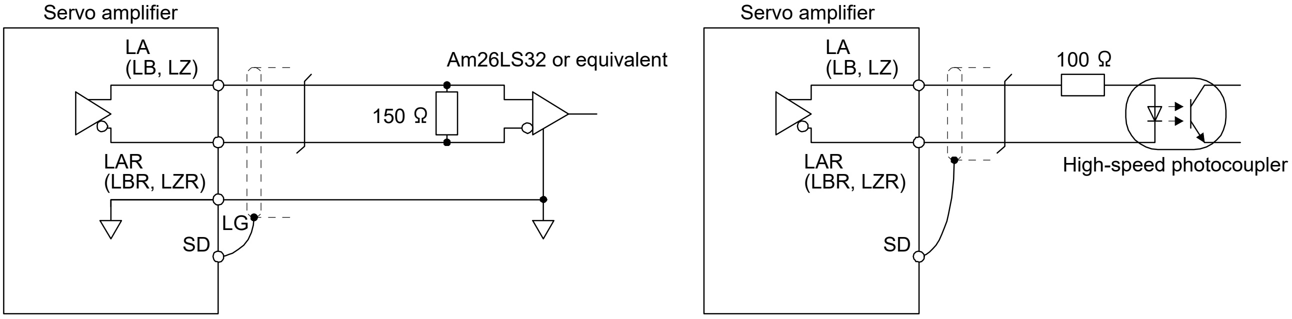


Note. If the voltage drop (maximum of 2.6 V) interferes with the relay operation, apply high voltage (maximum of 26.4 V) from external source.

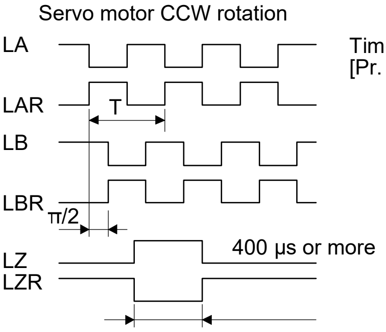
(3) Encoder output pulses DO-2 (differential line driver type)

(a) Interface

Maximum output current: 35 mA

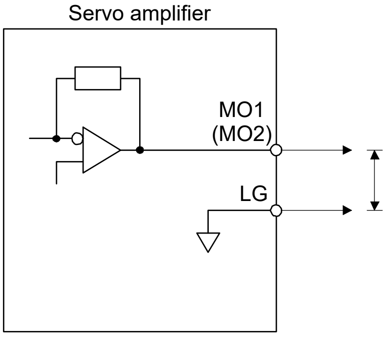


(b) Output pulse



Time cycle (T) is determined by the settings of [Pr. PA15] and [Pr. PC03].

(4) Analog output



Output voltage: ±10 V
Maximum output current: 1 mA
Resolution: 10 bits or equivalent

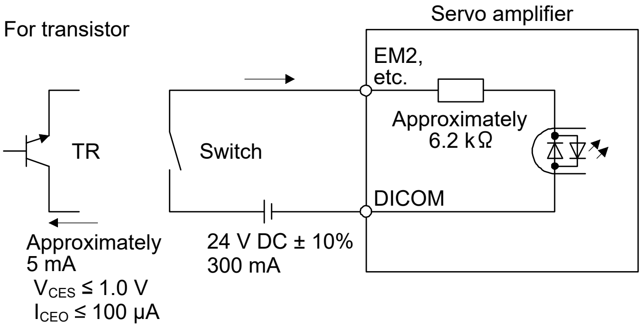
Note. Output voltage range varies depending on the output contents.

3.8.3 Source I/O interfaces

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

(1) Digital input interface DI-1

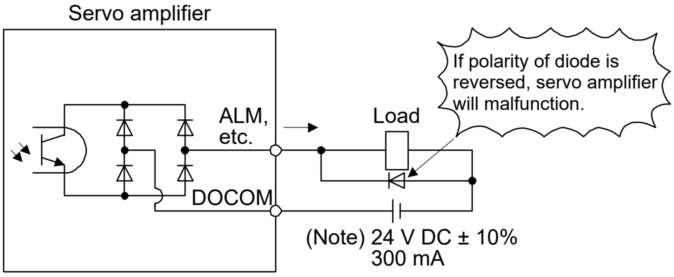
This is an input circuit whose photocoupler anode side is the input terminal. Transmit signals from source (open-collector) type transistor output, relay switch, etc.



(2) Digital output interface DO-1

This is a circuit in which the emitter of the output transistor is the output terminal. 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 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.

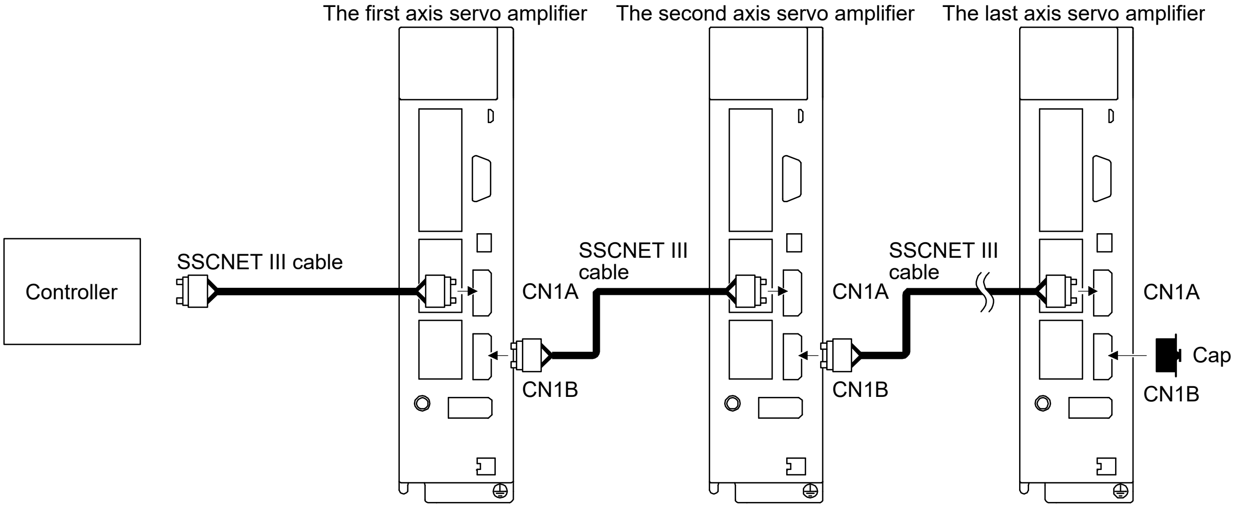
3.9 SSCNET III cable connection

POINT

- ●Do not look directly at the light generated from CN1A/CN1B connector of the servo amplifier or the end of SSCNET III cable. The light can be a discomfort when it enters the eye.

(1) SSCNET III cable connection

For the CN1A connector, connect the SSCNET III cable connected to a controller in host side or a servo amplifier of the previous axis. For CN1B connector, connect SSCNET III cable connected to servo amplifier of the next axis. For CN1B connector of the final axis, put a cap came with servo amplifier.



(2) How to connect/disconnect cable

POINT

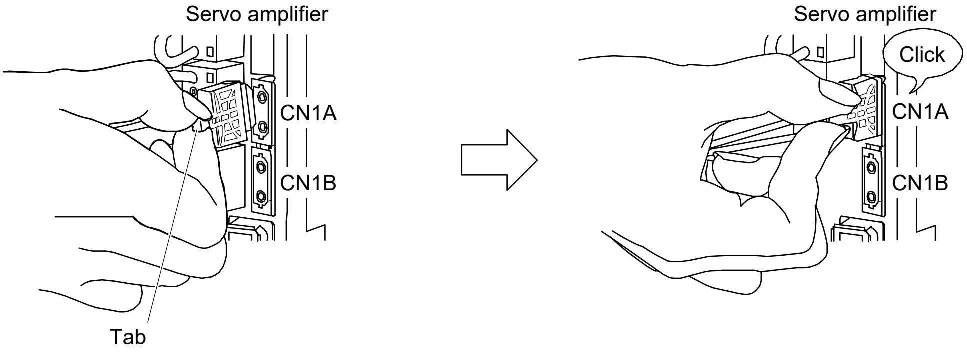
- ●CN1A and CN1B connector are capped to protect light device inside connector from dust. For this reason, do not remove the cap until just before connecting the SSCNET III cable. Then, when removing SSCNET III cable, make sure to put a cap.
- ●Keep the cap for CN1A/CN1B connector and the tube for protecting optical cord end of SSCNET III cable in a plastic bag with a slide fastener of SSCNET III cable to prevent them from becoming dirty.
- ●When asking repair of servo amplifier for some malfunctions, make sure to cap CN1A and CN1B connector. When the connector is not put a cap, the light device may be damaged at the transit. In this case, replacing and repairing the light device is required.

(a) Connection

1) For SSCNET III cable in the shipping status, the tube for protect optical cord end is put on the end of connector. Remove this tube.

2) Remove the CN1A and CN1B connector caps of the servo amplifier.

3) With holding a tab of SSCNET III cable connector, make sure to insert it into the CN1A and CN1B connector of the servo amplifier until you hear the click. If the end face of optical cord tip is dirty, optical transmission is interrupted and it may cause malfunctions. If it becomes dirty, wipe with a bonded textile, etc. Do not use solvent such as alcohol.



(b) Disconnection

With holding a tab of SSCNET III cable connector, pull out the connector.

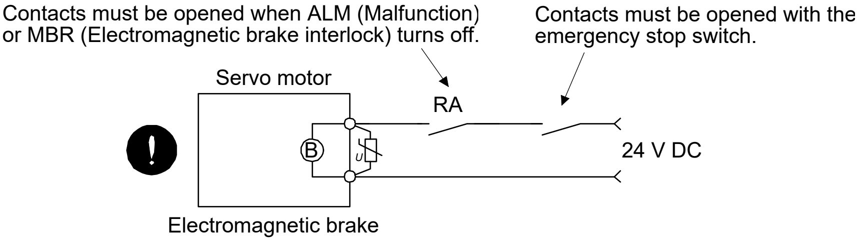
When pulling out the SSCNET III cable from servo amplifier, be sure to put the cap on the connector parts of servo amplifier to prevent it from becoming dirty. For SSCNET III cable, attach the tube for protection optical cord's end face on the end of connector.

3.10 Servo motor with an electromagnetic brake

3.10.1 Safety precautions

⚠CAUTION

- Configure an electromagnetic brake circuit which is interlocked with an external emergency stop switch.



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

POINT

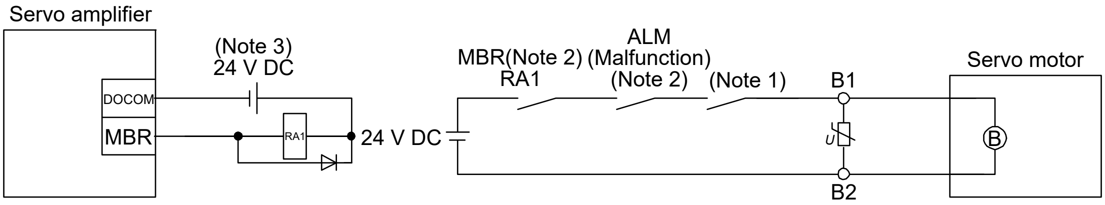
- Refer to "Servo Motor Instruction Manual (Vol. 3)" for specifications such as the power supply capacity and operation delay time of the electromagnetic brake.
- Refer to "Servo Motor Instruction Manual (Vol. 3)" for the selection of a surge absorber for the electromagnetic brake.

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

1) The electromagnetic brake will operate when the power (24 V DC) turns off.

2) Turn off the servo-on command after the servo motor stopped.

(1) Connection diagram



Note 1. Create the circuit in order to shut off by interlocking with the emergency stop switch.
2. Failure of MBR or ALM may cause brake malfunction.
3. Do not use the 24 V DC interface power supply for the electromagnetic brake.

(2) Setting

In [Pr. PC02 Electromagnetic brake sequence output], set a delay time (Tb) from MBR (Electromagnetic brake interlock) off to base circuit shut-off at a servo-off as in the timing chart in section 3.10.2.

3.10.2 Timing chart

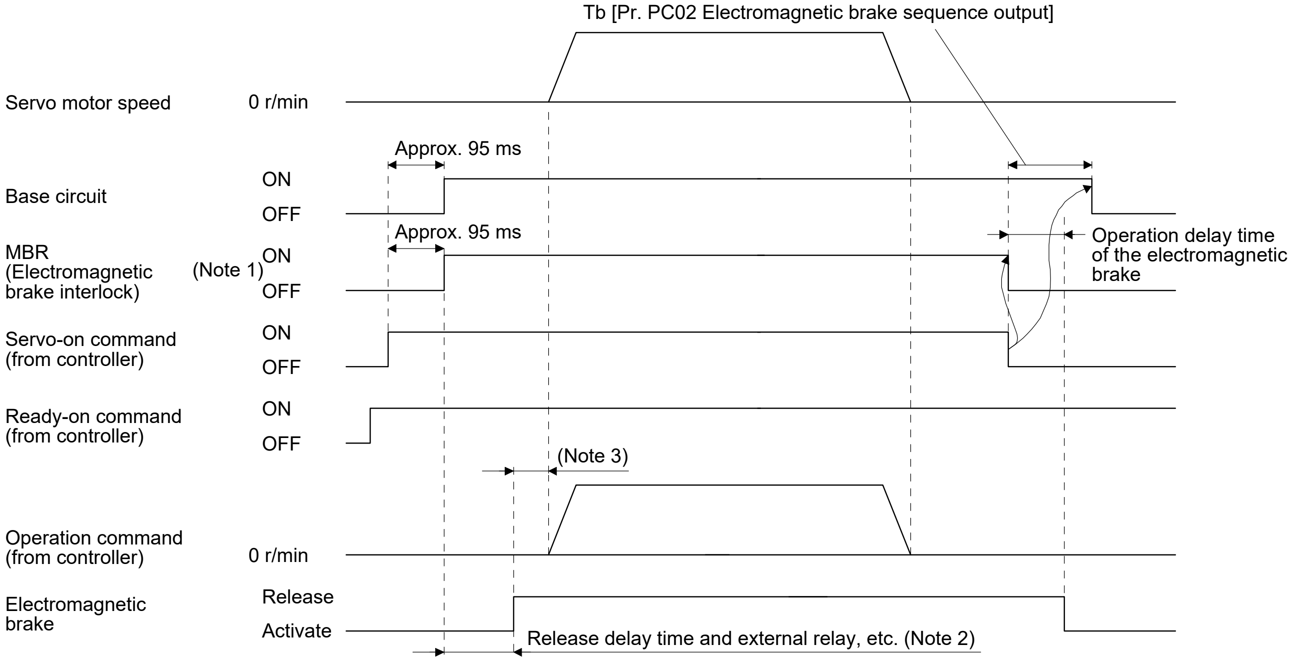
(1) When you use the forced stop deceleration function

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

(a) Servo-on command (from controller) on/off

POINT
●Keep the ready-on command (from controller) on while the servo-on command (from controller) is off. When the ready-off command (from controller) is off, Tb [Pr. PC02 Electromagnetic brake sequence output] does not function.

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



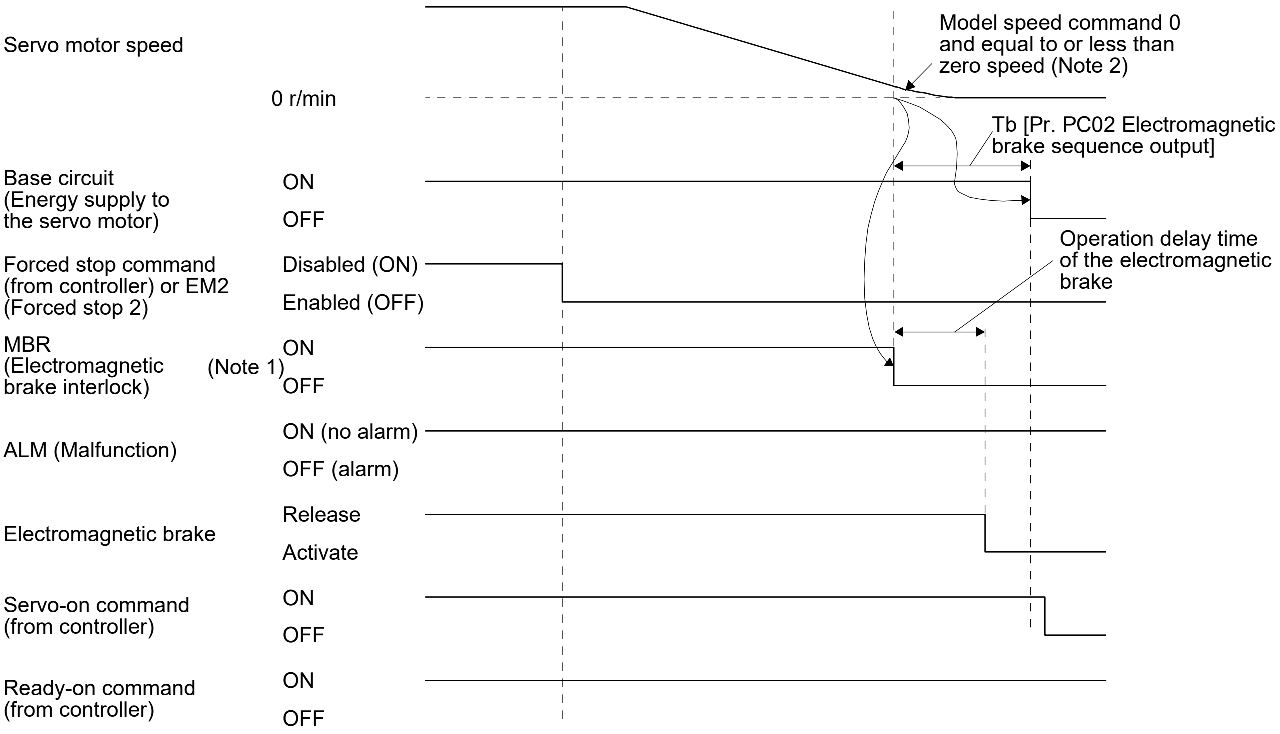
Note 1. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is activated.

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 the operation command from the controller after the electromagnetic brake is released.

(b) Off/on of the forced stop command (from controller) or EM2 (Forced stop 2)

POINT

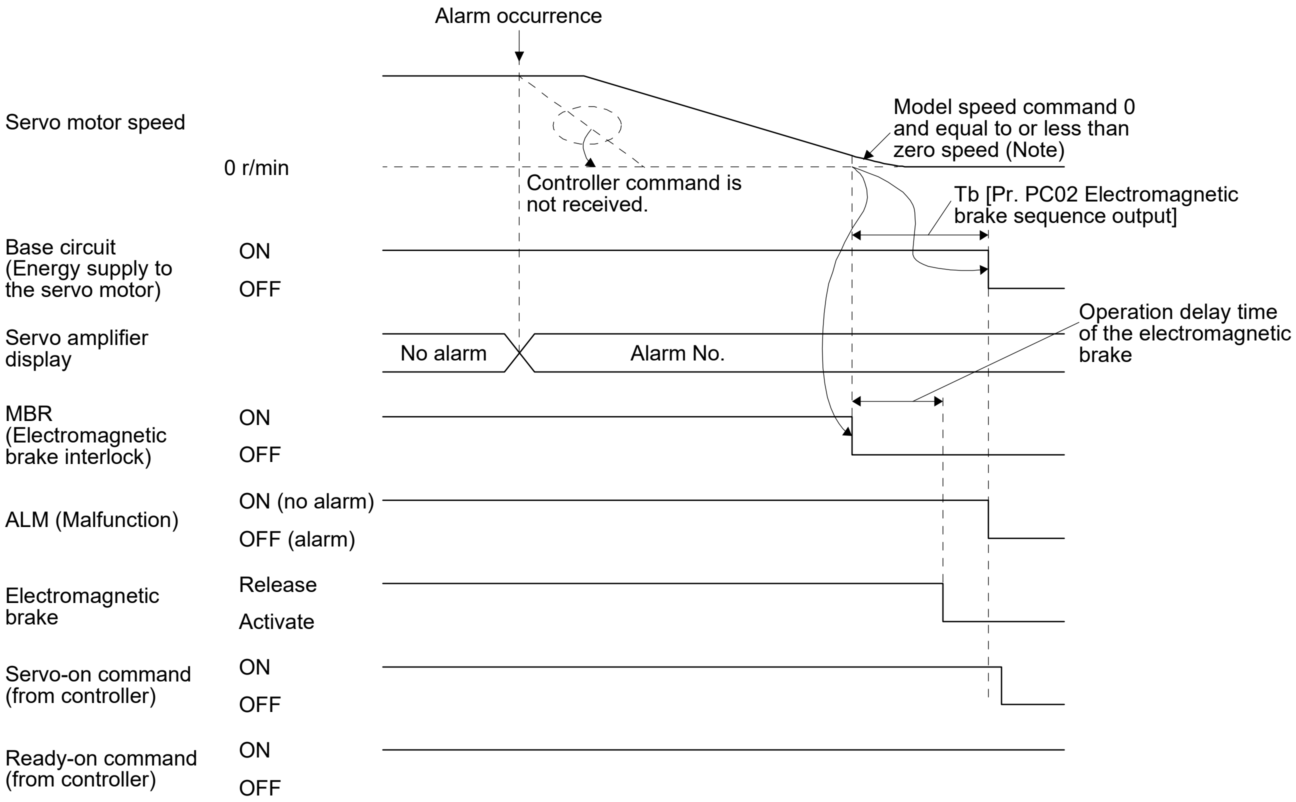
- ●In the torque control mode, the forced stop deceleration function is not available.
- ●Keep the servo-on command (from controller) and ready-on command (from controller) on while the forced stop command (from controller) or the EM2 (Forced stop 2) is off. When the ready-off command (from controller) is off, Tb [Pr. PC02 Electromagnetic brake sequence output] does not function.



Note 1. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is 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

1) When the forced stop deceleration function is enabled

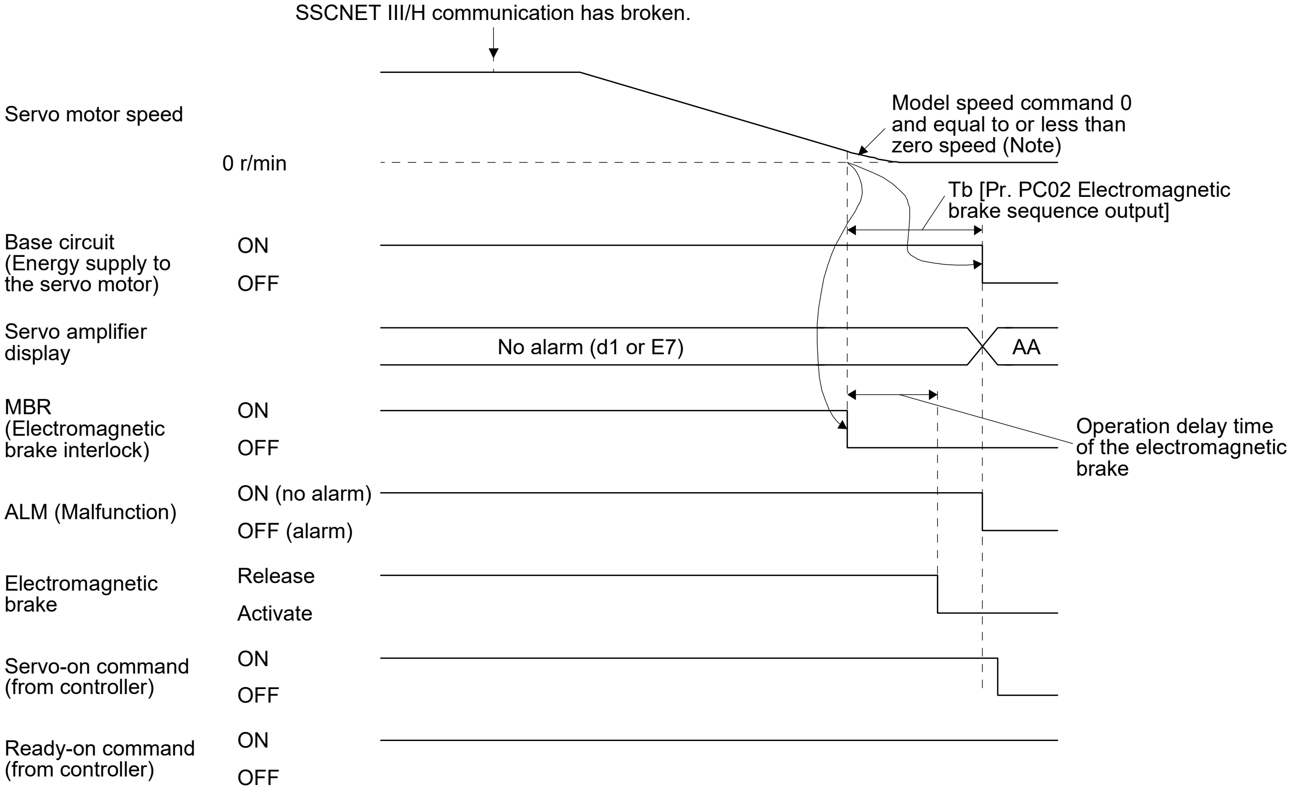


Note. The model speed command is a speed command generated in the servo amplifier for forced stop deceleration of the servo motor.

2) When the forced stop deceleration function is disabled
The operation status is the same as section 3.7.1 (2).

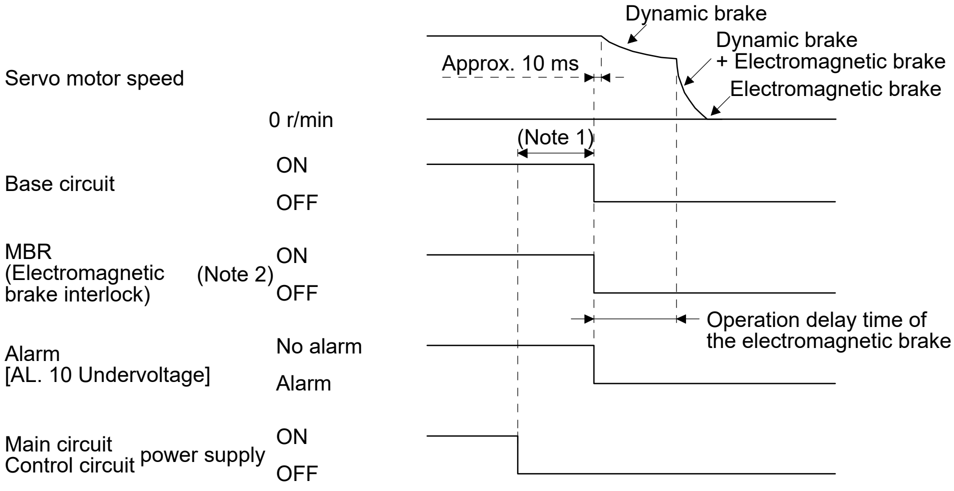
3) When SSCNET III/H communication shut-off occurs

The dynamic brake may operate depending on the communication shut-off status.



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

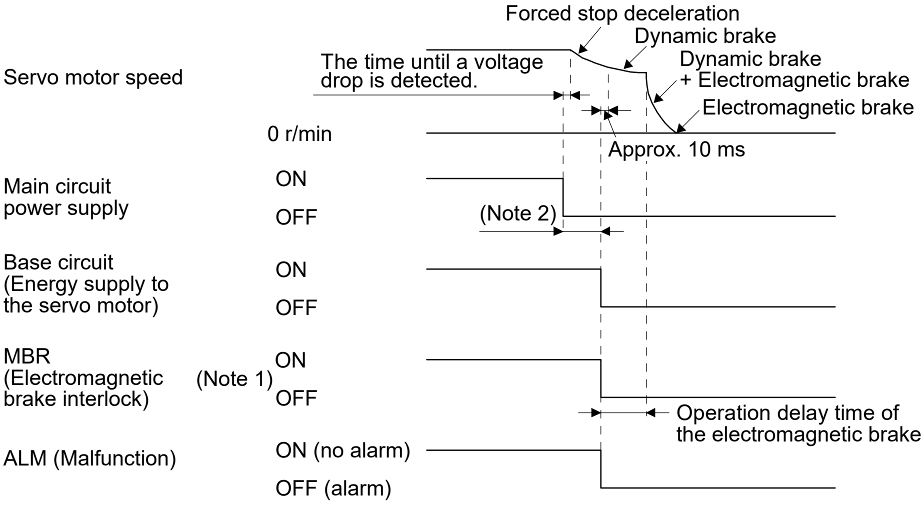
(d) Both main and control circuit power supplies off



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

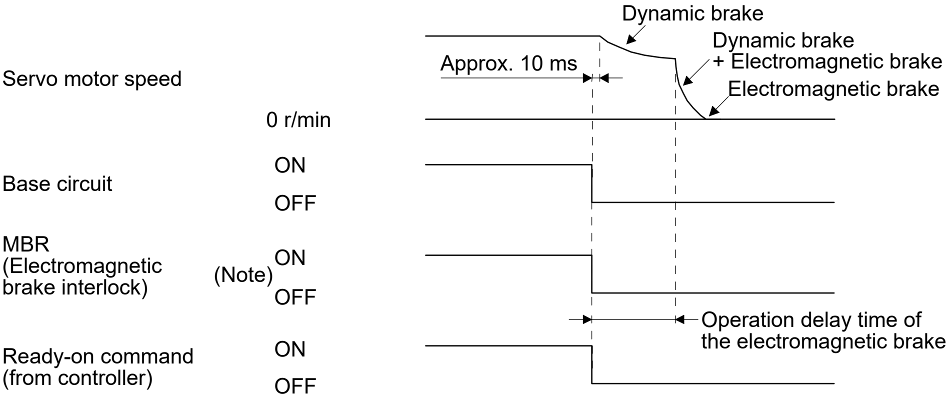
(e) Main circuit power supply off during control circuit power supply on

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 is activated.
2. Variable according to the operation status.

(f) Ready-off command from controller



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

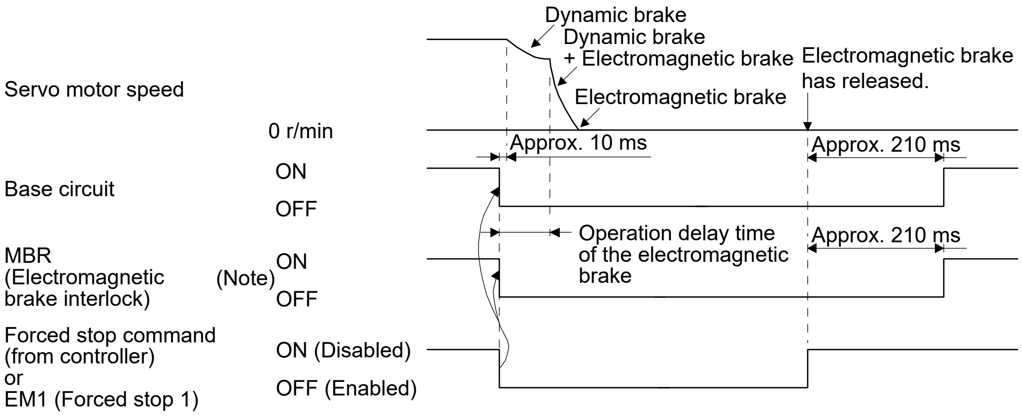
(2) When you do not use the forced stop deceleration function

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

(a) Servo-on command (from controller) on/off

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

(b) Off/on of the forced stop command (from controller) or EM1 (Forced stop 1)



Note. ON: Electromagnetic brake is not activated.

OFF: Electromagnetic brake is activated.

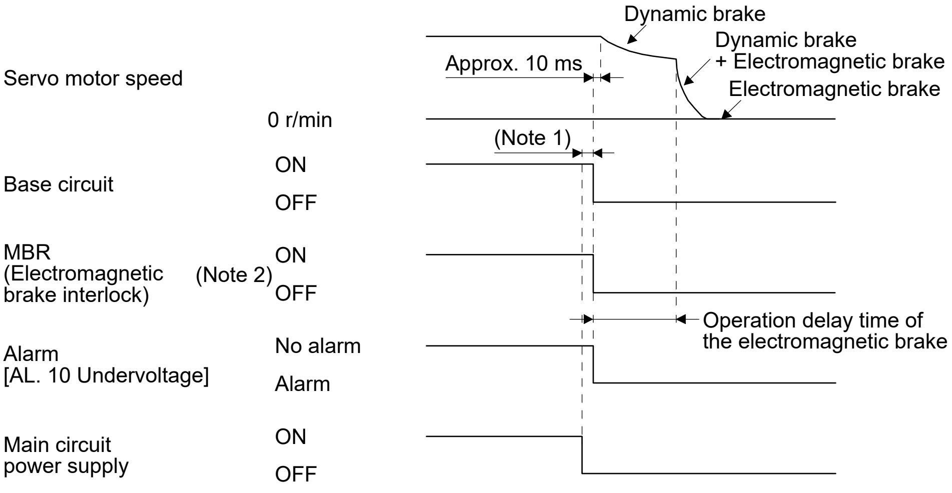
(c) Alarm occurrence

The operation status during an alarm is the same as section 3.7.2.

(d) Both main and control circuit power supplies off

It is the same as (1) (d) in 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.

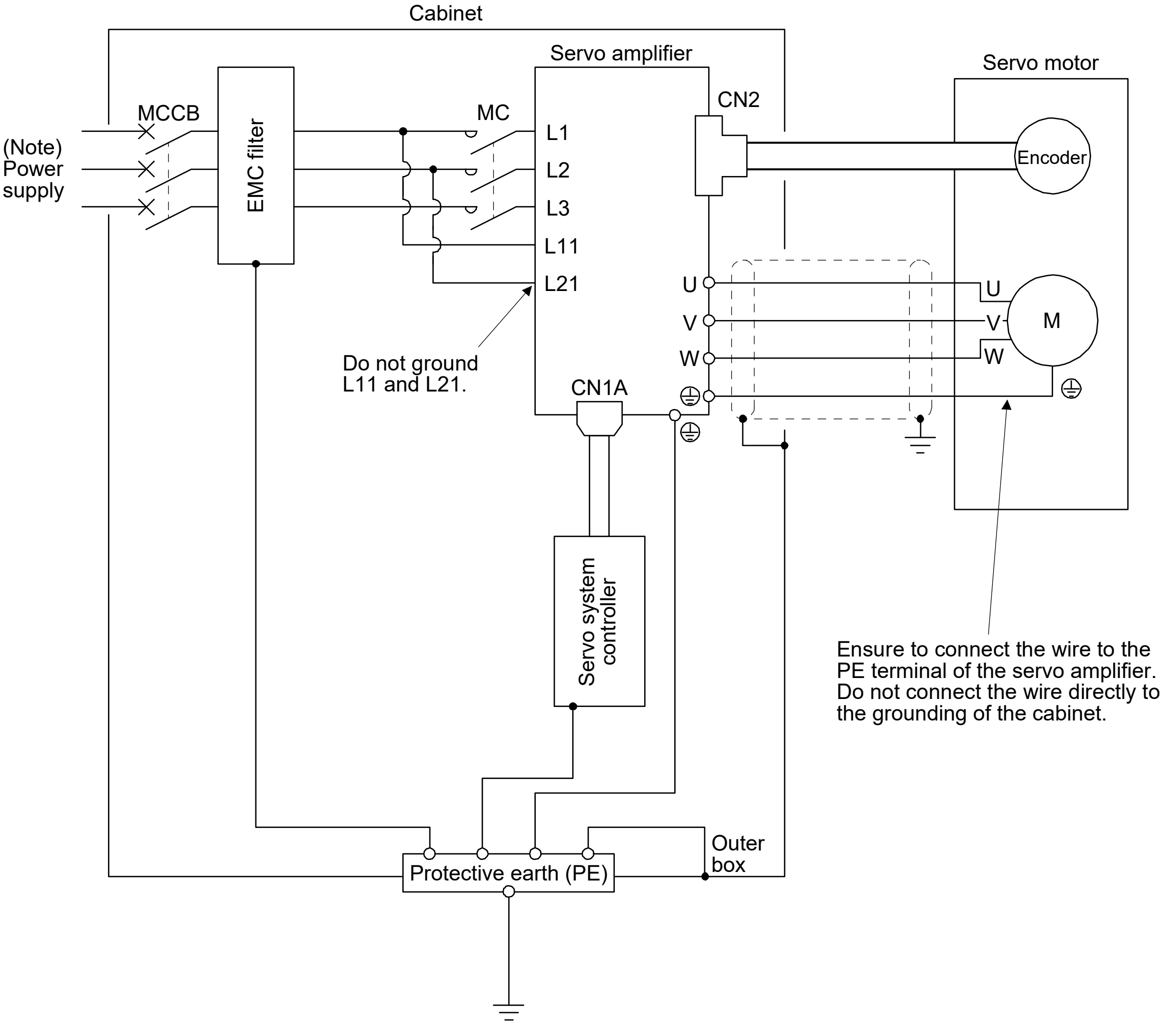
OFF: Electromagnetic brake is activated.

(f) Ready-off command from controller
It is the same as (1) (f) in this section.

3.11 Grounding

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

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



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

4. STARTUP

⚠WARNING

- When executing a test run, follow the notice and procedures in this instruction manual. Otherwise, it may cause a malfunction, damage to the machine, or injury.
- 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 the power is on and for some time after power-off. Take safety measures such as providing covers to avoid accidentally touching them by hands and parts such as cables.
- During operation, never touch the rotor of the servo motor. Otherwise, it may cause injury.
- Before wiring, switch operation, etc., eliminate static electricity. Otherwise, it may cause a malfunction.

POINT

- When you use a linear servo motor, replace the following words in the left to the words in the right.

Load to motor inertia ratio	→ Load to motor mass ratio
Torque	→ Thrust
(Servo motor) speed	→ (Linear servo motor) speed

4.1 Switching power on for the first time

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

4.1.1 Startup procedure

Wiring check	Check whether the servo amplifier and servo motor are wired correctly using visual inspection, DO forced output function (section 4.5.1), etc. (Refer to section 4.1.2.)
Surrounding environment check	Check the surrounding environment of the servo amplifier and servo motor. (Refer to section 4.1.3.)
Axis No. settings	Confirm that the control axis No. set with the auxiliary axis number setting switches (SW2-3 and SW2-4) and with the axis selection rotary switch (SW1) match the control axis No. set with the servo system controller. (Refer to section 4.3.1 (3).)
Parameter setting	Set the parameters as necessary, such as the used operation mode and regenerative option selection. (Refer to chapter 5.)
Test operation of the servo motor alone in test operation mode	For the test operation, with the servo motor disconnected from the machine and operated at the speed as low as possible, check whether the servo motor rotates correctly. (Refer to section 4.5.)
Test operation of the servo motor alone by commands	For the test operation with the servo motor disconnected from the machine and operated at the speed as low as possible, give commands to the servo amplifier and check whether the servo motor rotates correctly.
Test operation with the servo motor and machine connected	After connecting the servo motor with the machine, check machine motions with sending operation commands from the servo system controller.
Gain adjustment	Make gain adjustment to optimize the machine motions. (Refer to chapter 6.)
Actual operation	
Stop	Stop giving commands and stop operation.

4.1.2 Wiring check

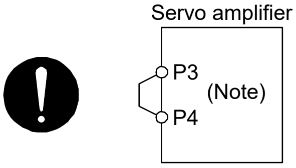
(1) Power supply system wiring

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

(a) Power supply system wiring

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

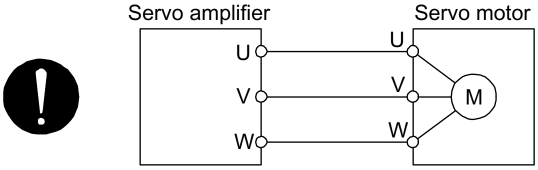
2) When the power factor improving DC reactor is not used, between P3 and P4 should be connected.



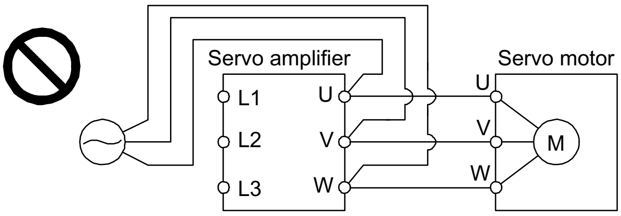
Note. The 100 V class servo amplifiers do not have P3 and P4.

(b) Connection of servo amplifier and servo motor

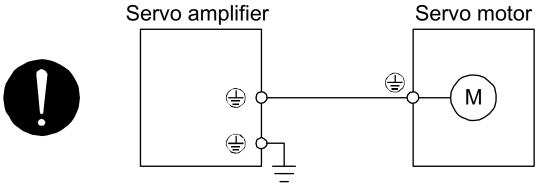
1) The servo amplifier power output (U/V/W) should match in phase with the servo motor power input terminals (U/V/W).



2) The power supplied to the servo amplifier should not be connected to the servo motor power terminals (U/V/W). Otherwise, the servo amplifier and servo motor will malfunction.



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



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

(c) When you use an option and auxiliary equipment

1) 200 V class

a) When you use a regenerative option for 5 kW or less servo amplifiers

- The lead wire between P+ terminal and D terminal should not be connected.
- The regenerative option wire should be connected between P+ and C terminal.
- Twisted wires cable should be used. (Refer to section 11.2.4.)

b) When you use a regenerative option for 7 kW or more servo amplifiers

- For 7 kW servo amplifiers, the lead wire of the built-in regenerative resistor connected to P+ terminal and C terminal should not be connected.
- The regenerative option wire should be connected between P+ and C terminal.
- Twisted wires cable should be used. (Refer to section 11.2.4.)

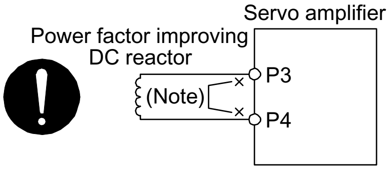
c) When you use a brake unit and power regeneration converter for 5 kW or more servo amplifiers

- 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 wire of the built-in regenerative resistor connected to P+ terminal and C terminal should not be connected.
- Brake unit, power regeneration converter should be connected to P+ terminal and N- terminal. (Refer to section 11.3 and 11.4.)
- Twisted wires cable should be used when wiring is over 5 m and equal to or less than 10 m using a brake unit. (Refer to section 11.3)

d) When you use a power regeneration 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 wire of built-in regenerative resistor connected to P+ terminal and C terminal should not be connected.
- The wire of power regeneration common converter should be connected to P4 terminal and N- terminal. (Refer to section 11.5.)

e) 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.

f) When you use a multifunction regeneration converter

- For 5 kW or less servo amplifiers, the lead wire between the P+ terminal and D terminal should be connected. (factory-wired)
- For 7 kW servo amplifiers, the lead wire of the built-in regenerative resistor connected to the P+ terminal and C terminal should be connected. (factory-wired)
- The wire of the multifunction regeneration converter should be connected to the P4 terminal and N- terminal. (Refer to section 11.19.)

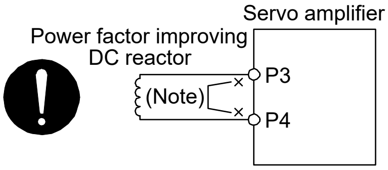
2) 400 V class
   a) When you use a regenerative option for 3.5 kW or less servo amplifiers
      - The lead wire between P+ terminal and D terminal should not be connected.
      - The regenerative option should be connected to P+ terminal and C terminal.
      - Twisted wires cable should be used. (Refer to section 11.2.4.)

   b) When you use a regenerative option for 5 kW or more servo amplifiers
      - For 5 kW or 7 kW servo amplifiers, the lead wire of the 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.
      - Twisted wires cable should be used. (Refer to section 11.2.4.)

   c) When you use a brake unit and power regeneration converter for 5 kW or more servo amplifiers
      - For 5 kW or 7 kW servo amplifiers, the lead wire of the built-in regenerative resistor connected to P+ terminal and C terminal should not be connected.
      - Brake unit, power regeneration converter should be connected to P+ terminal and N- terminal. (Refer to section 11.3 and 11.4.)
      - Twisted wires cable should be used when wiring is over 5 m and equal to or less than 10 m using a brake unit. (Refer to section 11.3)

   d) When you use a power regeneration common converter
      - Power regeneration common converter should be connected to P4 terminal and N- terminal. (Refer to section 11.5.)

   e) 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.

   f) When you use a multifunction regeneration converter
      - For 5 kW or 7 kW servo amplifiers, the lead wire of the built-in regenerative resistor connected to the P+ terminal and C terminal should be connected. (factory-wired)
      - The wire of the multifunction regeneration converter should be connected to the P4 terminal and N- terminal. (Refer to section 11.19.)

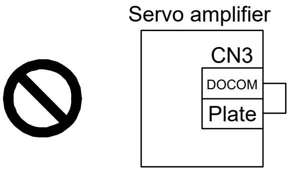
3) 100 V class
   - The lead wire between P+ terminal and D terminal should not be connected.
   - The regenerative option should be connected to P+ terminal and C terminal.
   - Twisted wires cable should be used. (Refer to section 11.2.4.)

(2) I/O signal wiring

(a) The I/O signals should be connected correctly.
Use DO forced output to forcibly turn on/off the pins of the CN3 connector. You can use this function to check the wiring. 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 CN3 connector.

(c) Plate and DOCOM of the CN3 connector is not shorted.



4.1.3 Surrounding environment

(1) Cable routing

(a) The wiring cables should not be stressed.

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

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

(2) Environment

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

4.2 Startup

Connect the servo motor with a machine after confirming that the servo motor operates properly alone.

(1) Power on

When the main and control circuit power supplies are turned on, "b01" (for the first axis) appears on the servo amplifier display.

When the absolute position detection system is used in a rotary servo motor, first power-on results in [AL. 25 Absolute position erased] and the servo-on cannot be ready. 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) Parameter setting

POINT

- The following encoder cables are of four-wire type. When using any of these encoder cables, set [Pr. PC04] 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
- If using the MR-J4-_B-RJ servo amplifier with the DC power supply input, set [Pr. PC20] to "_ _ _1".

Set the parameters according to the structure and specifications of the machine. Refer to chapter 5 for details.
After setting the above parameters, turn power off as necessary. Then switch power on again to enable the parameter values.

(3) Servo-on
Enable the servo-on with the following procedure.

(a) Switch on main circuit power supply and control circuit power supply.

(b) Transmit the servo-on command with the servo system controller.

When the servo-on status is enabled, the servo amplifier is ready to operate and the servo motor is locked.

(4) Home position return
Always perform home position return before starting positioning operation.

(5) Stop
Turn off the servo-on command after the servo motor has stopped, and then switch the power off.
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
Servo system controller	Servo-off command	The base circuit is shut off and the servo motor coasts.
	Ready-off command	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a stop.
	Forced stop command	The servo motor decelerates to a stop with the command. [AL. E7 Controller forced stop warning] occurs.
Servo amplifier	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 section 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.

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.

4.3 Switch setting and display of the servo amplifier

Switching to the test operation mode, deactivating control axes, and setting control axis No. are enabled with switches on the servo amplifier.
On the servo amplifier display (three-digit, seven-segment LED), check the status of communication with the servo system controller at power-on, and the axis number, and diagnose a malfunction at occurrence of an alarm.

4.3.1 Switches

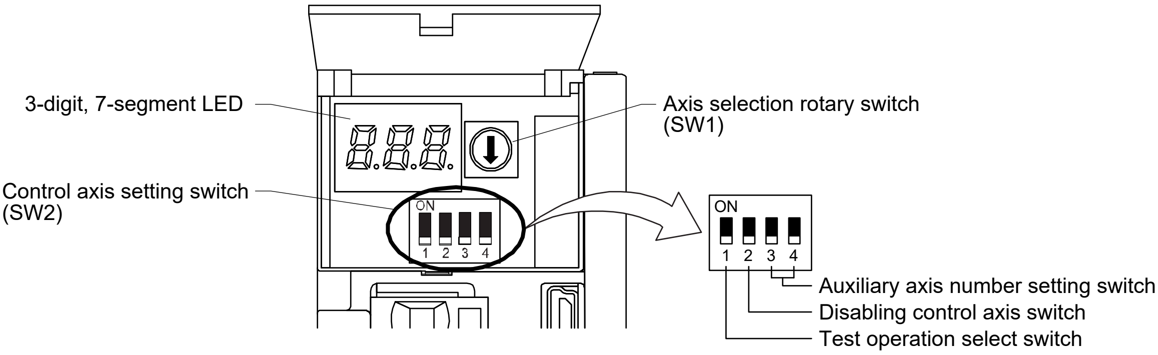
⚠WARNING

- When switching the axis selection rotary switch (SW1) and auxiliary axis number setting switch (SW2), use insulated screw driver. Do not use a metal screw driver. Touching patterns on electronic boards, lead of electronic parts, etc. may cause an electric shock.

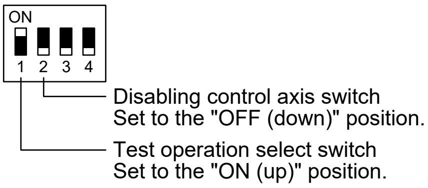
POINT

- Turning "ON (up)" all the control axis setting switches (SW2) enables an operation mode for manufacturer setting and displays "off". The mode is not available. Set the control axis setting switches (SW2) correctly according to this section.
- Cycling the main circuit power supply and control circuit power supply enables the setting of each switch.

The following explains the test operation select switch, the disabling control axis switch, auxiliary axis number setting switches, and the axis selection rotary switch.

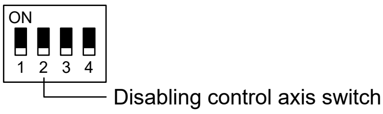


(1) Test operation select switch (SW2-1)
To use the test operation mode, turn "ON (up)" the switch. Turning "ON (up)" the switch enables the test operation mode. In the test operation mode, the functions such as JOG operation, positioning operation, and machine analyzer are available with MR Configurator2. Before turning "ON (up)" the test operation select switch, turn "OFF (down)" the disabling control axis switch.



(2) Disabling control axis switch (SW2-2)

Turning "ON (up)" the disabling control axis switch disables the corresponding servo motor. The servo motor will be disabled-axis status and will not be recognized by the controller.



(3) Switches for setting control axis No.

POINT

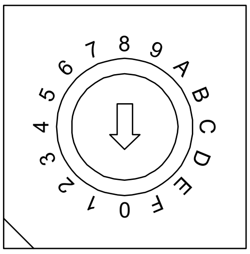
- ●The control axis No. set to the auxiliary axis number setting switches (SW2-3 and SW2-4) and the axis selection rotary switch (SW1) should be the same as the one set to the servo system controller. The number of the axes you can set depends on the servo system controller.
- ●For setting the axis selection rotary switch, use a flat-blade screwdriver with the blade edge width of 2.1 mm to 2.3 mm and the blade edge thickness of 0.6 mm to 0.7 mm.
- ●When the test operation mode is selected with the test operation select switch (SW2-1), the SSCNET III/H communication for the servo amplifier in the test operation mode and the following servo amplifiers is blocked.

You can set the control axis No. between 1 and 64 by using auxiliary axis number setting switches with the axis selection rotary switch. (Refer to (3) (c) in this section.)
If the same numbers are set to different control axes in a single communication system, the system will not operate properly. The control axes may be set independently of the SSCNET III cable connection sequence. The following shows the description of each switch.

(a) Auxiliary axis number setting switches (SW2-3 and SW2-4)
Turning these switches "ON (up)" enables you to set the axis No. 17 or more.

(b) Axis selection rotary switch (SW1)
You can set the control axis No. between 1 and 64 by using auxiliary axis number setting switches with the axis selection rotary switch. (Refer to (3) (c) in this section.)

Axis selection rotary switch (SW1)

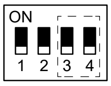


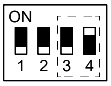
(c) Switch combination list for the control axis No. setting

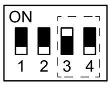
POINT

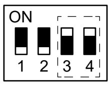
- Set control axis Nos. for one system. For details of the control axis No., refer to the servo system controller user's manual.

The following lists show the setting combinations of the auxiliary axis number setting switches and the axis selection rotary switch.

Auxiliary axis number setting switch	Axis selection rotary switch	Control axis No.
	0	1
	1	2
	2	3
	3	4
	4	5
	5	6
	6	7
	7	8
	8	9
	9	10
	A	11
	B	12
	C	13
	D	14
	E	15
	F	16

Auxiliary axis number setting switch	Axis selection rotary switch	Control axis No.
	0	17
	1	18
	2	19
	3	20
	4	21
	5	22
	6	23
	7	24
	8	25
	9	26
	A	27
	B	28
	C	29
	D	30
	E	31
	F	32

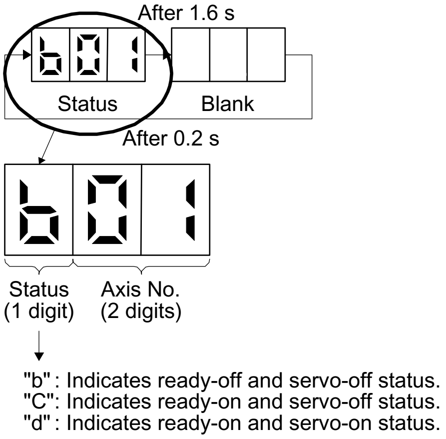
Auxiliary axis number setting switch	Axis selection rotary switch	Control axis No.
	0	33
	1	34
	2	35
	3	36
	4	37
	5	38
	6	39
	7	40
	8	41
	9	42
	A	43
	B	44
	C	45
	D	46
	E	47
	F	48

Auxiliary axis number setting switch	Axis selection rotary switch	Control axis No.
	0	49
	1	50
	2	51
	3	52
	4	53
	5	54
	6	55
	7	56
	8	57
	9	58
	A	59
	B	60
	C	61
	D	62
	E	63
	F	64

4.3.2 Scrolling display

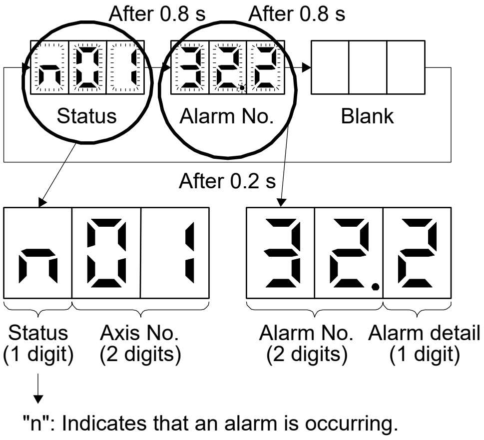
(1) Normal display

When there is no alarm, the axis No. and blank are displayed in rotation.



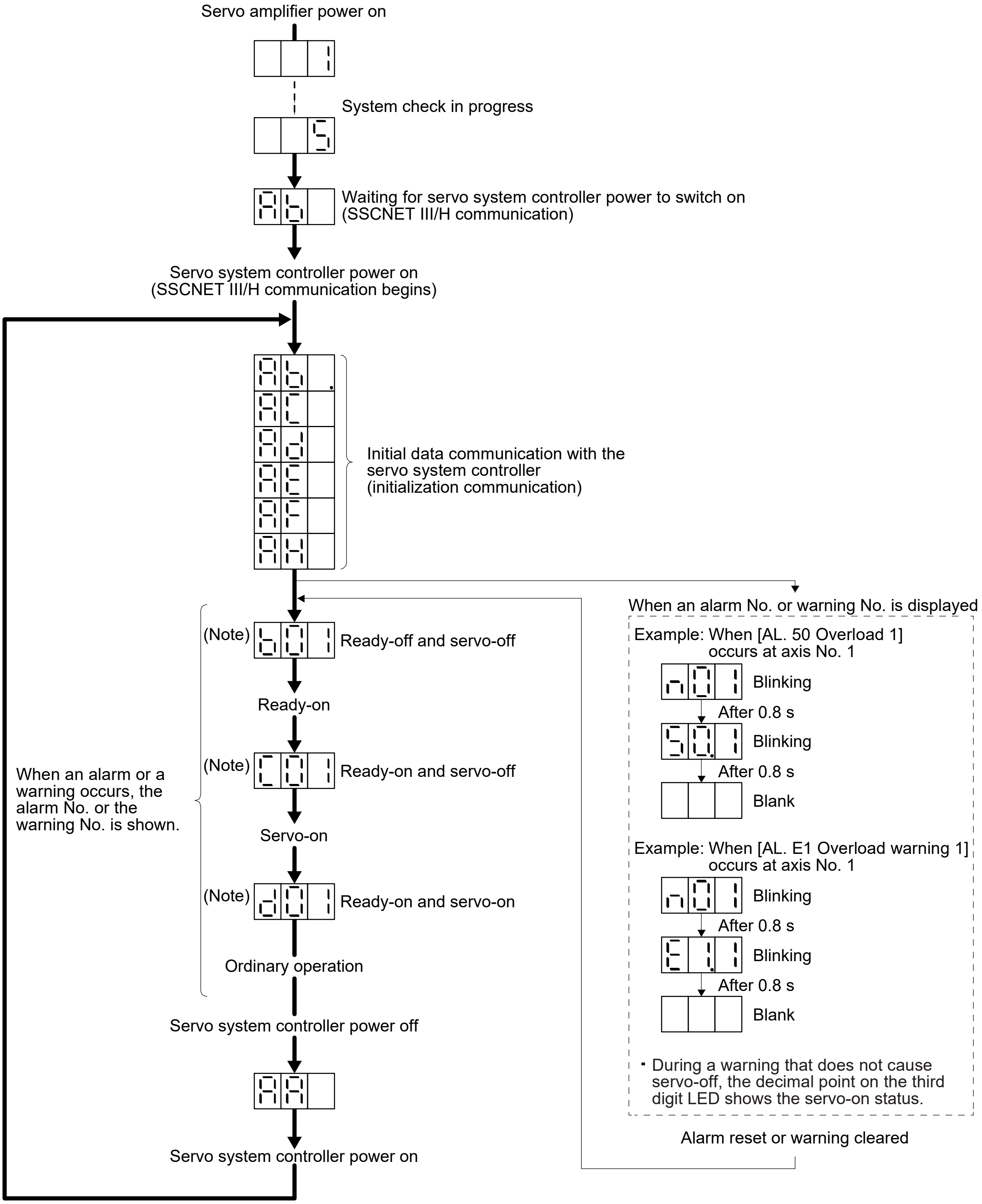
(2) Alarm display

When an alarm occurs, the alarm number (two digits) and the alarm detail (one digit) are displayed following the status display. For example, the following shows when [AL. 32 Overcurrent] is occurring.



4.3.3 Status display of an axis

(1) Display sequence



Note. 01 02 ··· 64 The segment of the last 2 digits shows the axis number.

Axis No. 1 Axis No. 2 Axis No. 64

(2) Indication list

Indication	Status	Description
1 ¦ 5	Initializing	System check in progress
Ab	Initializing	・Power of the servo amplifier was switched on at the condition that the power of the servo system controller is off. ・The control axis No. set to the auxiliary axis number setting switches (SW2-3 and SW2-4) and the axis selection rotary switch (SW1) do not match the one set to the servo system controller. ・A servo amplifier malfunctioned, or communication error occurred with the servo system controller or the previous axis servo amplifier. In this case, the indication changes as follows: "Ab", "AC", "Ad", and "Ab" ・The servo system controller is malfunctioning.
Ab .	Initializing	During initial setting for communication specifications
AC	Initializing	Initial setting for communication specifications completed, and then it synchronized with servo system controller.
Ad	Initializing	During initial parameter setting communication with servo system controller
AE	Initializing	During the servo motor/encoder information and telecommunication with servo system controller
AF	Initializing	During initial signal data communication with servo system controller
AH	Initializing completion	The process for initial data communication with the servo system controller is completed.
AA	Initializing standby	The power supply of servo system controller is turned off during the power supply of servo amplifier is on.
(Note 1) b##	Ready-off	The ready-off signal from the servo system controller was received.
(Note 1) d##	Servo-on	The ready-off signal from the servo system controller was received.
(Note 1) C##	Servo-off	The ready-off signal from the servo system controller was received.
(Note 2) ***	Alarm and warning	The alarm No. and the warning No. that occurred is displayed. (Refer to section 8. (Note 4))
888	CPU error	CPU watchdog error has occurred.
(Note 1) b##. d##. C##.	(Note 3) Test operation mode	JOG operation, positioning operation, program operation, output signal (DO) forced output, or motor-less operation was set.

Note 1. The meanings of ## are listed below.

##	Description
01 to 64	Axis No. 1 to Axis No. 64

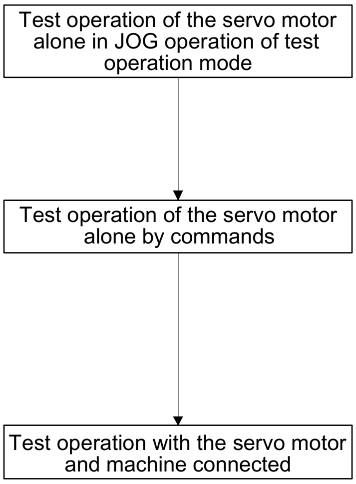
2. ** indicates the alarm No. and the warning No.
3. Requires the MR Configurator2.
4. Only a list of alarms and warnings is listed in chapter 8. Refer to "MELSERVO-J4 Servo Amplifier Instruction Manual (Troubleshooting)" for details of alarms and warnings.

4.4 Test operation

Before starting actual operation, perform test operation to make sure that the machine operates normally.
Refer to section 4.2 for the power on and off methods of the servo amplifier.

POINT

- ●If necessary, verify controller program by using motor-less operation. Refer to section 4.5.2 for the motor-less operation.



In this step, confirm that the servo amplifier and servo motor operate normally. With the servo motor disconnected from the machine, use the test operation mode and check whether the servo motor rotates correctly. Refer to section 4.5 for the test operation mode.

In this step, confirm that the servo motor rotates correctly under the commands from the controller.
Give a low speed command at first and check the rotation direction, etc. of the servo motor. If the machine does not operate in the intended direction, check the input signal.

In this step, connect the servo motor with the machine and confirm that the machine operates normally under the commands from the controller.
Give a low speed command at first and check the operation direction, etc. of the machine. If the machine does not operate in the intended direction, check the input signal.
Check any problems with the servo motor speed, load ratio, and other status display items with MR Configurator2.
Then, check automatic operation with the program of the controller.

4.5 Test operation mode

⚠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 servo motor alone.
- ●If the servo motor operates abnormally, use EM2 (Forced stop 2) to stop it.

POINT

- ●The content described in this section indicates that the servo amplifier and a personal computer are directly connected.

By using a personal computer and MR Configurator2, you can execute jog operation, positioning operation, output signal (DO) forced output program operation without connecting the servo system controller.

4.5.1 Test operation mode in MR Configurator2

POINT

- When the test operation mode is selected with the test operation select switch (SW2-1), the SSCNET III/H communication for the servo amplifier in the test operation mode and the following servo amplifiers is blocked.

(1) Test operation mode

(a) Jog operation

Jog operation can be performed without using the servo system controller. Use this operation with the forced stop reset. This operation may be used independently of whether the servo is on or off and whether the servo system controller is connected or not.
Exercise control on the jog operation screen of MR Configurator2.

1) Operation pattern

Item	initial value	Setting range
Speed [r/min]	200	0 to max. speed
Acceleration/deceleration time constant [ms]	1000	0 to 50000

2) Operation method

・When the check box of "Rotation only while the CCW or CW button is being pushed." is checked.

Operation	Screen control
Forward rotation start	Keep pressing "Forward".
Reverse rotation start	Keep pressing "Reverse".
Stop	Release "Forward" or "Reverse".
Forced stop	Click "Forced stop".

・When the check box of "Rotation only while the CCW or CW button is being pushed." is not checked.

Operation	Screen control
Forward rotation start	Click "Forward".
Reverse rotation start	Click "Reverse".
Stop	Click "Stop".
Forced stop	Click "Forced stop".

(b) Positioning operation

Positioning operation can be performed without using the servo system controller. Use this operation with the forced stop reset. This operation may be used independently of whether the servo is on or off and whether the servo system controller is connected or not.

Exercise control on the positioning operation screen of MR Configurator2.

1) Operation pattern

Item	initial value	Setting range
Travel distance [pulse]	4000	0 to 99999999
Speed [r/min]	200	0 to max. speed
Acceleration/deceleration time constant [ms]	1000	0 to 50000
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 repeats [time]	1	1 to 9999

2) Operation method

Operation	Screen control
Forward rotation start	Click "Forward".
Reverse rotation start	Click "Reverse".
Pause	Click "Pause".
Stop	Click "Stop".
Forced stop	Click "Forced stop".

(c) Program operation

Positioning operation can be performed in two or more operation patterns combined, without using the servo system controller. Use this operation with the forced stop reset. This operation may be used independently of whether the servo is on or off and whether the servo system controller is connected or not.

Exercise control on the program operation screen of MR Configurator2. For details, refer to Help of MR Configurator2.

Operation	Screen control
Start	Click "Start".
Pause	Click "Pause".
Stop	Click "Stop".
Forced stop	Click "Forced stop".

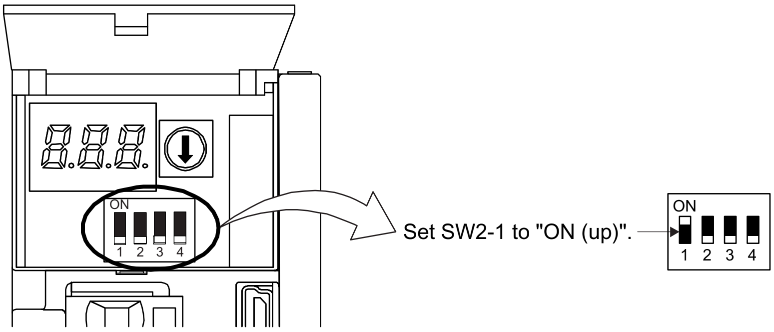
(d) Output signal (DO) forced output

Output signals can be switched on/off forcibly independently of the servo status. Use this function for output signal wiring check, etc. Exercise control on the DO forced output screen of MR Configurator2.

(2) Operation procedure

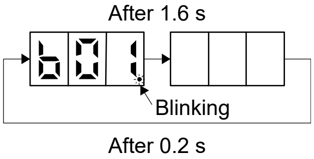
1) Turn off the power.

2) Turn "ON (up)" SW2-1.

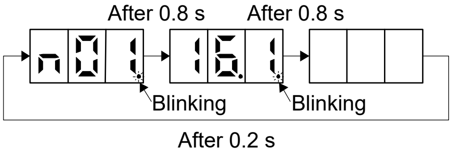


Turning "ON (up)" SW2-1 during power-on will not start the test operation mode.

3) Turn on the servo amplifier.
When initialization is completed, the decimal point on the first digit will blink.



When an alarm or warning also occurs during the test operation, the decimal point on the first digit will blink as follows.



4) Start operation with the personal computer.

4.5.2 Motor-less operation in controller

POINT

- ●Use motor-less operation which is available by making the servo system controller servo parameter setting.
- ●Connect the servo system controller to the servo amplifier before the motor-less operation.
- ●The motor-less operation is not used in the fully closed loop control mode, linear servo motor control mode, and DD motor control mode.

(1) Motor-less operation

Without connecting the servo motor to the servo amplifier, output signals or status displays can be provided in response to the servo system controller commands as if the servo motor is actually running. This operation may be used to check the servo system controller sequence. Use this operation with the forced stop reset. Use this operation with the servo amplifier connected to the servo system controller. To stop the motor-less operation, set the motor-less operation selection to "Disable" in the servo parameter setting of the servo system controller. When the power supply is turned on next time, motor-less operation will be disabled.

(a) Load conditions

Load item	Condition
Load torque	0
Load to motor inertia ratio	[Pr. PB06 Load to motor inertia ratio/load to motor mass ratio]

(b) Alarms

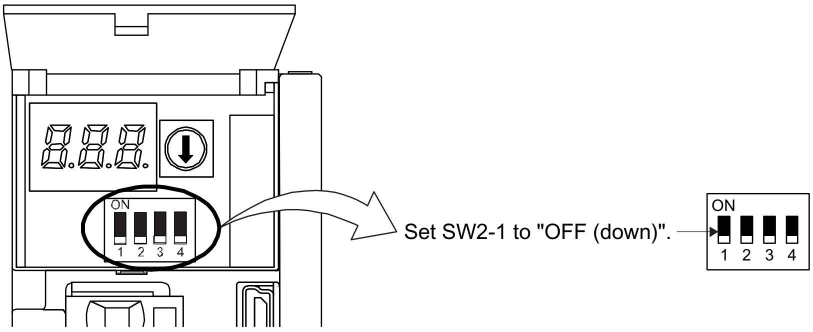
The following alarms and warning do not occur. However, the other alarms and warnings occur as when the servo motor is connected.

- [AL. 16 Encoder initial communication error 1]
- [AL. 1E Encoder initial communication error 2]
- [AL. 1F Encoder initial communication error 3]
- [AL. 20 Encoder normal communication error 1]
- [AL. 21 Encoder normal communication error 2]
- [AL. 25 Absolute position erased]
- [AL. 92 Battery cable disconnection warning]
- [AL. 9F Battery warning]

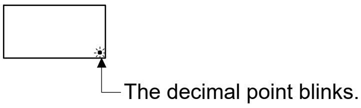
(2) Operation procedure

1) Set the servo amplifier to the servo-off status.

2) Set [Pr. PC05] to "_ _ _ 1", turn "OFF (down: normal condition side)" the test operation mode switch (SW2-1), and then turn on the power supply.



3) Start the motor-less operation with the servo system controller.
The display shows the following screen.



MEMO

5. PARAMETERS

⚠CAUTION

- Never make a drastic adjustment or change to the parameter values as doing so will make the operation unstable.
- Do not change the parameter settings as described below. Doing so may cause an unexpected condition, such as failing to start up the servo amplifier.
  - Changing the values of the parameters for manufacturer setting
  - Setting a value out of the range
  - Changing the fixed values in the digits of a parameter
- When you write parameters with the controller, make sure that the control axis No. of the servo amplifier is set correctly. Otherwise, the parameter settings of another axis may be written, possibly causing the servo amplifier to be an unexpected condition.

POINT

- When you connect the amplifier to a servo system controller, servo parameter values of the servo system controller will be written to each parameter.
- Setting may not be made to some parameters and their ranges depending on the servo system controller model, servo amplifier software version, and MR Configurator2 software version. For details, refer to the servo system controller user's manual. Check the software version of the servo amplifier using MR Configurator2.

5.1 Parameter list

POINT

- The parameter whose symbol is preceded by * is enabled with the following conditions:
  *: After setting the parameter, cycle the power or reset the controller.
  **: After setting the parameter, cycle the power.
- Abbreviations of operation modes indicate the followings.
  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
  D.D.: Direct drive motor use
- For servo amplifier with software version B3 or later, the parameter initial values for the manufacturer setting are partially changed.
- If using the MR-J4-_B-RJ servo amplifier with the DC power supply input, set [Pr. PC20] to "_ _ _1".

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

No.	Symbol	Name	Initial value	Unit	Operation mode			
					Standard	Full.	Lin.	D.D.
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		For manufacturer setting	10000					
PA06			1					
PA07			1					
PA08	ATU	Auto tuning mode	0001h		○	○	○	○
PA09	RSP	Auto tuning response	16		○	○	○	○
PA10	INP	In-position range	1600	[pulse]	○	○	○	○
PA11		For manufacturer setting	1000.0					
PA12			1000.0					
PA13			0000h					
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	00ABh		○	○	○	○
PA20	*TDS	Tough drive setting	0000h		○	○	○	○
PA21	*AOP3	Function selection A-3	0001h		○	○	○	○
PA22	**PCS	Position control composition selection	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					

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

No.	Symbol	Name	Initial value	Unit	Operation mode			
					Standard	Full.	Lin.	D.D.
PB01	FILT	Adaptive tuning mode (adaptive filter II)	0000h		○	○	○	○
PB02	VRFT	Vibration suppression control tuning mode (advanced vibration suppression control II)	0000h		○	○	○	○
PB03	TFBGN	Torque feedback loop gain	18000	[rad/s]	○	○	○	○
PB04	FFC	Feed forward gain	0	[%]	○	○	○	○
PB05		For manufacturer setting	500					
PB06	GD2	Load to motor inertia ratio/load to motor mass ratio	7.00	[Multiplier]	○	○	○	○
PB07	PG1	Model loop gain	15.0	[rad/s]	○	○	○	○
PB08	PG2	Position loop gain	37.0	[rad/s]	○	○	○	○
PB09	VG2	Speed loop gain	823	[rad/s]	○	○	○	○
PB10	VIC	Speed integral compensation	33.7	[ms]	○	○	○	○
PB11	VDC	Speed differential compensation	980		○	○	○	○
PB12	OVA	Overshoot amount compensation	0	[%]	○	○	○	○
PB13	NH1	Machine resonance suppression filter 1	4500	[Hz]	○	○	○	○
PB14	NHQ1	Notch shape selection 1	0000h		○	○	○	○
PB15	NH2	Machine resonance suppression filter 2	4500	[Hz]	○	○	○	○
PB16	NHQ2	Notch shape selection 2	0000h		○	○	○	○
PB17	NHF	Shaft resonance suppression filter	0000h		○	○	○	○
PB18	LPF	Low-pass filter setting	3141	[rad/s]	○	○	○	○
PB19	VRF11	Vibration suppression control 1 - Vibration frequency	100.0	[Hz]	○	○	○	○
PB20	VRF12	Vibration suppression control 1 - Resonance frequency	100.0	[Hz]	○	○	○	○
PB21	VRF13	Vibration suppression control 1 - Vibration frequency damping	0.00		○	○	○	○
PB22	VRF14	Vibration suppression control 1 - Resonance frequency damping	0.00		○	○	○	○
PB23	VFBF	Low-pass filter selection	0000h		○	○	○	○
PB24	*MVS	Slight vibration suppression control	0000h		○	○	○	○
PB25	*BOP1	Function selection B-1	0000h		○	○	○	○
PB26	*CDP	Gain switching function	0000h		○	○	○	○
PB27	CDL	Gain switching condition	10	[kpulse/s]/ [pulse]/ [r/min]	○	○	○	○
PB28	CDT	Gain switching time constant	1	[ms]	○	○	○	○
PB29	GD2B	Load to motor inertia ratio/load to motor mass ratio after gain switching	7.00	[Multiplier]	○	○	○	○
PB30	PG2B	Position loop gain after gain switching	0.0	[rad/s]	○	○	○	○
PB31	VG2B	Speed loop gain after gain switching	0	[rad/s]	○	○	○	○
PB32	VICB	Speed integral compensation after gain switching	0.0	[ms]	○	○	○	○
PB33	VRF11B	Vibration suppression control 1 - Vibration frequency after gain switching	0.0	[Hz]	○	○	○	○
PB34	VRF12B	Vibration suppression control 1 - Resonance frequency after gain switching	0.0	[Hz]	○	○	○	○
PB35	VRF13B	Vibration suppression control 1 - Vibration frequency damping after gain switching	0.00		○	○	○	○
PB36	VRF14B	Vibration suppression control 1 - Resonance frequency damping after gain switching	0.00		○	○	○	○
PB37		For manufacturer setting	1600					
PB38			0.00					
PB39			0.00					
PB40			0.00					
PB41			0					
PB42			0					
PB43			0000h					
PB44			0.00					
PB45	CNHF	Command notch filter	0000h		○	○	○	○

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

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

No.	Symbol	Name	Initial value	Unit	Operation mode			
					Standard	Full.	Lin.	D.D.
PC01	ERZ	Error excessive alarm level	0	[rev]/ [mm]	○	○	○	○
PC02	MBR	Electromagnetic brake sequence output	0	[ms]	○	○	○	○
PC03	*ENRS	Encoder output pulse selection	0000h		○	○	○	○
PC04	**COP1	Function selection C-1	0000h		○	○	○	○
PC05	**COP2	Function selection C-2	0000h		○			
PC06	*COP3	Function selection C-3	0000h		○	○	○	○
PC07	ZSP	Zero speed	50	[r/min]/ [mm/s]	○	○	○	○
PC08	OSL	Overspeed alarm detection level	0	[r/min]/ [mm/s]	○	○	○	○
PC09	MOD1	Analog monitor 1 output	0000h		○	○	○	○
PC10	MOD2	Analog monitor 2 output	0001h		○	○	○	○
PC11	MO1	Analog monitor 1 offset	0	[mV]	○	○	○	○
PC12	MO2	Analog monitor 2 offset	0	[mV]	○	○	○	○
PC13	MOSDL	Analog monitor - Feedback position output standard data - Low	0	[pulse]	○	○	○	○
PC14	MOSDH	Analog monitor - Feedback position output standard data - High	0	[10000 pulses]	○	○	○	○
PC15		For manufacturer setting	0					
PC16			0000h					
PC17	**COP4	Function selection C-4	0000h		○	○	○	○
PC18	*COP5	Function selection C-5	0000h		○	○	○	○
PC19		For manufacturer setting	0000h					
PC20	*COP7	Function selection C-7	0000h		○	○	○	○

No.	Symbol	Name	Initial value	Unit	Operation mode			
					Standard	Full.	Lin.	D.D.
PC21	*BPS	Alarm history clear	0000h		○	○	○	○
PC22		For manufacturer setting	0					
PC23			0000h					
PC24	RSBR	Forced stop deceleration time constant	100	[ms]	○	○	○	○
PC25		For manufacturer setting	0					
PC26	**COP8	Function selection C-8	0000h		○ (Note)	○	○	○
PC27	**COP9	Function selection C-9	0000h		○ (Note)	○	○	
PC28		For manufacturer setting	0000h					
PC29	*COPB	Function selection C-B	0000h		○		○	○
PC30		For manufacturer setting	0					
PC31	RSUP1	Vertical axis freefall prevention compensation amount	0	[0.0001 rev]/ [0.01 mm]	○	○	○	○
PC32		For manufacturer setting	0000h					
PC33			0					
PC34			100					
PC35			0000h					
PC36			0000h					
PC37			0000h					
PC38	ERW	Error excessive warning level	0	[rev]/[mm]	○	○	○	○
PC39		For manufacturer setting	0000h					
PC40			0000h					
PC41			0000h					
PC42			0000h					
PC43			0000h					
PC44			0000h					
PC45			0000h					
PC46			0000h					
PC47			0000h					
PC48			0000h					
PC49			0000h					
PC50			0000h					
PC51			0000h					
PC52			0000h					
PC53			0000h					
PC54			0000h					
PC55			0000h					
PC56			0000h					
PC57			0000h					
PC58			0000h					
PC59			0000h					
PC60			0000h					
PC61			0000h					
PC62			0000h					
PC63			0000h					
PC64			0000h					

Note. It is available when the scale measurement function is enabled ([Pr. PA22] is "1 _ _ _" or "2 _ _ _").

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

No.	Symbol	Name	Initial value	Unit	Operation mode			
					Standard	Full.	Lin.	D.D.
PD01		For manufacturer setting	0000h					
PD02	*DIA2	Input signal automatic on selection 2	0000h		○	○	○	○
PD03		For manufacturer setting	0020h					
PD04			0021h					
PD05			0022h					
PD06			0000h					
PD07	*DO1	Output device selection 1	0005h		○	○	○	○
PD08	*DO2	Output device selection 2	0004h		○	○	○	○
PD09	*DO3	Output device selection 3	0003h		○	○	○	○
PD10		For manufacturer setting	0000h					
PD11	*DIF	Input filter setting (Note)	0004h		○	○	○	○
PD12	*DOP1	Function selection D-1	0000h		○	○	○	○
PD13	*DOP2	Function selection D-2	0000h		○	○	○	○
PD14	*DOP3	Function selection D-3	0000h		○	○	○	○
PD15	*IDCS	Driver communication setting	0000h		○	○		
PD16	*MD1	Driver communication setting - Master - Transmit data selection 1	0000h		○	○		
PD17	*MD2	Driver communication setting - Master - Transmit data selection 2	0000h		○	○		
PD18		For manufacturer setting	0000h					
PD19			0000h					
PD20	*SLA1	Driver communication setting - Slave - Master axis No. selection 1	0		○			
PD21		For manufacturer setting	0					
PD22			0					
PD23			0					
PD24			0000h					
PD25			0000h					
PD26			0000h					
PD27			0000h					
PD28			0000h					
PD29			0000h					
PD30	TLC	Master-slave operation - Torque command coefficient on slave	0		○			
PD31	VLC	Master-slave operation - Speed limit coefficient on slave	0		○			
PD32	VLL	Master-slave operation - Speed limit adjusted value on slave	0	[r/min]	○			
PD33		For manufacturer setting	0000h					
PD34			0000h					
PD35			0000h					
PD36			0000h					
PD37			0000h					
PD38			0000h					
PD39			0000h					
PD40			0000h					
PD41			0000h					
PD42			0000h					
PD43			0000h					
PD44			0000h					
PD45			0000h					
PD46			0000h					
PD47			0000h					
PD48			0000h					

Note. Refer to the servo system controller instruction manual for the setting.

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

No.	Symbol	Name	Initial value	Unit	Operation mode			
					Standard	Full.	Lin.	D.D.
PE01	**FCT1	Fully closed loop function selection 1	0000h			○		
PE02		For manufacturer setting	0000h					
PE03	*FCT2	Fully closed loop function selection 2	0003h			○		
PE04	**FBN	Fully closed loop control - Feedback pulse electronic gear 1 - Numerator	1			○		
PE05	**FBD	Fully closed loop control - Feedback pulse electronic gear 1 - Denominator	1			○		
PE06	BC1	Fully closed loop control - Speed deviation error detection level	400	[r/min]		○		
PE07	BC2	Fully closed loop control - Position deviation error detection level	100	[kpulse]		○		
PE08	DUF	Fully closed loop dual feedback filter	10	[rad/s]		○		
PE09		For manufacturer setting	0000h					
PE10	FCT3	Fully closed loop function selection 3	0000h		○	○		
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			○		
PE35	**FBD2	Fully closed loop control - Feedback pulse electronic gear 2 - Denominator	1			○		
PE36		For manufacturer setting	0.0					
PE37			0.00					
PE38			0.00					
PE39			20					
PE40			0000h					
PE41	EOP3	Function selection E-3	0000h		○	○	○	○
PE42		For manufacturer setting	0					
PE43			0.0					
PE44	LMCP	Lost motion compensation positive-side compensation value selection	0	[0.01%]	○	○	○	○
PE45	LMCN	Lost motion compensation negative-side compensation value selection	0	[0.01%]	○	○	○	○
PE46	LMFLT	Lost motion filter setting	0	[0.1 ms]	○	○	○	○
PE47	TOF	Torque offset	0	[0.01%]	○	○		
PE48	*LMOP	Lost motion compensation function selection	0000h		○	○	○	○
PE49	LMCD	Lost motion compensation timing	0	[0.1 ms]	○	○	○	○
PE50	LMCT	Lost motion compensation non-sensitive band	0	[pulse]/ [kpulse]	○	○	○	○

No.	Symbol	Name	Initial value	Unit	Operation mode			
					Standard	Full.	Lin.	D.D.
PE51		For manufacturer setting	0000h					
PE52			0000h					
PE53			0000h					
PE54			0000h					
PE55			0000h					
PE56			0000h					
PE57			0000h					
PE58			0000h					
PE59			0000h					
PE60			0000h					
PE61			0.00					
PE62			0.00					
PE63			0.00					
PE64			0.00					

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

No.	Symbol	Name	Initial value	Unit	Operation mode			
					Standard	Full.	Lin.	D.D.
PF01		For manufacturer setting	0000h					
PF02			0000h					
PF03			0000h					
PF04			0					
PF05			0000h					
PF06	*FOP5	Function selection F-5	0000h		○	○		
PF07		For manufacturer setting	0000h					
PF08			0000h					
PF09			0					
PF10			0					
PF11			0					
PF12	DBT	Electronic dynamic brake operating time	2000	[ms]	○	○		
PF13		For manufacturer setting	0000h					
PF14			10					
PF15			0000h					
PF16			0000h					
PF17			0000h					
PF18	**STOD	STO diagnosis error detection time	0	[s]	○	○	○	○
PF19		For manufacturer setting	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	200	[ms]	○	○	○	○
PF26		For manufacturer setting	0					
PF27			0					
PF28			0					

No.	Symbol	Name	Initial value	Unit	Operation mode			
					Standard	Full.	Lin.	D.D.
PF29		For manufacturer setting	0000h					
PF30			0					
PF31	FRIC	Machine diagnosis function - Friction judgment speed	0	[r/min]/ [mm/s]	○	○	○	○
PF32		For manufacturer setting	50					
PF33			0000h					
PF34			0000h					
PF35			0000h					
PF36			0000h					
PF37			0000h					
PF38			0000h					
PF39			0000h					
PF40			0000h					
PF41			0000h					
PF42			0000h					
PF43			0000h					
PF44			0					
PF45			0000h					
PF46			0000h					
PF47			0000h					
PF48			0000h					

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

No.	Symbol	Name	Initial value	Unit	Operation mode			
					Standard	Full.	Lin.	D.D.
PL01	**LIT1	Linear servo motor/DD motor function selection 1	0301h				○	○
PL02	**LIM	Linear encoder resolution - Numerator	1000	[μm]			○	
PL03	**LID	Linear encoder resolution - Denominator	1000	[μm]			○	
PL04	*LIT2	Linear servo motor/DD motor function selection 2	0003h				○	○
PL05	LB1	Position deviation error detection level	0	[mm]/ [0.01 rev]			○	○
PL06	LB2	Speed deviation error detection level	0	[r/min]/ [mm/s]			○	○
PL07	LB3	Torque/thrust deviation error detection level	100	[%]			○	○
PL08	*LIT3	Linear servo motor/DD motor function selection 3	0010h				○	○
PL09	LPWM	Magnetic pole detection voltage level	30	[%]			○	○
PL10		For manufacturer setting	5					
PL11			100					
PL12			500					
PL13			0000h					
PL14			0					
PL15			20					
PL16			0					
PL17	LTSTS	Magnetic pole detection - Minute position detection method - Function selection	0000h				○	○
PL18	IDLV	Magnetic pole detection - Minute position detection method - Identification signal amplitude	0	[%]			○	○

No.	Symbol	Name	Initial value	Unit	Operation mode			
					Standard	Full.	Lin.	D.D.
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					

5.2 Detailed list of parameters

POINT

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

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

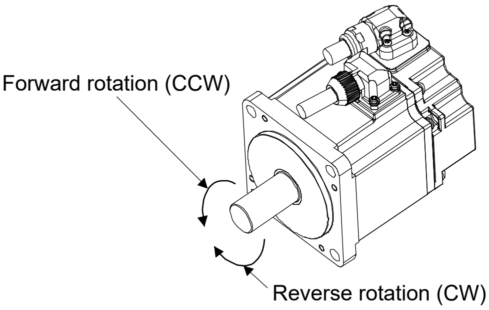
<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PA01</td><td>**STY</td><td>Operation mode
Select a operation mode.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>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 result in [AL. 37 Parameter error]. The fully closed loop system is available for the MR-J4-_B_(-RJ) servo amplifiers of which software version is A3 or later.</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>Compatibility mode selection
To change this digit, use the application "MR-J4(W)-B mode selection" or "MR Mode Change". When you change it without the application, [AL. 3E Operation mode error] will occur.
0: J3 compatibility mode
1: J4 mode</td><td>1h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

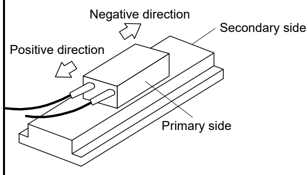
<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PA02</td><td>**REG</td><td>Regenerative option
Used to select the regenerative option.
Incorrect setting may cause the regenerative option to burn.
If a selected regenerative option is not for use with the servo amplifier, [AL. 37 Parameter error] occurs.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ x x</td><td>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-RC-(H)/FR-CV-(H)/FR-BU2-(H)/FR-XC-(H)
To use the FR-RC-(H), FR-CV-(H), or FR-XC-(H), select "When [AL. 10] occurs (_ _ _ 1)" of "Undervoltage alarm detection method selection" in [Pr. PC20].
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.)
80: MR-RB1H-4
81: MR-RB3M-4 (Cooling fan is required.)
82: MR-RB3G-4 (Cooling fan is required.)
83: MR-RB5G-4 (Cooling fan is required.)
84: MR-RB34-4 (Cooling fan is required.)
85: MR-RB54-4 (Cooling fan is required.)
91: MR-RB3U-4 (Cooling fan is required.)
92: MR-RB5U-4 (Cooling fan is required.)
FA: When the supplied regenerative resistors or the regenerative option is cooled by the cooling fan to increase the ability with the servo amplifier of 11 kW to 22 kW.</td><td>00h</td></tr>
<tr><td>_ x _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td></td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

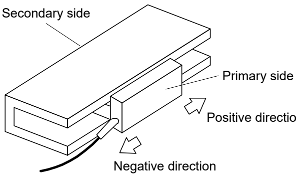
<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PA03</td><td>*ABS</td><td>Absolute position detection system
Set this parameter when using the absolute position detection system.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Absolute position detection system selection
0: Disabled (used in incremental system)
1: Enabled (used in absolute position detection system)</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PA04</td><td>*AOP1</td><td>Function selection A-1
This is used to select the forced stop input and forced stop deceleration function.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td rowspan="2">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>Servo forced stop selection
0: Enabled (The forced stop input EM2 or EM1 is used.)
1: Disabled (The forced stop input EM2 and EM1 are not used.)
Refer to table 5.1 for details.</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>Forced stop deceleration function selection
0: Forced stop deceleration function disabled (EM1)
2: Forced stop deceleration function enabled (EM2)
Refer to table 5.1 for details.</td><td>2h</td></tr>
</table>
Table 5.1 Deceleration method
<table>
<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>Controller forced stop is enabled/Alarm occurred</th></tr>
<tr><td>0 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 0 _ _</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>
<tr><td>0 1 _ _</td><td>Not using EM2 and EM1</td><td></td><td>MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.</td></tr>
<tr><td>2 1 _ _</td><td>Not using EM2 and EM1</td><td></td><td>MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

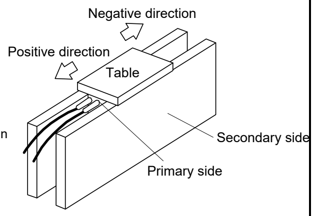
<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PA08</td><td>ATU</td><td>Auto tuning mode
Select the gain adjustment mode.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Gain adjustment mode selection
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.</td><td>1h</td></tr>
<tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td></td><td>0h</td></tr>
<tr><td>x _ _ _</td><td></td><td>0h</td></tr>
</table>
Table 5.2 Gain adjustment mode selection
<table>
<tr><th>Setting value</th><th>Gain adjustment mode</th><th>Automatically adjusted parameter</th></tr>
<tr><td>_ _ _ 0</td><td>2 gain adjustment mode 1 (interpolation mode)</td><td>[Pr. PB06 Load to motor inertia ratio/load to motor mass 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/load to motor mass 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>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PA09</td><td>RSP</td><td>Auto tuning response
Set a response of the auto tuning.
<table>
<tr><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></tr>
<tr><td>1</td><td rowspan="2">Low response</td><td>2.7</td></tr>
<tr><td>2</td><td>3.6</td></tr>
<tr><td>3</td><td rowspan="16"></td><td>4.9</td></tr>
<tr><td>4</td><td>6.6</td></tr>
<tr><td>5</td><td>10.0</td></tr>
<tr><td>6</td><td>11.3</td></tr>
<tr><td>7</td><td>12.7</td></tr>
<tr><td>8</td><td>14.3</td></tr>
<tr><td>9</td><td>16.1</td></tr>
<tr><td>10</td><td>18.1</td></tr>
<tr><td>11</td><td>20.4</td></tr>
<tr><td>12</td><td>23.0</td></tr>
<tr><td>13</td><td>25.9</td></tr>
<tr><td>14</td><td>29.2</td></tr>
<tr><td>15</td><td>32.9</td></tr>
<tr><td>16</td><td>37.0</td></tr>
<tr><td>17</td><td>41.7</td></tr>
<tr><td>18</td><td>47.0</td></tr>
<tr><td>19</td><td rowspan="2">Middle response</td><td>52.9</td></tr>
<tr><td>20</td><td>59.6</td></tr>
</table>
<table>
<tr><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></tr>
<tr><td>21</td><td rowspan="2">Middle response</td><td>67.1</td></tr>
<tr><td>22</td><td>75.6</td></tr>
<tr><td>23</td><td rowspan="16"></td><td>85.2</td></tr>
<tr><td>24</td><td>95.9</td></tr>
<tr><td>25</td><td>108.0</td></tr>
<tr><td>26</td><td>121.7</td></tr>
<tr><td>27</td><td>137.1</td></tr>
<tr><td>28</td><td>154.4</td></tr>
<tr><td>29</td><td>173.9</td></tr>
<tr><td>30</td><td>195.9</td></tr>
<tr><td>31</td><td>220.6</td></tr>
<tr><td>32</td><td>248.5</td></tr>
<tr><td>33</td><td>279.9</td></tr>
<tr><td>34</td><td>315.3</td></tr>
<tr><td>35</td><td>355.1</td></tr>
<tr><td>36</td><td>400.0</td></tr>
<tr><td>37</td><td>446.6</td></tr>
<tr><td>38</td><td>501.2</td></tr>
<tr><td>39</td><td rowspan="2">High response</td><td>571.5</td></tr>
<tr><td>40</td><td>642.7</td></tr>
</table>
</td><td>16</td><td>1 to 40</td></tr>
<tr><td>PA10</td><td>INP</td><td>In-position range
Set an in-position range per command pulse.</td><td>1600
[pulse]</td><td>0 to
65535</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PA14</td><td>*POL</td><td>Rotation direction selection/travel direction selection
Select the rotation direction or travel direction of command input pulses of the rotary servo motor, linear servo motor and direct drive motor.
For the setting for the master-slave operation function, refer to section 17.2.
<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Servo motor rotation direction/linear servo motor travel direction</th></tr>
<tr><th>Positioning address increase</th><th>Positioning address decrease</th></tr>
<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>
</table>
The following shows the servo motor rotation directions.


The positive/negative directions of the linear servo motor are as follows.


LM-H3/LM-F series


LM-U2 series


LM-K2 series</td><td>0</td><td>0 to 1</td></tr>
<tr><td>PA15</td><td>*ENR</td><td>Encoder output pulses
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)
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. PC03].
Refer to app. 17 for details.
The maximum output frequency is 4.6 Mpulses/s. Set the parameter within this range.
Depending on the servo motor stop position, the encoder output pulse may turn on and off repeatedly even if the servo motor is stopped.</td><td>4000 [pulse/rev]</td><td>1 to 65535</td></tr>
<tr><td>PA16</td><td>*ENR2</td><td>Encoder output pulses 2
Set a denominator of the electronic gear for the A/B-phase pulse output.
To set a denominator of the electronic gear, select "A-phase/B-phase pulse electronic gear setting (_ _ 3 _)" of "Encoder output pulse setting selection" in [Pr. PC03].
Refer to app. 17 for details.
The maximum output frequency is 4.6 Mpulses/s. Set the parameter within this range.
Depending on the servo motor stop position, the encoder output pulse may turn on and off repeatedly even if the servo motor is stopped.</td><td>1</td><td>1 to 65535</td></tr>
</table>

No.	Symbol	Name and function	Initial value [unit]	Setting range
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	Refer to the "Name and function" column.

Linear servo motor series	Linear servo motor (primary side)	Parameter	
		[Pr. PA17] setting	[Pr. PA18] setting
LM-H3	LM-H3P2A-07P-BSS0	00BBh	2101h
	LM-H3P3A-12P-CSS0		3101h
	LM-H3P3B-24P-CSS0		3201h
	LM-H3P3C-36P-CSS0		3301h
	LM-H3P3D-48P-CSS0		3401h
	LM-H3P7A-24P-ASS0		7101h
	LM-H3P7B-48P-ASS0		7201h
	LM-H3P7C-72P-ASS0		7301h
	LM-H3P7D-96P-ASS0		7401h
LM-U2	LM-U2PAB-05M-0SS0	00B4h	A201h
	LM-U2PAD-10M-0SS0		A401h
	LM-U2PAF-15M-0SS0		A601h
	LM-U2PBB-07M-1SS0		B201h
	LM-U2PBD-15M-1SS0		B401h
	LM-U2PBF-22M-1SS0		2601h
	LM-U2P2B-40M-2SS0		2201h
	LM-U2P2C-60M-2SS0		2301h
	LM-U2P2D-80M-2SS0		2401h
LM-F	LM-FP2B-06M-1SS0 (natural cooling)	00B2h	2201h
	LM-FP2D-12M-1SS0 (natural cooling)		2401h
	LM-FP2F-18M-1SS0 (natural cooling)		2601h
	LM-FP4B-12M-1SS0 (natural cooling)		4201h
	LM-FP4D-24M-1SS0 (natural cooling)		4401h
	LM-FP4F-36M-1SS0 (natural cooling)		4601h
	LM-FP4H-48M-1SS0 (natural cooling)		4801h
	LM-FP5H-60M-1SS0 (natural cooling)		5801h
	LM-FP2B-06M-1SS0 (liquid cooling)		2202h
	LM-FP2D-12M-1SS0 (liquid cooling)		2402h
	LM-FP2F-18M-1SS0 (liquid cooling)		2602h
	LM-FP4B-12M-1SS0 (liquid cooling)		4202h
	LM-FP4D-24M-1SS0 (liquid cooling)		4402h
	LM-FP4F-36M-1SS0 (liquid cooling)		4602h
	LM-FP4H-48M-1SS0 (liquid cooling)		4802h
	LM-FP5H-60M-1SS0 (liquid cooling)		5802h

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PA17</td><td>**MSR</td><td>
<table>
<tr><th>Linear servo motor series</th><th>Linear servo motor (primary side)</th><th colspan="2">Parameter</th></tr>
<tr><td rowspan="7">LM-K2</td><td>LM-K2P1A-01M-2SS1</td><td rowspan="7">00B8h</td><td>1101h</td></tr>
<tr><td>LM-K2P1C-03M-2SS1</td><td>1301h</td></tr>
<tr><td>LM-K2P2A-02M-1SS1</td><td>2101h</td></tr>
<tr><td>LM-K2P2C-07M-1SS1</td><td>2301h</td></tr>
<tr><td>LM-K2P2E-12M-1SS1</td><td>2501h</td></tr>
<tr><td>LM-K2P3C-14M-1SS1</td><td>3301h</td></tr>
<tr><td>LM-K2P3E-24M-1SS1</td><td>3501h</td></tr>
</table>
</td><td>0000h</td><td>Refer to the "Name and function" column.</td></tr>
<tr><td>PA18</td><td>**MTY</td><td>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.</td><td>0000h</td><td>Refer to the "Name and function" column of [Pr. PA17].</td></tr>
<tr><td>PA19</td><td>*BLK</td><td>Parameter writing inhibit
Select a reference range and writing range of the parameter.
Refer to table 5.3 for settings.
Table 5.3 [Pr. PA19] setting value and reading/writing range
<table>
<tr><th>PA19</th><th>Setting operation</th><th>PA</th><th>PB</th><th>PC</th><th>PD</th><th>PE</th><th>PF</th><th>PL</th></tr>
<tr><td rowspan="2">Other than below</td><td>Reading</td><td>○</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Writing</td><td>○</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">000Ah</td><td>Reading</td><td>Only 19</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Writing</td><td>Only 19</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">000Bh</td><td>Reading</td><td>○</td><td>○</td><td>○</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Writing</td><td>○</td><td>○</td><td>○</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">000Ch</td><td>Reading</td><td>○</td><td>○</td><td>○</td><td>○</td><td></td><td></td><td></td></tr>
<tr><td>Writing</td><td>○</td><td>○</td><td>○</td><td>○</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">000Fh</td><td>Reading</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td></td><td>○</td></tr>
<tr><td>Writing</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td></td><td>○</td></tr>
<tr><td rowspan="2">00AAh</td><td>Reading</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td></td></tr>
<tr><td>Writing</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td></td></tr>
<tr><td rowspan="2">00ABh (initial value)</td><td>Reading</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Writing</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td rowspan="2">100Bh</td><td>Reading</td><td>○</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Writing</td><td>Only 19</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">100Ch</td><td>Reading</td><td>○</td><td>○</td><td>○</td><td>○</td><td></td><td></td><td></td></tr>
<tr><td>Writing</td><td>Only 19</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">100Fh</td><td>Reading</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td></td><td>○</td></tr>
<tr><td>Writing</td><td>Only 19</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">10AAh</td><td>Reading</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td></td></tr>
<tr><td>Writing</td><td>Only 19</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">10ABh</td><td>Reading</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Writing</td><td>Only 19</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td><td>00ABh</td><td>Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PA20</td><td>*TDS</td><td>Tough drive setting
Alarms may not be avoided with the tough drive function depending on the situations of the power supply and load fluctuation.
You can assign MTTR (During tough drive) to pins CN3-9, CN3-13 and CN3-15 with [Pr. PD07] to [Pr. PD09].
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Vibration tough drive selection
0: Disabled
1: Enabled

Selecting "1" enables to suppress vibrations by automatically changing setting values of [Pr. PB13 Machine resonance suppression filter 1] and [Pr. PB15 Machine resonance suppression filter 2] in case that the vibration exceed the value of the oscillation level set in [Pr. PF23].
Refer to section 7.3 for details.</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>SEMI-F47 function selection
0: Disabled
1: Enabled

Selecting "1" enables to avoid occurring [AL. 10 Undervoltage] using the electrical energy charged in the capacitor in case that an instantaneous power failure occurs during operation. Set the time of until [AL. 10.1 Voltage drop in the control circuit power] occurs in [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time].</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PA21</td><td>*AOP3</td><td>Function selection A-3
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>One-touch tuning function selection
0: Disabled
1: Enabled

When the digit is "0", the one-touch tuning with MR Configurator2 will be disabled.</td><td>1h</td></tr>
<tr><td>_ _ x _</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PA22</td><td>**PCS</td><td>Position control composition selection
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Super trace control selection
0: Disabled
2: Enabled
This parameter setting is used with servo amplifier with software version B4 or later.</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>Scale measurement function selection
0: Disabled
1: Used in absolute position detection system
2: Used in incremental system

The absolute position detection system cannot be used while an incremental type encoder is used. Enabling absolute position detection system will trigger [AL. 37 Parameter error].
Additionally, the setting is enabled only in the standard control mode. Setting other than "0" in other operation modes triggers [AL. 37 Parameter error].</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PA23</td><td>DRAT</td><td>Drive recorder arbitrary alarm trigger setting
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ x x</td><td>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.</td><td>00h</td></tr>
<tr><td>x x _ _</td><td>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.</td><td>00h</td></tr>
</table>
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".</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PA24</td><td>AOP4</td><td>Function selection A-4
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Vibration suppression function selection
0: Standard mode
1: 3 inertia mode
2: Low response mode
When two low resonance frequencies are generated, select "3 inertia mode (_ _ _ 1)". When the load to motor inertia ratio exceeds the recommended load to motor inertia ratio, select "Low response mode (_ _ _ 2)".
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 with the controller during the 3 inertia mode or low response mode, stop the motor.</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PA25</td><td>OTHOV</td><td>One-touch tuning - Overshoot permissible level
This is used to set a permissible value of overshoot amount with a percentage to in-position range.
However, setting "0" will be 50%.</td><td>0
[%]</td><td>0 to 100</td></tr>
<tr><td>PA26</td><td>*AOP5</td><td>Function selection A-5
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Torque limit function selection at instantaneous power failure (instantaneous power failure tough drive selection)
0: Disabled
1: Enabled
When an instantaneous power failure occurs during operation, you can save electric energy charged in the capacitor in the servo amplifier by limiting torque at acceleration. You can also delay the time until [AL. 10.2 Voltage drop in the main circuit power] occurs with instantaneous power failure tough drive function. Doing this will enable you to set a longer time in [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time].
To enable the torque limit function at instantaneous power failure, select "Enabled (_ 1 _ _)" of "SEMI-F47 function selection" in [Pr. PA20].
This parameter setting is used with servo amplifier with software version A6 or later.</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td></td><td>0h</td></tr>
<tr><td>x _ _ _</td><td></td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

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

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PB01</td><td>FILT</td><td>Adaptive tuning mode (adaptive filter II)
Set the adaptive tuning.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Filter tuning mode selection
Select the adjustment mode of the machine resonance suppression filter 1. Refer to section 7.1.2 for details.
0: Disabled
1: Automatic setting
2: Manual setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td></td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>Tuning accuracy selection
0: Standard
1: High accuracy
The frequency is estimated more accurately in the high accuracy mode compared to the standard mode. However, the tuning sound may be larger in the high accuracy mode.
This digit is available with servo amplifier with software version C5 or later.</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PB02</td><td>VRFT</td><td>Vibration suppression control tuning mode (advanced vibration suppression control II)
This is used to set the vibration suppression control tuning. Refer to section 7.1.5 for details.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Vibration suppression control 1 tuning mode selection
Select the tuning mode of the vibration suppression control 1.
0: Disabled
1: Automatic setting
2: Manual setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Vibration suppression control 2 tuning mode selection
Select the tuning mode of the vibration suppression control 2. To enable the digit, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24 Function selection A-4].
0: Disabled
1: Automatic setting
2: Manual setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td></td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PB03</td><td>TFBGN</td><td>Torque feedback loop gain
This is used to set a torque feedback loop gain in the continuous operation to torque control mode.
Decreasing the setting value will also decrease a collision load during continuous operation to torque control mode.
If the servo motor speed or torque fluctuates when a workpiece comes into contact with a target object, decrease the setting value. Decreasing the setting value will help suppress fluctuation in servo motor speed or torque when a workpiece comes into contact with a target object. However, doing so will decrease trackability to the command torque.
Setting a value less than 6 rad/s will be 6 rad/s.</td><td>18000
[rad/s]</td><td>0 to 18000</td></tr>
<tr><td>PB04</td><td>FFC</td><td>Feed forward gain
Set the feed forward gain.
When the setting is 100%, the droop pulses during operation at constant speed are nearly zero. When the super trace control is enabled, constant speed and uniform acceleration/deceleration droop pulses will be almost 0. 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.</td><td>0
[%]</td><td>0 to 100</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PB06</td><td>GD2</td><td>Load to motor inertia ratio/load to motor mass ratio
This is used to set the load to motor inertia ratio or load to motor mass ratio. Setting a value considerably different from the actual load moment of inertia or load mass may cause an unexpected operation such as an overshoot.
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.
<table>
<tr><th>Pr. PA08</th><th>This parameter</th></tr>
<tr><td>_ _ _ 0 (2 gain adjustment mode 1 (interpolation mode))</td><td rowspan="2">Automatic setting</td></tr>
<tr><td>_ _ _ 1 (Auto tuning mode 1)</td></tr>
<tr><td>_ _ _ 2 (Auto tuning mode 2)</td><td rowspan="3">Manual setting</td></tr>
<tr><td>_ _ _ 3 (Manual mode)</td></tr>
<tr><td>_ _ _ 4 (2 gain adjustment mode 2)</td></tr>
</table>
</td><td>7.00
Multiplier</td><td>0.00 to 300.00</td></tr>
<tr><td>PB07</td><td>PG1</td><td>Model loop gain
Set the response gain up to the target position.
Increasing the setting value will also increase the response level to the position command but will be liable to generate vibration and noise.
For the vibration suppression control tuning mode, the setting range of [Pr. PB07] is limited. Refer to section 7.1.5 (4) for details.
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.
<table>
<tr><th>Pr. PA08</th><th>This parameter</th></tr>
<tr><td>_ _ _ 0 (2 gain adjustment mode 1 (interpolation mode))</td><td>Manual setting</td></tr>
<tr><td>_ _ _ 1 (Auto tuning mode 1)</td><td rowspan="2">Automatic setting</td></tr>
<tr><td>_ _ _ 2 (Auto tuning mode 2)</td></tr>
<tr><td>_ _ _ 3 (Manual mode)</td><td rowspan="2">Manual setting</td></tr>
<tr><td>_ _ _ 4 (2 gain adjustment mode 2)</td></tr>
</table>
</td><td>15.0
[rad/s]</td><td>1.0 to 2000.0</td></tr>
<tr><td>PB08</td><td>PG2</td><td>Position loop gain
This is used to set the gain of the position loop.
Set this parameter to increase the position response to level load disturbance.
Increasing the setting value will also increase the response level to the load disturbance but will be liable to generate vibration and noise.
The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the following table for details.
<table>
<tr><th>Pr. PA08</th><th>This parameter</th></tr>
<tr><td>_ _ _ 0 (2 gain adjustment mode 1 (interpolation mode))</td><td rowspan="3">Automatic setting</td></tr>
<tr><td>_ _ _ 1 (Auto tuning mode 1)</td></tr>
<tr><td>_ _ _ 2 (Auto tuning mode 2)</td></tr>
<tr><td>_ _ _ 3 (Manual mode)</td><td>Manual setting</td></tr>
<tr><td>_ _ _ 4 (2 gain adjustment mode 2)</td><td>Automatic setting</td></tr>
</table>
</td><td>37.0
[rad/s]</td><td>1.0 to 2000.0</td></tr>
<tr><td>PB09</td><td>VG2</td><td>Speed loop gain
This is used to 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 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.
When the continuous operation to torque control mode is used, if the value set in this parameter is smaller than the initial value, command torque tracking may not be successful.</td><td>823
[rad/s]</td><td>20 to 65535</td></tr>
<tr><td>PB10</td><td>VIC</td><td>Speed integral compensation
This is used to 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 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.</td><td>33.7
[ms]</td><td>0.1 to 1000.0</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PB11</td><td>VDC</td><td>Speed differential compensation
This is used to set the differential compensation.
To enable the parameter, select "Continuous PID control enabled (_ _ 3 _)" of "PI-PID switching control selection" in [Pr. PB24].</td><td>980</td><td>0 to 1000</td></tr>
<tr><td>PB12</td><td>OVA</td><td>Overshoot amount compensation
Set a dynamic friction torque in percentage to the rated torque at servo motor rated speed. Alternatively, set a dynamic friction force in percentage to the continuous thrust at linear servo motor rated speed.
When the response level is low or when the torque/thrust is limited, the efficiency of the parameter may be lower.</td><td>0
[%]</td><td>0 to 100</td></tr>
<tr><td>PB13</td><td>NH1</td><td>Machine resonance suppression filter 1
Set the notch frequency of the machine resonance suppression filter 1.
When "Filter tuning mode selection" is set to "Automatic setting (_ _ _ 1)" in [Pr. PB01], this parameter will be adjusted automatically by adaptive tuning.
When "Filter tuning mode selection" is set to "Manual setting (_ _ _ 2)" in [Pr. PB01],the setting value will be enabled.</td><td>4500
[Hz]</td><td>10
to
4500</td></tr>
<tr><td>PB14</td><td>NHQ1</td><td>Notch shape selection 1
Set the shape of the machine resonance suppression filter 1.
When "Filter tuning mode selection" is set to "Automatic setting (_ _ _ 1)" in [Pr. PB01], this parameter will be adjusted automatically by adaptive tuning.
To enable the setting value, select the manual setting.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Notch depth selection
0: -40 dB
1: -14 dB
2: -8 dB
3: -4 dB</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>Notch width selection
0: α = 2
1: α = 3
2: α = 4
3: α = 5</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PB15</td><td>NH2</td><td>Machine resonance suppression filter 2
Set the notch frequency of the machine resonance suppression filter 2.
To enable the setting value, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 2 selection" in [Pr. PB16].</td><td>4500
[Hz]</td><td>10
to
4500</td></tr>
<tr><td>PB16</td><td>NHQ2</td><td>Notch shape selection 2
Set the shape of the machine resonance suppression filter 2.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Machine resonance suppression filter 2 selection
0: Disabled
1: Enabled</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Notch depth selection
0: -40 dB
1: -14 dB
2: -8 dB
3: -4 dB</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>Notch width selection
0: α = 2
1: α = 3
2: α = 4
3: α = 5</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PB17</td><td>NHF</td><td>
Shaft resonance suppression filter
This is used for setting the shaft resonance suppression filter.
This is used to suppress a low-frequency machine vibration.
When you select "Automatic setting (_ _ _ 0)" of "Shaft resonance suppression filter selection" in [Pr. PB23], the value will be calculated automatically from the servo motor you use and load to motor inertia ratio. It will not automatically calculated for the linear servo motor. When "Manual setting (_ _ _ 1)" is selected, the setting written to the parameter is used.
When "Shaft resonance suppression filter selection" is "Disabled (_ _ _ 2)" in [Pr. PB23], the setting value of this parameter will be disabled.
When you select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 4 selection" in [Pr. PB49], the shaft resonance suppression filter is not available.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ x x</td><td>Shaft resonance suppression filter setting frequency selection
This is used for setting the shaft resonance suppression filter.
Refer to table 5.4 for settings.
Set the value closest to the frequency you need.</td><td>00h</td></tr>
<tr><td>_ x _ _</td><td>Notch depth selection
0: -40 dB
1: -14 dB
2: -8 dB
3: -4 dB</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
</table>
Table 5.4 Shaft resonance suppression filter setting frequency selection
<table>
<tr><th>Setting value</th><th>Frequency [Hz]</th><th>Setting value</th><th>Frequency [Hz]</th></tr>
<tr><td>_ _ 0 0</td><td>Disabled</td><td>_ _ 1 0</td><td>562</td></tr>
<tr><td>_ _ 0 1</td><td>Disabled</td><td>_ _ 1 1</td><td>529</td></tr>
<tr><td>_ _ 0 2</td><td>4500</td><td>_ _ 1 2</td><td>500</td></tr>
<tr><td>_ _ 0 3</td><td>3000</td><td>_ _ 1 3</td><td>473</td></tr>
<tr><td>_ _ 0 4</td><td>2250</td><td>_ _ 1 4</td><td>450</td></tr>
<tr><td>_ _ 0 5</td><td>1800</td><td>_ _ 1 5</td><td>428</td></tr>
<tr><td>_ _ 0 6</td><td>1500</td><td>_ _ 1 6</td><td>409</td></tr>
<tr><td>_ _ 0 7</td><td>1285</td><td>_ _ 1 7</td><td>391</td></tr>
<tr><td>_ _ 0 8</td><td>1125</td><td>_ _ 1 8</td><td>375</td></tr>
<tr><td>_ _ 0 9</td><td>1000</td><td>_ _ 1 9</td><td>360</td></tr>
<tr><td>_ _ 0 A</td><td>900</td><td>_ _ 1 A</td><td>346</td></tr>
<tr><td>_ _ 0 B</td><td>818</td><td>_ _ 1 B</td><td>333</td></tr>
<tr><td>_ _ 0 C</td><td>750</td><td>_ _ 1 C</td><td>321</td></tr>
<tr><td>_ _ 0 D</td><td>692</td><td>_ _ 1 D</td><td>310</td></tr>
<tr><td>_ _ 0 E</td><td>642</td><td>_ _ 1 E</td><td>300</td></tr>
<tr><td>_ _ 0 F</td><td>600</td><td>_ _ 1 F</td><td>290</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PB18</td><td>LPF</td><td>
Low-pass filter setting
Set the low-pass filter.
The following shows a relation of a required parameter to this parameter.
<table>
<tr><th>[Pr. PB23]</th><th>[Pr. PB18]</th></tr>
<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>
</table>
</td><td>3141
[rad/s]</td><td>100 to
18000</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PB19</td><td>VRF11</td><td>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 set to "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ _ 2)" is selected, the setting written to the parameter is used. The setting range of this parameter varies, depending on the value in [Pr. PB07]. If a value out of the range is set, the vibration suppression control will be disabled. Refer to section 7.1.5 for details.</td><td>100.0
[Hz]</td><td>0.1
to
300.0</td></tr>
<tr><td>PB20</td><td>VRF12</td><td>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 set to "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ _ 2)" is selected, the setting written to the parameter is used. The setting range of this parameter varies, depending on the value in [Pr. PB07]. If a value out of the range is set, the vibration suppression control will be disabled. Refer to section 7.1.5 for details.</td><td>100.0
[Hz]</td><td>0.1
to
300.0</td></tr>
<tr><td>PB21</td><td>VRF13</td><td>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 set to "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ _ 2)" is selected, the setting written to the parameter is used. Refer to section 7.1.5 for details.</td><td>0.00</td><td>0.00
to
0.30</td></tr>
<tr><td>PB22</td><td>VRF14</td><td>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 set to "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ _ 2)" is selected, the setting written to the parameter is used. Refer to section 7.1.5 for details.</td><td>0.00</td><td>0.00
to
0.30</td></tr>
<tr><td>PB23</td><td>VFBF</td><td>Low-pass filter selection
Select the shaft resonance suppression filter and low-pass filter.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Shaft resonance suppression filter selection
0: Automatic setting
1: Manual setting
2: Disabled
When you select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 4 selection" in [Pr. PB49], the shaft resonance suppression filter is not available.</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Low-pass filter selection
0: Automatic setting
1: Manual setting
2: Disabled</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PB24</td><td>*MVS</td><td>Slight vibration suppression control
Select the slight vibration suppression control and PI-PID switching control.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Slight vibration suppression control selection
0: Disabled
1: Enabled
To enable the slight vibration suppression control, select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08]. Slight vibration suppression control cannot be used in the speed control mode.</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>PI-PID switching control selection
0: PI control enabled
(The control can be switched to PID control (proportional control) with the servo system controller command.)
3: Continuous PID control (proportional control) enabled
If the servo motor at a stop is rotated even for a 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), enabling PID control and completing positioning simultaneously will suppress the unnecessary torque generated to compensate for a position shift.</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PB25</td><td>*BOP1</td><td>Function selection B-1
Select enabled/disabled of model adaptive control.
This parameter is supported with software version B4 or later.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Model adaptive control selection
0: Enabled (model adaptive control)
2: Disabled (PID control)</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PB26</td><td>*CDP</td><td>Gain switching function
Select the gain switching condition.
Set conditions to enable the gain switching values set in [Pr. PB29] to [Pr. PB36] and [Pr. PB56] to [Pr. PB60].
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Gain switching selection
0: Disabled
1: Control command from controller is enabled
2: Command frequency
3: Droop pulses
4: Servo motor speed/linear servo motor speed</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>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</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>Gain switching time constant disabling condition selection
0: Switching time constant enabled
1: Switching time constant disabled
2: Return time constant disabled
Refer to section 7.2.4 for details.
This parameter is used by servo amplifier with software version B4 or later.</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PB27</td><td>CDL</td><td>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.</td><td>10
[kpulse/s]
/[pulse]
/[r/min]</td><td>0 to 65535</td></tr>
<tr><td>PB28</td><td>CDT</td><td>Gain switching time constant
This is used to set the time constant until the gains switch in response to the conditions set in [Pr. PB26] and [Pr. PB27].</td><td>1
[ms]</td><td>0 to 100</td></tr>
<tr><td>PB29</td><td>GD2B</td><td>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 for when gain switching is enabled.
This parameter is enabled only when you select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08].</td><td>7.00
[Multiplier]</td><td>0.00 to 300.00</td></tr>
</table>

No.	Symbol	Name and function	Initial value [unit]	Setting range
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 you select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08].	0.0 [rad/s]	0.0 to 2000.0
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 you select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08].	0 [rad/s]	0 to 65535
PB32	VICB	Speed integral compensation after gain switching Set the speed integral compensation when the gain changing is enabled. When you set a value less than 0.1 ms, the value will be the same as [Pr. PB10]. This parameter is enabled only when you select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08].	0.0 [ms]	0.0 to 5000.0
PB33	VRF11B	Vibration suppression control 1 - Vibration frequency after gain switching Set the vibration frequency of the vibration suppression control 1 for 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 is enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ _ 2)". ・"Gain switching selection" in [Pr. PB26] is "Control command from controller is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.	0.0 [Hz]	0.0 to 300.0
PB34	VRF12B	Vibration suppression control 1 - Resonance frequency after gain switching Set the resonance frequency for vibration suppression control 1 when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PB20]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ _ 2)". ・"Gain switching selection" in [Pr. PB26] is "Control command from controller is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.	0.0 [Hz]	0.0 to 300.0
PB35	VRF13B	Vibration suppression control 1 - Vibration frequency damping after gain switching Set a damping of the vibration frequency for vibration suppression control 1 when the gain switching is enabled. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ _ 2)". ・"Gain switching selection" in [Pr. PB26] is "Control command from controller is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.	0.00	0.00 to 0.30
PB36	VRF14B	Vibration suppression control 1 - Resonance frequency damping after gain switching Set a damping of the resonance frequency for vibration suppression control 1 when the gain switching is enabled. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ _ 2)". ・"Gain switching selection" in [Pr. PB26] is "Control command from controller is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.	0.00	0.00 to 0.30

No.	Symbol	Name and function	Initial value [unit]	Setting range
PB45	CNHF	Command notch filter Set the command notch filter.	Refer to the "Name and function" column.	

Setting digit	Explanation	Initial value
_ _ x x	Command notch filter setting frequency selection Refer to table 5.5 for the relation of setting values to frequency.	00h
_ x _ _	Notch depth selection Refer to table 5.6 for details.	0h
x _ _ _	For manufacturer setting	0h

Table 5.5 Command notch filter setting frequency selection

Setting value	Frequency [Hz]
_ _ 0 0	Disabled
_ _ 0 1	2250
_ _ 0 2	1125
_ _ 0 3	750
_ _ 0 4	562
_ _ 0 5	450
_ _ 0 6	375
_ _ 0 7	321
_ _ 0 8	281
_ _ 0 9	250
_ _ 0 A	225
_ _ 0 B	204
_ _ 0 C	187
_ _ 0 D	173
_ _ 0 E	160
_ _ 0 F	150
_ _ 1 0	140
_ _ 1 1	132
_ _ 1 2	125
_ _ 1 3	118
_ _ 1 4	112
_ _ 1 5	107
_ _ 1 6	102
_ _ 1 7	97
_ _ 1 8	93
_ _ 1 9	90
_ _ 1 A	86
_ _ 1 B	83
_ _ 1 C	80
_ _ 1 D	77
_ _ 1 E	75
_ _ 1 F	72
_ _ 2 0	70
_ _ 2 1	66
_ _ 2 2	62
_ _ 2 3	59
_ _ 2 4	56
_ _ 2 5	53
_ _ 2 6	51
_ _ 2 7	48
_ _ 2 8	46
_ _ 2 9	45
_ _ 2 A	43
_ _ 2 B	41
_ _ 2 C	40
_ _ 2 D	38
_ _ 2 E	37
_ _ 2 F	36
_ _ 3 0	35.2
_ _ 3 1	33.1
_ _ 3 2	31.3
_ _ 3 3	29.6
_ _ 3 4	28.1
_ _ 3 5	26.8
_ _ 3 6	25.6
_ _ 3 7	24.5
_ _ 3 8	23.4
_ _ 3 9	22.5
_ _ 3 A	21.6
_ _ 3 B	20.8
_ _ 3 C	20.1
_ _ 3 D	19.4
_ _ 3 E	18.8
_ _ 3 F	18.2
_ _ 4 0	17.6
_ _ 4 1	16.5
_ _ 4 2	15.6
_ _ 4 3	14.8
_ _ 4 4	14.1
_ _ 4 5	13.4
_ _ 4 6	12.8
_ _ 4 7	12.2
_ _ 4 8	11.7
_ _ 4 9	11.3
_ _ 4 A	10.8
_ _ 4 B	10.4
_ _ 4 C	10
_ _ 4 D	9.7
_ _ 4 E	9.4
_ _ 4 F	9.1
_ _ 5 0	8.8
_ _ 5 1	8.3
_ _ 5 2	7.8
_ _ 5 3	7.4
_ _ 5 4	7.0
_ _ 5 5	6.7
_ _ 5 6	6.4
_ _ 5 7	6.1
_ _ 5 8	5.9
_ _ 5 9	5.6
_ _ 5 A	5.4
_ _ 5 B	5.2
_ _ 5 C	5.0
_ _ 5 D	4.9
_ _ 5 E	4.7
_ _ 5 F	4.5

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PB45</td><td>CNHF</td><td>Table 5.6 Notch depth selection
<table><tr><th>Setting value</th><th>Depth [dB]</th><th>Setting value</th><th>Depth [dB]</th></tr><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></table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PB46</td><td>NH3</td><td>Machine resonance suppression filter 3
Set the notch frequency of the machine resonance suppression filter 3.
To enable the setting value, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 3 selection" in [Pr. PB47].</td><td>4500
[Hz]</td><td>10 to
4500</td></tr>
<tr><td>PB47</td><td>NHQ3</td><td>Notch shape selection 3
Set the shape of the machine resonance suppression filter 3.
<table><tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr><tr><td>_ _ _ x</td><td>Machine resonance suppression filter 3 selection
0: Disabled
1: Enabled</td><td>0h</td></tr><tr><td>_ _ x _</td><td>Notch depth selection
0: -40 dB
1: -14 dB
2: -8 dB
3: -4 dB</td><td>0h</td></tr><tr><td>_ x _ _</td><td>Notch width selection
0: α = 2
1: α = 3
2: α = 4
3: α = 5</td><td>0h</td></tr><tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr></table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PB48</td><td>NH4</td><td>Machine resonance suppression filter 4
Set the notch frequency of the machine resonance suppression filter 4.
To enable the setting value, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 4 selection" in [Pr. PB49].</td><td>4500
[Hz]</td><td>10 to
4500</td></tr>
</table>

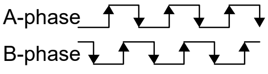
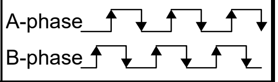
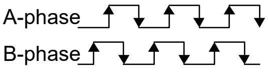
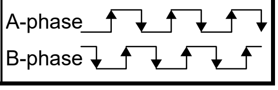
<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PB49</td><td>NHQ4</td><td>Notch shape selection 4
Set the shape of the machine resonance suppression filter 4.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Machine resonance suppression filter 4 selection
0: Disabled
1: Enabled
When you select "Enabled" of this digit, [Pr. PB17 Shaft resonance suppression filter] is not available.</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Notch depth selection
0: -40 dB
1: -14 dB
2: -8 dB
3: -4 dB</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>Notch width selection
0: α = 2
1: α = 3
2: α = 4
3: α = 5</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PB50</td><td>NH5</td><td>Machine resonance suppression filter 5
Set the notch frequency of the machine resonance suppression filter 5.
To enable the setting value, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 5 selection" in [Pr. PB51].</td><td>4500
[Hz]</td><td>10 to 4500</td></tr>
<tr><td>PB51</td><td>NHQ5</td><td>Notch shape selection 5
Set the shape of the machine resonance suppression filter 5.
When you select "Enabled (_ _ _ 1)" of "Robust filter selection" in [Pr. PE41], the machine resonance suppression filter 5 is not available.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Machine resonance suppression filter 5 selection
0: Disabled
1: Enabled</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Notch depth selection
0: -40 dB
1: -14 dB
2: -8 dB
3: -4 dB</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>Notch width selection
0: α = 2
1: α = 3
2: α = 4
3: α = 5</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PB52</td><td>VRF21</td><td>Vibration suppression control 2 - Vibration frequency
Set the vibration frequency for vibration suppression control 2 to suppress low-frequency machine vibration.
To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24].
When "Vibration suppression control 2 tuning mode selection" is set to "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ 2 _)" is selected, the setting written to the parameter is used.
The setting range of this parameter varies, depending on the value in [Pr. PB07]. If a value out of the range is set, the vibration suppression control will be disabled. Refer to section 7.1.5 for details.</td><td>100.0
[Hz]</td><td>0.1 to 300.0</td></tr>
</table>

No.	Symbol	Name and function	Initial value [unit]	Setting range
PB53	VRF22	Vibration suppression control 2 - Resonance frequency Set the resonance frequency for vibration suppression control 2 to suppress low-frequency machine vibration. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. When "Vibration suppression control 2 tuning mode selection" is set to "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ 2 _)" is selected, the setting written to the parameter is used. The setting range of this parameter varies, depending on the value in [Pr. PB07]. If a value out of the range is set, the vibration suppression control will be disabled. Refer to section 7.1.5 for details.	100.0 [Hz]	0.1 to 300.0
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. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. When "Vibration suppression control 2 tuning mode selection" is set to "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ 2 _)" is selected, the setting written to the parameter is used. Refer to section 7.1.5 for details.	0.00	0.00 to 0.30
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. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. When "Vibration suppression control 2 tuning mode selection" is set to "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ 2 _)" is selected, the setting written to the parameter is used. Refer to section 7.1.5 for details.	0.00	0.00 to 0.30
PB56	VRF21B	Vibration suppression control 2 - Vibration frequency after gain switching Set the vibration frequency for vibration suppression control 2 when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PB52]. To enable this, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 2 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Control command from controller is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.	0.0 [Hz]	0.0 to 300.0
PB57	VRF22B	Vibration suppression control 2 - Resonance frequency after gain switching Set the resonance frequency for vibration suppression control 2 when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PB53]. To enable this, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 2 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Control command from controller is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.	0.0 [Hz]	0.0 to 300.0

No.	Symbol	Name and function	Initial value [unit]	Setting range
PB58	VRF23B	Vibration suppression control 2 - Vibration frequency damping after gain switching Set a damping of the vibration frequency for vibration suppression control 2 when the gain switching is enabled. To enable this, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 2 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Control command from controller is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.	0.00	0.00 to 0.30
PB59	VRF24B	Vibration suppression control 2 - Resonance frequency damping after gain switching Set a damping of the resonance frequency for vibration suppression control 2 when the gain switching is enabled. To enable this, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 2 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Control command from controller is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.	0.00	0.00 to 0.30
PB60	PG1B	Model loop gain after gain switching Set the model loop gain when the gain switching is enabled. When you set a value less than 1.0 rad/s, the value will be the same as [Pr. PB07]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Gain switching selection" in [Pr. PB26] is "Control command from controller is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.	0.0 [rad/s]	0.0 to 2000.0

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

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PC01</td><td>ERZ</td><td>Error excessive alarm level
Set an error excessive alarm level.
Set this per rev. for rotary servo motors and direct drive motors. Setting "0" will be 3 rev. Setting over 200 rev will be clamped with 200 rev.
Set this per mm for linear servo motors. Setting "0" will be 100 mm.
Refer to app. 6 for the adjustment method.

Note. Setting can be changed in [Pr. PC06].</td><td>0
[rev]/
[mm]
(Note)</td><td>0 to 1000</td></tr>
<tr><td>PC02</td><td>MBR</td><td>Electromagnetic brake sequence output
This is used to set the delay time between MBR (Electromagnetic brake interlock) and the base drive circuit is shut-off. For the timing chart of when the servo motor with an electromagnetic brake is used, refer to section 3.10.2.</td><td>0
[ms]</td><td>0 to 1000</td></tr>
<tr><td>PC03</td><td>*ENRS</td><td>Encoder output pulse selection
This is used to select the encoder pulse direction and encoder output pulse setting.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Encoder output pulse phase selection
0: Increasing A-phase 90° in CCW or positive direction
1: Increasing A-phase 90° in CW or negative direction
<table>
<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>
<tr><td>0</td><td> </td><td> </td></tr>
<tr><td>1</td><td> </td><td> </td></tr>
</table>
</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Encoder output pulse setting selection
Refer to app. 17 for details.
0: Output pulse setting
1: Division ratio setting
3: A-phase/B-phase pulse electronic gear setting
4: A/B-phase pulse through output setting
Depending on the servo motor stop position, the encoder output pulse may turn on and off repeatedly even if the servo motor is stopped.</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>Selection of the encoders for encoder output pulse
This is used for selecting an encoder for servo amplifier output.
0: Servo motor encoder
1: Load-side encoder
When "_ 1 0 _" is set to this parameter, [AL. 37 Parameter error] will occur.
Selecting "1" in other than fully closed loop system or standard control system (scale measurement function: enabled) triggers [AL. 37 Parameter error].
Depending on the servo motor stop position, the encoder output pulse may turn on and off repeatedly even if the servo motor is stopped.</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PC04</td><td>**COP1</td><td>Function selection C-1
Select the encoder cable communication method.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>Encoder cable communication method selection
0: Two-wire type
1: Four-wire type
When using an encoder of A/B/Z-phase differential output method, set "0".
Incorrect setting will result in [AL. 16 Encoder initial communication error 1] or [AL. 20 Encoder normal communication error 1]. Setting "1" will trigger [AL. 37] while "Fully closed loop control mode (_ _ 1 _)" is selected in [Pr. PA01] (except MR-J4-_B_-RJ).
If the settings of the servo amplifier are unchanged from the factory settings and communication with the controller is performed for the first time, this digit will be automatically set according to the communication method of the connected encoder cable.</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PC05</td><td>**COP2</td><td>Function selection C-2
Set the motor-less operation and [AL. 9B Error excessive warning]. The motor-less operation cannot be used in the fully closed loop control mode, linear servo motor control mode, or DD motor control mode.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Motor-less operation selection
0: Disabled
1: Enabled</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td rowspan="2">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>[AL. 9B Error excessive warning] selection
0: [AL. 9B Error excessive warning] disabled
1: [AL. 9B Error excessive warning] enabled
The setting of this digit is used by servo amplifier with software version B4 or later.</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PC06</td><td>*COP3</td><td>Function selection C-3
Select units for error excessive alarm level setting with [Pr. PC01] and for error excessive warning level setting with [Pr. PC38]. The parameter is not available in the speed control mode and torque control mode.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>Error excessive alarm/error excessive warning level unit selection
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</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PC07</td><td>ZSP</td><td>Zero speed
Used to set the output range of ZSP (Zero speed detection).
ZSP (Zero speed detection) has hysteresis of 20 r/min or 20 mm/s.</td><td>50 [r/min]/ [mm/s]</td><td>0 to 10000</td></tr>
</table>

No.	Symbol	Name and function	Initial value [unit]	Setting range
PC08	OSL	Overspeed alarm detection level This is used to set an overspeed alarm detection level. When you set a value more than "servo motor maximum speed × 120%" or "linear servo motor maximum speed × 120%", the set value will be clamped. When you set "0", the value of "(linear) servo motor maximum speed × 120%" will be set.	0 [r/min]/ [mm/s]	0 to 20000
PC09	MOD1	Analog monitor 1 output Select a signal to output to MO1 (Analog monitor 1). Refer to app. 11.3 for detection point of output selection.	Refer to the "Name and function" column.	

Setting digit	Explanation	Initial value
_ _ x x	Analog monitor 1 output selection Refer to table 5.7 for settings.	00h
_ x _ _	For manufacturer setting	0h
x _ _ _		0h

Table 5.7 Analog monitor setting value

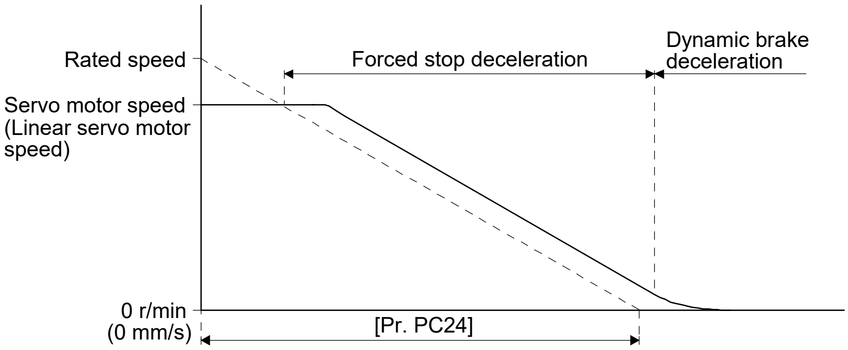
Setting value	Item	Operation mode (Note 1)			
		Standard	Full.	Lin.	D.D.
_ _ 0 0	(Linear) servo motor speed (±8 V/max. speed)	○	○	○	○
_ _ 0 1	Torque or thrust (±8 V/max. torque or max. thrust)	○	○	○	○
_ _ 0 2	(Linear) servo motor speed (+8 V/max. speed)	○	○	○	○
_ _ 0 3	Torque or thrust (+8 V/max. torque or max. thrust)	○	○	○	○
_ _ 0 4	Current command (±8 V/max. current command)	○	○	○	○
_ _ 0 5	Speed command (±8 V/max. speed)	○	○	○	○
_ _ 0 6	Servo motor-side droop pulses (±10 V/100 pulses) (Note 2)	○	○	○	○
_ _ 0 7	Servo motor-side droop pulses (±10 V/1000 pulses) (Note 2)	○	○	○	○
_ _ 0 8	Servo motor-side droop pulses (±10 V/10000 pulses) (Note 2)	○	○	○	○
_ _ 0 9	Servo motor-side droop pulses (±10 V/100000 pulses) (Note 2)	○	○	○	○
_ _ 0 A	Feedback position (±10 V/1 Mpulse) (Note 2)	○	╲	╲	╲
_ _ 0 B	Feedback position (±10 V/10 Mpulses) (Note 2)	○	╲	╲	╲
_ _ 0 C	Feedback position (±10 V/100 Mpulses) (Note 2)	○	╲	╲	╲
_ _ 0 D	Bus voltage (200 V class and 100 V class: +8 V/400 V, 400 V class: +8 V/800 V)	○	○	○	○
_ _ 0 E	Speed command 2 (±8 V/max. speed)	○	○	○	○
_ _ 1 0	Load-side droop pulses (±10 V/100 pulses) (Note 2)	╲	○	╲	╲
_ _ 1 1	Load-side droop pulses (±10 V/1000 pulses) (Note 2)	╲	○	╲	╲
_ _ 1 2	Load-side droop pulses (±10 V/10000 pulses) (Note 2)	╲	○	╲	╲
_ _ 1 3	Load-side droop pulses (±10 V/100000 pulses) (Note 2)	╲	○	╲	╲
_ _ 1 4	Load-side droop pulses (±10 V/1 Mpulse) (Note 2)	╲	○	╲	╲
_ _ 1 5	Servo motor-side/load-side position deviation (±10 V/100000 pulses)	╲	○	╲	╲
_ _ 1 6	Servo motor-side/load-side speed deviation (±8 V/max. speed)	╲	○	╲	╲
_ _ 1 7	Internal temperature of encoder (±10 V/±128 ˚C)	○	○	╲	○

Note 1. Items with ○ are available for each operation mode.
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
D.D.: Direct drive motor use
2. Encoder pulse unit

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PC10</td><td>MOD2</td><td>Analog monitor 2 output
Select a signal to output to MO2 (Analog monitor 2). Refer to app. 11.3 for detection point of output selection.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ x x</td><td>Analog monitor 2 output selection
Refer to [Pr. PC09] for settings.</td><td>01h</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PC11</td><td>MO1</td><td>Analog monitor 1 offset
This is used to set the offset voltage of MO1 (Analog monitor 1).</td><td>0
[mV]</td><td>-999 to 999</td></tr>
<tr><td>PC12</td><td>MO2</td><td>Analog monitor 2 offset
This is used to set the offset voltage of MO2 (Analog monitor 2).</td><td>0
[mV]</td><td>-999 to 999</td></tr>
<tr><td>PC13</td><td>MOSDL</td><td>Analog monitor - Feedback position output standard data - Low
Set a monitor output standard position (lower 4 digits) for the feedback position for when selecting "Feedback position" for MO1 (Analog monitor 1) and MO2 (Analog monitor 2).
Monitor output standard position = [Pr. PC14] setting × 10000 + [Pr. PC13] setting</td><td>0
[pulse]</td><td>-9999 to 9999</td></tr>
<tr><td>PC14</td><td>MOSDH</td><td>Analog monitor - Feedback position output standard data - High
Set a monitor output standard position (higher 4 digits) for the feedback position for when selecting "Feedback position" for MO1 (Analog monitor 1) and MO2 (Analog monitor 2).
Monitor output standard position = [Pr. PC14] setting × 10000 + [Pr. PC13] setting</td><td>0
[10000 pulses]</td><td>-9999 to 9999</td></tr>
<tr><td>PC17</td><td>**COP4</td><td>Function selection C-4
This is used to select a home position setting condition.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Selection of home position setting condition
When using an incremental type linear encoder, set "0". Setting "1" triggers [AL. 37 Parameter error].
0: Need to pass servo motor Z-phase after power on
1: Not need to pass servo motor Z-phase after power on</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Linear encoder multipoint Z-phase input function selection
When two or more reference marks exist in the fully stroke, set "1".
0: Disabled
1: Enabled
This parameter is used by servo amplifier with software version A5 or later.</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PC18</td><td>*COP5</td><td>Function selection C-5
This is used to select an occurring condition of [AL. E9 Main circuit off warning].
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>[AL. E9 Main circuit off warning] selection
0: Detection with ready-on and servo-on command
1: Detection with servo-on command</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PC20</td><td>*COP7</td><td>Function selection C-7
This is used to select an undervoltage alarm detection method.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>[AL. 10 Undervoltage] detection method selection
If [AL. 10 Undervoltage] occurs due to power supply voltage distortion while FR-RC-(H), FR-CV-(H), or FR-XC-(H) is being used, use this setting.
0: When [AL. 10] does not occur
1: When [AL. 10] occurs
When using the MR-J4-_B-RJ servo amplifier with the DC power supply input, set "1".</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>Undervoltage alarm selection
Select the alarm and warning for when the bus voltage drops to the undervoltage alarm level.
0: [AL. 10] regardless of servo motor speed
1: [AL. E9] at servo motor speed 50 r/min (50 mm/s) or less, [AL. 10] at over 50 r/min (50 mm/s)</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PC21</td><td>*BPS</td><td>Alarm history clear
Used to clear the alarm history.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Alarm history clear selection
0: Disabled
1: Enabled
When "Enabled" is set, the alarm history will be cleared at the next power-on. Once the alarm history is cleared, the setting becomes disabled automatically.</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PC24</td><td>RSBR</td><td>Forced stop deceleration time constant
This is used to 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. Setting "0" will be 100 ms.

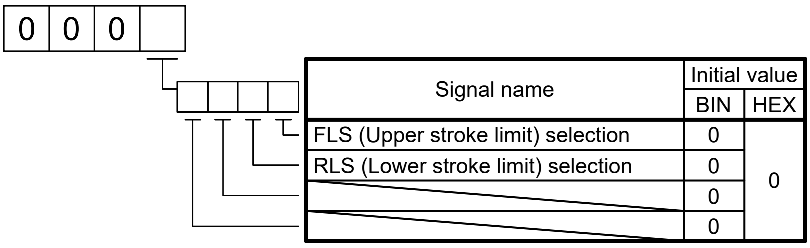


[Precautions]
・If the servo motor torque or linear servo motor thrust is saturated at the maximum torque during forced stop deceleration because the set time is too short, the time to stop will be longer than the set time constant.
・[AL. 50 Overload alarm 1] or [AL. 51 Overload alarm 2] may occur during forced stop deceleration, depending on the set value.
・After an alarm that leads to a forced stop deceleration, if an alarm that does not lead to a forced stop deceleration occurs or if the control circuit power supply is cut, dynamic braking will start regardless of the deceleration time constant setting.
・Set a longer time than deceleration time at quick stop of the controller. If a shorter time is set, [AL. 52 Error excessive] may occur.</td><td>100
[ms]</td><td>0 to
20000</td></tr>
<tr><td>PC26</td><td>**COP8</td><td>Function selection C-8
Used to select the communication method of the encoder cable to be connected to the CN2L connector of MR-J4-_B_-RJ.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td></td><td>0h</td></tr>
<tr><td>_ x _ _</td><td></td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>Load-side encoder communication method
0: Two-wire type
1: Four-wire type
When using a load-side encoder of A/B/Z-phase differential output method, set "0".
Setting "1" by using a servo amplifier other than MR-J4-_B_-RJ will trigger [AL. 37].</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PC27</td><td>**COP9</td><td>Function selection C-9
This is used to select a polarity of the linear encoder or load-side encoder.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Encoder pulse count polarity selection
0: Encoder pulse increasing direction in the servo motor CCW or positive direction
1: Encoder pulse decreasing direction in the servo motor CCW or positive direction</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>Selection of A/B/Z-phase input interface encoder Z-phase connection judgment function
This is used to select a non-signal detection of A/B/Z-phase input interface encoder pulse train signal used as linear encoder or load-side encoder.
This digit is enabled only when you use an A/B/Z-phase input interface encoder.
<table>
<tr><th rowspan="2">Setting value</th><th>Detection of disconnection</th><th colspan="3">Alarm status</th></tr>
<tr><th>Z-phase-side non-signal</th><th>Standard (scale measurement enabled)</th><th>Fully closed loop system</th><th>Linear servo system</th></tr>
<tr><td>0</td><td>Enabled</td><td>[AL. 71.6]
(Z-phase)</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><td></td></tr>
</table></td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PC29</td><td>*COPB</td><td>Function selection C-B
This is used to select the POL reflection at torque control.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>POL reflection selection at torque control
0: Enabled
1: Disabled</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PC31</td><td>RSUP1</td><td>Vertical axis freefall prevention compensation amount
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 a positive value is set, compensation is performed to the address increasing direction.
When a negative value is set, compensation is performed to the address decreasing direction.
The vertical axis freefall prevention function is performed when all of the following conditions are met.
1) Position control mode
2) The value of the parameter is other than "0".
3) "Forced stop deceleration function selection" of [Pr. PA04] is set to "Forced stop deceleration function enabled (2 _ _ _)".
4) EM2 (forced stop 2) is off, an alarm occurred, or SSCNET III/H communication shut off when the servo motor speed is the zero speed or less.
5) MBR (Electromagnetic brake interlock) was enabled in [Pr. PD07] to [Pr. PD09], and the base circuit shut-off delay time was set in [Pr. PC02].</td><td>0
[0.0001 rev]/
[0.01 mm]</td><td>-25000 to 25000</td></tr>
</table>

No.	Symbol	Name and function	Initial value [unit]	Setting range
PC38	ERW	Error excessive warning level Set an error excessive warning level. To enable the parameter, select "Enabled (1 _ _ _)" of "[AL. 9B Error excessive warning] selection" in [Pr. PC05]. You can change the setting unit with "Error excessive alarm/error excessive warning level unit selection" in [Pr. PC06]. Set this per rev. for rotary servo motors and direct drive motors. Setting "0" will be "1 rev", and setting over 200 rev will be clamped with 200 rev. Set this per mm for linear servo motors. Setting "0" will be 50 mm. When an error reaches the set value, [AL. 9B Error excessive warning] will occur. When the error decreases lower than the set value, the warning will be canceled automatically. The minimum pulse width of the warning signal is 100 [ms]. Set as follows.: [Pr. PC38 Error excessive warning level] < [Pr. PC01 Error excessive alarm level] When you set as follows, [AL. 52 Error excessive] will occur earlier than the warning.: [Pr. PC38 Error excessive warning level] ≥ [Pr. PC01 Error excessive alarm level] This parameter is used by servo amplifier with software version B4 or later.	0 [rev]/ [mm]	0 to 1000

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

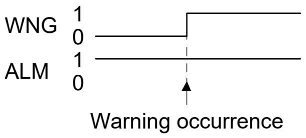
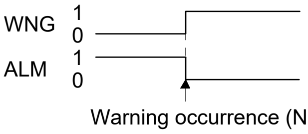
<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PD02</td><td>*DIA2</td><td>Input signal automatic on selection 2
<table>
<tr><th colspan="2">Setting digit</th><th rowspan="2">Explanation</th><th rowspan="2">Initial value</th></tr>
<tr><th>HEX.</th><th>BIN.</th></tr>
<tr><td rowspan="4">_ _ _ x</td><td>_ _ _ x</td><td>FLS (Upper stroke limit) selection
0: Disabled
1: Enabled</td><td rowspan="4">0h</td></tr>
<tr><td>_ _ x _</td><td>RLS (Lower stroke limit) selection
0: Disabled
1: Enabled</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td></tr>
<tr><td>x _ _ _</td></tr>
<tr><td>_ _ x _</td><td rowspan="3"></td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
Convert the setting value into hexadecimal as follows.


<table>
<tr><th rowspan="2">Signal name</th><th colspan="2">Initial value</th></tr>
<tr><th>BIN</th><th>HEX</th></tr>
<tr><td>FLS (Upper stroke limit) selection</td><td>0</td><td rowspan="4">0</td></tr>
<tr><td>RLS (Lower stroke limit) selection</td><td>0</td></tr>
<tr><td></td><td>0</td></tr>
<tr><td></td><td>0</td></tr>
</table>
BIN 0: Use for an external input signal.
BIN 1: Automatic on

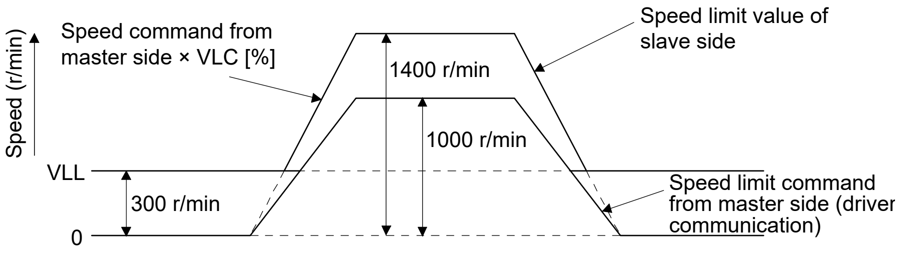
When performing a magnetic pole detection without using FLS (Upper stroke limit) and RLS (Lower stroke limit), you can disable FLS and RLS by setting [Pr. PL08 Linear servo motor/DD motor function selection 3] to "_ 1 _ _".</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PD07</td><td>*DO1</td><td>Output device selection 1
You can assign any output device to the CN3-13 pin. MBR (Electromagnetic brake interlock) is assigned as the initial value.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ x x</td><td>Device selection
Refer to table 5.8 for settings.</td><td>05h</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
Table 5.8 Selectable output devices
<table>
<tr><th>Setting value</th><th>Output device</th></tr>
<tr><td>_ _ 0 0</td><td>Always off</td></tr>
<tr><td>_ _ 0 2</td><td>RD (Ready)</td></tr>
<tr><td>_ _ 0 3</td><td>ALM (Malfunction)</td></tr>
<tr><td>_ _ 0 4</td><td>INP (In-position)</td></tr>
<tr><td>_ _ 0 5</td><td>MBR (Electromagnetic brake interlock)</td></tr>
<tr><td>_ _ 0 6</td><td>DB (Dynamic brake interlock)</td></tr>
<tr><td>_ _ 0 7</td><td>TLC (Limiting torque)</td></tr>
<tr><td>_ _ 0 8</td><td>WNG (Warning)</td></tr>
<tr><td>_ _ 0 9</td><td>BWNG (Battery warning)</td></tr>
<tr><td>_ _ 0 A</td><td>SA (Speed reached)</td></tr>
<tr><td>_ _ 0 C</td><td>ZSP (Zero speed detection)</td></tr>
<tr><td>_ _ 0 F</td><td>CDPS (Variable gain selection)</td></tr>
<tr><td>_ _ 1 0</td><td>CLDS (During fully closed loop control)</td></tr>
<tr><td>_ _ 1 1</td><td>ABSV (Absolute position undetermined)</td></tr>
<tr><td>_ _ 1 7</td><td>MTTR (During tough drive)</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PD08</td><td>*DO2</td><td>Output device selection 2
You can assign any output device to the CN3-9 pin. INP (In-position) is assigned as the initial value.
The devices that can be assigned and the setting method are the same as in [Pr. PD07].
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ x x</td><td>Device selection
Refer to table 5.8 in [Pr. PD07] for settings.</td><td>04h</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PD09</td><td>*DO3</td><td>Output device selection 3
You can assign any output device to the CN3-15 pin. ALM (Malfunction) is assigned as the initial value.
The devices that can be assigned and the setting method are the same as in [Pr. PD07].
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ x x</td><td>Device selection
Refer to table 5.8 in [Pr. PD07] for settings.</td><td>03h</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PD11</td><td>*DIF</td><td>Input filter setting
Select the input filter.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Input signal filter selection
Refer to the servo system controller instruction manual for the setting.
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]</td><td>4h</td></tr>
<tr><td>_ _ x _</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PD12</td><td>*DOP1</td><td>Function selection D-1
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>Servo motor or linear servo motor thermistor enabled/disabled selection
0: Enabled
1: Disabled
For servo motors or linear servo motor without thermistor, the setting will be disabled.
This parameter setting is used with servo amplifier with software version A5 or later.</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PD13</td><td>*DOP2</td><td>Function selection D-2
Select the INP (In-position) on condition.
This parameter is supported with software version B4 or later.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td rowspan="2">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>INP (In-position) on condition selection
Select a condition that INP (In-position) is turned on.
0: Droop pulses are within the in-position range.
1: The command pulse frequency is 0, and droop pulses are within the in-position range.
When the position command is not inputted for about 1 ms, the command pulse frequency is decided as 0.</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PD14</td><td>*DOP3</td><td>Function selection D-3
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Selection of output device at warning occurrence
Select WNG (Warning) and ALM (Malfunction) output status at warning occurrence.
<table>
<tr><th>Setting value</th><th>(Note 1) Device status</th></tr>
<tr><td>0</td><td>
</td></tr>
<tr><td>1</td><td>
</td></tr>
</table>
Note 1. 0: Off
1: On
2. Although ALM is turned off upon occurrence of the warning, the forced stop deceleration is performed.</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td></td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PD15</td><td>*IDCS</td><td>Driver communication setting
This parameter is used to select master/slave axis for the driver communication.
This is available only when the forced stop deceleration function is disabled. When the forced stop deceleration function is enabled, [AL. 37] will occur.
This parameter setting is used with servo amplifier with software version A8 or later.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Master axis operation selection
Setting "1" other than in standard control mode and fully closed loop control mode will trigger [AL. 37].
0: Disabled (not using master-slave operation function)
1: Enabled (this servo amplifier: master axis)</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Slave axis operation selection
Setting "1" other than in standard control mode will trigger [AL. 37].
0: Disabled (not using master-slave operation function)
1: Enabled (this servo amplifier: slave axis)</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td></td><td>0h</td></tr>
</table>
<table>
<tr><th colspan="2">Master-slave operation function</th><th>Setting value</th></tr>
<tr><td>Not used</td><td></td><td>0000</td></tr>
<tr><td rowspan="2">Used</td><td>Master</td><td>0001</td></tr>
<tr><td>Slave</td><td>0010</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PD16</td><td>*MD1</td><td>Driver communication setting - Master - Transmit data selection 1
This parameter is used to select transmit data from master axis to slave axis.
When setting this amplifier as master axis ([Pr. PD15] is "_ _ 0 1".), select "_ _ 3 8 (torque command)" with this parameter.
This parameter setting is used with servo amplifier with software version A8 or later.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ x x</td><td>Transmission data selection
00: Disabled
38: Torque command</td><td>00h</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PD17</td><td>*MD2</td><td>Driver communication setting - Master - Transmit data selection 2
This parameter is used to select transmit data from master axis to slave axis.
When setting this amplifier as master axis ([Pr. PD15] is "_ _ 0 1".), select "_ _ 3 A (speed limit command)" with this parameter.
This parameter setting is used with servo amplifier with software version A8 or later.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ x x</td><td>Transmission data selection
00: Disabled
3A: speed limit command</td><td>00h</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PD20</td><td>*SLA1</td><td>Driver communication setting - Slave - Master axis No. selection 1
Select a master axis when this amplifier is slave axis.
When setting this amplifier as slave axis ([Pr. PD15] is "_ _ 1 0".), set the axis No. of the servo amplifier of master. Refer to section 4.3.1 for details of axis Nos. Setting "0" disables this parameter.
This parameter setting is used with servo amplifier with software version A8 or later.</td><td>0</td><td>0 to 32</td></tr>
<tr><td>PD30</td><td>TLC</td><td>Master-slave operation - Torque command coefficient on slave
This parameter is used to set a internal torque command coefficient to torque command value received from master axis.
This parameter is enabled when this amplifier is set as slave axis ([Pr. PD15] is "_ _ 1 0".). The maximum value is 500. Setting over 500 will be 500.
Setting 100 [%] means multiplication of one. The torque ratio will be 100 (master) to 100 (slave).
Setting 90 [%] means multiplication of 0.9. The torque ratio will be 100 (master) to 90 (slave).
This parameter setting is used with servo amplifier with software version A8 or later.</td><td>0 [%]</td><td>0 to 500</td></tr>
</table>

No.	Symbol	Name and function	Initial value [unit]	Setting range
PD31	VLC	Master-slave operation - Speed limit coefficient on slave This parameter is used to set a internal speed limit value coefficient to speed limit command value received from master axis. This parameter is enabled when this amplifier is set as slave axis ([Pr. PD15] is "_ _ 1 0".). The maximum value is 500. Setting over 500 will be 500. Setting 100 [%] means multiplication of one. Setting example: [Pr. PD31 (VLC)] = 140 [%], [Pr. PD32 (VLL)] = 300 [r/min], and master side acceleration/deceleration at 1000 [r/min]  This parameter setting is used with servo amplifier with software version A8 or later.	0 [%]	0 to 500
PD32	VLL	Master-slave operation - Speed limit adjusted value on slave This parameter is used to set a minimum value for internal speed limit value. This parameter is enabled when this amplifier is set as slave axis ([Pr. PD15] is "_ _ 1 0".). The speed limit value will not be this setting value or lower. This parameter ensures torque control range at low speed driving (avoid area likely to reach speed limit). Set 100 to 500 [r/min] normally as a reference. Refer to [Pr. PD31] for the setting example. This parameter setting is used with servo amplifier with software version A8 or later.	0 [r/min]	0 to 32767

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

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PE01</td><td>**FCT1</td><td>Fully closed loop function selection 1
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Fully closed loop function selection
0: Always enabled
1: Switching with the control command of controller (switching semi./full.)
<table>
<tr><th>Switching with the control command of controller</th><th>Control method</th></tr>
<tr><td>Off</td><td>Semi closed loop control</td></tr>
<tr><td>On</td><td>Fully closed loop control</td></tr>
</table>
To enable the digit, select "Fully closed loop control mode (_ _ 1 _)" of "operation mode selection" in [Pr. PA01].
When "Absolute position detection system selection" is "Enabled (_ _ _ 1)" in [Pr. PA03], setting "1" will trigger [AL. 37 Parameter error].</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td></td><td>0h</td></tr>
<tr><td>x _ _ _</td><td></td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PE03</td><td>*FCT2</td><td>Fully closed loop function selection 2
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Fully closed loop control error detection function selection
0: Disabled
1: Speed deviation error detection
2: Position deviation error detection
3: Speed deviation error/position deviation error detection</td><td>3h</td></tr>
<tr><td>_ _ x _</td><td>Position deviation error detection system selection
0: Continuous detection system
1: Detection system at stop (detected with command set to "0")</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>Fully closed loop control error reset selection
0: Reset disabled (reset by powering off/on enabled)
1: Reset enabled</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PE04</td><td>**FBN</td><td>Fully closed loop control - Feedback pulse electronic gear 1 - Numerator
This is used to 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.</td><td>1</td><td>1 to 65535</td></tr>
<tr><td>PE05</td><td>**FBD</td><td>Fully closed loop control - Feedback pulse electronic gear 1 - Denominator
This is used to 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.</td><td>1</td><td>1 to 65535</td></tr>
<tr><td>PE06</td><td>BC1</td><td>Fully closed loop control - Speed deviation error detection level
This is used to 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.</td><td>400 [r/min]</td><td>1 to 50000</td></tr>
<tr><td>PE07</td><td>BC2</td><td>Fully closed loop control - Position deviation error detection level
This is used to 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.</td><td>100 [kpulse]</td><td>1 to 20000</td></tr>
</table>

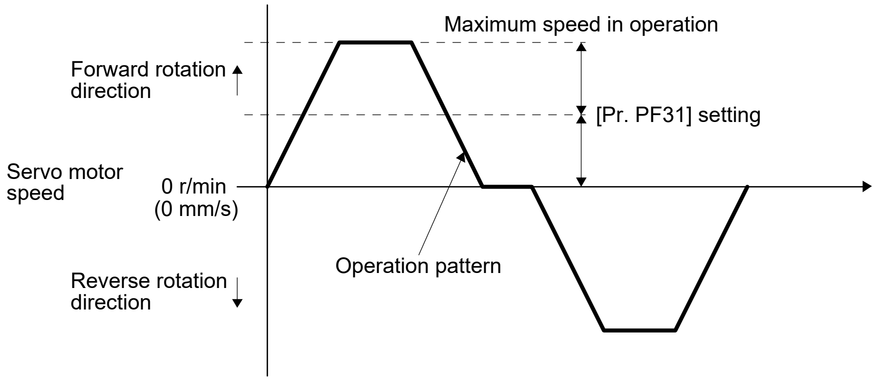
<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PE08</td><td>DUF</td><td>Fully closed loop dual feedback filter
This is used to set a dual feedback filter band.
Refer to section 16.3.1 (7) for details.</td><td>10
[rad/s]</td><td>0 to 4500</td></tr>
<tr><td>PE10</td><td>FCT3</td><td>Fully closed loop function selection 3
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Fully closed loop control - Position deviation error detection level - Unit selection
0: 1 kpulse unit
1: 1 pulse unit</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>Droop pulse monitor selection for controller display
0: Servo motor encoder
1: Load-side encoder
2: Deviation between the servo motor and load side</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>Cumulative feedback pulses monitor selection for controller display
0: Servo motor encoder
1: Load-side encoder
The setting of this digit is used for the fully closed loop system and scale measurement function.</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PE34</td><td>**FBN2</td><td>Fully closed loop control - Feedback pulse electronic gear 2 - Numerator
This is used to 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 16.3.1 (5) for details.</td><td>1</td><td>1 to 65535</td></tr>
<tr><td>PE35</td><td>**FBD2</td><td>Fully closed loop control - Feedback pulse electronic gear 2 - Denominator
This is used to 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 16.3.1 (5) for details.</td><td>1</td><td>1 to 65535</td></tr>
<tr><td>PE41</td><td>EOP3</td><td>Function selection E-3
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>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.</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PE44</td><td>LMCP</td><td>Lost motion compensation positive-side compensation value selection
Set the lost motion compensation for when reverse rotation (CW) switches to forward rotation (CCW) in increments of 0.01% assuming the rated torque as 100%.
This parameter is supported with software version B4 or later.</td><td>0
[0.01%]</td><td>0
to
30000</td></tr>
<tr><td>PE45</td><td>LMCN</td><td>Lost motion compensation negative-side compensation value selection
Set the lost motion compensation for when forward rotation (CCW) switches to reverse rotation (CW) in increments of 0.01% assuming the rated torque as 100%.
This parameter is supported with software version B4 or later.</td><td>0
[0.01%]</td><td>0
to
30000</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PE46</td><td>LMFLT</td><td>Lost motion filter setting
Set the time constant of the lost motion compensation filter in increments of 0.1 ms.
If the time constant is "0", the torque is compensated with the value set in [Pr. PE44] and [Pr. PE45]. If the time constant is other than "0", the torque is compensated with the high-pass filter output value of the set time constant, and the lost motion compensation will continue.
This parameter is supported with software version B4 or later.</td><td>0
[0.1 ms]</td><td>0
to
30000</td></tr>
<tr><td>PE47</td><td>TOF</td><td>Torque offset
Set this when canceling unbalanced torque of vertical axis. Set this assuming the rated torque of the servo motor as 100%.
The torque offset does not need to be set for a machine not generating unbalanced torque.
The torque offset cannot be used for linear servo motors and direct drive motors. Set 0.00%.
The torque offset set with this parameter will be enabled in the position control mode, speed control mode, and torque control mode. Input commands assuming torque offset for the torque control mode.
This parameter is supported with software version B4 or later.</td><td>0
[0.01%]</td><td>-10000
to
10000</td></tr>
<tr><td>PE48</td><td>*LMOP</td><td>Lost motion compensation function selection
Select the lost motion compensation function.
This parameter is supported with software version B4 or later.
<table>
<tr><th>Setting value</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Lost motion compensation selection
0: Disabled
1: Enabled</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Unit setting of lost motion compensation non-sensitive band
0: 1 pulse unit
1: 1 kpulse unit</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PE49</td><td>LMCD</td><td>Lost motion compensation timing
Set the lost motion compensation timing in increments of 0.1 ms.
You can delay the timing to perform the lost motion compensation for the set time.
This parameter is supported with software version B4 or later.</td><td>0
[0.1 ms]</td><td>0
to
30000</td></tr>
<tr><td>PE50</td><td>LMCT</td><td>Lost motion compensation non-sensitive band
Set the lost motion compensation non-sensitive band. When the fluctuation of the droop pulse is the setting value or less, the speed will be 0. Setting can be changed in [Pr. PE48]. Set the parameter per encoder unit.
This parameter is supported with software version B4 or later.</td><td>0
[pulse]/
[kpulse]</td><td>0
to
65535</td></tr>
</table>

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

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PF06</td><td>*FOP5</td><td>Function selection F-5
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Electronic dynamic brake selection
0: Automatic (enabled only for specified servo motors)
2: Disabled
Refer to the following table for the specified servo motors.
<table>
<tr><th>Series</th><th>Servo motor</th></tr>
<tr><td>HG-KR</td><td>HG-KR053/HG-KR13/HG-KR23/HG-KR43</td></tr>
<tr><td>HG-MR</td><td>HG-MR053/HG-MR13/HG-MR23/HG-MR43</td></tr>
<tr><td>HG-SR</td><td>HG-SR51/HG-SR52</td></tr>
</table>
</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PF12</td><td>DBT</td><td>Electronic dynamic brake operating time
Set an operating time for the electronic dynamic brake.</td><td>2000
[ms]</td><td>0 to
10000</td></tr>
<tr><td>PF18</td><td>**STOD</td><td>STO diagnosis error detection time
Set the time from when an error occurs in the STO input signal or STO circuit until the detection of [AL. 68.1 Mismatched STO signal error].
When 0 s is set, the detection of [AL. 68.1 Mismatched STO signal error] is not performed.

The following shows safety levels at the time of parameter setting.
<table>
<tr><th>Setting value</th><th>STO input diagnosis by TOFB output</th><th>Safety level</th></tr>
<tr><td rowspan="2">0</td><td>Execute</td><td rowspan="2">EN ISO 13849-1:2015 Category 3 PL d,
IEC 61508 SIL 2,
EN IEC 62061 maximum SIL 2</td></tr>
<tr><td>Not execute</td></tr>
<tr><td rowspan="2">1 to 60</td><td>Execute</td><td>EN ISO 13849-1:2015 Category 3 PL e,
IEC 61508 SIL 3,
EN IEC 62061 maximum SIL 3</td></tr>
<tr><td>Not execute</td><td>EN ISO 13849-1:2015 Category 3 PL d,
IEC 61508 SIL 2,
EN IEC 62061 maximum SIL 2</td></tr>
</table>
When the short-circuit connector is connected to the CN8 connector, set "0" in the parameter.
When MR-D30 functional safety unit is used, the parameter is not available.
For safety levels at the time of using MR-D30, refer to "MR-D30 Instruction Manual".
This parameter is available with servo amplifiers with software version C1 or later.</td><td>0
[s]</td><td>0
to
60</td></tr>
<tr><td>PF21</td><td>DRT</td><td>Drive recorder switching time setting
This is used to set a drive recorder switching time.
When a USB communication is cut during using a graph function, the function will be changed to the drive recorder function after the setting time of this parameter.
When a value from "1" to "32767" is set, it will switch after the setting value.
However, when "0" is set, it will switch after 600 s.
When "-1" is set, the drive recorder function is disabled.</td><td>0
[s]</td><td>-1 to
32767</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PF23</td><td>OSCL1</td><td>Vibration tough drive - Oscillation detection level
This is used to set a filter readjustment sensitivity of [Pr. PB13 Machine resonance suppression filter 1] and [Pr. PB15 Machine resonance suppression filter 2] while the vibration tough drive is enabled.
However, setting "0" will be 50%.
Example: When you set "50" to the parameter, the filter will be readjusted at the time of 50% or more oscillation level.</td><td>50
[%]</td><td>0 to 100</td></tr>
<tr><td>PF24</td><td>*OSCL2</td><td>Vibration tough drive function selection
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Oscillation detection alarm selection
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
Select alarm or warning when a 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].</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td></td><td>0h</td></tr>
<tr><td>x _ _ _</td><td></td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PF25</td><td>CVAT</td><td>SEMI-F47 function - Instantaneous power failure detection time
Set the time of the [AL. 10.1 Voltage drop in the control circuit power] occurrence.
This parameter setting range differs depending on the software version of the servo amplifier as follows.
・Software version C0 or later: Setting range 30 ms to 200 ms
・Software version C1 or earlier: Setting range 30 ms to 500 ms
To comply with SEMI-F47 standard, it is unnecessary to change the initial value (200 ms).
When the instantaneous power failure time exceeds 200 ms, and if the instantaneous power failure voltage is less than 70 % of the rated input voltage, the power may be turned off normally even if a value larger than 200 ms is set in the parameter.
To disable the parameter, select "Disabled (_ 0 _ _)" of "SEMI-F47 function selection" in [Pr. PA20].</td><td>200
[ms]</td><td>30 to 500</td></tr>
<tr><td>PF31</td><td>FRIC</td><td>Machine diagnosis function - Friction judgment speed
Set a (linear) servo motor speed to divide a friction estimation area into high and low for the friction estimation process of the machine diagnosis.
However, setting "0" will be the value half of the rated speed.
When your operation pattern is under rated speed, we recommend that you set half value to the maximum speed with this.
Set a larger value than the one set in [Pr. PC07 Zero speed] in this parameter. If the speed is the zero speed or less, the friction estimation process is not performed.


</td><td>0
[r/min]/
[mm/s]</td><td>0 to permiss-ible speed</td></tr>
</table>

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

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PL01</td><td>**LIT1</td><td>Linear servo motor/DD motor function selection 1
Select a magnetic pole detection timing of the linear servo motor/DD motor and stop interval of the home position returning.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>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</td><td>1h</td></tr>
<tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>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
When "Absolute position detection system selection" is "Enabled (_ _ _ 1)" in [Pr. PA03], setting "0" may prevent the absolute position from being restored properly.</td><td>3h</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PL02</td><td>**LIM</td><td>Linear encoder resolution - Numerator
Set a linear encoder resolution with the settings of [Pr. PL02] and [Pr. PL03].
Set the numerator in [Pr. PL02].
This is enabled only for linear servo motors.</td><td>1000
[μm]</td><td>1 to
65535</td></tr>
<tr><td>PL03</td><td>**LID</td><td>Linear encoder resolution - Denominator
Set a linear encoder resolution with the settings of [Pr. PL02] and [Pr. PL03].
Set the denominator in [Pr. PL03].
This is enabled only for linear servo motors.</td><td>1000
[μm]</td><td>1 to
65535</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PL04</td><td>*LIT2</td><td>Linear servo motor/DD motor function selection 2
This is used to select a detection function and detection controller reset condition of [AL. 42 Servo control error].
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>[AL. 42 Servo control error] detection function selection
Refer to the following table.
<table>
<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>
<tr><td>0</td><td rowspan="4">Disabled</td><td rowspan="2">Disabled</td><td>Disabled</td></tr>
<tr><td>1</td><td>Enabled</td></tr>
<tr><td>2</td><td rowspan="2">Enabled</td><td>Disabled</td></tr>
<tr><td>3</td><td>Enabled</td></tr>
<tr><td>4</td><td rowspan="4">Enabled</td><td rowspan="2">Disabled</td><td>Disabled</td></tr>
<tr><td>5</td><td>Enabled</td></tr>
<tr><td>6</td><td rowspan="2">Enabled</td><td>Disabled</td></tr>
<tr><td>7</td><td>Enabled</td></tr>
</table>
Note. Refer to chapter 14 and 15 for details of each deviation error.</td><td>3h</td></tr>
<tr><td>_ _ x _</td><td rowspan="2">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>[AL. 42 Servo control error] detection function controller reset condition selection
0: Reset disabled (reset by powering off/on enabled)
1: Reset enabled</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PL05</td><td>LB1</td><td>Position deviation error detection level
This is used to 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</td><td>0
[mm]/
[0.01 rev]</td><td>0 to 1000</td></tr>
<tr><td>PL06</td><td>LB2</td><td>Speed deviation error detection level
This is used to 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</td><td>0
[mm/s]/
[r/min]</td><td>0 to 5000</td></tr>
<tr><td>PL07</td><td>LB3</td><td>Torque/thrust deviation error detection level
This is used to 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.</td><td>100
[%]</td><td>0 to 1000</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PL08</td><td>*LIT3</td><td>Linear servo motor/DD motor function selection 3
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Magnetic pole detection method selection
0: Position detection method
4: Minute position detection method</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>For manufacturer setting</td><td>1h</td></tr>
<tr><td>_ x _ _</td><td>Magnetic pole detection - Stroke limit enabled/disabled selection
0: Enabled
1: Disabled</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>Minute position detection method - High-resolution encoder selection
0: Disabled
1: Enabled
This digit will be enabled when "minute position detection method" is selected in [Pr. PL08 (_ _ _ x)].
If a linear encoder whose resolution is smaller than 0.05 μm is used and also [AL. 27 Initial magnetic pole detection error] occurs because the travel distance at magnetic pole detection is too large or vibration occurs, set "1" (enabled).
This digit is available on servo amplifiers with software version A8 or later.</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PL09</td><td>LPWM</td><td>Magnetic pole detection voltage level
This is used to 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.</td><td>30
[%]</td><td>0 to 100</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PL17</td><td>LTSTS</td><td>Magnetic pole detection - Minute position detection method - Function selection
To enable the parameter, select "Minute position detection method (_ _ _ 4)" in [Pr. PL08].
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>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 5.9 for settings.</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>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 5.10 for settings.</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td></td><td>0h</td></tr>
</table>
Table 5.9 Response of minute position detection method at magnetic pole detection
<table>
<tr><th>Setting value</th><th>Response</th><th>Setting value</th><th>Response</th></tr>
<tr><td>_ _ _ 0</td><td>Low response</td><td>_ _ _ 8</td><td>Middle response</td></tr>
<tr><td>_ _ _ 1</td><td>↕</td><td>_ _ _ 9</td><td>↕</td></tr>
<tr><td>_ _ _ 2</td><td></td><td>_ _ _ A</td><td></td></tr>
<tr><td>_ _ _ 3</td><td></td><td>_ _ _ B</td><td></td></tr>
<tr><td>_ _ _ 4</td><td></td><td>_ _ _ C</td><td></td></tr>
<tr><td>_ _ _ 5</td><td></td><td>_ _ _ D</td><td></td></tr>
<tr><td>_ _ _ 6</td><td></td><td>_ _ _ E</td><td></td></tr>
<tr><td>_ _ _ 7</td><td>Middle response</td><td>_ _ _ F</td><td>High response</td></tr>
</table>
Table 5.10 Load to motor mass ratio/load to motor inertia ratio
<table>
<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>
<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>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PL18</td><td>IDLV</td><td>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.
However, setting "0" will be 100% amplitude.</td><td>0
[%]</td><td>0 to 100</td></tr>
</table>

6. NORMAL GAIN ADJUSTMENT

POINT

- In the torque control mode, you do not need to make gain adjustment.
- Before making gain adjustment, check that your machine is not being operated at maximum torque of the servo motor. If operated over maximum torque, the machine may vibrate and may operate unexpectedly. In addition, make gain adjustment with a safety margin considering characteristic differences of each machine. It is recommended that generated torque during operation is under 90% of the maximum torque of the servo motor.
- When you use a linear servo motor, replace the following words in the left to the words in the right.
  Load to motor inertia ratio → Load to motor mass ratio
  Torque → Thrust
  (Servo motor) speed → (Linear servo motor) speed
- For the vibration suppression control tuning mode, the setting range of [Pr. PB07] is limited. For the vibration suppression control tuning mode, the setting range of [Pr. PB07] is limited. Refer to section 7.1.5 (4) for details.

