MITSUBISHI
ELECTRIC

General-Purpose AC Servo

MITSUBISHI SERVO AMPLIFIERS & MOTORS
MELSERVO-J4

General-Purpose Interface Servo Amplifier Instruction Manual

-MR-J4-_A_
-MR-J4-_A_-RJ
-MR-J4-03A6
-MR-J4-03A6-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.
- Not doing so may cause a fire when a regenerative transistor malfunctions or the like may overheat the regenerative resistor.
- 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.
- 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 equipment. 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.

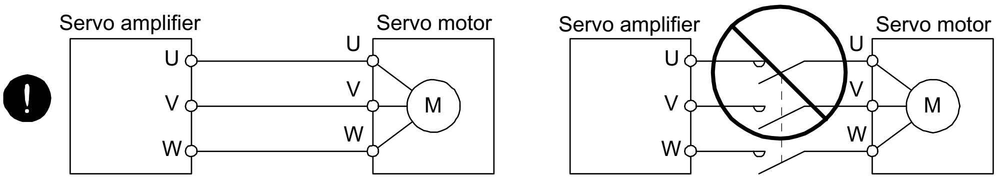
⚠ CAUTION

- 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.

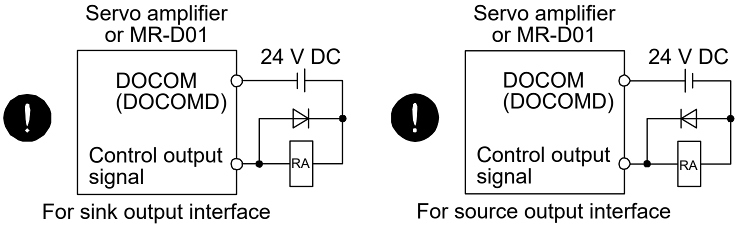
(2) Wiring

⚠ 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.



- 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

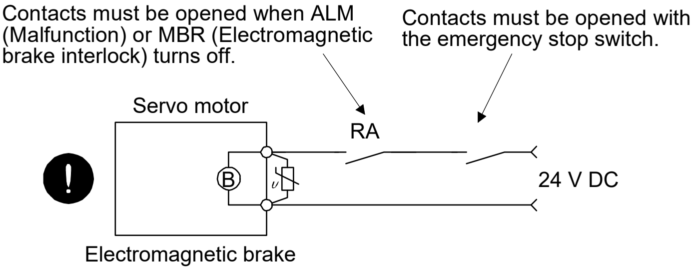
⚠ CAUTION

- 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.
- 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.
- 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.
- 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
- Home position setting in the absolute position detection system

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. 12 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.
When using the MR-J4-03A6(-RJ), refer to chapter 18.

Relevant manuals

Manual name	Manual No.
MELSERVO MR-J4-_A_-RJ Servo Amplifier Instruction Manual (Positioning Mode) (Note 5)	SH(NA)030143ENG
MELSERVO MR-J4-_A_-RJ Servo Amplifier Instruction Manual (Modbus RTU Protocol) (Note 7)	SH(NA)030175ENG
MELSERVO MR-J4-DU_(-RJ)/MR-CR55K_ Instruction Manual (Note 6)	SH(NA)030153ENG
MELSERVO MR-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
MELSERVO Parameter Unit MR-PRU03 Instruction Manual (MR-J4)	SH(NA)030186ENG
MELSERVO MR-D30 Instruction Manual (Note 8)	SH(NA)030132ENG

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-J4-_A_-RJ servo amplifier in the positioning mode.
6. It is necessary for using an MR-CV_ power regeneration converter unit, MR-CR_ resistance regeneration converter unit, and MR-J4-DU_A_(-RJ) drive unit.
7. It is necessary for using the Modbus RTU communication function.
8. It is necessary for using an MR-D30 functional safety 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.

CONTENTS

1. FUNCTIONS AND CONFIGURATION 1- 1 to 1-56

2. INSTALLATION 2- 1 to 2- 8

3. SIGNALS AND WIRING 3- 1 to 3-78

4. STARTUP 4- 1 to 4-44

5. PARAMETERS 5- 1 to 5-80

6. NORMAL GAIN ADJUSTMENT 6- 1 to 6-32

7. SPECIAL ADJUSTMENT FUNCTIONS 7- 1 to 7-40

8. TROUBLESHOOTING 8- 1 to 8-14

9. DIMENSIONS 9- 1 to 9-22

10. CHARACTERISTICS 10- 1 to 10-16

11. OPTIONS AND PERIPHERAL EQUIPMENT 11- 1 to 11-134

12. ABSOLUTE POSITION DETECTION SYSTEM 12- 1 to 12-30

13. USING STO FUNCTION 13- 1 to 13-14

14. COMMUNICATION FUNCTION (MITSUBISHI ELECTRIC GENERAL-PURPOSE AC SERVO PROTOCOL) 14- 1 to 14-44

15. USING A LINEAR SERVO MOTOR 15- 1 to 15-34

16. USING A DIRECT DRIVE MOTOR 16- 1 to 16-20

17. FULLY CLOSED LOOP SYSTEM 17- 1 to 17-24

18. MR-J4-03A6(-RJ) SERVO AMPLIFIER 18- 1 to 18-82

19. MR-D01 EXTENSION I/O UNIT 19- 1 to 19-48

APPENDIX App.- 1 to App.-54

1. FUNCTIONS AND CONFIGURATION

POINT

- In MELSERVO-J4 series, ultra-small capacity servo amplifiers compatible with 48 V DC and 24 V DC power supplies are available as MR-J4-03A6(-RJ). Refer to chapter 18 for details of MR-J4-03A6(-RJ) servo amplifiers.

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.
The MELSERVO-J4 series compatible rotary servo motor is equipped with 22-bit (4194304 pulses/rev) high-resolution absolute encoder. In addition, speed frequency response is increased to 2.5 kHz. Thus, faster and more accurate control is enabled as compared to the MELSERVO-J3 series.
The servo amplifier has position, speed, and torque control modes. In the position control mode, the maximum pulse train of 4 Mpulses/s is supported. Further, it can perform operation with the control modes switched, e.g. position/speed control, speed/torque control and torque/position control. Hence, it is applicable to a wide range of fields, not only precision positioning and smooth speed control of machine tools and general industrial machines but also line control and tension control.
With one-touch tuning and real-time auto tuning, you can automatically adjust the servo gains according to the machine.
The tough drive function and the drive recorder function, which are well-received in the MELSERVO-JN series, have been improved. The MR-J4 servo amplifier supports the improved functions. Additionally, the preventive maintenance support function detects an error in the machine parts. This function provides strong support for the machine maintenance and inspection.
The MR-J4-_A_ servo amplifier supports the STO (Safe Torque Off) function. By combining with optional MR-J3-D05, the servo amplifier supports SS1 (Safe Stop 1) function.
The servo amplifier has a USB communication interface. Therefore, you can connect the servo amplifier to the personal computer with MR Configurator2 installed to perform the parameter setting, test operation, gain adjustment, and others.
In the MELSERVO-J4 series, servo amplifiers with the CN2L connector are also available as MR-J4-_A_-RJ. By using the CN2L connector, an A/B/Z-phase differential output 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 the MR-J4-_A_ and MR-J4-_A_-RJ servo amplifiers.

Table 1.1 Connectors to connect external encoders

Operation mode	External encoder communication method	Connector	
		MR-J4-_A_	MR-J4-_A_-RJ
Linear servo system	Two-wire type	CN2 (Note 1, 4)	CN2 (Note 1)
	Four-wire type		
	A/B/Z-phase differential output method		CN2L (Note 5)
Fully closed loop system	Two-wire type	CN2 (Note 2, 3, 4)	CN2L
	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-_A_ cannot be used. Use an MR-J4-_A_-RJ.
4. This is used with software version A5 or later.
5. Connect a thermistor to CN2.

1.2 Function block diagram

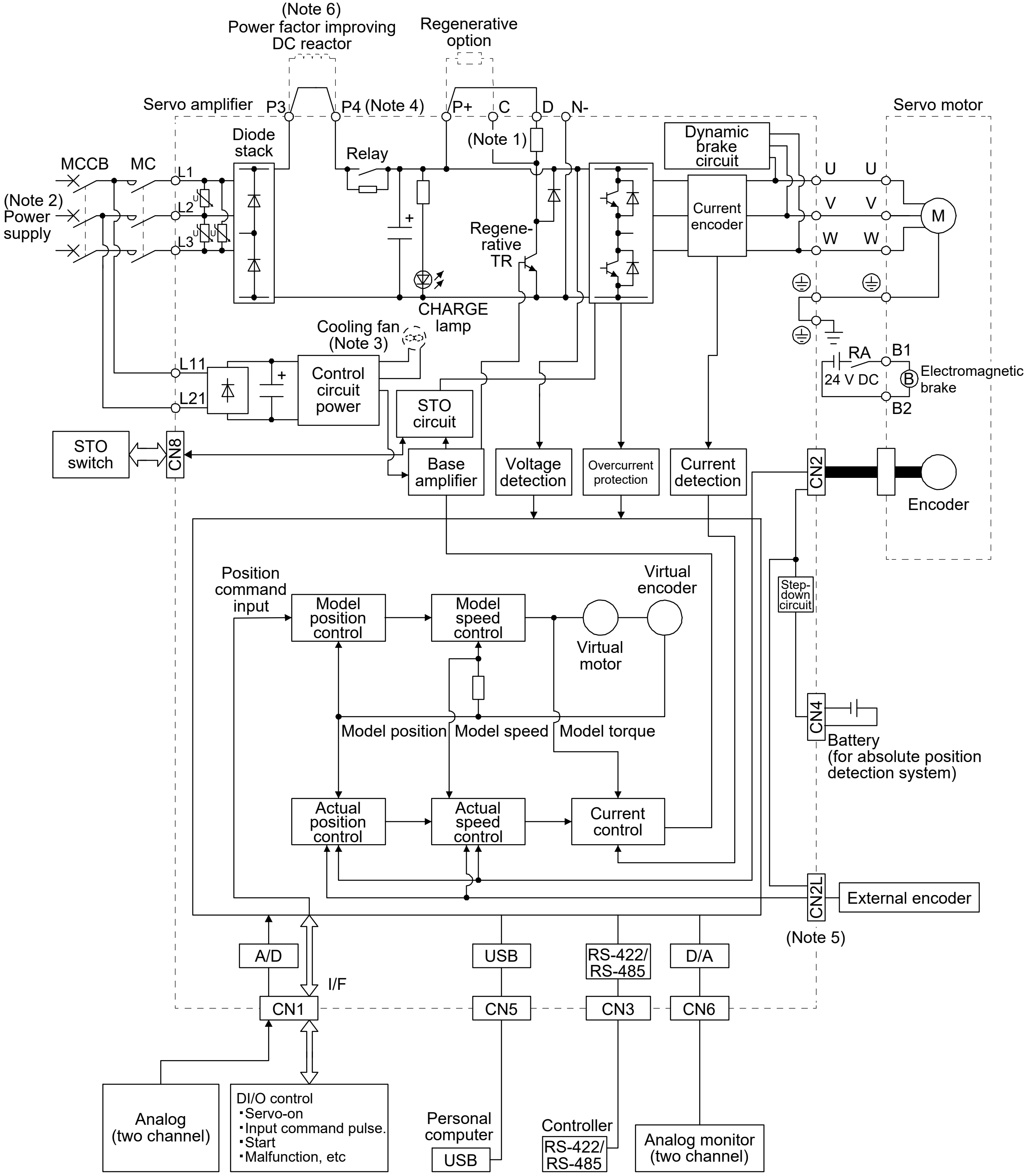
The function block diagram of this servo is shown below.

POINT

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

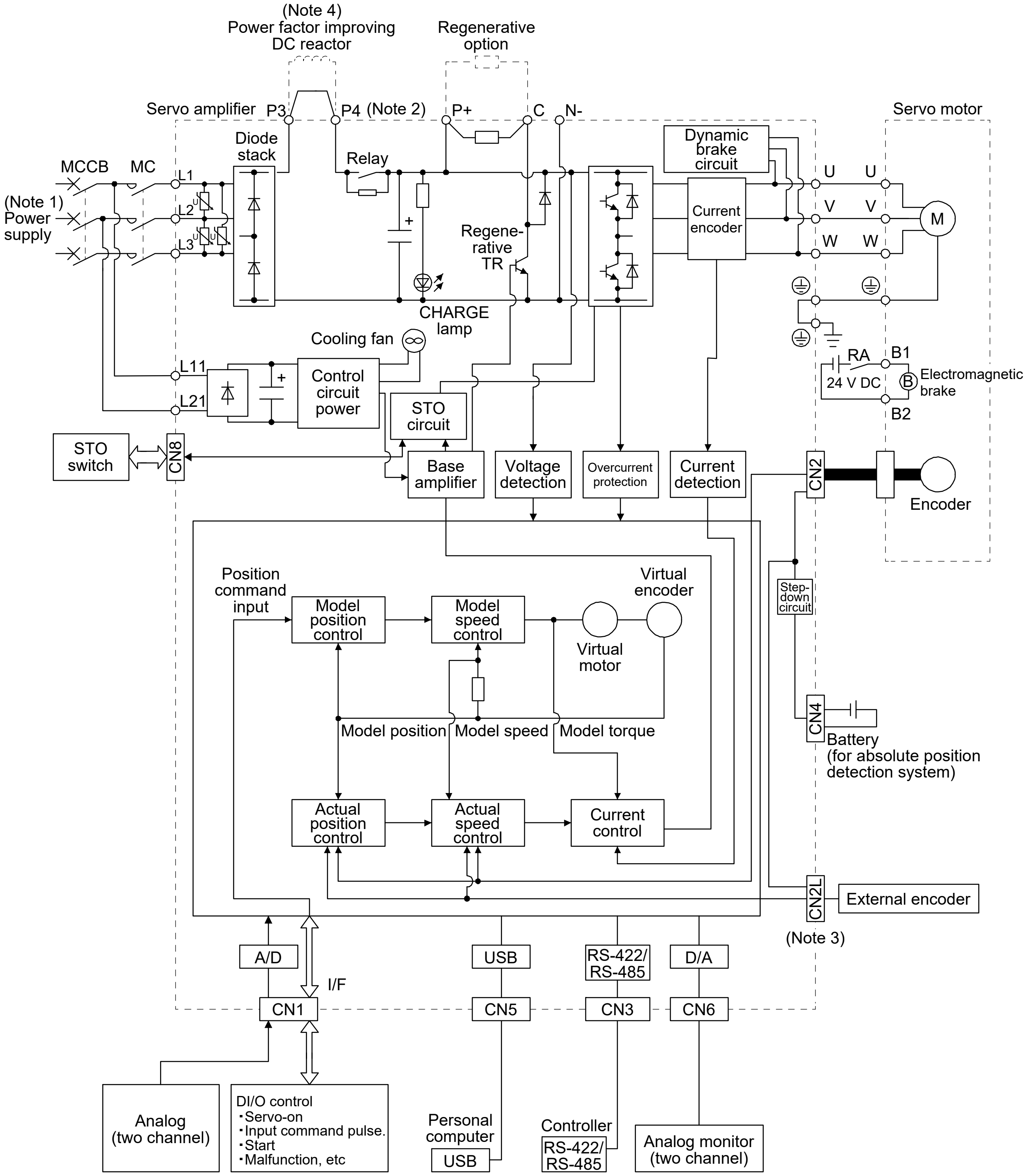
(1) 200 V class

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



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

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



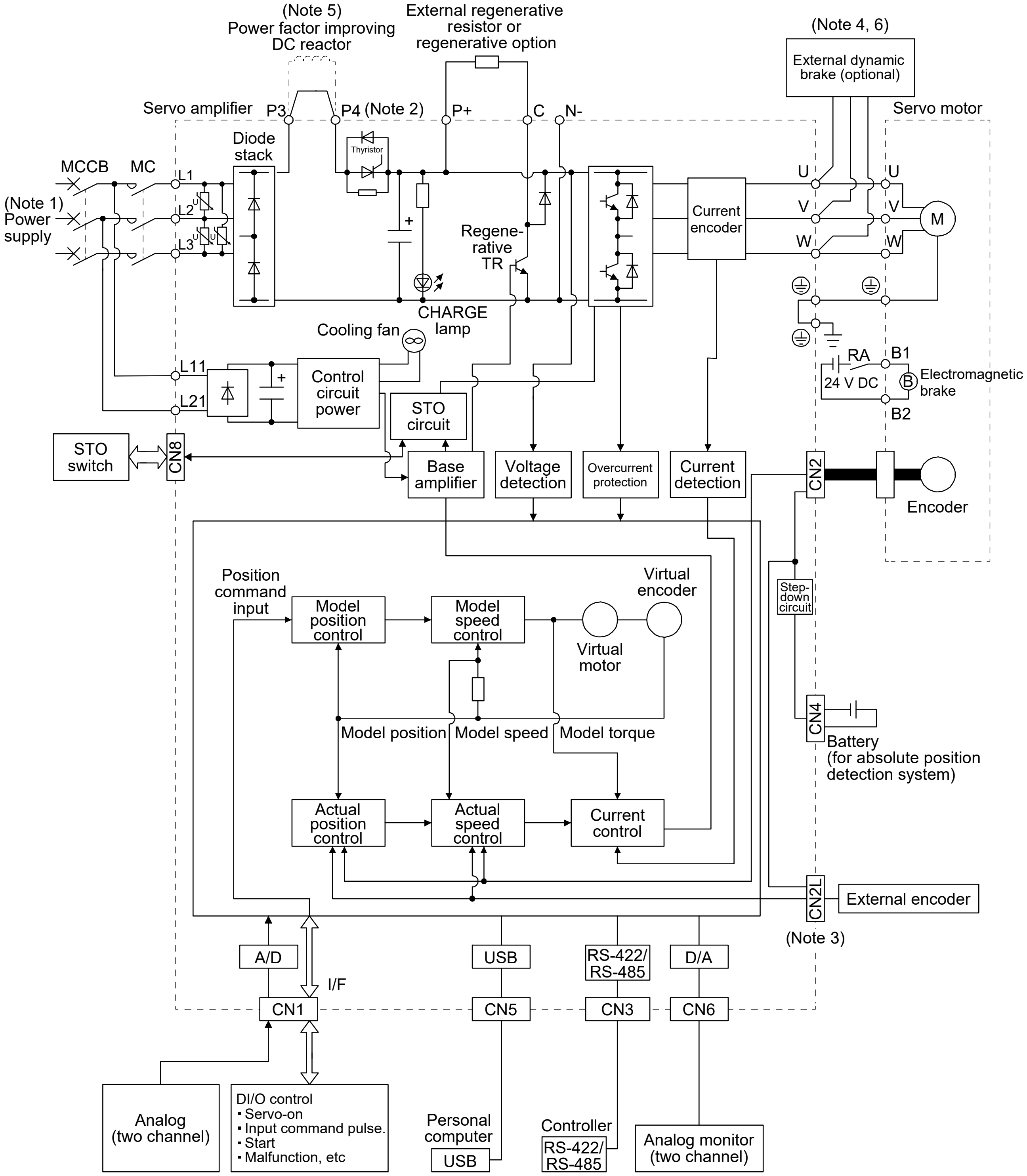
Note 1. For the power supply specifications, refer to section 1.3.

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

3. This is for the MR-J4-_A-RJ servo amplifier. The MR-J4-_A servo amplifier does not have the 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.

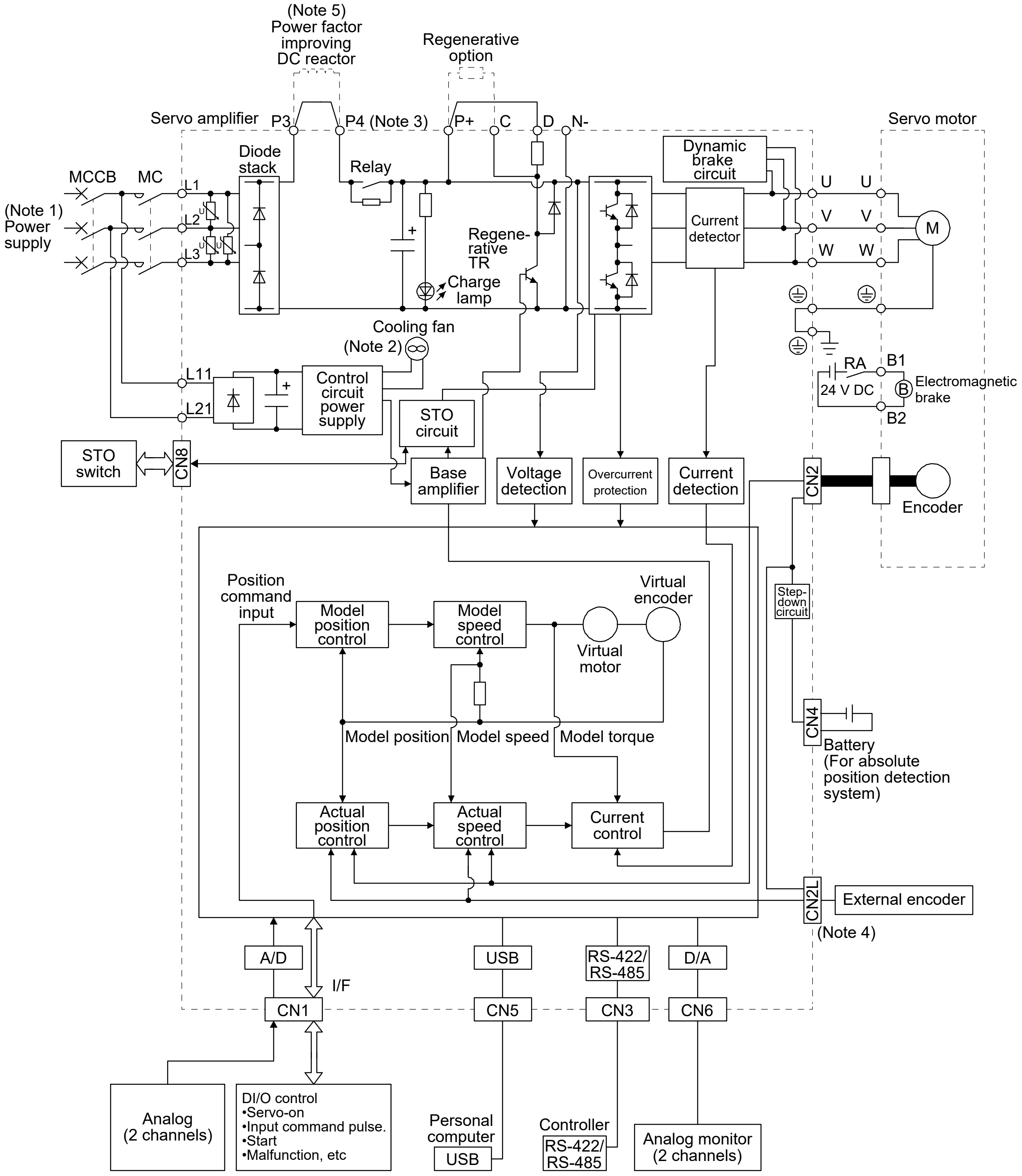
(c) MR-J4-11KA(-RJ)/MR-J4-15KA(-RJ)/MR-J4-22KA(-RJ)



Note
1. For the power supply specifications, refer to section 1.3.
2. The MR-J4 servo amplifier has P3 and P4 in the upstream of the inrush current suppression circuit. They are different from P1 and P2 of the MR-J3 servo amplifiers.
3. This is for the MR-J4-_A-RJ servo amplifier. The MR-J4-_A servo amplifier does not have the 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. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.

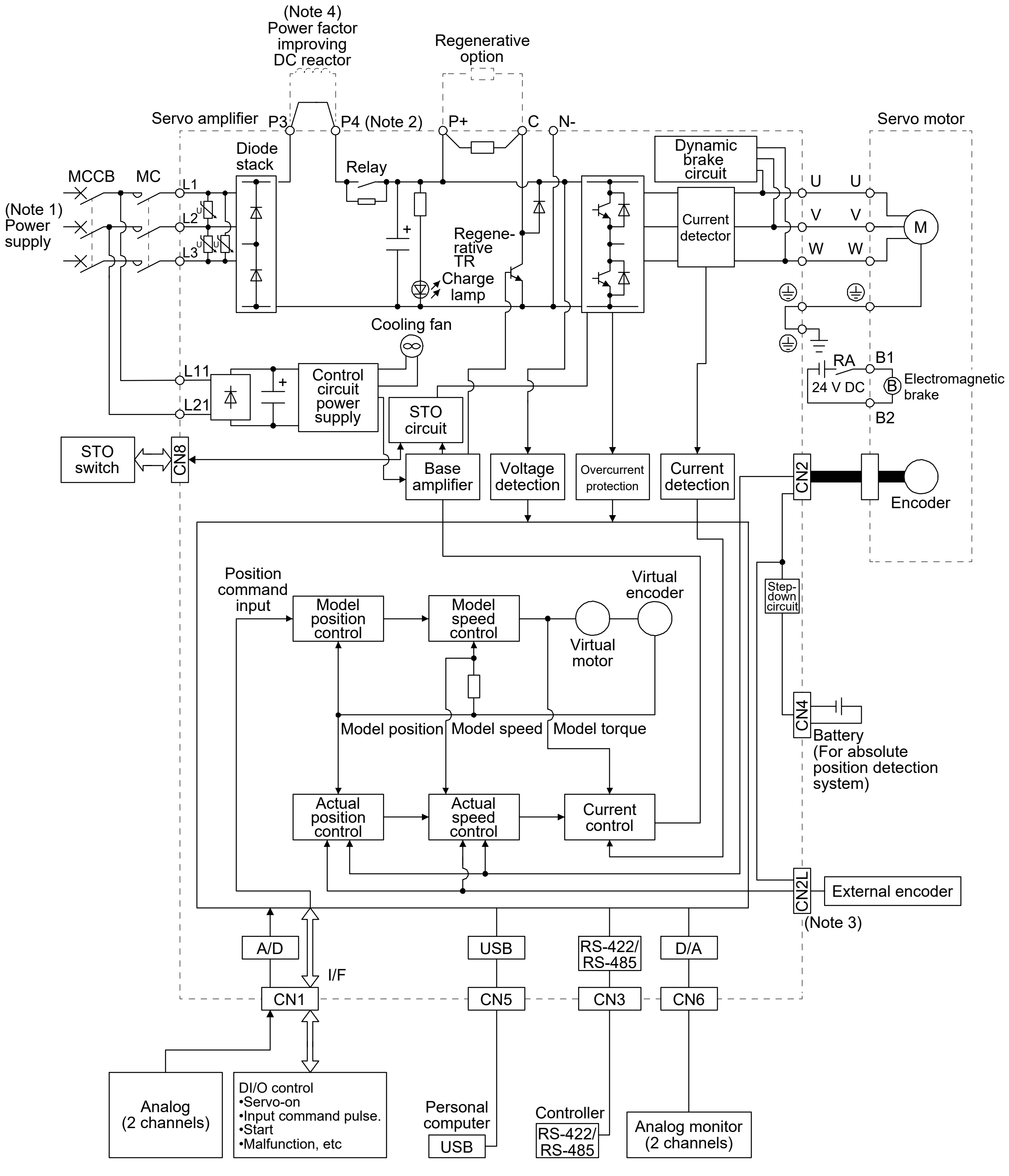
(2) 400 V class

(a) MR-J4-350A4(-RJ) or less



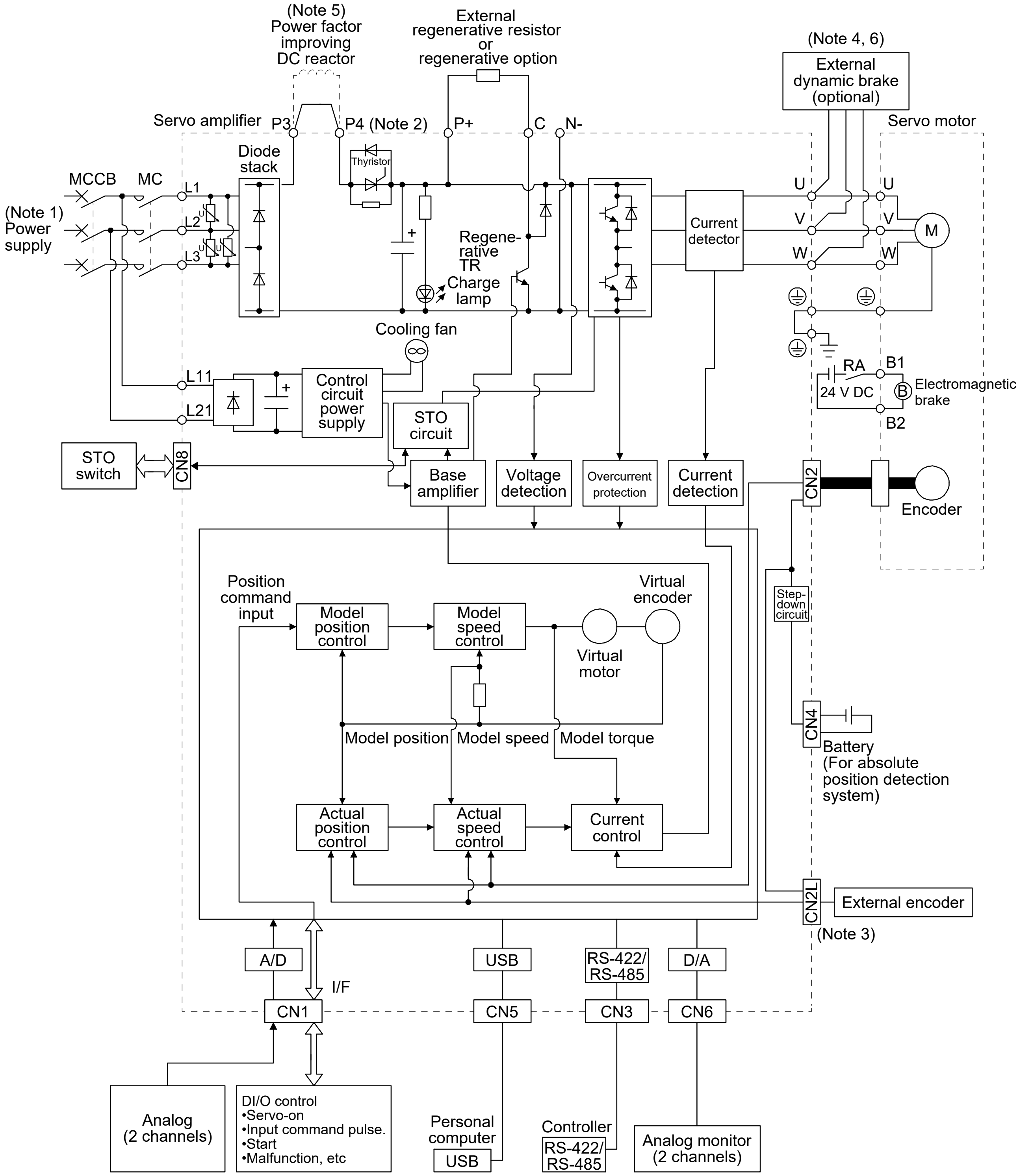
Note
1. Refer to section 1.3 for the power supply specification.
2. Servo amplifiers MR-J4-200A4(-RJ) or more have a cooling fan.
3. MR-J4 servo amplifier has P3 and P4 in the upstream of the inrush current suppression circuit. They are different from P1 and P2 of MR-J3 servo amplifiers.
4. This is for MR-J4-_A4-RJ servo amplifier. MR-J4-_A4 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-J4-500A4(-RJ)/MR-J4-700A4(-RJ)



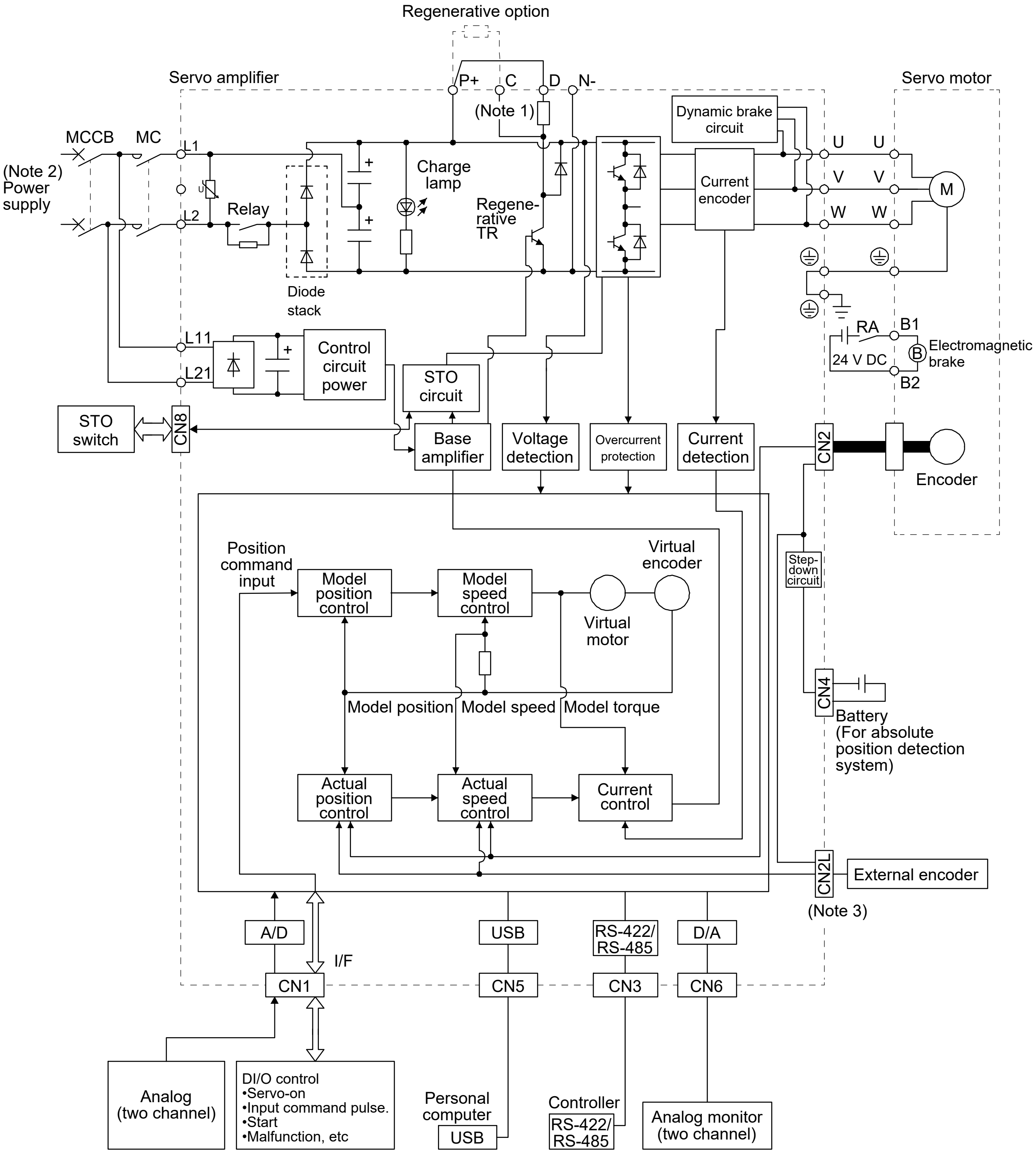
Note 1. Refer to section 1.3 for the power supply specification.
2. MR-J4 servo amplifier has P3 and P4 in the upstream of the inrush current suppression circuit. They are different from P1 and P2 of MR-J3 servo amplifiers.
3. This is for MR-J4-_A4-RJ servo amplifier. MR-J4-_A4 servo amplifier does not 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-J4-11KA4(-RJ)/MR-J4-15KA4(-RJ)/MR-J4-22KA4(-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-_A4-RJ servo amplifier. MR-J4-_A4 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. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]. 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-J4-10A1(-RJ).

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

3. This is for MR-J4-_A1-RJ servo amplifier. MR-J4-_A1 servo amplifier does not have CN2L connector.

1.3 Servo amplifier standard specifications

(1) 200 V class

Model: MR-J4-_(-RJ)			10A	20A	40A	60A	70A	100A	200A	350A	500A	700A	11KA	15KA	22KA
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 14)		3-phase 200 V AC to 240 V AC, 50 Hz/60 Hz					
		At DC input (Note 17)	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 5)	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 14)		3-phase 170 V AC to 264 V AC					
		At DC input (Note 17)	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 17)	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 17)	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]		0.5 (including the CN8 connector signals) (Note 1)												
Control method			Sine-wave PWM control, current control method												
Dynamic brake			Built-in										External option (Note 8, 12)		
Fully closed loop control			Compatible (Note 9)												
Load-side encoder interface (Note 10)			Mitsubishi Electric high-speed serial communication												
Communication function			USB: Connection to a personal computer or others (MR Configurator2-compatible)												
			RS-422/RS-485: 1: n communication (up to 32 axes) (Note 7, 13)												
Encoder output pulses			Compatible (A/B/Z-phase pulse)												
Analog monitor			Two channels												

Model: MR-J4-_(-RJ)			10A	20A	40A	60A	70A	100A	200A	350A	500A	700A	11KA	15KA	22KA
Position control mode	Max. input pulse frequency		4 Mpulses/s (for differential receiver) (Note 6), 200 kpulses/s (for open collector)												
	Positioning feedback pulse		Encoder resolution (resolution per servo motor revolution): 22 bits												
	Command pulse multiplying factor		Electronic gear A:1 to 16777215, B:1 to 16777215, 1/10 < A/B < 4000												
	In-position range setting		0 pulse to ±65535 pulses (command pulse unit)												
	Error excessive		±3 revolutions												
	Torque limit		Set by parameter setting or external analog input (0 V DC to +10 V DC/maximum torque)												
Speed control mode	Speed control range		Analog speed command 1: 2000, Internal speed command 1: 5000												
	Analog speed command input		0 to ±10 V DC/rated speed (The speed at 10 V is changeable with [Pr. PC12].)												
	Speed fluctuation ratio		±0.01% or less (load fluctuation: 0% to 100%), 0% (power fluctuation: ±10%) ±0.2% or less (ambient temperature: 25 °C ± 10 °C) when using analog speed command												
	Torque limit		Set by parameter setting or external analog input (0 V DC to +10 V DC/maximum torque)												
Torque control mode	Analog torque command input		0 V DC to ±8 V DC/maximum torque (input impedance 10 kΩ to 12 kΩ)												
	Speed limit		Set by parameter setting or external analog input (0 V DC to 10 V DC/rated speed)												
Positioning mode			Refer to "MR-J4-_A_-RJ Servo Amplifier Instruction Manual (Positioning Mode)" section 1.1. The positioning mode is used by MR-J4-_A_-RJ servo amplifier with software version B3 or later.												
Protective functions			Overcurrent shut-off, regenerative overvoltage shut-off, overload shut-off (electronic thermal), servo motor overheat protection, encoder error protection, regenerative error protection, undervoltage protection, instantaneous power failure protection, overspeed protection, 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 15)		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 IEC62061												
	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 16)												
	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. 0.5 A is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points.
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. 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.
6. 1 Mpulse/s or lower commands are supported in the initial setting. When inputting commands over 1 Mpulse/s and 4 Mpulses/s or lower, change the setting in [Pr. PA13].
7. RS-422 communication is supported by servo amplifier with software version A3.
8. 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.
9. For the compatible version for the fully closed loop system, refer to table 1.1.
10. The MR-J4-_A servo amplifier is compatible only with the two-wire type.
The MR-J4-_A-RJ servo amplifier is compatible with the two-wire type, four-wire type, and A/B/Z-phase differential output method. Refer to table 1.1 for details.
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. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.
13. RS-485 communication is available with servo amplifiers manufactured in November 2014 or later.
14. When using 1-phase 200 V AC to 240 V AC power supply, operate the servo amplifier at 75% or smaller effective load ratio.
15. 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.
16. Follow the restrictions in section 2.6 when using this product at altitude exceeding 1000 m and up to 2000 m above sea level.
17. The DC power supply input is available only with MR-J4-_A-RJ servo amplifiers. For parameter setting values when a DC input is used, refer to the Function column of [Pr. PC27] in section 5.2.3. For the connection example of the power circuit, refer to app. 13.

(2) 400 V class

Model: MR-J4-_(-RJ)		60A4	100A4	200A4	350A4	500A4	700A4	11KA4	15KA4	22KA4
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]	0.5 (including CN8 connector signals) (Note 1)								
Control method		Sine-wave PWM control, current control method								
Dynamic brake		Built-in						External option (Note 6, 7)		
Fully closed loop control		Compatible								
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)								
		RS-422/RS-485: 1: n communication (up to 32 axes) (Note 8)								
Encoder output pulses		Compatible (A/B/Z-phase pulse)								
Analog monitor		Two channels								
Position control mode	Max. input pulse frequency	4 Mpulses/s (for differential receiver) (Note 4), 200 kpulses/s (for open collector)								
	Positioning feedback pulse	Encoder resolution (resolution per servo motor revolution): 22 bits								
	Command pulse multiplying factor	Electronic gear A:1 to 16777215, B:1 to 16777215, 1/10 < A/B < 4000								
	In-position range setting	0 pulse to ±65535 pulses (command pulse unit)								
	Error excessive	±3 revolutions								
	Torque limit	Set by parameter setting or external analog input (0 V DC to +10 V DC/maximum torque)								
Speed control mode	Speed control range	Analog speed command 1: 2000, internal speed command 1: 5000								
	Analog speed command input	0 to ±10 V DC/rated speed (The speed at 10 V is changeable with [Pr. PC12].)								
	Speed fluctuation ratio	±0.01% or less (load fluctuation 0 % to 100%), 0% (power fluctuation ±10%), ±0.2% or less (ambient temperature 25 ± 10 °C) when using analog speed command								
	Torque limit	Set by parameter setting or external analog input (0 V DC to +10 V DC/maximum torque)								
Torque control mode	Analog torque command input	0 V DC to ±8 V DC/maximum torque (input impedance 10 kΩ to 12 kΩ)								
	Speed limit	Set by parameter setting or external analog input (0 V DC to 10 V DC/rated speed)								
Positioning mode		Refer to "MR-J4-_A_-RJ Servo Amplifier Instruction Manual (Positioning Mode)" section 1.1. The positioning mode is used by MR-J4-_A_-RJ servo amplifier with software version B3 or later.								
Protective functions		Overcurrent shut-off, regenerative overvoltage shut-off, overload shut-off (electronic thermal), servo motor overheat protection, encoder error protection, regenerative error protection, undervoltage protection, instantaneous power failure protection, overspeed protection, 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)			60A4	100A4	200A4	350A4	500A4	700A4	11KA4	15KA4	22KA4
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)								
	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 3)				
Close mounting			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 10)								
	Vibration resistance		5.9 m/s², 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. 0.5 A is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points.
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. 1 Mpulse/s or lower commands are supported in the initial setting. When inputting commands over 1 Mpulse/s and 4 Mpulses/s or lower, change the setting in [Pr. PA13].
5. MR-J4-_A4 servo amplifier is compatible only with two-wire type. MR-J4-_A4-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. 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. The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.
8. RS-485 communication is available with servo amplifiers manufactured in November 2014 or later.
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 2.6 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)		10A1	20A1	40A1
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]	0.5 (including the CN8 connector signals) (Note 1)		
Control method		Sine-wave PWM control, current control method		
Dynamic brake		Built-in		
Fully closed loop control		Compatible (Note 5)		
Load-side encoder interface (Note 6)		Mitsubishi Electric high-speed serial communication		
Communication function		USB: Connection to a personal computer or others (MR Configurator2-compatible)		
		RS-422/RS-485: 1: n communication (up to 32 axes) (Note 7)		
Encoder output pulses		Compatible (A/B/Z-phase pulse)		
Analog monitor		Two channels		
Position control mode	Max. input pulse frequency	4 Mpulses/s (for differential receiver) (Note 4), 200 kpulses/s (for open collector)		
	Positioning feedback pulse	Encoder resolution (resolution per servo motor revolution): 22 bits		
	Command pulse multiplying factor	Electronic gear A:1 to 16777215, B:1 to 16777215, 1/10 < A/B < 4000		
	In-position range setting	0 pulse to ±65535 pulses (command pulse unit)		
	Error excessive	±3 revolutions		
	Torque limit	Set by parameter setting or external analog input (0 V DC to +10 V DC/maximum torque)		
Speed control mode	Speed control range	Analog speed command 1: 2000, Internal speed command 1: 5000		
	Analog speed command input	0 to ±10 V DC/rated speed (The speed at 10 V is changeable with [Pr. PC12].)		
	Speed fluctuation ratio	±0.01% or less (load fluctuation: 0% to 100%), 0% (power fluctuation: ±10%) ±0.2% or less (ambient temperature: 25 °C ± 10 °C) when using analog speed command		
	Torque limit	Set by parameter setting or external analog input (0 V DC to +10 V DC/maximum torque)		
Torque control mode	Analog torque command input	0 V DC to ±8 V DC/maximum torque (input impedance 10 kΩ to 12 kΩ)		
	Speed limit	Set by parameter setting or external analog input (0 V DC to 10 V DC/rated speed)		
Positioning mode		Refer to "MR-J4-_A_-RJ Servo Amplifier Instruction Manual (Positioning Mode)" section 1.1. The positioning mode is used by MR-J4-_A_-RJ servo amplifier with software version B3 or later.		
Protective functions		Overcurrent shut-off, regenerative overvoltage shut-off, overload shut-off (electronic thermal), servo motor overheat protection, encoder error protection, regenerative error protection, undervoltage protection, instantaneous power failure protection, overspeed protection, 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)			10A1	20A1	40A1
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		
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. 0.5 A is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points.
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. 1 Mpulse/s or lower commands are supported in the initial setting. When inputting commands over 1 Mpulse/s and 4 Mpulses/s or lower, change the setting in [Pr. PA13].
5. For the compatible version for the fully closed loop system, refer to table 1.1.
6. The MR-J4-_A servo amplifier is compatible only with the two-wire type.
   The MR-J4-_A-RJ servo amplifier is compatible with the two-wire type, four-wire type, and A/B/Z-phase differential output method. Refer to table 1.1 for details.
7. RS-485 communication is available with servo amplifiers manufactured in November 2014 or later.
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 2.6 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-J4-100A or MR-J4-200A 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) (Note 1)	Direct drive motor (Note 1)
	HG-KR	HG-MR	HG-SR	HG-UR	HG-RR	HG-JR		
MR-J4-10A(-RJ)	053 13	053 13						
MR-J4-20A(-RJ)	23	23					LM-U2PAB-05M-0SS0 LM-U2PBB-07M-1SS0	TM-RFM002C20 TM-RG2M002C30 (Note 2) TM-RU2M002C30 (Note 2) TM-RG2M004E30 (Note 2) TM-RU2M004E30 (Note 2)
MR-J4-40A(-RJ)	43	43					LM-H3P2A-07P-BSS0 LM-H3P3A-12P-CSS0 LM-K2P1A-01M-2SS1 LM-U2PAD-10M-0SS0 LM-U2PAF-15M-0SS0	TM-RFM004C20 TM-RG2M004E30 (Note 2, 4) TM-RU2M004E30 (Note 2, 4) TM-RG2M009G30 (Note 2) TM-RU2M009G30 (Note 2)
MR-J4-60A(-RJ)			51 52			53	LM-U2PBD-15M-1SS0	TM-RFM006C20 TM-RFM006E20
MR-J4-70A(-RJ)	73	73		72		73	LM-H3P3B-24P-CSS0 LM-H3P3C-36P-CSS0 LM-H3P7A-24P-ASS0 LM-K2P2A-02M-1SS1 LM-U2PBF-22M-1SS0	TM-RFM012E20 TM-RFM012G20 TM-RFM040J10
MR-J4-100A(-RJ)			81 102			53 (Note 3) 103		TM-RFM018E20
MR-J4-200A(-RJ)			121 201 152 202	152	103 153	73 (Note 3) 103 (Note 3) 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-J4-350A(-RJ)			301 352	202	203	153 (Note 3) 203 (Note 3) 353	LM-H3P7D-96P-ASS0 LM-K2P2C-07M-1SS1 LM-K2P3C-14M-1SS1 LM-U2P2C-60M-2SS0	TM-RFM048G20 TM-RFM072G20 TM-RFM120J10
MR-J4-500A(-RJ)			421 502	352 502	353 503	353 (Note 3) 503	LM-FP2D-12M-1SS0 LM-FP4B-12M-1SS0 LM-K2P2E-12M-1SS1 LM-K2P3E-24M-1SS1 LM-U2P2D-80M-2SS0	TM-RFM240J10
MR-J4-700A(-RJ)			702			503 (Note 3) 601 701M 703	LM-FP2F-18M-1SS0 LM-FP4D-24M-1SS0	
MR-J4-11KA(-RJ)						801 12K1 11K1M 903	LM-FP4F-36M-1SS0	
MR-J4-15KA(-RJ)						15K1 15K1M	LM-FP4F-48M-1SS0	
MR-J4-22KA(-RJ)						20K1 25K1 22K1M		

Note 1. This is available with servo amplifiers with software version A5 or later.
2. This is available with servo amplifiers with software version C8 or later.
3. The combination increases the maximum torque of the servo motor to 400%.
4. The combination increases the rated torque and the maximum torque.

(2) 400 V class

Servo amplifier	Rotary servo motor		Linear servo motor (primary side) (Note 1)
	HG-SR	HG-JR	
MR-J4-60A4(-RJ)	524	534	
MR-J4-100A4(-RJ)	1024	534 (Note 2) 734 1034	
MR-J4-200A4(-RJ)	1524 2024	734 (Note 2) 1034 (Note 2) 1534 2034	
MR-J4-350A4(-RJ)	3524	1534 (Note 2) 2034 (Note 2) 3534	
MR-J4-500A4(-RJ)	5024	3534 (Note 2) 5034	
MR-J4-700A4(-RJ)	7024	5034 (Note 2) 6014 701M4 7034	
MR-J4-11KA4(-RJ)		8014 12K14 11K1M4 9034	
MR-J4-15KA4(-RJ)		15K14 15K1M4	
MR-J4-22KA4(-RJ)		20K14 25K14 22K1M4	LM-FP5H-60M-1SS0

Note 1. This is available with servo amplifiers with software version A5 or later.

2. The 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) (Note 1)	Direct drive motor (Note 1)
	HG-KR	HG-MR		
MR-J4-10A1(-RJ)	053 13	053 13		
MR-J4-20A1(-RJ)	23	23	LM-U2PAB-05M-0SS0 LM-U2PBB-07M-1SS0	TM-RFM002C20 TM-RG2M002C30 (Note 2) TM-RU2M002C30 (Note 2) TM-RG2M004E30 (Note 2) TM-RU2M004E30 (Note 2)
MR-J4-40A1(-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 2, 3) TM-RU2M004E30 (Note 2, 3) TM-RG2M009G30 (Note 2) TM-RU2M009G30 (Note 2)

Note 1. This is available with servo amplifiers with software version A5 or later.

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

3. The 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 indicated in the detailed explanation 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.	Section 3.2.1 Section 3.6.1 Section 4.2
Speed control mode	This servo amplifier is used as a speed control servo.	Section 3.2.2 Section 3.6.2 Section 4.3
Torque control mode	This servo amplifier is used as a torque control servo.	Section 3.2.3 Section 3.6.3 Section 4.4
Positioning mode	Used when you use an MR-J4-_A_-RJ servo amplifier in the positioning mode under the point table/program/indexer method. The positioning mode is used by MR-J4-_A_-RJ servo amplifier with software version B3 or later.	MR-J4-_A_-RJ Servo Amplifier Instruction Manual (Positioning Mode)
Position/speed control change mode	Using an input device, control can be switched between position control and speed control.	Section 3.6.4
Speed/torque control change mode	Using an input device, control can be switched between speed control and torque control.	Section 3.6.5
Torque/position control change mode	Using an input device, control can be switched between torque control and position control.	Section 3.6.6
High-resolution encoder	High-resolution encoder of 4194304 pulses/rev is used as the encoder of the rotary servo motor compatible with the MELSERVO-J4 series.	
Absolute position detection system	Merely setting a home position once makes home position return unnecessary at every power-on.	Chapter 12
Gain switching function	You can switch gains during rotation and during stop, and can use an input device to switch gains during operation.	Section 7.2
Advanced vibration suppression control II	This function suppresses vibration at the arm end or residual vibration.	Section 7.1.5
Machine resonance suppression filter	This is a filter function (notch filter) which decreases the gain of the specific frequency to suppress the resonance of the mechanical system.	Section 7.1.1
Shaft resonance suppression filter	When a load is mounted to the servo motor shaft, resonance by shaft torsion during driving may generate a mechanical vibration at high frequency. The shaft resonance suppression filter suppresses the vibration.	Section 7.1.3
Adaptive filter II	Servo amplifier detects mechanical resonance and sets filter characteristics automatically to suppress mechanical vibration.	Section 7.1.2
Low-pass filter	Suppresses high-frequency resonance which occurs as servo system response is increased.	Section 7.1.4
Machine analyzer function	Analyzes the frequency characteristic of the mechanical system by simply connecting an MR Configurator2 installed personal computer and servo amplifier. MR Configurator2 is necessary for this function.	
Robust filter	This function provides better disturbance response in case low response level that load to motor inertia ratio is high for such as roll send axis.	[Pr. PE41]
Slight vibration suppression control	Suppresses vibration of ±1 pulse produced at a servo motor stop.	[Pr. PB24]
Electronic gear	Input pulses can be multiplied by 1/10 to 4000.	[Pr. PA06] [Pr. PA07]
S-pattern acceleration/ deceleration time constant	Speed can be increased and decreased smoothly.	[Pr. PC03]

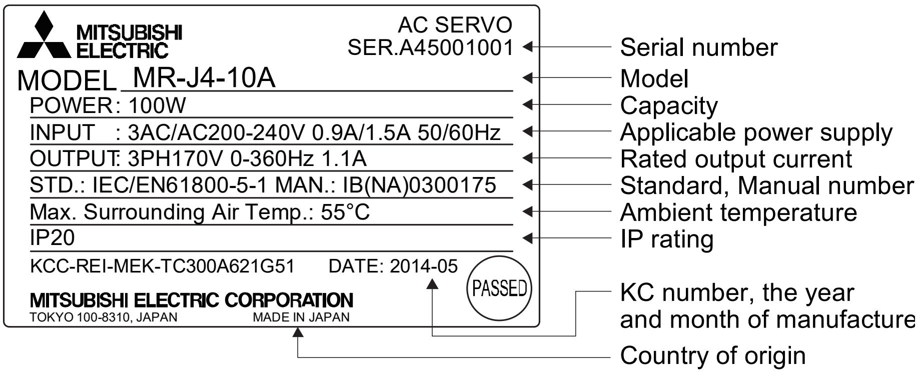
Function	Description	Detailed explanation
Auto tuning	Automatically adjusts the gain to optimum value if load applied to the servo motor shaft varies.	Section 6.3
Brake unit	Used when the regenerative option cannot provide enough regenerative power. Can be used for the 5 kW or more servo amplifier.	Section 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 large regenerative power generated.	Section 11.2
Alarm history clear	Alarm history is cleared.	[Pr. PC18]
Input signal selection (device settings)	ST1 (Forward rotation start), ST2 (Reverse rotation start), and SON (Servo-on) and other input device can be assigned to any pins.	[Pr. PD03] to [Pr. PD22]
Output signal selection (device settings)	The output devices including MBR (Electromagnetic brake interlock) can be assigned to certain pins of the CN1 connector.	[Pr. PD23] to [Pr. PD26] [Pr. PD28] [Pr. PD47]
Output signal (DO) forced output	Output signal can be forced on/off independently of the servo status. Use this function for checking output signal wiring, etc.	Section 4.5.8
Restart after instantaneous power failure	If the input power supply voltage had reduced to cause an alarm but has returned to normal, the servo motor can be restarted by merely switching on the start signal. (available in the future)	
Command pulse selection	Command pulse train form can be selected from among three different types.	[Pr. PA13]
Torque limit	Servo motor torque can be limited to any value.	Section 3.6.1 (5) [Pr. PA11] [Pr. PA12]
Speed limit	Servo motor speed can be limited to any value.	Section 3.6.3 (3) [Pr. PC05] to [Pr. PC11]
Status display	Servo status is shown on the 5-digit, 7-segment LED display	Section 4.5
External I/O signal display	On/off statuses of external I/O signals are shown on the display.	Section 4.5.7
Automatic VC offset	Voltage is automatically offset to stop the servo motor if it does not come to a stop when VC (Analog speed command) or VLA (Analog speed limit) is 0 V.	Section 4.5.4
Alarm code output	If an alarm has occurred, the corresponding alarm number is outputted in 3-bit code.	Chapter 8
Test operation mode	Jog operation, positioning operation, motor-less operation, DO forced output, and program operation can be used. MR Configurator2 is required to perform positioning operation or program operation.	Section 4.5.9
Analog monitor output	Servo status is output in terms of voltage in real time.	[Pr. PC14], [Pr. PC15]
MR Configurator2	Using a personal computer, you can perform the parameter setting, test operation, monitoring, and others.	Section 11.7
Linear servo system	Linear servo system can be configured using a linear servo motor and linear encoder. Refer to section 1.4 for the software version of a servo amplifier that is compatible.	Chapter 15
Direct drive servo system	The direct drive servo system can be configured to drive a direct drive motor. Refer to section 1.4 for the software version of a servo amplifier that is compatible.	Chapter 16
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 A5 or later.	Chapter 17
One-touch tuning	Gain adjustment is performed just by one click on a certain button on MR Configurator2 or operation section.	Section 6.2
SEMI-F47 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. 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. PE25] 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

Function		Description	Detailed explanation
Drive recorder function		This function continuously monitors the servo status and records the status transition before and after an alarm for a fixed period of time. You can check the recorded data on the drive recorder window on MR Configurator2 by clicking the "Graph" button. However, the drive recorder will not operate on the following conditions. 1. You are using the graph function of MR Configurator2. 2. You are using the machine analyzer function. 3. [Pr. PF21] is set to "-1".	[Pr. PA23]
STO function		This function is a functional safety that complies with IEC/EN 61800-5-2. You can create a safety system for the equipment easily.	Chapter 13
Servo amplifier life diagnosis function		You can check the cumulative energization time and the number of on/off times of the inrush relay. This function gives an indication of the replacement time for parts of the servo amplifier including a capacitor and a relay before they malfunction. MR Configurator2 is necessary for this function.	
Power monitoring function		This function calculates the power running energy and the regenerative power from the data in the servo amplifier such as speed and current. Power consumption and others are displayed on MR Configurator2.	
Machine diagnosis function		From the data in the servo amplifier, this function estimates the friction and vibrational component of the drive system in the equipment and recognizes an error in the machine parts, including a ball screw and bearing. MR Configurator2 is necessary for this function.	
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
Mark detection	Current position latch function	When the mark detection signal is turned on, the current position is latched. The latched data can be read with communication commands.	MR-J4-_A_-RJ Servo Amplifier Instruction Manual (Positioning Mode)
	Interrupt positioning function	When MSD (Mark detection) turns on, this function converts the remaining distance to the travel distance set in [Pr. PT30] and [Pr. PT31] (Mark sensor stop travel distance). This is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	
MR-D01 extension I/O unit		MR-D01 is an extension I/O unit that can extend the input/output signals of MR-J4-_A_-RJ servo amplifiers. MR-D01 is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later. MR-D01 cannot be used with MR-J4-03A6(-RJ) servo amplifiers.	Chapter 19 MR-J4-_A_-RJ Servo Amplifier Instruction Manual (Positioning Mode)
Modbus RTU communication function		The Modbus protocol uses dedicated message frames for the serial communication between a master and slaves. The dedicated message frames have functions for reading and writing data, and you can write parameters from servo amplifiers and check the operation status of the servo amplifiers by using this function. When the indexer method is used, there are functional restrictions. This function is supported by MR-J4-_A_-RJ servo amplifiers with a capacity of 100 W or more manufactured in November, 2014 or later. This function will be available with MR-J4-03A6-RJ servo amplifiers in the future.	MR-J4-_A_-RJ Servo Amplifier Instruction Manual (Modbus RTU Protocol)
High-resolution analog input (VC)		The analog input resolution can be increased to 16 bits. This function is available with servo amplifiers manufactured in November 2014 or later. This is not available with MR-J4-03A6-RJ servo amplifiers.	[Pr. PC60]

1.6 Model designation

(1) Rating plate

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



(2) Model

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

MR-J4-60A4-RJ

Series

Special specification

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

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 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

General-purpose interface

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. 10.2 for details.