6.1 Different adjustment methods

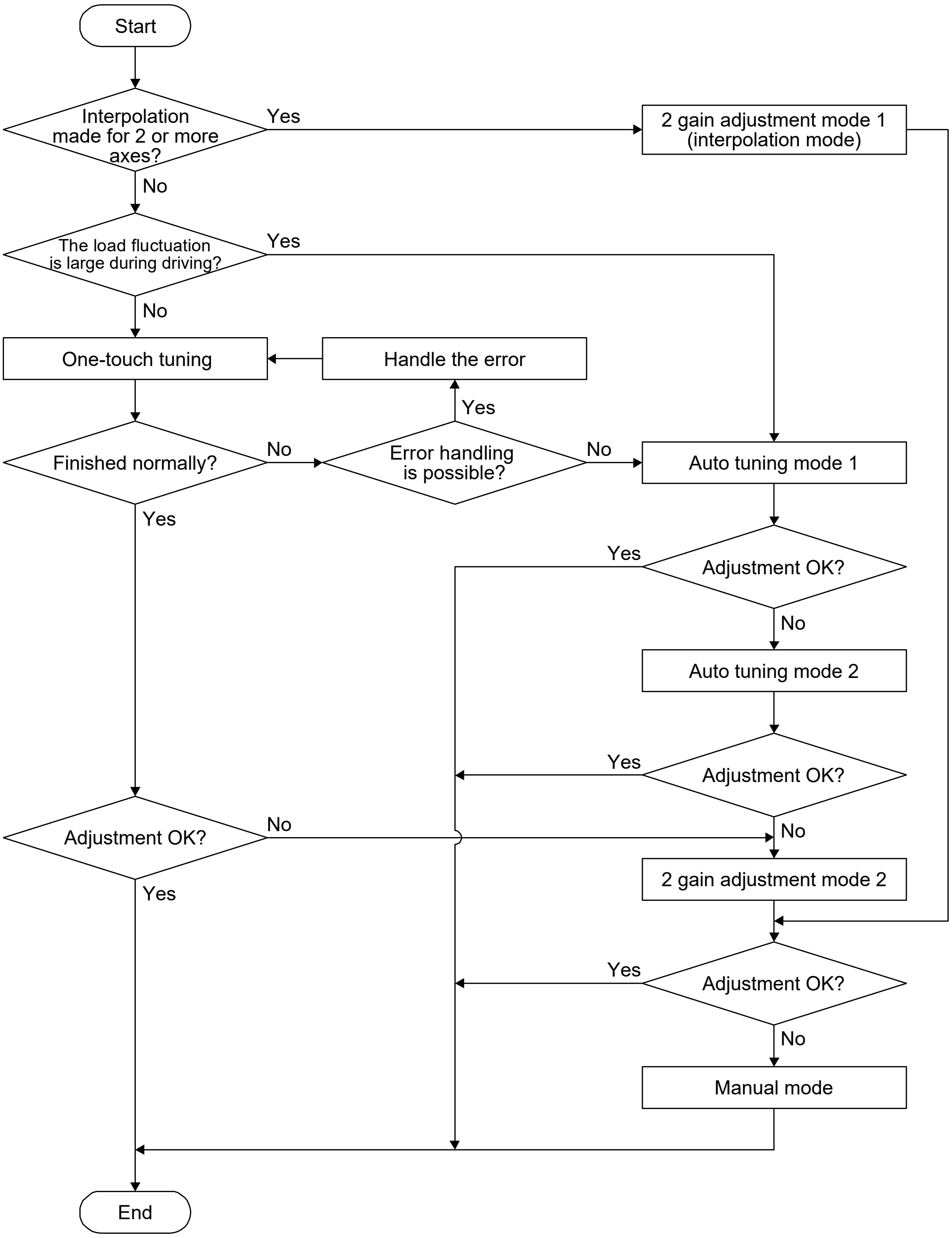
6.1.1 Adjustment on a single servo amplifier

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

(1) Gain adjustment mode explanation

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

(2) Adjustment sequence and mode usage



6.1.2 Adjustment using MR Configurator2

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

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

6.2 One-touch tuning

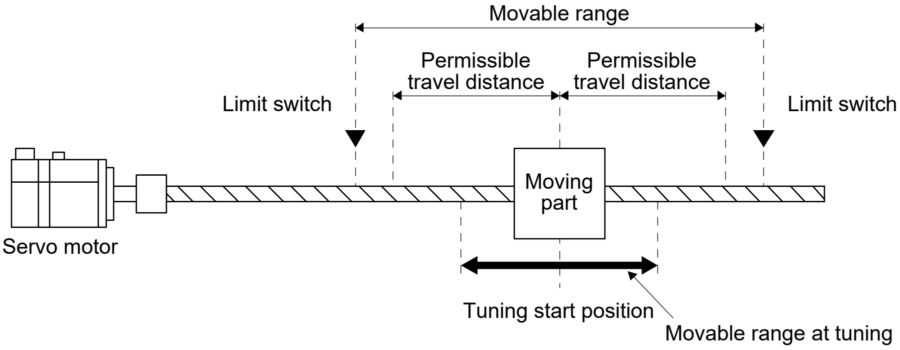
POINT

- ●After the one-touch tuning is completed, "Gain adjustment mode selection" in [Pr. PA08] will be set to "2 gain adjustment mode 2 (_ _ _ 4)". To estimate [Pr. PB06 Load to motor inertia ratio/load to motor mass ratio] again, set "Gain adjustment mode selection" in [Pr. PA08] to "Auto tuning mode 1 (_ _ _ 1)".
- ●When executing the one-touch tuning, check the [Pr. PA21 One-touch tuning function selection] is "_ _ _ 1" (initial value).
- ●At start of the one-touch tuning, only when "Auto tuning mode 1 (_ _ _ 1)" or "2 gain adjustment mode 1 (interpolation mode) (_ _ _ 0)" of "Gain adjustment mode selection" is selected in [Pr. PA08], [Pr. PB06 Load to motor inertia ratio/ load to motor mass ratio] will be estimated.
- ●Execute the one-touch tuning while the servo system controller and the servo amplifier are connected.
- ●When executing the one-touch tuning in the test operation mode (SW2-1 is on), write the tuning result to servo parameters of the servo system controller, and then connect the servo system controller and the servo amplifier.
- ●The amplifier command method can be used with the servo amplifier with software version C1 or later and MR Configurator2 with software version 1.45X or later.
- ●When the one-touch tuning is executed, MR Configurator2 is required.

The one-touch tuning includes two methods: the user command method and the amplifier command method.

(1) User command method
The user command method performs one-touch tuning by inputting commands from outside the servo amplifier.

(2) Amplifier command method
In the amplifier command method, when you simply input a travel distance (permissible travel distance) that collision against the equipment does not occur during servo motor driving, a command for the optimum tuning will be generated inside the servo amplifier to perform one-touch tuning.



The following parameters are set automatically with one-touch tuning. Also, "Gain adjustment mode selection" in [Pr. PA08] will be "2 gain adjustment mode 2 (_ _ _ 4)" automatically. Other parameters will be set to an optimum value depending on the setting of [Pr. PA09 Auto tuning response].

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

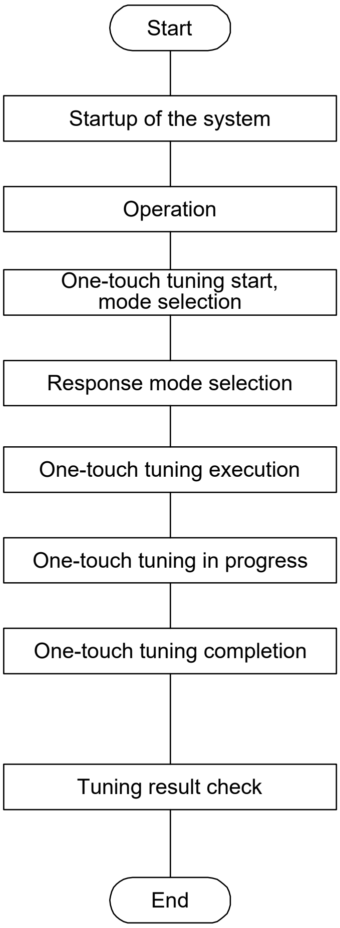
Parameter	Symbol	Name
PA08	ATU	Auto tuning mode
PA09	RSP	Auto tuning response
PB01	FILT	Adaptive tuning mode (adaptive filter II)
PB02	VRFT	Vibration suppression control tuning mode (advanced vibration suppression control II)
PB06	GD2	Load to motor inertia ratio
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation
PB12	OVA	Overshoot amount compensation
PB13	NH1	Machine resonance suppression filter 1
PB14	NHQ1	Notch shape selection 1
PB15	NH2	Machine resonance suppression filter 2
PB16	NHQ2	Notch shape selection 2
PB17	NHF	Shaft resonance suppression filter

Parameter	Symbol	Name
PB18	LPF	Low-pass filter setting
PB19	VRF11	Vibration suppression control 1 - Vibration frequency
PB20	VRF12	Vibration suppression control 1 - Resonance frequency
PB21	VRF13	Vibration suppression control 1 - Vibration frequency damping
PB22	VRF14	Vibration suppression control 1 - Resonance frequency damping
PB23	VFBF	Low-pass filter selection
PB46	NH3	Machine resonance suppression filter 3
PB47	NHQ3	Notch shape selection 3
PB48	NH4	Machine resonance suppression filter 4
PB49	NHQ4	Notch shape selection 4
PB51	NHQ5	Notch shape selection 5
PE41	EOP3	Function selection E-3

6.2.1 One-touch tuning flowchart

(1) User command method

Make one-touch tuning as follows.



Start a system referring to chapter 4.

Rotate the servo motor by a servo system controller. (In the user command method, the one-touch tuning cannot be executed if the servo motor is not operating.)

Start one-touch tuning of MR Configurator2, and select "User command method".

Select a response mode (High mode, Basic mode, and Low mode) in the one-touch tuning window of MR Configurator2.

Click "Start" during servo motor driving to execute one-touch tuning.

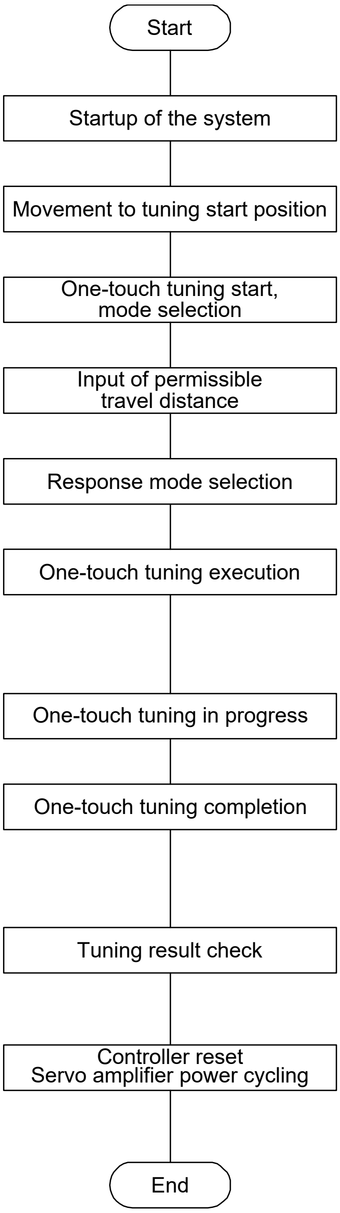
Gains and filters will be adjusted automatically. During processing of tuning, the tuning progress will be displayed in % in MR Configurator2.

When one-touch tuning is completed normally, the parameters described in table 6.1 will be set automatically.
When the tuning is not completed normally, the tuning error will be displayed. (Refer to section 6.2.2 (5).)

Check the tuning result.
When the tuning result is not satisfactory, you can return the parameter to the value before the one-touch tuning or the initial value. (Refer to section 6.2.2 (8).)

(2) Amplifier command method

Make one-touch tuning as follows.



Start a system referring to chapter 4.

Move the moving part to the center of a movable range.

Start one-touch tuning of MR Configurator2, and select "Amplifier command method".

In the one-touch tuning window of MR Configurator2, input a maximum travel distance to move the moving part at one-touch tuning.

Select a response mode (High mode, Basic mode, and Low mode) in the one-touch tuning window of MR Configurator2.

While the servo motor is stopped, click "Start" to start one-touch tuning. After the tuning is started, the servo motor will reciprocate automatically. Executing one-touch tuning during servo motor rotation will cause an error. After one-touch tuning is executed using the amplifier command method, control will not be performed by commands from the controller.

Gains and filters will be adjusted automatically. During processing of tuning, the tuning progress will be displayed in % in MR Configurator2.

One-touch tuning will be completed automatically after the tuning. When one-touch tuning is completed normally, the parameters described in table 6.1 will be updated automatically.

When the tuning is not completed normally, the tuning error will be displayed. (Refer to section 6.2.2 (5).)

Check the tuning result.

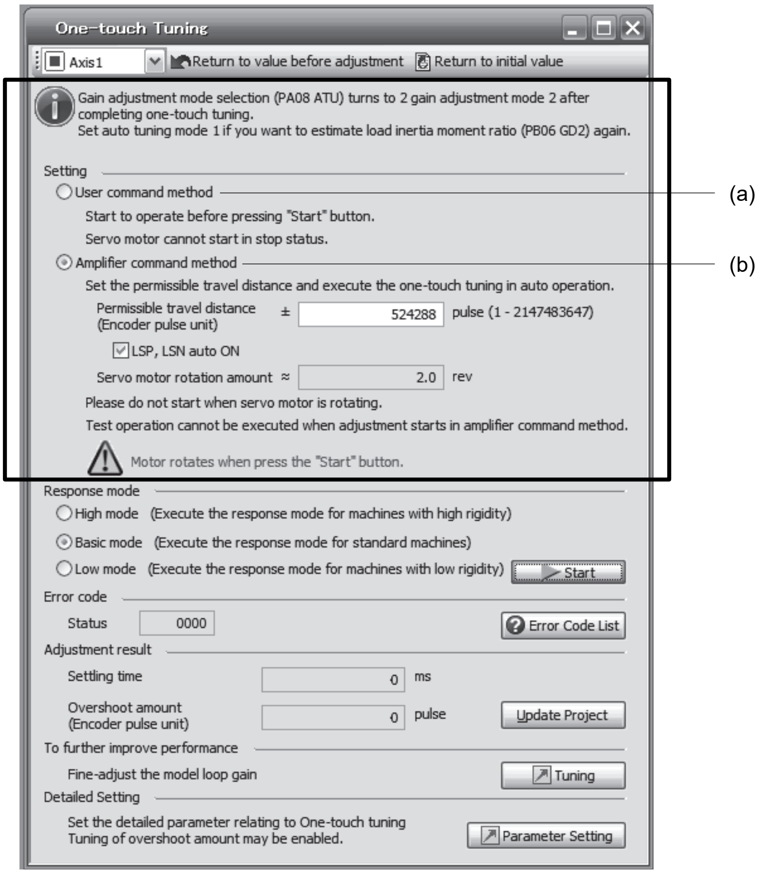
When the tuning result is not satisfactory, you can return the parameter to the value before the one-touch tuning or the initial value. (Refer to section 6.2.2 (8).)

After executing the one-touch tuning, resetting the controller or cycling the power of the servo amplifier returns to the state in which control is performed from the controller.

6.2.2 Display transition and operation procedure of one-touch tuning

(1) Command method selection

Select a command method from two methods in the one-touch tuning window of MR Configurator2.



Gain adjustment mode selection (PA08 ATU) turns to 2 gain adjustment mode 2 after completing one-touch tuning.
Set auto tuning mode 1 if you want to estimate load inertia moment ratio (PB06 GD2) again.

Setting

○ User command method

Start to operate before pressing "Start" button.
Servo motor cannot start in stop status.

● Amplifier command method

Set the permissible travel distance and execute the one-touch tuning in auto operation.

Permissible travel distance (Encoder pulse unit) ± 524288 pulse (1 - 2147483647)

☑ LSP, LSN auto ON

Servo motor rotation amount ≈ 2.0 rev

Please do not start when servo motor is rotating.
Test operation cannot be executed when adjustment starts in amplifier command method.

Motor rotates when press the "Start" button.

Response mode

○ High mode (Execute the response mode for machines with high rigidity)
● Basic mode (Execute the response mode for standard machines)
○ Low mode (Execute the response mode for machines with low rigidity)

Error code

Status 0000

Adjustment result

Settling time 0 ms
Overshoot amount (Encoder pulse unit) 0 pulse

To further improve performance

Fine-adjust the model loop gain

Detailed Setting

Set the detailed parameter relating to One-touch tuning
Tuning of overshoot amount may be enabled.

(a) User command method

It is recommended to input commands meeting the following conditions to the servo amplifier. If one-touch tuning is executed while commands which do not meet the conditions are inputted to the servo amplifier, the one-touch tuning error may occur.

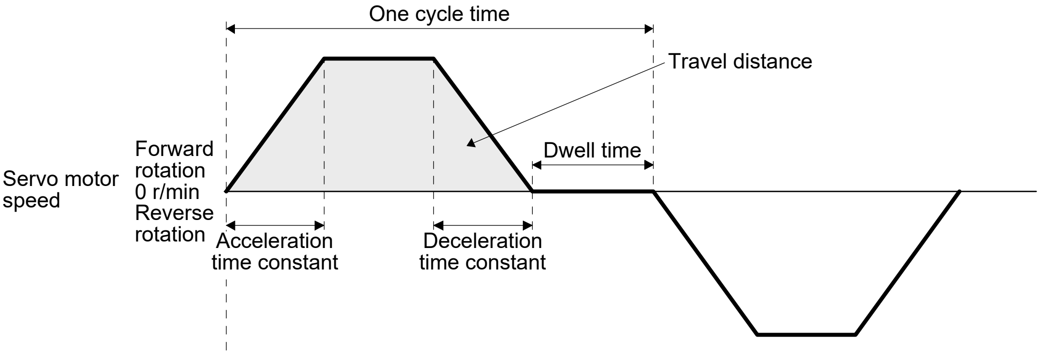
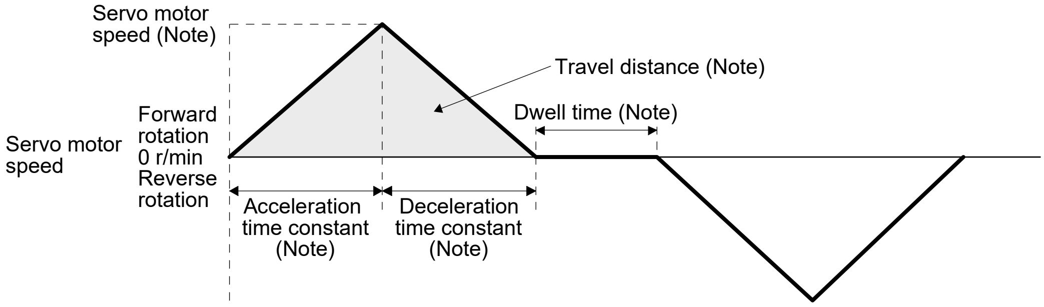


Fig. 6.1 Recommended command for one-touch tuning in the user command method

Item	Description
Travel distance	Set 100 pulses or more in encoder unit. Setting less than 100 pulses will cause the one-touch tuning error "C004".
Servo motor speed	Set 150 r/min (mm/s) or higher. Setting less than 150 r/min (mm/s) may cause the one-touch tuning error "C005".
Acceleration time constant Deceleration time constant	Set the time to reach 2000 r/min (mm/s) to 5 s or less. Set an acceleration time constant/deceleration time constant so that the acceleration/deceleration torque is 10% or more of the rated torque. The estimation accuracy of the load to motor inertia ratio is more improved as the acceleration/deceleration torque is larger, and the one-touch tuning result will be closer to the optimum value.
Dwell time	Set 200 ms or more. Setting a smaller value may cause the one-touch tuning error "C004".
One cycle time	Set 30 s or less. Setting over 30 s will cause the one-touch tuning error "C004".

(b) Amplifier command method

Input a permissible travel distance. Input it in the load-side resolution unit for the fully closed loop control mode, and in the servo motor-side resolution unit for other control modes. In the amplifier command method, the servo motor will be operated in a range between "current value ± permissible travel distance". Input the permissible travel distance as large as possible within a range that the movable part does not collide against the machine. Inputting a small permissible travel distance decreases the possibility that the moving part will collide against the machine. However, the estimation accuracy of the load to motor inertia ratio may be lower, resulting in improper tuning. Also, executing the one-touch tuning in the amplifier command method will generate a command for the following optimum tuning inside the servo amplifier to start the tuning.



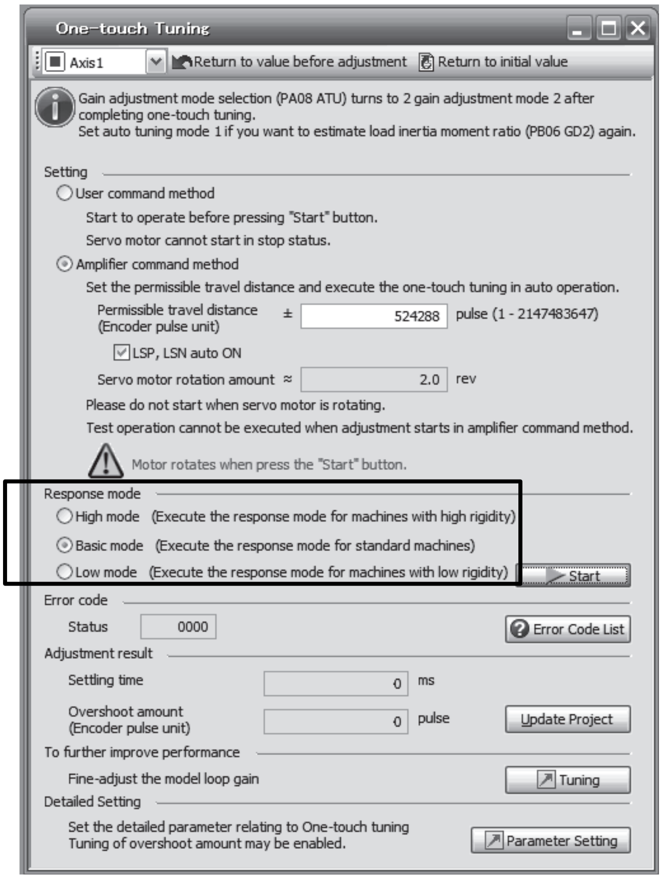
Note. It will be automatically generated in the servo amplifier.

Fig. 6.2 Command generated by one-touch tuning in the amplifier command method

Item	Description
Travel distance	An optimum travel distance will be automatically set in the range not exceeding the user-inputted permissible travel distance with MR Configurator2.
Servo motor speed	A speed not exceeding 1/2 of the rated speed and overspeed alarm detection level ([Pr. PC08]) will be automatically set.
Acceleration time constant Deceleration time constant	An acceleration time constant/deceleration time constant will be automatically set so as not to exceed 60% of the rated torque and the torque limit value set at the start of one-touch tuning in the amplifier command method.
Dwell time	A dwell time in which the one-touch tuning error "C004" does not occur will be automatically set.

(2) Response mode selection

Select a response mode from 3 modes in the one-touch tuning window of MR Configurator2.



Gain adjustment mode selection (PA08 ATU) turns to 2 gain adjustment mode 2 after completing one-touch tuning.
Set auto tuning mode 1 if you want to estimate load inertia moment ratio (PB06 GD2) again.

Setting

○ User command method

Start to operate before pressing "Start" button.

Servo motor cannot start in stop status.

● Amplifier command method

Set the permissible travel distance and execute the one-touch tuning in auto operation.

Permissible travel distance (Encoder pulse unit) ± 524288 pulse (1 - 2147483647)

☑ LSP, LSN auto ON

Servo motor rotation amount ≈ 2.0 rev

Please do not start when servo motor is rotating.

Test operation cannot be executed when adjustment starts in amplifier command method.

Motor rotates when press the "Start" button.

Response mode

○ High mode (Execute the response mode for machines with high rigidity)

● Basic mode (Execute the response mode for standard machines)

○ Low mode (Execute the response mode for machines with low rigidity)

Error code

Status 0000

Adjustment result

Settling time 0 ms

Overshoot amount (Encoder pulse unit) 0 pulse

To further improve performance

Fine-adjust the model loop gain

Detailed Setting

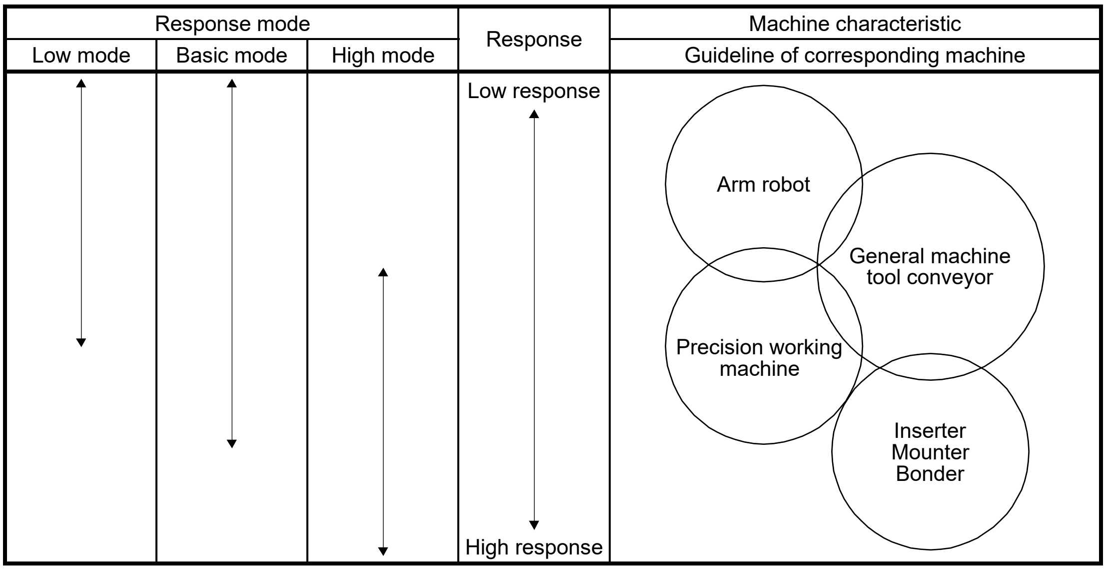
Set the detailed parameter relating to One-touch tuning
Tuning of overshoot amount may be enabled.

Table 6.2 Response mode explanations

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.

Table 6.3 Guideline for response mode



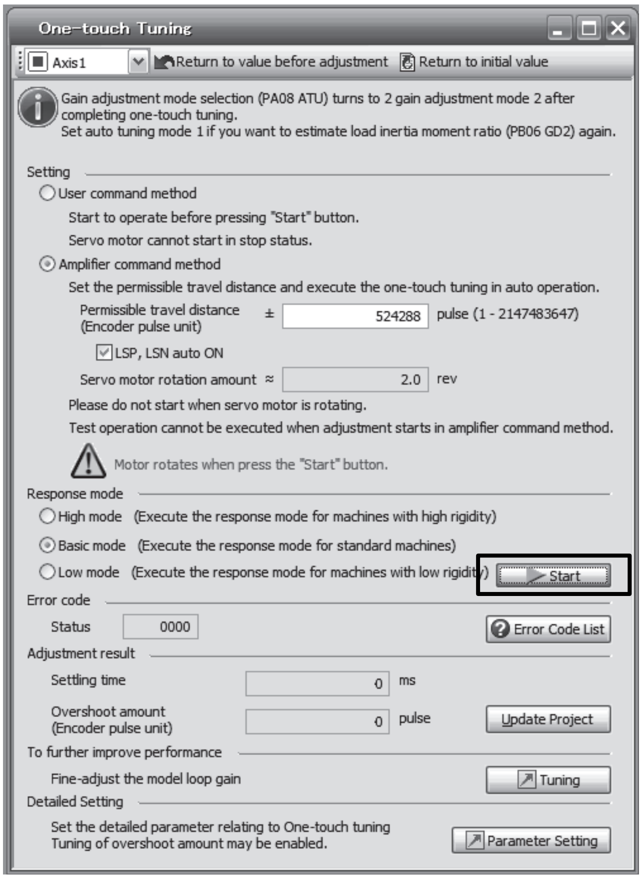
(3) One-touch tuning execution

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. ●When executing one-touch tuning in the amplifier command method, turn on EM2. When you turn off EM2 during one-touch tuning, "C008" will be displayed at status in error code, and the one-touch tuning will be canceled. ●When executing the one-touch tuning in the amplifier command method, FLS (Upper stroke limit) and RLS (Lower stroke limit) will be disabled. Thus, set a permissible travel distance within a range where moving part collision never occurs, or execute the one-touch tuning in a state in which the servo motor can immediately stop in emergency. ●When one-touch tuning is executed in the amplifier command method while magnetic pole detection is not being performed, magnetic pole detection will be performed, and then one-touch tuning will start after the magnetic pole detection is completed.

After the response mode is selected in (2) in this section, clicking "start" will start one-touch tuning. If "start" is clicked while the servo motor stops, "C002" or "C004" will be displayed at status in error code. (Refer to (5) in this section for error codes.)

Click "Start" with the amplifier command method selected in the servo-off, the servo-on will be automatically enabled, and the one-touch tuning will start. In the one-touch tuning by the amplifier command method, an optimum tuning command will be generated in the servo amplifier after servo-on. Then, the servo motor will reciprocate, and the one-touch tuning will be executed. After the tuning is completed or canceled, the servo amplifier will be the servo-off status. When the servo-on command is inputted from outside, the amplifier will be the servo-on status.

After one-touch tuning is executed using the amplifier command method, control will not be performed by commands from the controller. To return to the state in which control is performed by commands from the controller, reset the controller or cycle the power.


One-touch Tuning

Axis1 | Return to value before adjustment | Return to initial value

Gain adjustment mode selection (PA08 ATU) turns to 2 gain adjustment mode 2 after completing one-touch tuning.
Set auto tuning mode 1 if you want to estimate load inertia moment ratio (PB06 GD2) again.

Setting

○ User command method
Start to operate before pressing "Start" button.
Servo motor cannot start in stop status.

● Amplifier command method
Set the permissible travel distance and execute the one-touch tuning in auto operation.
Permissible travel distance (Encoder pulse unit) ± 524288 pulse (1 - 2147483647)
☑ LSP, LSN auto ON
Servo motor rotation amount ≈ 2.0 rev
Please do not start when servo motor is rotating.
Test operation cannot be executed when adjustment starts in amplifier command method.
Motor rotates when press the "Start" button.

Response mode

○ High mode (Execute the response mode for machines with high rigidity)
● Basic mode (Execute the response mode for standard machines)
○ Low mode (Execute the response mode for machines with low rigidity) Start

Error code

Status 0000 | Error Code List

Adjustment result

Settling time 0 ms
Overshoot amount (Encoder pulse unit) 0 pulse | Update Project

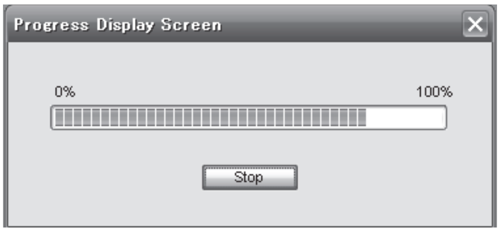
To further improve performance

Fine-adjust the model loop gain | Tuning

Detailed Setting

Set the detailed parameter relating to One-touch tuning
Tuning of overshoot amount may be enabled. | Parameter Setting

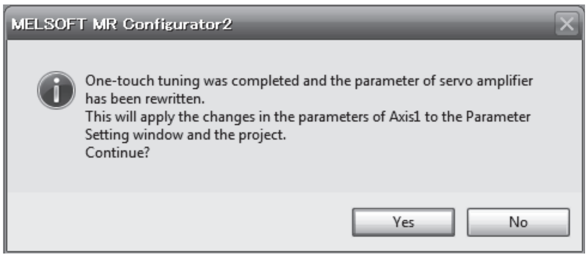
During processing of one-touch tuning, the progress will be displayed as follows. Tuning will be completed at 100%.


Progress Display Screen

0% 100%

Stop

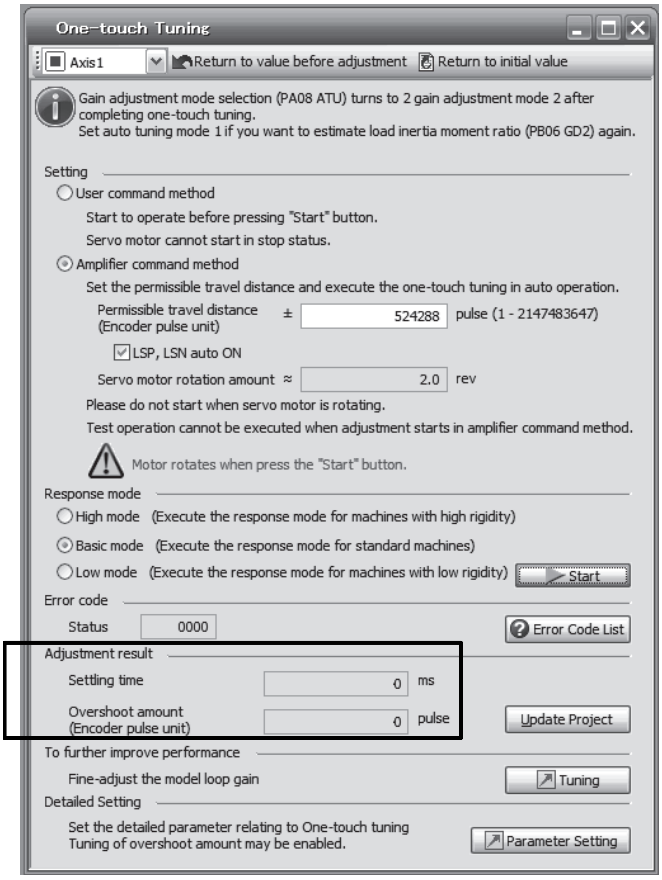
Completing the one-touch tuning will start writing tuning parameters to the servo amplifier, and the following window will be displayed. Select whether or not to reflect the tuning result in the project.


MELSOFT MR Configurator2

One-touch tuning was completed and the parameter of servo amplifier has been rewritten.
This will apply the changes in the parameters of Axis1 to the Parameter Setting window and the project.
Continue?

Yes | No

After the one-touch tuning is completed, "0000" will be displayed at status in error code. In addition, settling time and overshoot amount will be displayed in "Adjustment result".



One-touch Tuning

Axis1 | Return to value before adjustment | Return to initial value

Gain adjustment mode selection (PA08 ATU) turns to 2 gain adjustment mode 2 after completing one-touch tuning.
Set auto tuning mode 1 if you want to estimate load inertia moment ratio (PB06 GD2) again.

Setting

○ User command method

Start to operate before pressing "Start" button.
Servo motor cannot start in stop status.

● Amplifier command method

Set the permissible travel distance and execute the one-touch tuning in auto operation.

Permissible travel distance (Encoder pulse unit) ± 524288 pulse (1 - 2147483647)

☑ LSP, LSN auto ON

Servo motor rotation amount ≈ 2.0 rev

Please do not start when servo motor is rotating.
Test operation cannot be executed when adjustment starts in amplifier command method.

Motor rotates when press the "Start" button.

Response mode

○ High mode (Execute the response mode for machines with high rigidity)
● Basic mode (Execute the response mode for standard machines)
○ Low mode (Execute the response mode for machines with low rigidity)

Start

Error code

Status 0000

Error Code List

Adjustment result

Settling time 0 ms

Overshoot amount (Encoder pulse unit) 0 pulse

Update Project

To further improve performance

Fine-adjust the model loop gain

Tuning

Detailed Setting

Set the detailed parameter relating to One-touch tuning
Tuning of overshoot amount may be enabled.

Parameter Setting

(4) Stop of one-touch tuning

When "Stop" is clicked during one-touch tuning, the tuning will be stopped. At this time, "C000" will be displayed at status in error code. When the one-touch tuning is stopped, the parameter setting will be returned to the values at the start of the one-touch tuning. Stop the servo motor before executing the one-touch tuning again. In addition, execute it after the moving part is returned to the tuning start position.

(5) If an error occurs

If a tuning error occurs during tuning, one-touch tuning will be stopped. With that, the following error code will be displayed in status. Check the cause of tuning error. When executing one-touch tuning again, stop the servo motor once. In addition, after returning the moving part to the tuning start position, execute it.

Display	Name	Error detail	Corrective action example
C000	Tuning canceled	"Stop" was clicked during one-touch tuning.	
C001	Overshoot exceeded	Overshoot amount is a value larger than the one set in [Pr. PA10 In-position range] and [Pr. PA25 One-touch tuning - Overshoot permissible level].	Increase the in-position range or overshoot permissible level.
C002	Servo-off during tuning	The one-touch tuning was attempted in the user command method during servo-off. The servo amplifier will be servo-off status during one-touch tuning.	When executing one-touch tuning in the user command method, turn to servo-on, and then execute it. Prevent the servo amplifier from being the servo-off status during one-touch tuning.
C003	Control mode error	1. 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 execute one-touch tuning. Do not change the control mode during the one-touch tuning.
		2. During one-touch tuning, the control mode was attempted to change from the position control mode to the speed control mode.	
C004	Time-out	1. One cycle time during the operation has been over 30 s.	Set one cycle time during the operation (time from the command start to the next command start) to 30 s or less.
		2. The command speed is slow.	Set the servo motor speed to 100 r/min or higher. Error is less likely to occur as the setting speed is higher. When one-touch tuning by the amplifier command is used, set a permissible travel distance so that the servo motor speed is 100 r/min or higher. Set a permissible travel distance to two or more revolutions as a guide value to set the servo motor speed to 100 r/min.
		3. The operation interval of the continuous operation is short.	Set the stop interval during operation to 200 ms or more. Error is less likely to occur as the setting time is longer.
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. ・The acceleration time constant/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 an oscillation or other influences.	Set to the auto tuning mode that does not estimate the load to motor inertia ratio as follows, and then execute the one-touch tuning. ・Select "Auto tuning mode 2 (_ _ _ 2)", "Manual mode (_ _ _ 3)", or "2 gain adjustment mode 2 (_ _ _ 4)" of "Gain adjustment mode selection" in [Pr. PA08]. ・Manually set [Pr. PB06 Load to motor inertia ratio/load to motor mass ratio] properly.

Display	Name	Error detail	Corrective action example
C006	Amplifier command start error	One-touch tuning was attempted to start in the amplifier command method under the following speed condition. Servo motor speed: 20 r/min or higher	Execute the one-touch tuning in the amplifier command method while the servo motor is stopped.
C007	Amplifier command generation error	1. One-touch tuning was executed in the amplifier command method when the permissible travel distance is set to 100 pulses or less in the encoder pulse unit, or the distance is set not to increase the servo motor speed to 150 r/min (mm/s) (50 r/min for direct drive motor) or higher at the time of load to motor inertia ratio estimation.	Set a permissible travel distance to 100 pulses or more in the encoder pulse unit, or a distance so as to increase the servo motor speed to 150 r/min (mm/s) (50 r/min for direct drive motor) or higher at the time of load to motor inertia ratio estimation, and then execute the one-touch tuning. Set a permissible travel distance to four or more revolutions as a guide value. Load to motor inertia ratio will be estimated when "0000" or "0001" is set in [Pr. PA08 Auto tuning mode] at the start of one-touch tuning. If the permissible travel distance is short and the servo motor speed cannot be increased to 150 r/min (mm/s) (50 r/min for direct drive motor) or higher, select "Auto tuning mode 2 (_ _ _ 2)", "Manual mode (_ _ _ 3)", or "2 gain adjustment mode 2 (_ _ _ 4)" of "Gain adjustment mode selection" in [Pr. PA08].
		2. An overspeed alarm detection level is set so that the servo motor speed becomes 150 r/min (mm/s) (50 r/min for direct drive motor) or less at the time of load to motor inertia ratio estimation.	When estimating the load to motor inertia ratio, set the overspeed alarm detection level so that the speed becomes 150 r/min or more.
		3. The torque limit has been set to 0.	Set the torque limit value to greater than 0.
C008	Stop signal	EM2 was turned off during one-touch tuning in the amplifier command method.	Review the one-touch tuning start position and permissible travel distance for the amplifier command method. After ensuring safety, turn on EM2.
C009	Parameter	Parameters for manufacturer setting have been changed.	Return the parameters for manufacturer setting to the initial values.
C00A	Alarm	One-touch tuning was attempted to start in the amplifier command method during alarm or warning. Alarm or warning occurred during one-touch tuning by the amplifier command method.	Start one-touch tuning when no alarm or warning occurs. Prevent alarm or warning from occurring during one-touch tuning.
C00F	One-touch tuning disabled	"One-touch tuning function selection" in [Pr. PA21] is "Disabled (_ _ _ 0)".	Select "Enabled (_ _ _ 1)".

(6) If an alarm occurs

If an alarm occurs during the one-touch tuning, the tuning will be forcibly terminated. Remove the cause of the alarm and execute one-touch tuning again. When executing one-touch tuning in the amplifier command method again, return the moving part to the tuning start position.

(7) If a warning occurs

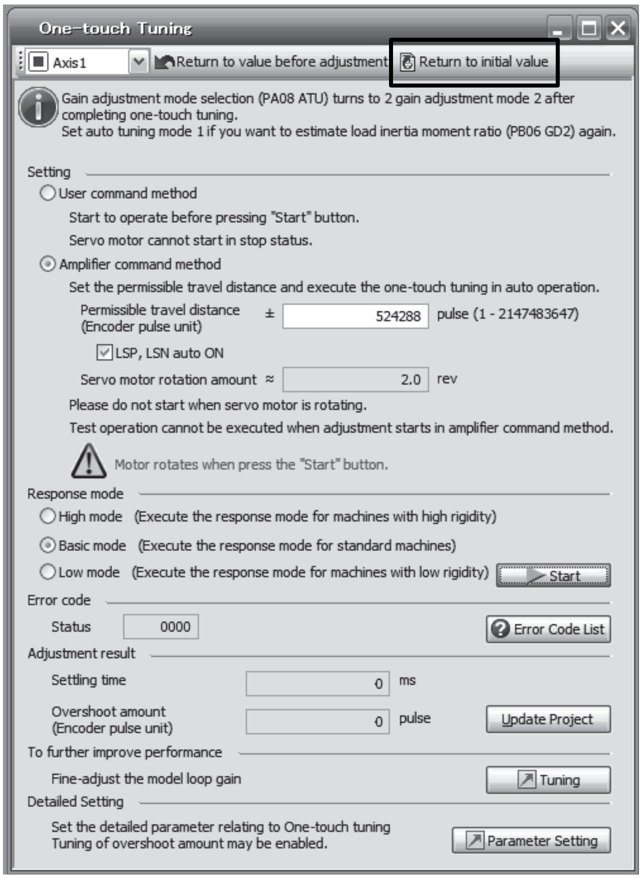
If a warning which continues the motor driving occurs during one-touch tuning by the user command method, the tuning will be continued. If a warning which does not continue the motor driving occurs during the tuning, one-touch tuning will be stopped.

One-touch tuning will be stopped when warning occurs during one-touch tuning by the amplifier command method regardless of the warning type. Remove the cause of the warning, and return the moving part to the tuning start position. Then, execute the tuning again.

(8) Initializing one-touch tuning

Clicking "Return to initial value" in the one-touch tuning window of MR Configurator2 enables to return the parameter to the initial value. Refer to table 6.1 for the parameters which you can initialize.

Clicking "Return to value before adjustment" in the one-touch tuning window of MR Configurator2 enables to return the parameter to the value before clicking "start".



Gain adjustment mode selection (PA08 ATU) turns to 2 gain adjustment mode 2 after completing one-touch tuning.
Set auto tuning mode 1 if you want to estimate load inertia moment ratio (PB06 GD2) again.

○ User command method
Start to operate before pressing "Start" button.
Servo motor cannot start in stop status.
● Amplifier command method
Set the permissible travel distance and execute the one-touch tuning in auto operation.
Permissible travel distance (Encoder pulse unit) ± 524288 pulse (1 - 2147483647)
☑ LSP, LSN auto ON
Servo motor rotation amount ≈ 2.0 rev
Please do not start when servo motor is rotating.
Test operation cannot be executed when adjustment starts in amplifier command method.
Motor rotates when press the "Start" button.

○ High mode (Execute the response mode for machines with high rigidity)
● Basic mode (Execute the response mode for standard machines)
○ Low mode (Execute the response mode for machines with low rigidity)

Status 0000

Settling time 0 ms
Overshoot amount (Encoder pulse unit) 0 pulse

Fine-adjust the model loop gain

Set the detailed parameter relating to One-touch tuning
Tuning of overshoot amount may be enabled.

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

Returned to the initial values.

6.2.3 Caution for one-touch tuning

(1) Caution common for user command method and amplifier command method

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

(b) The one-touch tuning cannot be executed while an alarm or warning which does not continue the motor driving is occurring.

(c) The one-touch tuning cannot be executed during the following test operation mode.

1) Output signal (DO) forced output

2) Motor-less operation

(d) If one-touch tuning is performed when the gain switching function is enabled, vibration and/or unusual noise may occur during the tuning.

(2) Caution for amplifier command method

(a) Starting one-touch tuning while the servo motor is rotating displays "C006" at status in error code, and the one-touch tuning cannot be executed.

(b) One-touch tuning is not available during the test operation mode. The following test operation modes cannot be executed during one-touch tuning.

1) Positioning operation

2) JOG operation

3) Program operation

4) Machine analyzer operation

(c) After one-touch tuning is executed, control will not be performed by commands from the servo system controller. To return to the state in which control is performed from the servo system controller, reset the controller or cycle the power of the servo amplifier.

(d) During one-touch tuning, the permissible travel distance may be exceeded due to overshoot, set a value sufficient to prevent machine collision.

(e) When Auto tuning mode 2, Manual mode, or 2 gain adjustment mode 2 is selected in [Pr. PA08 Auto tuning mode], the load to motor inertia ratio will not be estimated. An optimum acceleration/deceleration command will be generated by [Pr. PB06 Load to motor inertia ratio/load to motor mass ratio] at the start of one-touch tuning. When the load to motor inertia ratio is incorrect, the optimum acceleration/deceleration command may not be generated, causing the tuning to fail.

(f) When one-touch tuning is started by using USB communication, if the USB communication is interrupted during the tuning, the servo motor will stop, and the tuning will also stop. The parameter will return to the one at the start of the one-touch tuning.

(g) When one-touch tuning is started via the controller, if communication between the controller and the servo amplifier or personal computer is shut-off during the tuning, the servo motor will stop, and the tuning will also stop. The parameter will return to the one at the start of the one-touch tuning.

(h) When one-touch tuning is started during the speed control mode, the mode will be switched to the position control mode automatically. The tuning result may differ from the one obtained by executing tuning by using the speed command.

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/load to motor mass ratio
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

POINT

- ●The auto tuning mode 1 may not be performed properly if all of the following conditions are not satisfied.
  - ･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

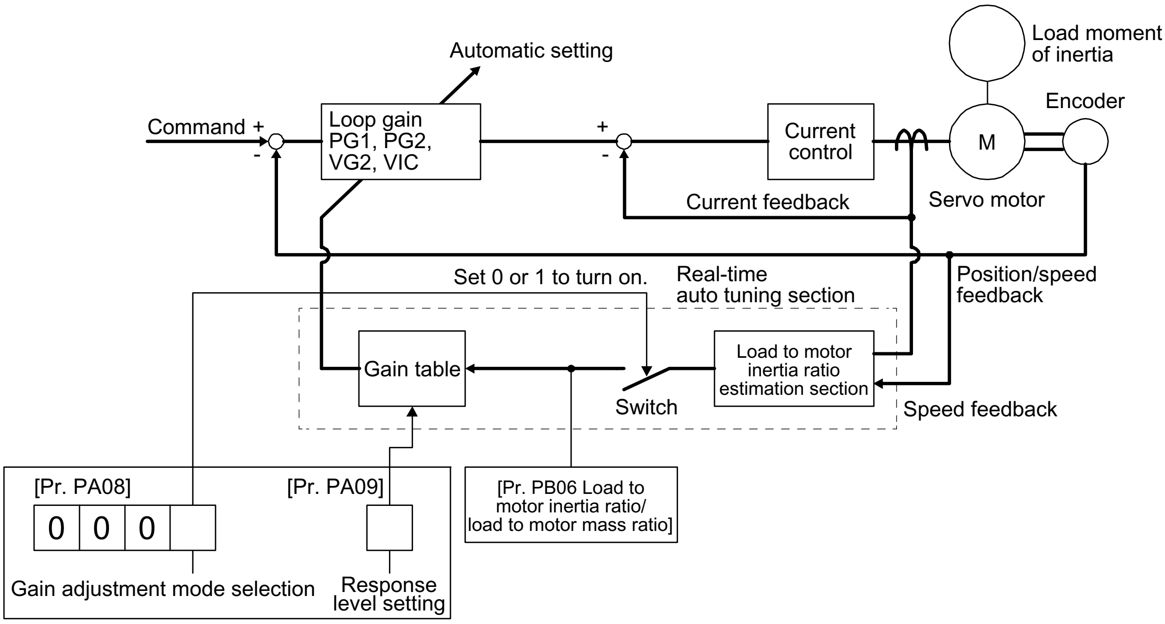
Use the auto tuning mode 2 when proper gain adjustment cannot be made by auto tuning mode 1. Since the load to motor inertia ratio is not estimated in this mode, set the value of a correct load to motor inertia ratio in [Pr. PB06].

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

6.3.2 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/load to motor mass 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 or load to motor mass ratio ([Pr. PB06]) manually.

From the preset load to motor inertia ratio ([Pr. PB06]) value and response ([Pr. PA09]), the optimum loop gains are automatically set on the basis of the internal gain table.

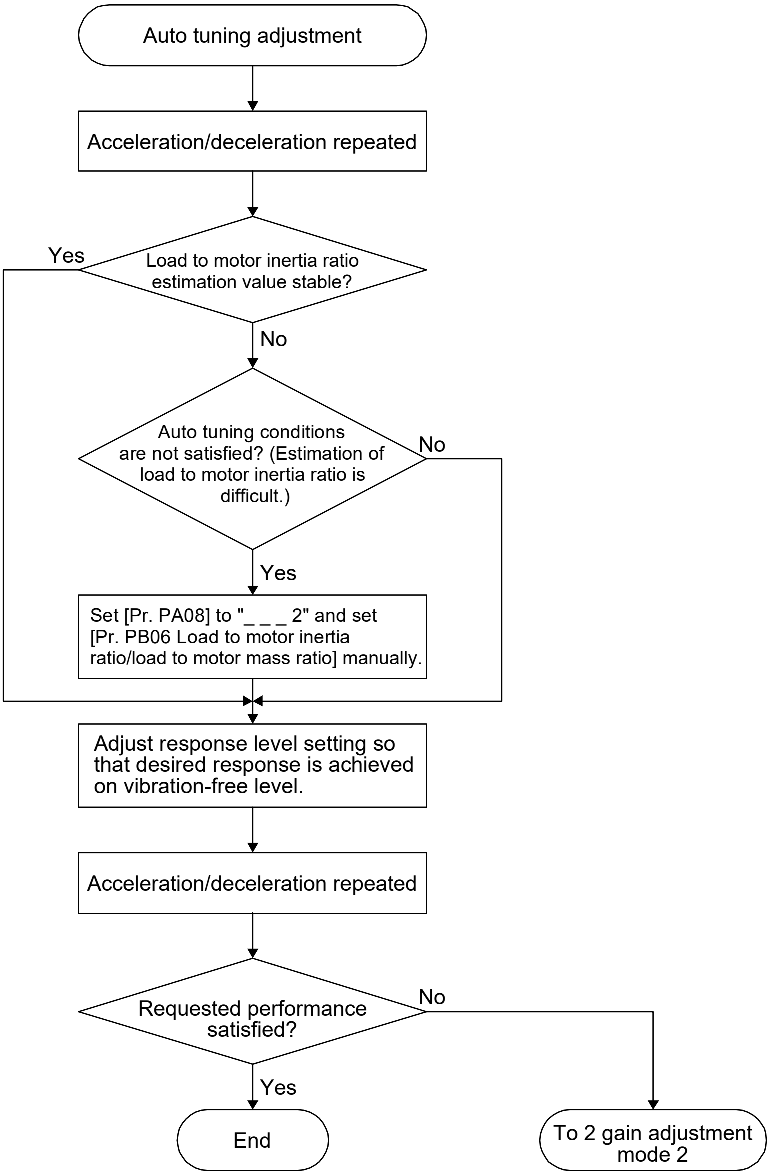
The auto tuning results are saved in the EEP-ROM of the servo amplifier every 60 minutes since power-on. At power-on, auto tuning is performed with the value of each loop gain saved in the EEP-ROM being used as an initial value.

POINT

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

6.3.3 Adjustment procedure by auto tuning

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



6.3.4 Response level setting in auto tuning mode

Set the response of the whole servo system by [Pr. PA09]. As the response level setting is increased, the trackability to a command improves and settling time decreases, but setting the response level too high will generate vibration. Set a value to obtain the desired response level 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
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	

6.4 Manual mode

If you are not satisfied with the adjustment of auto tuning, you can adjust all gains manually.

POINT

- ●If machine resonance occurs, filter tuning mode selection in [Pr. PB01] or machine resonance suppression filter in [Pr. PB13] to [Pr. PB16] and [Pr. PB46] to [Pr. PB51] may be used to suppress machine resonance. (Refer to section 7.2 to 7.3.)

(1) For speed control

(a) Parameter

The following parameters are used for gain adjustment.

Parameter	Symbol	Name
PB06	GD2	Load to motor inertia ratio/load to motor mass 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/load to motor mass ratio. (If the estimate value with auto tuning is correct, setting change is not required.)	
4	Set a small value to the model loop gain. Set a large 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

(c) Parameter adjustment

1) [Pr. PB09 Speed loop gain]

This parameter determines the response level of the speed control loop. Increasing this value will improve responsiveness, but increasing the value excessively will cause the mechanical system to easily vibrate. The actual response frequency of the speed loop is as indicated in the following expression.

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

2) [Pr. PB10 Speed integral compensation]

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

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

3) [Pr. PB07 Model loop gain]

This parameter determines the response level to a speed command. Increasing the value improves trackability 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/load to motor mass ratio
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

(b) Adjustment procedure

Step	Operation	Description
1	Brief-adjust with auto tuning. Refer to section 6.2.3.	
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/load to motor mass ratio. (If the estimate value with auto tuning is correct, setting change is not required.)	
4	Set a small value to the model loop gain. Set a large 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 will improve responsiveness, but increasing the value excessively will cause the mechanical system to easily 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.

Speed integral compensation setting [ms]

$$\geq \frac{2000 \text{ to } 3000}{\text{Speed loop gain}/(1 + \text{Load to motor inertia ratio})}$$

3) [Pr. PB08 Position loop gain]
This parameter determines the response level to a disturbance to the position control loop. Increasing the 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 trackability 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 trackability. 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 trackability. 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/load to motor mass ratio
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

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

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

(2) 2 gain adjustment mode 2

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

The following parameters are used for 2 gain adjustment mode 2.

(a) Automatically adjusted parameter

The following parameters are automatically adjusted by auto tuning.

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

(b) Manually adjusted parameter

The following parameters are adjustable manually.

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

(3) Adjustment procedure of 2 gain adjustment mode

POINT

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

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

(4) Parameter adjustment

[Pr. PB07 Model loop gain]

This parameter determines the response level of the position control loop. Increasing the value improves trackability to a position command, but a too high value will make overshoot liable to occur at settling. Number of droop pulses 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.

Rotary servo motor and direct drive motor:

Position command frequency

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

Linear servo motor:

Position command frequency = Speed [mm/s] ÷ Encoder resolution (travel distance per pulse)

MEMO

7. SPECIAL ADJUSTMENT FUNCTIONS

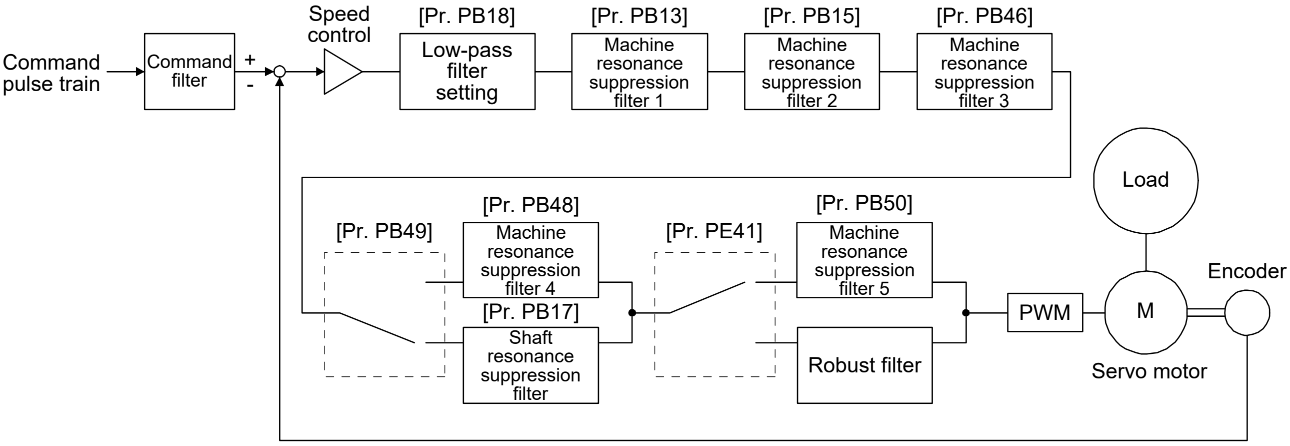
POINT

- The functions given in this chapter need not be used normally. Use them if you are not satisfied with the machine status after making adjustment in the methods in chapter 6.
- When you use a linear servo motor, replace the following words in the left to the words in the right.

Load to motor inertia ratio	→	Load to motor mass ratio
Torque	→	Thrust
(Servo motor) speed	→	(Linear servo motor) speed

7.1 Filter setting

The following filters are available with MR-J4 servo amplifiers.



7.1.1 Machine resonance suppression filter

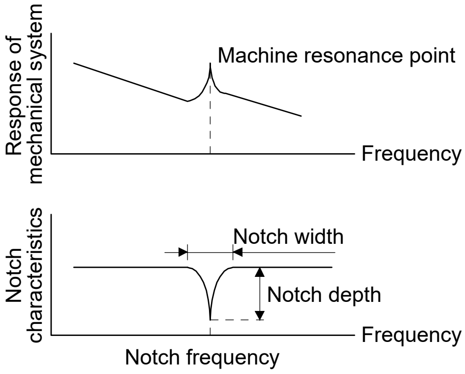
POINT

- ●The machine resonance suppression filter is a delay factor for the servo system. Therefore, vibration may increase if you set an incorrect resonance frequency or set notch characteristics too deep or too wide.
- ●If the frequency of machine resonance is unknown, decrease the notch frequency from higher to lower ones in order. The optimum notch frequency is set at the point where vibration is minimal.
- ●A deeper notch has a higher effect on machine resonance suppression but increases a phase delay and may increase vibration.
- ●A wider 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 unique resonance point, increasing the servo system response level may cause resonance (vibration or unusual noise) in the mechanical system at that resonance frequency. Using the machine resonance suppression filter and adaptive tuning can suppress the resonance of the mechanical system. The setting range is 10 Hz to 4500 Hz.

(1) Function

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



You can set five machine resonance suppression filters at most.

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

(2) Parameter

(a) Machine resonance suppression filter 1 ([Pr. PB13]/[Pr. PB14])
Set the notch frequency, notch depth and notch width of the machine resonance suppression filter 1 ([Pr. PB13]/[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]/[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]/[Pr. PB16]) is the same as for the machine resonance suppression filter 1 ([Pr. PB13]/[Pr. PB14]).

(c) Machine resonance suppression filter 3 ([Pr. PB46]/[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]/[Pr. PB47]) is the same as for the machine resonance suppression filter 1 ([Pr. PB13]/[Pr. PB14]).

(d) Machine resonance suppression filter 4 ([Pr. PB48]/[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]/[Pr. PB49]) is the same as for the machine resonance suppression filter 1 ([Pr. PB13]/[Pr. PB14]).

(e) Machine resonance suppression filter 5 ([Pr. PB50]/[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]/[Pr. PB51]) is the same as for the machine resonance suppression filter 1 ([Pr. PB13]/[Pr. PB14]).

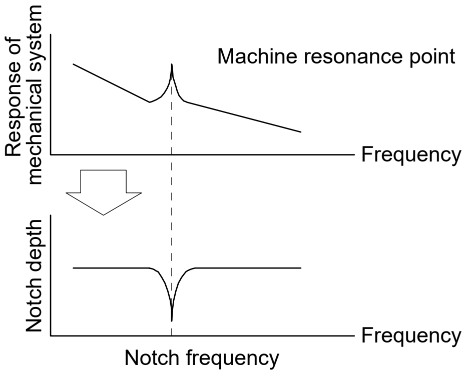
7.1.2 Adaptive filter II

POINT

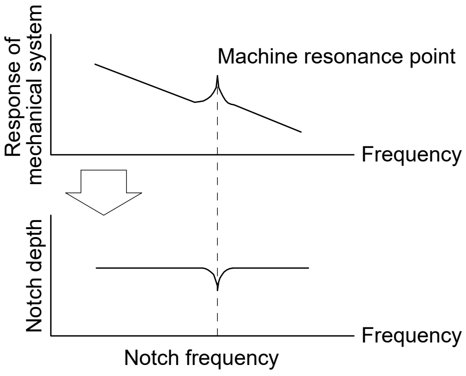
- The machine resonance frequency which adaptive filter II (adaptive tuning) can respond to is about 100 Hz to 2.25 kHz. As for the resonance frequency out of the range, set manually.
- When adaptive tuning is executed, vibration sound increases as an excitation signal is forcibly applied for several seconds.
- When adaptive tuning is executed, machine resonance is detected for a maximum of 10 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.
- Adaptive tuning in the high accuracy mode is available with servo amplifiers with software version C5 or later. The frequency is estimated more accurately in the high accuracy mode compared to the standard mode. However, the tuning sound may be larger in the high accuracy mode.

(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.



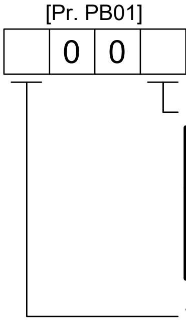
When machine resonance is large and frequency is low



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)].



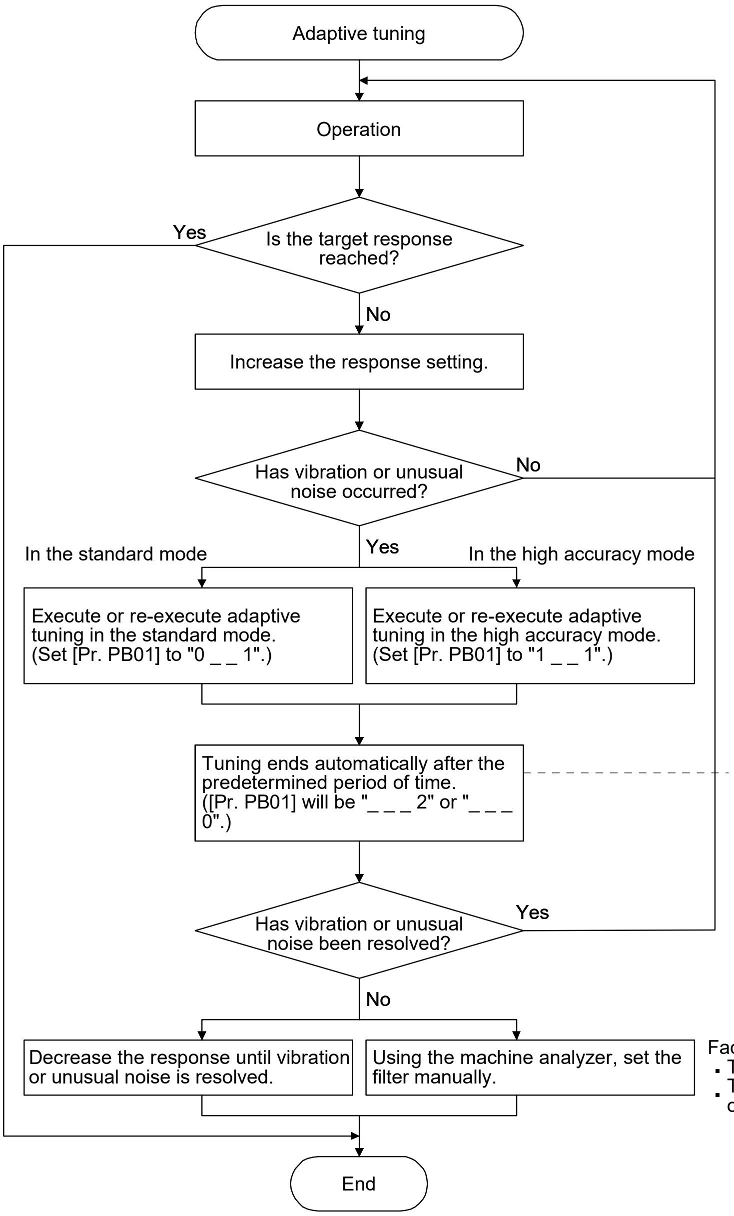
Filter tuning mode selection

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

Tuning accuracy selection (Note)
0: Standard
1: High accuracy

Note. This digit is available with servo amplifier with software version C5 or later.

(3) Adaptive tuning mode procedure



If assumption fails after tuning is executed at a large vibration or oscillation, decrease the response setting temporarily down to the vibration level and execute again.

Factor
- The response has increased to the machine limit.
- The machine is too complicated to provide the optimum filter.

7.1.3 Shaft resonance suppression filter

POINT

- ●This filter is set properly by default according to servo motor you use and load moment of inertia. It is recommended that [Pr. PB23] be set to "_ _ _ 0" (automatic setting) because changing "Shaft resonance suppression filter selection" in [Pr. PB23] or [Pr. PB17 Shaft resonance suppression filter] may lower the performance.

(1) Function

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

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

(2) Parameter

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

[Pr. PB23]

0	0	0	

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

To set [Pr. PB17 Shaft resonance suppression filter] automatically, select "Automatic setting".

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

Shaft resonance suppression filter setting frequency selection

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

7.1.4 Low-pass filter

(1) Function

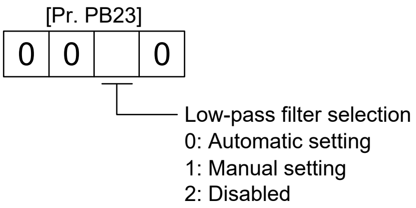
When a ball screw or the like is used, resonance of high frequency may occur as the response level of the servo system is increased. To prevent this, the low-pass filter is enabled for a torque command as a default. The filter frequency of the low-pass filter is automatically adjusted to the value in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

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

However, when an automatically adjusted value is smaller than VG2, the filter frequency will be the VG2 value. To set [Pr. PB18] manually, select "Manual setting (_ _ 1 _)" of "Low-pass filter selection" in [Pr. PB23].

(2) Parameter

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



7.1.5 Advanced vibration suppression control II

POINT

●The function is enabled when "Gain adjustment mode selection" in [Pr. PA08] is "Auto tuning mode 2 (_ _ _ 2)", "Manual mode (_ _ _ 3)", or "2 gain adjustment mode 2 (_ _ _ 4)".

●The machine resonance frequency supported in the vibration suppression control tuning mode is 1.0 Hz to 100.0 Hz. As for the vibration out of the range, set manually.

●Stop the servo motor before changing the vibration suppression control-related parameters. Otherwise, it may cause an unexpected operation.

●For positioning operation during execution of vibration suppression control tuning, provide a stop time to ensure a stop after vibration damping.

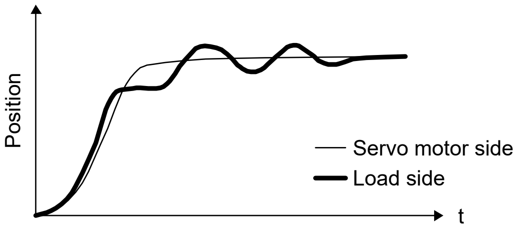
●Vibration suppression control tuning may not make normal estimation if the residual vibration at the servo motor side is small.

●Vibration suppression control tuning sets the optimum parameter with the currently set control gains. When the response setting is increased, set vibration suppression control tuning again.

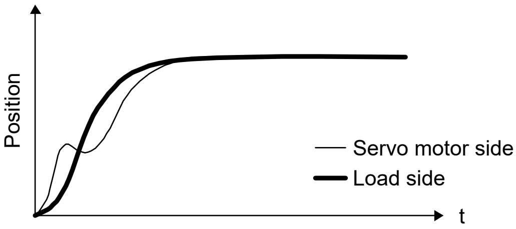
●When using the vibration suppression control 2, set "_ _ _ 1" in [Pr. PA24].

(1) Function

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.



Vibration suppression: off (normal)



Vibration suppression control: on

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

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

(2) Parameter

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

[Pr. PB02]

0 0 □ □

Vibration suppression control 1 tuning mode

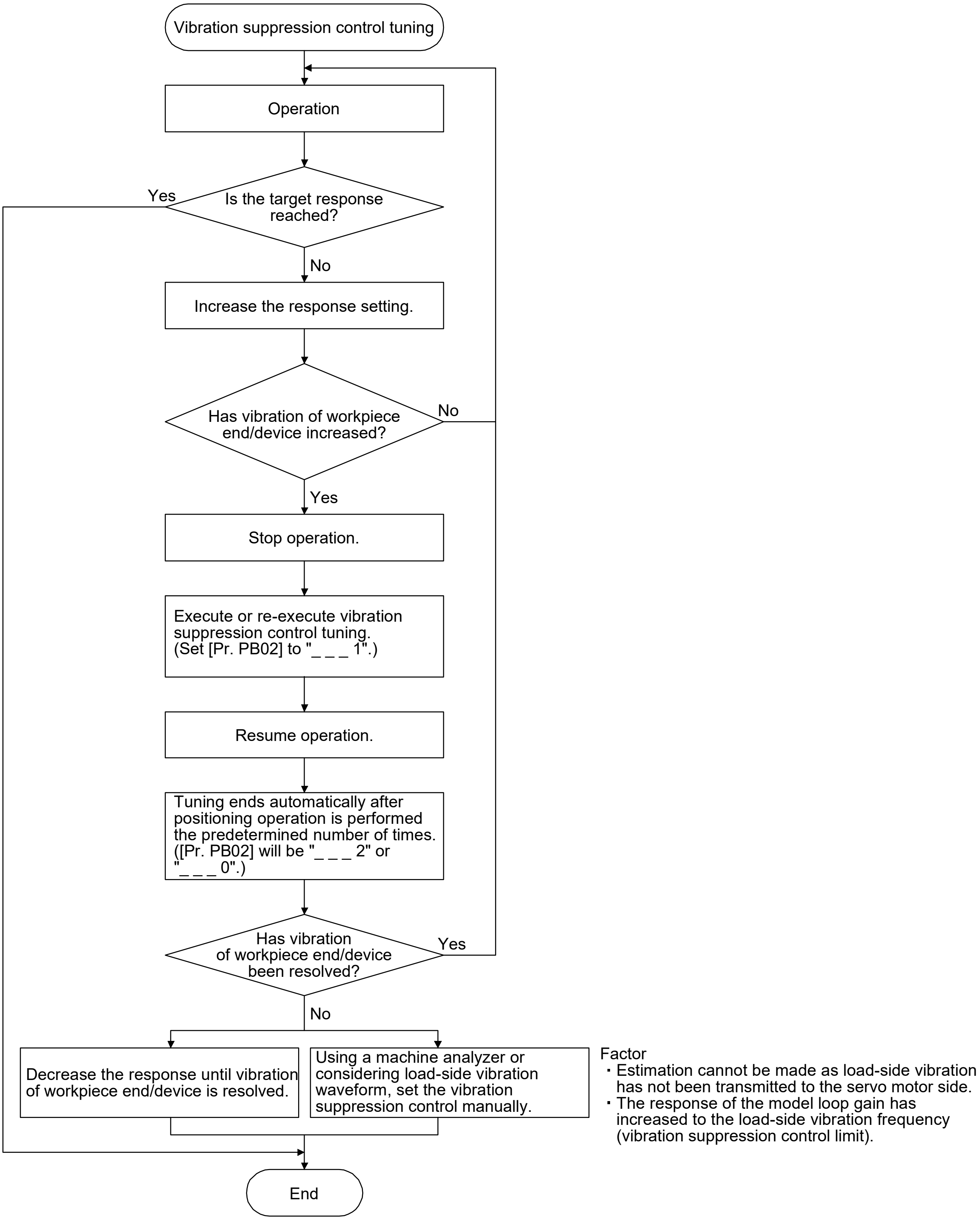
Setting value	Vibration suppression control 1 tuning mode selection	Automatically set parameter
_ _ _ 0	Disabled	
_ _ _ 1	Automatic setting	PB19/PB20/PB21/PB22
_ _ _ 2	Manual setting	

Vibration suppression control 2 tuning mode

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

(3) Vibration suppression control tuning procedure

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



(4) Vibration suppression control manual mode

POINT

- When load-side vibration does not show up in servo motor-side vibration, the setting of the servo motor-side vibration frequency does not produce an effect.
- When the anti-resonance frequency and resonance frequency can be confirmed using the machine analyzer or external equipment, do not set the same value but set different values to improve the vibration suppression performance.
- The setting range of [Pr. PB19], [Pr. PB20], [Pr. PB52], and [Pr. PB53] varies, depending on the value in [Pr. PB07]. If a value out of the range is set, the vibration suppression control will be disabled.

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

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

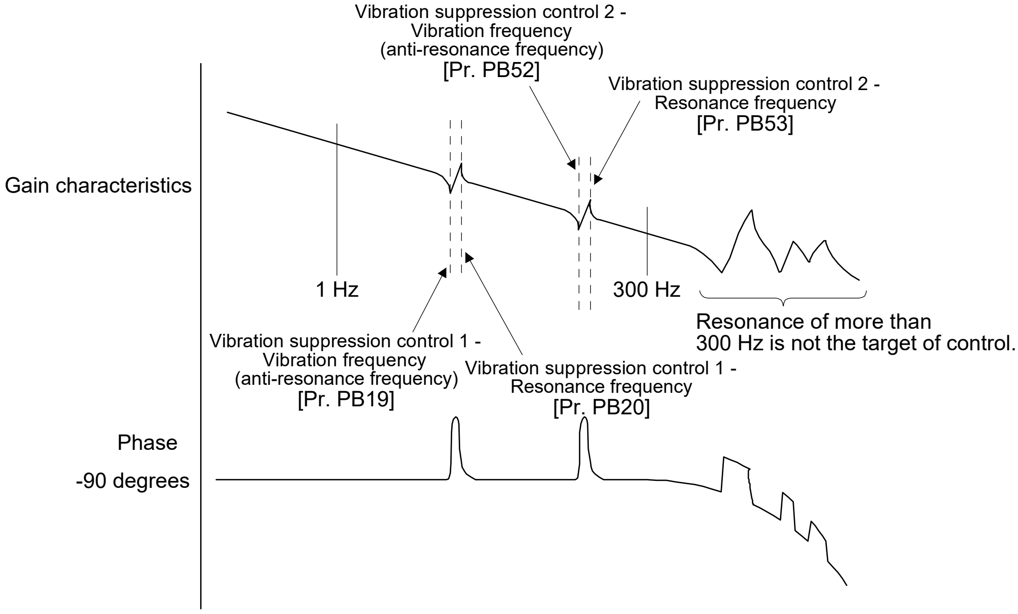
Step 1 Select "Manual setting (_ _ _ 2)" of "Vibration suppression control 1 tuning mode selection" or "Manual setting (_ _ 2 _)" of "Vibration suppression control 2 tuning mode selection" in [Pr. PB02].

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

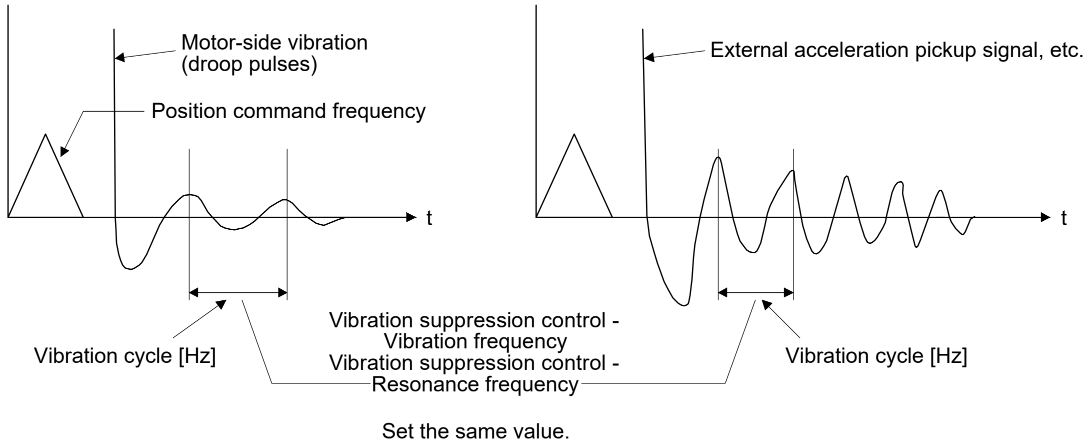
However, the value of [Pr. PB07 Model loop gain], vibration frequency, and resonance frequency have the following usable range and recommended range.

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

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



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



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

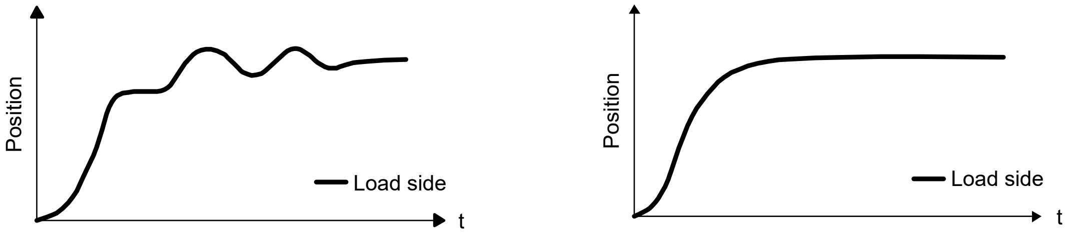
7.1.6 Command notch filter

POINT

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

(1) Function

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

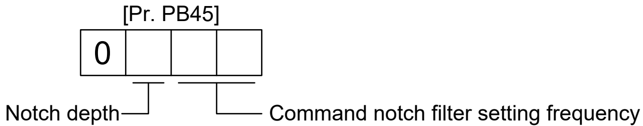


Command notch filter: disabled

Command notch filter: enabled

(2) Parameter

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



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

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

7.2 Gain switching function

You can switch gains with the function. You can switch gains during rotation and during stop, and can use a control command from a controller to switch gains during operation.

7.2.1 Applications

The following shows when you use the function.

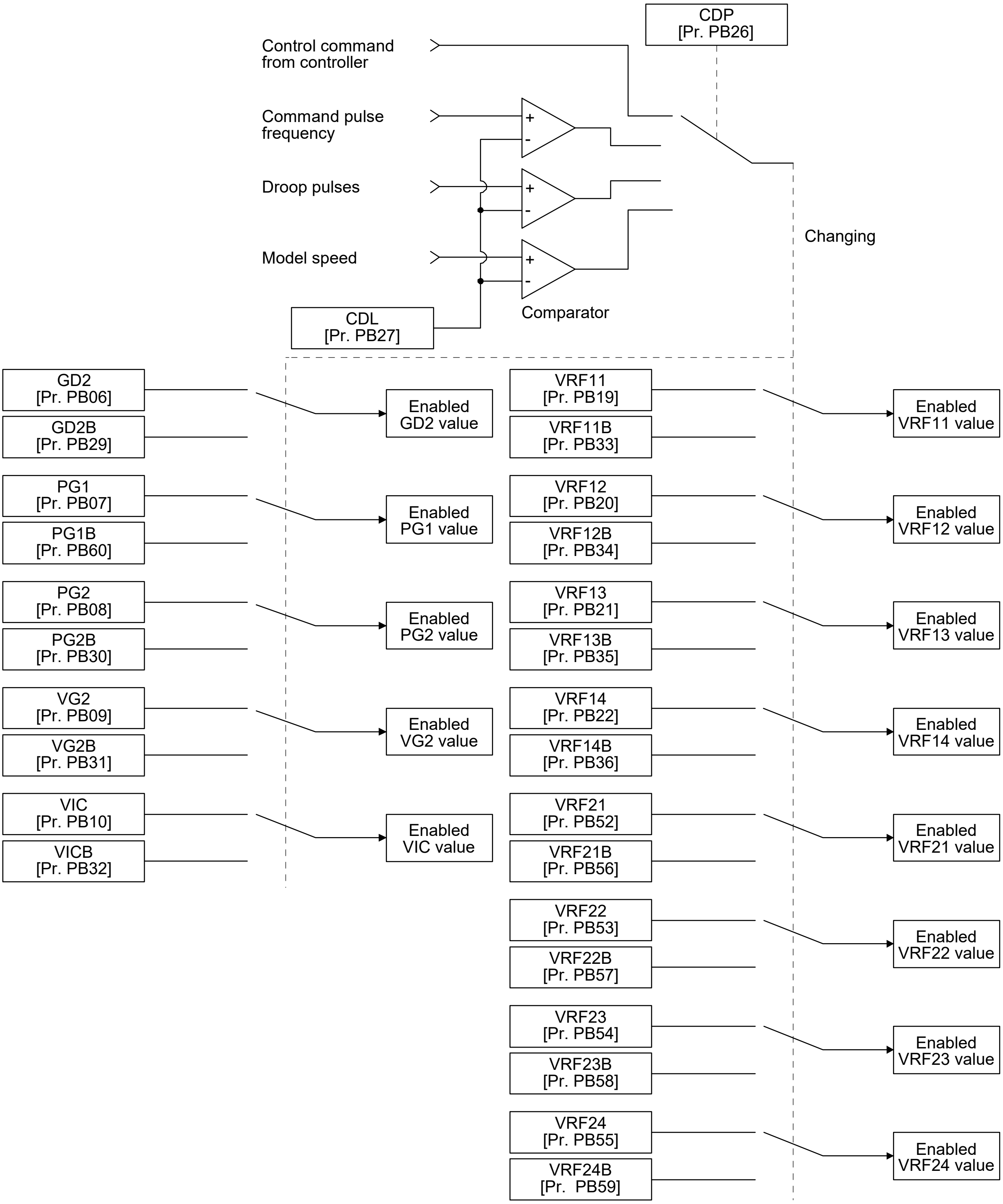
(1) You want to increase the gains during servo-lock but decrease the gains to reduce noise during rotation.

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

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

7.2.2 Function block diagram

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



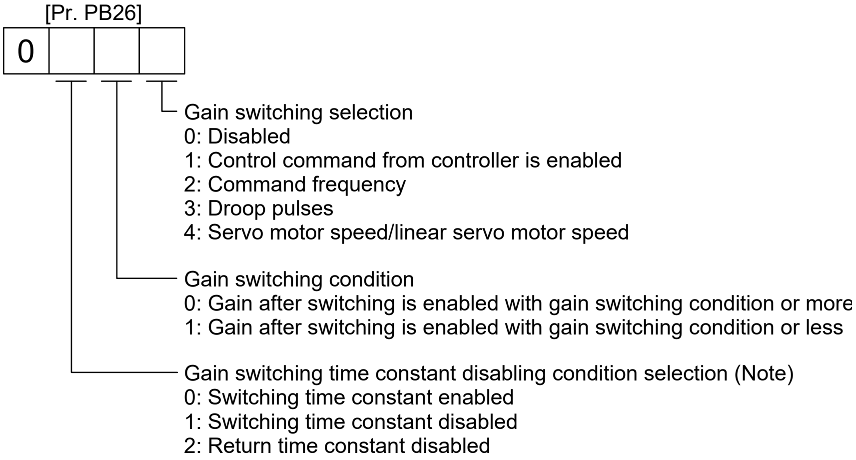
7.2.3 Parameter

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

(1) Parameter for setting gain switching condition

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

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



Gain switching selection
0: Disabled
1: Control command from controller is enabled
2: Command frequency
3: Droop pulses
4: Servo motor speed/linear servo motor speed

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

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

Note. This digit is available with servo amplifier with software version B4 or later.

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

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

(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.

(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 after gain switching
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/load to motor mass ratio, model loop gain, 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.

(c) [Pr. PB29 Load to motor inertia ratio/load to motor mass ratio after gain switching]
Set the load to motor inertia ratio or load to motor mass 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/load to motor mass 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 gain switching model loop gain are used only with control command from the controller.
You can switch the vibration frequency, resonance frequency, vibration frequency damping, resonance frequency damping, and model loop gain of the vibration suppression control 1 and vibration suppression control 2.

7.2.4 Gain switching procedure

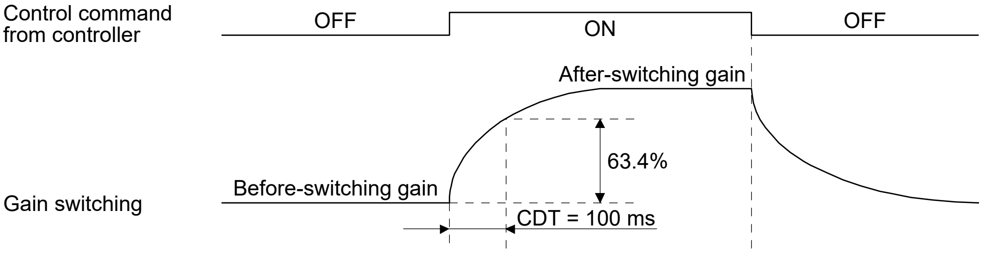
This operation will be described by way of setting examples.

(1) When you choose switching by control command from the controller

(a) Setting example

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 control command from the controller.)	
PB28	CDT	Gain switching time constant	100	[ms]
PB33	VRF11B	Vibration suppression control 1 - Vibration frequency after gain switching	60	[Hz]
PB34	VRF12B	Vibration suppression control 1 - Resonance frequency after gain switching	60	[Hz]
PB35	VRF13B	Vibration suppression control 1 - Vibration frequency damping after gain switching	0.15	
PB36	VRF14B	Vibration suppression control 1 - Resonance frequency damping after gain switching	0.15	
PB56	VRF21B	Vibration suppression control 2 - Vibration frequency after gain switching	30	[Hz]
PB57	VRF22B	Vibration suppression control 2 - Resonance frequency after gain switching	30	[Hz]
PB58	VRF23B	Vibration suppression control 2 - Vibration frequency damping after gain switching	0.05	
PB59	VRF24B	Vibration suppression control 2 - Resonance frequency damping after gain switching	0.05	

(b) Switching timing chart



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

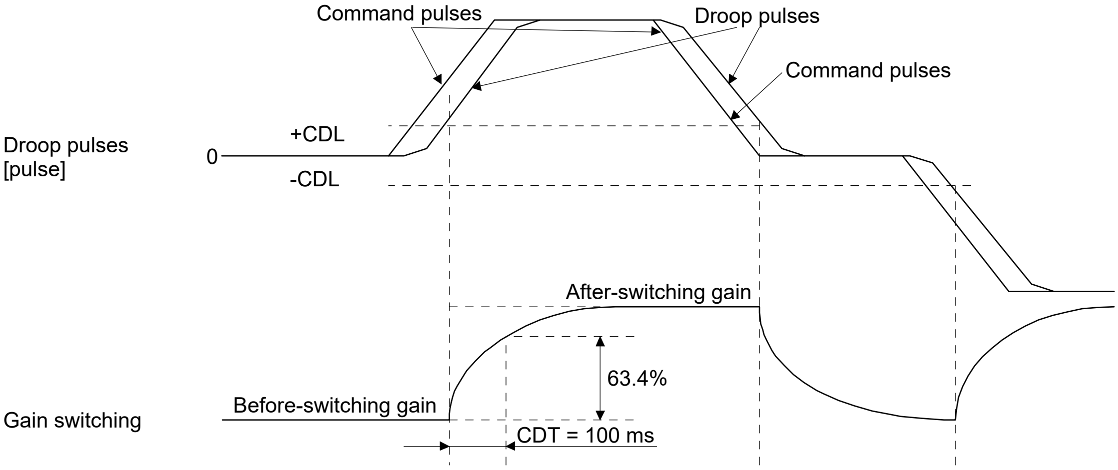
(2) When you choose switching by droop pulses

The vibration suppression control after gain switching and model loop gain after gain switching cannot be used.

(a) Setting example

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]

(b) Switching timing chart



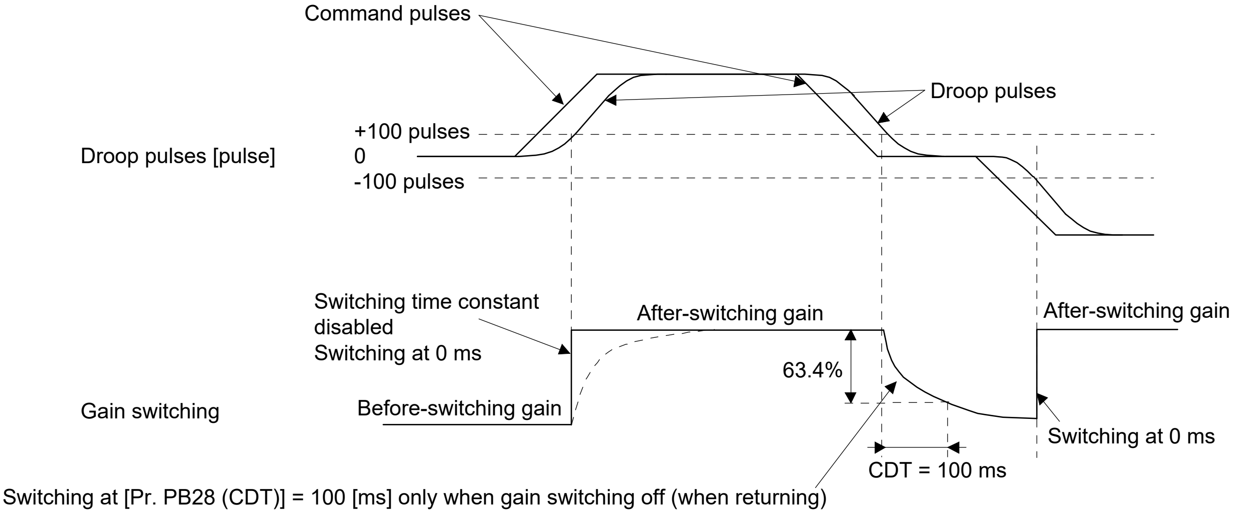
Load to motor inertia ratio/load to motor mass ratio	4.00	→	10.00	→	4.00	→	10.00
Position loop gain	120	→	84	→	120	→	84
Speed loop gain	3000	→	4000	→	3000	→	4000
Speed integral compensation	20	→	50	→	20	→	50

(3) When the gain switching time constant is disabled

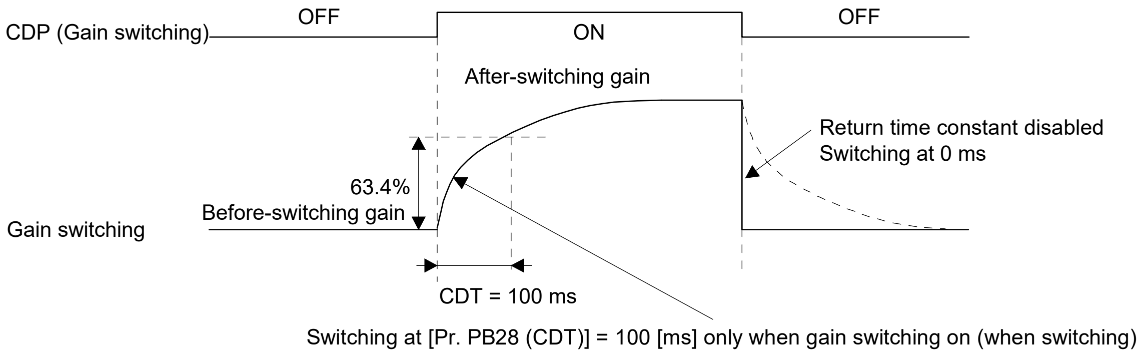
(a) Switching time constant disabled was selected.

The gain switching time constant is disabled. The time constant is enabled at gain return.

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



(b) Return time constant disabled was selected.
The gain switching time constant is enabled. The time constant is disabled at gain return.
The following example shows for [Pr. PB26 (CDP)] = 0201, [Pr. PB27 (CDL)] = 0, and [Pr. PB28 (CDT)] = 100 [ms].



7.3 Tough drive function

POINT

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

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

7.3.1 Vibration tough drive function

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

(1) One-touch tuning execution (section 6.1)

(2) Manual setting (section 4.2.2)

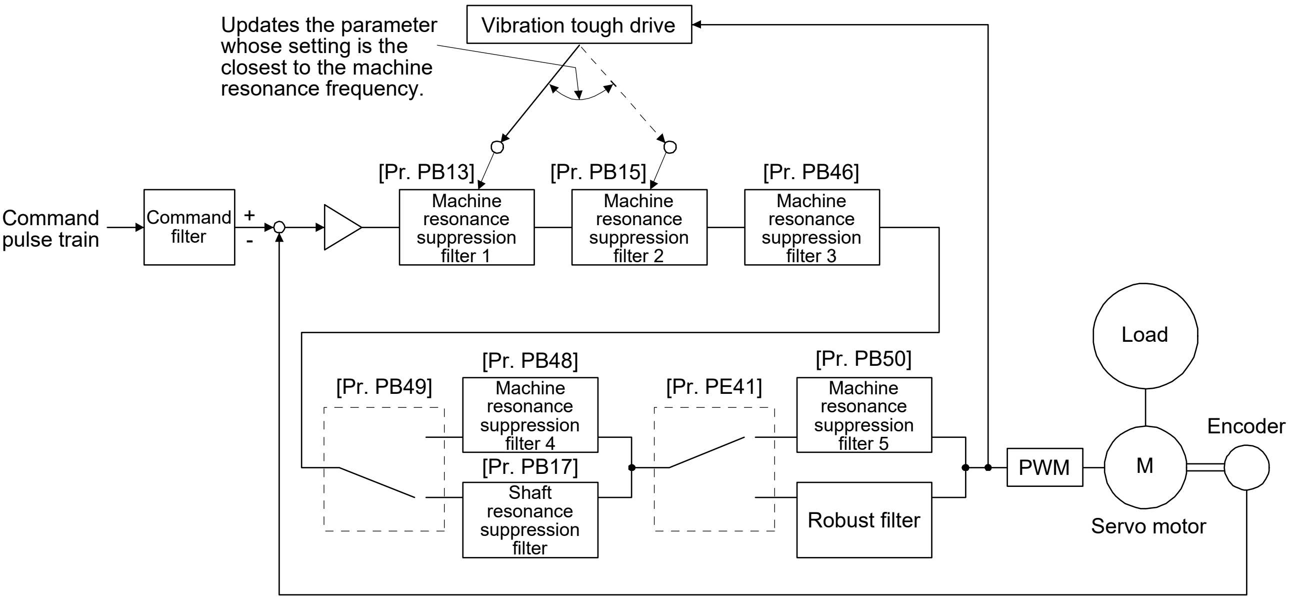
The vibration tough drive function operates when a detected machine resonance frequency is within ±30% for a value set in [Pr. PB13 Machine resonance suppression filter 1] or [Pr. PB15 Machine resonance suppression filter 2].
To set a detection level of the function, set sensitivity in [Pr. PF23 Vibration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

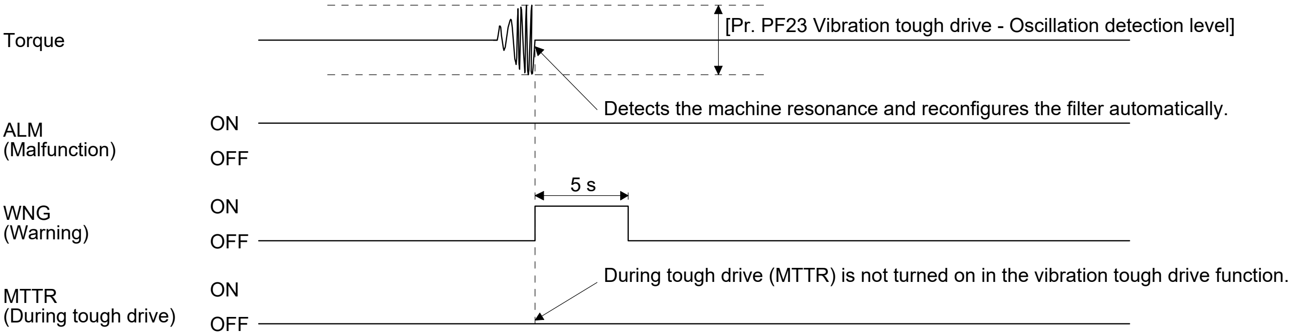
POINT

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

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

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





7.3.2 Instantaneous power failure tough drive function

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

POINT

●MBR (Electromagnetic brake interlock) will not turn off during the instantaneous power failure tough drive.

●When selecting "Enabled (_ _ _ 1)" for "Torque limit function selection at instantaneous power failure" in [Pr. PA26], if an instantaneous power failure occurs during operation, you can save electric energy charged in the capacitor in the servo amplifier by limiting torque at acceleration. You can also delay the time until the occurrence of [AL. 10.2 Voltage drop in the main circuit power]. Doing this will enable you to set a longer time in [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time].

●When the load of instantaneous power failure is large, [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].

●The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD07] to [Pr. PD09]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.

●The setting range of [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time] differs depending on the software version of the servo amplifier as follows.

・Software version C0 or later: Setting range 30 ms to 200 ms

・Software version C1 or earlier: Setting range 30 ms to 500 ms

To comply with SEMI-F47 standard, it is unnecessary to change the initial value (200 ms).

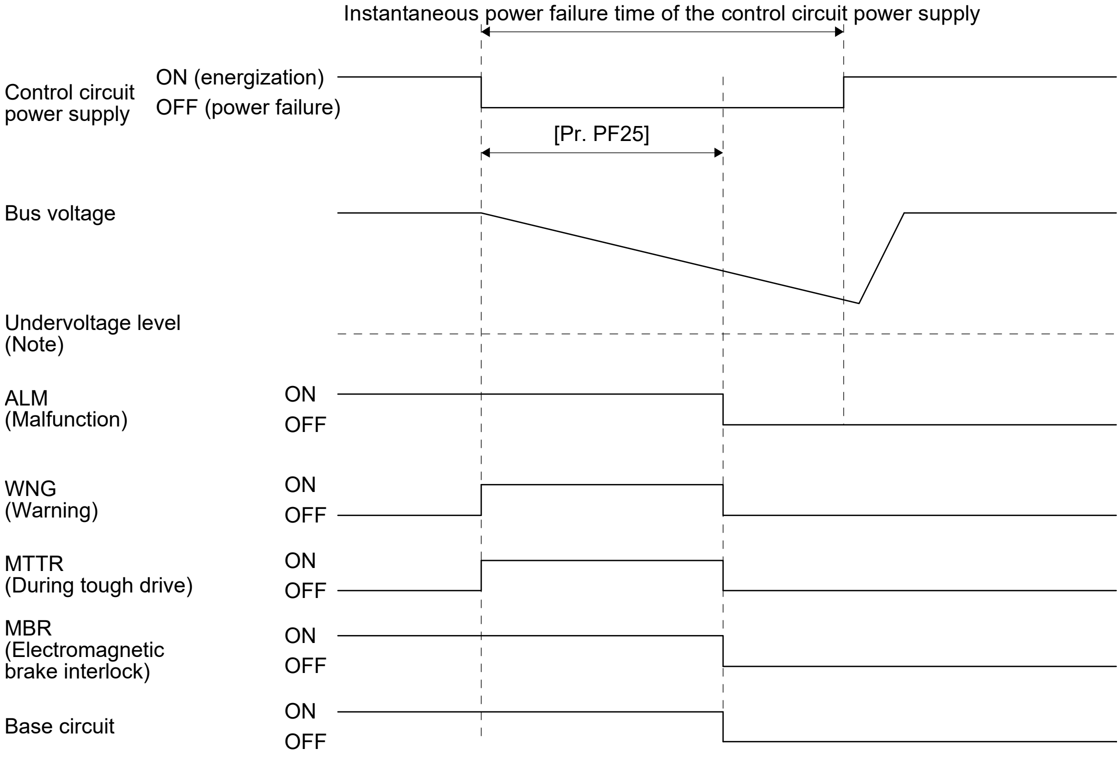
When the instantaneous power failure time exceeds 200 ms, and if the instantaneous power failure voltage is less than 70 % of the rated input voltage, the power may be turned off normally even if a value larger than 200 ms is set in the parameter.

(1) Instantaneous power failure time of the control circuit power supply > [Pr. PF25 SEMI-F47 function - Instantaneous power failure 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].

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

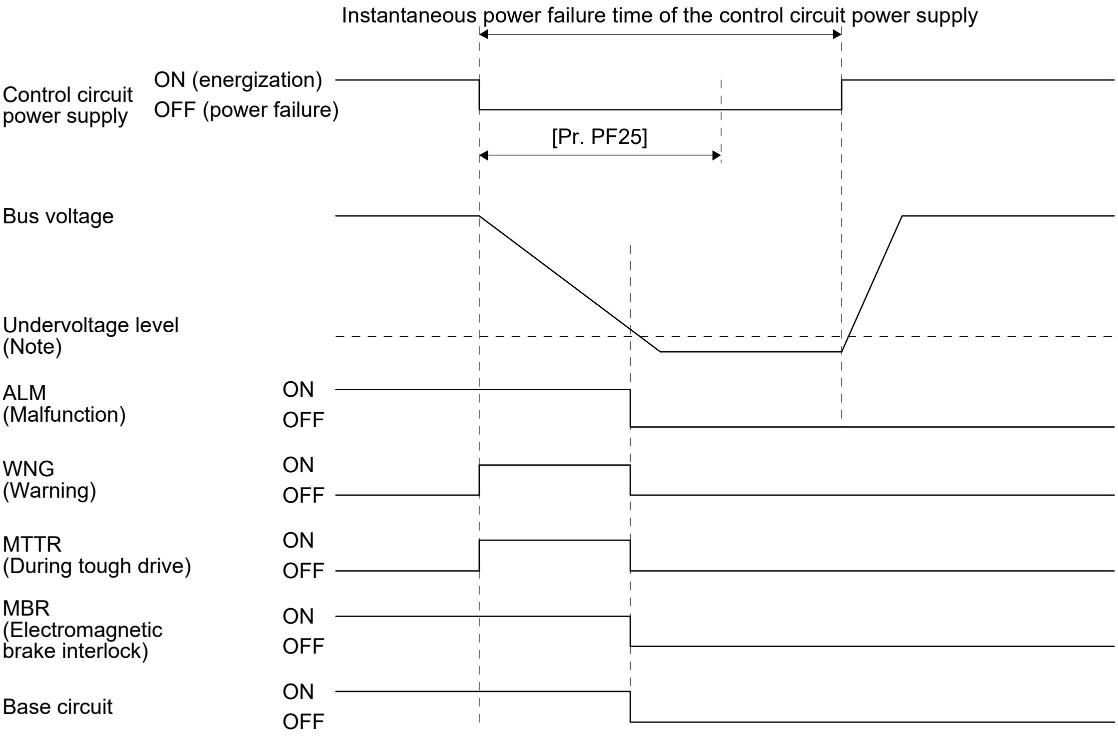
MBR (Electromagnetic brake interlock) turns off when the alarm occurs.



Note. Refer to table 7.1 for the undervoltage level.

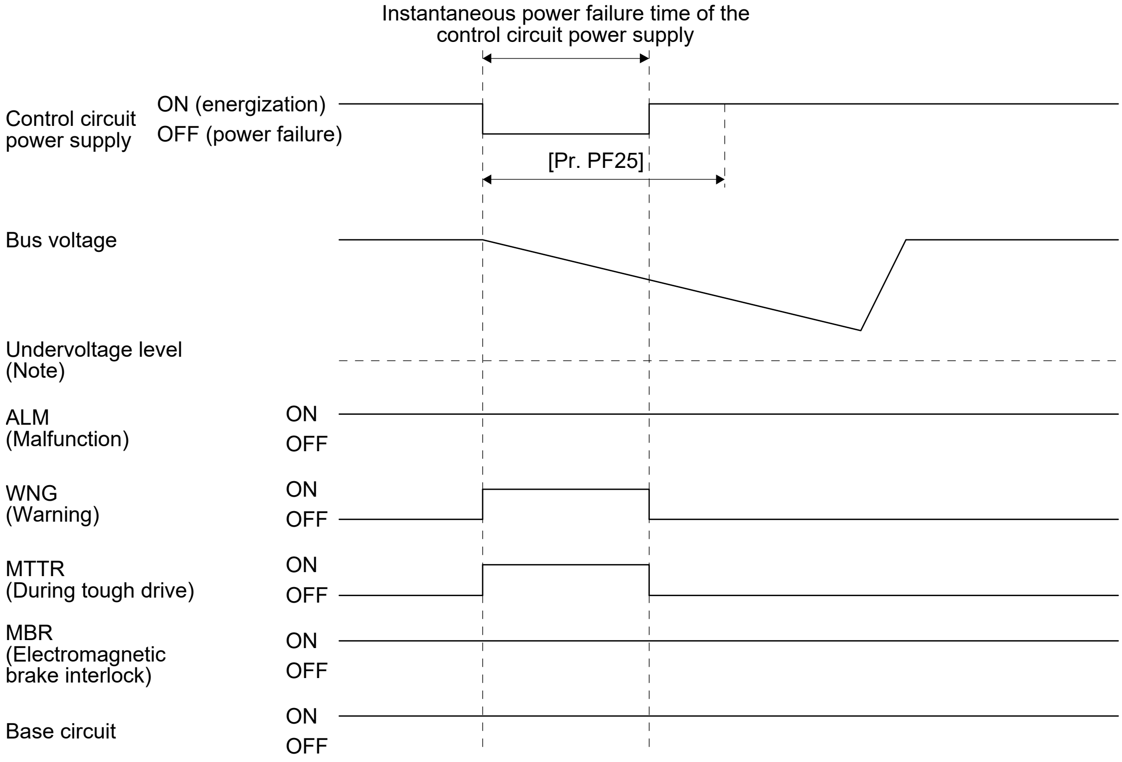
(2) Instantaneous power failure time of the control circuit power supply < [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time]
Operation status differs depending on how bus voltage decrease.

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



Note. Refer to table 7.1 for the undervoltage level.

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



Note. Refer to table 7.1 for the undervoltage level.

7.4 Compliance with SEMI-F47 standard

POINT

- ●The control circuit power supply of the servo amplifier can be possible to comply with SEMI-F47 standard. 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.
- ●Use a 3-phase for the input power supply of the servo amplifier. Using a 1-phase 100 V AC/200 V AC for the input power supply will not comply with SEMI-F47 standard.
- ●The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD07] to [Pr. PD09]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.
- ●Be sure to perform actual machine tests and detail checks for power supply instantaneous power failure of SEMI-F47 standard with your equipment.

The following explains the compliance with "SEMI-F47 semiconductor process equipment voltage sag immunity test" of MR-J4 series.
This function enables to avoid triggering [AL. 10 Undervoltage] using the electrical energy charged in the capacitor in case that an instantaneous power failure occurs during operation.

(1) Parameter setting
Setting [Pr. PA20] and [Pr. PF25] as follows will enable SEMI-F47 function.

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

Enabling SEMI-F47 function will change operation as follows.

(a) The voltage will drop in the control circuit power with "Rated voltage × 50% or less". 200 ms later, [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.

Table 7.1 Voltages which trigger [AL. 10.2 Voltage drop in the main circuit power]

Servo amplifier	Bus voltage which triggers alarm
MR-J4-10B(-RJ) to MR-J4-700B(-RJ)	158 V DC
MR-J4-11KB(-RJ) to MR-J4-22KB(-RJ)	200 V DC
MR-J4-60B4(-RJ) to MR-J4-22KB4(-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 conditions of SEMI-F47 standard

Table 7.2 shows the permissible time of instantaneous power failure for instantaneous power failure of SEMI-F47 standard.

Table 7.2 Requirements conditions of SEMI-F47 standard

Instantaneous power failure voltage	Permissible time of instantaneous power failure [s]
Rated voltage × 80%	1
Rated voltage × 70%	0.5
Rated voltage × 50%	0.2

(3) Calculation of tolerance against instantaneous power failure

Table 7.3 shows tolerance against instantaneous power failure when instantaneous power failure voltage is "rated voltage × 50%" and instantaneous power failure time is 200 ms.

Table 7.3 Tolerance against instantaneous power failure
(instantaneous power failure voltage = rated voltage × 50%,
instantaneous power failure time = 200 ms)

Servo amplifier	Instantaneous maximum output [W]	Tolerance against instantaneous power failure [W] (voltage drop between lines)
MR-J4-10B(-RJ)	350	250
MR-J4-20B(-RJ)	700	420
MR-J4-40B(-RJ)	1400	630
MR-J4-60B(-RJ)	2100	410
MR-J4-70B(-RJ)	2625	1150
MR-J4-100B(-RJ)	3000	1190
MR-J4-200B(-RJ)	5400	2040
MR-J4-350B(-RJ)	10500	2600
MR-J4-500B(-RJ)	15000	4100
MR-J4-700B(-RJ)	21000	5900
MR-J4-11KB(-RJ)	40000	2600
MR-J4-15KB(-RJ)	50000	3500
MR-J4-22KB(-RJ)	56000	4300
MR-J4-60B4(-RJ)	1900	190
MR-J4-100B4(-RJ)	3500	200
MR-J4-200B4(-RJ)	5400	350
MR-J4-350B4(-RJ)	10500	730
MR-J4-500B4(-RJ)	15000	890
MR-J4-700B4(-RJ)	21000	1500
MR-J4-11KB4(-RJ)	40000	2400
MR-J4-15KB4(-RJ)	50000	3200
MR-J4-22KB4(-RJ)	56000	4200

Instantaneous maximum output means power which servo amplifier can output in maximum torque at rated speed. You can examine margins to compare the values of following conditions and instantaneous maximum output.
Even if driving at maximum torque with low speed in actual operation, the motor will not drive with the maximum output. This can be handled as a margin.
The following shows the conditions of tolerance against instantaneous power failure.

(a) Delta connection
For the 3-phase (L1/L2/L3) delta connection, an instantaneous power failure occurs in the voltage between a pair of lines (e.g. between L1 and L2) among voltages between three pairs of lines (between L1 and L2, L2 and L3, or L3 and L1).

(b) Star connection
For the 3-phase (L1/L2/L3/neutral point N) star connection, an instantaneous power failure occurs in the voltage between a pair of lines (e.g. between L1 and N) among voltages at six locations, between three pairs of lines (between L1 and L2, L2 and L3, or L3 and L1) and between one of the lines and the neutral point (between L1 and N, L2 and N, or L3 and N).

7.5 Model adaptive control disabled

POINT

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

(1) Summary

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

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

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

(2) Parameter setting

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

(3) Restrictions

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

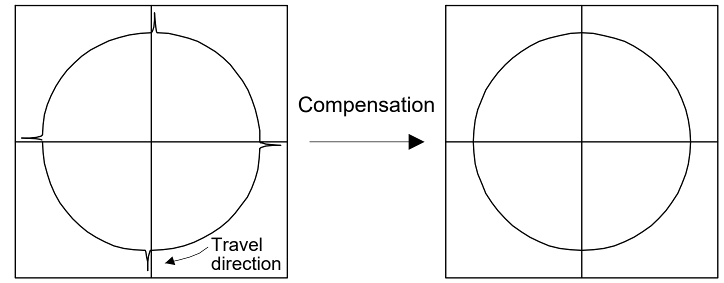
Function	Explanation
Forced stop deceleration function ([Pr. PA04])	Disabling the model adaptive control while the forced stop deceleration function is enabled, [AL. 37] will occur. The forced stop deceleration function is enabled at factory setting. Set [Pr. PA04] to "0 _ _ _" (Forced stop deceleration function disabled).
Vibration suppression control 1 ([Pr. PB02]/[Pr. PB19]/[Pr. PB20]) Vibration suppression control 2 ([Pr. PB02]/[Pr. PB52]/[Pr. PB53])	The vibration suppression control uses the model adaptive control. Disabling the model adaptive control will also disable the vibration suppression control.
Overshoot amount compensation ([Pr. PB12])	The overshoot amount compensation uses data used by the model adaptive control. Disabling the model adaptive control will also disable the overshoot amount compensation.
Super trace control ([Pr. PA22])	The super trace control uses the model adaptive control. Disabling the model adaptive control will also disable the super trace control.

7.6 Lost motion compensation function

POINT

- The lost motion compensation function is enabled only in the position control mode.

The lost motion compensation function corrects response delays (caused by a non-sensitive band due to friction, twist, expansion, and backlash) caused when the machine travel direction is reversed. This function contributes to improvement for protrusions that occur at a quadrant change and streaks that occur at a quadrant change during circular cutting.
This function is effective when a high follow-up performance is required such as drawing an arc with an X-Y table.

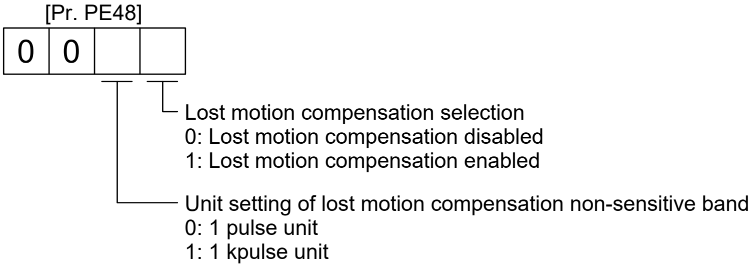


The locus before compensation

The locus after compensation

(1) Parameter setting
Setting [Pr. PE44] to [Pr. PE50] enables the lost motion compensation function.

(a) Lost motion compensation function selection ([Pr. PE48])
Select the lost motion compensation function.



(b) Lost motion compensation ([Pr. PE44]/[Pr. PE45])
Set the same value for the lost motion compensation for each of when the forward rotation switches to the reverse rotation and when the reverse rotation switches to the forward rotation. When the heights of protrusions differ depending on the travel direction, set the different compensation for each travel direction. Set a value twice the usual friction torque and adjust the value while checking protrusions.

(c) Torque offset ([Pr. PE47])
For a vertical axis, unbalanced torque occurs due to the gravity. Although setting the torque offset is usually unnecessary, setting unbalanced torque of a machine as a torque offset cancels the unbalanced torque. The torque offset does not need to be set for a machine not generating unbalanced torque. The torque offset cannot be used for linear servo motors and direct drive motors. Set 0.00%.

(d) Lost motion compensation timing ([Pr. PE49])
You can set the delay time of the lost motion compensation start timing with this parameter. When a protrusion occurs belatedly, set the lost motion compensation timing corresponding to the protrusion occurrence timing.

(e) Lost motion compensation non-sensitive band ([Pr. PE50])
When the travel direction reverses frequently around the zero speed, unnecessary lost motion compensation is triggered by the travel direction switching. By setting the lost motion compensation non-sensitive band, the speed is recognized as 0 when the fluctuation of the droop pulse is the setting value or less. This prevents unnecessary lost motion compensation.
When the value of this parameter is changed, the compensation timing is changed. Adjust the value of Lost motion compensation timing ([Pr. PE49]).

(f) Lost motion filter setting ([Pr. PE46])
Changing the value of this parameter is usually unnecessary. When a value other than 0.0 ms is set in this parameter, the high-pass filter output value of the set time constant is applied to the compensation and lost motion compensation continues.

(2) Adjustment procedure of the lost motion compensation function

(a) Measuring the load current
Measure the load currents during the forward direction feed and reverse direction feed with MR Configurator2.

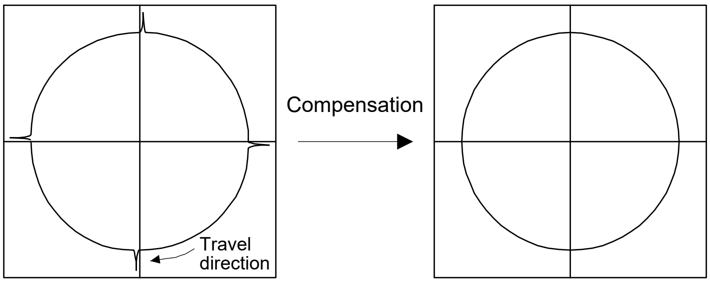
(b) Setting the lost motion compensation
Calculate the friction torque from the measurement result of (2) (a) in this section and set a value twice the friction torque in [Pr. PE44] and [Pr. PE45] as lost motion compensation.

$$\text{Friction torque [\%]} = \frac{\begin{array}{c}|(\text{load current during feed in the forward rotation direction [\%]}) - \\ (\text{load current during feed in the reverse rotation direction [\%]})|\end{array}}{2}$$

(c) Checking protrusions
Drive the servo motor and check that the protrusions are corrected.

(d) Adjusting the lost motion compensation

When protrusions still occur, the compensation is insufficient. Increase the lost motion compensation by approximately 0.5% until the protrusions are eliminated. When notches occur, the compensation is excessive. Decrease the lost motion compensation by approximately 0.5% until the notches are eliminated. Different values can be set as the compensation for each of when the forward rotation (CCW) switches to the reverse rotation (CW) and when the reverse rotation (CW) switches to the forward rotation (CCW).

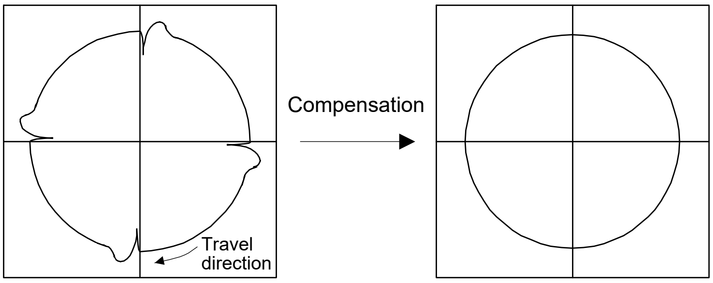


The locus before compensation

The locus after compensation

(e) Adjusting the lost motion compensation timing

When the machine has low rigidity, the speed loop gain is set lower than the standard setting value, or the servo motor is rotating at high speed, quadrant projections may occur behind the quadrant change points. In this case, you can suppress the quadrant projections by delaying the lost motion compensation timing with [Pr. PE49 Lost motion compensation timing]. Increase the setting value of [Pr. PE49] from 0 ms (Initial value) by approximately 0.5 ms to adjust the compensation timing.

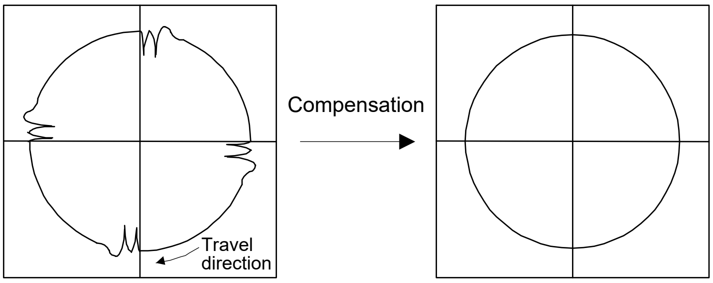


Before timing delay compensation

After timing delay compensation

(f) Adjusting the lost motion compensation non-sensitive band

When the lost motion is compensated twice around a quadrant change point, set [Pr. PE50 Lost motion compensation non-sensitive band]. Increase the setting value so that the lost motion is not compensated twice. Setting [Pr. PE50] may change the compensation timing. Adjust the lost motion compensation timing of (2) (e) in this section.



Before timing delay compensation

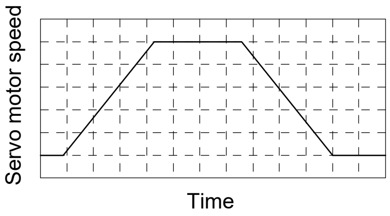
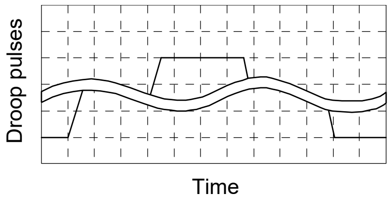
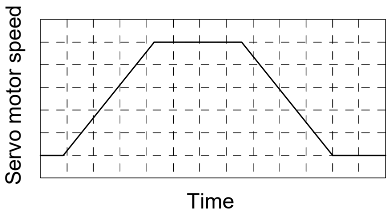
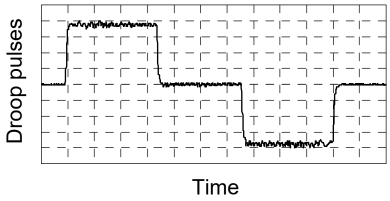
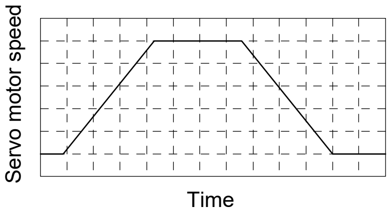
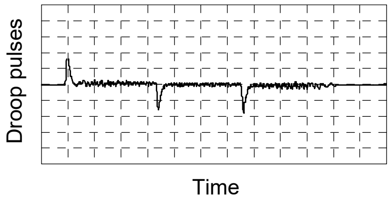
After timing delay compensation

7.7 Super trace control

(1) Summary

In the normal position control, droop pulses are generated against the position control command from the controller. Using the feed forward gain sets droop pulses at a constant speed to almost 0. However, droop pulses generated during acceleration/deceleration cannot be suppressed.

With the ideal model in the servo amplifier, the super trace control enables to set constant speed and uniform acceleration/deceleration droop pulses to almost 0 that cannot be coped with by the feed forward gain.

Control	Position command (the same command)	Droop pulses
Normal control		 Droop pulses are always generated.
Feed forward gain		 Droop pulses are generated during acceleration/ deceleration.
Super trace control		 Droop pulses are almost 0 including the time of acceleration or deceleration.

(2) Adjustment procedure

POINT

- In the super trace control, droop pulses are near 0 during the servo motor control. Thus, the normal INP (In-position) may always be turned on. Be sure to set "INP (In-position) on condition selection" in [Pr. PD13] to " _ 1 _ _".
- When you use the super trace control, it is recommended that the acceleration time constant up to the rated speed be set to 1 s or more.

The following shows the adjustment procedure.

Step	Operation
1	Execute the gain adjustment with one-touch tuning, auto tuning, etc. Refer to chapter 6 for details.
2	Change the setting of auto tuning mode to the manual mode ([Pr. PA08]: _ _ _ 3).
3	Change the setting of feed forward gain ([Pr. PB04]), and adjust that droop pulses will be 0 at a constant speed.
4	Set the setting of INP (In-position) on condition selection ([Pr. PD13]) to " _ 1 _ _".
5	Enable the super trace control. ([Pr. PA22]: _ _ 2 _)
6	Change the setting of model loop gain ([Pr. PB07]), and adjust droop pulses during acceleration/deceleration.

8. TROUBLESHOOTING

POINT

- ●Refer to "MELSERVO-J4 Servo Amplifier Instruction Manual (Troubleshooting)" for details of alarms and warnings.
- ●As soon as an alarm occurs, make the Servo-off status and interrupt the main circuit power.
- ●[AL. 37 Parameter error] and warnings (except [AL. F0 Tough drive warning]) are not recorded in the alarm history.

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

8.1 Explanation for the lists

(1) No./Name/Detail No./Detail name

Indicates each No./Name/Detail No./Detail name of alarms or warnings.

(2) Stop method

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

(3) Alarm deactivation

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

Alarm deactivation	Explanation
Alarm reset	1. Reset command from controller 2. Clicking "Occurred Alarm Reset" in the "Alarm Display" window of MR Configurator2
CPU reset	Resetting the controller itself
Cycling the power	Turning the power off and then turning it on again.

8.2 Alarm list

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)	Alarm deactivation		
						Alarm reset	CPU reset	Cycling the power
Alarm	10	Undervoltage	10.1	Voltage drop in the control circuit power	EDB	○	○	○
			10.2	Voltage drop in the main circuit power	SD	○	○	○
	11	Switch setting error	11.1	Axis number setting error/ Station number setting error	DB			○
			11.2	Disabling control axis setting error	DB			○
	12	Memory error 1 (RAM)	12.1	RAM error 1	DB			○
			12.2	RAM error 2	DB			○
			12.3	RAM error 3	DB			○
			12.4	RAM error 4	DB			○
			12.5	RAM error 5	DB			○
			12.6	RAM error 6	DB			○
	13	Clock error	13.1	Clock error 1	DB			○
			13.2	Clock error 2	DB			○
	14	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			○
			14.B	Control process error 11	DB			○
	15	Memory error 2 (EEP-ROM)	15.1	EEP-ROM error at power on	DB			○
			15.2	EEP-ROM error during operation	DB			○
			15.4	Home position information read error	DB			○
	16	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			○
			16.4	Encoder initial communication - Encoder malfunction (Note 6)	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			○
			16.8	Encoder initial communication - Incompatible encoder (Note 6)	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			○

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)	Alarm deactivation		
						Alarm reset	CPU reset	Cycling the power
Alarm	17	Board error	17.1	Board error 1	DB			○
			17.3	Board error 2	DB			○
			17.4	Board error 3	DB			○
			17.5	Board error 4	DB			○
			17.6	Board error 5	DB			○
			17.7	Board error 7	DB			○
			17.8	Board error 6 (Note 6)	EDB			○
			17.9	Board error 8	DB			○
	19	Memory error 3 (Flash-ROM)	19.1	Flash-ROM error 1	DB			○
			19.2	Flash-ROM error 2	DB			○
			19.3	Flash-ROM error 3	DB			○
	1A	Servo motor combination error	1A.1	Servo motor combination error 1	DB			○
			1A.2	Servo motor control mode combination error	DB			○
			1A.4	Servo motor combination error 2	DB			○
	1B	Converter error	1B.1	Converter unit error	DB			○
	1E	Encoder initial communication error 2	1E.1	Encoder malfunction	DB			○
			1E.2	Load-side encoder malfunction	DB			○
	1F	Encoder initial communication error 3	1F.1	Incompatible encoder	DB			○
			1F.2	Incompatible load-side encoder	DB			○
	20	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	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			○
			21.9	Encoder data error 2	EDB			○

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)	Alarm deactivation		
						Alarm reset	CPU reset	Cycling the power
Alarm	24	Main circuit error	24.1	Ground fault detected by hardware detection circuit	DB			○
			24.2	Ground fault detected by software detection function	DB	○	○	○
	25	Absolute position erased	25.1	Servo motor encoder - Absolute position erased	DB			○
			25.2	Scale measurement encoder - Absolute position erased	DB			○
	27	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 - Speed deviation error	DB	○		○
			27.6	Initial magnetic pole detection - Position deviation error	DB	○		○
			27.7	Initial magnetic pole detection - Current error	DB	○		○
	28	Linear encoder error 2	28.1	Linear encoder - Environment error	EDB			○
	2A	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	Encoder counter error	2B.1	Encoder counter error 1	EDB			○
			2B.2	Encoder counter error 2	EDB			○
	30	Regenerative error	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	Overspeed	31.1	Abnormal motor speed	SD	○	○	○
	32	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	Overvoltage	33.1	Main circuit voltage error	EDB	○	○	○

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)	Alarm deactivation		
						Alarm reset	CPU reset	Cycling the power
Alarm	34	SSCNET receive error 1	34.1	SSCNET receive data error	SD	○	○ (Note 5)	○
			34.2	SSCNET connector connection error	SD	○	○	○
			34.3	SSCNET communication data error	SD	○	○	○
			34.4	Hardware error signal detection	SD	○	○	○
			34.5	SSCNET receive data error (safety observation function)	SD	○	○	○
			34.6	SSCNET communication data error (safety observation function)	SD	○	○	○
	35	Command frequency error	35.1	Command frequency error	SD	○	○	○
	36	SSCNET receive error 2	36.1	Continuous communication data error	SD	○	○	○
			36.2	Continuous communication data error (safety observation function)	SD	○	○	○
	37	Parameter error	37.1	Parameter setting range error	DB		○	○
			37.2	Parameter combination error	DB		○	○
			37.3	Point table setting error	DB			○
	39	Program error	39.1	Program error	DB			○
			39.2	Instruction argument external error	DB			○
			39.3	Register No. error	DB			○
			39.4	Non-correspondence instruction error	DB			○
	3A	Inrush current suppression circuit error	3A.1	Inrush current suppression circuit error	EDB			○
	3D	Parameter setting error for driver communication	3D.1	Parameter combination error for driver communication on slave	DB			○
			3D.2	Parameter combination error for driver communication on master	DB			○
	3E	Operation mode error	3E.1	Operation mode error	DB		○	○
			3E.6	Operation mode switch error	DB			○
	42	Servo control error (for linear servo motor and direct drive motor)	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 (for fully closed loop control)	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	Main circuit device overheat	45.1	Main circuit device overheat error 1	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			45.2	Main circuit device overheat error 2	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)	Alarm deactivation		
						Alarm reset	CPU reset	Cycling the power
Alarm	46	Servo motor overheat	46.1	Abnormal temperature of servo motor 1	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			46.2	Abnormal temperature of servo motor 2	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			46.3	Thermistor disconnected error	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			46.4	Thermistor circuit error	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			46.5	Abnormal temperature of servo motor 3	DB	○ (Note 1)	○ (Note 1)	○ (Note 1)
			46.6	Abnormal temperature of servo motor 4	DB	○ (Note 1)	○ (Note 1)	○ (Note 1)
	47	Cooling fan error	47.1	Cooling fan stop error	SD			○
			47.2	Cooling fan speed reduction error	SD			○
	50	Overload 1	50.1	Thermal overload error 1 during operation	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			50.2	Thermal overload error 2 during operation	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			50.3	Thermal overload error 4 during operation	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			50.4	Thermal overload error 1 during a stop	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			50.5	Thermal overload error 2 during a stop	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			50.6	Thermal overload error 4 during a stop	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
	51	Overload 2	51.1	Thermal overload error 3 during operation	DB	○ (Note 1)	○ (Note 1)	○ (Note 1)
			51.2	Thermal overload error 3 during a stop	DB	○ (Note 1)	○ (Note 1)	○ (Note 1)
	52	Error excessive	52.1	Excess droop pulse 1	SD	○	○	○
			52.3	Excess droop pulse 2	SD	○	○	○
			52.4	Error excessive during 0 torque limit	SD	○	○	○
			52.5	Excess droop pulse 3	EDB	○	○	○
			52.6	Excessive droop pulse at servo-off	SD	○	○	○
	54	Oscillation detection	54.1	Oscillation detection error	EDB	○	○	○
	56	Forced stop error	56.2	Over speed during forced stop	EDB	○	○	○
			56.3	Estimated distance over during forced stop	EDB	○	○	○
	61	Operation error	61.1	Point table setting range error	DB	○		○
	63	STO timing error	63.1	STO1 off	DB	○	○	○
			63.2	STO2 off	DB	○	○	○
			63.5	STO by functional safety unit	DB	○	○	○
	64	Functional safety unit setting error	64.1	STO input error	DB			○
			64.2	Compatibility mode setting error	DB			○
			64.3	Operation mode setting error	DB			○

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)	Alarm deactivation		
						Alarm reset	CPU reset	Cycling the power
Alarm	65	Functional safety unit connection error	65.1	Functional safety unit communication error 1	SD			○
			65.2	Functional safety unit communication error 2	SD			○
			65.3	Functional safety unit communication error 3	SD			○
			65.4	Functional safety unit communication error 4	SD			○
			65.5	Functional safety unit communication error 5	SD			○
			65.6	Functional safety unit communication error 6	SD			○
			65.7	Functional safety unit communication error 7	SD			○
			65.8	Functional safety unit shut-off signal error 1	DB			○
			65.9	Functional safety unit shut-off signal error 2	DB			○
	66	Encoder initial communication error (safety observation function)	66.1	Encoder initial communication - Receive data error 1 (safety observation function)	DB			○
			66.2	Encoder initial communication - Receive data error 2 (safety observation function)	DB			○
			66.3	Encoder initial communication - Receive data error 3 (safety observation function)	DB			○
			66.7	Encoder initial communication - Transmission data error 1 (safety observation function)	DB			○
			66.9	Encoder initial communication - Process error 1 (safety observation function)	DB			○
	67	Encoder normal communication error 1 (safety observation function)	67.1	Encoder normal communication - Receive data error 1 (safety observation function)	DB			○
			67.2	Encoder normal communication - Receive data error 2 (safety observation function)	DB			○
			67.3	Encoder normal communication - Receive data error 3 (safety observation function)	DB			○
			67.4	Encoder normal communication - Receive data error 4 (safety observation function)	DB			○
			67.7	Encoder normal communication - Transmission data error 1 (safety observation function)	DB			○
	68	STO diagnosis error	68.1	Mismatched STO signal error	DB			○
	69	Command error	69.1	Forward rotation-side software limit detection - Command excess error	SD	○	○	○
			69.2	Reverse rotation-side software limit detection - Command excess error	SD	○	○	○
			69.3	Forward rotation stroke end detection - Command excess error	SD	○	○	○
			69.4	Reverse rotation stroke end detection - Command excess error	SD	○	○	○
			69.5	Upper stroke limit detection - Command excess error	SD	○	○	○
			69.6	Lower stroke limit detection - Command excess error	SD	○	○	○

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)	Alarm deactivation		
						Alarm reset	CPU reset	Cycling the power
Alarm	70	Load-side encoder initial communication error 1	70.1	Load-side encoder initial communication - Receive data error 1	DB			○
			70.2	Load-side encoder initial communication - Receive data error 2	DB			○
			70.3	Load-side encoder initial communication - Receive data error 3	DB			○
			70.4	Load-side encoder initial communication - Encoder malfunction (Note 6)	DB			○
			70.5	Load-side encoder initial communication - Transmission data error 1	DB			○
			70.6	Load-side encoder initial communication - Transmission data error 2	DB			○
			70.7	Load-side encoder initial communication - Transmission data error 3	DB			○
			70.8	Load-side encoder initial communication - Incompatible encoder (Note 6)	DB			○
			70.A	Load-side encoder initial communication - Process error 1	DB			○
			70.B	Load-side encoder initial communication - Process error 2	DB			○
			70.C	Load-side encoder initial communication - Process error 3	DB			○
			70.D	Load-side encoder initial communication - Process error 4	DB			○
			70.E	Load-side encoder initial communication - Process error 5	DB			○
			70.F	Load-side encoder initial communication - Process error 6	DB			○
	71	Load-side encoder normal communication error 1	71.1	Load-side encoder normal communication - Receive data error 1	EDB			○
			71.2	Load-side encoder normal communication - Receive data error 2	EDB			○
			71.3	Load-side encoder normal communication - Receive data error 3	EDB			○
			71.5	Load-side encoder normal communication - Transmission data error 1	EDB			○
			71.6	Load-side encoder normal communication - Transmission data error 2	EDB			○
			71.7	Load-side encoder normal communication - Transmission data error 3	EDB			○
			71.9	Load-side encoder normal communication - Receive data error 4	EDB			○
			71.A	Load-side encoder normal communication - Receive data error 5	EDB			○

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)	Alarm deactivation		
						Alarm reset	CPU reset	Cycling the power
Alarm	72	Load-side encoder normal communication error 2	72.1	Load-side encoder data error 1	EDB			○
			72.2	Load-side encoder data update error	EDB			○
			72.3	Load-side encoder data waveform error	EDB			○
			72.4	Load-side encoder non-signal error	EDB			○
			72.5	Load-side encoder hardware error 1	EDB			○
			72.6	Load-side encoder hardware error 2	EDB			○
			72.9	Load-side encoder data error 2	EDB			○
	74	Option card error 1	74.1	Option card error 1	DB			○
			74.2	Option card error 2	DB			○
			74.3	Option card error 3	DB			○
			74.4	Option card error 4	DB			○
			74.5	Option card error 5	DB			○
	75	Option card error 2	75.3	Option card connection error	EDB			○
			75.4	Option card disconnected	DB			○
	79	Functional safety unit diagnosis error	79.1	Functional safety unit power voltage error	DB	○ (Note 7)		○
			79.2	Functional safety unit internal error	DB			○
			79.3	Abnormal temperature of functional safety unit	SD	○ (Note 7)		○
			79.4	Servo amplifier error	SD			○
			79.5	Input device error	SD			○
			79.6	Output device error	SD			○
			79.7	Mismatched input signal error	SD			○
			79.8	Position feedback fixing error	DB			○
	7A	Parameter setting error (safety observation function)	7A.1	Parameter verification error (safety observation function)	DB			○
			7A.2	Parameter setting range error (safety observation function)	DB			○
			7A.3	Parameter combination error (safety observation function)	DB			○
			7A.4	Functional safety unit combination error (safety observation function)	DB			○
	7B	Encoder diagnosis error (safety observation function)	7B.1	Encoder diagnosis error 1 (safety observation function)	DB			○
			7B.2	Encoder diagnosis error 2 (safety observation function)	DB			○
			7B.3	Encoder diagnosis error 3 (safety observation function)	DB			○
			7B.4	Encoder diagnosis error 4 (safety observation function)	DB			○
	7C	Functional safety unit communication diagnosis error (safety observation function)	7C.1	Functional safety unit communication setting error (safety observation function)	SD	○ (Note 7)	○	○
			7C.2	Functional safety unit communication data error (safety observation function)	SD	○ (Note 7)	○	○
	7D	Safety observation error	7D.1	Stop observation error	DB	○ (Note 3)		○
			7D.2	Speed observation error	DB	○ (Note 7)		○
	82	Master-slave operation error 1	82.1	Master-slave operation error 1	EDB	○	○	○

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)	Alarm deactivation		
						Alarm reset	CPU reset	Cycling the power
Alarm	84	Network module initialization error	84.1	Network module undetected error	DB			○
			84.2	Network module initialization error 1	DB			○
			84.3	Network module initialization error 2	DB			○
	85	Network module error	85.1	Network module error 1	SD			○
			85.2	Network module error 2	SD			○
			85.3	Network module error 3	SD			○
	86	Network communication error	86.1	Network communication error 1	SD	○		○
			86.2	Network communication error 2	SD	○		○
			86.3	Network communication error 3	SD	○		○
	8A	USB communication time-out error/serial communication time-out error/Modbus RTU communication time-out error	8A.1	USB communication time-out error/serial communication time-out error	SD	○	○	○
			8A.2	Modbus RTU communication time-out error	SD	○	○	○
	8D	CC-Link IE communication error	8D.1	CC-Link IE communication error 1	SD	○		○
			8D.2	CC-Link IE communication error 2	SD	○		○
			8D.3	Master station setting error 1	DB	○		○
			8D.5	Master station setting error 2	DB			○
			8D.6	CC-Link IE communication error 3	SD	○		○
			8D.7	CC-Link IE communication error 4	SD	○		○
			8D.8	CC-Link IE communication error 5	SD	○		○
			8D.9	Synchronization error 1	SD			○
			8D.A	Synchronization error 2	SD			○
	8E	USB communication error/serial communication error/Modbus RTU communication error	8E.1	USB communication receive error/serial communication receive error	SD	○	○	○
			8E.2	USB communication checksum error/serial communication checksum error	SD	○	○	○
			8E.3	USB communication character error/serial communication character error	SD	○	○	○
			8E.4	USB communication command error/serial communication command error	SD	○	○	○
			8E.5	USB communication data number error/serial communication data number error	SD	○	○	○
			8E.6	Modbus RTU communication receive error	SD	○	○	○
			8E.7	Modbus RTU communication message frame error	SD	○	○	○
			8E.8	Modbus RTU communication CRC error	SD	○	○	○
	88888	Watchdog	8888._	Watchdog	DB			○

Note 1. After resolving the source of trouble, cool the equipment for approximately 30 minutes.

2. The following shows three stop methods of DB, EDB, and SD.

DB: Stops with dynamic brake. (Coasts for the servo amplifier without dynamic brake.)

Coasts for MR-J4-03A6(-RJ) and MR-J4W2-0303B6. Note that EDB is applied when an alarm below occurs;

[AL. 30.1], [AL. 32.2], [AL. 32.4], [AL. 51.1], [AL. 51.2], [AL. 888]

EDB: Electronic dynamic brake stop (available with specified servo motors)

Refer to the following table for the specified servo motors. The stop method for other than the specified servo motors will be DB.

Series	Servo motor
HG-KR	HG-KR053/HG-KR13/HG-KR23/HG-KR43
HG-MR	HG-MR053/HG-MR13/HG-MR23/HG-MR43
HG-SR	HG-SR51/HG-SR52
HG-AK	HG-AK0136/HG-AK0236/HG-AK0336

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. The alarm can be canceled by setting as follows:

For the fully closed loop control: set [Pr. PE03] to "1 _ _ _".

When a linear servo motor or direct drive motor is used: set [Pr. PL04] to "1 _ _ _".

5. In some controller communication status, the alarm factor may not be removed.

6. This alarm will occur only in the J3 compatibility mode.

7. Reset this while all the safety observation functions are stopped.

8.3 Warning list

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)
Warning	90	Home position return incomplete warning	90.1	Home position return incomplete	
			90.2	Home position return abnormal termination	
			90.5	Z-phase unpassed	
	91	Servo amplifier overheat warning (Note 1)	91.1	Main circuit device overheat warning	
	92	Battery cable disconnection warning	92.1	Encoder battery cable disconnection warning	
			92.3	Battery degradation	
	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
			95.3	STO warning 1 (safety observation function)	DB
			95.4	STO warning 2 (safety observation function)	DB
			95.5	STO warning 3 (safety observation function)	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	
	97	Positioning specification warning	97.1	Program operation disabled warning	
			97.2	Next station position warning	
	98	Software limit warning	98.1	Forward rotation-side software stroke limit reached	
			98.2	Reverse rotation-side software stroke limit reached	
	99	Stroke limit warning	99.1	Forward rotation stroke end off	(Note 4, 5)
			99.2	Reverse rotation stroke end off	(Note 4, 5)
			99.4	Upper stroke limit off	(Note 5)
			99.5	Lower stroke limit off	(Note 5)
	9A	Optional unit input data error warning	9A.1	Optional unit input data sign error	
			9A.2	Optional unit BCD input data error	
	9B	Error excessive warning	9B.1	Excess droop pulse 1 warning	
			9B.3	Excess droop pulse 2 warning	
			9B.4	Error excessive warning during 0 torque limit	
	9C	Converter error	9C.1	Converter unit error	
	9D	CC-Link IE warning 1	9D.1	Station number switch change warning	
			9D.2	Master station setting warning	
			9D.3	Overlapping station number warning	
			9D.4	Mismatched station number warning	

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)
Warning	9E	CC-Link IE warning 2	9E.1	CC-Link IE communication warning	
	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	
			E3.4	Absolute positioning counter EEP-ROM writing frequency warning	
			E3.5	Encoder absolute positioning counter warning	
	E4	Parameter warning	E4.1	Parameter setting range error 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
			E6.2	SS1 forced stop warning 1 (safety observation function)	SD
			E6.3	SS1 forced stop warning 2 (safety observation function)	SD
	E7	Controller forced stop warning	E7.1	Controller 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
			E9.3	Ready-on signal on during main circuit off	DB
			E9.4	Converter unit forced stop	DB
	EA	ABS servo-on warning	EA.1	ABS servo-on warning	
	EB	The other axis error warning	EB.1	The other axis error warning	DB
	EC	Overload warning 2	EC.1	Overload warning 2	

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)
Warning	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	
	F4	Positioning warning	F4.4	Target position setting range error warning	
			F4.6	Acceleration time constant setting range error warning	
			F4.7	Deceleration time constant setting range error warning	
			F4.9	Home position return type error warning	
	F5	Simple cam function - Cam data miswriting warning	F5.1	Cam data - Area writing time-out warning	
			F5.2	Cam data - Area miswriting warning	
			F5.3	Cam data checksum error	
	F6	Simple cam function - Cam control warning	F6.1	Cam axis one cycle current value restoration failed	
			F6.2	Cam axis feed current value restoration failed	
			F6.3	Cam unregistered error	
			F6.4	Cam control data setting range error	
			F6.5	Cam No. external error	
			F6.6	Cam control inactive	
	F7	Machine diagnosis warning	F7.1	Vibration failure prediction warning	
			F7.2	Friction failure prediction warning	
			F7.3	Total travel distance failure prediction warning	

Note 1. After resolving the source of trouble, cool the equipment for approximately 30 minutes.

2. The following shows two stop methods of DB and SD.
   DB: Stops with dynamic brake. (Coasts for the servo amplifier without dynamic brake.)
   Coasts for MR-J4-03A6(-RJ) and MR-J4W2-0303B6.
   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. For MR-J4-_A_ servo amplifier, quick stop or slow stop can be selected using [Pr. PD30].
5. For MR-J4-_GF_ servo amplifier, quick stop or slow stop can be selected using [Pr. PD12]. (I/O mode and CC-Link IE Field Network Basic)

8.4 Troubleshooting at power on

When the servo system does not boot and system error occurs at power on of the servo system controller, improper boot of the servo amplifier might be the cause. Check the display of the servo amplifier, and take actions according to this section.

Display	Description	Cause	Checkpoint	Action
AA	Communication with the servo system controller has disconnected.	The power of the servo system controller was turned off.	Check the power of the servo system controller.	Switch on the power of the servo system controller.
		A SSCNET III cable was disconnected.	"AA" is displayed in the corresponding axis and following axes.	Replace the SSCNET III cable of the corresponding axis.
			Check if the connectors (CNIA, CNIB) are unplugged.	Connect it correctly.
		The power of the servo amplifier was turned off.	"AA" is displayed in the corresponding axis and following axes.	Check the power of the servo amplifier.
				Replace the servo amplifier of the corresponding axis.
Ab	Initialization communication with the servo system controller has not completed.	The control axis is disabled.	Check if the disabling control axis switch (SW2-2) is on.	Turn off the disabling control axis switch (SW2-2).
		The setting of the axis No. is incorrect.	Check that the other servo amplifier is not assigned to the same axis No.	Set it correctly.
		Axis No. does not match with the axis No. set to the servo system controller.	Check the setting and axis No. of the servo system controller.	Set it correctly.
		Information about the servo series has not set in the simple motion module.	Check the value set in Servo series (Pr 100) in the simple motion module.	Set it correctly.
		Communication cycle does not match.	Check the communication cycle at the servo system controller side. When using 8 axes or less: 0.222 ms When using 16 axes or less: 0.444 ms When using 32 axes or less: 0.888 ms	Set it correctly.
		A SSCNET III cable was disconnected.	"Ab" is displayed in the corresponding axis and following axes.	Replace the SSCNET III cable of the corresponding axis.
			Check if the connectors (CNIA, CNIB) are unplugged.	Connect it correctly.
		The power of the servo amplifier was turned off.	"Ab" is displayed in an axis and the following axes.	Check the power of the servo amplifier.
		The servo amplifier is malfunctioning.	"Ab" is displayed in an axis and the following axes.	Replace the servo amplifier of the corresponding axis.
Ab ↑ ↓ AC or ↓ Ab ↓ AC ↓ Ad	Communication between servo system controller and servo amplifier are repeating connection and shut-off.	An MR-J4-_B_(-RJ) servo amplifier or MR-J4W_-_B servo amplifier which is set to J3 compatibility mode is connected to the SSCNET III/H network.	Check if the servo amplifier mode is set to "J3 compatibility mode" using "MR-J4(W)-B mode selection" or "MR Mode Change" included in MR Configurator2.	Use "MR-J4(W)-B mode selection" or "MR Mode Change" to switch the servo amplifier mode to "J4 mode".
b##. (Note)	The system has been in the test operation mode.	Test operation mode has been enabled.	Test operation setting switch (SW2-1) is turned on.	Turn off the test operation setting switch (SW2-1).
off	Operation mode for manufacturer setting is set.	Operation mode for manufacturer setting is enabled.	Check if all of the control axis setting switches (SW2) are on.	Set the control axis setting switches (SW2) correctly.

Note. ## indicates axis No.

MEMO

9. DIMENSIONS

9.1 Servo amplifier

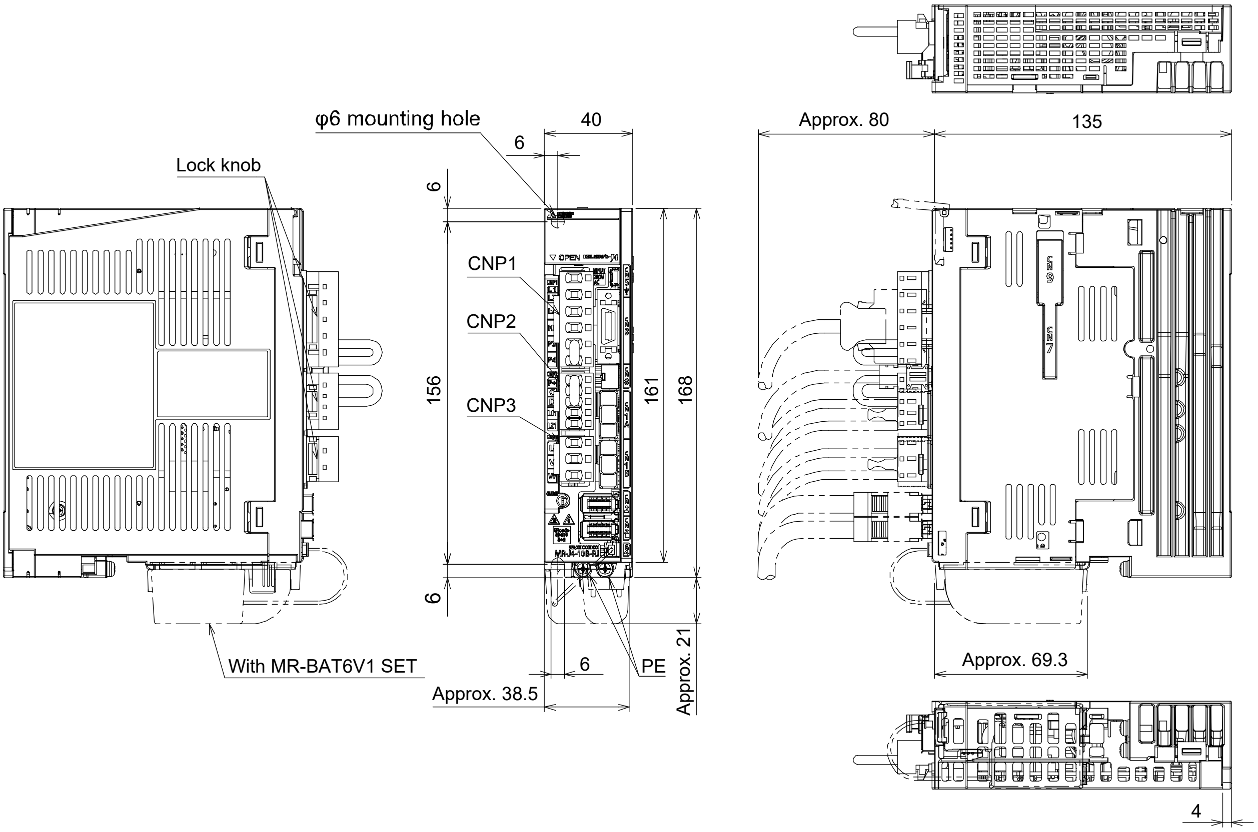
POINT

- Only MR-J4-_B_-RJ are shown for dimensions. MR-J4-_B_ does not have CN2L, CN7 and CN9 connectors. The dimensions of MR-J4-_B_ are not different from those of MR-J4-_B_-RJ except CN2L, CN7 and CN9 connectors.