2. Dynamic brake which is built in 7 kW or smaller servo amplifiers is removed. Refer to app. 10.1 for details.

3. Type with a specially-coated servo amplifier board (IEC 60721-3-3: 1994 Class 3C2). Refer to app. 10.3 for details.

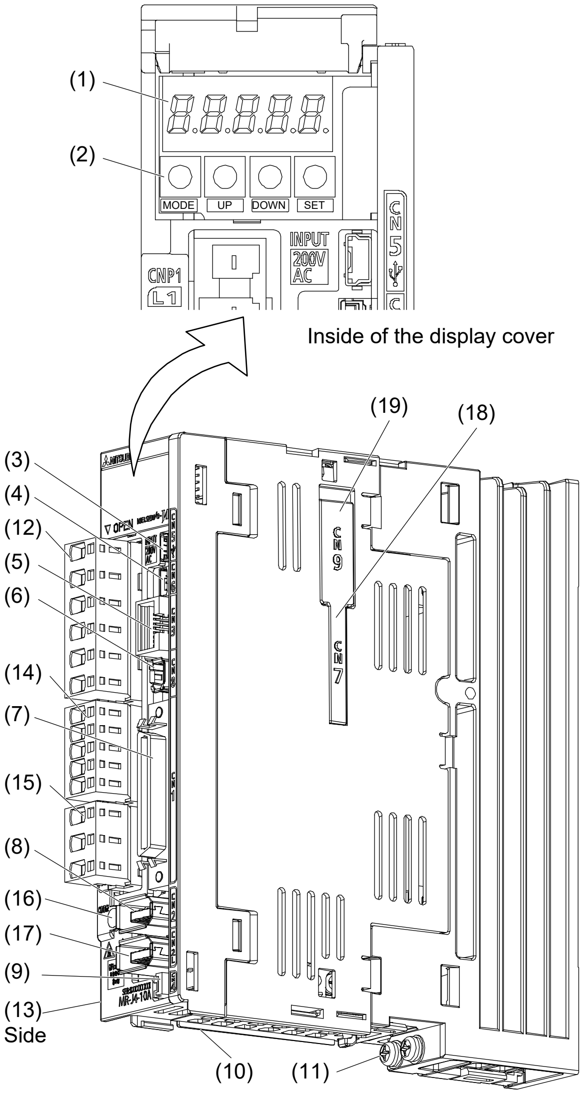
1.7 Structure

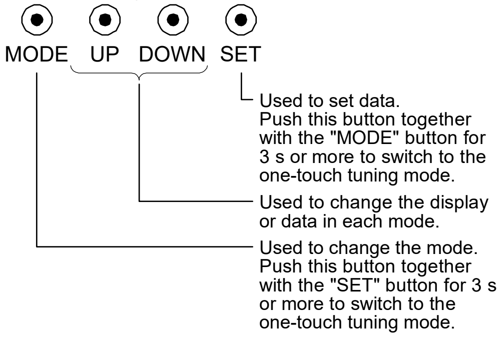
1.7.1 Parts identification

(1) 200 V class

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

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

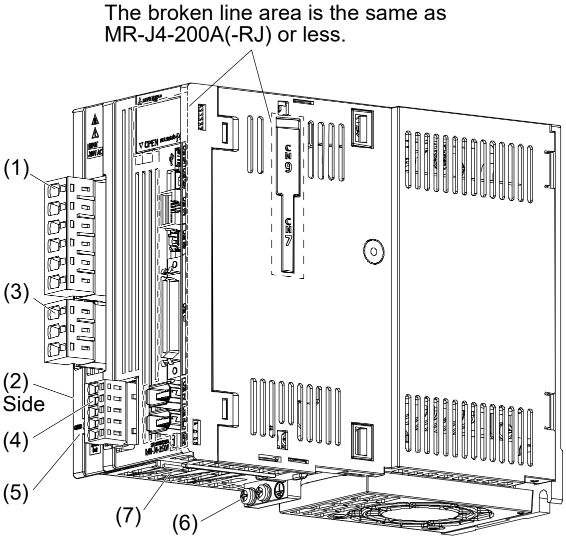


No.	Name/Application	Detailed explanation
(1)	Display The 5-digit, 7-segment LED shows the servo status and the alarm number.	Section 4.5
(2)	Operation section Used to perform status display, diagnostic, alarm, and parameter setting operations. Push the "MODE" and "SET" buttons at the same time for 3 s or more to switch to the one-touch tuning mode.  Used to set data. Push this button together with the "MODE" button for 3 s or more to switch to the one-touch tuning mode. Used to change the display or data in each mode. Used to change the mode. Push this button together with the "SET" button for 3 s or more to switch to the one-touch tuning mode.	Section 4.5
(3)	USB communication connector (CN5) Connect with the personal computer.	Section 11.7
(4)	Analog monitor connector (CN6) Outputs the analog monitor.	Section 3.2
(5)	RS-422/RS-485 communication connector (CN3) Connect with the RS-422/RS-485 communication controller, parameter unit, etc.	Chapter 14
(6)	STO input signal connector (CN8) Used to connect the MR-J3-D05 safety logic unit and external safety relay.	Chapter 13 App. 5
(7)	I/O signal connector (CN1) Used to connect digital I/O signals.	Section 3.2 Section 3.4
(8) (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)"
(9)	Battery connector (CN4) Used to connect the battery for absolute position data backup.	Chapter 12
(10)	Battery holder Install the battery for absolute position data backup.	Section 12.2
(11)	Protective earth (PE) terminal	Section 3.1 Section 3.3
(12)	Main circuit power connector (CNP1) Connect the input power supply.	
(13)	Rating plate	Section 1.6
(14)	Control circuit power connector (CNP2) Connect the control circuit power supply and regenerative option.	Section 3.1 Section 3.3
(15)	Servo motor power output connector (CNP3) Connect the servo motor.	
(16)	Charge lamp When the main circuit is charged, this will light up. While this lamp is lit, do not reconnect the cables. 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.	
(17) (Note 1, 2)	External encoder connector (CN2L) Refer to table 1.1 for the compatible external encoders.	Section 3.4 "Linear Encoder Instruction Manual"
(18)	Optional unit connector (CN7) Connect the optional unit. It is available with MR-J4-_A-RJ servo amplifiers manufactured in November 2014 or later. The MR-J4-_A servo amplifier does not have this connector.	
(19)	Optional unit connector (CN9) Connect the optional unit. It is available with MR-J4-_A-RJ servo amplifiers manufactured in November 2014 or later. The MR-J4-_A servo amplifier does not have this connector.	

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

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

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

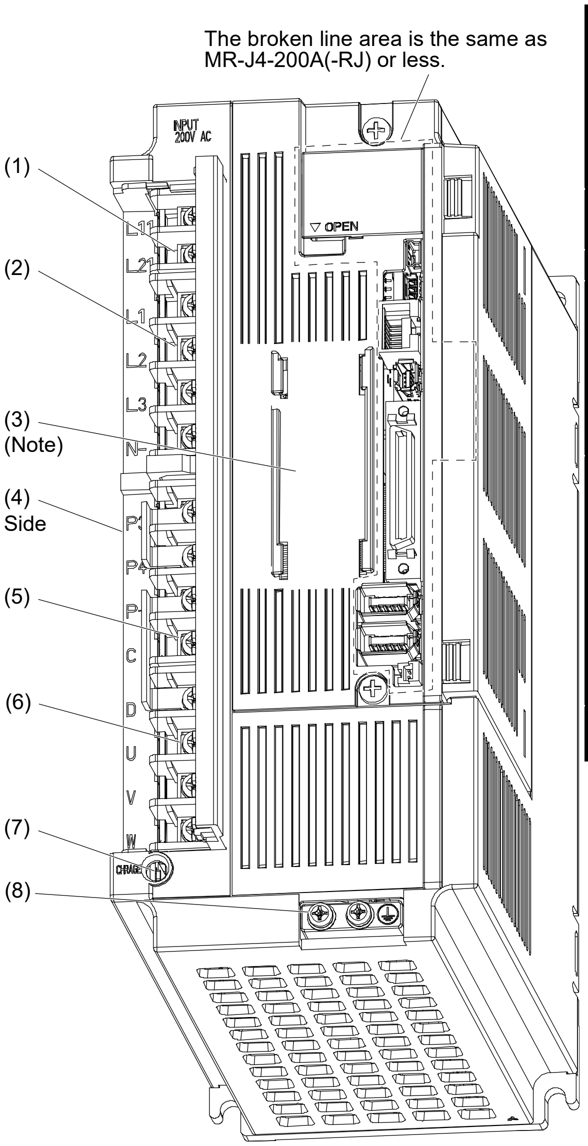


No.	Name/Application	Detailed explanation
(1)	Main circuit power connector (CNP1) Connect the input power supply.	Section 3.1 Section 3.3
(2)	Rating plate	Section 1.6
(3)	Servo motor power connector (CNP3) Connect the servo motor.	Section 3.1 Section 3.3
(4)	Control circuit power connector (CNP2) Connect the control circuit power supply and regenerative option.	
(5)	Charge lamp When the main circuit is charged, this will light up. 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-J4-500A(-RJ)

POINT

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



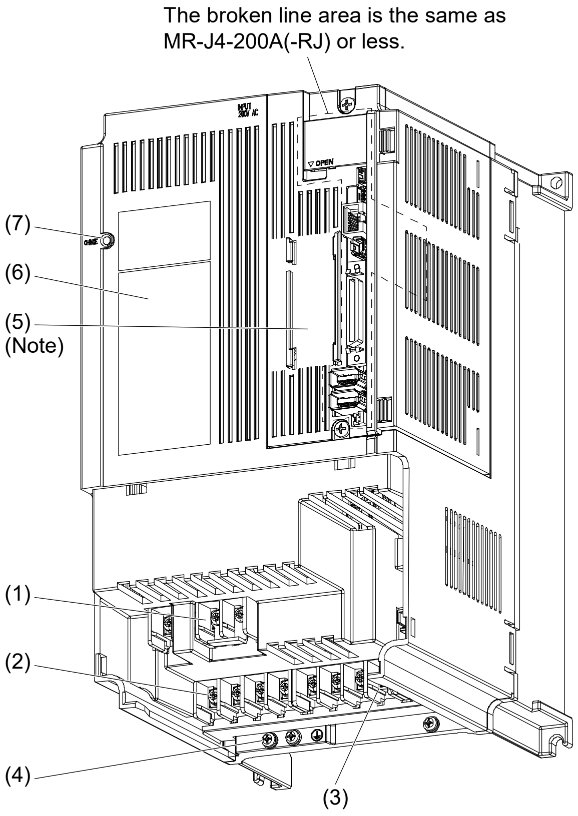
No.	Name/Application	Detailed explanation
(1)	Control circuit terminal block (TE2) Used to connect the control circuit power supply.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1) Connect the input power supply.	
(3)	Battery holder Install the battery for absolute position data backup.	Section 12.2
(4)	Rating plate	Section 1.6
(5)	Regenerative option/power factor improving reactor terminal block (TE3) Used to connect a regenerative option or a power factor improving DC reactor.	Section 3.1 Section 3.3
(6)	Servo motor power supply terminal block (TE4) Connect the servo motor.	
(7)	Charge lamp When the main circuit is charged, this will light up. While this lamp is lit, do not reconnect the cables. 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-J4-700A(-RJ)

POINT

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



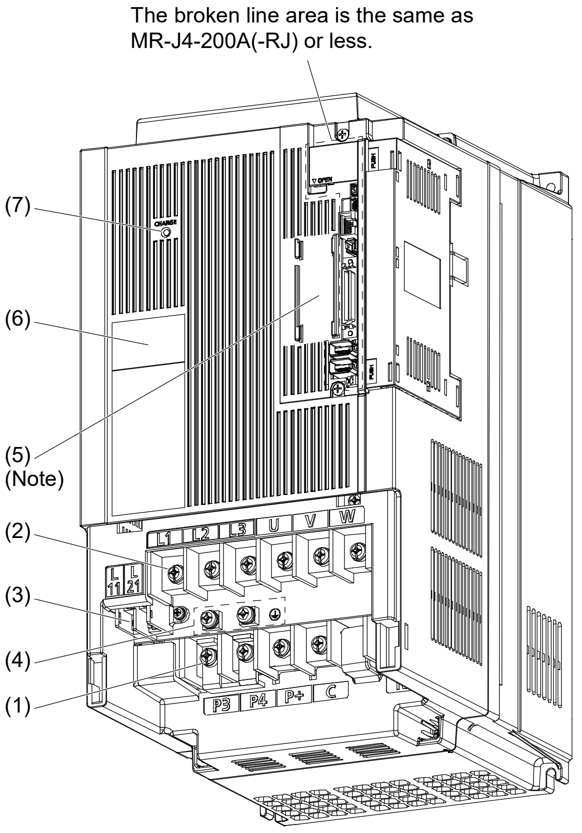
No.	Name/Application	Detailed explanation
(1)	Power factor improving reactor terminal block (TE3) Used to connect the DC reactor.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1) Used to connect the input power supply, regenerative option, and servo motor.	
(3)	Control circuit terminal block (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 up. 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-J4-11KA(-RJ)/MR-J4-15KA(-RJ)

POINT

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

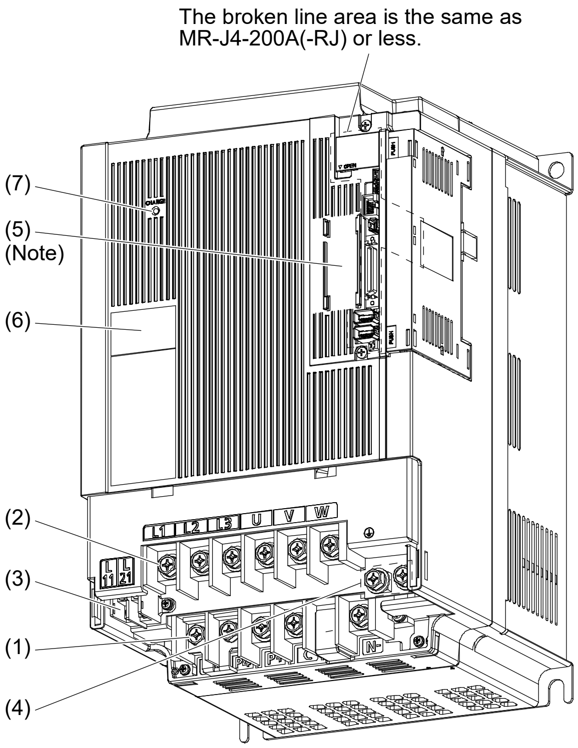


No.	Name/Application	Detailed explanation
(1)	Power factor improving reactor terminal block (TE1-2) Used to connect a power factor improving DC reactor and a regenerative option.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1-1) Used to connect the input power supply and servo motor.	
(3)	Control circuit terminal block (TE2) Used to connect the control circuit power supply.	
(4)	Protective earth (PE) terminal	
(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 up. 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-J4-22KA(-RJ)

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



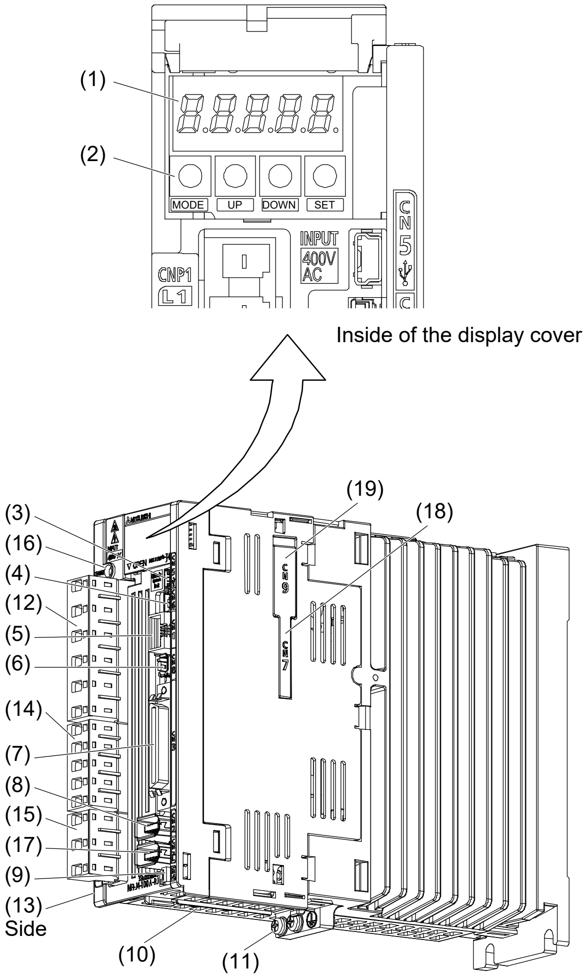
No.	Name/Application	Detailed explanation
(1)	Power factor improving reactor terminal block (TE1-2) Used to connect a power factor improving DC reactor and a regenerative option.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1-1) Used to connect the input power supply and servo motor.	
(3)	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 up. 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.	

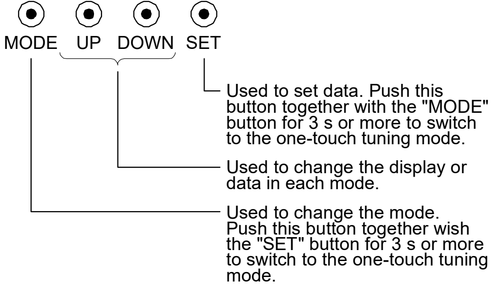
Note. Lines for slots around the battery holder are omitted from the illustration.

(2) 400 V class

(a) For MR-J4-200A4(-RJ) or less

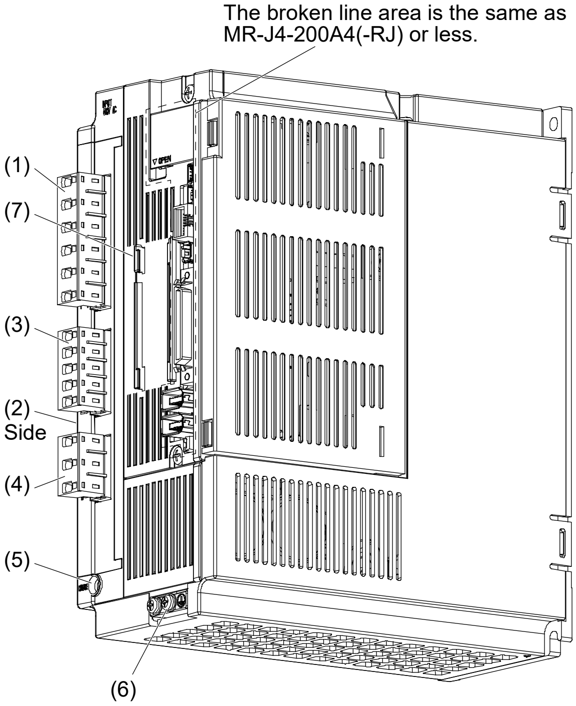
The diagram is for MR-J4-60A4-RJ.



No.	Name/Application	Detailed explanation
(1)	Display The 5-digit, seven-segment LED shows the servo status and the alarm number.	Section 4.5
(2)	Operation section Used to perform status display, diagnostic, alarm, and parameter setting operations. Push the "MODE" and "SET" buttons at the same time for 3 s or more to switch to the one-touch tuning mode.  MODE UP DOWN SET Used to set data. Push this button together with the "MODE" button for 3 s or more to switch to the one-touch tuning mode. Used to change the display or data in each mode. Used to change the mode. Push this button together wish the "SET" button for 3 s or more to switch to the one-touch tuning mode.	
(3)	USB communication connector (CN5) Connect with the personal computer.	Section 11.7
(4)	Analog monitor connector (CN6) Outputs the analog monitor.	Section 3.2
(5)	RS-422/RS-485 communication connector (CN3) Connect with the RS-422/RS-485 communication controller, parameter unit, etc.	Chapter 14
(6)	STO input signal connector (CN8) Used to connect MR-J3-D05 safety logic unit and external safety relay.	Chapter 13 App. 5
(7)	I/O signal connector (CN1) Used to connect digital I/O signals.	Section 3.2 Section 3.4
(8) (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)"
(9)	Battery connector (CN4) Used to connect the battery for absolute position data backup.	Chapter 12
(10)	Battery holder Install the battery for absolute position data backup.	Section 12.2
(11)	Protective earth (PE) terminal	Section 3.1 Section 3.3
(12)	Main circuit power connector (CNP1) Connect the input power supply.	
(13)	Rating plate	Section 1.6
(14)	Control circuit power connector (CNP2) Connect the control circuit power supply and regenerative option.	Section 3.1 Section 3.3
(15)	Servo motor power output connector (CNP3) Connect the servo motor.	
(16)	Charge lamp When the main circuit is charged, this will light. 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.	
(17) (Note 1)	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"
(18)	Optional unit connector (CN7) Connect the optional unit. It is available with MR-J4-_A4-RJ servo amplifiers manufactured in November 2014 or later. MR-J4-_A4 servo amplifier does not have this connector.	
(19)	Optional unit connector (CN9) Connect the optional unit. It is available with MR-J4-_A4-RJ servo amplifiers manufactured in November 2014 or later. The MR-J4-_A4 servo amplifier does not have this connector.	

Note 1. This is for MR-J4-_A4-RJ servo amplifier. MR-J4-_A4 servo amplifier does not have CN2L connector.
2. "External encoder" is a term for linear encoder used in the linear servo system and load-side encoder used in the fully closed loop system in this manual.

(b) MR-J4-350A4(-RJ)

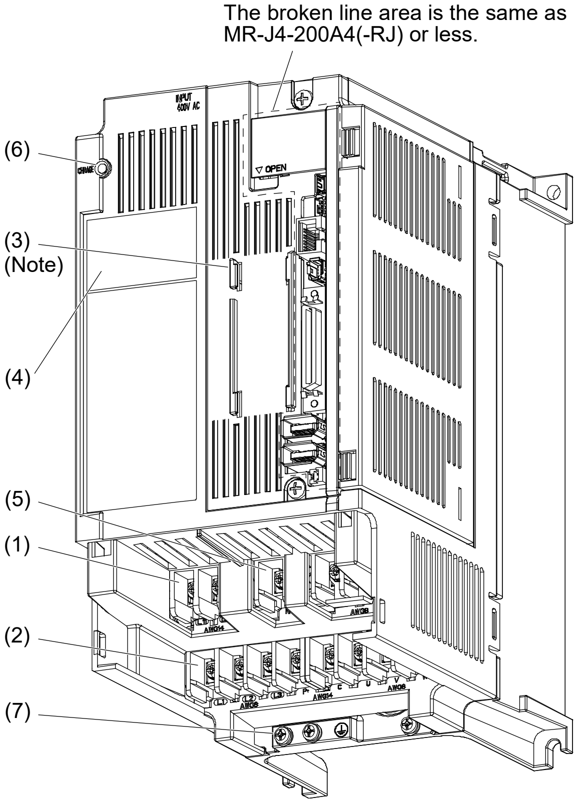


No.	Name/Application	Detailed explanation
(1)	Main circuit power connector (CNP1) Connect the input power supply.	Section 3.1 Section 3.3
(2)	Rating plate	Section 1.6
(3)	Control circuit power connector (CNP2) Connect the control circuit power supply and regenerative option.	Section 3.1 Section 3.3
(4)	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-J4-500A4(-RJ)

POINT

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



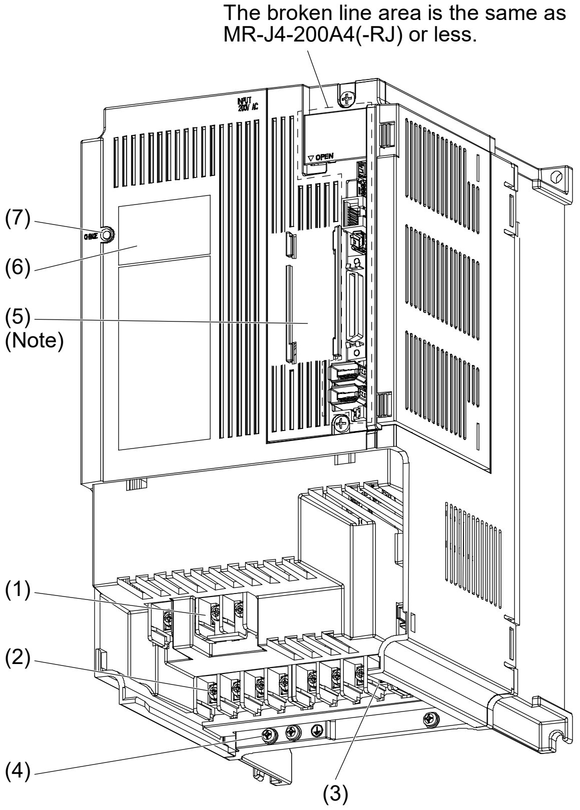
No.	Name/Application	Detailed explanation
(1)	Control circuit terminal block (TE2) Used to connect the control circuit power supply.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1) Used to connect the input power supply, regenerative option and servo motor.	
(3)	Battery holder Install the 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-J4-700A4(-RJ)

POINT

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



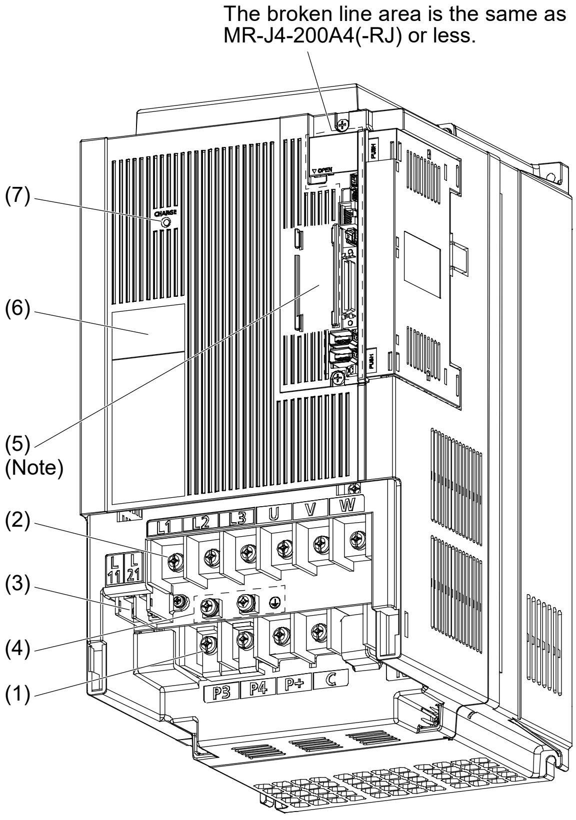
No.	Name/Application	Detailed explanation
(1)	Power factor improving reactor terminal block (TE3) Used to connect the DC reactor.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1) Used to connect the input power supply, regenerative option, and servo motor.	
(3)	Control circuit terminal block (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-J4-11KA4(-RJ)/MR-J4-15KA4(-RJ)

POINT

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

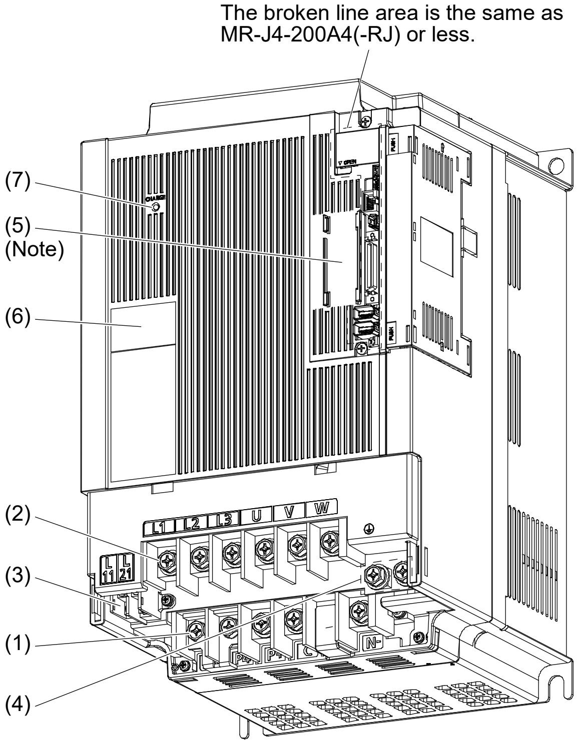


No.	Name/Application	Detailed explanation
(1)	Power factor improving reactor terminal block (TE1-2) Used to connect a power factor improving DC reactor and a regenerative option.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1-1) Used to connect the input power supply and servo motor.	
(3)	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-J4-22KA4(-RJ)

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

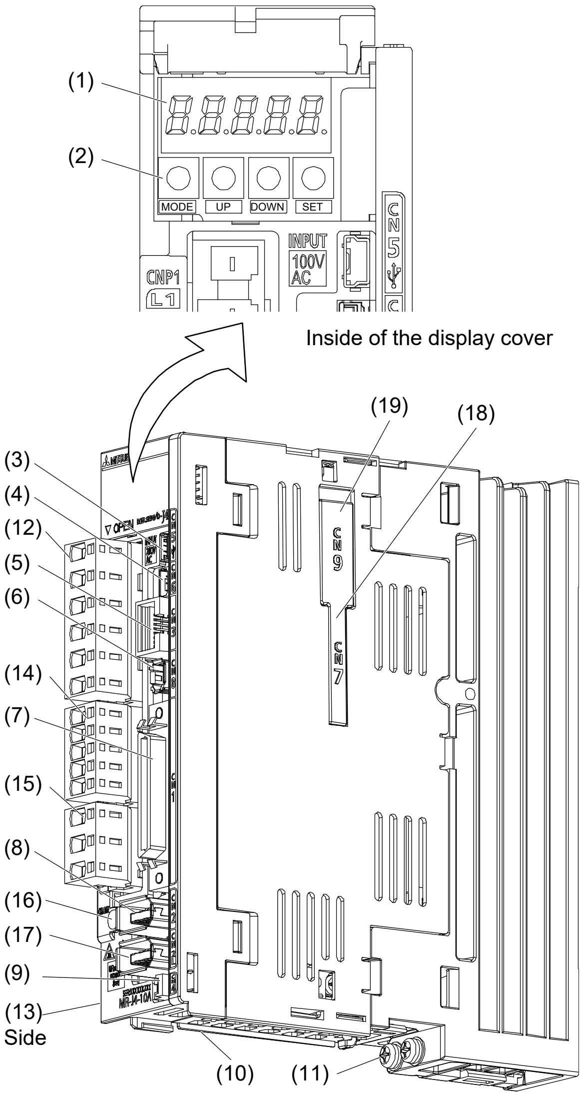


No.	Name/Application	Detailed explanation
(1)	Power factor improving reactor terminal block (TE1-2) Used to connect a power factor improving DC reactor and a regenerative option.	Section 3.1 Section 3.3
(2)	Main circuit terminal block (TE1-1) Used to connect the input power supply and servo motor.	
(3)	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-J4-10A1-RJ.



No.	Name/Application	Detailed explanation
(1)	Display The 5-digit, 7-segment LED shows the servo status and the alarm number.	Section 4.5
(2)	Operation section Used to perform status display, diagnostic, alarm, and parameter setting operations. Push the "MODE" and "SET" buttons at the same time for 3 s or more to switch to the one-touch tuning mode. ● MODE ● UP ● DOWN ● SET SET: Used to set data. Push this button together with the "MODE" button for 3 s or more to switch to the one-touch tuning mode. UP, DOWN: Used to change the display or data in each mode. MODE: Used to change the mode. Push this button together with the "SET" button for 3 s or more to switch to the one-touch tuning mode.	Section 4.5
(3)	USB communication connector (CN5) Connect with the personal computer.	Section 11.7
(4)	Analog monitor connector (CN6) Outputs the analog monitor.	Section 3.2
(5)	RS-422/RS-485 communication connector (CN3) Connect with the RS-422/RS-485 communication controller, parameter unit, etc.	Chapter 14
(6)	STO input signal connector (CN8) Used to connect the MR-J3-D05 safety logic unit and external safety relay.	Chapter 13 App. 5
(7)	I/O signal connector (CN1) Used to connect digital I/O signals.	Section 3.2 Section 3.4
(8) (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)"
(9)	Battery connector (CN4) Used to connect the battery for absolute position data backup.	Chapter 12
(10)	Battery holder Install the battery for absolute position data backup.	Section 12.2
(11)	Protective earth (PE) terminal	Section 3.1 Section 3.3
(12)	Main circuit power connector (CNP1) Connect the input power supply.	
(13)	Rating plate	Section 1.6
(14)	Control circuit power connector (CNP2) Connect the control circuit power supply and regenerative option.	Section 3.1 Section 3.3
(15)	Servo motor power output connector (CNP3) Connect the servo motor.	
(16)	Charge lamp When the main circuit is charged, this will light up. While this lamp is lit, do not reconnect the cables. 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.	
(17) (Note 1, 2)	External encoder connector (CN2L) Refer to table 1.1 for the compatible external encoders.	Section 3.4 "Linear Encoder Instruction Manual"
(18)	Optional unit connector (CN7) Connect the optional unit. It is available with MR-J4-_A1-RJ servo amplifiers manufactured in November 2014 or later. The MR-J4-_A1 servo amplifier does not have this connector.	
(19)	Optional unit connector (CN9) Connect the optional unit. It is available with MR-J4-_A1-RJ servo amplifiers manufactured in November 2014 or later. The MR-J4-_A1 servo amplifier does not have this connector.	

Note 1. This is for the MR-J4-_A1-RJ servo amplifier. The MR-J4-_A1 servo amplifier does not have the CN2L connector.

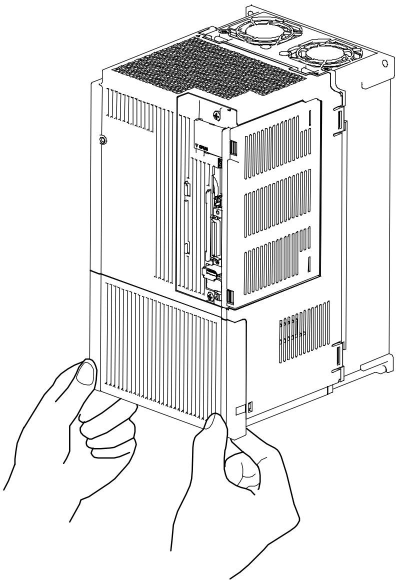
2. "External encoder" is a term for linear encoder used in the linear servo system and load-side encoder used in the fully closed loop system in this manual.

1.7.2 Removal and reinstallation of the front cover

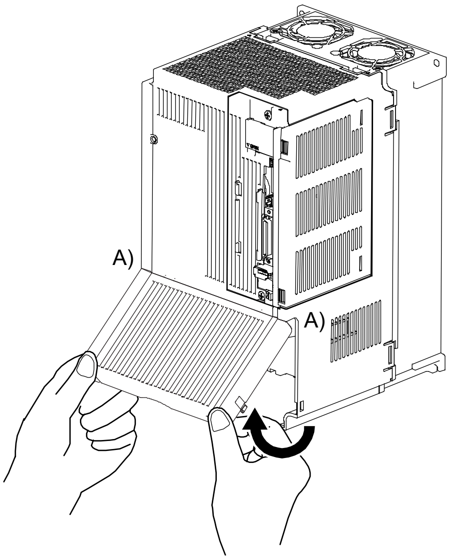
⚠WARNING	●Before removing or installing the front cover, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, when confirming 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-J4-700A(-RJ) to MR-J4-22KA(-RJ) and MR-J4-500A4(-RJ) to MR-J4-22KA4(-RJ).
The diagram shows MR-J4-700A.

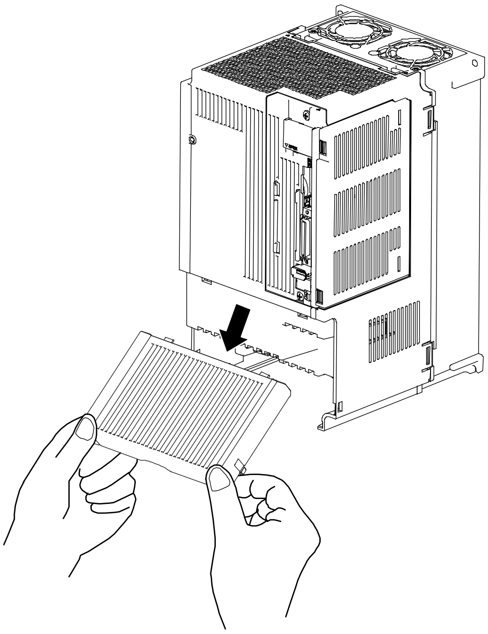
(1) Removal of the front cover



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

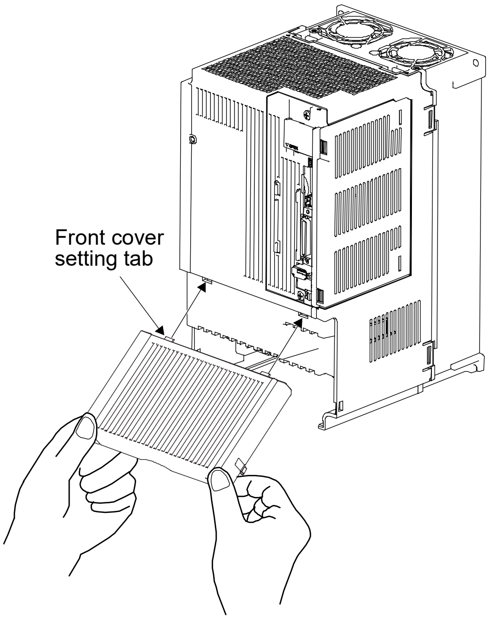


2) Pull up the cover, supporting at point A).

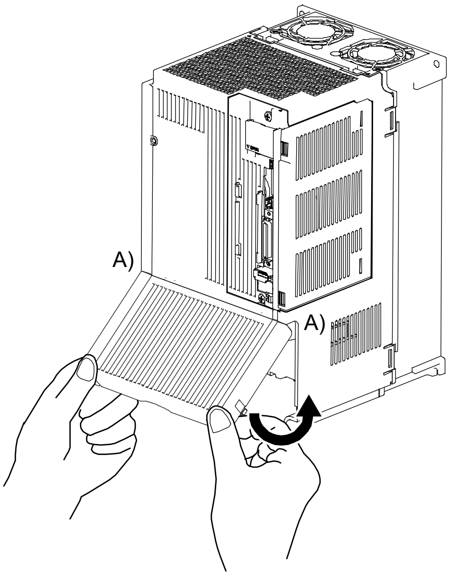


3) Pull out the front cover to remove.

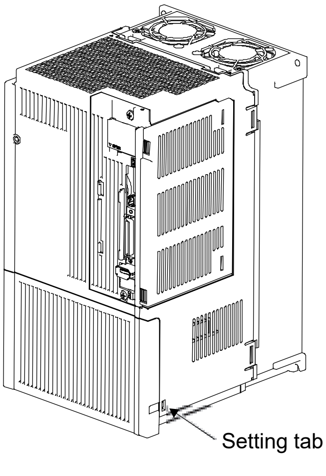
(2) Reinstallation of the front cover



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



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



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

1.8 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.

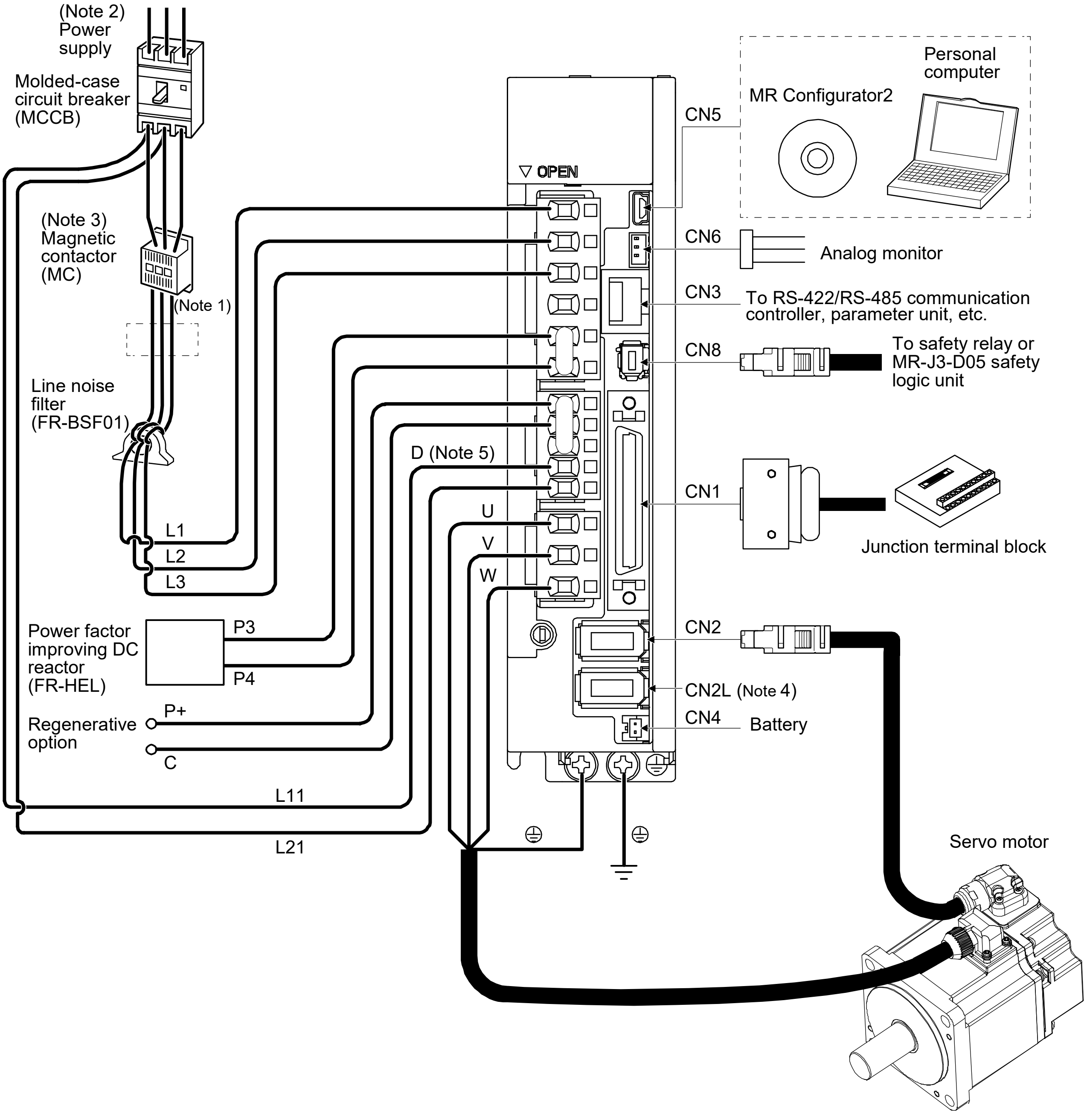
POINT

- Equipment other than the servo amplifier and servo motor are optional or recommended products.
- When using the MR-J4-_A-RJ servo amplifier with the DC power supply input, refer to app. 13.

(1) 200 V class

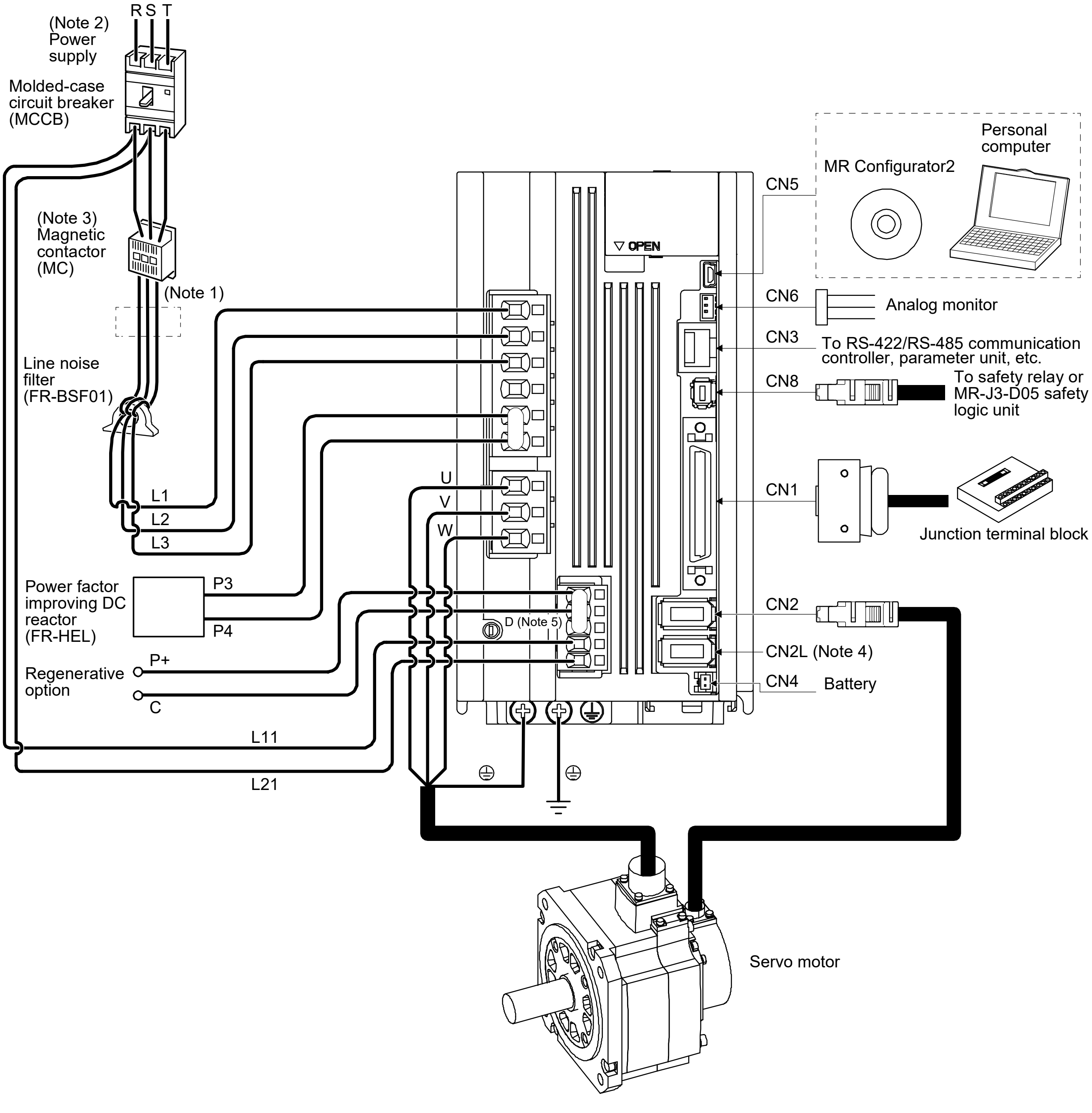
(a) MR-J4-200A(-RJ) or less

The diagram shows MR-J4-20A-RJ.



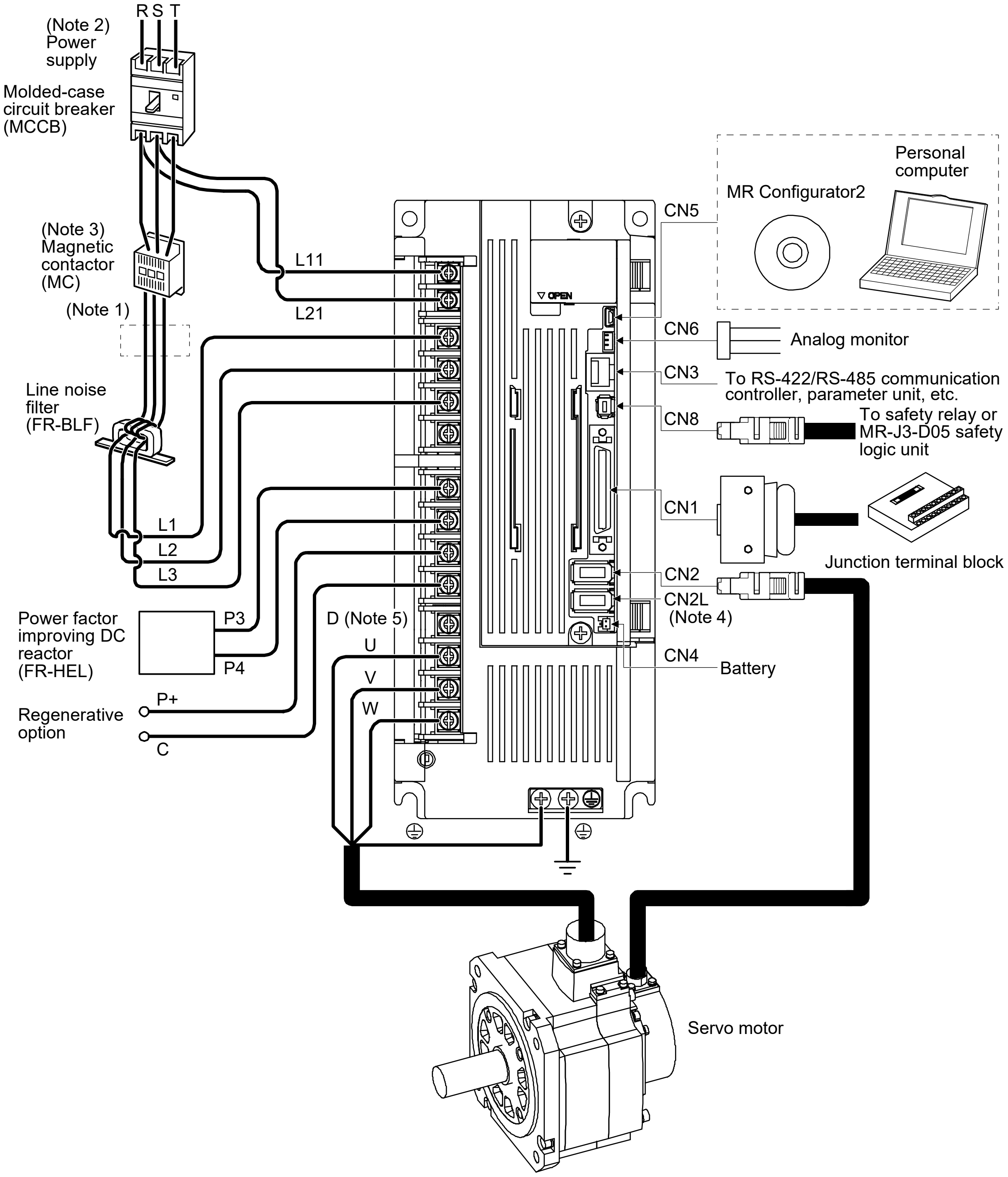
Note
1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
2. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open. For the power supply specifications, refer to section 1.3.
3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
4. This is for the MR-J4-_A-RJ servo amplifier. The MR-J4-_A servo amplifier does not have the CN2L connector. When using an MR-J4-_A-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to 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-J4-350A(-RJ)



Note
1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
2. For the power supply specifications, refer to section 1.3.
3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
4. This is for the MR-J4-_A-RJ servo amplifier. The MR-J4-_A servo amplifier does not have the CN2L connector. When using MR-J4-_A-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to 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-J4-500A(-RJ)



Note 1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.

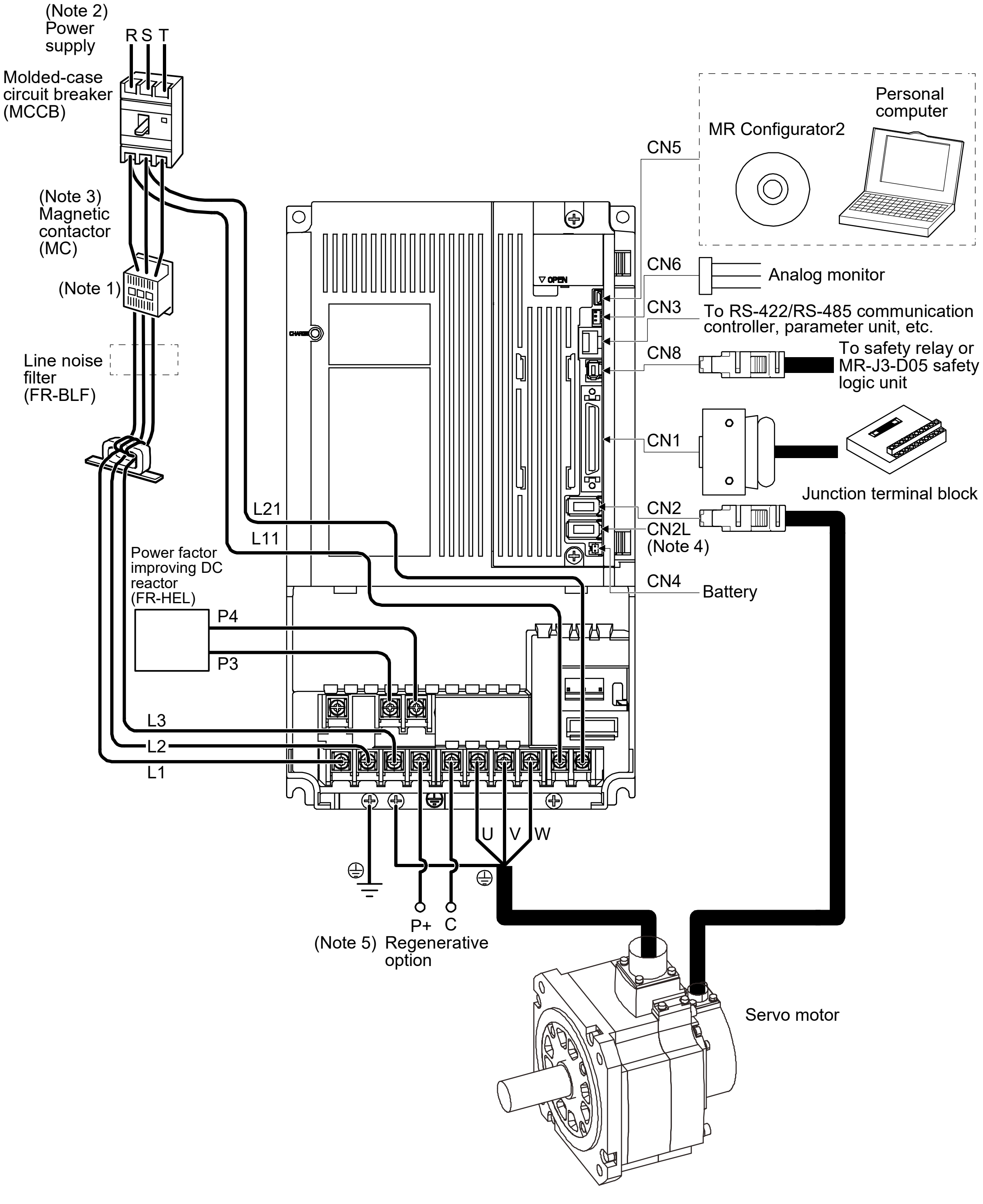
2. For the power supply specifications, refer to section 1.3.

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

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

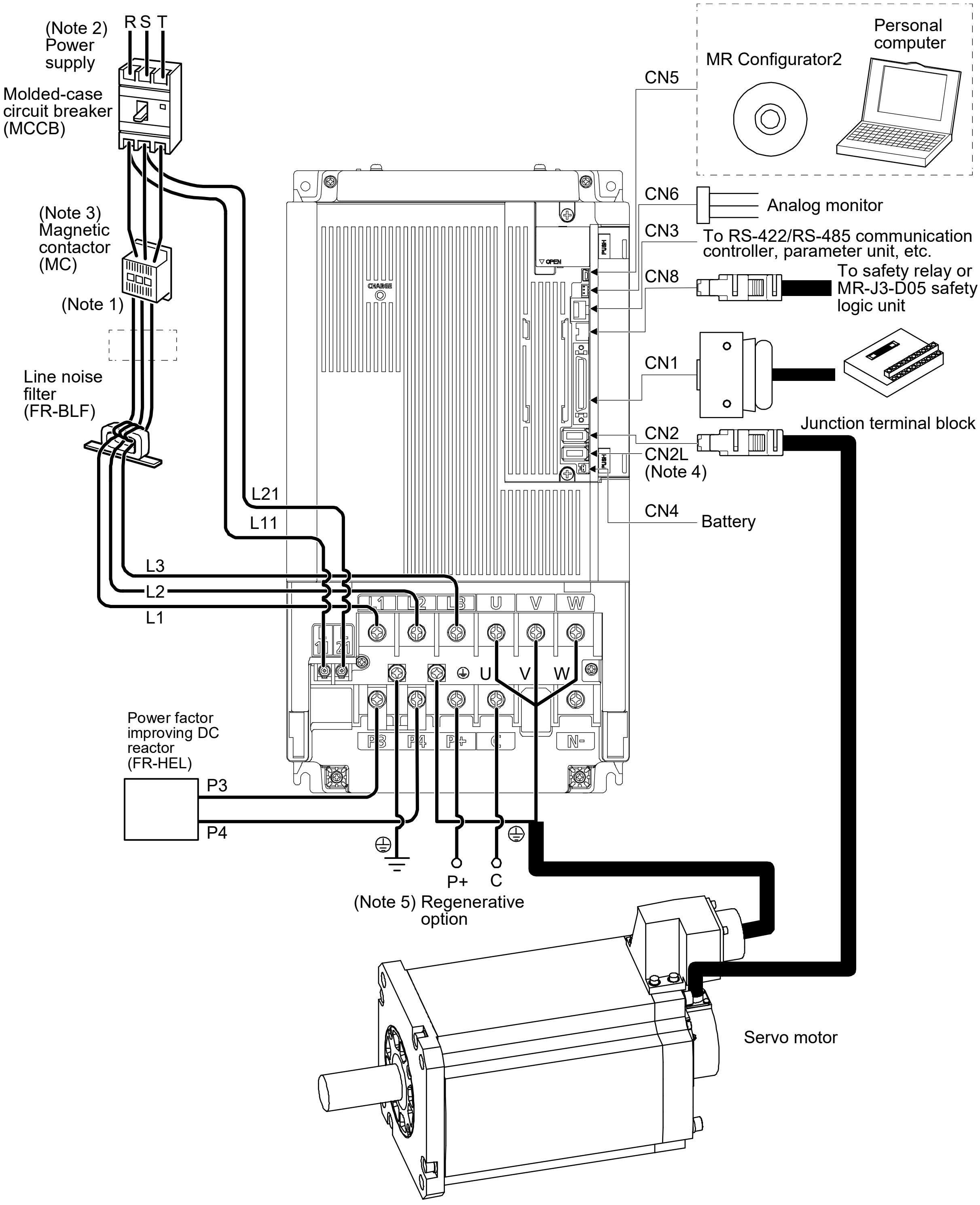
5. Always connect between P+ and D terminals. When using the regenerative option, refer to section 11.2.