(1) 200 V class

(a) MR-J4-10B(-RJ)/MR-J4-20B(-RJ)

[Unit: mm]



Mass: 0.8 [kg]

Mounting screw

Screw size: M5

Tightening torque: 3.24 [N•m]

Terminal

CNP1

L1

L2

L3

N-

P3

P4

CNP2

P+

C

D

L11

L21

CNP3

U

V

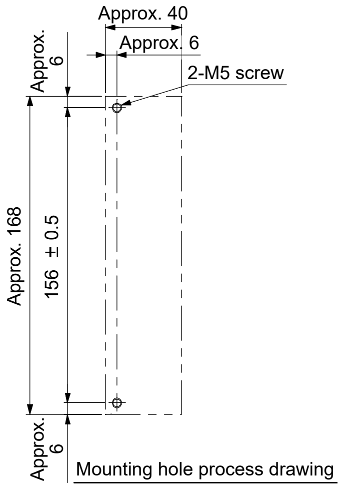
W

PE

⏚ ⏚

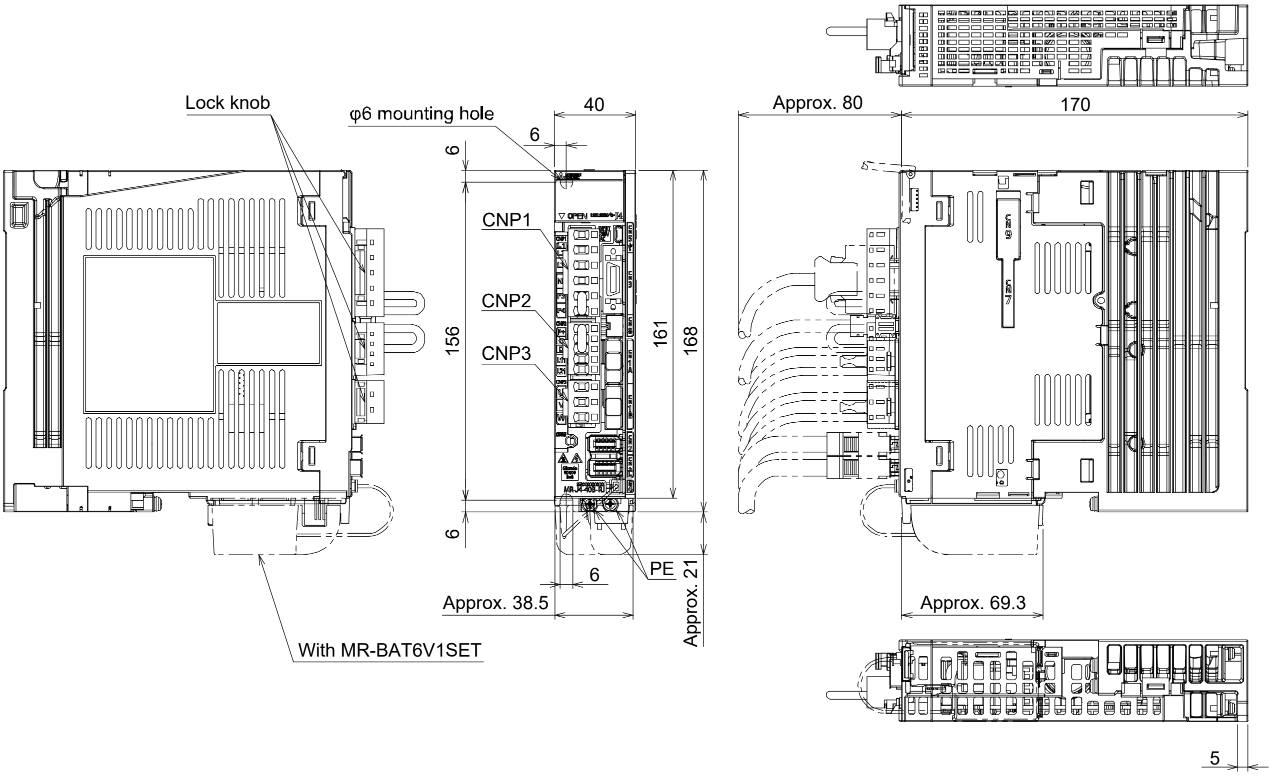
Screw size: M4

Tightening torque: 1.2 [N•m]



(b) MR-J4-40B(-RJ)/MR-J4-60B(-RJ)

[Unit: mm]



Mass: 1.0 [kg]

Terminal

CNP1
- L1
- L2
- L3
- N-
- P3
- P4

CNP2
- P+
- C
- D
- L11
- L21

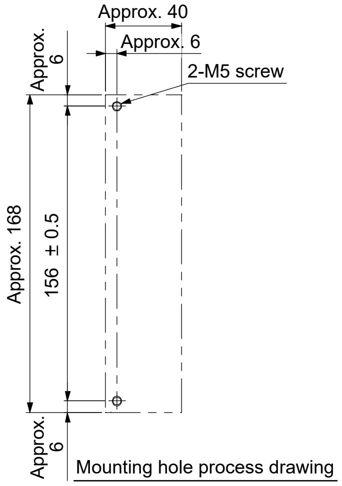
CNP3
- U
- V
- W

PE

⏚ ⏚

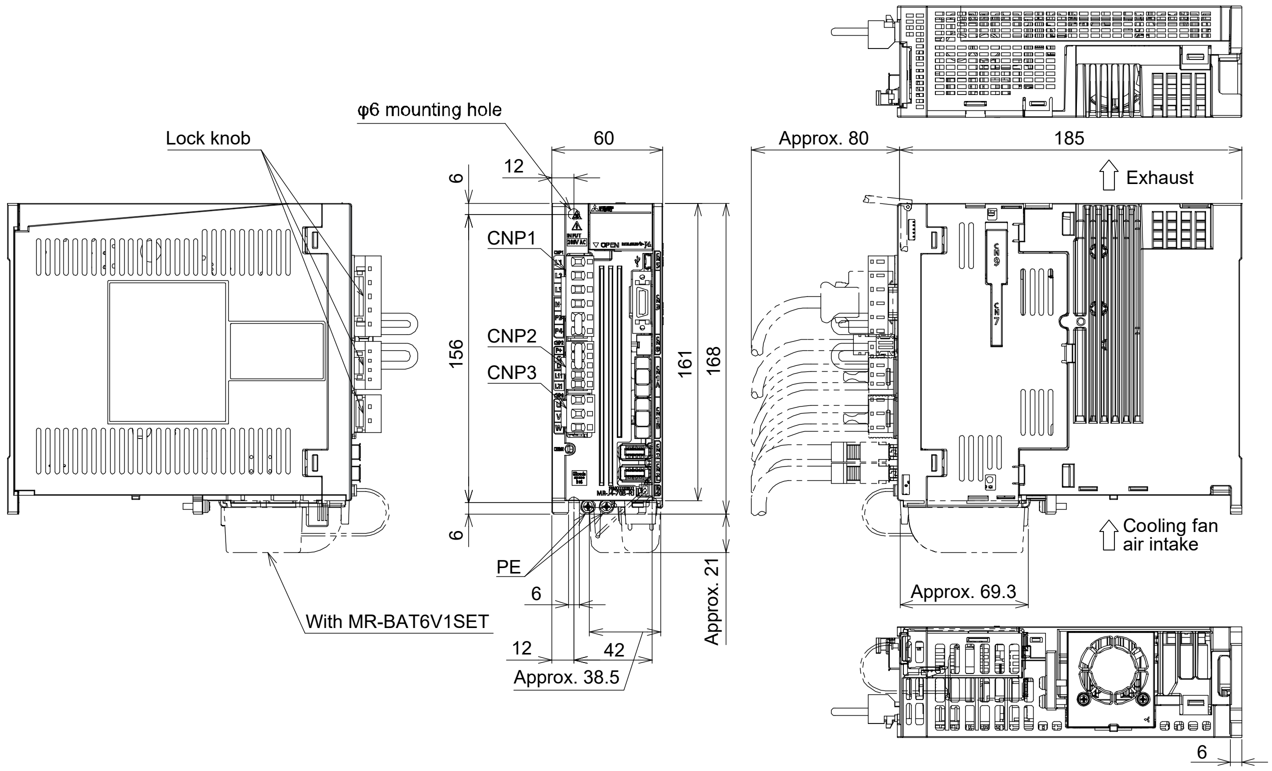
Screw size: M4
Tightening torque: 1.2 [N•m]

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



(c) MR-J4-70B(-RJ)/MR-J4-100B(-RJ)

[Unit: mm]



Mass: 1.4 [kg]

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

Terminal

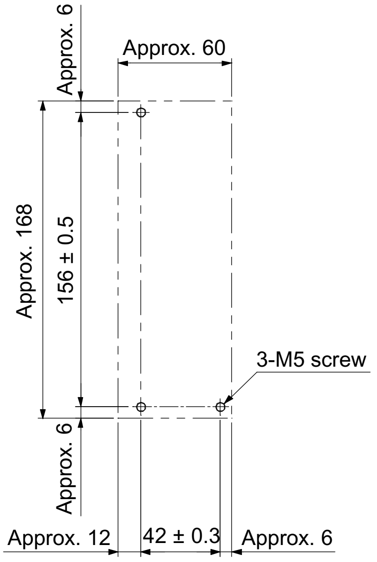
CNP1
- L1
- L2
- L3
- N-
- P3
- P4

CNP2
- P+
- C
- D
- L11
- L21

CNP3
- U
- V
- W

PE
⏚ ⏚

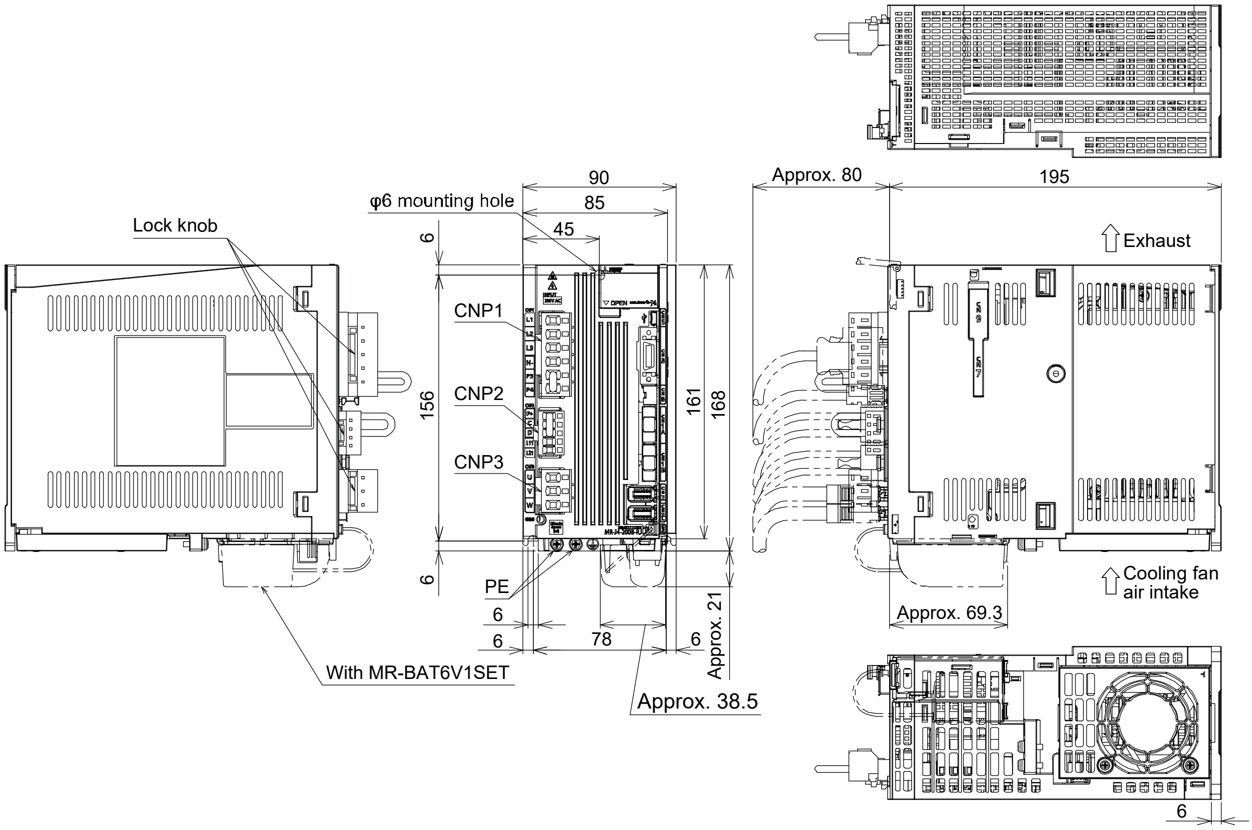
Screw size: M4
Tightening torque: 1.2 [N•m]



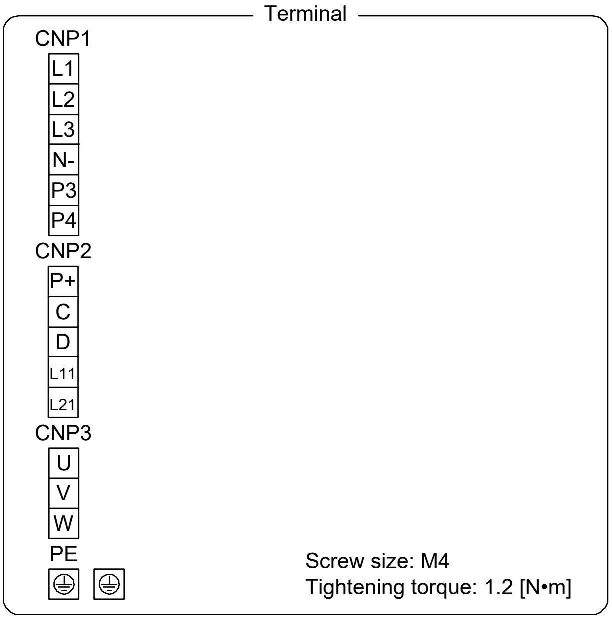
Mounting hole process drawing

(d) MR-J4-200B(-RJ)

[Unit: mm]

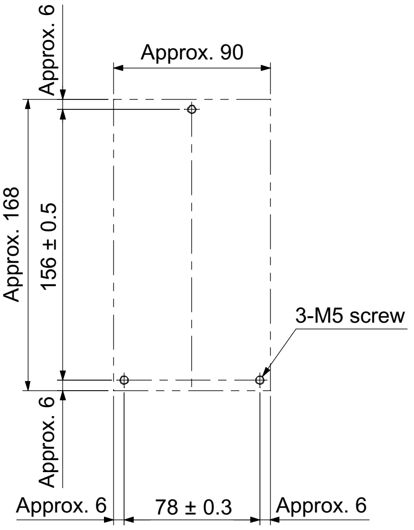


Mass: 2.1 [kg]



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

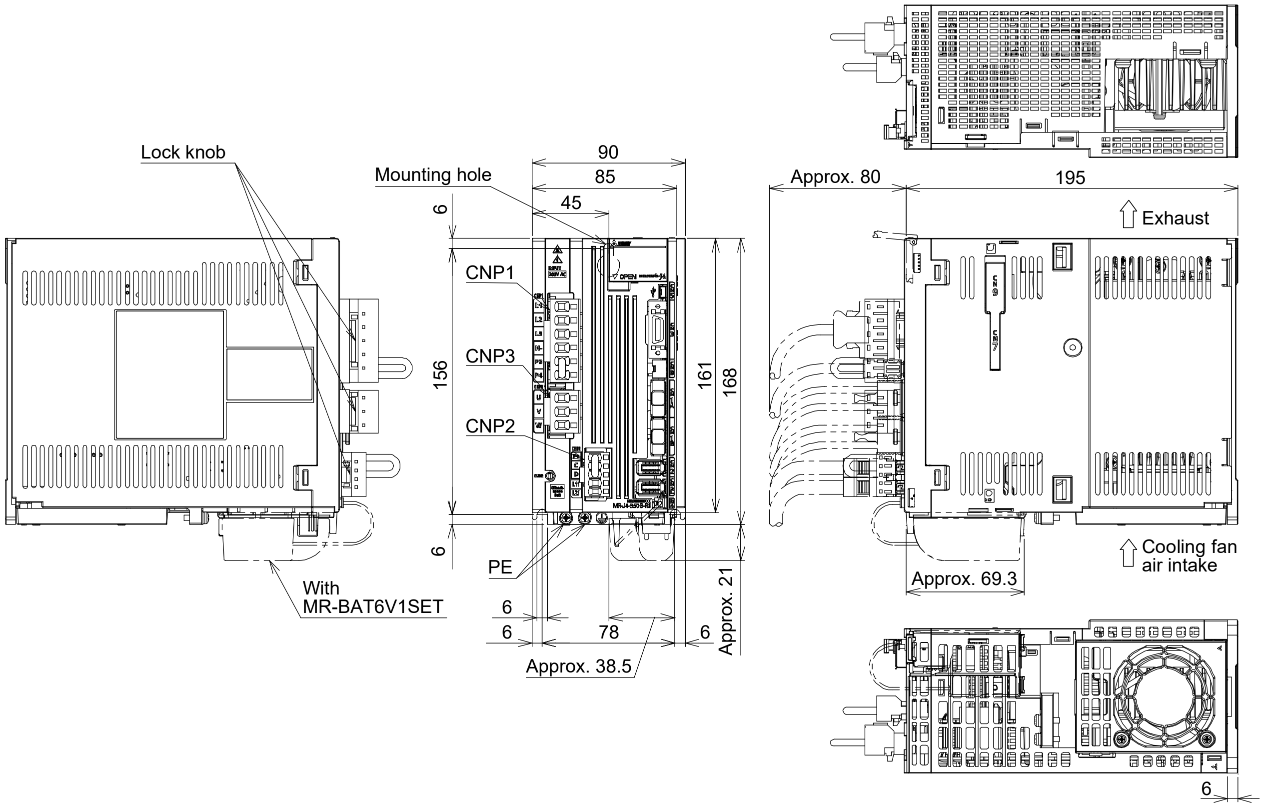
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]



Mounting hole process drawing

(e) MR-J4-350B(-RJ)

[Unit: mm]



Mass: 2.3 [kg]

Terminal

CNP1
L1
L2
L3
N-
P3
P4

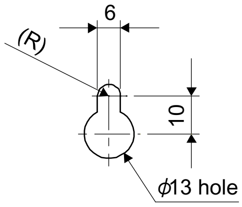
CNP3
U
V
W

CNP2
P+
C
D
L11
L21

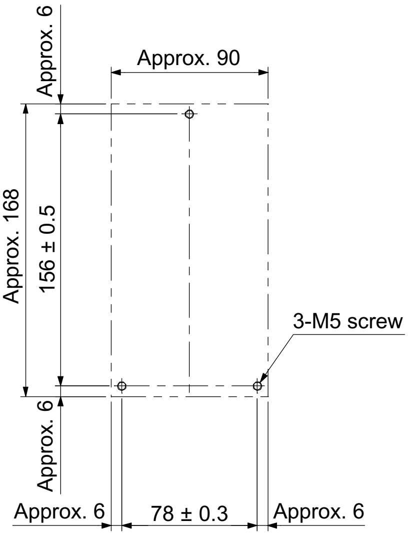
PE
⏚ ⏚

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

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



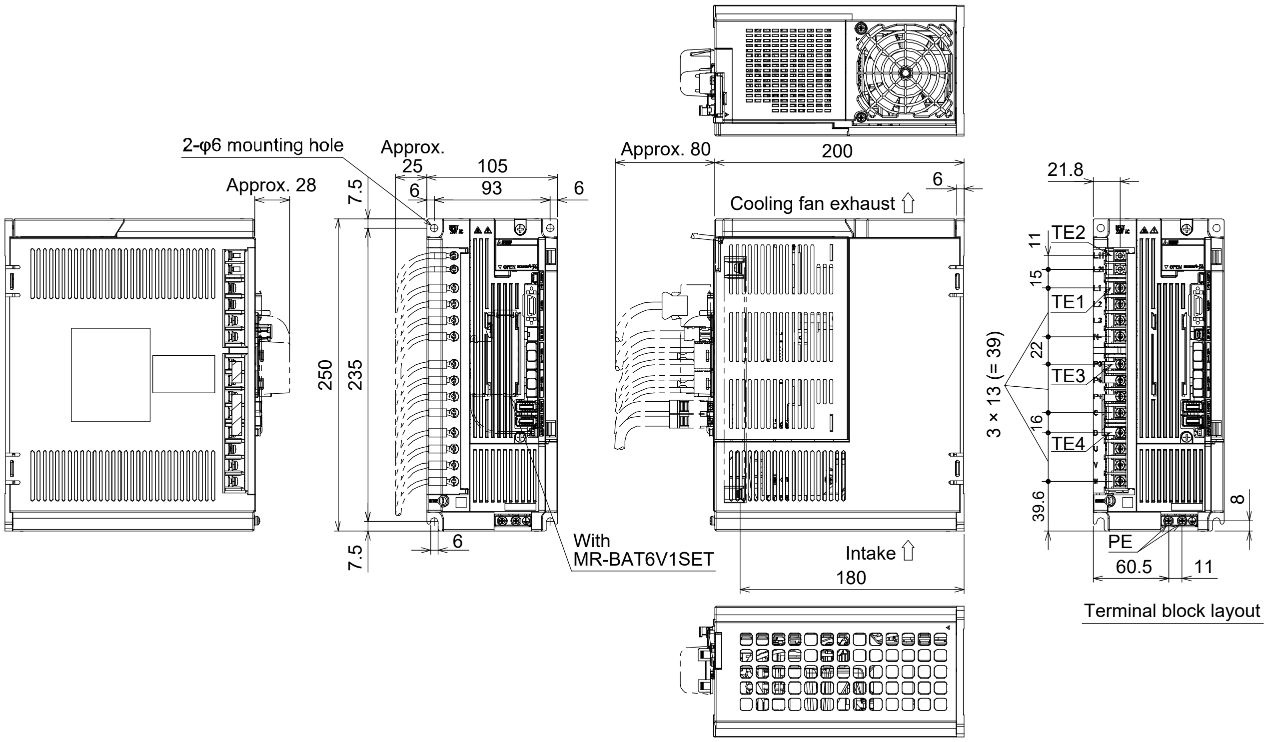
Mounting hole dimensions



Mounting hole process drawing

(f) MR-J4-500B(-RJ)

[Unit: mm]

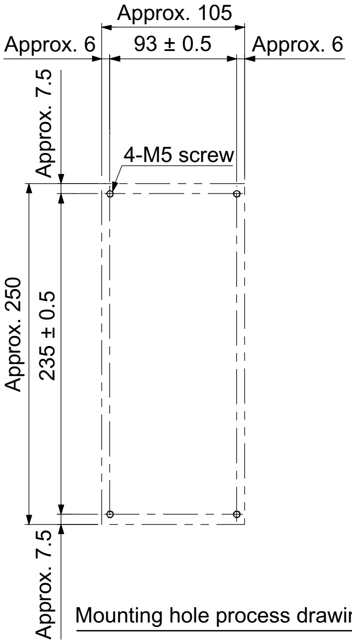


Mass: 4.0 [kg]

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]

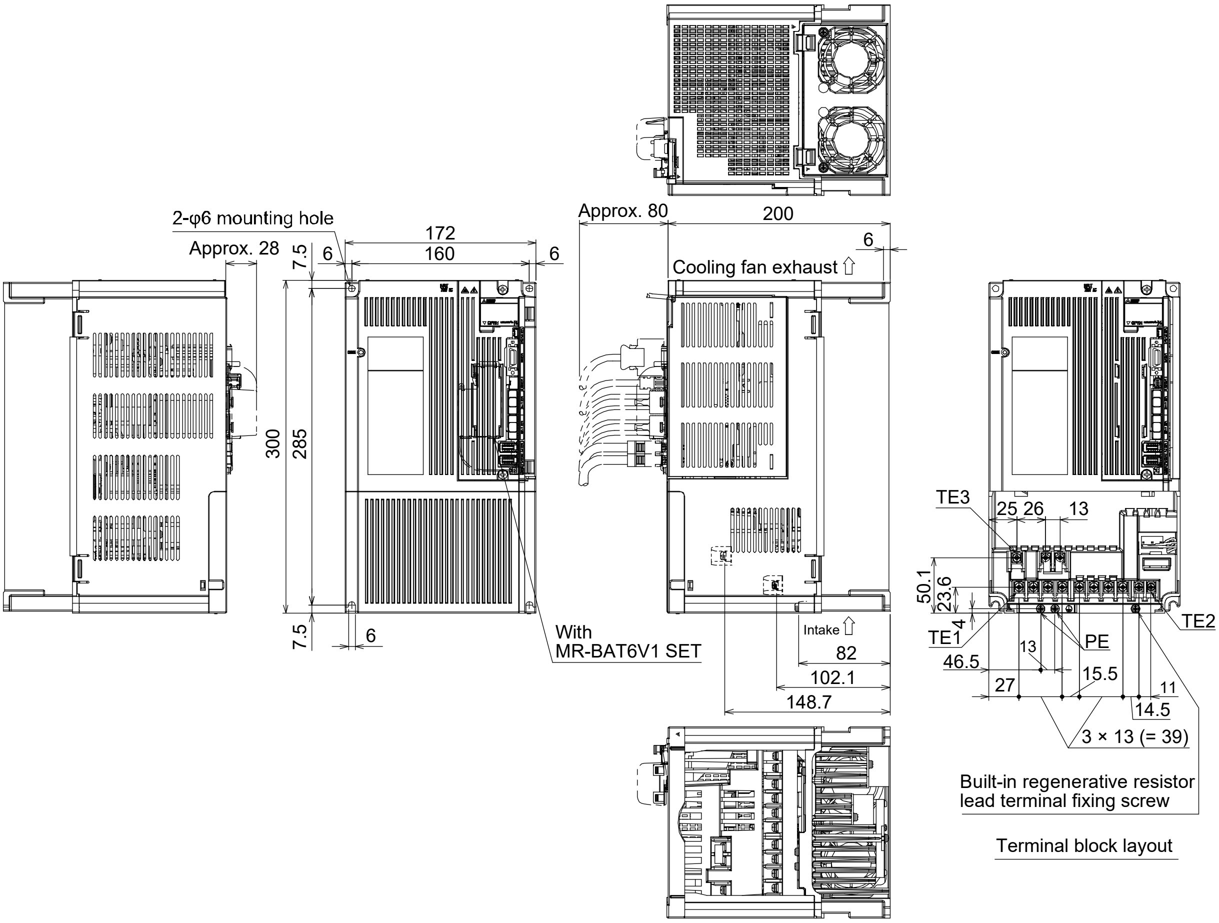
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]



Mounting hole process drawing

(g) MR-J4-700B(-RJ)

[Unit: mm]



Mass: 6.2 [kg]

Terminal

TE3 N- P3 P4

TE1 L1 L2 L3 P+ C U V W TE2 L11 L21

PE ⏚ ⏚

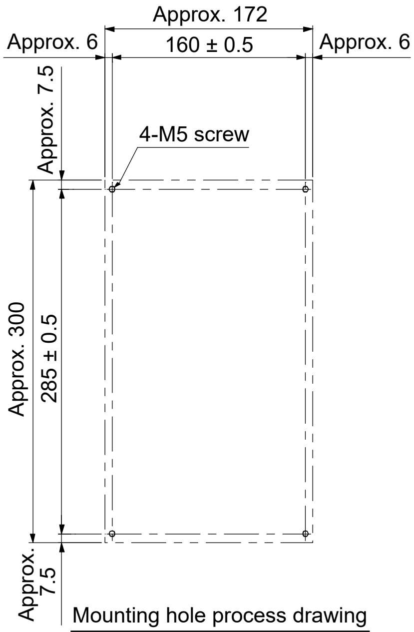
TE3 Screw size: M4
Tightening torque: 1.2 [N•m]

TE1 Screw size: M4
Tightening torque: 1.2 [N•m]

TE2 Screw size: M3.5
Tightening torque: 0.8 [N•m]

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

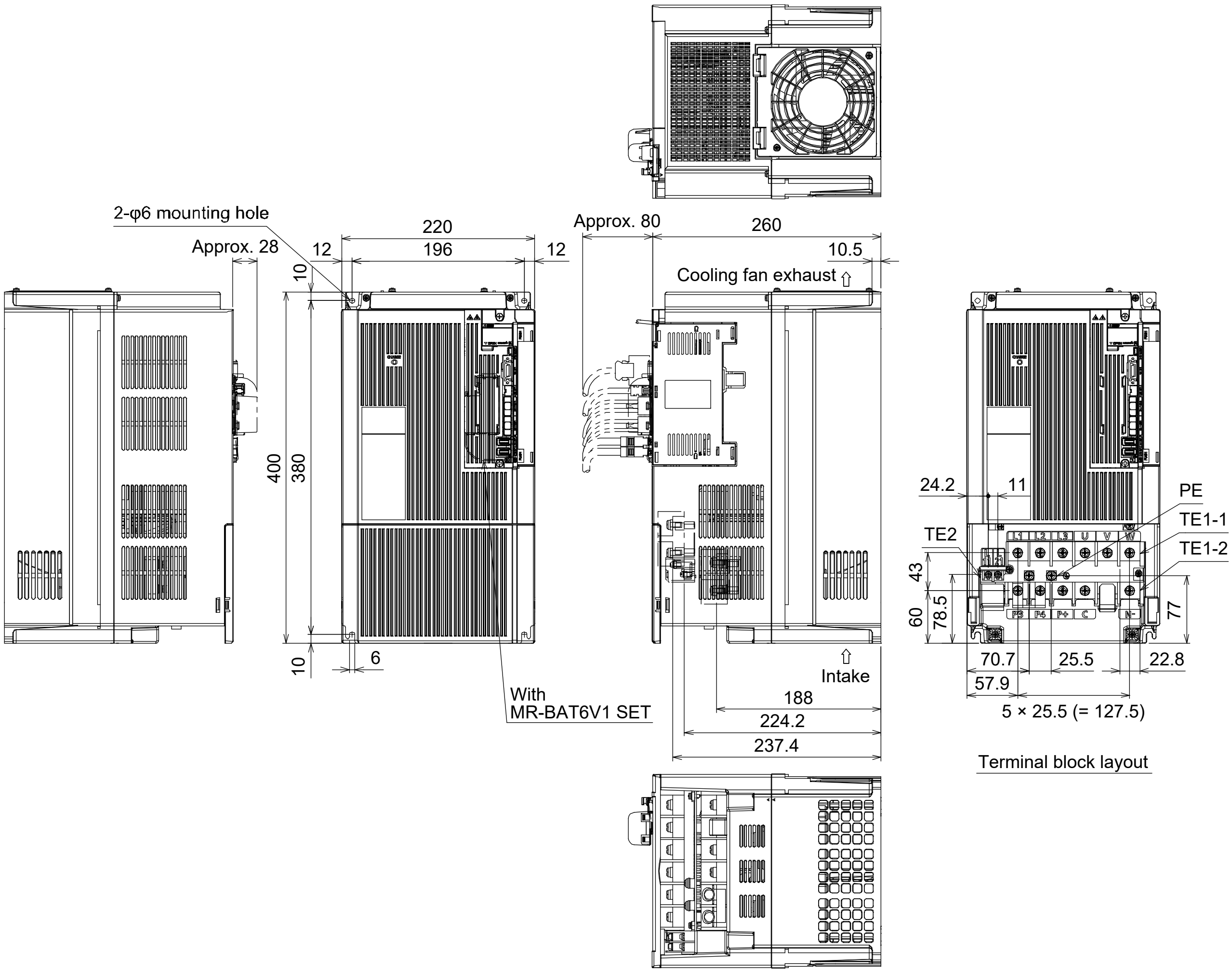
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]



Mounting hole process drawing

(h) MR-J4-11KB(-RJ)/MR-J4-15KB(-RJ)

[Unit: mm]



Mass: 13.4 [kg]

Mounting screw

Screw size: M5

Tightening torque: 3.24 [N•m]

Terminal

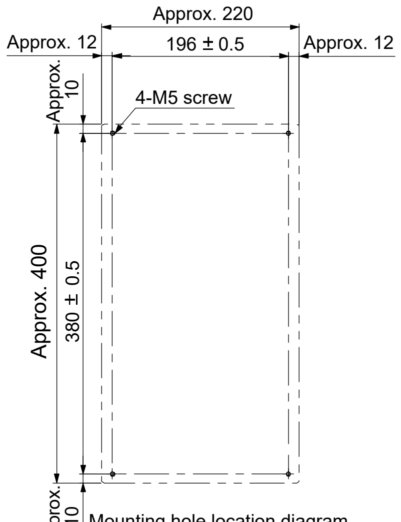
TE1-1	L1	L2	L3	U	V	W
TE1-2	P3	P4	P+	C	⧅	N-
TE2	L11	L21				
PE	⏚	⏚				

TE1-1 Screw size: M6
Tightening torque: 3.0 [N•m]

TE1-2 Screw size: M6
Tightening torque: 3.0 [N•m]

TE2 Screw size: M4
Tightening torque: 1.2 [N•m]

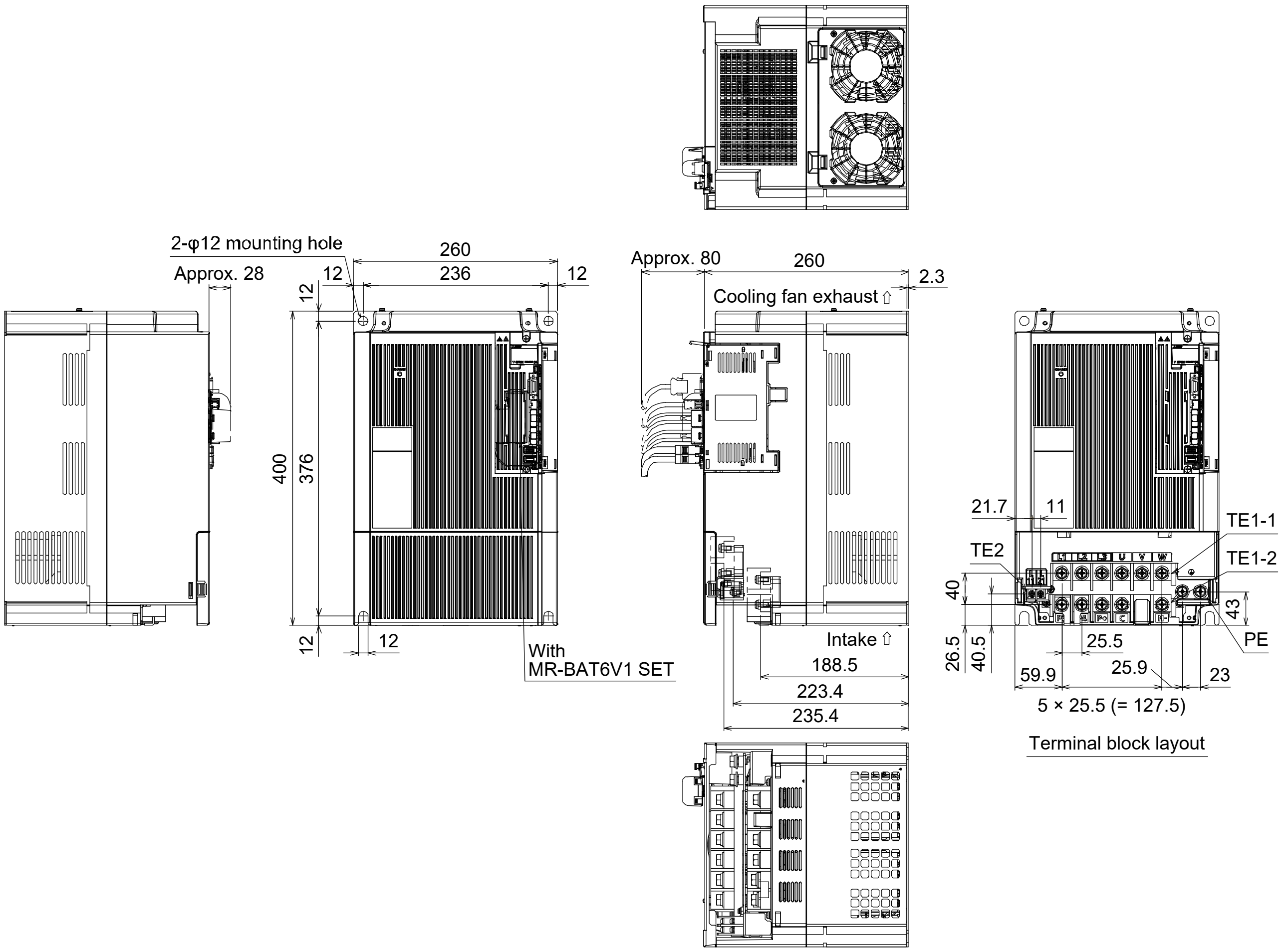
PE Screw size: M6
Tightening torque: 3.0 [N•m]



Mounting hole location diagram

(i) MR-J4-22KB(-RJ)

[Unit: mm]



Terminal block layout

Mass: 18.2 [kg]

Mounting screw

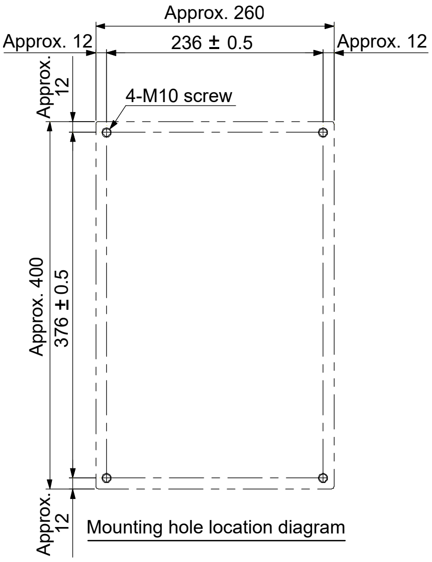
Screw size: M10

Tightening torque: 26.5 [N•m]

Terminal

TE1-1	L1	L2	L3	U	V	W
TE1-2	P3	P4	P+	C	╲	N-
PE	⏚	⏚				
TE2	L11	L21				

TE1-1	Screw size: M8	Tightening torque: 6.0 [N•m]
TE1-2	Screw size: M8	Tightening torque: 6.0 [N•m]
TE2	Screw size: M4	Tightening torque: 1.2 [N•m]
PE	Screw size: M8	Tightening torque: 6.0 [N•m]

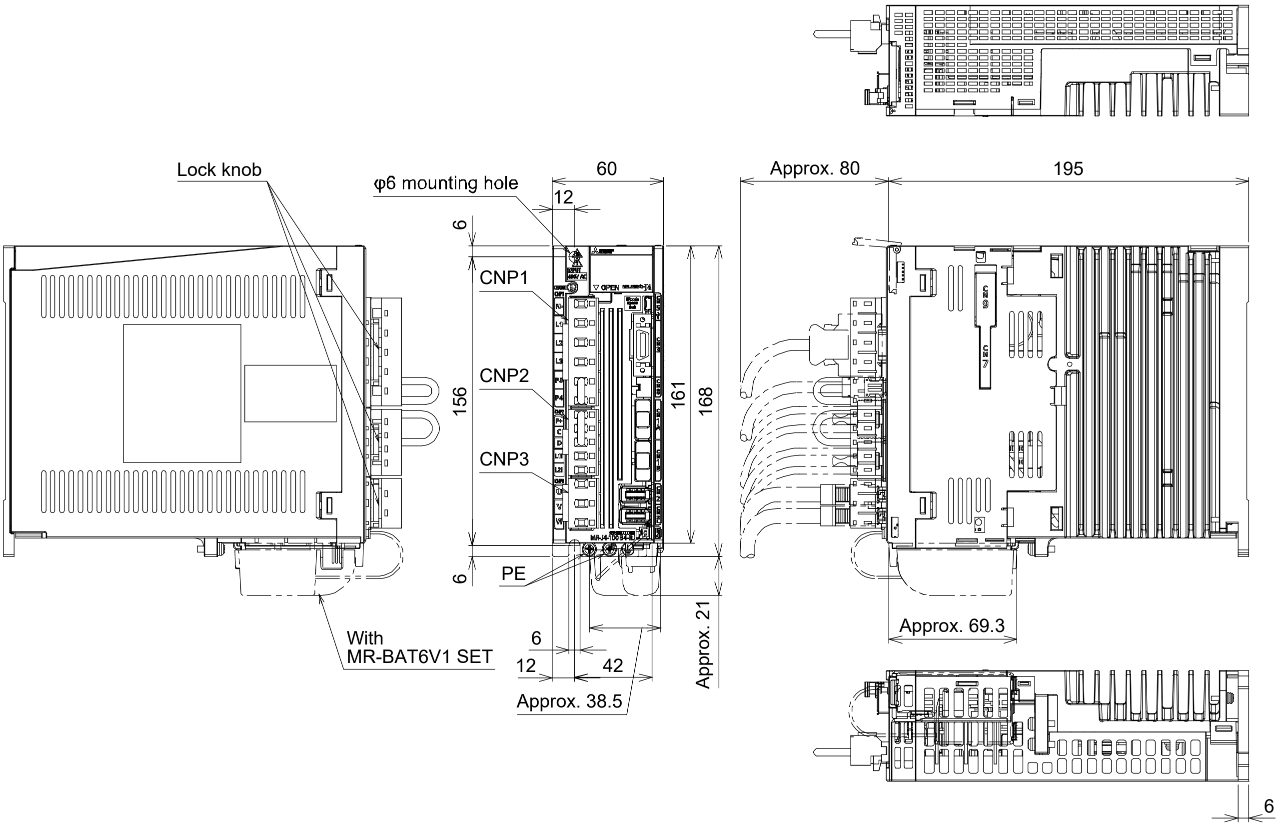


Mounting hole location diagram

(2) 400 V class

(a) MR-J4-60B4(-RJ)/MR-J4-100B4(-RJ)

[Unit: mm]



Mass: 1.7 [kg]

Terminal

CNP1
N-
L1
L2
L3
P3
P4

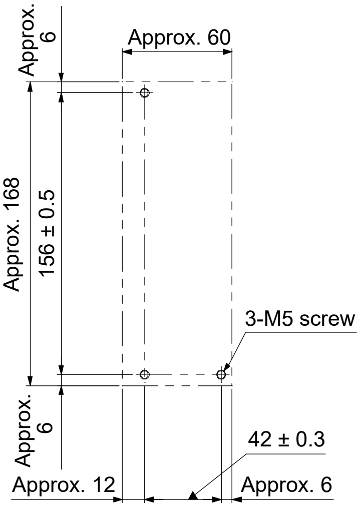
CNP2
P+
C
D
L11
L21

CNP3
U
V
W

PE
⏚ ⏚

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

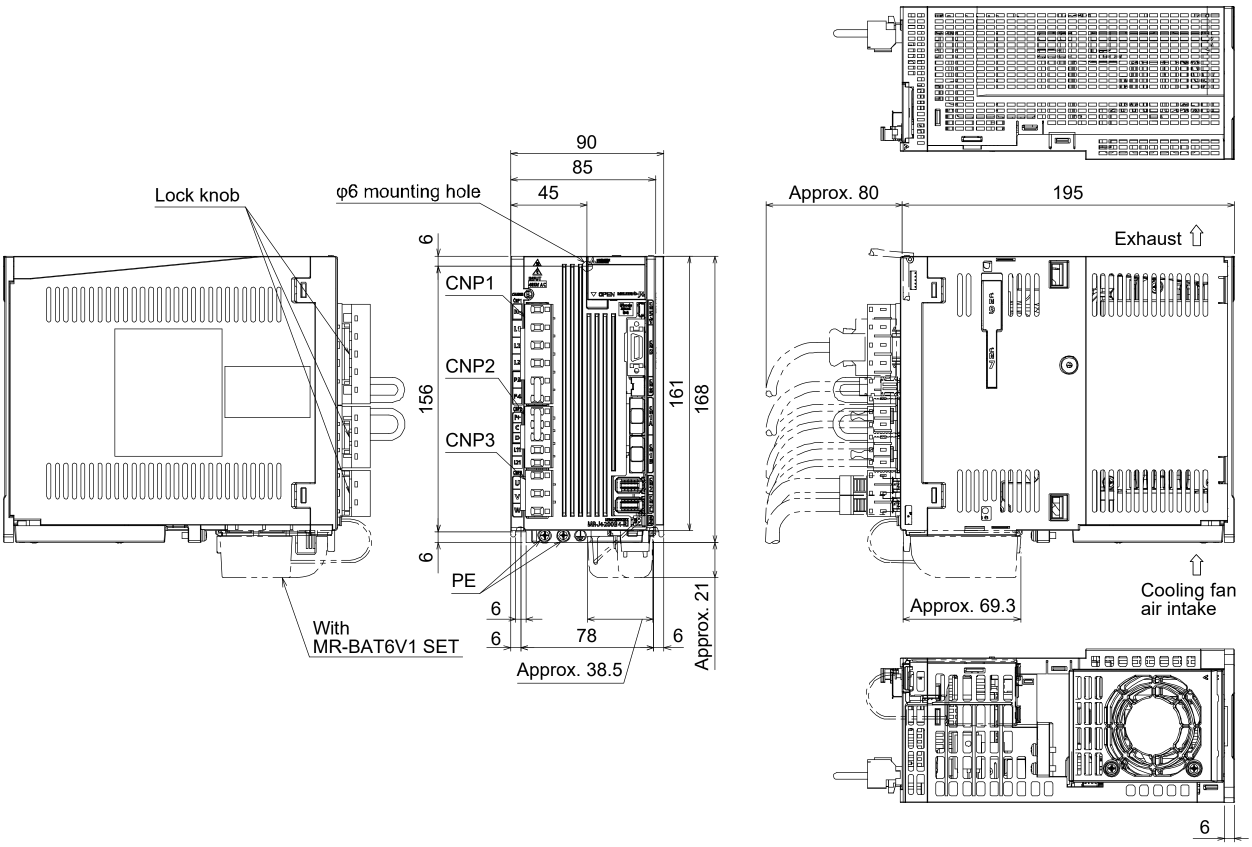
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]



Mounting hole process drawing

(b) MR-J4-200B4(-RJ)

[Unit: mm]



Mass: 2.1 [kg]

Terminal

CNP1
- N-
- L1
- L2
- L3
- P3
- P4

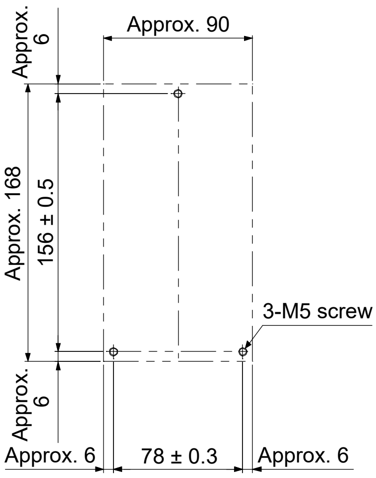
CNP2
- P+
- C
- D
- L11
- L21

CNP3
- U
- V
- W

PE
⏚ ⏚

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

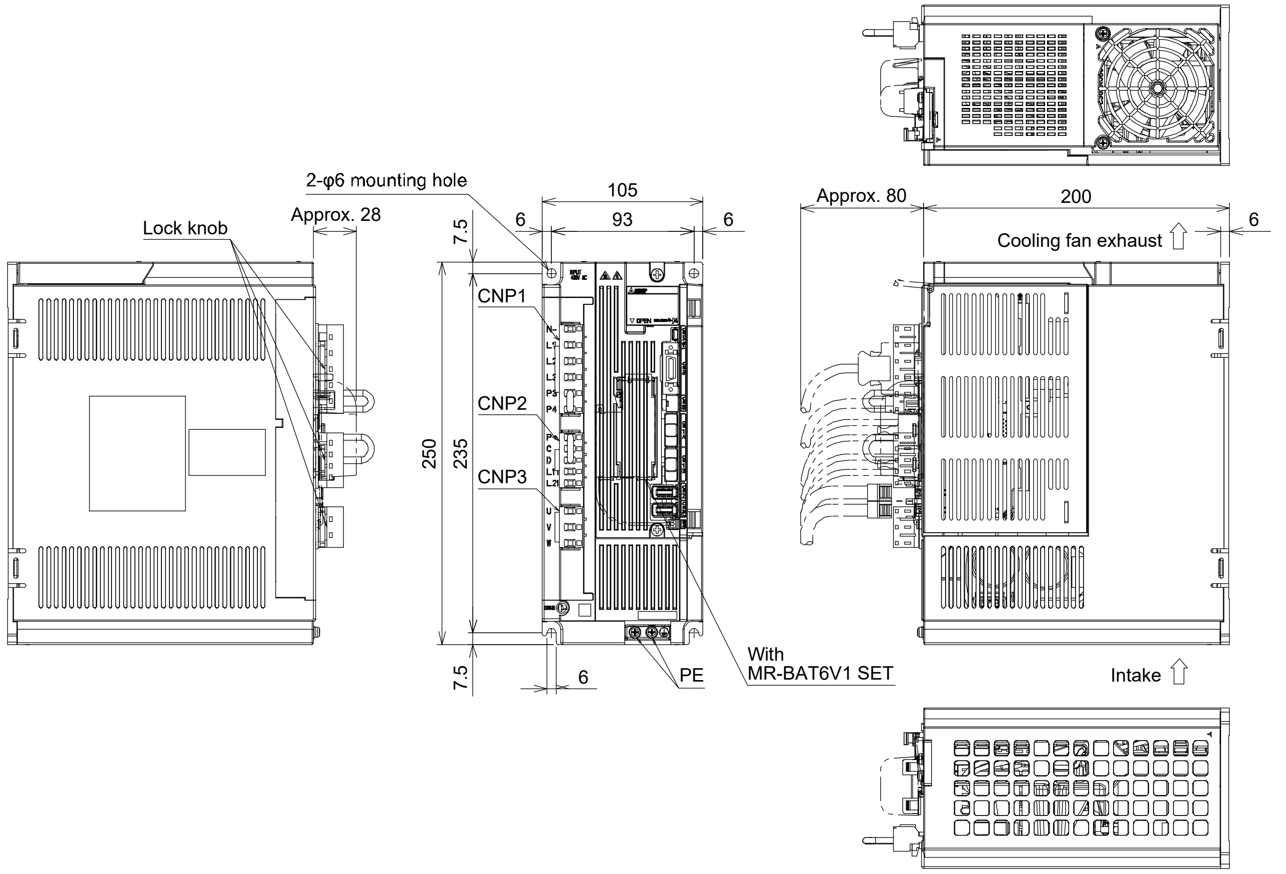
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]



Mounting hole process drawing

(c) MR-J4-350B4(-RJ)

[Unit: mm]



Mass: 3.6 [kg]

Terminal

CNP1
- N-
- L1
- L2
- L3
- P3
- P4

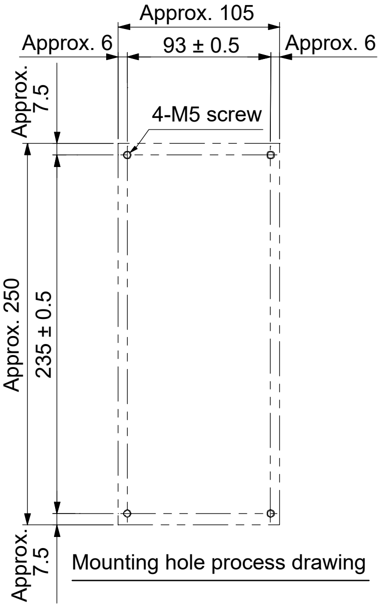
CNP2
- P+
- C
- D
- L11
- L21

CNP3
- U
- V
- W

PE
⏚ ⏚

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

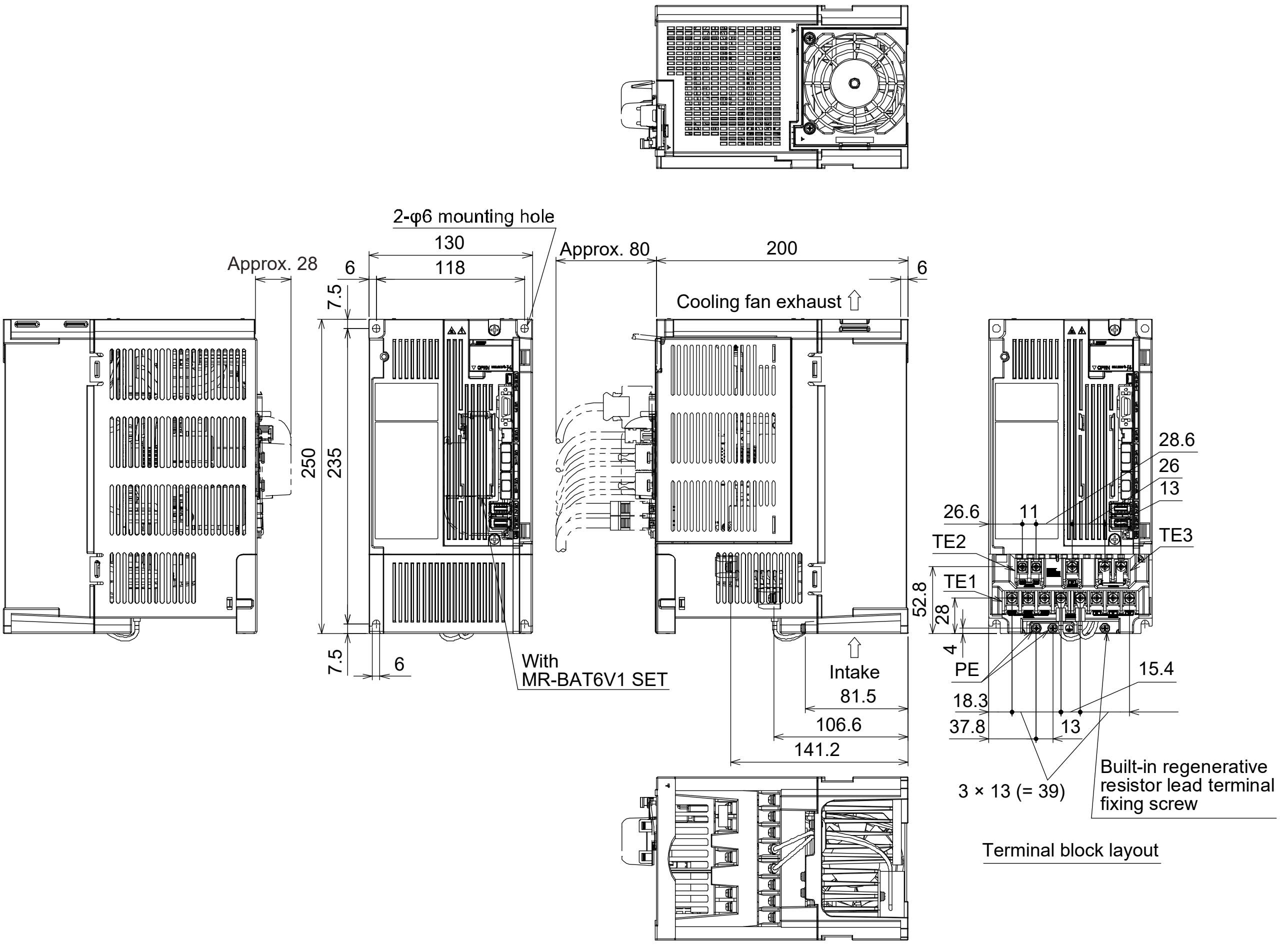
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]



Mounting hole process drawing

(d) MR-J4-500B4(-RJ)

[Unit: mm]



Mass: 4.3 [kg]

Mounting screw

Screw size: M5

Tightening torque: 3.24 [N•m]

Terminal

TE2 L11 L21 TE3 N- P3 P4

TE1 L1 L2 L3 P+ C U V W

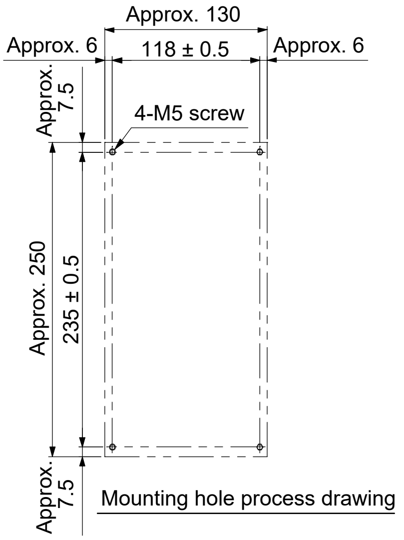
PE ⏚ ⏚

TE2 Screw size: M3.5
Tightening torque: 0.8 [N•m]

TE3 Screw size: M4
Tightening torque: 1.2 [N•m]

TE1 Screw size: M4
Tightening torque: 1.2 [N•m]

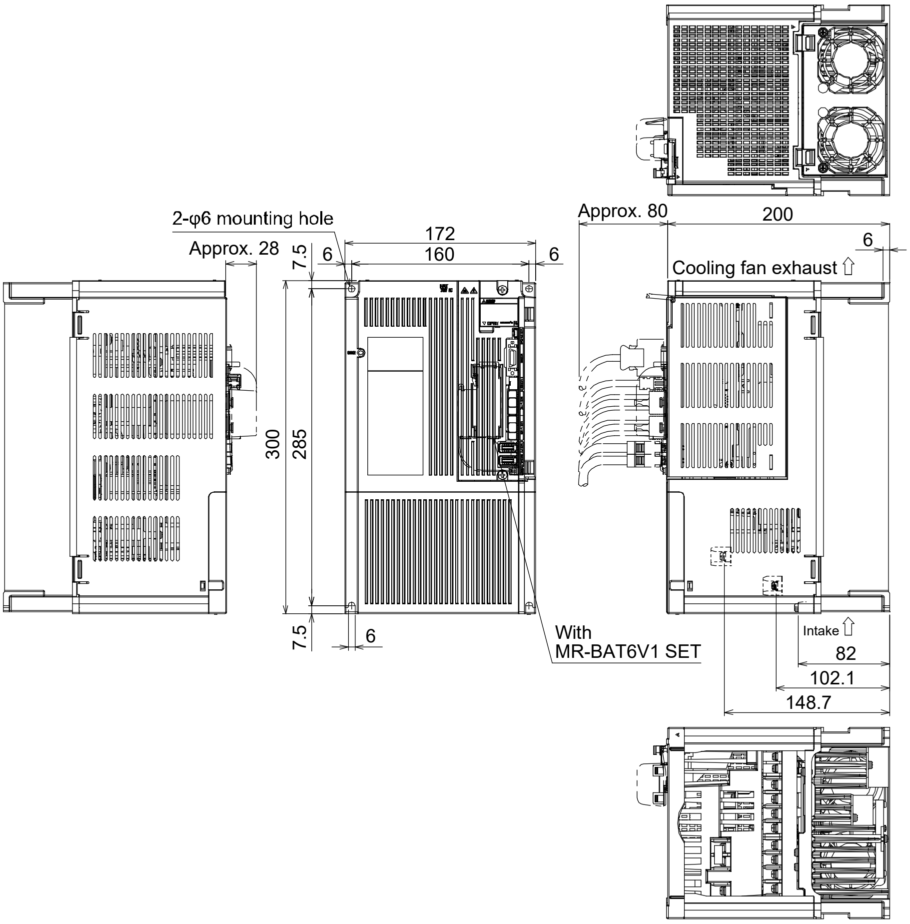
PE Screw size: M4
Tightening torque: 1.2 [N•m]

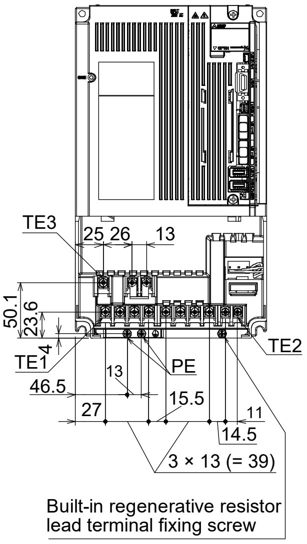


Mounting hole process drawing

(e) MR-J4-700B4(-RJ)

[Unit: mm]





Terminal block layout

Mass: 6.5 [kg]

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

Terminal

TE3 N- P3 P4

TE1 L1 L2 L3 P+ C U V W TE2 L11 L21

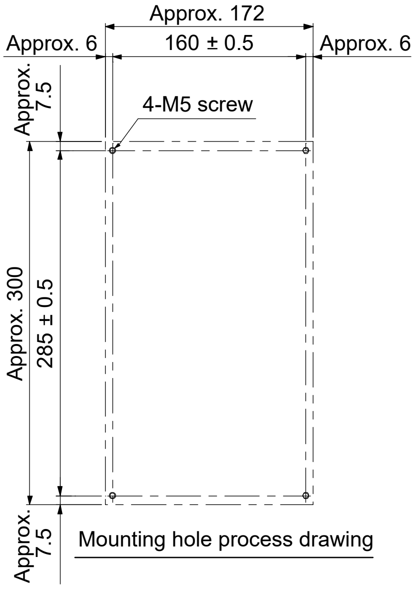
PE ⏚ ⏚

TE3 Screw size: M4
Tightening torque: 1.2 [N•m]

TE1 Screw size: M4
Tightening torque: 1.2 [N•m]

TE2 Screw size: M3.5
Tightening torque: 0.8 [N•m]

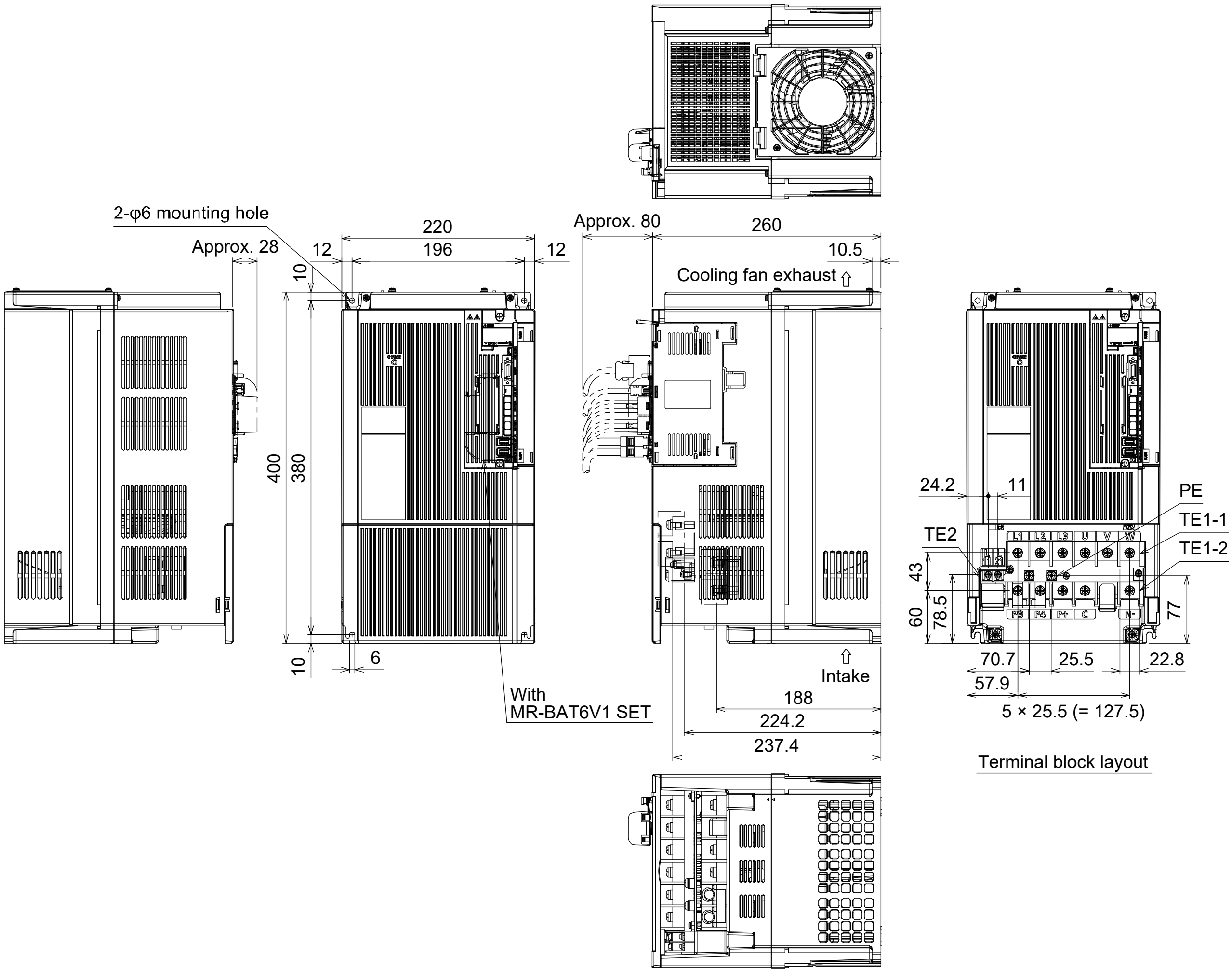
PE Screw size: M4
Tightening torque: 1.2 [N•m]



Mounting hole process drawing

(f) MR-J4-11KB4(-RJ)/MR-J4-15KB4(-RJ)

[Unit: mm]



Mass: 13.4 [kg]

Terminal

TE1-1 L1 L2 L3 U V W

TE1-2 P3 P4 P+ C ⍀ N-

TE2 L11 L21

PE ⏚ ⏚

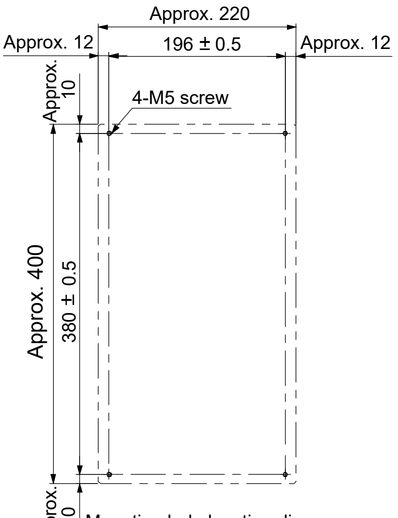
TE1-1 Screw size: M6
Tightening torque: 3.0 [N•m]

TE1-2 Screw size: M6
Tightening torque: 3.0 [N•m]

TE2 Screw size: M4
Tightening torque: 1.2 [N•m]

PE Screw size: M6
Tightening torque: 3.0 [N•m]

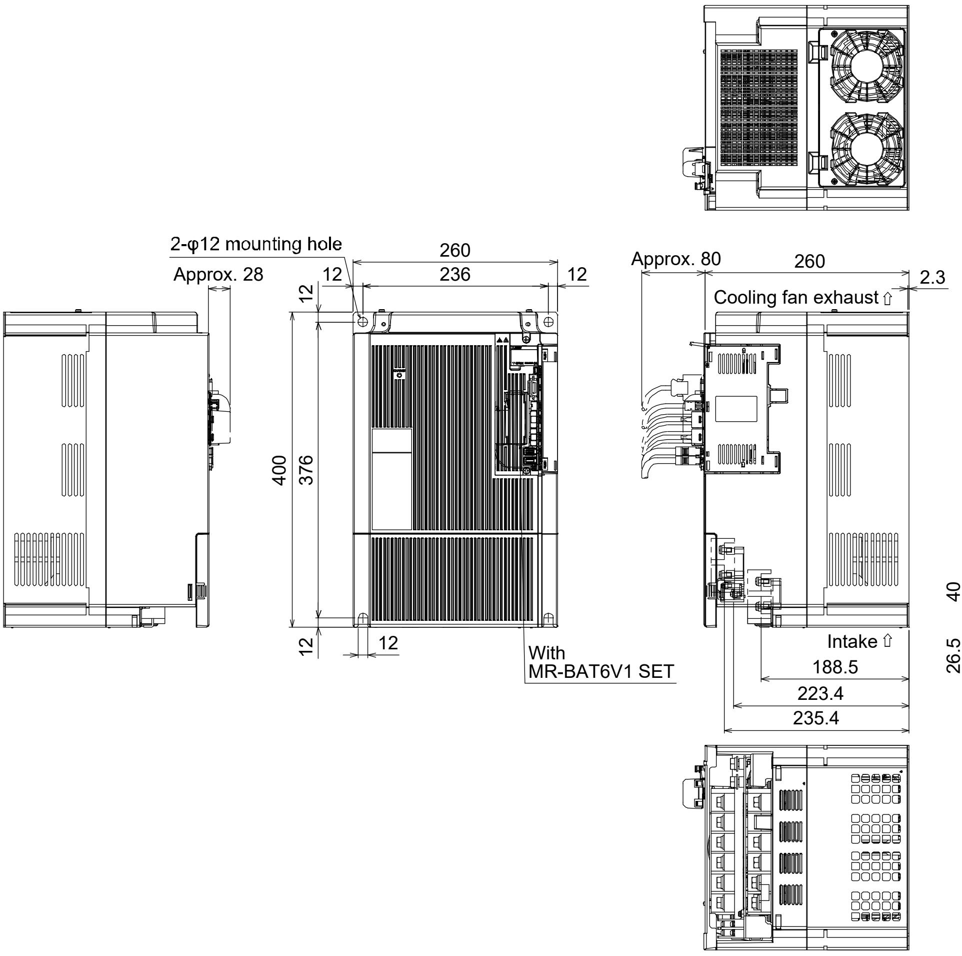
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]

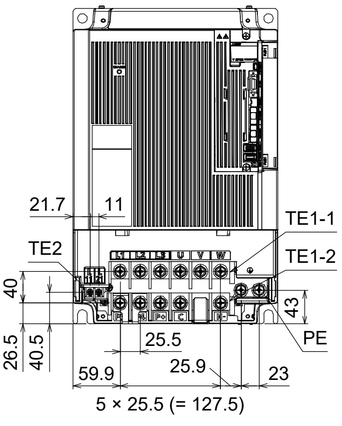


Mounting hole location diagram

(g) MR-J4-22KB4(-RJ)

[Unit: mm]





Terminal block layout

Mass: 18.2 [kg]

Mounting screw
Screw size: M10
Tightening torque: 26.5 [N•m]

Terminal

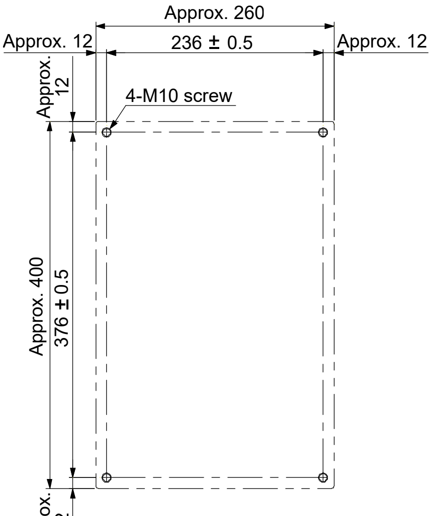
TE1-1	L1	L2	L3	U	V	W
TE1-2	P3	P4	P+	C	╲	N-
PE	⏚	⏚				
TE2	L11	L21				

TE1-1 Screw size: M8
Tightening torque: 6.0 [N•m]

TE1-2 Screw size: M8
Tightening torque: 6.0 [N•m]

TE2 Screw size: M4
Tightening torque: 1.2 [N•m]

PE Screw size: M8
Tightening torque: 6.0 [N•m]

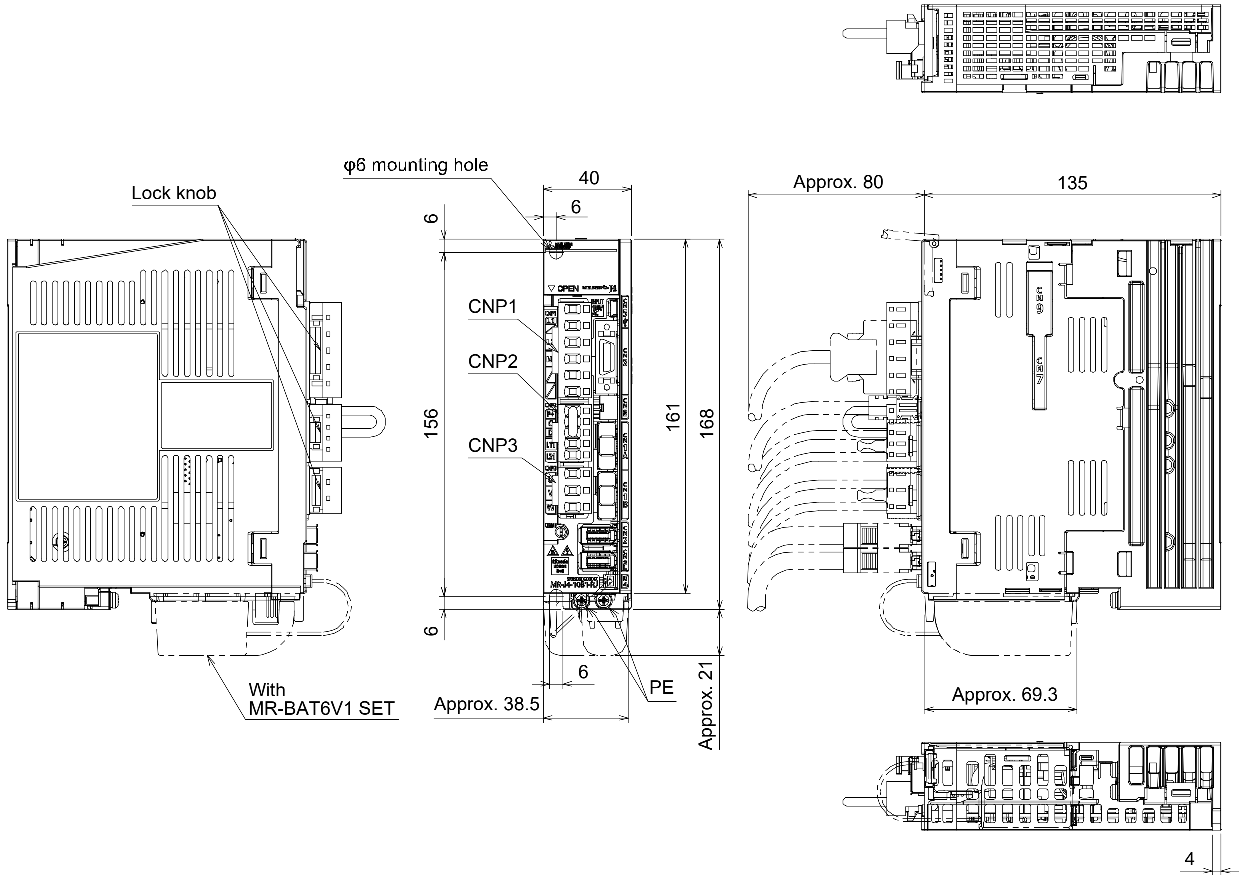


Mounting hole location diagram

(3) 100 V class

(a) MR-J4-10B1(-RJ)/MR-J4-20B1(-RJ)

[Unit: mm]

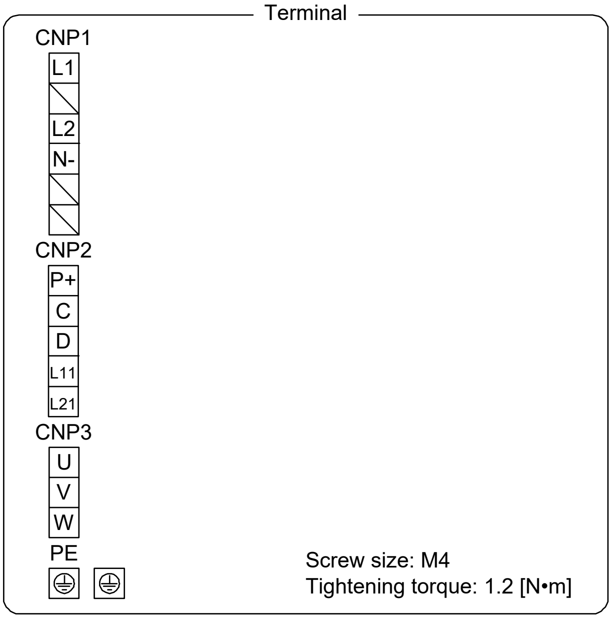


Mass: 0.8 [kg]

Mounting screw

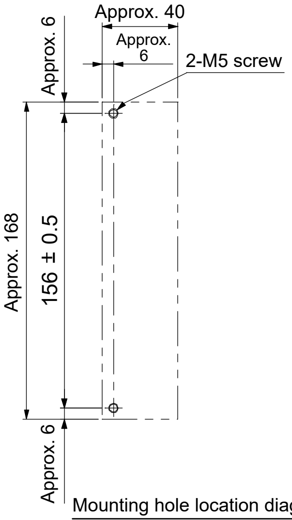
Screw size: M5

Tightening torque: 3.24 [N•m]



Screw size: M4

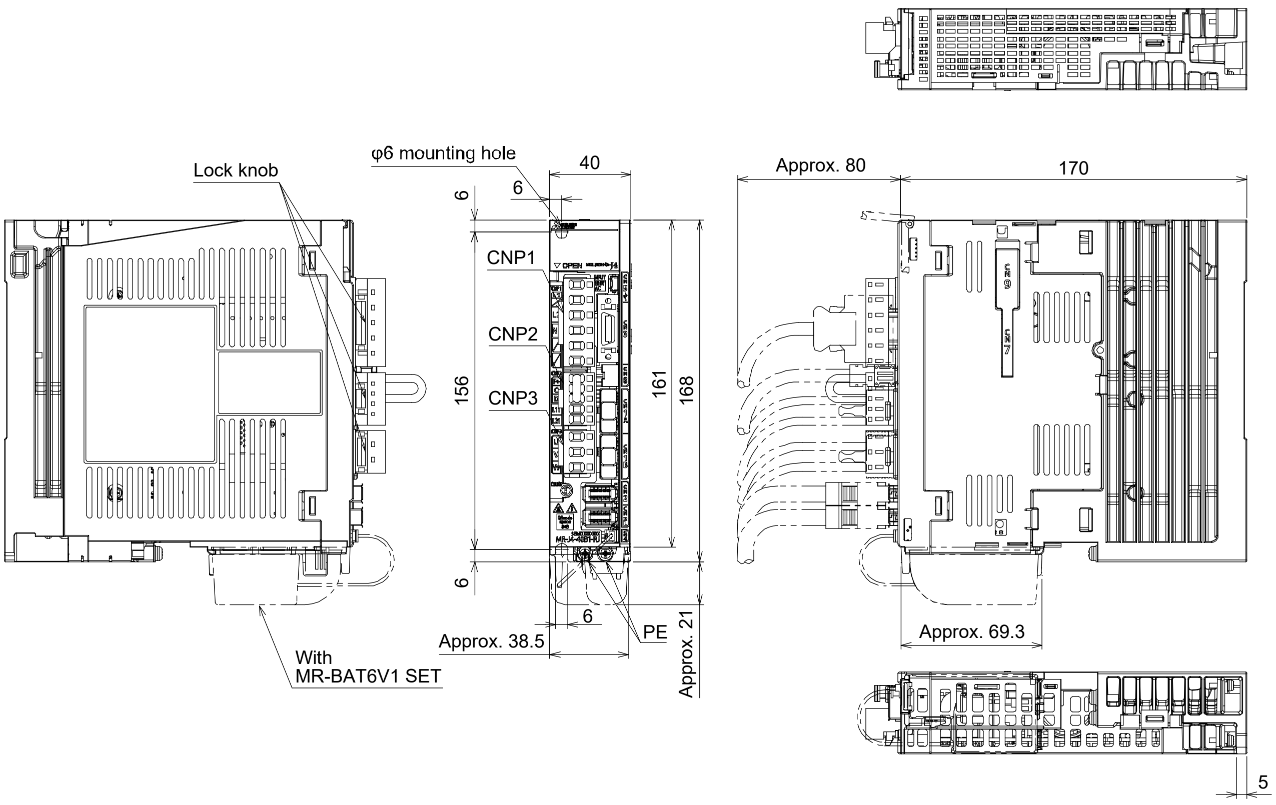
Tightening torque: 1.2 [N•m]



Mounting hole location diagram

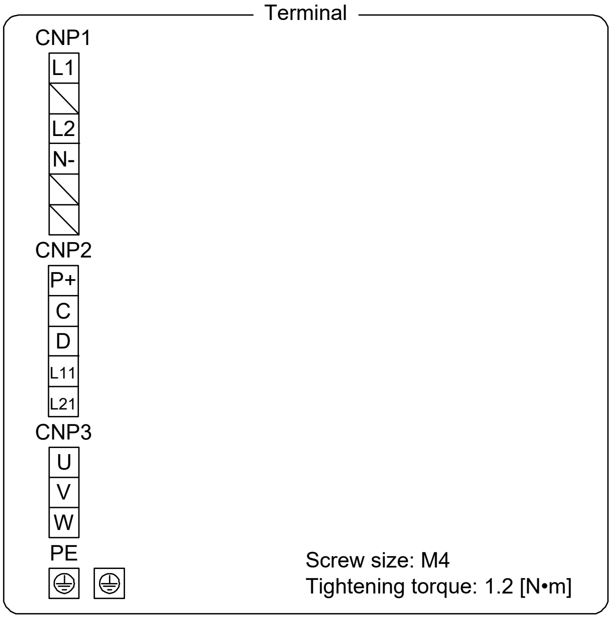
(b) MR-J4-40B1(-RJ)

[Unit: mm]

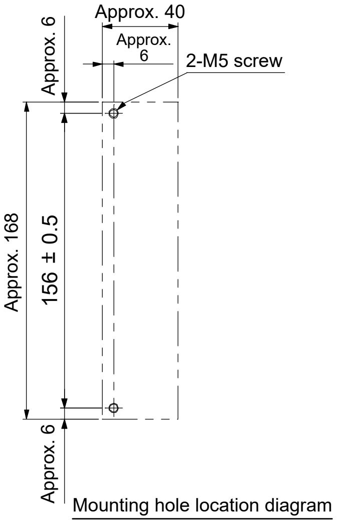


Mass: 1.0 [kg]

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



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



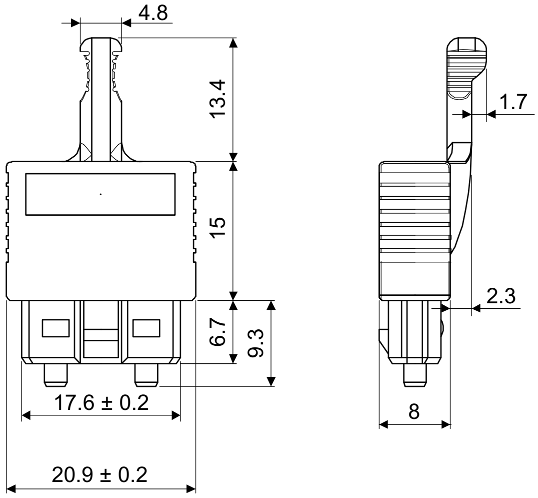
Mounting hole location diagram

9.2 Connector

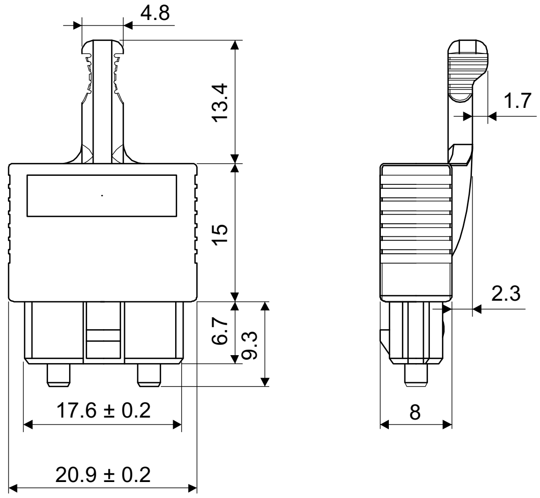
(1) CN1A/CN1B connector

[Unit: mm]

F0-PF2D103



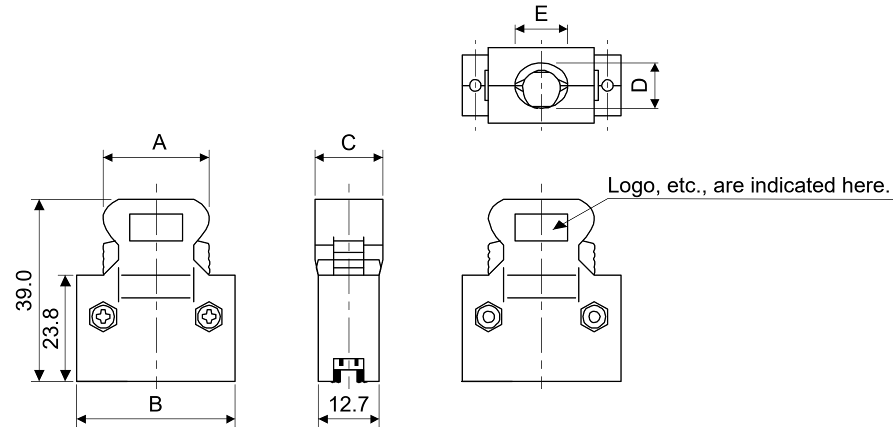
F0-PF2D103-S



(2) Miniature delta ribbon (MDR) system (3M)

(a) One-touch lock type

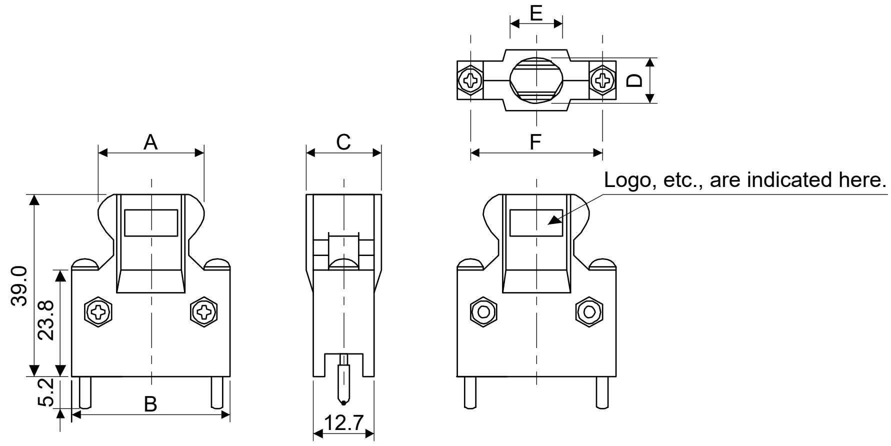
[Unit: mm]



Connector	Shell kit	Each type of dimension				
		A	B	C	D	E
10120-3000PE	10320-52F0-008	22.0	33.3	14.0	10.0	12.0

(b) Jack screw M2.6 type
This is not available as option.

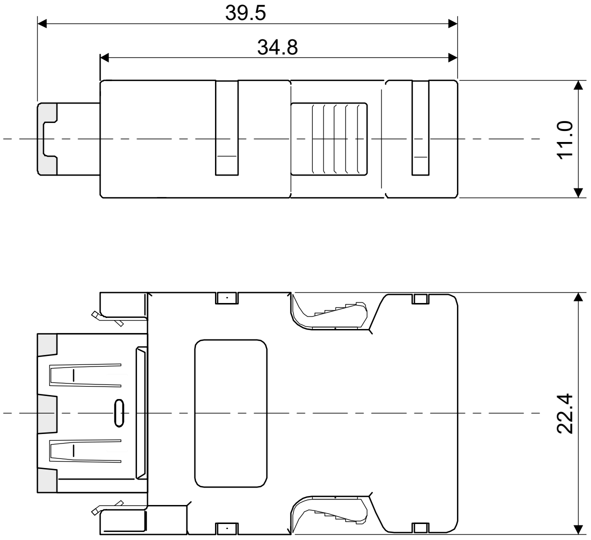
[Unit: mm]



Connector	Shell kit	Each type of dimension					
		A	B	C	D	E	F
10120-3000PE	10320-52F0-008	22.0	33.3	14.0	10.0	12.0	27.4

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

[Unit: mm]



MEMO

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

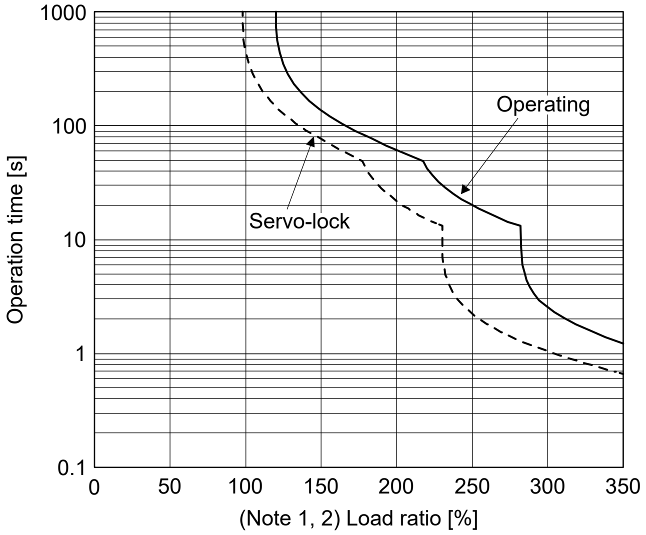
An electronic thermal is built in the servo amplifier to protect the servo motor, servo amplifier and servo motor power wires from overloads.
[AL. 50 Overload 1] occurs if overload operation performed is above the electronic thermal protection curve shown in fig. 10.1 [AL. 51 Overload 2] occurs if the 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.
For the system where the unbalanced torque occurs, such as a vertical axis system, the unbalanced torque of the machine should be kept at 70% or less of the 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.

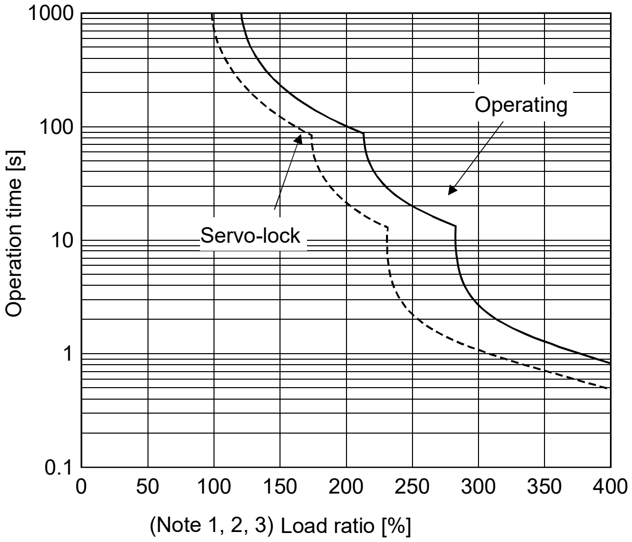
Rotary servo motor						Graph of overload protection characteristics
HG-KR	HG-MR	HG-SR	HG-UR	HG-RR	HG-JR	
053 13	053 13					Characteristics a
23 43 73	23 43 73	51 81 52 102	72		53 (Note) 73 103	Characteristics b
		121 201 152 202 301 352	152 202	103 153 203	73 (Note) 103 (Note) 153 (Note) 203 (Note) 353	Characteristics c
		421 502 702	352 502	353 503	353 (Note) 601 701M 503 (Note) 703	Characteristics d
					801 12K1 15K1 20K1 25K1 11K1M 15K1M 22K1M 903	Characteristics e
		524 1024			534 (Note) 734 1034	Characteristics b
		1524 2024 3524			734 (Note) 1034 (Note) 1534 (Note) 2034 (Note) 3534	Characteristics c
		5024 7024			3534 (Note) 6014 701M4 5034 (Note) 7034	Characteristics d
					8014 12K14 15K14 20K14 25K14 11K1M4 15K1M4 22K1M4 9034	Characteristics e

Note. This combination is for increasing the maximum torque of the servo motor to 400%.

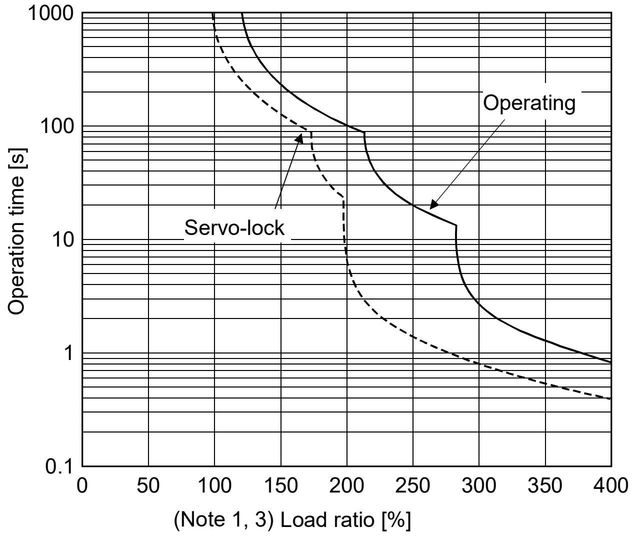
The following graphs show overload protection characteristics.



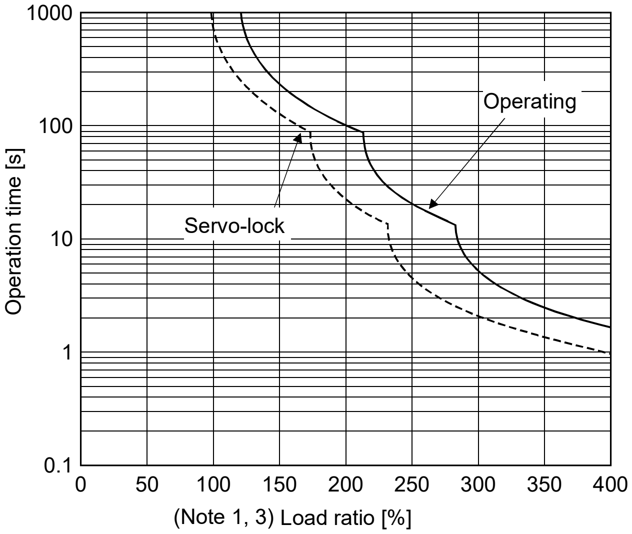
Characteristics a



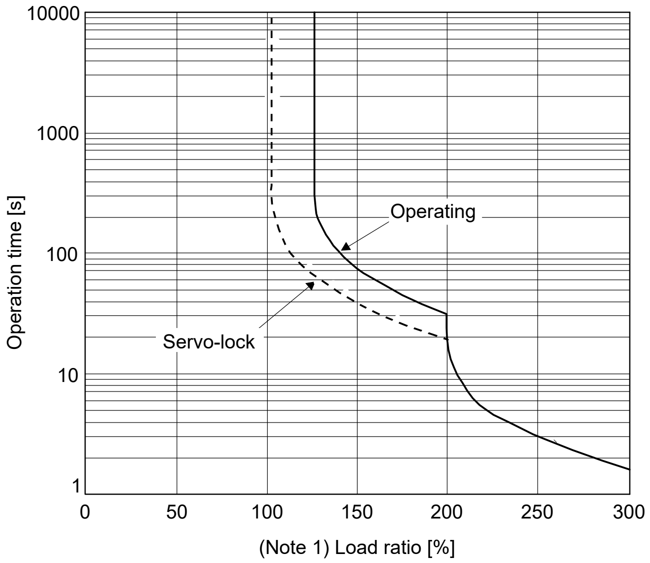
Characteristics b



Characteristics c



Characteristics d



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 50 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

10.2 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 tables in consideration for the harshest conditions with regard to the environment and operation pattern. 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

Servo amplifier	Servo motor	Power supply capacity [kVA] (Note 1)	Servo amplifier-generated heat [W] (Note 2)			Area required for heat dissipation [m²]
			At rated output	At rated output [Generated heat in the cabinet when cooled outside the cabinet] (Note 3)	With servo-off	
MR-J4-10B(-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-J4-20B(-RJ)	HG-MR23	0.5	25		15	0.5
	HG-KR23	0.5	25		15	0.5
MR-J4-40B(-RJ)	HG-MR43	0.9	35		15	0.7
	HG-KR43	0.9	35		15	0.7
MR-J4-60B(-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-J4-70B(-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-J4-100B(-RJ)	HG-SR102	1.7	50		15	1.0
	HG-SR81	1.5	50		15	1.0
	HG-JR103	1.7	50		15	1.0
MR-J4-200B(-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
	HG-JR203	3.5	90		20	1.8
MR-J4-350B(-RJ)	HG-SR352	5.5	130		20	2.6
	HG-SR301	4.8	120		20	2.4
	HG-RR203	3.5	90		20	1.8
	HG-UR202	3.5	90		20	1.8
	HG-JR353	5.5	160		20	2.7
MR-J4-500B(-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
	HG-JR503	7.5	195		25	3.9
MR-J4-700B(-RJ)	HG-SR702	10	300		25	6.0
	HG-JR703	10	300		25	6.0
	HG-JR701M	10	300		25	6.0
	HG-JR601	8.6	250		25	5.0

Servo amplifier	Servo motor	Power supply capacity [kVA] (Note 1)	Servo amplifier-generated heat [W] (Note 2)			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
	HG-JR801	12	370	110	45	7.0
	HG-JR12K1	18	570	170	45	11.5
MR-J4-15KB(-RJ)	HG-JR15K1M	22	640	195	45	13.0
	HG-JR15K1	22	640	195	45	12.8
MR-J4-22KB(-RJ)	HG-JR22K1M	33	850	260	55	17.0
	HG-JR20K1	30	800	240	55	16.0
	HG-JR25K1	38	900	270	55	19.0
MR-J4-60B4(-RJ)	HG-SR524	1.0	40		18	0.8
	HG-JR534	1.0	40		18	0.8
MR-J4-100B4(-RJ)	HG-SR1024	1.7	60		18	1.2
	HG-JR734	1.3	60		18	1.2
	HG-JR1034	1.7	60		18	1.2
MR-J4-200B4(-RJ)	HG-SR1524	2.5	90		20	1.8
	HG-SR2024	3.5	90		20	1.8
	HG-JR1534	2.5	90		20	1.8
	HG-JR2034	3.5	90		20	1.8
MR-J4-350B4(-RJ)	HG-SR3524	5.5	130		20	2.6
	HG-JR3534	5.5	160		20	2.7
MR-J4-500B4(-RJ)	HG-SR5024	7.5	195		25	3.9
	HG-JR5034	7.5	195		25	3.9
MR-J4-700B4(-RJ)	HG-SR7024	10	300		25	6.0
	HG-JR7034	10	300		25	6.0
	HG-JR701M4	10	300		25	6.0
	HG-JR6014	8.6	250		25	5.0
MR-J4-11KB4(-RJ)	HG-JR9034	13	435	130	45	8.7
	HG-JR11K1M4	16	530	160	45	11.0
	HG-JR8014	12	370	110	45	7.0
	HG-JR12K14	18	570	170	45	11.5
MR-J4-15KB4(-RJ)	HG-JR15K1M4	22	640	195	45	13.0
	HG-JR15K14	22	640	195	45	12.8
MR-J4-22KB4(-RJ)	HG-JR22K1M4	33	850	260	55	17.0
	HG-JR20K14	30	800	240	55	16.0
	HG-JR25K14	38	900	270	55	19.0
MR-J4-10B1(-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-J4-20B1(-RJ)	HG-MR23	0.5	25		15	0.5
	HG-KR23	0.5	25		15	0.5
MR-J4-40B1(-RJ)	HG-MR43	0.9	35		15	0.7
	HG-KR43	0.9	35		15	0.7

Note 1. The power supply equipment capacity changes with the power supply impedance. This value is applicable when the power factor improving AC reactor or power factor improving DC reactor is not used.

2. Heat generated during regeneration is not included in the servo amplifier-generated heat. To calculate heat generated by the regenerative option, refer to section 11.2.

3. This value is applicable when the servo amplifier is cooled by using the panel through 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.

$$A = \frac{P}{K \bullet \Delta T} \cdots\cdots (10.1)$$

A: Heat dissipation area [m^2]
P: Loss generated in the cabinet [W]
ΔT: Difference between internal and ambient temperatures [°C]
K: Heat dissipation coefficient [5 to 6]

When calculating the heat dissipation area with equation 10.1, assume that P is the sum of all losses generated in the cabinet. Refer to table 10.1 for heat generated by the servo amplifier. "A" indicates the effective area for heat dissipation, but if the cabinet is directly installed on an insulated wall, that extra amount must be added to the cabinet's surface area. The required heat dissipation area will vary with the conditions in the cabinet. If convection in the cabinet is poor and heat builds up, effective heat dissipation will not be possible. Therefore, arrangement of the equipment in the cabinet and the use of a cooling fan should be considered. Table 10.1 lists the cabinet dissipation area for each servo amplifier (guideline) when the servo amplifier is operated at the ambient temperature of 40 °C under rated load.

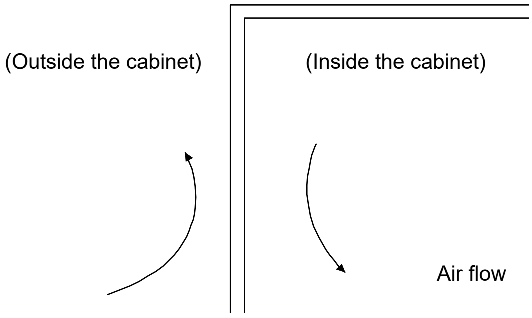


Fig. 10.2 Temperature distribution in an enclosed type cabinet

When air flows along the outer wall of the cabinet, effective heat exchange will be possible, because the temperature slope inside and outside the cabinet will be steeper.

10.3 Dynamic brake characteristics

⚠CAUTION

- The coasting distance is a theoretically calculated value that does not consider factors such as friction. The calculated value will be longer than the actual distance. If the braking distance is not longer than the calculated value, a moving part may crash into the stroke end, causing a dangerous situation. Install an 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.

POINT

- Do not use dynamic brake to stop in a normal operation as it is the function to stop in emergency.
- For a machine operating at the recommended load to motor inertia ratio or less, the estimated number of usage times of the dynamic brake is 1000 times while the machine decelerates from the rated speed to a stop once in 10 minutes.
- Be sure to enable EM1 (Forced stop 1) after servo motor stops when using EM1 (Forced stop 1) frequently in other than emergency.
- 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 shorter 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) in 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.

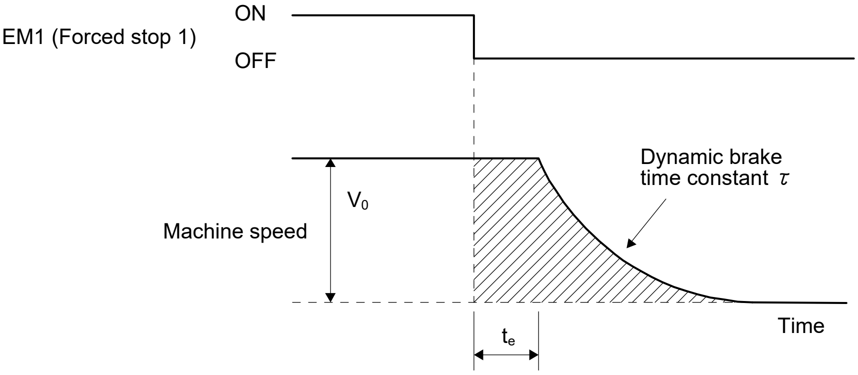


Fig. 10.3 Dynamic brake operation diagram

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

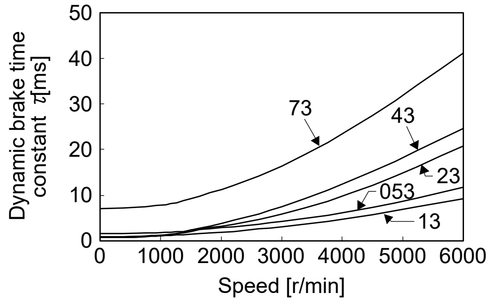
L_{max}: Maximum coasting distance ··········[mm]
V_0: Machine's fast feed speed ··········[mm/min]
J_M: Moment of inertia of the servo motor··········[$\times 10^{-4}$ kg•m^2]
J_L: Load moment of inertia converted into equivalent value on servo motor shaft··········[$\times 10^{-4}$ kg•m^2]
τ: Dynamic brake time constant ··········[s]
t_e: Delay time of control section ··········[s]

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

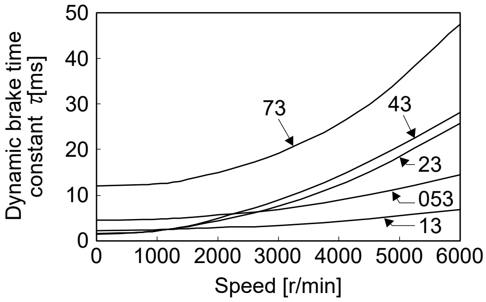
(2) Dynamic brake time constant

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

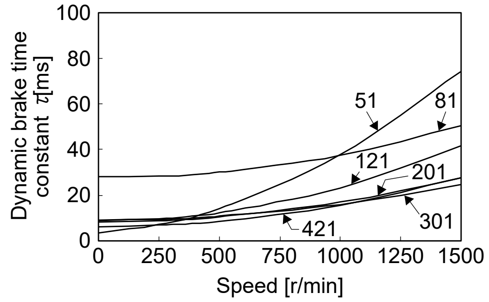
(a) 200 V class



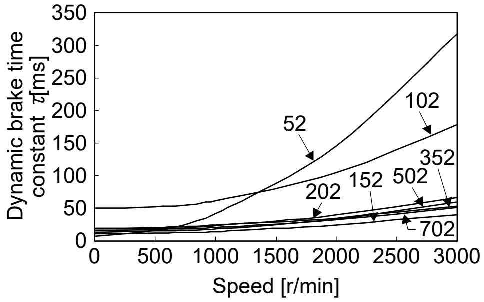
HG-MR series



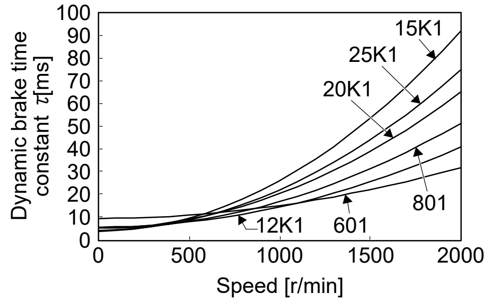
HG-KR series



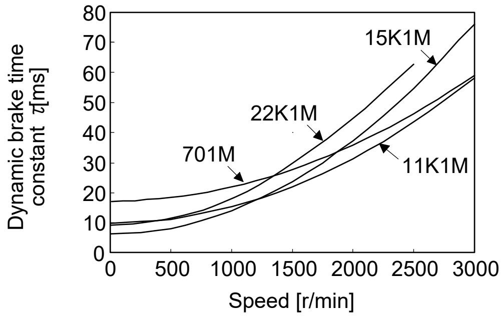
HG-SR 1000 r/min series



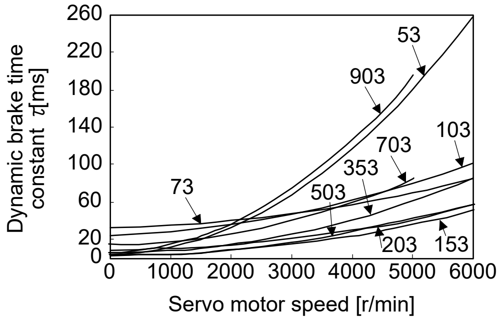
HG-SR 2000 r/min series



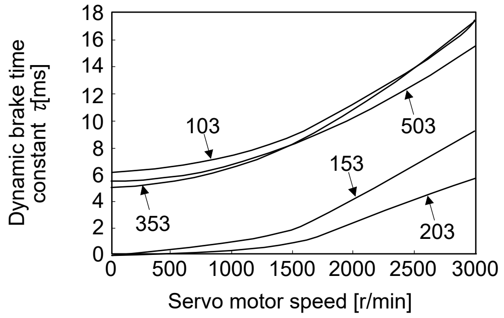
HG-JR1000 r/min series



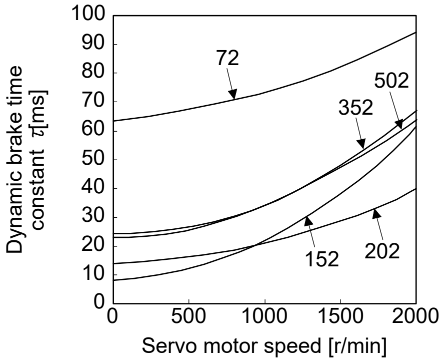
HG-JR1500 r/min series



HG-JR3000 r/min series

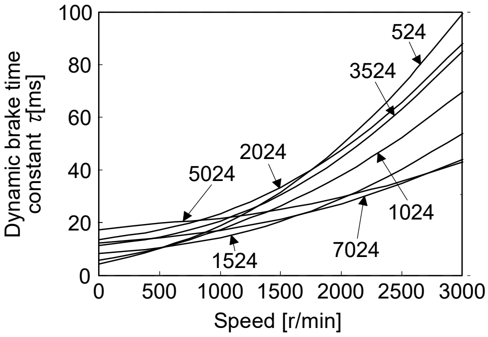


HG-RR series

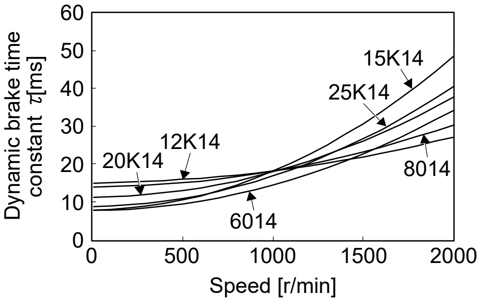


HG-UR series

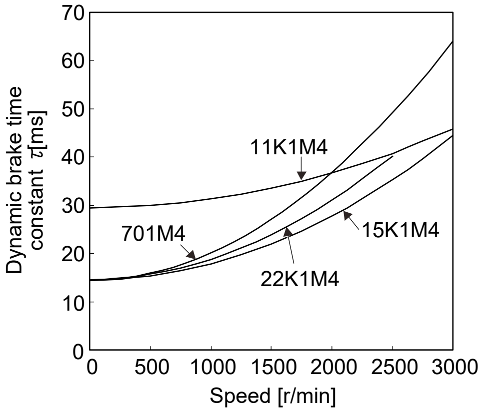
(b) 400 V class



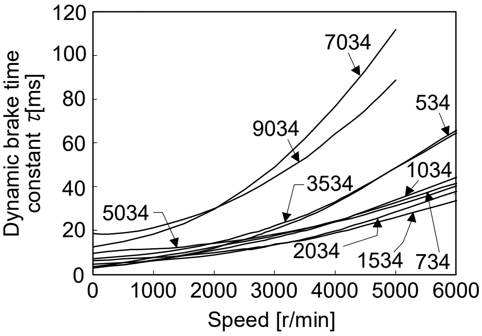
HG-SR series



HG-JR1000 r/min series



HG-JR1500 r/min series



HG-JR3000 r/min series

10.3.2 Permissible load to motor inertia when the dynamic brake is used

Use the dynamic brake under the load to motor inertia ratio indicated in the following table. If the 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. The value in the parenthesis shows the value at the rated speed.

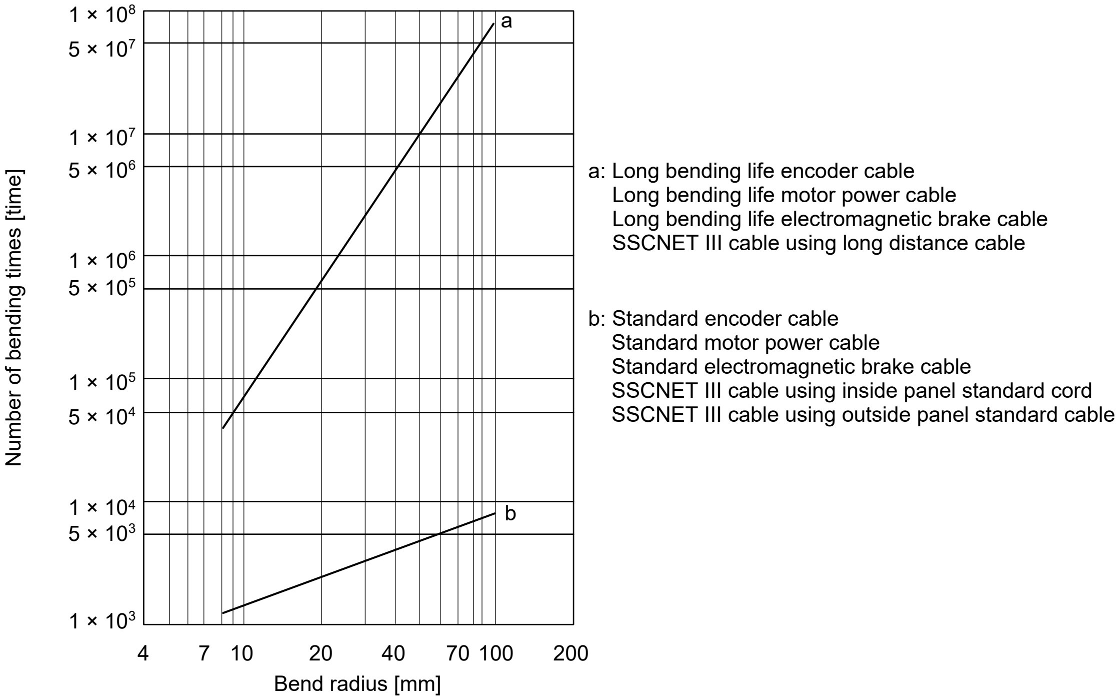
Servo motor	Permissible load to motor inertia ratio [multiplier]
HG-KR053	30
HG-KR13	
HG-KR23	
HG-KR43	
HG-KR73	
HG-MR053	35
HG-MR13	32
HG-MR23	
HG-MR43	
HG-MR73	
HG-SR51	30
HG-SR81	
HG-SR121	
HG-SR201	
HG-SR301	16
HG-SR421	15
HG-SR52	30
HG-SR102	
HG-SR152	21
HG-SR202	
HG-SR352	13 (15)
HG-SR502	
HG-SR702	5 (15)
HG-SR524	5 (15)
HG-SR1024	5 (17)
HG-SR1524	
HG-SR2024	5 (15)
HG-SR3524	
HG-SR5024	
HG-SR7024	
HG-UR72	30
HG-UR152	
HG-UR202	16
HG-UR352	
HG-UR502	15
HG-RR103	30
HG-RR153	
HG-RR203	16
HG-RR353	15
HG-RR503	

Servo motor	Permissible load to motor inertia ratio [multiplier]
HG-JR53	30
HG-JR73	
HG-JR103	
HG-JR153	
HG-JR203	
HG-JR353	16 (30)
HG-JR503	15 (30)
HG-JR703	11 (30)
HG-JR903	18 (30)
HG-JR701M	5
HG-JR11K1M	10 (30)
HG-JR15K1M	
HG-JR22K1M	20 (30)
HG-JR601	5
HG-JR801	30
HG-JR12K1	20 (30)
HG-JR15K1	17 (30)
HG-JR20K1	26 (30)
HG-JR25K1	21 (30)
HG-JR534	30 (30)
HG-JR734	
HG-JR1034	
HG-JR1534	
HG-JR2034	
HG-JR3534	20 (30) (Note)
HG-JR5034	15 (30)
HG-JR7034	11 (30)
HG-JR9034	18 (30)
HG-JR701M4	7 (10)
HG-JR11K1M4	10 (30)
HG-JR15K1M4	
HG-JR22K1M4	20 (30)
HG-JR6014	10
HG-JR8014	30
HG-JR12K14	20 (30)
HG-JR15K14	30 (30)
HG-JR20K14	26 (30)
HG-JR25K14	21 (30)

Note. When the maximum torque is increased to 400%, the permissible load to motor inertia ratio at the maximum speed of the servo motor is 25 times.

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.



a: Long bending life encoder cable
Long bending life motor power cable
Long bending life electromagnetic brake cable
SSCNET III cable using long distance cable

b: Standard encoder cable
Standard motor power cable
Standard electromagnetic brake cable
SSCNET III cable using inside panel standard cord
SSCNET III cable using outside panel standard cable

10.5 Inrush currents at power-on of main circuit and control circuit

POINT

- For a servo amplifier of 600 W or less, the inrush current values can change depending on frequency of turning on/off the power and ambient temperature.

A molded-case circuit breaker and magnetic contactor may fail or malfunction due to an inrush current flowing through the servo amplifier's power lines (input lines) at power on. Therefore, use products with the specifications as described. (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.

(1) 200 V class

The following shows the inrush currents (reference data) that will flow when 240 V AC servo amplifier) is applied at the power supply capacity. Even when you use a 1-phase 200 V AC power supply with MR-J4-10B(-RJ) to MR-J4-200B(-RJ), the inrush currents of the main circuit power supply is the same.

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

(2) 400 V class

The following shows the inrush currents (reference data) that will flow when 480 V AC is applied at the power supply capacity.

Servo amplifier	Inrush currents (A_{0-P})	
	Main circuit power supply (L1/L2/L3)	Control circuit power supply (L11/L21)
MR-J4-60B4(-RJ) MR-J4-100B4(-RJ)	65 A (attenuated to approx. 5 A in 10 ms)	40 A to 50 A (attenuated to approx. 0 A in 2 ms)
MR-J4-200B4(-RJ)	80 A (attenuated to approx. 5 A in 10 ms)	
MR-J4-350B4(-RJ)	100 A (attenuated to approx. 20 A in 10 ms)	
MR-J4-500B4(-RJ)	65 A (attenuated to approx. 9 A in 20 ms)	41 A (attenuated to approx. 0 A in 3 ms)
MR-J4-700B4(-RJ)	68 A (attenuated to approx. 34 A in 20 ms)	
MR-J4-11KB4(-RJ)	339 A (attenuated to approx. 10 A in 30 ms)	38 A (attenuated to approx. 1 A in 30 ms)
MR-J4-15KB4(-RJ)	339 A (attenuated to approx. 15 A in 30 ms)	
MR-J4-22KB4(-RJ)	339 A (attenuated to approx. 20 A in 30 ms)	

(3) 100 V class

The following shows the inrush currents (reference data) that will flow when 120 V AC is applied at the power supply capacity.

Servo amplifier	Inrush currents (A_{0-P})	
	Main circuit power supply (L1/L2)	Control circuit power supply (L11/L21)
MR-J4-10B1(-RJ) MR-J4-20B1(-RJ) MR-J4-40B1(-RJ)	38 A (attenuated to approx. 14 A in 10 ms)	20 A to 30 A (attenuated to approx. 0 A in 1 ms to 2 ms)

MEMO

11. OPTIONS AND PERIPHERAL 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.

⚠CAUTION	●Use the specified peripheral equipment and options to prevent a malfunction or a fire.

POINT
●We recommend using HIV wires to wire the servo amplifiers, options, and peripheral equipment. Therefore, the recommended wire sizes may differ from those used for the previous servo amplifiers.

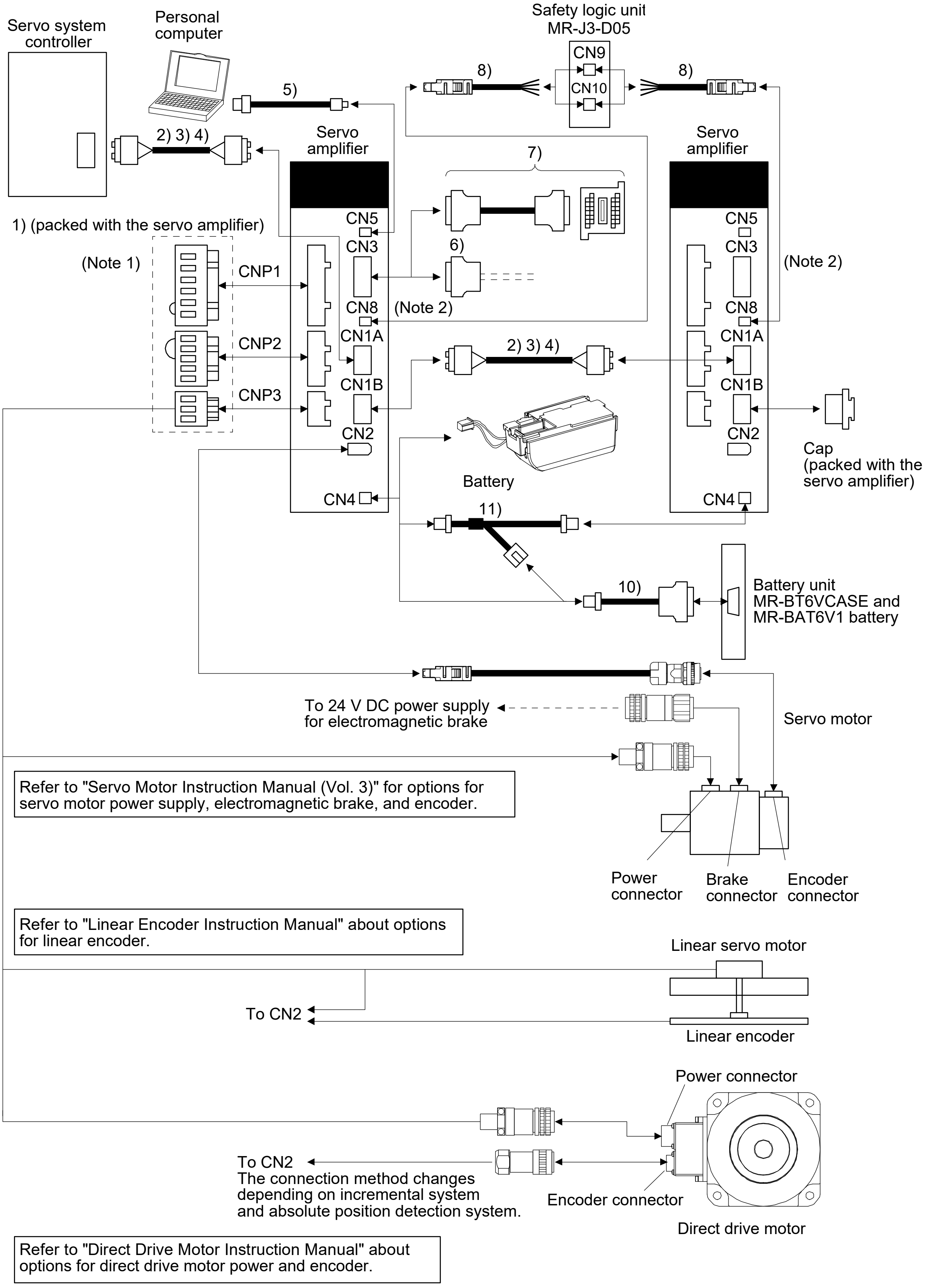
11.1 Cable/connector sets

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

Please purchase the cable and connector options indicated in this section.

11.1.1 Combinations of cable/connector sets

For MR-J4-_B_ servo amplifier



Refer to "Servo Motor Instruction Manual (Vol. 3)" for options for servo motor power supply, electromagnetic brake, and encoder.

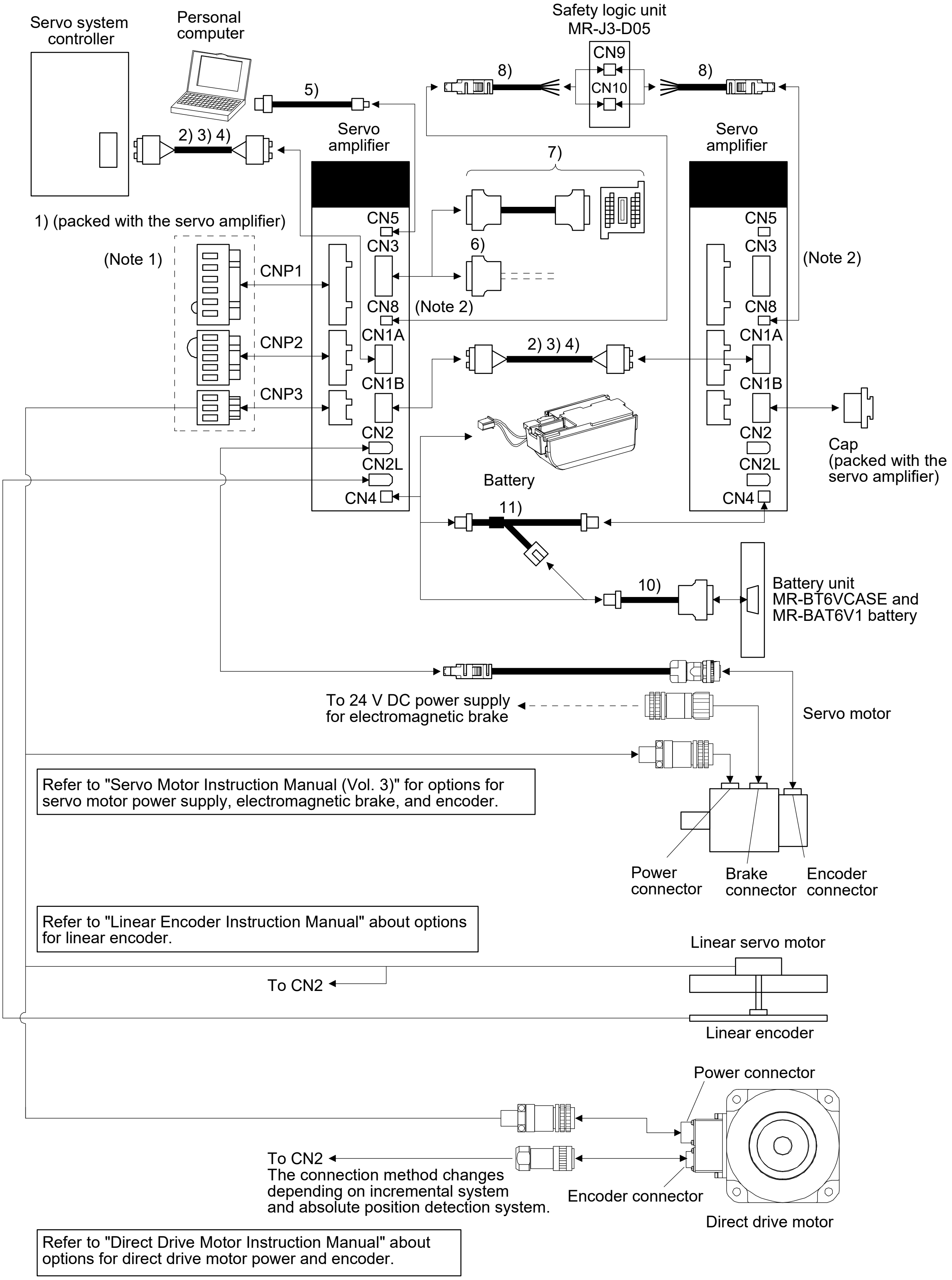
Refer to "Linear Encoder Instruction Manual" about options for linear encoder.

Refer to "Direct Drive Motor Instruction Manual" about options for direct drive motor power and encoder.

Note 1. Connectors for 3.5 kW or less. For 5 kW or more, it is a terminal block.

2. When not using the STO function, attach the short-circuit connector (9)) came with a servo amplifier.

For MR-J4-_B_-RJ servo amplifier



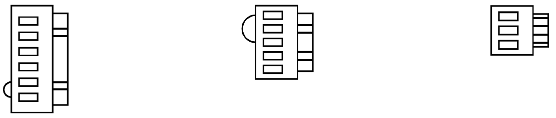
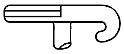
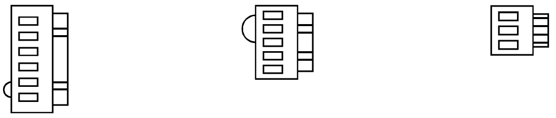
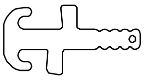
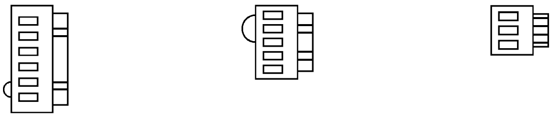
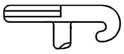
Refer to "Servo Motor Instruction Manual (Vol. 3)" for options for servo motor power supply, electromagnetic brake, and encoder.

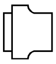
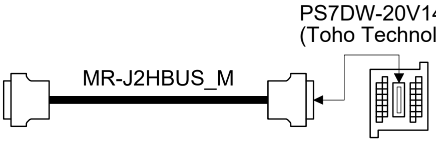
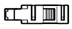
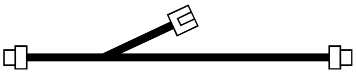
Refer to "Linear Encoder Instruction Manual" about options for linear encoder.

Refer to "Direct Drive Motor Instruction Manual" about options for direct drive motor power and encoder.

Note 1. Connectors for 3.5 kW or less. For 5 kW or more, it is a terminal block.

2. When not using the STO function, attach the short-circuit connector (9)) came with a servo amplifier.

No.	Product name	Model	Description	Remark
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 (N) or J-FAT-OT (JST)	Supplied with 200 V class and 100 V class 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) (CNP1 and CNP3) Applicable wire size: 1.25 mm^2 to 5.5 mm^2 (AWG 16 to 10) Insulator OD: to 4.7 mm (CNP2) Applicable wire size: 0.8 mm^2 to 2.1 mm^2 (AWG 18 to 14) Insulator OD: to 3.9 mm  Open tool Quantity: 1 Model: J-FAT-OT-EXL (JST)	Supplied with 200 V class servo amplifiers of 2 kW and 3.5 kW
			 CNP1 connector: 06JFAT-SAXGDK-HT10.5 (JST) CNP2 connector: 05JFAT-SAXGDK-HT7.5 (JST) CNP3 connector: 03JFAT-SAXGDK-HT10.5 (JST) Applicable wire size: 1.25 mm^2 to 2.1 mm^2 (AWG 16 to 14) Insulator OD: to 3.9 mm  Open tool J-FAT-OT-XL (JST)	Supplied with 400 V class servo amplifiers of 3.5 kW or less
2)	SSCNET III cable	MR-J3BUS_M Cable length: 0.15 m to 3 m (Refer to section 11.1.3.)	Connector: PF-2D103 (JAE) Connector: PF-2D103 (JAE) 	Standard cord inside cabinet
3)	SSCNET III cable	MR-J3BUS_M-A Cable length: 5 m to 20 m (Refer to section 11.1.3.)		Standard cable outside cabinet
4)	SSCNET III cable	MR-J3BUS_M-B Cable length: 30 m to 50 m (Refer to section 11.1.3.)	Connector: CF-2D103-S (JAE) Connector: CF-2D103-S (JAE) 	Long-distance cable
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

No.	Product name	Model	Description	Remark
6)	Connector set	MR-CCN1	 Connector: 10120-3000PE Shell kit: 10320-52F0-008 (3M or equivalent)	
7)	Junction terminal block (recommended)		 Junction terminal block PS7DW-20V14B-F is not option. For using the junction terminal block, option MR-J2HBUS_M is necessary. Refer to section 11.6 for details.	
8)	STO cable	MR-D05UDL3M-B	Connector set: 2069250-1 (TE Connectivity) 	Connection cable for the CN8 connector
9)	Short-circuit connector			Supplied with servo amplifier
10)	Battery cable	MR-BT6V1CBL_M Cable length: 0.3/1 m (Refer to section 11.1.4.)	Housing: PAP-02V-O Contact: SPHD-001G-P0.5 (JST) Connector: 10114-3000PE Shell kit: 10314-52F0-008 (3M or equivalent) 	For connection with battery unit
11)	Junction battery cable	MR-BT6V2CBL_M Cable length: 0.3/1 m (Refer to section 11.1.4.)	Housing: PAP-02V-O Contact: SPHD-001G-P0.5 (JST) Housing: PALR-02VF-O Contact: SPAL-001GU-P0.5 (JST)  Housing: PAP-02V-O Contact: SPHD-001G-P0.5 (JST)	For battery junction

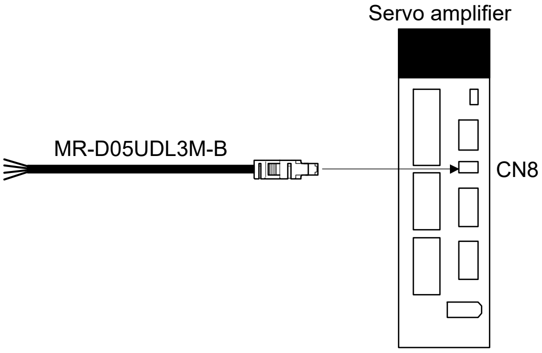
11.1.2 MR-D05UDL3M-B STO cable

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

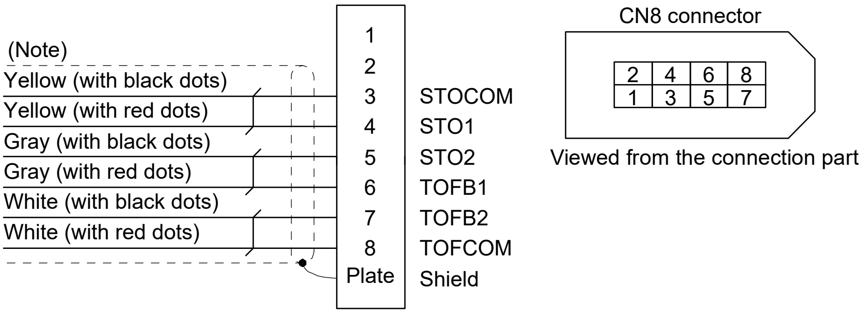
Cable model	Cable length	Cable OD (Note)	Application
MR-D05UDL3M-B	3 m	5.7 mm	Connection cable for the CN8 connector

Note. Standard OD. The maximum OD is about 10 % greater for dimensions without tolerances.

(1) Configuration diagram



(2) Internal wiring diagram



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

11.1.3 SSCNET III cable

POINT

- ●Do not look directly at the light generated from CN1A/CN1B connector of servo amplifier or the end of SSCNET III cable. The light can be a discomfort when it enters the eye.
- ●Refer to app. 10 for long distance cable over 50 m and ultra-long bending life cable.

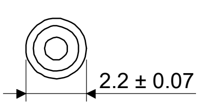
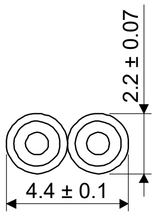
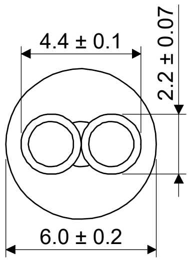
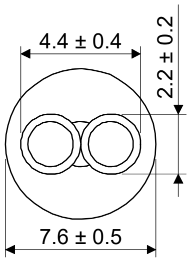
(1) Model explanations

The numbers in the cable length field of the table indicate the symbol filling the underline "_" in the cable model. The cables of the lengths with the symbols are available.

Cable model	Cable length											Bending life	Application/remark
	0.15 m	0.3 m	0.5 m	1 m	3 m	5 m	10 m	20 m	30 m	40 m	50 m		
MR-J3BUS_M	015	03	05	1	3							Standard	Using standard cord inside cabinet
MR-J3BUS_M-A						5	10	20				Standard	Using standard cable outside cabinet
(Note) MR-J3BUS_M-B									30	40	50	Long bending life	Using long distance cable

Note. For cable of 30 m or shorter, contact your local sales office.

(2) Specifications

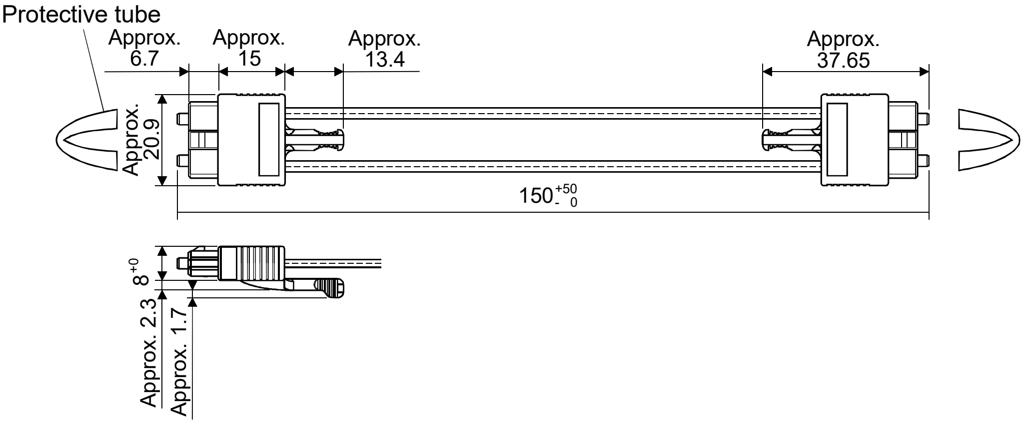
		Description			
SSCNET III cable model		MR-J3BUS_M		MR-J3BUS_M-A	MR-J3BUS_M-B
SSCNET III cable length		0.15 m	0.3 m to 3 m	5 m to 20 m	30 m to 50 m
Optical cable (cord)	Minimum bend radius	25 mm		Enforced covering cable: 50 mm Cord: 25 mm	Enforced covering cable: 50 mm Cord: 30 mm
	Tension strength	70 N	140 N	420 N (Enforced covering cable)	980 N (Enforced covering cable)
	Temperature range for use (Note)	-40 °C to 85 °C			-20 °C to 70 °C
	Ambience	Indoors (no direct sunlight), no solvent or oil			
	Appearance [mm]				

Note. This temperature range for use is the value for optical cable (cord) only. Temperature condition for the connector is the same as that for servo amplifier.

(3) Dimensions

(a) MR-J3BUS015M

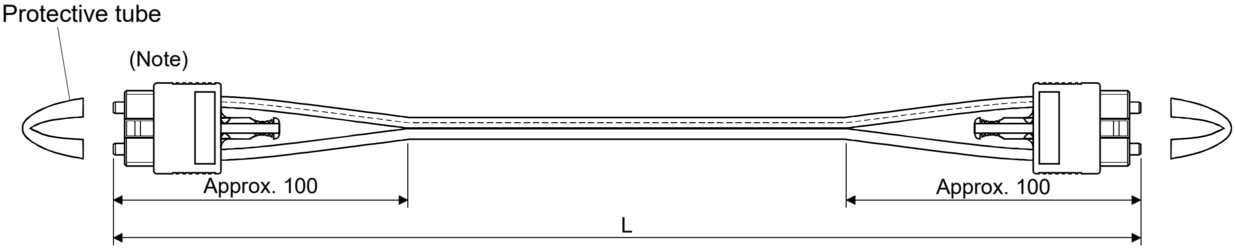
[Unit: mm]



(b) MR-J3BUS03M to MR-J3BUS3M

Refer to the table shown in (1) in this section for cable length (L).

[Unit: mm]



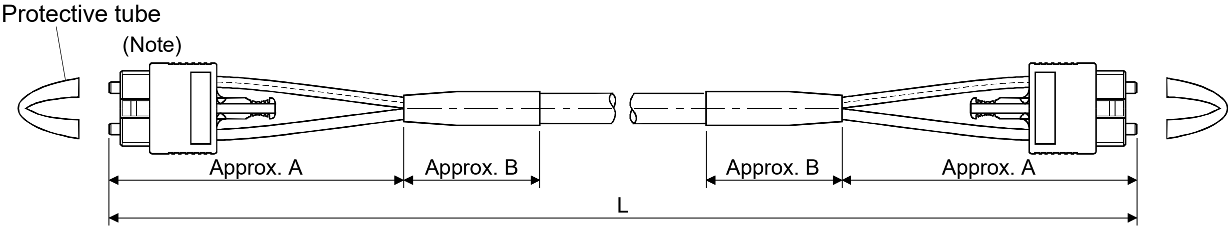
Note. Dimension of connector part is the same as that of MR-J3BUS015M.

(c) MR-J3BUS5M-A to MR-J3BUS20M-A/MR-J3BUS30M-B to MR-J3BUS50M-B

Refer to the table shown in (1) in this section for cable length (L).

SSCNET III cable	Variable dimensions [mm]	
	A	B
MR-J3BUS5M-A to MR-J3BUS20M-A	100	30
MR-J3BUS30M-B to MR-J3BUS50M-B	150	50

[Unit: mm]



Note. Dimension of connector part is the same as that of MR-J3BUS015M.

11.1.4 Battery cable/junction battery cable

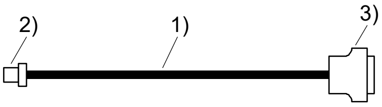
(1) Model explanations

The numbers in the cable length field of the table indicate the symbol filling the underline "_" in the cable model. The cables of the lengths with the symbols are available.

Cable model	Cable length		Bending life	Application/remark
	0.3 m	1 m		
MR-BT6V1CBL_M	03	1	Standard	For connection with MR-BT6VCASE
MR-BT6V2CBL_M	03	1	Standard	For junction

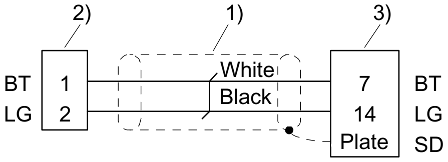
(2) MR-BT6V1CBL_M

(a) Appearance



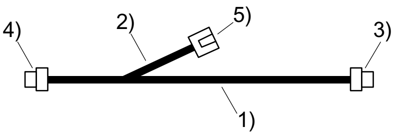
Components	Description
1) Cable	VSVC 7/0.18 × 2C
2) Connector	Housing: PAP-02V-O Contact: SPHD-001G-P0.5 (JST)
3) Connector	Connector: 10114-3000PE Shell kit: 10314-52F0-008 (3M or equivalent)

(b) Internal wiring diagram



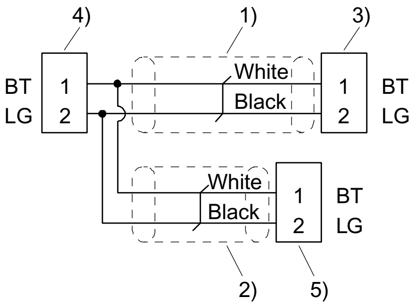
(3) MR-BT6V2CBL_M

(a) Appearance



Components	Description
1) Cable	VSVC 7/0.18 × 2C
2) Cable	
3) Connector	Housing: PAP-02V-O
4) Connector	Contact: SPHD-001G-P0.5 (JST)
5) Connector	Housing: PALR-02VF-O Contact: SPAL-001GU-P0.5 (JST)

(b) Internal wiring diagram



11.2 Regenerative options

⚠CAUTION

- Do not use servo amplifiers with regenerative options other than the combinations specified below.
  Otherwise, it may cause a fire.

11.2.1 Combination and regenerative power

The power values in the table are resistor-generated powers and not rated powers.

(1) 200 V class

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-J4-10B (-RJ)		30								
MR-J4-20B (-RJ)	10	30	100							
MR-J4-40B (-RJ)	10	30	100							
MR-J4-60B (-RJ)	10	30	100							
MR-J4-70B (-RJ)	20	30	100				300			
MR-J4-100B (-RJ)	20	30	100				300			
MR-J4-200B (-RJ)	100			300				500		
MR-J4-350B (-RJ)	100				300				500	
MR-J4-500B (-RJ)	130					300				500
MR-J4-700B (-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-J4-11KB (-RJ)	500 (800)	500 (800)		
MR-J4-15KB (-RJ)	850 (1300)		850 (1300)	
MR-J4-22KB (-RJ)	850 (1300)			850 (1300)

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

(2) 400 V class

Servo amplifier	Regenerative power [W]								
	Built-in regenerative resistor	MR-RB1H-4 [82 Ω]	(Note 1) MR-RB3M-4 [120 Ω]	(Note 1) MR-RB3G-4 [47 Ω]	(Note 1) MR-RB5G-4 [47 Ω]	(Note 1) MR-RB34-4 [26 Ω]	(Note 1) MR-RB54-4 [26 Ω]	(Note 1) MR-RB3U-4 [22 Ω]	(Note 1) MR-RB5U-4 [22 Ω]
MR-J4-60B4(-RJ)	15	100	300						
MR-J4-100B4(-RJ)	15	100	300						
MR-J4-200B4(-RJ)	100			300	500				
MR-J4-350B4(-RJ)	100			300	500				
MR-J4-500B4(-RJ)	130					300	500		
MR-J4-700B4(-RJ)	170							300	500

Servo amplifier	(Note 2) Regenerative power [W]		
	External regenerative resistor (accessory)	MR-RB5K-4 [10 Ω]	MR-RB6K-4 [10 Ω]
MR-J4-11KB4(-RJ)	500 (800)	500 (800)	
MR-J4-15KB4(-RJ)	850 (1300)		850 (1300)
MR-J4-22KB4(-RJ)	850 (1300)		850 (1300)

Note 1. Always install a cooling fan.

2. Values in parentheses assume the installation of a cooling fan.

(3) 100 V class

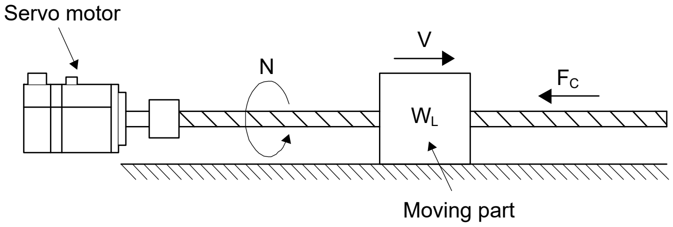
Servo amplifier	Regenerative power [W]		
	Built-in regenerative resistor	MR-RB032 [40 Ω]	MR-RB12 [40 Ω]
MR-J4-10B1(-RJ)		30	
MR-J4-20B1(-RJ)	10	30	100
MR-J4-40B1(-RJ)	10	30	100

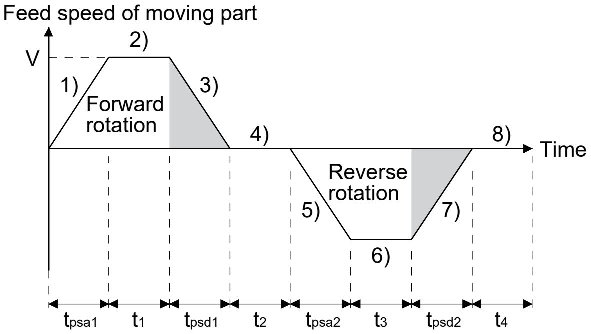
11.2.2 Selection of regenerative option

A regenerative option for a horizontal axis can be selected with the rough calculation shown in this section. To select a regenerative option precisely, use the capacity selection software.

(1) Rotary servo motor

(a) Regenerative energy calculation





V: Feed speed of moving part	[mm/min]
N: Servo motor speed (N = V/ΔS)	[r/min]
ΔS: Travel distance per servo motor revolution (ΔS = P_B)	[mm/rev]
P_B: Ball screw lead	[mm]
L_B: Ball screw length	[mm]
D_B: Ball screw diameter	[mm]
W_L: Moving part mass	[kg]
F_C: Load antidrag setting	[N]
T_L: Load torque converted into equivalent value on servo motor shaft [N•m]	[N•m]
η: Drive system efficiency	
μ: Friction coefficient	
J_L: Load moment of inertia converted into equivalent value on servo motor shaft	[kg•cm^2]
J_M: Moment of inertia of the servo motor	[kg•cm^2]
π: Pi constant	
g: Gravitational acceleration	[m/s^2]

Formulas for calculating torque and energy in operation

Regenerative power	Torque applied to servo motor [N•m] (Note 1, 2)	Energy E [J]
1)	$T_1 = \frac{(J_L/\eta + J_M) \bullet N}{9.55 \bullet 10^4} \bullet \frac{1}{t_{psa1}} + T_L$	$E_1 = \frac{0.1047}{2} \bullet N \bullet T_1 \bullet t_{psa1}$
2)	$T_2 = T_L$	$E_2 = 0.1047 \bullet N \bullet T_2 \bullet t_1$
3)	$T_3 = \frac{-(J_L \bullet \eta + J_M) \bullet N}{9.55 \bullet 10^4} \bullet \frac{1}{t_{psd1}} + T_L$	$E_3 = \frac{0.1047}{2} \bullet N \bullet T_3 \bullet t_{psd1}$
4), 8)	T_4, $T_8 = 0$	E_4, $E_8 = 0$ (No regeneration)
5)	$T_5 = \frac{(J_L/\eta + J_M) \bullet N}{9.55 \bullet 10^4} \bullet \frac{1}{t_{psa2}} + T_L$	$E_5 = \frac{0.1047}{2} \bullet N \bullet T_5 \bullet t_{psa2}$
6)	$T_6 = T_L$	$E_6 = 0.1047 \bullet N \bullet T_6 \bullet t_3$
7)	$T_7 = \frac{-(J_L \bullet \eta + J_M) \bullet N}{9.55 \bullet 10^4} \bullet \frac{1}{t_{psd2}} + T_L$	$E_7 = \frac{0.1047}{2} \bullet N \bullet T_7 \bullet t_{psd2}$

Note 1. Load torque converted into equivalent value on servo motor shaft T_L can be calculated with the following expression.

$T_L = \{(F_C + (\mu \times W_L \times g)) \times \Delta S\}/(2000 \times \pi \times \eta)$

2. Load moment of inertia converted into equivalent value on servo motor shaft J_L can be calculated with the following expression.

$J_L = J_{L1} + J_{L2} + J_{L3}$

J_{L1} is the load moment of inertia of the moving part, J_{L2} is the load moment of inertia of the ball screw, and J_{L3} is the load moment of inertia of the coupling. J_{L1} and J_{L2} can be calculated with the following expressions.

$J_{L1} = W_L \times (\Delta S/(20 \times \pi))^2$

$J_{L2} = \{(\pi \times 0.0078 \times (L_B/10))/32\} \times (D_B/10)^4$

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

(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]
MR-J4-10B(-RJ)	55	9
MR-J4-20B(-RJ)	75	9
MR-J4-40B(-RJ)	85	11
MR-J4-60B(-RJ)	85	11
MR-J4-70B(-RJ)	85	18
MR-J4-100B(-RJ)	85	18
MR-J4-200B(-RJ)	85	36
MR-J4-350B(-RJ)	85	40
MR-J4-500B(-RJ)	90	45
MR-J4-700B(-RJ)	90	70
MR-J4-11KB(-RJ)	90	120
MR-J4-15KB(-RJ)	90	170
MR-J4-22KB(-RJ)	90	250

Servo amplifier	Inverse efficiency [%]	Capacitor charging [J]
MR-J4-60B4(-RJ)	85	12
MR-J4-100B4(-RJ)	85	12
MR-J4-200B4(-RJ)	85	25
MR-J4-350B4(-RJ)	85	43
MR-J4-500B4(-RJ)	90	45
MR-J4-700B4(-RJ)	90	70
MR-J4-11KB4(-RJ)	90	120
MR-J4-15KB4(-RJ)	90	170
MR-J4-22KB4(-RJ)	90	250
MR-J4-10B1(-RJ)	55	4
MR-J4-20B1(-RJ)	75	4
MR-J4-40B1(-RJ)	85	10

Inverse efficiency (η_m): Efficiency including some efficiencies of the servo motor and servo amplifier when rated (regenerative) torque is generated at rated speed. Efficiency varies with the speed and generated torque. Since the characteristics of the electrolytic capacitor change with time, allow for approximately 10% higher inverse efficiency.

Capacitor charging (Ec): Energy charged into the electrolytic capacitor in the servo amplifier

Subtract the capacitor charging from the result of multiplying the sum total of regenerative energies by the inverse efficiency to calculate the energy consumed by the regenerative option.

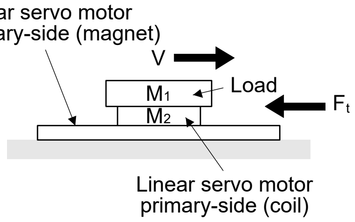
$$ER\ [J] = \eta_m \cdot Es - Ec$$

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

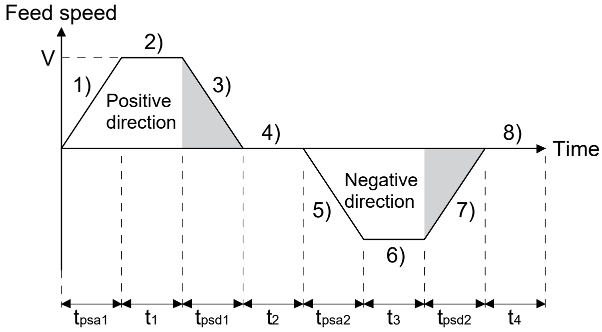
$$PR\ [W] = ER/tf$$

(2) Linear servo motor

(a) Thrust and energy calculation



Linear servo motor



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)	$F_1 = (M_1 + M_2) \bullet V/t_{psa1} + F_t$	$E_1 = V/2 \bullet F_1 \bullet t_{psa1}$
2)	$F_2 = F_1$	$E_2 = V \bullet F_2 \bullet t_1$
3)	$F_3 = -(M_1 + M_2) \bullet V/t_{psd1} + F_t$	$E_3 = V/2 \bullet F_3 \bullet t_{psd1}$
4), 8)	$F_4, F_8 = 0$	E_4, $E_8 = 0$ (No regeneration)
5)	$F_5 = (M_1 + M_2) \bullet V/t_{psa2} + F_t$	$E_5 = V/2 \bullet F_5 \bullet t_{psa2}$
6)	$F_6 = F_t$	$E_6 = V \bullet F_6 \bullet t_3$
7)	$F_7 = -(M_1 + M_2) \bullet V/t_{psd2} + F_t$	$E_7 = V/2 \bullet F_7 \bullet t_{psd2}$

From the calculation results in 1) to 8), find the absolute value (Es) 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) in 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] = $\eta \bullet Es - Ec$

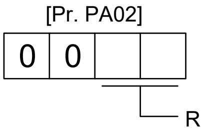
From the total of ER's whose subtraction results are positive and one-cycle period, the power consumption PR [W] of the regenerative option can be calculated with the following equation.

PR [W] = total of positive ER's/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.

11.2.3 Parameter setting

Set [Pr. PA02] according to the option to be used.



Regenerative option selection
00: Regenerative option is not used.
  - For servo amplifier of 100 W, regenerative resistor is not used.
  - Built-in regenerative resistors are used on servo amplifiers with a capacity of 0.2 kW to 7 kW.
  - Supplied regenerative resistors or regenerative option is used with the servo amplifier of 11 kW to 22 kW.

01: FR-BU2/FR-BU2-H/FR-RC/FR-RC-H/FR-CV/FR-CV-H/FR-XC/FR-XC-H
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)
80: MR-RB1H-4
81: MR-RB3M-4 (Cooling fan is required.)
82: MR-RB3G-4 (Cooling fan is required.)
83: MR-RB5G-4 (Cooling fan is required.)
84: MR-RB34-4 (Cooling fan is required.)
85: MR-RB54-4 (Cooling fan is required.)
91: MR-RB3U-4 (Cooling fan is required.)
92: MR-RB5U-4 (Cooling fan is required.)
FA: When the supplied regenerative resistors or the regenerative option is cooled by the cooling fan to increase the ability with the servo amplifier of 11 kW to 22 kW.

11.2.4 Connection of regenerative option

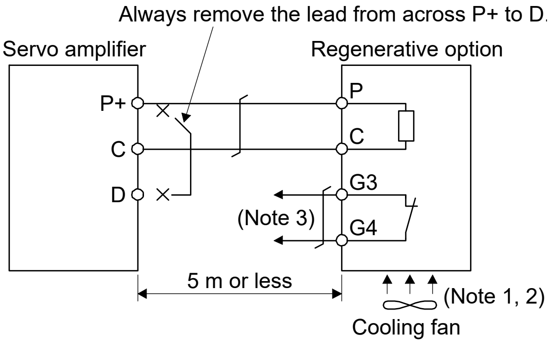
POINT

- ●When MR-RB50, MR-RB51, MR-RB5N, MR-RB3M-4, MR-RB3G-4, MR-RB5G-4, MR-RB34-4, MR-RB54-4, MR-RB5K-4, or MR-RB6K-4 is used, a cooling fan is required to cool it. The cooling fan should be prepared by the customer.
- ●For the wire sizes used for wiring, refer to section 11.9.

The regenerative option generates heat of 100 ˚C higher than the ambient temperature. Fully consider heat dissipation, installation position, wires used, etc. before installing the option. For wiring, use flame-resistant wires or make the wires flame-resistant and keep them away from the regenerative option. Use twisted wires with a maximum length of 5 m for a connection with the servo amplifier.

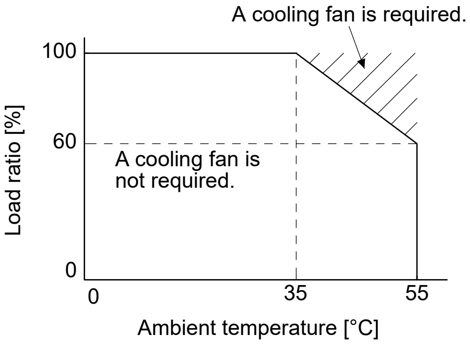
(1) MR-J4-500B(-RJ) or less/MR-J4-350B4(-RJ) or less

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, MR-RB51, MR-RB3M-4, MR-RB3G-4, or MR-RB5G-4, forcibly cool it with a cooling fan (1.0 m³/min or more, 92 mm × 92 mm).

2. When the ambient temperature is more than 55 °C and the regenerative load ratio is more than 60% in MR-RB30, MR-RB31, MR-RB32, and MR-RB3N, forcefully 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

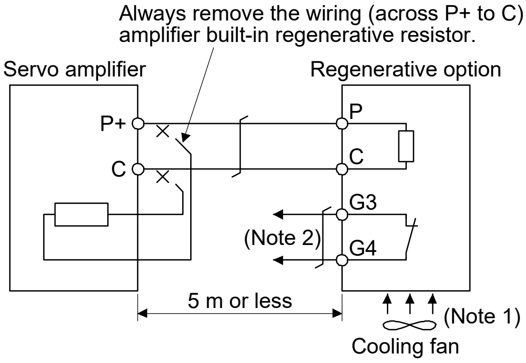
Maximum voltage: 120 V AC/DC

Maximum current: 0.5 A/4.8 V DC

Maximum capacity: 2.4 VA

(2) MR-J4-500B4(-RJ)/MR-J4-700B(-RJ)/MR-J4-700B4(-RJ)

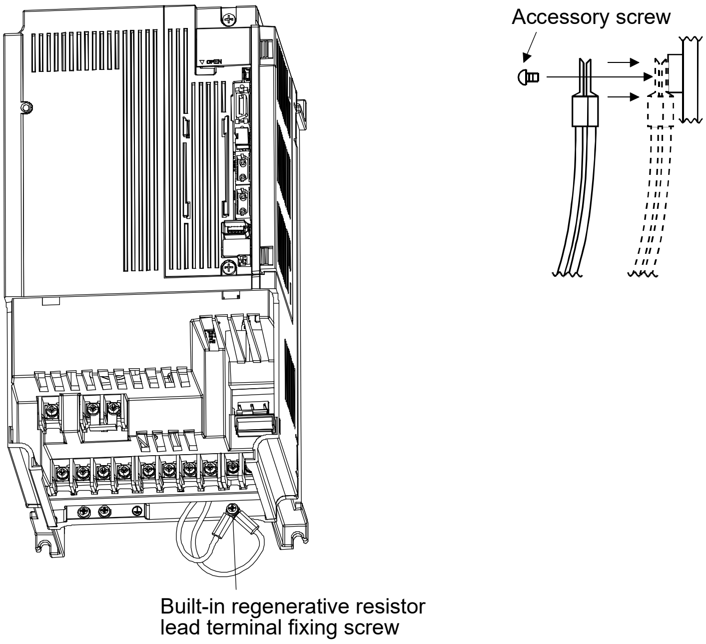
Always remove the wiring (across P+ to C) of the servo amplifier built-in regenerative resistor and fit the regenerative option across P+ to C. G3 and G4 are thermal sensor's terminals. Between G3 and G4 is opened when the regenerative option overheats abnormally.



Note 1. When using the MR-RB51, MR-RB34-4, MR-RB54-4, MR-RB3U-4, or MR-RB5U-4, forcibly cool it with a cooling fan (1.0 m^3/min or more, 92 mm × 92 mm).

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.

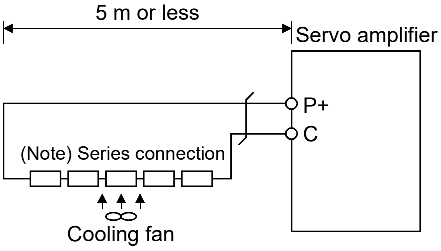


(3) MR-J4-11KB(-RJ) to MR-J4-22KB(-RJ)/MR-J4-11KB4(-RJ) to MR-J4-22KB4(-RJ) (when using the supplied regenerative resistor)

⚠CAUTION

- ●The regenerative resistor supplied with 11 kW to 22 kW servo amplifiers does not have a protective cover. Touching the resistor (including wiring/screw hole area) may cause a burn injury and electric shock. Even if the power was shut-off, be careful until the bus voltage discharged and the temperature decreased because of the following reasons.
  - ・It may cause a burn injury due to very high temperature without cooling.
  - ・It may cause an electric shock due to charged capacitor of the servo amplifier.
- ●Do not use servo amplifiers with external regenerative resistors other than the combinations specified below. Otherwise, it may cause a fire.

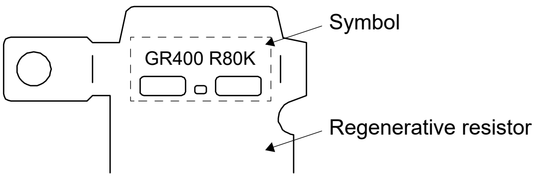
When using the regenerative resistors supplied to the servo amplifier, the specified number of resistors (4 or 5 resistors) must be connected in series. If they are connected in parallel or in less than the specified number, the servo amplifier may become faulty and/or the regenerative resistors burn.
Install the resistors at intervals of about 70 mm. Cooling the resistors with two cooling fans (1.0 m^3/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, MR-RB9F, MR-RB9T, MR-RB5K-4, or MR-RB6K-4)

Servo amplifier	Regenerative resistor	Symbol (Note)	Regenerative power [W]		Resultant resistance [Ω]	Number of resistors
			Normal	Cooling		
MR-J4-11KB(-RJ)	GRZG400-0.8Ω	GR400 R80K	500	800	3.2	4
MR-J4-15KB(-RJ)	GRZG400-0.6Ω	GR400 R60K	850	1300	3	5
MR-J4-22KB(-RJ)	GRZG400-0.5Ω	GR400 R50K			2.5	
MR-J4-11KB4(-RJ)	GRZG400-2.5Ω	GR400 2R5K	500	800	10	4
MR-J4-15KB4(-RJ) MR-J4-22KB4(-RJ)	GRZG400-2Ω	GR400 2R0K	850	1300	10	5

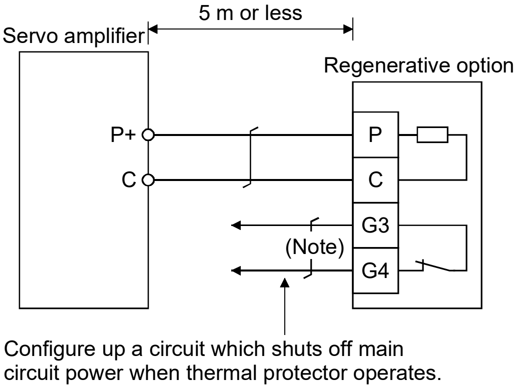
Note. The following shows an indication example of symbol.



(4) MR-J4-11KB-PX to MR-J4-22KB-PX/MR-J4-11KB-RZ to MR-J4-22KB-RZ/MR-J4-11KB4-PX to MR-J4-22KB4-PX/MR-J4-11KB4-RZ to MR-J4-22KB4-RZ (when using the regenerative option)

The MR-J4-11KB-PX to MR-J4-22KB-PX, MR-J4-11KB-RZ to MR-J4-22KB-RZ, MR-J4-11KB4-PX to MR-J4-22KB4-PX, and MR-J4-11KB4-RZ to MR-J4-22KB4-RZ servo amplifiers are not supplied with regenerative resistors. When using any of these servo amplifiers, always use the regenerative option MR-RB5R, MR-RB9F, MR-RB9T, MR-RB5K-4, and MR-RB6K-4.

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.



Note. G3-G4 contact specifications

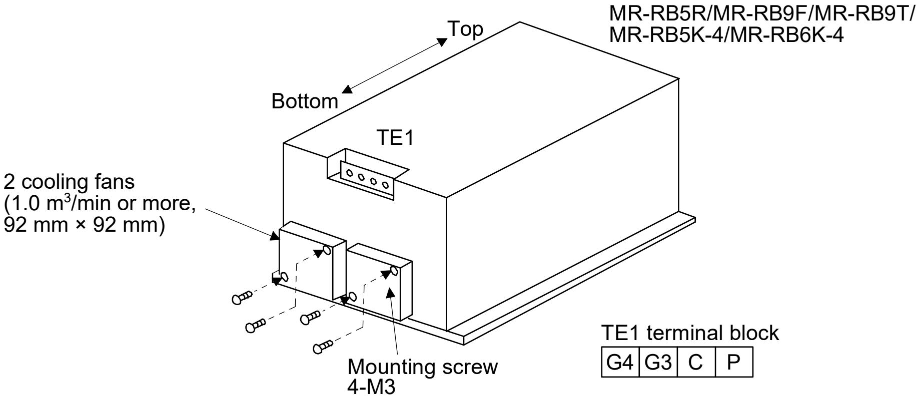
Maximum voltage: 120 V AC/DC

Maximum current: 0.5 A/4.8 V DC

Maximum capacity: 2.4 VA

Servo amplifier	Regenerative option	Resistance [Ω]	Regenerative power [W]	
			Without cooling fans	With cooling fans
MR-J4-11KB-PX MR-J4-11KB-RZ	MR-RB5R	3.2	500	800
MR-J4-15KB-PX MR-J4-15KB-RZ	MR-RB9F	3	850	1300
MR-J4-22KB-PX MR-J4-22KB-RZ	MR-RB9T	2.5	850	1300
MR-J4-11KB4-PX MR-J4-11KB4-RZ	MR-RB5K-4	10	500	800
MR-J4-15KB4-PX MR-J4-15KB4-RZ MR-J4-22KB4-PX MR-J4-22KB4-RZ	MR-RB6K-4	10	850	1300

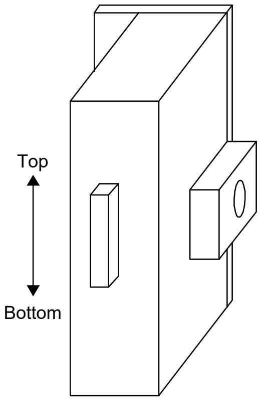
When using cooling fans, install them using the mounting holes provided in the bottom of the regenerative option.



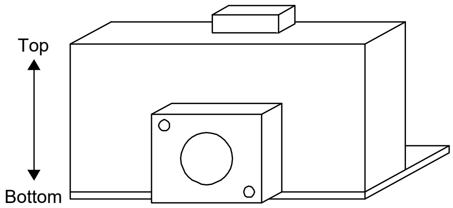
11.2.5 Mounting direction

The mounting direction of the regenerative option is shown below.

Regenerative option	Mounting direction
MR-RB032	Vertical mounting
MR-RB12	Vertical mounting
MR-RB32	Vertical mounting
MR-RB30	Vertical mounting
MR-RB50 (A cooling fan is required.)	Vertical mounting/horizontal mounting
MR-RB31	Vertical mounting
MR-RB51 (A cooling fan is required.)	Vertical mounting/horizontal mounting
MR-RB3N	Vertical mounting
MR-RB5N (A cooling fan is required.)	Vertical mounting/horizontal mounting
MR-RB5R	Vertical mounting
MR-RB9F	Vertical mounting
MR-RB9T	Vertical mounting
MR-RB1H-4	Vertical mounting
MR-RB3M-4 (A cooling fan is required.)	Vertical mounting
MR-RB3G-4 (A cooling fan is required.)	Vertical mounting
MR-RB5G-4 (A cooling fan is required.)	Vertical mounting/horizontal mounting
MR-RB34-4 (A cooling fan is required.)	Vertical mounting
MR-RB54-4 (A cooling fan is required.)	Vertical mounting/horizontal mounting
MR-RB3U-4 (A cooling fan is required.)	Vertical mounting
MR-RB5U-4 (A cooling fan is required.)	Vertical mounting/horizontal mounting
MR-RB5K-4	Vertical mounting
MR-RB6K-4	Vertical mounting



Vertical installation

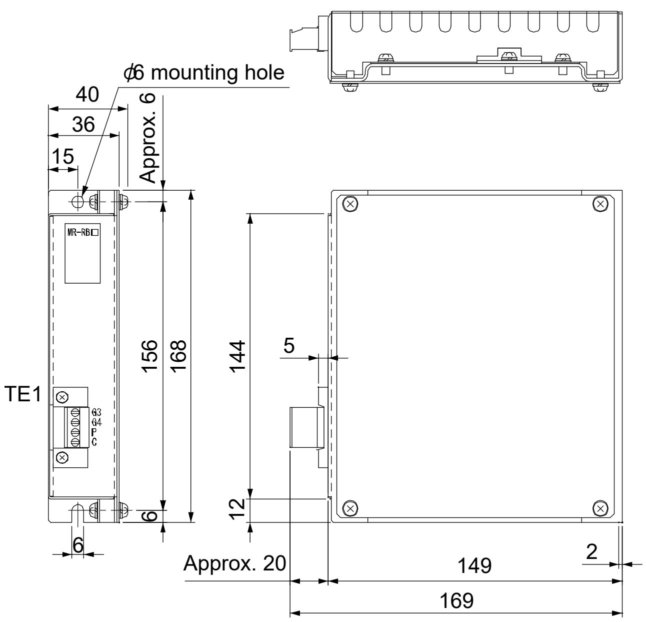


Horizontal installation

11.2.6 Dimensions

(1) MR-RB12

[Unit: mm]



- TE1 terminal

G3
G4
P
C

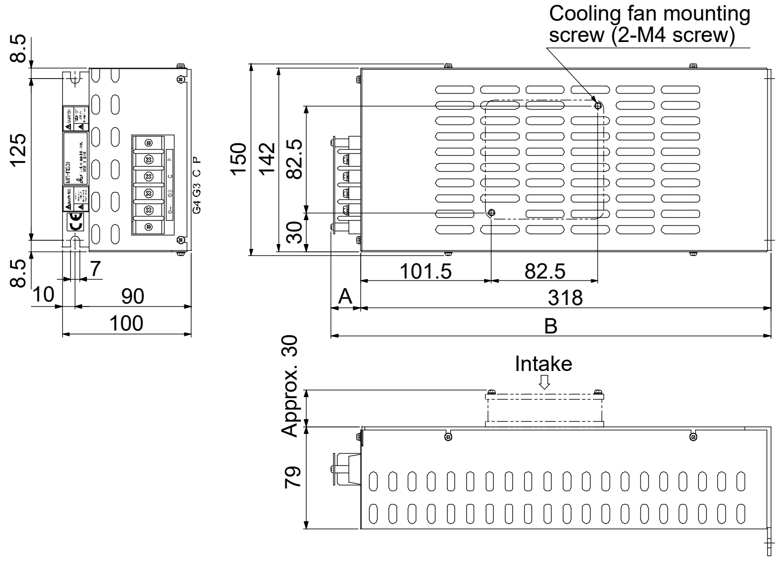
Applicable wire size: 0.2 mm² to 2.5 mm² (AWG 24 to 12)
Tightening torque: 0.5 to 0.6 [N•m]

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

Mass: 1.1 [kg]

(2) MR-RB30/MR-RB31/MR-RB32/MR-RB3N/MR-RB34-4/MR-RB3M-4/MR-RB3G-4/MR-RB3U-4

[Unit: mm]



- Terminal block

P
C
G3
G4

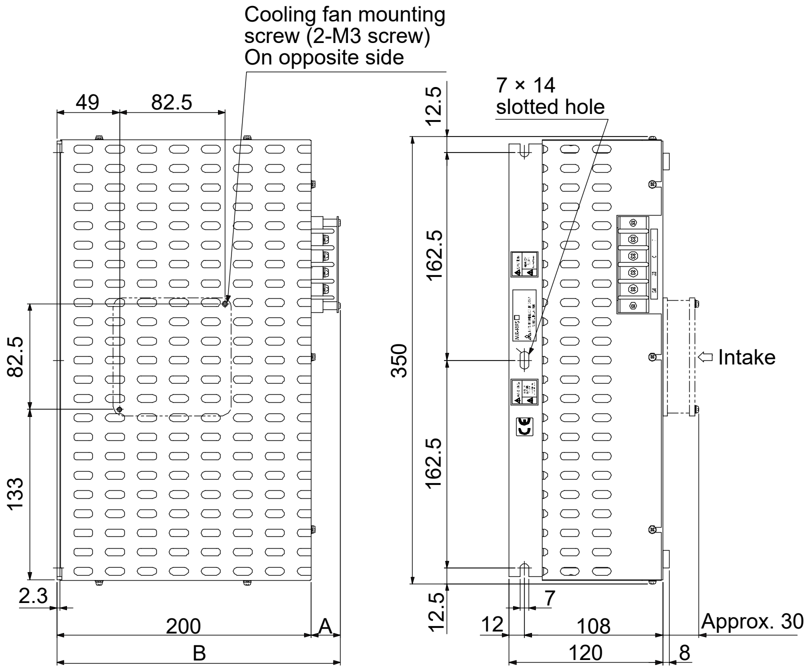
Terminal screw size: M4
Tightening torque: 1.2 [N•m]

- Mounting screw
  Screw size: M6
  Tightening torque: 5.4 [N•m]

Regenerative option	Variable dimensions		Mass [kg]
	A	B	
MR-RB30	17	335	2.9
MR-RB31			
MR-RB32			
MR-RB3N			
MR-RB34-4	23	341	
MR-RB3M-4			
MR-RB3G-4			
MR-RB3U-4			

(3) MR-RB50/MR-RB51/MR-RB5N/MR-RB54-4/MR-RB5G-4/MR-RB5U-4

[Unit: mm]



- Terminal block

P
C
G3
G4

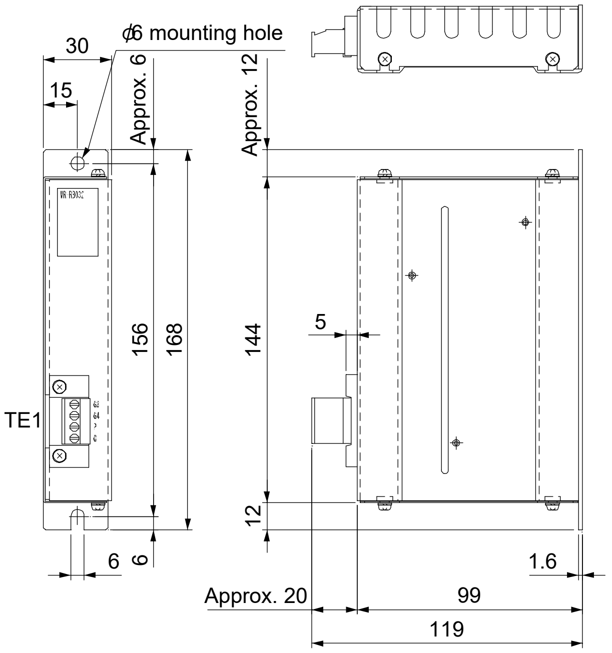
Terminal screw size: M4
Tightening torque: 1.2 [N•m]

- Mounting screw
  Screw size: M6
  Tightening torque: 5.4 [N•m]

Regenerative option	Variable dimensions		Mass [kg]
	A	B	
MR-RB50	17	217	5.6
MR-RB51			
MR-RB5N			
MR-RB54-4	23	223	
MR-RB5G-4			
MR-RB5U-4			

(4) MR-RB032

[Unit: mm]



- TE1 terminal

G3
G4
P
C

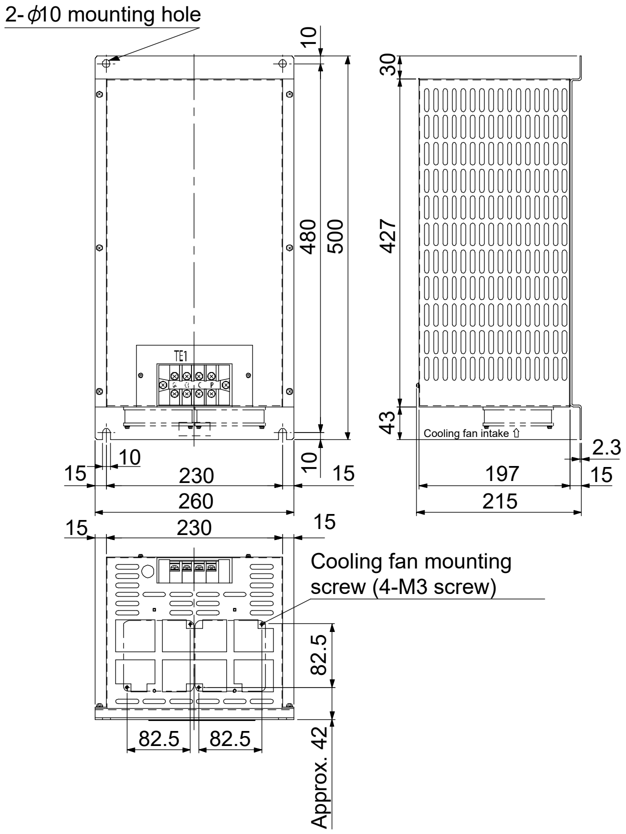
Applicable wire size: 0.2 mm^2 to 2.5 mm^2 (AWG 24 to 12)
Tightening torque: 0.5 to 0.6 [N•m]

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

Mass: 0.5 [kg]

(5) MR-RB5R/MR-RB9F/MR-RB9T/MR-RB5K-4/MR-RB6K-4

[Unit: mm]



- TE1 terminal block

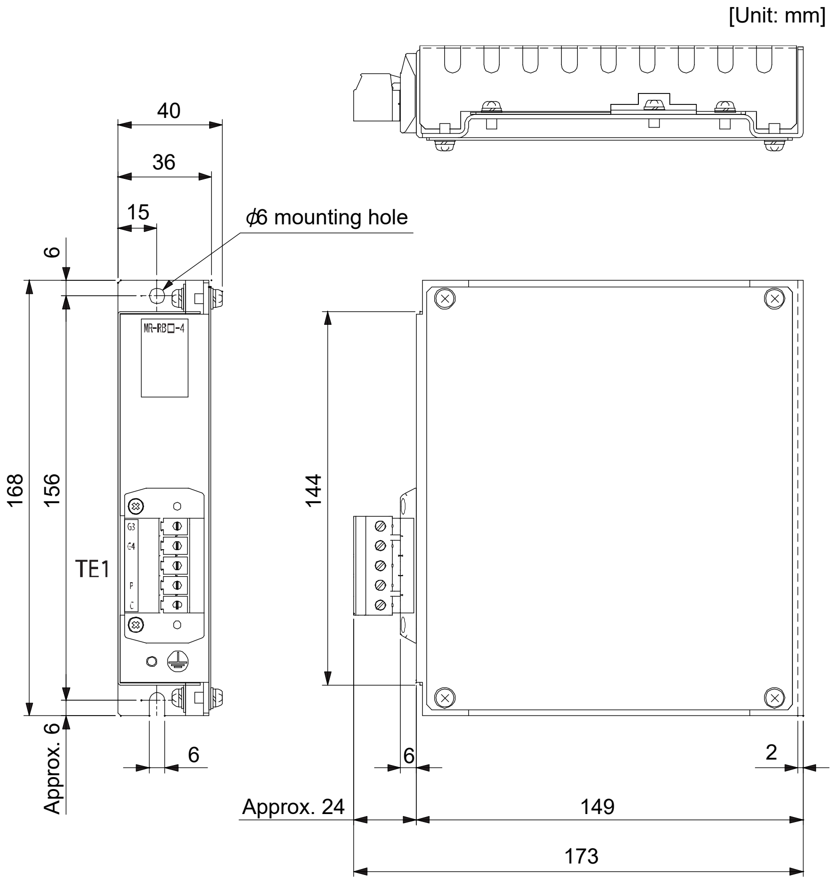
G4	G3	C	P

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

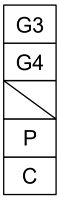
- Mounting screw
Screw size: M8
Tightening torque: 13.2 [N•m]

Regenerative option	Mass [kg]
MR-RB5R	10
MR-RB9F	11
MR-RB9T	
MR-RB5K-4	10
MR-RB6K-4	11

(6) MR-RB1H-4



・TE1 terminal

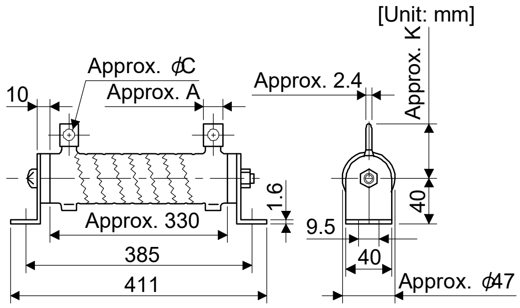


Applicable wire size: AWG 24 to 10
Tightening torque: 0.5 to 0.6 [N•m]

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

Mass: 1.1 [kg]

(7) GRZG400-0.8Ω/GRZG400-0.6Ω/GRZG400-0.5Ω/GRZG400-2.5Ω/GRZG400-2.0Ω (standard accessories)



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						
GRZG400-2.5Ω	10	5.5	39			
GRZG400-2.0Ω						

11.3 FR-BU2-(H) brake unit

POINT

- ●Use a 200 V class brake unit and a resistor unit with a 200 V class servo amplifier, and a 400 V class brake unit and a resistor unit with a 400 V class servo amplifier. Combination of different voltage class units cannot be used.
- ●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.
- ●The temperature of the resistor unit case will be higher than the ambient temperature by 100 ˚C or over. Keep cables and flammable materials away from the case.
- ●Ambient temperature condition of the brake unit is between -10 ˚C and 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.
- ●To perform continuous regenerative operation, use the FR-RC-(H) power regeneration converter, FR-CV-(H) power regeneration common converter, or FR-XC-(H) multifunction regeneration 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] to "_ _ 0 1".
When using the brake unit, always refer to the FR-BU2 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 3)
200 V class	FR-BU2-15K	FR-BR-15K	1	0.99	8	MR-J4-500B(-RJ) (Note 1)
			2 (parallel)	1.98	4	MR-J4-500B(-RJ) MR-J4-700B(-RJ) MR-J4-11KB(-RJ) MR-J4-15KB(-RJ)
	FR-BU2-30K	FR-BR-30K	1	1.99	4	MR-J4-500B(-RJ) MR-J4-700B(-RJ) MR-J4-11KB(-RJ) MR-J4-15KB(-RJ)
	FR-BU2-55K	FR-BR-55K	1	3.91	2	MR-J4-11KB(-RJ) MR-J4-15KB(-RJ) MR-J4-22KB(-RJ)
		MT-BR5-55K	1	5.5	2	MR-J4-22KB(-RJ)

Brake unit		Resistor unit	Number of connected units	Permissible continuous power [kW]	Resultant resistance [Ω]	Applicable servo amplifier (Note 3)
400 V class	FR-BU2-H30K	FR-BR-H30K	1	1.99	16	MR-J4-500B4(-RJ) MR-J4-700B4(-RJ) MR-J4-11KB4(-RJ) (Note 2)
	FR-BU2-H55K	FR-BR-H55K	1	3.91	8	MR-J4-11KB4(-RJ) MR-J4-15KB4(-RJ) MR-J4-22KB4(-RJ)
	FR-BU2-H75K	MT-BR5-H75K	1	7.5	6.5	MR-J4-22KB4(-RJ)

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

2. When HG-JR11K1M4 servo motor is used, limit the torque during power running to 180% or less, or the servo motor speed to 1800 r/min or less.

3. 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.

11.3.2 Brake unit parameter setting

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

Parameter		Change possible/ impossible	Remark
No.	Name		
0	Brake mode switchover	Impossible	Do not change the parameter.
1	Monitor display data selection	Possible	Refer to the FR-BU2 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		

11.3.3 Connection example

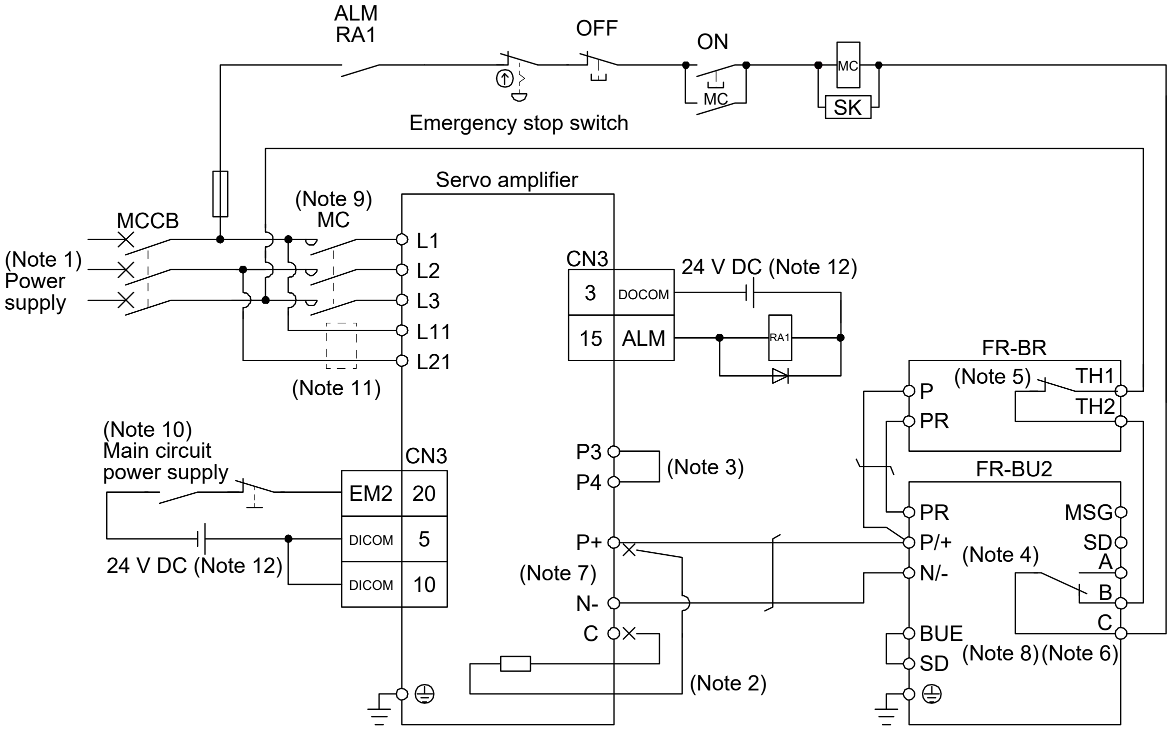
POINT

- ●EM2 has the same function as EM1 in the torque control mode.
- ●Connecting PR terminal of the brake unit to the 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-(H) resistor unit

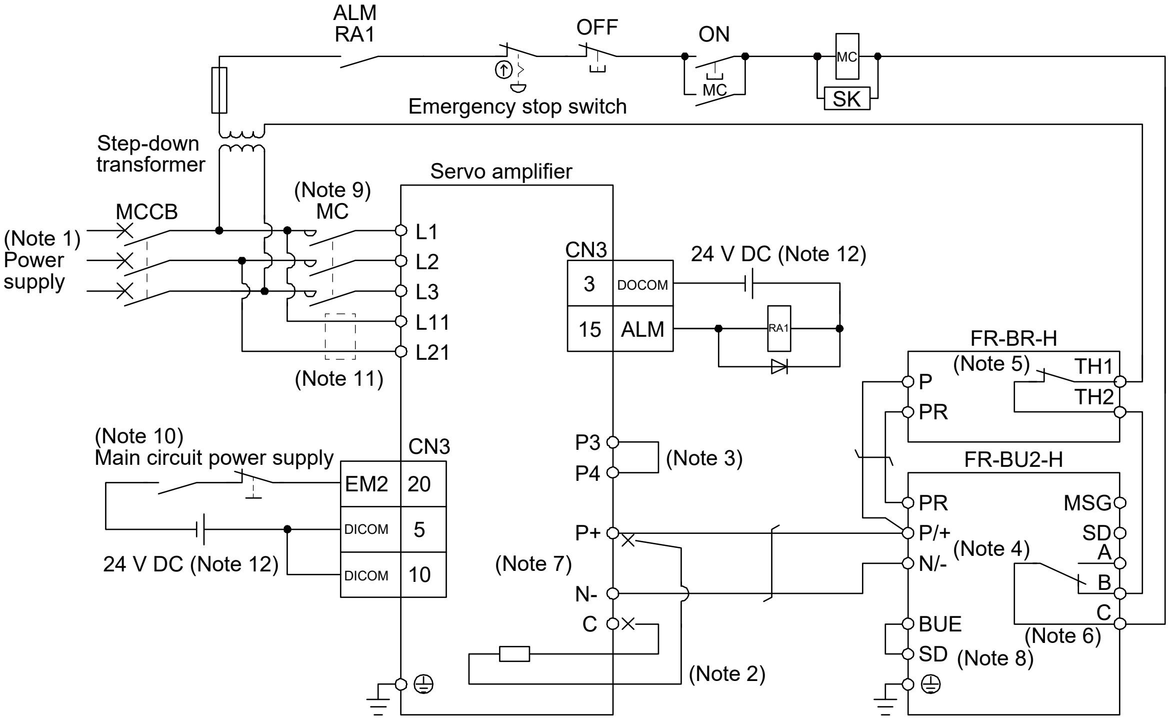
(a) When connecting a brake unit to a servo amplifier

1) 200 V class



Note
1. For the power supply specifications, refer to section 1.3.
2. 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). For the servo amplifier of 11 kW to 22 kW, do not connect a supplied regenerative resistor to the P+ and C terminals.
3. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
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: 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.
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+ and 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.

2) 400 V class

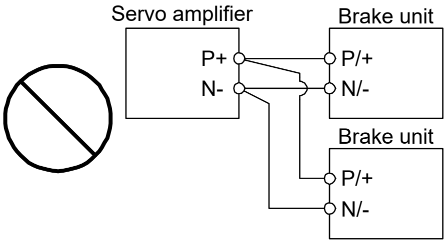


Note
1. For the power supply specifications, refer to section 1.3.
2. For the servo amplifier of 5 kW and 7 kW, always disconnect the lead wire of built-in regenerative resistor, which is connected to P+ and C terminals. For the servo amplifier of 11 kW to 22 kW, do not connect a supplied regenerative resistor to the P+ and C terminals.
3. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
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: 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.
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+ and 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.

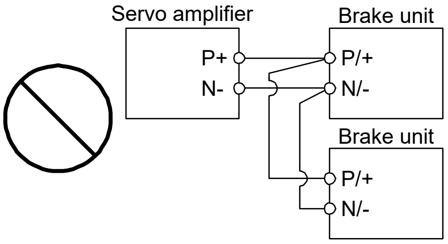
(b) When connecting two brake units to a servo amplifier

POINT

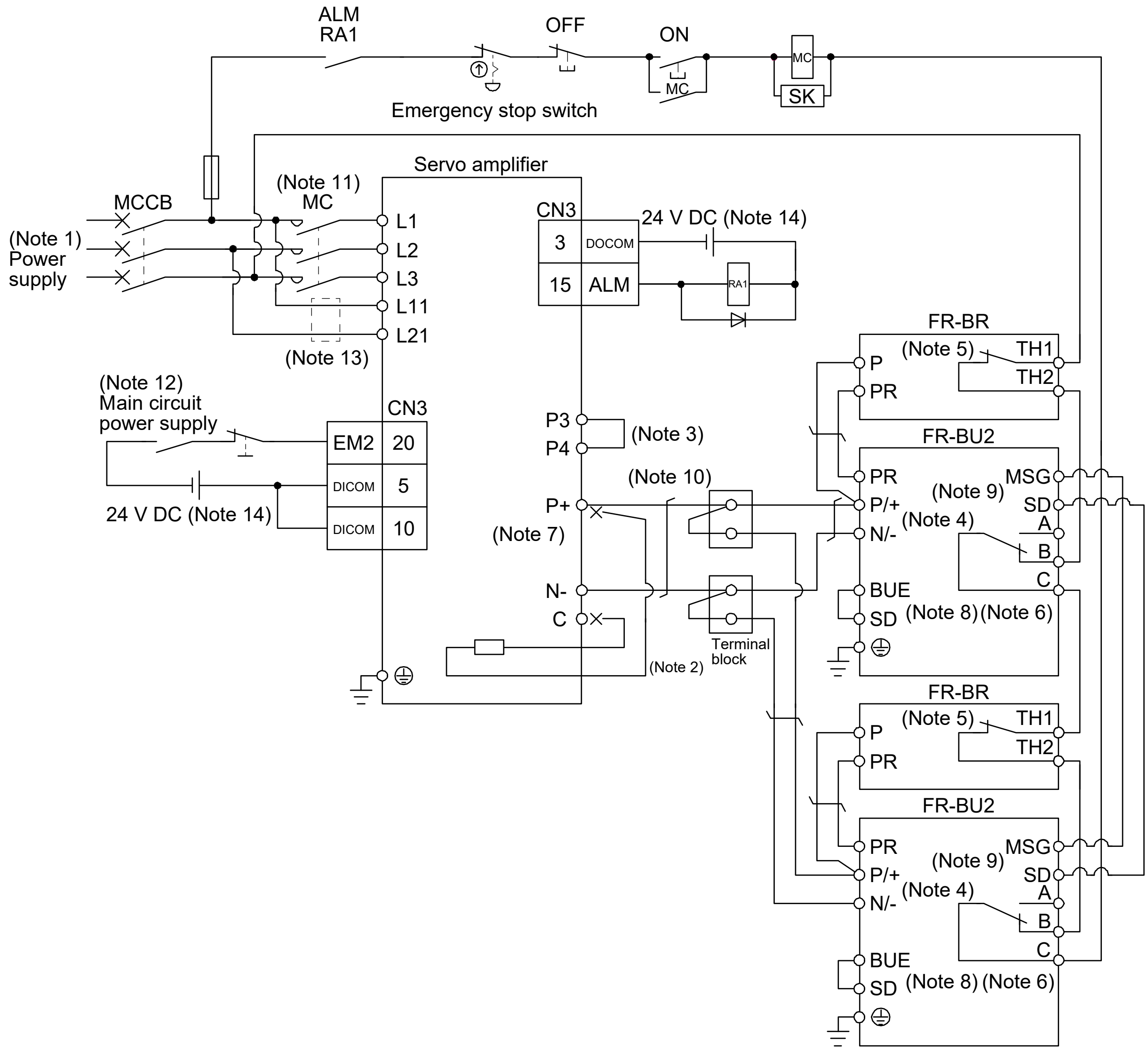
- To use brake units with a parallel connection, use two sets of FR-BU2 brake unit. Combination with other brake unit results in alarm occurrence or malfunction.
- Always connect the terminals for master/slave (MSG to MSG, SD to SD) between the two brake units.
- Do not connect the servo amplifier and brake units as below. Connect the cables with a terminal block to distribute as indicated in this section.



Connecting two cables to P+ and N- terminals



Passing wiring



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

2. 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). For the servo amplifier of 11 kW to 22 kW, do not connect a supplied regenerative resistor to the P+ and C terminals.

3. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.

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: 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.

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+ and N- terminals of the servo amplifier.

8. Always connect BUE and SD terminals. (factory-wired)

9. Connect MSG and SD terminals of the brake unit to a correct destination. Incorrect connection destination results in servo amplifier and brake unit malfunction.

10. For connecting P+ and N- terminals of the servo amplifier to the terminal block, use the cable indicated in (4) (b) in this section.

11. 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.

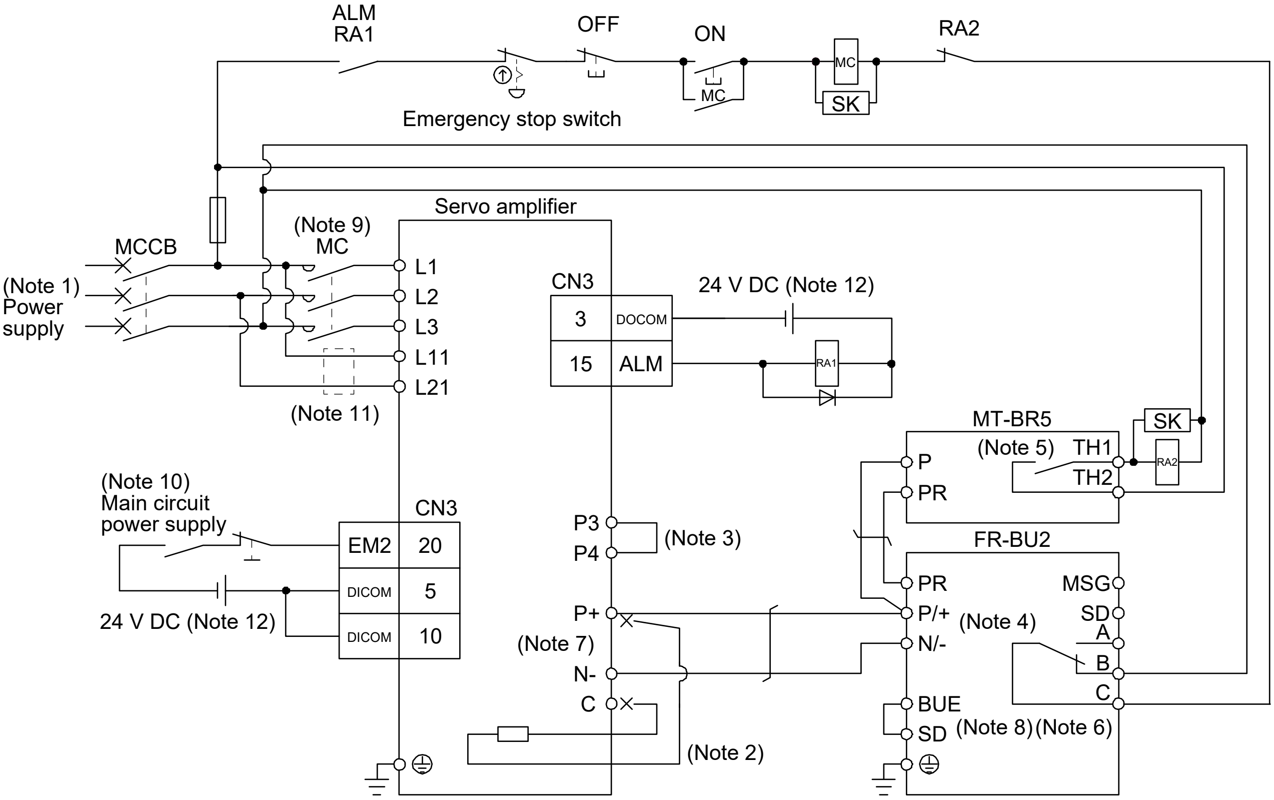
12. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.

13. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker.

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

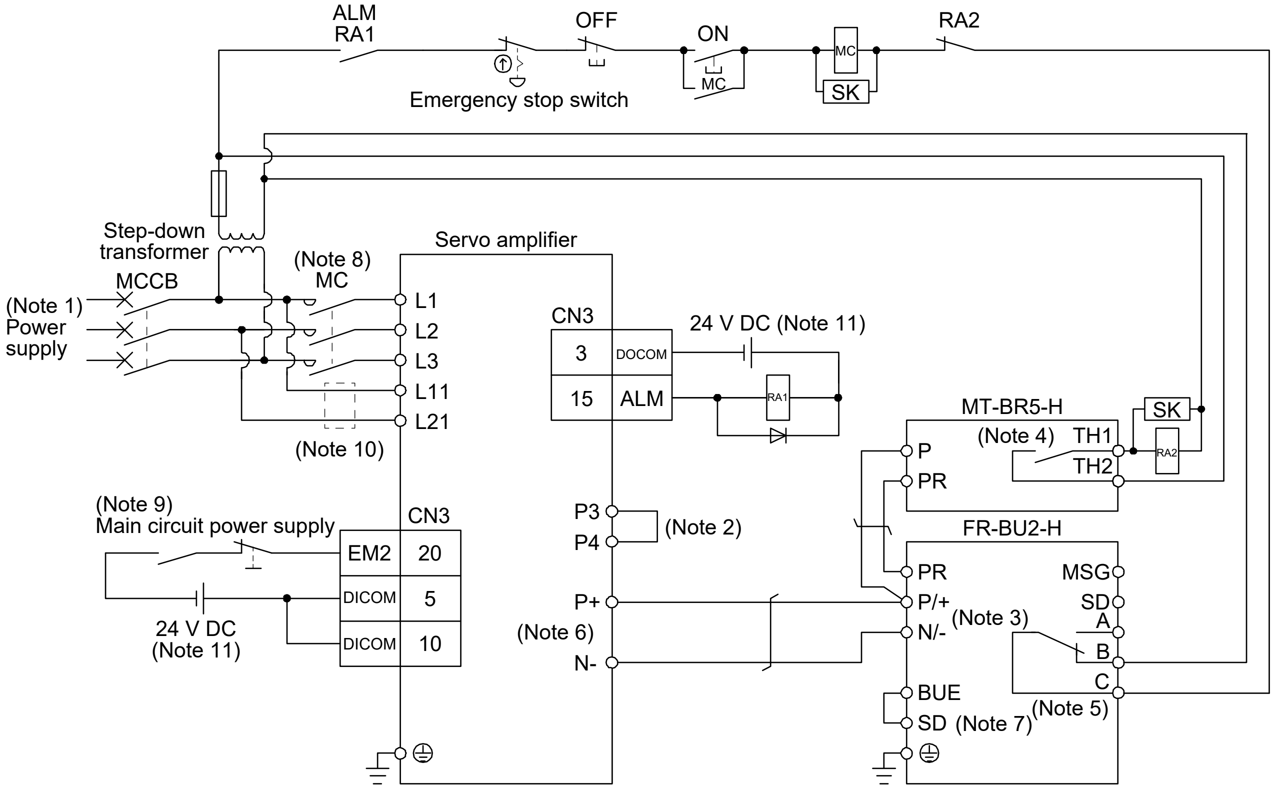
(2) Combination with MT-BR5-(H) resistor unit

(a) 200 V class



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. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
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+ and 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.

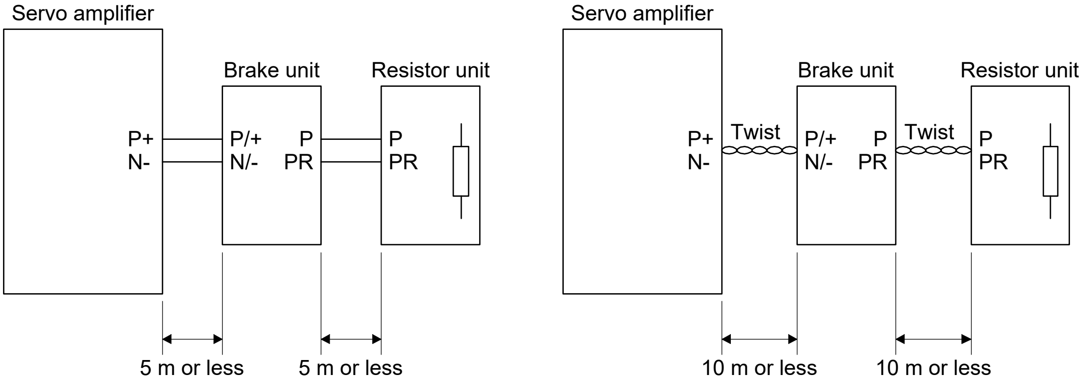
(b) 400 V class



Note
1. For power supply specifications, refer to section 1.3.
2. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
3. Connect P/+ and N/- terminals of the brake unit to a correct destination. Incorrect connection destination results in servo amplifier and brake unit malfunction.
4. 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.
5. 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.
6. Do not connect more than one cable to each P+ and N- terminals of the servo amplifier.
7. Always connect BUE and SD terminals. (factory-wired)
8. 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.
9. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
10. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker.
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) Connection instructions

Keep the wires between the servo amplifier and the brake unit, and between the resistor unit and the brake unit as short as possible. For wires longer than 5 m, twist the wires five times or more per meter. The wires should not exceed 10 m even when the wires are twisted. If wires exceeding 5 m without twisted or exceeding 10 m with or without twisted are used, the brake unit may malfunction.

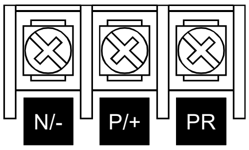


(4) Wires

(a) Wires for the brake unit

For the brake unit, HIV wire (600 V Grade heat-resistant polyvinyl chloride insulated wire) is recommended.

1) Main circuit terminal



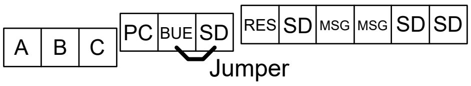
Terminal block

Brake unit		Main circuit screw size	Crimp terminal	Tightening torque [N•m]	Wire size	
			N/-, P/+, PR,⏚		N/-, P/+, PR,⏚	
					HIV wire [mm^2]	AWG
200 V class	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
400 V class	FR-BU2-H30K	M4	5.5-4	1.5	3.5	12
	FR-BU2-H55K	M5	5.5-5	2.5	5.5	10
	FR-BU2-H75K	M6	14-6	4.4	14	6

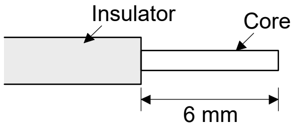
2) Control circuit terminal

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 mm^2 to 0.75 mm^2
Screw driver: Small flat-blade screwdriver
(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

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

POINT

- Some crimp terminals may not be mounted depending on the size. Make sure to use the recommended ones or equivalent ones.

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

Servo amplifier		Brake unit	Number of connected units	Crimp terminal (Manufacturer)	(Note 1) Applicable tool
400 V class	MR-J4-500B4(-RJ)	FR-BU2-H30K	1	FVD5.5-S4 (JST)	a
	MR-J4-700B4(-RJ)	FR-BU2-H30K	1	FVD5.5-S4 (JST)	a
	MR-J4-11KB4(-RJ)	FR-BU2-H30K	1	FVD5.5-6 (JST)	a
		FR-BU2-H55K	1	FVD5.5-6 (JST)	a
	MR-J4-15KB4(-RJ)	FR-BU2-H55K	1	FVD5.5-6 (JST)	a
	MR-J4-22KB4(-RJ)	FR-BU2-H55K	1	FVD5.5-8 (JST)	a
		FR-BU2-H75K	1	FVD14-8 (JST)	d

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

(b) Applicable tool

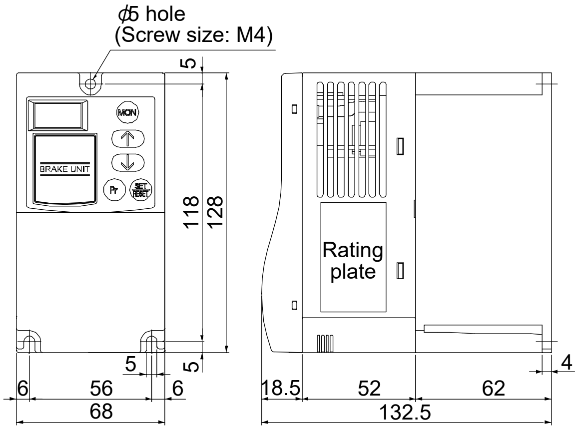
Symbol	Servo amplifier-side crimp terminals				
	Crimp terminal	Applicable tool			Manufacturer
		Body	Head	Dice	
a	FDV5.5-S4 FDV5.5-6	YNT-1210S			JST
b	8-4NS	YHT-8S			
c	FVD8-6	YF-1 E-4	YNE-38	DH-111 DH-121	
d	FVD14-6 FVD14-8	YF-1 E-4	YNE-38	DH-112 DH-122	

11.3.4 Dimensions

(1) FR-BU2-(H) brake unit

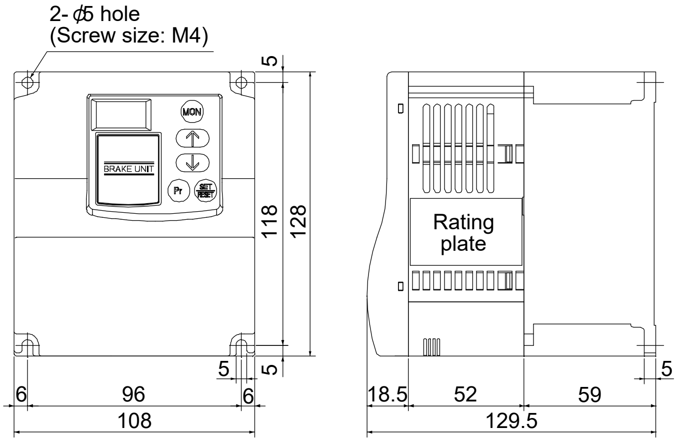
FR-BU2-15K

[Unit: mm]



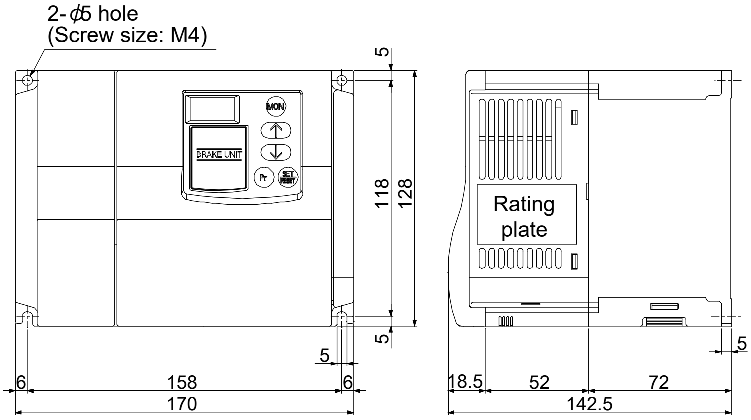
FR-BU2-30K/FR-BU2-H30K

[Unit: mm]



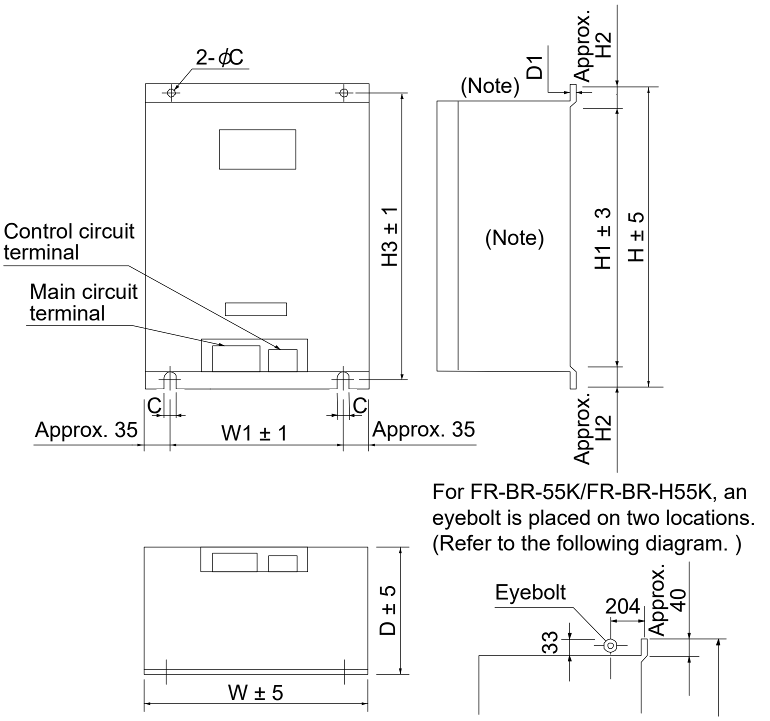
FR-BU2-55K/FR-BU2-H55K/FR-BU2-H75K

[Unit: mm]



(2) FR-BR-(H) resistor unit

[Unit: mm]



For FR-BR-55K/FR-BR-H55K, an eyebolt is placed on two locations. (Refer to the following diagram.)

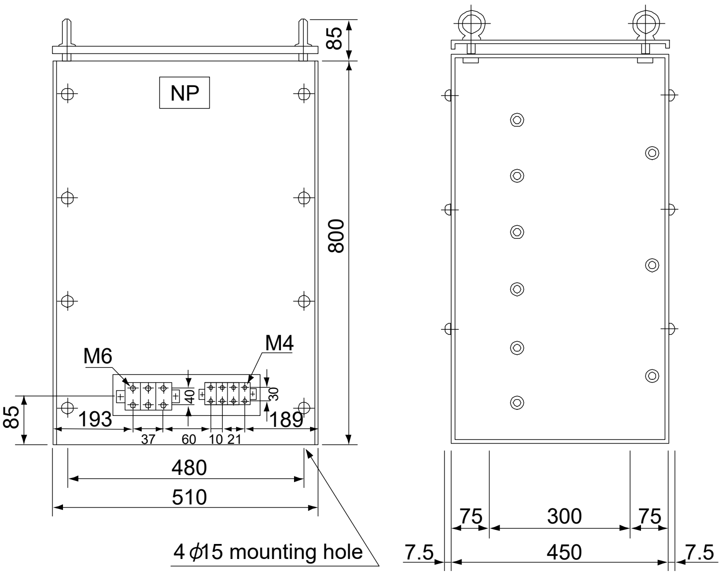
Note. Ventilation ports are provided on both sides and the top. The bottom is open.

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
400 V class	FR-BR-H30K	340	270	600	560	20	582	220	4	10	30
	FR-BR-H55K	480	410	700	620	40	670	450	3.2	12	70

(3) MT-BR5-(H) resistor unit

[Unit: mm]

Resistor unit		Resistance	Approximate mass [kg]
200 V class	MT-BR5-55K	2.0 Ω	50
400 V class	MT-BR5-H75K	6.5 Ω	70



11.4 FR-RC-(H) power regeneration converter

POINT

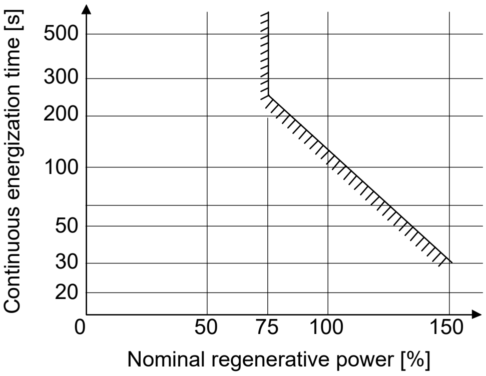
- ●When using the FR-RC-(H) power regeneration converter, set [Pr. PA04] to "0 0 _ _" to enable EM1 (Forced stop 1).
- ●When using the FR-RC-(H) power regeneration converter, refer to "Power Regeneration Converter FR-RC Instruction Manual (IB(NA)66330)".

When using the FR-RC-(H) power regeneration converter, set [Pr. PA02] to "_ _ 0 1" and set [Pr. PC20] to "_ _ _ 1".

(1) Selection

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 regeneration converter	Nominal regenerative power [kW]	Servo amplifier
FR-RC-15K	15	MR-J4-500B(-RJ) MR-J4-700B(-RJ) MR-J4-11KB(-RJ) MR-J4-15KB(-RJ)
FR-RC-30K	30	
FR-RC-55K	55	MR-J4-22KB(-RJ)
FR-RC-H15K	15	MR-J4-500B4(-RJ) MR-J4-700B4(-RJ)
FR-RC-H30K	30	MR-J4-11KB4(-RJ) MR-J4-15KB4(-RJ)
FR-RC-H55K	55	MR-J4-22KB4(-RJ)

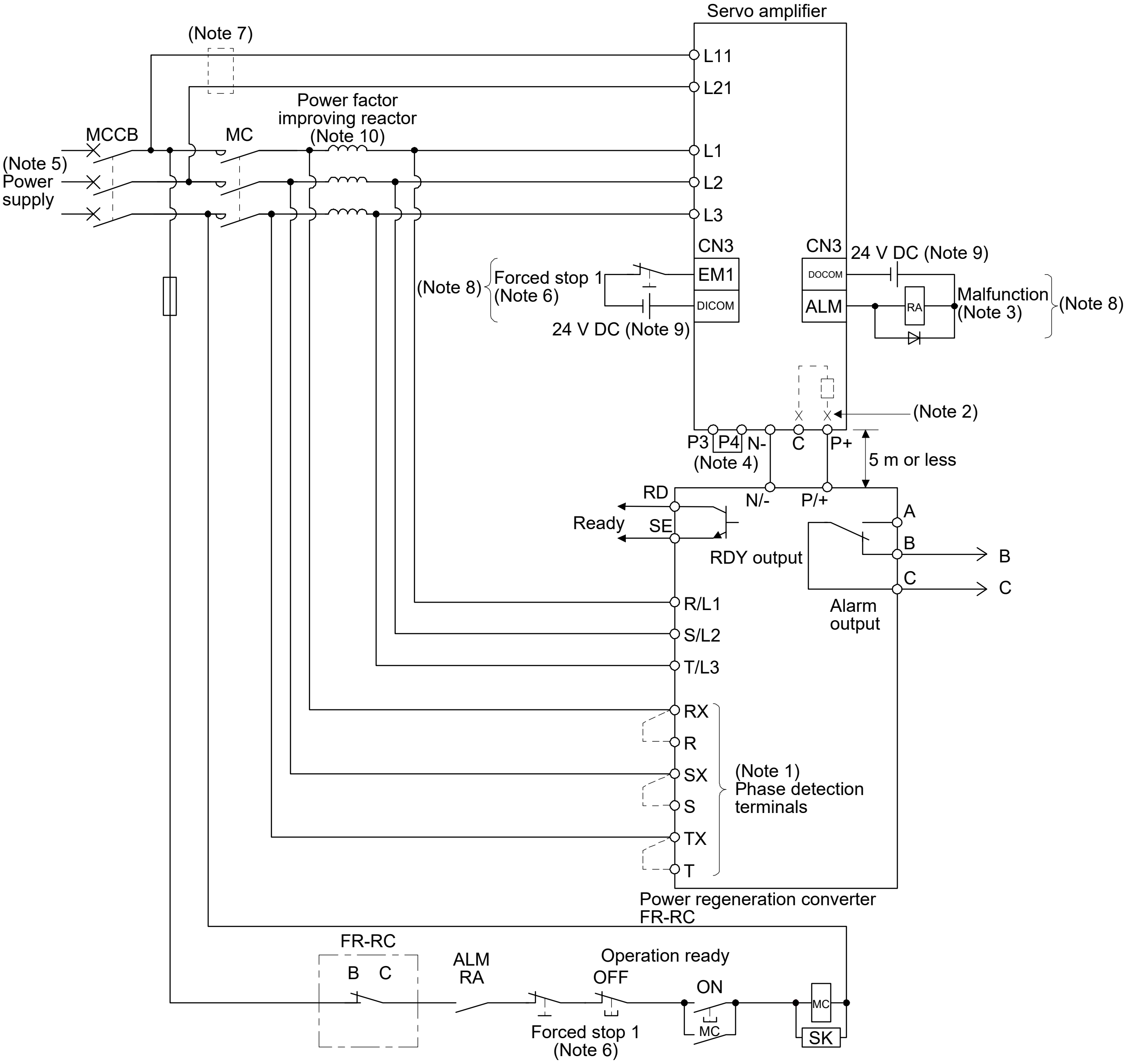


(2) Connection example

POINT

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

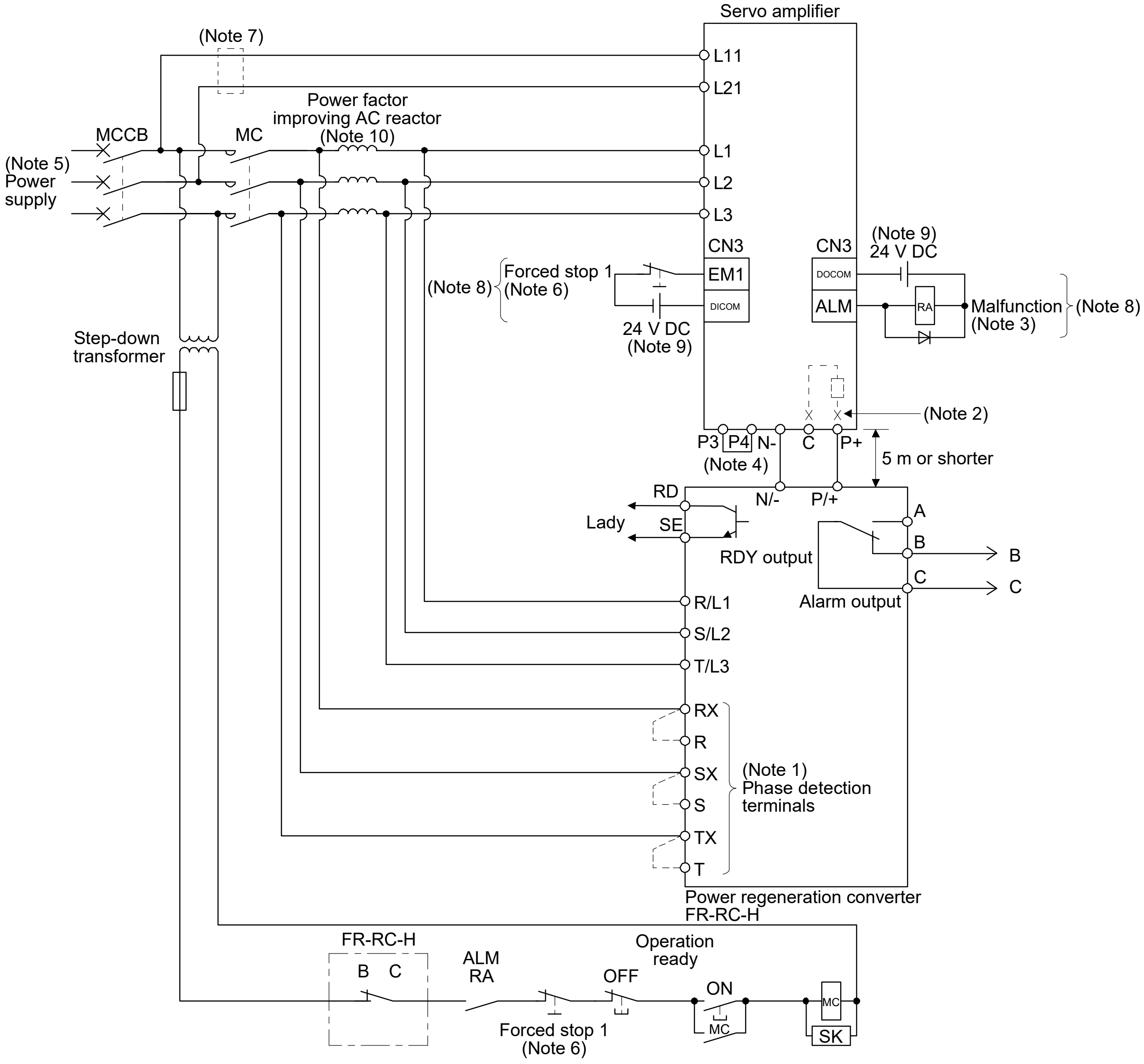
(a) 200 V class



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.

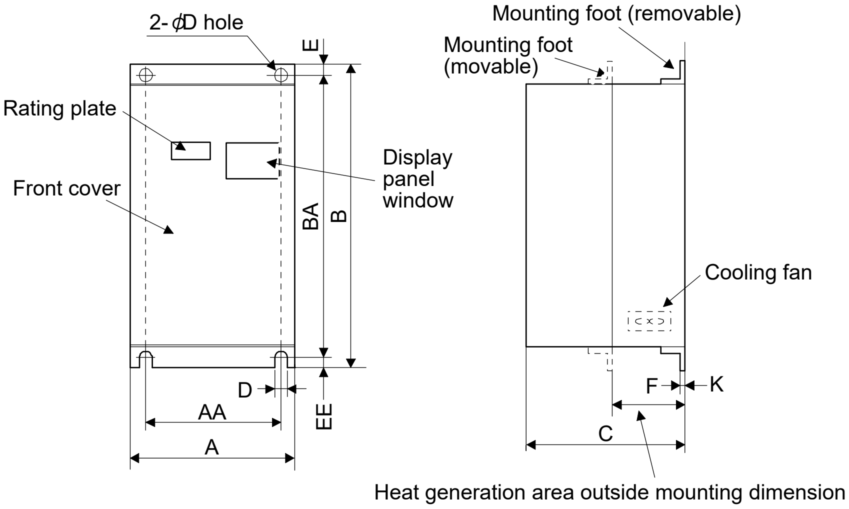
2. When using the servo amplifier of 7 kW or less, make sure to disconnect the wiring of built-in regenerative resistor (5 kW or less: P+ and D, 7 kW: P+ and C). For the servo amplifier of 11 kW to 22 kW, do not connect a supplied regenerative resistor to the P+ and C terminals.
3. If ALM (Malfunction) output is disabled 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. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
5. For the 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 shows sink I/O interface. For source I/O interface, refer to section 3.8.3.
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.
10. For selection of power factor improving AC reactors, refer to "Power Regeneration Converter FR-RC Instruction Manual (IB(NA)66330)".

(b) 400 V class



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-H will not operate.
2. When using the servo amplifier of 7 kW and 5 kW, make sure to disconnect the wiring of built-in regenerative resistor across 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 ALM (Malfunction) output is disabled 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. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
5. For the 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 shows sink I/O interface. For source I/O interface, refer to section 3.8.3.
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.
10. For selection of power factor improving AC reactors, refer to "Power Regeneration Converter FR-RC Instruction Manual (IB(NA)66330)".

(3) Dimensions

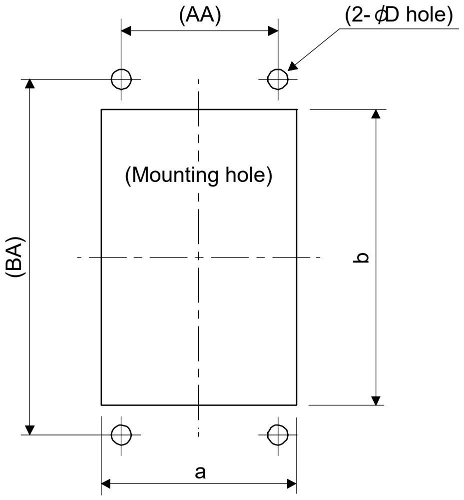


[Unit: mm]

Power regeneration 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
FR-RC-H15K	340	270	600	582	195	10	10	8	3.2	90	31
FR-RC-H30K											
FR-RC-H55K	480	410	700	670	250	12	15	15	3.2	135	55

(4) Mounting hole machining dimensions

The following shows mounting hole dimensions for mounting the heat generation area of the power regeneration converter outside a cabinet as measures against heat generation when the converter is mounted in an enclosed type cabinet.



[Unit: mm]

Power regeneration converter	a	b	D	AA	BA
FR-RC-15K	260	412	10	200	432
FR-RC-30K	330	562	10	270	582
FR-RC-55K	470	642	12	410	670
FR-RC-H15K	330	562	10	270	582
FR-RC-H30K					
FR-RC-H55K	470	642	12	410	670

11.5 FR-CV-(H) power regeneration common converter

POINT

- ●For details of the power regeneration common converter FR-CV-(H), refer to the FR-CV Installation Guide (IB(NA)0600075).
- ●Do not supply power to the main circuit power supply terminals (L1/L2/L3) of the servo amplifier. Otherwise, the servo amplifier and FR-CV-(H) will malfunction.
- ●Connect the DC power supply between the FR-CV-(H) and servo amplifier with correct polarity. Connection with incorrect polarity will fail the FR-CV-(H) and servo amplifier.
- ●Two or more FR-CV-(H)s cannot be installed to improve regeneration capability. Two or more FR-CV-(H)s cannot be connected to the same DC power supply line.
- ●When using FR-CV-(H), set [Pr. PA04] to "0 0 _ _" to enable EM1 (Forced stop 1).

When using the FR-CV-(H) power regeneration common converter, set [Pr. PA02] to "_ _ 0 1" and set [Pr. PC20] to "_ _ _ 1".

11.5.1 Model designation

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

FR-CV-H7.5K

Capacity

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

Symbol	Voltage class
None	200 V class
H	400 V class

11.5.2 Selection

(1) 200 V class

FR-CV power regeneration 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] ≥ Total of rated capacities [W] × 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 rated capacity of the servo amplifier with the maximum rated capacity should be equal to or less the value of than "Maximum servo amplifier capacity" in the following table.

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 regeneration 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

(2) 400 V class

FR-CV-H power regeneration common converter can be used for the servo amplifier of 600 W to 22 kW. The following shows the restrictions on using the FR-CV-H.

(a) Up to six servo amplifiers can be connected to one FR-CV-H.

(b) FR-CV-H capacity [W] ≥ Total of rated capacities [W] × 2 of servo amplifiers connected to FR-CV-H.

(c) When FR-CV-H capacity is less than the total of rated capacities of the connected servo amplifiers × 2.5, make the maximum torque of the connected servo motors equal to or less than 200 % of the rated torque. When FR-CV-H capacity exceeds the total of rated capacities of the connected servo amplifiers × 2.5, the maximum torque of the connected servo amplifiers is not limited.

(d) The total of used servo motor rated currents should be equal to or less than the applicable current [A] of the FR-CV-H.

(e) Among the servo amplifiers connected to the FR-CV-H, the rated capacity of the servo amplifier with the maximum rated capacity should be equal to or less than the value of "Maximum servo amplifier capacity" in the following table.

The following table lists the restrictions.

Item	FR-CV-H_						
	7.5K	11K	15K	22K	30K	37K	55K
Maximum number of connected servo amplifiers	6						
Total capacity of connectable servo amplifiers [kW]	3.75	5.5	7.5	11	15	18.5	27.5
Total rated current of connectable servo motors [A]	17	23	31	43	57	71	110
Maximum servo amplifier capacity [kW]	3.5	5	7	11	15	15	22

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

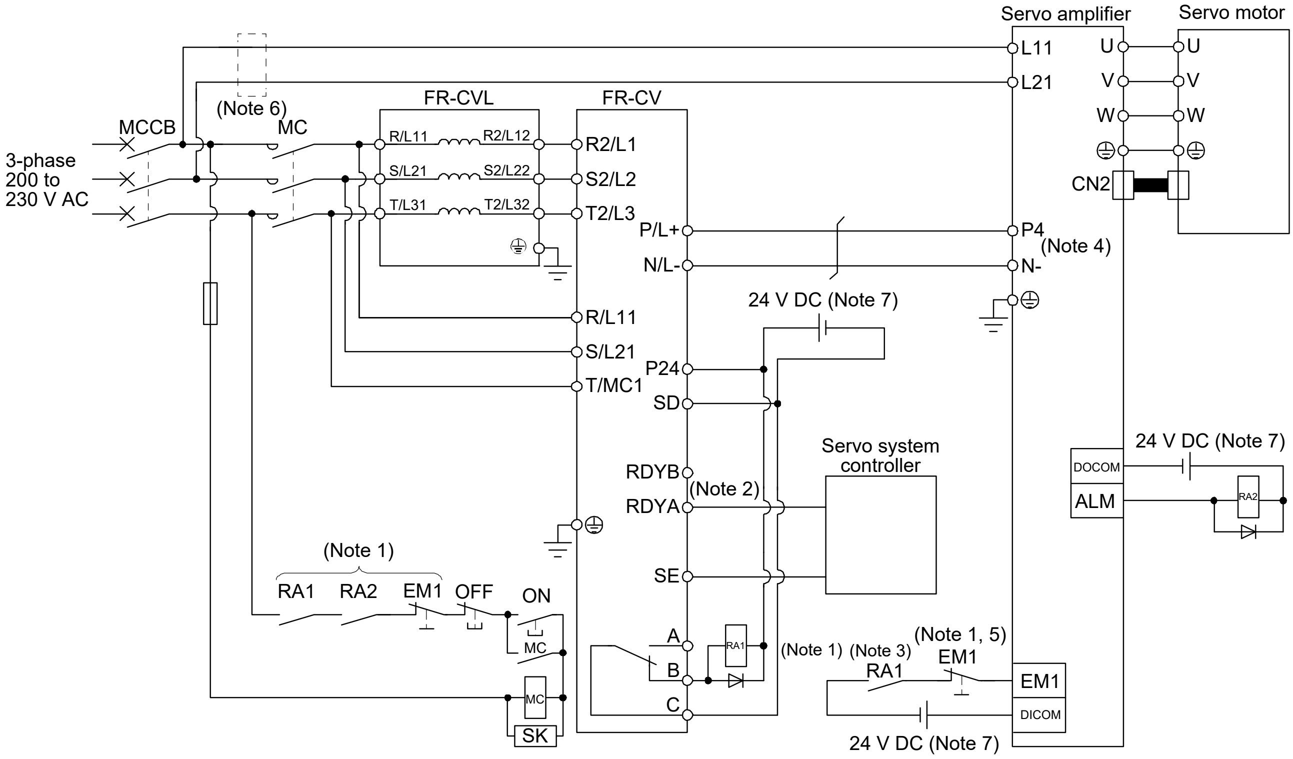
Power regeneration common converter	Dedicated stand-alone reactor
FR-CV-H7.5K(-AT)	FR-CVL-H7.5K
FR-CV-H11K(-AT)	FR-CVL-H11K
FR-CV-H15K(-AT)	FR-CVL-H15K
FR-CV-H22K(-AT)	FR-CVL-H22K
FR-CV-H30K(-AT)	FR-CVL-H30K
FR-CV-H37K	FR-CVL-H37K
FR-CV-H55K	FR-CVL-H55K

(3) Connection diagram

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

(a) 200 V class

POINT
●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).



Note 1. Configure a sequence that will shut off main circuit power in the following.

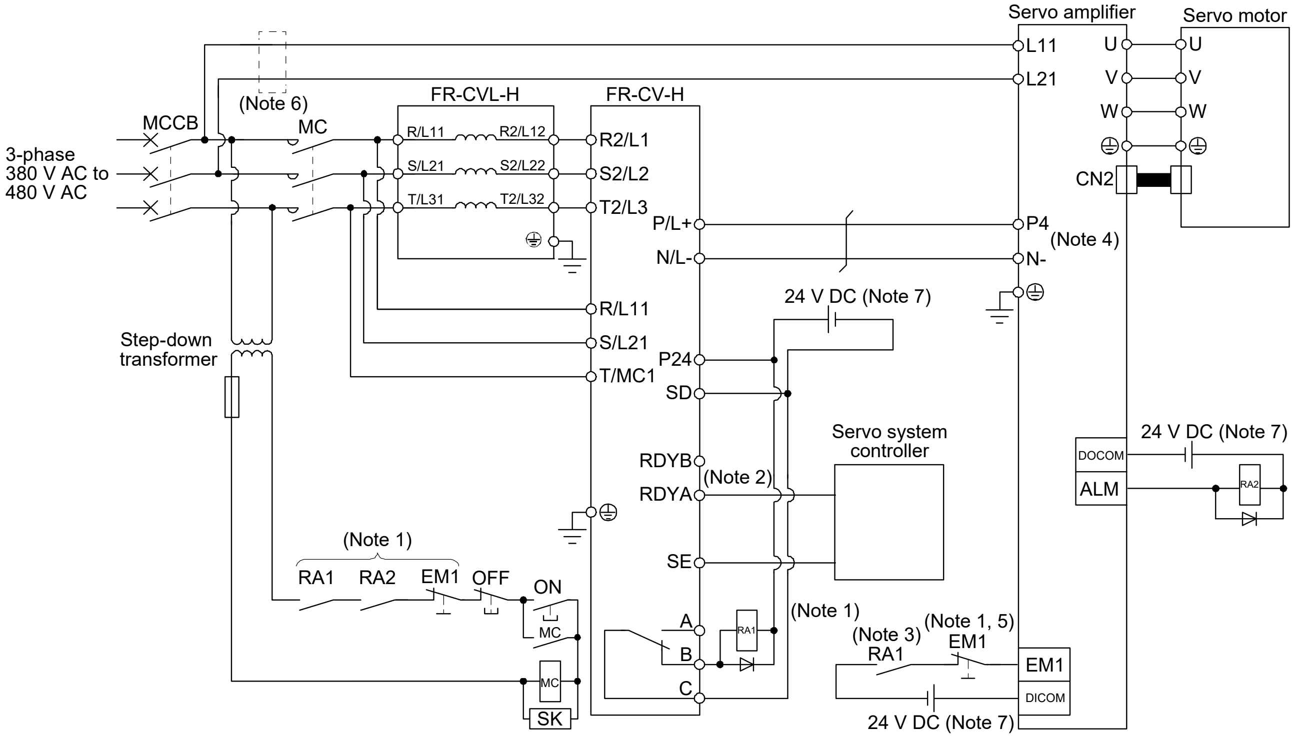
- An alarm occurred at FR-CV or servo amplifier.
- EM1 (Forced stop 1) is enabled.

2. For the servo amplifier, configure a sequence that will switch the servo-on after the FR-CV is ready.
3. 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. When the servo system controller does not have an emergency stop input, use the forced stop input of the servo amplifier to make a stop as shown in the diagram.
4. When using FR-CV, always disconnect wiring between P3 and P4 terminals.
5. Set [Pr. PA04] to "0 0 _ _" to enable EM1 (Forced stop 1).
6. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker.
7. 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.

(b) 400 V class

POINT

- When using the servo amplifier of 7 kW or less, be sure to disconnect the wiring of built-in regenerative resistor (3.5 kW or less: P+ and D, 5 kW/7 kW: P+ and C).



Note 1. Configure a sequence that will shut off main circuit power in the following.
- An alarm occurred at FR-CV-H or servo amplifier.
- EM1 (Forced stop 1) is enabled.

2. For the servo amplifier, configure a sequence that will switch the servo-on after the FR-CV-H is ready.
3. 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-H. When the servo system controller does not have an emergency stop input, use the forced stop input of the servo amplifier to make a stop as shown in the diagram.
4. When using FR-CV-H, always disconnect wiring between P3 and P4 terminals.
5. Set [Pr. PA04] to "0 0 _ _" to enable EM1 (Forced stop 1).
6. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker.
7. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.

(4) Selection example of wires used for wiring

POINT

- Selection conditions of wire size are as follows.
  600 V grade heat-resistant polyvinyl chloride insulated wire (HIV wire)
  Construction condition: Single wire set in midair

(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 1/0)
27.5	50 (AWG 1/0)

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

Total of servo amplifier capacities [kW]	Wire [mm^2]
2 or less	2 (AWG 14)
3.5	3.5 (AWG 12)
5	5.5 (AWG 10)
7	5.5 (AWG 10)
11	8 (AWG 8)
15	8 (AWG 8)
22	14 (AWG 6)
27.5	22 (AWG 4)

2) Grounding

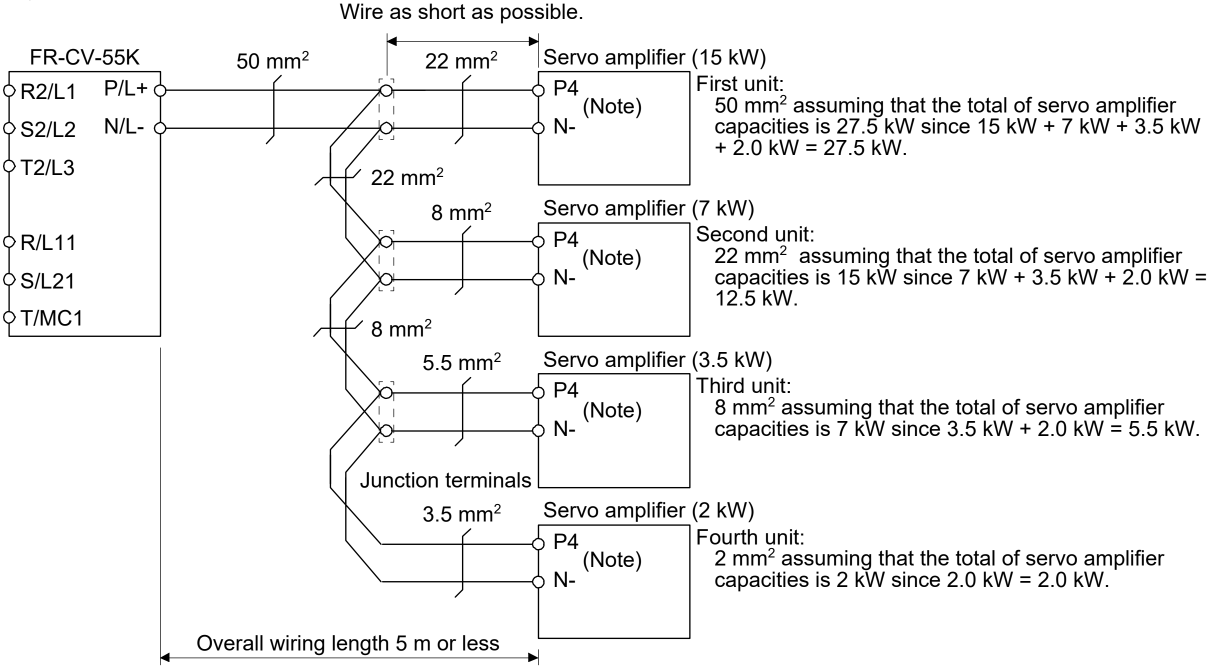
For grounding, use the wire of the size equal to or greater than that indicated in the following table, and make it as short as possible.

Power regeneration 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)
FR-CV-H7.5K to FR-CV-H15K	3.5 (AWG 12)
FR-CV-H22K/FR-CV-H30K	8 (AWG 8)
FR-CV-H37K/FR-CV-H55K	14 (AWG 6)

(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.

1) 200 V class



First unit:
50 mm² assuming that the total of servo amplifier capacities is 27.5 kW since 15 kW + 7 kW + 3.5 kW + 2.0 kW = 27.5 kW.

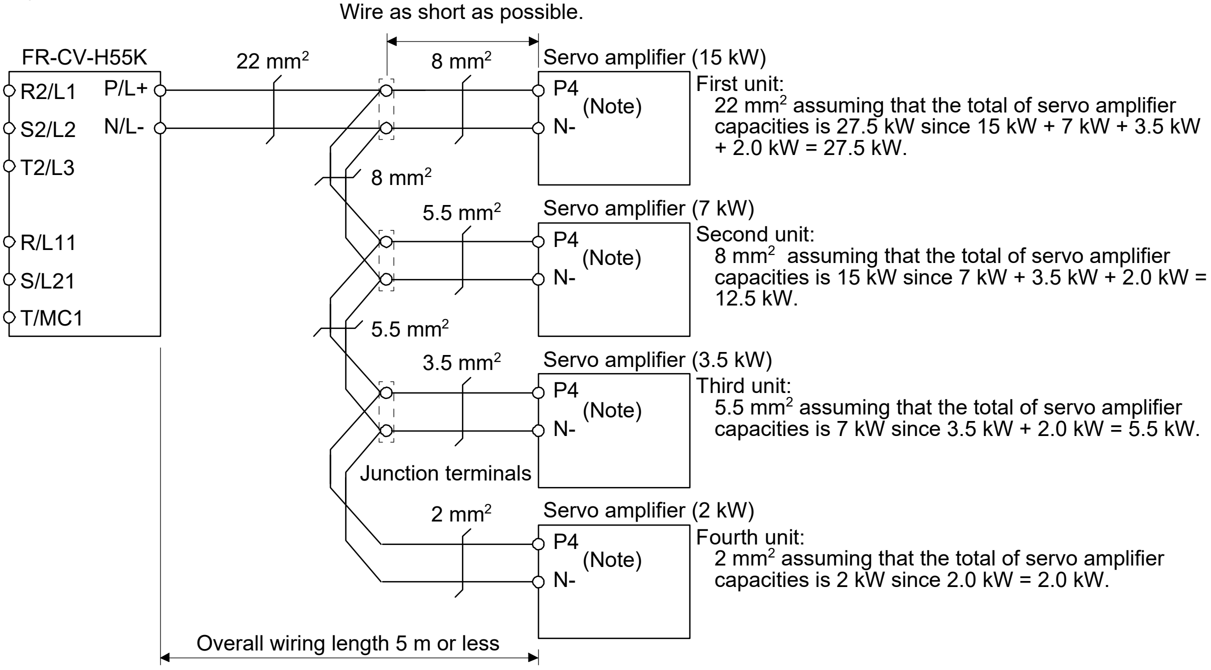
Second unit:
22 mm² assuming that the total of servo amplifier capacities is 15 kW since 7 kW + 3.5 kW + 2.0 kW = 12.5 kW.

Third unit:
8 mm² assuming that the total of servo amplifier capacities is 7 kW since 3.5 kW + 2.0 kW = 5.5 kW.

Fourth unit:
2 mm² assuming that the total of servo amplifier capacities is 2 kW since 2.0 kW = 2.0 kW.

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).

2) 400 V class



First unit:
22 mm² assuming that the total of servo amplifier capacities is 27.5 kW since 15 kW + 7 kW + 3.5 kW + 2.0 kW = 27.5 kW.

Second unit:
8 mm² assuming that the total of servo amplifier capacities is 15 kW since 7 kW + 3.5 kW + 2.0 kW = 12.5 kW.

Third unit:
5.5 mm² assuming that the total of servo amplifier capacities is 7 kW since 3.5 kW + 2.0 kW = 5.5 kW.

Fourth unit:
2 mm² assuming that the total of servo amplifier capacities is 2 kW since 2.0 kW = 2.0 kW.

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).

(5) Other precautions

(a) When using the FR-CV-(H), always install the dedicated stand-alone reactor (FR-CVL-(H)). Do not use the power factor improving AC reactor (FR-HAL-(H)) or power factor improving DC reactor (FR-HEL-(H)).

(b) The inputs/outputs (main circuits) of the FR-CV-(H) 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(-H)) or line noise filter (FR-BSF01, FR-BLF).

(c) The overall wiring length for connection of the DC power supply between the FR-CV-(H) and servo amplifiers should be 5 m or less, and the wiring must be twisted.

(6) Specifications

Item \ Power regeneration common converter FR-CV-_			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, 60 s (Note 1)						
		Continuous rating	100% torque						
Power	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		5 %RH to 90 %RH (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			30AF 30A	50AF 50A	100AF 75A	100AF 100A	125AF 125A	125AF 125A	225AF 175A
Magnetic contactor			S-N20 S-T21	S-N35 S-T35	S-N50 S-T50	S-N65 S-T65	S-N80 S-T80	S-N95 S-T100	S-N125

Item / Power regeneration common converter FR-CV-H_			7.5K	11K	15K	22K	30K	37K	55K
Total of connectable servo amplifier capacities [kW]			3.75	5.5	7.5	11	15	185	27.5
Maximum servo amplifier capacity [kW]			3.5	5	7	11	15	15	22
Output	Total of connectable servo motor rated currents [A]		17	23	31	43	57	71	110
	Regenerative braking torque	Short-time rating	Total capacity of applicable servo motors, 300% torque, 60 s (Note 1)						
		Continuous rating	100% torque						
Power supply	Rated input AC voltage/frequency		3-phase 380 V AC to 480 V AC, 50 Hz/60 Hz						
	Permissible AC voltage fluctuation		3-phase 323 V AC to 528 V AC, 50 Hz/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		5 %RH to 90 %RH (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			30AF 15A	30AF 20A	30AF 30A	50AF 50A	60AF 60A	100AF 75A	100AF 100A
Magnetic contactor			S-N20 S-T21	S-N20 S-T21	S-N20 S-T21	S-N25 S-T25	S-N35 S-T35	S-N50 S-T50	S-N65 S-T65

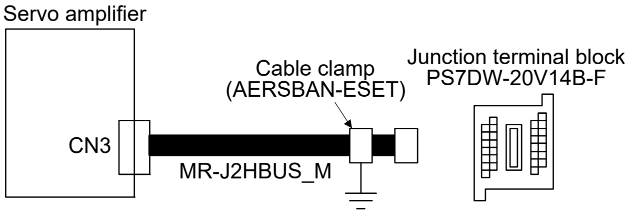
Note 1. This is the time when the protective function of the FR-CV-(H) is activated. The protective function of the servo amplifier is activated in the time indicated in section 10.1.

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

11.6 Junction terminal block PS7DW-20V14B-F (recommended)

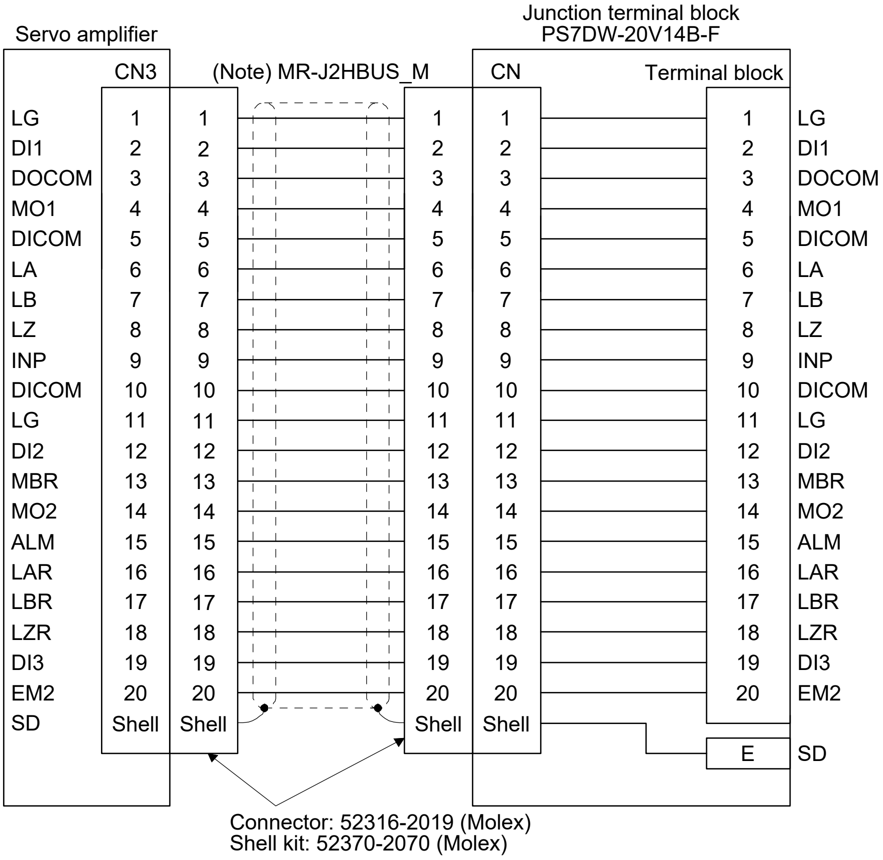
(1) Usage

Always use the junction terminal block (PS7W-20V14B-F (Toho Technology)) with the option cable (MR-J2HBUS_M) as a set. A connection example is shown below.



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

(2) Connection of MR-J2HBUS_M cable and junction terminal block



Note. Symbol indicating cable length is put in _.

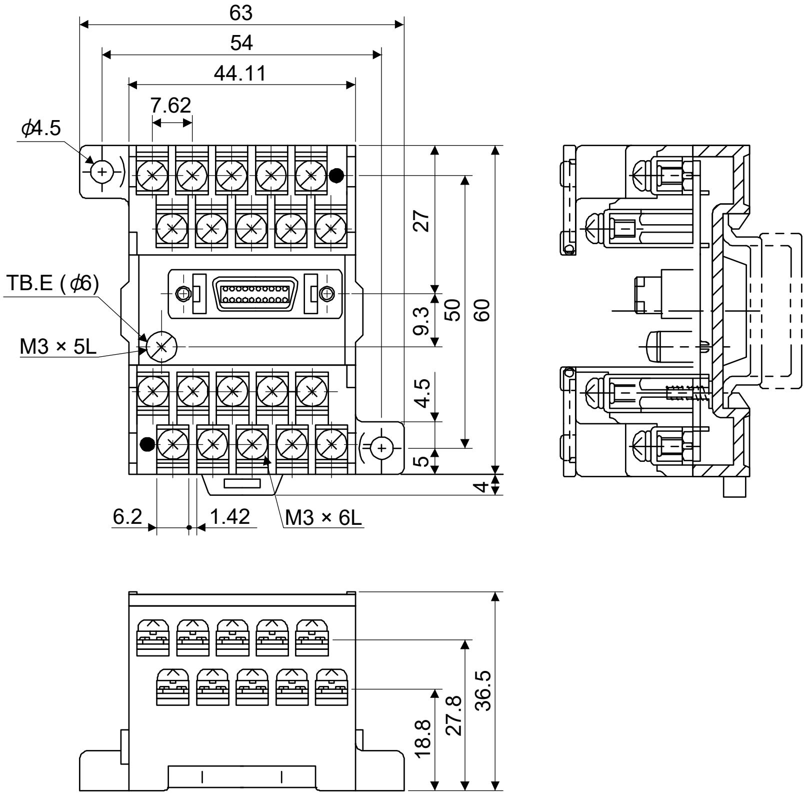
05: 0.5 m

1: 1 m

5: 5 m

(3) Dimensions of junction terminal block

[Unit: mm]



11.7 MR Configurator2

POINT

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

11.7.1 Engineering software

The following engineering software is available with this servo amplifier.

Engineering software	Installation guide
MR Configurator2 SW1DNC-MRC2-_	MR Configurator2 SW1DNC-MRC2-_ INSTALLATION GUIDE (IB(NA)0300163ENG)

For the engineering software specifications and system configuration, refer to the installation guide.

11.7.2 Precautions for using USB communication function

Note the following to prevent an electric shock and malfunction of the servo amplifier.

(1) Power connection of personal computers
Connect your personal computer with the following procedures.

- (a) When you use a personal computer with AC power supply
    - 1) When using a personal computer with a three-core power plug or power plug with grounding wire, use a three-pin socket or ground the grounding wire.
    - 2) When your personal computer has two-core plug and has no grounding wire, connect the personal computer to the servo amplifier with the following procedures.
        - a) Disconnect the power plug of the personal computer from an AC power socket.
        - b) Check that the power plug was disconnected and connect the device to the servo amplifier.
        - c) Connect the power plug of the personal computer to the AC power socket.
- (b) When you use a personal computer with battery
You can use as it is.

(2) Connection with other devices using servo amplifier communication function
When the servo amplifier is charged with electricity due to connection with a personal computer and the charged servo amplifier is connected with other devices, the servo amplifier or the connected devices may malfunction. Connect the servo amplifier and other devices with the following procedures.

- (a) Shut off the power of the device for connecting with the servo amplifier.
- (b) Shut off the power of the servo amplifier which was connected with the personal computer and check the charge lamp is off.
- (c) Connect the device with the servo amplifier.
- (d) Turn on the power of the servo amplifier and the device.

11.8 Battery

POINT

- Refer to app. 2 and 3 for battery transportation and the new EU Battery Directive.

This battery is used to construct an absolute position detection system. Refer to chapter 12 for construction of the absolute position detection system.

11.8.1 Selection of battery

The available batteries vary depending on servo amplifiers. Select a required battery.

(1) Applications of the batteries

Model	Name	Application	Built-in battery
MR-BAT6V1SET	Battery	For absolute position data backup	MR-BAT6V1
MR-BAT6V1BJ	Battery for junction battery cable	For transporting a servo motor and machine apart	
MR-BT6VCASE	Battery case	For absolute position data backup of multi-axis servo motor	MR-BAT6V1

(2) Combinations of batteries and the servo amplifier

Model	MR-J4-_B_(-RJ)
MR-BAT6V1SET	○
MR-BAT6V1BJ	○
MR-BT6VCASE	○

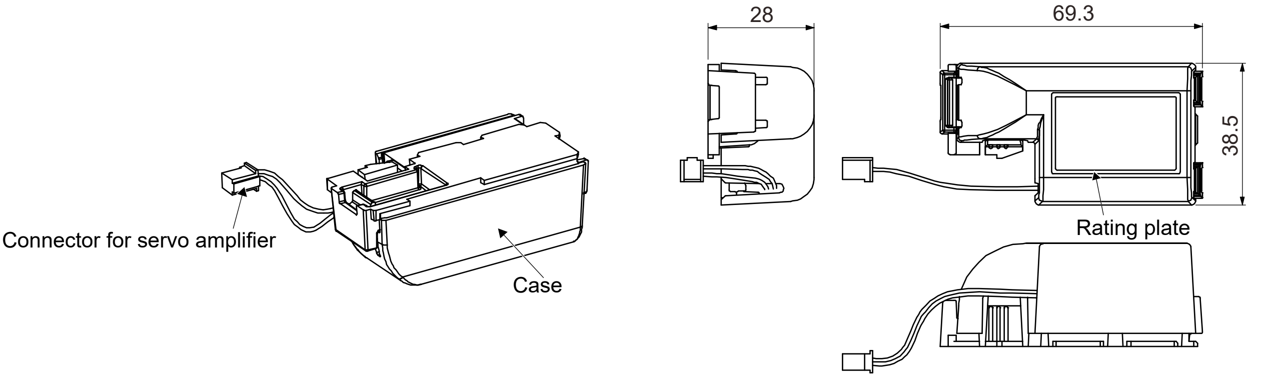
11.8.2 MR-BAT6V1SET battery

POINT

- For the specifications and year and month of manufacture of the built-in MR-BAT6V1 battery, refer to section 11.8.5.

(1) Parts identification and dimensions

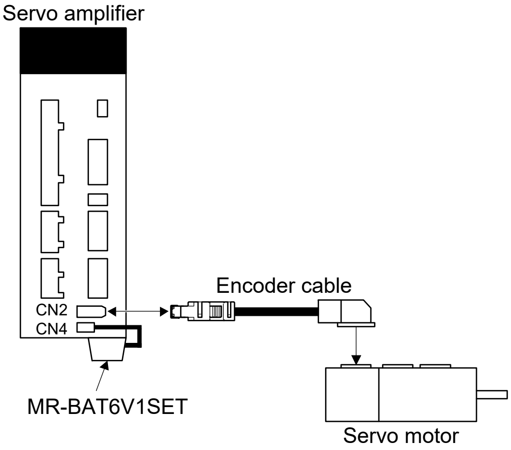
[Unit: mm]



Mass: 55 [g] (including MR-BAT6V1 battery)

(2) Battery mounting

Connect as follows.



(3) Battery replacement procedure

⚠WARNING

- ●Before replacing 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.
  - ･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 battery is within battery life.

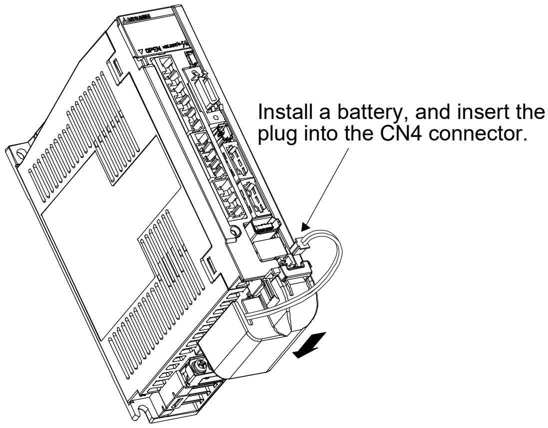
Replace the battery while only control circuit power is on. Replacing battery with the control circuit power on triggers [AL. 9F.1 Low battery]. However, the absolute position data will not be erased.

(a) Battery installation and removal procedure

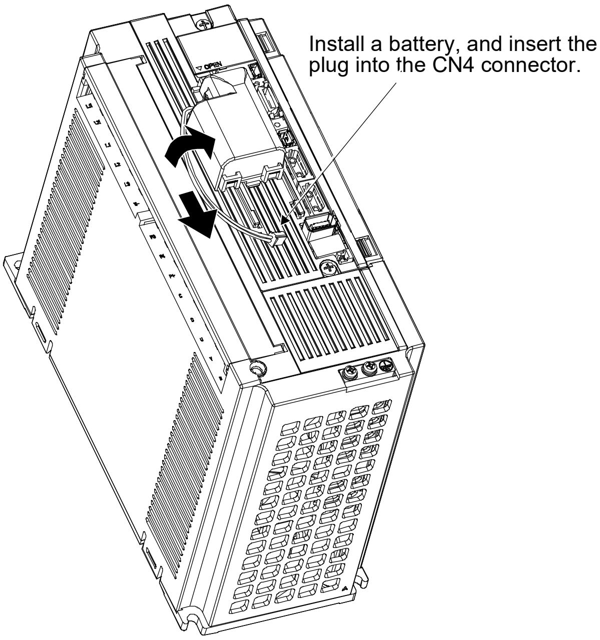
1) Installation procedure

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.



For the servo amplifier
with a battery holder on the bottom

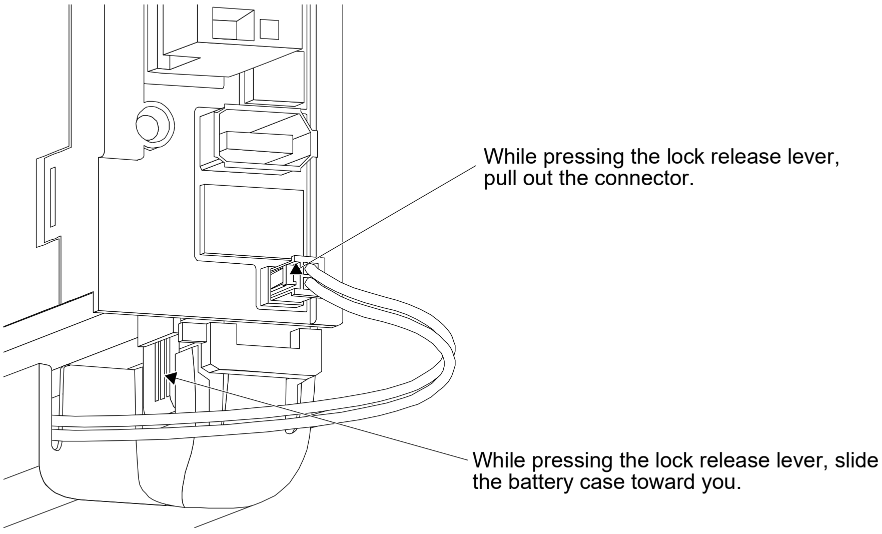


For the servo amplifier
with a battery holder on the front

2) Removal procedure

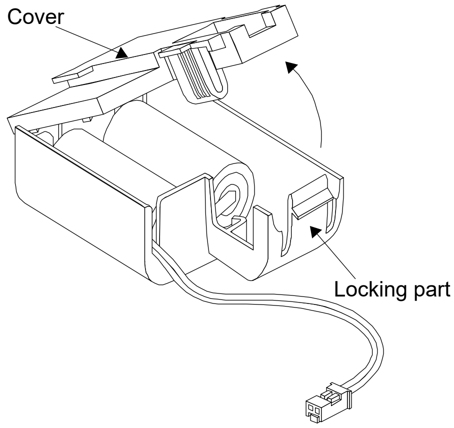
⚠CAUTION

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

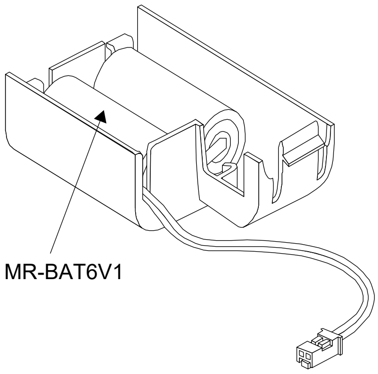


(4) Replacement procedure of the built-in battery

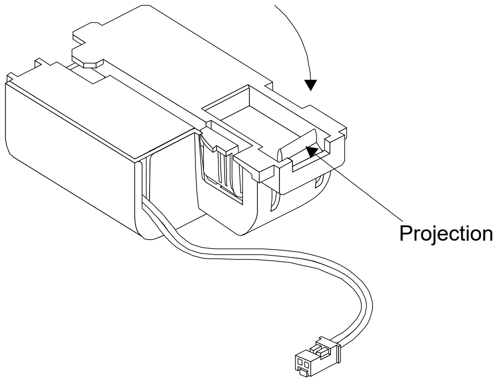
When the MR-BAT6V1SET reaches the end of its life, replace the built-in MR-BAT6V1 battery.



1) While pressing the locking part, open the cover.



2) Replace the battery with a new MR-BAT6V1.



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

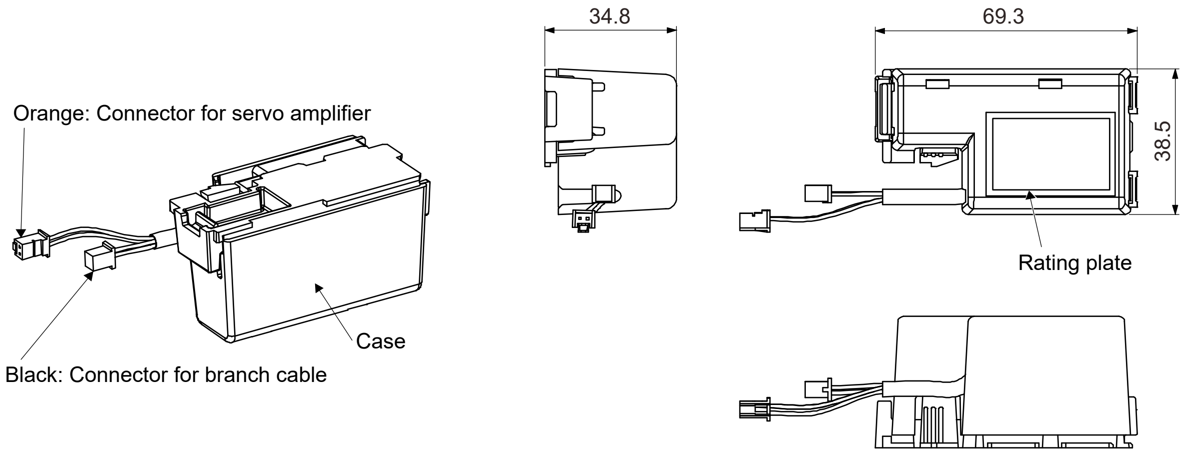
11.8.3 MR-BAT6V1BJ battery for junction battery cable

POINT

- ●MR-BAT6V1BJ is compatible only with HG series servo motors. It cannot be used with direct drive motors.
- ●MR-BAT6V1BJ cannot be used for fully closed loop system and scale measurement function.

(1) Parts identification and dimensions

[Unit: mm]



Mass: 66 [g]

(2) Year and month of manufacture of battery

Production year and month are indicated in a serial number (SERIAL) on the rating plate. The second digit from left in the number indicates the first digit of the year, the third digit from left indicates a month (Oct: X, Nov: Y, Dec.: Z). For November 2013, the serial is like, "SERIAL: _ 3Y _ _ _ _ _ _".

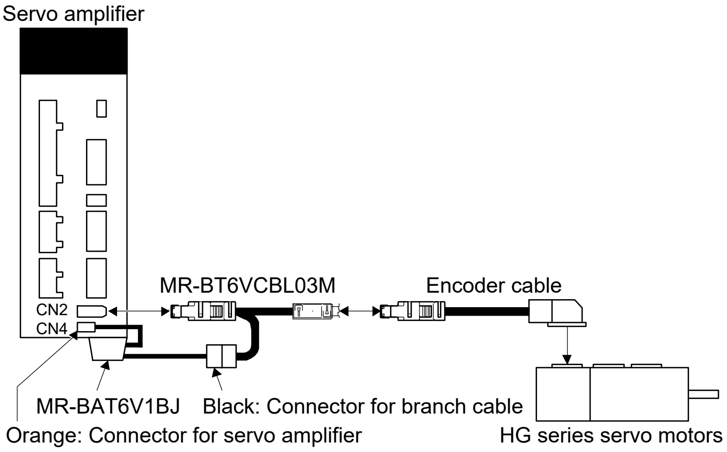
(3) Specification list

Item	Description
Battery pack	2CR17335A (CR17335A × 2 pcs. in series)
Nominal voltage [V]	6
Nominal capacity [mAh]	1650
Storage temperature [°C]	0 to 55
Operating temperature [°C]	0 to 55
Lithium content [g]	1.2
Mercury content	Less than 1 ppm
Dangerous goods class	Not subject to the dangerous goods (Class 9) Refer to app. 2 for details.
Operating humidity and storage humidity	5 %RH to 90 %RH (non-condensing)
(Note) Battery life	5 years from date of manufacture
Mass [g]	66

Note. 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) Battery mounting

Connect the MR-BAT6V1BJ using the MR-BT6VCBL03M junction battery cable as follows.

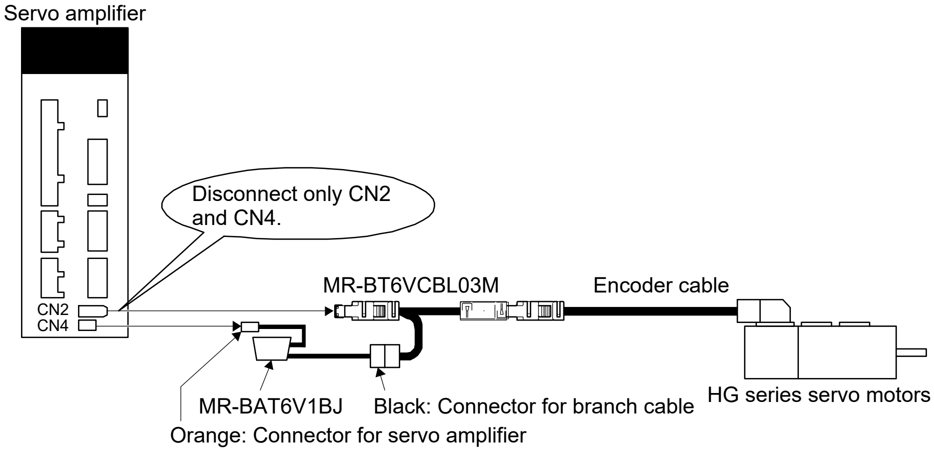


(5) Transporting a servo motor and machine apart

POINT

- Be sure to connect the connector for branch cable connection (black) when transporting a servo motor and machine apart. When the connector for branch cable connection (black) is not connected to the MR-BT6VCBL03M junction battery cable, no alarm will occur. However, the absolute position data will be erased when you transport a servo motor and machine apart.

When you transport a servo motor and machine apart, disconnect only CN2 and CN4 of the servo amplifier. When other connectors or cables are disconnected between the servo motor and battery, the absolute position data will be deleted.



(6) Battery replacement procedure

⚠WARNING

- Before replacing 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.
  - Ground human body and work bench.
  - Do not touch the conductive areas, such as connector pins and electrical parts, directly by hand.
- The battery built in MR-BAT6V1BJ cannot be replaced. Do not disassemble the MR-BAT6V1BJ. Otherwise, it may cause a malfunction.

POINT

- To replace the MR-BAT6V1BJ, follow the procedures given in this section to avoid erasing absolute position data.
- Before replacing batteries, check that the new battery is within battery life.

For MR-BAT6V1BJ, the battery can be replaced with the control circuit power supply off.

(a) Battery installation and removal procedure

The battery installation and removal procedure to the servo amplifier are the same as for the MR-BAT6V1SET battery. Refer to (3) of section 11.8.2.

(b) Preparation for replacing MR-BAT6V1BJ

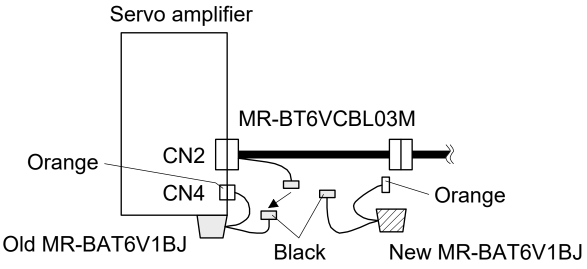
Prepare a new MR-BAT6V1BJ as follows.

Model	Number and use	Remark
MR-BAT6V1BJ	1 for replacement	Battery within two years from the production date.

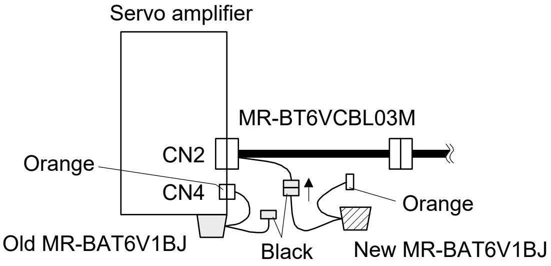
(c) Procedures of replacing MR-BAT6V1BJ

Replace the product as follows regardless of on/off of the control circuit power supply. When it is replaced with other procedures, the absolute position data will be erased.

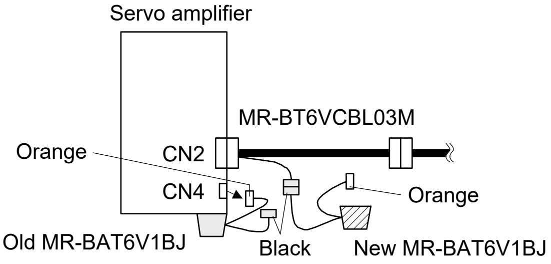
1) Remove the connector for branch cable connection (black) of the old MR-BAT6V1BJ.



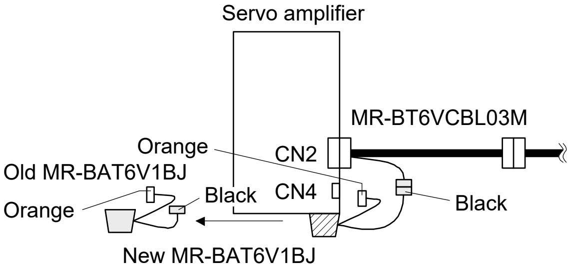
2) Connect the connector for branch cable connection (black) of the new MR-BAT6V1BJ.



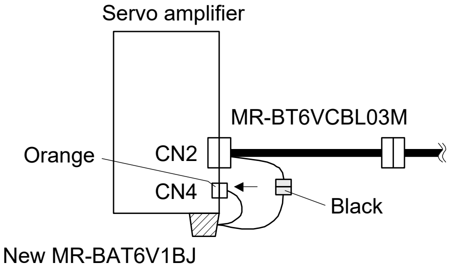
3) Remove the connector for servo amplifier (orange) of the old MR-BAT6V1BJ. When the control circuit power supply is on, performing 3) without [AL. 9F.1 Low battery] will trigger [AL. 9F.1].



4) Remove the old MR-BAT6V1BJ from servo amplifier and mount the new MR-BAT6V1BJ. When the control circuit power supply is on, [AL. 9F.1] will occur after 3).



5) Mount the connector for servo amplifier (orange) of the new MR-BAT6V1BJ. When the control circuit power supply is on, [AL. 9F.1] will be canceled.



11.8.4 MR-BT6VCASE battery case

POINT

- ●The battery unit consists of an MR-BT6VCASE battery case and five MR-BAT6V1 batteries.
- ●For the specifications and year and month of manufacture of MR-BAT6V1 battery, refer to section 11.8.5.

MR-BT6VCASE is a case used for connecting and mounting five MR-BAT6V1 batteries. A battery case does not have any batteries. Please prepare MR-BAT6V1 batteries separately.

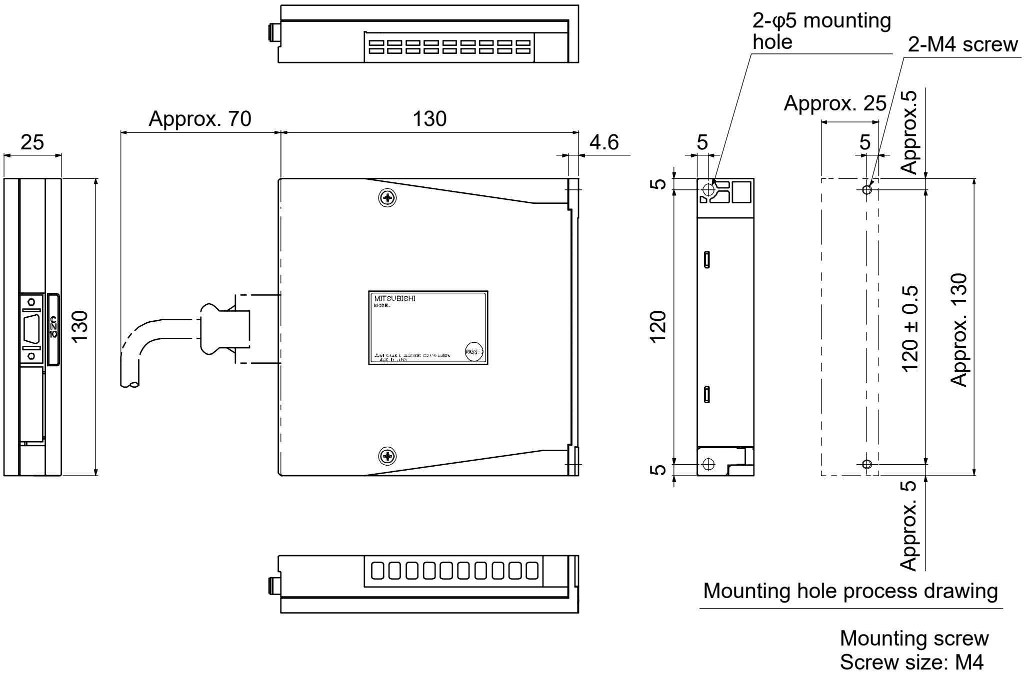
(1) The number of connected servo motors

One MR-BT6VCASE holds absolute position data up to eight axes servo motors. For direct drive motors, up to four axes can be connected. Servo motors and direct drive motors in the incremental system are included as the axis Nos. Linear servo motors are not counted as the axis Nos. Refer to the following table for the number of connectable axes of each servo motor.

Servo motor	Number of axes								
Rotary servo motor	0	1	2	3	4	5	6	7	8
Direct drive motor	4	4	4	4	4	3	2	1	0

(2) Dimensions

[Unit: mm]



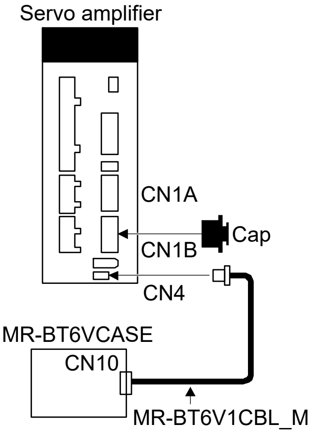
[Mass: 0.18 kg]

(3) Battery mounting

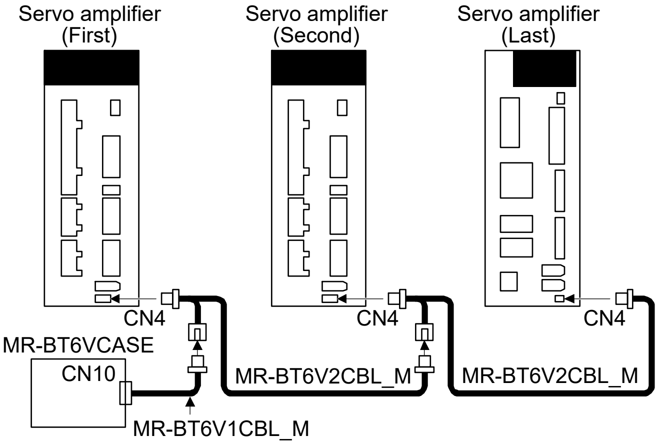
POINT

- ●One battery unit can be connected to up to 8-axis servo motors. However, when using direct drive motors, the number of axes of the direct drive motors should be up to 4 axes. Servo motors and direct drive motors in the incremental system are included as the axis Nos. Linear servo motors are not counted as the axis Nos.
- ●The MR-J4W_-_B servo amplifiers can be combined with MR-J4-_B_(-RJ) servo amplifiers. However, it cannot be used for MR-J4W2-0303B6.

(a) When using 1-axis servo amplifier



(b) When using up to 8-axis servo amplifiers



(4) Battery replacement procedure

⚠WARNING	●Before replacing 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. ・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 battery is within battery life.

Replace the battery while only control circuit power is on. Replacing battery with the control circuit power on triggers [AL. 9F.1 Low battery]. However, the absolute position data will not be erased.

(a) Assembling a battery unit

⚠CAUTION
- ●Do not mount new and old batteries together.
- ●When you replace a battery, replace all batteries at the same time.

POINT
- ●Always install five MR-BAT6V1 batteries to an MR-BT6VCASE battery case.

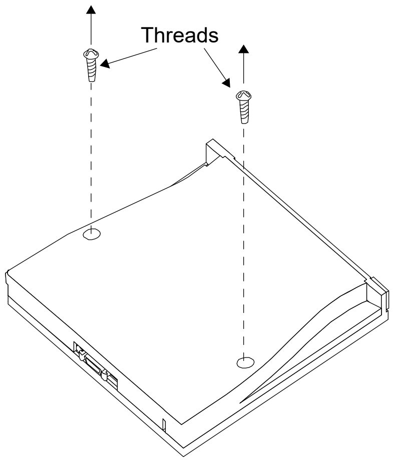
1) Required items

Product name	Model	Quantity	Remark
Battery case	MR-BT6VCASE	1	MR-BT6VCASE is a case used for connecting and mounting five MR-BAT6V1 batteries.
Battery	MR-BAT6V1	5	Lithium battery (primary battery, nominal + 6 V)

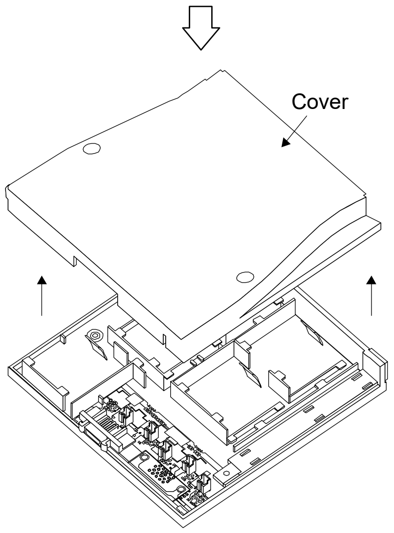
2) Disassembly and assembly of the battery case MR-BT6VCASE

a) Disassembly of the case

MR-BT6VCASE is shipped assembled. To mount MR-BAT6V1 batteries, the case needs to be disassembled.

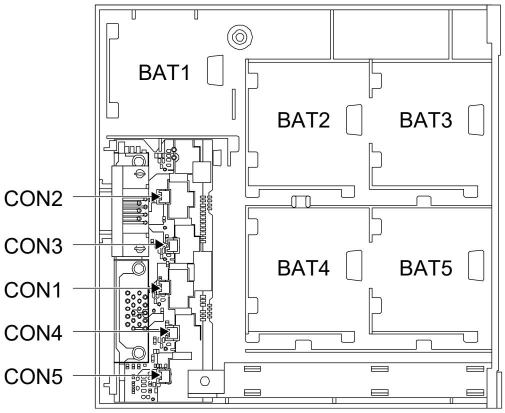


Remove the two screws using a Phillips screwdriver.

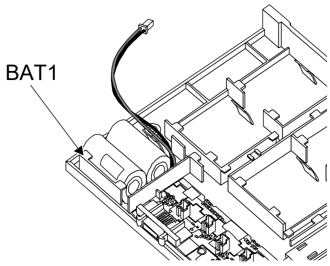


Remove the cover.

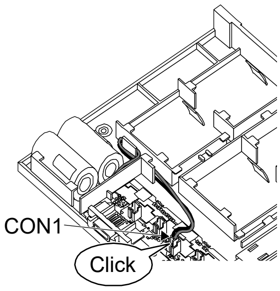
Parts identification



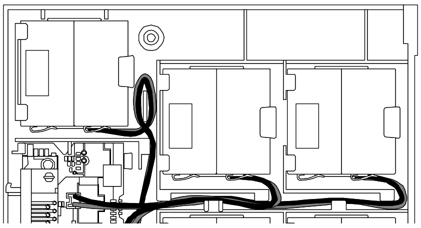
b) Mounting MR-BAT6V1



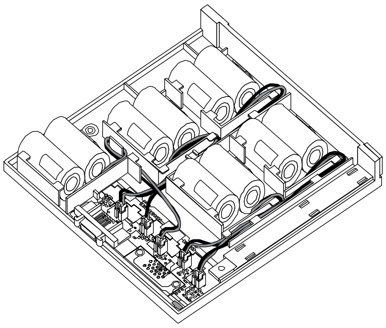
Securely mount a MR-BAT6V1 to the BAT1 holder.



Insert the MR-BAT6V1 connector mounted on BAT1 holder to CON1.
Confirm the click sound at this point.
The connector has to be connected in the right direction.
If the connector is pushed forcefully in the incorrect direction, the connector will break.
Place the MR-BAT6V1 lead wire to the duct designed to store lead wires.
Insert MR-BAT6V1 to the holder in the same procedure in the order from BAT2 to BAT5.



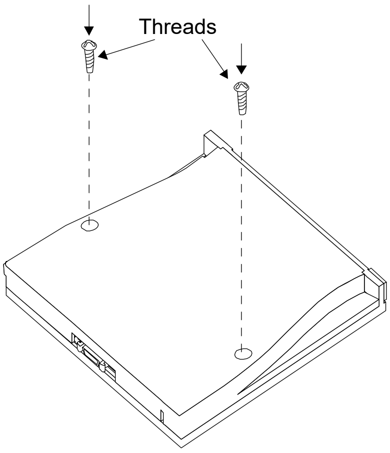
Bring out the lead wire from the space between the ribs, and bend it as shown above to store it in the duct. Connect the lead wire to the connector. Be careful not to get the lead wire caught in the case or other parts.
When the lead wire is damaged, external short circuit may occur, and the battery can become hot.



c) Assembly of the case
After all MR-BAT6V1 batteries are mounted, fit the cover and insert screws into the two holes and tighten them. Tightening torque is 0.71 N•m.

POINT

- ●When assembling the case, be careful not to get the lead wires caught in the fitting parts or the screwing parts.

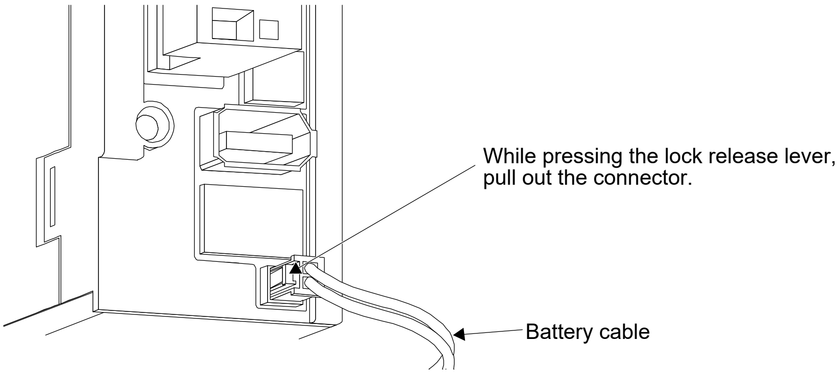


d) Precautions for removal of battery
The connector attached to the MR-BAT6V1 battery has the lock release lever. When removing the connector, pull out the connector while pressing the lock release lever.

3) Battery cable removal

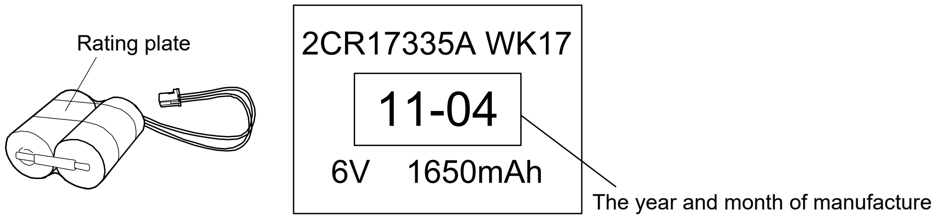
⚠CAUTION

- ●Pulling out the connector of the MR-BT6V1CBL and the MR-BT6V2CBL without the lock release lever pressed may damage the CN4 connector of the servo amplifier or the connector of the MR-BT6V1CBL or MR-BT6V2CBL.



11.8.5 MR-BAT6V1 battery

The MR-BAT6V1 battery is a lithium primary battery for replacing MR-BAT6V1SET and a battery built-in MR-BT6VCASE.
Store the MR-BAT6V1 in the case to use.
The year and month of manufacture of MR-BAT6V1 battery have been described to the rating plate put on a MR-BAT6V1 battery.



Item		Description
Battery pack		2CR17335A (CR17335A × 2 pcs. in series)
Nominal voltage	[V]	6
Nominal capacity	[mAh]	1650
Storage temperature	[°C]	0 to 55
Operating temperature	[°C]	0 to 55
Lithium content	[g]	1.2
Mercury content		Less than 1 ppm
Dangerous goods class		Not subject to the dangerous goods (Class 9) Refer to app. 2 for details.
Operating humidity and storage humidity		5 %RH to 90 %RH (non-condensing)
(Note) Battery life		5 years from date of manufacture
Mass	[g]	34

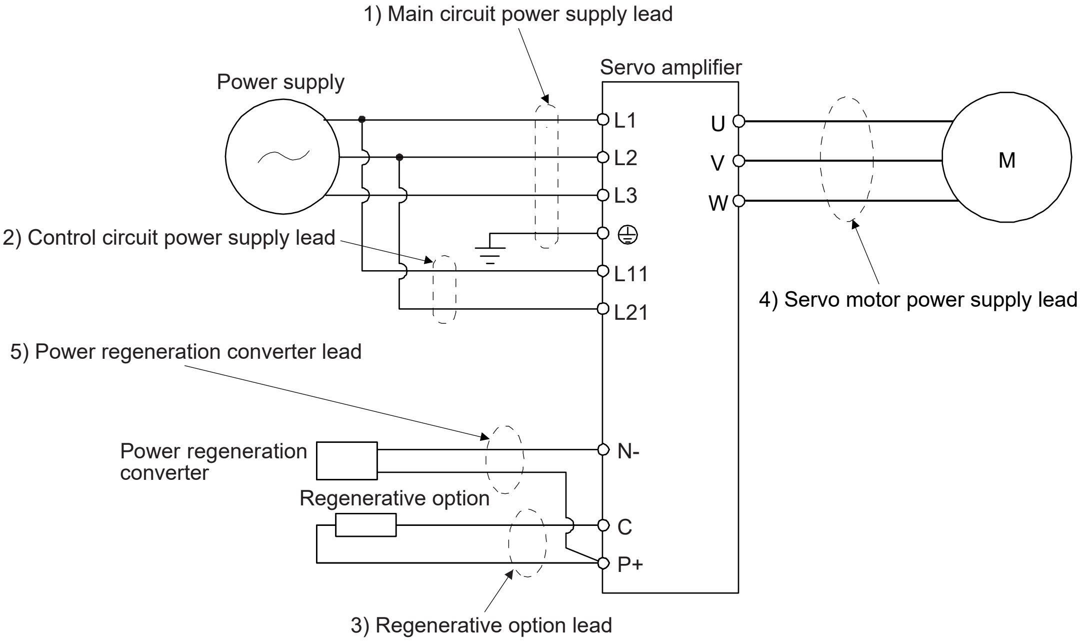
Note. Quality of the batteries degrades by the storage condition. The battery life is 5 years from the production date regardless of the connection status.

11.9 Selection example of wires

POINT

- Refer to section 11.1.3 for SSCNET III cable.
- To comply with the IEC/EN/UL/CSA standard, use the wires shown in app. 4 for wiring. To comply with other standards, use a wire that is complied with each standard.
- For the selection example when the MR-J4-_B-RJ servo amplifier is used with the DC power supply input, refer to app. 15.3.
- Selection conditions of wire size are as follows.
  Construction condition: Single wire set in midair
  Wire length: 30 m or less

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



(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.

(a) 200 V class

Table 11.1 Wire size selection example (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-J4-10B(-RJ)	2 (AWG 14)	1.25 to 2 (AWG 16 to 14) (Note 4)	2 (AWG 14)	AWG 18 to 14 (Note 4)
MR-J4-20B(-RJ)				
MR-J4-40B(-RJ)				
MR-J4-60B(-RJ)				
MR-J4-70B(-RJ)				
MR-J4-100B(-RJ)				
MR-J4-200B(-RJ) (3-phase power supply input)				AWG 16 to 10
MR-J4-200B(-RJ) (1-phase power supply input) MR-J4-350B(-RJ)	3.5 (AWG 12)			
MR-J4-500B(-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-J4-700B(-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-J4-11KB(-RJ) (Note 2)	14 (AWG 6): f	1.25 (AWG 16): c 2 (AWG 14): c (Note 4)	3.5 (AWG 12): g	14 (AWG 6): f 5.5 (AWG 10): g (Note 5) 8 (AWG 8): k
MR-J4-15KB(-RJ) (Note 2)	22 (AWG 4): h		5.5 (AWG 10): g	22 (AWG 4): h 8 (AWG 8): k (Note 5)
MR-J4-22KB(-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 mm^2 when corresponding to IEC/EN/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 regeneration converter (FR-RC).

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

(b) 400 V class

Table 11.2 Wire size selection example (HIV wire)

Servo amplifier	Wires [mm^2] (Note 1)			
	1) L1/L2/L3/⏚	2) L11/L21	3) P+/C	4) U/V/W/⏚ (Note 3)
MR-J4-60B4(-RJ)/ MR-J4-100B4(-RJ)	2 (AWG 14)	1.25 to 2 (AWG 16 to 14) (Note 4)	2 (AWG 14)	AWG 16 to 14
MR-J4-200B4(-RJ)				
MR-J4-350B4(-RJ)				
MR-J4-500B4(-RJ) (Note 2)	2 (AWG 14): b	1.25 (AWG 16): a 2 (AWG 14): c (Note 4)	2 (AWG 14): b	3.5 (AWG 12): a
MR-J4-700B4(-RJ) (Note 2)	3.5 (AWG 12): a			5.5 (AWG 10): a
MR-J4-11KB4(-RJ) (Note 2)	5.5 (AWG 10): d	1.25 (AWG 16): b 2 (AWG 14): b (Note 4)	2 (AWG 14): f	8 (AWG 8): g
MR-J4-15KB4(-RJ) (Note 2)	8 (AWG 8): g		3.5 (AWG 12): d	
MR-J4-22KB4(-RJ) (Note 2)	14 (AWG 6): i		3.5 (AWG 12): e	5.5 (AWG 10): e (Note 5) 8 (AWG 8): h (Note 6) 14 (AWG 6): 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 mm^2 when corresponding to IEC/EN/UL/CSA standard.
5. This is for connecting to the linear servo motor with natural cooling method.
6. This is for connecting to the linear servo motor with liquid cooling method.

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

Model	Wire [mm^2]
FR-RC-H15K	14 (AWG 6)
FR-RC-H30K	
FR-RC-H55K	

(c) 100 V class

Table 11.3 Wire size selection example (HIV wire)

Servo amplifier	Wires [mm^2]			
	1) L1/L2/⏚	2) L11/L21	3) P+/C	4) U/V/W/⏚ (Note 1)
MR-J4-10B1(-RJ)	2 (AWG 14)	1.25 to 2 (AWG 16 to 14) (Note 2)	2 (AWG 14)	AWG 18 to 14 (Note 2)
MR-J4-20B1(-RJ)				
MR-J4-40B1(-RJ)				

Note
1. 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.
2. Be sure to use the size of 2 mm^2 when corresponding to IEC/EN/UL/CSA standard.

(2) Selection example of crimp terminals

(a) 200 V class

Symbol	Servo amplifier-side crimp terminals				
	(Note 2) Crimp terminal	Applicable tool			Manufacturer
		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.

2. Some crimp terminals may not be mounted depending on the size. Make sure to use the recommended ones or equivalent ones.

(b) 400 V class

Symbol	Servo amplifier-side crimp terminals				Manufacturer
	Crimp terminal (Note)	Applicable tool			
		Body	Head	Dice	
a	FVD5.5-4	YNT-1210S			JST
b	FVD2-4	YNT-1614			
c	FVD2-M3				
d	FVD5.5-6	YNT-1210S			
e	FVD5.5-8	YNT-1210S			
f	FVD2-6	YNT-1614			
g	FVD8-6	YF-1	YNE-38	DH-121/DH-111	
h	FVD8-8				
i	FVD14-8			DH-122/DH-112	

Note. 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

⚠CAUTION

- ●To prevent the servo amplifier from smoke and a fire, select a molded-case circuit breaker which shuts off with high speed.
- ●Always use one molded-case circuit breaker and one magnetic contactor with one servo amplifier.

POINT

- ●For the selection when the MR-J4-_B-RJ servo amplifier is used with the DC power supply input, refer to app. 15.4.

(1) For main circuit power supply

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]	
	Power factor improving reactor is not used	Power factor improving reactor is used					
MR-J4-10B(-RJ)	30 A frame 5 A	30 A frame 5 A	240	T	10	300	S-N10 S-T10
MR-J4-20B(-RJ)	30 A frame 5 A	30 A frame 5 A					
MR-J4-40B(-RJ)	30 A frame 10 A	30 A frame 5 A			15		
MR-J4-60B(-RJ)	30 A frame 15 A	30 A frame 10 A			20		
MR-J4-70B(-RJ)	30 A frame 15 A	30 A frame 10 A					
MR-J4-100B(-RJ) (3-phase power supply input)	30 A frame 15 A	30 A frame 10 A					
MR-J4-100B(-RJ) (1-phase power supply input)	30 A frame 15 A	30 A frame 15 A			30		
MR-J4-200B(-RJ)	30 A frame 20 A	30 A frame 20 A			40		S-N20 (Note 3) S-T21
MR-J4-350B(-RJ)	30 A frame 30 A	30 A frame 30 A			70		S-N20 S-T21
MR-J4-500B(-RJ)	50 A frame 50 A	50 A frame 50 A			125		S-N35 S-T35
MR-J4-700B(-RJ)	100 A frame 75 A	60 A frame 60 A			150		S-N50 S-T50
MR-J4-11KB(-RJ)	100 A frame 100 A	100 A frame 100 A			200		
MR-J4-15KB(-RJ)	125 A frame 125 A	125 A frame 125 A			250		S-N65 S-T65
MR-J4-22KB(-RJ)	225 A frame 175 A	225 A frame 175 A			350		S-N95 S-T100
MR-J4-60B4(-RJ)	30 A frame 5 A	30 A frame 5 A	480	T	10	600	S-N10 S-T10
MR-J4-100B4(-RJ)	30 A frame 10 A	30 A frame 5 A			15		
MR-J4-200B4(-RJ)	30 A frame 15 A	30 A frame 10 A			25		
MR-J4-350B4(-RJ)	30 A frame 20 A	30 A frame 15 A			35		S-N20 (Note 3) S-T21
MR-J4-500B4(-RJ)	30 A frame 20 A	30 A frame 20 A			50		
MR-J4-700B4(-RJ)	30 A frame 30 A	30 A frame 30 A			65		S-N20 S-T21
MR-J4-11KB4(-RJ)	50 A frame 50 A	50 A frame 50 A			100		S-N25 S-T35
MR-J4-15KB4(-RJ)	60 A frame 60 A	60 A frame 60 A			150		S-N35 S-T35
MR-J4-22KB4(-RJ)	100 A frame 100 A	100 A frame 100 A			175		S-N50 S-T50
MR-J4-10B1(-RJ)	30 A frame 5 A	30 A frame 5 A	240	T	10	300	S-N10 S-T10
MR-J4-20B1(-RJ)	30 A frame 10 A	30 A frame 10 A			15		
MR-J4-40B1(-RJ)	30 A frame 15 A	30 A frame 10 A			20		

Note 1. When having the servo amplifier comply with the IEC/EN/UL/CSA standard, refer to app. 4.

2. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less.

3. S-N18 can be used when auxiliary contact is not required.

The Type E Combination motor controller can also be used instead of a molded-case circuit breaker.

Servo amplifier	Rated input voltage AC [V]	Input phase	Type E Combination motor controller			SCCR [kA]
			Model	Rated voltage AC [V]	Rated current [A] (Heater design)	
MR-J4-10B(-RJ)	200 to 240	3-phase	MMP-T32	240	1.6	50
MR-J4-20B(-RJ)					2.5	
MR-J4-40B(-RJ)					4	
MR-J4-60B(-RJ)					6.3	
MR-J4-70B(-RJ)					6.3	
MR-J4-100B(-RJ)					8	
MR-J4-200B(-RJ)					18	
MR-J4-350B(-RJ)					25	25
MR-J4-500B(-RJ)					32	
MR-J4-60B4(-RJ)	380 to 480	3-phase		480Y/277	2.5	50
MR-J4-100B4(-RJ)					4	
MR-J4-200B4(-RJ)					8	
MR-J4-350B4(-RJ)					13	
MR-J4-500B4(-RJ)					18	
MR-J4-700B4(-RJ)					25	25

(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-J4-10B(-RJ)	30 A frame 5 A	240	1	300	1	250
MR-J4-20B(-RJ)						
MR-J4-40B(-RJ)						
MR-J4-60B(-RJ)						
MR-J4-70B(-RJ)						
MR-J4-100B(-RJ)						
MR-J4-200B(-RJ)						
MR-J4-350B(-RJ)						
MR-J4-500B(-RJ)						
MR-J4-700B(-RJ)						
MR-J4-11KB(-RJ)						
MR-J4-15KB(-RJ)						
MR-J4-22KB(-RJ)						
MR-J4-60B4(-RJ)	30 A frame 5 A	480	1	600	1	600
MR-J4-100B4(-RJ)						
MR-J4-200B4(-RJ)						
MR-J4-350B4(-RJ)						
MR-J4-500B4(-RJ)						
MR-J4-700B4(-RJ)						
MR-J4-11KB4(-RJ)						
MR-J4-15KB4(-RJ)						
MR-J4-22KB4(-RJ)						
MR-J4-10B1(-RJ)	30 A frame 5 A	240	1	300	1	250
MR-J4-20B1(-RJ)						
MR-J4-40B1(-RJ)						

Note. When having the servo amplifier comply with the IEC/EN/UL/CSA standard, refer to app. 4.

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 about 85%.
- As compared to the power factor improving AC reactor (FR-HAL-(H)), 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.

(1) 200 V class

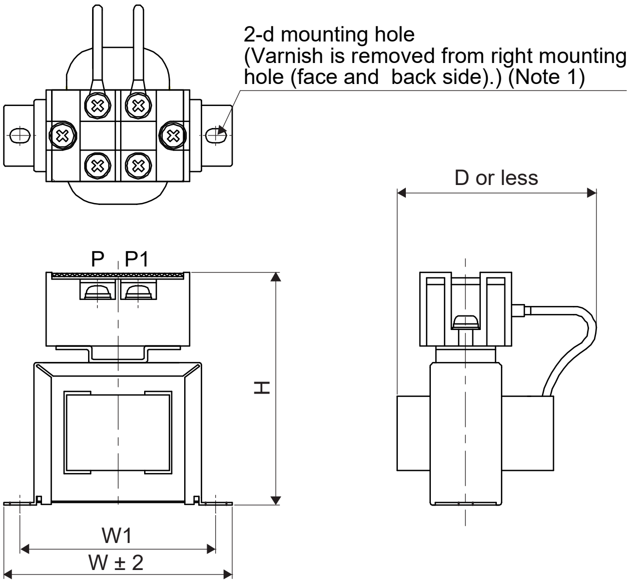


Fig. 11.1

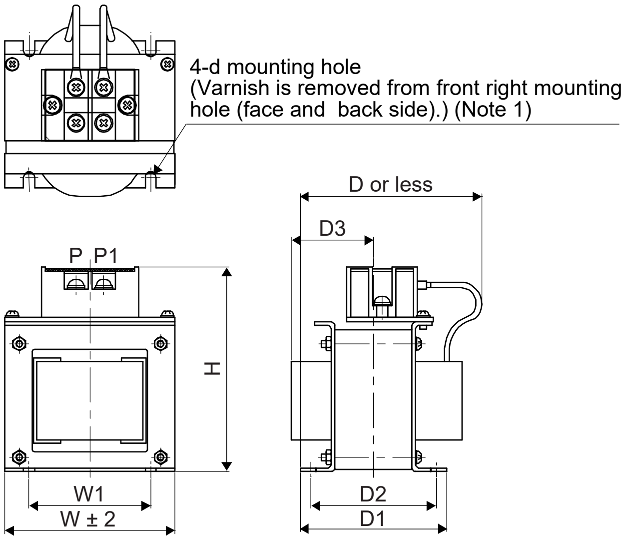


Fig. 11.2

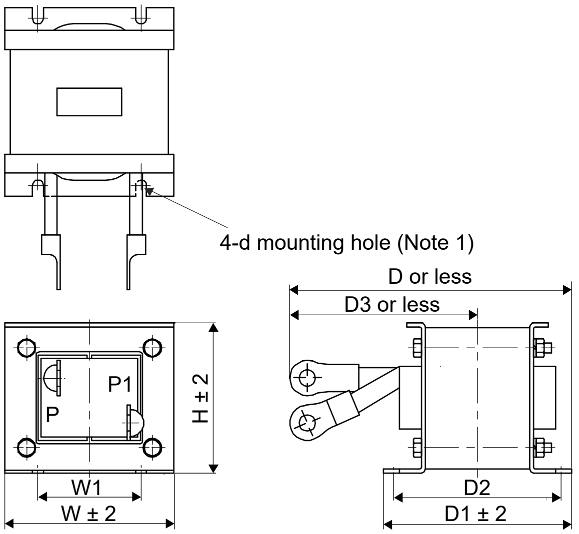
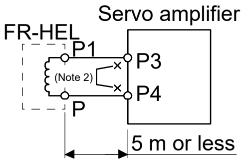


Fig. 11.3



Note 1. Use this for grounding.

2. When using the power factor improving DC reactor, remove the short bar across P3 and P4.

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-J4-10B(-RJ) MR-J4-20B(-RJ)	FR-HEL-0.4K	Fig. 11.1	70	60	71	61		21		M4	M4	0.4	2 (AWG 14)
MR-J4-40B(-RJ)	FR-HEL-0.75K		85	74	81	61		21		M4	M4	0.5	
MR-J4-60B(-RJ) MR-J4-70B(-RJ)	FR-HEL-1.5K		85	74	81	70		30		M4	M4	0.8	
MR-J4-100B(-RJ)	FR-HEL-2.2K		85	74	81	70		30		M4	M4	0.9	
MR-J4-200B(-RJ)	FR-HEL-3.7K	Fig. 11.2	77	55	92	82	66	57	37	M4	M4	1.5	
MR-J4-350B(-RJ)	FR-HEL-7.5K		86	60	113	98	81	72	43	M4	M5	2.5	3.5 (AWG 12)
MR-J4-500B(-RJ)	FR-HEL-11K		105	64	133	112	92	79	47	M6	M6	3.3	5.5 (AWG 10)
MR-J4-700B(-RJ)	FR-HEL-15K		105	64	133	115	97	84	48.5	M6	M6	4.1	8 (AWG 8)
MR-J4-11KB(-RJ)	FR-HEL-15K		105	64	133	115	97	84	48.5	M6	M6	4.1	14 (AWG 6)
MR-J4-15KB(-RJ)	FR-HEL-22K	Fig. 11.3	105	64	93	175	117	104	115 (Note 1)	M6	M10	5.6	22 (AWG 4)
MR-J4-22KB(-RJ)	FR-HEL-30K		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 are as follows.
600 V grade heat-resistant polyvinyl chloride insulated wire (HIV wire)
Construction condition: Single wire set in midair

(2) 400 V class

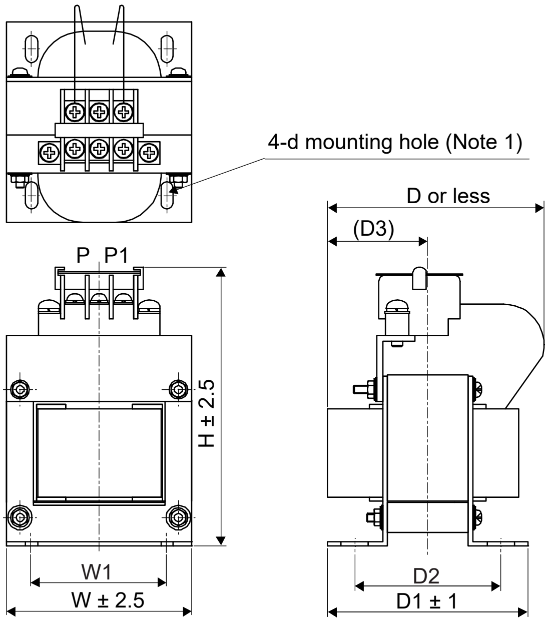


Fig. 11.4

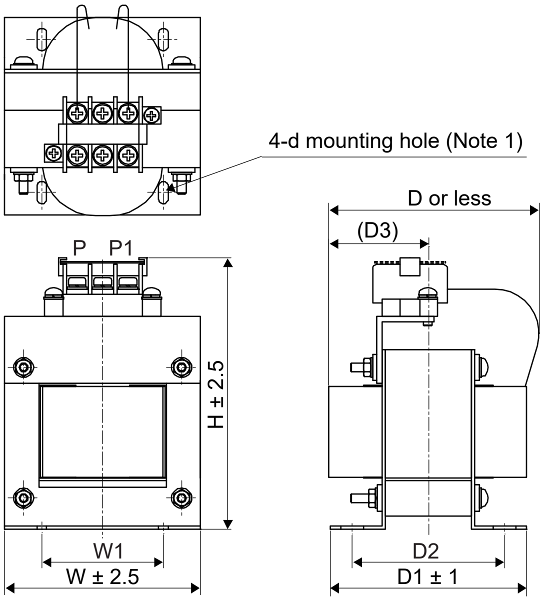
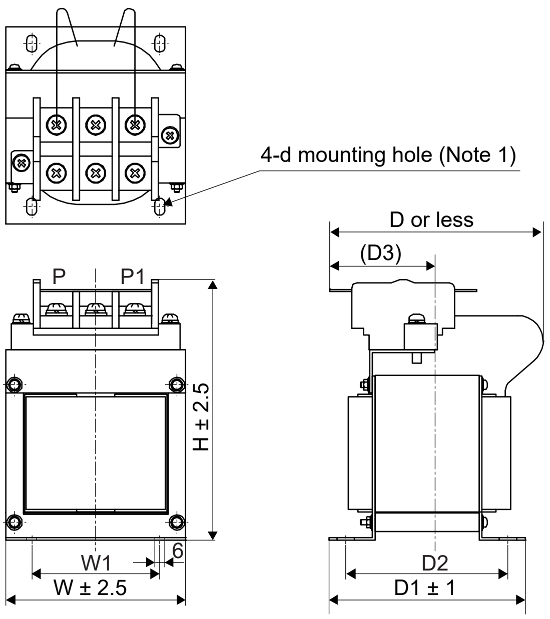


Fig. 11.5



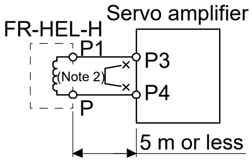


Fig. 11.6

Note 1. Use this for grounding.
2. When using the power factor improving DC reactor, remove the short bar across P3 and P4.

Servo amplifier	Power factor improving DC reactor	Dimensions	Dimensions [mm]								Terminal size	Mass [kg]	Wire [mm^2] (Note)
			W	W1	H	D	D1	D2	D3	d			
MR-J4-60B4(-RJ)	FR-HEL-H1.5K	Fig. 11.4	66	50	100	80	74	54	37	M4	M3.5	1.0	2 (AWG 14)
MR-J4-100B4(-RJ)	FR-HEL-H2.2K		76	50	110	80	74	54	37	M4	M3.5	1.3	2 (AWG 14)
MR-J4-200B4(-RJ)	FR-HEL-H3.7K	Fig. 11.5	86	55	120	95	89	69	45	M4	M4	2.3	2 (AWG 14)
MR-J4-350B4(-RJ)	FR-HEL-H7.5K		96	60	128	105	100	80	50	M5	M4	3.5	2 (AWG 14)
MR-J4-500B4(-RJ)	FR-HEL-H11K		105	75	137	110	105	85	53	M5	M5	4.5	3.5 (AWG 12)
MR-J4-700B4(-RJ)	FR-HEL-H15K	Fig. 11.6	105	75	152	125	115	95	62	M5	M6	5.0	5.5 (AWG 10)
MR-J4-11KB4(-RJ)													8 (AWG 8)
MR-J4-15KB4(-RJ)	FR-HEL-H22K		133	90	178	120	95	75	53	M5	M6	6.0	8 (AWG 8)
MR-J4-22KB4(-RJ)	FR-HEL-H30K		133	90	178	120	100	80	56	M5	M6	6.5	14 (AWG 6)

Note. Selection conditions of wire size are as follows.
Wire type: 600 V grade heat-resistant polyvinyl chloride insulated wire (HIV wire)
Construction condition: Single wire set in midair

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 about 80%.

When using power factor improving reactors for two servo amplifiers or more, be sure to connect a power factor improving reactor to each servo amplifier. If using only one power factor improving reactor, enough improvement effect of phase factor cannot be obtained unless all servo amplifiers are operated.

(1) 200 V class/100 V class

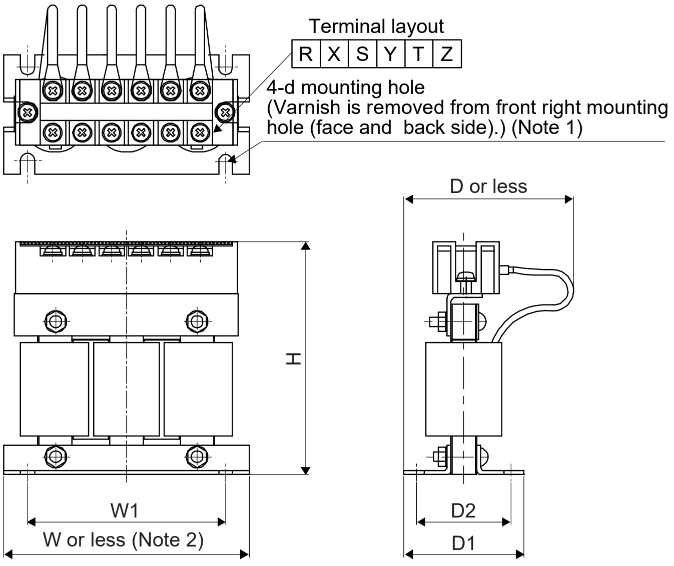
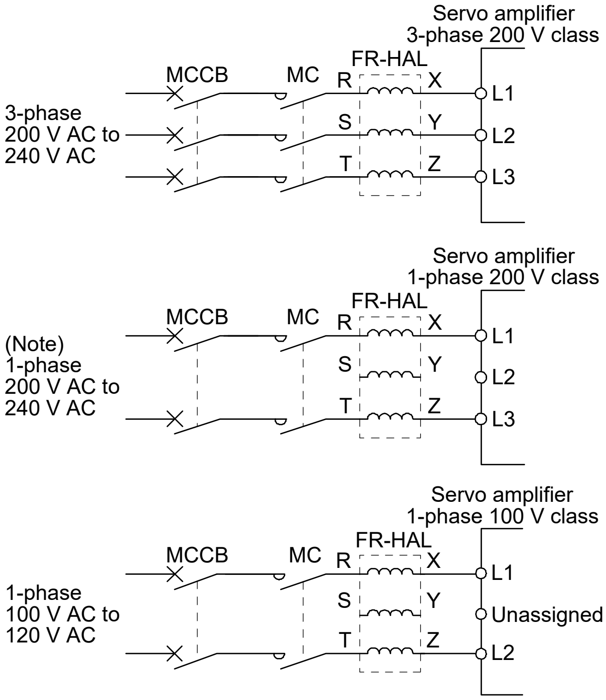


Fig. 11.7

Note 1. Use this for grounding.
2. W ± 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.

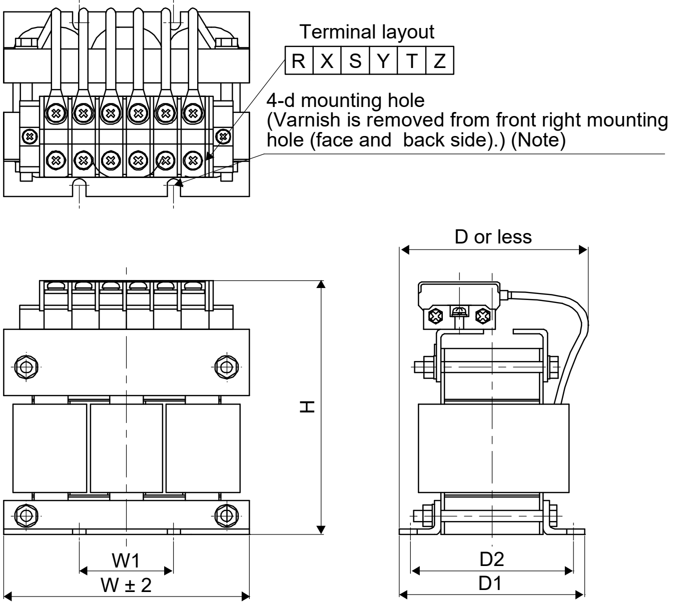


Fig. 11.8

Note. Use this for grounding.

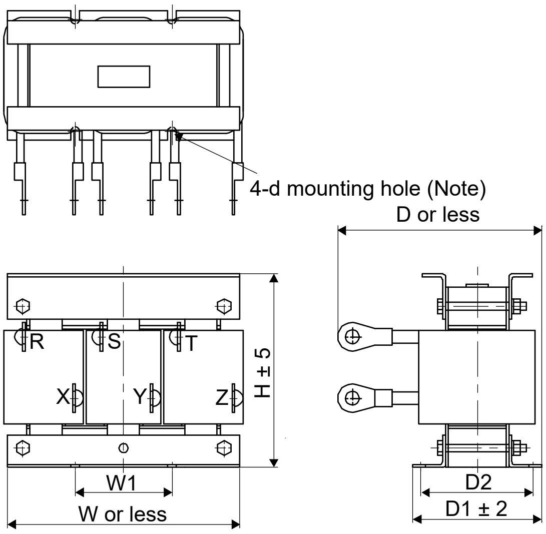


Fig. 11.9

Note. Use this for grounding.

Servo amplifier	Power factor improving AC reactor	Dimensions	Dimensions [mm]							Terminal size	Mass [kg]
			W	W1	H	D (Note)	D1	D2	d		
MR-J4-10B(-RJ) MR-J4-20B(-RJ)	FR-HAL-0.4K	Fig. 11.7	104	84	99	72	51	40	M5	M4	0.6
MR-J4-40B(-RJ) MR-J4-10B1(-RJ)	FR-HAL-0.75K		104	84	99	74	56	44	M5	M4	0.8
MR-J4-60B(-RJ) MR-J4-70B(-RJ) MR-J4-20B1(-RJ)	FR-HAL-1.5K		104	84	99	77	61	50	M5	M4	1.1
MR-J4-100B(-RJ) (3-phase power supply input) MR-J4-40B1(-RJ)	FR-HAL-2.2K		115 (Note)	40	115	77	71	57	M6	M4	1.5
MR-J4-100B(-RJ) (1-phase power supply input) MR-J4-200B(-RJ) (3-phase power supply input)	FR-HAL-3.7K		115 (Note)	40	115	83	81	67	M6	M4	2.2
MR-J4-200B(-RJ) (1-phase power supply input)	FR-HAL-5.5K		115 (Note)	40	115	83	81	67	M6	M4	2.3
MR-J4-350B(-RJ)	FR-HAL-7.5K	Fig. 11.8	130	50	135	100	98	86	M6	M5	4.2
MR-J4-500B(-RJ)	FR-HAL-11K		160	75	164	111	109	92	M6	M6	5.2
MR-J4-700B(-RJ)	FR-HAL-15K		160	75	167	126	124	107	M6	M6	7.0
MR-J4-11KB(-RJ)	FR-HAL-15K		160	75	167	126	124	107	M6	M6	7.0
MR-J4-15KB(-RJ)	FR-HAL-22K		185 (Note)	75	150	158	100	87	M6	M8	9.0
MR-J4-22KB(-RJ)	FR-HAL-30K	Fig. 11.9	185 (Note)	75	150	168	100	87	M6	M10	9.7

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

(2) 400 V class

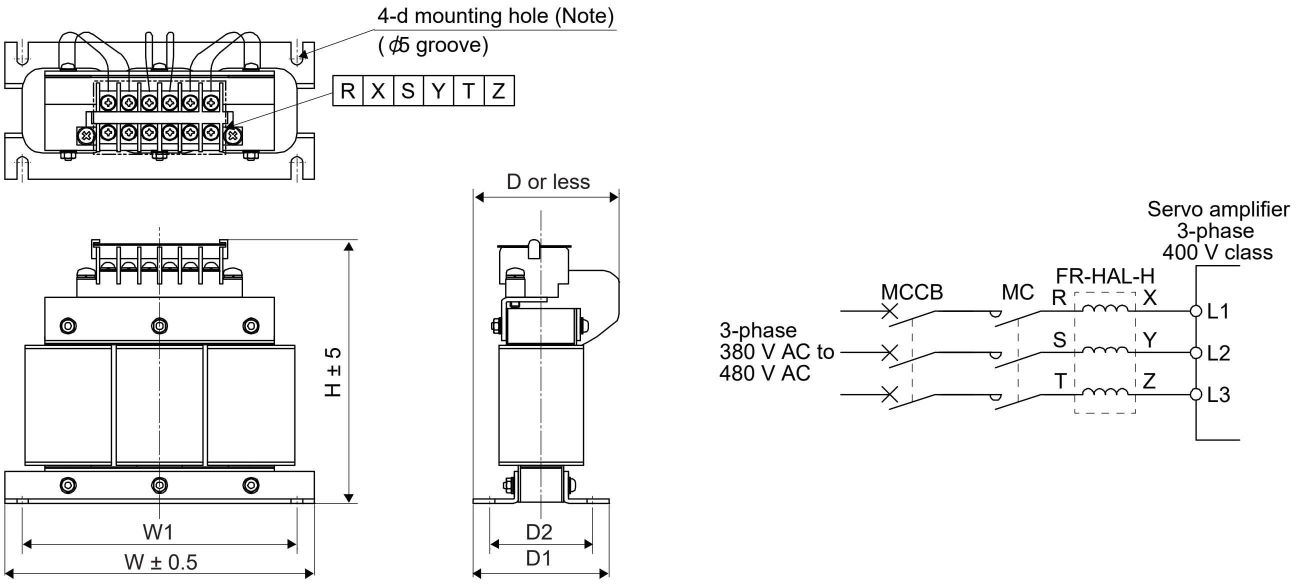


Fig. 11.10

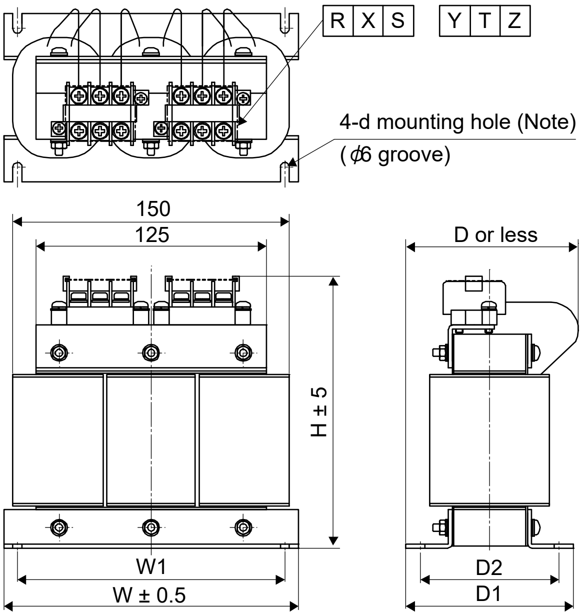


Fig. 11.11

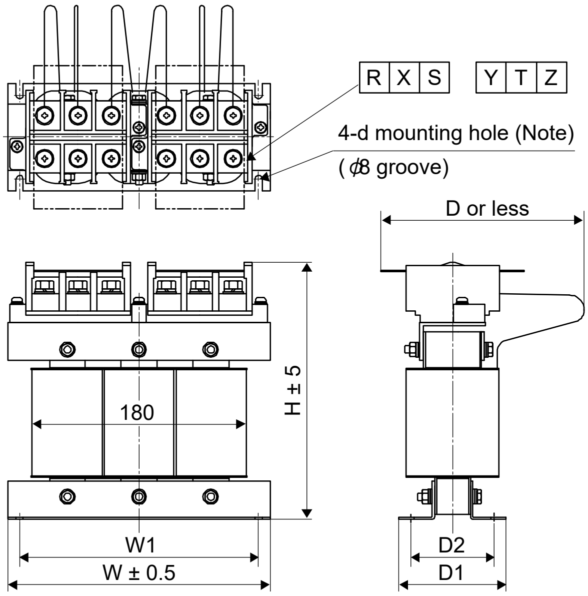


Fig. 11.12

Note. Use this for grounding.

Servo amplifier	Power factor improving AC reactor	Dimensions	Dimensions [mm]							Terminal size	Mass [kg]
			W	W1	H	D (Note)	D1	D2	d		
MR-J4-60B4(-RJ)	FR-HAL-H1.5K	Fig. 11.10	135	120	115	59	59.6	45	M4	M3.5	1.5
MR-J4-100B4(-RJ)	FR-HAL-H2.2K		135	120	115	59	59.6	45	M4	M3.5	1.5
MR-J4-200B4(-RJ)	FR-HAL-H3.7K		135	120	115	69	70.6	57	M4	M3.5	2.5
MR-J4-350B4(-RJ)	FR-HAL-H7.5K	Fig. 11.11	160	145	142	91	91	75	M4	M4	5.0
MR-J4-500B4(-RJ)	FR-HAL-H11K		160	145	146	91	91	75	M4	M5	6.0
MR-J4-700B4(-RJ) MR-J4-11KB4(-RJ)	FR-HAL-H15K		220	200	195	105	90	70	M5	M5	9.0
MR-J4-15KB4(-RJ)	FR-HAL-H22K	Fig. 11.12	220	200	215	170	90	70	M5	M8	9.5
MR-J4-22KB4(-RJ)	FR-HAL-H30K		220	200	215	170	96	75	M5	M8	11

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

11.13 Relay (recommended)

The following relays should be used with the interfaces

Interface	Selection example
Digital input (interface DI-1) Relay used for digital input command signals	To prevent defective contacts, use a relay for small signal (twin contacts). (Ex.) Omron : type G2A, 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

11.14 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 equipment to malfunction. Since the servo amplifier is an electronic device which handles small signals, the following general noise reduction techniques are required. Also, the servo amplifier can be a source of noise as its outputs are chopped by high carrier frequencies. If peripheral equipment malfunctions 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.)

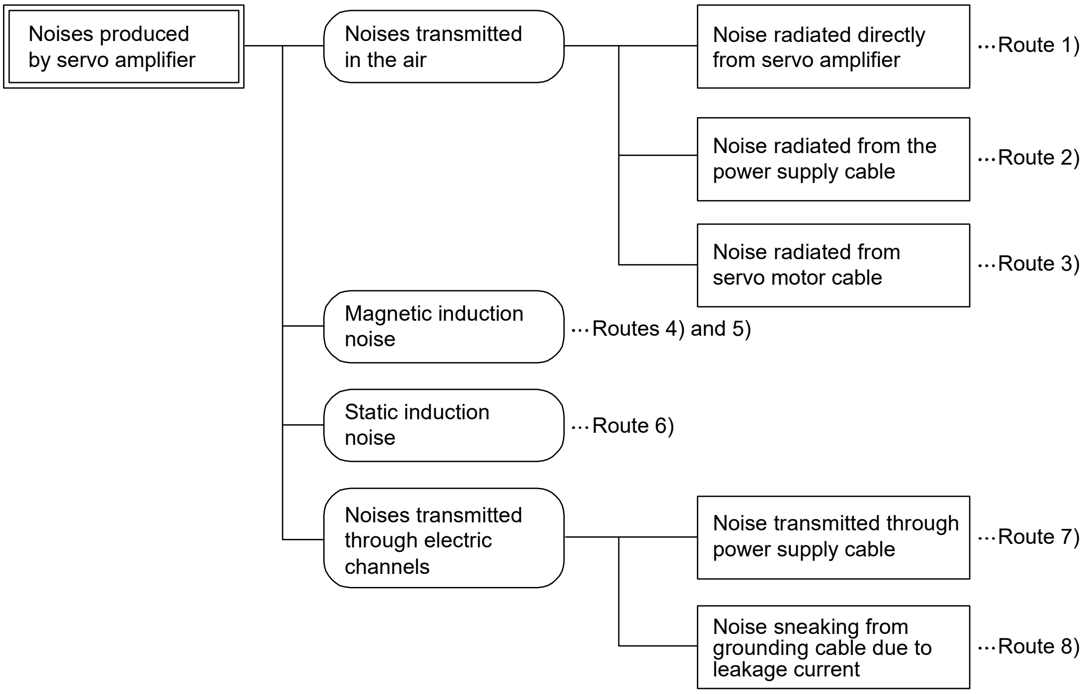
(b) Reduction techniques for external noises that cause the servo amplifier to malfunction

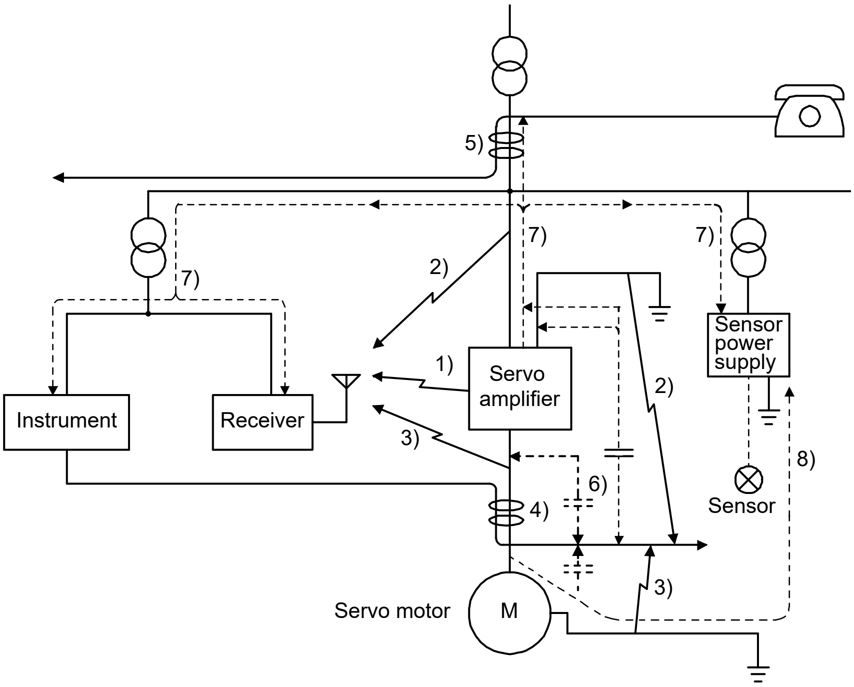
If there are noise sources (such as a magnetic contactor, an electromagnetic brake, and many relays which make a large amount of noise) near the servo amplifier and the servo amplifier may malfunction, the following countermeasures are required.

- 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 equipment to malfunction

Noises produced by the servo amplifier are classified into those radiated from the cables connected to the servo amplifier and its main circuits (input and output circuits), those induced electromagnetically or statically by the signal cables of the peripheral equipment located near the main circuit cables, and those transmitted through the power supply cables.





Noise transmission route	Suppression techniques
1) 2) 3)	When measuring instruments, receivers, sensors, etc. which handle weak signals and may malfunction due to noise and/or their signal cables are contained in a cabinet together with the servo amplifier or run near the servo amplifier, such devices may malfunction due to noises transmitted through the air. The following techniques are required. 1. Provide maximum clearance between easily affected devices and the servo amplifier. 2. Provide maximum clearance between easily affected signal cables and the I/O cables of the servo amplifier. 3. Avoid wiring the power lines (input/output lines of the servo amplifier) and signal lines side by side or bundling them together. 4. Insert a line noise filter to the I/O cables or a radio noise filter on the input line. 5. Use shielded wires for the signal and power lines, or put the lines in separate metal conduits.
4) 5) 6)	When the power lines and the signal lines are laid side by side or bundled together, magnetic induction noise and static induction noise will be transmitted through the signal cables and malfunction may occur. The following techniques are required. 1. Provide maximum clearance between easily affected devices and the servo amplifier. 2. Provide maximum clearance between easily affected signal cables and the I/O cables of the servo amplifier. 3. Avoid wiring the power lines (input/output lines of the servo amplifier) and signal lines side by side or bundling them together. 4. Use shielded wires for the signal and power lines, or put the lines in separate metal conduits.
7)	When the power supply of peripheral equipment is connected to the power supply of the servo amplifier system, noises produced by the servo amplifier may be transmitted back through the power supply cable and the devices may malfunction. The following techniques are required. 1. Install the radio noise filter (FR-BIF(-H)) 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)	If the grounding wires of the peripheral equipment and the servo amplifier make a closed loop circuit, leakage current may flow through, causing the equipment to malfunction. In this case, the malfunction may be prevented by the grounding wires disconnected from the equipment.

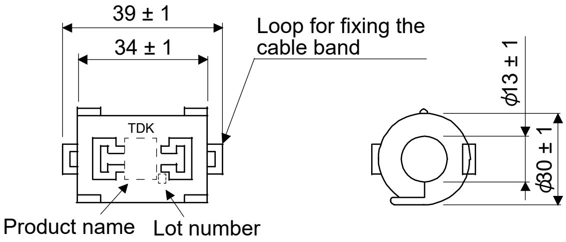
(2) Noise reduction techniques

(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 TOKIN, GRFC-13 by Kitagawa Industries, and E04SRM563218 by SEIWA ELECTRIC are available as data line filters.
As a reference example, the impedance specifications of the ZCAT3035-1330 (TDK) are indicated below. These impedances are reference values and not guaranteed values.

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

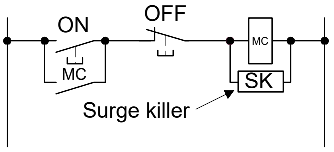
[Unit: mm]

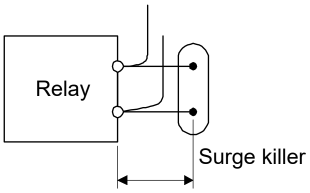


Outline drawing (ZCAT3035-1330)

(b) Surge killer (recommended)

Use of a surge killer is recommended for AC relay, magnetic contactor or the like near the servo amplifier. Use the following surge killer or equivalent.

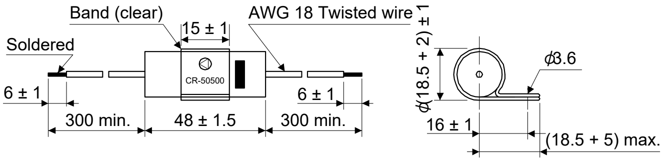




This distance should be short (within 20 cm).

(Ex.) CR-50500 Okaya Electric Industries)

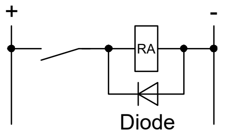
Rated voltage AC [V]	C [μF ± 20%]	R [Ω ± 30%]	Test voltage
250	0.5	50 (1/2 W)	Between terminals: 625 V AC, 50 Hz/60 Hz 60 s Between terminal and case: 2000 V AC 50/60 Hz 60 s

Dimensions [Unit: mm]


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

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

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



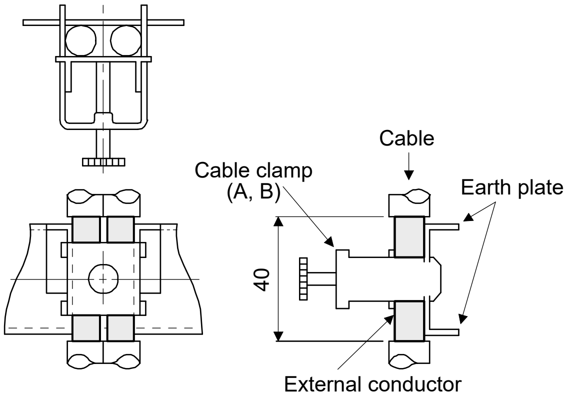
(c) Cable clamp fitting AERSBAN-_SET

Generally, connecting the grounding of the shielded wire to the SD terminal of the connector provides a sufficient effect. However, the effect can be increased when the shielded wire is connected directly to the grounding plate as shown below.

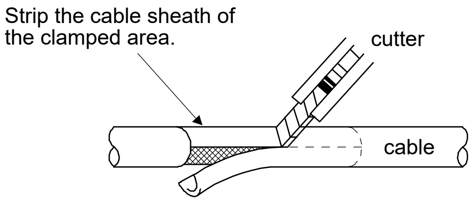
Install the grounding plate near the servo amplifier for the encoder cable. Peel part of the cable sheath to expose the external conductor, and press that part against the grounding plate with the cable clamp. If the cable is thin, clamp several cables in a bunch.

The cable clamp comes as a set with the grounding plate.

[Unit: mm]



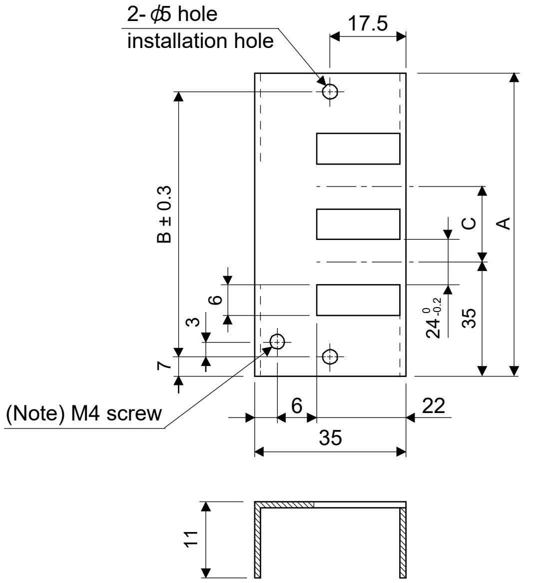
Clamp section diagram



· Dimensions

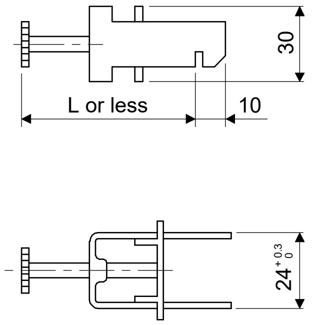
[Unit: mm]

Earth plate



[Unit: mm]

Clamp section diagram



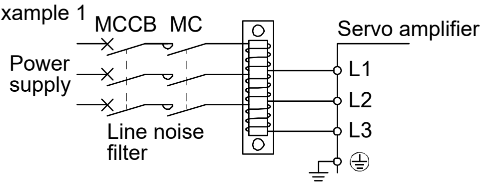
Note. Screw hole for grounding. Connect it to the grounding plate of the cabinet.

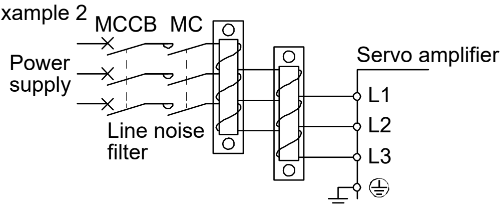
Model	A	B	C	Accessory fittings
AERSBAN-DSET	100	86	30	Clamp A: 2pcs.
AERSBAN-ESET	70	56		Clamp B: 1pc.

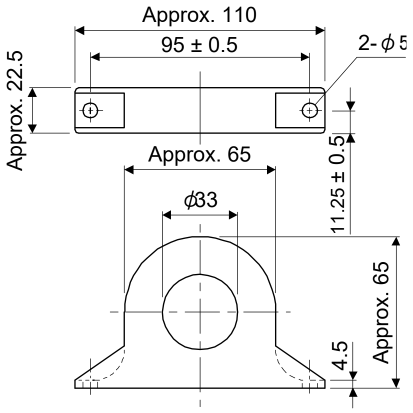
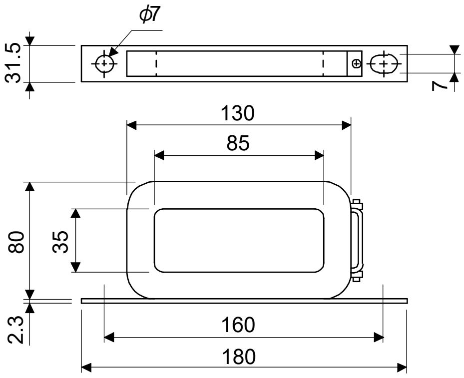
Clamp fitting	L
A	70
B	45

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

<table>
<tr><th>Connection diagram</th><th>Dimensions [Unit: mm]</th></tr>
<tr><td rowspan="2">The line noise filters can be mounted on lines of the main power supply (L1/L2/L3) and of the servo motor power (U/V/W). Pass each of the wires through the line noise filter an equal number of times in the same direction. For wires of 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. Otherwise, the effect of the filter will drop.
Wind the wires by passing through the filter to satisfy the required number of passes as shown in Example 1. If the wires are too thick to wind, use two or more filters to have the required number of passes as shown in Example 2.
Place the line noise filters as close to the servo amplifier as possible for their best performance.
Example 1


(Number of passes: 4)
Example 2


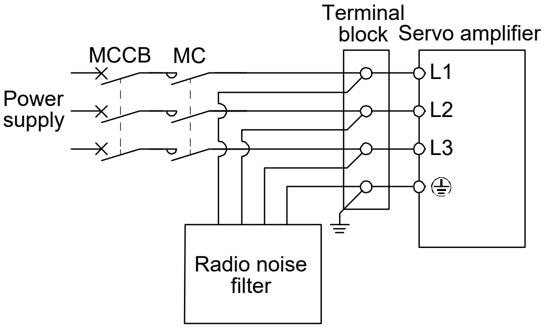
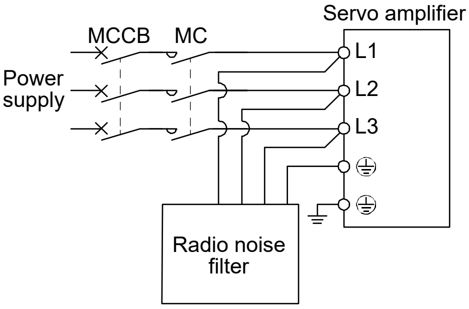
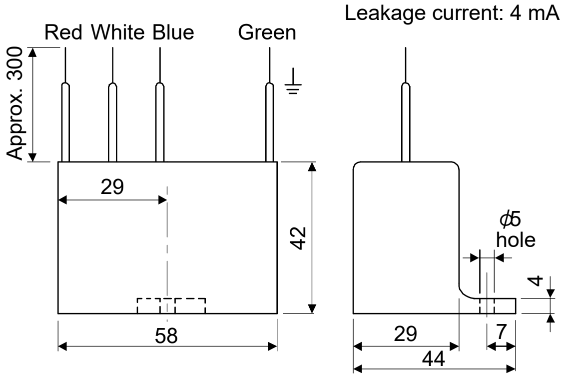
Two filters are used
(Total number of passes: 4)</td><td>FR-BSF01 (for wire size 3.5 mm^2 (AWG 12) or less)

 </td></tr>
<tr><td>FR-BLF (for wire size 5.5 mm^2 (AWG 10) or more)

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

(e) Radio noise filter (FR-BIF(-H))

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/100 V class: FR-BIF

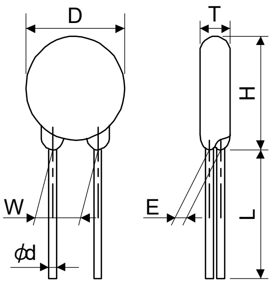
400 V class: FR-BIF-H

Connection diagram	Dimensions [Unit: mm]
Make the connection cables as short as possible. Grounding is always required. When using the FR-BIF with a single-phase power supply, always insulate the lead wires that are not used for wiring. ・MR-J4-350B(-RJ) or less/MR-J4-350B4(-RJ) or less/MR-J4-40B1(-RJ) or less  ・MR-J4-500B(-RJ) or less/MR-J4-500B4(-RJ) or less  	

(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, TND20V-471K and TND20V-102K, manufactured by NIPPON CHEMI-CON, are recommended. For detailed specification and usage of the varistors, refer to the manufacturer catalog.

Power supply voltage	Varistor	Maximum rating					Maximum limit voltage		Static capacity (reference value)	Varistor voltage rating (range) V1 mA
		Permissible circuit voltage		Surge current immunity	Energy immunity	Rated pulse power	[A]	[V]		
		AC [Vrms]	DC [V]	8/20 μs [A]	2 ms [J]	[W]			[pF]	[V]
200 V class/ 100 V class	TND20V-431K	275	350	10000/1 times 7000/2 times	195	1.0	100	710	1300	430 (387 to 473)
	TND20V-471K	300	385		215			775	1200	470 (423 to 517)
400 V class	TND20V-102K	625	825	7500/1 time 6500/2 times	400	1.0	100	1650	560	1000 (900 to 1100)



[Unit: mm]

Model	D Max.	H Max.	T Max.	E ±1.0	L Min. (Note)	φd ±0.05	W ±1.0
TND20V-431K	21.5	24.5	6.4	3.3	20	0.8	10.0
TND20V-471K			6.6	3.5			
TND20V-102K	22.5	25.5	9.5	6.4	20	0.8	10.0

Note. For special purpose items for lead length (L), contact the manufacturer.

11.15 Earth-leakage current breaker

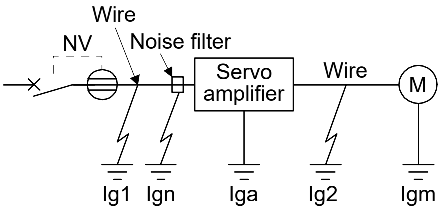
(1) Selection method

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 wires as short as possible, and keep a distance of 30 cm or longer between the wires and ground.

Rated sensitivity current $\geq 10 \cdot \{Ig1 + Ign + Iga + K \cdot (Ig2 + Igm)\}$ [mA] ···································· (11.1)



Earth-leakage current breaker		K
Type	Mitsubishi Electric products	
Models provided with harmonic and surge reduction techniques	NV-SP NV-SW NV-CP NV-CW NV-HW	1
General models	BV-C1 NFB NV-L	3

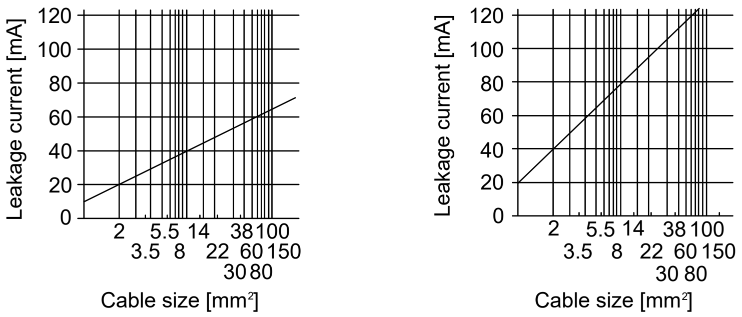
Ig1: Leakage current on the electric channel from the earth-leakage current breaker to the input terminals of the servo amplifier (Found from Fig. 11.13.)

Ig2: Leakage current on the electric channel from the output terminals of the servo amplifier to the servo motor (Found from Fig. 11.13.)

Ign: Leakage current when a filter is connected to the input side (4.4 mA per one FR-BIF(-H))

Iga: Leakage current of the servo amplifier (Found from table 11.5.)

Igm: Leakage current of the servo motor (Found from table 11.4.)



200 V class/100 V class (Note)

400 V class

Note. "Ig1" of 100 V class servo amplifiers will be 1/2 of 200 V class servo amplifiers.

Fig. 11.13 Example of leakage current per km (Ig1, Ig2) for CV cable run in metal conduit

Table 11.4 Servo motor leakage current example (Igm)

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
6 to 7	0.7
8 to 11	1.0
12 to 15	1.3
20 to 25	2.3

Table 11.5 Servo amplifier leakage current example (Iga)

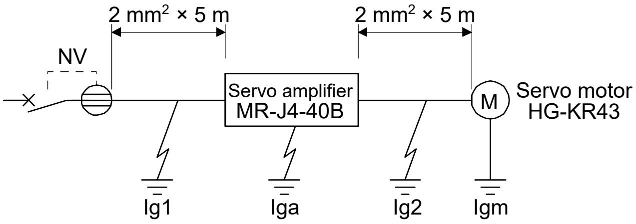
Servo amplifier capacity [kW]	Leakage current [mA]
0.1 to 0.6	0.1
0.75 to 3.5	0.15
5/7	2
11/15	5.5
22	7

Table 11.6 Earth-leakage current breaker selection example

Servo amplifier	Rated sensitivity current of earth-leakage current breaker [mA]
MR-J4-10B(-RJ) to MR-J4-350B(-RJ) MR-J4-60B4(-RJ) to MR-J4-350B4(-RJ) MR-J4-10B1(-RJ) to MR-J4-40B1(-RJ)	15
MR-J4-500B(-RJ) MR-J4-500B4(-RJ)	30
MR-J4-700B(-RJ) MR-J4-700B4(-RJ)	50
MR-J4-11KB(-RJ) to MR-J4-22KB(-RJ) MR-J4-11KB4(-RJ) to MR-J4-22KB4(-RJ)	100

(2) Selection example

Indicated below is an example of selecting an earth-leakage current breaker under the following conditions.



Use an earth-leakage current breaker designed for suppressing harmonics/surges.

Find the terms of equation (11.1) from the diagram.

$$Ig1 = 20 \cdot \frac{5}{1000} = 0.1 \text{ [mA]}$$

$$Ig2 = 20 \cdot \frac{5}{1000} = 0.1 \text{ [mA]}$$

Ign = 0 (not used)

Iga = 0.1 [mA]

Igm = 0.1 [mA]

Insert these values in equation (11.1).

$$\begin{aligned} Ig &\geq 10 \cdot \{0.1 + 0 + 0.1 + 1 \cdot (0.1 + 0.1)\} \\ &\geq 4 \text{ [mA]} \end{aligned}$$

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

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

11.16 EMC filter (recommended)

POINT

- ●For when multiple servo amplifiers are connected to one EMC filter, refer to section 6.4 of "EMC Installation Guidelines".

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

(1) Combination with the servo amplifier

Servo amplifier	Recommended filter (Soshin Electric)				Mass [kg]
	Model	Rated current [A]	Rated voltage [VAC]	Leakage current [mA]	
MR-J4-10B(-RJ) to MR-J4-100B(-RJ)	HF3010A-UN (Note)	10	250	5	3.5
MR-J4-200B(-RJ) MR-J4-350B(-RJ)	HF3010A-UN (Note)	30			5.5
MR-J4-500B(-RJ) MR-J4-700B(-RJ)	HF3040A-UN (Note)	40		6.5	6
MR-J4-11KB(-RJ) MR-J4-15KB(-RJ) MR-J4-22KB(-RJ)	HF3100A-UN (Note)	100			12
MR-J4-60B4(-RJ) MR-J4-100B4(-RJ)	TF3005C-TX	5	500	5.5	6
MR-J4-200B4(-RJ) to MR-J4-700B4(-RJ)	TF3020C-TX	20			
MR-J4-11KB4(-RJ)	TF3030C-TX	30			7.5
MR-J4-15KB4(-RJ)	TF3040C-TX	40			12.5
MR-J4-22KB4(-RJ)	TF3060C-TX	60			
MR-J4-10B1(-RJ) to MR-J4-40B1(-RJ)	HF3010A-UN (Note)	10	250	5	3.5

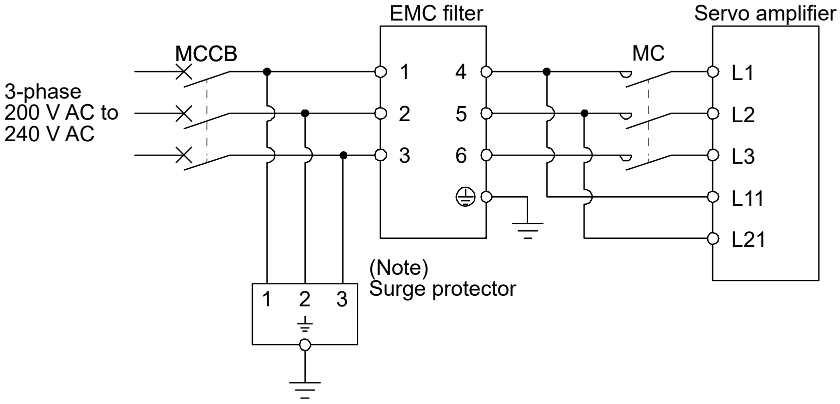
Note. To use any of these EMC filters, the surge protector RSPD-500-U4 (Okaya Electric Industries) is required.

Servo amplifier	Recommended filter (COSEL)				Mass [kg]
	Model	Rated current [A]	Rated voltage [VAC]	Leakage current [mA]	
MR-J4-11KB(-RJ) to MR-J4-22KB(-RJ)	FTB-100-355-L (Note)	100	500	40	5.3
MR-J4-22KB4(-RJ)	FTB-80-355-L (Note)	80	500	80	5.3

Note. To use any of these EMC filters, the surge protector RSPD-500-U4 (Okaya Electric Industries) is required.

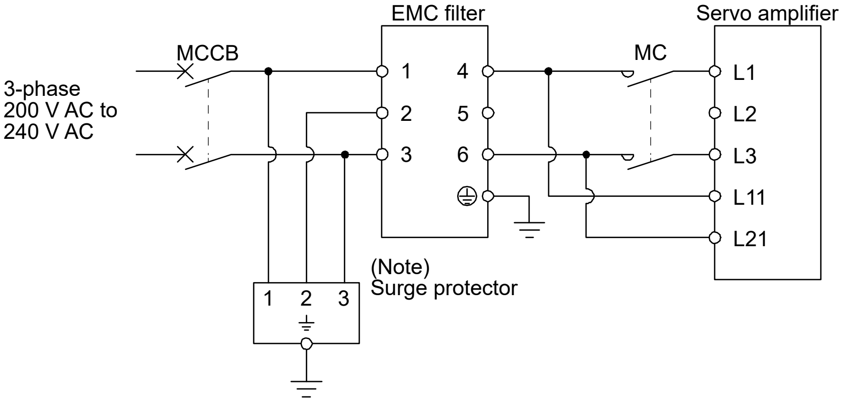
(2) Connection example

(a) For 3-phase 200 V AC to 240 V AC power supply



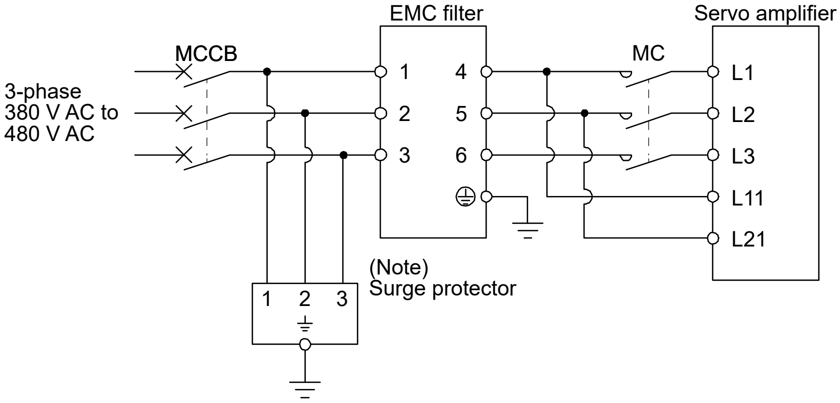
Note. When a surge protector is used.

(b) For 1-phase 200 V AC to 240 V AC power supply



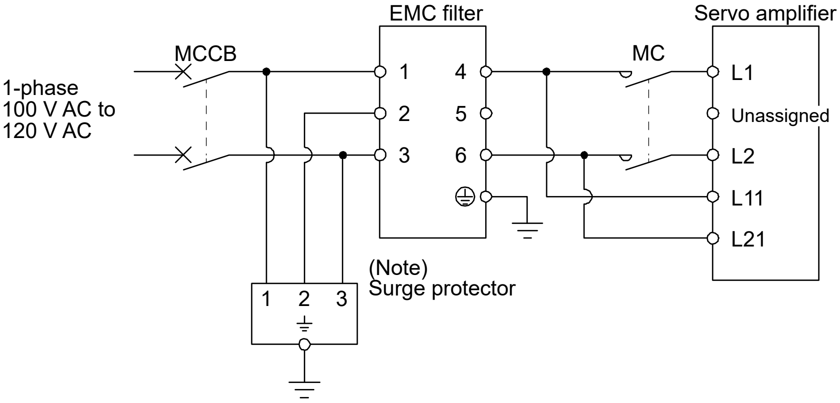
Note. When a surge protector is used.

(c) For 3-phase 380 V AC to 480 V AC power supply



Note. When a surge protector is used.

(d) For 1-phase 100 V AC to 120 V AC power supply



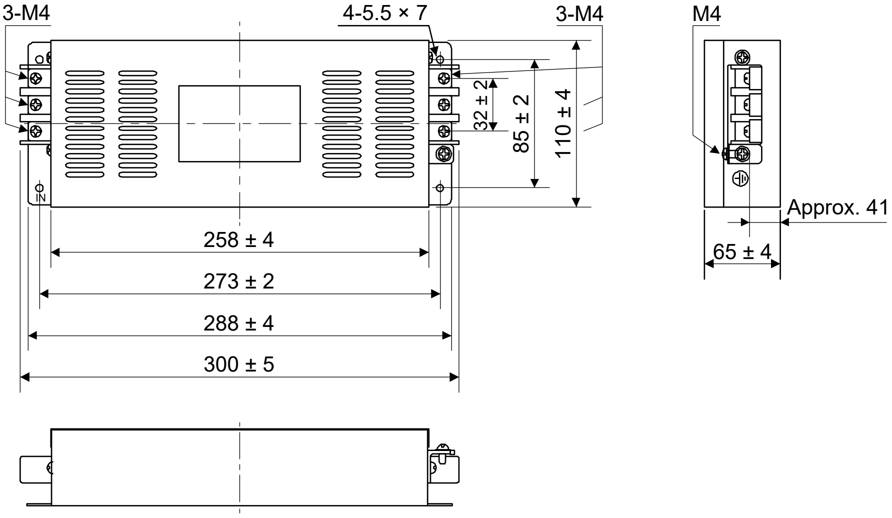
Note. When a surge protector is used.

(3) Dimensions

(a) EMC filter

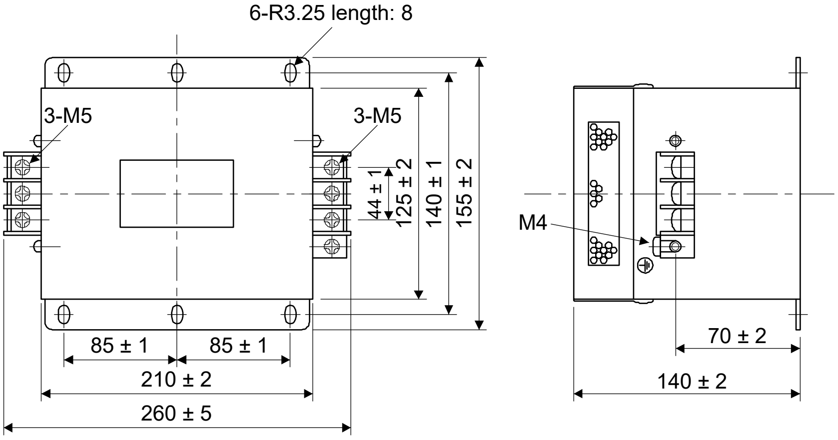
HF3010A-UN

[Unit: mm]



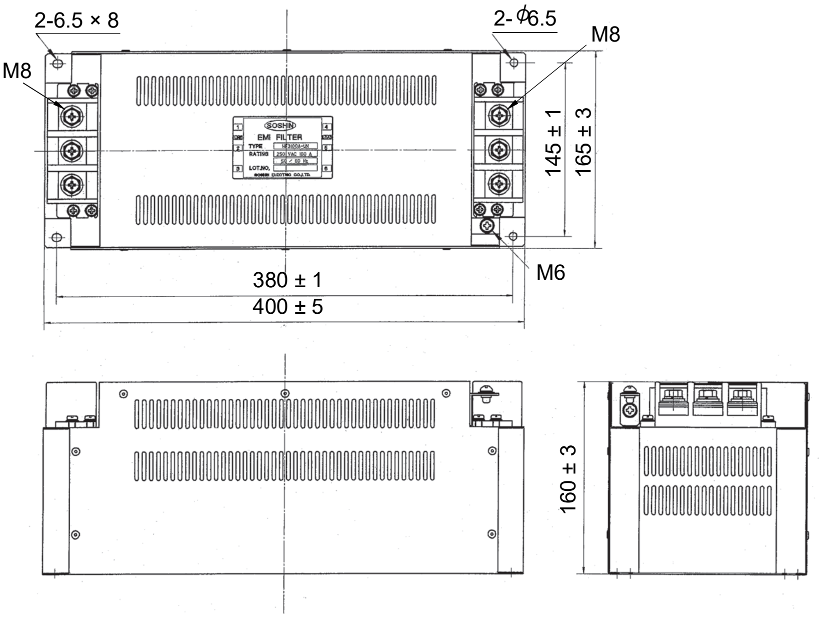
HF3030A-UN/HF-3040A-UN

[Unit: mm]



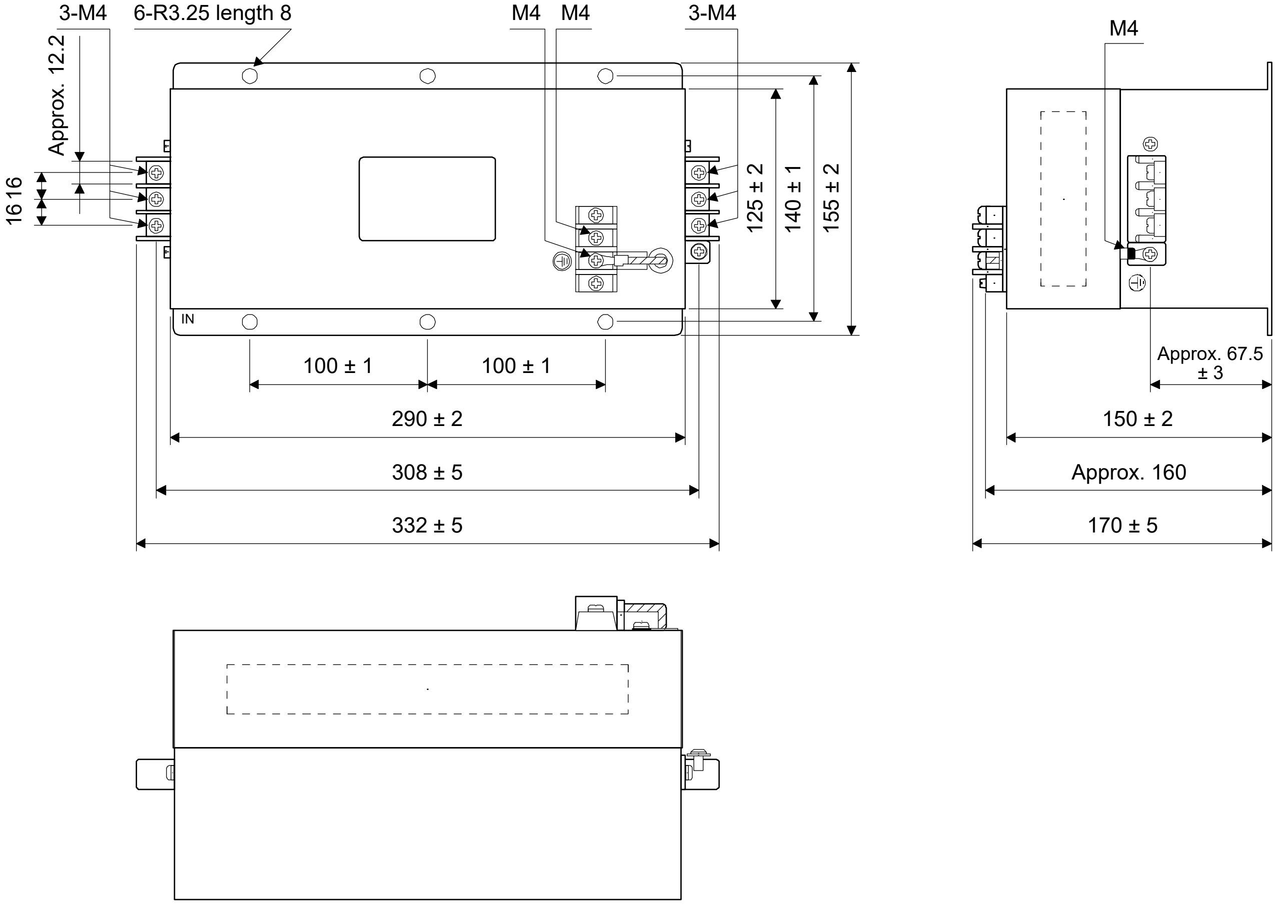
HF3100A-UN

[Unit: mm]



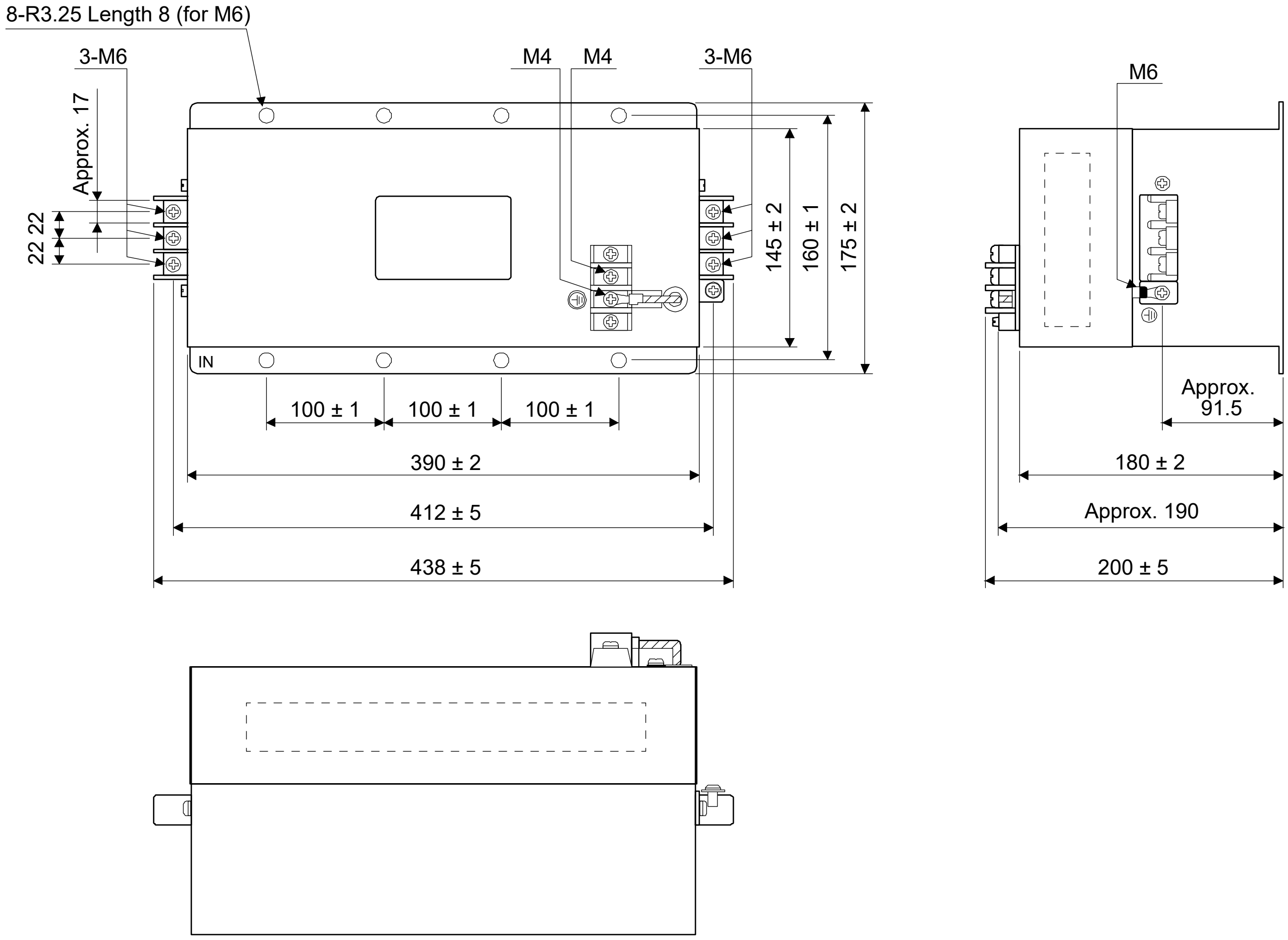
TF3005C-TX/TX3020C-TX/TF3030C-TX

[Unit: mm]



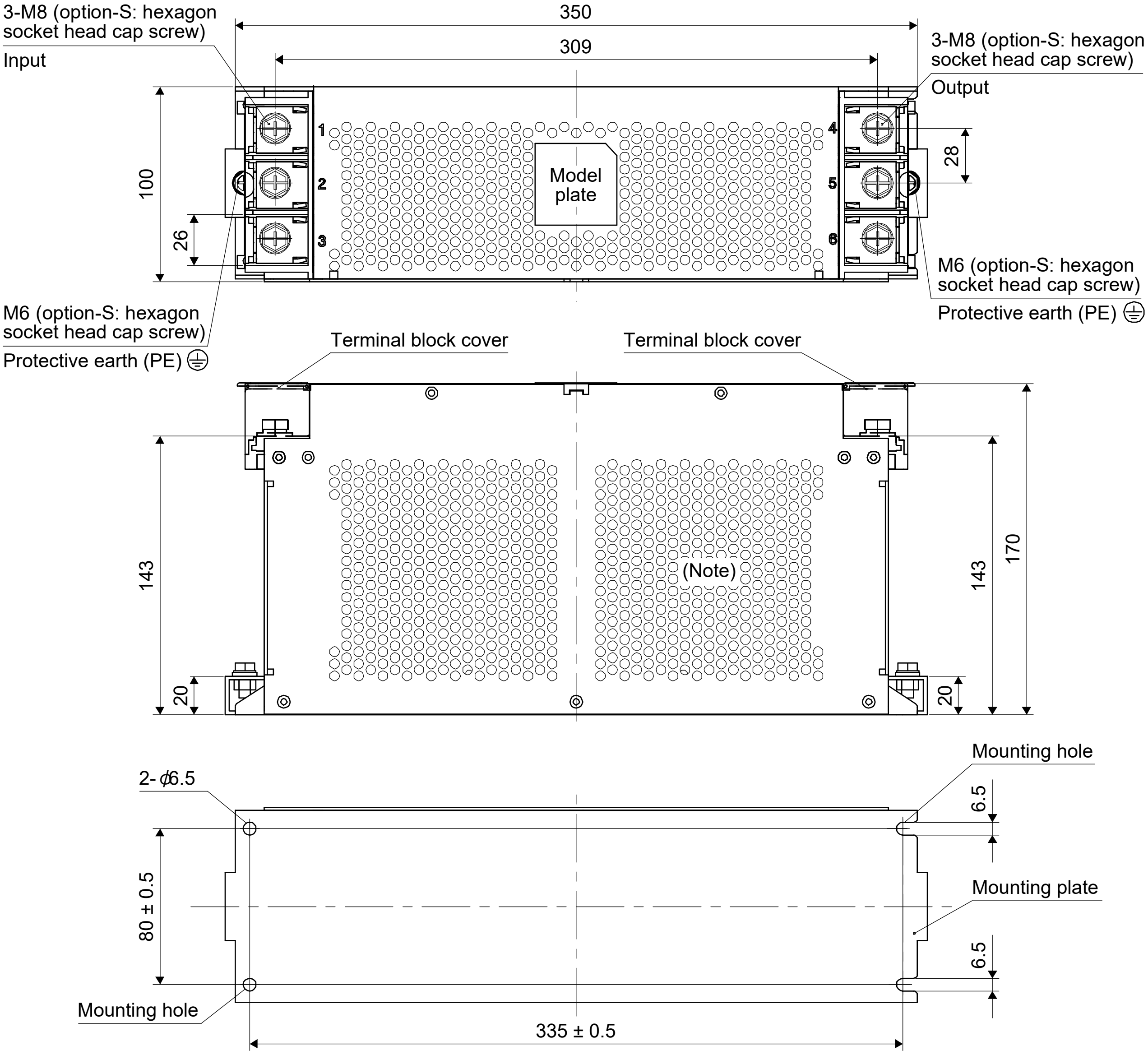
TF3040C-TX/TF3060C-TX

[Unit: mm]



FTB-100-355-L/FTB-80-355-L

[Unit: mm]

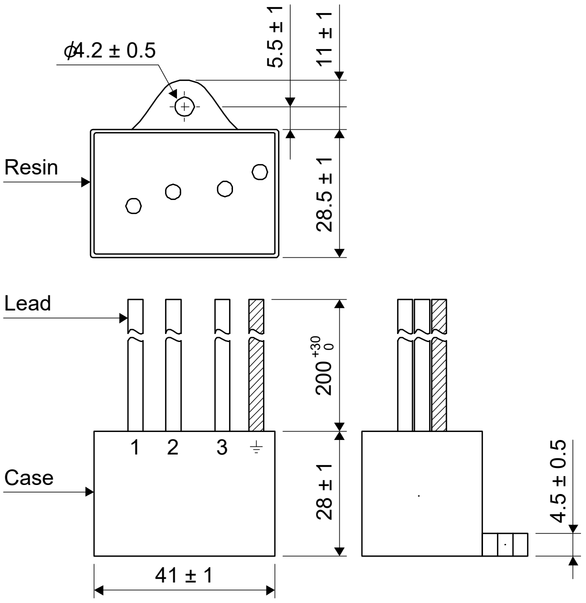


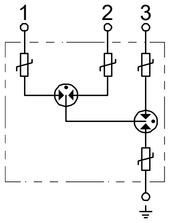
Note. No heat radiation holes on the opposite face.