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



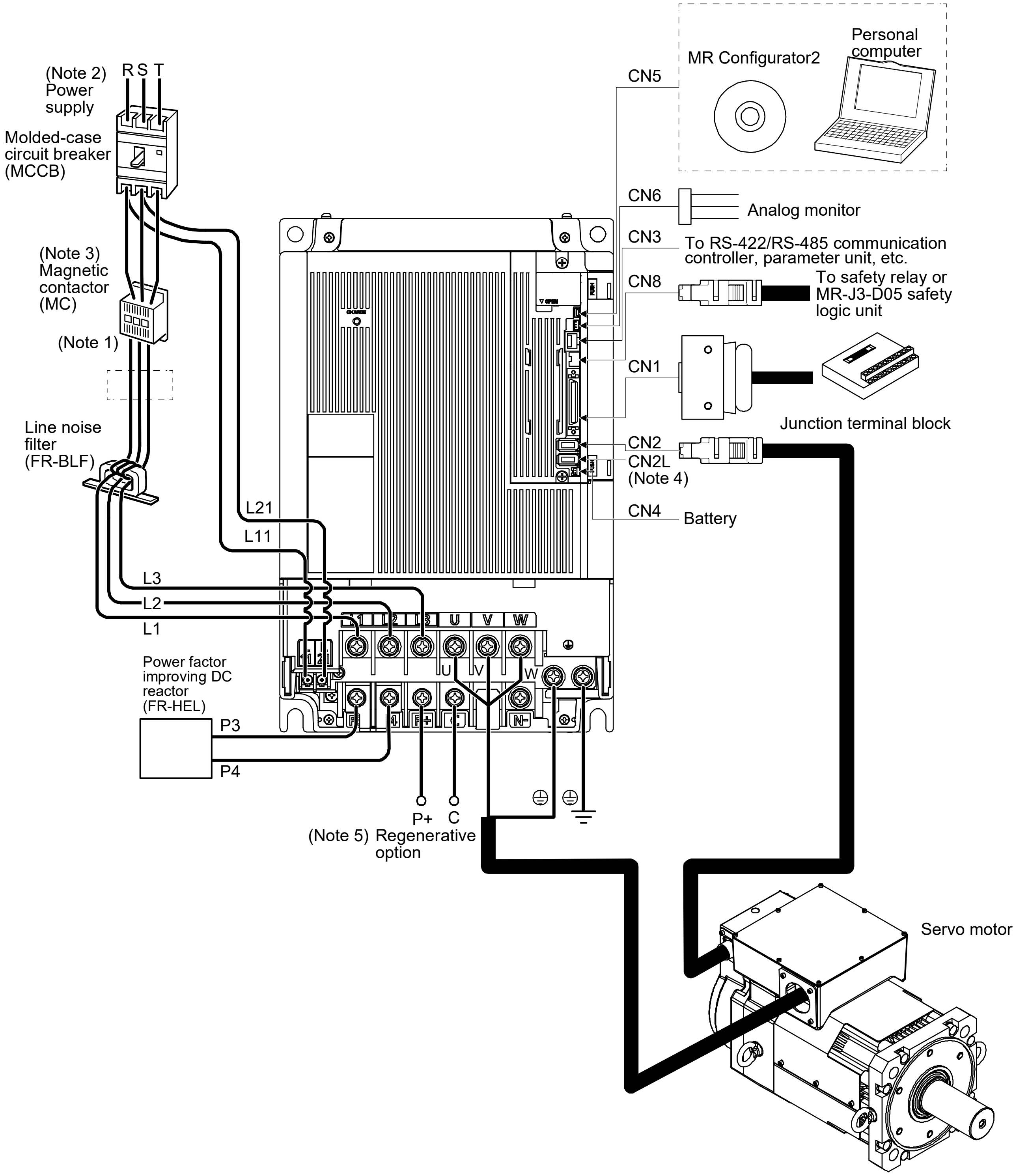
Note
1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
2. For the power supply specifications, refer to section 1.3.
3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
4. This is for the MR-J4-_A-RJ servo amplifier. The MR-J4-_A servo amplifier does not have the CN2L connector. When using an MR-J4-_A-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to 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-J4-11KA(-RJ)/MR-J4-15KA(-RJ)



Note
1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
2. For the power supply specifications, refer to section 1.3.
3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
4. This is for the MR-J4-_A-RJ servo amplifier. The MR-J4-_A servo amplifier does not have the CN2L connector. When using an MR-J4-_A-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to 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-J4-22KA(-RJ)

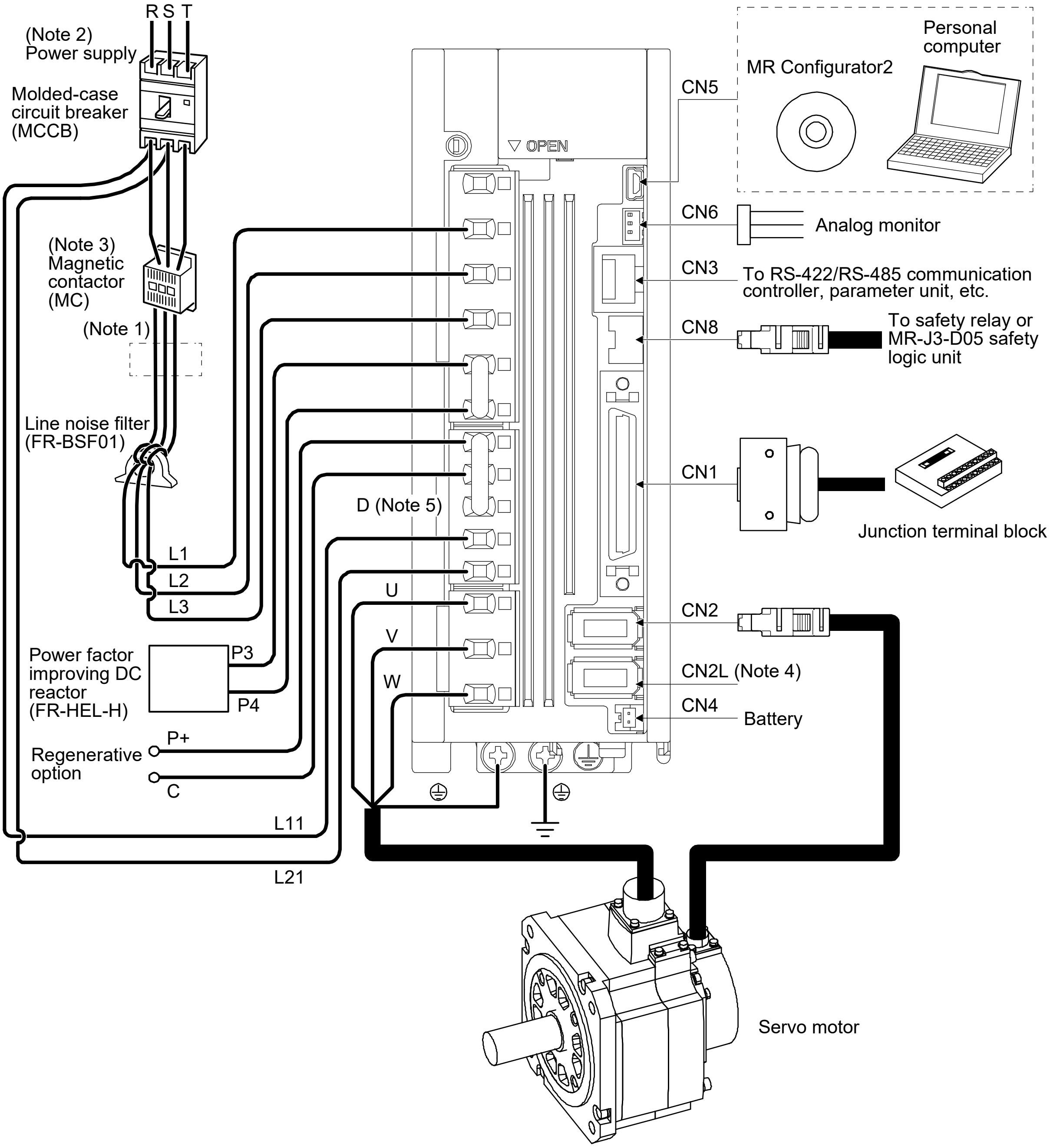


Note
1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
2. For the power supply specifications, refer to section 1.3.
3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
4. This is for the MR-J4-_A-RJ servo amplifier. The MR-J4-_A servo amplifier does not have the CN2L connector. When using an MR-J4-_A-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to 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-J4-200A4(-RJ) or less

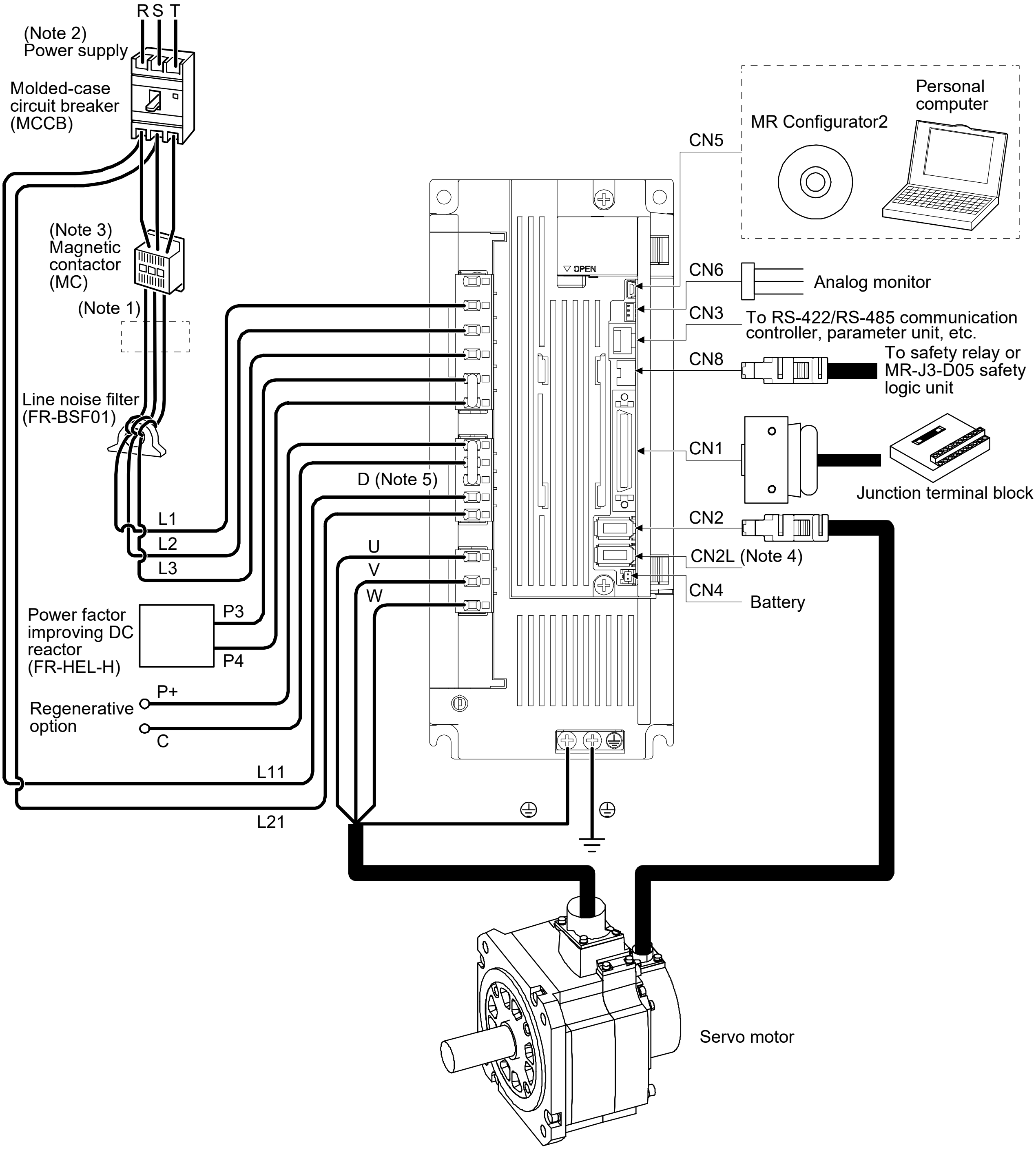
The diagram is for MR-J4-60A4-RJ and MR-J4-100A4-RJ.



Note

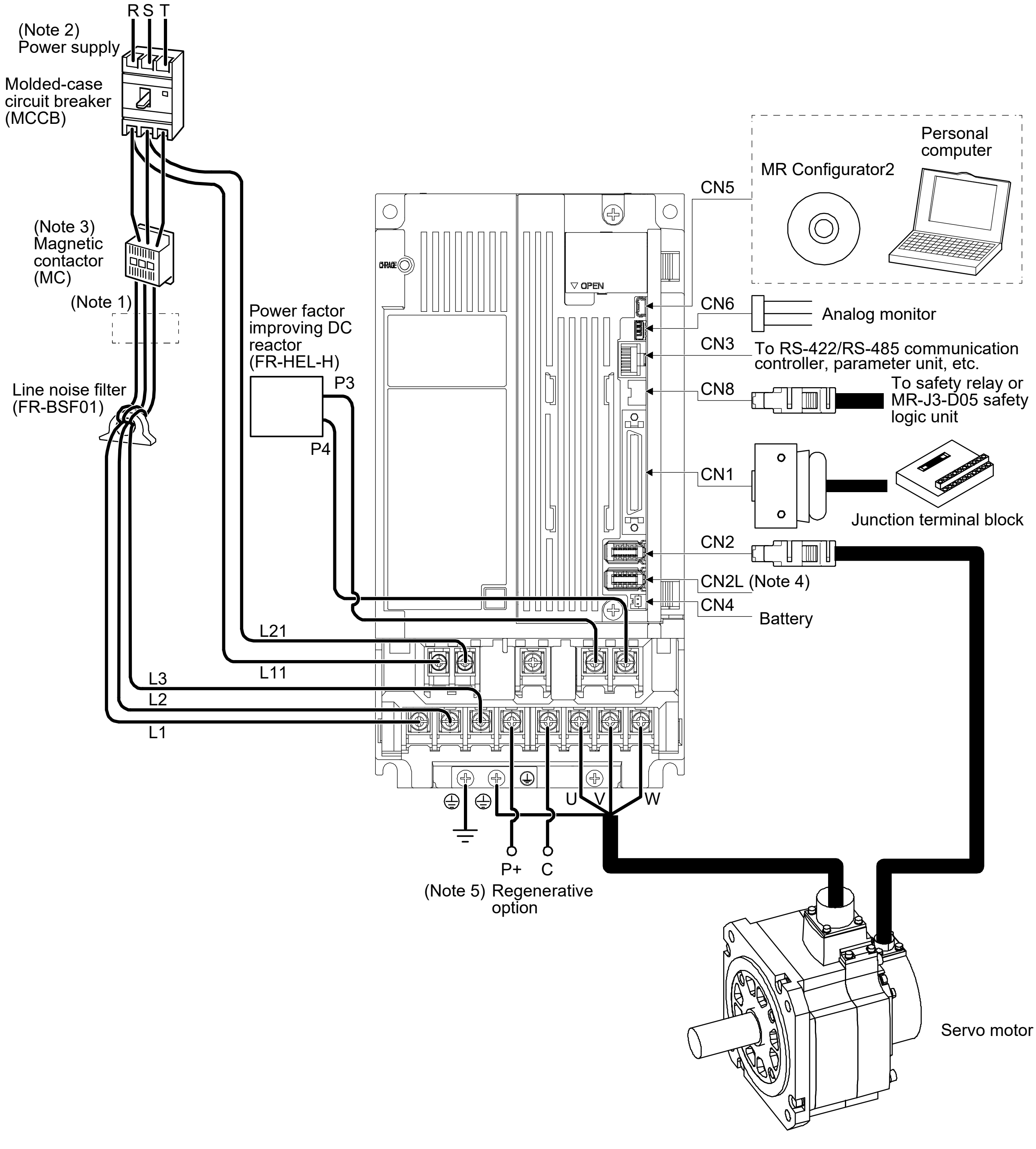
1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P3 and P4.
2. Refer to section 1.3 for the power supply specification.
3. Depending on the main circuit voltage and 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-_A4-RJ servo amplifier. MR-J4-_A4 servo amplifier does not have CN2L connector. When using MR-J4-_A4-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-J4-350A4(-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-_A4-RJ servo amplifier. MR-J4-_A4 servo amplifier does not have CN2L connector. When using MR-J4-_A4-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.

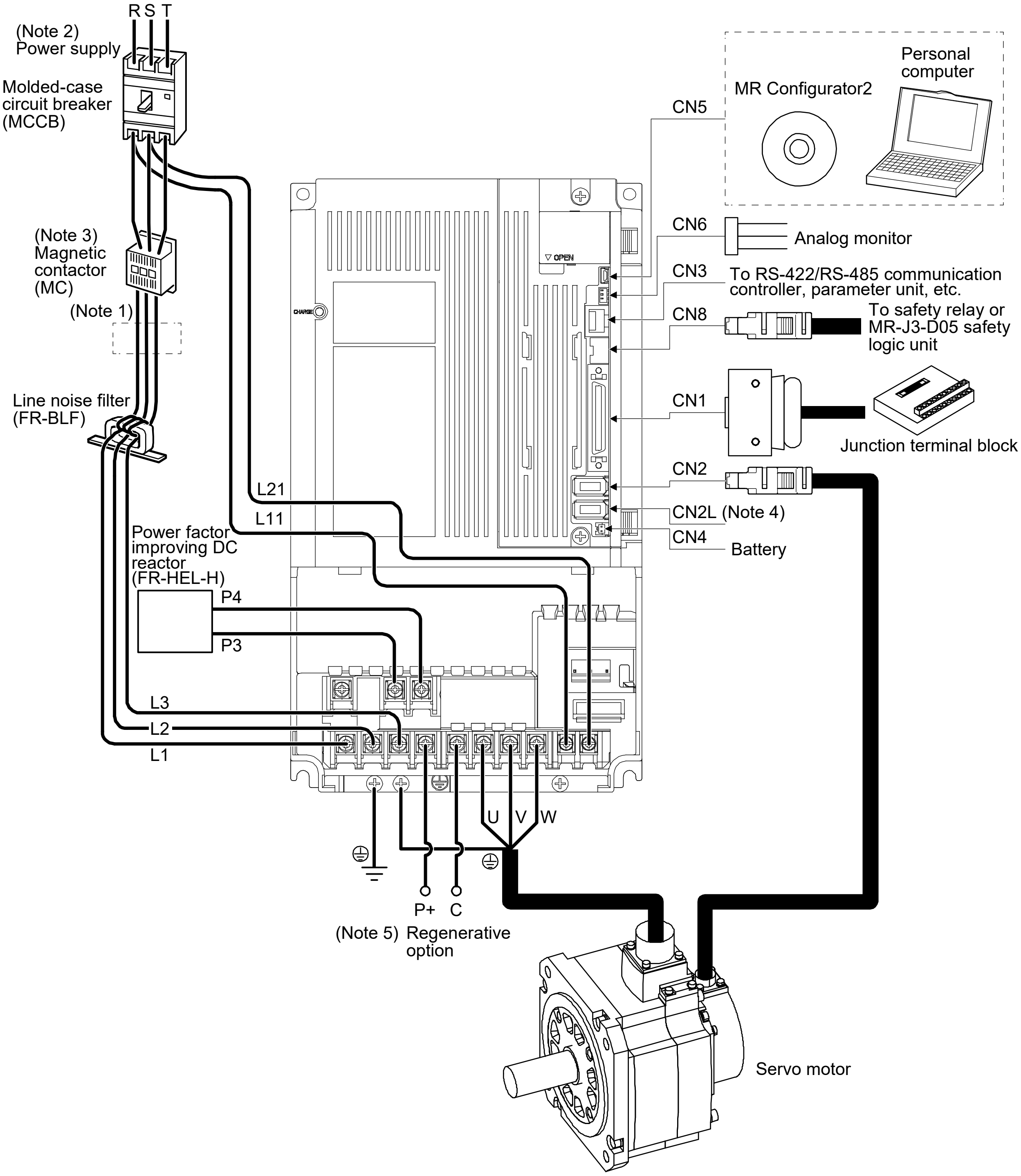
(c) MR-J4-500A4(-RJ)



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-_A4-RJ servo amplifier. MR-J4-_A4 servo amplifier does not have CN2L connector. When using MR-J4-_A4-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-J4-700A4(-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.

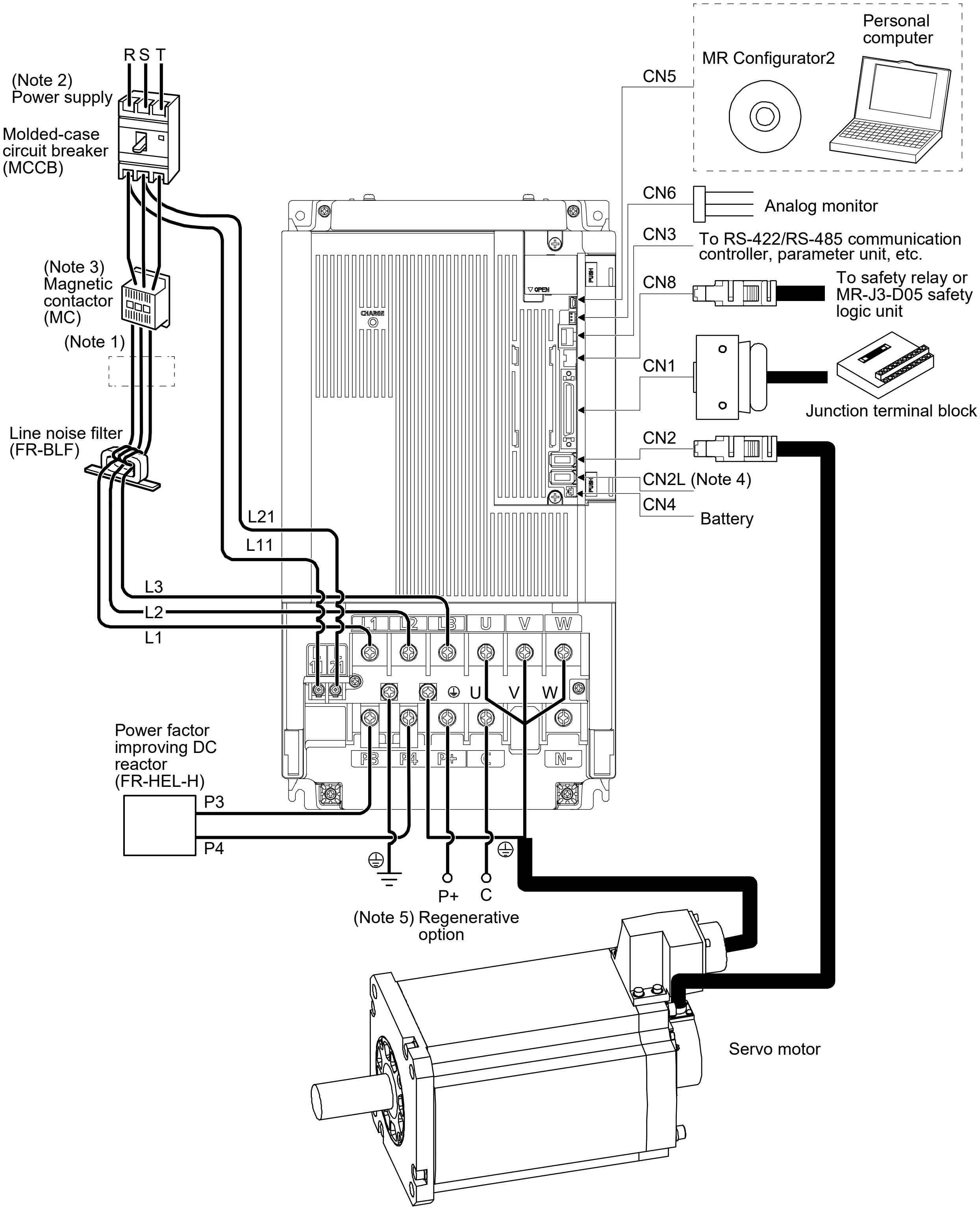
2. Refer to section 1.3 for the power supply specification.

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-_A4-RJ servo amplifier. MR-J4-_A4 servo amplifier does not have CN2L connector. When using MR-J4-_A4-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.

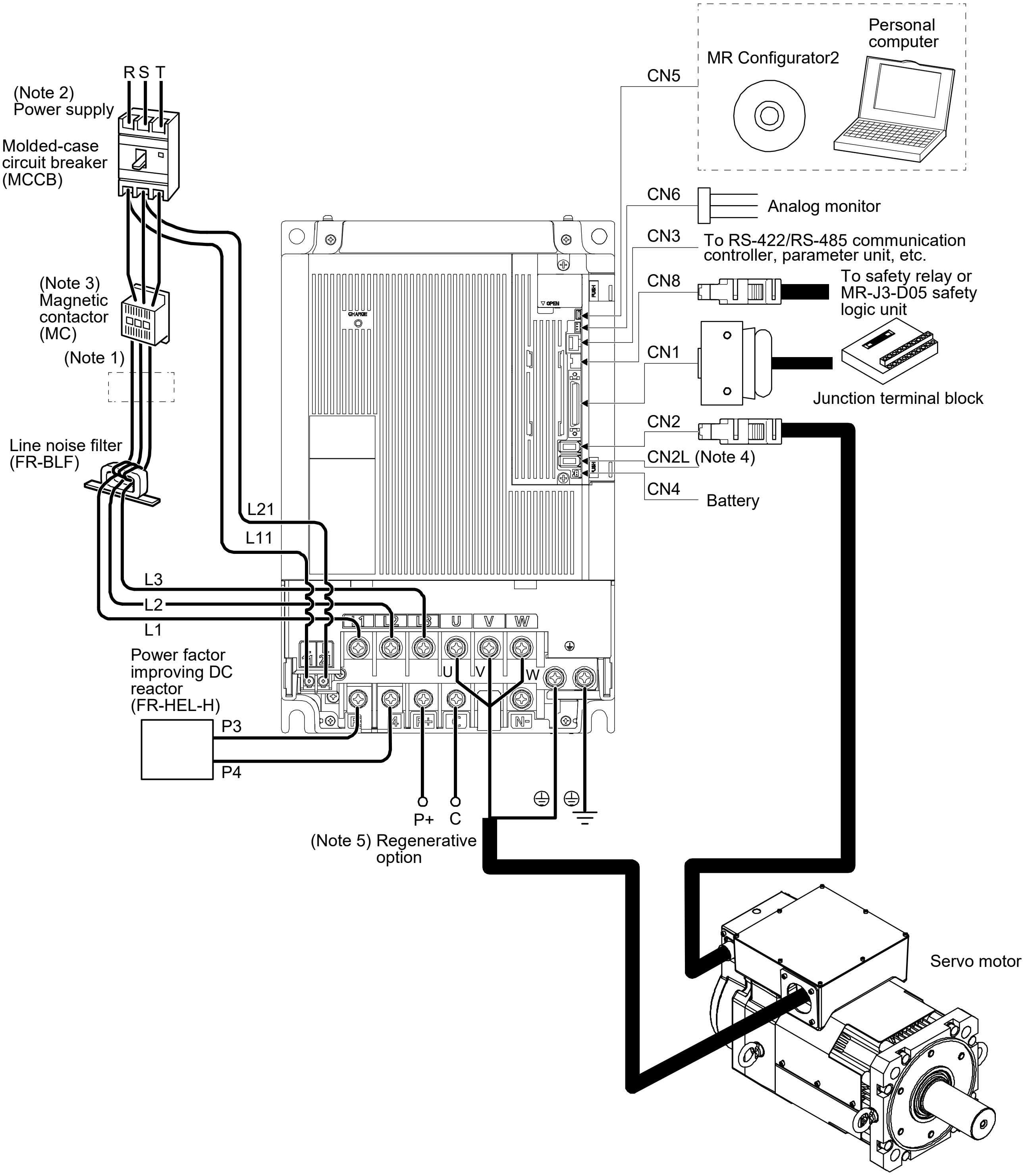
5. When using the regenerative option, refer to section 11.2.

(e) MR-J4-11KA4(-RJ)/MR-J4-15KA4(-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-_A4-RJ servo amplifier. MR-J4-_A4 servo amplifier does not have CN2L connector. When using MR-J4-_A4-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.

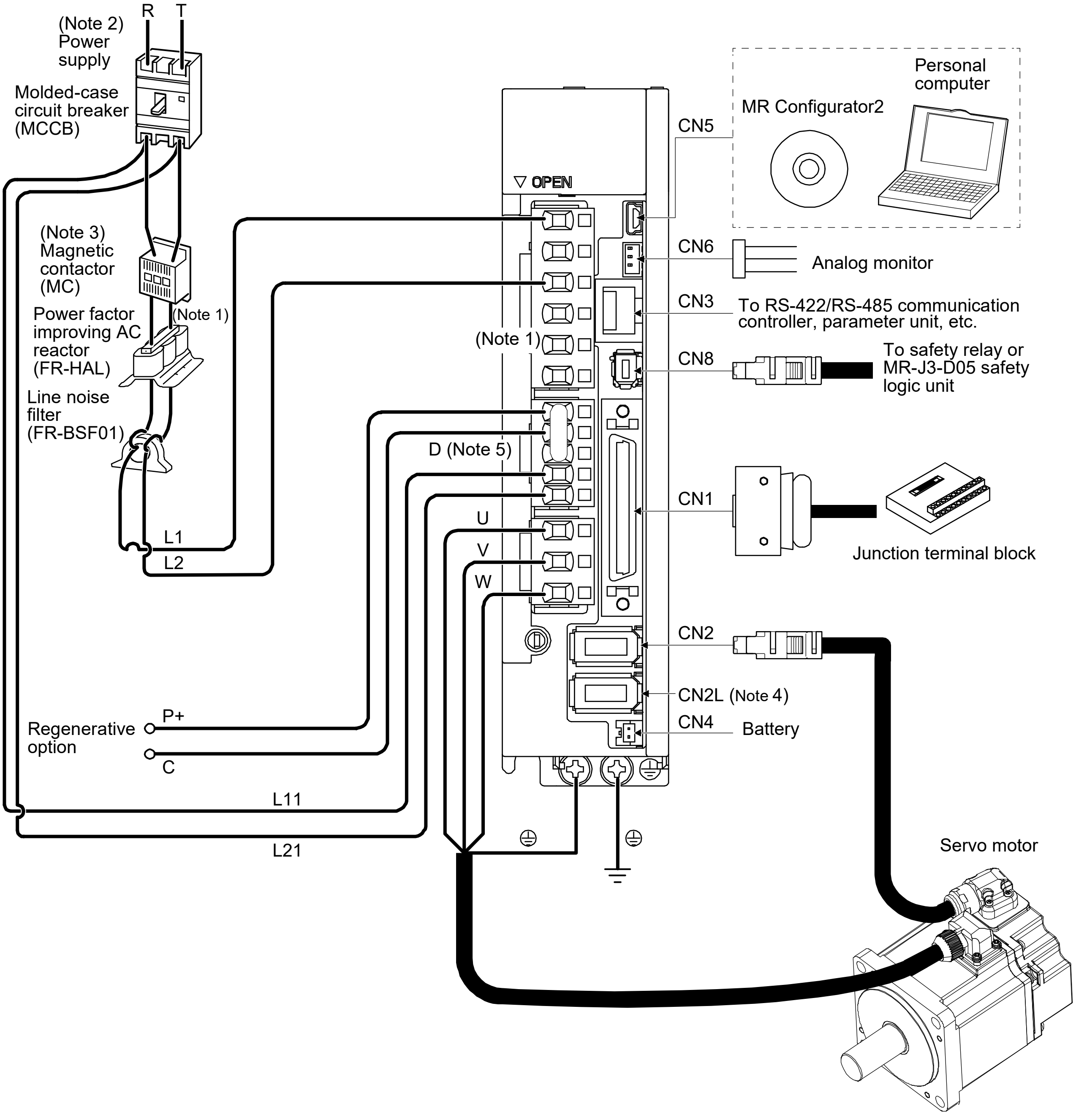
(f) MR-J4-22KA4(-RJ)



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-_A4-RJ servo amplifier. MR-J4-_A4 servo amplifier does not have CN2L connector. When using MR-J4-_A4-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 shows MR-J4-20A1-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-_A1-RJ servo amplifier. MR-J4-_A1 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.

MEMO

2. INSTALLATION

⚠WARNING

- To prevent electric shock, ground each equipment securely.