(b) Surge protector

RSPD-250-U4/RSPD-500-U4

[Unit: mm]





11.17 External dynamic brake

⚠CAUTION

- ●Use an external dynamic brake for a servo amplifier of MR-J4-11KB(-RJ) to MR-J4-22KB(-RJ) and MR-J4-11KB4(-RJ) to MR-J4-22KB4(-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 chapter 8.
- ●The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD07] to [Pr. PD09]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.

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 external dynamic brake after (or as soon as) the servo-on command has been turned off at a power failure or a malfunction.
- ●For the braking time taken when the external dynamic brake is operated, refer to section 10.3.
- ●The external dynamic brake is rated for a short duration. Do not use it very frequently.
- ●When using the 400 V class external dynamic brake, the power supply voltage is restricted to 1-phase 380 V AC to 463 V AC (50 Hz/60 Hz).
- ●The external dynamic brake is activated in the following situations: When an alarm, [AL. E6 Servo forced stop warning], or [AL. E7 Controller forced stop warning] occurs; or when STO (STO1, STO2), ready-on command, or power is turned off. Do not use external 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 external 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.

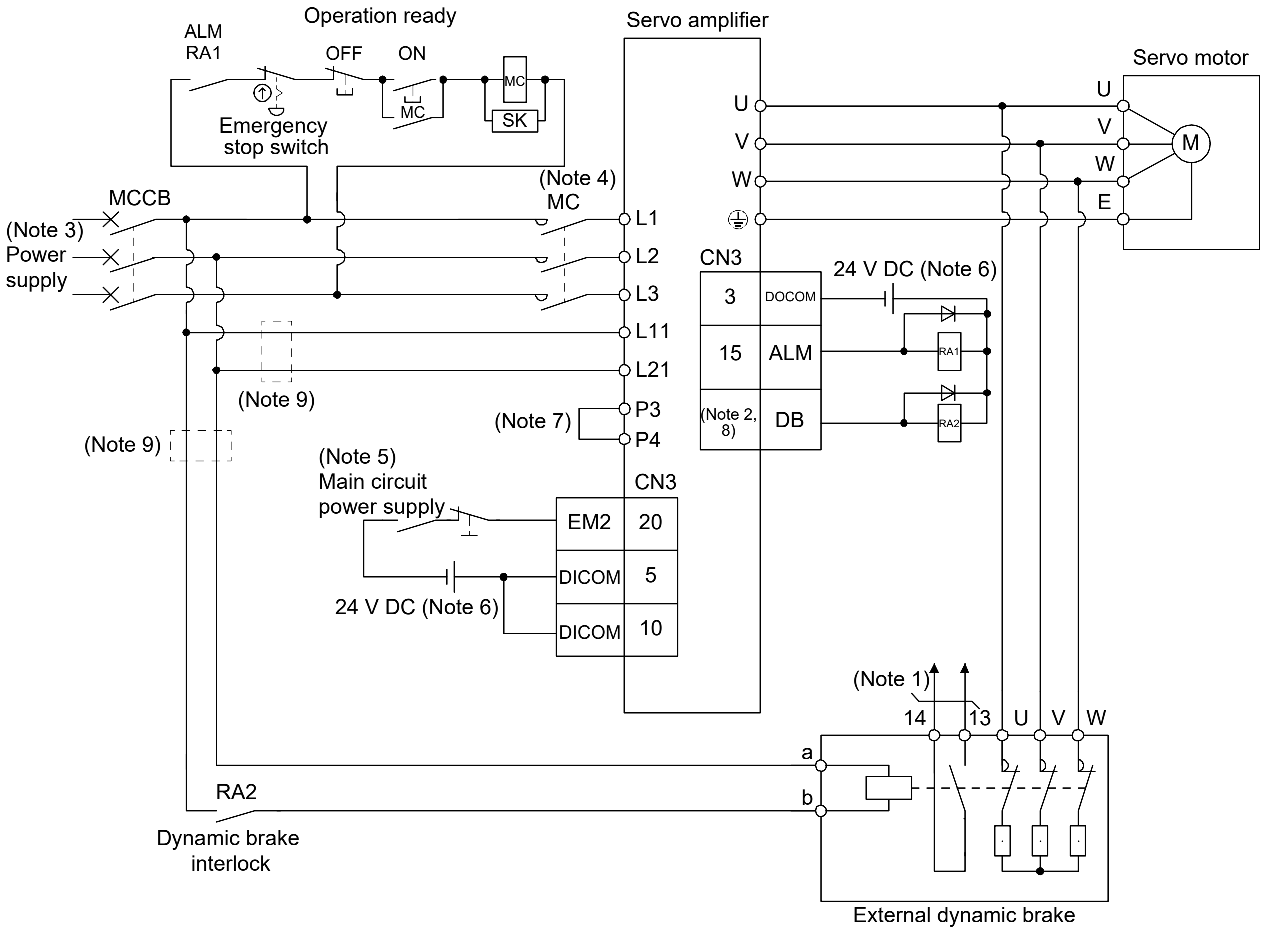
(1) Selection of external dynamic brake

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 CN3-9, CN3-13, and CN3-15 pins in [Pr. PD07] to [Pr. PD09].

Servo amplifier	External dynamic brake	Molded-case circuit breaker		Fuse (Class T)		Fuse (Class K5)	
		Frame, rated current	Voltage AC [V]	Current [A]	Voltage AC [V]	Current [A]	Voltage AC [V]
MR-J4-11KB(-RJ)	DBU-11K	30 A frame 5 A	240	1	300	1	250
MR-J4-15KB(-RJ)	DBU-15K						
MR-J4-22KB(-RJ)	DBU-22K-R1						
MR-J4-11KB4(-RJ)	DBU-11K-4	30 A frame 5 A	480	1	600	1	600
MR-J4-15KB4(-RJ)	DBU-22K-4						
MR-J4-22KB4(-RJ)							

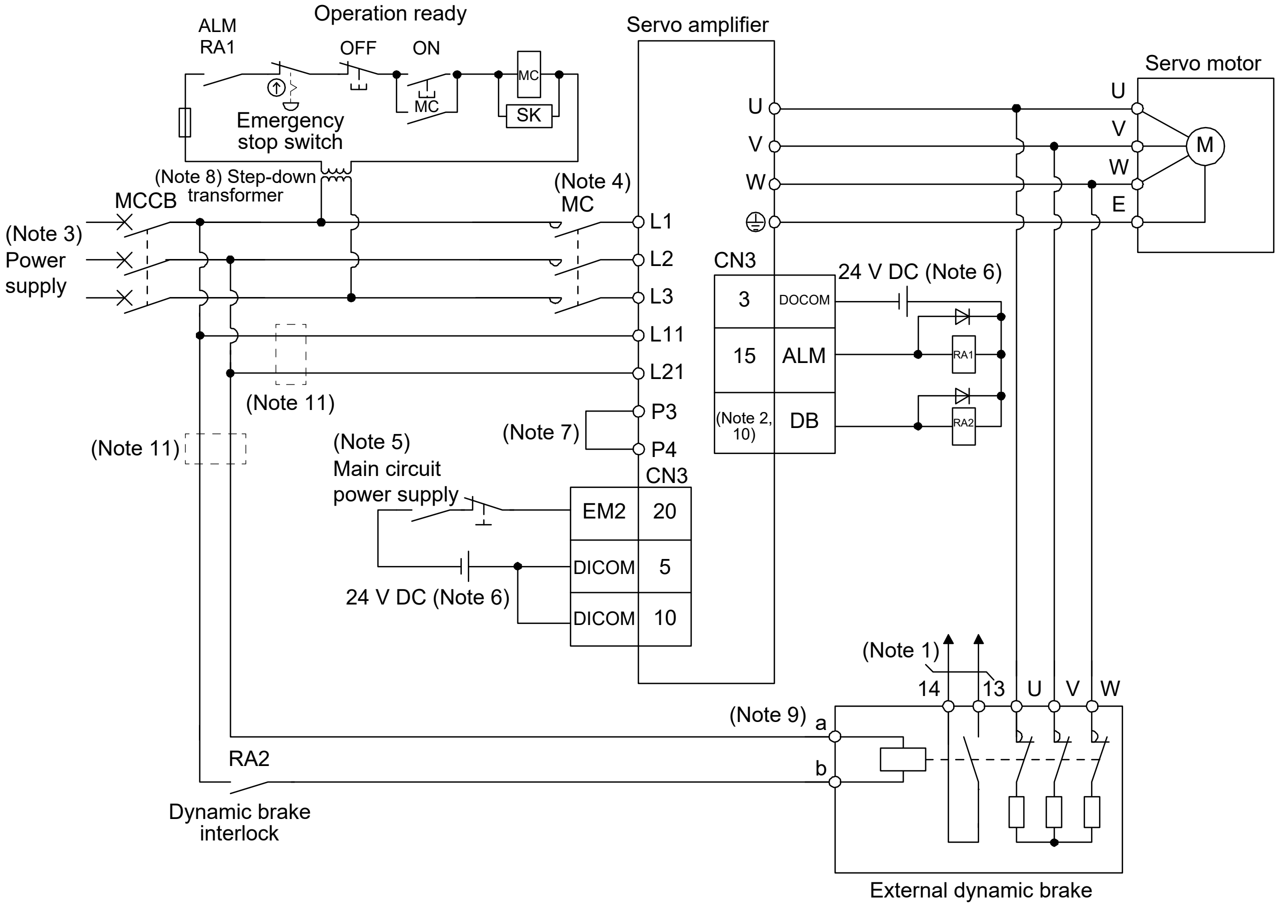
(2) Connection example

(a) 200 V class



Note
1. Terminals 13 and 14 are normally open contact outputs. If the external dynamic brake is seized, terminals 13 and 14 will open. Therefore, configure up an external sequence to prevent servo-on.
2. Assign DB (Dynamic brake interlock) in [Pr. PD07] to [Pr. PD09].
3. For the power supply specifications, refer to section 1.3.
4. 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.
5. Turn off EM2 when the main power circuit power supply is off.
6. 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.
7. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
8. The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD07] to [Pr. PD09]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.
9. Install an overcurrent protection device (molded-case circuit breaker, fuse, or others) to protect the branch circuit. (Refer to section 11.10 and (1) in this section.)

(b) 400 V class



Note
1. Terminals 13 and 14 are normally open contact outputs. If the external dynamic brake is seized, terminals 13 and 14 will open. Therefore, configure an external sequence to prevent servo-on.
2. Assign DB (Dynamic brake interlock) in [Pr. PD07] to [Pr. PD09].
3. For power supply specifications, refer to section 1.3.
4. 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.
5. Turn off EM2 when the main power circuit power supply is off.
6. 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.
7. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
8. Stepdown transformer is required when the coil voltage of the magnetic contactor is 200 V class.
9. The power supply voltage of the inside magnet contactor for 400 V class external dynamic brake DBU-11K-4 and DBU-22K-4 is restricted as follows. When using these external dynamic brakes, use them within the range of the power supply.

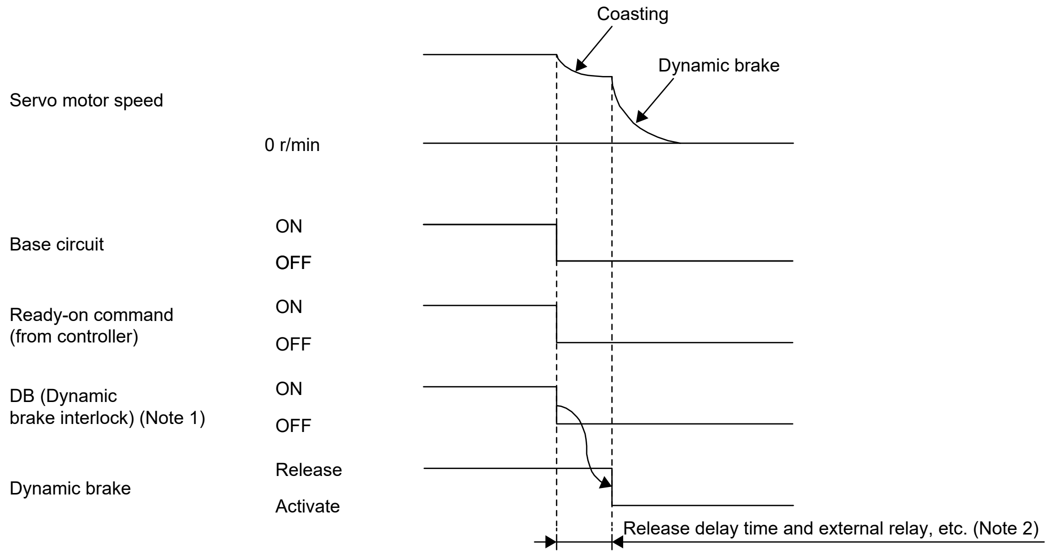
External dynamic brake	Power supply voltage
DBU-11K-4 DBU-22K-4	1-phase 380 V AC to 463 V AC, 50 Hz/60 Hz

10. The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD07] to [Pr. PD09]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.
11. Install an overcurrent protection device (molded-case circuit breaker, fuse, or others) to protect the branch circuit. (Refer to section 11.10 and (1) in this section.)

(3) Timing chart

(a) When using the forced stop deceleration function

1) Ready-off command from controller



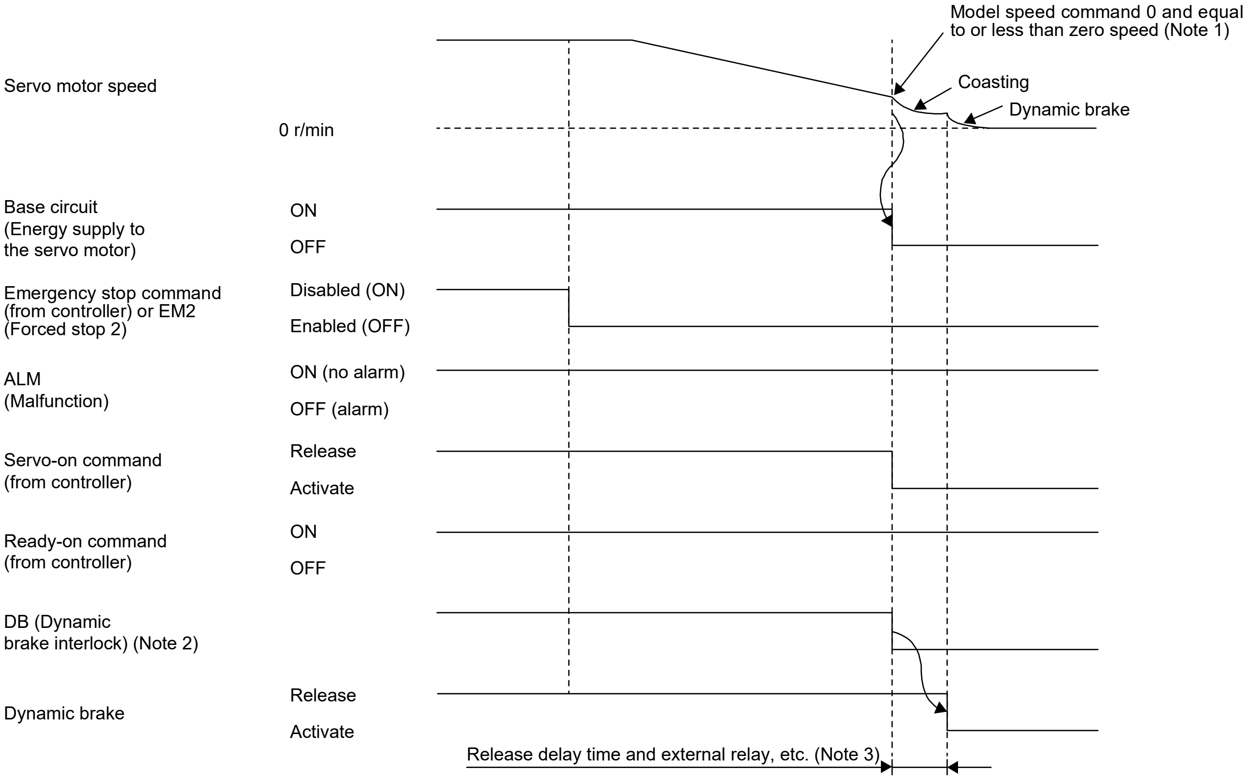
Note 1. ON: Dynamic brake is not activated
OFF: Dynamic brake is activated

2. There is delay caused by the magnetic contactor built into the external dynamic brake (about 50 ms) and delay caused by the external relay.

2) Turning the forced stop command (from controller) or EM2 (Forced stop 2) off

POINT

- Keep the servo-on command (from controller) and ready-on command (from controller) on while the forced stop command (from controller) or EM2 (Forced stop 2) is off. When the servo-on command (from controller) and ready-on command (from controller) are off, forced stop deceleration is not performed.



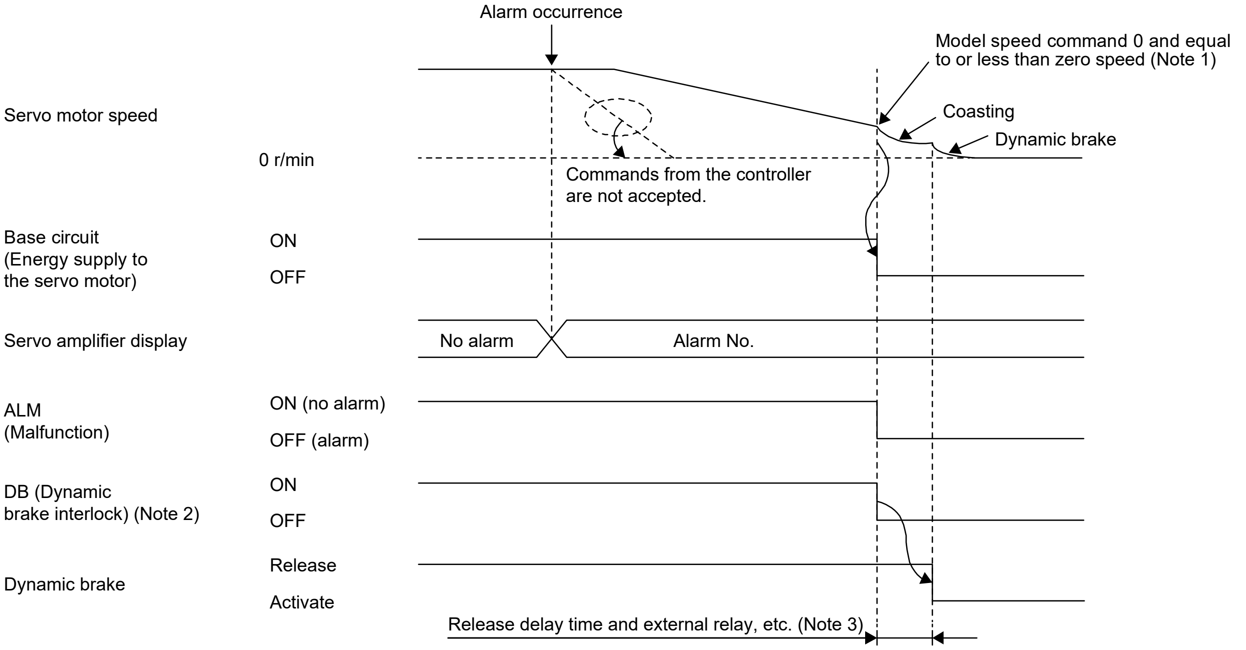
Note 1. The model speed command is a speed command generated in the servo amplifier for forced stop deceleration of the servo motor.

2. ON: Dynamic brake is not activated
OFF: Dynamic brake is activated

3. There is delay caused by the magnetic contactor built into the external dynamic brake (about 50 ms) and delay caused by the external relay.

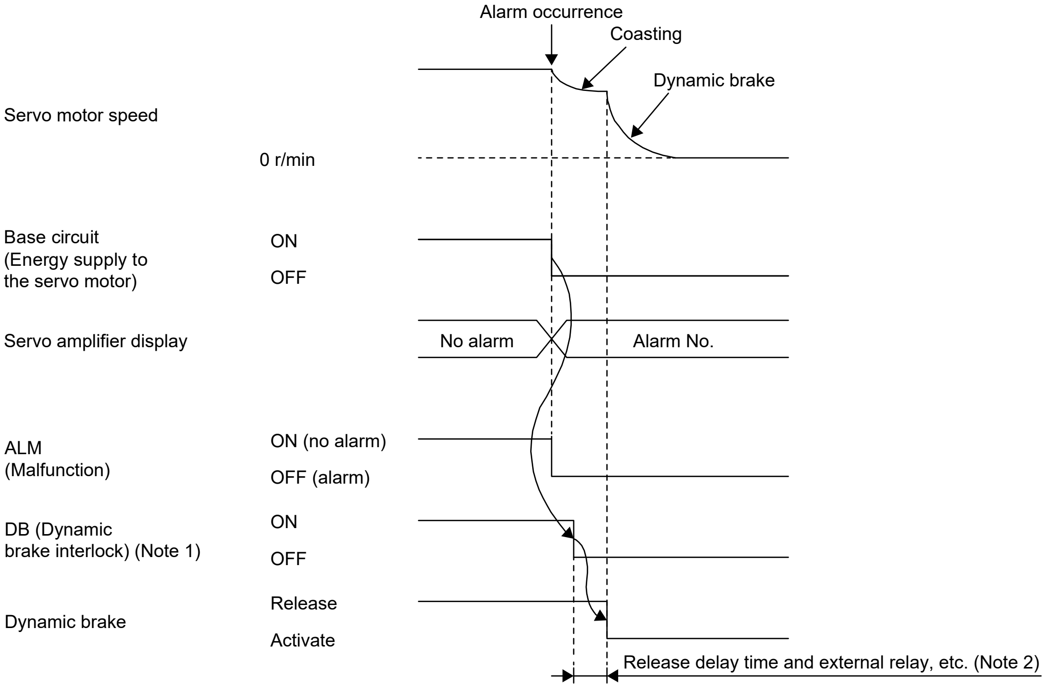
3) Alarm occurrence

a) When the forced stop deceleration function is enabled



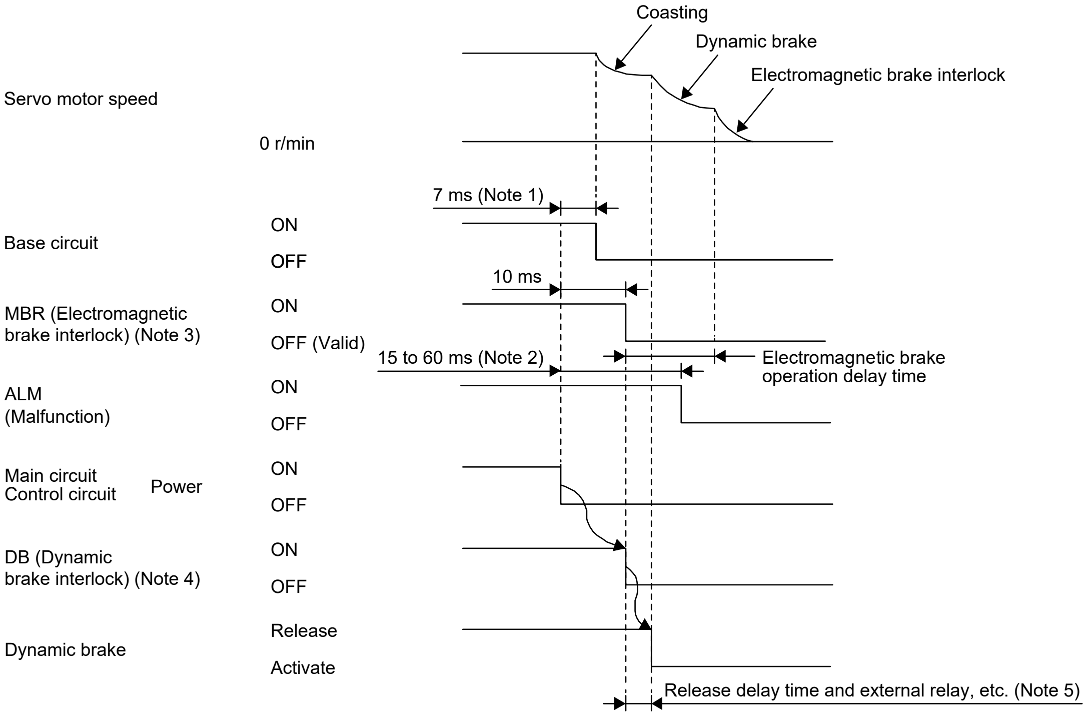
Note 1. The model speed command is a speed command generated in the servo amplifier for forced stop deceleration of the servo motor.
2. ON: Dynamic brake is not activated
OFF: Dynamic brake is activated
3. There is delay caused by the magnetic contactor built into the external dynamic brake (about 50 ms) and delay caused by the external relay.

b) When the forced stop deceleration function is disabled



Note 1. ON: Dynamic brake is not activated
OFF: Dynamic brake is activated
2. There is delay caused by the magnetic contactor built into the external dynamic brake (about 50 ms) and delay caused by the external relay.

4) When both the main circuit power supply and the control circuit power supply are turned off



Note 1. When the power is off, DB (dynamic brake interlock) will turn off. Before an output short-circuit occurs, the base circuit turns off faster than normal cases. (Only when DB is assigned as an output signal)

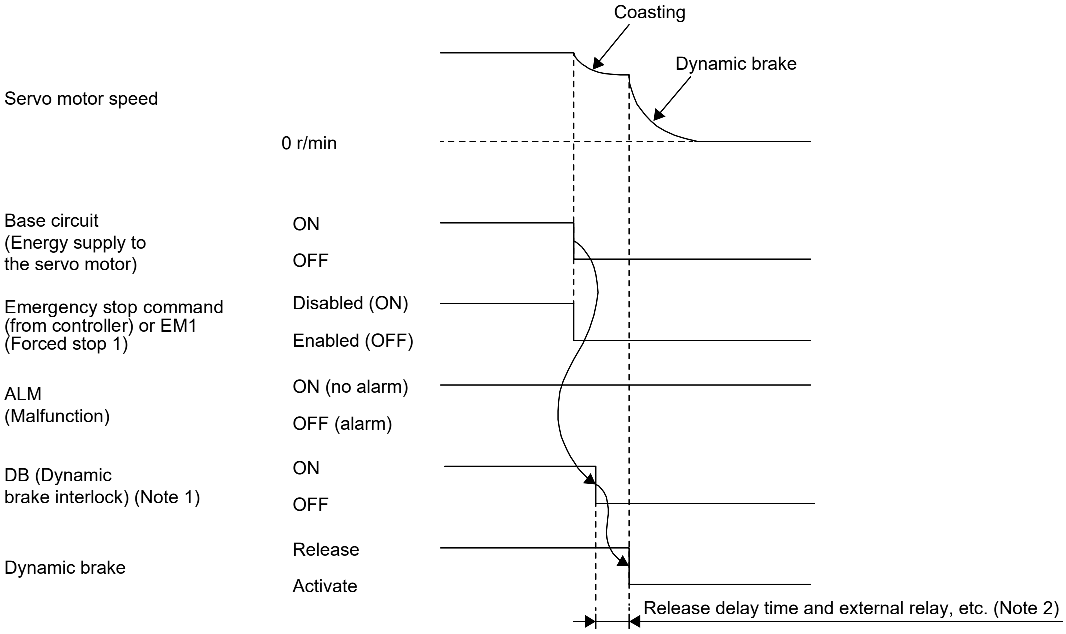
2. The length of time varies depending on the operation status.
3. ON: Electromagnetic brake is not activated
OFF: Electromagnetic brake is activated
4. ON: Dynamic brake is not activated
OFF: Dynamic brake is activated
5. There is delay caused by the magnetic contactor built into the external dynamic brake (about 50 ms) and delay caused by the external relay.

(b) When the forced stop deceleration function is not used

1) Ready-off command from controller

For information on the ready-off command from controller, refer to section 11.17 (3) (a) 1).

2) Turning the forced stop command (from controller) or EM1 (Forced stop 1) off



Note 1. ON: Dynamic brake is not activated
OFF: Dynamic brake is activated

2. There is delay caused by the magnetic contactor built into the external dynamic brake (about 50 ms) and delay caused by the external relay.

3) Alarm occurrence

For information on the alarm occurrence, refer to section 11.17 (3) (a) 3) b).

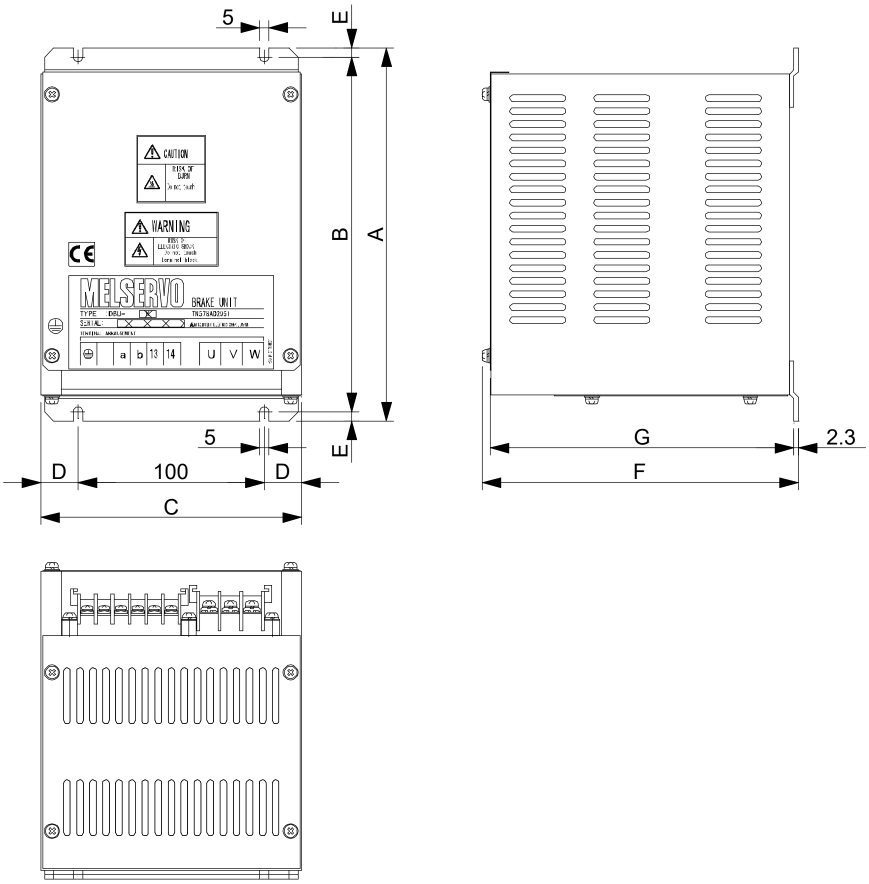
4) When both the main circuit power supply and the control circuit power supply are turned off

For information on when both the main circuit power supply and the control circuit power supply are turned off, refer to section 11.17 (3) (a) 4).

(4) Dimensions

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

[Unit: mm]



Terminal block

⏚		a	b	13	14

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

U	V	W

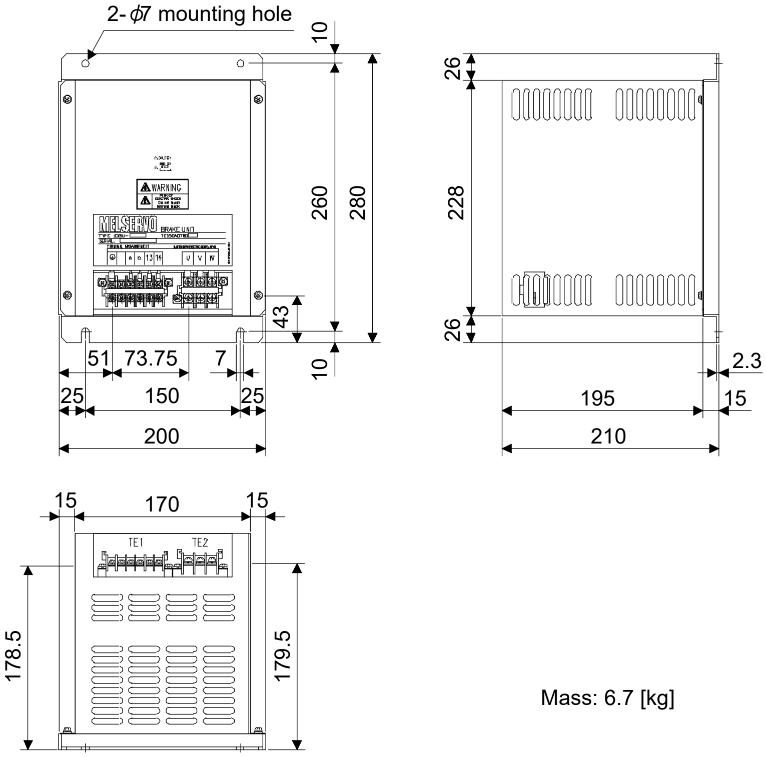
Screw: M4
Tightening torque: 1.2 [N•m]

External 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 are as follows.
600 V grade heat-resistant polyvinyl chloride insulated wire (HIV wire)
Construction condition: Single wire set in midair

(b) DBU-11K-4/DBU-22K-4

[Unit: mm]



Mass: 6.7 [kg]

Terminal block

TE1

⏚		a	b	13	14

Screw: M3.5

Tightening torque: 0.8 [N•m]

TE2

U	V	W

Screw: M4

Tightening torque: 1.2 [N•m]

External dynamic brake	(Note) Connection wire [mm^2]	
	U/V/W	Except U/V/W
DBU-11K-4	5.5 (AWG 10)	2 (AWG 14)
DBU-22K-4	5.5 (AWG 10)	2 (AWG 14)

Note. Selection conditions of wire size are as follows.

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

Construction condition: Single wire set in midair

11.18 Panel through attachment (MR-J4ACN15K/MR-J3ACN)

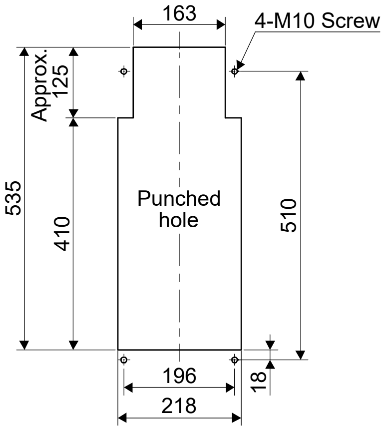
Use the panel through attachment to mount the heat generation area of the servo amplifier in the outside of the cabinet to dissipate servo amplifier-generated heat to the outside of the cabinet and reduce the amount of heat generated in the cabinet. In addition, designing a compact cabinet is allowed.
In the cabinet, machine a hole having the panel cut dimensions, fit the panel through 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 panel through attachment should be within the range of the servo amplifier operating environment.
The panel through attachments are used for MR-J4-11KB(-RJ) to MR-J4-22KB(-RJ) and MR-J4-11KB4(-RJ) to MR-J4-22KB4(-RJ).
The following shows the combinations.

Servo amplifier	Panel through attachment
MR-J4-11KB(-RJ) MR-J4-15KB(-RJ)	MR-J4ACN15K
MR-J4-22KB(-RJ)	MR-J3ACN
MR-J4-11KB4(-RJ) MR-J4-15KB4(-RJ)	MR-J4ACN15K
MR-J4-22KB4(-RJ)	MR-J3ACN

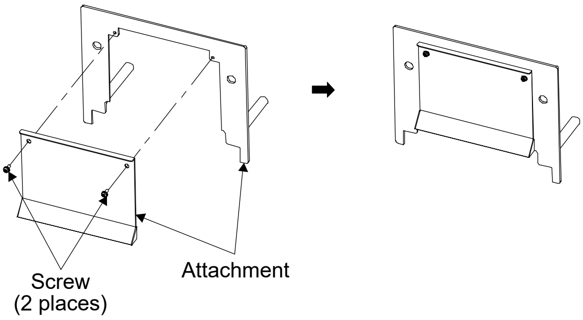
(1) MR-J4ACN15K

(a) Panel cut dimensions

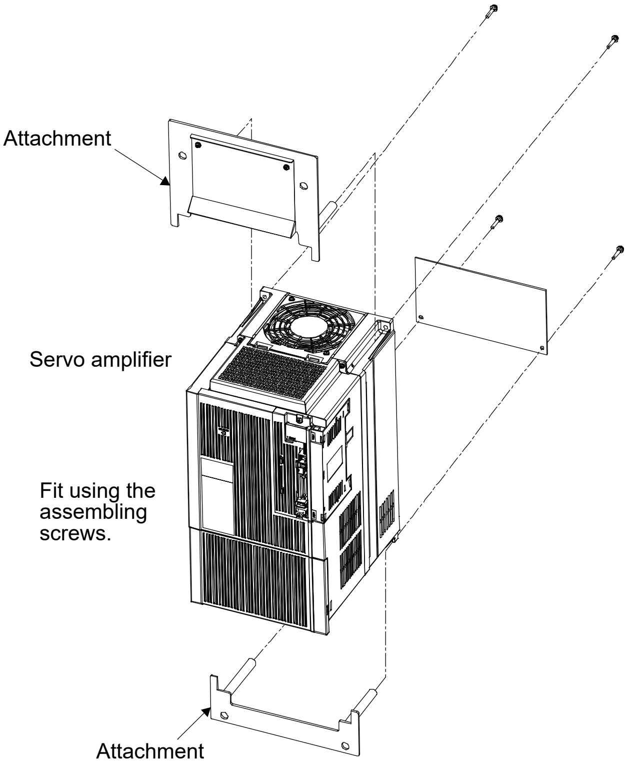
[Unit: mm]



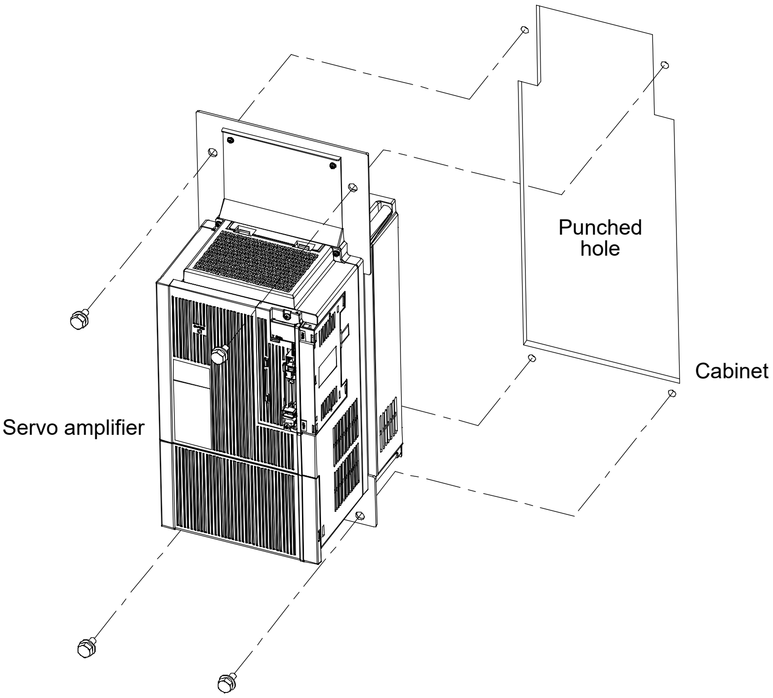
(b) How to assemble the attachment for panel through attachment



(c) Mounting method



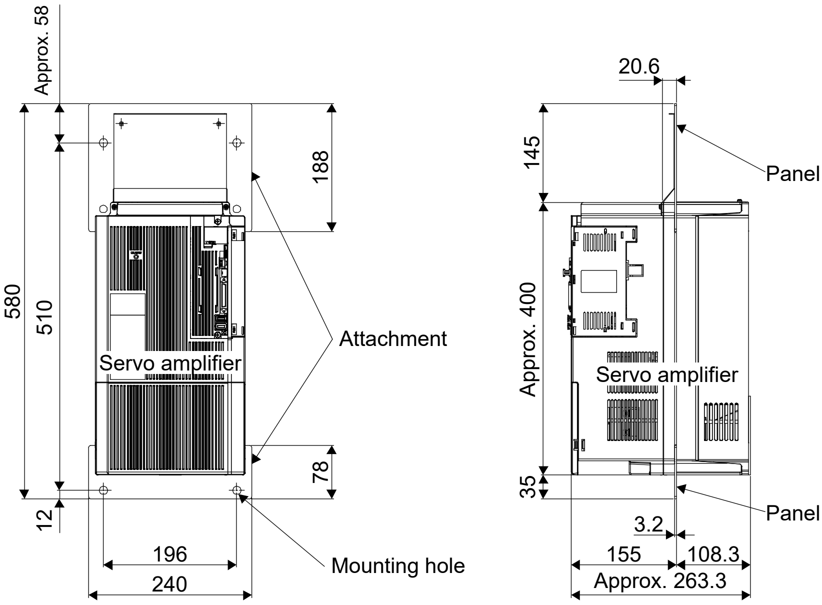
a. Assembling the panel through attachment



b. Mounting it to inside cabinet

(d) Mounting dimensional diagram

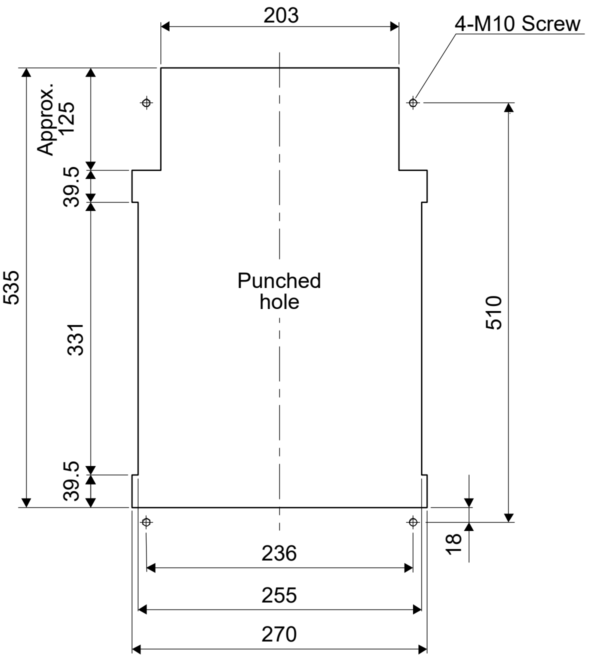
[Unit: mm]



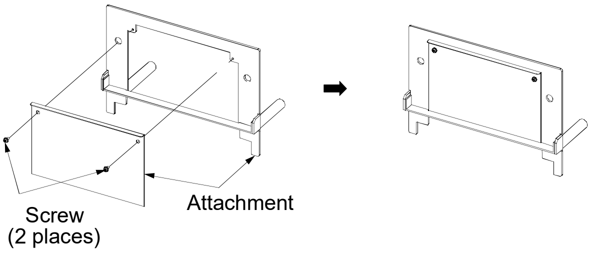
(2) MR-J3ACN

(a) Panel cut dimensions

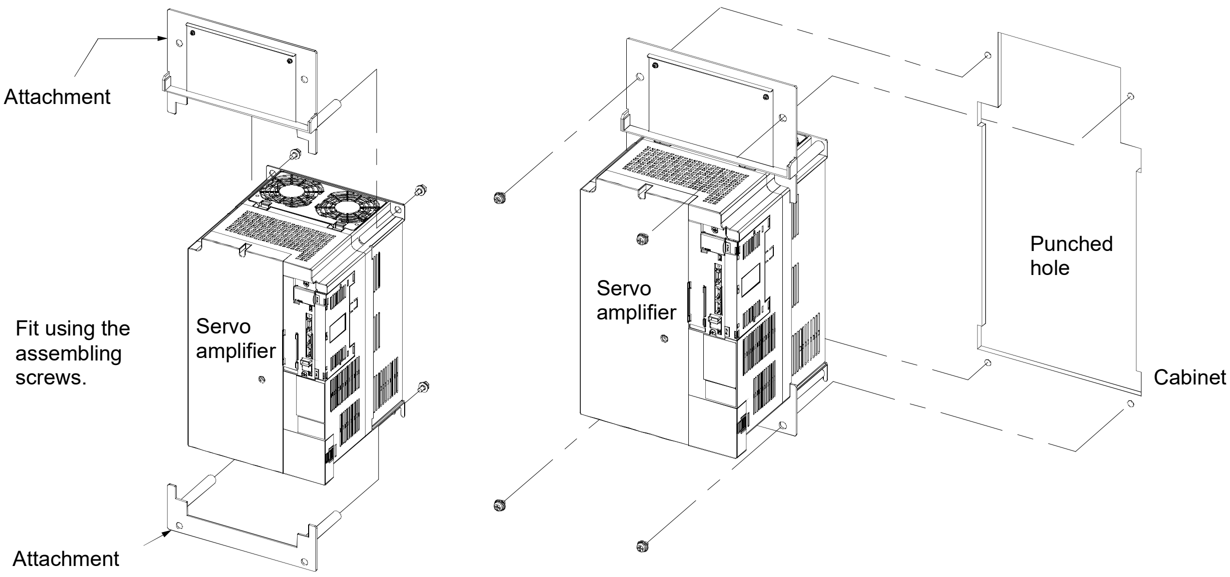
[Unit: mm]



(b) How to assemble the attachment for panel through attachment



(c) Mounting method

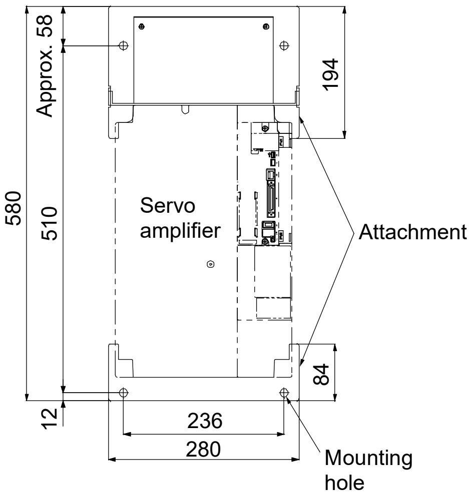


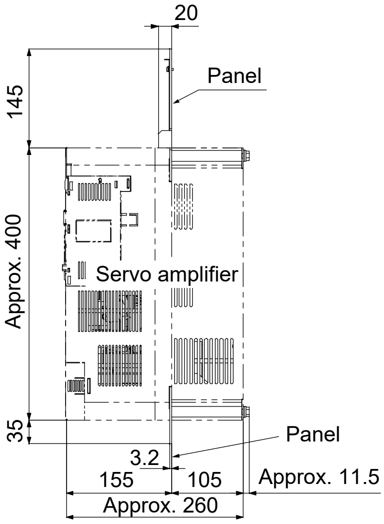
a. Assembling the panel through attachment

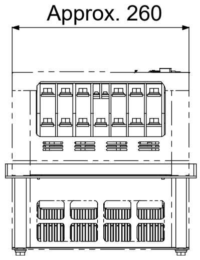
b. Mounting it to inside cabinet

(d) Mounting dimensional diagram

[Unit: mm]







11.19 Multifunction regeneration converter FR-XC-(H)

POINT

●For details on the multifunction regeneration converter (FR-XC-(H)), refer to "FR-XC INSTRUCTION MANUAL (IB(NA)-0600668ENG)".

11.19.1 Multifunction regeneration converters and dedicated stand-alone reactors

Install a dedicated stand-alone reactor on the multifunction regeneration converter FR-XC-(H) according to the following table.

Multifunction regeneration converter	Dedicated stand-alone reactor
FR-XC-7.5K	FR-XCL-7.5K
FR-XC-11K	FR-XCL-11K
FR-XC-15K	FR-XCL-15K
FR-XC-22K	FR-XCL-22K
FR-XC-30K	FR-XCL-30K
FR-XC-37K	FR-XCL-37K
FR-XC-55K	FR-XCL-55K
FR-XC-H7.5K	FR-XCL-H7.5K
FR-XC-H11K	FR-XCL-H11K
FR-XC-H15K	FR-XCL-H15K
FR-XC-H22K	FR-XCL-H22K
FR-XC-H30K	FR-XCL-H30K
FR-XC-H37K	FR-XCL-H37K
FR-XC-H55K	FR-XCL-H55K

11.19.2 Precautions

- Set the FR-XC-(H) to the common bus regeneration mode by turning on switch 1 of the function selecting switch (SW2).
- Do not supply power to the main circuit power supply terminals (L1/L2/L3) of the servo amplifier. Doing so may fail the servo amplifier and the FR-XC-(H).
- Connect the polarities of the DC power supply between the FR-XC-(H) and the servo amplifier correctly. Failing to do so may fail the FR-XC-(H) and the servo amplifier.
- For 400 V, use the rated voltage and permissible fluctuation of the input power supply within the following range.
  Rated voltage: 3-phase 380 V to 480 V, 50 Hz/60 Hz
  Permissible fluctuation: 3-phase 323 V to 528 V, 50 Hz/60 Hz

11.19.3 Servo amplifier settings

When using the FR-XC-(H), set the parameters as follows.

- [Pr. PA02]: "_ _ 0 1"
- [Pr. PA04]: "0 0 _ _"
- [Pr. PC20]: "_ _ _ 1"

11.19.4 Capacity selection

(1) Selection conditions

The multifunction regeneration converter FR-XC-(H) can be used with 200 V class servo amplifiers with capacities of 100 W to 22 kW and 400 V class servo amplifiers with capacities of 600 W to 22 kW. Select a multifunction regeneration converter based on the following selection conditions.

- Number of servo amplifiers to be connected to one FR-XC-(H) is 10 or less
- Total capacity of servo amplifiers [kW] ≤ Total capacity of servo amplifiers that can be connected to the FR-XC-(H) [kW]
- Effective value of the total servo motor output power [kW] ≤ Continuous output of the FR-XC-(H) [kW]
- Maximum value of the total servo motor output power [kW] ≤ Instantaneous maximum output of the FR-XC-(H) [kW]

Item	FR-XC-(H)_						
	7.5K	11K	15K	22K	30K	37K	55K
Rated capacity [kW]	7.5	11	15	22	30	37	55
Maximum number of connectable servo amplifiers	10						
Total capacity of connectable servo amplifiers [kW] (Note)	3.5 (5.5)	5.5 (7.5)	7.5 (11)	22	30	37	55
Continuous output [kW] (Note)	3.5 (5.5)	5.5 (7.5)	7.5 (11)	18.5	22	30	45
Instantaneous maximum output [kW]	11.25	16.5	22.5	33	45	55.5	82.5

Note. Values in parentheses are when six servo amplifiers or less are connected.

(2) Selection example

The following information explains how to select a multifunction regeneration converter to connect to the servo amplifiers listed below.

Servo amplifier	Servo motor
MR-J4-500B	HG-SR502
MR-J4-500B	HG-SR502
MR-J4-11KB	HG-JR11K1M
MR-J4-22KB	HG-JR22K1M

(a) Calculate the running power and regenerative power from the servo motor speed and torque with the following formulas.

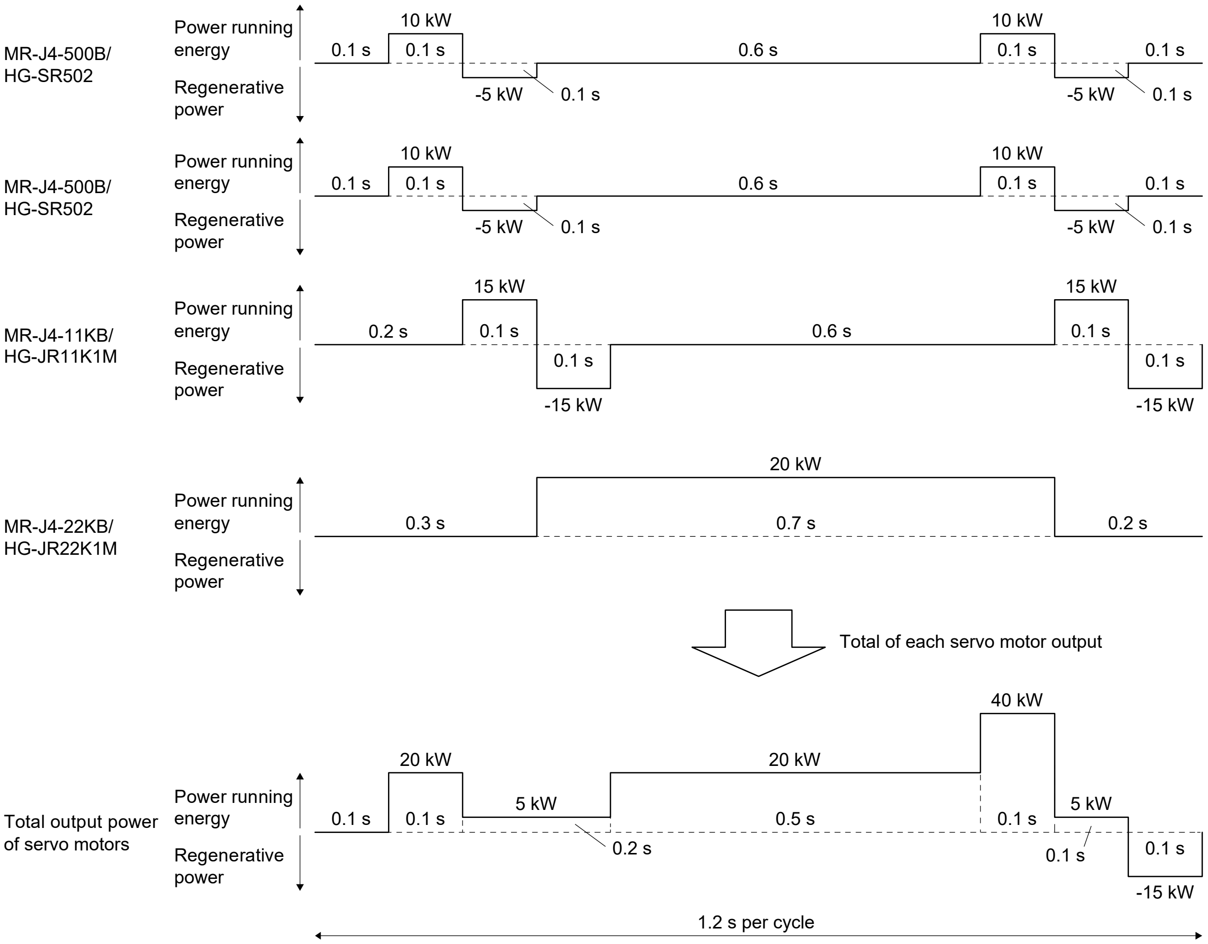
- For rotary servo motors

  Running power and regenerative power [W] = Servo motor speed [r/min] × Torque [N•m]/9.55
- For linear servo motors

  Running power and regenerative power [W] = Servo motor speed [m/s] × Thrust [N]

  (Running power is indicated by positive values, and regenerative power is indicted by negative values.)

(b) Calculate the total output power of the servo motors from the running power and regenerative power of each servo motor.



(c) Select a multifunction regeneration converter based on the selection conditions.

- Number of servo amplifiers: 4 ≤ 10
  ⇒Number of servo amplifiers OK.
- Total capacity of servo amplifiers [kW] = 5 kW + 5 kW + 11 kW + 22 kW = 43 kW
  ⇒FR-XC-55K
- Effective value of the total servo motor output power [kW]

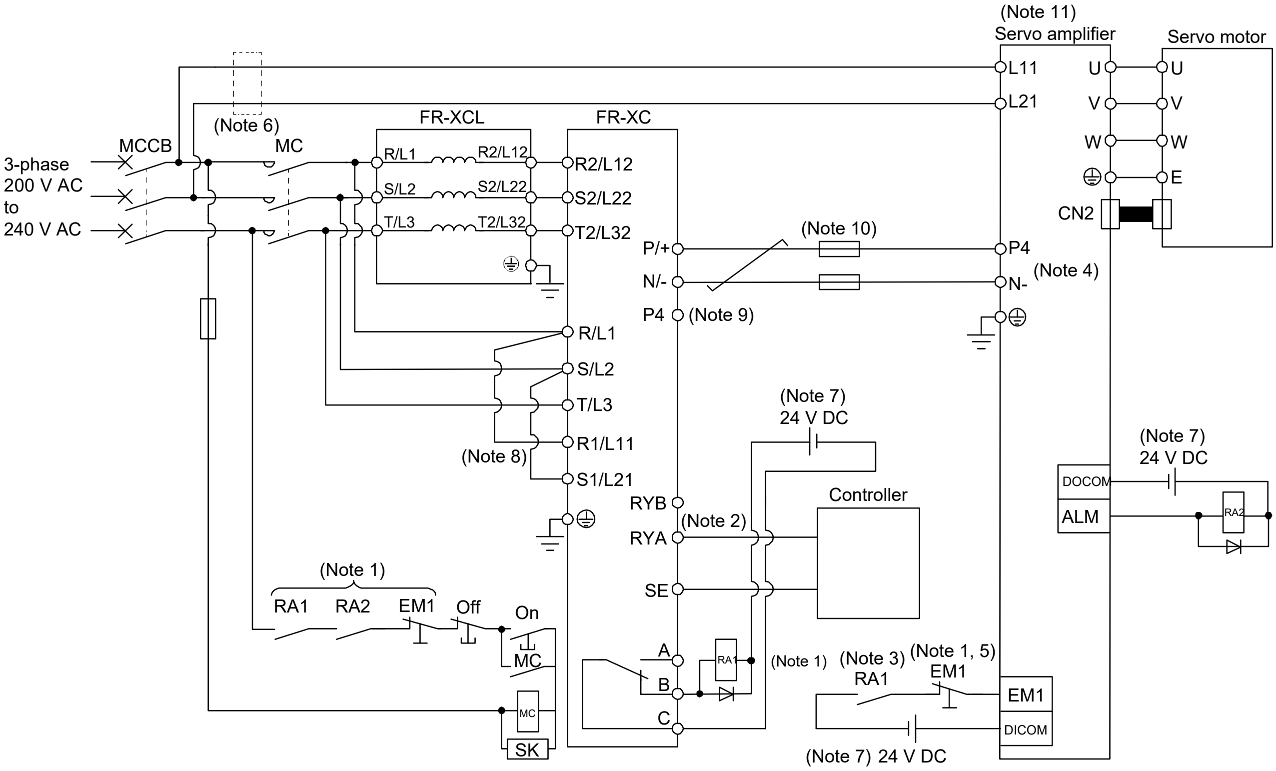
$$= \sqrt{(20^2 \times 0.1 + 5^2 \times 0.2 + 20^2 \times 0.5 + 40^2 \times 0.1 + 5^2 \times 0.1 + (-15)^2 \times 0.1)/1.2} = 18.93 \text{ kW}$$

  ⇒FR-XC-30K or more
- Maximum value of the total servo motor output power [kW] = 40 kW
  ⇒FR-XC-30K or more

Therefore, the multifunction regeneration converter selected should be the "FR-XC-55K".

11.19.5 Connection diagrams

(1) 200 V class

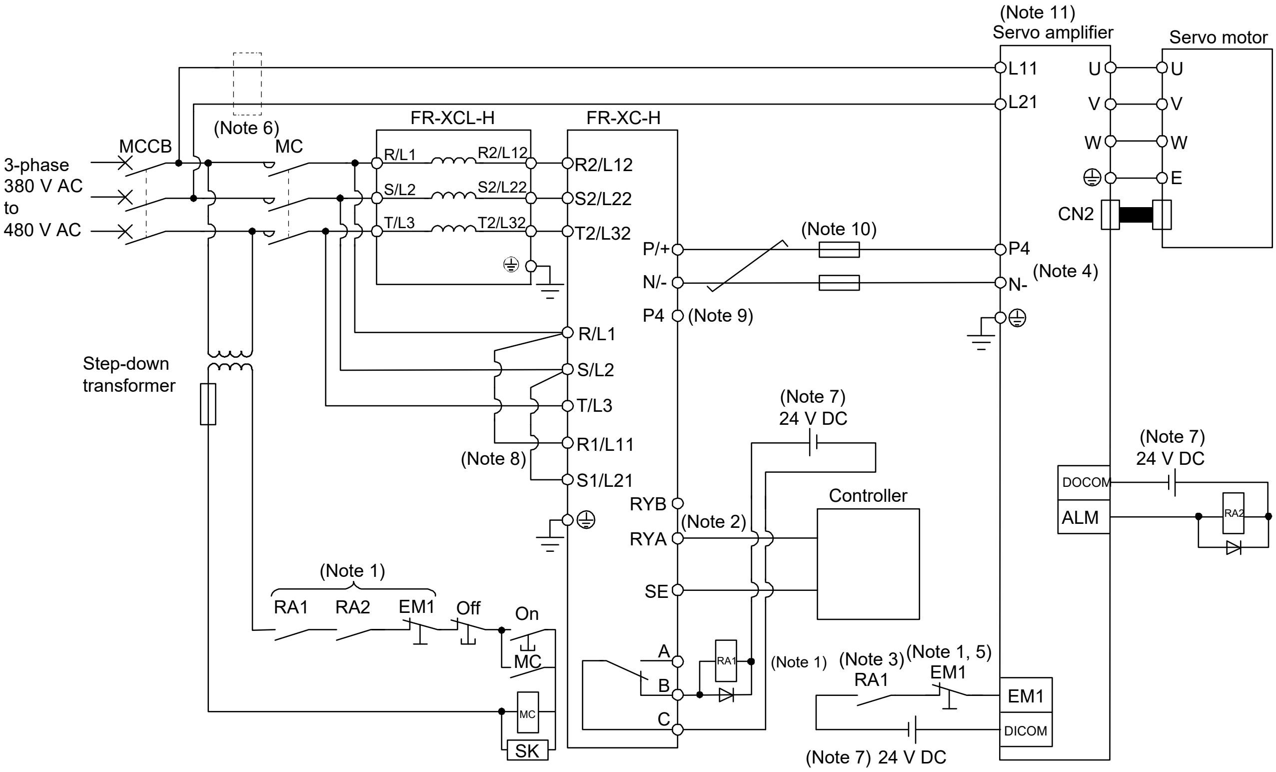


Note 1. Configure a sequence that shuts off the main circuit power supply in the following situations:

- When an alarm occurs in the FR-XC or servo amplifier
- When EM1 (Forced stop 1) is enabled.

2. Configure a sequence that shifts the status to servo-on once the FR-XC is ready.
3. Ensure that the servo motor stops with a forced stop input of the servo amplifier when an alarm occurs in the FR-XC. If the controller does not have an emergency stop input, use the forced stop input of the servo amplifier to stop the servo motor.
4. When using the FR-XC, remove the wire between P3 and P4.
5. To use EM1 (Forced stop 1), set [Pr. PA04] to "0 0 _ _".
6. If wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker.
7. Although the diagram shows the input signal and the output signal each using a separate 24 V DC power supply for illustrative purposes, the system can be configured to use a single 24 V DC power supply.
8. Remove the R1/L11 and S1/L21 jumpers when using a dedicated power supply for the control circuit.
9. Do not connect anything to the P4 terminal of the FR-XC.
10. Install a fuse on each wire between the FR-XC and servo amplifier.
11. Make sure to wire the built-in regenerative resistor when using servo amplifiers with a capacity of 7 kW or less. (factory-wired) (5 kW or less: between P+ and D, 7 kW: between P+ and C)

(2) 400 V class



Note
1. Configure a sequence that shuts off the main circuit power supply in the following situations:
    - When an alarm occurs in the FR-XC-H or servo amplifier
    - When EM1 (Forced stop 1) is enabled.
2. Configure a sequence that shifts the status to servo-on once the FR-XC-H is ready.
3. Ensure that the servo motor stops with a forced stop input of the servo amplifier when an alarm occurs in the FR-XC-H. If the controller does not have an emergency stop input, use the forced stop input of the servo amplifier to stop the servo motor.
4. When using the FR-XC-H, remove the wire between P3 and P4.
5. To use EM1 (Forced stop 1), set [Pr. PA04] to "0 0 _ _".
6. If wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker.
7. Although the diagram shows the input signal and the output signal each using a separate 24 V DC power supply for illustrative purposes, the system can be configured to use a single 24 V DC power supply.
8. Remove the R1/L11 and S1/L21 jumpers when using a dedicated power supply for the control circuit.
9. Do not connect anything to the P4 terminal of the FR-XC-H.
10. Install a fuse on each wire between the FR-XC-H and servo amplifier.
11. Make sure to wire the built-in regenerative resistor when using servo amplifiers with a capacity of 7 kW or less. (factory-wired) (3.5 kW or less: between P+ and D, 5 kW/7 kW: between P+ and C)

11.19.6 Wiring and peripheral options

(1) Wire size

POINT

●Selection requirements for the wire size are as follows.
Wire type: 600 V Grade heat-resistant polyvinyl chloride insulated wire (HIV wire)
Construction requirements: Single wire set in midair

(a) Between P/+ and P4, and between N/- and N-

The following table shows the size of the wire between the FR-XC-(H) and servo amplifier.

Total capacity of servo amplifiers [kW]	Wire size [mm^2]	
	200 V class	400 V class
1 or less	2 (AWG 14)	2 (AWG 14)
2	3.5 (AWG 12)	2 (AWG 14)
3.5	5.5 (AWG 10)	3.5 (AWG 12)
5	5.5 (AWG 10)	5.5 (AWG 10)
7	8 (AWG 8)	5.5 (AWG 10)
11	14 (AWG 6)	8 (AWG 8)
15	22 (AWG 4)	8 (AWG 8)
18.5	38 (AWG 2)	8 (AWG 8)
22	50 (AWG 1/0)	14 (AWG 6)
27.5	50 (AWG 1/0)	22 (AWG 4)
30	60 (AWG 2/0)	22 (AWG 4)
37	80 (AWG 3/0)	38 (AWG 2)
45	100 (AWG 4/0)	38 (AWG 2)
55	100 (AWG 4/0)	50 (AWG 1/0)

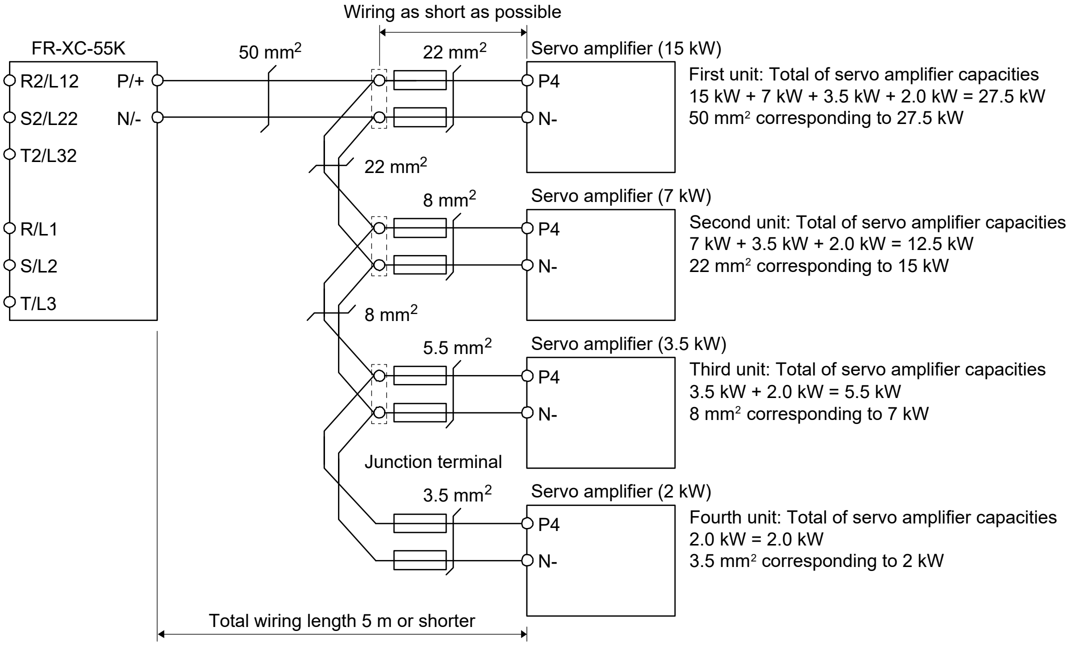
(b) Grounding

The following table shows the size of the grounding wire for the FR-XC-(H). Use the shortest size wire possible.

Multifunction regeneration converter	Wire size [mm^2]	
	Rated capacity of multifunction regeneration converter ≥ Total capacity of connected servo amplifiers × 2	Rated capacity of multifunction regeneration converter < Total capacity of connected servo amplifiers × 2
FR-XC-7.5K	8 (AWG 8)	8 (AWG 8)
FR-XC-11K	8 (AWG 8)	14(AWG 6)
FR-XC-15K	8 (AWG 8)	22 (AWG 4)
FR-XC-22K	22 (AWG 4)	38 (AWG 2)
FR-XC-30K	22 (AWG 4)	38 (AWG 2)
FR-XC-37K	38 (AWG 2)	60 (AWG 2/0)
FR-XC-55K	38 (AWG 2)	80 (AWG 3/0)
FR-XC-H7.5K	3.5 (AWG 12)	3.5 (AWG 12)
FR-XC-H11K	3.5 (AWG 12)	5.5 (AWG 10)
FR-XC-H15K	3.5 (AWG 12)	8 (AWG 8)
FR-XC-H22K	8 (AWG 8)	14 (AWG 6)
FR-XC-H30K	8 (AWG 8)	22 (AWG 4)
FR-XC-H37K	14 (AWG 6)	22 (AWG 4)
FR-XC-H55K	14 (AWG 6)	38 (AWG 2)

(2) Wire size selection example (between P/+ and P4, between N/- and N-)
When connecting multiple servo amplifiers to the FR-XC, junction terminal blocks must be used for the wiring to terminals P4 and N- on the servo amplifiers. Connect the servo amplifiers in order with the largest capacity first.

(a) 200 V class



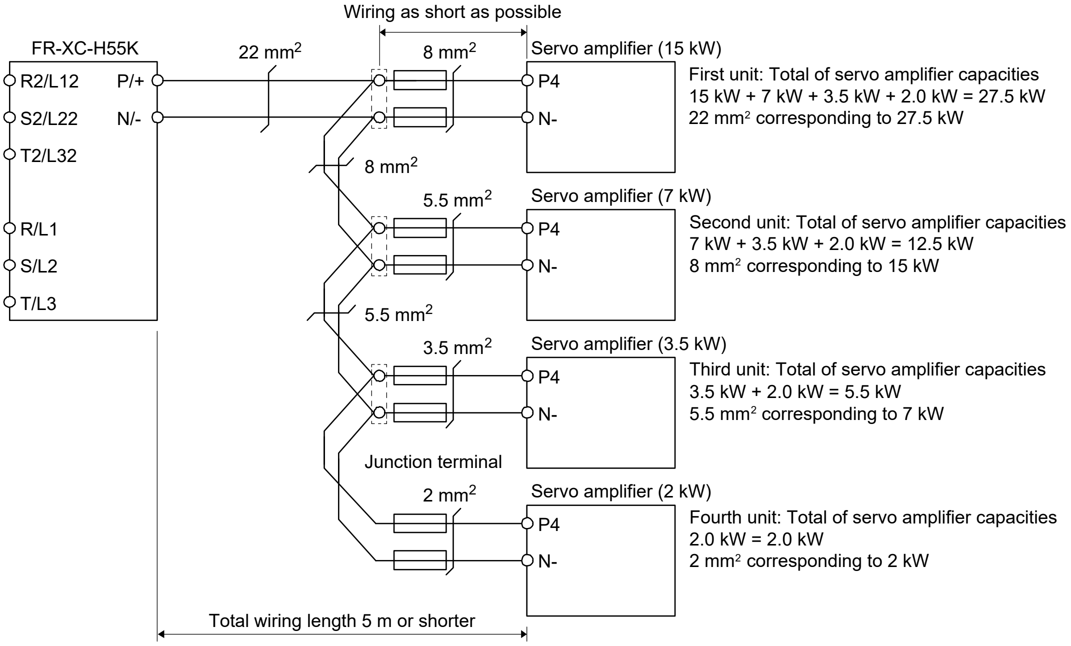
First unit: Total of servo amplifier capacities
15 kW + 7 kW + 3.5 kW + 2.0 kW = 27.5 kW
50 mm² corresponding to 27.5 kW

Second unit: Total of servo amplifier capacities
7 kW + 3.5 kW + 2.0 kW = 12.5 kW
22 mm² corresponding to 15 kW

Third unit: Total of servo amplifier capacities
3.5 kW + 2.0 kW = 5.5 kW
8 mm² corresponding to 7 kW

Fourth unit: Total of servo amplifier capacities
2.0 kW = 2.0 kW
3.5 mm² corresponding to 2 kW

(b) 400 V class



First unit: Total of servo amplifier capacities
15 kW + 7 kW + 3.5 kW + 2.0 kW = 27.5 kW
22 mm² corresponding to 27.5 kW

Second unit: Total of servo amplifier capacities
7 kW + 3.5 kW + 2.0 kW = 12.5 kW
8 mm² corresponding to 15 kW

Third unit: Total of servo amplifier capacities
3.5 kW + 2.0 kW = 5.5 kW
5.5 mm² corresponding to 7 kW

Fourth unit: Total of servo amplifier capacities
2.0 kW = 2.0 kW
2 mm² corresponding to 2 kW

(3) Fuses (between P/+ and P4, between N/- and N-)

The following table shows the recommended fuses which are to be installed between the FR-XC-(H) and servo amplifier.

Servo amplifier capacity [kW]	200 V class		400 V class	
	Fuse rating [A]	Model (Note)	Fuse rating [A]	Model (Note)
0.1	20	6.900CPGR10.38 0020		
0.2	20	6.900CPGR10.38 0020		
0.4	25	6.900CPGR10.38 0025		
0.6	25	6.900CPGR10.38 0025	20	6.900CPGR10.38 0020
0.75	30	6.900CPGR10.38 0030		
1	32	6.900CPGR10.38 0032	20	6.900CPGR10.38 0020
2	63	6.9URD30TTF0063	25	6.900CPGR10.38 0025
3.5	80	6.9URD30TTF0080	63	6.9URD30TTF0063
5	160	6.9URD30TTF0160	80	6.9URD30TTF0080
7	200	6.9URD30TTF0200	100	6.9URD30TTF0100
11	250	6.9URD30TTF0250	160	6.9URD30TTF0160
15	315	6.9URD30TTF0315	160	6.9URD30TTF0160
22	350	6.9URD30TTF0350	200	6.9URD30TTF0200

Note. Manufacturer: Mersen Fma Japan KK
Service inquiries: Sun-wa Technos Corp.

(4) Molded-case circuit breakers/earth-leakage current breakers and magnetic contactors

Recommended molded-case circuit breakers/earth-leakage current breakers and magnetic contactors are listed in the table below.

(a) 200 V class

Item	FR-XC-_						
	7.5K	11K	15K	22K	30K	37K	55K
Molded-case circuit breaker or earth-leakage current breaker (Note)	100AF 60A (30AF 30A)	100AF 75A (50AF 50A)	225AF 125A (100AF 75A)	225AF 175A (100AF 100A)	225AF 225A (125AF 125A)	400AF 250A (125AF 125A)	400AF 400A (225AF 175A)
Magnetic contactor (Note)	S-T35 (S-T21)	S-T50 (S-T35)	S-T65 (S-T50)	S-T100 (S-T65)	S-N125 (S-T80)	S-N150 (S-T100)	S-N220 (S-N125)

Note. Models in parentheses can be used when the rated capacity of multifunction regeneration converter ≥ total capacity of connected servo amplifiers × 2.

(b) 400 V class

Item	FR-XC-H_						
	7.5K	11K	15K	22K	30K	37K	55K
Molded-case circuit breaker or earth-leakage current breaker (Note)	30AF 30A (30AF 15A)	50AF 50A (30AF 20A)	100AF 60A (30AF 30A)	100AF 100A (50AF 50A)	225AF 125A (60AF 60A)	225AF 150A (100AF 75A)	225AF 200A (100AF 100A)
Magnetic contactor (Note)	S-T21	S-T25 (S-T21)	S-T35 (S-T21)	S-T50 (S-T25)	S-T65 (S-T35)	S-T80 (S-T50)	S-N125 (S-T65)

Note. Models in parentheses can be used when the rated capacity of multifunction regeneration converter ≥ total capacity of connected servo amplifiers × 2.

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.
- If [AL. 25], [AL. 92], or [AL. 9F] occurs due to such as short circuit of the battery, the MR-BAT6V1 battery can become hot. Use the MR-BAT6V1 battery with case to prevent getting burnt.

POINT

- Refer to section 11.8 for the replacement procedure of the battery.
- There are three types of batteries, MR-BAT6V1SET, MR-BAT6V1BJ, and MR-BT6VCASE available to construct the absolute position detection system. MR-BAT6V1BJ has the following advantages compared to other batteries.
  - You can disconnect the encoder cable from the servo amplifier.
  - You can replace the battery with the control circuit power supply off.
- When absolute position data is erased from the encoder, always execute home position setting before operation. The absolute position data of the encoder will be erased in the followings. Additionally, when the battery is used out of specification, the absolute position data can be erased.
  MR-BAT6V1SET and MR-BT6VCASE
  - The encoder cable was disconnected.
  - The battery was replaced when the control circuit power supply was off.

  MR-BAT6V1BJ
  - A connector or cable was disconnected between the servo motor and battery.
  - The battery was replaced with procedures other than those of (6) in section 11.8.3.

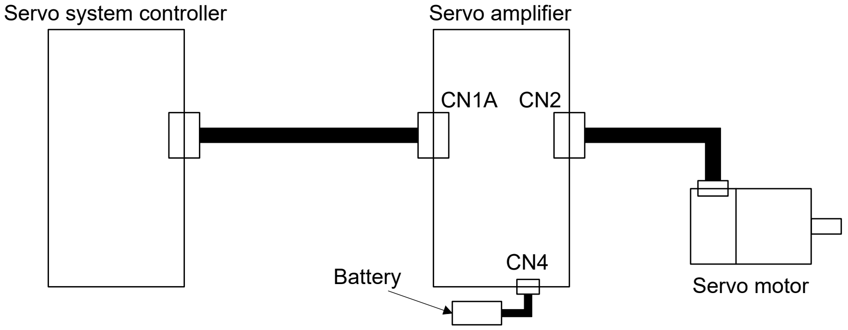
12.1 Summary

12.1.1 Features

For normal operation, 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 servo system 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.

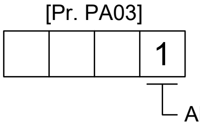
12.1.2 Structure

The following shows a configuration of the absolute position detection system. Refer to section 11.8 for each battery connection.



12.1.3 Parameter setting

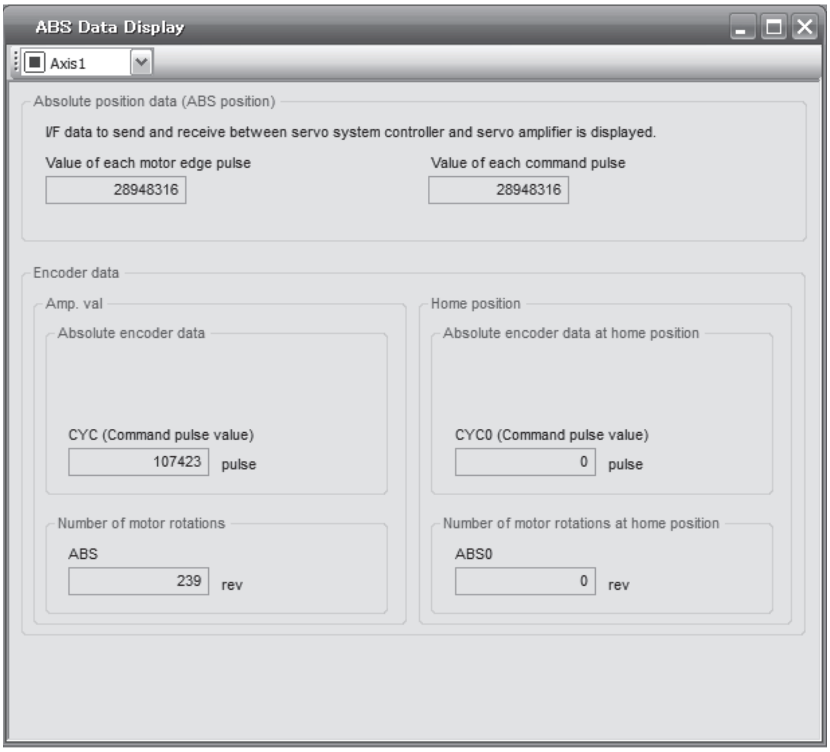
Set "_ _ _ 1" in [Pr. PA03] to enable the absolute position detection system.



Absolute position detection system selection
0: Disabled (used in incremental system)
1: Enabled (used in absolute position detection system)

12.1.4 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.



Absolute position data (ABS position)

I/F data to send and receive between servo system controller and servo amplifier is displayed.

Value of each motor edge pulse: 28948316

Value of each command pulse: 28948316

Encoder data

Amp. val

Absolute encoder data

CYC (Command pulse value): 107423 pulse

Number of motor rotations

ABS: 239 rev

Home position

Absolute encoder data at home position

CYC0 (Command pulse value): 0 pulse

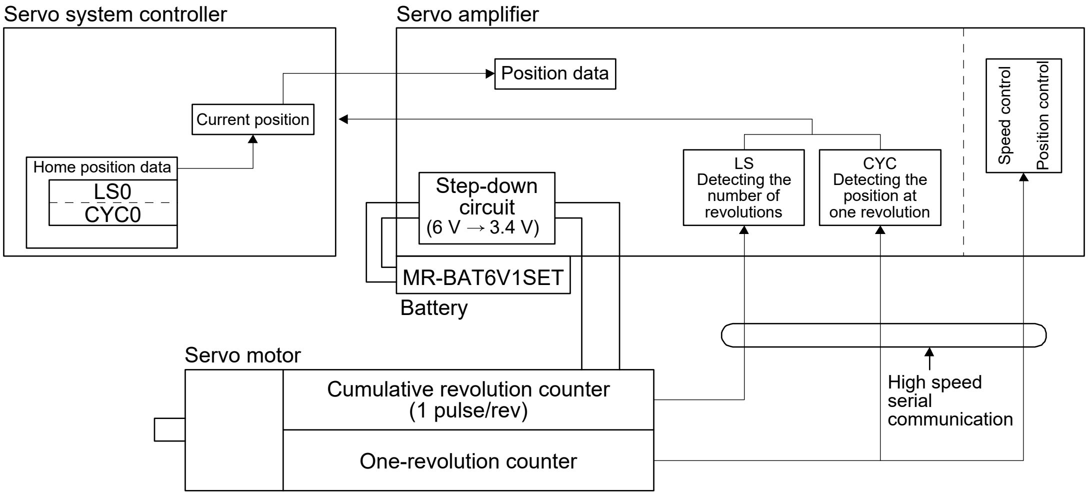
Number of motor rotations at home position

ABS0: 0 rev

12.2 Battery

12.2.1 Using MR-BAT6V1SET battery

(1) Configuration diagram



(2) Specifications

(a) Specification list

Item		Description
System		Electronic battery backup type
Maximum revolution range		Home position ± 32767 rev.
(Note 1) Maximum speed at power failure [r/min]	Rotary servo motor	6000 (only when acceleration time until 6000 r/min is 0.2 s or more)
	Direct drive motor	500 (only when acceleration time until 500 r/min is 0.1 s or more)
(Note 2) Battery backup time	Rotary servo motor	Approximately 20,000 hours (equipment power supply: off, ambient temperature: 20 °C) Approximately 29,000 hours (power-on time ratio: 25%, ambient temperature: 20 °C) (Note 3)
	Direct drive motor	Approximately 5,000 hours (equipment power supply: off, ambient temperature: 20 °C) Approximately 15,000 hours (power-on time ratio: 25%, ambient temperature: 20 °C) (Note 3)

Note 1. Maximum speed available when the shaft is rotated by external force at the time of power failure or the like. 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.

2. The data-holding time by the battery using MR-BAT6V1SET. Replace the batteries within three years since the operation start regardless of the power supply of the servo amplifier on/off. If the battery is used out of specification, [AL. 25 Absolute position erased] may occur.

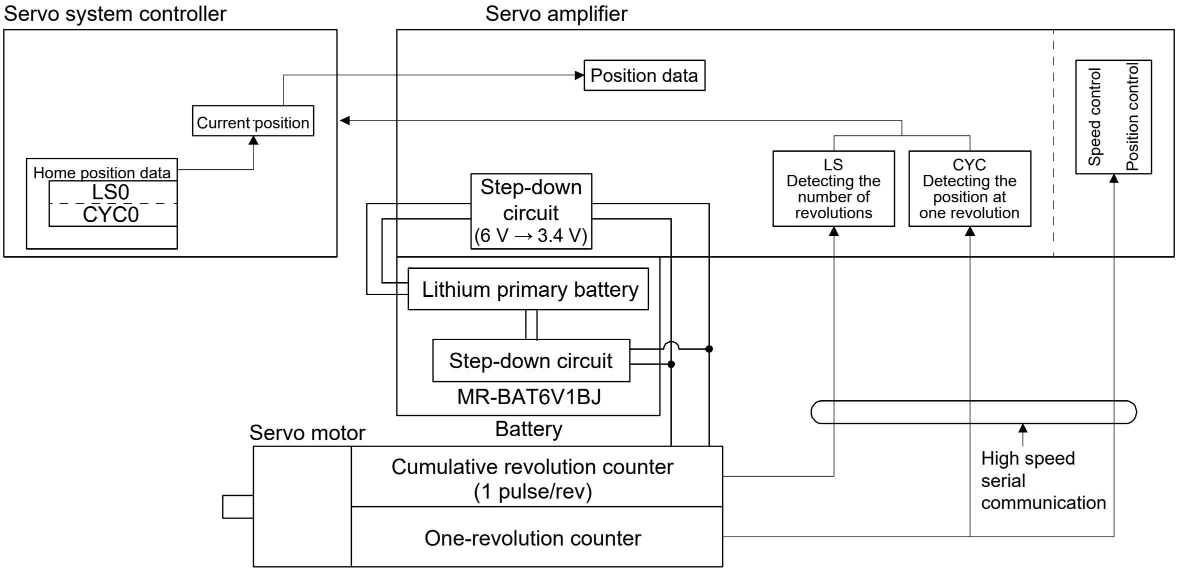
3. The power-on time ratio 25% is equivalent to 8 hours power on for a weekday and off for a weekend.

12.2.2 Using MR-BAT6V1BJ battery for junction battery cable

POINT

- ●MR-BAT6V1BJ is compatible only with HG series servo motors. It cannot be used with direct drive motors.
- ●MR-BAT6V1BJ cannot be used for fully closed loop system.

(1) Configuration diagram



(2) Specifications

(a) Specification list

Item		Description
System		Electronic battery backup type
Maximum revolution range		Home position ± 32767 rev.
(Note 1) Maximum speed at power failure [r/min]	Rotary servo motor	6000 (only when acceleration time until 6000 r/min is 0.2 s or more)
(Note 2) Battery backup time	Rotary servo motor	Approximately 20,000 hours (equipment power supply: off, ambient temperature: 20 ˚C) Approximately 29,000 hours (power-on time ratio: 25%, ambient temperature: 20 °C) (Note 3)

Note 1. Maximum speed available when the shaft is rotated by external force at the time of power failure or the like. 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.

2. The data-holding time by the battery using MR-BAT6V1BJ. Replace the batteries within three years since the operation start regardless of the power supply of the servo amplifier on/off. If the battery is used out of specification, [AL. 25 Absolute position erased] may occur.

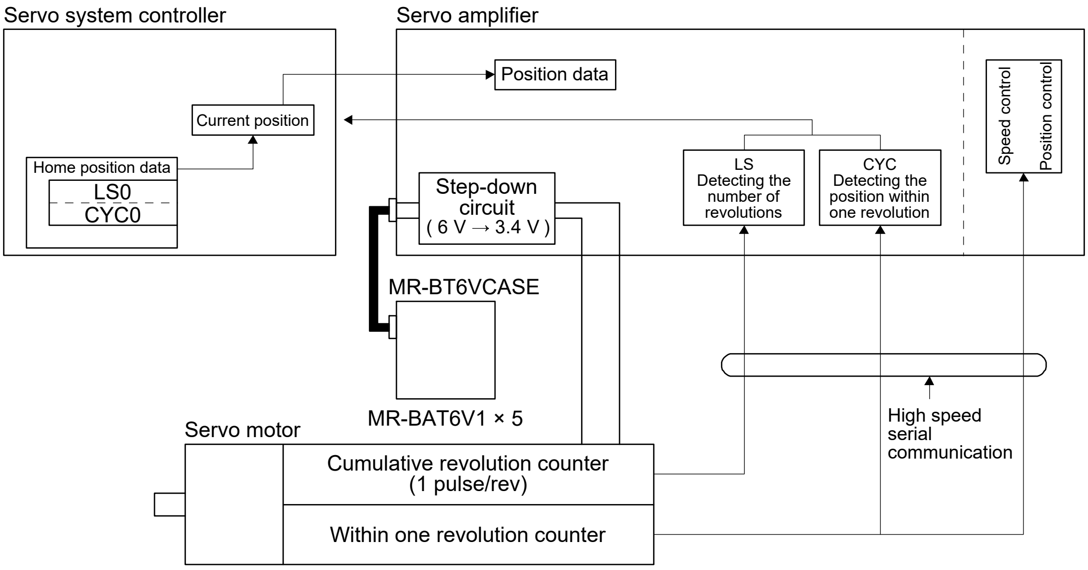
3. The power-on time ratio 25% is equivalent to 8 hours power on for a weekday and off for a weekend.

12.2.3 Using MR-BT6VCASE battery case

POINT

- ●One MR-BT6VCASE holds absolute position data up to eight axes servo motors.
- ●Always install five MR-BAT6V1 batteries to an MR-BT6VCASE.

(1) Configuration diagram



(2) Specification list

Item		Description
System		Electronic battery backup type
Maximum revolution range		Home position ± 32767 rev.
(Note 1) Maximum speed at power failure [r/min]	Rotary servo motor	6000 (only when acceleration time until 6000 r/min is 0.2 s or more)
	Direct drive motor	500 (only when acceleration time until 500 r/min is 0.1 s or more)
(Note 2) Battery backup time	Rotary servo motor	Approximately 40,000 hours/2 axes or less, 30,000 hours/3 axes, or 10,000 hours/8 axes (equipment power supply: off, ambient temperature: 20 ˚C) Approximately 55,000 hours/2 axes or less, 38,000 hours/3 axes, or 15,000 hours/8 axes (power-on time ratio: 25%, ambient temperature: 20 °C) (Note 3)
	Direct drive motor	Approximately 10,000 hours/2 axes or less, 7,000 hours/3 axes, or 5,000 hours/4 axes (equipment power supply: off, ambient temperature: 20 ˚C) Approximately 15,000 hours/2 axes or less, 13,000 hours/3 axes, or 10,000 hours/4 axes (power-on time ratio: 25%, ambient temperature: 20 °C) (Note 3)

Note 1. Maximum speed available when the shaft is rotated by external force at the time of power failure or the like. 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.

2. The data-holding time by the battery using five MR-BAT6V1s. The battery life varies depending on the number of axes (including axis for using in the incremental system). Replace the batteries within three years since the operation start regardless of the power supply of the servo amplifier on/off. If the battery is used out of specification, [AL. 25 Absolute position erased] may occur.

3. The power-on time ratio 25% is equivalent to 8 hours power on for a weekday and off for a weekend.

MEMO

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 13849-1:2015 Category 3 PL e
- IEC 61508 SIL 3
- IEC/EN 61800-5-2
- IEC/EN IEC 62061 maximum SIL 3

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 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.

⚠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

- 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.

13.1.4 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 Electric 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/L3) of the servo amplifier.

(2) The STO function disables energy supply to the servo motor by electrical shut-off. It does not guarantee stop control or 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 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 modules in the servo amplifier are shorted and damaged simultaneously, the servo motor may make a half revolution at a maximum. For a linear servo motor, the primary side will move a distance of pole pitch.

(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.

13.1.5 Specifications

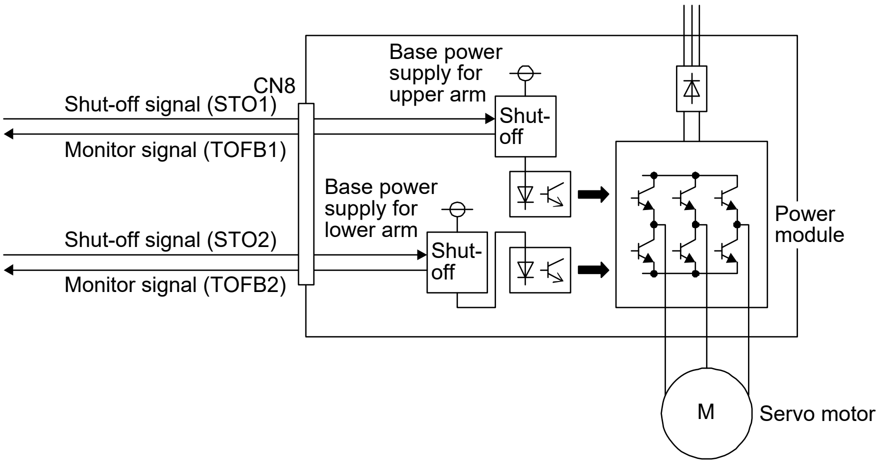
(1) Specifications

Item	Specifications
Safety observation function	STO (IEC/EN 61800-5-2)
Standards (Note 2)	EN ISO 13849-1:2015 Category 3 PL e, IEC 61508 SIL 3, EN IEC 62061 maximum SIL 3, EN 61800-5-2
Mean time to dangerous failure (MTTFd)	MTTFd ≥ 100 [years] (314a) (Note 1)
Diagnostic converge (DC)	DC = Medium, 97.6 [%] (Note 1)
Probability of dangerous failures per hour (PFH)	PFH = 6.4 × 10^{-9} [1/h]
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 13849-1:2015, EN 61800-5-2, EN IEC 62061

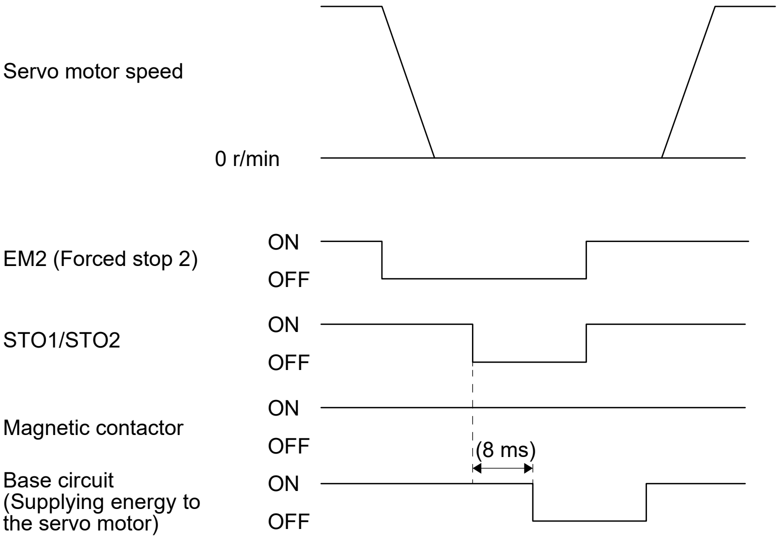
Note 1. This is the value required by safety standards.

2. The safety level depends on the setting value of [Pr. PF18 STO diagnosis error detection time] and whether STO input diagnosis by TOFB output is performed or not. For details, refer to the Function column of [Pr. PF18] in section 5.2.6.

(2) Function block diagram (STO function)



(3) Operation sequence (STO function)



13.1.6 Maintenance

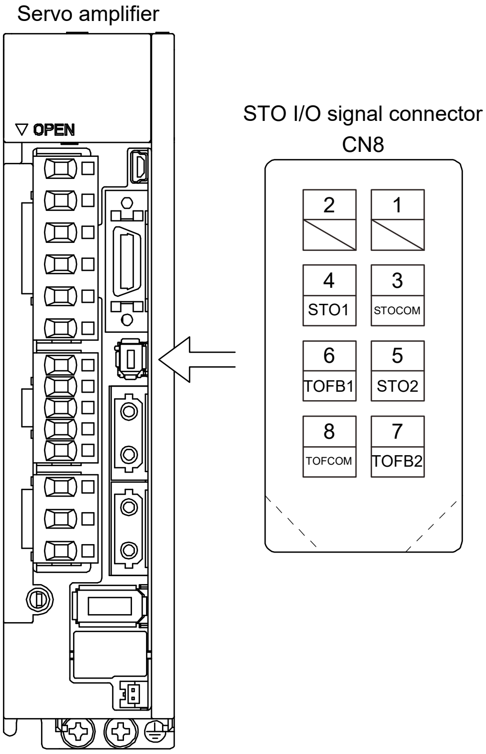
This servo amplifier has alarms and warnings for maintenance that supports the Drive safety function. (Refer to chapter 8.)

13.2 STO I/O signal connector (CN8) and signal layouts

13.2.1 Signal layouts

POINT

- The pin assignment of the connectors is as viewed from the cable connector wiring section.



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 (STO1 state)	Between TOFB2 and TOFCOM (STO2 state)	Between TOFB1 and TOFB2 (STO state)	STO
Off	Off	ON: STO state	ON: STO state	ON	STO state
Off	On	ON: STO state	OFF: STO release state	OFF (Note)	STO state
On	Off	OFF: STO release state	ON: STO state	OFF (Note)	STO state
On	On	OFF: STO release state	OFF: STO release state	OFF	STO release state

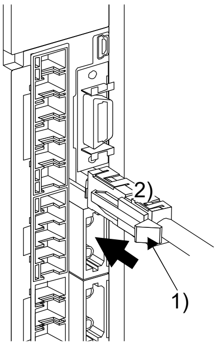
Note. Between TOFB1 and TOFB2 is off, but the servo amplifier is in the STO state.

(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.

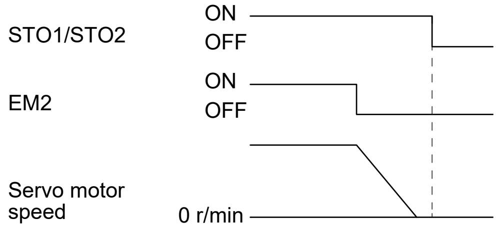


While pressing knob 1) of the STO cable plug in the direction of the arrow, pull out the plug 2).

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.



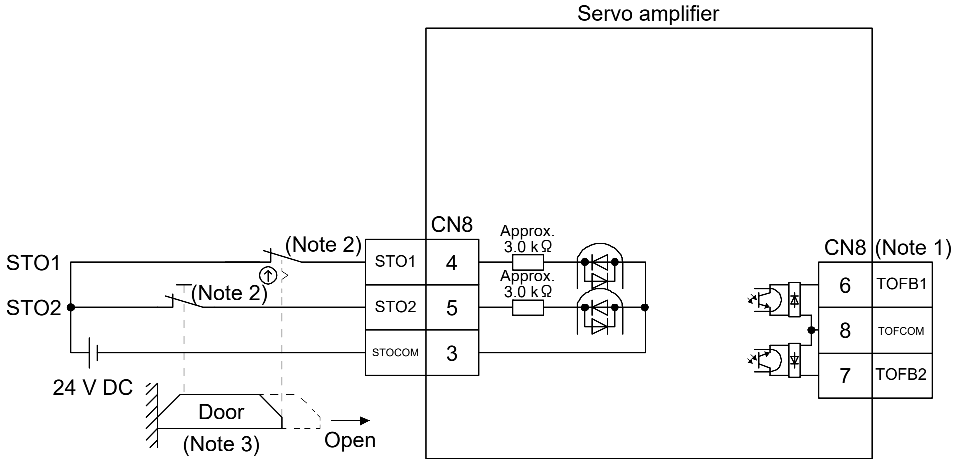
- If STO is turned off during operation, the servo motor is in dynamic brake stop (stop category 0), and [AL. 63 STO timing error] will occur.

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 app. 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. The safety level depends on the setting value of [Pr. PF18 STO diagnosis error detection time] and whether STO input diagnosis by TOFB output is performed or not. For details, refer to the Function column of [Pr. PF18] in section 5.2.6.

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).

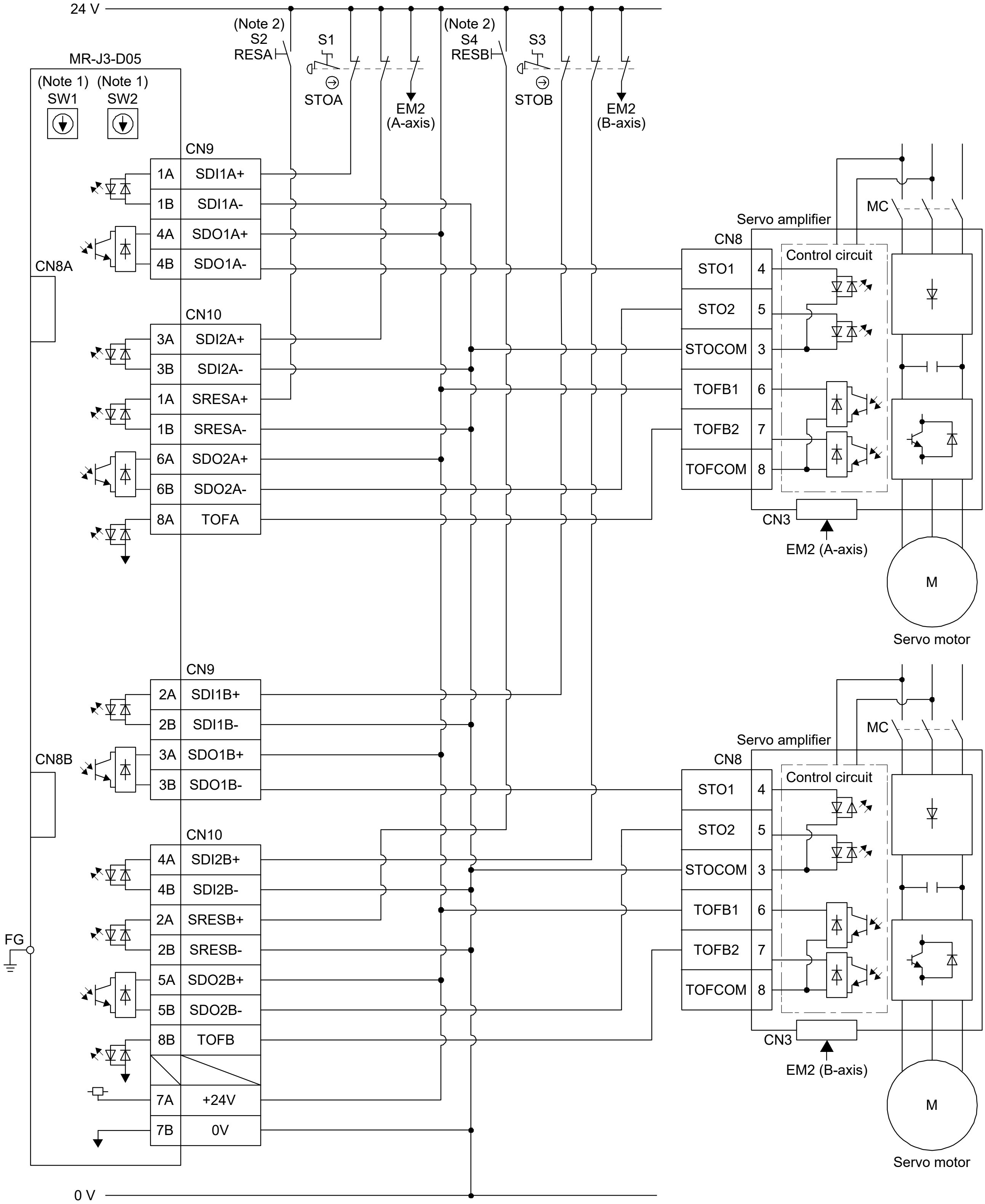
3. Configure the interlock circuit so that the door is open after the servo motor is stopped.

13.3.2 External I/O signal connection example using an MR-J3-D05 safety logic unit

POINT

- This connection is for source interface. For the other I/O signals, refer to the connection examples in section 3.2.2.

(1) Connection example



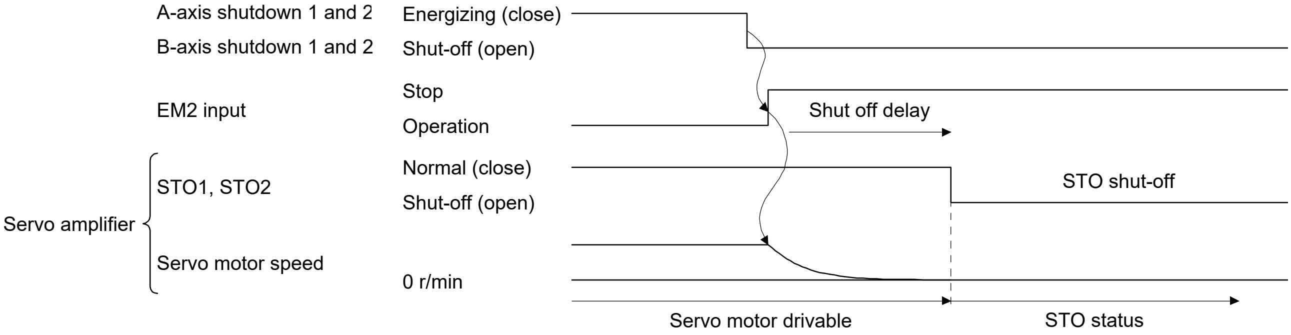
Note 1. Set the delay time of STO output with SW1 and SW2. These switches are located in a recessed area to prevent accidental setting changes.

2. To release the STO state (base circuit shut-off), turn RESA and RESB on and turn them off.

(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.

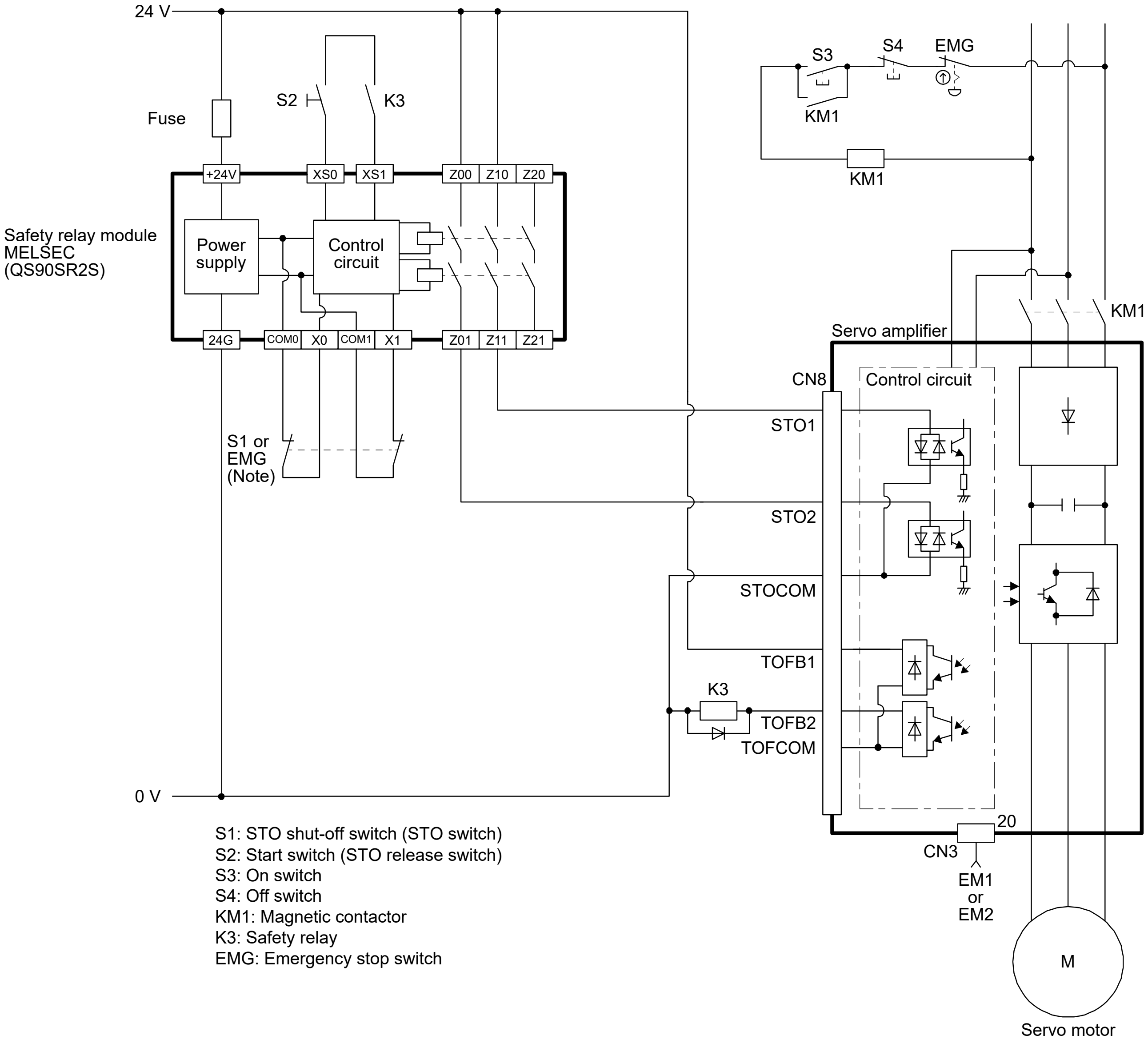


13.3.3 External I/O signal connection example using an external safety relay unit

POINT

- This connection is for source interface. For the other I/O signals, refer to the connection examples in section 3.2.2.

This connection example complies with the requirement of ISO/EN ISO 13849-1:2015 Category 3 PL d. For details, refer to the safety relay module user's manual.



S1: STO shut-off switch (STO switch)
S2: Start switch (STO release switch)
S3: On switch
S4: Off switch
KM1: Magnetic contactor
K3: Safety relay
EMG: Emergency stop switch

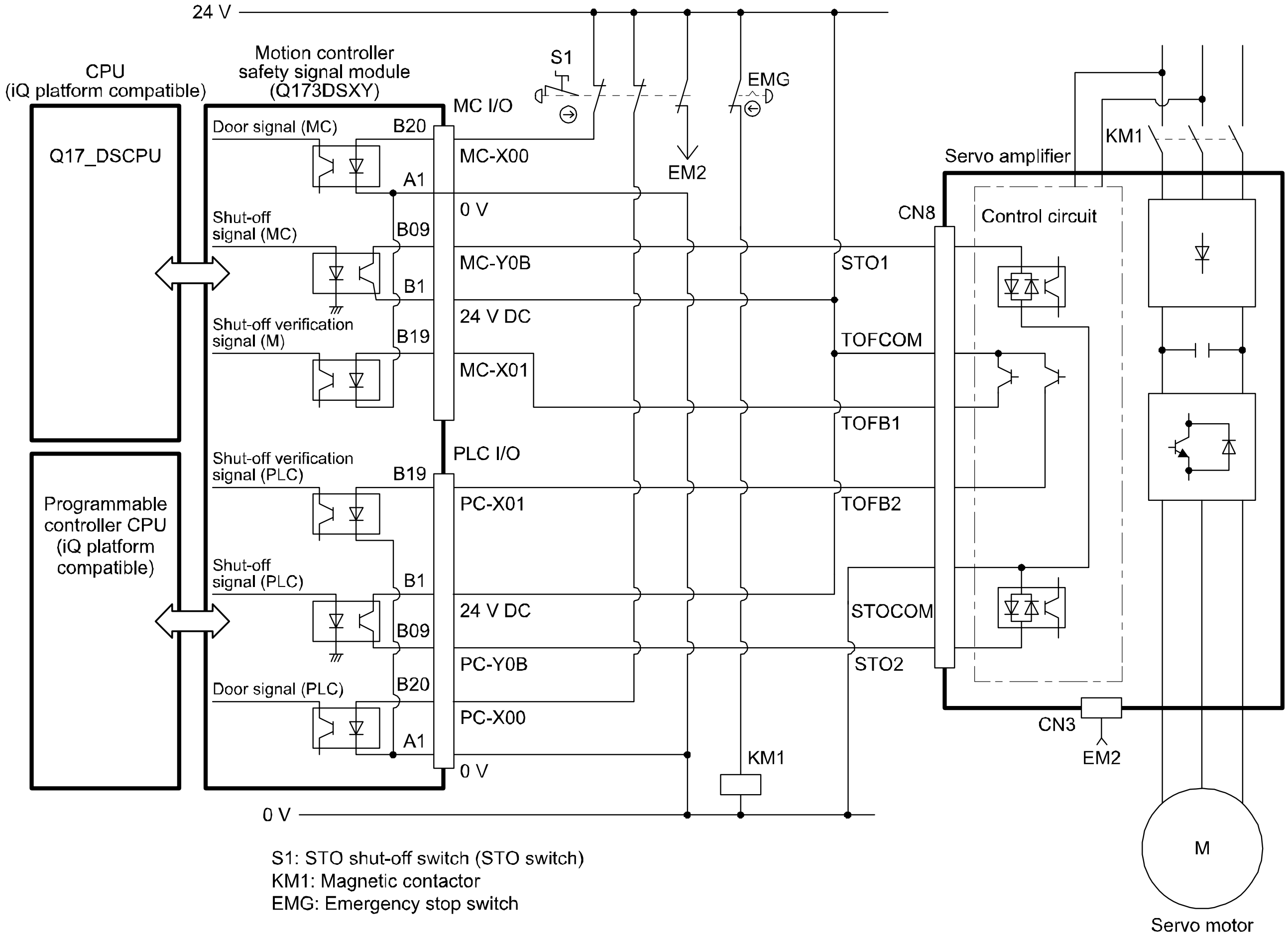
Note. To enable the STO function of the servo amplifier by using "Emergency switching off", change S1 to EMG. The stop category at this time is "0". If STO is turned off while the servo motor is rotating, [AL. 63 STO timing error] will occur.

13.3.4 External I/O signal connection example using a motion controller

POINT

- ●This connection is for source interface. For the other I/O signals, refer to the connection examples in section 3.2.2.
- ●For MC-Y0B and PC-Y0B, design a sequence program to output MC-Y0B and PC-Y0B after the servo motor stops.

This connection diagram is an example of STO circuit configured with a servo amplifier and motion controller. Use the switch that complies with the requirement of ISO/EN ISO 13849-1:2015 Category 3 PL d as an emergency stop switch. This connection example complies with the requirement of ISO/EN ISO 13849-1:2015 Category 3 PL d. The following shows an example of I/O (X and Y) signal assignment of the motion controller safety signal module. For details, refer to the motion controller user's manual.



S1: STO shut-off switch (STO switch)
KM1: Magnetic contactor
EMG: Emergency stop switch

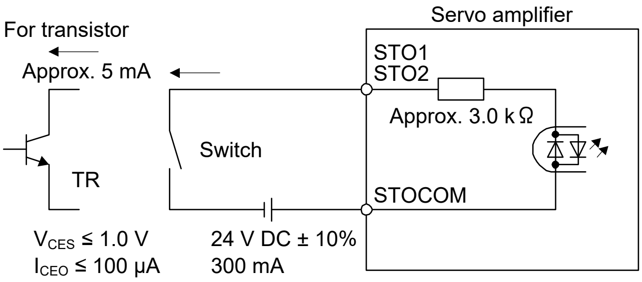
13.4 Detailed description of interfaces

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 the input terminal. Transmit signals from sink (open-collector) type transistor output, relay switch, etc.



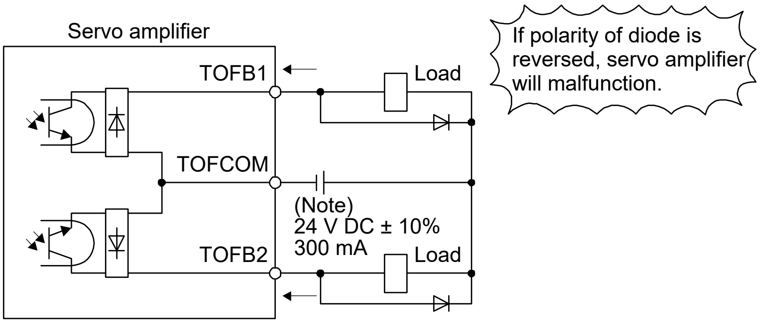
(2) Digital output interface DO-1

This is a circuit in which the collector of the output transistor is the output terminal. When the output transistor is turned on, the current will flow to 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.

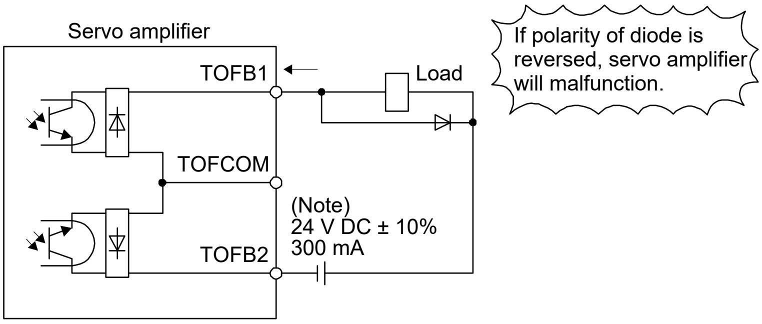
(Rated current: 40 mA or less, maximum current: 50 mA or less, inrush current: 100 mA or less) A maximum of 5.2 V voltage drop occurs in the servo amplifier.

(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.

(b) When outputting two STO states by using one TOFB



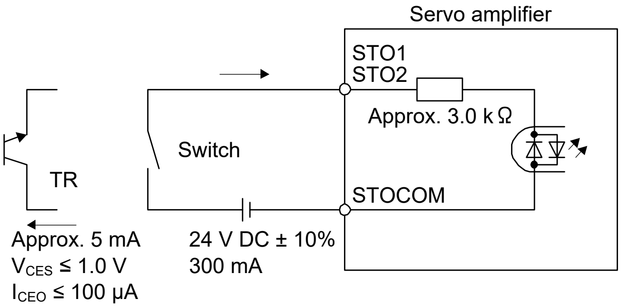
Note. If the voltage drop (maximum of 5.2 V) interferes with the relay operation, apply high voltage (maximum of 26.4 V) from external source.

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 the input terminal. Transmit signals from source (open-collector) type transistor output, relay switch, etc.

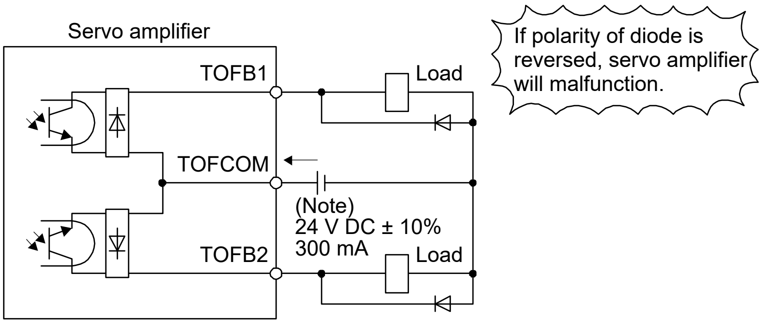


(2) Digital output interface DO-1

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

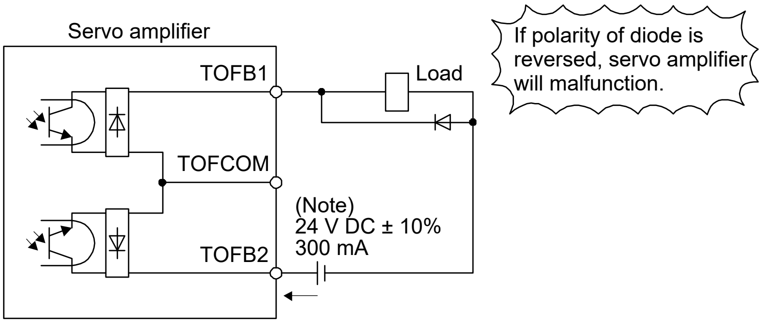
A maximum of 5.2 V voltage drop occurs in the servo amplifier.

(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.

(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. USING A LINEAR SERVO MOTOR

⚠WARNING	●When using the linear servo motor, read "Linear Servo Motor Instruction Manual" and "Linear Encoder Instruction Manual".

14.1 Functions and configuration

14.1.1 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. Using a linear servo system can achieve higher speed and acceleration/deceleration characteristics than the ball screw-drive system. Unlike the ball screw-drive system, the linear servo system does not have disadvantages such as ball screw wear. The linear servo system allows the service life of equipment to be prolonged. 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		Remark
			Linear servo motor	Rotary servo motor	
External I/O signal	FLS (Upper stroke limit), RLS (Lower stroke limit)		Required (for magnetic pole detection)	Not required	Automatically turns on in the parameter setting.
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 14.3.3.)
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 14.3.3)
Absolute position detection system	Absolute position encoder battery		Not required	Required	The following alarms and warnings are not provided for the linear servo motor. ・[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-_) (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	None	Supported	
		JOG operation	None	Supported	
		Program operation	Supported	Supported	

14.1.2 Servo system with auxiliary equipment

⚠CAUTION

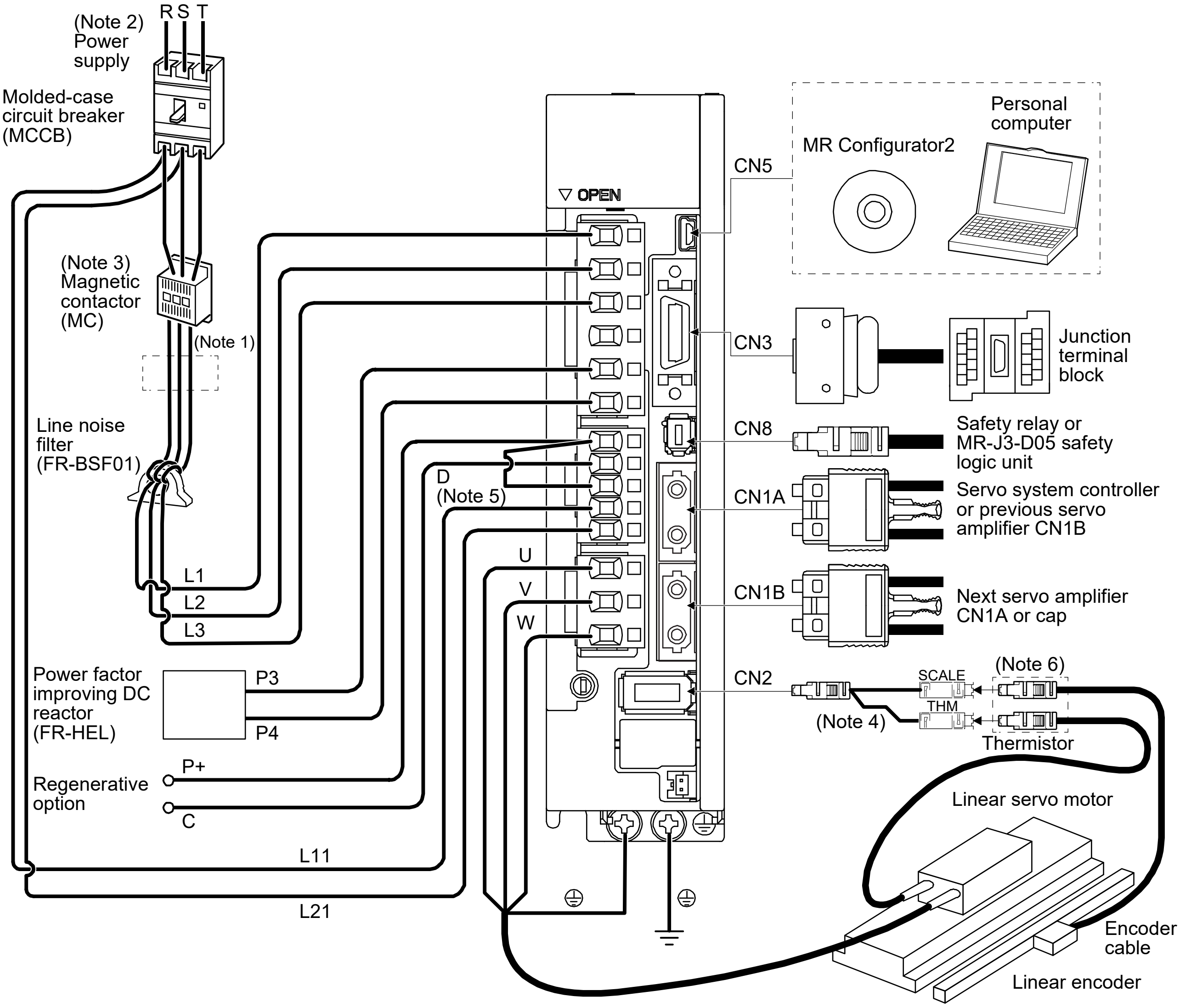
- Connecting a linear servo motor for different axis to the U, V, W, or CN2 may cause a malfunction.

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-_B_

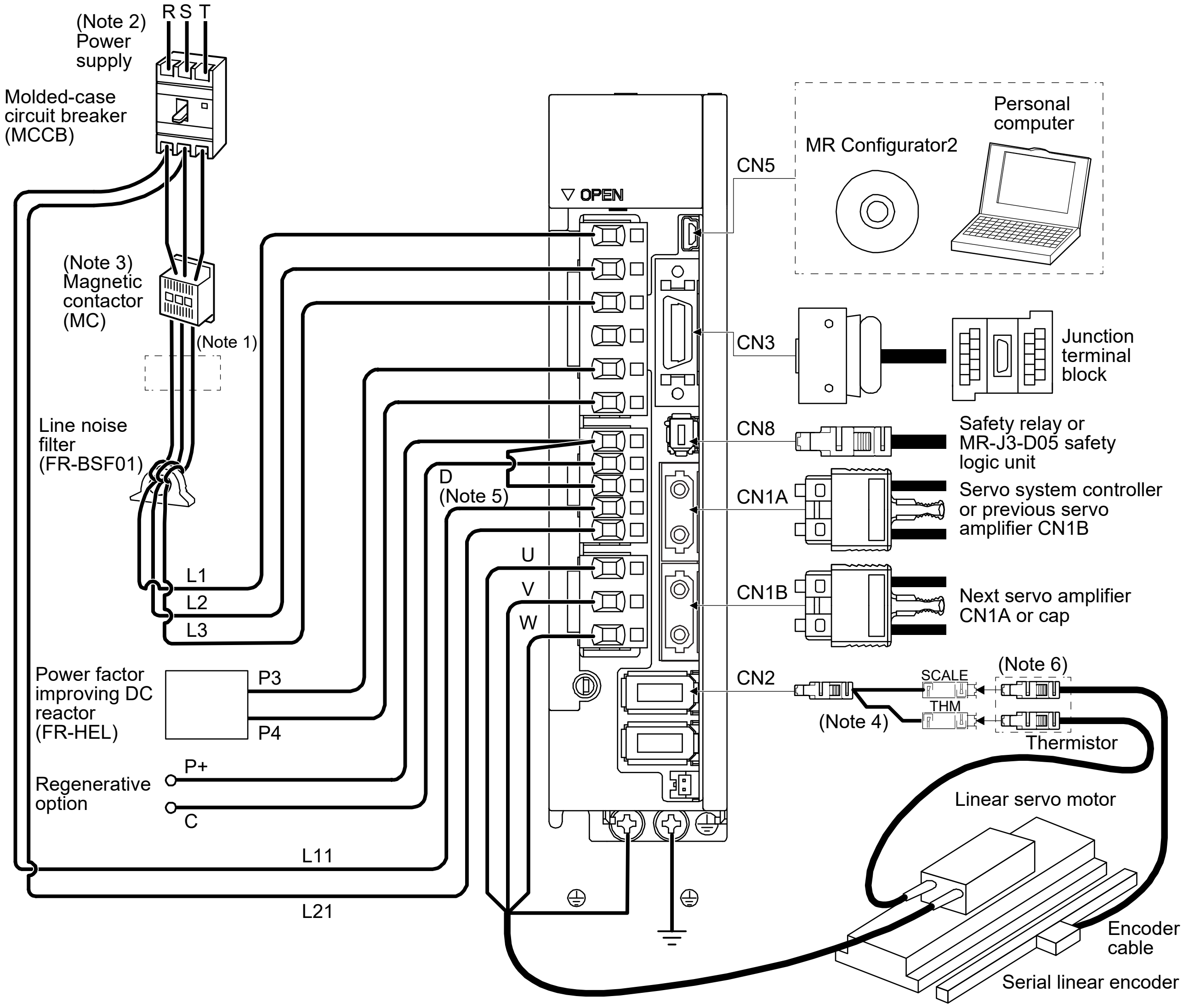
The configuration diagram is an example of MR-J4-20B. When using the other servo amplifiers, the configuration will be the same as rotary servo motors except for connections of linear servo motors and linear encoders. Refer to section 1.8 depending on servo amplifiers you use.



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-J4-200B or less. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open. For 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.
6. Connect the thermistor to THM of branch cable and connect the encoder cable to SCALE correctly. Incorrect setting will trigger [AL. 16].

(2) When using serial linear encoder with MR-J4-_B_-RJ

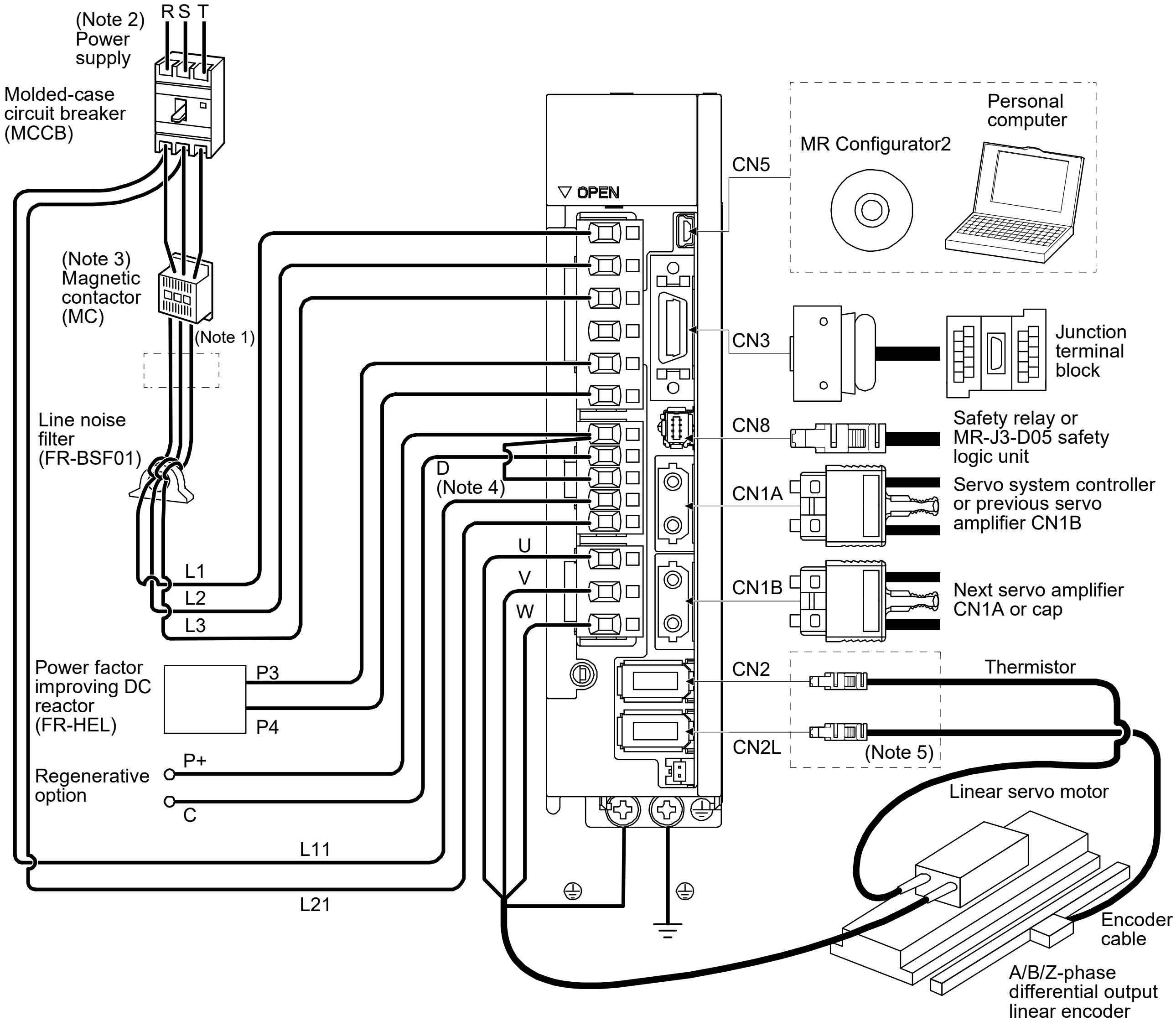
The configuration diagram is an example of MR-J4-20B-RJ. When using the other servo amplifiers, the configuration will be the same as rotary servo motors except for connections of linear servo motors and linear encoders. Refer to section 1.8 depending on servo amplifiers you use.



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-J4-200B-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 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.
6. Connect the thermistor to THM of branch cable and connect the encoder cable to SCALE correctly. Incorrect setting will trigger [AL. 16].

(3) When using A/B/Z-phase differential output linear encoder with MR-J4-_B_-RJ

The configuration diagram is an example of MR-J4-20B-RJ. When using the other servo amplifiers, the configuration will be the same as rotary servo motors except for connections of linear servo motors and linear encoders. Refer to section 1.8 depending on servo amplifiers you use.



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-J4-200B-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. Always connect between P+ and D terminals. When using the regenerative option, refer to section 11.2.
5. Connect the thermistor to CN2 of servo amplifier and connect the encoder cable to CN2L correctly. Incorrect setting will trigger [AL. 16].

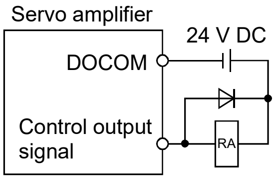
14.2 Signals and wiring

⚠WARNING

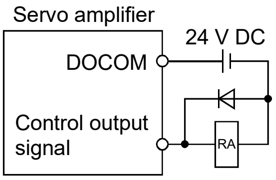
- Any person who is involved in wiring should be fully competent to do the work.
- Before wiring, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. Otherwise, an electric shock 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.

⚠CAUTION

- 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.

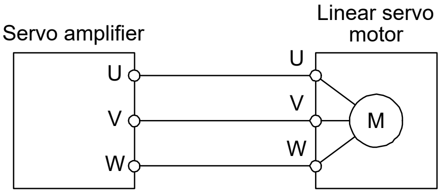


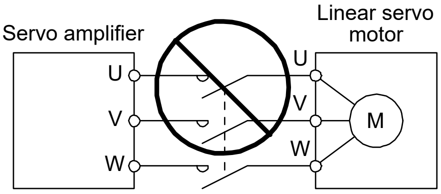
For sink output interface



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(-H)) 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/W) to the linear servo motor power input (U/V/W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.





⚠CAUTION

- ●Before wiring, switch operation, etc., eliminate static electricity. Otherwise, it may cause a malfunction.
- ●Connecting a linear servo motor for different axis to the U, V, W, or CN2 may cause a malfunction.
- ●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 chapter does not describe the following items. For details of the items, refer to each section of the detailed description field.

Item	Detailed explanations
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 3.7
Interfaces	Section 3.8
SSCNET III cable connection	Section 3.9
Grounding	Section 3.11
Switch setting and display of the servo amplifier	Section 4.3

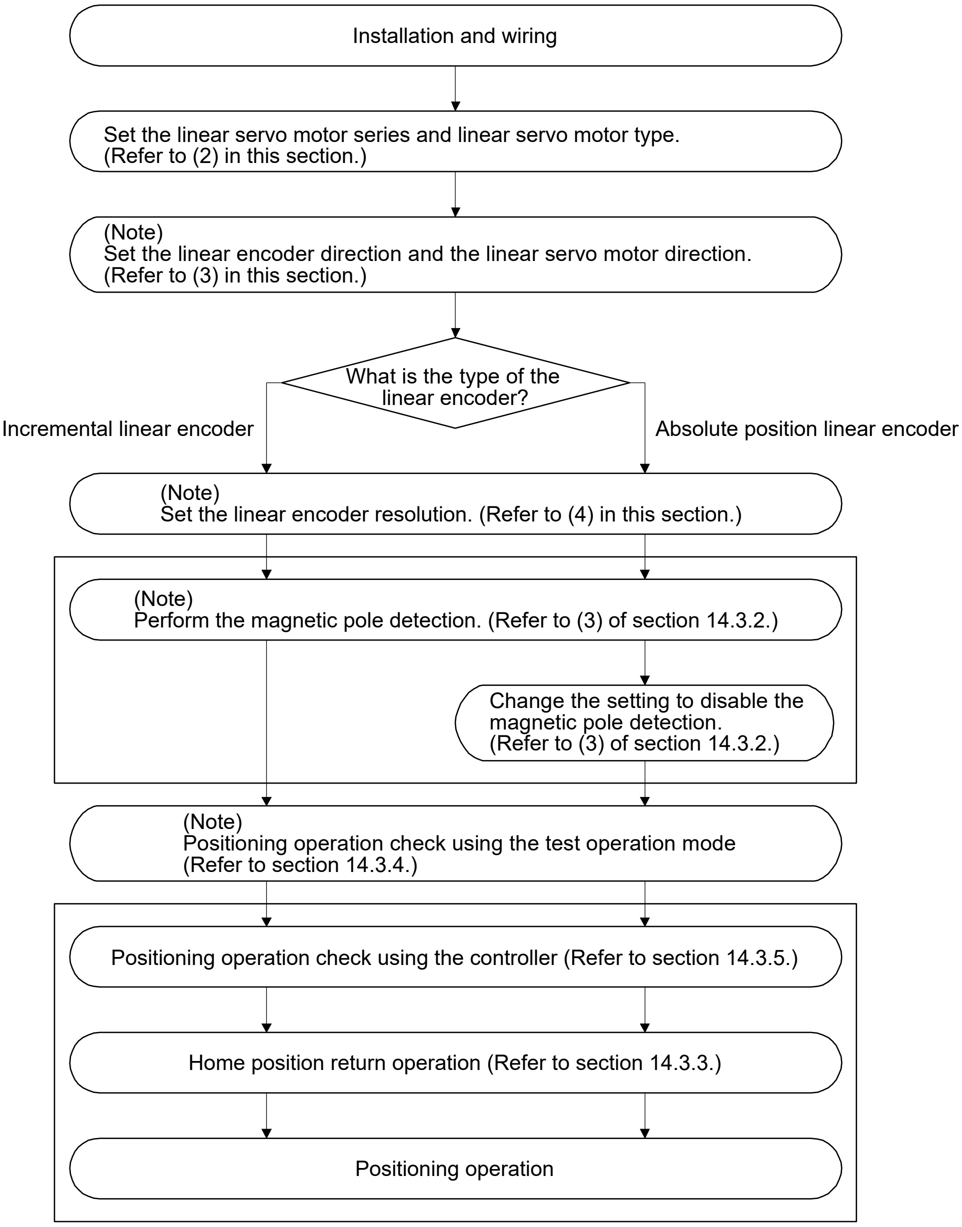
14.3 Operation and functions

14.3.1 Startup

POINT
●When using the linear servo motor, set [Pr. PA01] to "_ _ 4 _".

(1) Startup procedure

Start up the linear servo system in the following procedure.



Note. Use MR Configurator2.

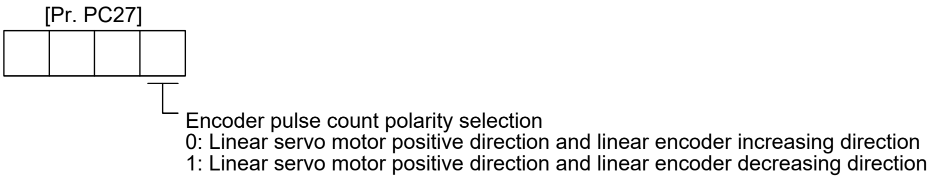
(2) Set the linear servo motor series and linear servo motor type.

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.)

(3) Settings of the linear encoder direction and the linear servo motor direction

> **POINT**
>
> - If an incorrect value is set for [Pr. PC27], the servo motor may not operate properly, or [AL. 50] or [AL. 51] may occur at the positioning operation or the magnetic pole detection.

Set the first digit of [Pr. PC27] (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.

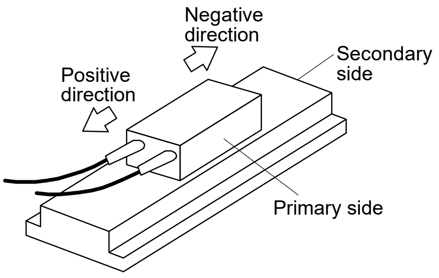


(a) Parameter setting method

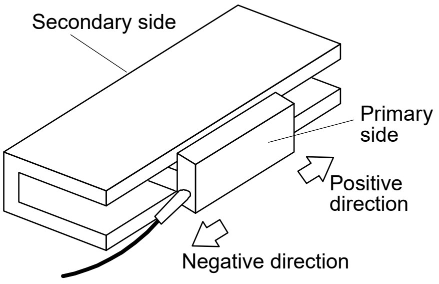
1) Confirm the positive direction of the linear servo motor. [Pr. PA14] determines the relation of the travel direction of the linear servo motor under commands as shown below.

[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

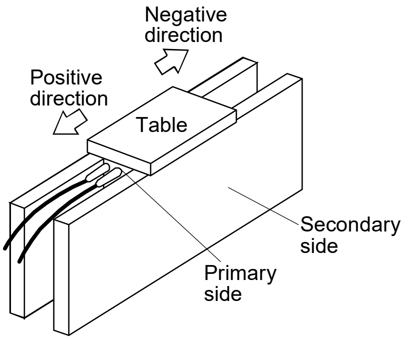
The positive/negative directions of the linear servo motor are as follows.



LM-H3 and LM-F series



LM-U2 series



LM-K2 series

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. PC27] to "_ _ _ 0". If the positive direction of the linear servo motor does not match with the increasing direction of the linear encoder, set [Pr. PC27] 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. PC27] 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. PC27] 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.

(4) Linear encoder resolution setting

POINT

●To enable the parameter value, cycle the power after setting.

●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.

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].

(a) Parameter setting

Set the values that apply to the following equation.

$$\frac{\text{[Pr. PL02 Linear encoder resolution - Numerator]}}{\text{[Pr. PL03 Linear encoder resolution - Denominator]}} = \text{Linear encoder resolution [μm]}$$

(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

14.3.2 Magnetic pole detection

POINT

- ●Set [Pr. PE47 Torque offset] to "0 (initial value)" before executing the 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.

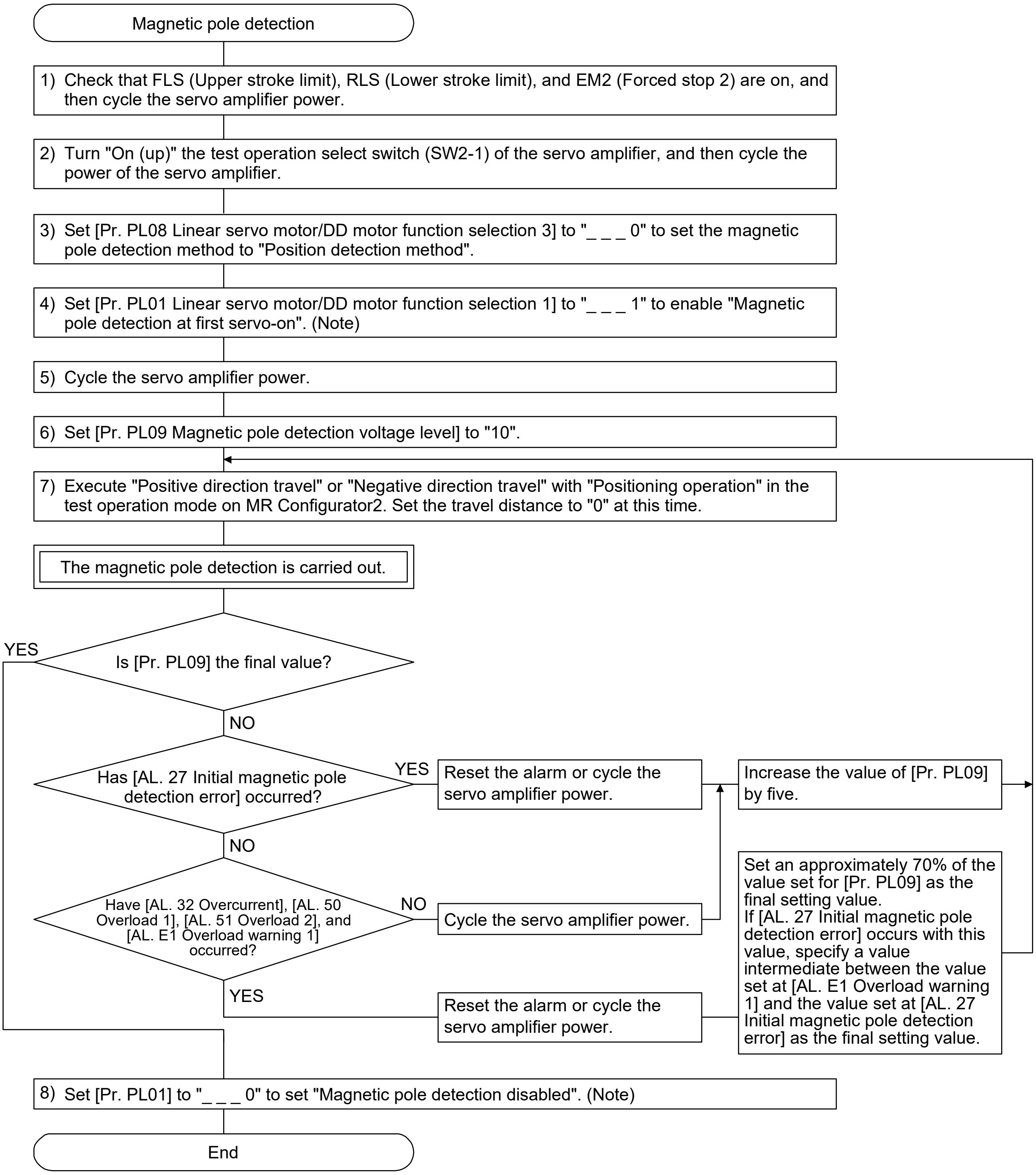
The magnetic pole detection includes the following two methods. Each method has advantages and disadvantages. Select a magnetic pole detection method suitable for your usage.
The position detection method is selected in the initial setting.

Magnetic pole detection	Advantage	Disadvantage
Position detection method	1. The magnetic pole detection has a high degree of accuracy. 2. The adjustment procedure at the magnetic pole detection is simple.	1. The travel distance at the magnetic pole detection is large. 2. For equipment with small friction, the initial magnetic pole detection error may occur.
Minute position detection method	1. The travel distance at the magnetic pole detection is small. 2. Even for equipment with small friction, the magnetic pole detection is available.	1. The adjustment procedure at the magnetic pole detection is complex. 2. If a disturbance occurs during the magnetic pole detection, [AL. 27 Initial magnetic pole detection error] may occur.

(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



Magnetic pole detection

1) Check that FLS (Upper stroke limit), RLS (Lower stroke limit), and EM2 (Forced stop 2) are on, and then cycle the servo amplifier power.

2) Turn "On (up)" the test operation select switch (SW2-1) of the servo amplifier, and then cycle the power of the servo amplifier.

3) Set [Pr. PL08 Linear servo motor/DD motor function selection 3] to "_ _ _ 0" to set the magnetic pole detection method to "Position detection method".

4) Set [Pr. PL01 Linear servo motor/DD motor function selection 1] to "_ _ _ 1" to enable "Magnetic pole detection at first servo-on". (Note)

5) Cycle the servo amplifier power.

6) Set [Pr. PL09 Magnetic pole detection voltage level] to "10".

7) Execute "Positive direction travel" or "Negative direction travel" with "Positioning operation" in the test operation mode on MR Configurator2. Set the travel distance to "0" at this time.

The magnetic pole detection is carried out.

Is [Pr. PL09] the final value?

Has [AL. 27 Initial magnetic pole detection error] occurred?

Reset the alarm or cycle the servo amplifier power.

Increase the value of [Pr. PL09] by five.

Have [AL. 32 Overcurrent], [AL. 50 Overload 1], [AL. 51 Overload 2], and [AL. E1 Overload warning 1] occurred?

Cycle the servo amplifier power.

Set an approximately 70% of the value set for [Pr. PL09] as the final setting value. If [AL. 27 Initial magnetic pole detection error] occurs with this value, specify a value intermediate between the value set at [AL. E1 Overload warning 1] and the value set at [AL. 27 Initial magnetic pole detection error] as the final setting value.

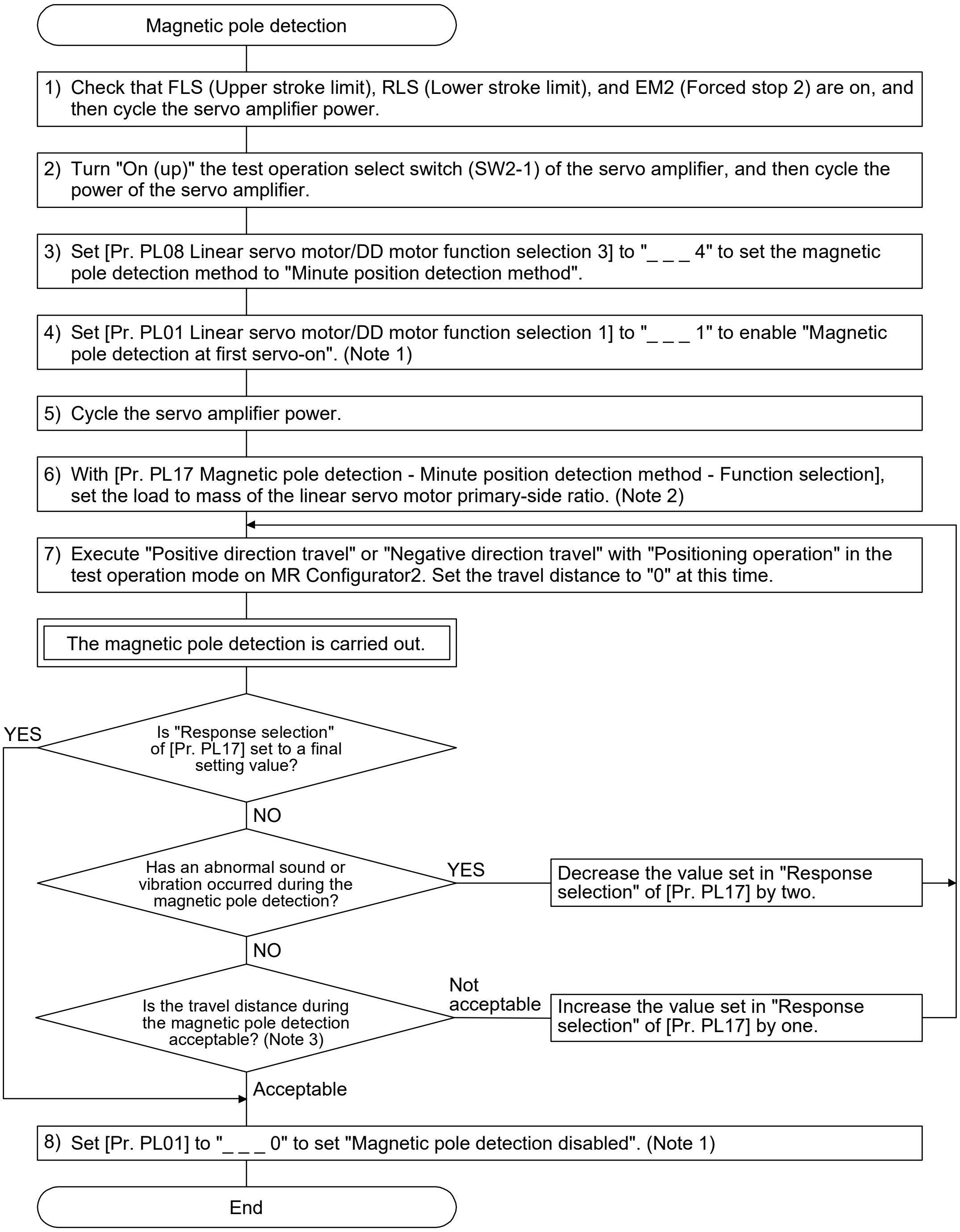
Reset the alarm or cycle the servo amplifier power.

8) Set [Pr. PL01] to "_ _ _ 0" to set "Magnetic pole detection disabled". (Note)

End

Note. For the incremental system, the [Pr. PL01] setting is not required.

(b) Magnetic pole detection by the minute position detection method



Magnetic pole detection

1) Check that FLS (Upper stroke limit), RLS (Lower stroke limit), and EM2 (Forced stop 2) are on, and then cycle the servo amplifier power.

2) Turn "On (up)" the test operation select switch (SW2-1) of the servo amplifier, and then cycle the power of the servo amplifier.

3) Set [Pr. PL08 Linear servo motor/DD motor function selection 3] to "_ _ _ 4" to set the magnetic pole detection method to "Minute position detection method".

4) Set [Pr. PL01 Linear servo motor/DD motor function selection 1] to "_ _ _ 1" to enable "Magnetic pole detection at first servo-on". (Note 1)

5) Cycle the servo amplifier power.

6) With [Pr. PL17 Magnetic pole detection - Minute position detection method - Function selection], set the load to mass of the linear servo motor primary-side ratio. (Note 2)

7) Execute "Positive direction travel" or "Negative direction travel" with "Positioning operation" in the test operation mode on MR Configurator2. Set the travel distance to "0" at this time.

The magnetic pole detection is carried out.

Is "Response selection" of [Pr. PL17] set to a final setting value?

Has an abnormal sound or vibration occurred during the magnetic pole detection?

Decrease the value set in "Response selection" of [Pr. PL17] by two.

Is the travel distance during the magnetic pole detection acceptable? (Note 3)

Increase the value set in "Response selection" of [Pr. PL17] by one.

8) Set [Pr. PL01] to "_ _ _ 0" to set "Magnetic pole detection disabled". (Note 1)

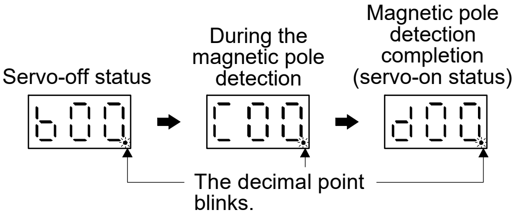
End

Note 1. When the linear encoder is an incremental type, the [Pr. PL01] setting is not required.

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.

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 value of "Response selection" in [Pr. PL17].

(c) State transition of the servo amplifier display (3-digit, 7-segment LED) at the magnetic pole detection
When the magnetic pole detection with MR Configurator2 is normally executed, the servo amplifier display (3-digit, 7-segment LED) shows the state as below.

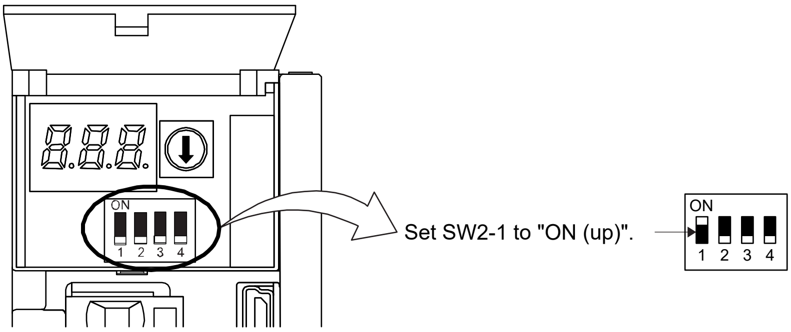


(2) Preparation for the magnetic pole detection

POINT

- When the test operation mode is selected with the test operation select switch (SW2-1), the SSCNET III/H communication for the servo amplifier in the test operation mode and the following servo amplifiers is blocked.

For the magnetic pole detection, use the test operation mode (positioning operation) of MR Configurator2. Turn off the servo amplifier power, and set the test operation select switch (SW2-1) as shown below. Turning on the power enables the test operation mode.



(3) 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

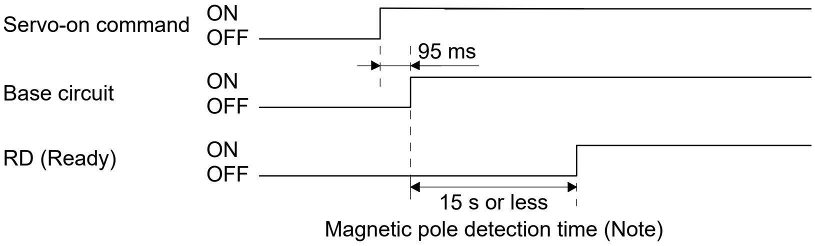
- ●Establish the machine configuration using FLS (Upper stroke limit) and RLS (Lower stroke limit). Otherwise, the machine may be damaged due to a collision.
- ●At the magnetic pole detection, whether the linear servo motor moves in the positive or negative direction is unpredictable.
- ●Depending on the setting value of [Pr. PL09 Magnetic pole detection voltage level], an overload, overcurrent, magnetic pole detection alarm, or others may occur.
- ●When performing the positioning operation from a controller, use the sequence which confirms the normal completion of the magnetic pole detection and the servo-on status, then outputs the positioning command. If the controller outputs the positioning command before RD (Ready) turns on, the command may not be accepted or a servo alarm 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.
- ●An 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.

(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.

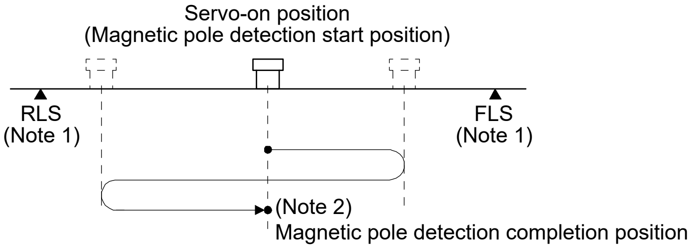
By turning on the servo-on command from the controller after the power-on, the magnetic pole detection is automatically carried out. Therefore, there is no need to set the parameter (first digit of [Pr. PL01]) for executing the magnetic pole detection.

1) Timing chart



Note. The magnetic pole detection time indicates the operation time when FLS (Upper stroke limit) and RLS (Lower stroke limit) are on.

2) Linear servo motor movement (when FLS (Upper stroke limit) and RLS (Lower stroke limit) are on)

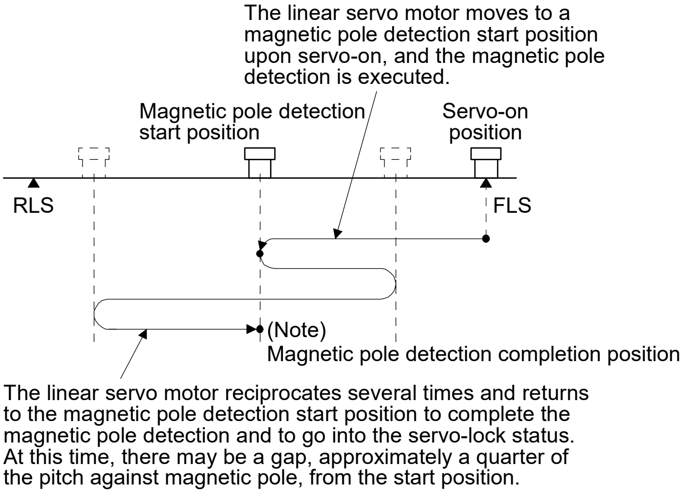


Note 1. When you turn off FLS (Upper stroke limit) or RLS (Lower stroke limit) during the magnetic pole detection, the operation of the magnetic pole detection is carried on to the opposite direction. When both FLS and RLS are off, [AL. 27 Initial magnetic pole detection error] occurs.

2. 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

3) Linear servo motor movement (when FLS (Upper stroke limit) or RLS (Lower stroke limit) is off)
When FLS or RLS 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 in this section.

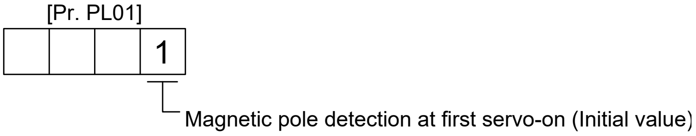
(b) For the absolute position linear encoder

POINT

- ●The magnetic pole detection is required in the following timings.
  - ･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 remounted
- ●If a gap is generated to the positional relation between the linear encoder and the linear servo motor, perform the magnetic pole detection again.

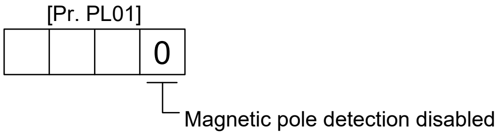
Perform the magnetic pole detection in the following procedure.

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) in this section.)

3) After the completion of the magnetic pole detection, change [Pr. PL01] to "_ _ _ 0" (Magnetic pole detection disabled).



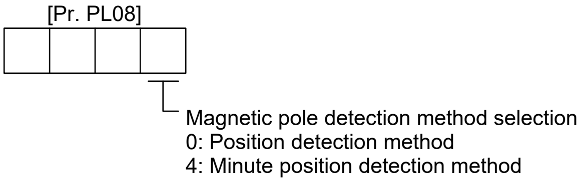
After the magnetic pole detection, by disabling the magnetic pole detection function with [Pr. PL01], the magnetic pole detection after each power-on is not required.

(4) Magnetic pole detection method setting

POINT

- In the following cases, set the magnetic pole detection method to the minute position detection method.
  - 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
- When a linear encoder with a resolution smaller than 0.05 μm is used and the magnetic pole detection does not complete normally by minute position detection method, select "Enabled (1 _ _ _)" of "Minute position detection method - High-resolution encoder selection" in [Pr. PL08].

Set the magnetic pole detection method using the first digit of [Pr. PL08] (Magnetic pole detection method selection).



(5) 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) / Servo status	Small ← Medium → Large (10 or less (initial value) 50 or more)	
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

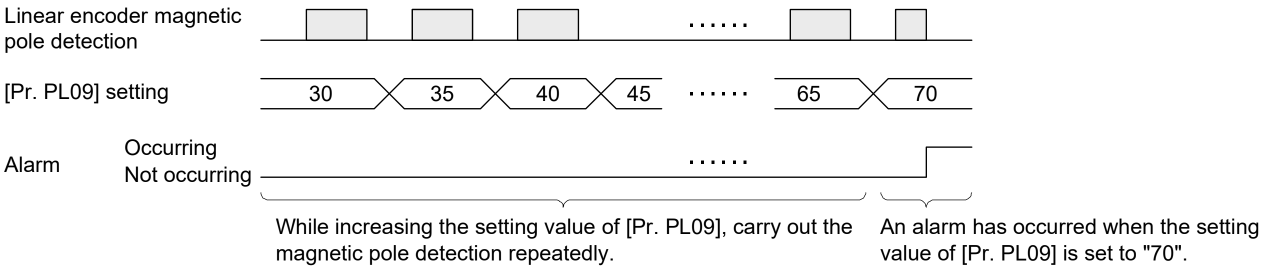
(b) Setting procedure

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.

(c) Setting example



In this example, the final setting value of [Pr. PL09] is 49 (Setting value at the alarm occurrence = 70 × 0.7).

14.3.3 Home position return

POINT

- ●The incremental linear encoder and the absolute position linear encoder have different reference home positions at the home position return.

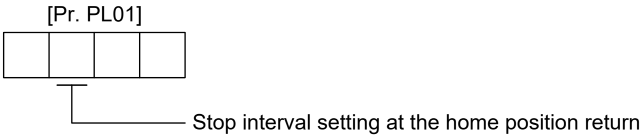
(1) Incremental linear encoder

⚠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 an incremental 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 (reference mark) that is passed through first after a home position return start. Change the setting value of [Pr. PL01] according to the linear encoder resolution.



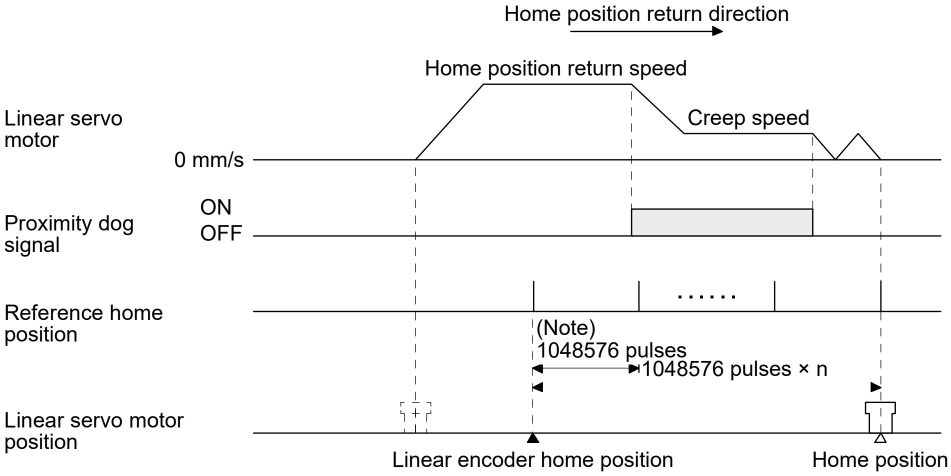
Setting value	Stop interval [pulse]
0	8192
1	131072
2	262144
3	1048576 (initial value)
4	4194304
5	16777216
6	67108864

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.
Set one linear encoder home position in the full stroke, and set it in the position that can always be passed through after a home position return start. LZ (Encoder Z-phase pulse) cannot be used.
When two or more reference marks exist during the full stroke of the linear encoder, select "Enabled (_ _ 1 _)" of "Linear scale multipoint Z-phase input function selection" in [Pr. PC17].



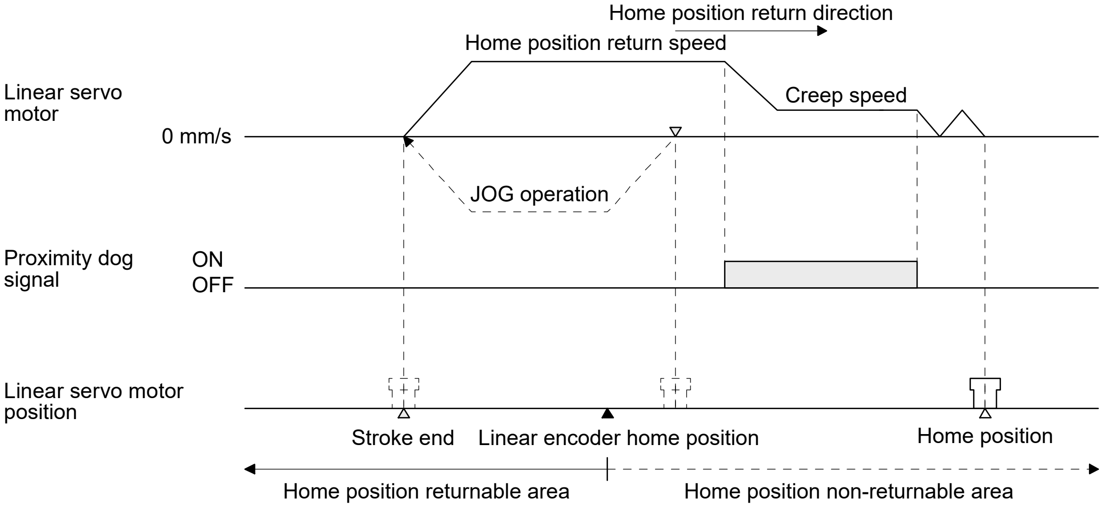
Note. Changeable with [Pr. PL01].

(b) When the linear encoder home position does not exist in the home position return direction

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 from the controller and others.
- Change the third digit value of [Pr. PL01] according to the linear encoder resolution.

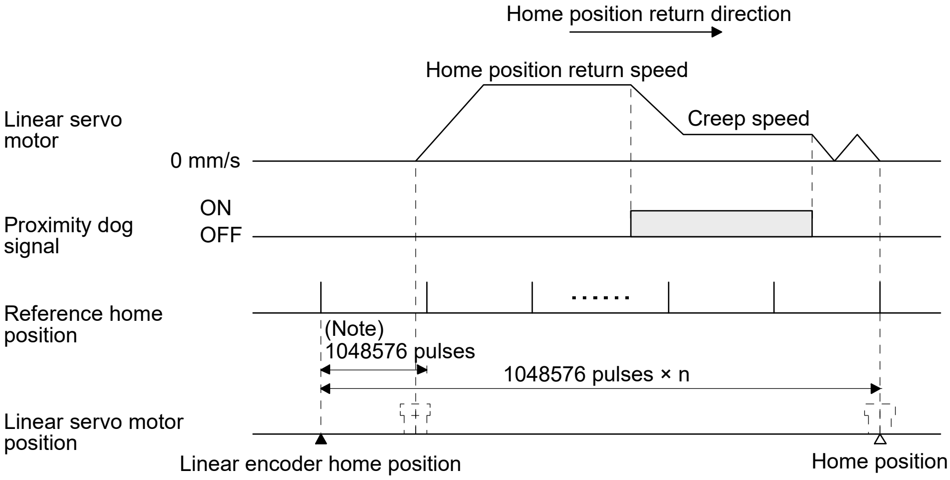
If the home position return is performed from the position where the linear encoder does not exist in the home position return direction, a home position return error occurs on the controller. The error contents differ according to the controller type. Move the linear servo motor to the stroke end on 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.



(2) Absolute position linear encoder

POINT
●The data set type home position return can also be carried out.

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].

14.3.4 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

- ●The content described in this section indicates the environment where the servo amplifier and a personal computer are directly connected.
- ●When the test operation mode is selected with the test operation select switch (SW2-1), the SSCNET III/H communication for the servo amplifier in the test operation mode and the following servo amplifiers is blocked.

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 servo system controller.

(1) Test operation mode type

(a) Positioning operation

Positioning operation can be performed without using the servo system controller. Use this operation with the forced stop reset. This operation may be used independently of whether the servo is on or off and whether the servo system controller is connected or not.
Exercise control on the positioning operation screen of MR Configurator2.

1) 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	01 to 50.0
Number of repeats [time]	1	1 to 9999

2) Operation method

Operation	Screen control
Positive direction travel	Click "Positive Direction Movement".
Negative direction travel	Click "Reverse Direction Movement".
Pause	Click "Pause".
Stop	Click "Stop".
Forced stop	Click "Forced stop".

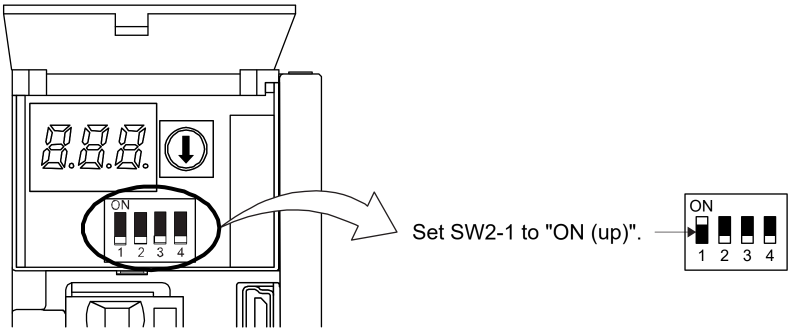
(b) Output signal (DO) forced output
Output signals can be switched on/off forcibly independently of the servo status. This function is used for output signal wiring check, etc. Exercise control on the DO forced output screen of MR Configurator2.

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

Operation	Screen control
Start	Click "Operation start".
Pause	Click "Pause".
Stop	Click "Stop".
Forced stop	Click "Forced stop".

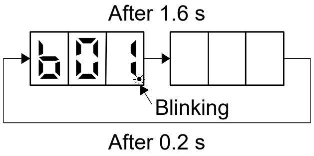
(2) Operation procedure
1) Turn off the power.

2) Turn "ON (up)" SW2-1.



Turning "ON (up)" SW2-1 during power-on will not enable the test operation mode.

3) Turn on the servo amplifier.
When initialization is over, the display shows the following screen.



4) Start operation with the personal computer.

14.3.5 Operation from controller

The linear servo can be used with any of the following controllers.

Servo system controller	Model
Motion controller	R_MTCPU/Q17_DSCPU
Simple motion module	RD77MS_/QD77MS_ /LD77MS_

(1) Operation method

For the system using the incremental linear encoder, the magnetic pole detection is automatically performed at the first servo-on after the power-on. For this reason, when performing the positioning operation, create the sequence which surely confirms the servo-on status as the inter lock condition of the positioning command.

Also, some parameter settings and the home position return type differ according to the controller type.

(2) Servo system controller setting

(a) Setting precautions

The following parameters will be enabled by cycling the servo amplifier power after the controller writes the parameters to the servo amplifier.

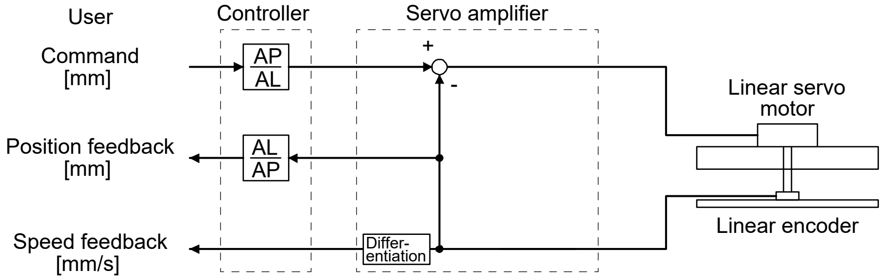
Setting item					Set content	
					Motion controller R_MTCPU/Q17_DSCPU	Simple motion module RD77MS_/QD77MS_ / LD77MS_
Command resolution					Linear encoder resolution unit	
Parameter	Servo amplifier setting				MR-J4-B Linear	
	Motor setting				Automatic setting	
	No.	(Note) Symbol	Name	Initial value		
	PA01	**STY	Operation mode	1000h	1040h	
	PC01	ERZ	Error excessive alarm level	0	Set the items as required.	
	PC03	*ENRS	Encoder output pulse selection	0000h		
	PC27	**COP9	Function selection C-9	0000h		
	PL01	**LIT1	Linear servo motor/DD motor function selection 1	0301h		
	PL02	**LIM	Linear encoder resolution - Numerator	1000		
	PL03	**LID	Linear encoder resolution - Denominator	1000		
	PL04	*LIT2	Linear servo motor/DD motor function selection 2	0003h		
	PL05	LB1	Position deviation error detection level	0		
	PL06	LB2	Speed deviation error detection level	0		
	PL07	LB3	Torque/thrust deviation error detection level	100		
	PL08	*LIT3	Linear servo motor/DD motor function selection 3	0010h		
	PL09	LPWM	Magnetic pole detection voltage level	30		
	PL17	LTSTS	Magnetic pole detection - Minute position detection method - Function selection	0000h		
	PL18	IDLV	Magnetic pole detection - Minute position detection method - Identification signal amplitude	0		
Positioning control parameter	Unit setting				mm	
	Number of pulses (AP) Travel distance (AL)				Refer to (2) (b) in this section.	

Note. The parameter whose symbol is preceded by * is enabled with the following conditions.

* : After setting the parameter, power off and on the servo amplifier or reset the controller.

**: After setting the parameter, cycle the power of the servo amplifier.

(b) Settings of the number of pulses (AP) and travel distance (AL)



Calculate the number of pulses (AP) and travel distance (AL) of the linear encoder in the following conditions.

When the linear encoder resolution is 0.05 μm

$$\frac{\text{Number of pulses (AP) [pulse]}}{\text{Travel distance (AL) [μm]}} = \frac{1}{0.05} = \frac{20}{1}$$

14.3.6 Function

(1) Linear servo control error detection function

POINT

- ●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].

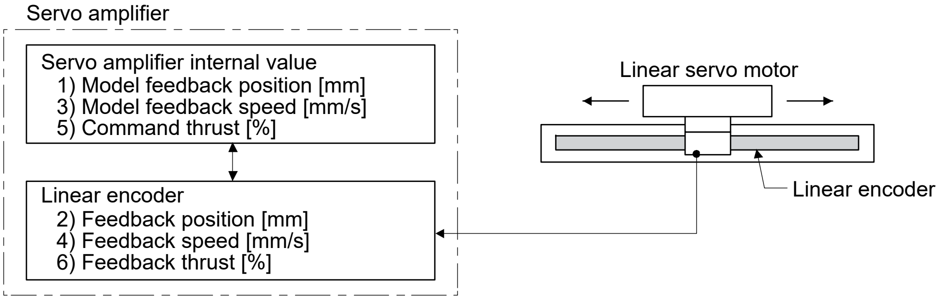
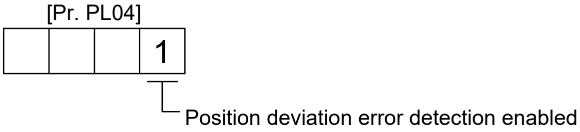


Figure 14.1 Outline of linear servo control error detection function

(a) Position deviation error detection

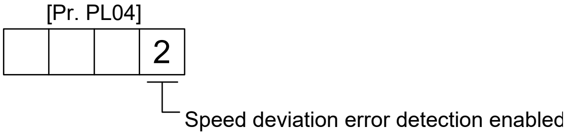
Set [Pr. PL04] to "_ _ _ 1" to enable the position deviation error detection.



When you compare the model feedback position (1)) and the feedback position (2)) in figure 14.1, 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. Replace the set value as required.

(b) Speed deviation error detection

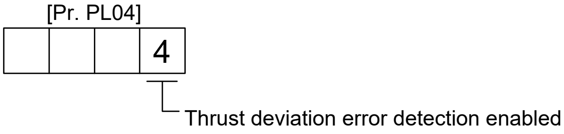
Set [Pr. PL04] to "_ _ _ 2" to enable the speed deviation error detection.



When you compare the model feedback speed (3)) and the feedback speed (4)) in figure 14.1, 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. Replace the set value as required.

(c) Thrust deviation error detection level

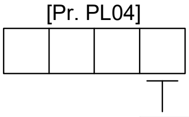
Set [Pr. PL04] to "_ _ _ 4" to enable the thrust deviation error detection.



When you compare the command thrust (5)) and the feedback thrust (6)) in figure 14.1, 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%. Replace the set value as required.

(d) Detecting multiple deviation errors

When setting [Pr. PL04] as shown below, multiple deviation errors can be detected. For the error detection methods, refer to (1) (a), (b), (c) in this section.



Setting value	Position deviation error detection	Speed deviation error detection	Thrust deviation error detection
1	○		
2		○	
3	○	○	
4			○
5	○		○
6		○	○
7	○	○	○

(2) Auto tuning function

POINT

- The auto tuning mode 1 may not be performed properly if the following conditions are not satisfied.
  - 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.

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.

(3) Machine analyzer function

POINT

- 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.

14.3.7 Absolute position detection system

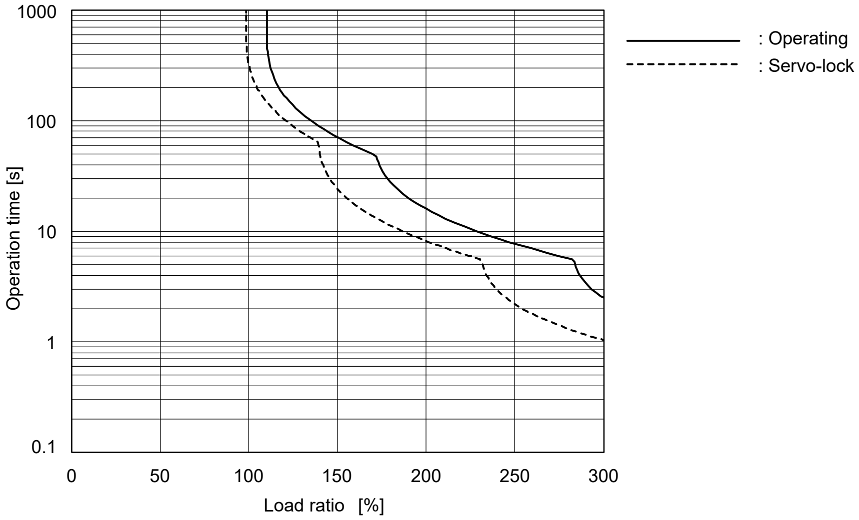
When the linear servo motor is used with the absolute position detection system, an absolute position linear encoder is required. The linear encoder backs up the absolute position data. Therefore, the encoder battery need not be installed to the servo amplifier. Additionally, [AL. 25 Absolute position 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.

14.4 Characteristics

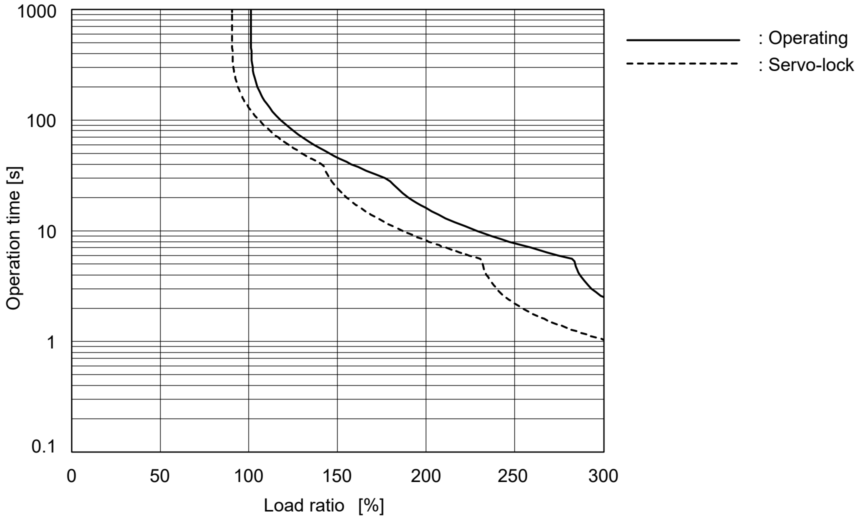
14.4.1 Overload protection characteristics

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. 14.2. [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.
Use the linear servo motor with 70% or less of the effective load ratio when it is in the servo lock state or in a small reciprocating motion.
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.)

(1) LM-H3 series

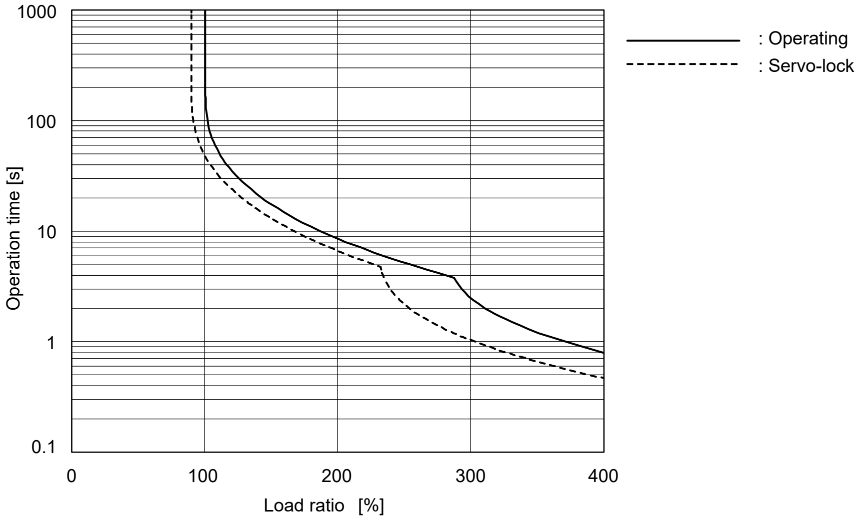


(2) LM-K2 series

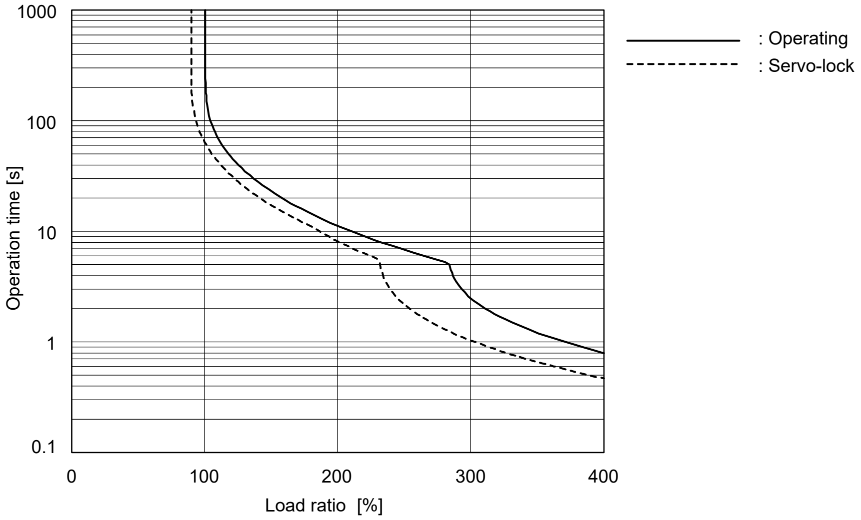


(3) LM-U2 series

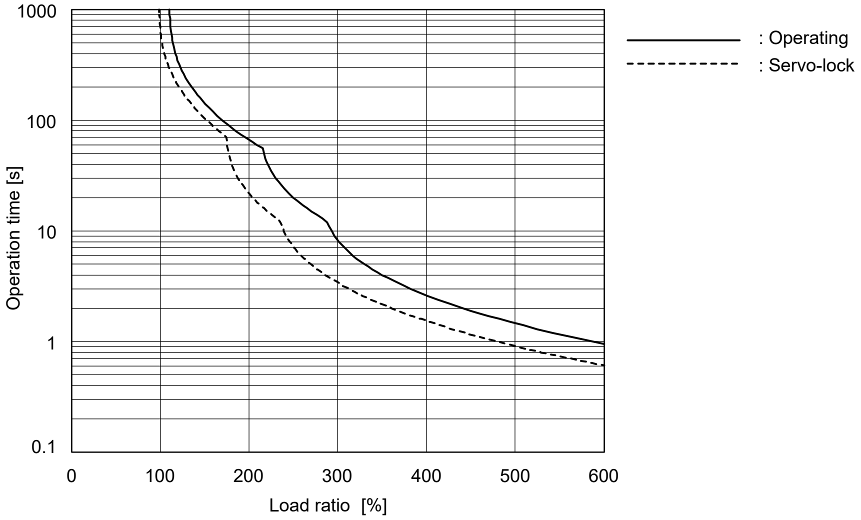
(a) LM-U2PBD-15M-1SS0



(b) Other than LM-U2PBD-15M-1SS0

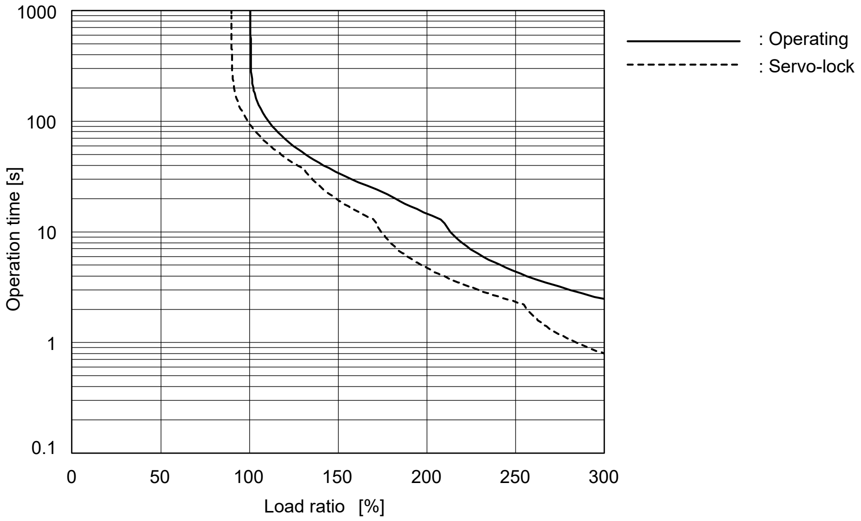


(4) LM-F series (natural cooling)

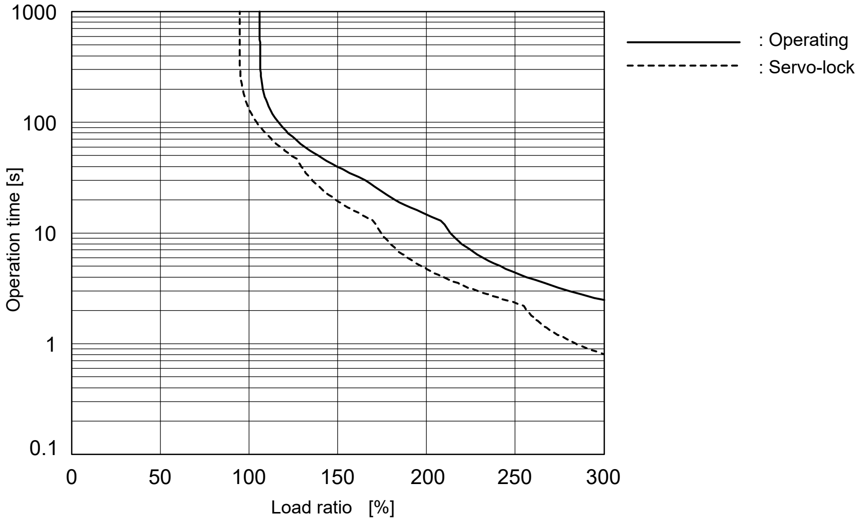


(5) LM-F series (liquid cooling)

(a) LM-FP2B-06M-1SS0 (liquid cooling)



(b) Other than LM-FP2B-06M-1SS0 (liquid cooling)



14.4.2 Power supply capacity and generated loss

Table 14.1 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 tables in consideration for the harshest conditions with regard to the environment and operation pattern. 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 14.1 Power supply capacity and generated loss per linear servo motor

Linear servo motor (primary side)	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-J4-40B(-RJ) MR-J4-40B1(-RJ)	0.9	35	15	0.7
LM-H3P3A-12P-CSS0		0.9	35	15	0.7
LM-H3P3B-24P-CSS0	MR-J4-70B(-RJ)	1.3	50	15	1.0
LM-H3P3C-36P-CSS0		1.9	75	15	1.5
LM-H3P3D-48P-CSS0	MR-J4-200B(-RJ)	3.5	90	20	1.8
LM-H3P7A-24P-ASS0	MR-J4-70B(-RJ)	1.3	50	15	1.0
LM-H3P7B-48P-ASS0	MR-J4-200B(-RJ)	3.5	90	20	1.8
LM-H3P7C-72P-ASS0		3.8	100	20	1.1
LM-H3P7D-96P-ASS0	MR-J4-350B(-RJ)	5.5	130	20	2.7
LM-U2PAB-05M-0SS0	MR-J4-20B(-RJ) MR-J4-20B1(-RJ)	0.5	25	15	0.5
LM-U2PAD-10M-0SS0	MR-J4-40B(-RJ) MR-J4-40B1(-RJ)	0.9	35	15	0.7
LM-U2PAF-15M-0SS0		0.9	35	15	0.7
LM-U2PBB-07M-1SS0	MR-J4-20B(-RJ) MR-J4-20B1(-RJ)	0.5	25	15	0.5
LM-U2PBD-15M-1SS0	MR-J4-60B(-RJ)	1.0	40	15	0.8
LM-U2PBF-22M-1SS0	MR-J4-70B(-RJ)	1.3	50	15	1.0
LM-U2P2B-40M-2SS0	MR-J4-200B(-RJ)	3.5	90	20	1.8
LM-U2P2C-60M-2SS0	MR-J4-350B(-RJ)	5.5	130	20	2.7
LM-U2P2D-80M-2SS0	MR-J4-500B(-RJ)	7.5	195	25	3.9
LM-FP2B-06M-1SS0	MR-J4-200B(-RJ)	3.5	90	20	1.8
LM-FP2D-12M-1SS0	MR-J4-500B(-RJ)	7.5	195	25	3.9
LM-FP2F-18M-1SS0	MR-J4-700B(-RJ)	10	300	25	6.0
LM-FP4B-12M-1SS0	MR-J4-500B(-RJ)	7.5	195	25	3.9
LM-FP4D-24M-1SS0	MR-J4-700B(-RJ)	10	300	25	6.0
LM-FP4F-36M-1SS0	MR-J4-11KB(-RJ)	14	460	45	9.2
LM-FP4H-48M-1SS0	MR-J4-15KB(-RJ)	18	580	45	11.6
LM-FP5H-60M-1SS0	MR-J4-22KB4(-RJ)	22	640	45	12.8
LM-K2P1A-01M-2SS1	MR-J4-40B(-RJ) MR-J4-40B1(-RJ)	0.9	35	15	0.7
LM-K2P1C-03M-2SS1	MR-J4-200B(-RJ)	3.5	90	20	1.8
LM-K2P2A-02M-1SS1	MR-J4-70B(-RJ)	1.3	50	15	1.0
LM-K2P2C-07M-1SS1	MR-J4-350B(-RJ)	5.5	130	20	2.7
LM-K2P2E-12M-1SS1	MR-J4-500B(-RJ)	7.5	195	25	3.9
LM-K2P3C-14M-1SS1	MR-J4-350B(-RJ)	5.5	130	20	2.7
LM-K2P3E-24M-1SS1	MR-J4-500B(-RJ)	7.5	195	25	3.9

Note 1. The power supply equipment capacity changes with the power supply impedance. This value is applicable when the power factor improving AC reactor or power factor improving DC reactor is not used.

2. Heat generated during regeneration is not included in the servo amplifier-generated heat. To calculate heat generated by the regenerative option, refer to section 11.2.

14.4.3 Dynamic brake characteristics

⚠CAUTION

- The coasting distance is a theoretically calculated value that does not consider factors such as friction. The calculated distance is longer than the actual distance. If the braking distance is not longer than the calculated value, a moving part may crash into the stroke end, causing a dangerous situation. Install an 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.

POINT

- Do not use dynamic brake to stop in a normal operation as it is the function to stop in emergency.
- For a machine operating at the recommended load to motor 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.

$$\text{Lmax} = V_0 \bullet (0.03 + M \bullet (A + B \bullet V_0^2))$$

Lmax: Coasting distance of the machine [m]
V_0: 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 (primary side)	Coefficient A	Coefficient B
LM-H3P2A-07P-BSS0	7.15×10^{-3}	2.94×10^{-3}
LM-H3P3A-12P-CSS0	2.81×10^{-3}	1.47×10^{-3}
LM-H3P3B-24P-CSS0	7.69×10^{-3}	2.27×10^{-4}
LM-H3P3C-36P-CSS0	7.22×10^{-3}	1.13×10^{-4}
LM-H3P3D-48P-CSS0	1.02×10^{-3}	2.54×10^{-4}
LM-H3P7A-24P-ASS0	7.69×10^{-3}	2.14×10^{-4}
LM-H3P7B-48P-ASS0	9.14×10^{-4}	2.59×10^{-4}
LM-H3P7C-72P-ASS0	7.19×10^{-4}	1.47×10^{-4}
LM-H3P7D-96P-ASS0	6.18×10^{-4}	9.59×10^{-5}

Linear servo motor (primary side)	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 (primary side)	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}
LM-FP5H-60M-1SS0	1.95×10^{-4}	4.00×10^{-5}

Linear servo motor (primary side)	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}

14.4.4 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 load to motor mass ratio is higher than this value, the dynamic brake may burn. If there is a possibility that the load inertia moment 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 (primary side)	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 linear 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 at the time of using the dynamic brake = Value in the table × (Servo motor maximum speed^2/Actual using speed^2)

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 at the time of using the dynamic brake = $40 \times 3^2/2^2 = 90$ [times]

15. USING A DIRECT DRIVE MOTOR

⚠CAUTION ●When using the direct drive motor, read the "Direct Drive Motor Instruction Manual".

POINT

●Refer to section 1.4 for the software version of a servo amplifier that is compatible with the direct drive servo system.

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 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
  (a) The direct drive servo system ensures the high-rigidity and the high-torque. A high-resolution encoder enables the high-accuracy control.
  (b) The high-resolution encoder contributes to the high-indexer accuracy.
  (c) Since reducer is no longer required, no backlash occurs. In addition, the settling time is reduced, and the high-frequency operation is enabled.
  (d) Since reducer is no longer required, the motor does not deteriorate with time by reducer.

(2) Mechanism
  (a) The motor's low profile design contributes to compact moving part of the machine and a low center of gravity for enhanced equipment stability.
  (b) The motor has an inner rotor with hollow shaft which enables cables and pipes to be passed through.
  (c) 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		Remark
		Direct drive motor	Rotary servo motor	
External I/O signal	FLS (Upper stroke limit), RLS (Lower stroke limit)	Required (for magnetic pole detection)	Not required	Automatically turns on in the parameter setting.
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 (3) (a) of section 15.3.2.)
Absolute position detection system	Absolute position encoder battery	Required	Required	
	Absolute position storage unit (MR-BTAS01)	Required	Not required	

15.1.2 Servo system with auxiliary equipment

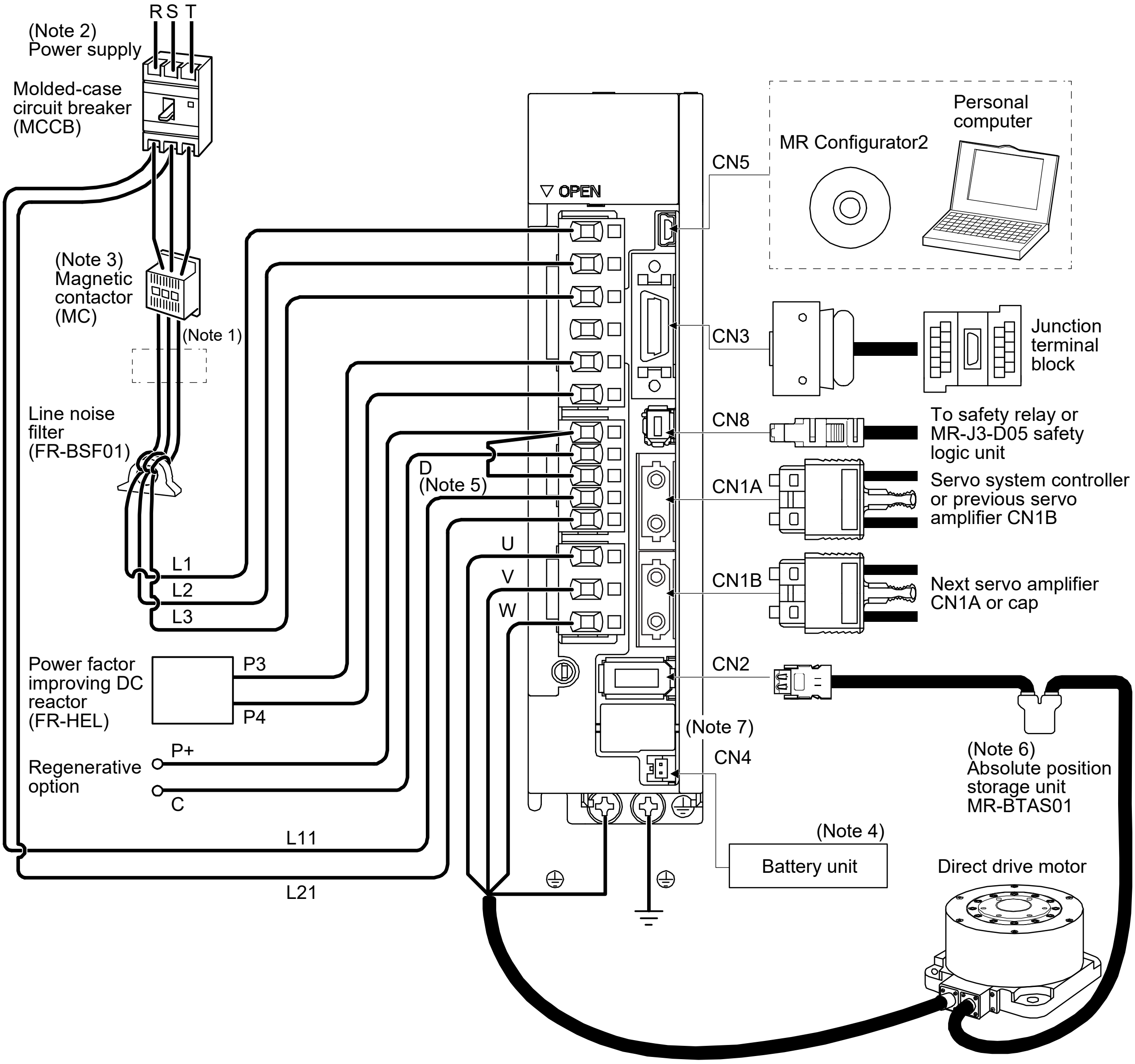
⚠CAUTION

- ●Connecting a direct drive motor for different 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 _".

The configuration diagram is an example of MR-J4-20B. When using the other servo amplifiers, the configuration will be the same as rotary servo motors except for connections of direct drive motors. Refer to section 1.8 depending on servo amplifiers you use.



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-J4-200B(-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 is used for the absolute position detection system. (Refer to chapter 12.)
5. Always connect P+ and D. 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-_B_. MR-J4-_B_-RJ has a CN2L connector. However, CN2L is not used for the direct drive servo system.

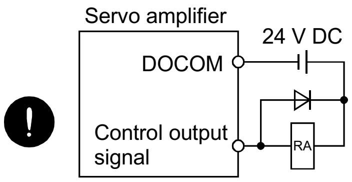
15.2 Signals and wiring

⚠WARNING

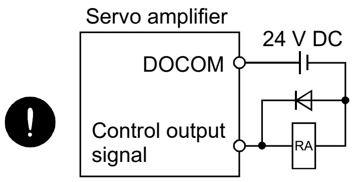
- Any person who is involved in wiring should be fully competent to do the work.
- Before wiring, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. Otherwise, an electric shock 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 direct drive motor securely.
- Do not attempt to wire the servo amplifier and the 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

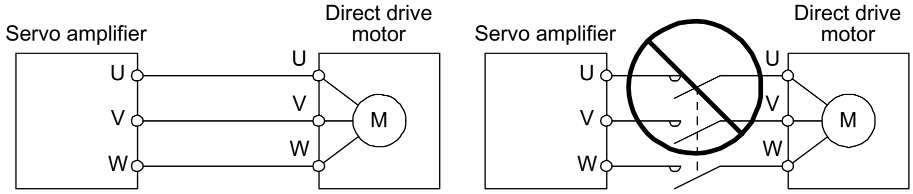


For source output interface

- 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) with the power wire of the direct drive motor.

⚠CAUTION

- 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/W) to the power input of the direct drive motor (U/V/W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.



- Connecting a servo motor for different axis to the U, V, W, or CN2 may cause a malfunction.
- Before wiring, switch operation, etc., eliminate static electricity. Otherwise, it may cause a malfunction.

This chapter 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 3.7
Interfaces	Section 3.8
SSCNET III cable connection	Section 3.9
Grounding	Section 3.11
Switch setting and display of the servo amplifier	Section 4.3
PARAMETERS	Chapter 5
TROUBLESHOOTING	Chapter 8

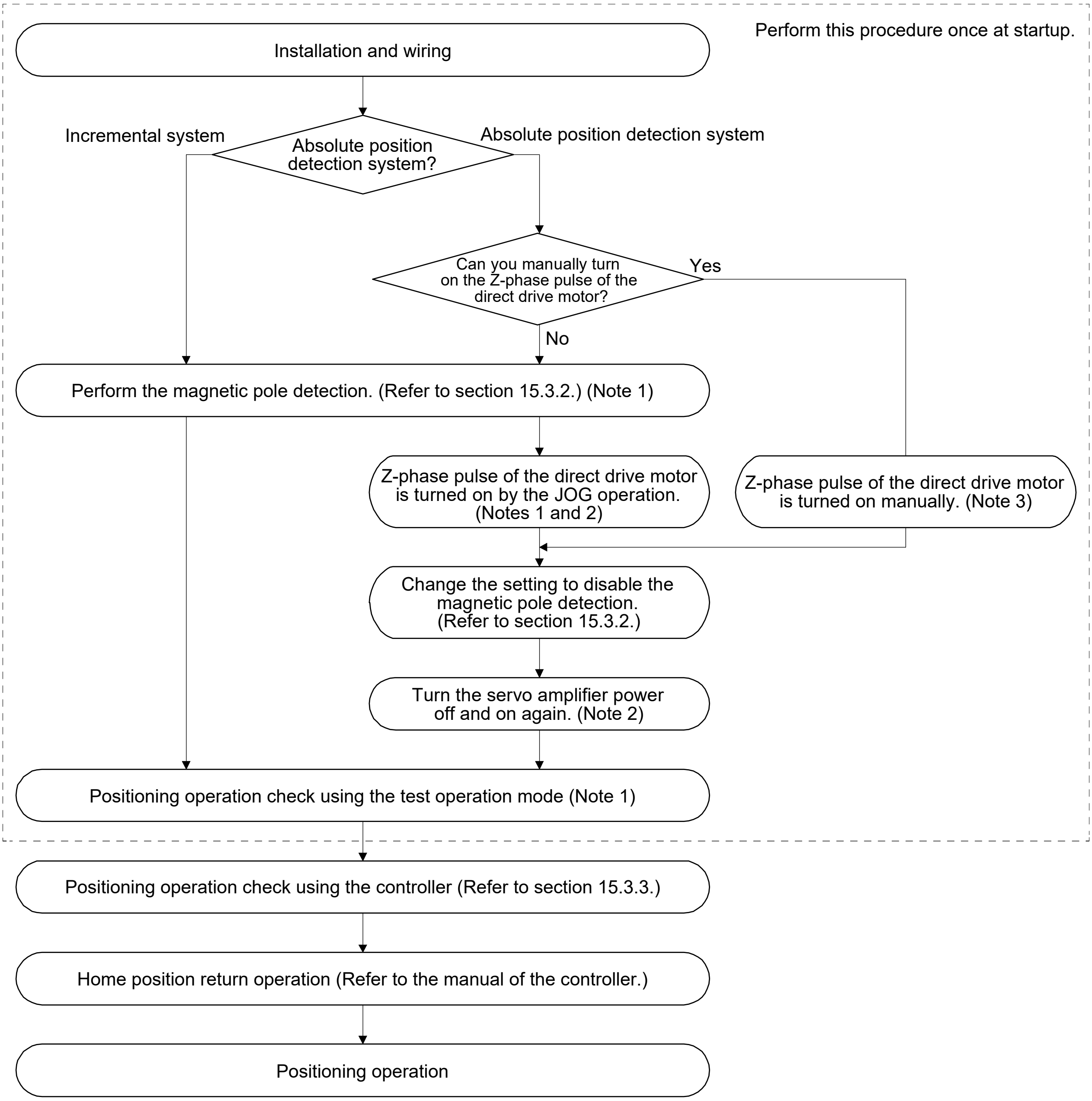
15.3 Operation and functions

POINT

- When using the direct drive motor, set [Pr. PA01] to "_ _ 6 _".
- For the test operation, refer to section 4.4.
- The Z-phase pulse of the direct drive motor must be turned on after power-on. When the machine configuration does not allow one or more revolution of the direct drive motor, install the direct drive motor so that the Z-phase pulse can be turned on.

15.3.1 Startup procedure

Start up the direct drive servo system in the following procedure.



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, make sure to connect the direct drive motor encoder and the servo amplifier, and turn on the control circuit power supply of the servo amplifier (L11/L21) (turn off the main circuit power supply L1, L2, and L3). Ensure safety at this time.

15.3.2 Magnetic pole detection

POINT

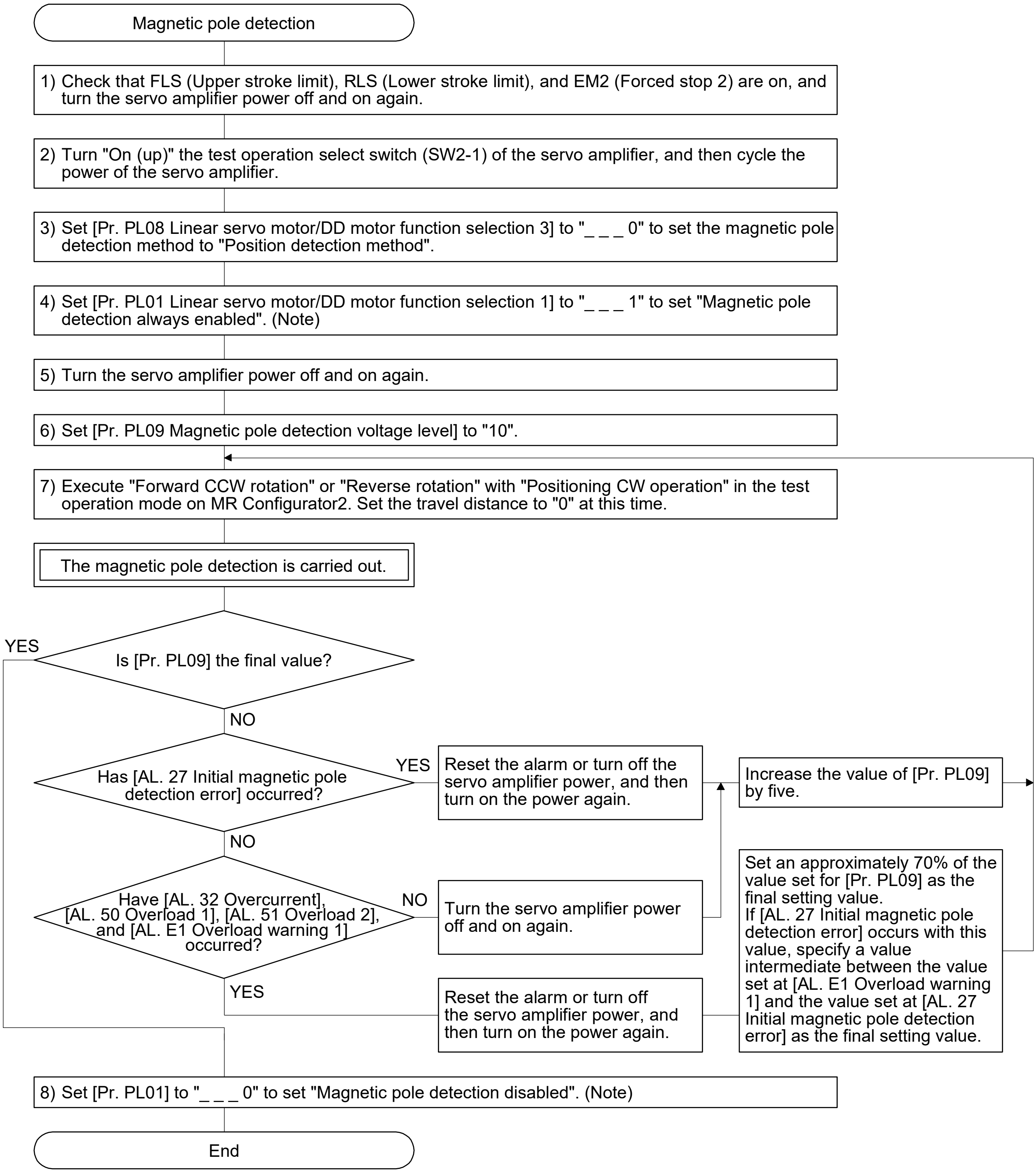
- The magnetic pole detection is not required for the configured absolute position detection system where the Z-phase pulse of the direct drive motor can be turned on manually.
  For this operation, always connect the direct drive motor encoder and the servo amplifier and turn on the control circuit power supply of the servo amplifier.
  Perform this operation by considering the safety.
- When performing a magnetic pole detection without using FLS (Upper stroke limit) and RLS (Lower stroke limit), set [Pr. PL08 Linear servo motor/DD motor function selection 3] to "_ 1 _ _" to disable FLS and RLS.
- Set [Pr. PE47 Torque offset] to "0 (initial value)" before executing the magnetic pole detection.
- For the magnetic pole detection of vertical axis with direct drive motors, refer to section 2.1 of "Direct Drive Motor Instruction Manual".

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.

(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



Magnetic pole detection

1) Check that FLS (Upper stroke limit), RLS (Lower stroke limit), and EM2 (Forced stop 2) are on, and turn the servo amplifier power off and on again.

2) Turn "On (up)" the test operation select switch (SW2-1) of the servo amplifier, and then cycle the power of the servo amplifier.

3) Set [Pr. PL08 Linear servo motor/DD motor function selection 3] to "_ _ _ 0" to set the magnetic pole detection method to "Position detection method".

4) Set [Pr. PL01 Linear servo motor/DD motor function selection 1] to "_ _ _ 1" to set "Magnetic pole detection always enabled". (Note)

5) Turn the servo amplifier power off and on again.

6) Set [Pr. PL09 Magnetic pole detection voltage level] to "10".

7) Execute "Forward CCW rotation" or "Reverse rotation" with "Positioning CW operation" in the test operation mode on MR Configurator2. Set the travel distance to "0" at this time.

The magnetic pole detection is carried out.

Is [Pr. PL09] the final value?

Has [AL. 27 Initial magnetic pole detection error] occurred?

Reset the alarm or turn off the servo amplifier power, and then turn on the power again.

Increase the value of [Pr. PL09] by five.

Have [AL. 32 Overcurrent], [AL. 50 Overload 1], [AL. 51 Overload 2], and [AL. E1 Overload warning 1] occurred?

Turn the servo amplifier power off and on again.

Set an approximately 70% of the value set for [Pr. PL09] as the final setting value. If [AL. 27 Initial magnetic pole detection error] occurs with this value, specify a value intermediate between the value set at [AL. E1 Overload warning 1] and the value set at [AL. 27 Initial magnetic pole detection error] as the final setting value.

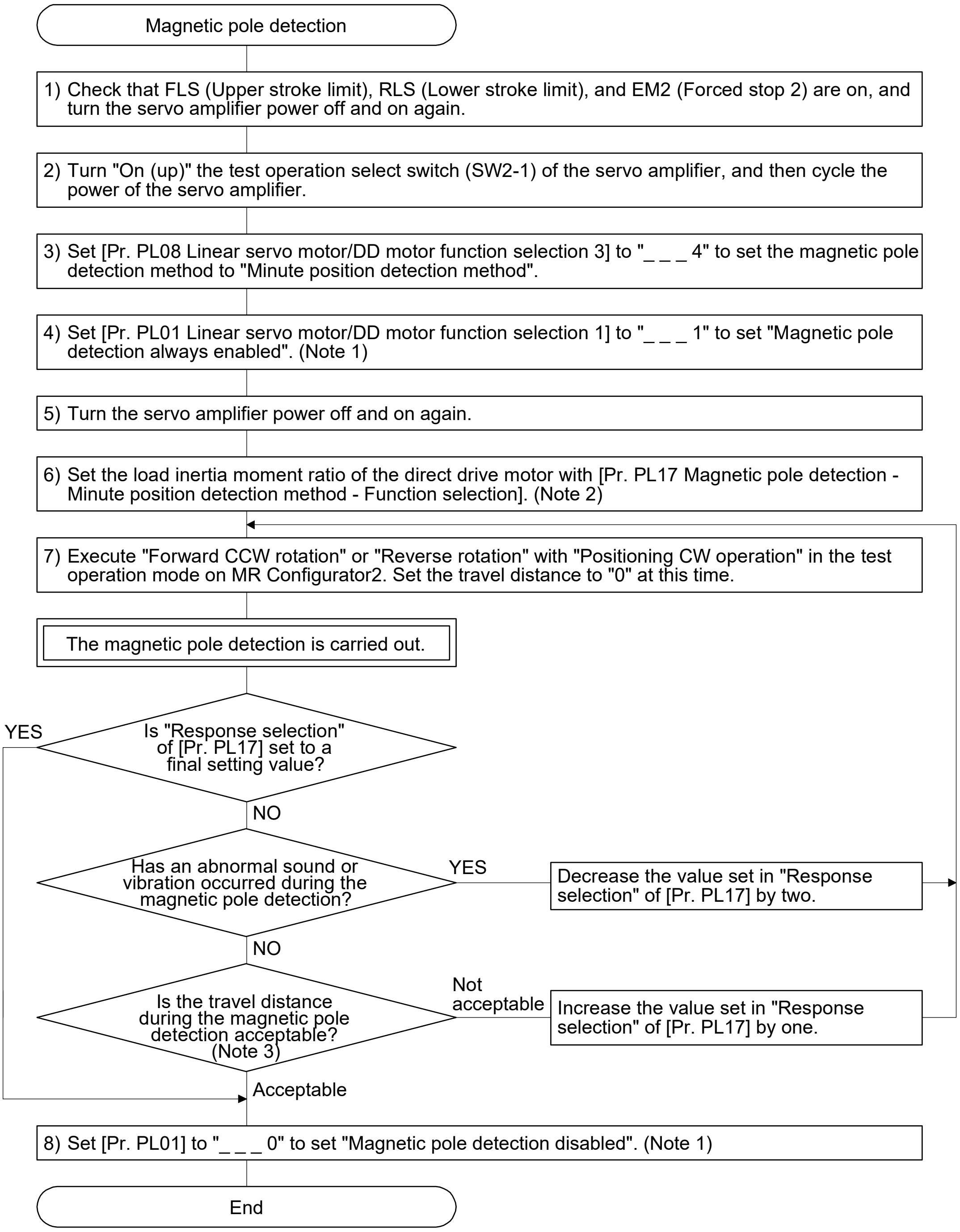
Reset the alarm or turn off the servo amplifier power, and then turn on the power again.

8) Set [Pr. PL01] to "_ _ _ 0" to set "Magnetic pole detection disabled". (Note)

End

Note. For the incremental system, the [Pr. PL01] setting is not required.

(b) Magnetic pole detection by the minute position detection method



Magnetic pole detection

1) Check that FLS (Upper stroke limit), RLS (Lower stroke limit), and EM2 (Forced stop 2) are on, and turn the servo amplifier power off and on again.

2) Turn "On (up)" the test operation select switch (SW2-1) of the servo amplifier, and then cycle the power of the servo amplifier.

3) Set [Pr. PL08 Linear servo motor/DD motor function selection 3] to "_ _ _ 4" to set the magnetic pole detection method to "Minute position detection method".

4) Set [Pr. PL01 Linear servo motor/DD motor function selection 1] to "_ _ _ 1" to set "Magnetic pole detection always enabled". (Note 1)

5) Turn the servo amplifier power off and on again.

6) Set the load inertia moment ratio of the direct drive motor with [Pr. PL17 Magnetic pole detection - Minute position detection method - Function selection]. (Note 2)

7) Execute "Forward CCW rotation" or "Reverse rotation" with "Positioning CW operation" in the test operation mode on MR Configurator2. Set the travel distance to "0" at this time.

The magnetic pole detection is carried out.

Is "Response selection" of [Pr. PL17] set to a final setting value?

Has an abnormal sound or vibration occurred during the magnetic pole detection?

Decrease the value set in "Response selection" of [Pr. PL17] by two.

Is the travel distance during the magnetic pole detection acceptable? (Note 3)

Increase the value set in "Response selection" of [Pr. PL17] by one.

8) Set [Pr. PL01] to "_ _ _ 0" to set "Magnetic pole detection disabled". (Note 1)

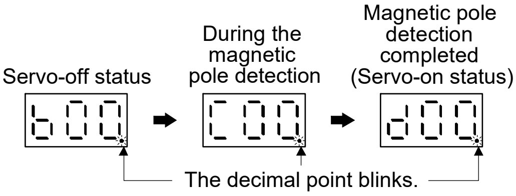
End

Note 1. For the incremental system, the [Pr. PL01] setting is not required.

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.

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 value of "Response selection" in [Pr. PL17].

(c) State transition of the servo amplifier display (3-digit, 7-segment LED) at the magnetic pole detection
When the magnetic pole detection with MR Configurator2 is normally executed, the servo amplifier display (3-digit, 7-segment LED) shows the state as below.

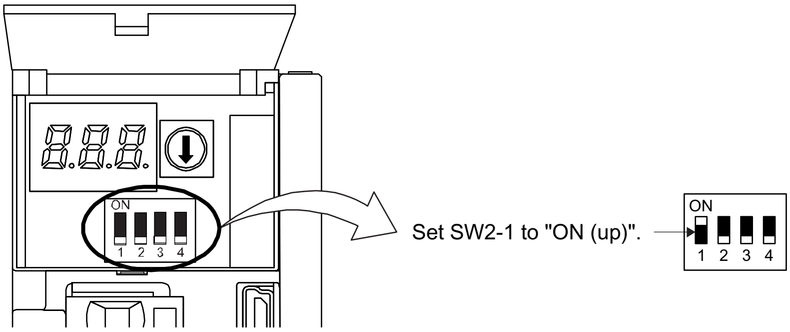


(2) Preparation for the magnetic pole detection

POINT

- When the test operation mode is selected with the test operation select switch (SW2-1), the SSCNET III/H communication for the servo amplifier in the test operation mode and the following servo amplifiers is blocked.

For the magnetic pole detection, use the test operation mode (positioning operation) of MR Configurator2. Turn off the servo amplifier power, and set the test operation select switch (SW2-1) and the disabling control axis switch (SW2-2, SW2-3, and SW2-4) as shown below. Turning on the power enables the test operation mode.



(3) 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.

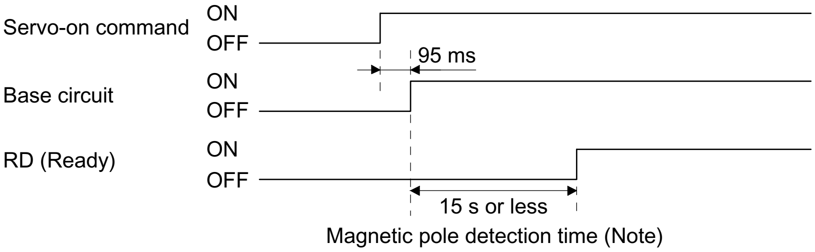
POINT
- Establish the machine configuration using FLS (Upper stroke limit) and RLS (Lower stroke limit). Otherwise, the machine may be damaged due to a collision.
- At the magnetic pole detection, whether the motor rotates in the forward or reverse direction is unpredictable.
- Depending on the setting value of [Pr. PL09 Magnetic pole detection voltage level], an overload, overcurrent, magnetic pole detection alarm, or others may occur.
- When performing the positioning operation from a controller, use the sequence which confirms the normal completion of the magnetic pole detection and the servo-on status, then outputs the positioning command. If the controller outputs the positioning command before RD (Ready) turns on, the command may not be accepted or a servo alarm 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
- For the incremental system, the magnetic pole detection is required every time the power is turned on.

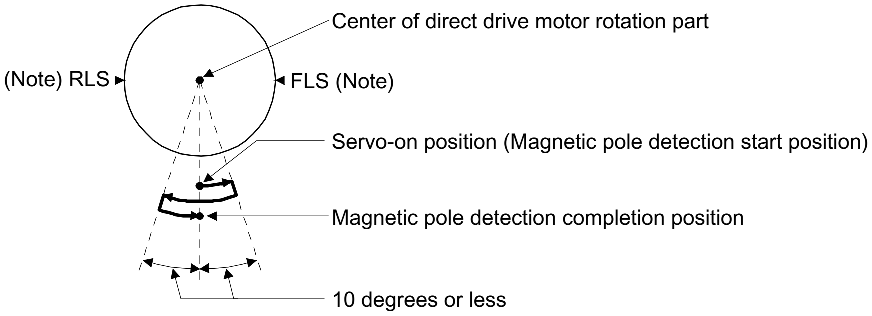
By turning on the servo-on command from the controller after the power-on, the magnetic pole detection is automatically carried out. Therefore, there is no need to set the parameter (first digit of [Pr. PL01]) for executing the magnetic pole detection.

1) Timing chart



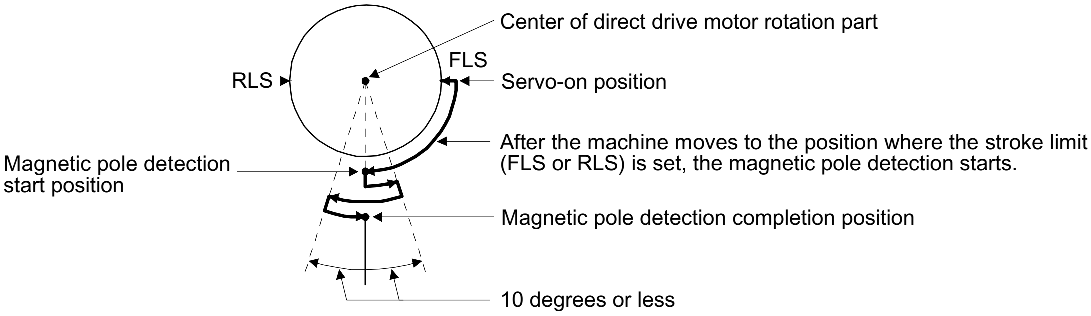
Note. The magnetic pole detection time indicates the operation time when FLS (Upper stroke limit) and RLS (Lower stroke limit) are on.

2) Direct drive motor movement (when FLS and RLS are on)



Note. When you turn off FLS (Upper stroke limit) or RLS (Lower stroke limit) during the magnetic pole detection, the magnetic pole detection is carried on to the opposite direction. When FLS and RLS are off, [AL. 27 Initial magnetic pole detection error] occurs.

3) Direct drive motor movement (when FLS or RLS is off)
When FLS or RLS is off at servo-on, the magnetic pole detection is carried out as follows.



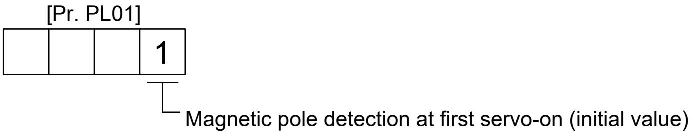
(b) Absolute position detection system

POINT

- The magnetic pole detection is required in the following timings.
  - When the system is 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.

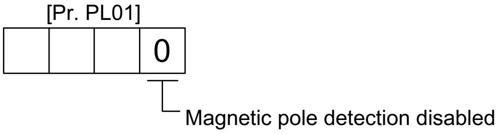
Perform the magnetic pole detection in the following procedure.

1) Set [Pr. PL01 Linear servo motor/DD motor function selection 1] to "_ _ _ 1" (Magnetic pole detection at first servo-on).



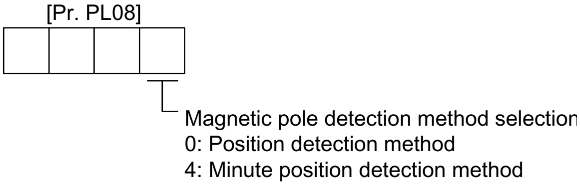
2) Execute the magnetic pole detection. (Refer to (3) (a) in this section.)

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 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.

(4) Magnetic pole detection method setting
Set the magnetic pole detection method using the first digit of [Pr. PL08] (Magnetic pole detection method selection).



(5) 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) Servo status	Small ← Medium → Large (10 or less (initial value) 50 or more)	
Torques required for operation	Small	Large
Overload, overcurrent alarm	Not frequently occurs	Frequently occurs
Magnetic pole detection alarm	Frequently occurs	Not frequently occurs
Magnetic pole detection accuracy	Low	High

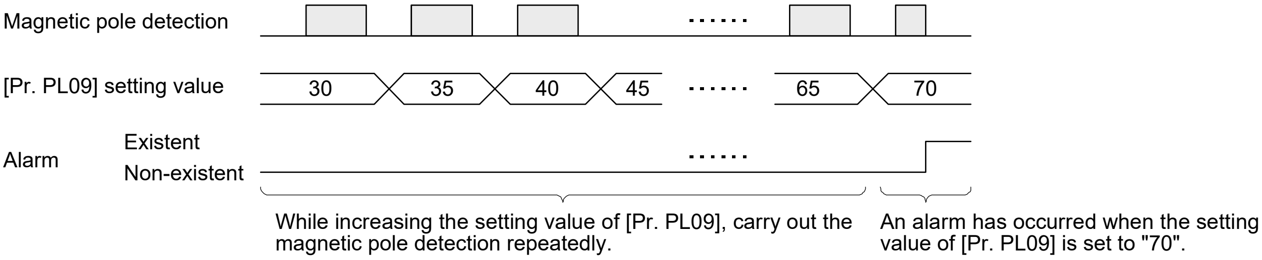
(b) Setting procedure

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.

(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 Operation from controller

To configure the absolute position detection system by using the direct drive motor, the battery and the absolute position storage unit MR-BTAS01 are required.

(1) Operation method

For the incremental system, the magnetic pole detection is automatically performed at the first servo-on after the power-on. For this reason, when performing the positioning operation, create the sequence which surely confirms the servo-on status as the inter lock condition of the positioning command.
Also, some parameter settings and the home position return differ according to the controller type.

(2) Servo system controller setting

The following parameters will be enabled by cycling the servo amplifier power after the controller writes the parameters to the servo amplifier.

Setting item					Setting	
					Motion controller R_MTCPU/Q17_DSCPU	Simple motion module RD77MS_/QD77MS_ / LD77MS_
Parameter	Amplifier setting				MR-J4-B DD	
	Motor setting				Automatic setting	
	No.	(Note) Symbol	Name	Initial value		
	PA01	**STY	Operation mode	1000h	1060h	
	PC01	*ERZ	Error excessive alarm level	0	Set the items as required.	
	PC03	*ENRS	Encoder output pulse selection	0000h		
	PL01	**LIT1	Linear servo motor/DD motor function selection 1	0301h		
	PL04	*LIT2	Linear servo motor/DD motor function selection 2	0003h		
	PL05	LB1	Position deviation error detection level	0		
	PL06	LB2	Speed deviation error detection level	0		
	PL07	LB3	Torque/thrust deviation error detection level	100		
	PL08	*LIT3	Linear servo motor/DD motor function selection 3	0010h		
	PL09	LPWM	Magnetic pole detection voltage level	30		
	PL17	LTSTS	Magnetic pole detection - Minute position detection method - Function selection	0000h		
	PL18	IDLV	Magnetic pole detection - Minute position detection method - Identification signal amplitude	0		

Note. The parameter whose symbol is preceded by * is enabled with the following conditions.

* : After setting the parameter, power off and on the servo amplifier or reset the controller.

**: After setting the parameter, power off and on the servo amplifier.

15.3.4 Function

(1) Servo control error detection function

POINT

- 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].

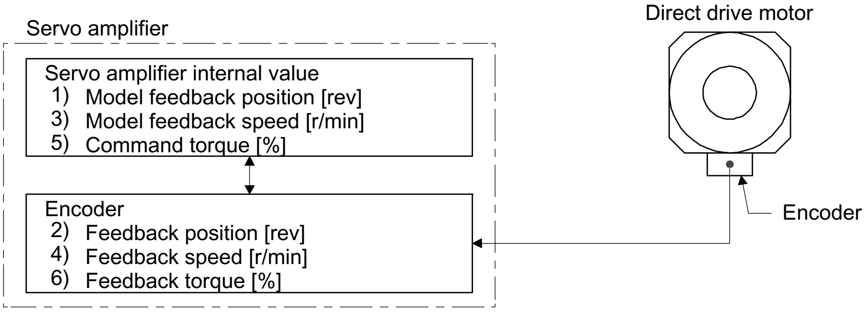
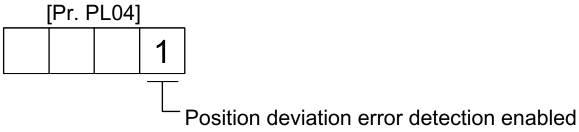


Figure 15.1 Outline of servo control error detection function

(a) Position deviation error detection

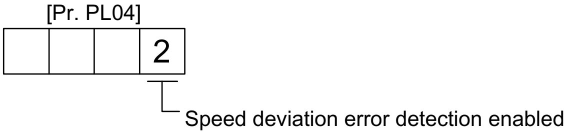
Set [Pr. PL04] to "_ _ _ 1" to enable the position deviation error detection.



When you compare the model feedback position (1)) and the feedback position (2)) in figure 15.1, 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. Replace the set value as required.

(b) Speed deviation error detection

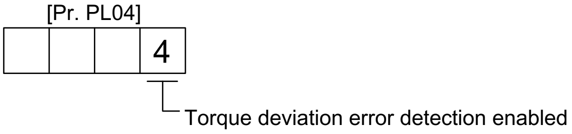
Set [Pr. PL04] to "_ _ _ 2" to enable the speed deviation error detection.



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 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. Replace the set value as required.

(c) Torque deviation error detection level

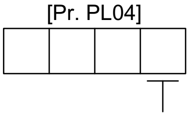
Set [Pr. PL04] to "_ _ _ 4" to enable the torque deviation error detection.



When you compare the command torque (5)) and the feedback torque (6)) in figure 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%. Replace the set value as required.

(d) Detecting multiple deviation errors

When setting [Pr. PL04] as shown below, multiple deviation errors can be detected. For the error detection methods, refer to (1) (a), (b), (c) in this section.

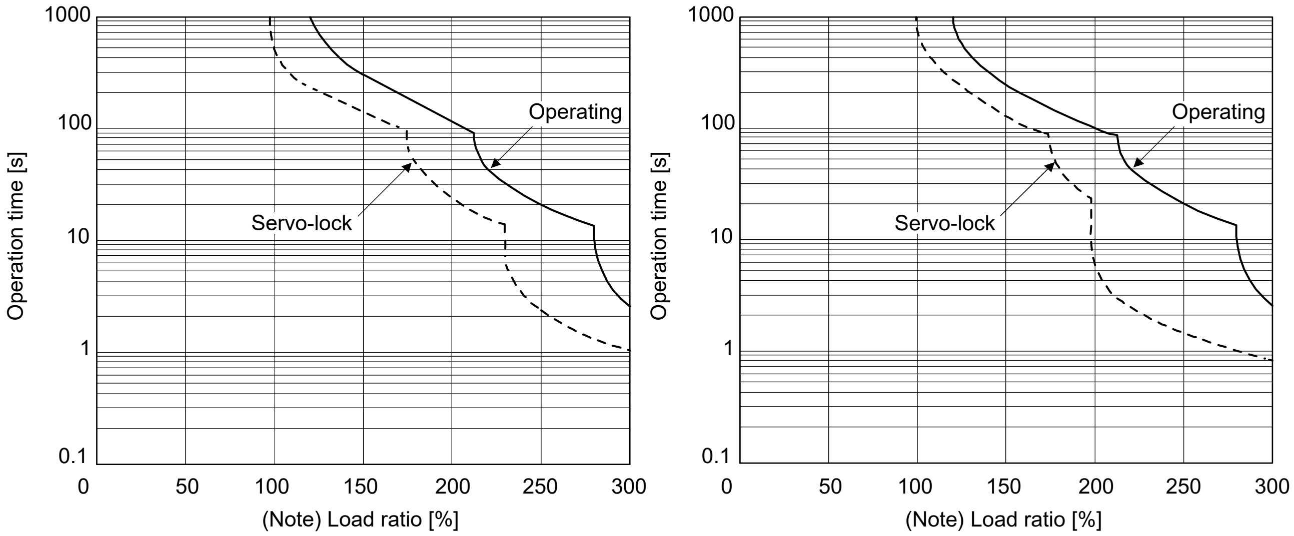


Setting value	Position deviation error detection	Speed deviation error detection	Torque deviation error detection
1	○		
2		○	
3	○	○	
4			○
5	○		○
6		○	○
7	○	○	○

15.4 Characteristics

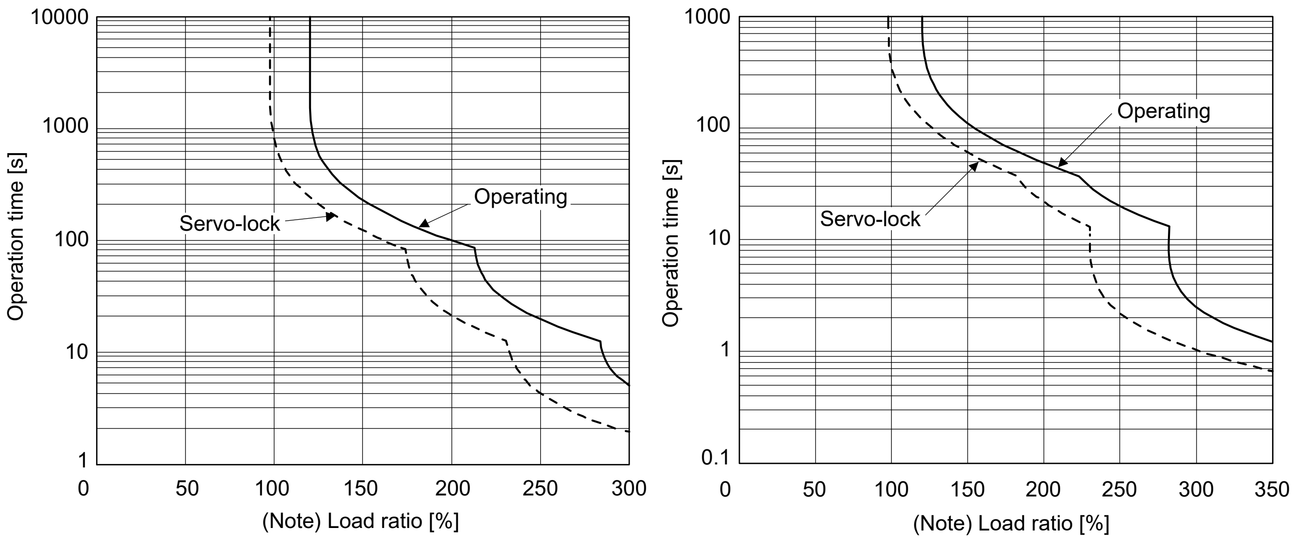
15.4.1 Overload protection characteristics

An electronic thermal is built in the servo amplifier to protect the servo amplifier, 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 relay 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.
When unbalanced torque is generated, such as in a vertical lift machine, the unbalanced torque of the machine should be kept at 70% or lower 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.)



TM-RFM002C20/TM-RFM004C20/
TM-RFM006C20/TM-RFM006E20/
TM-RFM012E20/TM-RFM018E20/
TM-RFM012G20/TM-RFM040J10

TM-RFM120J10



TM-RFM048G20/TM-RFM072G20/
TM-RFM240J10

TM-RG2M002C30/TM-RU2M002C30/
TM-RG2M004E30/TM-RU2M004E30/
TM-RG2M009G30/TM-RU2M009G30

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 50 r/min or less low-speed operation status, the servo amplifier may malfunction regardless of the electronic thermal relay protection.

Fig. 15.2 Electronic thermal relay protection characteristics

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 tables in consideration for the harshest conditions with regard to the environment and operation pattern. 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 direct drive 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 15.1 Power supply capacity and generated loss per direct drive motor

Direct drive motor	Servo amplifier	Power supply capacity [kVA]	Servo amplifier-generated heat [W]		Area required for heat dissipation [m^2]
			At rated output	With servo-off	
TM-RG2M002C30	MR-J4-20B(-RJ) MR-J4-20B1(-RJ)	0.25	25	15	0.5
TM-RU2M002C30					
TM-RG2M004E30	MR-J4-20B(-RJ) MR-J4-20B1(-RJ)	0.5	25	15	0.5
TM-RU2M004E30					
TM-RG2M004E30 (Note)	MR-J4-40B(-RJ) MR-J4-40B1(-RJ)	0.7	35	15	0.7
TM-RU2M004E30 (Note)					
TM-RG2M009G30	MR-J4-40B(-RJ) MR-J4-40B1(-RJ)	0.9	35	15	0.7
TM-RU2M009G30					
TM-RFM002C20	MR-J4-20B(-RJ) MR-J4-20B1(-RJ)	0.25	25	15	0.5
TM-RFM004C20	MR-J4-40B(-RJ) MR-J4-40B1(-RJ)	0.38	35	15	0.7
TM-RFM006C20	MR-J4-60B(-RJ)	0.53	40	15	0.8
TM-RFM006E20		0.46	40	15	0.8
TM-RFM012E20	MR-J4-70B(-RJ)	0.81	50	15	1.0
TM-RFM018E20	MR-J4-100B(-RJ)	1.3	50	15	1.0
TM-RFM012G20	MR-J4-70B(-RJ)	0.71	50	15	1.0
TM-RFM048G20	MR-J4-350B(-RJ)	2.7	90	20	1.8
TM-RFM072G20	MR-J4-350B(-RJ)	3.8	110	20	2.2
TM-RFM040J10	MR-J4-70B(-RJ)	1.2	50	15	1.0
TM-RFM120J10	MR-J4-350B(-RJ)	3.4	90	20	1.8
TM-RFM240J10	MR-J4-500B(-RJ)	6.6	160	25	3.2

Note. This combination increases the rated torque and the maximum torque.

15.4.3 Dynamic brake characteristics

⚠CAUTION

- ●The coasting distance is a theoretically calculated value that does not consider factors such as friction. The calculated distance is longer than the actual distance. If the braking distance is not longer than the calculated value, a moving part may crash into the stroke end, causing a dangerous situation. Install an 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.

POINT

- ●Do not use dynamic brake to stop in a normal operation as it is the function to stop in emergency.
- ●For a machine operating at the recommended load to motor inertia ratio or less, the estimated number of usage times of the dynamic brake is 1000 times while the machine decelerates from the rated speed to a stop once in 10 minutes.
- ●Be sure to enable EM1 (Forced stop 1) after 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. 15.3 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use equation 15.1 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) in this section.)

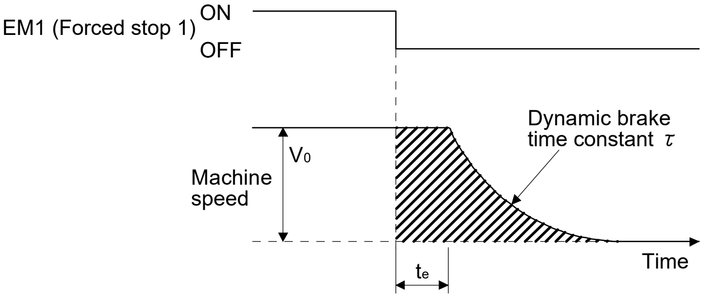


Fig. 15.3 Dynamic brake operation diagram

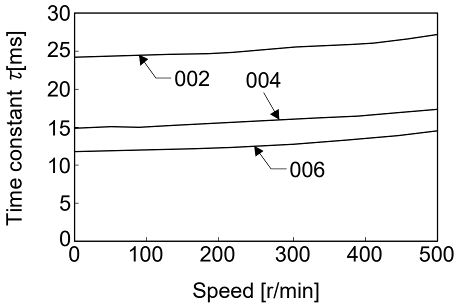
$$L_{max} = \frac{V_0}{60} \bullet \left\{ t_e + T\left(1 + \frac{J_L}{J_M}\right)\right\} \cdots\cdots (15.1)$$

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•cm^2]
J_L: Load moment of inertia converted into equivalent value on direct drive motor rotor	[kg•cm^2]
τ: Dynamic brake time constant	[s]
t_e: Delay time of control section	[s]

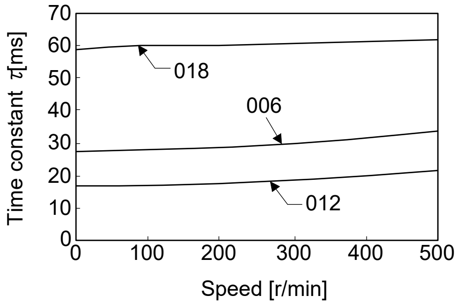
There is internal relay delay time of about 10 ms.

(b) Dynamic brake time constant

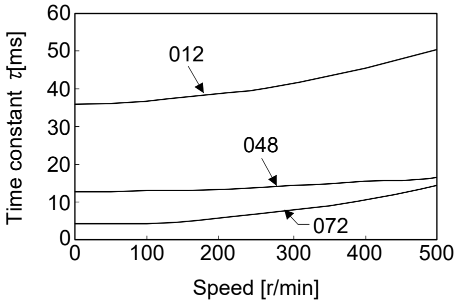
The following shows necessary dynamic brake time constant τ for equation 15.1.



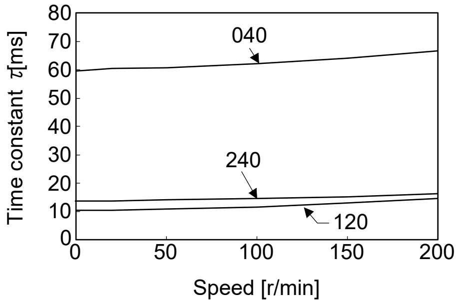
TM-RFM_C20



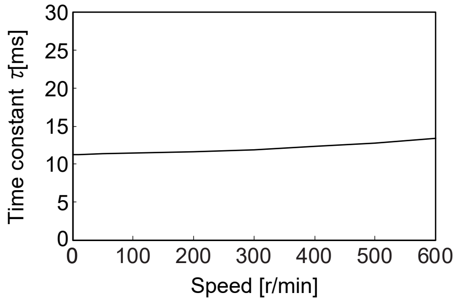
TM-RFM_E20



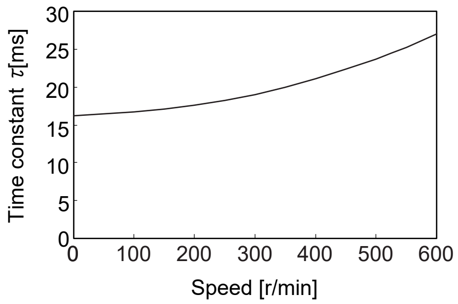
TM-RFM_G20



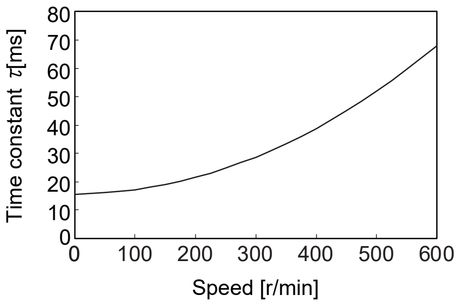
TM-RFM_J10



TM-RG2M002C30
TM-RU2M002C30



TM-RG2M004E30
TM-RU2M004E30



TM-RG2M009G30
TM-RU2M009G30

(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 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 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-RG2M002C30	
TM-RU2M002C30	
TM-RFM_G20	50 (300)
TM-RFM_J10	50 (200)
TM-RG2M_E30	20 (80)
TM-RG2M_G30	
TM-RU2M_E30	
TM-RU2M_G30	

16. FULLY CLOSED LOOP SYSTEM

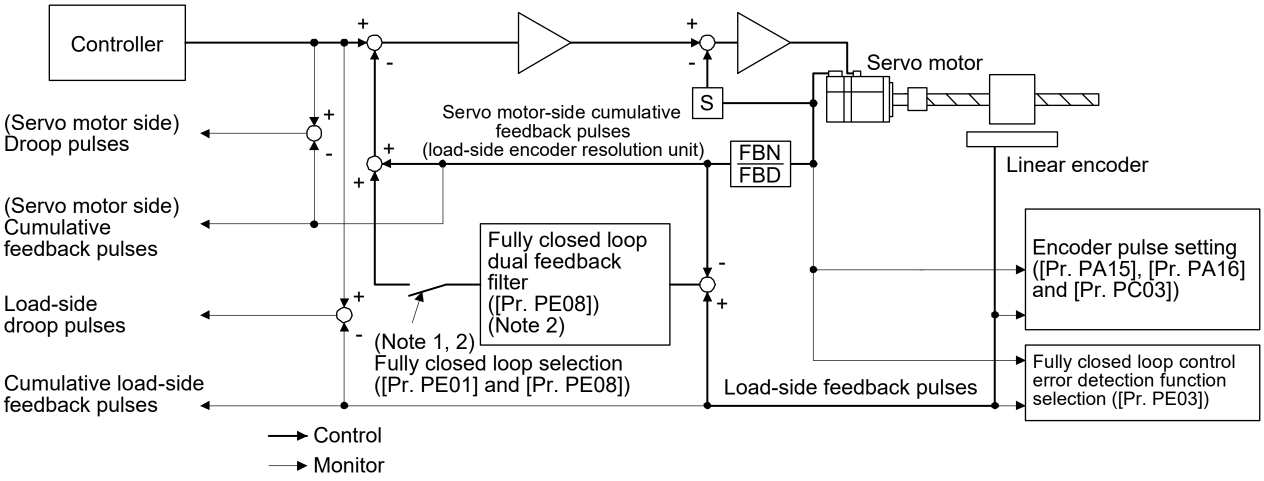
POINT

- The fully closed loop system is available for the servo amplifiers of which software version is A3 or later.
- 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-_B_ servo amplifier, the following restrictions apply. However, these restrictions will not be applied for MR-J4-_B_-RJ servo amplifiers.
  - 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 a two-wire type encoder cable according to app. 8.
- The synchronous encoder Q171ENC-W8 can be used with servo amplifiers with software version A8 or later.

16.1 Functions and configuration

16.1.1 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.

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 Dual feedback filter], fully closed loop control is always performed.

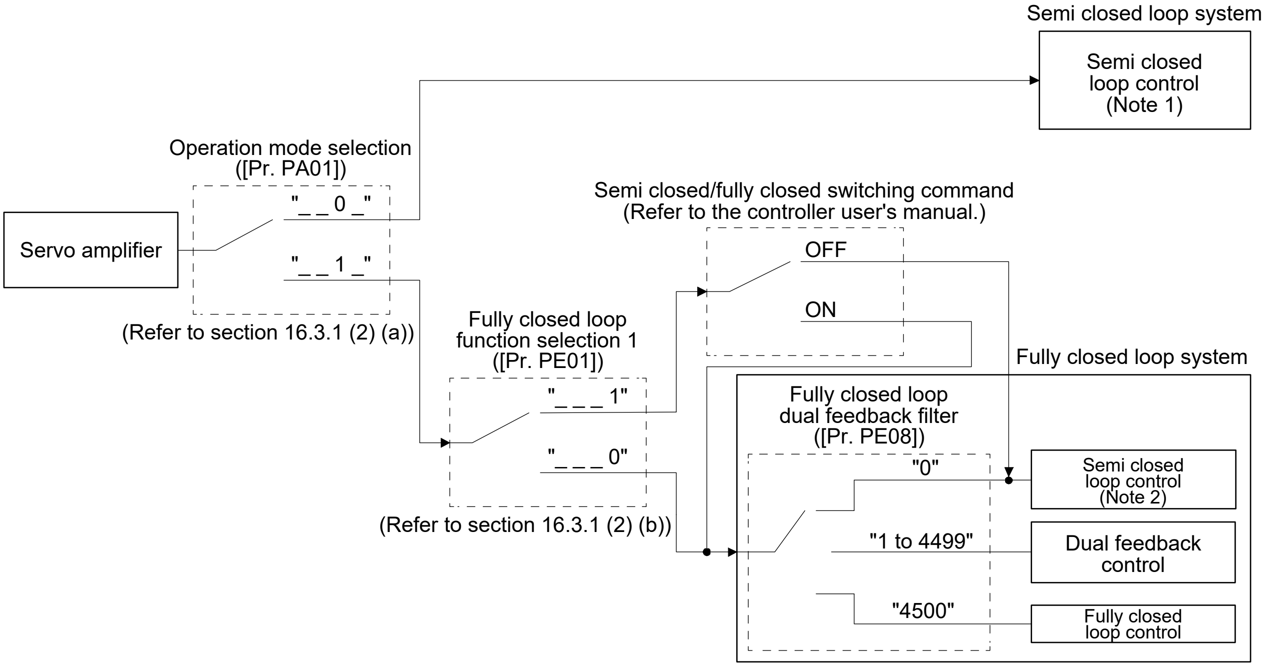
The following table shows the functions of each control mode.

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.

16.1.2 Selecting procedure of control mode

(1) Control mode configuration

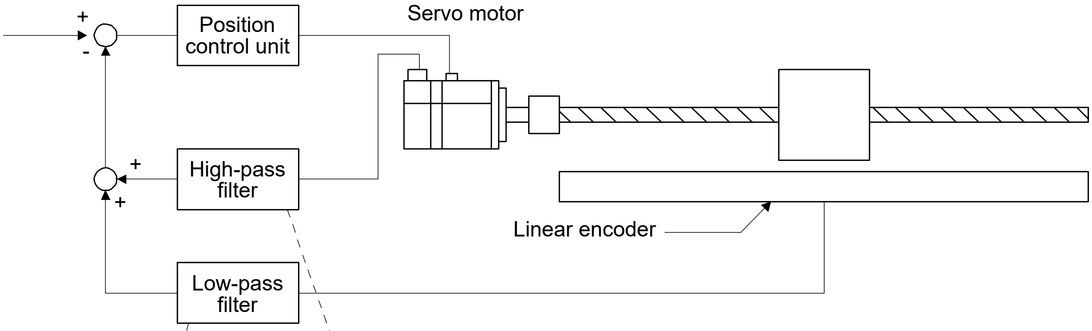
In this servo, a semi closed loop system or fully closed loop system can be selected as a control system. In addition, on the fully closed loop system, the semi closed loop control, fully closed loop control and dual feedback control can be selected by the [Pr. PE08] settings.

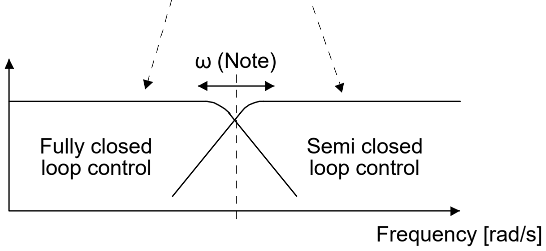


Note 1. Use the servo motor encoder unit for the command unit. Use the servo motor-side information for the alarm determination.
2. Use the load-side encoder information for the command unit. When [Pr. PE08 Fully closed loop dual feedback filter] is set to "0", the load-side information is used for determining alarms such as error excessive. When the semi closed/fully closed switching command is turned off, the servo motor-side information is used for determining alarms such as error excessive.

(2) Dual feedback filter equivalent block diagram

A dual feedback filter equivalent block diagram on the dual feedback control is shown below.





Dual feedback filter

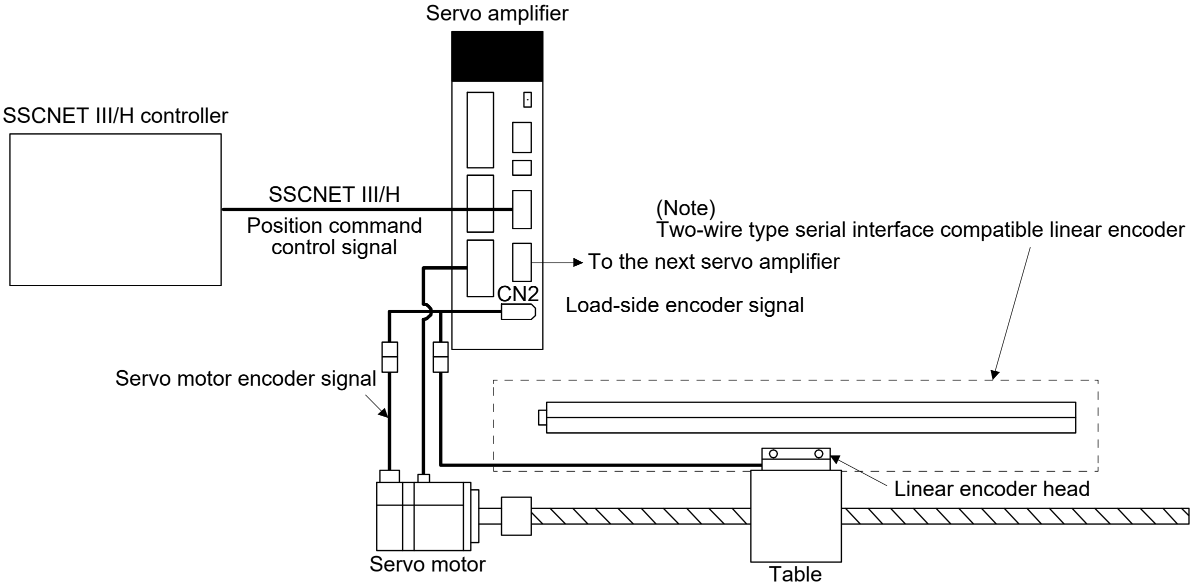
Operation status	Control status
Servo motor during a stop (0 to ω)	Fully closed loop control
In operation (ω or more)	Semi closed loop control

Note. "ω" (a dual feedback filter band) is set by [Pr. PE08].

16.1.3 System configuration

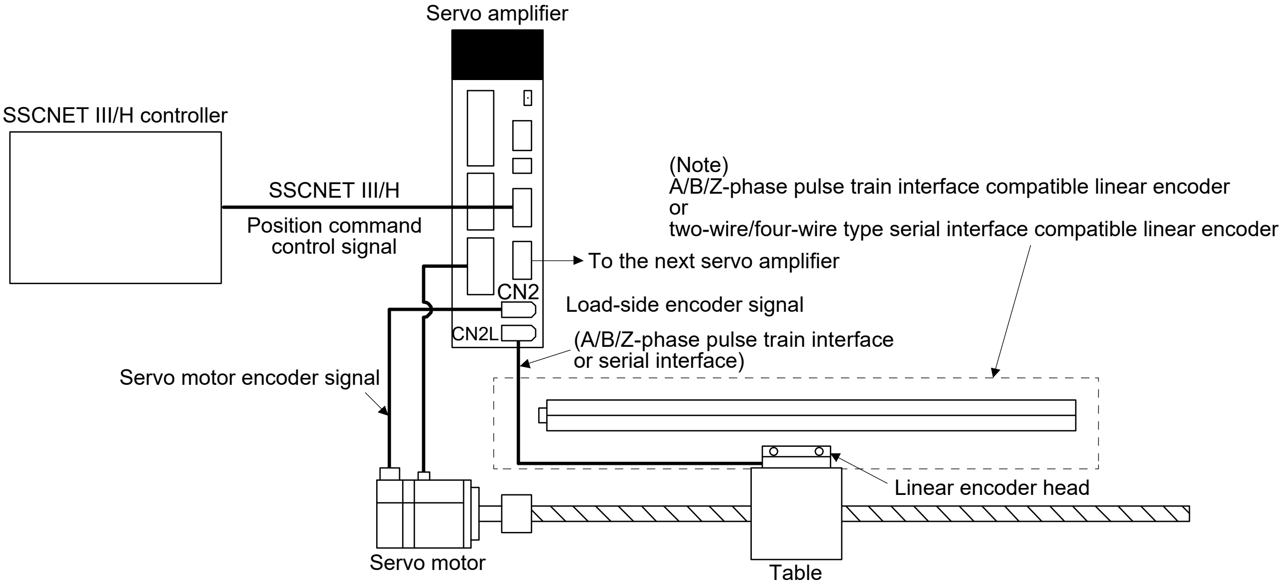
(1) For a linear encoder

(a) MR-J4-_B_ servo amplifier



Note. Applicable for the absolute position detection system when an absolute position linear encoder is used.
In that case, a battery is not required.

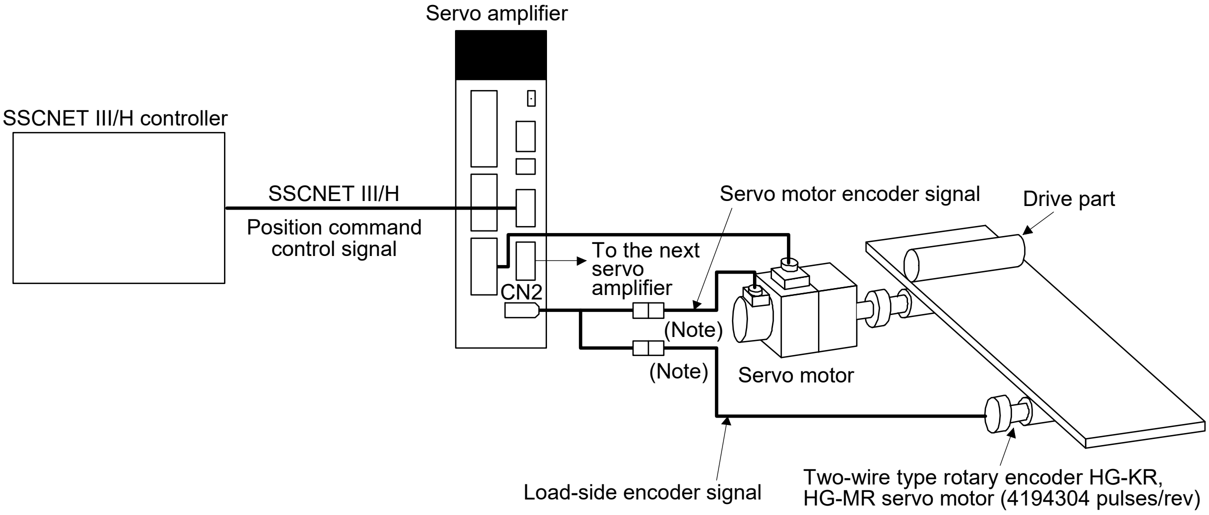
(b) MR-J4-_B_-RJ servo amplifier



Note. Applicable for the absolute position detection system when an absolute position linear encoder is used.
In that case, a battery is not required.

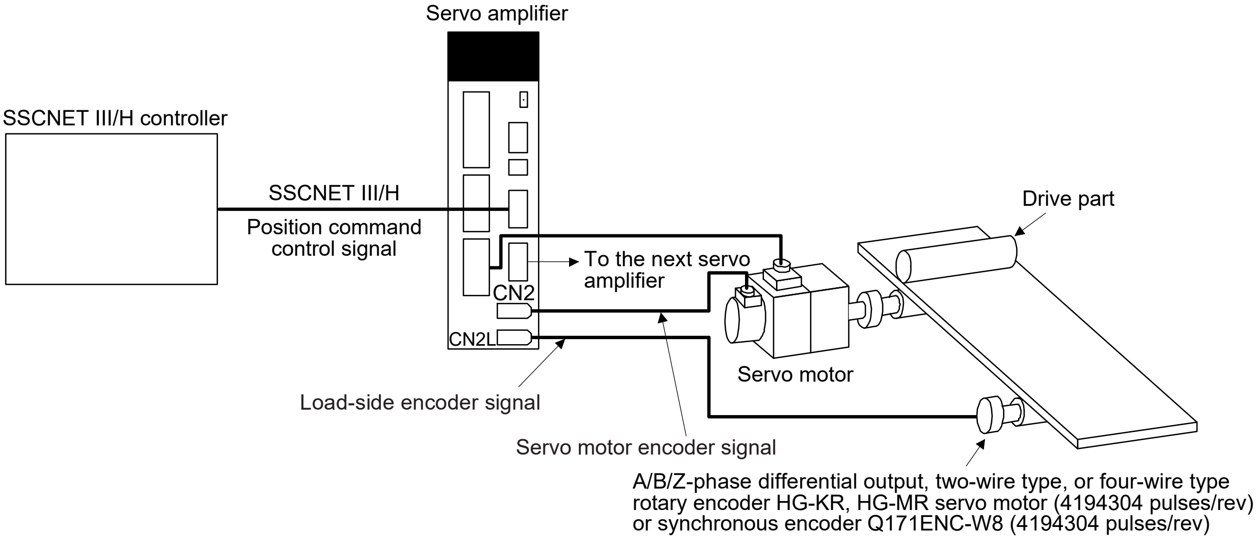
(2) For a rotary encoder

(a) MR-J4-_B_ servo amplifier



Note. Use a two-wire type encoder cable. A four-wire type linear encoder cable cannot be used.

(b) MR-J4-_B_-RJ servo amplifier



16.2 Load-side encoder

POINT

- ●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.

16.2.1 Linear encoder

Refer to "Linear Encoder Instruction Manual" for usable linear encoders.

16.2.2 Rotary encoder

If using a rotary encoder as a load-side encoder, use the following servo motor or encoder.

Servo amplifier	HG-KR	HG-MR	Synchronous encoder Q171ENC-W8	A/B/Z-phase differential output (Note)
MR-J4-_B_	○	○		
MR-J4-_B_-RJ	○	○	○	○

Note. A/B/Z-phase differential output rotary encoders with the same specifications as A/B/Z-phase differential output linear encoders can be used as load-side encoders. Refer to "Linear Encoder Instruction Manual".

Use a two-wire type encoder cable for MR-J4-_B_ servo amplifiers. Do not use MR-EKCBL30M-L, MREKCBL30M-H, MR-EKCBL40M-H, or MR-EKCBL50M-H as they are four-wire type. If a 30 to 50 m encoder cable is required, fabricate a two-wire type encoder cable by referring to app. 9.

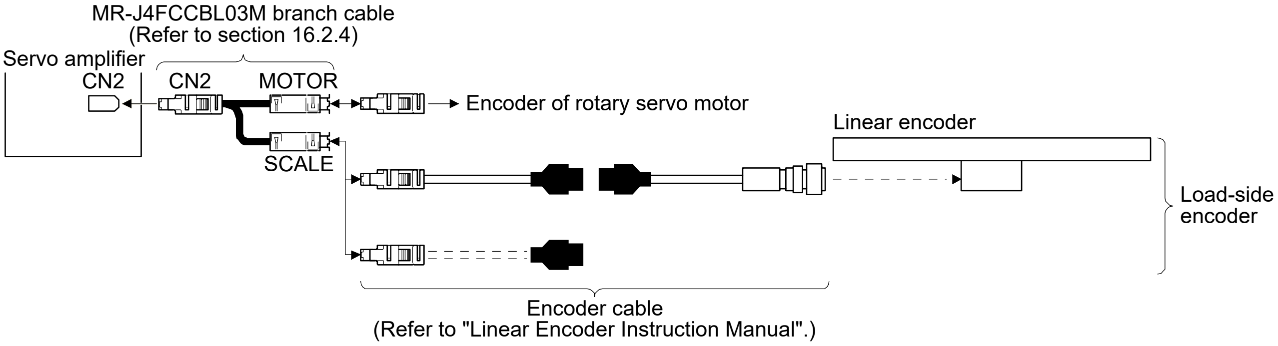
16.2.3 Configuration diagram of encoder cable

Configuration diagram for servo amplifier and load-side encoder is shown below. Cables used vary, depending on the load-side encoder.

(1) Linear encoder

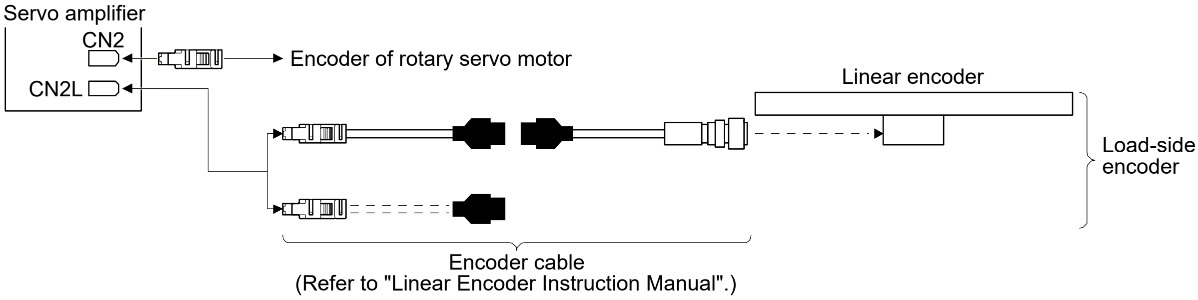
Refer to "Linear Encoder Instruction Manual" for encoder cables for linear encoder.

(a) MR-J4-_B_ servo amplifier



(b) MR-J4-_B_-RJ servo amplifier

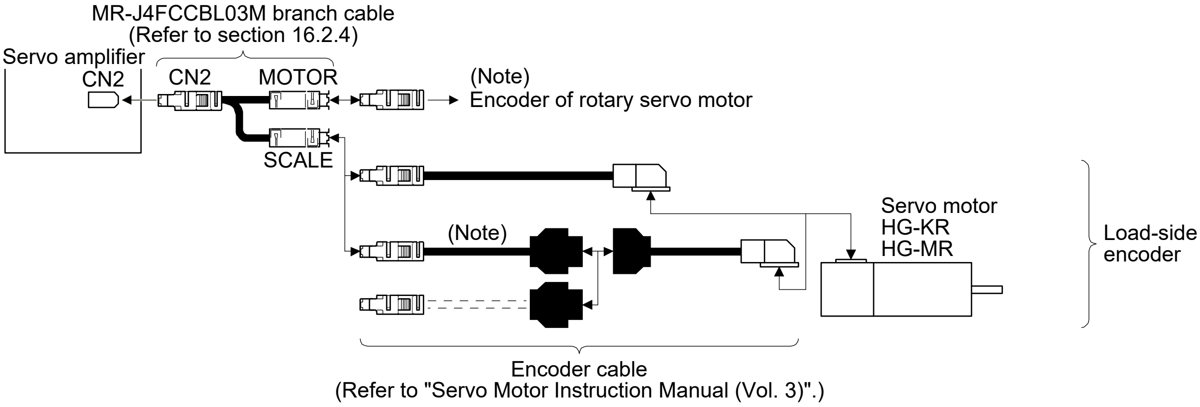
You can connect the linear encoder without using a branch cable shown in (a) for MR-J4-_B_-RJ servo amplifier. You can also use a four-wire type linear encoder.



(2) Rotary encoder

(a) MR-J4-_B_ servo amplifier

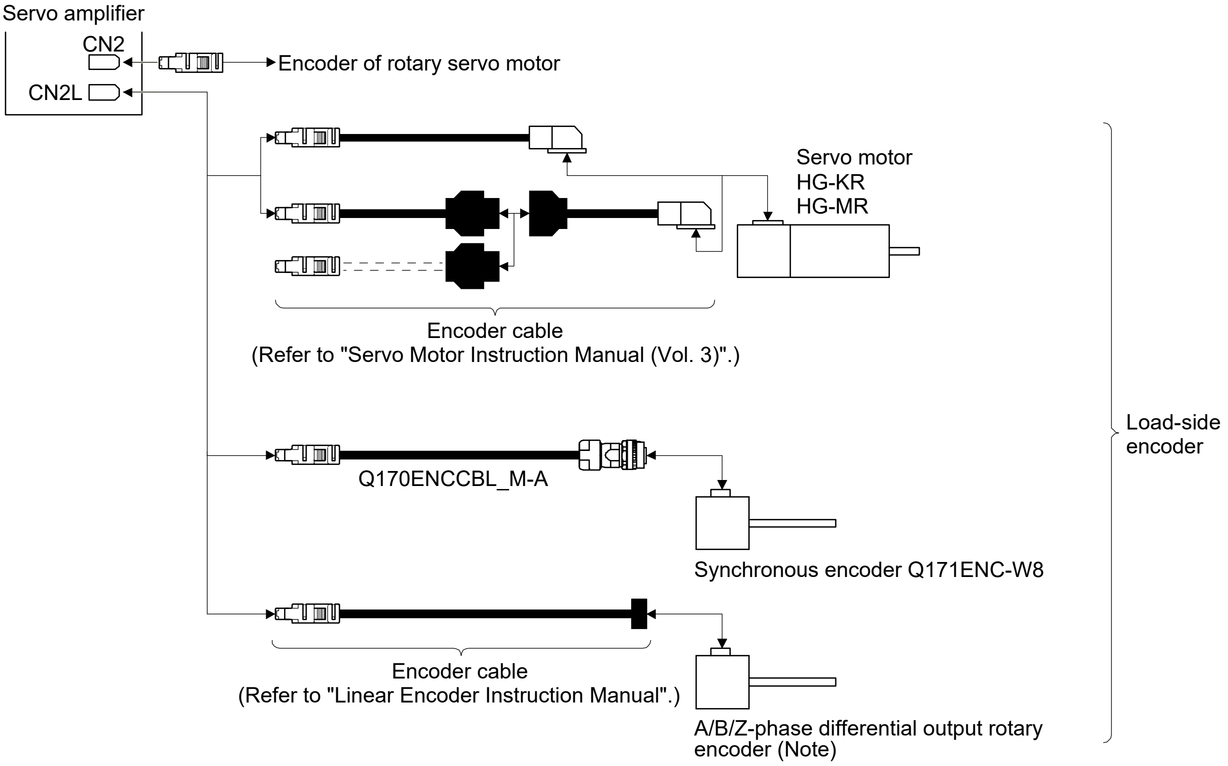
Refer to "Linear Encoder Instruction Manual" for encoder cables for rotary encoder.



Note. Use a two-wire type encoder cable. A four-wire type linear encoder cable cannot be used.

(b) MR-J4-_B_-RJ servo amplifier

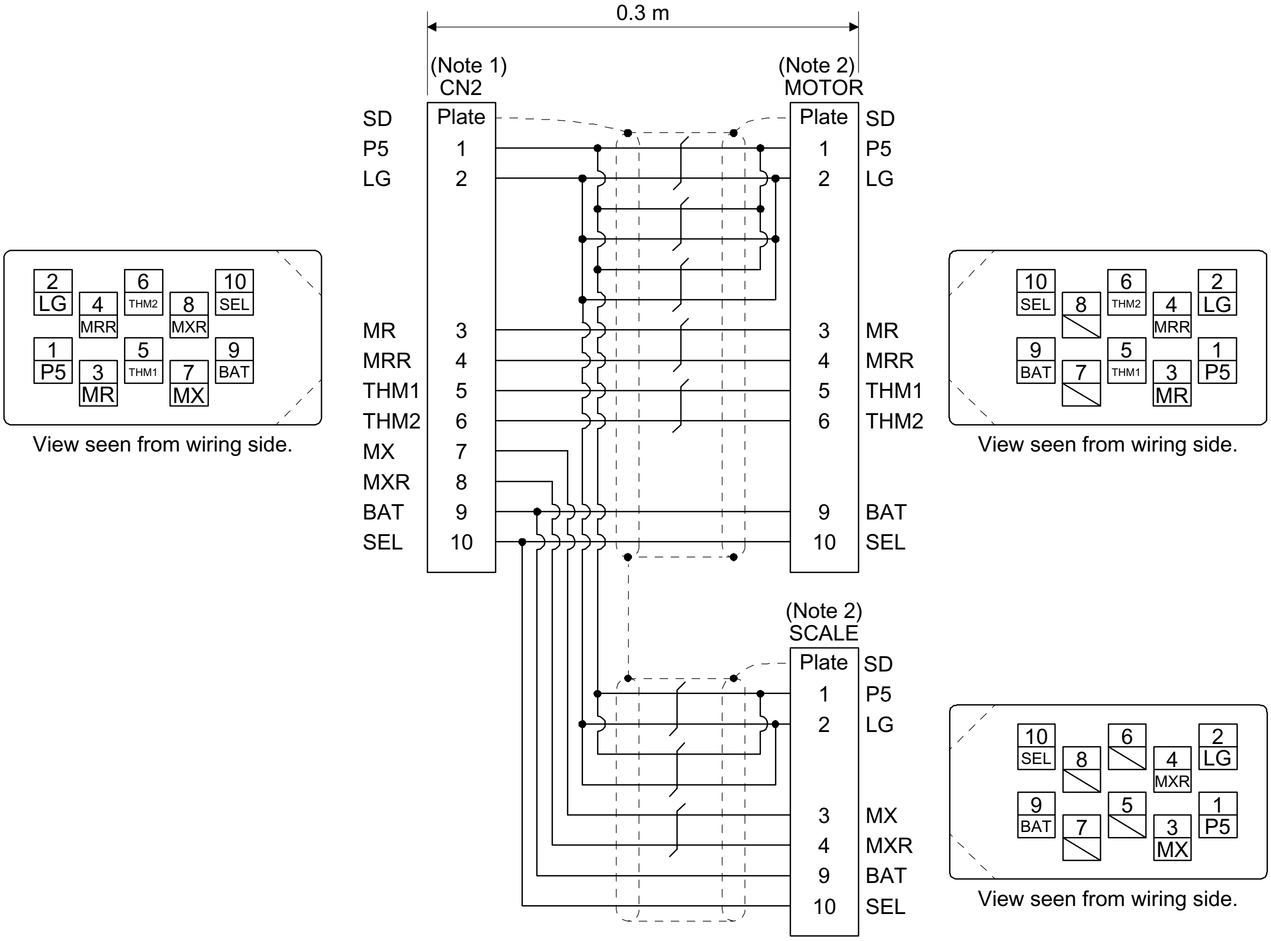
For the MR-J4-_B_-RJ servo amplifier, a rotary encoder can be connected without the branch cable shown in the above (a). In addition, a four-wire type or A/B/Z-phase differential output rotary encoder can also be used.



Note. A/B/Z-phase differential output rotary encoders with the same specifications as A/B/Z-phase differential output linear encoders can be used as load-side encoders. Refer to "Linear Encoder Instruction Manual".

16.2.4 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".



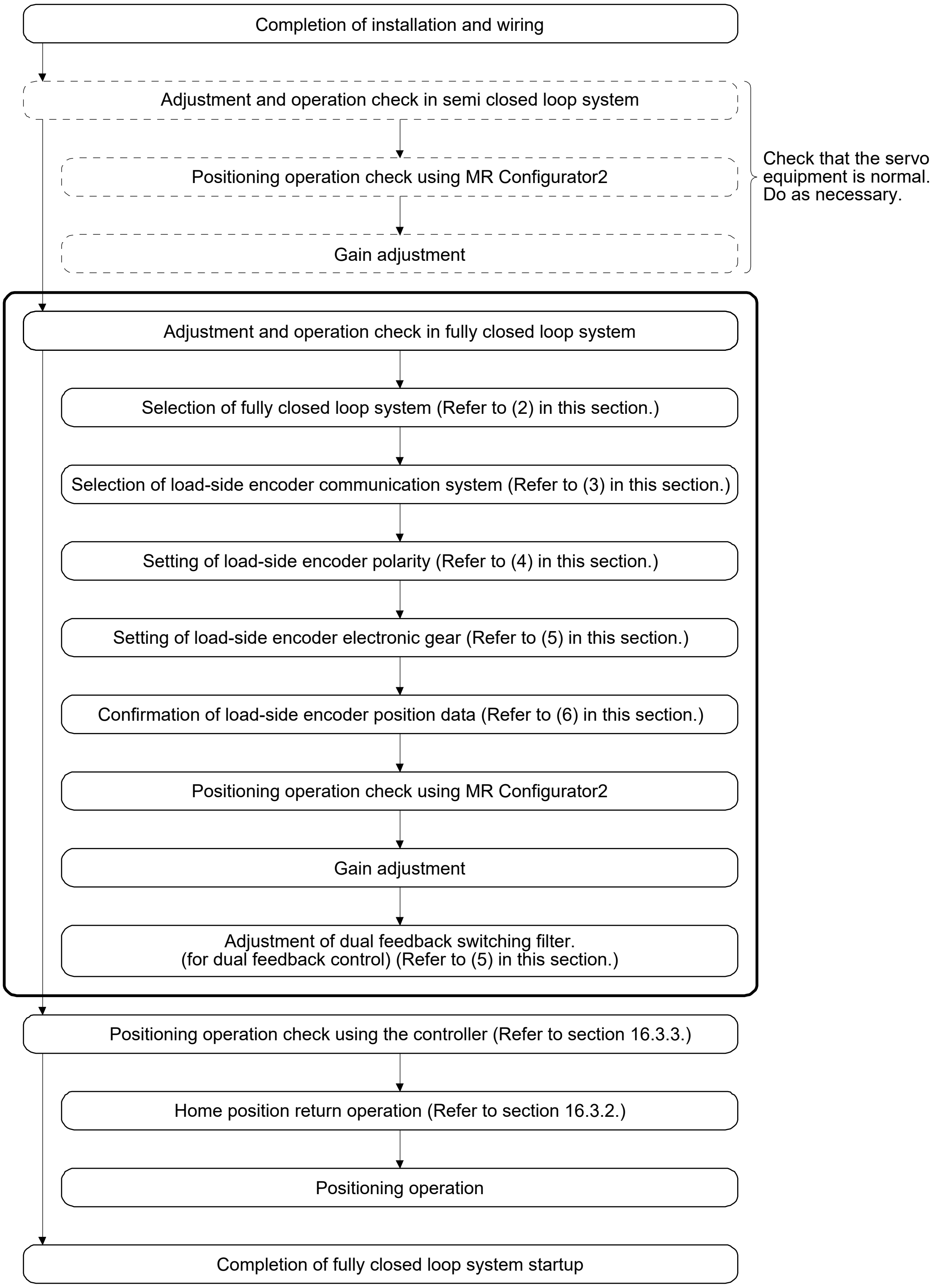
Note 1. Receptacle: 36210-0100PL, shell kit: 36310-3200-008 (3M)
2. Plug: 36110-3000FD, shell kit: 36310-F200-008 (3M)

16.3 Operation and functions

16.3.1 Startup

(1) Startup procedure

Start up the fully closed loop system in the following procedure.



(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 System	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)	"_ _ _ 0"		Load-side encoder unit	Dual feedback control (fully closed loop control)	○ (Note)
	"_ _ _ 1"	Off		Semi closed loop control	×
		On		Dual feedback control (fully closed loop control)	×

Note. Applicable when the load-side encoder is set as the absolute position encoder.

(a) Operation mode selection

Select a operation mode.

[Pr. PA01]

1 0 ☐ 0

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.

[Pr. PE01]

0 0 0 ☐

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.

(3) Selection of load-side encoder communication method

The communication method changes depending on the load-side encoder type. Refer to table 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. PC26].

[Pr. PC26]

	0	0	0

Load-side encoder cable communication method selection
0: Two-wire type
1: Four-wire type
When using a load-side encoder of A/B/Z-phase differential output method, set "0". Incorrect setting will trigger [AL. 70] and [AL. 71]. Setting "1" while using a servo amplifier other than MR-J4-_B_-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. PC27]. 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. PC27] 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. PC27]. Doing so may cause [AL. 42 Fully closed loop control error] during the positioning operation.

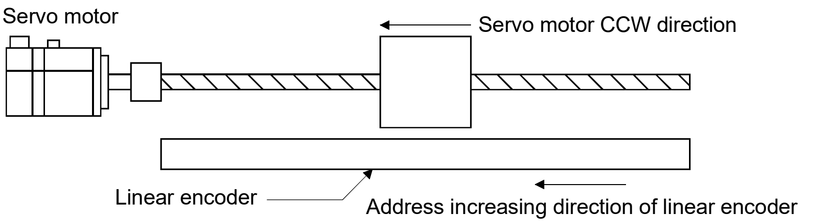
(a) Parameter setting method

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.

[Pr. PC27]

0	0	0	

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.

(5) Setting of feedback pulse electronic gear

POINT

- ●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.

Set the electronic gear ([Pr. PE04], [Pr. PE34], [Pr. PE05], and [Pr. PE35]) for servo motor-side encoder pulses. 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.

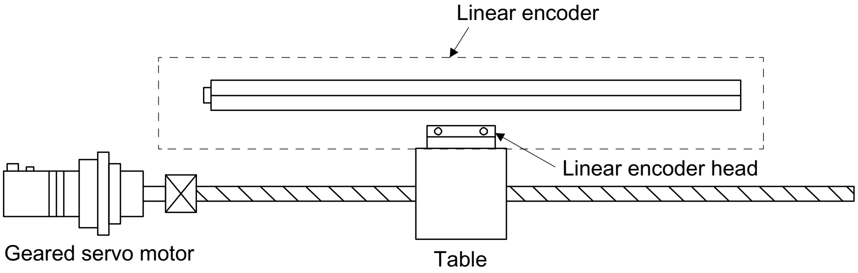
$$\text{Number of load-side encoder pulses per servo motor revolution} \\ = \text{Number of servo motor encoder pulses per servo motor revolution} \times \frac{[\text{Pr. PE04}] \times [\text{Pr. PE34}]}{[\text{Pr. PE05}] \times [\text{Pr. PE35}]}$$

Select the load-side encoder so that the number of load-side encoder pulses per servo motor revolution is within the following range.

$4096\ (2^{12}) \leq$ 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



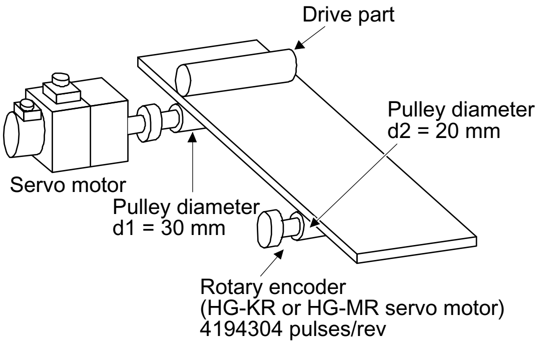
Calculate the number of linear encoder pulses per ball screw revolution.

Number of linear encoder pulses per ball screw revolution
= Ball screw lead/linear encoder resolution
= 20 mm/0.05 μm = 400000 pulses

$$\frac{[\text{Pr. PE04}] \times [\text{Pr. PE34}]}{[\text{Pr. PE05}] \times [\text{Pr. PE35}]} = \frac{400000}{4194304} \times \frac{1}{11} = \frac{3125}{32768} \times \frac{1}{11}$$

(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 pulse/rev



When the pulley diameters or reduction ratios differ, consider that in calculation.

$$\frac{[\text{Pr. PE04}] \times [\text{Pr. PE34}]}{[\text{Pr. PE05}] \times [\text{Pr. PE35}]} = \frac{4194304 \times 30}{4194304 \times 20} = \frac{1}{1} \times \frac{3}{2}$$

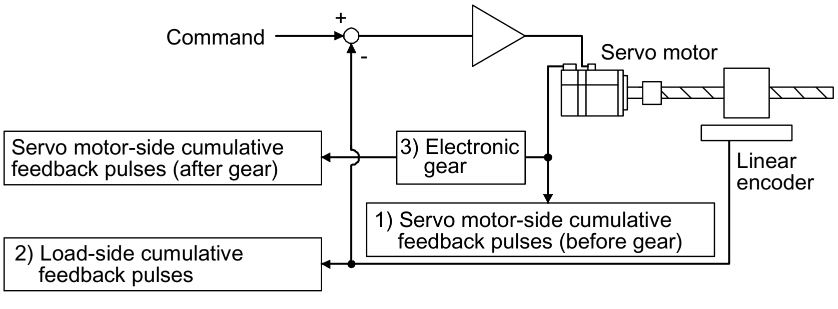
(6) Confirmation of load-side encoder position data

Check the load-side encoder mounting and parameter settings for any problems.

POINT

- ●Depending on the check items, MR Configurator2 may be used. Refer to section 16.3.9 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	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. 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 home position (reference mark, Z-phase)	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. 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)	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.
4	Setting of load-side encoder electronic gear	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. 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. 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. 

(7) Setting of fully closed loop dual feedback filter

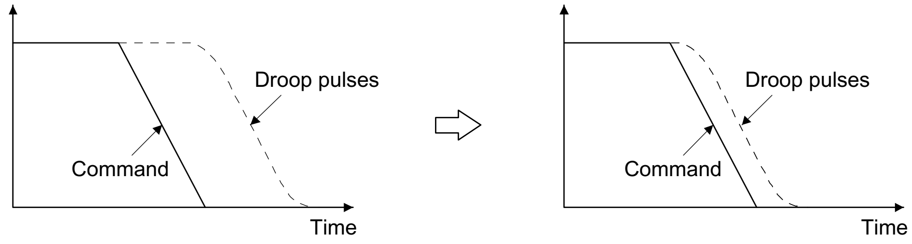
With the initial value (setting = 10) set in [Pr. PE08 Fully closed loop dual feedback filter the dual feedback filter], make gain adjustment by auto tuning, etc. as in semi closed loop control. While observing the servo operation waveform with the graph function, etc. of MR Configurator2, adjust the dual feedback filter.

The dual feedback filter operates as described below depending on the setting.

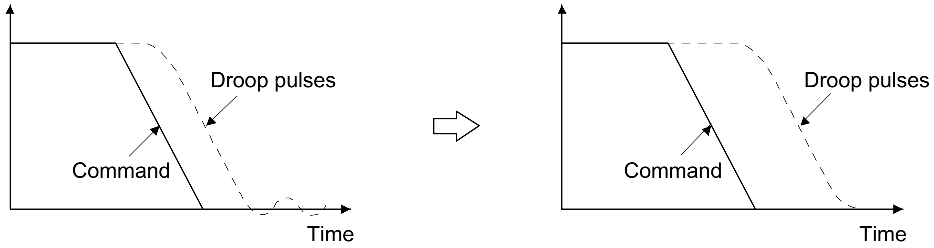
[Pr. PE08] setting	Control mode	Vibration	Settling time
0	Semi closed loop		
1 to 4499	Dual feedback	Not frequently occurs to Frequently occurs	Long time to Short time
4500	Fully closed loop		

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.



16.3.2 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 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.

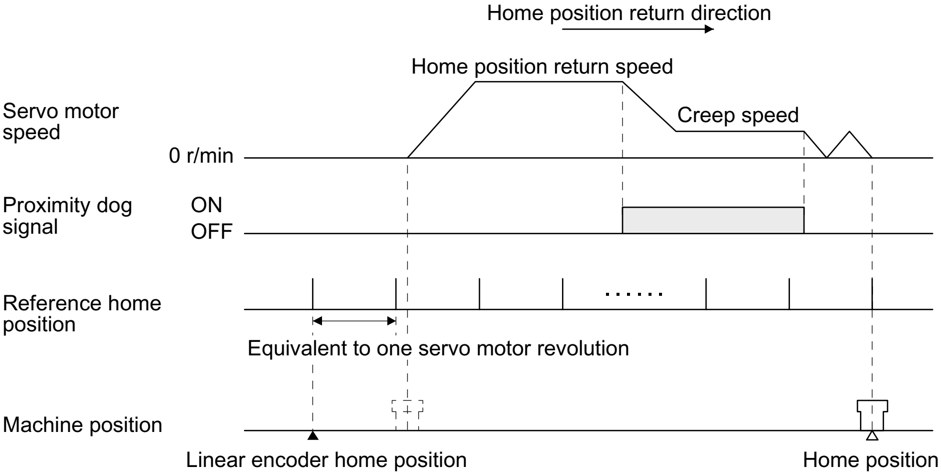
(2) Load-side encoder types and home position return methods

(a) About proximity dog type home position return using absolute type linear encoder

When an absolute type linear encoder is used, the home position reference 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.



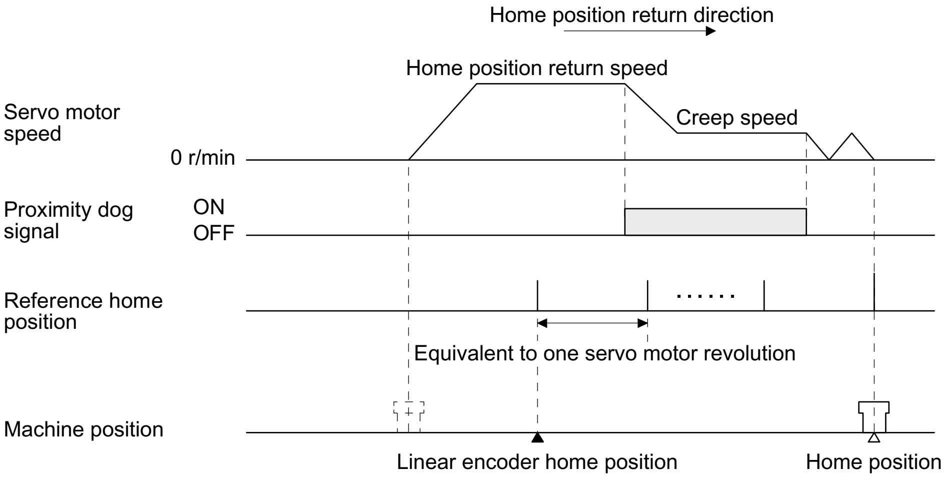
(b) About proximity dog type home position return using incremental linear encoder

1) When the linear encoder home position (reference mark) exists in the home position return direction

When an incremental linear encoder is used, the home position is the position per servo motor revolution to the linear encoder home position (reference mark) passed through first after a home position return start.

In the case of a proximity dog type home position return, the nearest position after proximity dog off is the home position.

Set one linear encoder home position in the full stroke, and set it in the position that can always be passed through after a home position return start.

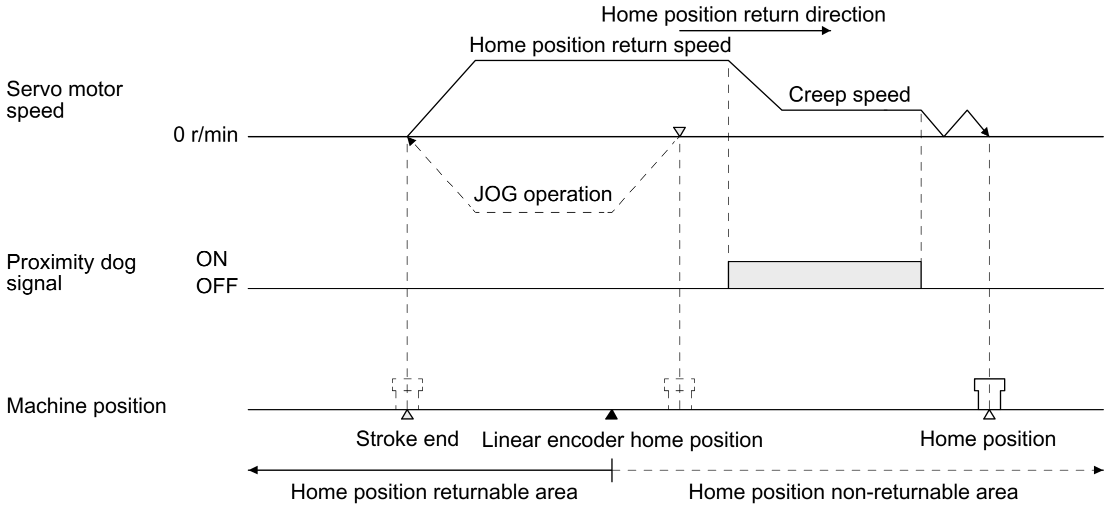


2) When the linear encoder home position does not exist in the home position return direction

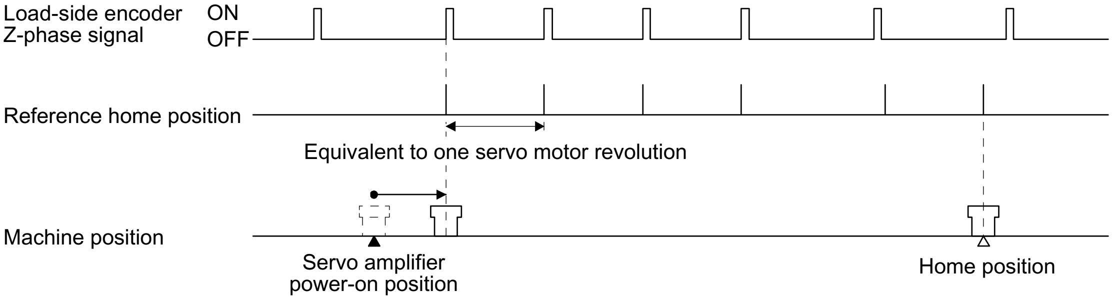
POINT

- ●To execute a home position return securely, start a home position return after moving the axis to the opposite stroke end by jog operation, etc. of the controller.
- ●A home position return cannot be made if the incremental linear encoder does not have a linear encoder home position (reference mark). Always provide a linear encoder home position (reference mark). (one place in the fully stroke)

If the home position return is performed from the position where the linear encoder home position (reference mark) does not exist, a home position return error occurs on the controller side. The error contents differ according to the controller type. When starting a home position return at the position where the linear encoder home position (reference mark) does not exist in the home position return direction, move the axis up to the stroke end on the side opposite to the home position return direction by JOG operation, etc. of the controller once, then make a home position return.



(c) About dog type home position return when using the rotary encoder of a serial communication servo motor
The home position for when using the rotary encoder of a serial communication servo motor for the load-side encoder is at the load-side Z-phase position.



(d) About data setting type (Common to all load-side encoders)
In the data setting type home position return method, pass through a home position (reference mark) and the Z-phase signal of the rotary encoder, and then make a home position return.
When the machine has no distance of one servo motor encoder revolution until the Z-phase of the rotary encoder is passed through, a home position return can be made by changing the home position setting condition selection in [Pr. PC17] if the home position is not yet passed through.

16.3.3 Operation from controller

The fully closed loop control compatible servo amplifier can be used with any of the following controllers.

Category	Model	Remark
Motion controller	R_MTCPU/Q17_DSCPU	Speed control (II) instructions (VVF and VVR) cannot be used.
Simple motion module	RD77MS_/QD77MS_ / LD77MS_	

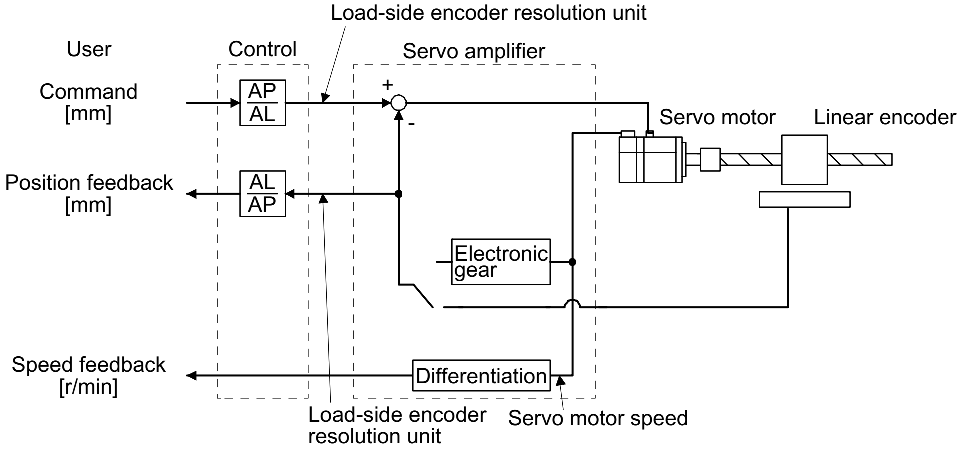
An absolute type linear encoder is necessary to configure an absolute position detection system under fully closed loop control using a linear encoder. In this case, the encoder battery need not be installed to the servo amplifier. When an rotary encoder is used, an absolute position detection system can be configured by installing the encoder battery 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.

(1) Operation from controller
Positioning operation from the controller is basically performed like the semi closed loop control.

(2) Servo system controller setting
When using fully closed loop system, make the following setting.
[Pr. PA01], [Pr. PC17], [Pr. PE01], [Pr. PE03] to [Pr. PE05], [Pr. PE34] and [Pr. PE35] are written to the servo amplifier and then are enabled using any of the methods indicated by ○ in Parameter enabled conditions. [Pr. PE06] to [Pr. PE08] are enabled at setting regardless of the valid conditions.

Setting item		Parameter enabled conditions		Settings	
		Controller reset	Power supply Off→on	Motion controller R_MTCPU/ Q17_DSCPU	Simple motion module RD77MS_/ QD77MS_ / LD77MS_
Command resolution				Load-side encoder resolution unit	
Servo parameter	MR-J4-B fully closed loop servo amplifier setting			MR-J4-B(-RJ) fully closed loop control	
	Motor setting			Automatic setting	
	Home position setting condition selection ([Pr. PC17])	○	○	Set the items as required.	
	Fully closed loop selection ([Pr. PA01] and [Pr. PE01])	×	○		
	Fully closed loop selection 2 ([Pr. PE03])	○	○		
	Fully closed loop control error detection speed deviation error detection level ([Pr. PE06])	Enabled at setting regardless of the enabled conditions			
	Fully closed loop control error detection position deviation error detection level ([Pr. PE07])				
	Fully closed loop electronic gear numerator ([Pr. PE04] and [Pr. PE34])	×	○		
	Fully closed loop electronic gear denominator ([Pr. PE05] and [Pr. PE35])	×	○		
	Fully closed loop dual feedback filter ([Pr. PE08])	Enabled at setting regardless of the enabled conditions			
Positioning control parameter	Unit setting	mm/inch/degree/pulse			
	Number of pulses per revolution (AP) Travel distance per revolution (AL)	For the setting methods, refer to (2) (a), (b) in this section.			

(a) When using a linear encoder (unit setting: mm)



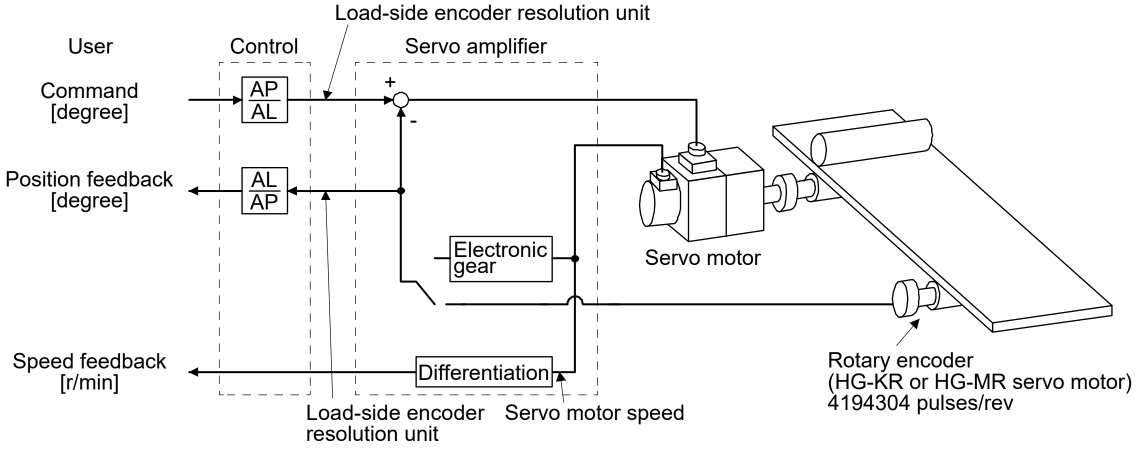
Calculate the number of pulses (AP) and travel distance (AL) of the linear encoder per ball screw revolution in the following conditions.

Ball screw lead: 20 mm
Linear encoder resolution: 0.05 μm

Number of linear encoder pulses (AP) per ball screw revolution
= Ball screw lead/linear encoder resolution = 20 mm/0.05 μm = 400000 pulses

$$\frac{\text{Number of pulses per revolution [pulse] (AP)}}{\text{Travel distance per revolution [μm] (AL)}} = \frac{\text{400000 pulses}}{\text{20 mm}} = \frac{400000}{20000}$$

(b) When using a rotary encoder (unit setting: degree)



Calculate the number of pulses (AP) and travel distance (AL) of the rotary encoder per servo motor revolution in the following conditions.

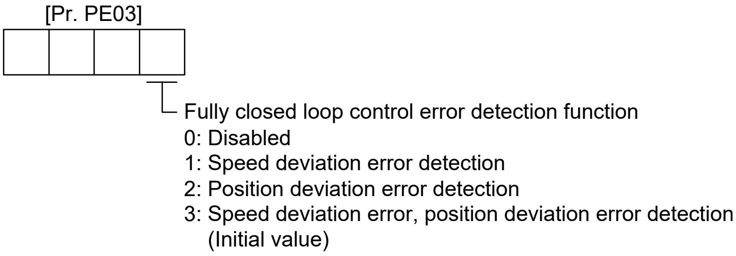
Resolution of rotary encoder = Load-side resolution: 4194304 pulses/rev

$$\frac{\text{Number of pulses per revolution [pulse] (AP)}}{\text{Travel distance per revolution [degree] (AL)}} = \frac{\text{4194304 pulses}}{\text{360 degrees}} = \frac{524288}{45}$$

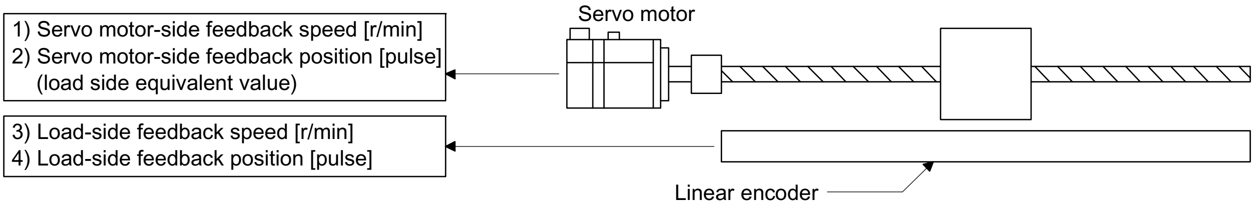
16.3.4 Fully closed loop control error detection functions

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 types of detection methods: speed deviation and position deviation. Select a detection method with [Pr. PE03 Fully closed loop function selection 2].
The detection level setting can be changed using [Pr. PE06] and [Pr. PE07].

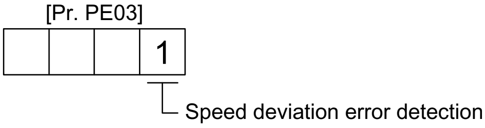
(1) Parameter
The fully closed loop control error detection function is selected.



(2) Fully closed loop control error detection functions



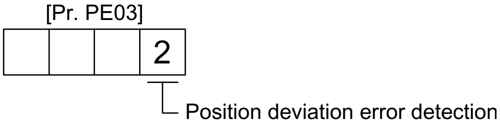
(a) Speed deviation error detection
Set [Pr. PE03] to "_ _ _ 1" to enable the speed deviation error detection.



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 initial value of [Pr. PE06] is 400 r/min. Change the set value as required.

(b) Position deviation error detection

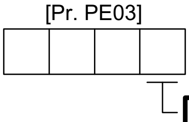
Set [Pr. PE03] to "_ _ _ 2" to enable the position deviation error detection.



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 initial value of [Pr. PE07] is 100 kpulses. Change the set value as required.

(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.



Setting value	Speed deviation error detection	Position deviation error detection
1	○	
2		○
3	○	○

16.3.5 Auto tuning function

Refer to section 6.3 for the auto tuning function.

16.3.6 Machine analyzer function

Refer to Help of MR Configurator2 for the machine analyzer function of MR Configurator2.

16.3.7 Test operation mode

Test operation mode is enabled by MR Configurator2.

For details on the test operation mode, refer to section 4.5.

Function	Item	Usability	Remark
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 4.5.1 (1) (c).
	Program operation	○	
	Output signal (DO) forced output	○	Refer to section 4.5.1 (1) (d).
	Motor-less operation		

16.3.8 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 need not be installed to the servo amplifier. When an rotary encoder is used, an absolute position detection system can be configured by installing the encoder battery 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.
If using an absolute position detection system with a linear encoder, enable the system with [Pr. PA03 Absolute position detection system], and use this servo with the following restrictions.

(1) Using conditions

(a) Use an absolute type linear encoder with the load-side encoder.

(b) Set [Pr. PA01] to "_ _ 1 _", and [Pr. PE01] to "_ _ _ 0".

(2) Absolute position detection range using encoder

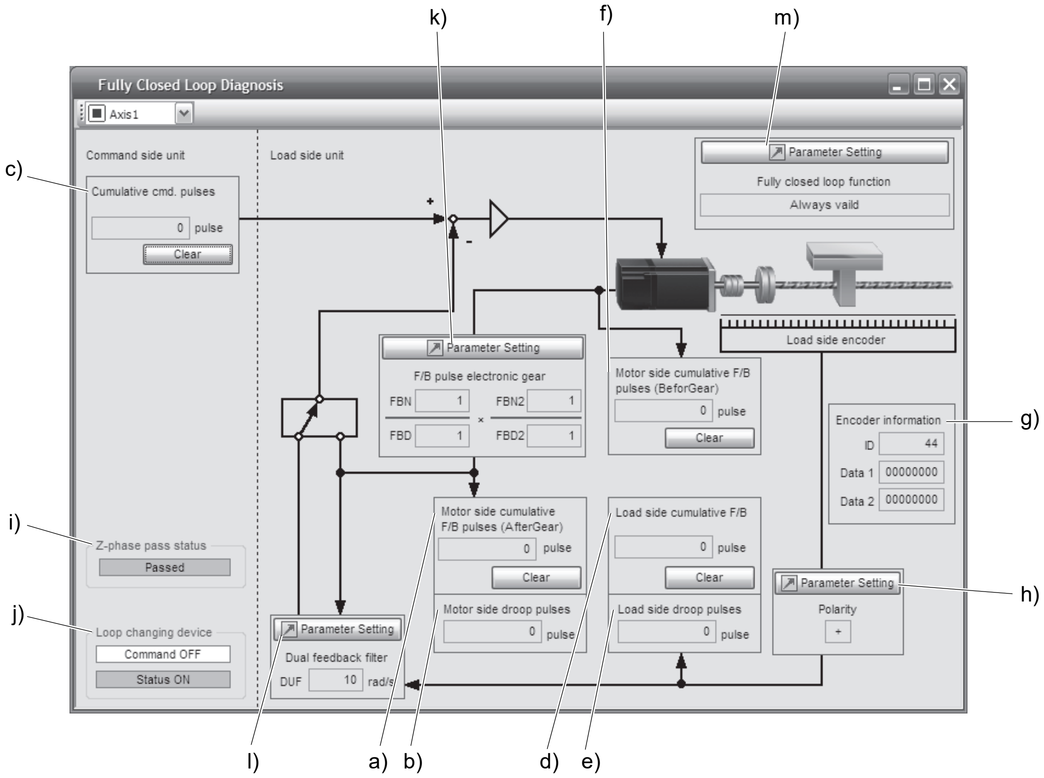
Encoder type	Absolute position detection enabled range
Linear encoder (Serial Interface)	Movable distance range of linear encoder (within 32-bit absolute position data)

(3) Alarm detection

The absolute position-related alarm ([AL. 25]) and warnings (AL. 92] and [AL. 9F]) are not detected.

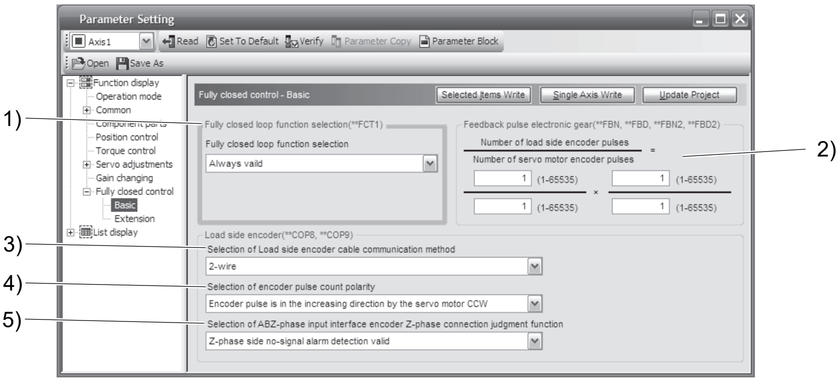
16.3.9 About MR Configurator2

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.



Cumulative cmd. pulses: 0 pulse
Fully closed loop function: Always vaild
FBN 1, FBN2 1, FBD 1, FBD2 1
Motor side cumulative F/B pulses (BeforGear): 0 pulse
Encoder information: ID 44, Data 1 00000000, Data 2 00000000
Motor side cumulative F/B pulses (AfterGear): 0 pulse
Load side cumulative F/B: 0 pulse
Z-phase pass status: Passed
Loop changing device: Command OFF, Status ON
Motor side droop pulses: 0 pulse
Load side droop pulses: 0 pulse
Polarity: +
Dual feedback filter: DUF 10 rad/s

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)	Cumu. Com. 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 cumu. 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

Symbol	Name	Explanation	Unit
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
g)	Encoder information	The load-side encoder information is displayed. The display contents differ depending on the load-side encoder type. ・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 16.3.1 (5).)	
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 selection)	The parameter for the fully closed loop control is displayed or set. Click "Parameter setting" to display the "Fully closed loop control - Basic" window.  Fully closed control - Basic Fully closed loop function selection(**FCT1) Fully closed loop function selection: Always vaild Feedback pulse electronic gear(**FBN, **FBD, **FBN2, **FBD2) Number of load side encoder pulses / Number of servo motor encoder pulses = 1 (1-65535) / 1 (1-65535) × 1 (1-65535) / 1 (1-65535) Load side encoder(**COP8, **COP9) Selection of Load side encoder cable communication method: 2-wire Selection of encoder pulse count polarity: Encoder pulse is in the increasing direction by the servo motor CCW Selection of ABZ-phase input interface encoder Z-phase connection judgment function: Z-phase side no-signal alarm detection valid 1) Fully closed loop selection ([Pr. PE01]) "Always valid" or "Switching with the control command of controller" is selected here. 2) 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. PC26]) 4) Selection of encoder pulse count polarity ([Pr. PC27]) Polarity of the load-side encoder information is selected. 5) Selection of A/B/Z-phase input interface encoder Z-phase connection judgment function ([Pr. PC27]) 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.	

17. APPLICATION OF FUNCTIONS

This chapter explains application of using servo amplifier functions.

17.1 J3 compatibility mode

POINT

- ●The fully closed loop control in the J3 compatibility mode is available for the servo amplifiers with software version A3 or later.
- ●Specifications of the J3 compatibility mode of the servo amplifier with software version A4 or earlier differ from those with software version A5 or later.
- ●The J3 compatibility mode is not compatible with the master-slave operation function.

17.1.1 Outline of J3 compatibility mode

MR-J4W_-_B servo amplifiers and MR-J4-_B_(-RJ) servo amplifiers have two operation modes: "J4 mode" is for using all functions with full performance and "J3 compatibility mode" for using the conventional MR-J3-B servo amplifiers.
When you connect a servo amplifier with SSCNET III/H communication for the first controller communication by factory setting, the operation mode will be fixed to "J4 mode". To restore the factory settings or select a desired mode, change the settings using the application "MR-J4(W)-B mode selection" or "MR Mode Change".
The application "MR-J4(W)-B mode selection" or "MR Mode Change" is included in MR Configurator2 with version 1.12N or later. The application "MR-J4(W)-B mode selection" is packed with MR Configurator2 of software version 1.12N or later.
For information on the operating conditions of the application "MR-J4(W)-B mode selection" and "MR Mode Change", refer to the operating conditions of MR Configurator2. (Refer to section 11.7.)

17.1.2 Operation modes supported by J3 compatibility mode

The J3 compatibility mode supports the following operation modes.

Operation mode in J3 compatibility mode	Model of MR-J3-_B	Model of MR-J3-_BS	Model of MR-J3W-_B
MR-J3-B standard control mode (rotary servo motor)	MR-J3-_B	MR-J3-_BS	MR-J3W-_B
MR-J3-B fully closed loop control mode	MR-J3-_B-RJ006	MR-J3-_BS	
MR-J3-B linear servo motor control mode	MR-J3-_B-RJ004		MR-J3W-_B
MR-J3-B DD motor control mode	MR-J3-_B-RJ080W		MR-J3W-_B

Each operation mode has the same ordering as conventional MR-J3-B series servo amplifiers and is compatible with their settings.
In addition, the control response characteristic in the J3 compatibility mode will be the same as that of MR-J3 series. By enabling the J3 extension function, control response will be equal to MR-J4 series using a controller compatible with SSCNET III.

17.1.3 J3 compatibility mode supported function list

The following shows functions which are compatible with J4 mode and J3 compatibility mode. The letters such as "A0" described after ◎ and ○ mean servo amplifier software versions which compatible with each function. Each function is used with servo amplifiers with these software versions or later.

Function	Name	Compatibility (◎: J4 new, ○: Equivalent to J3, ×: Not available)		
		MR-J4 series		MR-J3/MR-J3W series (Note 8)
		J4 mode	J3 compatibility mode	
Basic specification	Speed frequency response	2.5 kHz	2.1 kHz	2.1 kHz
	Encoder resolution	22 bits (Note 1)	18 bits (Note 1)	18 bits
SSCNET III/H communication or SSCNET III communication	Communication baud rate	150 Mbps	50 Mbps	50 Mbps
	Maximum distance between stations	100 m	50 m	50 m
Basic function	Absolute position detection system	○ A0	○ A0	○
	Fully closed loop control (Note 9)	○ A3 (Two-wire type only) (Note 13)	○ A3 (Two-wire type only) (Note 13)	MR-J3-_B-RJ006 MR-J3-_S
	Linear servo motor driving	○ A0 (Two-wire type/ four-wire type only) (Note 13)	○ A0 (Two-wire type/ four-wire type only) (Note 13)	MR-J3-_B-RJ004 MR-J3W-_B
	Direct drive motor driving	○ A0	○ A0	MR-J3-_B-RJ080W MR-J3W-_B
	Motor-less operation	○ A0 (Note 2)	○ A0 (Note 2)	○
	Rotation direction selection/travel direction selection	○ A0	○ A0	○
Encoder output pulses	A/B-phase pulse output	○ A0 (Note 3)	○ A0 (Note 3)	○
	Z-phase pulse output	○ A0 (Note 4)	○ A0 (Note 4)	○ (Note 4)
Input/output	Analog monitor output	○ A0 (Note 5)	○ A0 (Note 5)	○
	Motor thermistor	○ A0	○ A0	MR-J3-_B-RJ004 MR-J3-_B-RJ080W MR-J3W-_B
Control mode	Position control mode	○ A0	○ A0	○
	Speed control mode	○ A0	○ A0	○
	Torque control mode	○ A0	○ A0	○
	Continuous operation to torque control mode	○ A0	○ A0	○
Auto tuning	Auto tuning mode 1	○ A0	○ A0	○
	Auto tuning mode 2	○ A0	○ A0	○
	2 gain adjustment mode 1 (interpolation mode)	○ A0	○ A0	○
	2 gain adjustment mode 2	◎ A0	×	×
	Manual mode	○ A0	○ A0	○
Filter function	Machine resonance suppression filter 1	○ A0	○ A0	○
	Machine resonance suppression filter 2	○ A0	○ A0	○
	Machine resonance suppression filter 3	◎ A0	◎ B0 (Note 15)	×
	Machine resonance suppression filter 4	◎ A0	◎ B0 (Note 15)	×
	Machine resonance suppression filter 5	◎ A0	◎ B0 (Note 15)	×
	Shaft resonance suppression filter	○ A0	◎ B0 (Note 15)	×
	Low-pass filter	○ A0	○ A0	○
	Robust disturbance compensation (Note 10)	×	○ A0	○
	Robust filter	◎ A0	◎ B0 (Note 15)	×

Function	Name	Compatibility (◎: J4 new, ○: Equivalent to J3, ×: Not available)		
		MR-J4 series		MR-J3/MR-J3W series (Note 8)
		J4 mode	J3 compatibility mode	
Vibration suppression control	Standard mode/3 inertia mode	◎ A0	◎ B0 (Note 15)	×
	Vibration suppression control 1	○ A0	○ A0	○
	Vibration suppression control 2	◎ A0	◎ B0 (Note 15)	×
	Command notch filter	○ A0	○ A0	○
Applied control	Gain switching	○ A0	○ A0	○
	Slight vibration suppression control	○ A0	○ A0	○
	Overshoot amount compensation	○ A0	○ A0	○
	PI-PID switching control	○ A0	○ A0	○
	Feed forward	○ A0	○ A0	○
	Torque limit	○ A0	○ A0	○
	Master-slave operation function	○ A8 (Note 5)	×	○
	Scale measurement function	◎ A8 (Note 3)	×	×
	Model adaptive control disabled	○ B4	○ B4	×
	Lost motion compensation function	◎ B4 (Note 5)	◎ (Note 5, 15)	×
	Super trace control	◎ B4 (Note 5)	×	×
Adjustment function	One-touch tuning	◎ A0	◎ B0 (Note 15)	×
	Adaptive tuning	○ A0	○ A0	○
	Vibration suppression control 1 tuning	○ A0	○ A0	○
	Vibration suppression control 2 tuning	◎ A0	◎ B0 (Note 15)	×
Fully closed loop control	Fully closed loop electronic gear	○ A3	○ A3	MR-J3-_S MR-J3-_B-RJ006
	Dual feedback control	○ A3	○ A3	
	Semi closed/fully closed switching loop control	○ A3	○ A3	
	Fully closed loop control error detection function	○ A3	○ A3	
Linear compatible	Linear servo control error detection function	○ A0	○ A0	MR-J3-_B-RJ004 MR-J3W-_B
	Servo motor series/types setting function	○ A0	○ A0	
Magnetic pole detection	Direct current exciting method magnetic pole detection	○ A0	○ A0	MR-J3-_B-RJ004 MR-J3-_B-RJ080W MR-J3W-_B
	Current detection method magnetic pole detection	× (Note 6)	○ A0	MR-J3-_B-RJ004 MR-J3W-_B
	Minute position detection method magnetic pole detection	○ A0	○ A0	MR-J3-_B-RJ004 MR-J3-_B-RJ080W MR-J3W-_B
	Initial magnetic pole detection error detection function	○ A0	○ A0	
Encoder	Semi closed loop control two-wire type/four-wire type selection	○ A0	○ A0	○
	Serial interface compatible linear encoder	○ A0	○ A0	MR-J3-_S MR-J3-_B-RJ006 MR-J3-_B-RJ004 MR-J3W-_B
	Pulse train interface (A/B/Z-phase differential output type) compatible linear encoder	○ A5 (Note 14)	○ A5 (Note 14)	MR-J3-_S MR-J3-_B-RJ006 MR-J3-_B-RJ004
Functional safety	STO function	○ A0	○ A0	MR-J3-_S
	Forced stop deceleration function at alarm occurrence	○ A0	○ A0 (Note 12)	MR-J3-_S
	Vertical axis freefall prevention function	○ A0	○ A0	MR-J3-_S
Tough drive function	SEMI-F47 function	◎ A0	◎ B0 (Note 15, 16)	×
	Vibration tough drive	◎ A0	◎ B0 (Note 15)	×
	Instantaneous power failure tough drive	◎ A0	◎ B0 (Note 15)	×

Function	Name	Compatibility (◎: J4 new, ○: Equivalent to J3, ×: Not available)		
		MR-J4 series		MR-J3/MR-J3W series (Note 8)
		J4 mode	J3 compatibility mode	
Diagnosis function	3-digit alarm display	◎ A0	◎ A0	MR-J3W-_B
	16 alarm histories supported	◎ A0	× (Note 7)	× (Note 7)
	Drive recorder function	◎ A0	◎ B0 (Note 15)	×
	Machine diagnosis function	◎ A0	◎ B0 (Note 15)	×
Controller	SSCNET III	×	○ A0	○
	SSCNET III/H	◎ A0	×	×
	Home position return function	○ A0	○ A0	○
Others	J4 mode/J3 compatibility mode automatic identification (Note 11)	○ A0	○ A0	×
	Power monitoring function	◎ A0	◎ B0 (Note 15)	×

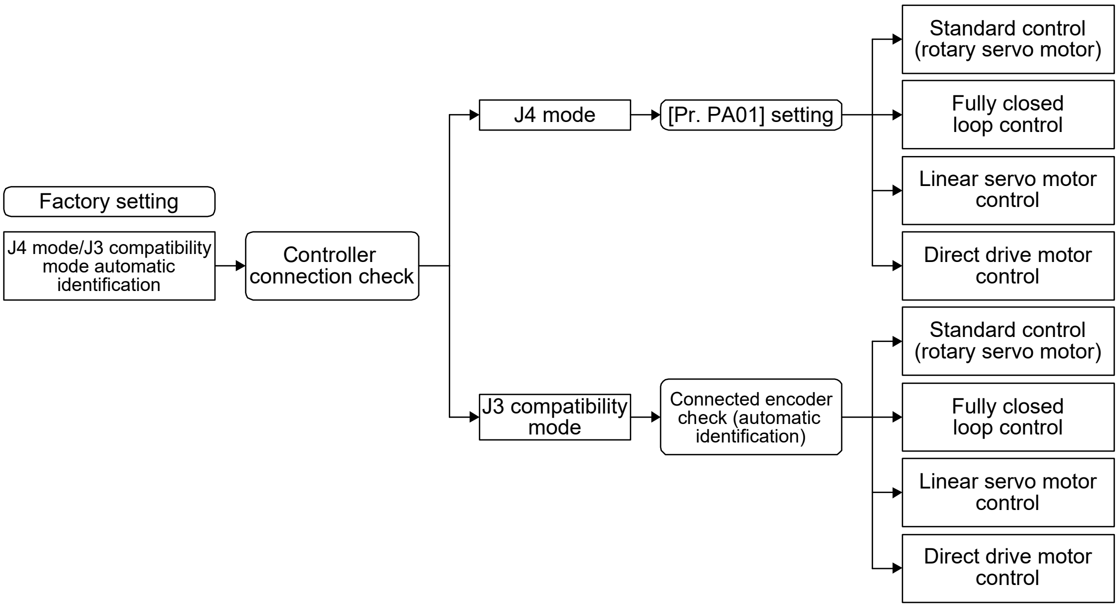
Note 1. The value is at the HG series servo motor driving. The resolution of the linear encoder/direct drive motor is the same both in the J4 mode and J3 compatibility mode. Refer to the instruction manual.

2. The motor-less operation cannot be used in the fully closed loop control mode, linear servo motor control mode, or DD motor control mode.
3. It is not available with MR-J4W3-_B servo amplifiers.
4. It is not available with the MR-J3W-_B, MR-J4W2-_B, and MR-J4W3-_B servo amplifiers.
5. It is not available with the MR-J4W2-_B and MR-J4W3-_B servo amplifiers.
6. The minute position detection method is available instead.
7. Alarm history will be saved up to six times.
8. The functions of the product with modified parts (GA) in the MR-J3-_B servo amplifiers are all covered by the J3 compatibility mode of the MR-J4-_B servo amplifiers.
9. MR-J4W3-_B servo amplifiers do not support the fully closed loop control system.
10. For MR-J4 series, the robust filter and vibration tough drive are available instead.
11. The operation mode will be identified automatically at the first controller communication. To switch the operation mode, use the application "MR-J4(W)-B mode selection" or "MR Mode Change".
12. When MR-J4 is used as a replacement of MR-J3-_S, "Servo forced stop selection" in [Pr. PA04] will be "Disabled (_ 1 _ _)" in the initial setting. Change the setting as necessary.
13. This is for MR-J4-_B servo amplifier. MR-J4-_B-RJ servo amplifier is compatible with two-wire type, four-wire type, and A/B/Z-phase differential output method.
14. It is available with only MR-J4-_B-RJ servo amplifiers. It is not available with MR-J4-_B servo amplifiers.
15. This is available when the J3 extension function is enabled. Refer to section 17.1.9 for details.
16. For servo system controllers which are available with this, contact your local sales office.

17.1.4 How to switch J4 mode/J3 compatibility mode

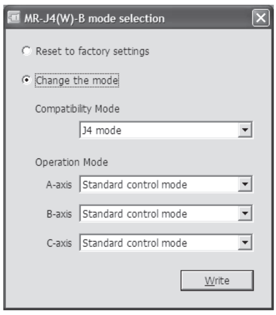
There are two ways to switch the J4 mode/J3 compatibility mode with the MR-J4W_-_B servo amplifier and MR-J4-_B_(-RJ) servo amplifier.

(1) Mode selection by the automatic identification of the servo amplifier
J4 mode/J3 compatibility mode is identified automatically depending on the connected controller.
When the controller makes a connection request with SSCNET III/H communication, the mode will be "J4 mode". For SSCNET communication, it will be "J3 compatibility mode".
For the J3 compatibility mode, standard control, linear servo motor control, or direct drive motor control will be identified automatically with a motor (encoder) connected to the servo amplifier. For the J4 mode, the operation mode will be the setting of [Pr. PA01].



(2) Mode selection using the application "MR-J4(W)-B mode selection" or "MR Mode Change"

You can set the factory setting, J4 mode/J3 compatibility mode, and operation mode with the dedicated application.



MR-J4(W)-B mode selection

○ Reset to factory settings

● Change the mode

Compatibility Mode: J4 mode

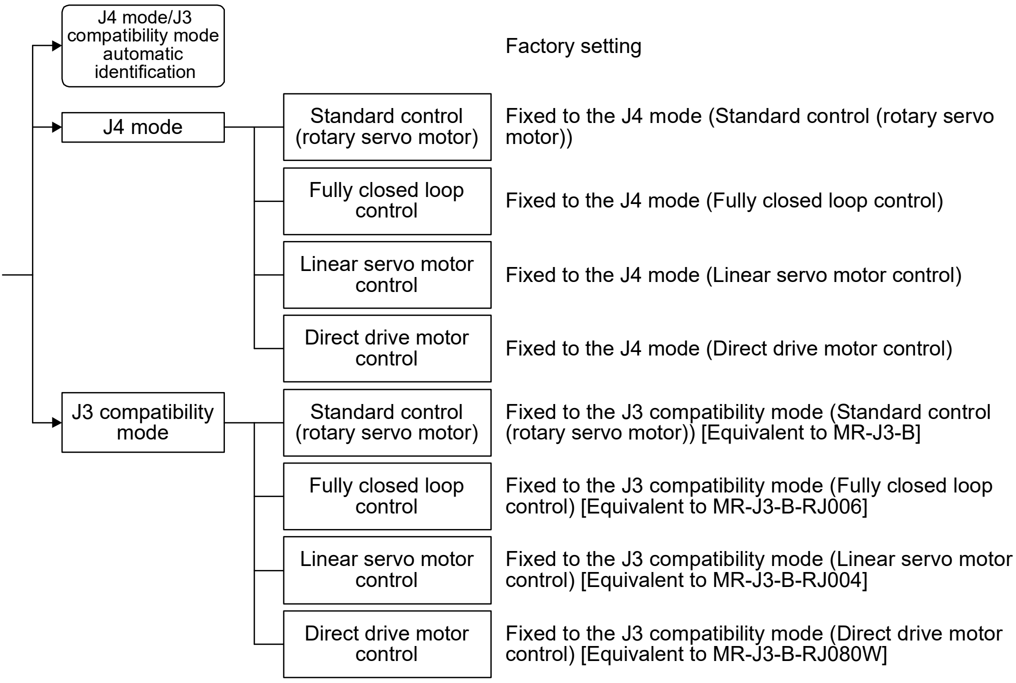
Operation Mode

A-axis: Standard control mode

B-axis: Standard control mode

C-axis: Standard control mode

"MR-J4(W)-B mode selection" or "MR Mode Change"



17.1.5 How to use the J3 compatibility mode

(1) Setting of the controller

To use in the J3 compatibility mode, select MR-J3 series in the system setting window.

Operation mode in J3 compatibility mode	System setting
MR-J3-B standard control mode (rotary servo motor)	Select MR-J3-_B.
MR-J3-B fully closed loop control mode	Select MR-J3-_B fully closed.
MR-J3-B linear servo motor control mode	Select MR-J3-_B linear.
MR-J3-B DD motor control mode	Select MR-J3-_B DDM.

(2) Setting of MR Configurator

To use in the J3 compatibility mode, make the system setting as follows.

Operation mode in J3 compatibility mode	System setting
MR-J3-B standard control mode (rotary servo motor)	Select MR-J3-_B.
MR-J3-B fully closed loop control mode	Select MR-J3-_B fully closed.
MR-J3-B linear servo motor control mode	Select MR-J3-_B linear.
MR-J3-B DD motor control mode	Select MR-J3-_B DDM.

Cautions for using MR Configurator

- The gain search cannot be used. You can use the advanced gain search.
- The C-axis of MR-J4W3-_B cannot be set with MR Configurator. Use MR Configurator2 for it.

(3) Setting of MR Configurator2

To use in the J3 compatibility mode, make the system setting as follows.

Operation mode in J3 compatibility mode	System setting
MR-J3-B standard control mode (rotary servo motor)	Select MR-J3-_B.
MR-J3-B fully closed loop control mode	Select MR-J3-_B fully closed.
MR-J3-B linear servo motor control mode	Select MR-J3-_B linear.
MR-J3-B DD motor control mode	Select MR-J3-_B DDM.

Cautions for using MR Configurator2

- Use MR Configurator2 with software version 1.12N or later. Older version than 1.12N cannot be used.
- Information about existing models (MR-J3) cannot be updated with the parameter setting range update function. Register a new model to use.
- The alarm will be displayed by 3 digits.
- The robust disturbance compensation cannot be used.

17.1.6 Cautions for switching J4 mode/J3 compatibility mode

The J3 compatibility mode of the operation mode is automatically identified by factory setting depending on a connected encoder. If a proper encoder is not connected at the first connection, the system will not start normally due to a mismatch with a set mode with the controller. (For the J4 mode, you can set the operation mode with [Pr. PA01].) For example, if the controller is connected without connecting a linear encoder at linear servo motor driving, the servo amplifier will be the standard control mode (rotary servo motor). The system will not start because the controller is connected with the linear servo motor driving amplifier.
When the operation mode mismatches, the servo amplifier will display [AL. 3E.1 Operation mode error]. Restore the factory settings or configure the correct settings (J4 mode/J3 compatibility mode and operation mode) using the application "MR-J4(W)-B mode selection" or "MR Mode Change" described in section 17.1.1.

17.1.7 Cautions for the J3 compatibility mode

The J3 compatibility mode are partly changed and has restrictions compared with MR-J3 series.

(1) The alarm display was changed from 2 digits (_ _) to 3 digits (_ _. _). The alarm detail number (._) is displayed in addition to the alarm No (_ _). The alarm No. (_ _) is not changed.

(2) When the power of the servo amplifier is cut or fiber-optic cable is disconnected, the same type communication can be cut regardless of connection order. When you power on/off the servo amplifier during operation, use the connect/disconnect function of the controller. Refer to the following manuals for detail.
  - MELSEC iQ-R Motion Controller Programming Manual (Common) (R16MTCPU/R32MTCPU) (IB-0300237) "5.3.1 Connect/disconnect function of SSCNET communication"
  - Motion controller Q series Programming Manual (COMMON) (Q173D(S)CPU/Q172D(S)CPU) (IB-0300134) "4.11.1 Connect/disconnect function of SSCNET communication"
  - MELSEC iQ-R Simple Motion Module User's Manual (Application) (RD77MS2/RD77MS4/RD77MS8/RD77MS16) (IB-0300247) "8.12 Connect/Disconnect Function of SSCNET Communication"
  - MELSEC-Q QD77MS Simple Motion Module User's Manual (IB-0300185) "14.12 Connect/disconnect function of SSCNET communication"
  - MELSEC-L LD77MH Simple Motion Module User's Manual (IB-0300172) "14.13 Connect/disconnect function of SSCNET communication"
  - MELSEC-L LD77MS Simple Motion Module User's Manual (Positioning Control) (IB-0300211) "14.13 Connect/disconnect function of SSCNET communication"

(3) The J3 compatibility mode has a functional compatibility. However, the operation timing may differ. Check the operation timing on customer side to use.

(4) The J3 compatibility mode is not compatible with high-response control set by [Pr. PA01 Operation mode].

(5) For MR-J3 series, a linear encoder was connected to the CN2L connector. For J4 (J3 compatibility mode), it is connected to the CN2 connector. Therefore, set the two-wire/four-wire type of the linear encoder in the J3 compatibility mode with [Pr. PC26], not with [Pr. PC04].

(6) When you use a linear servo motor, select linear servo motor with [Pr. PA17] and [Pr. PA18].

17.1.8 Change of specifications of "J3 compatibility mode" switching process

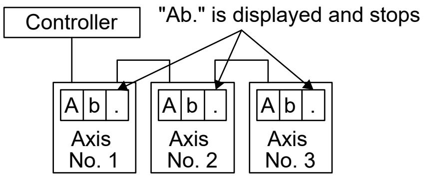
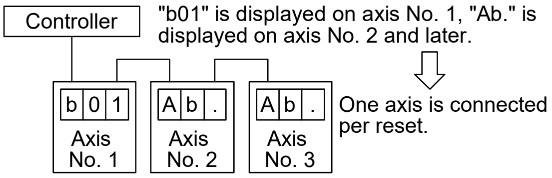
(1) Detailed explanation of "J3 compatibility mode" switching

(a) Operation when using a servo amplifier before change of specifications
For the controllers in which "Not required" is described to controller reset in table 17.1, the mode will be switched to "J3 compatibility mode" for all axes at the first connection. However, it takes about 10 s per axis for completing the connection.
For the controllers in which "Reset required" is described in table 17.1, the operation at the first connection is shown in table 17.2. The LED displays will be "Ab." for all axes at the first connection to the controller as shown in table 17.2. After that, resetting controller will change the 1-axis to "b01". The 2-axis and later will not change from "Ab.". After that, one axis will be connected per two times of controller reset.

Table 17.1 Controller reset required/not required list (before change of specifications)

Controller	Model	Controller reset required/not required	
		Single-axis connection	Multi-axis connection
Motion controller	R_MTCPU	Not required	Not required
	Q17_DSCPU	Not required	Not required
	Q17_DCPU	Not required	Not required
	Q17_HCPU	Not required	Not required
	Q170MCPU	Not required	Not required
Simple motion module Positioning module	RD77MS_	Not required	Not required
	QD77MS_	Not required	Not required
	LD77MS_	Not required	Not required
	QD75MH_	Not required	Not required
	QD74MH_	Reset required	Reset required
	LD77MH_	Not required	Not required
	FX3U-20SSC-H	Not required	Reset required

Table 17.2 Controller connection operation before change of specifications

	Before change of specifications (software version A4 or earlier)
First connection of controller	
After controller reset	

(b) Operation when using a servo amplifier after change of specifications

For the controllers in which "Not required" is described to controller reset in table 17.3, the mode will be switched to "J3 compatibility mode" for all axes at the first connection. It takes about 10 s for completing the connection not depending on the number of axes.

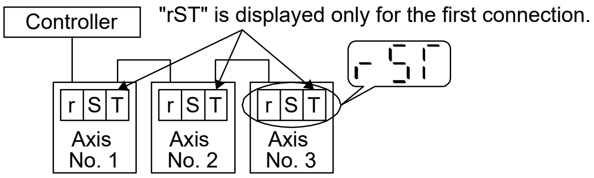
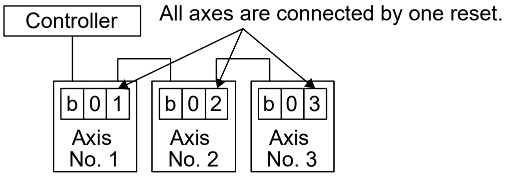
For the controllers in which "Reset required" is described in table 17.3, the operation at the first connection is shown in table 17.4. The servo amplifier's mode will be "J3 compatibility mode" and the LED displays will be "rST" for all axes at the first connection to the controller as shown in table 17.4. At the status, resetting controller once will change the display to "b##" (## means axis No.) for all axes and all axes will be ready to connect.

(One controller reset enables to all-axis connection.)

Table 17.3 Controller reset required/not required list (after change of specifications)

Controller	Model	Controller reset required/not required	
		Single-axis connection	Multi-axis connection
Motion controller	R_MTCPU	Not required	Not required
	Q17_DSCPU	Not required	Not required
	Q17_DCPU	Not required	Not required
	Q17_HCPU	Not required	Not required
	Q170MCPU	Not required	Not required
Simple motion module Positioning module	RD77MS_	Not required	Not required
	QD77MS_	Not required	Not required
	LD77MS_	Not required	Not required
	QD75MH_	Not required	Not required
	QD74MH_	Reset required	Reset required
	LD77MH_	Not required	Not required
	FX3U-20SSC-H	Reset required	Reset required

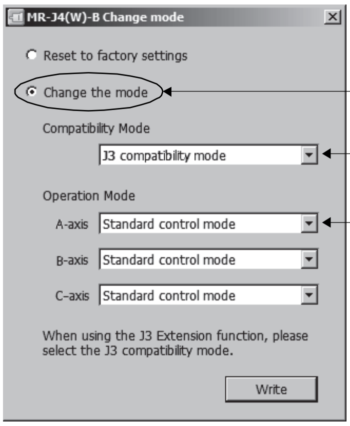
Table 17.4 Controller connection operation after change of specifications

	After change of specifications (software version A5 or later)
First connection of controller	
After controller reset	

(c) Using servo amplifiers before and after change of specifications simultaneously

When using servo amplifiers before change of specifications and after change of specifications simultaneously, controller reset is necessary for number of connecting axes of servo amplifiers.

(2) How to select "J3 compatibility mode" using the application "MR-J4(W)-B mode selection" or "MR Mode Change"
The application "MR-J4(W)-B mode selection" or "MR Mode Change" included in MR Configurator2 can be used to manually switch the servo amplifier mode to "J3 compatibility mode" beforehand. Use it for a solution when it is difficult to reset many times with your "Reset required" controller such as "QD74MH_".
The application "MR-J4(W)-B mode selection" and "MR Mode Change" are also available by downloading the free trial version of MR Configurator2 from the "Mitsubishi Electric FA site". The application "MR-J4(W)-B mode selection" and "MR Mode Change" do not have an expiration date.



MR-J4(W)-B Change mode

○ Reset to factory settings

● Change the mode

Compatibility Mode: J3 compatibility mode

Operation Mode

A-axis: Standard control mode

B-axis: Standard control mode

C-axis: Standard control mode

When using the J3 Extension function, please select the J3 compatibility mode.

Select "Change the mode".

Select "J3 compatibility mode".

Select "Operation Mode" .

17.1.9 J3 extension function

POINT

- ●The J3 extension function is used with servo amplifiers with software version B0 or later.
- ●To enable the J3 extension function, MR Configurator2 with software version 1.25B or later is necessary.
- ●The J3 extension function of the amplifier differs from MR-J3-B in motion.

The J3 extension function is for using functions of J4 mode with J3 compatibility mode.
By enabling the J3 extension function, control response will be equal to MR-J4 series using a controller compatible with SSCNET III.

J4 mode	J3 compatibility mode	
	J3 extension function enabled: [Pr. PX01] = "_ _ _ 1"	J3 extension function disabled: [Pr. PX01] = "_ _ _ 0"
・SSCNET III/H communication ・MR-J4-B function	・SSCNET III communication ・The same parameter ordering as MR-J3-B ・MR-J4-B control function ・Parameter added	・SSCNET III communication ・The same parameter ordering as MR-J3-B

The following shows functions used with the J3 extension function.

Function	Description	Detailed explanation
Gain switching function (Vibration suppression control 2 and model loop gain)	You can switch gains during rotation/stop, and can use input devices to switch gains during operation.	Section 17.1.9 (6)
Advanced vibration suppression control II	This function suppresses vibration at the arm end or residual vibration.	Section 17.1.9 (5) (c)
Machine resonance suppression filter 3 Machine resonance suppression filter 4 Machine resonance suppression filter 5	This is a filter function (notch filter) which decreases the gain of the specific frequency to suppress the resonance of the mechanical system.	Section 17.1.9 (5) (a)
Shaft resonance suppression filter	When a load is mounted to the servo motor shaft, resonance by shaft torsion during driving may generate a mechanical vibration at high frequency. The shaft resonance suppression filter suppresses the vibration.	Section 17.1.9 (5) (b)
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. PX31]
One-touch tuning	Gain adjustment is performed just by one click on a certain button on MR Configurator2. MR Configurator2 is necessary for this function.	Section 17.1.9 (4)
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 17.1.9 (7)
SEMI-F47 function (Note)	Enables to avoid triggering [AL. 10 Undervoltage] using the electrical energy charged in the capacitor in case that an instantaneous power failure occurs during operation. Use a 3-phase for the input power supply of the servo amplifier. Using a 1-phase 200 V AC for the input power supply will not comply with SEMI-F47 standard.	[Pr. PX25] [Pr. PX28] Section 17.1.9 (8)
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. PX30] is set to "-1". 4. The controller is not connected (except the test operation mode). 5. An alarm related to the controller is occurring.	[Pr. PX29]
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 in the system of SSCNET III/H. Since the servo amplifier sends data to a servo system controller, you can analyze the data and display the data on a display.	
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.	
Lost motion compensation function	This function improves the response delay occurred when the machine moving direction is reversed. This is used with servo amplifiers with software version B4 or later.	Section 17.1.9 (9)

Note. For servo system controllers which are available with this, contact your local sales office.

The following shows how to use the J3 extension function.

(1) Settings of J3 extension function

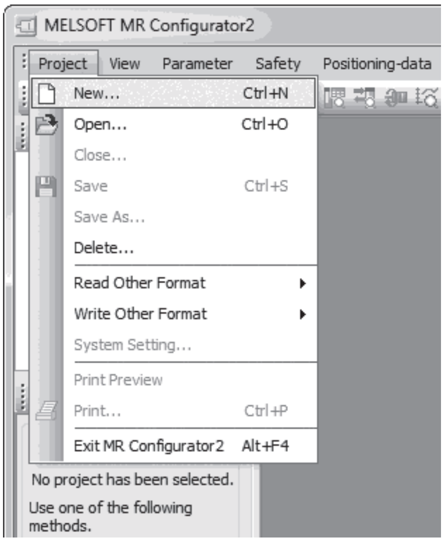
POINT

- ●To set the J3 extension function, connect a personal computer with MR Configurator2 of software version 1.25B or later to the servo amplifier with USB cable.
- ●The extension control 2 parameters ([Pr. PX_ _]) cannot be set from a controller.

To use the J3 the extension function, enable the setting of the extension control 2 parameters ([Pr. PX_ _]). Set as follows using MR Configurator2.

(a) Setting to enable the extension control 2 parameters ([Pr. PX_ _])

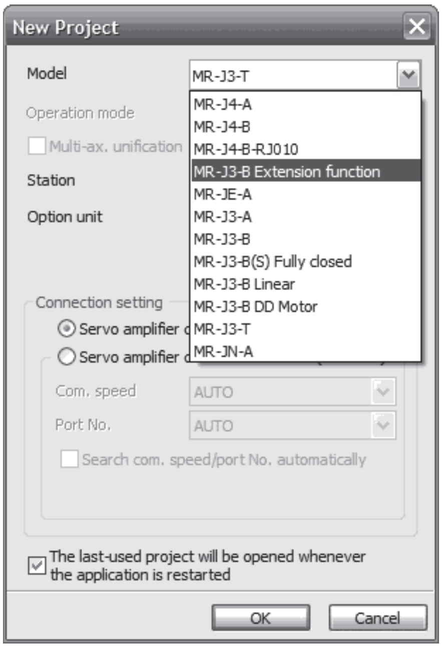
1) Open the "Project" menu and click "New" in MR Configurator2. The "New" window will be displayed.



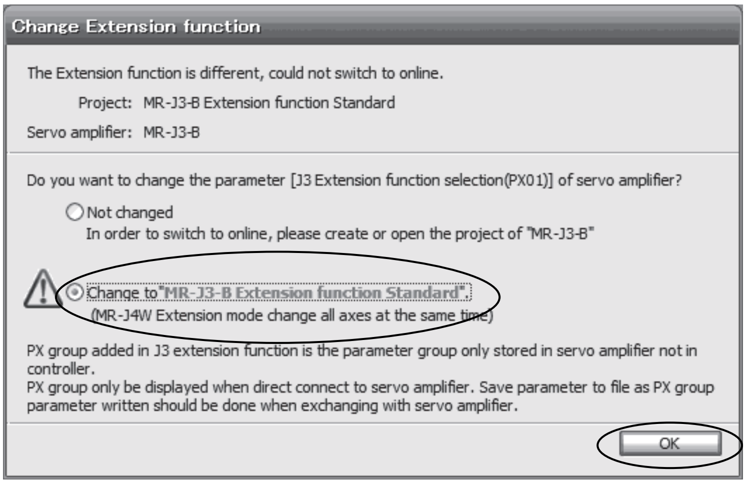
No project has been selected.

Use one of the following methods.

2) Select "MR-J3-B extension function" of model selection in the "New" window and click "OK". The "Extension function change" window will be displayed.



3) Click "Change to MR-J3-B extension function" in the "Extension function change" window and click "OK". Now, you can set the extension control 2 parameters ([Pr. PX_ _]).



Change Extension function

The Extension function is different, could not switch to online.

Project: MR-J3-B Extension function Standard

Servo amplifier: MR-J3-B

Do you want to change the parameter [J3 Extension function selection(PX01)] of servo amplifier?

○ Not changed
In order to switch to online, please create or open the project of "MR-J3-B"

● Change to "MR-J3-B Extension function Standard".
(MR-J4W Extension mode change all axes at the same time)

PX group added in J3 extension function is the parameter group only stored in servo amplifier not in controller.
PX group only be displayed when direct connect to servo amplifier. Save parameter to file as PX group parameter written should be done when exchanging with servo amplifier.

(b) Setting to enable the J3 extension function

To enable the J3 extension function, set [Pr. PX01] to "_ _ _ 1".

[Pr. PX01]

0	0	0	

J3 extension function selection
0: Disabled
1: Enabled

(2) Extension control 2 parameters ([Pr. PX_ _])

⚠CAUTION

- Never make a drastic adjustment or change to the parameter values as doing so will make the operation unstable.
- Do not change the parameter settings as described below. Doing so may cause an unexpected condition, such as failing to start up the servo amplifier.
  - Changing the values of the parameters for manufacturer setting
  - Setting a value out of the range
  - Changing the fixed values in the digits of a parameter
- When you write parameters with the controller, make sure that the control axis No. of the servo amplifier is set correctly. Otherwise, the parameter settings of another axis may be written, possibly causing the servo amplifier to be an unexpected condition.