⚠CAUTION

- Stacking in excess of the specified number of product packages is not allowed.
- Do not hold the 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 equipment. Otherwise, it may cause injury.
- Use the equipment within the specified environment. For the environment, refer to section 1.3.
- Provide an adequate protection to prevent screws and other conductive matter, oil and other combustible matter from entering the servo amplifier.
- Do not block the intake and exhaust areas of the servo amplifier. Otherwise, it may cause a malfunction.
- Do not drop or 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 equipment has been stored for an extended period of time, contact your local sales office.
- When handling the servo amplifier, be careful about the edged parts such as corners of the servo amplifier.
- The servo amplifier must be installed in the metal cabinet.
- 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.

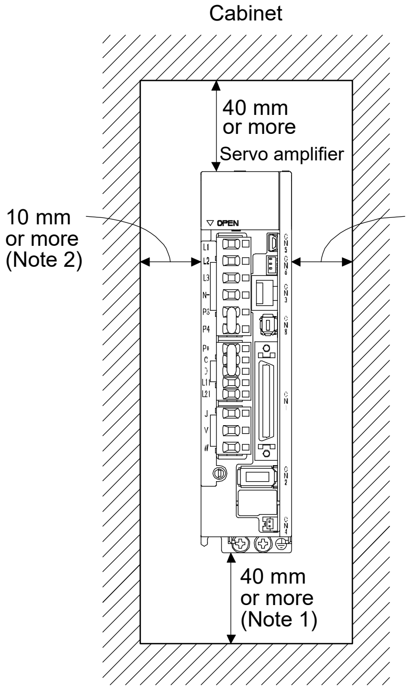
2.1 Installation direction and clearances

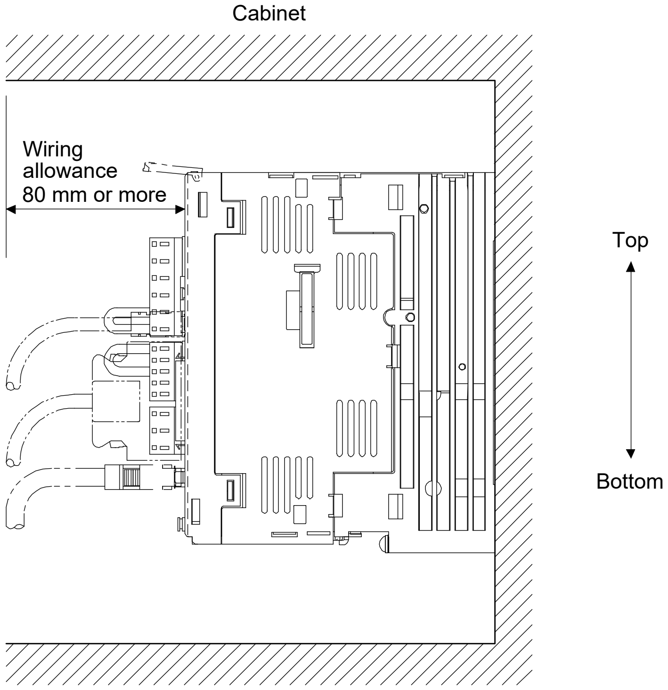
⚠CAUTION

- ●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





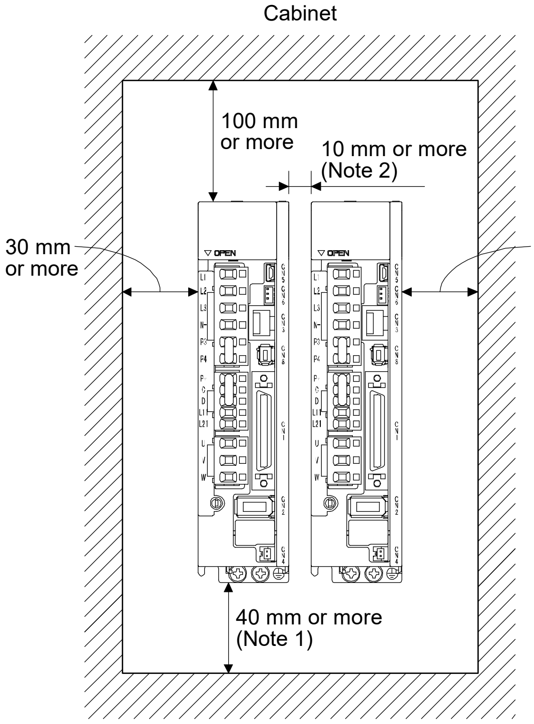
Note 1. For 11 kW to 22 kW servo amplifiers, the clearance between the bottom and ground will be 120 mm or more.
2. When mounting MR-J4-500A(-RJ), maintain a minimum clearance of 25 mm on the left side.

(b) Installation of two or more servo amplifiers

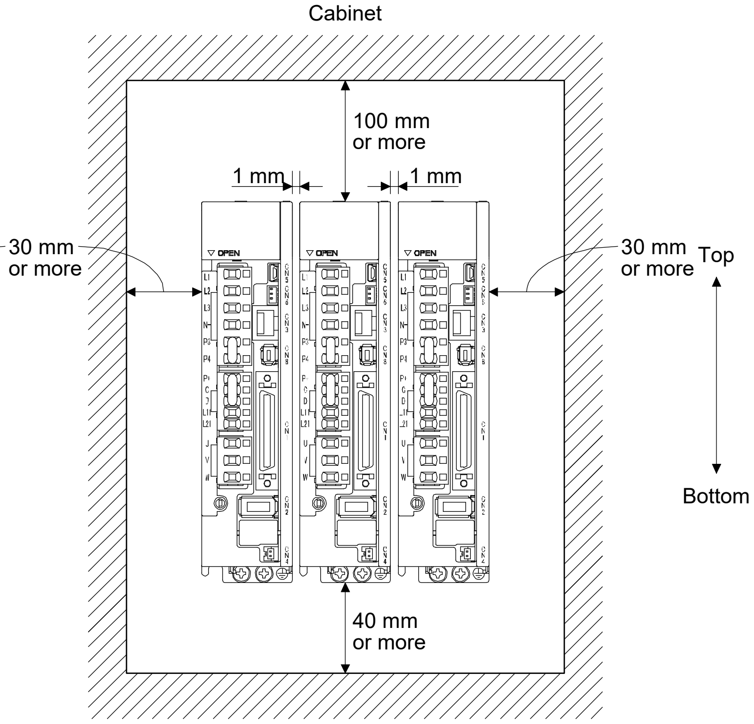
POINT

- ●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-J4-500A(-RJ), maintain a minimum clearance of 25 mm between the MR-J4-500A(-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 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.

2.5 Parts having service life

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

Part name	Life guideline
Smoothing capacitor	10 years
Relay	Number of 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

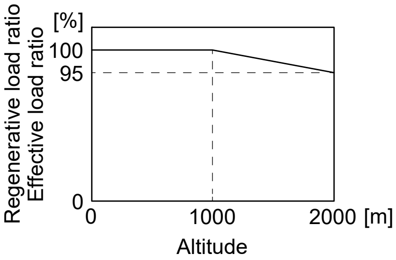
The cooling fan bearings reach the end of their life in 10,000 hours to 30,000 hours. Normally, therefore, the cooling fan must be replaced in a few years of continuous operation as a guideline. If unusual noise or vibration is found during inspection, the cooling fan must also be replaced.

The life indicates under the yearly average ambient temperature of 40 °C, free from corrosive gas, flammable gas, oil mist, dust and dirt.

2.6 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 2.4.)

(c) Servo amplifier cooling fan

There is no restriction. Use in the same manner as in 1000 m or less. (Refer to section 2.4.)

MEMO

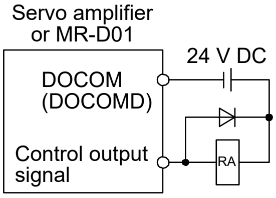
3. SIGNALS AND WIRING

WARNING

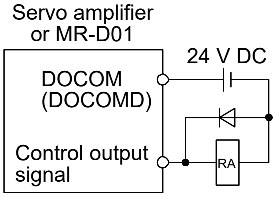
- Any person who is involved in wiring should be fully competent to do the work.
- Before wiring, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. Otherwise, an electric shock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

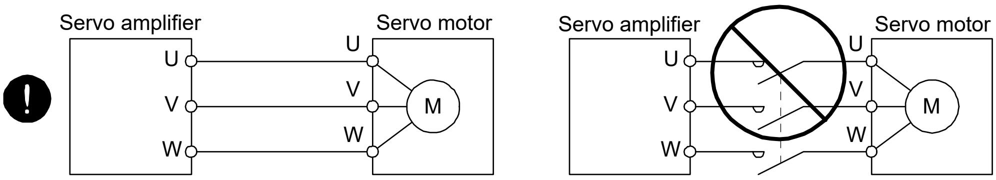


For source output interface

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

3.1 Input power supply circuit

⚠CAUTION

- Always connect a magnetic contactor between the power supply and the main circuit power supply (L1/L2/L3) of the servo amplifier, in order to configure a circuit that shuts down the power supply on the side of the servo amplifier's power supply. If a magnetic contactor is not connected, continuous flow of a large current may cause a fire when the servo amplifier malfunctions.
- Use ALM (Malfunction) to switch main circuit power supply off. Not doing so may cause a fire when a regenerative transistor malfunctions or the like may overheat the regenerative resistor.
- Check the servo amplifier model, and then input proper voltage to the servo amplifier power supply. If input voltage exceeds the upper limit of the specification, the servo amplifier will break down.
- The servo amplifier has a built-in surge absorber (varistor) to reduce 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.

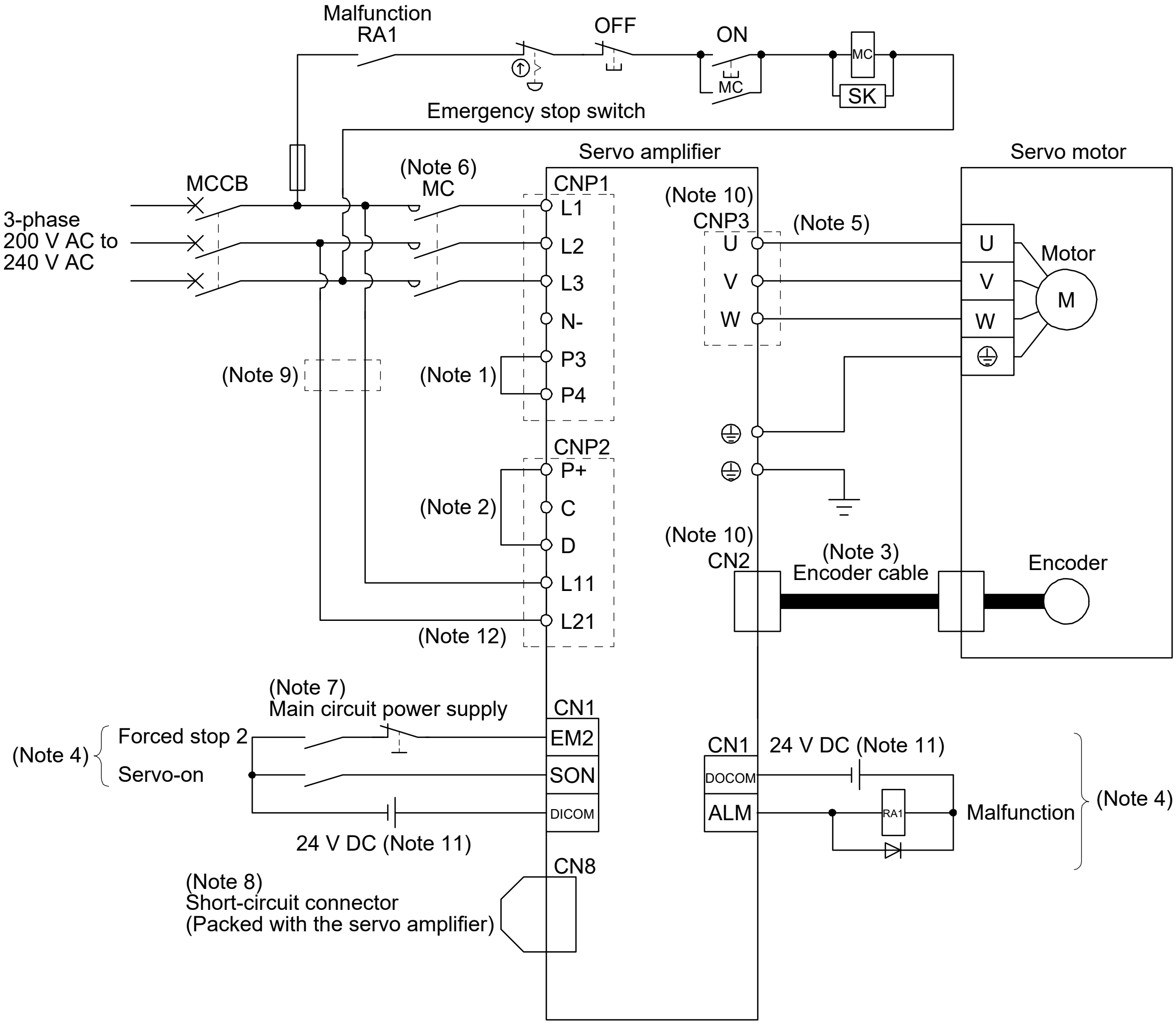
POINT

- 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-_A-RJ servo amplifier with the DC power supply input, refer to app. 13.

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

3.1.1 200 V class

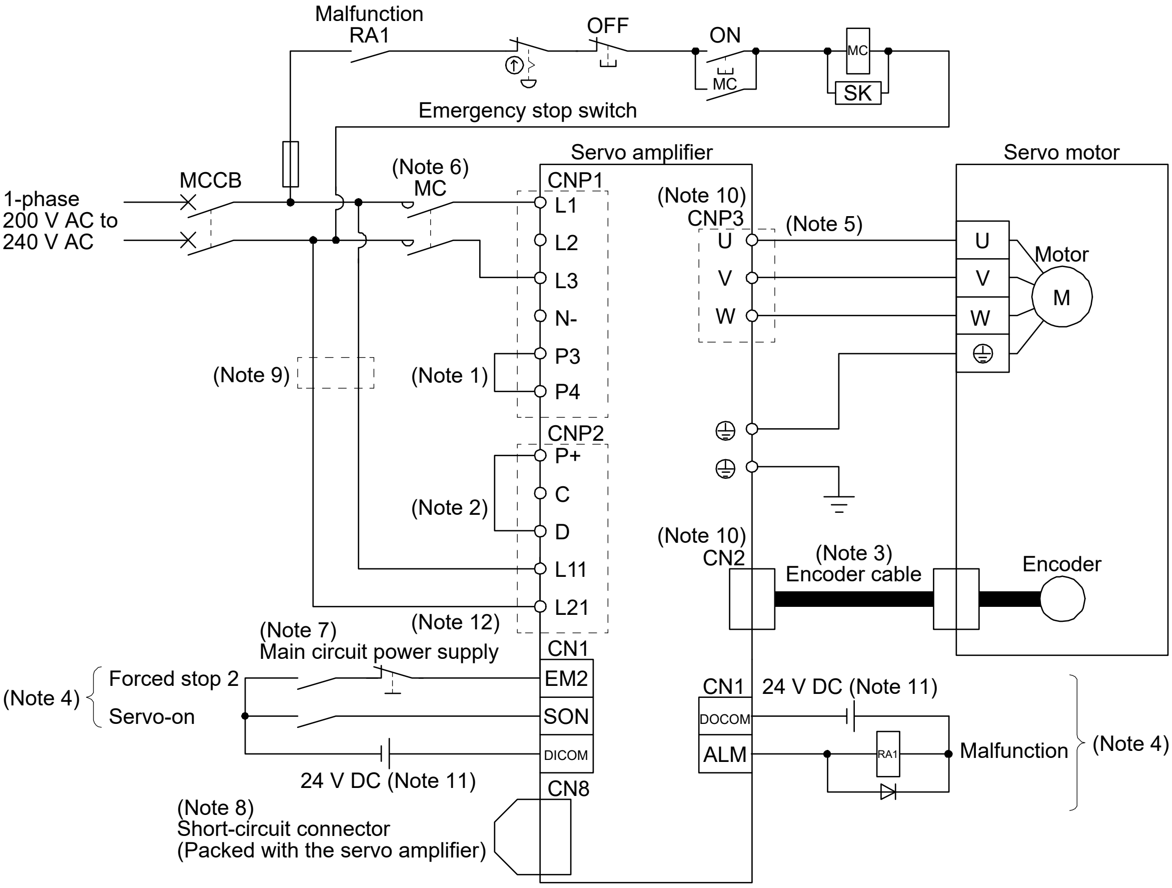
(1) Using 3-phase 200 V AC to 240 V AC power supply for MR-J4-10A(-RJ) to MR-J4-350A(-RJ)



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. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
5. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
6. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
7. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
8. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
9. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker. (Refer to section 11.10.)
10. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
11. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
12. Do not ground L11 and L21.

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

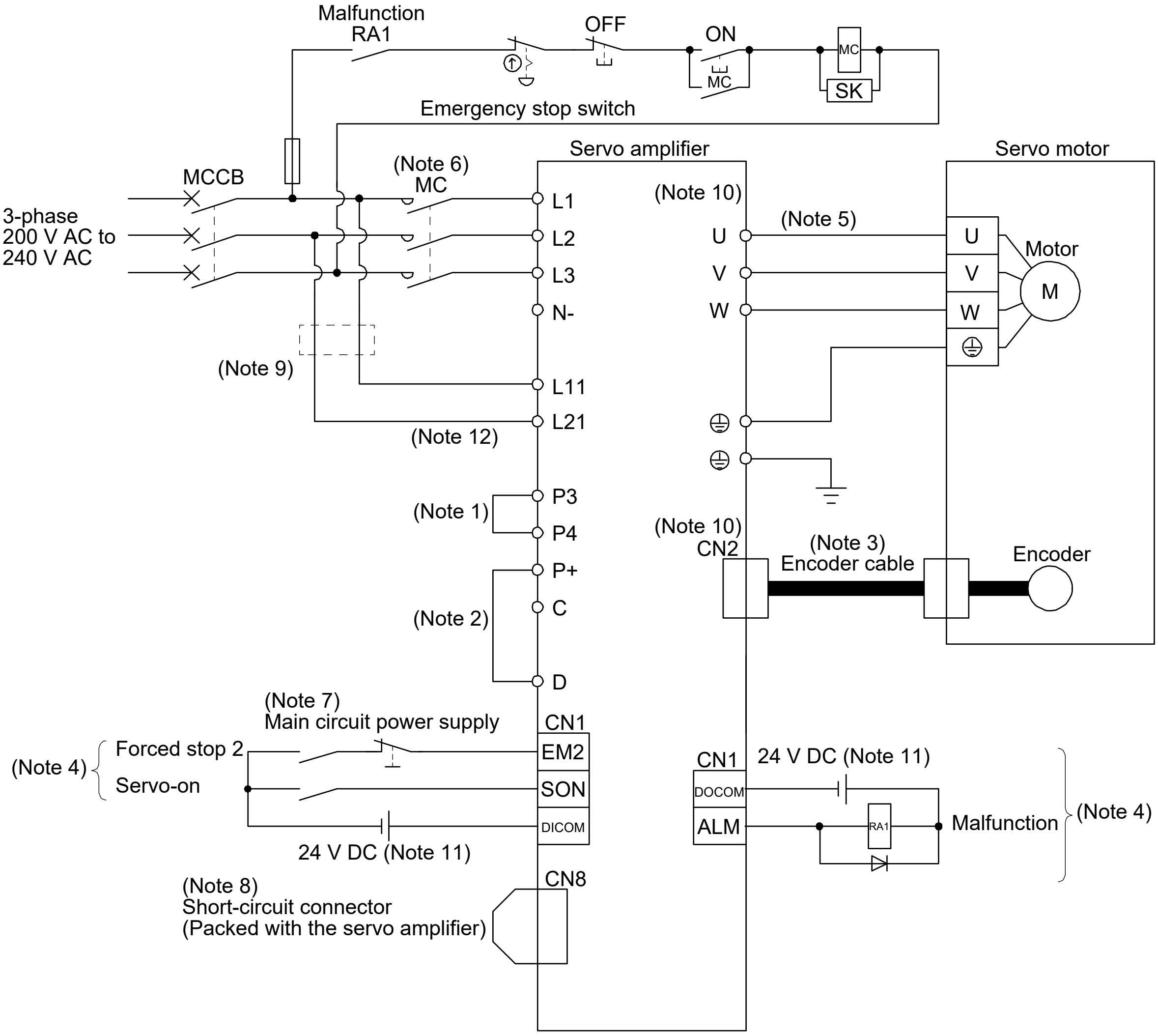
POINT
●Connect the 1-phase 200 V AC to 240 V AC power supply to L1 and L3. One of the connecting destinations is different from MR-J3 Series Servo Amplifier's. When using MR-J4 as a replacement for MR-J3, be careful not to connect the power to L2.



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.

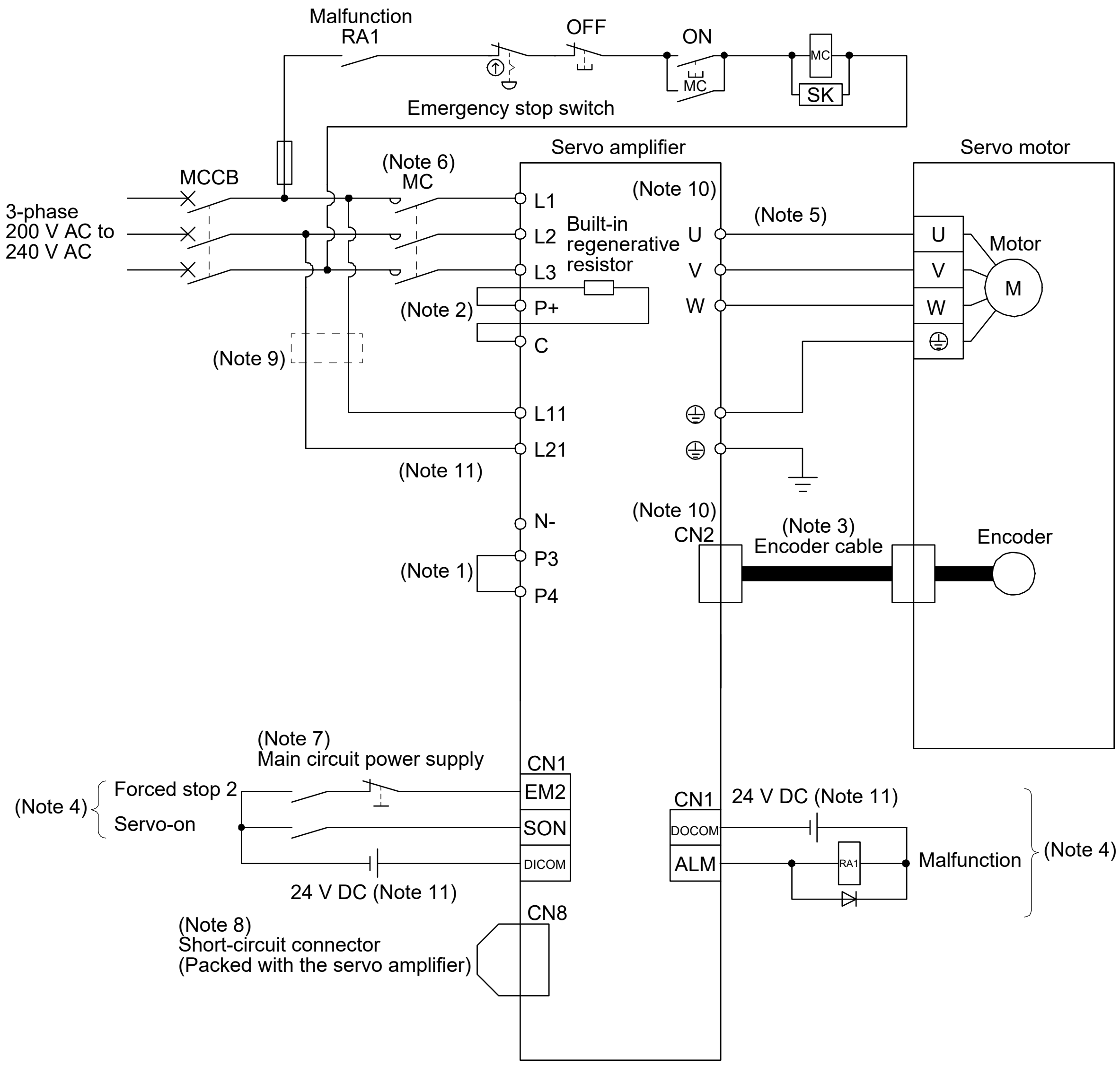
2. Always connect between P+ and D terminals (factory-wired). When using the regenerative option, refer to section 11.2.
3. For the encoder cable, use of the option cable is recommended. For selecting cables, refer to "Servo Motor Instruction Manual (Vol. 3)".
4. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
5. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
6. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
7. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
8. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
9. When wires used for L11 and L21 are thinner than wires used for L1, and L3, use a molded-case circuit breaker. (Refer to section 11.10.)
10. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
11. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
12. Do not ground L11 and L21.

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



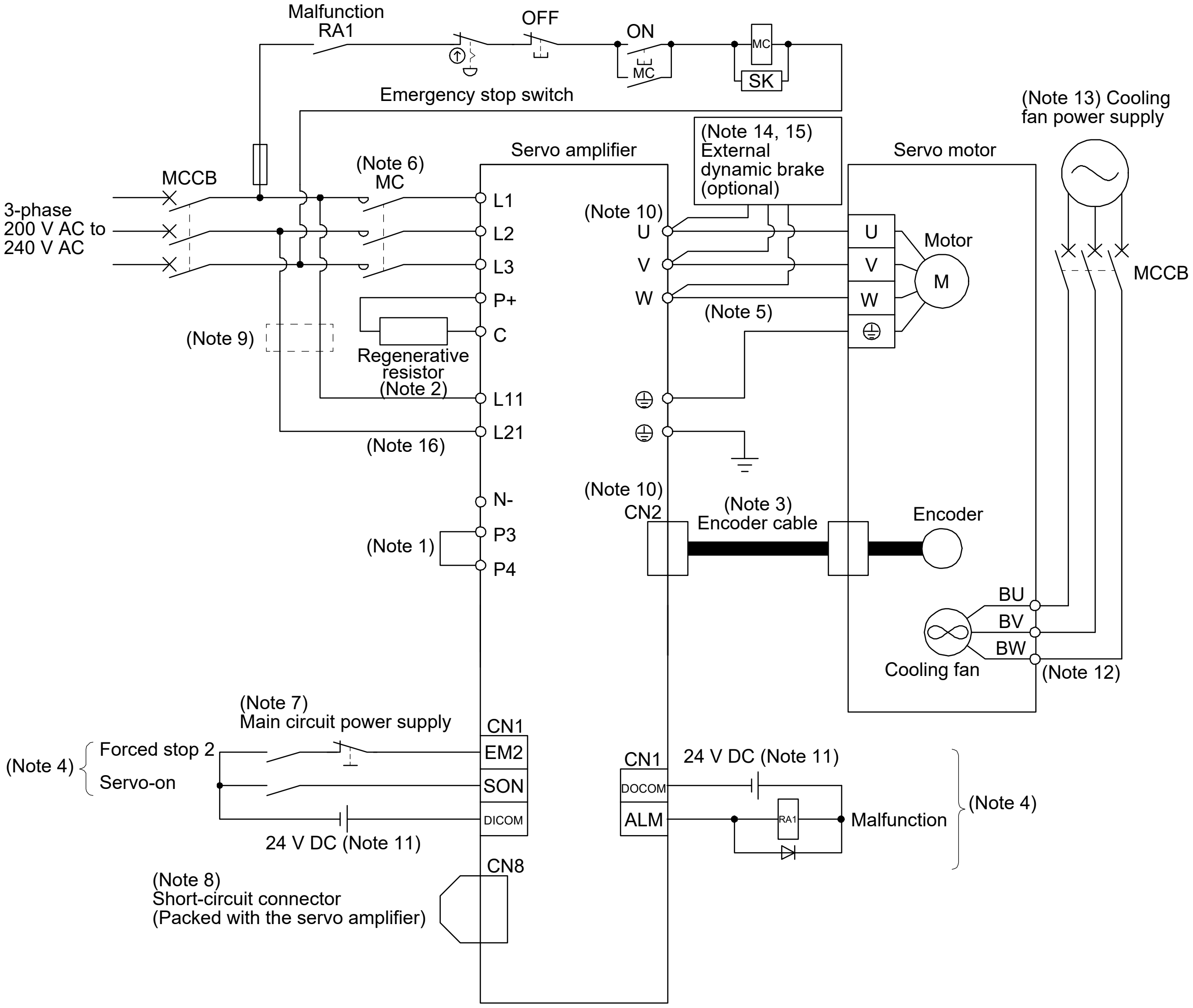
Note
1. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
2. Always 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. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
5. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
6. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
7. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
8. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
9. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker. (Refer to section 11.10.)
10. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
11. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
12. Do not ground L11 and L21.

(4) MR-J4-700A(-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. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
5. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
6. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
7. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
8. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
9. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker. (Refer to section 11.10.)
10. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
11. Do not ground L11 and L21.