POINT

- The parameter whose symbol is preceded by * is enabled with the following conditions:
  *: After setting the parameter, cycle the power or reset the controller.
  **: After setting the parameter, cycle the power.
- Abbreviations of J3 compatibility mode 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
  Lin.: Linear servo motor use
  DD: Direct drive (DD) motor use

No.	Symbol	Name	Initial value	Unit	J3 compatibility mode			
					Standard	Full.	Lin.	DD
PX01	**J3EX	J3 extension function	0000h		○	○	○	○
PX02	XOP1	Function selection X-1	0000h		○	○	○	○
PX03	VRFTX	Vibration suppression control tuning mode (advanced vibration suppression control II)	0000h		○	○	○	○
PX04	VRF21	Vibration suppression control 2 - Vibration frequency	100.0	[Hz]	○	○	○	○
PX05	VRF22	Vibration suppression control 2 - Resonance frequency	100.0	[Hz]	○	○	○	○
PX06	VRF23	Vibration suppression control 2 - Vibration frequency damping	0.00		○	○	○	○
PX07	VRF24	Vibration suppression control 2 - Resonance frequency damping	0.00		○	○	○	○
PX08	VRF21B	Vibration suppression control 2 - Vibration frequency after gain switching	0.0	[Hz]	○	○	○	○
PX09	VRF22B	Vibration suppression control 2 - Resonance frequency after gain switching	0.0	[Hz]	○	○	○	○
PX10	VRF23B	Vibration suppression control 2 - Vibration frequency damping after gain switching	0.00		○	○	○	○
PX11	VRF24B	Vibration suppression control 2 - Resonance frequency damping after gain switching	0.00		○	○	○	○
PX12	PG1B	Model loop gain after gain switching	0.0	[rad/s]	○	○	○	○
PX13	*XOP2	Function selection X-2	0001h		○	○	○	○
PX14	OTHOV	One-touch tuning - Overshoot permissible level	0	[%]	○	○	○	○
PX15		For manufacturer setting	0000h					
PX16			0000h					
PX17	NH3	Machine resonance suppression filter 3	4500	[Hz]	○	○	○	○

No.	Symbol	Name	Initial value	Unit	J3 compatibility mode			
					Standard	Full.	Lin.	DD
PX18	NHQ3	Notch shape selection 3	0000h		○	○	○	○
PX19	NH4	Machine resonance suppression filter 4	4500	[Hz]	○	○	○	○
PX20	NHQ4	Notch shape selection 4	0000h		○	○	○	○
PX21	NH5	Machine resonance suppression filter 5	4500	[Hz]	○	○	○	○
PX22	NHQ5	Notch shape selection 5	0000h		○	○	○	○
PX23	XOP3	Function selection X-3	0000h		○	○	○	○
PX24	FRIC	Machine diagnosis function - Friction judgment speed	0	[r/min]/[mm/s]	○	○	○	○
PX25	*TDS	Tough drive setting	0000h		○	○	○	○
PX26	OSCL1	Vibration tough drive - Oscillation detection level	50	[%]	○	○	○	○
PX27	*OSCL2	Vibration tough drive function selection	0000h		○	○	○	○
PX28	CVAT	SEMI-F47 function - Instantaneous power failure detection time	200	[ms]	○	○	○	○
PX29	DRAT	Drive recorder arbitrary alarm trigger setting	0000h		○	○	○	○
PX30	DRT	Drive recorder switching time setting	0	[s]	○	○	○	○
PX31	XOP4	Function selection X-4	0000h		○	○	○	○
PX32		For manufacturer setting	0					
PX33			0.0					
PX34			0.0					
PX35			50					
PX36	LMCP	Lost motion compensation positive-side compensation value selection	0	[0.01%]	○	○	○	○
PX37	LMCN	Lost motion compensation negative-side compensation value selection	0	[0.01%]	○	○	○	○
PX38	LMFLT	Lost motion filter setting	0	[0.1 ms]	○	○	○	○
PX39	TOF	Torque offset	0	[0.01%]	○	○		
PX40	*LMOP	Lost motion compensation function selection	0000h		○	○	○	○
PX41	LMCD	Lost motion compensation timing	0	[0.1 ms]	○	○	○	○
PX42	LMCT	Lost motion compensation non-sensitive band	0	[pulse]/ [kpulse]	○	○	○	○
PX43	**STOD	STO diagnosis error detection time	0	[s]	○	○	○	○
PX44		For manufacturer setting	0000h					
PX45			0000h					
PX46			0000h					
PX47			0000h					
PX48			0000h					
PX49			0000h					
PX50			0000h					
PX51			0000h					
PX52			0000h					
PX53			0000h					
PX54			0000h					
PX55			0000h					
PX56			0000h					
PX57			0000h					
PX58			0000h					
PX59			0000h					
PX60			0000h					
PX61			0000h					
PX62			0000h					
PX63			0000h					
PX64			0000h					

(3) Extension control 2 parameters ([Pr. PX_ _]) detailed list

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PX01</td><td>**J3EX</td><td>J3 extension function
Select enabled or disabled of the J3 extension function.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>J3 extension function selection
0: Disabled
1: Enabled

When you enable the J3 extension function selection, setting of [Pr. PX01] to [Pr. PX35] will be enabled and you will be able to also use functions in J4 mode with J3 compatibility mode. Additionally, the J3 extension function of the amplifier differs from MR-J3-B in motion.</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td></td><td>0h</td></tr>
<tr><td>x _ _ _</td><td></td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PX02</td><td>XOP1</td><td>Function selection X-1
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Vibration suppression mode selection
0: Standard mode
1: 3 inertia mode
2: Low response mode
When two low resonance frequencies are generated, select "3 inertia mode (_ _ _ 1)". When the load to motor inertia ratio exceeds the recommended load to motor inertia ratio, select "Low response mode (_ _ _ 2)".
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 with the controller during the 3 inertia mode or low response mode, stop the motor.</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td></td><td>0h</td></tr>
<tr><td>x _ _ _</td><td></td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PX03</td><td>VRFTX</td><td>Vibration suppression control tuning mode (advanced vibration suppression control II)
This is used to set the vibration suppression control tuning. Refer to (5) (c) in this section for details.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Vibration suppression control 2 tuning mode selection
Select the tuning mode of the vibration suppression control 2. To enable the digit, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PX02 Function selection X-1].
0: Disabled
1: Automatic setting
2: Manual setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td></td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

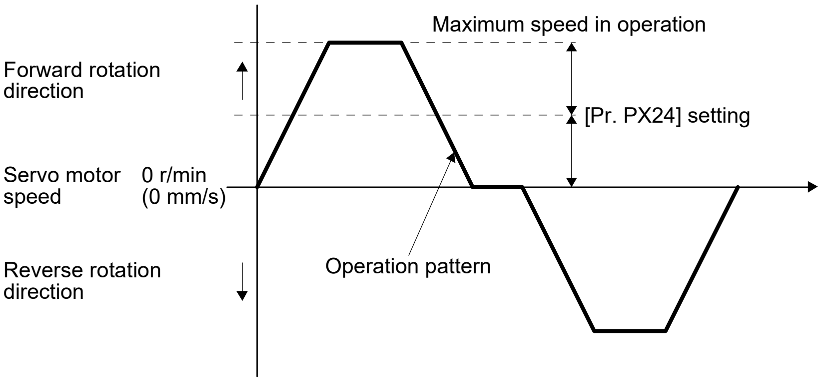
No.	Symbol	Name and function	Initial value [unit]	Setting range
PX04	VRF21	Vibration suppression control 2 - Vibration frequency Set the vibration frequency for vibration suppression control 2 to suppress low-frequency machine vibration. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PX02]. When "Vibration suppression control 2 tuning mode selection" is set to "Automatic setting (_ _ 1 _)" in [Pr. PX03], this parameter will be set automatically. When "Manual setting (_ _ 2 _)" is selected, the setting written to the parameter is used. The setting range of this parameter varies, depending on the value in [Pr. PB07]. If a value out of the range is set, the vibration suppression control will be disabled. Refer to section 17.1.9 (5) (c) for details.	100.0 [Hz]	0.1 to 300.0
PX05	VRF22	Vibration suppression control 2 - Resonance frequency Set the resonance frequency for vibration suppression control 2 to suppress low-frequency machine vibration. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PX02]. When "Vibration suppression control 2 tuning mode selection" is set to "Automatic setting (_ _ 1 _)" in [Pr. PX03], this parameter will be set automatically. When "Manual setting (_ _ 2 _)" is selected, the setting written to the parameter is used. The setting range of this parameter varies, depending on the value in [Pr. PB07]. If a value out of the range is set, the vibration suppression control will be disabled. Refer to section 17.1.9 (5) (c) for details.	100.0 [Hz]	0.1 to 300.0
PX06	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. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PX02]. When "Vibration suppression control 2 tuning mode selection" is set to "Automatic setting (_ _ 1 _)" in [Pr. PX03], this parameter will be set automatically. When "Manual setting (_ _ 2 _)" is selected, the setting written to the parameter is used. Refer to section 17.1.9 (5) (2) for details.	0.00	0.00 to 0.30
PX07	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. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PX02]. When "Vibration suppression control 2 tuning mode selection" is set to "Automatic setting (_ _ 1 _)" in [Pr. PX03], this parameter will be set automatically. When "Manual setting (_ _ 2 _)" is selected, the setting written to the parameter is used. Refer to section 17.1.9 (5) (2) for details.	0.00	0.00 to 0.30
PX08	VRF21B	Vibration suppression control 2 - Vibration frequency after gain switching Set the vibration frequency for vibration suppression control 2 when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PX04]. To enable this, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PX02]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 2 tuning mode selection" in [Pr. PX03] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Control command from controller is enabled (_ _ _ 1)". When you set "0.0", the value will be the same as [Pr. PX04]. Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.	0.0 [Hz]	0.0 to 300.0

No.	Symbol	Name and function	Initial value [unit]	Setting range
PX09	VRF22B	Vibration suppression control 2 - Resonance frequency after gain switching Set the resonance frequency for vibration suppression control 2 when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PX05]. To enable this, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PX02]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 2 tuning mode selection" in [Pr. PX03] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Control command from controller is enabled (_ _ _ 1)". When you set "0.0", the value will be the same as [Pr. PX05]. Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.	0.0 [Hz]	0.0 to 300.0
PX10	VRF23B	Vibration suppression control 2 - Vibration frequency damping after gain switching Set a damping of the vibration frequency for vibration suppression control 2 when the gain switching is enabled. To enable this, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PX02]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 2 tuning mode selection" in [Pr. PX03] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Control command from controller is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.	0.00	0.00 to 0.30
PX11	VRF24B	Vibration suppression control 2 - Resonance frequency damping after gain switching Set a damping of the resonance frequency for vibration suppression control 2 when the gain switching is enabled. To enable this, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PX02]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 2 tuning mode selection" in [Pr. PX03] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Control command from controller is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.	0.00	0.00 to 0.30
PX12	PG1B	Model loop gain after gain switching Set the model loop gain when the gain switching is enabled. When you set a value less than 1.0 rad/s, the value will be the same as [Pr. PB07]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Gain switching selection" in [Pr. PB26] is "Control command from controller is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops.	0.0 [rad/s]	0.0 to 2000.0

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PX13</td><td>*XOP2</td><td>Function selection X-2
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>One-touch tuning function selection
0: Disabled
1: Enabled

When the digit is "0", the one-touch tuning with MR Configurator2 will be disabled.</td><td>1h</td></tr>
<tr><td>_ _ x _</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PX14</td><td>OTHOV</td><td>One-touch tuning - Overshoot permissible level
Set a permissible value of overshoot amount for one-touch tuning as a percentage of the in-position range.
However, setting "0" will be 50%.</td><td>0
[%]</td><td>0
to
100</td></tr>
<tr><td>PX17</td><td>NH3</td><td>Machine resonance suppression filter 3
Set the notch frequency of the machine resonance suppression filter 3.
To enable the setting value, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 3 selection" in [Pr. PX18].</td><td>4500
[Hz]</td><td>10
to
4500</td></tr>
<tr><td>PX18</td><td>NHQ3</td><td>Notch shape selection 3
Set the shape of the machine resonance suppression filter 3.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Machine resonance suppression filter 3 selection
0: Disabled
1: Enabled</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Notch depth selection
0: -40 dB
1: -14 dB
2: -8 dB
3: -4 dB</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>Notch width selection
0: α = 2
1: α = 3
2: α = 4
3: α = 5</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PX19</td><td>NH4</td><td>Machine resonance suppression filter 4
Set the notch frequency of the machine resonance suppression filter 4.
To enable the setting value, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 4 selection" in [Pr. PX20].</td><td>4500
[Hz]</td><td>10
to
4500</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PX20</td><td>NHQ4</td><td>Notch shape selection 4
Set the shape of the machine resonance suppression filter 4.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Machine resonance suppression filter 4 selection
0: Disabled
1: Enabled
When you select "Enabled" of this digit, [Pr. PB17 Shaft resonance suppression filter] is not available.</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Notch depth selection
0: -40 dB
1: -14 dB
2: -8 dB
3: -4 dB</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>Notch width selection
0: α = 2
1: α = 3
2: α = 4
3: α = 5</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PX21</td><td>NH5</td><td>Machine resonance suppression filter 5
Set the notch frequency of the machine resonance suppression filter 5.
To enable the setting value, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 5 selection" in [Pr. PX22].</td><td>4500
[Hz]</td><td>10
to
4500</td></tr>
<tr><td>PX22</td><td>NHQ5</td><td>Notch shape selection 5
Set the shape of the machine resonance suppression filter 5.
When you select "Enabled (_ _ _ 1)" of "Robust filter selection" in [Pr. PX31], the machine resonance suppression filter 5 is not available.
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Machine resonance suppression filter 5 selection
0: Disabled
1: Enabled</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Notch depth selection
0: -40 dB
1: -14 dB
2: -8 dB
3: -4 dB</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>Notch width selection
0: α = 2
1: α = 3
2: α = 4
3: α = 5</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PX23</td><td>*XOP3</td><td>Function selection X-3
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Torque limit function selection at instantaneous power failure (instantaneous power failure tough drive selection)
0: Disabled
1: Enabled
When an instantaneous power failure occurs during operation, you can save electric energy charged in the capacitor in the servo amplifier by limiting torque at acceleration. You can also delay the time until [AL. 10.2 Voltage drop in the main circuit power] occurs with instantaneous power failure tough drive function. Doing this will enable you to set a longer time in [Pr. PX28 SEMI-F47 function - Instantaneous power failure detection time].
To enable the torque limit function at instantaneous power failure, select "Enabled (_ 1 _ _)" of "SEMI-F47 function selection" in [Pr. PX25].
This parameter setting is used with servo amplifier with software version B0 or later.</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PX24</td><td>FRIC</td><td>Machine diagnosis function - Friction judgment speed
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.

</td><td>0
[r/min]/
[mm/s]</td><td>0 to permis-sible speed</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PX25</td><td>*TDS</td><td>Tough drive setting
Alarms may not be avoided with the tough drive function depending on the situations of the power supply and load fluctuation.
You can assign MTTR (During tough drive) to pins CN3-9, CN3-13, and CN3-15 with [Pr. PD07] to [Pr. PD09].
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Vibration tough drive selection
0: Disabled
1: Enabled

Selecting "1" enables to suppress vibrations by automatically changing setting values of [Pr. PB13 Machine resonance suppression filter 1] and [Pr. PB15 Machine resonance suppression filter 2] in case that the vibration exceeds the value of the oscillation level set in [Pr. PX26].
Refer to (8) in this section for details.</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>SEMI-F47 function selection
0: Disabled
1: Enabled

Selecting "1" enables to avoid triggering [AL. 10 Undervoltage] using the electrical energy charged in the capacitor in case that an instantaneous power failure occurs during operation. In [Pr. PX28 SEMI-F47 function - Instantaneous power failure detection time], set the time until the occurrence of [AL. 10.1 Voltage drop in the control circuit power].</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PX26</td><td>OSCL1</td><td>Vibration tough drive - Oscillation detection level
Set a filter readjustment sensitivity of [Pr. PB13 Machine resonance suppression filter 1] and [Pr. PB15 Machine resonance suppression filter 2] while the vibration tough drive is enabled.
However, setting "0" will be 50%.
Example: When you set "50" to the parameter, the filter will be readjusted at the time of 50% or more oscillation level.</td><td>50
[%]</td><td>0
to
100</td></tr>
<tr><td>PX27</td><td>*OSCL2</td><td>Vibration tough drive function selection
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Oscillation detection alarm selection
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
Select alarm or warning when an oscillation continues at a filter readjustment sensitivity level of [Pr. PX26].
The digit is continuously enabled regardless of the vibration tough drive in [Pr. PX25].</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table>
</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PX28</td><td>CVAT</td><td>SEMI-F47 function - Instantaneous power failure detection time
Set the time until the occurrence of [AL. 10.1 Voltage drop in the control circuit power].
This parameter setting range differs depending on the software version of the servo amplifier as follows.
・Software version C0 or later: Setting range 30 ms to 200 ms
・Software version C1 or earlier: Setting range 30 ms to 500 ms
To comply with SEMI-F47 standard, it is unnecessary to change the initial value (200 ms).
When the instantaneous power failure time exceeds 200 ms, and if the instantaneous power failure voltage is less than 70 % of the rated input voltage, the power may be turned off normally even if a value larger than 200 ms is set in the parameter.
To disable the parameter, set "Disabled (_ 0 _ _)" of "SEMI-F47 function selection" in [Pr. PX25].</td><td>200
[ms]</td><td>30
to
500</td></tr>
<tr><td>PX29</td><td>DRAT</td><td>Drive recorder arbitrary alarm trigger setting
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ x x</td><td>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.</td><td>00h</td></tr>
<tr><td>x x _ _</td><td>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.</td><td>00h</td></tr>
</table>
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".</td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PX30</td><td>DRT</td><td>Drive recorder switching time setting
Set the drive recorder switching time.
When a USB communication is cut during using a graph function, the function will be changed to the drive recorder function after the setting time of this parameter.
When a value from "1" to "32767" is set, it will switch after the setting value.
However, when "0" is set, it will switch after 600 s.
When "-1" is set, the drive recorder function is disabled.</td><td>0
[s]</td><td>-1
to
32767</td></tr>
<tr><td>PX31</td><td>XOP4</td><td>Function selection X-4
<table>
<tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Robust filter selection
0: Disabled
1: Enabled
When you select "Enabled" of this digit, the machine resonance suppression filter 5 set in [Pr. PX22] is not available.</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td rowspan="3">For manufacturer setting</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PX36</td><td>LMCP</td><td>Lost motion compensation positive-side compensation value selection
Set the lost motion compensation for when reverse rotation (CW) switches to forward rotation (CCW) in increments of 0.01% assuming the rated torque as 100%.
This parameter is supported with software version B4 or later.</td><td>0
[0.01%]</td><td>0
to
30000</td></tr>
<tr><td>PX37</td><td>LMCN</td><td>Lost motion compensation negative-side compensation value selection
Set the lost motion compensation for when forward rotation (CCW) switches to reverse rotation (CW) in increments of 0.01% assuming the rated torque as 100%.
This parameter is supported with software version B4 or later.</td><td>0
[0.01%]</td><td>0
to
30000</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value [unit]</th><th>Setting range</th></tr>
<tr><td>PX38</td><td>LMFLT</td><td>Lost motion filter setting
Set the time constant of the lost motion compensation filter in increments of 0.1 ms.
If the time constant is "0", the torque is compensated with the value set in [Pr. PX36] and [Pr. PX37]. If the time constant is other than "0", the torque is compensated with the high-pass filter output value of the set time constant, and the lost motion compensation will continue.
This parameter is supported with software version B4 or later.</td><td>0
[0.1 ms]</td><td>0
to
30000</td></tr>
<tr><td>PX39</td><td>TOF</td><td>Torque offset
Set this when canceling unbalanced torque of vertical axis. Set this assuming the rated torque of the servo motor as 100%.
The torque offset does not need to be set for a machine not generating unbalanced torque. The torque offset cannot be used for linear servo motors and direct drive motors. Set 0.00%.
The torque offset set with this parameter will be enabled in the position control mode, speed control mode, and torque control mode. Input commands assuming torque offset for the torque control mode.
This parameter is supported with software version B4 or later.</td><td>0
[0.01%]</td><td>-10000
to
10000</td></tr>
<tr><td>PX40</td><td>*LMOP</td><td>Lost motion compensation function selection
Select the lost motion compensation function.
This parameter is supported with software version B4 or later.
<table>
<tr><th>Setting value</th><th>Explanation</th><th>Initial value</th></tr>
<tr><td>_ _ _ x</td><td>Lost motion compensation selection
0: Disabled
1: Enabled</td><td>0h</td></tr>
<tr><td>_ _ x _</td><td>Unit setting of lost motion compensation non-sensitive band
0: 1 pulse unit
1: 1 kpulse unit</td><td>0h</td></tr>
<tr><td>_ x _ _</td><td>For manufacturer setting</td><td>0h</td></tr>
<tr><td>x _ _ _</td><td></td><td>0h</td></tr>
</table></td><td colspan="2">Refer to the "Name and function" column.</td></tr>
<tr><td>PX41</td><td>LMCD</td><td>Lost motion compensation timing
Set the lost motion compensation timing in increments of 0.1 ms.
You can delay the timing to perform the lost motion compensation for the set time.
This parameter is supported with software version B4 or later.</td><td>0
[0.1 ms]</td><td>0
to
30000</td></tr>
<tr><td>PX42</td><td>LMCT</td><td>Lost motion compensation non-sensitive band
Set the lost motion compensation non-sensitive band. When the fluctuation of the droop pulse is the setting value or less, the speed will be 0. Setting can be changed in [Pr. PX40]. Set the parameter per encoder unit.
This parameter is supported with software version B4 or later.</td><td>0
[pulse]/
[kpulse]</td><td>0
to
65535</td></tr>
<tr><td>PX43</td><td>**STOD</td><td>STO diagnosis error detection time
Set the time from when an error occurs in the STO input signal or STO circuit until the detection of [AL. 68.1 Mismatched STO signal error].
When 0 s is set, the detection of [AL. 68.1 Mismatched STO signal error] is not performed.

The following shows safety levels at the time of parameter setting.
<table>
<tr><th>Setting value</th><th>STO input diagnosis by TOFB output</th><th>Safety level</th></tr>
<tr><td rowspan="2">0</td><td>Execute</td><td rowspan="2">EN ISO 13849-1:2015 Category 3 PL d,
IEC 61508 SIL 2,
EN IEC 62061 maximum SIL 2</td></tr>
<tr><td>Not execute</td></tr>
<tr><td rowspan="2">1 to 60</td><td>Execute</td><td>EN ISO 13849-1:2015 Category 3 PL e,
IEC 61508 SIL 3,
EN IEC 62061 maximum SIL 3</td></tr>
<tr><td>Not execute</td><td>EN ISO 13849-1:2015 Category 3 PL d,
IEC 61508 SIL 2,
EN IEC 62061 maximum SIL 2</td></tr>
</table>
When the short-circuit connector is connected to the CN8 connector, set "0" in the parameter.
This parameter is available with servo amplifiers with software version C1 or later.</td><td>0
[s]</td><td>0
to
60</td></tr>
</table>

(4) One-touch tuning

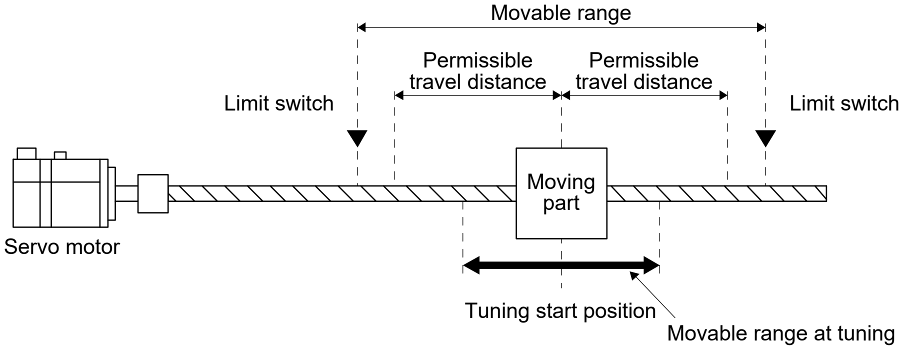
POINT

- ●After the one-touch tuning is completed, "Gain adjustment mode selection" in [Pr. PA08] will be set to "2 gain adjustment mode 2 (_ _ _ 4)". To estimate [Pr. PB06 Load to motor inertia ratio/load to motor mass ratio] again, set "Gain adjustment mode selection" in [Pr. PA08] to "Auto tuning mode 1 (_ _ _ 1)".
- ●When executing the one-touch tuning, check the [Pr. PX13 One-touch tuning function selection] is "_ _ _ 1" (initial value).
- ●At start of the one-touch tuning, only when "Auto tuning mode 1 (_ _ _ 1)" or "2 gain adjustment mode 1 (interpolation mode) (_ _ _ 0)" of "Gain adjustment mode selection" is selected in [Pr. PA08], [Pr. PB06 Load to motor inertia ratio/load to motor mass ratio] will be estimated.
- ●Execute the one-touch tuning while the servo system controller and the servo amplifier are connected.
- ●When executing the one-touch tuning in the test operation mode (SW2-1 is on), write the tuning result to servo parameters of the servo system controller, and then connect the servo system controller and the servo amplifier.
- ●The amplifier command method can be used with the servo amplifier with software version C1 or later and MR Configurator2 with software version 1.45X or later.
- ●When the one-touch tuning is executed, MR Configurator2 is required.

The one-touch tuning includes two methods: the user command method and the amplifier command method.

1) User command method
The user command method performs one-touch tuning by inputting commands from outside the servo amplifier.

2) Amplifier command method
In the amplifier command method, when you simply input a travel distance (permissible travel distance) that collision against the equipment does not occur during servo motor driving, a command for the optimum tuning will be generated inside the servo amplifier to perform one-touch tuning.



The following parameters are set automatically with one-touch tuning. Also, "Gain adjustment mode selection" in [Pr. PA08] will be "2 gain adjustment mode 2 (_ _ _ 4)" automatically. Other parameters will be set to an optimum value depending on the setting of [Pr. PA09 Auto tuning response].

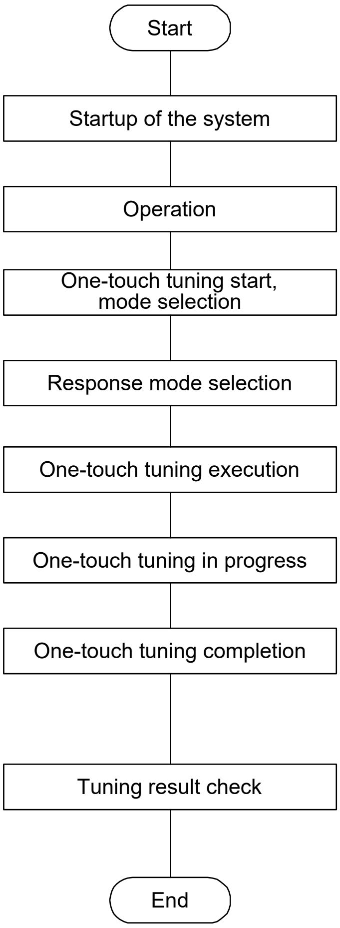
Table 17.5 List of parameters automatically set with one-touch tuning

Parameter	Symbol	Name
PA08	ATU	Auto tuning mode
PA09	RSP	Auto tuning response
PB01	FILT	Adaptive tuning mode (adaptive filter II)
PB02	VRFT	Vibration suppression control tuning mode (advanced vibration suppression control II)
PB06	GD2	Load to motor inertia ratio
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation
PB12	OVA	Overshoot amount compensation
PB13	NH1	Machine resonance suppression filter 1
PB14	NHQ1	Notch shape selection 1
PB15	NH2	Machine resonance suppression filter 2
PB16	NHQ2	Notch shape selection 2
PB17	NHF	Shaft resonance suppression filter
PB18	LPF	Low-pass filter setting
PB19	VRF11	Vibration suppression control 1 - Vibration frequency
PB20	VRF12	Vibration suppression control 1 - Resonance frequency
PB21	VRF13	Vibration suppression control 1 - Vibration frequency damping
PB22	VRF14	Vibration suppression control 1 - Resonance frequency damping
PB23	VFBF	Low-pass filter selection
PX17	NH3	Machine resonance suppression filter 3
PX18	NHQ3	Notch shape selection 3
PX19	NH4	Machine resonance suppression filter 4
PX20	NHQ4	Notch shape selection 4
PX22	NHQ5	Notch shape selection 5
PX31	XOP4	Function selection X-4

(a) One-touch tuning flowchart

1) User command method

Make one-touch tuning as follows.



Start a system referring to chapter 4.

Rotate the servo motor by a servo system controller. (In the user command method, the one-touch tuning cannot be executed if the servo motor is not operating.)

Start one-touch tuning of MR Configurator2, and select "User command method".

Select a response mode (High mode, Basic mode, and Low mode) in the one-touch tuning window of MR Configurator2.

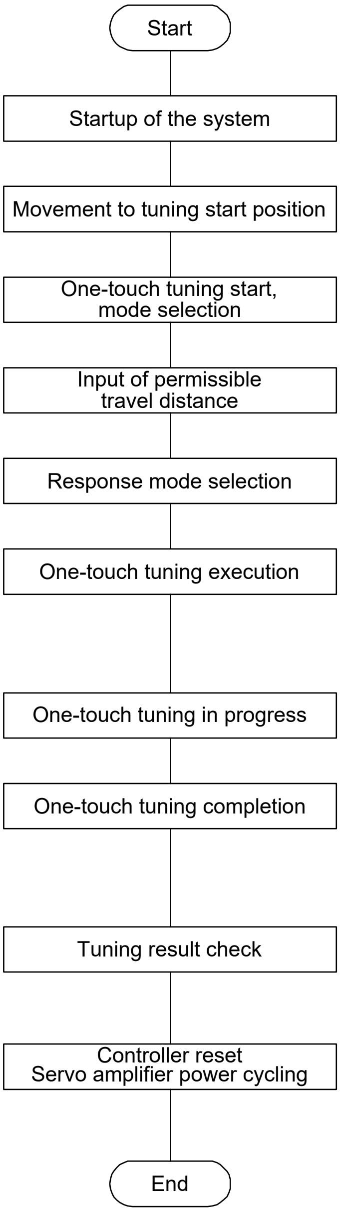
Click "Start" during servo motor driving to execute one-touch tuning.

Gains and filters will be adjusted automatically. During processing of tuning, the tuning progress will be displayed in % in MR Configurator2.

When one-touch tuning is completed normally, the parameters described in table 17.5 will be set automatically.
When the tuning is not completed normally, the tuning error will be displayed. (Refer to (4) (b) 5) in this section.))

Check the tuning result.
When the tuning result is not satisfactory, you can return the parameter to the value before the one-touch tuning or the initial value. (Refer to (4) (b) 8) in this section.))

2) Amplifier command method
Make one-touch tuning as follows.



Start a system referring to chapter 4.

Move the moving part to the center of a movable range.

Start one-touch tuning of MR Configurator2, and select "Amplifier command method".

In the one-touch tuning window of MR Configurator2, input a maximum travel distance to move the moving part at one-touch tuning.

Select a response mode (High mode, Basic mode, and Low mode) in the one-touch tuning window of MR Configurator2.

While the servo motor is stopped, click "Start" to start one-touch tuning. After the tuning is started, the servo motor will reciprocate automatically. Executing one-touch tuning during servo motor rotation will cause an error. After one-touch tuning is executed using the amplifier command method, control will not be performed by commands from the controller.

Gains and filters will be adjusted automatically. During processing of tuning, the tuning progress will be displayed in % in MR Configurator2.

One-touch tuning will be completed automatically after the tuning. When one-touch tuning is completed normally, the parameters described in table 17.5 will be updated automatically. When the tuning is not completed normally, the tuning error will be displayed. (Refer to (4) (b) 5) in this section.))

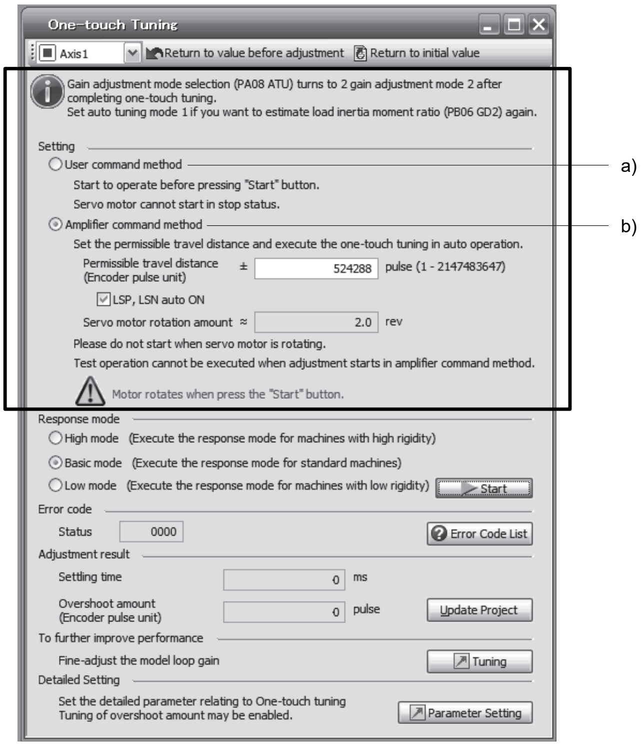
Check the tuning result.
When the tuning result is not satisfactory, you can return the parameter to the value before the one-touch tuning or the initial value. (Refer to (4) (b) 8) in this section.))

After executing the one-touch tuning, resetting the controller or cycling the power of the servo amplifier returns to the state in which control is performed from the controller.

(b) Display transition and operation procedure of one-touch tuning

1) Command method selection

Select a command method from two methods in the one-touch tuning window of MR Configurator2.



Gain adjustment mode selection (PA08 ATU) turns to 2 gain adjustment mode 2 after completing one-touch tuning.
Set auto tuning mode 1 if you want to estimate load inertia moment ratio (PB06 GD2) again.

Setting

○ User command method

Start to operate before pressing "Start" button.
Servo motor cannot start in stop status.

● Amplifier command method

Set the permissible travel distance and execute the one-touch tuning in auto operation.

Permissible travel distance (Encoder pulse unit) ± 524288 pulse (1 - 2147483647)

☑ LSP, LSN auto ON

Servo motor rotation amount ≈ 2.0 rev

Please do not start when servo motor is rotating.
Test operation cannot be executed when adjustment starts in amplifier command method.

Motor rotates when press the "Start" button.

Response mode

○ High mode (Execute the response mode for machines with high rigidity)
● Basic mode (Execute the response mode for standard machines)
○ Low mode (Execute the response mode for machines with low rigidity)

Error code

Status 0000

Adjustment result

Settling time 0 ms

Overshoot amount (Encoder pulse unit) 0 pulse

To further improve performance

Fine-adjust the model loop gain

Detailed Setting

Set the detailed parameter relating to One-touch tuning
Tuning of overshoot amount may be enabled.

a) User command method

It is recommended to input commands meeting the following conditions to the servo amplifier. If one-touch tuning is executed while commands which do not meet the conditions are inputted to the servo amplifier, the one-touch tuning error may occur.

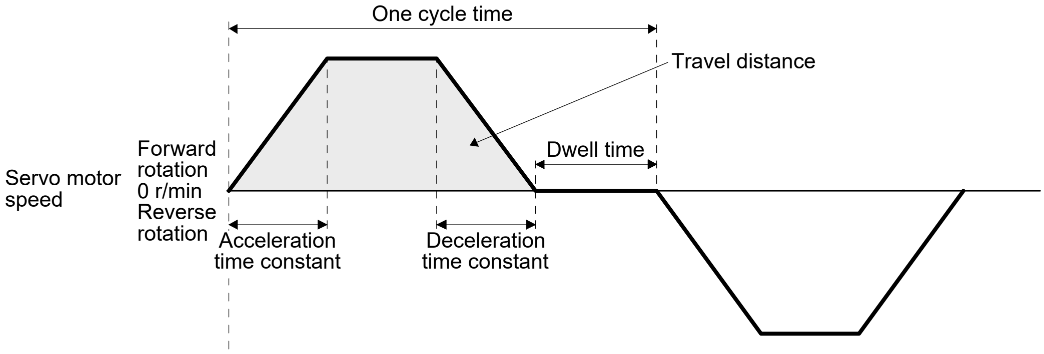


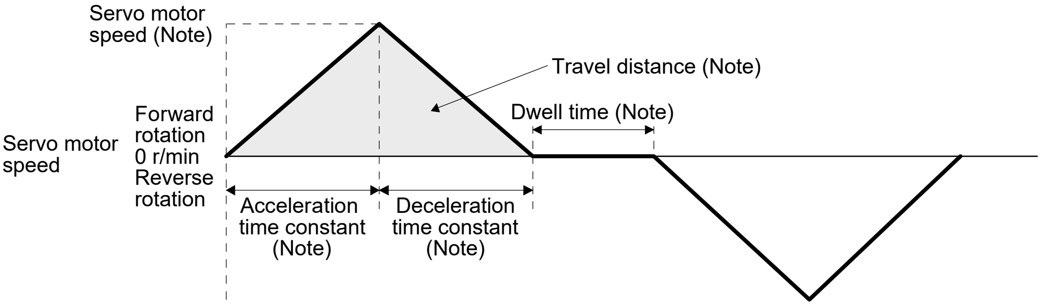
Fig. 17.1 Recommended command for one-touch tuning in the user command method

Item	Description
Travel distance	Set 100 pulses or more in encoder unit. Setting less than 100 pulses will cause the one-touch tuning error "C004".
Servo motor speed	Set 150 r/min (mm/s) or higher. Setting less than 150 r/min (mm/s) may cause the one-touch tuning error "C005".
Acceleration time constant Deceleration time constant	Set the time to reach 2000 r/min (mm/s) to 5 s or less. Set an acceleration time constant/deceleration time constant so that the acceleration/deceleration torque is 10% or more of the rated torque. The estimation accuracy of the load to motor inertia ratio is more improved as the acceleration/deceleration torque is larger, and the one-touch tuning result will be closer to the optimum value.
Dwell time	Set 200 ms or more. Setting a smaller value may cause the one-touch tuning error "C004".
One cycle time	Set 30 s or less. Setting over 30 s will cause the one-touch tuning error "C004".

b) Amplifier command method

Input a permissible travel distance. Input it in the load-side resolution unit for the fully closed loop control mode, and in the servo motor-side resolution unit for other control modes. In the amplifier command method, the servo motor will be operated in a range between "current value ± permissible travel distance". Input the permissible travel distance as large as possible within a range that the movable part does not collide against the machine. Inputting a small permissible travel distance decreases the possibility that the moving part will collide against the machine. However, the estimation accuracy of the load to motor inertia ratio may be lower, resulting in improper tuning.

Also, executing the one-touch tuning in the amplifier command method will generate a command for the following optimum tuning inside the servo amplifier to start the tuning.



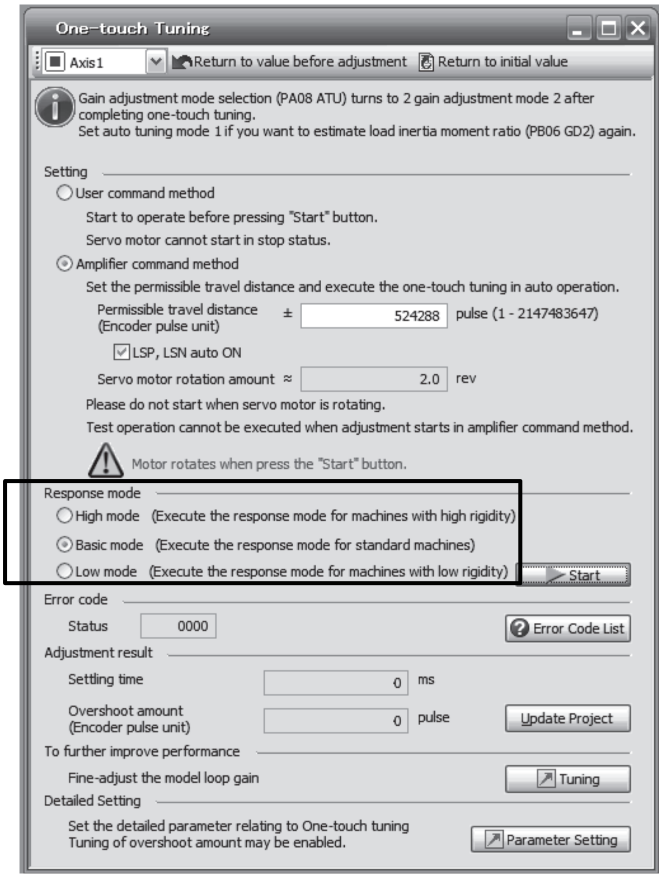
Note. It will be automatically generated in the servo amplifier.

Fig. 17.2 Command generated by one-touch tuning in the amplifier command method

Item	Description
Travel distance	An optimum travel distance will be automatically set in the range not exceeding the user-inputted permissible travel distance with MR Configurator2.
Servo motor speed	A speed not exceeding 1/2 of the rated speed and overspeed alarm detection level ([Pr. PC08]) will be automatically set.
Acceleration time constant Deceleration time constant	An acceleration time constant/deceleration time constant will be automatically set so as not to exceed 60% of the rated torque and the torque limit value set at the start of one-touch tuning in the amplifier command method.
Dwell time	A dwell time in which the one-touch tuning error "C004" does not occur will be automatically set.

2) Response mode selection

Select a response mode from 3 modes in the one-touch tuning window of MR Configurator2.



Gain adjustment mode selection (PA08 ATU) turns to 2 gain adjustment mode 2 after completing one-touch tuning.
Set auto tuning mode 1 if you want to estimate load inertia moment ratio (PB06 GD2) again.

Setting

○ User command method

Start to operate before pressing "Start" button.
Servo motor cannot start in stop status.

● Amplifier command method

Set the permissible travel distance and execute the one-touch tuning in auto operation.

Permissible travel distance (Encoder pulse unit) ± 524288 pulse (1 - 2147483647)

☑ LSP, LSN auto ON

Servo motor rotation amount ≈ 2.0 rev

Please do not start when servo motor is rotating.
Test operation cannot be executed when adjustment starts in amplifier command method.

Motor rotates when press the "Start" button.

Response mode

○ High mode (Execute the response mode for machines with high rigidity)
● Basic mode (Execute the response mode for standard machines)
○ Low mode (Execute the response mode for machines with low rigidity)

Error code

Status 0000

Adjustment result

Settling time 0 ms

Overshoot amount (Encoder pulse unit) 0 pulse

To further improve performance

Fine-adjust the model loop gain

Detailed Setting

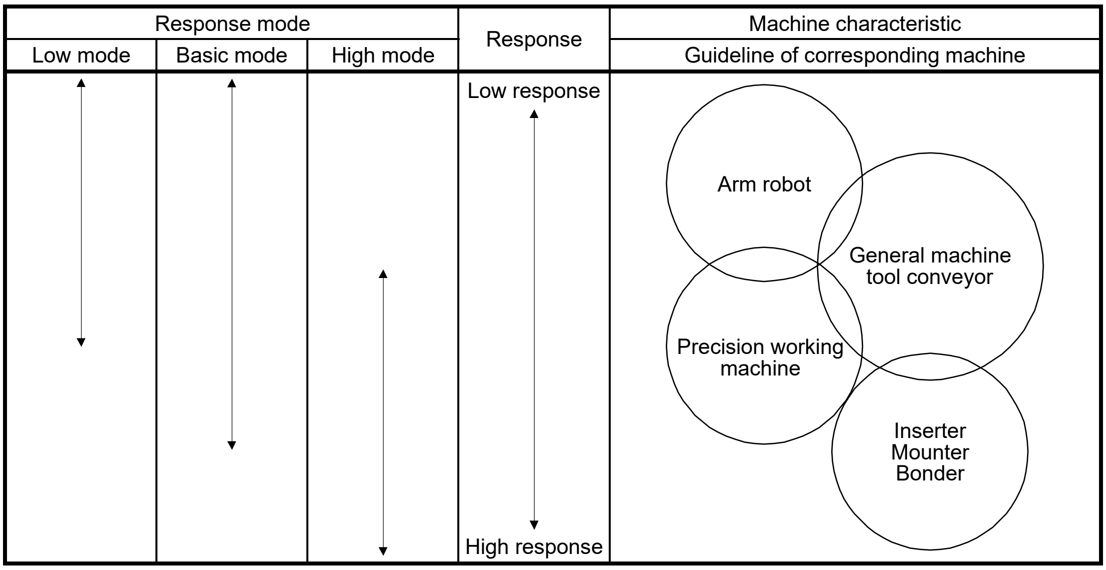
Set the detailed parameter relating to One-touch tuning
Tuning of overshoot amount may be enabled.

Table 17.6 Response mode explanations

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.

Table 17.7 Guideline for response mode



3) One-touch tuning execution

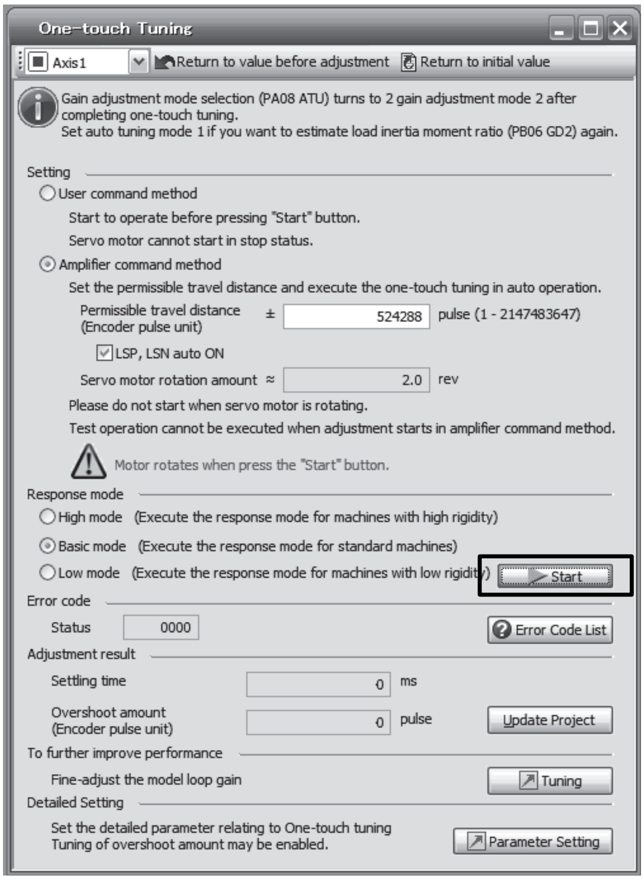
POINT

- ●For equipment in which overshoot during one-touch tuning is in the permissible level of the in-position range, changing the value of [Pr. PX14 One-touch tuning overshoot permissible level] will shorten the settling time and improve the response.
- ●When executing one-touch tuning in the amplifier command method, turn on EM2. When you turn off EM2 during one-touch tuning, "C008" will be displayed at status in error code, and the one-touch tuning will be canceled.
- ●When executing the one-touch tuning in the amplifier command method, FLS (Upper stroke limit) and RLS (Lower stroke limit) will be disabled. Thus, set a permissible travel distance within a range where moving part collision never occurs, or execute the one-touch tuning in a state in which the servo motor can immediately stop in emergency.
- ●When one-touch tuning is executed in the amplifier command method while magnetic pole detection is not being performed, magnetic pole detection will be performed, and then one-touch tuning will start after the magnetic pole detection is completed.

After the response mode is selected in (4) (b) 2) in this section, clicking "start" will start one-touch tuning. If "start" is clicked while the servo motor stops, "C002" or "C004" will be displayed at status in error code. (Refer to (4) (b) 5) in this section for error codes.)

Click "Start" with the amplifier command method selected in the servo-off, the servo-on will be automatically enabled, and the one-touch tuning will start. In the one-touch tuning by the amplifier command method, an optimum tuning command will be generated in the servo amplifier after servo-on. Then, the servo motor will reciprocate, and the one-touch tuning will be executed. After the tuning is completed or canceled, the servo amplifier will be the servo-off status. When the servo-on command is inputted from outside, the amplifier will be the servo-on status.

After one-touch tuning is executed using the amplifier command method, control will not be performed by commands from the controller. To return to the state in which control is performed by commands from the controller, reset the controller or cycle the power.



Gain adjustment mode selection (PA08 ATU) turns to 2 gain adjustment mode 2 after completing one-touch tuning.
Set auto tuning mode 1 if you want to estimate load inertia moment ratio (PB06 GD2) again.

Setting

○ User command method
Start to operate before pressing "Start" button.
Servo motor cannot start in stop status.

● Amplifier command method
Set the permissible travel distance and execute the one-touch tuning in auto operation.
Permissible travel distance (Encoder pulse unit) ± 524288 pulse (1 - 2147483647)
☑ LSP, LSN auto ON
Servo motor rotation amount ≈ 2.0 rev
Please do not start when servo motor is rotating.
Test operation cannot be executed when adjustment starts in amplifier command method.
Motor rotates when press the "Start" button.

Response mode
○ High mode (Execute the response mode for machines with high rigidity)
● Basic mode (Execute the response mode for standard machines)
○ Low mode (Execute the response mode for machines with low rigidity)

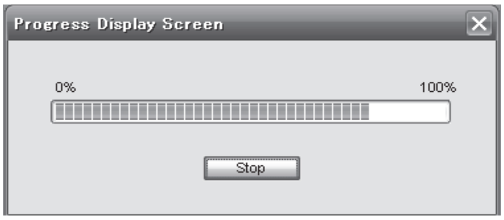
Error code
Status 0000

Adjustment result
Settling time 0 ms
Overshoot amount (Encoder pulse unit) 0 pulse

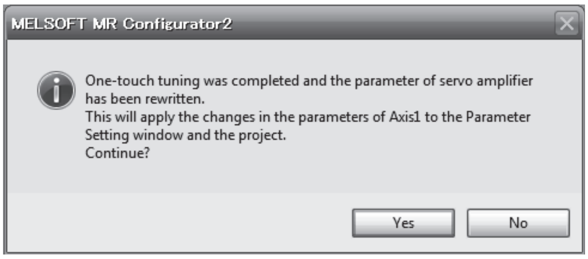
To further improve performance
Fine-adjust the model loop gain

Detailed Setting
Set the detailed parameter relating to One-touch tuning
Tuning of overshoot amount may be enabled.

During processing of one-touch tuning, the progress will be displayed as follows. Tuning will be completed at 100%.

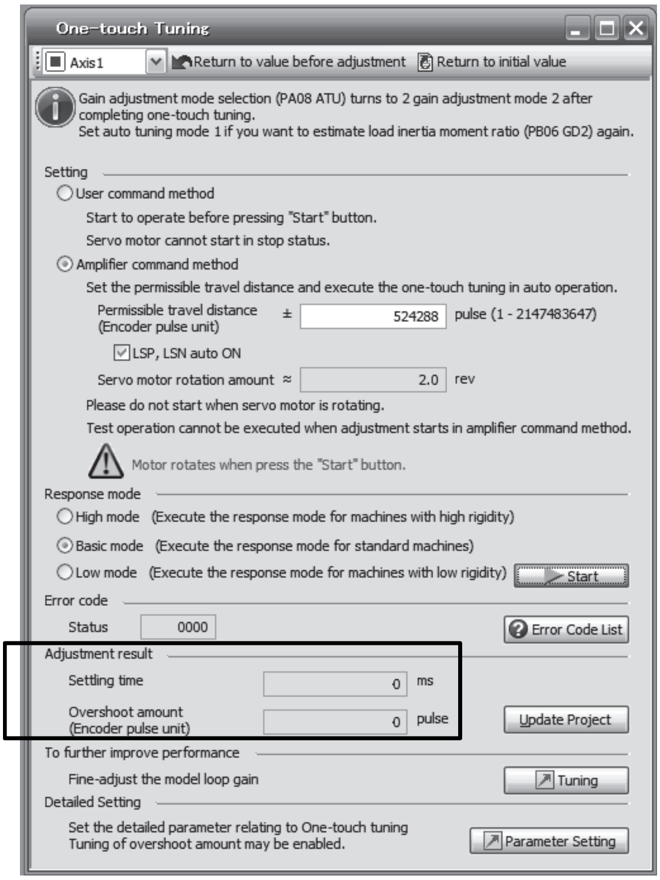


Completing the one-touch tuning will start writing tuning parameters to the servo amplifier, and the following window will be displayed. Select whether or not to reflect the tuning result in the project.


MELSOFT MR Configurator2

One-touch tuning was completed and the parameter of servo amplifier has been rewritten.
This will apply the changes in the parameters of Axis1 to the Parameter Setting window and the project.
Continue?

After the one-touch tuning is completed, "0000" will be displayed at status in error code. In addition, settling time and overshoot amount will be displayed in "Adjustment result".


One-touch Tuning

Axis1 | Return to value before adjustment | Return to initial value

Gain adjustment mode selection (PA08 ATU) turns to 2 gain adjustment mode 2 after completing one-touch tuning.
Set auto tuning mode 1 if you want to estimate load inertia moment ratio (PB06 GD2) again.

Setting

○ User command method
Start to operate before pressing "Start" button.
Servo motor cannot start in stop status.

● Amplifier command method
Set the permissible travel distance and execute the one-touch tuning in auto operation.
Permissible travel distance (Encoder pulse unit) ± 524288 pulse (1 - 2147483647)
☑ LSP, LSN auto ON
Servo motor rotation amount ≈ 2.0 rev
Please do not start when servo motor is rotating.
Test operation cannot be executed when adjustment starts in amplifier command method.
⚠ Motor rotates when press the "Start" button.

Response mode

○ High mode (Execute the response mode for machines with high rigidity)
● Basic mode (Execute the response mode for standard machines)
○ Low mode (Execute the response mode for machines with low rigidity)

Error code

Status 0000

Adjustment result

Settling time 0 ms
Overshoot amount (Encoder pulse unit) 0 pulse

To further improve performance

Fine-adjust the model loop gain

Detailed Setting

Set the detailed parameter relating to One-touch tuning
Tuning of overshoot amount may be enabled.

4) Stop of one-touch tuning
When "Stop" is clicked during one-touch tuning, the tuning will be stopped. At this time, "C000" will be displayed at status in error code. When the one-touch tuning is stopped, the parameter setting will be returned to the values at the start of the one-touch tuning. Stop the servo motor before executing the one-touch tuning again. In addition, execute it after the moving part is returned to the tuning start position.

5) If an error occurs

If a tuning error occurs during tuning, one-touch tuning will be stopped. With that, the following error code will be displayed in status. Check the cause of tuning error. When executing one-touch tuning again, stop the servo motor once. In addition, after returning the moving part to the tuning start position, execute it.

Display	Name	Error detail	Corrective action example
C000	Tuning canceled	"Stop" was clicked during one-touch tuning.	
C001	Overshoot exceeded	Overshoot amount is a value larger than the one set in [Pr. PA10 In-position range] and [Pr. PX14 One-touch tuning - Overshoot permissible level].	Increase the in-position range or overshoot permissible level.
C002	Servo-off during tuning	The one-touch tuning was attempted in the user command method during servo-off. The servo amplifier will be servo-off status during one-touch tuning.	When executing one-touch tuning in the user command method, turn to servo-on, and then execute it. Prevent the servo amplifier from being the servo-off status during one-touch tuning.
C003	Control mode error	1. 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 execute one-touch tuning. Do not change the control mode during the one-touch tuning.
		2. During one-touch tuning, the control mode was attempted to change from the position control mode to the speed control mode.	
C004	Time-out	1. One cycle time during the operation has been over 30 s.	Set one cycle time during the operation (time from the command start to the next command start) to 30 s or less.
		2. The command speed is slow.	Set the servo motor speed to 100 r/min or higher. Error is less likely to occur as the setting speed is higher. When one-touch tuning by the amplifier command is used, set a permissible travel distance so that the servo motor speed is 100 r/min or higher. Set a permissible travel distance to two or more revolutions as a guide value to set the servo motor speed to 100 r/min.
		3. The operation interval of the continuous operation is short.	Set the stop interval during operation to 200 ms or more. Error is less likely to occur as the setting time is longer.
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. ・The acceleration time constant/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 an oscillation or other influences.	Set to the auto tuning mode that does not estimate the load to motor inertia ratio as follows, and then execute the one-touch tuning. ・Select "Auto tuning mode 2 (_ _ _ 2)", "Manual mode (_ _ _ 3)", or "2 gain adjustment mode 2 (_ _ _ 4)" of "Gain adjustment mode selection" in [Pr. PA08]. ・Manually set [Pr. PB06 Load to motor inertia ratio/load to motor mass ratio] properly.

Display	Name	Error detail	Corrective action example
C006	Amplifier command start error	One-touch tuning was attempted to start in the amplifier command method under the following speed condition. Servo motor speed: 20 r/min or higher	Execute the one-touch tuning in the amplifier command method while the servo motor is stopped.
C007	Amplifier command generation error	1. One-touch tuning was executed in the amplifier command method when the permissible travel distance is set to 100 pulses or less in the encoder pulse unit, or the distance is set not to increase the servo motor speed to 150 r/min (mm/s) (50 r/min for direct drive motor) or higher at the time of load to motor inertia ratio estimation.	Set a permissible travel distance to 100 pulses or more in the encoder pulse unit, or a distance so as to increase the servo motor speed to 150 r/min (mm/s) (50 r/min for direct drive motor) or higher at the time of load to motor inertia ratio estimation, and then execute the one-touch tuning. Set a permissible travel distance to four or more revolutions as a guide value. Load to motor inertia ratio will be estimated when "0000" or "0001" is set in [Pr. PA08 Auto tuning mode] at the start of one-touch tuning. If the permissible travel distance is short and the servo motor speed cannot be increased to 150 r/min (mm/s) (50 r/min for direct drive motor) or higher, select "Auto tuning mode 2 (_ _ _ 2)", "Manual mode (_ _ _ 3)", or "2 gain adjustment mode 2 (_ _ _ 4)" of "Gain adjustment mode selection" in [Pr. PA08].
		2. An overspeed alarm detection level is set so that the servo motor speed becomes 150 r/min (mm/s) (50 r/min for direct drive motor) or less at the time of load to motor inertia ratio estimation.	When estimating the load to motor inertia ratio, set the overspeed alarm detection level so that the speed becomes 150 r/min or more.
		3. The torque limit has been set to 0.	Set the torque limit value to greater than 0.
C008	Stop signal	EM2 was turned off during one-touch tuning in the amplifier command method.	Review the one-touch tuning start position and permissible travel distance for the amplifier command method. After ensuring safety, turn on EM2.
C009	Parameter	Parameters for manufacturer setting have been changed.	Return the parameters for manufacturer setting to the initial values.
C00A	Alarm	One-touch tuning was attempted to start in the amplifier command method during alarm or warning. Alarm or warning occurred during one-touch tuning by the amplifier command method.	Start one-touch tuning when no alarm or warning occurs. Prevent alarm or warning from occurring during one-touch tuning.
C00F	One-touch tuning disabled	"One-touch tuning function selection" in [Pr. PX13] is "Disabled (_ _ _ 0)".	Select "Enabled (_ _ _ 1)".

6) If an alarm occurs

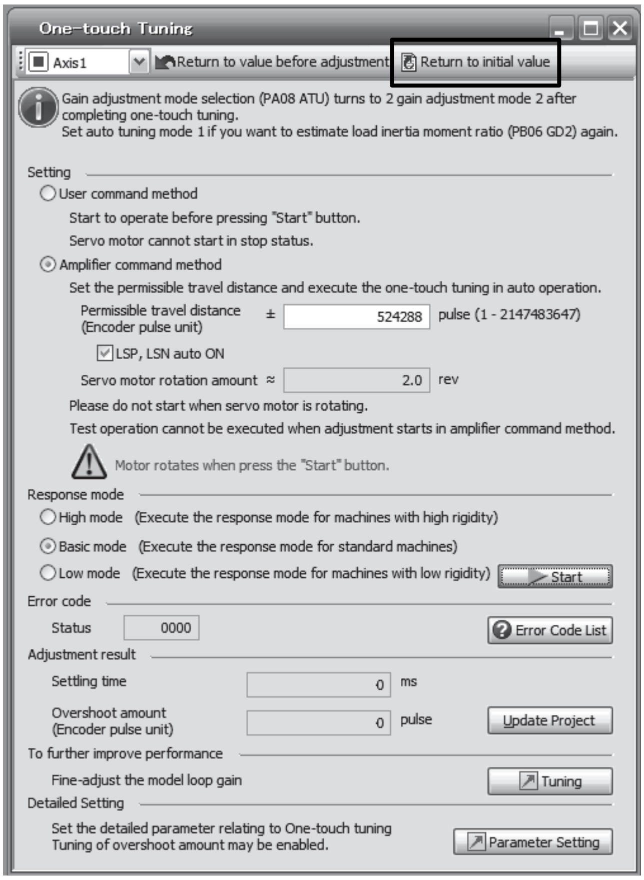
If an alarm occurs during the one-touch tuning, the tuning will be forcibly terminated. Remove the cause of the alarm and execute one-touch tuning again. When executing one-touch tuning in the amplifier command method again, return the moving part to the tuning start position.

7) If a warning occurs

If a warning which continues the motor driving occurs during one-touch tuning by the user command method, the tuning will be continued. If a warning which does not continue the motor driving occurs during the tuning, one-touch tuning will be stopped.

One-touch tuning will be stopped when warning occurs during one-touch tuning by the amplifier command method regardless of the warning type. Remove the cause of the warning, and return the moving part to the tuning start position. Then, execute the tuning again.

8) Initializing one-touch tuning
Clicking "Return to initial value" in the one-touch tuning window of MR Configurator2 enables to return the parameter to the initial value. Refer to table 17.5 for the parameters which you can initialize.
Clicking "Return to value before adjustment" in the one-touch tuning window of MR Configurator2 enables to return the parameter to the value before clicking "start".



Gain adjustment mode selection (PA08 ATU) turns to 2 gain adjustment mode 2 after completing one-touch tuning.
Set auto tuning mode 1 if you want to estimate load inertia moment ratio (PB06 GD2) again.

Setting
○ User command method
Start to operate before pressing "Start" button.
Servo motor cannot start in stop status.
● Amplifier command method
Set the permissible travel distance and execute the one-touch tuning in auto operation.
Permissible travel distance (Encoder pulse unit) ± 524288 pulse (1 - 2147483647)
☑ LSP, LSN auto ON
Servo motor rotation amount ≈ 2.0 rev
Please do not start when servo motor is rotating.
Test operation cannot be executed when adjustment starts in amplifier command method.
Motor rotates when press the "Start" button.

Response mode
○ High mode (Execute the response mode for machines with high rigidity)
● Basic mode (Execute the response mode for standard machines)
○ Low mode (Execute the response mode for machines with low rigidity)

Error code
Status 0000

Adjustment result
Settling time 0 ms
Overshoot amount (Encoder pulse unit) 0 pulse

To further improve performance
Fine-adjust the model loop gain

Detailed Setting
Set the detailed parameter relating to One-touch tuning
Tuning of overshoot amount may be enabled.

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

Returned to the initial values.

(c) Caution for one-touch tuning

1) Caution common for user command method and amplifier command method

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

b) The one-touch tuning cannot be executed while an alarm or warning which does not continue the motor driving is occurring.

c) The one-touch tuning cannot be executed during the following test operation mode.
- Output signal (DO) forced output
- Motor-less operation

d) If one-touch tuning is performed when the gain switching function is enabled, vibration and/or unusual noise may occur during the tuning.

2) Caution for amplifier command method

a) Starting one-touch tuning while the servo motor is rotating displays "C006" at status in error code, and the one-touch tuning cannot be executed.

b) One-touch tuning is not available during the test operation mode. The following test operation modes cannot be executed during one-touch tuning.
- Positioning operation
- JOG operation
- Program operation
- Machine analyzer operation

c) After one-touch tuning is executed, control will not be performed by commands from the servo system controller. To return to the state in which control is performed from the servo system controller, reset the controller or cycle the power of the servo amplifier.

d) During one-touch tuning, the permissible travel distance may be exceeded due to overshoot, set a value sufficient to prevent machine collision.

e) When Auto tuning mode 2, Manual mode, or 2 gain adjustment mode 2 is selected in [Pr. PA08 Auto tuning mode], the load to motor inertia ratio will not be estimated. An optimum acceleration/deceleration command will be generated by [Pr. PB06 Load to motor inertia ratio/load to motor mass ratio] at the start of one-touch tuning. When the load to motor inertia ratio is incorrect, the optimum acceleration/deceleration command may not be generated, causing the tuning to fail.

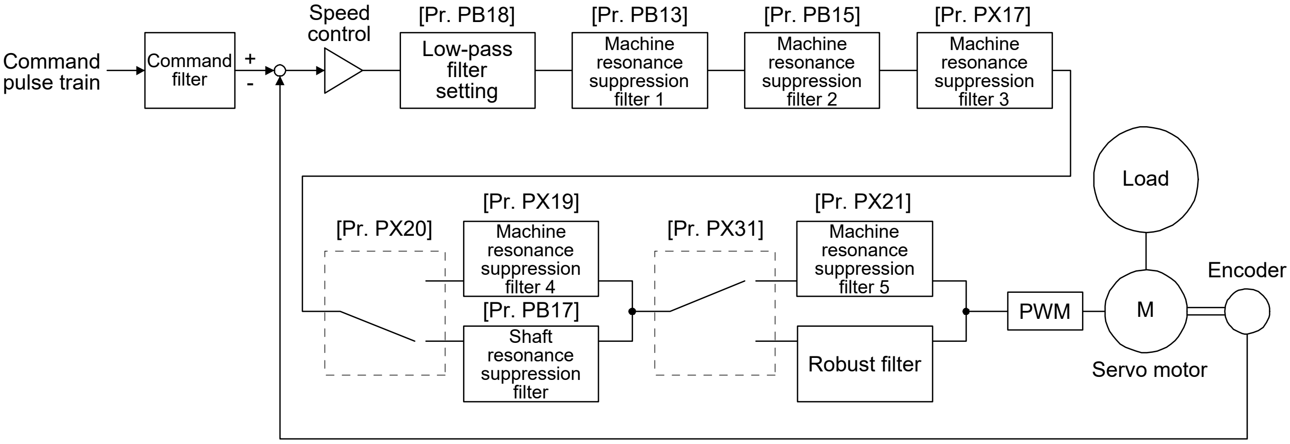
f) When one-touch tuning is started by using USB communication, if the USB communication is interrupted during the tuning, the servo motor will stop, and the tuning will also stop. The parameter will return to the one at the start of the one-touch tuning.

g) When one-touch tuning is started via the controller, if communication between the controller and the servo amplifier or personal computer is shut-off during the tuning, the servo motor will stop, and the tuning will also stop. The parameter will return to the one at the start of the one-touch tuning.

h) When one-touch tuning is started during the speed control mode, the mode will be switched to the position control mode automatically. The tuning result may differ from the one obtained by executing tuning by using the speed command.

(5) Filter setting

The following filters are available with the J3 extension function.



(a) Machine resonance suppression filter

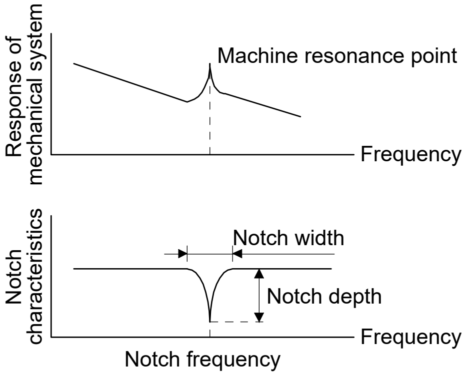
POINT

- ●The machine resonance suppression filter is a delay factor for the servo system. Therefore, vibration may increase if you set an incorrect resonance frequency or set notch characteristics too deep or too wide.
- ●If the frequency of machine resonance is unknown, decrease the notch frequency from higher to lower ones in order. The optimum notch frequency is set at the point where vibration is minimal.
- ●A deeper notch has a higher effect on machine resonance suppression but increases a phase delay and may increase vibration.
- ●A wider 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 unique resonance point, increasing the servo system response level may cause resonance (vibration or unusual noise) in the mechanical system at that resonance frequency. Using the machine resonance suppression filter and adaptive tuning can suppress the resonance of the mechanical system. The setting range is 10 Hz to 4500 Hz.

1) Function

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



You can set five machine resonance suppression filters at most.

Filter	Setting parameter	Precaution	Parameter that is reset with vibration tough drive function	Parameter automatically adjusted with one-touch tuning
Machine resonance suppression filter 1	PB01/PB13/PB14	The filter can be set automatically with "Filter tuning mode selection" in [Pr. PB01].	PB13	PB01/PB13/PB14
Machine resonance suppression filter 2	PB15/PB16		PB15	PB15/PB16
Machine resonance suppression filter 3	PX17/PX18			PX17/PX18
Machine resonance suppression filter 4	PX19/PX20	Enabling the machine resonance suppression filter 4 disables the shaft resonance suppression filter. Using the shaft resonance suppression filter is recommended because it is adjusted properly depending on the usage situation. The shaft resonance suppression filter is enabled for the initial setting.		PX19/PX20
Machine resonance suppression filter 5	PX21/PX22	Enabling the robust filter disables the machine resonance suppression filter 5. The robust filter is disabled for the initial setting.		PX22

2) Parameter

a) Machine resonance suppression filter 1 ([Pr. PB13]/[Pr. PB14])

Set the notch frequency, notch depth and notch width of the machine resonance suppression filter 1 ([Pr. PB13]/[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]/[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]/[Pr. PB16]) is the same as for the machine resonance suppression filter 1 ([Pr. PB13]/[Pr. PB14]).

c) Machine resonance suppression filter 3 ([Pr. PX17]/[Pr. PX18])

To use this filter, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 3 selection" in [Pr. PX18].

How to set the machine resonance suppression filter 3 ([Pr. PX17]/[Pr. PX18]) is the same as for the machine resonance suppression filter 1 ([Pr. PB13]/[Pr. PB14]).

d) Machine resonance suppression filter 4 ([Pr. PX19]/[Pr. PX20])

To use this filter, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 4 selection" in [Pr. PX20]. However, enabling the machine resonance suppression filter 4 disables the shaft resonance suppression filter.

How to set the machine resonance suppression filter 4 ([Pr. PX19]/[Pr. PX20]) is the same as for the machine resonance suppression filter 1 ([Pr. PB13]/[Pr. PB14]).

e) Machine resonance suppression filter 5 ([Pr. PX21]/[Pr. PX22])

To use this filter, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 5 selection" in [Pr. PX22]. However, enabling the robust filter ([Pr. PX31]: _ _ _ 1) disables the machine resonance suppression filter 5.

How to set the machine resonance suppression filter 5 ([Pr. PX21]/[Pr. PX22]) is the same as for the machine resonance suppression filter 1 ([Pr. PB13]/[Pr. PB14]).

(b) Shaft resonance suppression filter

POINT

- This filter is set properly by default according to servo motor you use and load moment of inertia. It is recommended that [Pr. PB23] be set to "_ _ _ 0" (automatic setting) because changing "Shaft resonance suppression filter selection" in [Pr. PB23] or [Pr. PB17 Shaft resonance suppression filter] may lower the performance.

1) Function

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

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

2) Parameter

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

[Pr. PB23]

0 0 0 _

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

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

Shaft resonance suppression filter setting frequency selection

Setting value	Frequency [Hz]
_ _ 0 0	Disabled
_ _ 0 1	Disabled
_ _ 0 2	4500
_ _ 0 3	3000
_ _ 0 4	2250
_ _ 0 5	1800
_ _ 0 6	1500
_ _ 0 7	1285
_ _ 0 8	1125
_ _ 0 9	1000
_ _ 0 A	900
_ _ 0 B	818
_ _ 0 C	750
_ _ 0 D	692
_ _ 0 E	642
_ _ 0 F	600

Setting value	Frequency [Hz]
_ _ 1 0	562
_ _ 1 1	529
_ _ 1 2	500
_ _ 1 3	473
_ _ 1 4	450
_ _ 1 5	428
_ _ 1 6	409
_ _ 1 7	391
_ _ 1 8	375
_ _ 1 9	360
_ _ 1 A	346
_ _ 1 B	333
_ _ 1 C	321
_ _ 1 D	310
_ _ 1 E	300
_ _ 1 F	290

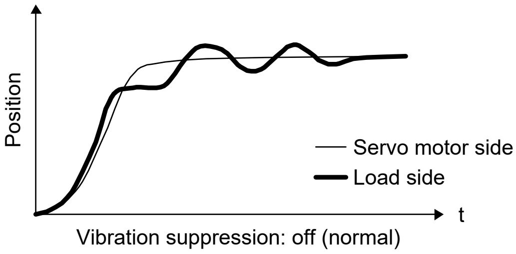
(c) Advanced vibration suppression control II

POINT

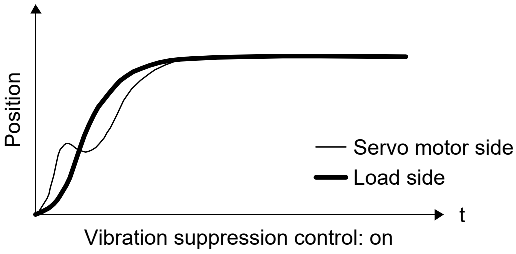
- ●This is enabled when "Gain adjustment mode selection" is "Auto tuning mode 2 (_ _ _ 2)" or "Manual mode (_ _ _ 3)" in [Pr. PA08].
- ●The machine resonance frequency supported in the vibration suppression control tuning mode is 1.0 Hz to 100.0 Hz. As for the vibration out of the range, set manually.
- ●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. PX02].

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.



Vibration suppression: off (normal)



Vibration suppression control: on

When the advanced vibration suppression control II ([Pr. PB02] and [Pr. PX03]) 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. PX04] to [Pr. PX07].

2) Parameter

Set the advanced vibration suppression control II ([Pr. PB02] and [Pr. PX03]).
When you use a vibration suppression control, set "Vibration suppression control 1 tuning mode selection" in [Pr. PB02]. When you use two vibration suppression controls, set "Vibration suppression control 2 tuning mode selection" in [Pr. PX03] in addition.

[Pr. PB02]

0 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	

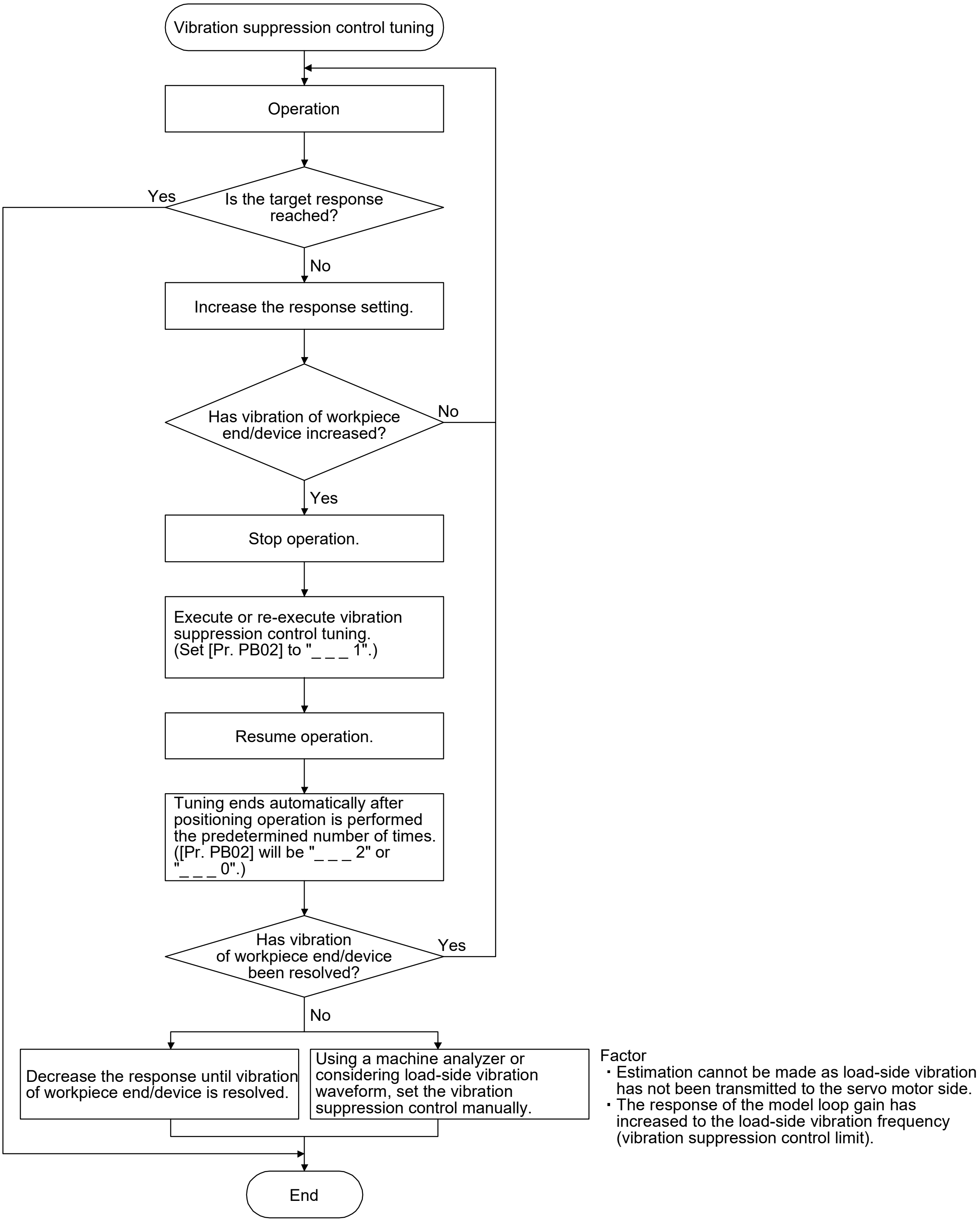
[Pr. PX03]

0 0 ☐ 0

Vibration suppression control 2 tuning mode

Setting value	Vibration suppression control 2 tuning mode selection	Automatically set parameter
_ _ 0 _	Disabled	
_ _ 1 _	Automatic setting	PX04/PX05/PX06/PX07
_ _ 2 _	Manual setting	

3) Vibration suppression control tuning procedure
The following flow chart is for the vibration suppression control 1. For the vibration suppression control 2, set "_ _ 1 _" in [Pr. PX03] to execute the vibration suppression control tuning.



4) Vibration suppression control manual mode

POINT

- When load-side vibration does not show up in servo motor-side vibration, the setting of the servo motor-side vibration frequency does not produce an effect.
- When the anti-resonance frequency and resonance frequency can be confirmed using the machine analyzer or external equipment, do not set the same value but set different values to improve the vibration suppression performance.
- The setting range of [Pr. PB19], [Pr. PB20], [Pr. PX04], and [Pr. PX05] varies, depending on the value in [Pr. PB07]. If a value out of the range is set, the vibration suppression control will be disabled.

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. PX04]
Vibration suppression control - Resonance frequency	[Pr. PB20]	[Pr. PX05]
Vibration suppression control - Vibration frequency damping	[Pr. PB21]	[Pr. PX06]
Vibration suppression control - Resonance frequency damping	[Pr. PB22]	[Pr. PX07]

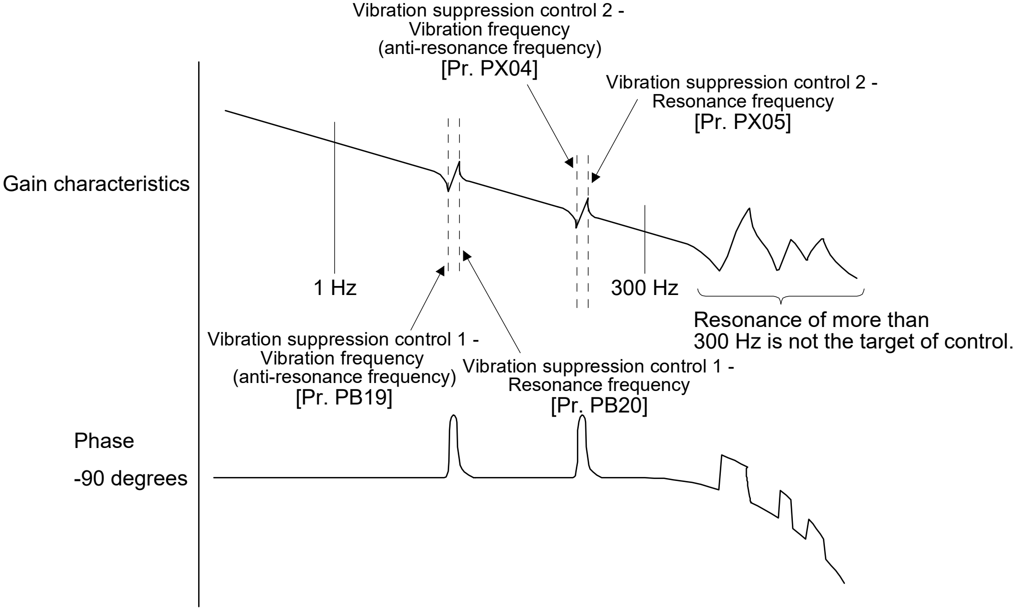
Step 1. Select "Manual setting (_ _ _ 2)" of "Vibration suppression control 1 tuning mode selection" in [Pr. PB02] or "Manual setting (_ _ 2 _)" of "Vibration suppression control 2 tuning mode selection" in [Pr. PX03].

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

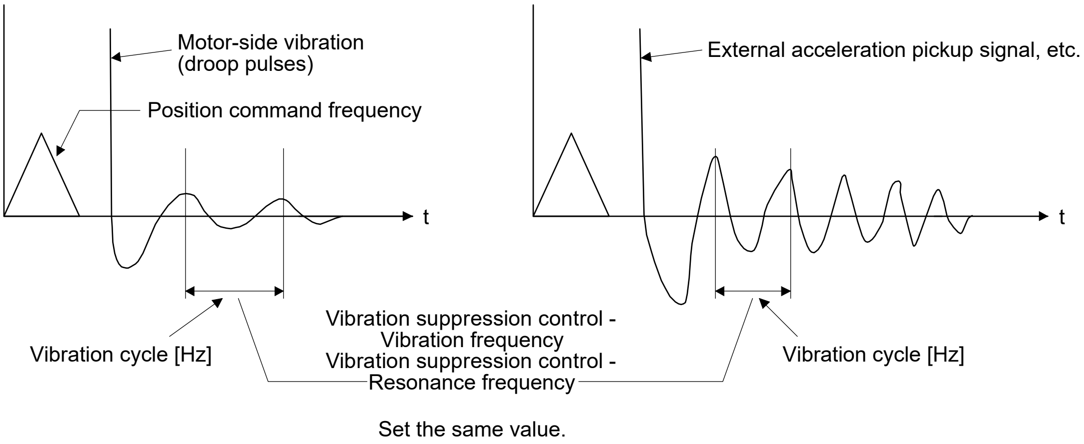
However, the value of [Pr. PB07 Model loop gain], vibration frequency, and resonance frequency have the following usable range and recommended range.

Vibration suppression control	Usable range	Recommended setting range
Vibration suppression control 1	[Pr. PB19] > 1/2π × (0.9 × [Pr. PB07]) [Pr. PB20] > 1/2π × (0.9 × [Pr. PB07])	[Pr. PB19] > 1/2π × (1.5 × [Pr. PB07]) [Pr. PB20] > 1/2π × (1.5 × [Pr. PB07])
Vibration suppression control 2	When [Pr. PB19] < [Pr. PX04], [Pr. PX04] > (5.0 + 0.1 × [Pr. PB07]) [Pr. PX05] > (5.0 + 0.1 × [Pr. PB07]) 1.1 < [Pr. PX04]/[Pr. PB19] < 5.5 [Pr. PB07] < 2π (0.3 × [Pr. PB19] + 1/8 × [Pr. PX04])	When [Pr. PB19] < [Pr. PX04], [Pr. PX04], [Pr. PX05] > 6.25 Hz 1.1 < [Pr. PX04]/[Pr. PB19] < 4 [Pr. PB07] < 1/3 × (4 × [Pr. PB19] + 2 × [Pr. PX04])

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".

(6) Gain switching function

You can switch gains with the function. You can switch gains during rotation and during stop, and can use a control command from a controller to switch gains during operation.

(a) Use

The following shows when you use the function.

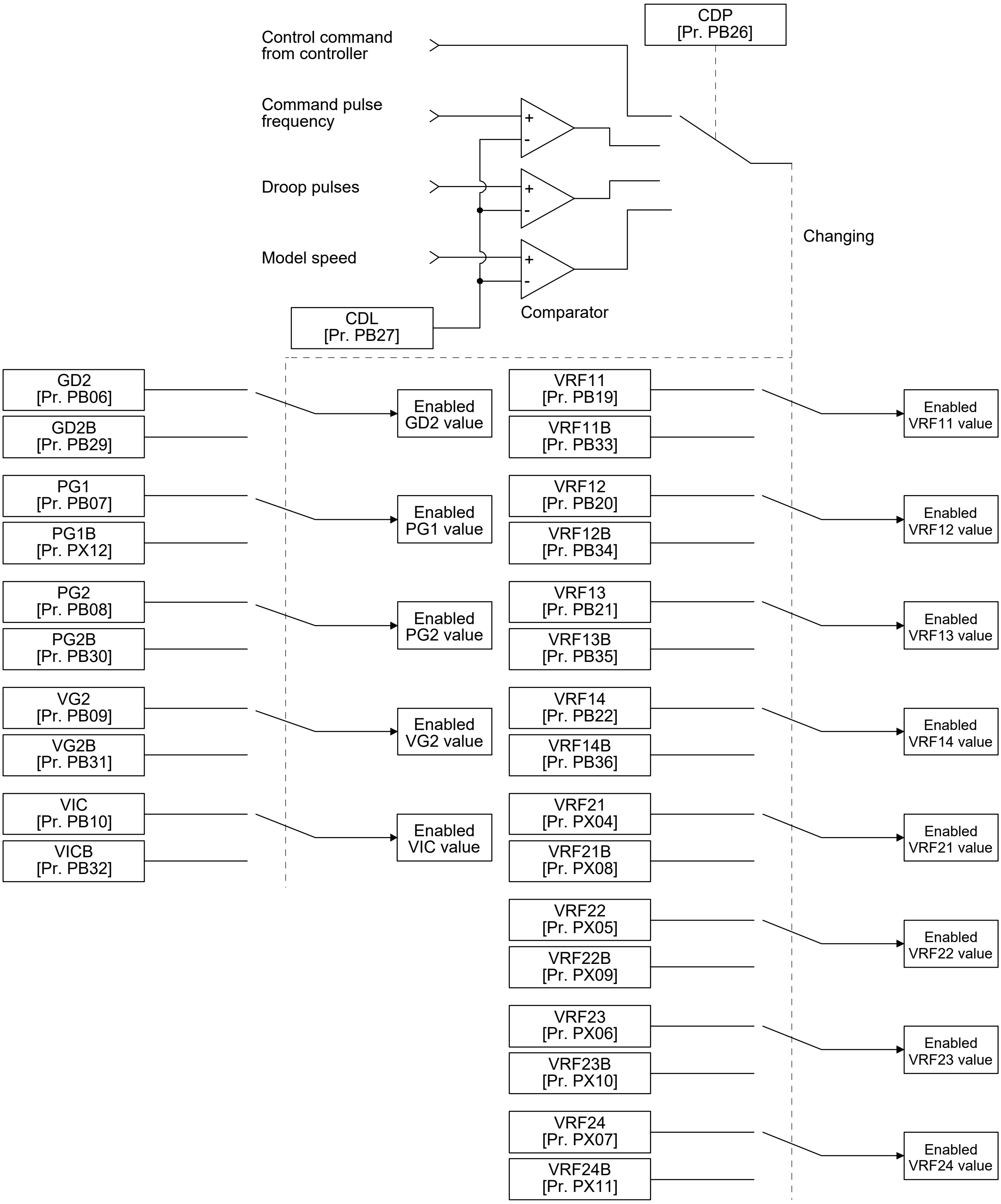
1) You want to increase the gains during servo-lock but decrease the gains to reduce noise during rotation.

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

3) You want to change the gains using a control command from a controller 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).

(b) 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].



(c) Parameter

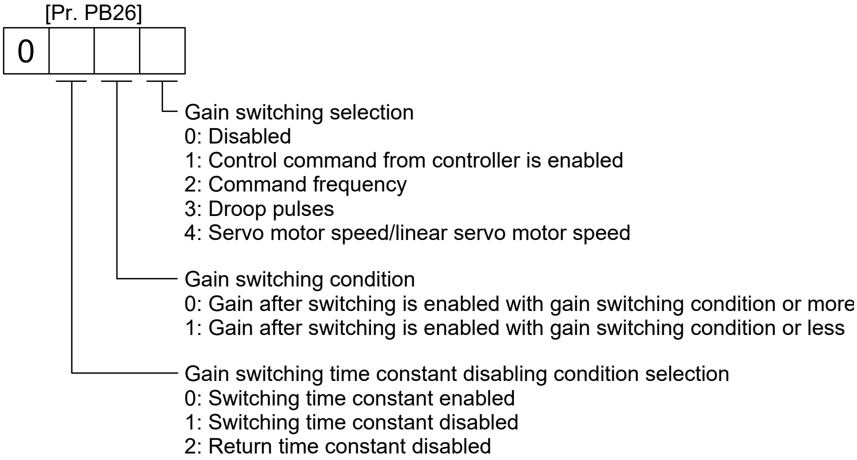
When using the gain switching function, always select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08 Auto tuning mode]. The gain switching function cannot be used in the auto tuning mode.

1) Parameter for setting gain switching condition

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

a) [Pr. PB26 Gain switching function]

Used to set the gain switching condition. Select the switching condition in the first to third digits.



Gain switching selection
0: Disabled
1: Control command from controller is enabled
2: Command frequency
3: Droop pulses
4: Servo motor speed/linear servo motor speed

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

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

b) [Pr. PB27 Gain switching condition]

Set a level to switch gains with [Pr. PB27] after you select "Command frequency", "Droop pulses", or "Servo motor speed/linear servo motor speed" with the gain switching selection in [Pr. PB26 Gain switching function].

The setting unit is as follows.

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

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.

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 after gain switching
Model loop gain	PB07	PG1	Model loop gain	PX12	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	PX04	VRF21	Vibration suppression control 2 - Vibration frequency	PX08	VRF21B	Vibration suppression control 2 - Vibration frequency after gain switching
Vibration suppression control 2 - Resonance frequency	PX05	VRF22	Vibration suppression control 2 - Resonance frequency	PX09	VRF22B	Vibration suppression control 2 - Resonance frequency after gain switching
Vibration suppression control 2 - Vibration frequency damping	PX06	VRF23	Vibration suppression control 2 - Vibration frequency damping	PX10	VRF23B	Vibration suppression control 2 - Vibration frequency damping after gain switching
Vibration suppression control 2 - Resonance frequency damping	PX07	VRF24	Vibration suppression control 2 - Resonance frequency damping	PX11	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/load to motor mass ratio, model loop gain, position loop gain, speed loop gain, and speed integral compensation to be switched.

b) [Pr. PB19] to [Pr. PB22]/[Pr. PX04] to [Pr. PX07]
These parameters are the same as in ordinary manual adjustment. You can switch the vibration frequency, resonance frequency, vibration frequency damping, and resonance frequency damping by switching gain during motor stop.

c) [Pr. PB29 Load to motor inertia ratio/load to motor mass ratio after gain switching]
Set the load to motor inertia ratio or load to motor mass 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/load to motor mass 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. PX08] to [Pr. PX11]) , and [Pr. PX12 Model loop gain after gain switching]
The gain switching vibration suppression control and gain switching model loop gain are used only with control command from the controller.
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.

(d) Gain switching procedure

This operation will be described by way of setting examples.

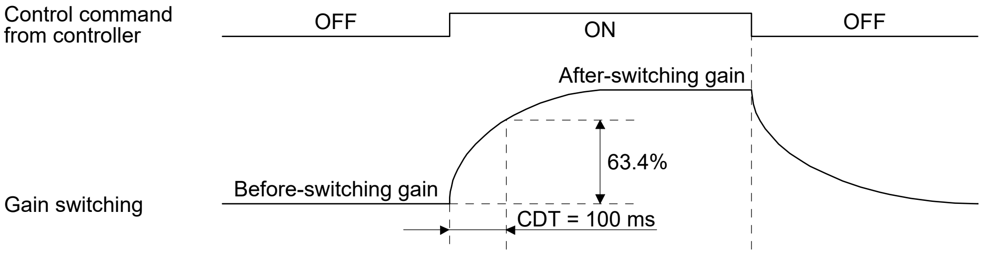
1) When you choose switching by control command from the controller

a) Setting example

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	
PX04	VRF21	Vibration suppression control 2 - Vibration frequency	20	[Hz]
PX05	VRF22	Vibration suppression control 2 - Resonance frequency	20	[Hz]
PX06	VRF23	Vibration suppression control 2 - Vibration frequency damping	0.10	
PX07	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]
PX12	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 control command from the controller.)	
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	
PX08	VRF21B	Vibration suppression control 2 - Vibration frequency after gain switching	30	[Hz]
PX09	VRF22B	Vibration suppression control 2 - Resonance frequency after gain switching	30	[Hz]

Parameter	Symbol	Name	Setting value	Unit
PX10	VRF23B	Vibration suppression control 2 - Vibration frequency damping after gain switching	0.05	
PX11	VRF24B	Vibration suppression control 2 - Resonance frequency damping after gain switching	0.05	

b) Switching timing chart



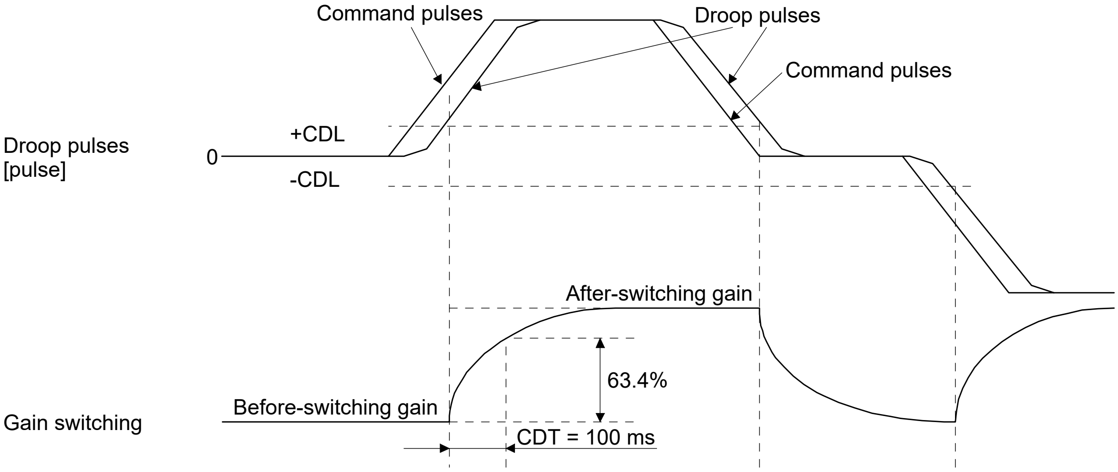
Model loop gain	100	→	50	→	100
Load to motor inertia ratio/load to motor mass ratio	4.00	→	10.00	→	4.00
Position loop gain	120	→	84	→	120
Speed loop gain	3000	→	4000	→	3000
Speed integral compensation	20	→	50	→	20
Vibration suppression control 1 - Vibration frequency	50	→	60	→	50
Vibration suppression 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
The vibration suppression control after gain switching and model loop gain after gain switching cannot be used.

a) Setting example

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]

b) Switching timing chart

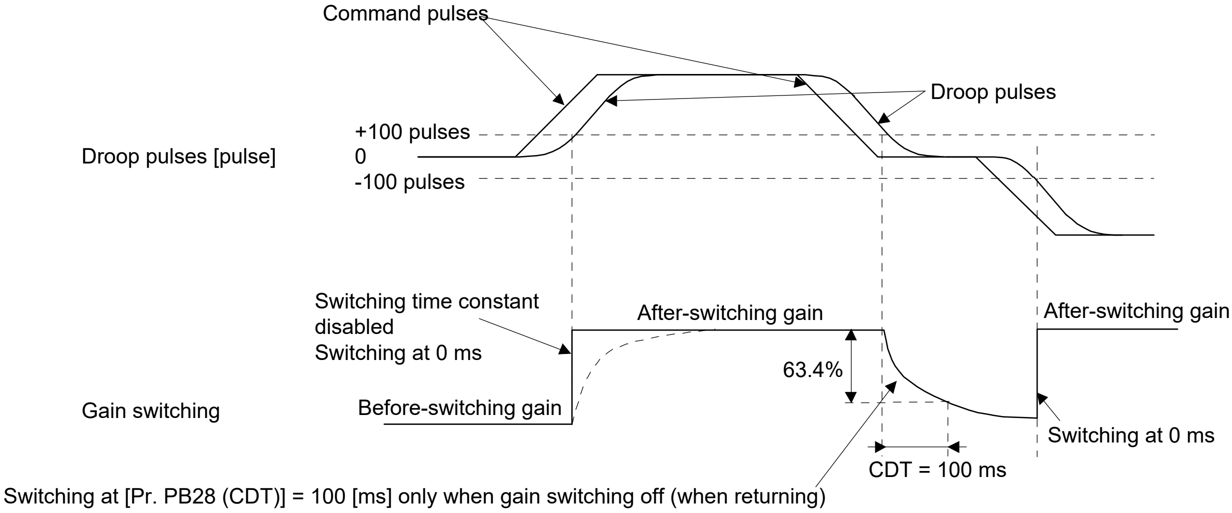


Load to motor inertia ratio/load to motor mass ratio	4.00	→	10.00	→	4.00	→	10.00
Position loop gain	120	→	84	→	120	→	84
Speed loop gain	3000	→	4000	→	3000	→	4000
Speed integral compensation	20	→	50	→	20	→	50

3) When the gain switching time constant is disabled

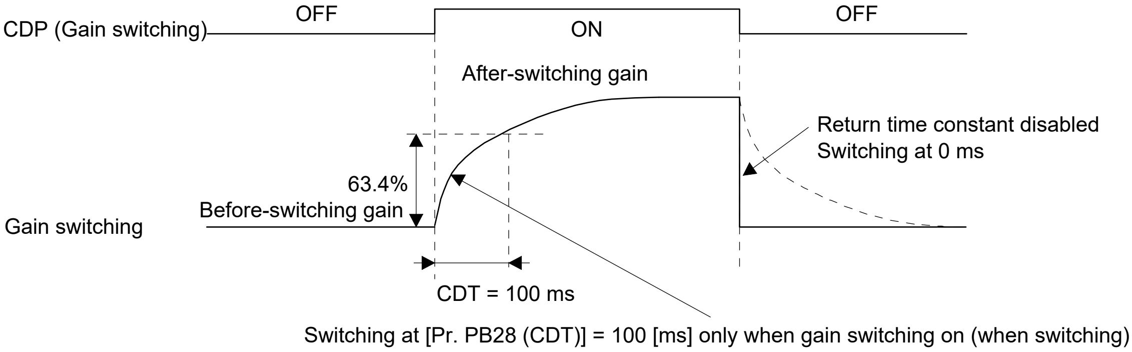
a) Switching time constant disabled was selected.

The gain switching time constant is disabled. The time constant is enabled at gain return. The following example shows for [Pr. PB26 (CDP)] = 0103, [Pr. PB27 (CDL)] = 100 [pulse], and [Pr. PB28 (CDT)] = 100 [ms].



b) Return time constant disabled was selected.

The gain switching time constant is enabled. The time constant is disabled at gain return. The following example shows for [Pr. PB26 (CDP)] = 0201, [Pr. PB27 (CDL)] = 0, and [Pr. PB28 (CDT)] = 100 [ms].



(7) Tough drive function

POINT

- ●Set enable/disable of the tough drive function with [Pr. PX25 Tough drive setting]. (Refer to (2) in this section.)

This function makes the equipment continue operating even under the condition that an alarm occurs. The vibration tough drive function and instantaneous power failure tough drive function are available with the J3 extension function.

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

1) One-touch tuning execution (Refer to (4) in this section.)

2) Manual setting (Refer to (2) in this section.)

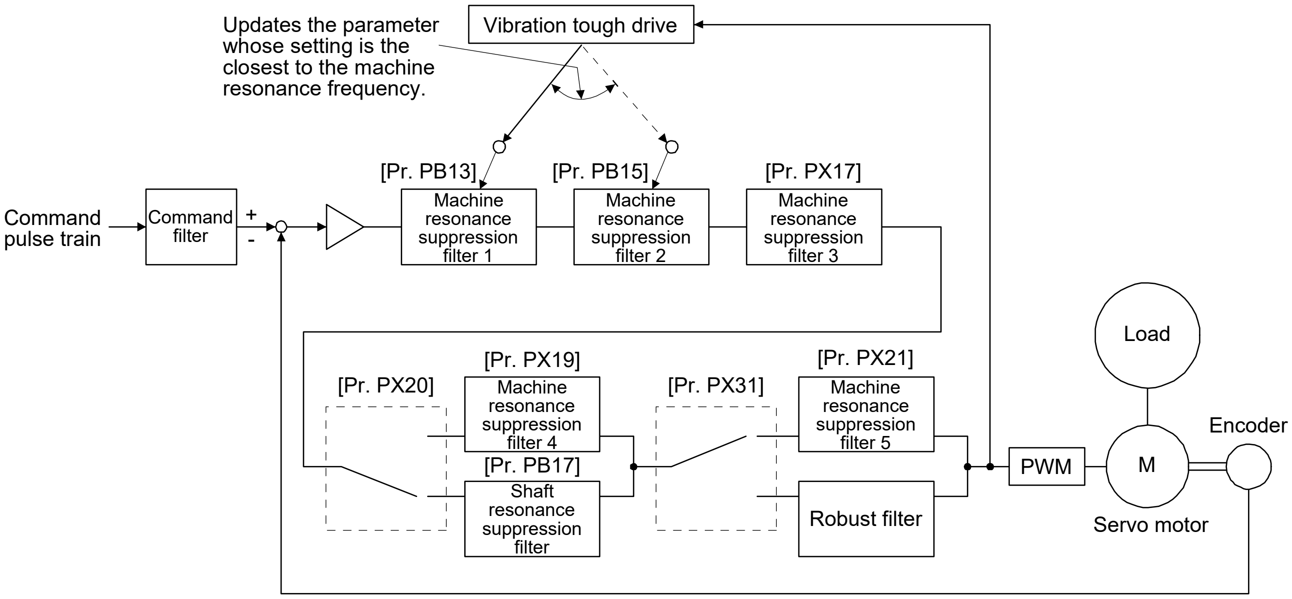
The vibration tough drive function operates when a detected machine resonance frequency is within ±30% for a value set in [Pr. PB13 Machine resonance suppression filter 1] or [Pr. PB15 Machine resonance suppression filter 2].
To set a detection level of the function, set sensitivity in [Pr. PX26 Vibration tough drive - Oscillation detection level].

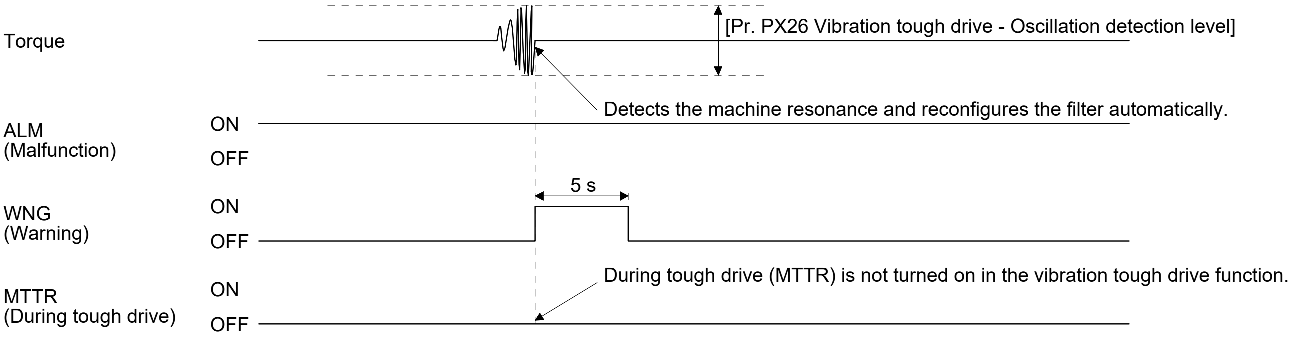
POINT

- ●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. PX17 Machine resonance suppression filter 3], [Pr. PX19 Machine resonance suppression filter 4], and [Pr. PX21 Machine resonance suppression filter 5].
- ●The vibration tough drive function does not detect a vibration of 100 Hz or less.

The following shows the function block diagram of the vibration tough drive function.
The function detects machine resonance frequency and compares 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	PX17/PX18		
Machine resonance suppression filter 4	PX19/PX20	Enabling the machine resonance suppression filter 4 disables the shaft resonance suppression filter. Using the shaft resonance suppression filter is recommended because it is adjusted properly depending on the usage situation. The shaft resonance suppression filter is enabled for the initial setting.	
Machine resonance suppression filter 5	PX21/PX22	Enabling the robust filter disables the machine resonance suppression filter 5. The robust filter is disabled for the initial setting.	





(b) 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 tolerance against instantaneous power failure using the electrical energy charged in the capacitor in the servo amplifier and will change an alarm level of [AL. 10 Undervoltage] simultaneously. The [AL. 10.1 Voltage drop in the control circuit power] detection time for the control circuit power supply can be changed by [Pr. PX28 SEMI-F47 function - Instantaneous power failure detection time]. In addition, [AL. 10.2 Voltage drop in the main circuit power] detection level for the bus voltage is changed automatically.

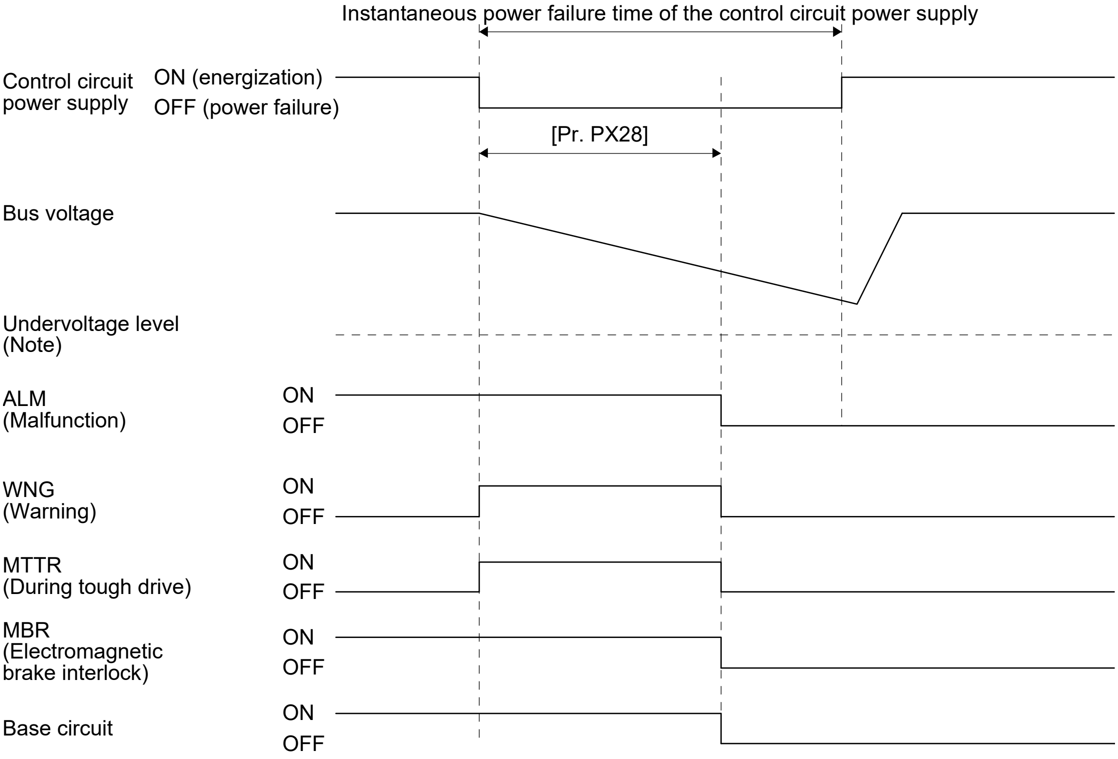
POINT

- MBR (Electromagnetic brake interlock) will not turn off during the instantaneous power failure tough drive.
- When selecting "Enabled (_ _ _ 1)" for "Torque limit function selection at instantaneous power failure" in [Pr. PX23], if an instantaneous power failure occurs during operation, you can save electric energy charged in the capacitor in the servo amplifier by limiting torque at acceleration. You can also delay the time until the occurrence of [AL. 10.2 Voltage drop in the main circuit power]. Doing this will enable you to set a longer time in [Pr. PX28 SEMI-F47 function - Instantaneous power failure detection time].
- When the load of instantaneous power failure is large, [AL. 10.2] caused by the bus voltage drop may occur regardless of the set value of [Pr. PX28 SEMI-F47 function - Instantaneous power failure detection time].
- The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD07] to [Pr. PD09]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.
- The setting range of [Pr. PX28 SEMI-F47 function - Instantaneous power failure detection time] differs depending on the software version of the servo amplifier as follows.
  - Software version C0 or later: Setting range 30 ms to 200 ms
  - Software version C1 or earlier: Setting range 30 ms to 500 ms

  To comply with SEMI-F47 standard, it is unnecessary to change the initial value (200 ms).

  When the instantaneous power failure time exceeds 200 ms, and if the instantaneous power failure voltage is less than 70 % of the rated input voltage, the power may be turned off normally even if a value larger than 200 ms is set in the parameter.

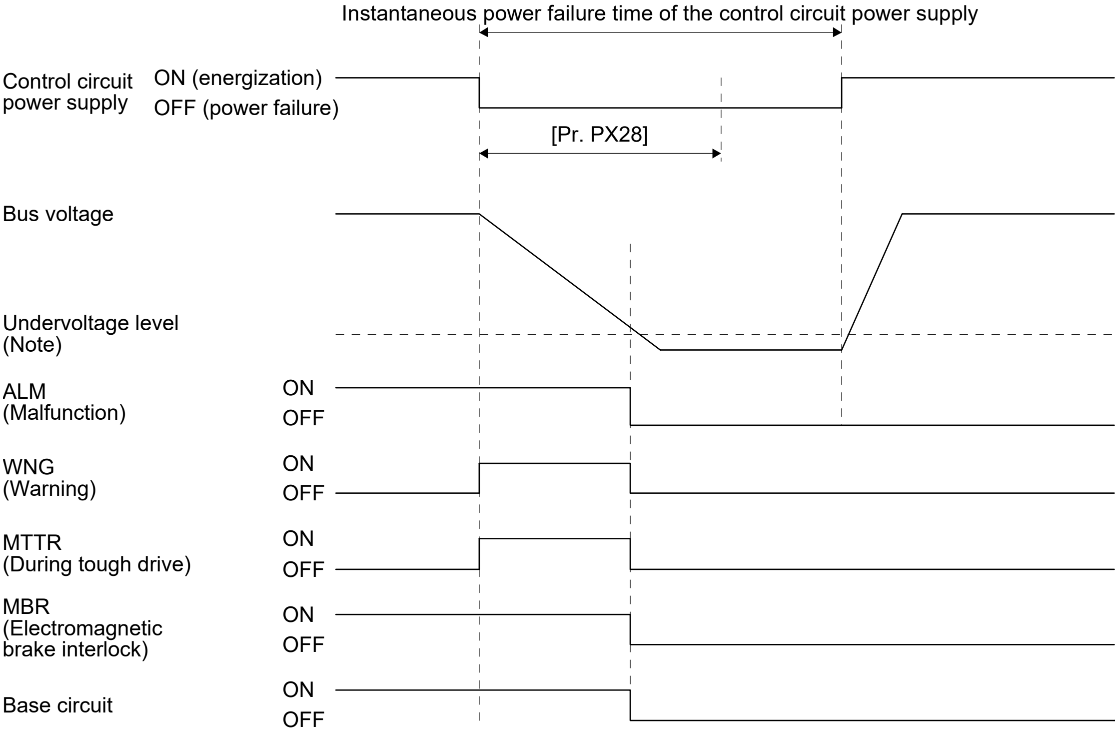
1) Instantaneous power failure time of control circuit power supply > [Pr. PX28 SEMI-F47 function - Instantaneous power failure detection time]
The alarm occurs when the instantaneous power failure time of the control circuit power supply exceeds [Pr. PX28 SEMI-F47 function - Instantaneous power failure detection time].
MTTR (During tough drive) turns on after the instantaneous power failure is detected.
MBR (Electromagnetic brake interlock) turns off when the alarm occurs.



Note. Refer to table 17.8 for the undervoltage level.

2) Instantaneous power failure time of control circuit power supply < [Pr. PX28 SEMI-F47 function - Instantaneous power failure detection time]
   Operation status differs depending on how bus voltage decrease.

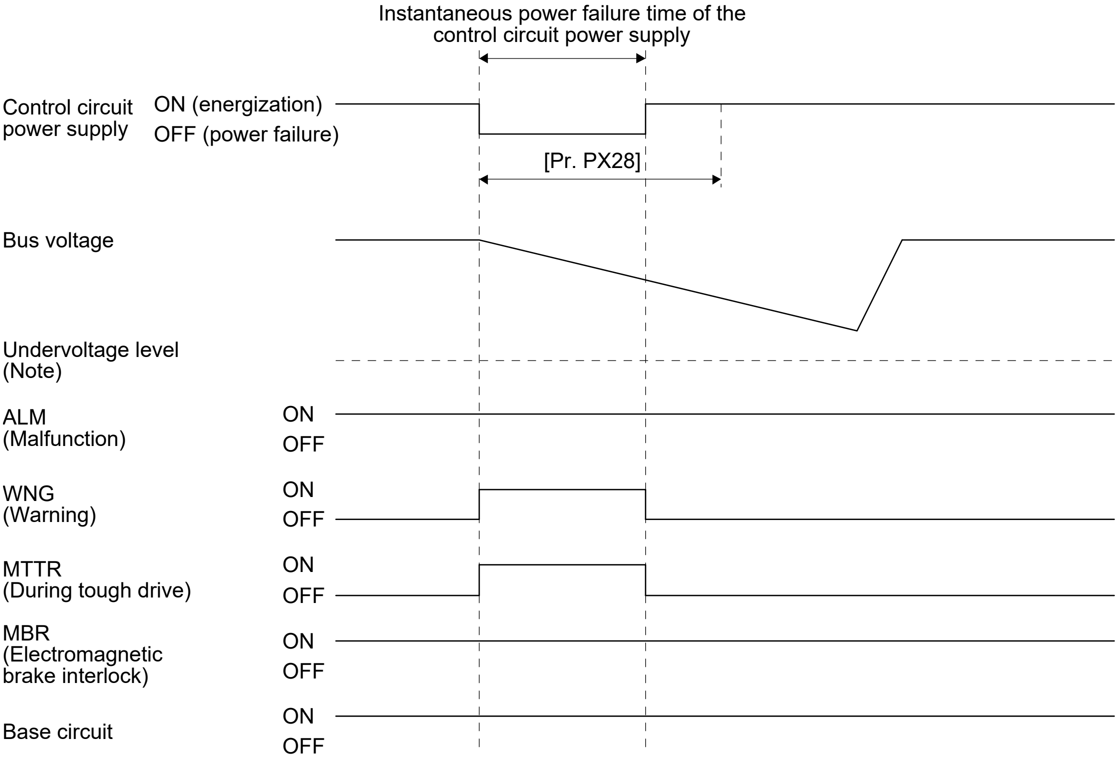
   a) When the bus voltage decreases lower than Undervoltage level within the instantaneous power failure time of the control circuit power supply
      [AL. 10 Undervoltage] occurs when the bus voltage decrease lower than Undervoltage level regardless of the enabled instantaneous power failure tough drive.



Note. Refer to table 17.8 for the undervoltage level.

b) When the bus voltage does not decrease lower than Undervoltage level within the instantaneous power failure time of the control circuit power supply

The operation continues without alarming.



Note. Refer to table 17.8 for the undervoltage level.

(8) Compliance with SEMI-F47 standard

POINT

- The control circuit power supply of the servo amplifier can be possible to comply with SEMI-F47 standard. 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.
- Use a 3-phase for the input power supply of the servo amplifier. Using a 1-phase 100 V AC/200 V AC for the input power supply will not comply with SEMI-F47 standard.
- The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD07] to [Pr. PD09]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.
- Be sure to perform actual machine tests and detail checks for power supply instantaneous power failure of SEMI-F47 standard with your equipment.

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

This function enables to avoid triggering [AL. 10 Undervoltage] using the electrical energy charged in the capacitor in case that an instantaneous power failure occurs during operation.

(a) Parameter setting

Setting [Pr. PX25] and [Pr. PX28] as follows will enable SEMI-F47 function.

Parameter	Setting value	Description
PX25	_ 1 _ _	Enable SEMI-F47 function selection.
PX28	200	Set the time [ms] of the [AL. 10.1 Voltage drop in the control circuit power] occurrence.

Enabling SEMI-F47 function will change operation as follows.

1) The voltage will drop in the control circuit power with "Rated voltage × 50% or less". 200 ms later, [AL. 10.1 Voltage drop in the control circuit power] will occur.

2) [AL. 10.2 Voltage drop in the main circuit power] will occur when bus voltage is as follows.

Table 17.8 Voltages which trigger [AL. 10.2 Voltage drop in the main circuit power]

Servo amplifier	Bus voltage which triggers alarm
MR-J4-10B(-RJ) to MR-J4-700B(-RJ)	158 V DC
MR-J4-11KB(-RJ) to MR-J4-22KB(-RJ)	200 V DC
MR-J4-60B4(-RJ) to MR-J4-22KB4(-RJ)	380 V DC

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

(b) Requirements conditions of SEMI-F47 standard

Table 17.9 shows the permissible time of instantaneous power failure for instantaneous power failure of SEMI-F47 standard.

Table 17.9 Requirements conditions of SEMI-F47 standard

Instantaneous power failure voltage	Permissible time of instantaneous power failure [s]
Rated voltage × 80%	1
Rated voltage × 70%	0.5
Rated voltage × 50%	0.2

(c) Calculation of tolerance against instantaneous power failure

Table 17.10 shows tolerance against instantaneous power failure when instantaneous power failure voltage is "rated voltage × 50%" and instantaneous power failure time is 200 ms.

Table 17.10 Tolerance against instantaneous power failure (instantaneous power failure voltage = rated voltage × 50%, instantaneous power failure time = 200 ms)

Servo amplifier	Instantaneous maximum output [W]	Tolerance against instantaneous power failure [W] (voltage drop between lines)
MR-J4-10B(-RJ)	350	250
MR-J4-20B(-RJ)	700	420
MR-J4-40B(-RJ)	1400	630
MR-J4-60B(-RJ)	2100	410
MR-J4-70B(-RJ)	2625	1150
MR-J4-100B(-RJ)	3000	1190
MR-J4-200B(-RJ)	5400	2040
MR-J4-350B(-RJ)	10500	2600
MR-J4-500B(-RJ)	15000	4100
MR-J4-700B(-RJ)	21000	5900
MR-J4-11KB(-RJ)	40000	2600
MR-J4-15KB(-RJ)	50000	3500
MR-J4-22KB(-RJ)	56000	4300
MR-J4-60B4(-RJ)	1900	190
MR-J4-100B4(-RJ)	3500	200
MR-J4-200B4(-RJ)	5400	350
MR-J4-350B4(-RJ)	10500	730
MR-J4-500B4(-RJ)	15000	890
MR-J4-700B4(-RJ)	21000	1500
MR-J4-11KB4(-RJ)	40000	2400
MR-J4-15KB4(-RJ)	50000	3200
MR-J4-22KB4(-RJ)	56000	4200

Instantaneous maximum output means power which servo amplifier can output in maximum torque at rated speed. You can examine margins to compare the values of following conditions and instantaneous maximum output.

Even if driving at maximum torque with low speed in actual operation, the motor will not drive with the maximum output. This can be handled as a margin.

The following shows the conditions of tolerance against instantaneous power failure.

1) Delta connection

For the 3-phase (L1/L2/L3) delta connection, an instantaneous power failure occurs in the voltage between a pair of lines (e.g. between L1 and L2) among voltages between three pairs of lines (between L1 and L2, L2 and L3, or L3 and L1).

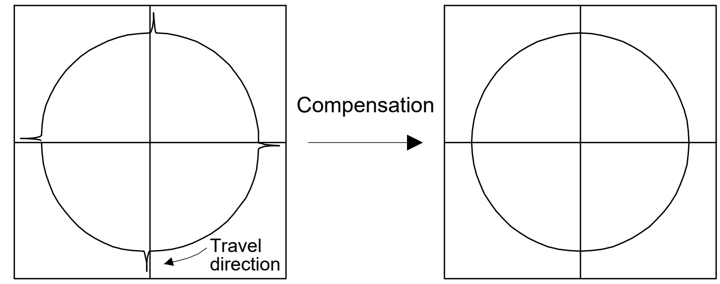
2) Star connection

For the 3-phase (L1/L2/L3/neutral point N) star connection, an instantaneous power failure occurs in the voltage between a pair of lines (e.g. between L1 and N) among voltages at six locations, between three pairs of lines (between L1 and L2, L2 and L3, or L3 and L1) and between one of the lines and the neutral point (between L1 and N, L2 and N, or L3 and N).

(9) Lost motion compensation function

POINT
●The lost motion compensation function is enabled only in the position control mode.

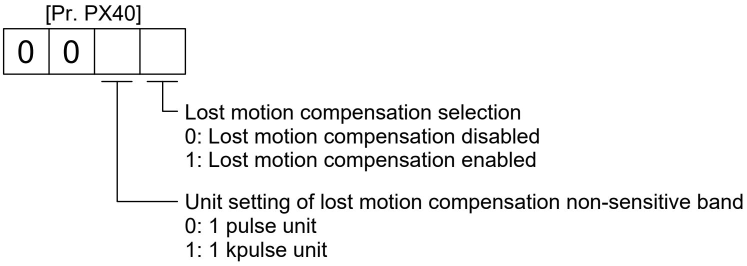
The lost motion compensation function corrects response delays (caused by a non-sensitive band due to friction, twist, expansion, and backlash) caused when the machine travel direction is reversed. This function contributes to improvement for protrusions that occur at a quadrant change and streaks that occur at a quadrant change during circular cutting.
This function is effective when a high follow-up performance is required such as drawing an arc with an X-Y table.



The locus before compensation The locus after compensation

(a) Parameter setting
Setting [Pr. PX36] to [Pr. PX42] enables the lost motion compensation function.

1) Lost motion compensation function selection ([Pr. PX40])
Select the lost motion compensation function.



Lost motion compensation selection
0: Lost motion compensation disabled
1: Lost motion compensation enabled

Unit setting of lost motion compensation non-sensitive band
0: 1 pulse unit
1: 1 kpulse unit

2) Lost motion compensation ([Pr. PX36]/[Pr. PX37])
Set the same value for the lost motion compensation for each of when the forward rotation switches to the reverse rotation and when the reverse rotation switches to the forward rotation. When the heights of protrusions differ depending on the travel direction, set the different compensation for each travel direction. Set a value twice the usual friction torque and adjust the value while checking protrusions.

3) Torque offset ([Pr. PX39])
For a vertical axis, unbalanced torque occurs due to the gravity. Although setting the torque offset is usually unnecessary, setting unbalanced torque of a machine as a torque offset cancels the unbalanced torque. The torque offset does not need to be set for a machine not generating unbalanced torque. The torque offset cannot be used for linear servo motors and direct drive motors. Set 0.00%.

4) Lost motion compensation timing ([Pr. PX41])
You can set the delay time of the lost motion compensation start timing with this parameter. When a protrusion occurs belatedly, set the lost motion compensation timing corresponding to the protrusion occurrence timing.

5) Lost motion compensation non-sensitive band ([Pr. PX42])
When the travel direction reverses frequently around the zero speed, unnecessary lost motion compensation is triggered by the travel direction switching. By setting the lost motion compensation non-sensitive band, the speed is recognized as 0 when the fluctuation of the droop pulse is the setting value or less.
When the value of this parameter is changed, the compensation timing is changed. Adjust the value of Lost motion compensation timing ([Pr. PX41]).

6) Lost motion filter setting ([Pr. PX38])
Changing the value of this parameter is usually unnecessary. When a value other than 0.0 ms is set in this parameter, the high-pass filter output value of the set time constant is applied to the compensation and lost motion compensation continues.

(b) Adjustment procedure of the lost motion compensation function

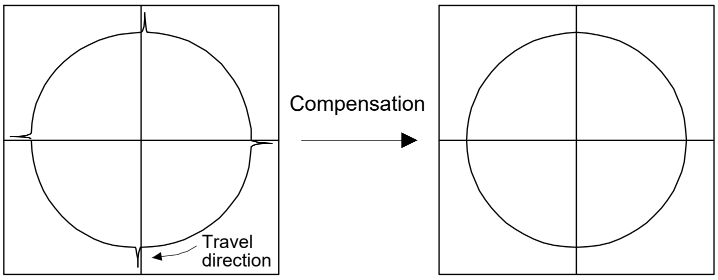
1) Measuring the load current
Measure the load currents during the forward direction feed and reverse direction feed with MR Configurator2.

2) Setting the lost motion compensation
Calculate the friction torque from the measurement result of (9) (b) 1) in this section and set a value twice the friction torque in [Pr. PX36] and [Pr. PX37] as lost motion compensation.

$$\text{Friction torque [\%]} = \frac{\begin{array}{c}|(\text{load current during feed in the forward rotation direction [\%]}) - \\ (\text{load current during feed in the reverse rotation direction [\%]})|\end{array}}{2}$$

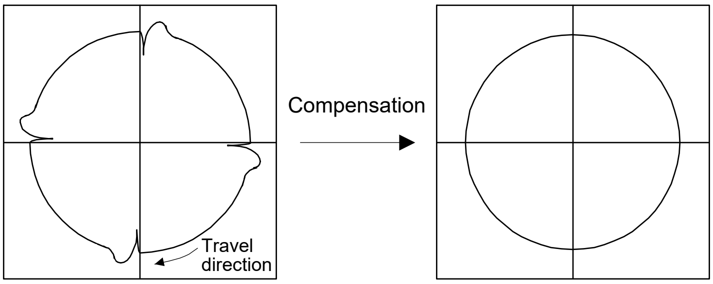
3) Checking protrusions
Drive the servo motor and check that the protrusions are corrected.

4) Adjusting the lost motion compensation
When protrusions still occur, the compensation is insufficient. Increase the lost motion compensation by approximately 0.5% until the protrusions are eliminated. When notches occur, the compensation is excessive. Decrease the lost motion compensation by approximately 0.5% until the notches are eliminated. Different values can be set as the compensation for each of when the forward rotation (CCW) switches to the reverse rotation (CW) and when the reverse rotation (CW) switches to the forward rotation (CCW).



The locus before compensation The locus after compensation

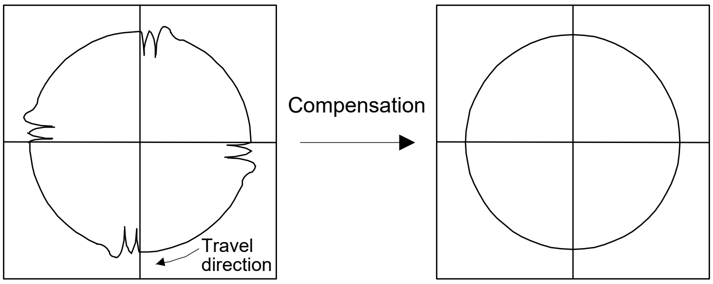
5) Adjusting the lost motion compensation timing
When the machine has low rigidity, the speed loop gain is set lower than the standard setting value, or the servo motor is rotating at high speed, quadrant projections may occur behind the quadrant change points. In this case, you can suppress the quadrant projections by delaying the lost motion compensation timing with [Pr. PX41 Lost motion compensation timing]. Increase the setting value of [Pr. PX41] from 0 ms (Initial value) by approximately 0.5 ms to adjust the compensation timing.



Before timing delay compensation

After timing delay compensation

6) Adjusting the lost motion compensation non-sensitive band
When the lost motion is compensated twice around a quadrant change point, set [Pr. PX42 Lost motion compensation non-sensitive band]. Increase the setting value so that the lost motion is not compensated twice. Setting [Pr. PX42] may change the compensation timing. Adjust the lost motion compensation timing of (9) (b) 5) in this section.



Before timing delay compensation

After timing delay compensation

17.2 Master-slave operation function

⚠WARNING

- Configure the circuit so that all the master and slave axes for the same machine are stopped by the controller forced stop at the moment of a stop of a master or slave axis due to such as a servo alarm. When they are not stopped simultaneously by the controller forced stop, the servo motor may operate unexpectedly and the machine can be damaged.
- All the master and slave axes for the same machine should turn on/off EM1 (Forced stop 1) simultaneously. When EM1 (Forced stop 1) is not turned on/off simultaneously, the servo motor may operate unexpectedly and the machine can be damaged.

POINT

- The master-slave operation function works only when the forced stop deceleration function is disabled. When the forced stop deceleration function is enabled, [AL. 37] will occur.
- The master-slave operation function cannot be used with the continuous operation to torque control.
- Use the master-slave operation function with the following controllers. Refer to the manuals for each servo system controller for compatible software versions, and other details.
  RD77MS/QD77MS_/LD77MS_
  R_MTCPU/Q17_DSCPU
  Q170MSCPU
- When the function is used in vertical axis system, set the same value to the parameters regarding the dynamic brake and electromagnetic brake to prevent a drop of axes.
- The servo-on command of the master axis and slave axis should be turned on/off simultaneously. If the servo-on command is turned on only for a slave axis, torque will not be generated. Therefore, an extreme load will be applied to the electromagnetic brake of the master axis for using in vertical axis system.
- The master-slave operation function is available for servo amplifier with software version A8 or later. All servo amplifiers used in the same system connected to a controller should be software version A8 or later.

(1) Summary

The master-slave operation function transmits a master axis torque to slave axes using driver communication and the torque as a command drives slave axes by torque control.

Transmission of torque data from the master axis to slave axes is via SSCNET III/H. Additional wiring is not required.

(2) System configuration

POINT

- The control modes compatible with the master-slave operation function are as follows.

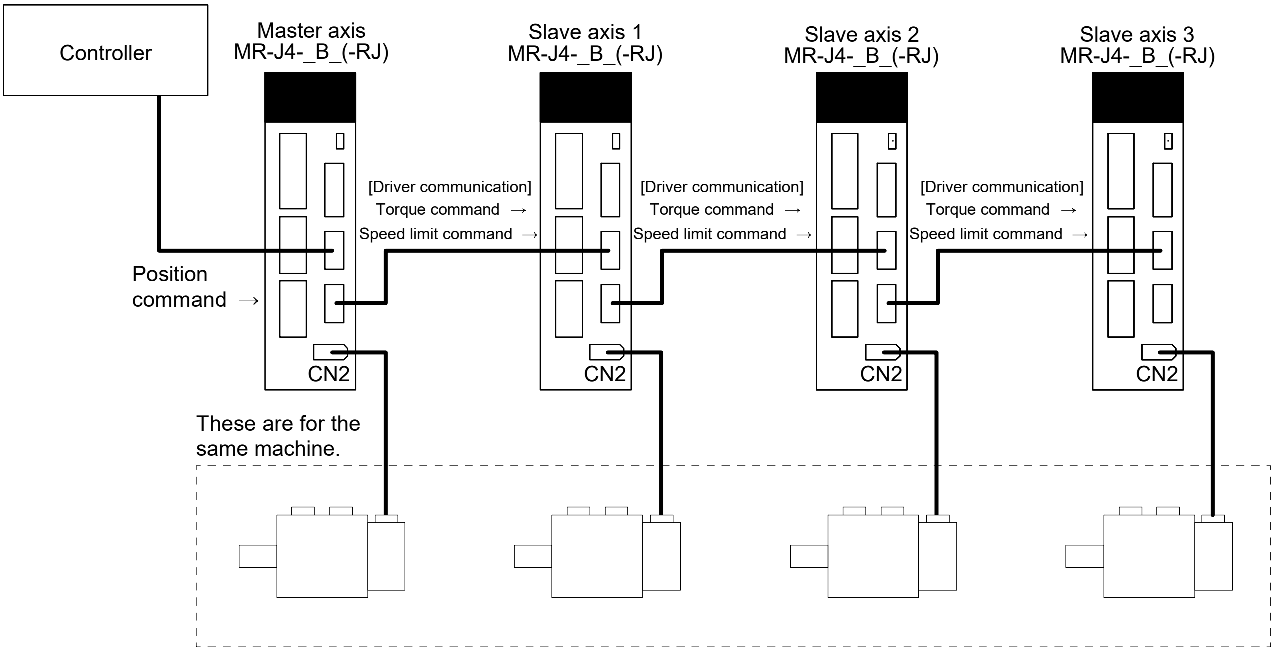
Master-slave operation function compatibility table

Control mode	Forced stop deceleration function	Master axis (Note)	Slave axis (Note)
Standard control mode	Enabled		
	Disabled	○	○
Fully closed loop control mode	Enabled		
	Disabled	○	
Linear servo motor control mode	Enabled		
	Disabled		
DD motor control mode	Enabled		
	Disabled		

Note. When a setting for the master-slave operation is set to an axis which is not compatible with the master-slave operation function, [AL. 37] will occur.

- The master axis and slave axis are recommended to use for a linked condition on a mechanical constitution. When they are not linked, they can reach a speed limit level. Doing so may cause [AL. 31 Overspeed].
- The slave axes use the control command from the master axis. Therefore, the controller mainly controls parameter settings, servo-on command, acquisition of monitor information from a servo amplifier, etc. The commands regarding absolute positioning such as setting absolute position detection and requiring home position setting from the controller to slave axes must not be made.
- Configure the circuit so that all the master and slave axes are stopped at the moment of a stop of a master or slave axis due to such as an alarm.
- When the STO signal of a servo amplifier is used, the master axis and slave axis should be turned off simultaneously.

Eight master axes can be set at most per one system of SSCNET III/H. The maximum number of slave axes to each master axis is not limited. However, the total number of the master and slave axes should be the maximum number of the servo amplifiers at most. In addition, when an SSCNET III/H communication shut-off occurs due to malfunction of a servo amplifier, the malfunctioning axis and later axis cannot be communicated. Therefore, the first amplifier from the controller via SSCNET III/H cable should be master axis.



(3) Parameter setting for the master-slave operation function

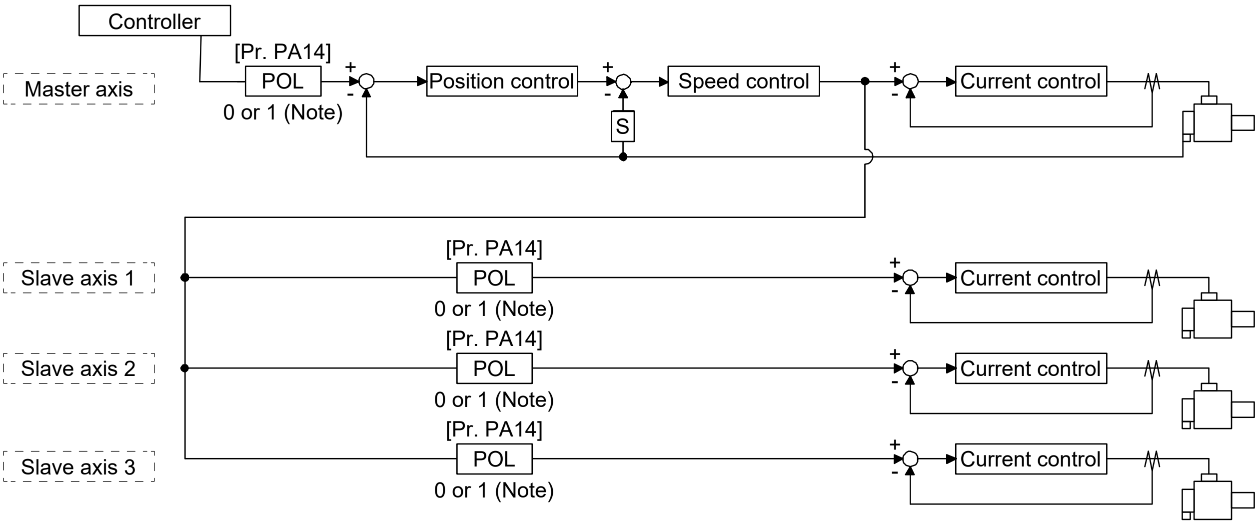
To use the master-slave operation function, the following parameter settings are necessary. For details of the parameters, refer to section 5.2.1 and 5.2.4.

No.	Name	Initial value	Setting value		Setting
			Master axis	Slave axis	
PA04	Forced stop deceleration function selection	2000	0 _ _ _	0 _ _ _	Used to disable the forced stop deceleration function.
PA14	Rotation direction selection/travel direction selection	0	Refer to section 5.2.1.		Used to set a torque generation direction.
PD15 (Note)	Driver communication setting	0000	0001	0010	Master and slave setting
PD16 (Note)	Driver communication setting - Master - Transmit data selection 1	0000	0038	0000	Communication data from master to slave ・Torque command ・Speed limit value
PD17 (Note)	Driver communication setting - Master - Transmit data selection 2	0000	003A	0000	
PD20 (Note)	Master axis No. selection 1 for slave	0	0	Master axis No.	Master axis No. of transmitting data
PD30	Master-slave operation - Torque command coefficient on slave	0	0	Refer to section 5.2.4.	Ratio of torque command of slave axis, ratio of speed limit value, and setting of speed limit minimum value
PD31	Master-slave operation - Speed limit coefficient on slave	0	0		
PD32	Master-slave operation - Speed limit adjusted value on slave	0	0		

Note. Always set this with parameters of the controller.

(4) Rotation direction setting

Rotation directions can be different among a controller command, master axis, and slave axes. To align the directions, set [Pr. PA14] referring to (4) in this section. Not doing so can cause such as an overload due to a reverse direction torque against machine system rotation direction.



Note. Setting "1" will reverse the polarity.

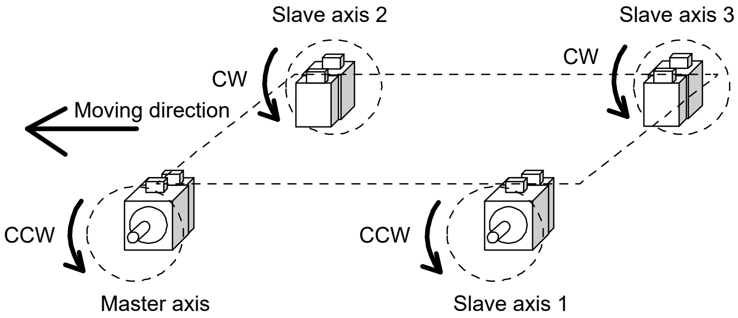
Fig. 17.3 Rotation direction setting of master and slave axes with torque command method for an example of one master axis and three slave axes

Table 17.11 Rotation direction setting parameter

No.	Symbol	Name and function
PA14	*POL	Rotation direction selection 1. For master axis Select a servo motor rotation direction of master axis to SSCNET controller command. 0: Servo motor CCW rotation in positioning address increase direction 1: Servo motor CW rotation in positioning address increase direction 2. For slave axis Select servo motor rotation direction to a command from master axis. 0: Torque command polarity from master axis 1: Reverse of torque command polarity from master axis

The following shows a setting example of rotation direction for a platform truck with one master axis and three slave axes.

To set a rotation direction of the servo motor according to the moving direction, set the torque command polarity to the slave axis 1 the same as that to the master axis, and set the opposite polarity to the slave axis 2 and slave axis 3 from the master axis.



[Pr. PA14] setting

Axis	[Pr. PA14]
Master axis	0
Slave axis 1	0
Slave axis 2	1
Slave axis 3	1

17.3 Scale measurement function

The scale measurement function transmits position information of a scale measurement encoder to the controller by connecting the scale measurement encoder in semi closed loop control.

POINT

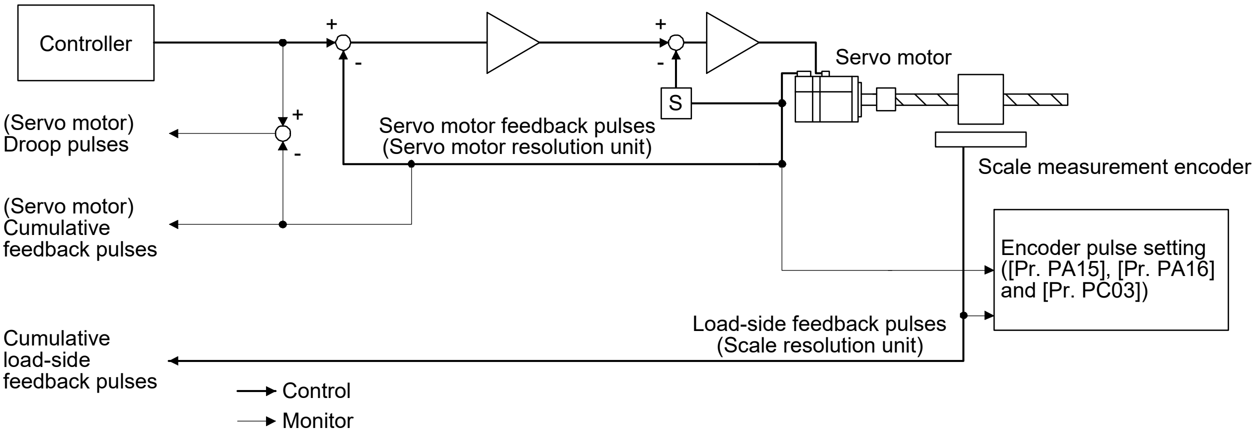
- ●The scale measurement function is available for the servo amplifiers of software version A8 or later.
- ●When a linear encoder is used as a scale measurement encoder for this servo amplifier, "Linear Encoder Instruction Manual" is necessary.
- ●When the scale measurement function is used for MR-J4-_B_ servo amplifiers, the following restrictions apply. However, these restrictions will not be applied for MR-J4-_B_-RJ servo amplifiers.
  - ・A/B/Z-phase differential output type encoder cannot be used.
  - ・The scale measurement encoder and servo motor encoder are compatible with only the two-wire type. The four-wire type scale measurement encoder and servo motor encoder cannot be used.
  - ・When you use the HG-KR and HG-MR series for driving and scale measurement 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 a two-wire type encoder cable according to app. 8.
- ●The scale measurement function compatible servo amplifier can be used with any of the following controllers.
  - ・Motion controller R_MTCPU/Q17_DSCPU
  - ・Simple motion module RD77MS/QD77MS_/LD77MS_

  For settings and restrictions of controllers compatible with the scale measurement function, refer to user's manuals for each controller.

17.3.1 Functions and configuration

(1) Function block diagram

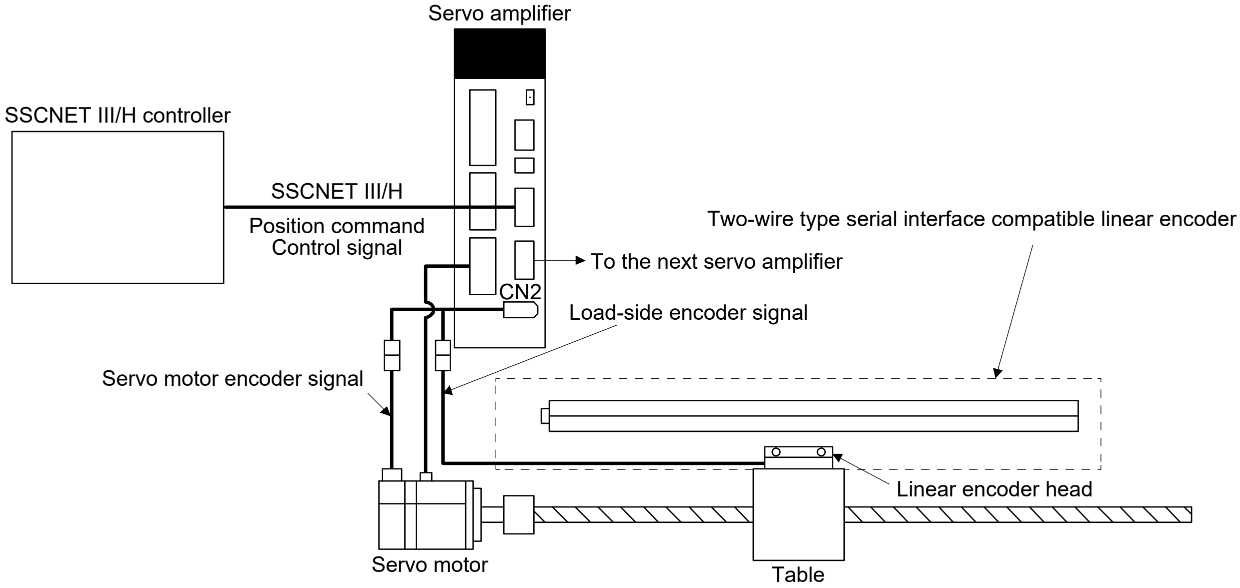
The following shows a block diagram of the scale measurement function. The control will be performed per servo motor encoder unit for the scale measurement function.



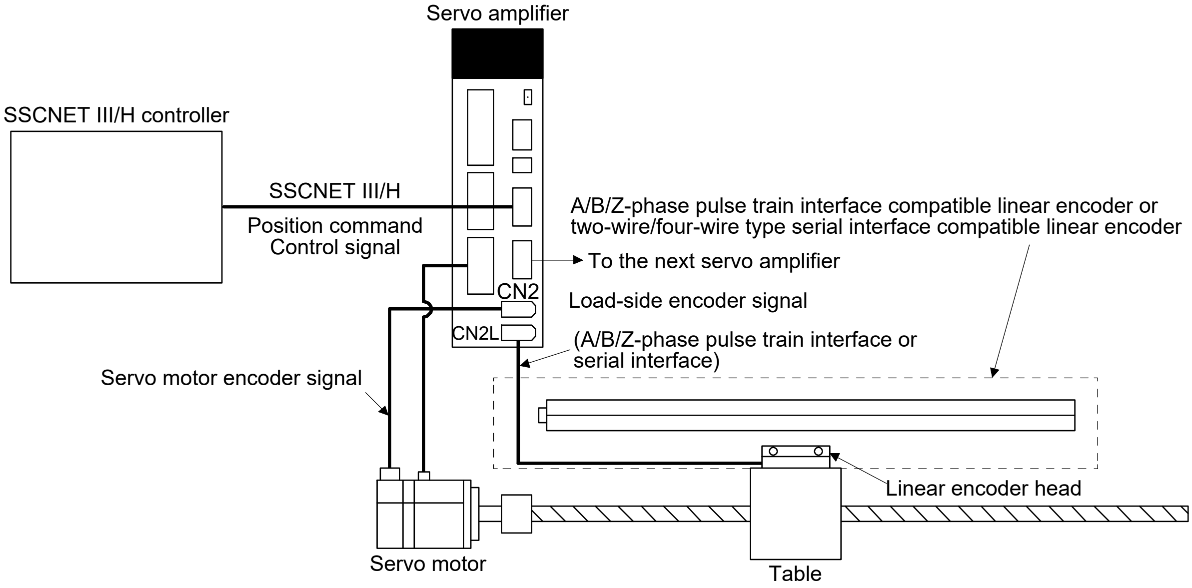
(2) System configuration

(a) For a linear encoder

1) MR-J4-_B_ servo amplifier

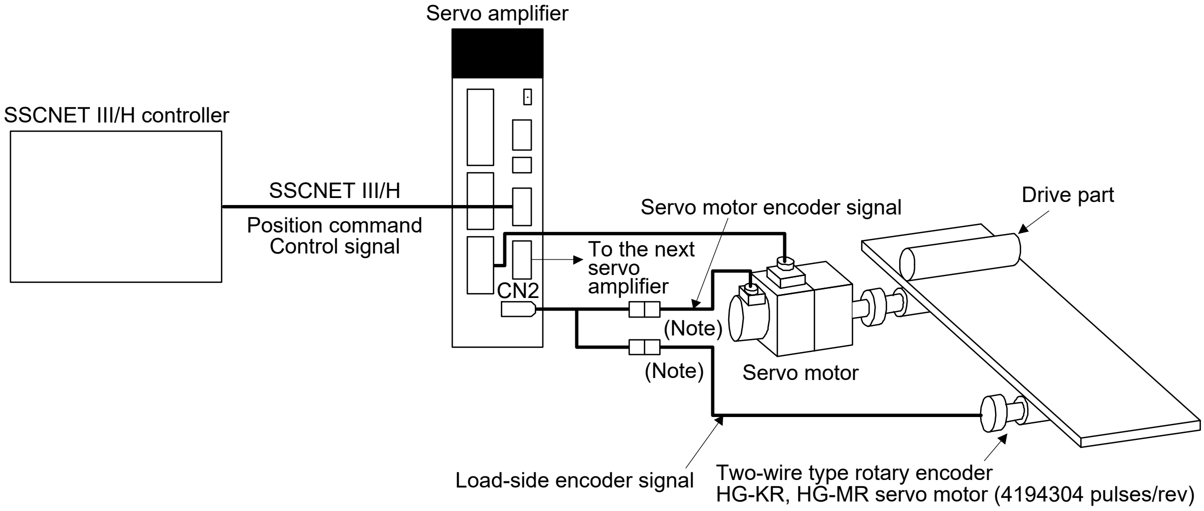


2) MR-J4-_B_-RJ servo amplifier



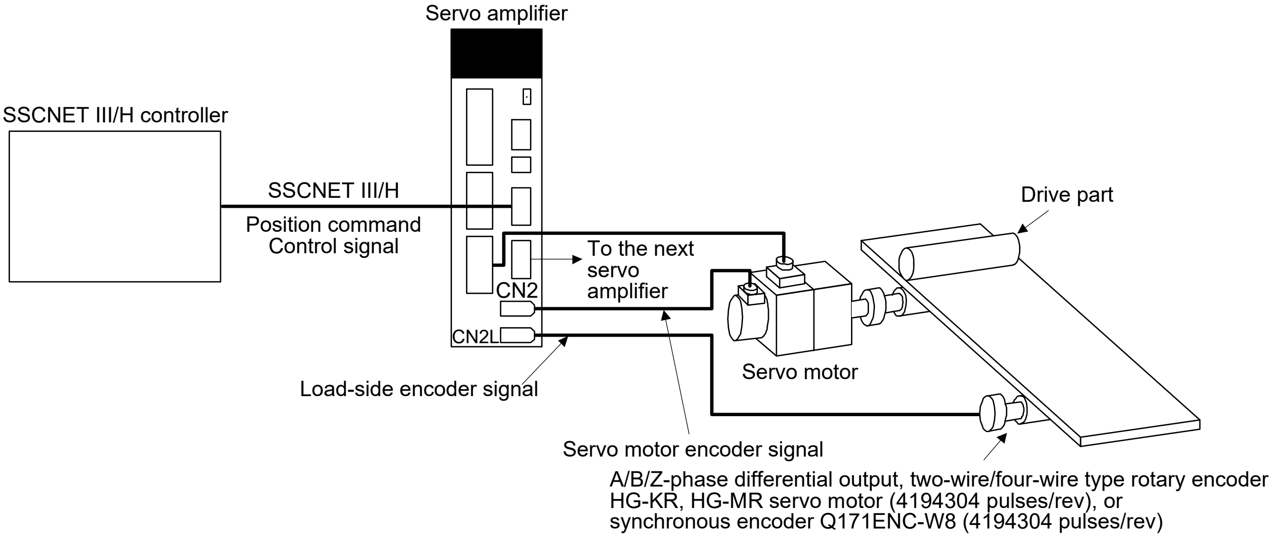
(b) For a rotary encoder

1) MR-J4-_B_ servo amplifier



Note. Use a two-wire type encoder cable. A four-wire type linear encoder cable cannot be used.

2) MR-J4-_B_-RJ servo amplifier



17.3.2 Scale measurement encoder

POINT

- ●Always use the scale measurement encoder cable introduced in this section. Using other products may cause a malfunction.
- ●For details of the scale measurement encoder specifications, performance and assurance, contact each encoder manufacturer.

(1) Linear encoder

Refer to "Linear Encoder Instruction Manual" for usable linear encoders.

To use the scale measurement function in the absolute position detection system ([Pr. PA22] = 1_ _ _), an absolute position linear encoder is required. In this case, you do not need to install the encoder battery to the servo amplifier for backing up the absolute position data of the load side. To use a servo motor in the absolute position detection system ([Pr. PA03] = _ _ _1), the encoder battery must be installed to the servo amplifier for backing up the absolute position data of the servo motor side.

(2) Rotary encoder

If using a rotary encoder as a scale measurement encoder, use the following servo motor or encoder.

Servo amplifier	HG-KR	HG-MR	Synchronous encoder Q171ENC-W8	A/B/Z-phase differential output (Note)
MR-J4-_B_	○	○		
MR-J4-_B_-RJ	○	○	○	○

Note. A/B/Z-phase differential output rotary encoders with the same specifications as A/B/Z-phase differential output linear encoders can be used as scale measurement encoders. Refer to "Linear Encoder Instruction Manual".

Use a two-wire type encoder cable for MR-J4-_B_ servo amplifiers. Do not use MR-EKCBL30M-L, MR-EKCBL30M-H, MR-EKCBL40M-H, or MR-EKCBL50M-H as they are four-wire type.

When an encoder cable of 30 m to 50 m is needed, fabricate a two-wire type encoder cable according to app. 8.

To use the scale measurement function in the absolute position detection system ([Pr. PA22] = 1_ _ _), the encoder battery must be installed to the servo amplifier for backing up the absolute position data of the load side. 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.

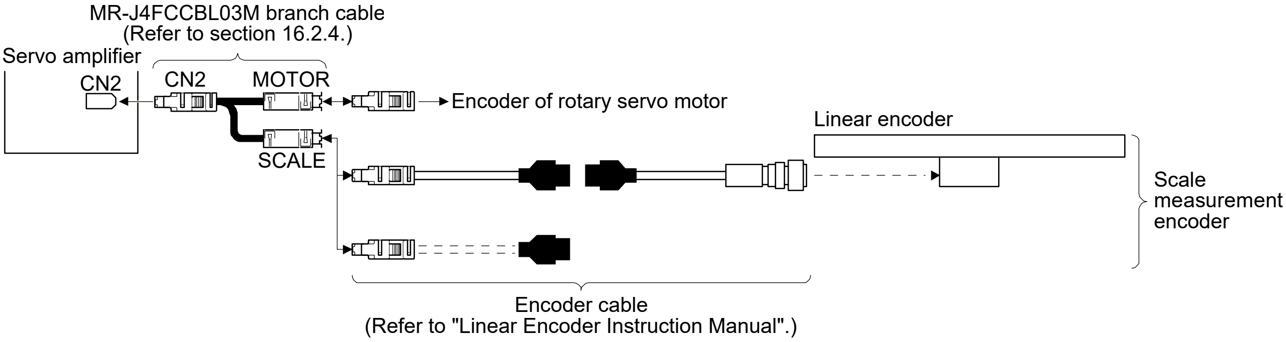
(3) Configuration diagram of encoder cable

Configuration diagram for servo amplifier and scale measurement encoder is shown below. Cables vary depending on the scale measurement encoder.

(a) Linear encoder

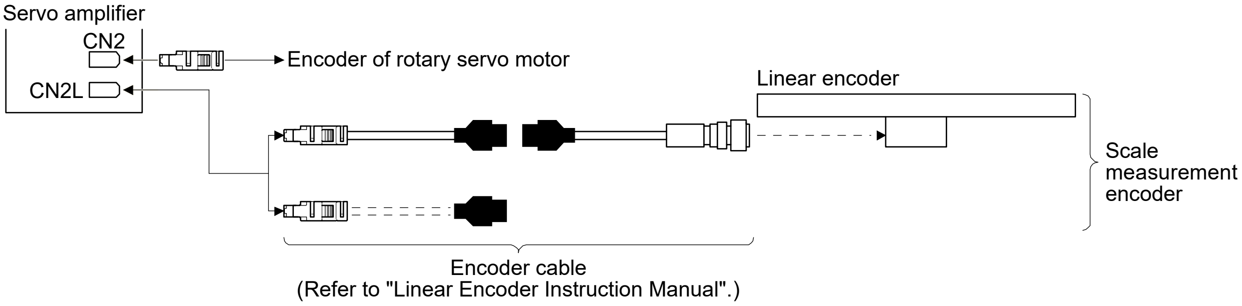
Refer to Linear Encoder Instruction Manual for encoder cables for linear encoder.

1) MR-J4-_B_ servo amplifier



2) MR-J4-_B_-RJ servo amplifier

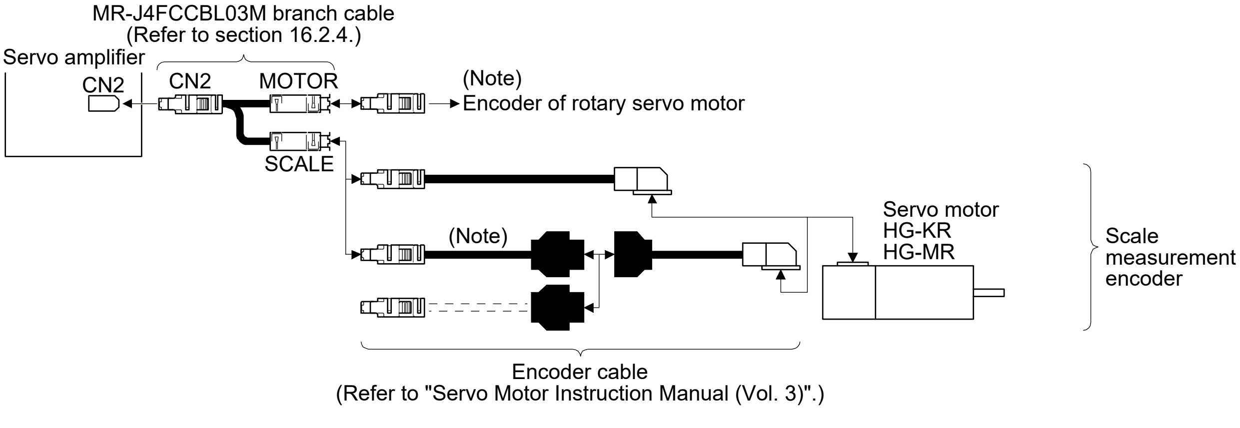
You can connect the linear encoder without using a branch cable shown in 1) for MR-J4-_B_-RJ servo amplifier. You can also use a four-wire type linear encoder.



(b) Rotary encoder

Refer to "Servo Motor Instruction Manual (Vol. 3)" for encoder cables for rotary encoders.

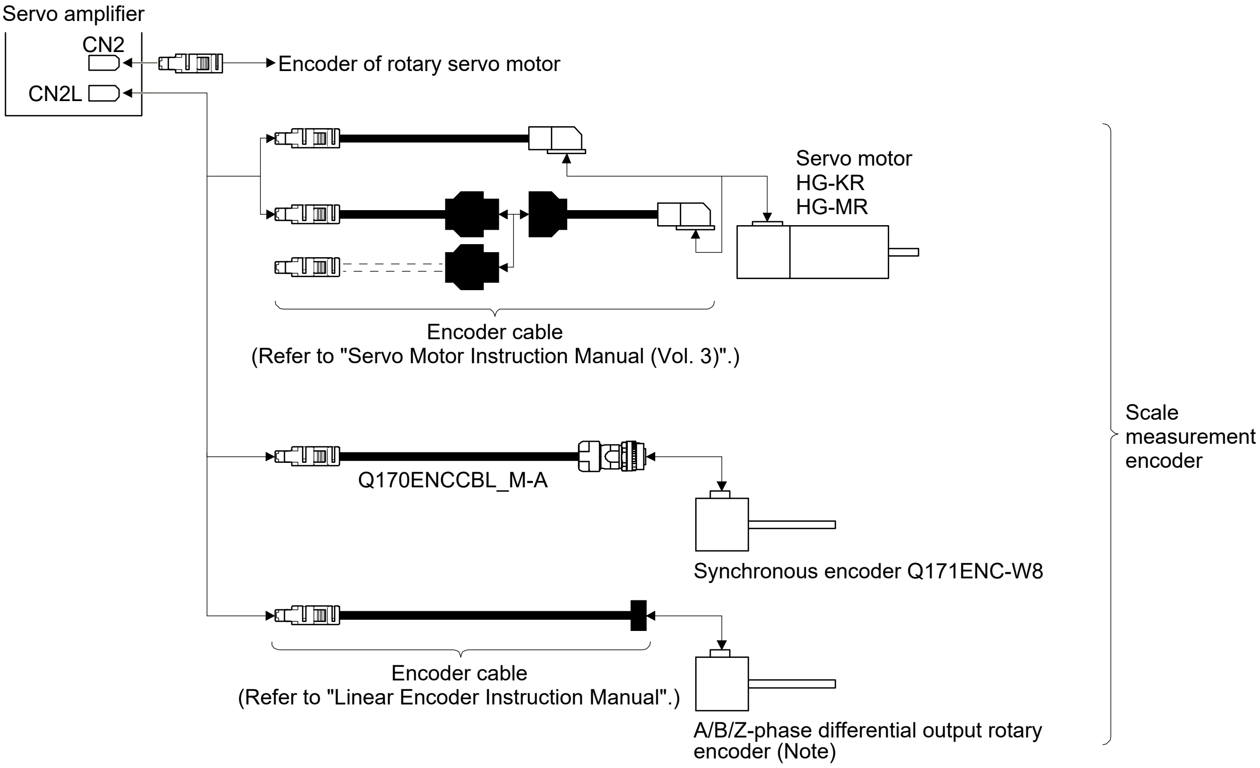
1) MR-J4-_B_ servo amplifier



Note. Use a two-wire type encoder cable. A four-wire type linear encoder cable cannot be used.

2) MR-J4-_B_-RJ servo amplifier

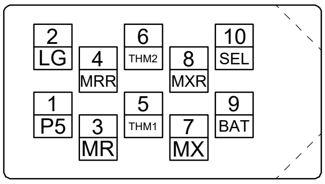
You can connect the rotary encoder without using a branch cable shown in 1) for MR-J4-_B-RJ servo amplifier. In addition, a four-wire type or A/B/Z-phase differential output rotary encoder can also be used.



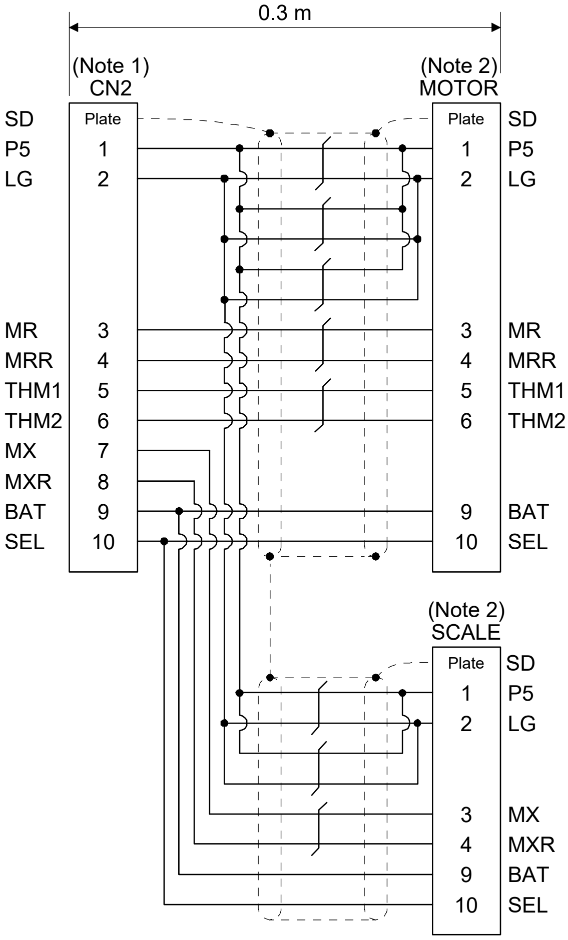
Note. A/B/Z-phase differential output rotary encoders with the same specifications as A/B/Z-phase differential output linear encoders can be used as scale measurement encoders. Refer to "Linear Encoder Instruction Manual".

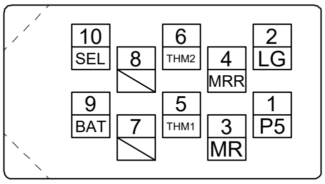
(4) MR-J4FCCBL03M branch cable

Use MR-J4FCCBL03M branch cable to connect the scale measurement encoder to CN2 connector. When fabricating the branch cable using MR-J3THMCN2 connector set, refer to "Linear Encoder Instruction Manual".

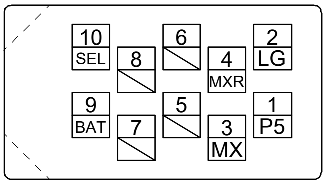


View seen from the wiring side.





View seen from the wiring side.



View seen from the wiring side.

Note 1. Receptacle: 36210-0100PL, shell kit: 36310-3200-008 (3M)

2. Plug: 36110-3000FD, shell kit: 36310-F200-008 (3M)

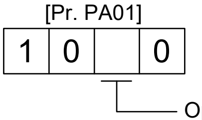
17.3.3 How to use scale measurement function

(1) Selection of scale measurement function

The scale measurement function is set with the combination of basic setting parameters [Pr. PA01] and [Pr. PA22].

(a) Operation mode selection

The scale measurement function can be used during semi closed loop system (standard control mode). Set [Pr. PA01] to "_ _ 0 _".

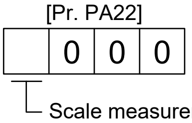


Operation mode selection

Setting value	Operation mode	Control unit
0	Semi closed loop system (Standard control mode)	Servo motor-side resolution unit

(b) Scale measurement function selection

Select the scale measurement function. Select "1 _ _ _" (Used in absolute position detection system) or "2 _ _ _" (Used in incremental system) according to the encoder you use.

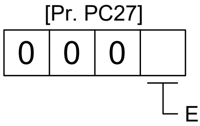


Scale measurement function selection
0: Disabled
1: Used in absolute position detection system
2: Used in incremental system

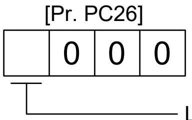
(2) Selection of scale measurement encoder communication method and polarity.

The communication method differs depending on the scale measurement encoder type. For the communication method for using a linear encoder as scale measurement encoder, refer to "Linear Encoder Instruction Manual". Select "Four-wire type" because there is only four-wire type for synchronous encoder.

Select the cable to be connected to CN2L connector in [Pr. PC26].



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



Load-side encoder cable communication method selection
0: Two-wire type
1: Four-wire type
When using a load-side encoder of A/B/Z-phase differential output method, set "0". Incorrect setting will trigger [AL. 70] and [AL. 71].
Setting "1" while using an MR-J4-_B_ servo amplifier will trigger [AL. 37].
If the settings of the servo amplifier are unchanged from the factory settings and communication with the controller is performed for the first time, this digit will be automatically set according to the communication method of the connected encoder cable.

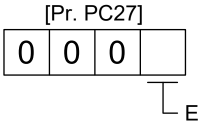
Select a polarity of the scale measurement encoder with the following "Encoder pulse count polarity selection" and "Selection of A/B/Z-phase input interface encoder Z-phase connection judgment function" of [Pr. PC27] as necessary.

POINT

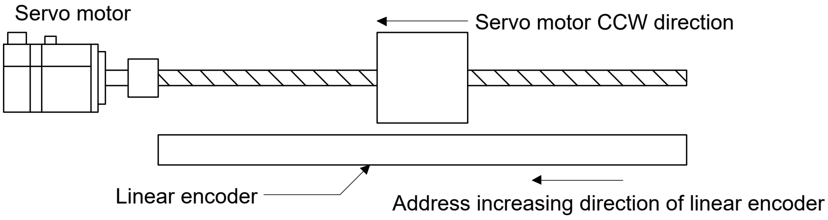
- "Encoder pulse count polarity selection" in [Pr. PC27] is not related to [Pr. PA14 Rotation direction selection]. Make sure to set the parameter according to the relationships between servo motor and linear encoder/rotary encoder.

(a) Parameter setting method

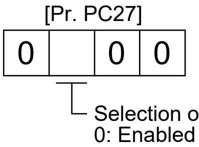
1) Select a encoder pulse count polarity.
This parameter is used to set the load-side encoder polarity to be connected to CN2L connector in order to match the CCW direction of servo motor and the increasing direction of load-side encoder feedback. Set this as necessary.



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



2) A/B/Z-phase input interface encoder Z-phase connection judgment function
This function can trigger an alarm by detecting non-signal for Z phase.
The Z-phase connection judgment function is enabled by default. To disable the Z-phase connection judgment function, set [Pr. PC27].



Selection of A/B/Z-phase input interface encoder Z-phase connection judgment function
0: Enabled
1: Disabled

(b) How to confirm the scale measurement encoder feedback direction
You can confirm the directions of the cumulative feedback pulses of servo motor encoder and the load-side cumulative feedback pulses are matched by moving the device (scale measurement encoder) manually in the servo-off status. If mismatched, reverse the polarity.

(3) Confirmation of scale measurement encoder position data
Check the scale measurement encoder mounting and parameter settings for any problems.
Operate the device (scale measurement encoder) to check the data of the scale measurement encoder is renewed correctly. If the data is not renewed correctly, check the wiring and parameter settings.
Change the scale polarity as necessary.

APPENDIX

App. 1 Peripheral equipment manufacturer (for reference)

Manufacturer names given in the table are as of August 2021.
For information, such as the delivery time, price, and specifications of the recommended products, contact each manufacturer.

Manufacturer	Reference
NEC TOKIN	TOKIN Corporation
Kitagawa Industries	Kitagawa Industries Co., Ltd.
JST	J.S.T. Mfg. Co., Ltd.
Junkosha	Purchase from Toa Electric Industrial Co. Ltd., Nagoya Branch
3M	3M
SEIWA ELECTRIC	Seiwa Electric Mfg. Co. Ltd.
Soshin Electric	Soshin Electric Co., Ltd.
TE Connectivity	TE Connectivity
TDK	TDK Corporation
Molex	Molex Japan LLC
Toho Technology	Toho Technology Corp. Yoshida terminal block Division
COSEL	COSEL CO., LTD.

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	Type	Lithium content	Mass of battery	Remark
ER6	MR-J3BAT	Cell	0.65 g	16 g	Cells with more than 0.3 grams of lithium content must be handled as dangerous goods (Class 9) depending on packaging requirements.
ER17330	MR-BAT	Cell	0.48 g	13 g	
	A6BAT	Cell	0.48 g	13 g	

(b) Battery unit (assembled battery)

Model	Option model	Type	Lithium content	Mass of battery	Remark
ER6	MR-J2M-BT	Assembled battery (Seven)	4.55 g	112 g	Assembled batteries with more than two grams of lithium content must be handled as dangerous goods (Class 9) regardless of packaging requirements.
CR17335A	MR-BAT6V1	Assembled battery (Two)	1.20 g	34 g	Assembled batteries with more than 0.3 grams of lithium content must be handled as dangerous goods (Class 9) depending on packaging requirements.
	MR-BAT6V1SET(-A)	Assembled battery (Two)	1.20 g	34 g	
	MR-BAT6V1BJ	Assembled battery (Two)	1.20 g	34 g	

(2) Purpose

Safer transportation of lithium metal batteries.

(3) Change in regulations

The following points are changed for lithium metal batteries in transportation by sea or air based on the revision of Recommendations of the United Nations Rev. 15 and ICAO-TI 2009-2010 edition, and IATA Dangerous Goods Regulations 54th Edition (effective January 1, 2013). For lithium metal batteries, cells are classified as UN3090, and batteries contained in or packed with equipment are classified as UN3091.

(a) Transportation of lithium metal batteries alone

Packaging requirement	Classification	Main requirement
Less than eight cells per package with less than one gram of lithium content	UN3090 PI968 Section II	The package must pass a 1.2 m drop test, and the handling label with battery illustration (size: 120 × 110 mm) must be attached on the package.
Less than two assembled batteries per package with less than two grams of lithium content		
More than eight cells per package with less than one gram of lithium content	UN3090 PI968 Section IB	The package must pass a 1.2 m drop test, and the handling label with battery illustration (size: 120 × 110 mm) must be attached on the package. The Class 9 hazard label must be attached or others to comply with dangerous goods (Class 9).
More than two assembled batteries per package with less than two grams of lithium content		
Cells with more than one gram of lithium content	UN3090 PI968 Section IA	The package must be compliant with Class 9 Packages, and the Class 9 hazard label must be attached or others to comply with dangerous goods (Class 9).
Assembled batteries with more than two grams of lithium content		

(b) Transportation of lithium metal batteries packed with or contained in equipment

1) For batteries packed with equipment, follow the necessary requirements of UN3091 PI969. Batteries are classified into either Section II/Section I depending on the lithium content/packaging requirements.

2) For batteries contained in equipment, follow the necessary requirements of UN3091 PI970. Batteries are classified into either Section II/Section I depending on the lithium content/packaging requirements.
The special handling may be unnecessary depending on the number of batteries and gross mass per package.

Fig. app. 1 Example of Mitsubishi label with battery illustration

(Available until December 31, 2018)

* Place for UN number (s)
** Place for telephone number for additional information

Fig. app. 2 Example of Mitsubishi label with battery illustration

(Available from January 1, 2017)

The handling label shown in Fig. app. 1 has been changed to the one shown in Fig. app. 2 in accordance with the IATA Dangerous Goods Regulations 58th Edition (effective January 1, 2017). However, the label shown in Fig. app. 1 may be used until December 31, 2018 (for two years as an interim measure).

(4) Details of the package change
The following caution is 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 (Fig. app. 1) must be attached to the package of a Mitsubishi Electric cell or battery. In addition, attaching it to the outer package containing several packages of Mitsubishi Electric cells or batteries is also required. When the content of a package must be handled as dangerous goods (Class 9), the Shipper's Declaration for Dangerous Goods is required, and the package must be compliant with Class 9 Packages. Documentations like the handling label in the specified design and the Shipper's Declaration for Dangerous Goods are required for transportation. Please attach the documentations to the packages and the outer package.

The IATA Dangerous Goods Regulations are revised, and the requirements are changed annually. When customers transport lithium batteries by themselves, the responsibility for the cargo lies with the customers. Thus, be sure to check the latest version of the IATA Dangerous Goods Regulations.

App. 3 Symbol for the new EU Battery Directive

The symbol for the new EU Battery Directive (2006/66/EC) that is plastered to the general-purpose AC servo battery is explained here.

Note. This symbol is valid only in EU.

This symbol is in accordance with 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 center.
Please, help us to conserve the environment we live in!