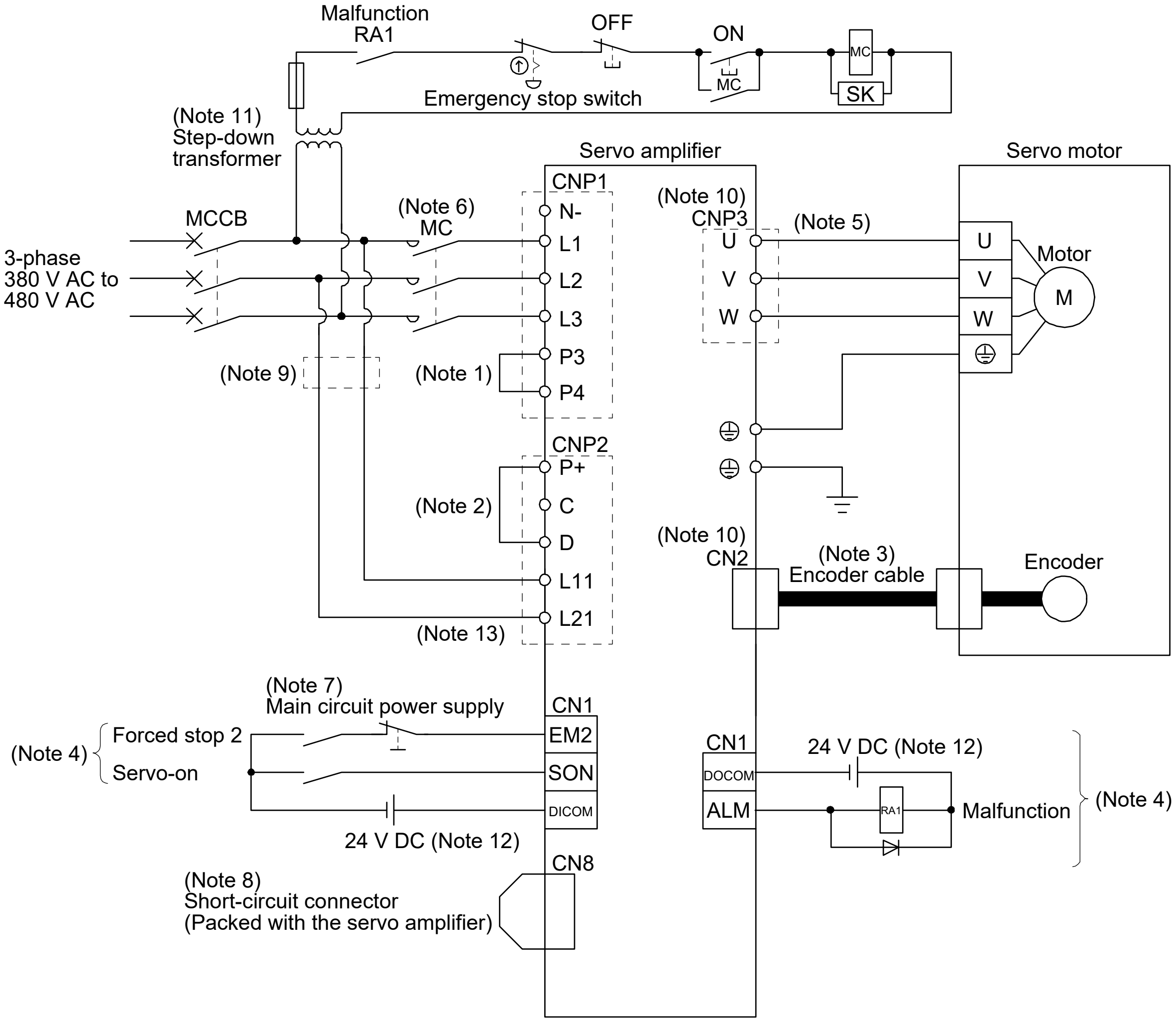
(5) MR-J4-11KA(-RJ)/MR-J4-15KA(-RJ)/MR-J4-22KA(-RJ)



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. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
5. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
6. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
7. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
8. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
9. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker. (Refer to section 11.10.)
10. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
11. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
12. For the servo motor with a cooling fan.
13. For the cooling fan power supply, refer to "Servo Motor Instruction Manual (Vol. 3)".
14. Use an external dynamic brake for this servo amplifier. Failure to do so will cause an accident because the servo motor does not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire equipment. For alarms for which the servo motor does not decelerate to stop, refer to chapter 8. For wiring of the external dynamic brake, refer to section 11.17.
15. The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.
16. Do not ground L11 and L21.

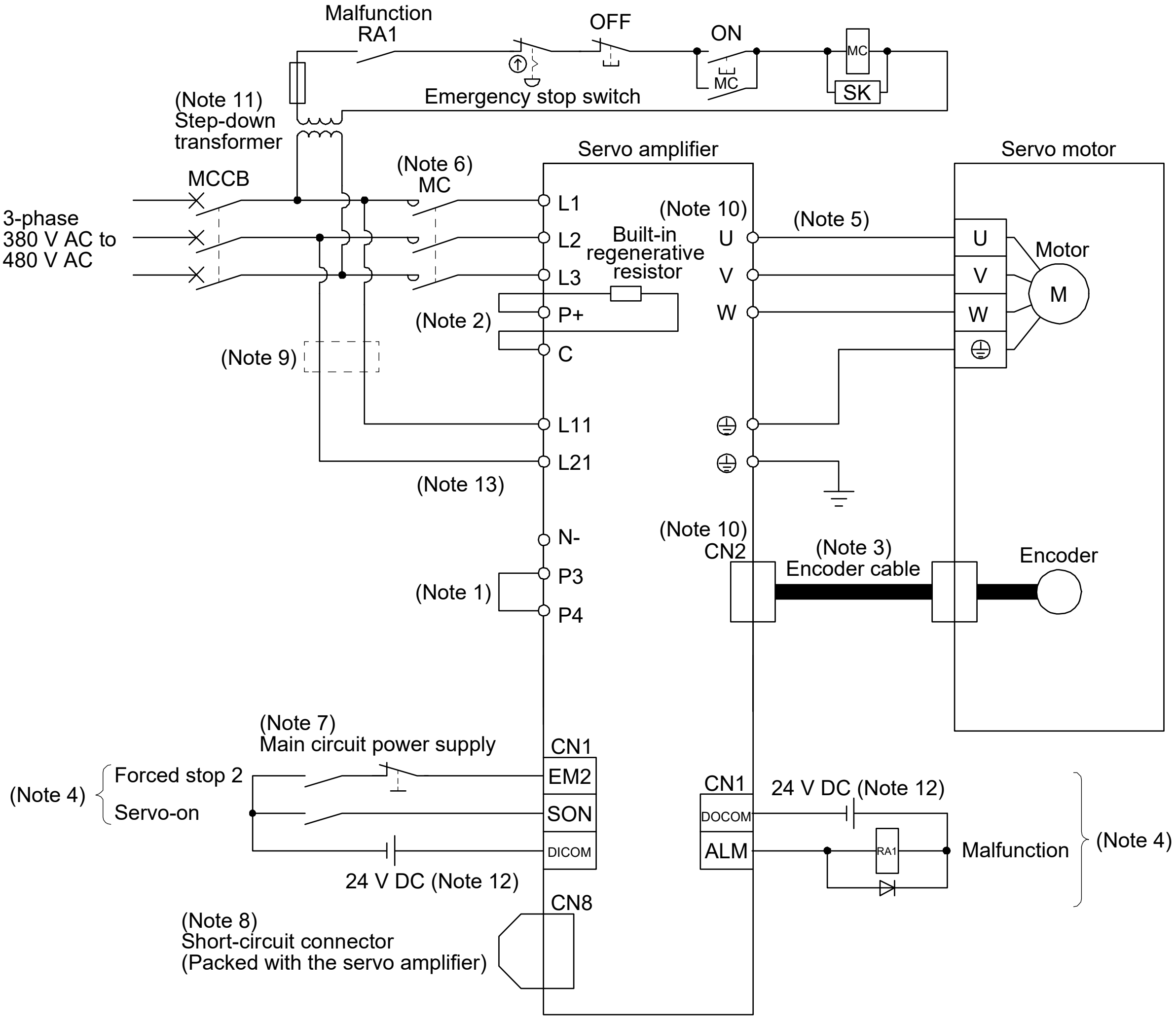
3.1.2 400 V class

(1) MR-J4-60A4(-RJ) to MR-J4-350A4(-RJ)



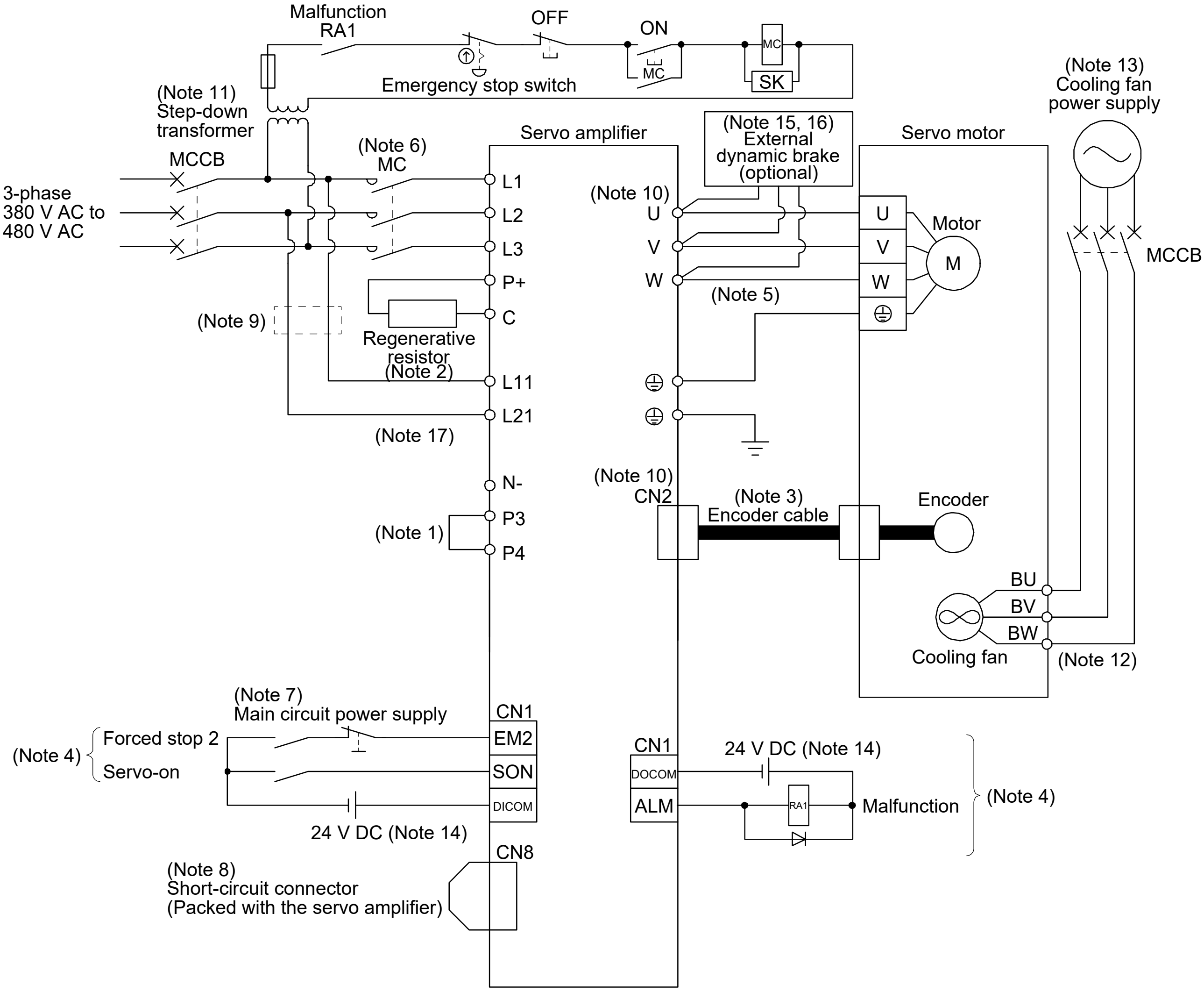
Note
1. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
2. Always 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. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
5. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
6. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
7. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
8. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
9. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker. (Refer to section 11.10.)
10. Connecting a servo motor for different axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
11. Stepdown transformer is required when the coil voltage of the magnetic contactor is 200 V class.
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) MR-J4-500A4(-RJ)/MR-J4-700A4(-RJ)



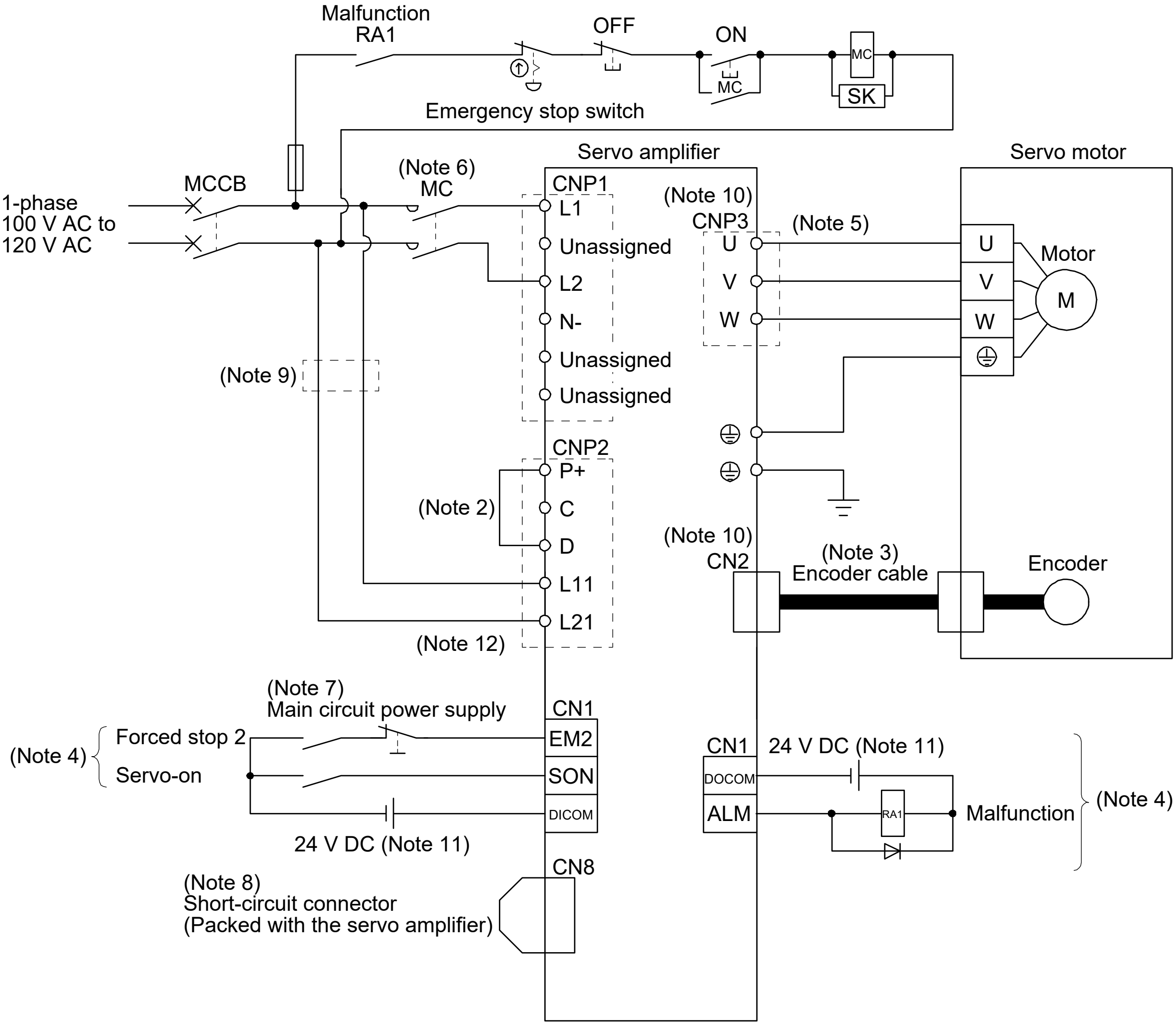
Note 1. Between P3 and P4 is connected by default. When using the power factor improving DC reactor, remove the short bar between P3 and P4. Refer to section 11.11 for details. Additionally, a power factor improving DC reactor and power factor improving AC reactor cannot be used simultaneously.
2. When 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. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
5. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
6. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
7. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
8. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
9. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker. (Refer to section 11.10.)
10. Connecting a servo motor for different axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
11. Stepdown transformer is required when the coil voltage of the magnetic contactor is 200 V class.
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-J4-11KA4(-RJ) to MR-J4-22KA4(-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. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
5. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
6. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
7. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
8. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
9. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker. (Refer to section 11.10.)
10. Connecting a servo motor for different axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
11. Stepdown transformer is required when the coil voltage of the magnetic contactor is 200 V class.
12. For the servo motor with a cooling fan.
13. For the cooling fan power supply, refer to "Servo Motor Instruction Manual (Vol. 3)".
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.
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. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]. 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.

3.1.3 100 V class

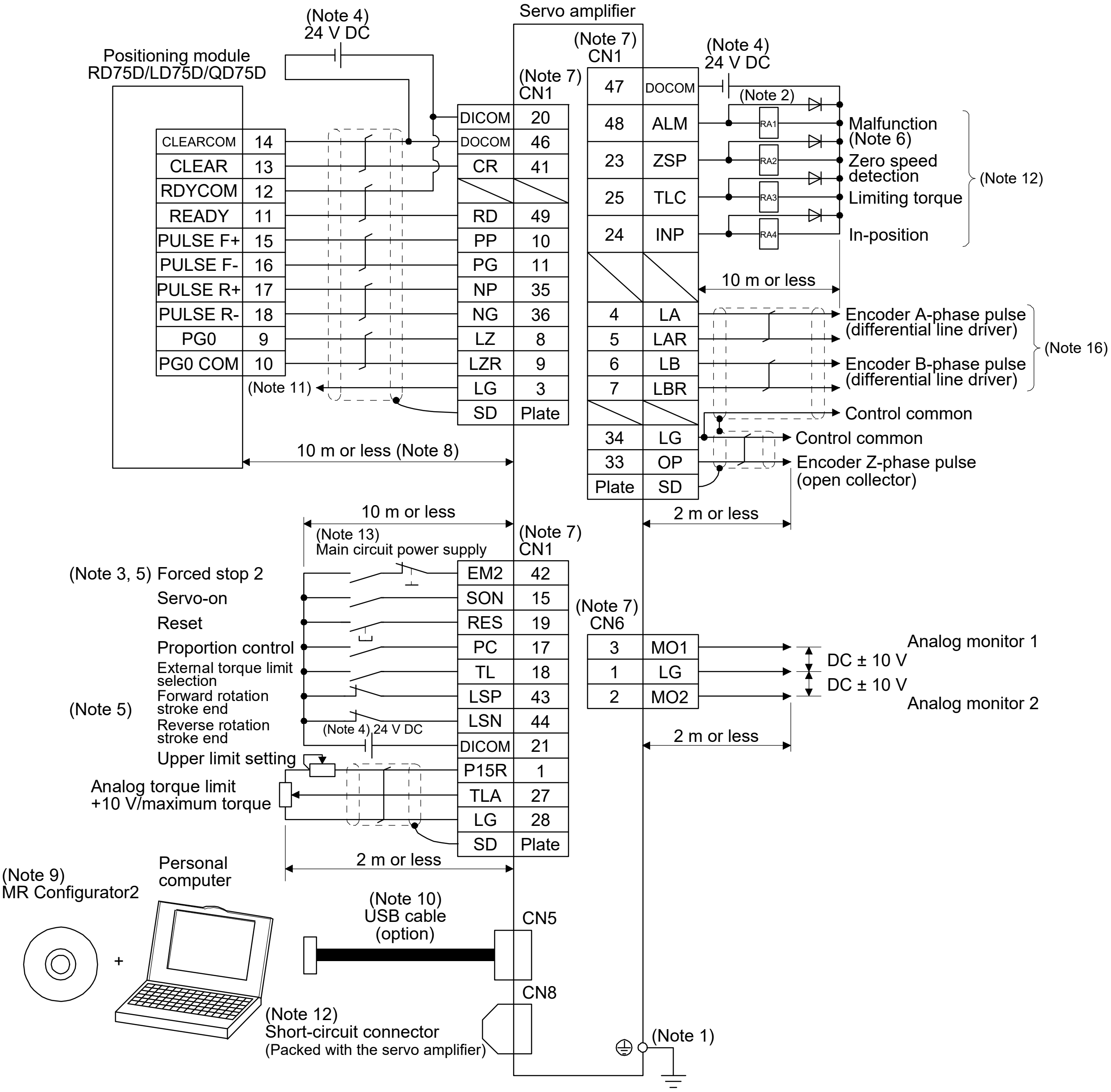


Note
1. The power factor improving DC reactor cannot be used.
2. Always connect between P+ and D terminals (factory-wired). When using the regenerative option, refer to section 11.2.
3. For the encoder cable, use of the option cable is recommended. For selecting cables, refer to "Servo Motor Instruction Manual (Vol. 3)".
4. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
5. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
6. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
7. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
8. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
9. When wires used for L11 and L21 are thinner than wires used for L1 and L2, use a molded-case circuit breaker. (Refer to section 11.10.)
10. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
11. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
12. Do not ground L11 and L21.

3.2 I/O signal connection example

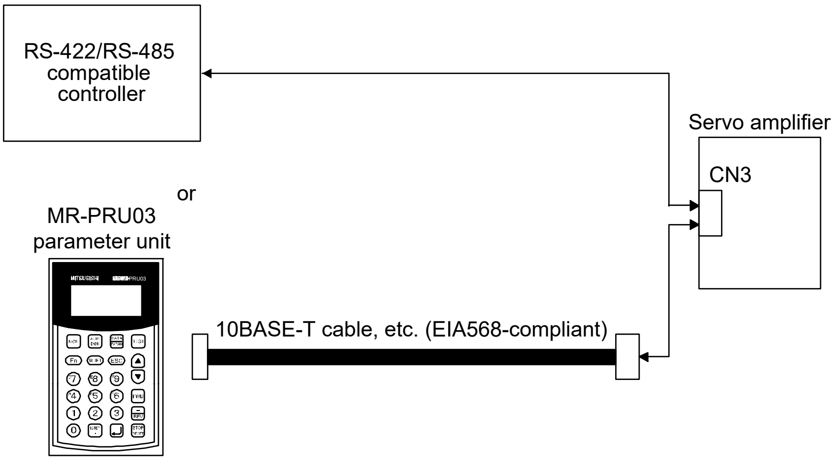
3.2.1 Position control mode

(1) Sink I/O interface



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

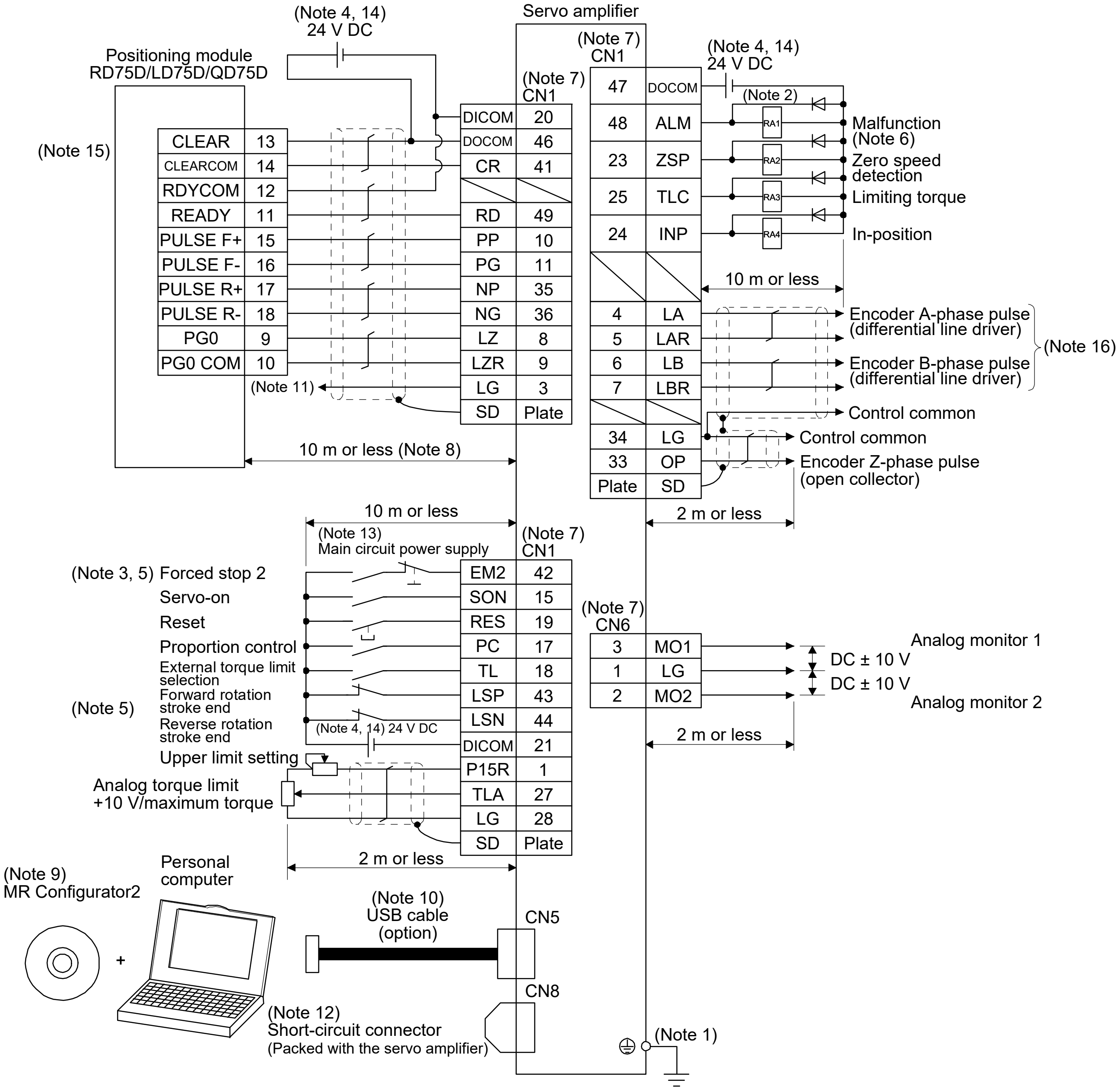
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity is up to 500 mA. 500 mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.9.2 (1) that gives the current value necessary for the interface. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
5. When starting operation, always turn on EM2 (Forced stop 2), LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end). (Normally closed contact)
6. ALM (Malfunction) turns on in normal alarm-free condition. When this signal (normally closed contact) is switched off (at occurrence of an alarm), the output of the programmable controller should be stopped by the sequence program.
7. The pins with the same signal name are connected in the servo amplifier.
8. This length applies to the command pulse train input in the differential line driver type. It is 2 m or less in the open-collector type.
9. Use SW1DNC-MRC2-_. (Refer to section 11.7.)
10. Controller or parameter units can also be connected via the CN3 connector, enabling RS-422/RS-485 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422/RS-485 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.



11. This connection is not required for RD75D, LD75D and QD75D. However, to enhance noise tolerance, it is recommended to connect LG of servo amplifier and control common depending on the positioning module.
12. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
13. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
14. Plus and minus of the power of source interface are the opposite of those of sink interface.
15. CLEAR and CLEARCOM of source interface are interchanged to sink interface.
16. When a command cable for connection with the controller side malfunctions due to disconnection or noise, a position mismatch can occur. To avoid position mismatch, it is recommended that Encoder A-phase pulse and Encoder B-phase pulse be checked.