App. 4 Compliance with global standards

For compliance with the standards of Europe/UK, United States/Canada, and South Korea, refer to the following manual.
Instructions and Cautions for Safe Use of AC Servos (IB(NA)-0300175)

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 61800-5-2:2016 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 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 61800-5-2:2016 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 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 60204-1:2016 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 shut-off (Refer to IEC/EN 60204-1:2016 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.

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 regulations and laws in which machines with these components are installed, particularly the standards mentioned in this user's manual and the requirements described in ISO/EN ISO 13849-1:2015, EN IEC 62061, 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 Electric 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 installation guide of each individual safety related component.

(4) Be sure that all safety related switches, relays, sensors, etc., meet the required safety standards.
A Certification Body has confirmed that the Mitsubishi Electric safety-related components mentioned in this manual meet ISO/EN ISO 13849-1:2015 Category 3, PL d, EN IEC 62061, and 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 functions before commissioning the system.

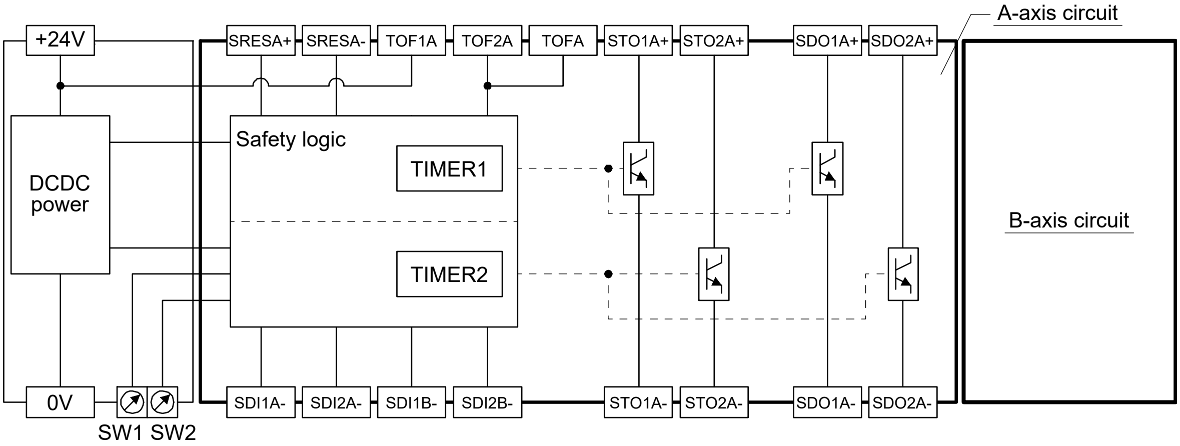
(7) Perform all risk assessments and safety level certification to the machine or the system as a whole. It is recommended that a Certification Body final safety certification of the system be used.

(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.

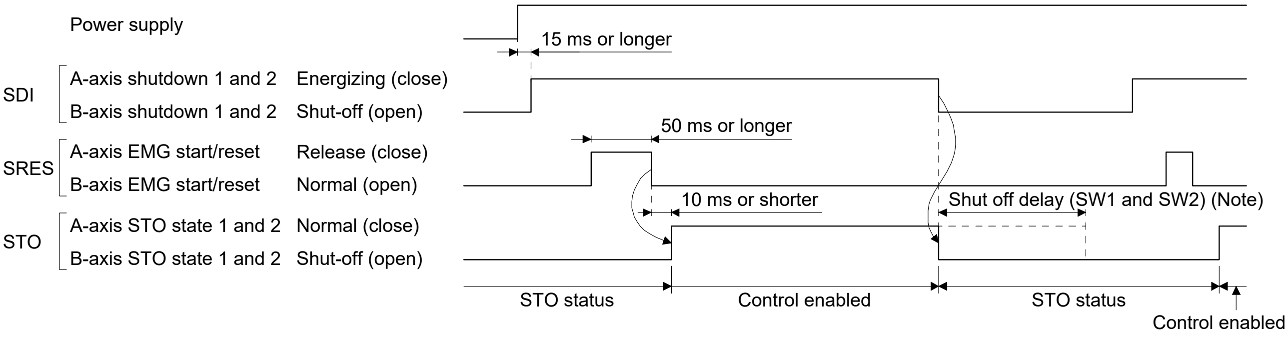
(9) If the upper and lower power modules in the servo amplifier are shorted and damaged simultaneously, the servo motor may make a half revolution at a maximum. For a linear servo motor, the primary side will move a distance of pole pitch.

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.

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 ± 10%
	Power supply capacity [A]	0.5 (Note 1, 2)
Compatible system		2 systems (A-axis, B-axis independent)
Shut-off input		2 points (duplex wiring) SDI_: (source/sink compatible) (Note 3)
Shut-off release input		1 point (duplex wiring) SRES_: (source/sink compatible) (Note 3)
Feedback input		1 point (duplex wiring) TOF_: (source compatible) (Note 3)
Input type		Photocoupler insulation, 24 V DC (external supply), internal limited resistance 5.4 kΩ
Shut-off output		4 points (duplex wiring) STO_: (source compatible) (Note 3) SDO_: (source/sink compatible) (Note 3)
Output method		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: ±2%
Functional safety		STO, SS1 (IEC/EN 61800-5-2) EMG STOP, EMG OFF IEC/EN 60204-1)
Safety performance	Standard	ISO 13849-1:2015 Category 3 PL d, EN IEC 62061, EN 61508 SIL2, IEC 61800-5-2
	Response performance (when delay time is set to 0 s) (Note 4)	10 ms or less (STO input off → shut-off output off)
	Mean time to dangerous failure (MTTFd)	MTTFd ≥ 100 [years] (516a)
	Diagnosis converge (DC avg)	DC = Medium, 93.1 [%]
	Probability of dangerous failures per hour (PFH)	4.75 × 10^{-9} [1/h]
Global standards	CE marking	LVD: EN 61800-5-1 EMC: EN 61800-3 MD: EN ISO 13849-1:2015, EN 61800-5-2, EN IEC 62061
Structure		Natural-cooling, open (IP rating: IP 00)
Environment	Ambient temperature	0 °C to 55 °C (non-freezing), storage: -20 °C to 65 °C (non-freezing)
	Ambient humidity	5 %RH to 90 %RH (non-condensing), storage: 5 %RH to 90 %RH (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)

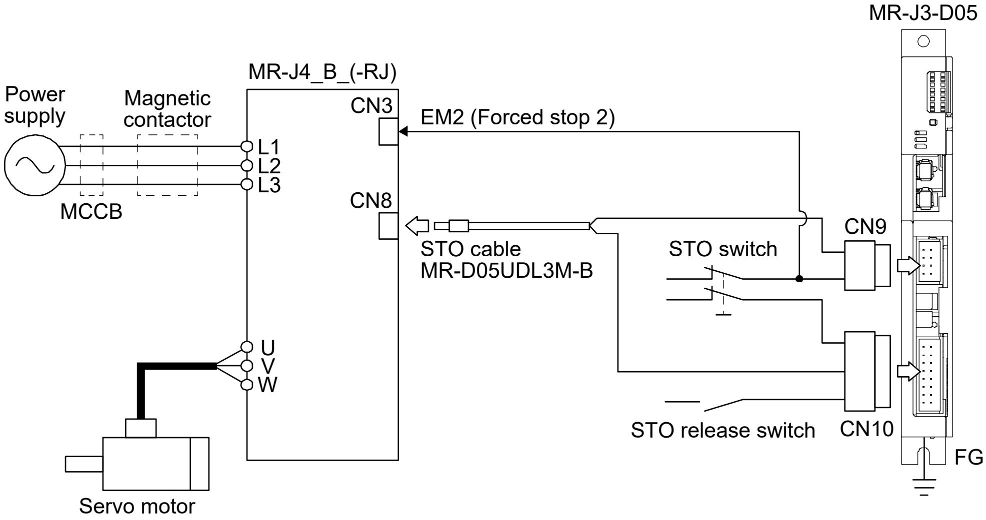
Note
1. Inrush current of approximately 1.5 A flows instantaneously when turning the control circuit power supply on. Select an appropriate capacity of power supply considering the inrush current.
2. Power-on duration of the safety logic unit is 100,000 times.
3. _: in signal name indicates a number or axis name.
4. For the test pulse input, contact your local sales office.

App. 5.7.3 When using MR-J3-D05 with an MR-J4 series servo amplifier

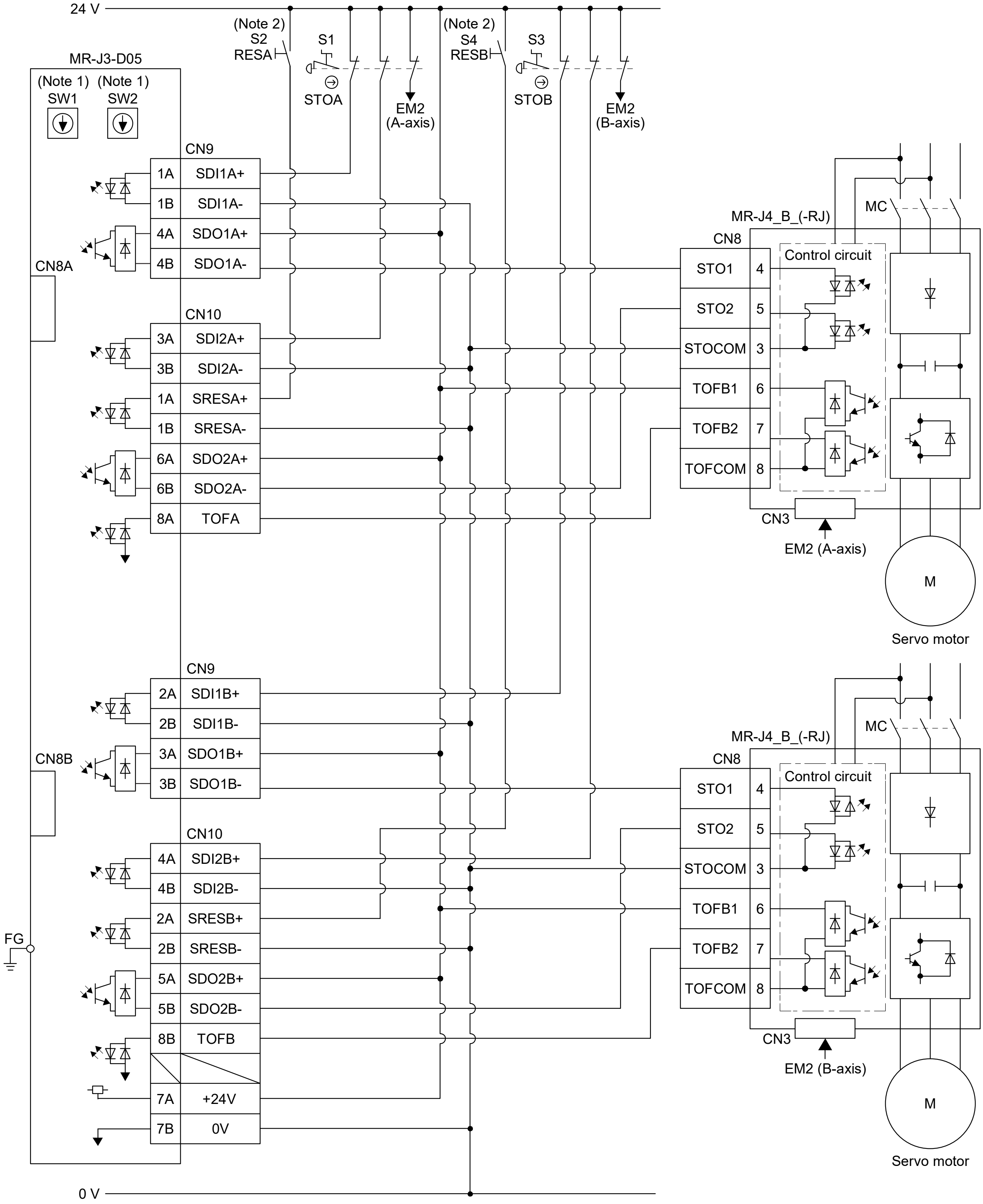
(1) System configuration diagram

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.



(2) Connection example



Note 1. Set the delay time of STO output with SW1 and SW2. These switches are located in a recessed area to prevent accidental setting changes.

2. To release the STO state (base circuit shut-off), turn RESA and RESB on and turn them off.

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 4	Outputs STO1 to A-axis driving device. 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.	O
A-axis STO2	STO2A- STO2A+	5 6	Outputs STO2 to A-axis driving device. 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.	O
A-axis STO state	TOF2A TOF1A	7 8	Inputs STO state of A-axis driving device. STO state (base shutdown): Open between TOF2A and TOF1A. STO release state (in driving): Close between TOF2A and TOF1A.	I

(2) CN8B

Device	Symbol	Pin No.	Function/application	I/O division
B-axis STO1	STO1B- STO1B+	1 4	Outputs STO1 to B-axis driving device. 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.	O
B-axis STO2	STO2B- STO2B+	5 6	Outputs STO2 to B-axis driving device. 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.	O
B-axis STO state	TOF2B TOF1B	7 8	Inputs STO state of B-axis driving device. STO state (base shutdown): Open between TOF2B and TOF1B. STO release state (in driving): Close between TOF2B and TOF1B.	I

(3) CN9

Device	Symbol	Pin No.	Function/application	I/O division
A-axis shutdown 1	SDI1A+ SDI1A-	1A 1B	Connect this device to a safety switch for A-axis driving device. 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-.	DI-1
B-axis shutdown 1	SDI1B+ SDI1B-	2A 2B	Connect this device to a safety switch for B-axis driving device. 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-.	DI-1
A-axis SDO1	SDO1A+ SDO1A-	4A 4B	Outputs STO1 to A-axis driving device. 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.	DO-1
B-axis SDO1	SDO1B+ SDO1B-	3A 3B	Outputs STO1 to B-axis driving device. 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.	DO-1

(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.	

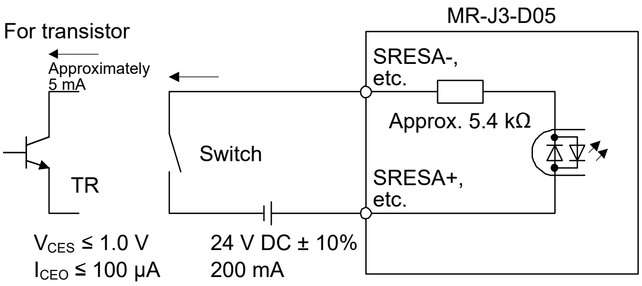
App. 5.8.2 Interfaces

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

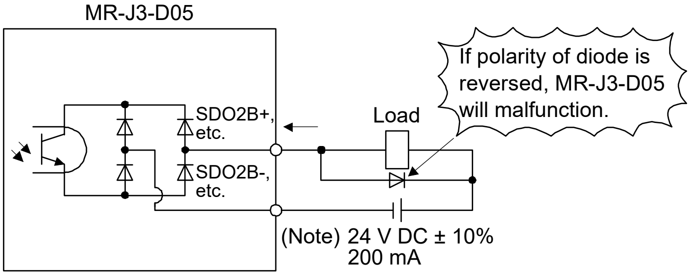
This is an input circuit whose photocoupler cathode side is the input terminal. Transmit signals from sink (open-collector) type transistor output, relay switch, etc.



(b) Digital output interface DO-1

This is a circuit in which the collector of the output transistor is the output terminal. When the output transistor is turned on, the current will flow to 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 MR-J3-D05.

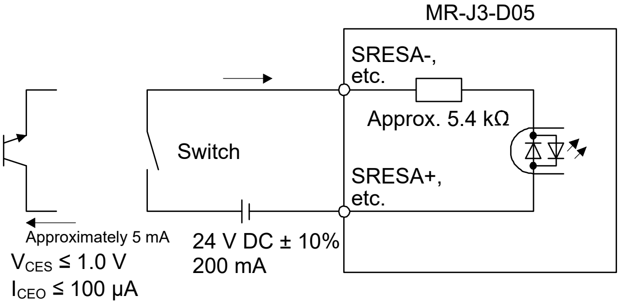


Note. If the voltage drop (maximum of 2.6 V) interferes with the relay operation, apply high voltage (maximum of 26.4 V) from external source.

(2) Source I/O interfaces (CN9, CN10 connector)

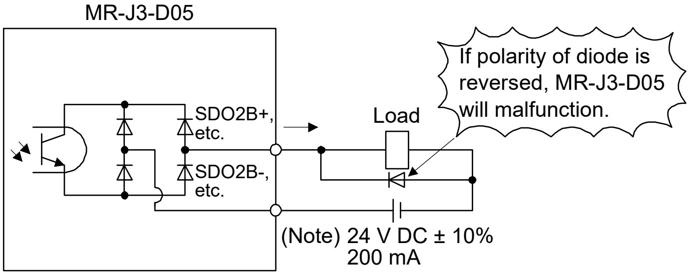
(a) Digital input interface DI-1

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



(b) Digital output interface DO-1

This is a circuit in which the emitter of the output transistor is the output terminal. 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.

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 mm ± 0.3 mm. Confirm the stripped length with gauge, etc. before using the wires.

(b) If the stripped wires are bent, loose 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.

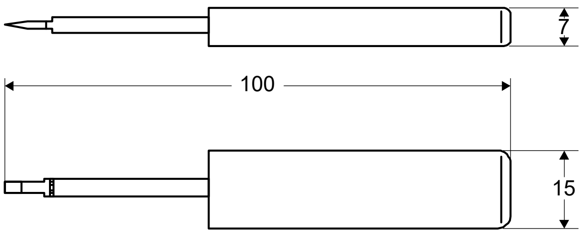
(2) Connecting wires

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

[Unit: mm]

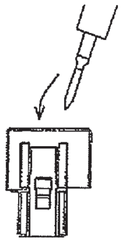


Mass: Approx. 20 g

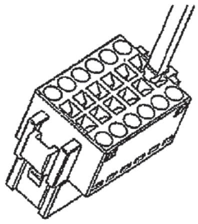
2) Connecting wires

a) Confirm the model number of the housing, contact and tool to be used.

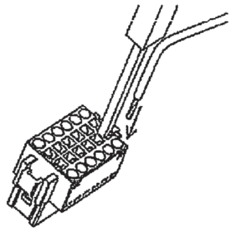
b) Insert the tool diagonally into the receptacle assembly.



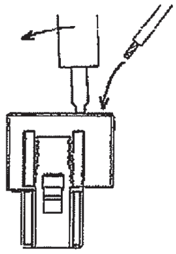
c) Insert the tool until it hits the surface of the receptacle assembly. At this stage, the tool is vertical to the receptacle assembly.



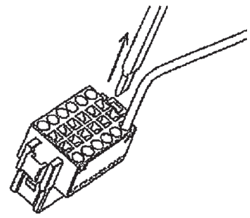
d) Insert wires in the wiring hole till the end. The wires should be slightly twisted in advance to prevent it from being loose.



It is easy to insert the wire if the wire is inserted diagonally while twisting the tool.



e) Remove the tool.



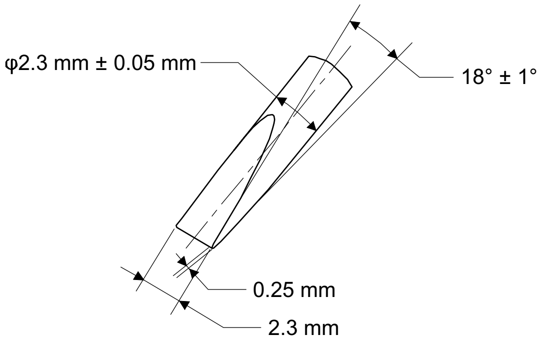
(b) Using a screwdriver

To avoid damaging housings and springs when wiring with screwdriver, do not put excessive force. Be cautious when connecting.

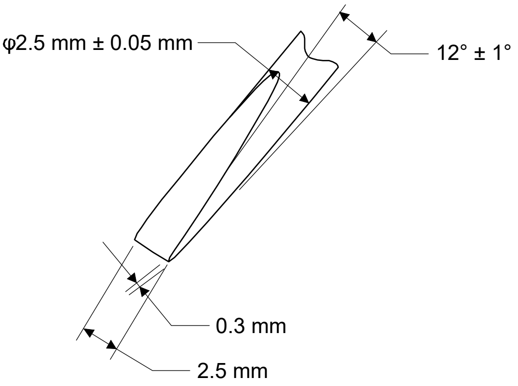
1) Adjusting screw driver

Diameter: 2.3 mm ± 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

Diameter: 2.5 mm ± 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 2.3 mm



Screwdriver diameter: φ 2.5 mm

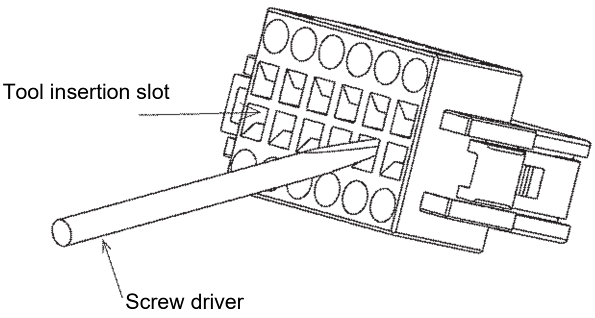
2) Connecting wires

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.



(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.

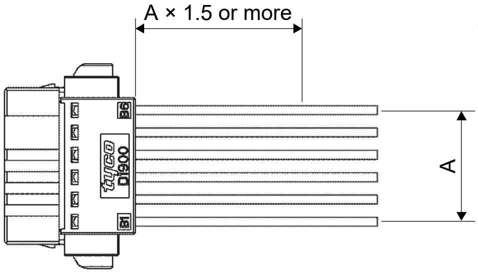
(4) Compatible wire

Compatible wire size is listed below.

Wire size	
mm^2	AWG
0.22	24
0.34	22
0.50	20

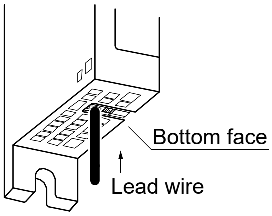
(5) Others

(a) Fix a cable 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



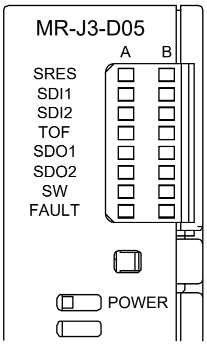
Wire range

Single wire: φ 0.4 mm to 1.2 mm (AWG 26 to AWG 16)

Stranded wire: 0.2 mm^2 to 1.25 mm^2 (AWG 24 to AWG 16), wire φ 0.18 mm or more

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	Definition	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 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 from when the STO shut off switch is pressed until when STO output is performed. Set the same setting for SW1 and SW2. The following table shows the delay time to be set according to the setting value of the rotary switch.
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-axis/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

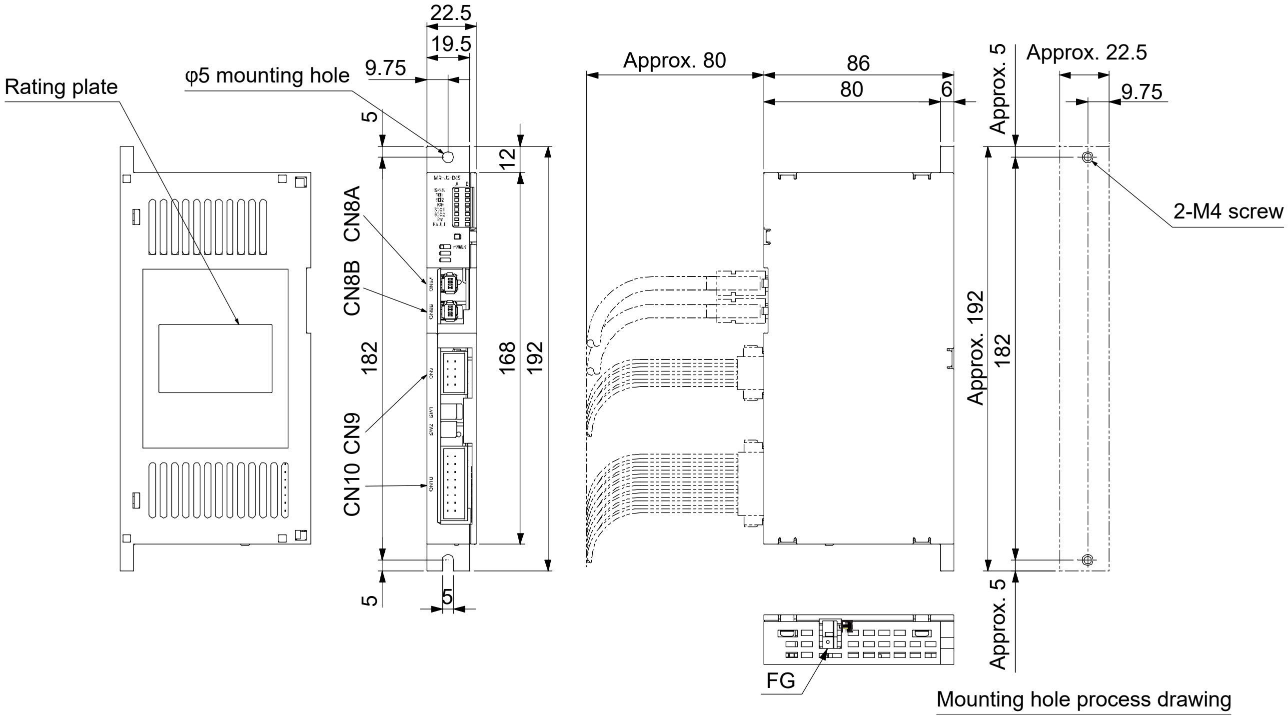
App. 5.11 Troubleshooting

When power is not supplied or FAULT LED turns on, refer the following table and take the appropriate action.

Event	Definition	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.

App. 5.12 Dimensions

[Unit: mm]



Mounting screw

Screw size: M4

Tightening torque: 1.2 N•m

Mass: 0.2 [kg]

Pin assignment

CN8A

7	TOF2A	8	TOF1A
5	STO2A-	6	STO2A+
3		4	STO1A+
1	STO1A-	2	

CN8B

7	TOF2B	8	TOF1B
5	STO2B-	6	STO2B+
3		4	STO1B+
1	STO1B-	2	

CN9

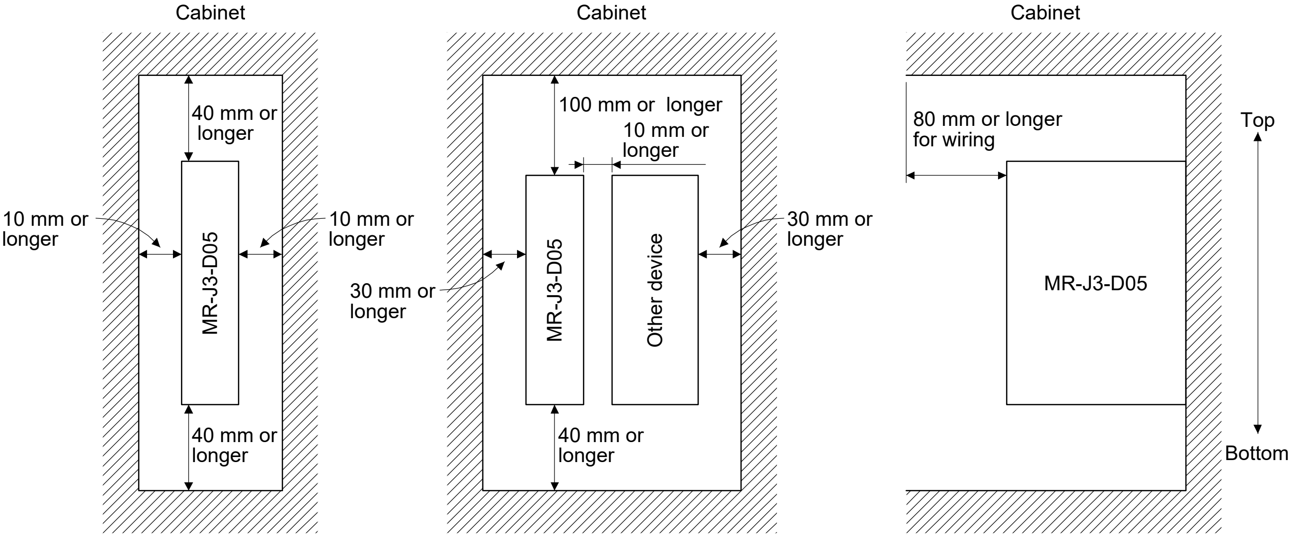
1A	SDI1A+	1B	SDI1A-
2A	SDI1B+	2B	SDI1B-
3A	SDO1B+	3B	SDO1B-
4A	SDO1A+	4B	SDO1A-

CN10

1A	SRESA+	1B	SRESA-
2A	SRESB+	2B	SRESB-
3A	SDI2A+	3B	SDI2A-
4A	SDI2B+	4B	SDI2B-
5A	SDO2B+	5B	SDO2B-
6A	SDO2A+	6B	SDO2A-
7A	+24 V	7B	0 V
8A	TOFA	8B	TOFB

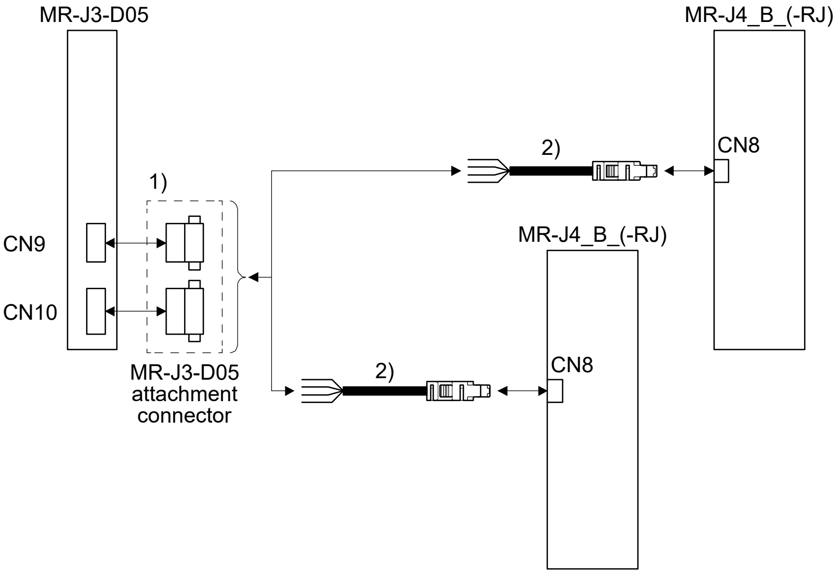
App. 5.13 Installation

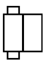
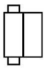
Follow the instructions in this section and install MR-J3-D05 in the specified direction. Leave clearances between MR-J3-D05 and other equipment including the cabinet.



App. 5.14 Combinations of cable/connector

POINT
●MR-D05UDL_M (STO cable) for MR-J3 series cannot be used.



No.	Product	Model	Description
1)	Connector	MR-J3-D05 attachment connector	 Connector for CN9: 1-1871940-4 (TE Connectivity)  Connector for CN10: 1-1871940-8 (TE Connectivity)
2)	STO cable	MR-D05UDL3M-B Cable length: 3 m	Connector set: 2069250-1 (TE Connectivity) 

App. 5.15. Compliance with standards

MR-J3-D05 complies with the following standard.
IEC/EN/KN 61800-3/GB 12668.3

COMPLIANCE WITH THE MACHINERY DIRECTIVES

The MR-J3-D05 complies with the safety components laid down in the Machinery directive (2006/42/EC).

App. 6 How to adjust the error excessive alarm level

The error excessive alarm level can be adjusted as required.

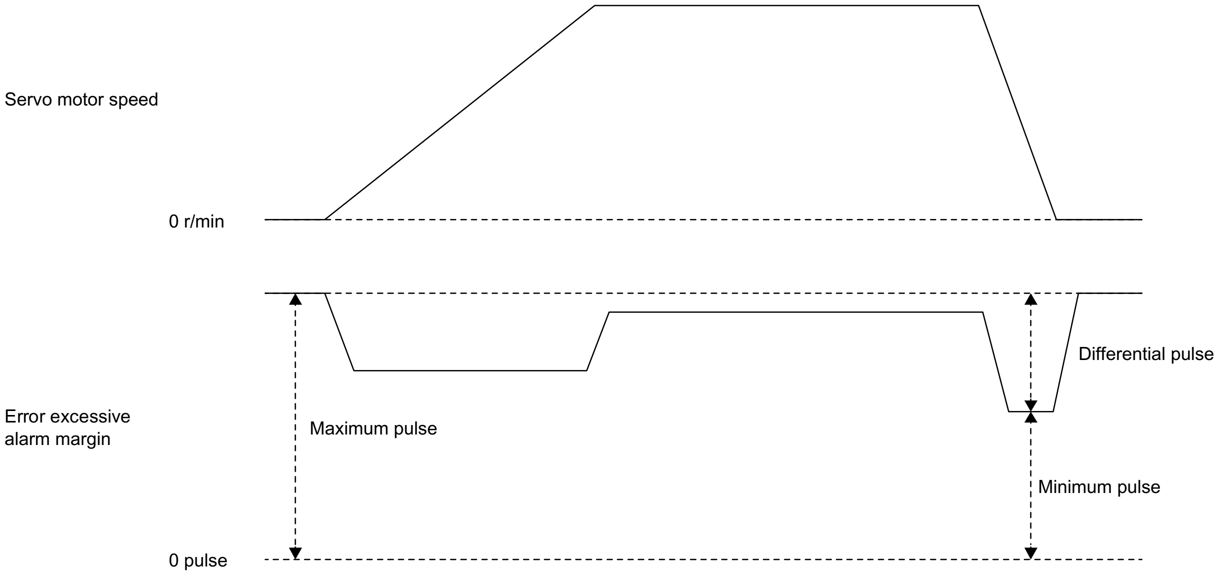
(1) Parameters

The error excessive alarm level can be increased with the following parameters.

Parameter	Symbol	Name	Setting range	Unit
PC01	ERZ	Error excessive alarm level	0 to 1000	[rev or mm]
PC06 "x _ _ _"	*COP3	Error excessive alarm/error excessive warning level unit selection 0: 1 rev or 1 mm 1: 0.1 rev or 0.1 mm 2: 0.01 rev or 0.01 mm 3: 0.001 rev or 0.001 mm	0 to 3	-

(2) Checking the error excessive alarm margin

Monitor the error excessive alarm margin using the graph function of MR Configurator2. When the command position and feedback position match, the error excessive alarm margin is the maximum pulse. Additionally, if the error excessive alarm margin is 0 pulses, [AL. 52 Error excessive alarm] will occur. Calculate the pulse difference from the maximum and minimum pulses of "error excessive alarm margin".



(3) Adjusting the error excessive alarm level

Adjust the error excessive alarm level with [Pr. PC01] and " x _ _ _ " of [Pr. PC06] so that the following formula is satisfied.

[Pr. PC01] × Unit set with "x _ _ _" of [Pr. PC06] > Error excessive alarm margin difference/Resolution per revolution

For linear servo motors, the following value indicates the resolution per revolution.

[Pr. PL02 Linear encoder resolution setting - Numerator]/[Pr. PL03 Linear encoder resolution setting - Denominator] × 1000

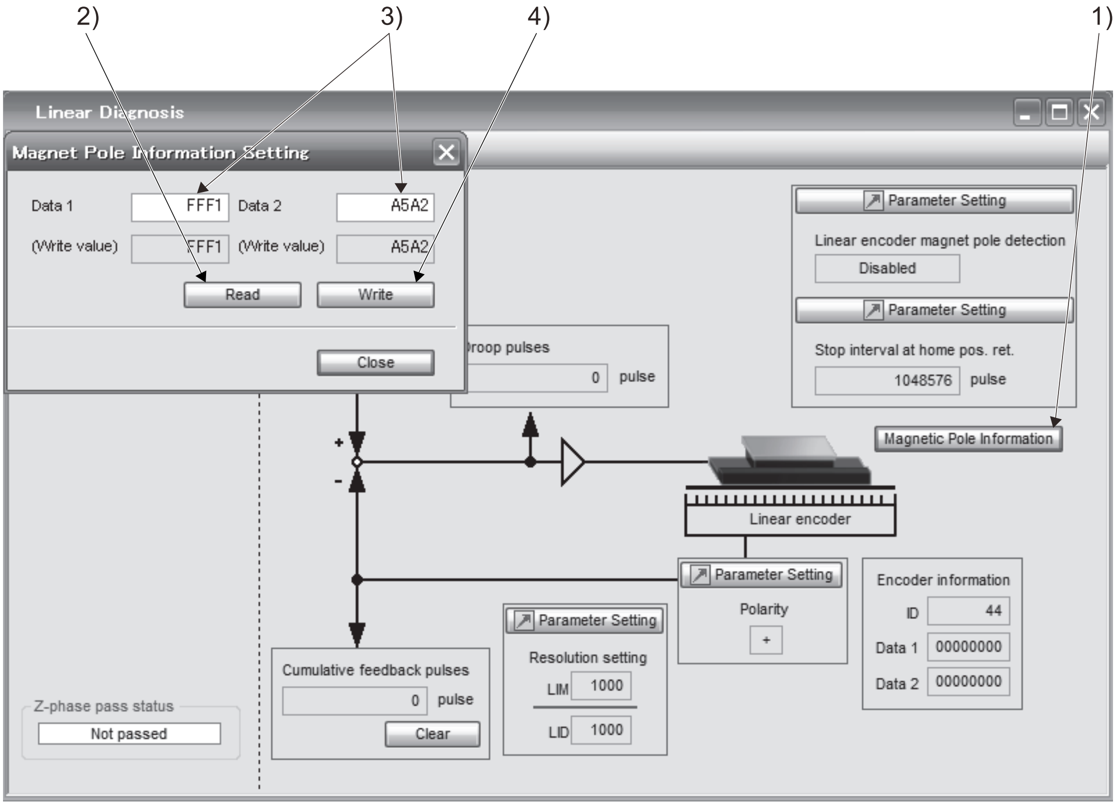
App. 7 How to replace servo amplifier without magnetic pole detection

⚠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 different, 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
  (a) Read the magnetic pole information of the servo amplifier before the replacement.
  (b) Write the read magnetic pole information to the servo amplifier after the replacement.
  (c) 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
  (a) How to read the magnetic pole information from the servo amplifier before 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 "Magnetic pole information" (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 "Magnetic pole information" (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.



Data 1 FFF1 Data 2 A5A2

(Write value) FFF1 (Write value) A5A2

Linear encoder magnet pole detection: Disabled

Stop interval at home pos. ret.: 1048576 pulse

Droop pulses: 0 pulse

Cumulative feedback pulses: 0 pulse

Z-phase pass status: Not passed

Resolution setting: LIM 1000, LID 1000

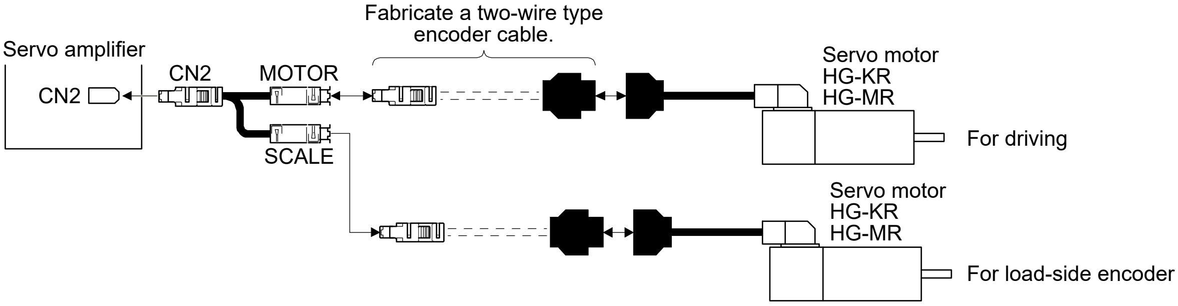
Polarity: +

Encoder information: ID 44, Data 1 00000000, Data 2 00000000

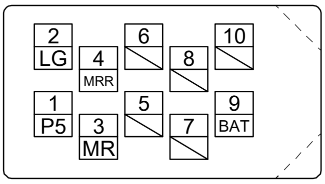
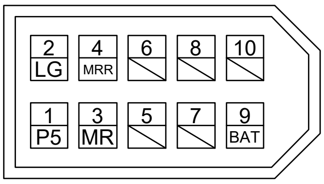
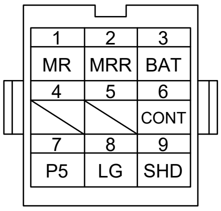
App. 8 Two-wire type encoder cable for HG-MR/HG-KR

Use a two-wire type encoder cable for the fully closed loop control by the MR-J4-_B_ servo amplifiers.
For MR-EKCBL_M-_ encoder cables for HG-MR and HG-KR, up to 20 m cables are two-wire type. If a two-wire type encoder cable with a length of 20 m or more is required, fabricate it using the MR-ECNM connector set as shown in the internal wiring diagram of this section. In this case, the cable should not be longer than 50 m.

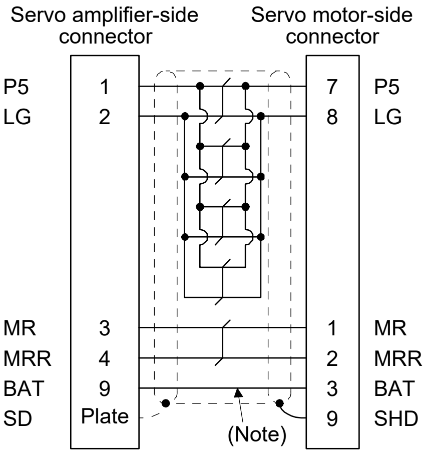
App. 8.1 Configuration diagram



App. 8.2 Connector set

Connector set	1) Servo amplifier-side connector	2) Servo motor-side connector
MR-ECNM	Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M)  View seen from wiring side. (Note) or Connector set: 54599-1019 (Molex)  View seen from wiring side. (Note) Note. Keep open the pins shown with ⧅. Especially, pin 10 is provided for manufacturer adjustment. If it is connected with any other pin, the servo amplifier cannot operate normally.	Housing: 1-172161-9 Connector pin: 170359-1 (TE Connectivity or equivalent) Cable clamp: MTI-0002 (Toa Electric Industrial)  View seen from wiring side.

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 SSCNET III cable (SC-J3BUS_M-C) manufactured by Mitsubishi Electric System & Service

POINT

- ●For the details of the SSCNET III cables, contact your local sales office.
- ●Do not look directly at the light generated from CN1A/CN1B connector of servo amplifier or the end of SSCNET III cable. The light can be a discomfort when it enters the eye.

The cable is available per 1 m up to 100 m. The number of the length (1 to 100) will be in the underscore in the cable model.

Cable model	Cable length	Bending life	Application/remark
	1 m to 100 m		
SC-J3BUS_M-C	1 to 100	Ultra-long bending life	Using long distance cable

App. 10 Analog monitor

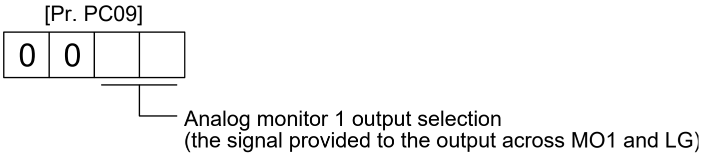
POINT

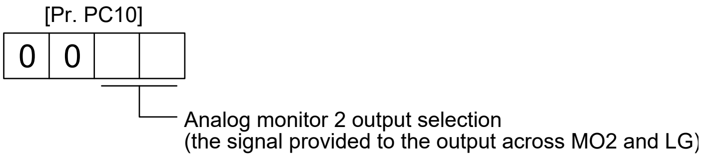
- ●A voltage of analog monitor output may be irregular at power-on.

The servo status can be output to two channels in terms of voltage.

App. 10.1 Setting

Change the following digits of [Pr. PC09] and [Pr. PC10].





[Pr. PC11] and [Pr. PC12] can be used to set the offset voltages to the analog output voltages. Setting value is -999 mV to 999 mV.

Parameter	Description	Setting range [mV]
PC11	This is used to set the offset voltage of MO1 (Analog monitor 1).	-999 to 999
PC12	This is used to set the offset voltage of MO2 (Analog monitor 2).	

App. 10.2 Setting

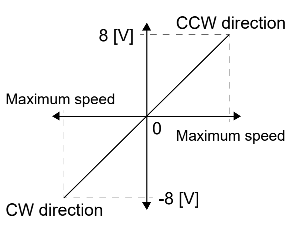
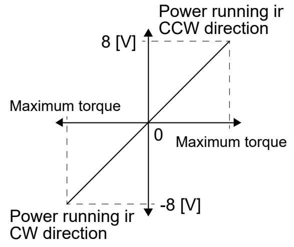
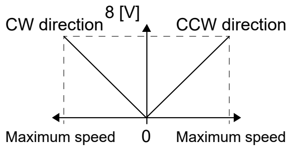
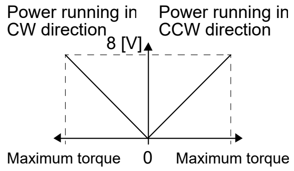
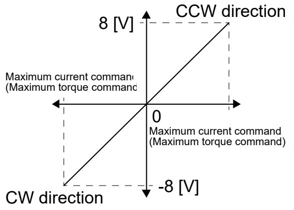
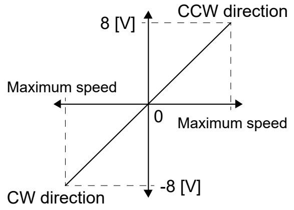
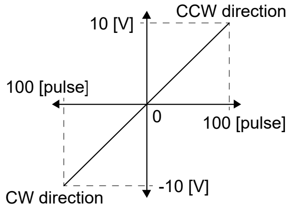
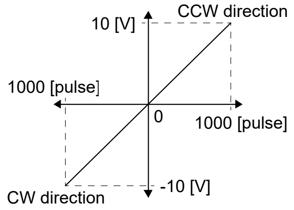
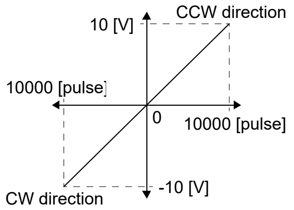
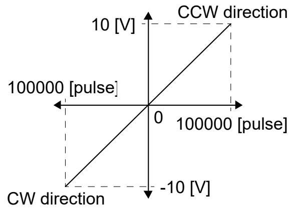
POINT

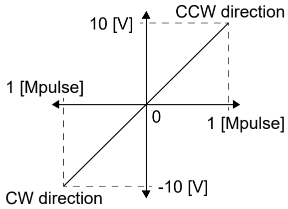
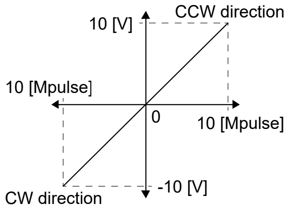
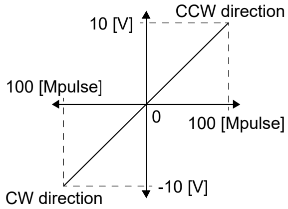
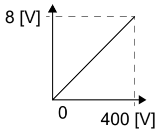
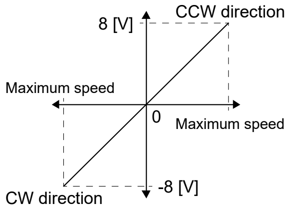
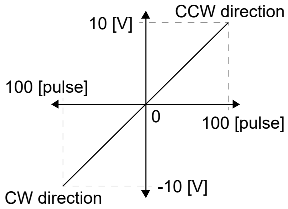
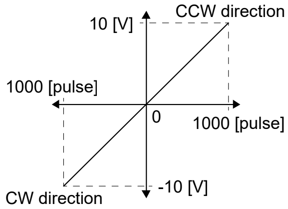
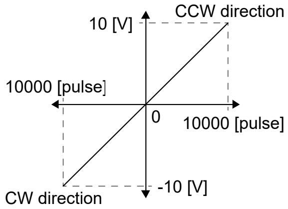
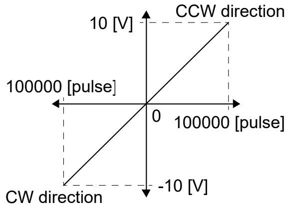
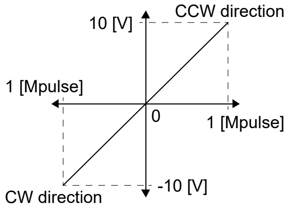
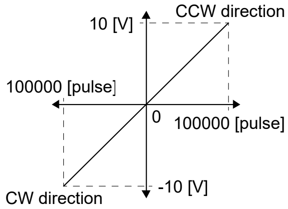
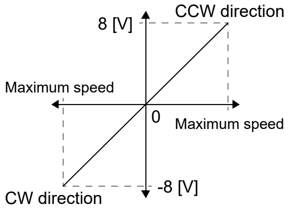
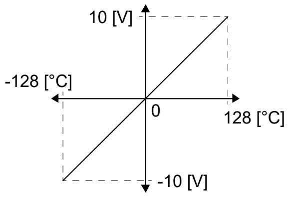
- When you use a linear servo motor, replace the following words in the left to the words in the right.

(servo motor) speed	→(linear servo motor) speed
CCW direction	→Positive direction
CW direction	→Negative direction
Torque	→Thrust

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. PC09] and [Pr. PC10] value.

Refer to (3) for the detection point.

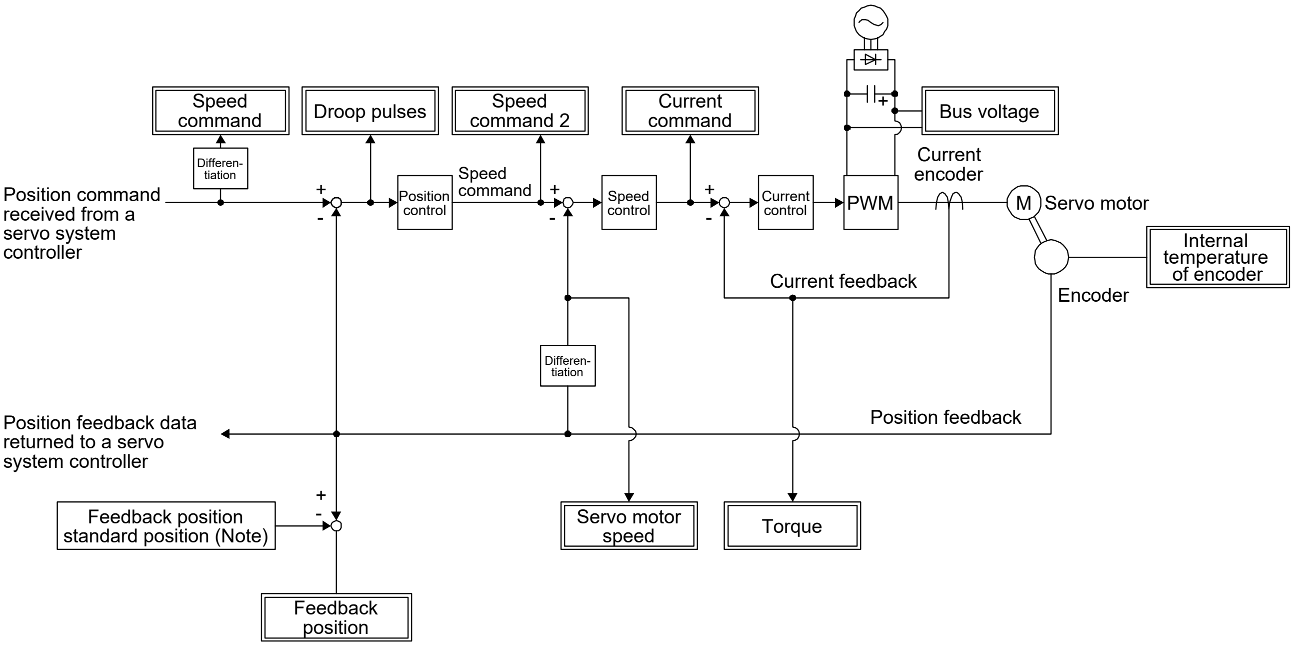
Setting value	Output item	Description	Setting value	Output item	Description
00	Servo motor speed/ Linear servo motor speed		01	Torque/Thrust (Note 8)	
02	Servo motor speed/ Linear servo motor speed		03	Torque/Thrust (Note 8)	
04	Current command (Note 8)		05	Speed command	
06	Servo motor-side droop pulses (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)	

Setting value	Output item	Description	Setting value	Output item	Description
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 (Note 7)	
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 Mpulse)	
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	Internal temperature of encoder (±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.
7. For 400 V class servo amplifier, the bus voltage becomes +8 V/800 V.
8. For details on the maximum current command (maximum torque) for ±8 V, refer to app. 10.4 for details.

App. 10.3 Analog monitor block diagram

App. 10.3.1 Semi closed loop control

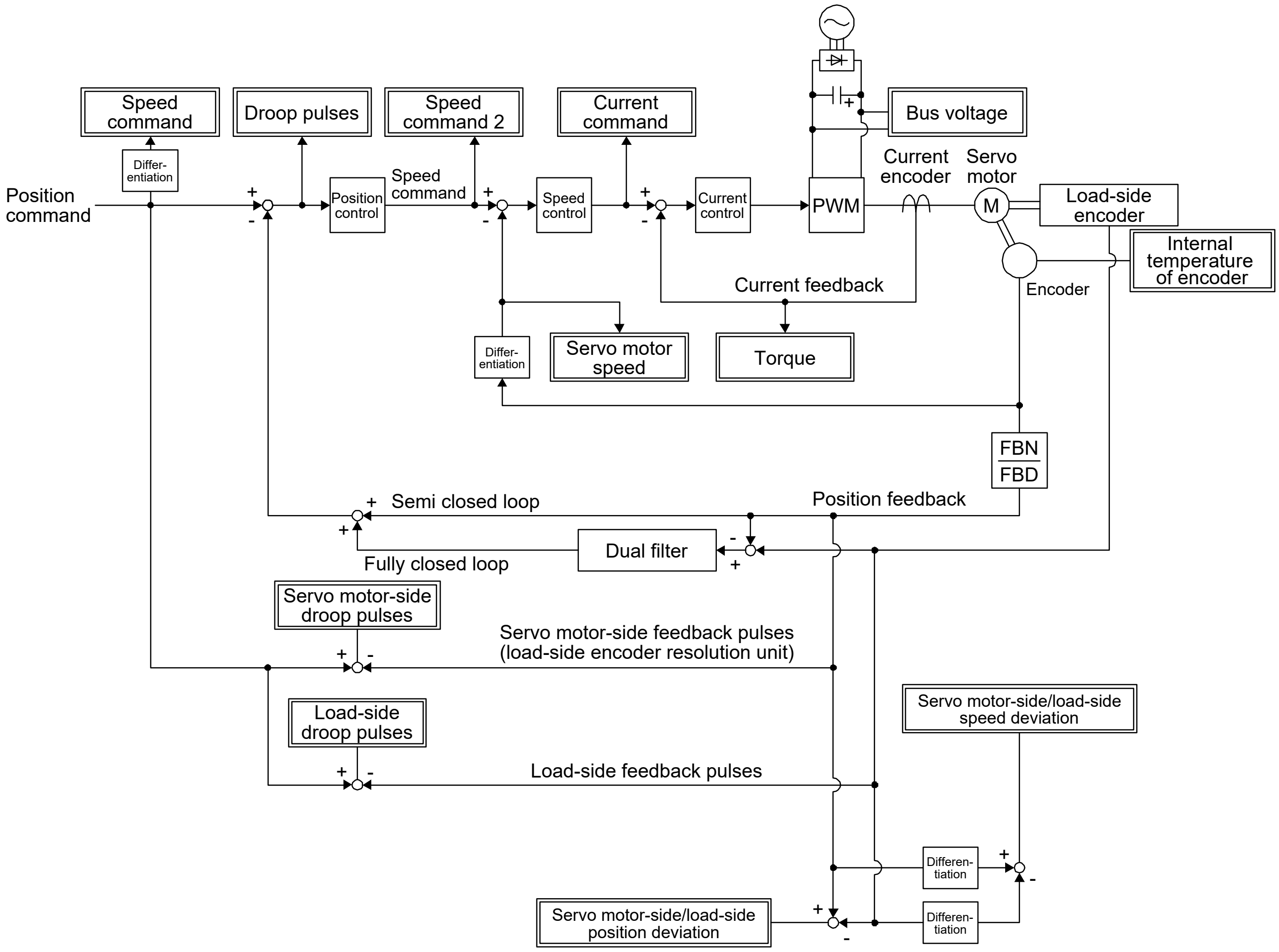


Note. The feedback position is output based on the position data passed between servo system controller and servo amplifier. [Pr. PC13] and [Pr. PC14] can set up the standard position of feedback position that is output to analog monitor in order to adjust the output range of feedback position. The setting range is between -9999 pulses and 9999 pulses.

Standard position of feedback position = [Pr. PC14] setting value × 10000 + [Pr. PC13] setting value

Parameter	Description	Setting range
PC13	Sets the lower-order four digits of the standard position of feedback position	-9999 to 9999 [pulse]
PC14	Sets the higher-order four digits of the standard position of feedback position	-9999 to 9999 [10000 pulses]

App. 10.3.2 Fully closed loop control



App. 10.4 Maximum current command (maximum torque) for analog monitor ±8 V

Values of the maximum current command (maximum torque) when the analog monitor is ±8 V are listed. The current command (torque) outputs the maximum current command (maximum torque) at ±8 V. The maximum current command (maximum torque) may not match the rated current/maximum current ratio since it is created from the torque current in the servo amplifier.

App. 10.4.1 Rotary servo motor

(1) 200 V/100 V class

Servo motor		Servo amplifier/drive unit	Maximum current command (maximum torque) [%]
HG-KR series	HG-KR053	MR-J4-10_(-RJ)/MR-J4-10_1(-RJ)	370
	HG-KR13	MR-J4-10_(-RJ)/MR-J4-10_1(-RJ)	373
	HG-KR23	MR-J4-20_(-RJ)/MR-J4-20_1(-RJ)	387
	HG-KR43	MR-J4-40_(-RJ)/MR-J4-40_1(-RJ)	383
	HG-KR73	MR-J4-70_(-RJ)	367
HG-MR series	HG-MR053	MR-J4-10_(-RJ)/MR-J4-10_1(-RJ)	342
	HG-MR13	MR-J4-10_(-RJ)/MR-J4-10_1(-RJ)	336
	HG-MR23	MR-J4-20_(-RJ)/MR-J4-20_1(-RJ)	396
	HG-MR43	MR-J4-40_(-RJ)/MR-J4-40_1(-RJ)	361
	HG-MR73	MR-J4-70_(-RJ)	345
HG-SR 1000 r/min series	HG-SR51	MR-J4-60_(-RJ)	311
	HG-SR81	MR-J4-100_(-RJ)	329
	HG-SR121	MR-J4-200_(-RJ)	353
	HG-SR201	MR-J4-200_(-RJ)	334
	HG-SR301	MR-J4-350_(-RJ)	366
	HG-SR421	MR-J4-500_(-RJ)	347
HG-SR 2000 r/min series	HG-SR52	MR-J4-60_(-RJ)	302
	HG-SR102	MR-J4-100_(-RJ)	310
	HG-SR152	MR-J4-200_(-RJ)	320
	HG-SR202	MR-J4-200_(-RJ)	327
	HG-SR352	MR-J4-350_(-RJ)	332
	HG-SR502	MR-J4-500_(-RJ)	341
	HG-SR702	MR-J4-700_(-RJ)	336
		MR-J4-DU900_(-RJ)	446
HG-UR series	HG-UR72	MR-J4-70_(-RJ)	355
	HG-UR152	MR-J4-200_(-RJ)	340
	HG-UR202	MR-J4-350_(-RJ)	350
	HG-UR352	MR-J4-500_(-RJ)	320
	HG-UR502	MR-J4-500_(-RJ)	330
HG-RR series	HG-RR103	MR-J4-200_(-RJ)	300
	HG-RR153	MR-J4-200_(-RJ)	250
	HG-RR203	MR-J4-350_(-RJ)	290
	HG-RR353	MR-J4-500_(-RJ)	270
	HG-RR503	MR-J4-500_(-RJ)	270
HG-JR 1000 r/min series	HG-JR601	MR-J4-700_(-RJ)/MR-J4-DU900_(-RJ)	337
	HG-JR801	MR-J4-11K_(-RJ)/MR-J4-DU900_(-RJ)	366
	HG-JR12K1	MR-J4-11K_(-RJ)/MR-J4-DU11K_(-RJ)	346
	HG-JR15K1	MR-J4-15K_(-RJ)/MR-J4-DU15K_(-RJ)	339
	HG-JR20K1	MR-J4-22K_(-RJ)/MR-J4-DU22K_(-RJ)	337
	HG-JR25K1	MR-J4-22K_(-RJ)/MR-J4-DU22K_(-RJ)	330
	HG-JR30K1	MR-J4-DU30K_(-RJ)	330
	HG-JR37K1	MR-J4-DU37K_(-RJ)	330

Servo motor		Servo amplifier/drive unit	Maximum current command (maximum torque) [%]
HG-JR 1500 r/min series	HG-JR701M	MR-J4-700_(-RJ)/MR-J4-DU900_(-RJ)	326
	HG-JR11K1M	MR-J4-11K_(-RJ)/MR-J4-DU11K_(-RJ)	335
	HG-JR15K1M	MR-J4-15K_(-RJ)/MR-J4-DU15K_(-RJ)	334
	HG-JR22K1M	MR-J4-22K_(-RJ)/MR-J4-DU22K_(-RJ)	317
	HG-JR30K1M	MR-J4-DU30K_(-RJ)	342
	HG-JR37K1M	MR-J4-DU37K_(-RJ)	365
HG-JR 3000 r/min series	HG-JR53	MR-J4-60_(-RJ)	341
		MR-J4-100_(-RJ)	460
	HG-JR73	MR-J4-70_(-RJ)	331
		MR-J4-200_(-RJ)	460
	HG-JR103	MR-J4-100_(-RJ)	341
		MR-J4-200_(-RJ)	460
	HG-JR153	MR-J4-200_(-RJ)	320
		MR-J4-350_(-RJ)	460
	HG-JR203	MR-J4-200_(-RJ)	320
		MR-J4-350_(-RJ)	460
	HG-JR353	MR-J4-350_(-RJ)	307
		MR-J4-500_(-RJ)	464
	HG-JR503	MR-J4-500_(-RJ)	342
		MR-J4-700_(-RJ)/MR-J4-DU900_(-RJ)	430
	HG-JR703	MR-J4-700_(-RJ)/MR-J4-DU900_(-RJ)	341
	HG-JR903	MR-J4-11K_(-RJ)/MR-J4-DU900_(-RJ)	352

(2) 400 V class

Servo motor		Servo amplifier/drive unit	Maximum current command (maximum torque) [%]
HG-SR 2000 r/min series	HG-SR524	MR-J4-60_4(-RJ)	313
	HG-SR1024	MR-J4-100_4(-RJ)	322
	HG-SR1524	MR-J4-200_4(-RJ)	330
	HG-SR2024	MR-J4-200_4(-RJ)	327
	HG-SR3524	MR-J4-350_4(-RJ)	336
	HG-SR5024	MR-J4-500_4(-RJ)	336
	HG-SR7024	MR-J4-700_4(-RJ)	346
		MR-J4-DU900_4(-RJ)	443
HG-JR 1000 r/min series	HG-JR6014	MR-J4-700_4(-RJ)/MR-J4-DU900_4(-RJ)	337
	HG-JR8014	MR-J4-11K_4(-RJ)/MR-J4-DU11K_4(-RJ)	336
	HG-JR12K14	MR-J4-11K_4(-RJ)/MR-J4-DU11K_4(-RJ)	346
	HG-JR15K14	MR-J4-15K_4(-RJ)/MR-J4-DU15K_4(-RJ)	335
	HG-JR20K14	MR-J4-22K_4(-RJ)/MR-J4-DU22K_4(-RJ)	341
	HG-JR25K14	MR-J4-22K_4(-RJ)/MR-J4-DU22K_4(-RJ)	337
	HG-JR30K14	MR-J4-DU30K_4(-RJ)	330
	HG-JR37K14	MR-J4-DU37K_4(-RJ)	330
HG-JR 1500 r/min series	HG-JR701M4	MR-J4-700_4(-RJ)/MR-J4-DU900_4(-RJ)	329
	HG-JR11K1M4	MR-J4-11K_4(-RJ)/MR-J4-DU11K_4(-RJ)	338
	HG-JR15K1M4	MR-J4-15K_4(-RJ)/MR-J4-DU15K_4(-RJ)	338
	HG-JR22K1M4	MR-J4-22K_4(-RJ)/MR-J4-DU22K_4(-RJ)	342
	HG-JR30K1M4	MR-J4-DU30K_4(-RJ)	335
	HG-JR37K1M4	MR-J4-DU37K_4(-RJ)	323
	HG-JR45K1M4	MR-J4-DU45K_4(-RJ)	344
	HG-JR55K1M4	MR-J4-DU55K_4(-RJ)	321
HG-JR 3000 r/min series	HG-JR534	MR-J4-60_4(-RJ)	320
		MR-J4-100_4(-RJ)	460
	HG-JR734	MR-J4-100_4(-RJ)	320
		MR-J4-200_4(-RJ)	459
	HG-JR1034	MR-J4-100_4(-RJ)	320
		MR-J4-200_4(-RJ)	459
	HG-JR1534	MR-J4-200_4(-RJ)	320
		MR-J4-350_4(-RJ)	459
	HG-JR2034	MR-J4-200_4(-RJ)	320
		MR-J4-350_4(-RJ)	459
	HG-JR3534	MR-J4-350_4(-RJ)	320
		MR-J4-500_4(-RJ)	470
	HG-JR5034	MR-J4-500_4(-RJ)	320
		MR-J4-700_4(-RJ)/MR-J4-DU900_4(-RJ)	413
	HG-JR7034	MR-J4-700_4(-RJ)/MR-J4-DU900_4(-RJ)	337
	HG-JR9034	MR-J4-11K_4(-RJ)/MR-J4-DU900_4(-RJ)	336

(3) 24 V/48 V class

Servo motor		Servo amplifier/drive unit	Maximum current command (maximum torque) [%]
HG-AK series	HG-AK0136	MR-J4-03A6/MR-J4W2-0303B6	380
	HG-AK0236	MR-J4-03A6/MR-J4W2-0303B6	380
	HG-AK0336	MR-J4-03A6/MR-J4W2-0303B6	363

App. 10.4.2 Servo motor with functional safety

(1) 200 V/100 V class

Servo motor		Servo amplifier/drive unit	Maximum current command (maximum torque) [%]
HG-KR series	HG-KR053W0C	MR-J4-10_(-RJ)/MR-J4-10_1(-RJ)	370
	HG-KR13W0C	MR-J4-10_(-RJ)/MR-J4-10_1(-RJ)	373
	HG-KR23W0C	MR-J4-20_(-RJ)/MR-J4-20_1(-RJ)	387
	HG-KR43W0C	MR-J4-40_(-RJ)/MR-J4-40_1(-RJ)	383
	HG-KR73W0C	MR-J4-70_(-RJ)	367
HG-SR 1000 r/min series	HG-SR51W0C	MR-J4-60_(-RJ)	311
	HG-SR81W0C	MR-J4-100_(-RJ)	329
	HG-SR121W0C	MR-J4-200_(-RJ)	353
	HG-SR201W0C	MR-J4-200_(-RJ)	334
	HG-SR301W0C	MR-J4-350_(-RJ)	366
	HG-SR421W0C	MR-J4-500_(-RJ)	347
HG-SR 2000 r/min series	HG-SR52W0C	MR-J4-60_(-RJ)	302
	HG-SR102W0C	MR-J4-100_(-RJ)	310
	HG-SR152W0C	MR-J4-200_(-RJ)	320
	HG-SR202W0C	MR-J4-200_(-RJ)	327
	HG-SR352W0C	MR-J4-350_(-RJ)	332
	HG-SR502W0C	MR-J4-500_(-RJ)	341
	HG-SR702W0C	MR-J4-700_(-RJ)	336
		MR-J4-DU900_(-RJ)	446
HG-JR 1500 r/min series	HG-JR701MW0C	MR-J4-700_(-RJ)/MR-J4-DU900_(-RJ)	326
	HG-JR11K1MW0C	MR-J4-11K_(-RJ)/MR-J4-DU11K_(-RJ)	335
	HG-JR15K1MW0C	MR-J4-15K_(-RJ)/MR-J4-DU15K_(-RJ)	334
	HG-JR22K1MW0C	MR-J4-22K_(-RJ)/MR-J4-DU22K_(-RJ)	317
HG-JR 3000 r/min series	HG-JR53W0C	MR-J4-60_(-RJ)	341
		MR-J4-100_(-RJ)	460
	HG-JR73W0C	MR-J4-70_(-RJ)	331
		MR-J4-200_(-RJ)	460
	HG-JR103W0C	MR-J4-100_(-RJ)	341
		MR-J4-200_(-RJ)	460
	HG-JR153W0C	MR-J4-200_(-RJ)	320
		MR-J4-350_(-RJ)	460
	HG-JR203W0C	MR-J4-200_(-RJ)	320
		MR-J4-350_(-RJ)	460
	HG-JR353W0C	MR-J4-350_(-RJ)	307
		MR-J4-500_(-RJ)	464
	HG-JR503W0C	MR-J4-500_(-RJ)	342
		MR-J4-700_(-RJ)/MR-J4-DU900_(-RJ)	430
	HG-JR703W0C	MR-J4-700_(-RJ)/MR-J4-DU900_(-RJ)	341
	HG-JR903W0C	MR-J4-11K_(-RJ)/MR-J4-DU900_(-RJ)	352

(2) 400 V class

Servo motor		Servo amplifier/drive unit	Maximum current command (maximum torque) [%]
HG-SR 2000 r/min series	HG-SR524W0C	MR-J4-60_4(-RJ)	313
	HG-SR1024W0C	MR-J4-100_4(-RJ)	322
	HG-SR1524W0C	MR-J4-200_4(-RJ)	330
	HG-SR2024W0C	MR-J4-200_4(-RJ)	327
	HG-SR3524W0C	MR-J4-350_4(-RJ)	336
	HG-SR5024W0C	MR-J4-500_4(-RJ)	336
	HG-SR7024W0C	MR-J4-700_4(-RJ)	346
		MR-J4-DU900_4(-RJ)	443
HG-JR 1500 r/min series	HG-JR701M4W0C	MR-J4-700_4(-RJ)/MR-J4-DU900_4(-RJ)	329
	HG-JR11K1M4W0C	MR-J4-11K_4(-RJ)/MR-J4-DU11K_4(-RJ)	338
	HG-JR15K1M4W0C	MR-J4-15K_4(-RJ)/MR-J4-DU15K_4(-RJ)	338
	HG-JR22K1M4W0C	MR-J4-22K_4(-RJ)/MR-J4-DU22K_4(-RJ)	342
HG-JR 3000 r/min series	HG-JR534W0C	MR-J4-60_4(-RJ)	320
		MR-J4-100_4(-RJ)	460
	HG-JR734W0C	MR-J4-100_4(-RJ)	320
		MR-J4-200_4(-RJ)	459
	HG-JR1034W0C	MR-J4-100_4(-RJ)	320
		MR-J4-200_4(-RJ)	459
	HG-JR1534W0C	MR-J4-200_4(-RJ)	320
		MR-J4-350_4(-RJ)	459
	HG-JR2034W0C	MR-J4-200_4(-RJ)	320
		MR-J4-350_4(-RJ)	459
	HG-JR3534W0C	MR-J4-350_4(-RJ)	320
		MR-J4-500_4(-RJ)	470
	HG-JR5034W0C	MR-J4-500_4(-RJ)	320
		MR-J4-700_4(-RJ)/MR-J4-DU900_4(-RJ)	413
	HG-JR7034W0C	MR-J4-700_4(-RJ)/MR-J4-DU900_4(-RJ)	337
	HG-JR9034W0C	MR-J4-700_4(-RJ)/MR-J4-DU900_4(-RJ)	336

App. 10.4.3 Linear servo motor (primary side)

(1) 200 V/100 V class

Linear servo motor (primary side)			Servo amplifier/drive unit	Maximum current command (maximum torque) [%]
LM-H3 series	LM-H3P2A-07P-BSS0		MR-J4-40_(-RJ)/MR-J4-40_1(-RJ)	390
	LM-H3P3A-12P-CSS0		MR-J4-40_(-RJ)/MR-J4-40_1(-RJ)	340
	LM-H3P3B-24P-CSS0		MR-J4-70_(-RJ)	320
	LM-H3P3C-36P-CSS0		MR-J4-70_(-RJ)	350
	LM-H3P3D-48P-CSS0		MR-J4-200_(-RJ)	335
	LM-H3P7A-24P-ASS0		MR-J4-70_(-RJ)	315
	LM-H3P7B-48P-ASS0		MR-J4-200_(-RJ)	297
	LM-H3P7C-72P-ASS0		MR-J4-200_(-RJ)	320
	LM-H3P7D-96P-ASS0		MR-J4-350_(-RJ)	320
LM-F series	LM-FP2B-06M-1SS0	(Natural cooling)	MR-J4-200_(-RJ)	756
		(Liquid cooling)	MR-J4-200_(-RJ)	355
	LM-FP2D-12M-1SS0	(Natural cooling)	MR-J4-500_(-RJ)	815
		(Liquid cooling)	MR-J4-500_(-RJ)	409
	LM-FP2F-18M-1SS0	(Natural cooling)	MR-J4-700_(-RJ)/MR-J4-DU900_(-RJ)	800
		(Liquid cooling)	MR-J4-700_(-RJ)/MR-J4-DU900_(-RJ)	409
	LM-FP4B-12M-1SS0	(Natural cooling)	MR-J4-500_(-RJ)	742
		(Liquid cooling)	MR-J4-500_(-RJ)	383
	LM-FP4D-24M-1SS0	(Natural cooling)	MR-J4-700_(-RJ)/MR-J4-DU900_(-RJ)	778
		(Liquid cooling)	MR-J4-700_(-RJ)/MR-J4-DU900_(-RJ)	384
	LM-FP4F-36M-1SS0	(Natural cooling)	MR-J4-11K_(-RJ)/MR-J4-DU11K_(-RJ)	709
		(Liquid cooling)	MR-J4-11K_(-RJ)/MR-J4-DU11K_(-RJ)	356
	LM-FP4H-48M-1SS0	(Natural cooling)	MR-J4-15K_(-RJ)/MR-J4-DU15K_(-RJ)	763
		(Liquid cooling)	MR-J4-15K_(-RJ)/MR-J4-DU15K_(-RJ)	389
LM-K2 series	LM-K2P1A-01M-2SS1		MR-J4-40_(-RJ)/MR-J4-40_1(-RJ)	400
	LM-K2P1C-03M-2SS1		MR-J4-200_(-RJ)	375
	LM-K2P2A-02M-1SS1		MR-J4-70_(-RJ)	366
	LM-K2P2C-07M-1SS1		MR-J4-350_(-RJ)	380
	LM-K2P2E-12M-1SS1		MR-J4-500_(-RJ)	405
	LM-K2P3C-14M-1SS1		MR-J4-350_(-RJ)	354
	LM-K2P3E-24M-1SS1		MR-J4-500_(-RJ)	359
LM-U2 series	LM-U2PAB-05M-0SS0		MR-J4-20_(-RJ)/MR-J4-20_1(-RJ)	315
	LM-U2PAD-10M-0SS0		MR-J4-40_(-RJ)/MR-J4-40_1(-RJ)	318
	LM-U2PAF-15M-0SS0		MR-J4-40_(-RJ)/MR-J4-40_1(-RJ)	334
	LM-U2PBB-07M-1SS0		MR-J4-20_(-RJ)/MR-J4-20_1(-RJ)	325
	LM-U2PBD-15M-1SS0		MR-J4-60_(-RJ)	320
	LM-U2PBF-22M-1SS0		MR-J4-70_(-RJ)	322
	LM-U2P2B-40M-2SS0		MR-J4-200_(-RJ)	424
	LM-U2P2C-60M-2SS0		MR-J4-350_(-RJ)	434
	LM-U2P2D-80M-2SS0		MR-J4-500_(-RJ)	432

(2) 400 V class

Linear servo motor (primary side)			Servo amplifier/drive unit	Maximum current command (maximum torque) [%]
LM-F series	LM-FP5H-60M-1SS0	(Natural cooling)	MR-J4-22K_(-RJ)/MR-J4-DU22K_(-RJ)	738
		(Liquid cooling)	MR-J4-22K_(-RJ)/MR-J4-DU22K_(-RJ)	364

App. 10.4.4 Direct drive motor

(1) 200 V/100 V class

Direct drive motor		Servo amplifier/drive unit	Maximum current command (maximum torque) [%]
TM-RFM series	TM-RFM002C20	MR-J4-20_(-RJ)/MR-J4-20_1(-RJ)	320
	TM-RFM004C20	MR-J4-40_(-RJ)/MR-J4-40_1(-RJ)	321
	TM-RFM006C20	MR-J4-60_(-RJ)	320
	TM-RFM006E20	MR-J4-60_(-RJ)	333
	TM-RFM012E20	MR-J4-70_(-RJ)	321
	TM-RFM018E20	MR-J4-100_(-RJ)	321
	TM-RFM012G20	MR-J4-70_(-RJ)	300
	TM-RFM048G20	MR-J4-350_(-RJ)	321
	TM-RFM072G20	MR-J4-350_(-RJ)	321
	TM-RFM040J10	MR-J4-70_(-RJ)	323
	TM-RFM120J10	MR-J4-350_(-RJ)	321
	TM-RFM240J10	MR-J4-500_(-RJ)	321
TM-RG2M series	TM-RG2M002C30	MR-J4-20_(-RJ)/MR-J4-20_1(-RJ)	433
	TM-RG2M004E30	MR-J4-20_(-RJ)/MR-J4-20_1(-RJ)/ MR-J4-40_(-RJ)/MR-J4-40_1(-RJ)	324
	TM-RG2M009G30	MR-J4-40_(-RJ)/MR-J4-40_1(-RJ)	324
TM-RU2M series	TM-RU2M002C30	MR-J4-20_(-RJ)/MR-J4-20_1(-RJ)	433
	TM-RU2M004E30	MR-J4-20_(-RJ)/MR-J4-20_1(-RJ)/ MR-J4-40_(-RJ)/MR-J4-40_1(-RJ)	324
	TM-RU2M009G30	MR-J4-40_(-RJ)/MR-J4-40_1(-RJ)	324

App. 11 Special specification

App. 11.1 Amplifiers without dynamic brake

App. 11.1.1 Summary

This section explains servo amplifiers without a dynamic brake. The things not explained in this section will be the same as MR-J4-_B_(-RJ).

App. 11.1.2 Model

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

MR-J4-60B4-ED

Series

Special specifications

Symbol	Special specifications
ED	MR-J4_-B_ without a dynamic brake
RU	MR-J4-_B_-RJ without a dynamic brake

Power supply

Symbol	Power supply
None	3-phase 200 V AC to 240 V AC
1	1-phase 100 V AC to 120 V AC
4	3-phase 380 V AC to 480 V AC

Rated output

Symbol	Rated output [kW]
10	0.1
20	0.2
40	0.4
60	0.6
70	0.75
100	1
200	2
350	3.5
500	5
700	7

App. 11.1.3 Specifications

Dynamic brake which is built in 7 kW or smaller servo amplifiers is removed.
Take safety measures such as making another circuit for an emergency stop, alarm occurrence, and power shut-off.
The following servo motors may function an electronic dynamic brake at an alarm occurrence.

Series	Servo motor
HG-KR	HG-KR053/HG-KR13/HG-KR23/HG-KR43
HG-MR	HG-MR053/HG-MR13/HG-MR23/HG-MR43
HG-SR	HG-SR51/HG-SR52

Setting the following parameter disables the electronic dynamic brake.

Servo amplifier	Parameter	Setting value
MR-J4-_B_-ED MR-J4-_B_-RU	[Pr. PF06]	_ _ _ 2

When [Pr. PA04] is "2 _ _ _" (default), the motor can be a state of forced stop deceleration at an alarm occurrence. Setting "0 _ _ _" in [Pr. PA04] disables the forced stop deceleration function.

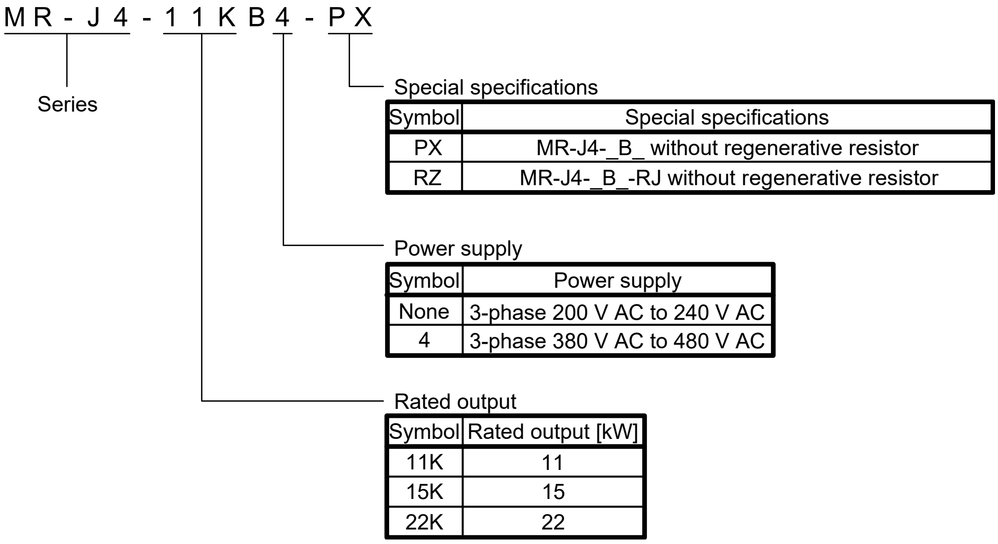
App. 11.2 Without regenerative resistor

App. 11.2.1 Summary

This section explains servo amplifiers without a regenerative resistor. The things not explained in this section will be the same as MR-J4-_B_(-RJ).

App. 11.2.2 Model

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



Special specifications

Symbol	Special specifications
PX	MR-J4-_B_ without regenerative resistor
RZ	MR-J4-_B_-RJ without regenerative resistor

Power supply

Symbol	Power supply
None	3-phase 200 V AC to 240 V AC
4	3-phase 380 V AC to 480 V AC

Rated output

Symbol	Rated output [kW]
11K	11
15K	15
22K	22

App. 11.2.3 Specifications

Indicates a servo amplifier of 11 kW to 22 kW that does not use a regenerative resistor as standard accessory. When using any of these servo amplifiers, always use the MR-RB5R, MR-RB9F, MR-RB9T, MR-RB5K-4, or MR-RB6K-4 regenerative option.

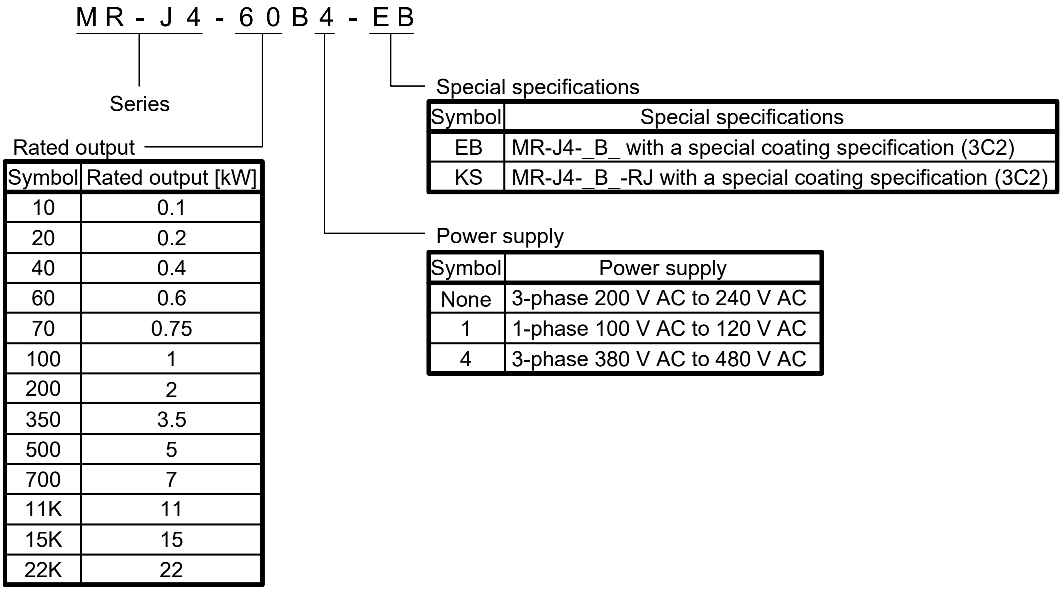
App. 11.3 Special coating-specification product (IEC 60721-3-3:1994 Class 3C2)

App. 11.3.1 Summary

This section explains servo amplifiers with a special coating specification. Items not given in this section will be the same as MR-J4-_B_(-RJ).

App. 11.3.2 Model

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



Rated output

Symbol	Rated output [kW]
10	0.1
20	0.2
40	0.4
60	0.6
70	0.75
100	1
200	2
350	3.5
500	5
700	7
11K	11
15K	15
22K	22

Power supply

Symbol	Power supply
None	3-phase 200 V AC to 240 V AC
1	1-phase 100 V AC to 120 V AC
4	3-phase 380 V AC to 480 V AC

Special specifications

Symbol	Special specifications
EB	MR-J4-_B_ with a special coating specification (3C2)
KS	MR-J4-_B_-RJ with a special coating specification (3C2)

App. 11.3.3 Specifications

(1) Special coating

Using the MR-J4 series in an atmosphere containing a corrosive gas may cause its corrosion with time, resulting in a malfunction. For the printed circuit board of the servo amplifiers with a special coating specification, a urethane coating agent is applied to some parts capable of being coated technically (except LEDs, connectors, terminal blocks, etc.) to improve the resistance to corrosive gases. Use a servo amplifier with a special coating specification specifically for applications susceptible to corrosive gases, including tire manufacturing and water treatment. Although the special coating-specification products have the improved resistance to corrosive gases, proper operations in environments mentioned above are not guaranteed. Therefore, perform periodic inspections for any abnormality.

(2) Standard for corrosive gases

In IEC 60721-3-3, corrosive gases refer to sea salt, sulfur dioxide, hydrogen sulfide, chlorine, hydrogen chloride, hydrogen fluoride, ammonia, ozone, and nitrogen oxides shown in the environmental parameter column of the table below.

The table also shows the corrosive gas concentrations defined in IEC 60721-3-3:1994 Class 3C2.

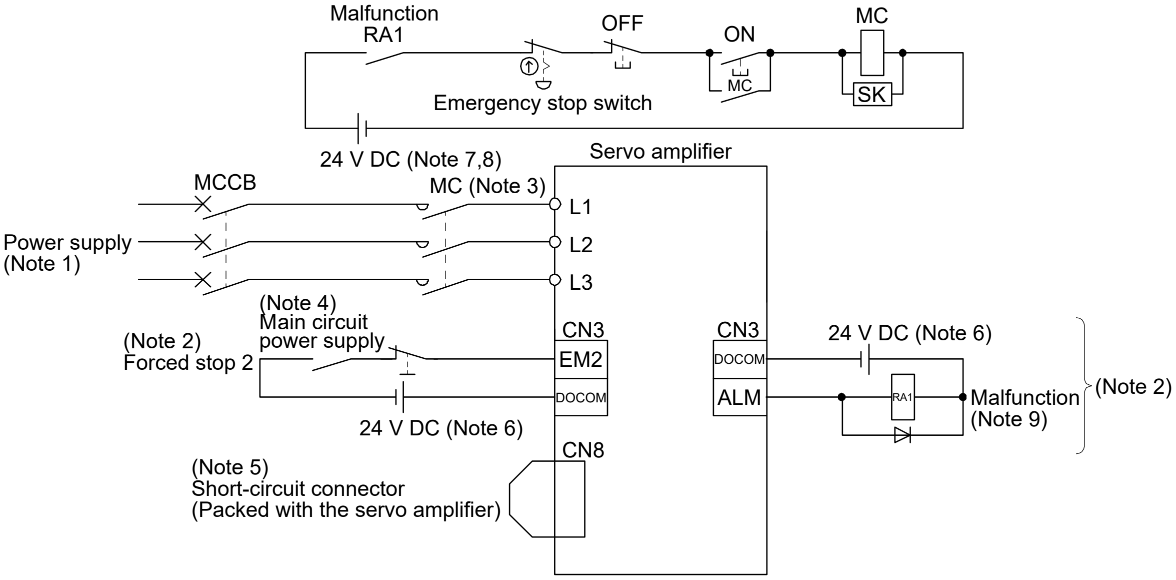
Environmental parameter	Unit	3C2	
		Mean value	Maximum value
a) Sea salt	None	Salt mist	
b) Sulfur dioxide	cm^3/m^3	0.11	0.37
c) Hydrogen sulfide	cm^3/m^3	0.071	0.36
d) Chlorine	cm^3/m^3	0.034	0.1
e) Hydrogen chloride	cm^3/m^3	0.066	0.33
f) Hydrogen fluoride	cm^3/m^3	0.012	0.036
g) Ammonia	cm^3/m^3	1.4	4.2
h) Ozone	cm^3/m^3	0.025	0.05
i) Nitrogen oxides	cm^3/m^3	0.26	0.52

The special coating-specification products have the improved corrosion resistance in environments with corrosive gas concentrations conforming to IEC 60721-3-3:1994 Class 3C2. We tested typical models and confirmed that their corrosive gas resistance was improved, compared with the standard models.

App. 12 Driving on/off of main circuit power supply with DC power supply

App. 12.1 Connection example

The power circuit is common to all capacity type of servo amplifiers. For the signal and wirings not given in this section, refer to section 3.1.1 to 3.1.3.



Note 1. For the power supply specifications, refer to section 1.3.
2. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
3. Use the magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less (160 ms or less for 5 kW or more). 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. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
5. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
6. 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.
7. Driving the on switch and off switch with the DC power supply meets IEC/EN 60204-1 requirements.
8. Do not use the 24 V DC interface power supply for the magnetic contactor DC power supply. Always use the power supply designed exclusively for the magnetic contactor.
9. If ALM (Malfunction) output is disabled with the parameter, configure the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.

App. 12.2 Magnetic contactor

Use the magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less (160 ms or less for 5 kW or more).

Servo amplifier	Magnetic contactor
MR-J4-10B(-RJ)	SD-N11
MR-J4-20B(-RJ)	
MR-J4-40B(-RJ)	
MR-J4-60B(-RJ)	
MR-J4-70B(-RJ)	
MR-J4-100B(-RJ)	
MR-J4-200B(-RJ)	SD-N21
MR-J4-350B(-RJ)	
MR-J4-500B(-RJ)	SD-N35
MR-J4-700B(-RJ)	SD-N50
MR-J4-11KB(-RJ)	
MR-J4-15KB(-RJ)	SD-N65
MR-J4-22KB(-RJ)	SD-N95

Servo amplifier	Magnetic contactor
MR-J4-60B4(-RJ)	SD-N11
MR-J4-100B4(-RJ)	
MR-J4-200B4(-RJ)	
MR-J4-350B4(-RJ)	SD-N21
MR-J4-500B4(-RJ)	
MR-J4-700B4(-RJ)	
MR-J4-11KB4(-RJ)	SD-N25
MR-J4-15KB4(-RJ)	SD-N35
MR-J4-22KB4(-RJ)	SD-N50
MR-J4-10B1(-RJ)	SD-N11
MR-J4-20B1(-RJ)	
MR-J4-40B1(-RJ)	

App. 13 Optional data monitor function

The optional data monitor function is used to monitor data in the servo amplifier with the servo system controller. In the optional data monitor function, data types of registered monitor and transient command can be set.

For details of usage, the unit of data types, and others, refer to the manuals for servo system controllers.

App. 13.1 Registered monitor

Data type	Description
Effective load ratio	The continuous effective load current is displayed. The effective value is displayed considering a rated current as 100%.
Regenerative load ratio	The ratio of regenerative power to permissible regenerative power is displayed in %.
Peak load ratio	The maximum torque generated is displayed. The highest value in the past 15 s is displayed, with the rated torque being 100%.
Position feedback	Feedback pulses from the servo motor encoder are counted and displayed.
Encoder position within one revolution	The position in servo motor-side 1-revolution is displayed in the encoder pulse unit. When the value exceeds the maximum number of pulses, it resets to 0.
Encoder multiple revolution counter	The rotation amount of the servo motor is displayed. The value is counted up by one per servo motor revolution.
Load inertia moment ratio	The set ratio of the load inertia moment to the servo motor shaft inertia moment is displayed.
Load to motor mass ratio	The load to mass of the linear servo motor primary-side ratio is displayed.
Model loop gain	The model loop gain value is displayed.
Main circuit bus voltage	The voltage of main circuit converter (between P+ and N-) is displayed.
Cumulative current value	The cumulative current value of the servo motor is displayed.
Servo motor speed	The servo motor speed is displayed.
Servo motor speed	The linear servo motor speed is displayed at linear servo motor driving.
Selected droop pulse	The droop pulse set in [Pr. PE10] is displayed.
Module power consumption	The module power consumption is displayed. The positive value is displayed in power running. The negative value is displayed in regeneration.
Module integral power consumption	The module integral power consumption is displayed.
Instantaneous torque	The instantaneous torque is displayed. The value of torque being occurred is displayed in real time considering a rated torque as 100%.
Instantaneous thrust	The instantaneous thrust is displayed at linear servo motor driving. The value of thrust being occurred is displayed in real time considering a continuous thrust as 100%.
Load-side encoder information 1 (Note)	The item to be displayed depends on the encoder being connected to the load side as follows. For a rotary servo motor (HG-KR, HG-MR) or synchronous encoder (Q171ENC-W8), the cycle counter is displayed. For an absolute position linear encoder, the absolute position data is displayed. For an incremental linear encoder, the Z-phase counter (distance from the linear encoder home position (reference mark)) (32-bit data) is displayed after the Z-phase is passed. The value before the Z-phase is passed is undefined. For an A/B/Z-phase differential output linear encoder, the Z-phase counter (distance from the linear encoder home position (Z-phase)) (16-bit data) is displayed after the Z-phase is passed. Before the Z-phase is passed, the free-run counter is displayed (the position at power-on is 0). For an A/B/Z-phase differential output rotary encoder, the Z-phase counter (distance from the encoder home position (Z-phase)) (16-bit data) is displayed after the Z-phase is passed. Before the Z-phase is passed, the free-run counter is displayed (the position at power-on is 0).

Data type	Description
Load-side encoder information 2 (Note)	The item to be displayed depends on the encoder being connected to the load side as follows. For an encoder of a rotary servo motor (HG-KR, HG-MR) or synchronous encoder (Q171ENC-W8), the multi-revolution ABS counter is displayed. For an absolute position linear encoder, "0" is displayed. For an incremental linear encoder, "0" is displayed. For an A/B/Z-phase differential output linear encoder, "0" is displayed. For an A/B/Z-phase differential output rotary encoder, "0" is displayed.
Scale free-run counter	The free-run counter of the load-side encoder is displayed (the position at power-on is 0).
Z-phase counter	The Z-phase counter is displayed in the encoder pulse unit. For an incremental type 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 type linear encoder, the encoder absolute position is displayed.
Servo motor thermistor temperature	The thermistor temperature is displayed for the servo motor with a thermistor. For the servo motor without thermistor, "9999" is displayed. For the servo motor with a thermistor, refer to each servo motor instruction manual.
Disturbance torque	The difference between the torque necessary to drive the servo motor and the actually required torque (Torque current value) is displayed as the disturbance torque.
Disturbance thrust	The difference between the thrust necessary to drive the linear servo motor and the actually required thrust (Thrust current value) is displayed as the disturbance thrust.
Overload alarm margin	The margins to the levels which trigger [AL. 50 Overload 1] and [AL. 51 Overload 2] are displayed in percentage.
Error excessive alarm margin	The margin to the level which triggers the error excessive alarm is displayed in units of encoder pulses. The error excessive alarm occurs at 0 pulses.
Settling time	The time (Settling time) after command is completed until INP (In-position) turns on is displayed.
Overshoot amount	The overshoot amount during position control is displayed in units of encoder pulses.
Servo motor side/load-side position deviation	During fully closed loop control, a deviation between servo motor side position and load-side position is displayed. The number of pulses displayed is in the load-side encoder pulse unit.
Servo motor side/load-side speed deviation	During fully closed loop control, a deviation between servo motor side speed and load-side speed is displayed.
Internal temperature of encoder	The internal temperature of encoder is displayed. "0" is displayed for the linear servo motor. When an encoder communication error occurs, the last value will be displayed before the error. This is available with servo amplifiers with software version C4 or later.
Servo command value	The position command from the controller is displayed.
Torque command	The torque command from the controller is displayed.

Note. The contents of "Load-side encoder information 1" and "Load-side encoder information 2" differ from those described in app. 13.2.

App. 13.2 Transient command

Data type	Description
Motor serial number (First 8 characters)	The servo motor serial number is displayed. The serial number is not displayed for linear servo motors. This data type is available with servo amplifier with software version C8 or later.
Motor serial number (Last 8 characters)	
Servo motor ID (SSCNET III)/Encoder ID	The servo motor ID and encoder ID sent from the encoder are displayed. The types of the connected servo motor and encoder can be checked by referring to the ID. For details, refer to "Servo Motor Instruction Manual (Vol. 3)".
Servo motor ID (SSCNET III/H)	The servo motor ID sent from the encoder is displayed. The type of the connected servo motor can be checked by referring to the ID. For details, refer to "Servo Motor Instruction Manual (Vol. 3)".
Encoder resolution	The encoder resolution is displayed.
Servo amplifier serial number (First 8 characters)	The servo amplifier serial number is displayed.
Servo amplifier serial number (Last 8 characters)	
Servo amplifier recognition information (First 8 characters)	The servo amplifier name is displayed.
Servo amplifier recognition information (Last 8 characters)	
Servo amplifier software number (First 8 characters)	The software version of the servo amplifier is displayed.
Servo amplifier software number (Last 8 characters)	
Power ON cumulative time	The cumulative time after power on of the servo amplifier is displayed.
Inrush relay ON/OFF number	The number of on and off for inrush relay of the servo amplifier is displayed.
Read alarm history number	The maximum number of alarm histories of the connected servo amplifier is displayed.
Alarm history/Detail #1, #2	The alarm history/detail #1, #2 are displayed. (Hexadecimal)
Alarm history/Detail #3, #4	The alarm history/detail #3, #4 are displayed. (Hexadecimal)
Alarm history/Detail #5, #6	The alarm history/detail #5, #6 are displayed. (Hexadecimal)
Alarm history/Detail #7, #8	The alarm history/detail #7, #8 are displayed. (Hexadecimal)
Alarm history/Detail/Occurrence time	The alarm history data of specific number # is displayed.
Alarm occurrence time #1, #2	The alarm occurrence time #1, #2 are displayed.
Alarm occurrence time #3, #4	The alarm occurrence time #3, #4 are displayed.
Alarm occurrence time #5, #6	The alarm occurrence time #5, #6 are displayed.
Alarm occurrence time #7, #8	The alarm occurrence time #7, #8 are displayed.
Alarm history clear command	Used for alarm history clear.
Home position [command unit]	The home position is displayed.
Main circuit bus voltage	The voltage of main circuit converter (between P+ and N-) is displayed.
Regenerative load ratio	The ratio of regenerative power to permissible regenerative power is displayed in %.
Effective load ratio	The continuous effective load current is displayed. The effective value is displayed considering a rated current as 100%.
Peak load ratio	The maximum torque generated is displayed. The highest value in the past 15 s is displayed, with the rated torque being 100 %.
Estimate inertia moment ratio	The set ratio of the load inertia moment to the servo motor shaft inertia moment is displayed.
Model loop gain	The model loop gain value is displayed.
LED display	The value shown on the 7-segment LED display of the servo amplifier is displayed.
Load-side encoder information 1 (Note)	The item to be displayed depends on the encoder being connected to the load side as follows. For a rotary servo motor (HG-KR, HG-MR) or synchronous encoder (Q171ENC-W8), the multi-revolution ABS counter is displayed. For an absolute position linear encoder, the absolute position data is displayed. For an incremental linear encoder, the free-run counter of the load-side encoder is displayed (the position at power-on is 0). For an A/B/Z-phase differential output linear encoder, the free-run counter of the load-side encoder is displayed (the position at power-on is 0). For an A/B/Z-phase differential output rotary encoder, the free-run counter of the load-side encoder is displayed (the position at power-on is 0).

Data type	Description
Load-side encoder information 2 (Note)	The item to be displayed depends on the encoder being connected to the load side as follows. For a rotary servo motor (HG-KR, HG-MR) or synchronous encoder (Q171ENC-W8), the cycle counter is displayed. For an absolute position linear encoder, "0" is displayed. For an incremental linear encoder, the Z-phase counter (distance from the linear encoder home position (reference mark)) (32-bit data) is displayed after the Z-phase is passed. The value before the Z-phase is passed is undefined. For an A/B/Z-phase differential output linear encoder, the free-run counter displayed is the one latched at the time the Z-phase is passed. For an A/B/Z-phase differential output rotary encoder, the free-run counter displayed is the one latched at the time the Z-phase is passed.
Speed feedback	The servo motor speed is displayed.
Servo motor thermistor temperature	The thermistor temperature is displayed for the servo motor with a thermistor. For the servo motor without thermistor, "9999" is displayed. For the servo motor with a thermistor, refer to each servo motor instruction manual.
Z-phase counter	The item to be displayed depends on the linear encoder being connected to the motor side as follows. For an absolute position linear encoder, "0" is displayed. For an incremental linear encoder, the Z-phase counter (distance from the linear encoder home position (reference mark)) (32-bit data) is displayed after the Z-phase is passed. The value before the Z-phase is passed is undefined. For an A/B/Z-phase differential output linear encoder, the Z-phase counter (distance from the linear encoder home position (Z-phase)) (32-bit data) is displayed after the Z-phase is passed. Before the Z-phase is passed, the free-run counter is displayed (the position at power-on is 0).
Module power consumption	The module power consumption is displayed. The positive value is displayed in power running. The negative value is displayed in regeneration.
Module integral power consumption	The module integral power consumption is displayed.
Disturbance torque	The difference between the torque necessary to drive the servo motor and the actually required torque (Torque current value) is displayed as the disturbance torque.
Instantaneous torque	The instantaneous torque is displayed. The value of torque being occurred is displayed in real time considering a rated torque as 100%.
Overload alarm margin	The margins to the levels which trigger [AL. 50 Overload 1] and [AL. 51 Overload 2] are displayed in percentage.
Error excessive alarm margin	The margin to the level which triggers the error excessive alarm is displayed in units of encoder pulses. The error excessive alarm occurs at 0 pulses.
Settling time	The time (Settling time) after command is completed until INP (In-position) turns on is displayed.
Overshoot amount	The overshoot amount during position control is displayed in units of encoder pulses.
Servo motor side/load-side position deviation	During fully closed loop control, a deviation between servo motor side position and load-side position is displayed. The number of pulses displayed is in the load-side encoder pulse unit.
Servo motor side/load-side speed deviation	During fully closed loop control, a deviation between servo motor side speed and load-side speed is displayed.
Internal temperature of encoder	The internal temperature of encoder is displayed. "0" is displayed for the linear servo motor. When an encoder communication error occurs, the last value will be displayed before the error. This is available with servo amplifiers with software version C4 or later.
Machine diagnostic status	The current status of the machine diagnostic function is displayed.
Friction estimation data	The friction estimation data estimated by the machine diagnostic function is displayed.
Vibration estimation data	The vibration estimation data estimated by the machine diagnostic function is displayed.

Note. The contents of "Load-side encoder information 1" and "Load-side encoder information 2" differ from those described in app. 13.1.

App. 14 STO function with SIL 3 certification

The MR-J4 series general-purpose AC servo amplifiers now comply with safety integrity level 3 (SIL 3) of the IEC 61508:2010 functional safety standard.

App. 14.1 Target models

MR-J4 series AC servo amplifiers (excluding MR-J4-03A6(-RJ) and MR-J4W2-0303B6)

App. 14.2 Change of the compliance

The target MR-J4 servo amplifiers now comply with SIL 3 (Table app. 3).

Table app. 3 Compliance with SIL 3

	Before change	After change
Safety performance (Standards certified by CB)	EN ISO 13849-1:2015 Category 3 PL d, IEC 61508 SIL 2, EN 62061 SIL CL 2, EN 61800-5-2 STO function	EN ISO 13849-1:2015 Category 3 PL e, IEC 61508 SIL 3, EN 62061 SIL CL 3, EN 61800-5-2 STO function

App. 14.3 Schedule

For the products manufactured in Japan, this change has been made sequentially from the June 2015 production.
For the products manufactured and sold in China, this change has been made sequentially from the December 2015 production.
There may be cases where both the former and new products exist in the distribution stage.

App. 14.4 Use with SIL 3

Set the safety level with [Pr. PF18 STO diagnosis error detection time].
To use the servo amplifier with SIL 3, set [Pr. PF18 STO diagnosis error detection time] within the range of 1 to 60, connect the TOFB output (CN8) of the servo amplifier to the input of a SIL 3-certified controller and execute the diagnosis. SIL 3 functional safety of the servo amplifiers is certified by TÜV SÜD.

App. 14.5 Use with SIL 2 (as conventional)

The servo amplifiers are still capable of SIL 2 as before regardless of whether the STO diagnosis function is enabled or not.
Either of the conventionally-used TÜV Rheinland certification or the new TÜV SÜD certification may be used.

App. 14.6 How to check the country of origin, and the year and month of manufacture

The country of origin, and the year and month of manufacture are indicated on the packaging box (Fig. app. 3) and the rating plate (Fig. app. 4).

Fig. app. 3 Indication example on the packaging box

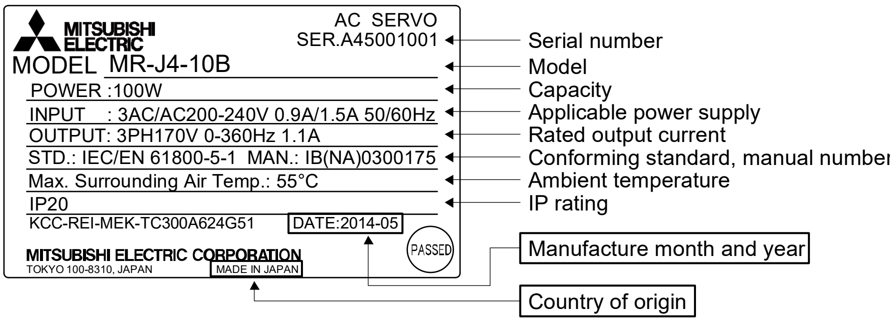


Fig. app. 4 Indication example on the rating plate

App. 15 When using the servo amplifier with the DC power supply input

POINT

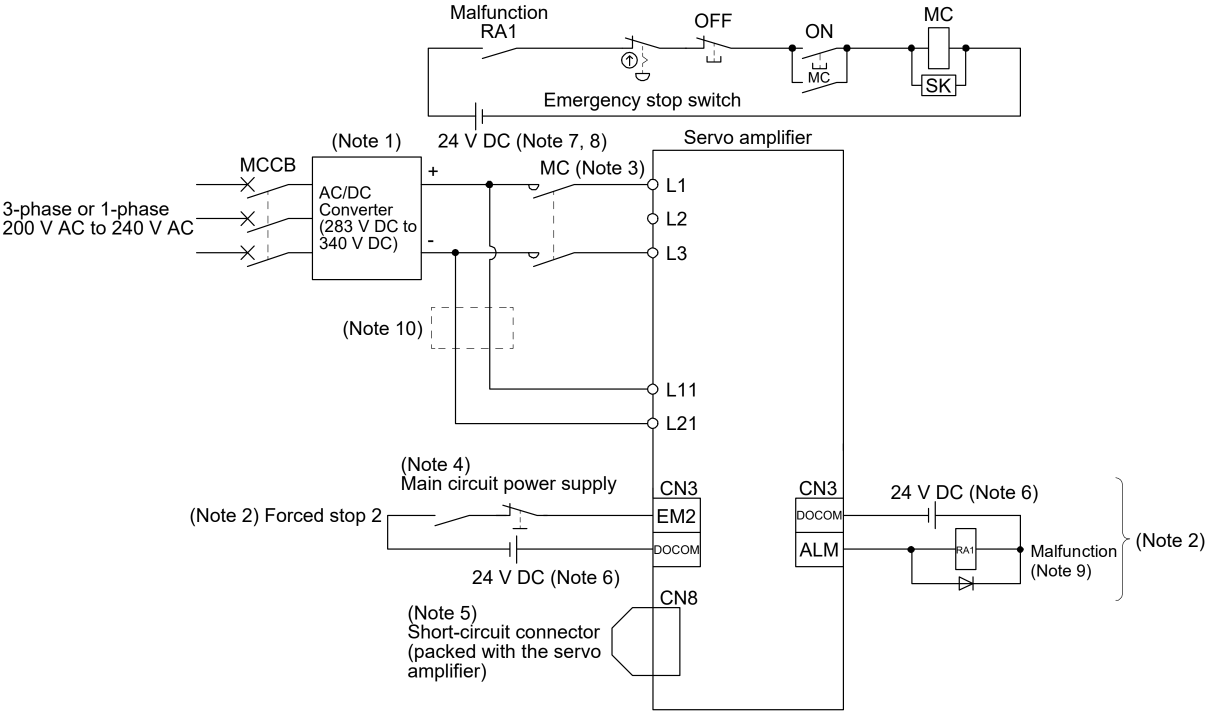
- ●The DC power supply input is available with MR-J4-_B-RJ servo amplifiers with software version C2 or later.
- ●When using the MR-J4-_B-RJ servo amplifier with the DC power supply input, set [Pr. PC20] to "_ _ _ 1".

App. 15.1 Connection example

⚠CAUTION ● Ensure that polarity (+/-) is correct. Otherwise, a burst, damage, etc. may occur.

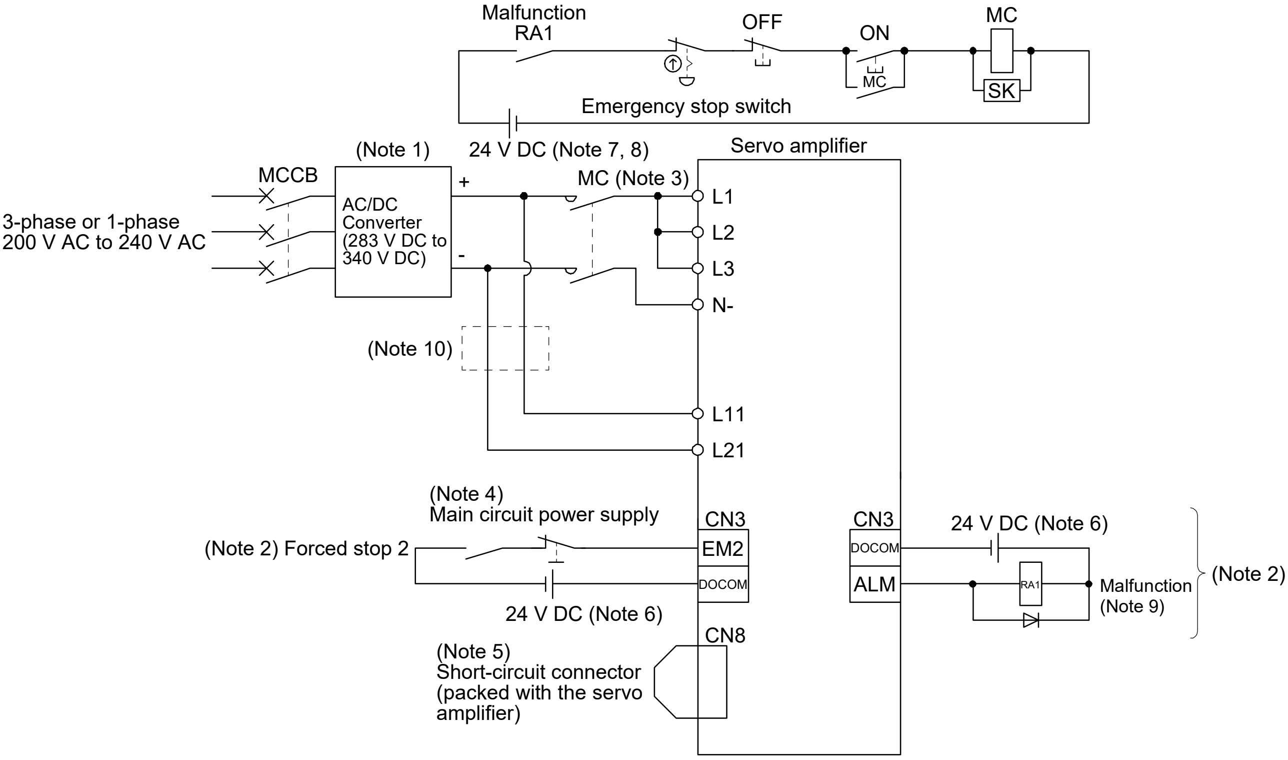
For the signal and wirings not given in this section, refer to section 3.1.1 to 3.1.3.

(1) MR-J4-10B-RJ to MR-J4-100B-RJ



Note
1. For the power supply specifications, refer to section 1.3.
2. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.8.3.
3. Use the magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less (160 ms or less for 5 kW or more). 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, delay the time to turn off the magnetic contactor.
4. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
5. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
6. 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.
7. Driving the on switch and off switch with the DC power supply meets IEC/EN 60204-1 requirements.
8. Do not use the 24 V DC interface power supply for the magnetic contactor DC power supply. Always use the power supply designed exclusively for the magnetic contactor.
9. If ALM (Malfunction) output is disabled with the parameter, configure the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the servo system controller side.
10. When wires used for L11 and L21 are thinner than wires used for L1 and L3, use a fuse. (Refer to app. 15.4.)

(2) MR-J4-200B-RJ to MR-J4-22KB-RJ



Note
1. For the power supply specifications, refer to section 1.3.
2. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.8.3.
3. 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 (160 ms or less for 5 kW or more). 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, delay the time to turn off the magnetic contactor.
4. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
5. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
6. 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.
7. Driving the on switch and off switch with the DC power supply meets IEC/EN 60204-1 requirements.
8. Do not use the 24 V DC interface power supply for the magnetic contactor DC power supply. Always use the power supply designed exclusively for the magnetic contactor.
9. If ALM (Malfunction) output is disabled with the parameter, configure the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the servo system controller side.
10. When wires used for L11 and L21 are thinner than wires used for L1/L2/L3 and N-, use a fuse. (Refer to app. 15.4.)

App. 15.2 Power supply capacity

The power supply capacity is the same as that for the AC power supply input. Refer to section 10.2 for details.

App. 15.3 Selection example of wires

POINT

- ●Selection conditions of wire size are as follows.
  Construction condition: Single wire set in midair
  Wiring length: 30 m or shorter

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

(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.

Servo amplifier	Wire [mm^2] (Note 1)	
	L1/L2/L3/N-/⏚	L11/L21
MR-J4-10B-RJ	2 (AWG 14)	1.25 to 2 (AWG 16 to 14)
MR-J4-20B-RJ		
MR-J4-40B-RJ		
MR-J4-60B-RJ		
MR-J4-70B-RJ		
MR-J4-100B-RJ		
MR-J4-200B-RJ MR-J4-350B-RJ	3.5 (AWG 12)	
MR-J4-500B-RJ (Note 2)	5.5 (AWG 10): a	1.25 (AWG 16): a 2 (AWG 14): d
MR-J4-700B-RJ (Note 2)	8 (AWG 8): b	
MR-J4-11KB-RJ (Note 2)	14 (AWG 6): e	1.25 (AWG 16): c 2 (AWG 14): c
MR-J4-15KB-RJ (Note 2)	22 (AWG 4): f	
MR-J4-22KB-RJ (Note 2)	38 (AWG 2): g	

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.

(2) Selection example of crimp terminals

Symbol	Servo amplifier-side crimp terminal				
	(Note 2) Crimp terminal	Applicable tool			Manufacturer
		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	FVD14-6	YF-1	YNE-38	DH-122 DH-112	
f	FVD22-6	YF-1	YNE-38	DH-123 DH-113	
g	FVD38-8	YF-1	YNE-38	DH-124 DH-114	

Note 1. Coat the crimping part with an insulation tube.

2. Some crimp terminals may not be mounted depending on their sizes. Make sure to use the recommended ones or equivalent ones.

App. 15.4 Molded-case circuit breakers, fuses, magnetic contactors

(1) For main circuit power supply

⚠CAUTION

- ●To prevent the servo amplifier from smoke and a fire, select a molded-case circuit breaker which shuts off with high speed.
- ●Always use one molded-case circuit breaker and one magnetic contactor with one servo amplifier.

When using a fuse instead of the molded-case circuit breaker, use the one having the specifications given in this section.

Servo amplifier	Molded-case circuit breaker			Fuse			Magnetic contactor (Note)
	Frame, rated current		Voltage AC [V]	Class	Current [A]	Voltage DC [V]	
	Power factor improving reactor is not used	Power factor improving reactor is used					
MR-J4-10B-RJ	30 A frame 5 A	30 A frame 5 A	240	T	10	400	DUD-N30
MR-J4-20B-RJ	30 A frame 5 A	30 A frame 5 A					
MR-J4-40B-RJ	30 A frame 10 A	30 A frame 5 A			15		
MR-J4-60B-RJ	30 A frame 15 A	30 A frame 10 A			20		
MR-J4-70B-RJ	30 A frame 15 A	30 A frame 10 A					
MR-J4-100B-RJ (3-phase power supply input)	30 A frame 15 A	30 A frame 10 A					
MR-J4-100B-RJ (1-phase power supply input)	30 A frame 15 A	30 A frame 15 A					
MR-J4-200B-RJ	30 A frame 20 A	30 A frame 20 A			30		
MR-J4-350B-RJ	30 A frame 30 A	30 A frame 30 A			40		
MR-J4-500B-RJ	50 A frame 50 A	50 A frame 50 A			60		DUD-N60
MR-J4-700B-RJ	100 A frame 75 A	60 A frame 60 A			80		
MR-J4-11KB-RJ	100 A frame 100 A	100 A frame 100 A			125		DUD-N120
MR-J4-15KB-RJ	125 A frame 125 A	125 A frame 125 A			175		
MR-J4-22KB-RJ	225 A frame 175 A	225 A frame 175 A			300		DUD-N180

Note. Use the magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less (160 ms or less for 5 kW or more).

(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/N-), install an overcurrent protection device (fuse, etc.) to protect the branch circuit.

Servo amplifier	Fuse (Class T)		Fuse (Class K5)	
	Current [A]	Voltage DC [V]	Current [A]	Voltage DC [V]
MR-J4-10B-RJ	1	400	1	400
MR-J4-20B-RJ				
MR-J4-40B-RJ				
MR-J4-60B-RJ				
MR-J4-70B-RJ				
MR-J4-100B-RJ				
MR-J4-200B-RJ				
MR-J4-350B-RJ				
MR-J4-500B-RJ				
MR-J4-700B-RJ				
MR-J4-11KB-RJ				
MR-J4-15KB-RJ				
MR-J4-22KB-RJ				

App. 16 Status of general-purpose AC servo products for compliance with the China RoHS directive

(1) Summary

The China RoHS directive: 电子信息产品污染控制管理办法 (Management Methods for Controlling Pollution by Electronic Information Products) came into effect on March 1, 2007. The China RoHS directive was replaced by the following China RoHS directive: 电器电子产品有害物质限制使用管理办法 (Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products). The succeeding China RoHS directive has been in effect since July 1, 2016.

The China RoHS directive restricts the use of six hazardous substances (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE)) and other hazardous substances specified by the State (currently no applicable substances). The EU RoHS directive (2011/65/EU) also restricts the use of the above six hazardous substances.

(2) Status of our products for compliance with the China RoHS directive

The following tables show the content of six hazardous substances in our products and Environment-Friendly Use Period marks. Table app. 4 is created based on the standard SJ/T11364.

Table app. 4 Names and the content of hazardous substances in the products

Substance name Threshold standard Part name		Hazardous substance (Note 1)						Environment-Friendly Use Period mark (Note 2)	Remark
		Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent chromium (Cr(VI))	PBB	PBDE		
		Threshold of cadmium: 0.01 wt% (100 ppm), Threshold of substances other than cadmium: 0.1 wt% (1000 ppm)							
Servo amplifier Servo system controller	Mounting board	×	○	○	○	○	○	15	
	Heat sink	×	○	○	○	○	○		
	Resin cabinet	○	○	○	○	○	○		
	Plate and screw	○	○	○	○	○	○		
Servo motor	Bracket	×	○	○	○	○	○	15	
	Mounting board	×	○	○	○	○	○		
	Resin cabinet	○	○	○	○	○	○		
	Core and cable	○	○	○	○	○	○		
Cable product	Cable	○	○	○	○	○	○	e	Including connector set
	Connector	○	○	○	○	○	○		
Optional unit	Mounting board	×	○	○	○	○	○	15	
	Resin cabinet	○	○	○	○	○	○		
	Plate and screw	○	○	○	○	○	○		

Note 1. ○: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T26572.

×: Indicates that said hazardous substance contained in at least one of the homogeneous materials for this part is above the limit requirement of GB/T26572.

2. Indications based on "Marking for the restriction of the use of hazardous substances in electrical and electronic product" [SJ/T11364-2014]

15 Indicates that a certain hazardous substance is contained in the product manufactured or sold in China. Observe safety and usage precautions for the product, and use it within a limited number of years from the production date. Thereby, any of the hazardous substances in the product does not cause environmental pollution, or seriously affect human health or property.

e Indicates that no certain hazardous substance is contained in the product.

(3) Difference between the China RoHS directive and the EU RoHS directive

The China RoHS directive allows no restriction exemption unlike the EU RoHS directive. Although a product complies with the EU RoHS directive, a hazardous substance in the product may be considered to be above the limit requirement (marked "×") in the China RoHS directive.

The following shows some restriction exemptions and their examples according to the EU RoHS directive.

- Lead as an alloying element in steel for machining purposes and in galvanized steel containing up to 0.35% lead by weight, lead as an alloying element in aluminum containing up to 0.4% lead by weight, and copper alloy containing up to 4% lead by weight, e.g. brass-made insert nuts
- Lead in high melting temperature type solders (i.e. lead-based alloys containing 85% by weight or more lead)
- Electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezoelectronic devices
- Electrical and electronic components containing lead in a glass or ceramic matrix compound, e.g. chip resistors

(4) Status of our products for compliance with the China RoHS directive (Chinese)

The following shows table app. 4 in Chinese according to "Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products".

表附.5 产品中所含有害物质的名称及含量

部件名称	物质名称 阈值 基准	有害物质 (注1)						环境保护使用期限标识 (注2)	备注
		铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	PBB	PBDE		
		阈值：镉：0.01wt%(100ppm)、 镉以外：0.1wt%(1000ppm)、							
伺服放大器 伺服系统 控制器	电路板组件	×	○	○	○	○	○	15	
	散热片	×	○	○	○	○	○		
	树脂壳体	○	○	○	○	○	○		
	金属板、螺丝	○	○	○	○	○	○		
伺服电机	托架	×	○	○	○	○	○	15	
	电路板组件	×	○	○	○	○	○		
	树脂壳体	○	○	○	○	○	○		
	铁心、电线	○	○	○	○	○	○		
电缆 加工品	电线	○	○	○	○	○	○	e	包括连接器组件
	连接器	○	○	○	○	○	○		
选件 模块	电路板组件	×	○	○	○	○	○	15	
	树脂壳体	○	○	○	○	○	○		
	金属板、螺丝	○	○	○	○	○	○		

注 1. ○：表示该有害物质在该部件所有均质材料中的含量均在GB/T26572规定的限量要求以下。

×：表示该有害物质在该部件的至少一种均质材料中的含量超出GB/T26572规定的限量要求。

2. 根据“电子电气产品有害物质限制使用标识要求”、[SJ/T11364-2014]的表示

15 该标志表示在中国制造/销售的产品中含有特定有害物质。只要遵守本产品的安全及使用方面的注意事项，从生产日算起的环保使用期限内不会造成环境污染或对人体、财产产生深刻的影响。

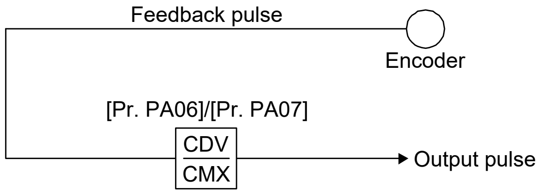
e 该标志表示制造的产品中不含有特定有害物质。

App. 17 Encoder output pulse setting method

POINT

- ●Depending on the servo motor stop position, the encoder output pulse may turn on and off repeatedly even if the servo motor is stopped.

For details of "Encoder output pulse setting selection" in [Pr. PC19], refer to the following table.

Setting value	Servo motor/direct drive motor	Linear servo motor
_ _ 0 _ (Output pulse setting)	Set the output pulses per revolution with [Pr. PA15 Encoder output pulses]. Output pulse = a value set in [Pr. PA15] [pulse/rev] Selecting "Load side encoder (_ 1 _ _)" of "Encoder selection for encoder output pulse" in [Pr. PC19] triggers [AL. 37 Parameter error].	The output pulse setting cannot be used. If "0" is selected, the dividing ratio setting is used.
_ _1 _ (Dividing ratio setting)	Set the dividing ratio to the resolution per servo motor revolution with [Pr. PA15 Encoder output pulses]. Output pulse = $\frac{\text{Resolution per revolution}}{\text{[Pr. PA15] setting}}$ [pulse/rev]	Set the dividing ratio to the travel distance of the linear servo motor with [Pr. PA15 Encoder output pulses]. Output pulse = $\frac{\text{Travel distance of linear servo motor}}{\text{[Pr. PA15] setting}}$ [pulse]
_ _ 2 _ (The same output pulse setting as the command pulse)	Feedback pulses from the encoder are processed as follows to be outputted. Feedback pulses are outputted in the same pulse unit as the command pulse. 	
_ _ 3 _ (A-phase/B-phase pulse electronic gear setting)	Set the A-phase/B-phase pulse electronic gear with [Pr. PA15 Encoder output pulses] and [Pr. PA16 Encoder output pulses 2]. Output pulse = the servo motor resolution per revolution × $\frac{\text{[Pr. PA15] setting}}{\text{[Pr. PA16] setting}}$ [pulse/rev]	Set the A-phase/B-phase pulse electronic gear with [Pr. PA15 Encoder output pulses] and [Pr. PA16 Encoder output pulses 2]. Output pulse = Travel direction of linear servo motor × $\frac{\text{[Pr. PA15] setting}}{\text{[Pr. PA16] setting}}$ [pulse]
_ _ 4 _ (A/B-phase pulse through output setting)	[AL. 37 Parameter error] occurs.	A/B-phase pulse of A/B/Z-phase differential output encoder is outputted. This is enabled only when A/B/Z-phase differential output encoder is used. Output pulse = A/B-phase pulse of A/B/Z-phase differential output encoder [pulse] The value set for "Encoder output pulse phase selection" in [Pr. PC19] is not applied. When another encoder is connected, [AL. 37 Parameter error] occurs. Selecting "Standard control mode (_ _ 0 _)" of "Operation mode" in [Pr. PA01] triggers [AL. 37 Parameter error]. The values set for [Pr. PA15 Encoder output pulses] and [Pr. PA16 Encoder output pulses 2] are not applied.

MEMO

REVISION

*The manual number is given on the bottom left of the back cover.

Revision Date	*Manual Number	Revision	
Mar. 2012	SH(NA)030106ENG-A	First edition	
Jun. 2012	SH(NA)030106ENG-B	4. Additional instructions (2) Wiring	The sentences are added.
		4. Additional instructions (3) Test run and adjustment	The sentences are added.
		COMPLIANCE WITH CE MARKING	The reference is changed.
		COMPLIANCE WITH UL/CSA STANDARD	The reference is changed.
		COMPLIANCE WITH KC MARK	Added.
		Section 1.2	The diagram is changed.
		Section 1.3	The table and Note are changed.
		Section 1.5	The sentences of the fully closed loop system and drive recorder are changed.
		Section 1.7.1	The diagram is changed.
		Chapter 2	CAUTION is changed.
		Section 2.5	POINT is changed to CAUTION.
		Section 2.6	The explanation of relay lifetime is changed.
		Chapter 3	The sentences are added to CAUTION.
		Section 3.1	The sentences are added to CAUTION. Note 12 is added.
		Section 3.1.1 (1)	Note 11 is added.
		Section 3.1.1 (2)	Note 11 is added.
		Section 3.1.1 (3)	Note 11 is added.
		Section 3.1.1 (4)	Note 11 is added.
		Section 3.2.1	Note 17 is added.
		Section 3.2.2	Note 17 is added.
		Section 3.3.1	The sentences of N- are changed.
		Section 3.3.3 (2) (a)	The ferrule is added.
		Section 3.5.2 (2)	The sentences of INP (In-position) are added. CLDS (During fully closed loop control) is added.
		Section 3.6.2 (1)	The sentences are added.
		Section 3.7.1 (3)	The sentences are added.
		Section 3.8.2 (1)	The sentences are changed.
		Section 3.8.2 (2)	The sentences are added.
		Section 3.8.3 (1)	The sentences are added.
		Section 3.8.3 (2)	The sentences are added.
		Section 3.10.2 (1) (a)	The sentences are changed.
		Section 4.1.2 (1) (b) 4)	Added.
		Section 4.3.3 (1)	The diagram is changed.
		Section 4.5.2 (1) (b)	Note is added. [AL. 20 Encoder normal communication error 1 (ABZ input)] in the table is deleted.
		Section 5.1	POINT is changed and Note is deleted.
		Section 5.1.1	PA25 is changed from "For manufacturer setting".
		Section 5.1.6	PF06 and PF12 are changed from "For manufacturer setting".
		Section 5.2.1	The sentences are added to PA01 and PA25 is added.
		Section 5.2.3	The sentences of PC01 are changed and sentences are added to PC03.
		Section 5.2.4	The table of PD07 is changed.
		Section 5.2.5	The sentences are added to PE08.
		Section 5.2.6	PF06 and PF12 are added.
		Chapter 6	The sentences in POINT are changed.

Revision Date	*Manual Number	Revision	
Jun. 2012	SH(NA)030106ENG-B	Chapter 7	The sentences in POINT are changed.
		Section 7.3.1	The sentences are added to POINT.
		Section 8.1	The column of the fully closed loop control is added. [AL. 1E.2], [AL. 1F.2], [AL. 42.8], [AL. 42.9], [AL. 42.A], [AL. 70], [AL. 71], [AL. 72], and [AL. E8.2] are added.
		Section 10.3	POINT is added.
		Section 10.3.2	The table is changed.
		Section 11.3	The sentences are changed.
		Section 11.4	The sentences are changed.
		Section 11.5	The sentences are changed.
		Section 11.5 (3)	The diagram is changed.
		Section 11.5 (4)	The connection destination of the servo amplifier is changed.
		Section 11.7 (1)	Note is changed.
		Chapter 12	The sentences are added to POINT.
		Section 13.1.5	The value in table is changed.
		Section 13.3.2 (1)	The diagram is changed.
		Section 13.3.2 (2)	Added.
		Section 13.3.3	The part of diagram is changed.
		Section 13.3.4	The part of diagram is changed.
		Section 13.4.1 (1)	The sentences are changed.
		Section 13.4.1 (2)	The sentences are added.
		Section 13.4.1 (2) (a)	Note is changed.
		Section 13.4.2 (1)	The sentences are added.
		Section 13.4.2 (2)	The sentences are added.
		Section 14.1.2	CAUTION is changed.
		Section 14.2	CAUTION is added.
		Section 14.3.1 (1)	The diagram is added.
		Section 14.3.1 (2)	"Set the linear servo motor series and linear servo motor type" is added.
		Section 14.3.2 (3) (a)	POINT and sentences are changed.
		Section 14.3.2 (3) (b)	POINT is changed.
		Section 14.4.4	The table is changed and the sentences are added. CAUTION is changed.
		Section 15.1.2	CAUTION is changed.
		Section 15.2	CAUTION is added.
		Section 15.3.2 (3) (a)	POINT and sentences are changed.
		Section 15.3.2 (3) (b)	POINT is changed.
		Section 15.4.3 (2)	The table is changed.
		Chapter 16	"Available in the future" is deleted. The sentences in POINT are changed.
		Section 16.1.1	The sentences of Note 2 are changed.
		Section 16.1.2 (1)	The part of diagram is changed.
		Section 16.3.1 (5)	The part of table is changed.
		Section 16.3.4 (3)	The part of table is changed.
		Appendix. 4	The sentences are changed.
		Appendix. 5	The sentences are changed.
		Appendix. 6	The sentences are changed.
		Appendix. 7.7.3 (1)	POINT and diagram are changed.
		Appendix. 7.7.3 (2)	The diagram is changed.
		Appendix. 7.7.3 (3)	Deleted.
		Appendix. 7.7.3 (4)	Deleted.
		Appendix. 7.8.1 (1)	The pin number is changed and Note is deleted.
		Appendix. 7.8.1 (2)	CAUTION is deleted.
		Appendix. 7.8.2	The sentences are changed.
		Appendix. 7.12	The diagram is added.

Revision Date	*Manual Number	Revision	
Jun. 2012	SH(NA)030106ENG-B	Appendix. 7.14	POINT is changed.
		Appendix. 8	TUV certificate of MR-J4 series is added.
		Appendix. 10.1	The diagram is changed.
		Appendix. 13	Added.
Sep. 2012	SH(NA)030106ENG-C	Section 3.2.1	The diagram is changed.
		Section 3.2.2	The diagram is changed.
		Section 3.10.2 (1) (b)	The diagram is changed.
		Section 13.3.1	The sentences are changed.
		Section 13.4.1 (1)	The diagram is changed.
		Section 13.4.2 (1)	The diagram is changed.
Feb. 2013	SH(NA)030106ENG-D	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 Instructions 4 (1)	Two items are added to CAUTION.
		Safety Instructions 4 (2)	The diagram in CAUTION is changed.
		COMPLIANCE WITH CE MARKING	The reference is changed.
		COMPLIANCE WITH UL/CSA STANDARD	The reference is changed.
		COMPLIANCE WITH KC MARK	The reference is changed.
		Section 1.1	The sentences and table of combination are added.
		Section 1.2	POINT is added.
		Section 1.2 (1)	CN2L, Note 5, and Note 6 are added.
		Section 1.2 (2)	CN2L, Note 3, and Note 4 are added.
		Section 1.2 (3)	Newly added.
		Section 1.3	The item is added to Safety performance. Note 9 and 11 kW to 22 kW are added. The content of Note 3 is changed.
		Section 1.4	POINT and function are added. The table of combination is changed.
		Section 1.5	Function item is added.
		Section 1.6 (2)	The content is added.
		Section 1.7.1 (1)	(18) to (20), and Note are added. The diagram is changed.
		Section 1.7.1 (1) to (4)	The diagram is changed.
		Section 1.7.1 (5), (6)	Newly added.
		Section 1.7.2	The sentences are added.
		Section 1.8 (1) to (4)	CN2L and Note 4 are added.
		Section 1.8 (5), (4)	Newly added.
		Chapter 2	Two items are added to CAUTION.
		Section 2.1 (1) (a), (b)	Note 1 and 2 are added.
		Section 2.4 (1) to (6)	Note 5 is added.
		Chapter 3	The diagram in CAUTION is changed.
		Section 3.1 (1) to (4)	The connection diagram is changed. Note 12 is added.
		Section 3.1 (5)	Newly added.
		Section 3.2.1	The connection diagram is changed. Note 10 is changed.
		Section 3.2.2	The connection diagram is changed.
		Section 3.3.1	The content of the table is changed.
		Section 3.3.2	POINT is added.
		Section 3.4	Note 1, 2, and CN2L are added. The connector explanation is deleted.
		Section 3.5.2 (2)	The content is changed.
		Section 3.6	POINT is added.
		Section 3.6.2	The sentences are changed.
		Section 3.6.3	The content is changed.
		Section 3.8	CN2L, Note 4, and Note 5 are added.
		Section 3.8.1	The connection diagram is changed. Note 5 is added.

Revision Date	*Manual Number	Revision	
Feb. 2013	SH(NA)030106ENG-D	Section 3.10.1 (1)	The connection diagram is changed.
		Section 3.10.2 (1) (b)	Timing chart is changed.
		Section 4.1.2 (1) (b) 5)	Newly added.
		Section 4.1.2 (1) (c) 1)	The sentences are changed.
		Section 4.1.2 (1) (c) 2)	The sentences are changed.
		Section 4.1.2 (1) (c) 4)	Newly added.
		Section 4.1.2 (5)	Newly added.
		Section 4.2 (5)	The content of the table is changed.
		Section 4.5.3 (3)	The content is changed.
		Chapter 5	CAUTION is added.
		Section 5.1.1	The name of [Pr. PA20] is changed. [Pr. PA22] and [Pr. PA26] are released. The content of [Pr. PC20] is changed.
		Section 5.1.4	The content of [Pr. PD12] is changed.
		Section 5.1.6	The name of [Pr. PF25] is changed.
		Section 5.2.1	The contents of [Pr. PA02] and [Pr. PA17] are changed. The name of [Pr. PA20] is changed. [Pr. PA22] and [Pr. PA26] are released.
		Section 5.2.3	The content of [Pr. PC20] is changed. The sentences are added to [Pr. PC04] and [Pr. PC05]. [Pr. PC26] is added. The contents are added to [Pr. PC03] and [Pr. PC27]. Note 2 is added to [Pr. PC09].
		Section 5.2.4	The contents are added to [Pr. PD01], [Pr. PD02], [Pr. PD07], [Pr. PD12], and [Pr. PD30].
		Section 5.2.5	[Pr. PE06] and [Pr. PE07] are changed.
		Section 5.2.6	The name of [Pr. PF25] is changed.
		Section 5.2.7	Note is added to [Pr. PL04].
		Section 6.2.2	The display of MR Configurator2 is changed.
		Section 6.2.2 (2)	POINT is added.
		Section 6.2.2 (5)	The sentences are added.
		Section 6.3.4	The content of the table is changed.
		Section 7.3.2	Newly added.
		Section 7.4	Newly added.
		Chapter 8	POINT is added.
		Section 8.1	The name of [AL. F0.1] is changed. [AL. 17.8] and Note 6 are added.
		Section 9.1	POINT is added.
		Section 9.1 (1) to (7)	The dimensions are changed.
		Section 9.1 (8), (9)	Newly added.
		Chapter 10	POINT is added.
		Section 10.1	The table of combination is added. The graph is changed and added. Note 3 is added.
		Section 10.2 (1)	The content of the table is changed. Note 3 is added.
		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 and Note 2 are 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.
		Section 11.3	POINT is added. The sentences are changed.
		Section 11.3.1	The content of the table, Note 1, and Note 2 are added.

Revision Date	*Manual Number	Revision	
Feb. 2013	SH(NA)030106ENG-D	Section 11.3.3 (1) (a)	The connection diagram is changed. Note 12 is added.
		Section 11.3.3 (1) (b)	The connection diagram and Note 12 are changed. Note 14 is added.
		Section 11.3.3 (2)	The connection diagram is added.
		Section 11.3.3 (3), (4)	The content of the table is changed.
		Section 11.3.4 (1)	The dimensions are added.
		Section 11.3.4 (2)	FR-BR-55K is added.
		Section 11.3.4 (3)	Newly added.
		Section 11.4 (1)	FR-RC-55K is added.
		Section 11.4 (2)	The connection diagram is changed. Note 9 is added.
		Section 11.4 (3), (4)	FR-RC-55K is added.
		Section 11.5 (3)	The connection diagram is changed. Note 8 is added.
		Section 11.5 (4)	The content is changed.
		Section 11.5 (6)	Note 2 is changed.
		Section 11.7	POINT is added.
		Section 11.7 (1)	Note 2 to Note 4 are added.
		Section 11.7 (2) (a)	Note 1 is changed.
		Section 11.9 (1)	The content and Note 5 are added.
		Section 11.9 (2)	The crimp terminal is added.
		Section 11.10 (1)	The contents for 11 kW to 22 kW are added.
		Section 11.10 (2)	The contents of molded-case circuit breaker and magnetic contactor are changed. Note 3 is added.
		Section 11.11	Power factor improving DC reactors for 11 kW to 22 kW are added.
		Section 11.12	Power factor improving AC reactor is added for 11 kW to 22 kW.
		Section 11.14 (2) (c)	The dimensions are changed.
		Section 11.15	11 kW to 22 kW are added. The content of the table is changed.
		Section 11.16	The EMC filters for 11 kW to 22 kW are added.
		Section 11.17	Newly added.
		Section 11.18	Newly added.
		Chapter 13	The names of overseas standards are unified.
		Section 13.2.2 (2)	The sentences are changed.
		Section 13.3.1	The connection diagram is changed.
		Section 13.4.1 (1)	The connection diagram is changed.
		Section 13.4.2 (1)	The connection diagram is changed.
		Section 14.1.1	The software version of MR Configurator2 is changed.
		Section 14.1.2 (2)	The connections of MR-J4-_B-RJ servo amplifiers are added.
		Section 14.2	The diagram in CAUTION is changed.
		Section 14.3.2 (1)	The sentences of Note are changed.
		Section 14.3.2 (5) (b) 3)	The sentences are changed.
		Section 14.3.3 (2)	The sentences are changed.
		Section 14.3.5 (2) (a)	The [Pr. PA01] setting value is changed.
		Section 14.4.2	The content of the table is changed.
		Section 14.4.4	The sentences are changed.
		Section 15.1.2	Note 7 is added.
		Section 15.2	The diagram of CAUTION is changed. The content of table is added.
		Section 15.3.2 (3) (b)	The content of POINT is changed.
		Section 15.3.3	The [Pr. PA01] setting value is changed.
		Section 15.3.4 (1) (a)	The sentences are partially changed.
		Chapter 16	The content of POINT is changed.
		Section 16.1.1	Note 2 is changed.
		Section 16.1.2 (1)	The content of the diagram is changed.

Revision Date	*Manual Number	Revision	
Feb. 2013	SH(NA)030106ENG-D	Section 16.1.3 (1)	The composition is changed due to addition of MR-J4_B-RJ servo amplifier.
		Section 16.1.3 (2)	The composition is changed due to addition of MR-J4_B-RJ servo amplifier.
		Section 16.2.1	The sentences are added. The table is deleted. The content is changed.
		Section 16.2.1 (1), (2)	The connections of MR-J4-_B-RJ servo amplifiers are added.
		Section 16.2.2	The sentences are changed.
		Section 16.2.3 (1)	The composition is changed due to addition of MR-J4_B-RJ servo amplifier.
		Section 16.2.3 (2)	The composition is changed due to addition of MR-J4_B-RJ servo amplifier.
		Section 16.3.1 (1)	The startup procedure is changed.
		Section 16.3.1 (3), (4)	Newly added.
		Section 16.3.1 (6)	The content of the table is added.
		Section 16.3.1 (7)	The [Pr. PE08] setting value is changed.
		Section 16.3.5	Newly added.
		Section 16.3.6	Newly added.
		Section 16.3.9 m)	The diagram of MR Configurator2 is changed. 3) and 5) are added.
		App. 4	Compliance with global standards is changed. App. 4 to 6 are combined.
		App. 5	The content is changed. Carried from App. 7.
		App. 6	Carried from App. 8.
		App. 7	Carried from App. 9.
		App. 8	Carried from App. 10.
		App. 9	Carried from App. 11.
		App. 10	Carried from App. 12. POINT is added.
		App. 10 (2)	Note 3 is deleted.
		App. 11	Carried from App. 13. POINT is added.
		App. 11.1	The sentences are changed.
		App. 11.3	Note 13 and 14 are added.
		App. 11.7 (5)	Newly added.
		App. 11.8	Newly added.
Aug. 2013	SH(NA)030106ENG-E	The master-slave operation function, scale measurement function, and J3 compatibility mode are added.	
		Safety Instructions 4 (1)	A sentence is changed. An item is deleted.
		Safety Instructions 4 (2)	An item is added.
		Section 1.1	Table 1.1 is changed.
		Section 1.3	The scale measurement function is added. Note 10 is added.
		Section 1.5	The master-slave operation function, scale measurement function, and J3 compatibility mode are added.
		Section 1.6 (1)	The content is changed.
		Section 1.7.1 (1)	The table is changed. Note 2 is added and (9), (10), and (18) are changed.
		Chapter 2	A sentence is changed. An item is deleted.
		Section 3.1 (1) to (5)	Note 1 is changed.
		Section 3.4	Note 2 is changed.
		Section 3.8.1	Note 6 is added.
		Section 5.1.3	[Pr. PC26] and [Pr. PC27] are changed. Note is added.
		Section 5.1.4	[Pr. PD11], [Pr. PD15] to [Pr. PD17], [Pr. PD20], [Pr. PD30] to [Pr. PD32] are released. Note is added.
		Section 5.2.1	[Pr. PA14] is partly added. [Pr. PA22] is changed.
		Section 5.2.3	The table in [Pr. PC27] is changed.

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Aug. 2013	SH(NA)030106ENG-E	Section 5.2.4	[Pr. PD11], [Pr. PD15] to [Pr. PD17], [Pr. PD30] to [Pr. PD32] are released.
		Section 5.2.6	[Pr. PF23] is partly added.
		Section 7.1.5 (4)	POINT is deleted. Table is added.
		Section 7.4 (3)	Newly added.
		Section 8.1	[AL. 25.2], [AL. 3E.3], [AL. 3D] and [AL. 82] are added. [AL. 28], [AL. 2A], [AL. 3E], [AL. 70] to [AL. 72] are changed. Note 7 is added.
		Section 8.2	The display content is added.
		Section 9.1 (6) to (9)	A dimension is changed.
		Section 11.2.4 (3)	CAUTION is added.
		Section 11.3.3 (1) (a)	Note 3 is changed.
		Section 11.3.3 (1) (b)	Note 3 is changed.
		Section 11.3.3 (2) (a)	Note 3 is changed.
		Section 11.4	POINT is added.
		Section 11.4 (2)	Note 4 is changed. Model of Power factor improving reactor is deleted. Note 4 is changed. Note 10 is added.
		Section 11.5 (5) (a)	The sentences are changed.
		Section 11.7 (2) (a)	The content is added.
		Section 11.7.3	Newly added.
		Section 11.10 (1)	Table and Note 3 are changed.
		Section 11.17 (2)	Note 7 is added.
		Section 14.1.2 (1)	Note 6 is added.
		Section 14.1.2 (2)	The content is changed.
		Section 14.1.2 (3)	Newly added.
		Section 15.3.2	POINT is added.
		Section 16.1.3 (2) (a)	Note is added.
		Section 16.1.3 (2) (b)	The diagram is changed.
		Chapter 17	Newly added.
		App. 4.2.1 (1)	The title is changed.
		App. 4.2.3 (4)	The sentences are added.
		App. 4.3	CAUTION is added.
Oct. 2013	SH(NA)030106ENG-F	400 V class is added.	
		Safety Instructions 4 (1)	One item is added.
		About the manuals	The content of the table is added.
		Section 1.2 (1)	The diagram is changed.
		Section 1.2 (2)	Newly added.
		Section 1.3 (2)	Newly added.
		Section 1.4 (2)	Newly added.
		Section 1.5	The content of the table is added.
		Section 1.6 (2)	A combination is added.
		Section 1.7.1 (1) (a)	The content of the table is added. The diagram is changed.
		Section 1.7.1 (1) (b)	The diagram is changed.
		Section 1.7.1 (2)	Newly added.
		Section 1.7.1 (2) (a)	The content of the table is added.
		Section 1.8 (2)	Newly added.
		Section 3.1.2	Newly added.
		Section 3.3.1	The content of the 400 V class is added.
		Section 3.3.2 (2)	The content of Note 1 is changed. Note 2 is added.
		Section 3.3.3 (1) (c)	Newly added.
		Section 3.3.3 (2) (a)	The content of the table is added.
		Section 4.1.2 (1) (c) 2)	Newly added.
		Section 4.5.2 (1) (b)	The content of the table is changed.
		Section 5.1.4	The names of [Pr. PD16], [Pr. PD17], and [Pr. PD20] are changed.

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Oct. 2013	SH(NA)030106ENG-F	Section 5.1.5	[Pr. PE10] The content is changed.
		Section 5.1.6	[Pr. PF25] The name is changed.
		Section 5.2.1	A sentence is added to [Pr. PA01]. [Pr. PA02] and [Pr. PA20] are changed. [Pr. PA17] The content is added. [Pr. PA26] The name is changed.
		Section 5.2.3	[Pr. PC09] The content is changed.
		Section 5.2.4	The names of [Pr. PD16], [Pr. PD17], and [Pr. PD20] are changed.
		Section 5.2.5	[Pr. PE10] The content is changed.
		Section 5.2.6	[Pr. PF25] The name is changed.
		Section 6.2	POINT is added.
		Section 7.1.3	POINT is added.
		Section 7.3	The sentences are added.
		Section 7.3.1 (2)	The content of the table is changed.
		Section 7.3.2 (1)	Note is added.
		Section 7.3.2 (2) (a), (b)	The sentences are changed and note is added.
		Section 7.4 (2)	The title and content of the table are changed.
		Section 8.1	The POINT is added. The content of the table is changed. Note 4 of alarm table is changed. Note 7 is deleted. Note 2 of warning table is changed.
		Section 9.1 (1) (a) to (e)	The diagram is changed.
		Section 9.1 (2)	Newly added.
		Section 10.1	The content of the table is changed.
		Section 10.2 (1)	The content of the table is added.
		Section 10.3.1 (2) (b)	Newly added.
		Section 10.3.2 (2)	Newly added.
		Section 10.5	The content of the table is added.
		Section 11.1.1	The content of the table is added.
		Section 11.2.1 (2)	Newly added.
		Section 11.2.2 (1) (b)	The content of the table is added.
		Section 11.2.3	The content is added.
		Section 11.2.4	The content of POINT is changed.
		Section 11.2.4 (1) to (4)	The content is added.
		Section 11.2.5 (1), (3), (5)	The content is added.
		Section 11.2.5 (6)	Newly added.
		Section 11.2.5 (7)	The content is added.
		Section 11.3	POINT is added.
		Section 11.3.1	The content of the table is added. Note is added.
		Section 11.3.3 (1) (a) 2)	Newly added.
		Section 11.3.3 (1) (b)	POINT is added.
		Section 11.3.3 (2) (b)	Newly added.
		Section 11.3.3 (4)	The content of the table is added.
		Section 11.3.3 (5)	The content of the table is added.
		Section 11.3.4 (1) to (3)	The content is added.
		Section 11.4 (1)	The content of the table is added.
		Section 11.4 (2) (b)	Newly added.
		Section 11.4 (3), (4)	The content of the table is added.
		Section 11.5.1	The content is changed.
		Section 11.5.2 (2)	Newly added.
		Section 11.5.2 (3) (b)	Newly added.
		Section 11.5.2 (4) (a)	Newly added.
		Section 11.5.2 (4) (b)	Newly added.
		Section 11.5.2 (6)	The content is added.
		Section 11.8	POINT is added.

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Oct. 2013	SH(NA)030106ENG-F	Section 11.8.1	The content is changed.
		Section 11.8.2	Newly added.
		Section 11.9	The content of POINT is changed.
		Section 11.9 (1) (a)	Note 4 is changed.
		Section 11.9 (1) (b)	The content is added. The content of Note 4 is changed.
		Section 11.9 (2) (b)	The content is added.
		Section 11.10 (1), (2)	The content of the table is added. The content of Note 1 is changed.
		Section 11.11 (2)	Newly added.
		Section 11.12 (2)	Newly added.
		Section 11.14 (2) (e)	The content is added.
		Section 11.14 (2) (f)	The content is added.
		Section 11.15 (1)	The graph is added. The content of table 5 is added.
		Section 11.16	The sentences are added.
		Section 11.16 (1)	The content of the table is added.
		Section 11.16 (2) (b)	Newly added.
		Section 11.16 (3) (a)	The content is added.
		Section 11.17	POINT is added.
		Section 11.17 (1)	The content of the table is added.
		Section 11.17 (2) (b)	Newly added.
		Section 11.17 (4) (b)	Newly added.
		Section 11.18	The content of the table is added.
		Chapter 12	Note is added. POINT is added. The content is changed. The configuration is changed.
		Section 14.1.2 (1) to (3)	The sentences are added.
		Section 14.4.1	The sentences are added.
		Section 14.4.2	The content of the table is added.
		Section 14.4.3	The content of the table is added.
		Section 16.1.1	The diagram is changed.
		Section 17.1.2	The sentences are changed.
		Section 17.1.3	The sentences are changed. The content of the table is changed. Note 15 is added.
		Section 17.2 (3)	The content of the table is changed.
		Section 17.3.1 (1)	The content of the table is changed.
		Section 17.3.2 (3) (b) 2)	The diagram is changed.
		App. 4.2.3 (1)	The sentences are added.
		App. 4.2.3 (1) (a)	The content of the table is changed.
		App. 4.2.3 (1) (a) 2)	Newly added.
		App. 4.2.3 (1) (b) 2)	Newly added.
		App. 4.2.3 (4)	The sentences are changed.
		App. 4.3	Note 2 is added.
		App. 4.4 (b)	Newly added.
		App. 4.6.1 (1) (b)	Newly added.
		App. 4.6.2	The content of the table is added. The contents of Note 1 and Note 2 are changed. Note 5 is added.
		App. 4.8.1 (2)	Newly added.
		App. 4.8.2	The content of the table is added.
		App. 4.8.3	The content of the table is added.
		App. 10 (2)	Note 7 is added.
Mar. 2014	SH(NA)030106ENG-G	100 V class MR-J4 series servo amplifiers are added.	
		Section 1.2 (3)	Newly added.
		Section 1.3 (1)	Note 11 is added.
		Section 1.3 (3)	Newly added.
		Section 1.4 (3)	Newly added.
		Section 1.5	The content is added. Note is added.

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Mar. 2014	SH(NA)030106ENG-G	Section 1.6 (2)	The content is added.
		Section 1.7.1 (3)	Newly added.
		Section 1.8 (3)	Newly added.
		Chapter 2	POINT is changed.
		Section 3.1.3	Newly added.
		Section 3.3.1	The content is added.
		Section 3.3.3	The content of POINT is changed.
		Section 3.3.3 (1) (d)	Newly added.
		Section 3.3.3 (2) (a)	The content is added.
		Section 3.11	The content of the note is changed.
		Section 4.1.2 (1) (a) 2)	Newly added.
		Section 4.1.2 (1) (b) 5)	Deleted.
		Section 4.1.2 (1) (c) 3)	Newly added.
		Section 5.2.2	The sentences of [Pr. PB24] are added.
		Section 5.2.3	The content of [Pr. PC09] is added.
		Section 7.1.1 (1)	Caution for the table is changed.
		Section 7.2.3 (1)	The title is changed.
		Section 7.3.1 (2)	Caution for the table is changed.
		Section 7.4	POINT is changed. Sentences are added.
		Section 7.4 (1)	Terms are changed.
		Chapter 8	The content of POINT is changed.
		Section 9.1 (3)	Newly added.
		Section 10.2 (1)	The content of the table is added.
		Section 10.3.2	Sentences are added. (1) and (2) are combined. Note 1 and 2 are deleted.
		Section 10.5	POINT is added. (2) and (3) are added.
		Section 11.1.1	Use of 1) in the table is changed.
		Section 11.2.1 (3)	Newly added.
		Section 11.2.2 (1) (b)	The content of the table is added.
		Section 11.2.5 (2), (3)	Table is added.
		Section 11.4 (2) (a)	Note 4 is changed.
		Section 11.4 (2) (b)	Note 4 is changed.
		Section 11.7.2 (1)	Note 1 is deleted.
		Section 11.9 (1) (c)	Newly added.
		Section 11.10 (1)	The content of the table is added.
		Section 11.10 (2)	The content of the table is added.
		Section 11.12 (1)	The title is changed. The diagram is added. The content of the table is changed.
		Section 11.14 (2) (e)	The content is added.
		Section 11.14 (2) (f)	The content is added.
		Section 11.15 (1)	Note is added. The content is added to table 11.6.
		Section 11.16 (1)	The content of the table is added.
		Section 11.16 (2) (a)	The title and content of the Note 1 are changed.
		App. 1	The content of the table is added.
		App. 4.2.3 (1) (a)	The sentences are changed.
		App. 4.2.3 (1) (a) 1)	The title is changed. The content of the table is changed.
		App. 4.2.3 (1) (a) 2)	The content of the table is changed.
		App. 4.2.3 (1) (b)	The sentences are changed.
		App. 4.2.3 (1) (b) 3)	Newly added.
		App. 4.4 (2)	Note 2 is added.
		App. 4.6.1 (1) (a)	The title is changed. The content of the table is changed.
		App. 4.8.1 (1)	The title is changed. The content of the table is changed.
		App. 4.8.2	The content of the table is changed.
		App. 11	Newly added.

Revision Date	*Manual Number	Revision
Jan. 2015	SH(NA)030106ENG-H	The model adaptive control disabled, lost motion compensation function, super trace control, MR-BT6VCASE, and HG-JR servo motor are added. Safety Instructions 2 The sentences are changed. Safety Instructions 4 (6) The sentences are added. About the manuals The content of the table is changed. Section 1.2 Note is added. Section 1.3 Note is added. Section 1.4 The content of the table is changed. Section 1.5 The content of the table is changed. Section 1.6 (1) The diagram is changed. Section 1.6 (2) The content of the table is changed. Section 1.8 Note is added. Section 3.1 The sentences are added. Section 3.1.1 (5) Note is added. Section 3.1.2 The diagram is changed. Note is added. Section 3.3.2 POINT is changed. Section 3.3.3 (2) (a) The sentences are changed. Section 3.5.2 (2) The content of the table is changed. Section 3.10.1 CAUTION is added. Section 4.3.1 (3) (c) POINT is added. Section 5.1 POINT is added. The content of the table is changed. Section 5.2 The content of the table is changed. Section 7.2.3 (1) (a) The sentences are added. Section 7.2.4 (3) Newly added. Section 7.3.2 POINT is added. Section 7.4 POINT is added. Section 7.5 to 7.7 Newly added. Chapter 8 The content of the chapter is changed. Section 10.1 The sentences are changed. The content of the table is changed. Section 10.2 (1) The content of the table is changed. Section 10.3.1 (2) The diagram is changed. Section 10.3.2 The content of the table is changed. Section 11.1.1 The diagram is changed. The content of the table is changed. Section 11.1.4 Newly added. Section 11.2.4 (3) CAUTION is changed. Section 11.3.3 The diagram is changed. Section 11.4 (2) The diagram is changed. Section 11.5.2 (3) The diagram is changed. Section 11.7.2 (1) The content of the table is changed. Section 11.8 POINT is added. Section 11.8.1 (3) Newly added. Section 11.8.3 Newly added. Section 11.10 CAUTION is added. Section 11.10 (1) Note 4 is added. Section 11.17 CAUTION is added. Section 11.17 (2) Note is added. Chapter 12 POINT is changed. Section 12.2.2 (2) (c) Newly added. Section 12.2.3 Newly added. Section 13.3.3 The diagram is changed. Section 14.1.2 The sentences are changed.

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Jan. 2015	SH(NA)030106ENG-H	Section 14.3.2	POINT is added.
		Section 14.4.2	The content of the table is changed.
		Section 15.1.2	The sentences are changed.
		Section 15.3.2	POINT is added.
		Section 15.4.1	The sentences are changed.
		Section 15.4.2	The content of the table is changed.
		Section 17.1.3	The content of the table is changed.
		Section 17.1.9	Newly added.
		App. 4	The content of the section is changed.
Feb. 2015	SH(NA)030106ENG-J	Safety Instructions	
		Section 1.7.1 (1) (a)	The diagram is changed. The part of table is changed.
		Section 1.7.1 (1) (b)	The diagram is changed.
		Section 1.7.1 (2) (a)	The diagram is changed. The part of table is changed.
		Section 1.7.1 (3)	The diagram is changed. The part of table is changed.
		Section 2.2	The section name is changed.
		Section 3.2.1	Note 14 is changed.
		Section 3.5.1	The explanations of DI1, DI2, and DI3 are changed.
		Section 3.7.1 (1)	The diagram is partially changed.
		Section 5.2.1	The item name of "_ _ 6 _" in [Pr. PA01] is changed. The sentences of "_ _ 0 1" in [Pr. PA02] are changed. The sentences of [Pr. PA03] are changed.
		Section 5.2.3	The sentences of "_ x _ _" in [Pr. PC03] are added. The sentences of "x _ _ _" in [Pr. PC04] are added. "_ _ x _" is added to [Pr. PC17]. The sentences of "x _ _ _" in [Pr. PC26] are added.
		Section 5.2.4	The sentences of [Pr. PD02] are added. The sentences of [Pr. PD15] are added.
		Section 9.1 (1) (a)	The diagram is changed.
		Section 9.1 (1) (b)	The diagram is changed.
		Section 9.1 (1) (c)	The diagram is changed.
		Section 9.1 (1) (d)	The diagram is changed.
		Section 9.1 (1) (e)	The diagram is changed.
		Section 9.1 (2) (a)	The diagram is changed.
		Section 9.1 (2) (b)	The diagram is changed.
		Section 9.1 (3) (a)	The diagram is changed.
		Section 9.1 (3) (b)	The diagram is changed.
		Section 11.8	The contents are entirely changed.
		Chapter 12	The contents are entirely changed.
		Section 14.3.5	The part of table is changed.
		Section 14.3.5 (2) (a)	The part of table is changed.
		Section 15.3.3 (2)	The part of table is changed.
		Section 16.3.1 (3)	The diagram is partially changed.
		Section 16.3.3	The part of table is changed.
		Section 16.3.3 (2)	The part of table is changed.
		Section 17.1.7 (2)	The manuals are added.
		Section 17.1.8 (1) (a)	The part of table is changed.
		Section 17.1.8 (1) (b)	The part of table is changed.
		Section 17.2	POINT is changed.
		Section 17.2 (4)	The content is added.
		Section 17.3	POINT is changed.
		Section 17.3.3 (2)	The diagram is partially changed.
		App. 12	Added.
Sep. 2015	SH(NA)030106ENG-K	MR-J4-100B(-RJ)/MR-J4-200B(-RJ) are compatible with a 1-phase 200 V AC input, the contents of the one-touch tuning are changed, and operable environment is changed to maximum altitude of 2000 m above sea level.	

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Sep. 2015	SH(NA)030106ENG-K	1. To prevent electric shock, note the following	Partially changed.
		4. Additional instructions (1)	The altitude is changed.
		Section 1.3	Partially changed.
		Section 1.4	POINT is added.
		Section 1.6 (2)	Partially added.
		Section 1.8	Partially changed.
		Section 2.7	Added.
		Section 3.1.1 (2)	Partially changed.
		Section 3.3.1	Partially changed.
		Section 5.1.6	[Pr. PF18] is added.
		Section 5.2.2	Partially changed.
		Section 5.2.3	Partially changed.
		Section 5.2.6	[Pr. PF18] is added. The sentences are added to [Pr. PF25].
		Section 6.2	Changed.
		Section 7.1.1	Partially added.
		Section 7.2.3	Note is added.
		Section 7.3.2	POINT is added.
		Section 8.2	[AL. 68] is added. Partially changed.
		Section 10.5	Partially changed.
		Section 11.1.1	Partially changed.
		Section 11.5.2	Note is added.
		Section 11.6	Partially changed.
		Section 11.7.2	Partially changed.
		Section 11.9	Partially changed.
		Section 11.10	Partially changed.
		Section 11.12	Partially changed.
		Section 11.15	Partially changed.
		Section 13.1.1	Partially changed.
		Section 13.1.5	Partially changed.
		Section 13.3.1	Partially changed.
		Section 13.3.3	Partially changed.
		Section 14.3.5	Partially added.
		Section 15.3.3	Partially added.
		Section 16.3.3	Partially added.
		Section 17.1.7	Partially added.
		Section 17.1.9	Partially added.
		Section 17.3	POINT is partially changed.
		App. 1	Partially changed.
		App. 2	Partially changed.
		App. 4	Partially changed.
		App. 11.3	Partially added.
		App. 13	Added.
Feb. 2016	SH(NA)030106ENG-L	The schedule for the compliance with safety integrity level 3 (SIL 3) of the IEC 61508:2010 functional safety standard is added.	
		STO function of the servo amplifier	Partially added.
		App. 6	Partially added.
		App. 14	Newly added.
May 2016	SH(NA)030106ENG-M	Items are added to the description of the optional data monitor function, and the DC power supply input is supported.	
		4. Additional instructions	
		(2) Wiring	Partially added.

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May 2016	SH(NA)030106ENG-M	(5) Corrective actions	Partially added.
		(6) Maintenance, inspection and parts replacement	Partially added and partially changed.
		Section 1.3	Partially added and partially changed.
		Section 1.7	Partially changed.
		Section 1.8	Partially added.
		Section 2.5	Partially added.
		Section 3.1	Partially changed.
		Section 3.3.1	Partially added.
		Section 4.3.3 (2)	Partially changed.
		Section 4.5.1 (1)	Partially changed.
		Section 4.5.2 (1)	Partially changed.
		Section 5.2.2	Partially added and partially changed.
		Section 5.2.3	Partially added and partially changed.
		Section 5.2.4	Partially added.
		Section 5.2.5	Partially changed.
		Section 6.2	Partially changed.
		Section 7.1.2	Partially added and partially changed.
		Section 7.2.3	Partially changed.
		Section 7.6	Partially changed.
		Section 8.2	Partially added and partially changed.
		Section 8.3	Partially added and partially changed.
		Section 10.5	Partially changed.
		Section 11.1.1	Partially added.
		Section 11.2.2	Partially changed.
		Section 11.3.3	Partially changed.
		Section 11.4	Partially changed.
		Section 11.5.2	Partially added and partially changed.
		Section 11.7	Partially changed.
		Section 11.8.3	Partially changed.
		Section 11.8.5	Partially changed.
		Section 11.9	Partially added.
		Section 11.10	Partially added.
		Section 11.14	Partially changed.
		Section 11.16	Partially added and partially changed.
		Section 13.1.5	Partially changed.
		Section 13.3.2	Partially changed.
		Section 14.3.4	Partially changed.
		Section 16.3.1 (4)	Partially changed.
		Section 17.1.3	Partially changed.
		Section 17.1.9	Partially changed.
		Section 17.3.2	Partially added and partially changed.
		Section 17.3.3	Partially changed.
		App. 4	Partially changed.
		App. 5.7.3 (2)	Partially changed.
		App. 7	Partially changed.
		App. 13	Partially added.
		App. 15	Newly added.
Mar. 2017	SH(NA)030106ENG-N	TM-RG2M series / TM-RU2M series direct drive motor is added.	
		4. Additional instructions	
		(1) Transportation and installation	Partially changed.
		Relevant manuals	Partially changed.
		Section 1.3	Partially changed.
		Section 1.4	Partially changed.

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Mar. 2017	SH(NA)030106ENG-N	Section 1.7	Partially changed.
		Section 1.8	Partially changed.
		Section 3.3.3	Partially changed.
		Chapter 5	POINT is partially changed.
		Section 6.2	POINT is partially added.
		Section 6.2.3	Partially added.
		Section 5.2.6	Partially changed.
		Section 8.3	Partially added.
		Section 9.1	Partially changed.
		Section 10.1	Partially changed.
		Section 11.1.1	Partially changed.
		Section 11.1.4	Partially changed.
		Section 11.2	Partially changed.
		Section 11.3.3	Partially changed.
		Section 11.4	Partially changed.
		Section 11.5.2	Partially changed.
		Section 11.7.2	Partially changed.
		Section 11.8	Partially changed.
		Section 11.10	Partially added.
		Section 11.17	The diagram is partially changed.
		Section 13.3.3	The diagram is partially changed.
		Chapter 15	POINT is added.
		Section 15.4	Partially added.
		Section 17.1.9	Partially added.
		App. 4	Partially changed.
		App. 5	Partially changed.
		App. 6	Partially changed.
		App. 13	Partially changed.
		App. 15	Partially changed.
		App. 16	Newly added.
Oct. 2017	SH(NA)030106ENG-P	TM-RG2M002C30/TM-RU2M002C30 are added.	
		3. To prevent injury, note the following	Partially changed.
		4. Additional instructions	Partially changed.
		Section 1.3	Partially changed.
		Section 1.4	Partially changed.
		Section 1.6	Partially changed.
		Chapter 2	CAUTION is partially changed.
		Section 2.7	Partially changed.
		Chapter 3	CAUTION is partially changed.
		Section 3.3.3	Partially added.
		Section 3.6	Partially added.
		Section 3.7.1	Partially added.
		Chapter 4	CAUTION is partially changed.
		Section 4.2	Partially changed.
		Section 4.5.1	Partially changed.
		Section 5.2.1	Partially changed.
		Section 5.2.2	Partially changed.
		Section 5.2.6	Partially changed.
		Chapter 6	POINT is partially added.
		Section 6.2.2	Partially changed.
		Section 6.3.3	Partially changed.
		Section 7.1.5	Partially changed.
		Section 8.2	Partially added.
		Section 10.1	Partially changed.

Revision Date	*Manual Number	Revision	
Oct. 2017	SH(NA)030106ENG-P	Section 10.3	CAUTION is added.
		Section 11.5.2	Partially changed.
		Section 11.7.2	Partially changed.
		Section 11.17	Partially changed.
		Section 14.2	Partially changed.
		Section 14.3.4	Partially changed.
		Section 15.2	Partially changed.
		Section 15.4	Partially changed.
		Section 17.1.9	Partially changed.
		App. 1	Partially changed.
		App. 2	Partially changed.
		App. 4.1	Partially changed.
		App. 4.2	Partially changed.
		App. 4.2.2	Partially changed.
		App. 4.2.3	Partially changed.
		App. 4.3	Partially changed.
		App. 4.7	CAUTION is partially changed.
		App. 10.2	Partially changed.
		App. 10.4.4	Partially changed.
		App. 13.2	Partially changed.
Feb. 2018	SH(NA)030106ENG-Q	FR-CV-H7.5K, FR-CV-H11K, and FR-CV-H15K are added.	
		Section 3.4	The structure of the diagram is changed.
		Section 3.6	POINT is added.
		Section 3.6.1 (2)	The diagram is changed.
		Section 3.6.2 (1)	The diagram is changed.
		Section 3.6.3 (1)	The diagram is changed.
		Section 3.10.2 (1) (a)	POINT is added. The diagram is changed.
		Section 3.10.2 (1) (b)	POINT is added. The diagram is changed.
		Section 3.10.2 (1) (c)	Fully changed.
		Section 4.3.3 (1)	The diagram is changed.
		Section 5.1	POINT is partially changed.
		Section 5.2.1	The sentences are added to PA15. The sentences are added to PA16.
		Section 5.2.3	The sentences are added to PC02. PC03 is partially changed.
		Section 9.1 (2) (a)	The dimensions are changed.
		Section 11.2.2	Fully changed.
		Section 11.5	FR-CV-H7.5K, FR-CV-H11K, and FR-CV-H15K are added.
		Section 11.8.2 (4)	The sentences are changed.
		Section 17.1.9 (3)	The sentences in PX04 and PX05 are changed.
		App. 4.7	POINT is partially deleted.
		App. 5.10	The table is changed.
		App. 17	Added.
Nov. 2020	SH(NA)030106ENG-R	The dimensions of MR-J4-500B(4)(-RJ), MR-J4-700B(4)(-RJ), and MR-J4-22KB(4)(-RJ) are changed.	
		Section 9.1	The diagrams are changed.
Sep. 2021	SH(NA)030106ENG-S	4. Additional instructions	
		(4) Transportation and installation	Partially changed.
		Section 1.3	Partially changed.
		Section 1.7.1	Partially changed.
		Section 2.5	Partially changed.
		Section 3.1	POINT is added and partially added.
		Section 3.4	Partially changed.
		Section 3.6	Partially changed.

Revision Date	*Manual Number	Revision	
Sep. 2021	SH(NA)030106ENG-S	Section 3.7	Partially changed.
		Section 3.10	Partially changed.
		Section 3.11	Partially changed.
		Section 5.1.3	Partially added.
		Section 5.2	Partially added and partially changed.
		Section 8.2	Partially changed.
		Section 9.1	The diagram is changed.
		Section 10.3	POINT is changed.
		Section 10.5	Partially changed.
		Section 11.1.2	Partially changed.
		Section 11.2.3	Partially changed.
		Section 11.2.5	Added.
		Section 11.5.2 (3)	Partially changed.
		Section 11.11	Partially changed.
		Section 11.16 (2)	Partially added and partially changed.
		Section 11.17	POINT is partially changed.
		Section 11.17 (3)	Partially changed.
		Section 11.19	Added.
		Section 12.1.2	Partially deleted.
		Section 13.2.2 (2)	Partially changed.
		Section 14.3.2 (4)	Partially changed.
		Section 14.4.1	Partially added and partially changed.
		Section 15.3.2 (1)	Partially changed.
		Section 15.3.2 (3)	POINT is added.
		Section 15.3.3	POINT is partially changed.
		Section 15.4.3	POINT is changed.
		Section 16.3.1 (1)	Partially changed.
		Chapter 17	POINT is added.
		Section 17.1	Partially added and partially changed.
		Section 17.2	Partially added and partially changed.
		Section 17.3.1 (5)	Partially changed.
		Section 17.3.2	Partially added and partially changed.
		App. 1	Partially added and partially changed.
		App. 3	Partially changed.
		App. 4	Partially added and partially changed.
		App. 9	Partially changed.
		App. 16	Partially added and partially changed.
		App. 18	Partially changed.
Jun. 2024	SH(NA)030106ENG-T	Complied with UKCA Complied with UL 61800-5-1 The description of the compliance with global standards is changed. Disposal of Waste is deleted. The rated current value when 1-phase power supply is input is added. The erroneous description of overload protection characteristics is changed. •Added/edited: Safety Instructions, Section 1.3, Section 1.6, Section 3.10, Section 4.2, Section 5.2, Section 10.1, Section 10.2, Section 13.1, Section 14.4, Section 15.4, Section 16.1.2, Appendix 5, Appendix 6, Appendix 11, Appendix 18	

MEMO

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]

For terms of warranty, please contact your original place of purchase.

[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 loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to:

(1) Damages caused by any cause found not to be the responsibility of Mitsubishi.

(2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products.

(3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products.

(4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

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 AC Servo, its applications should be those that may not result in a serious damage even if any failure or malfunction occurs in AC Servo, and a backup or fail-safe function should operate on an external system to AC Servo when any failure or malfunction occurs.

(2) Our 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.

SH(NA)030106ENG-T(2406)MEE
MODEL: MR-J4-B INSTRUCTIONMANUAL
MODEL CODE: 1CW805

MITSUBISHI ELECTRIC CORPORATION

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