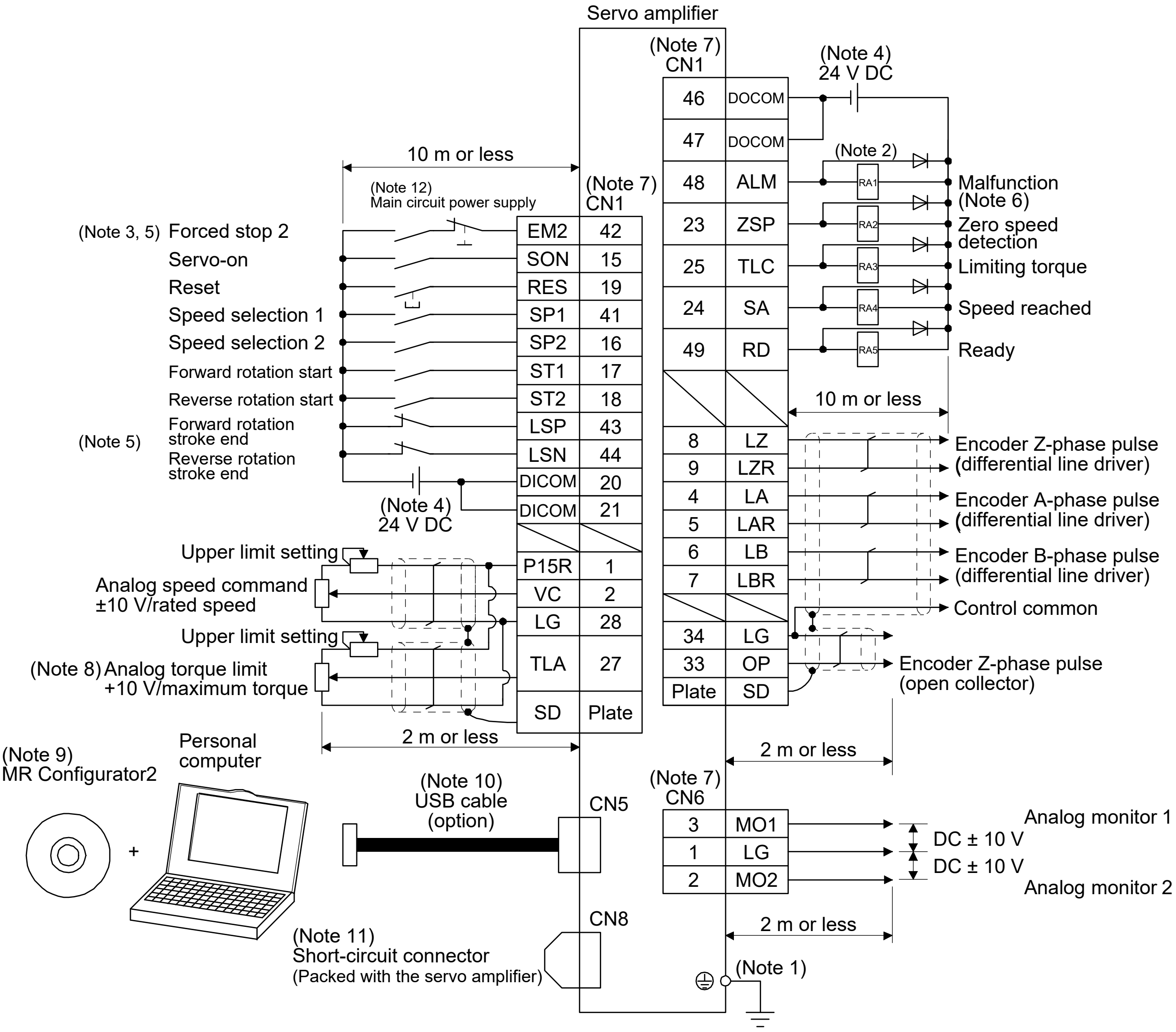
(2) Source I/O interface

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



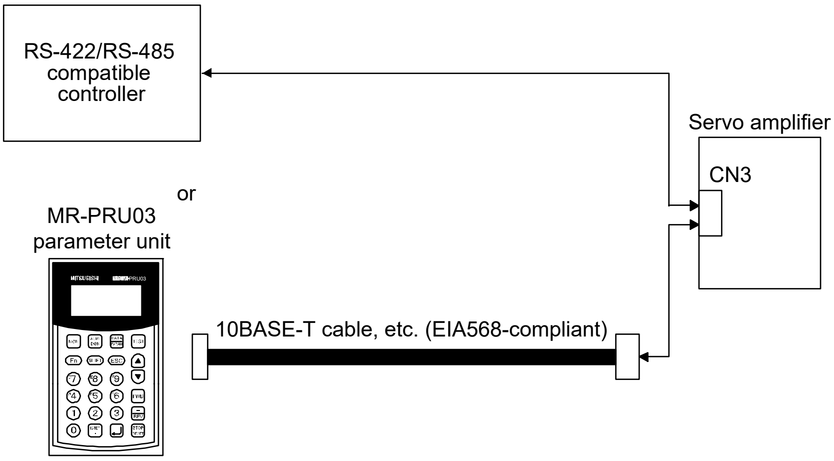
3.2.2 Speed control mode

(1) Sink I/O interface



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

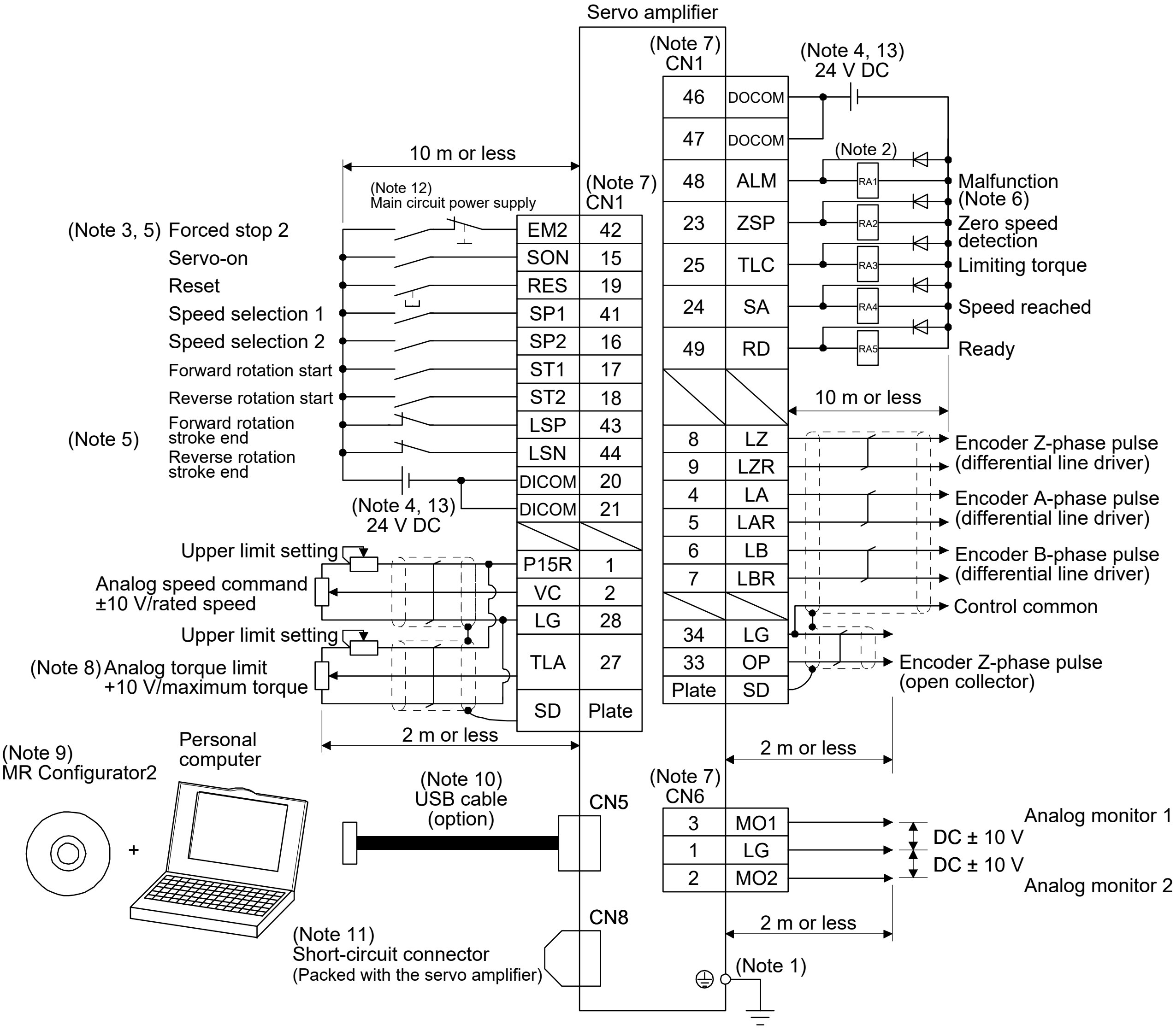
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity is up to 500 mA. 500 mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.9.2 (1) that gives the current value necessary for the interface. The 24 V DC power supply can be used both for input signals and output signals.
5. When starting operation, always turn on EM2 (Forced stop 2), LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end). (Normally closed contact)
6. ALM (Malfunction) turns on in normal alarm-free condition. (Normally closed contact)
7. The pins with the same signal name are connected in the servo amplifier.
8. TLA will be available when TL (External torque limit selection) is enabled with [Pr. PD03] to [Pr. PD22]. (Refer to section 3.6.1 (5).)
9. Use SW1DNC-MRC2-_. (Refer to section 11.7.)
10. Controller or parameter units can also be connected via the CN3 connector, enabling RS-422/RS-485 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422/RS-485 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.



11. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
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. Plus and minus of the power of source interface are the opposite of those of sink interface.

(2) Source I/O interface

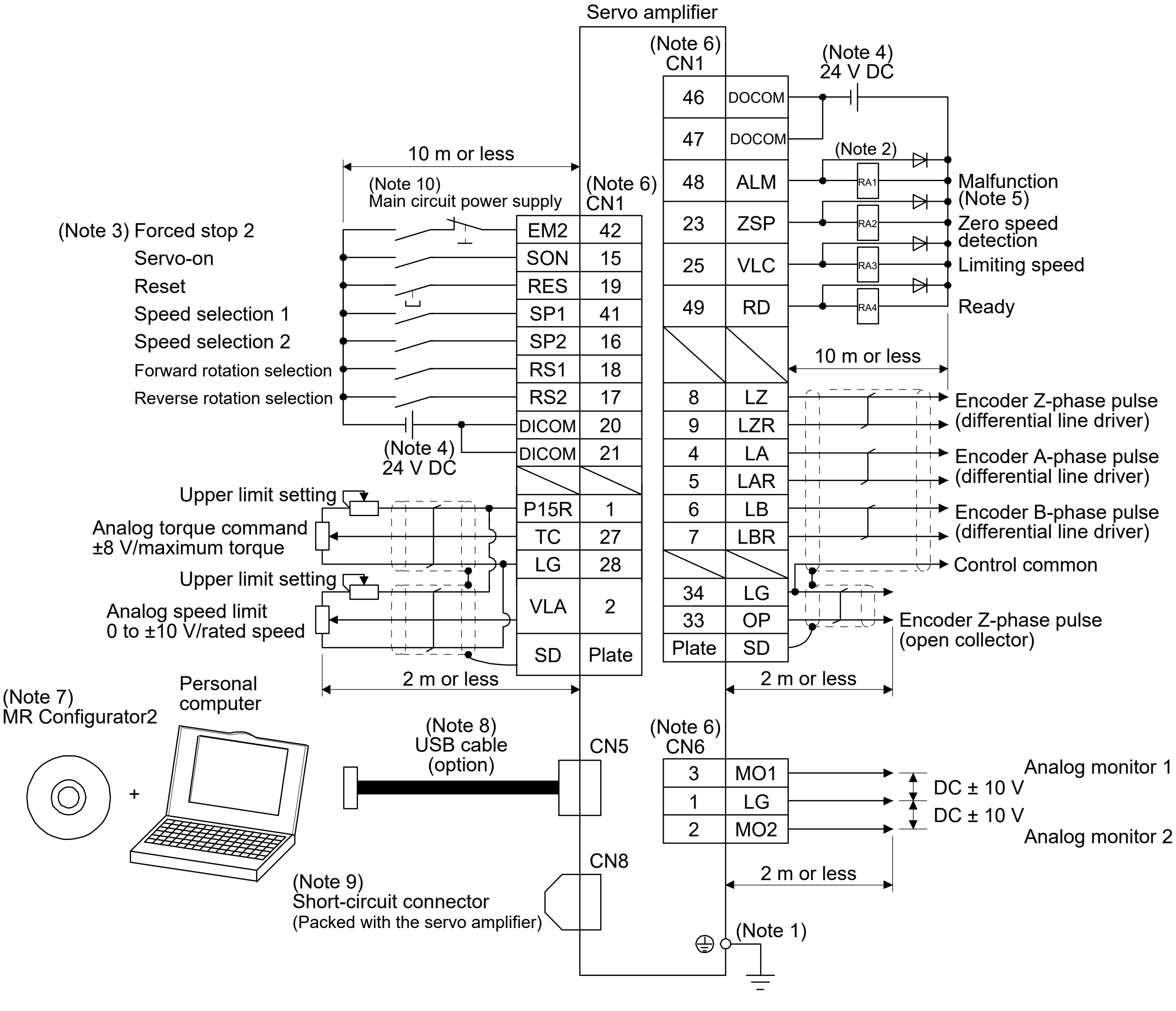
POINT
●For notes, refer to (1) in this section.



3.2.3 Torque control mode

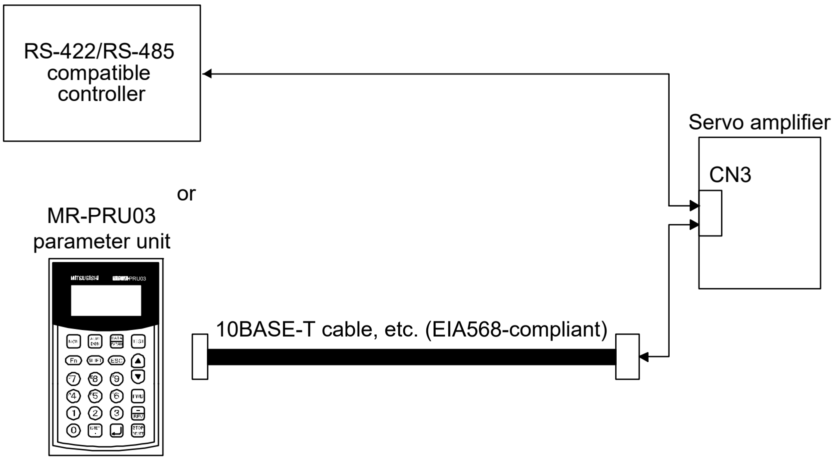
POINT
●EM2 has the same function as EM1 in the torque control mode.

(1) For sink I/O interface



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

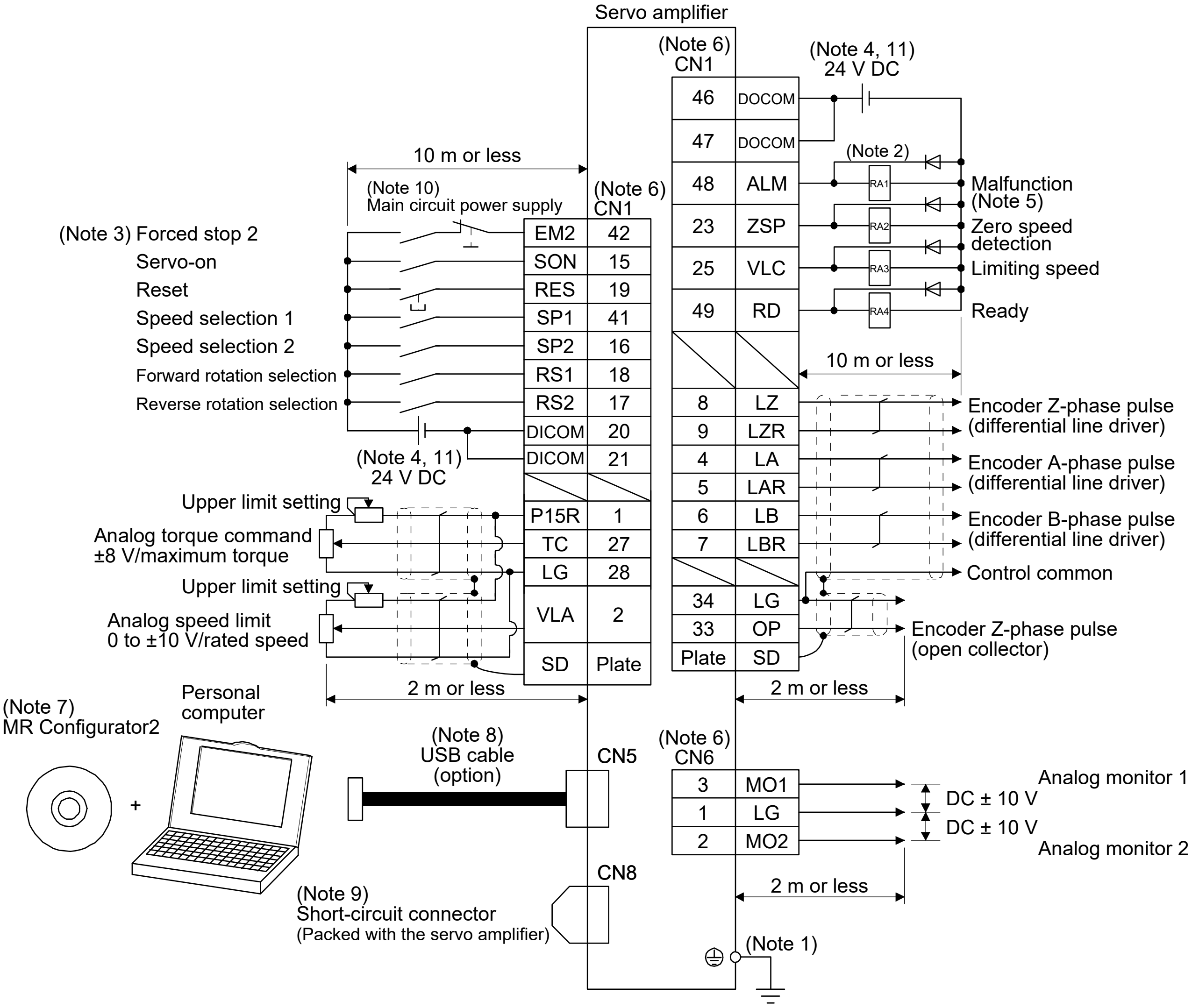
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity is up to 500 mA. 500 mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.9.2 (1) that gives the current value necessary for the interface. The 24 V DC power supply can be used both for input signals and output signals.
5. ALM (Malfunction) turns on in normal alarm-free condition. (Normally closed contact)
6. The pins with the same signal name are connected in the servo amplifier.
7. Use SW1DNC-MRC2-_. (Refer to section 11.7.)
8. Controller or parameter units can also be connected via the CN3 connector, enabling RS-422/RS-485 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422/RS-485 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.



9. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
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. Plus and minus of the power of source interface are the opposite of those of sink interface.

(2) For source I/O interface

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



3.3 Explanation of power supply system

3.3.1 Signal explanations

POINT

- ●For the layout of connector and terminal block, refer to chapter 9 DIMENSIONS.
- ●When using the MR-J4-_A-RJ servo amplifier with the DC power supply input, refer to app. 13.

<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-J4-10A (-RJ) to MR-J4-200A (-RJ)</th><th>MR-J4-350A (-RJ) to MR-J4-22KA (-RJ)</th><th>MR-J4-60A4 (-RJ) to MR-J4-22KA4 (-RJ)</th><th>MR-J4-10A1 to MR-J4-40A1</th></tr>
<tr><td>3-phase 200 V AC to 240 V AC, 50 Hz/60 Hz</td><td>L1/L2/L3</td><td></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-J4-500A(-RJ) or less and MR-J4-40A1(-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-J4-700A(-RJ) to MR-J4-22KA(-RJ)
MR-J4-700A(-RJ) to MR-J4-22KA(-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-J4-350A4(-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-J4-500A4(-RJ) to MR-J4-22KA4(-RJ)
MR-J4-500A4(-RJ) to MR-J4-22KA4(-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-J4-10A(-RJ) to MR-J4-22KA(-RJ)</th><th>MR-J4-60A4(-RJ) to MR-J4-22KA4(-RJ)</th><th>MR-J4-10A1 to MR-J4-40A1</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 output</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.
Refer to section 11.3 to 11.5 and 11.19 for details.</td></tr>
<tr><td>⏚</td><td>Protective earth (PE)</td><td>Connect it to the grounding terminal of the servo motor and to the protective earth (PE) of the cabinet for grounding.</td></tr>
</table>

3.3.2 Power-on sequence

POINT

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

(1) Power-on procedure

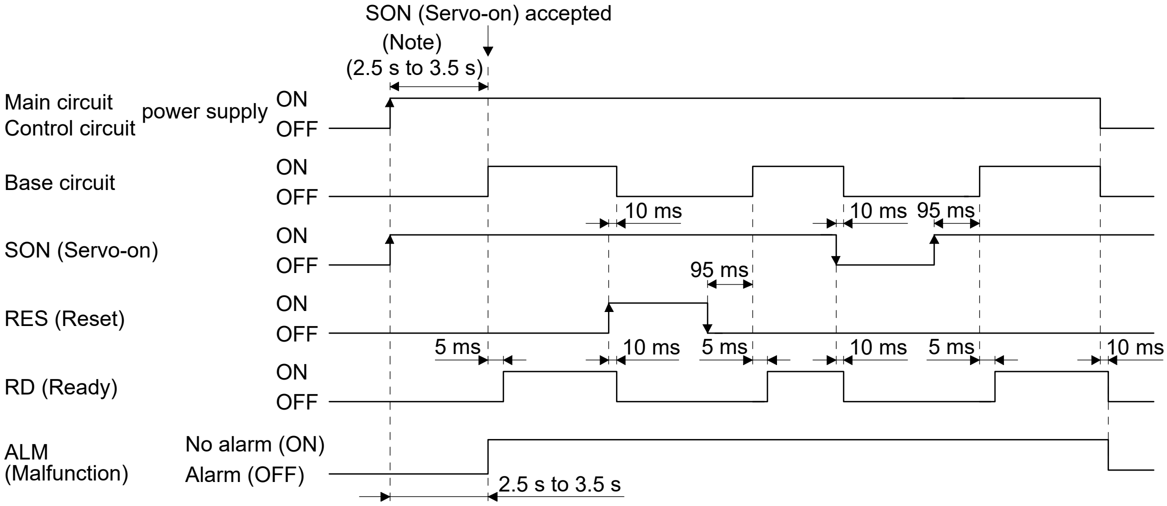
1) Always use a magnetic contactor for the main circuit power supply wiring (L1/L2/L3) as shown in above section 3.1. Configure up an external sequence to switch off the magnetic contactor as soon as an alarm occurs.

2) Switch on the control circuit power supply (L11/L21) simultaneously with the main circuit power supply or before switching on the main circuit power supply. If the main circuit power supply is not on, the display shows the corresponding warning. However, by switching on the main circuit power supply, the warning disappears and the servo amplifier will operate properly.

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

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

(2) Timing chart



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

3.3.3 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-J4-500A(-RJ) or more and MR-J4-500A4(-RJ) or more do not have these connectors.

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

(1) Connector

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

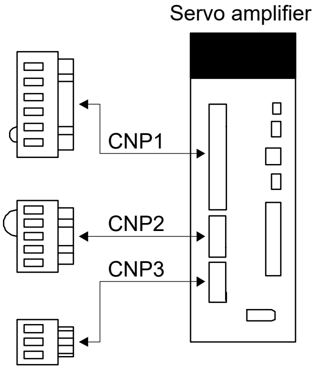


Table 3.1 Connector and applicable wire

Connector	Receptacle assembly	Applicable wire		Stripped length [mm]	Open tool	Manufacturer
		Size	Insulator OD			
CNP1	06JFAT-SAXGDK-H7.5	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-J4-200A(-RJ)/MR-J4-350A(-RJ)

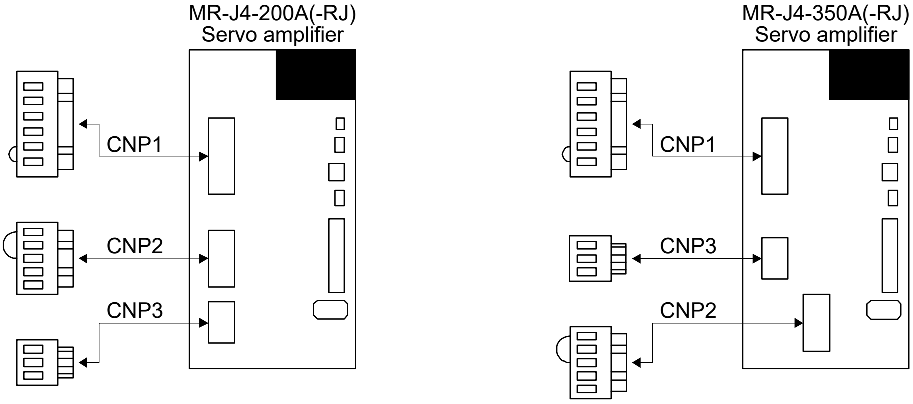
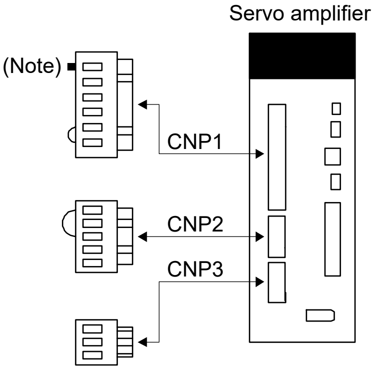


Table 3.2 Connector and applicable wire

Connector	Receptacle assembly	Applicable wire		Stripped length [mm]	Open tool	Manufac turer
		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-J4-60A4(-RJ) to MR-J4-350A4(-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	Manufac turer
		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-J4-10A1(-RJ) to MR-J4-40A1(-RJ)

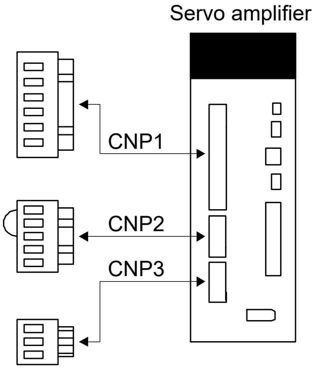


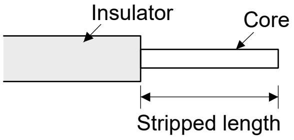
Table 3.4 Connector and applicable wire

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					

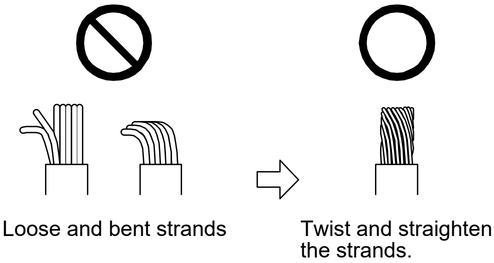
(2) Cable connection procedure

(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 you use a ferrule, use the following ferrules and crimp terminal.

Servo amplifier	Wire size	Ferrule model (Phoenix Contact)		Crimp terminal (Phoenix Contact)
		For one	For two	
MR-J4-10A(-RJ) to MR-J4-100A(-RJ)	AWG 16	AI1.5-10BK	AI-TWIN2×1.5-10BK	CRIMPFOX-ZA3
	AWG 14	AI2.5-10BU		
MR-J4-200A(-RJ) to MR-J4-350A(-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-J4-60A4(-RJ) to MR-J4-350A4(-RJ)	AWG 16	AI1.5-10BK	AI-TWIN2×1.5-10BK	
	AWG 14	AI2.5-10BU		
MR-J4-10A1(-RJ) to MR-J4-40A1(-RJ)	AWG 16	AI1.5-10BK	AI-TWIN2×1.5-10BK	
	AWG 14	AI2.5-10BU		

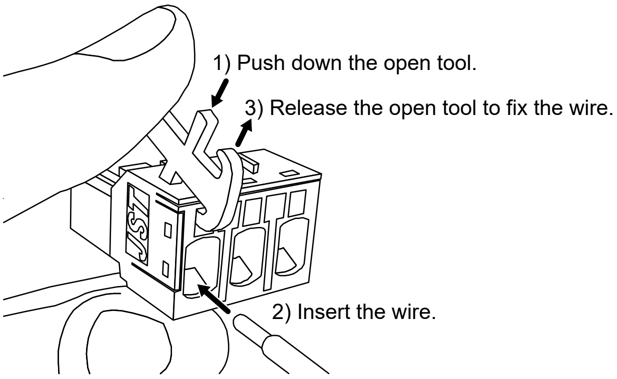
(b) Inserting wire

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.

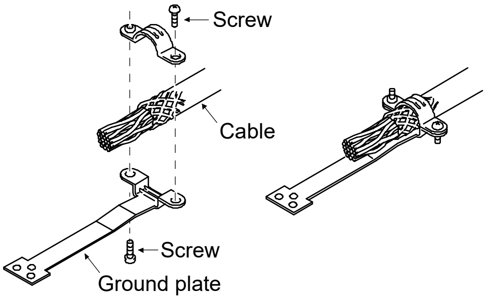
The following shows a connection example of the CNP3 connector for MR-J4-200A(-RJ) and MR-J4-350A(-RJ).



3.4 Connectors and pin assignment

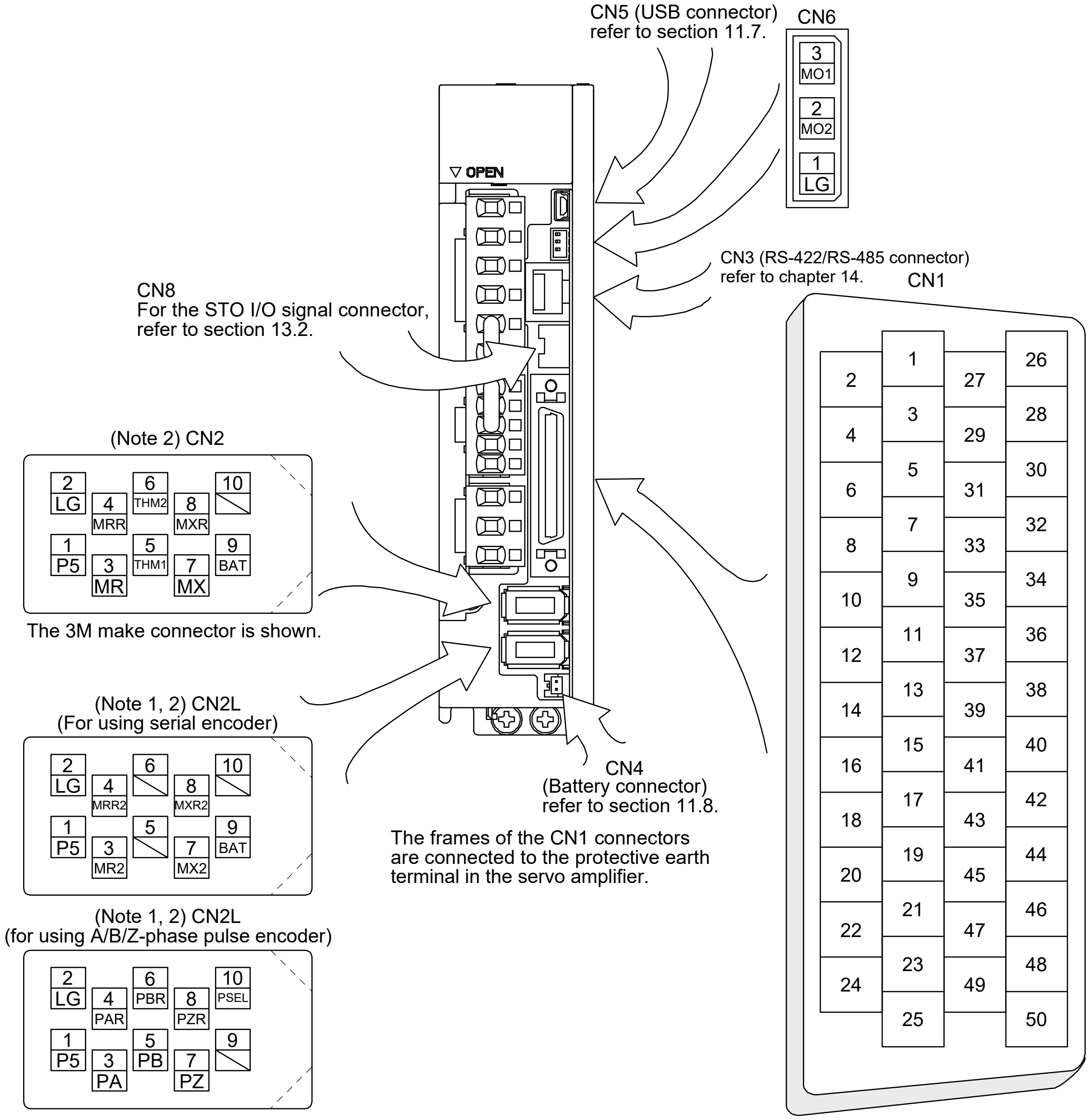
POINT

- 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 CN1 connector, securely connect the external conductive portion of the shielded cable to the ground plate and fix it to the connector shell.



- PP (CN1-10 pin)/NP (CN1-35 pin) and PP2 (CN1-37 pin)/NP2 (CN1-38 pin) are exclusive. They cannot be used together.

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



Note 1. The MR-J4-_A_-RJ servo amplifiers have CN2L connectors. This CN2L is a connector of 3M. When using any other connector, refer to each servo motor instruction manual.

2. Refer to table 1.1 and "Linear Encoder Instruction Manual" for connections of external encoders.

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

Pin No.	(Note 1) I/O	(Note 2) I/O signals in control modes						Related parameter
		P	P/S	S	S/T	T	T/P	
1		P15R	P15R	P15R	P15R	P15R	P15R	
2	I		-/VC	VC	VC/VLA	VLA	VLA/-	
3		LG	LG	LG	LG	LG	LG	
4	O	LA	LA	LA	LA	LA	LA	
5	O	LAR	LAR	LAR	LAR	LAR	LAR	
6	O	LB	LB	LB	LB	LB	LB	
7	O	LBR	LBR	LBR	LBR	LBR	LBR	
8	O	LZ	LZ	LZ	LZ	LZ	LZ	
9	O	LZR	LZR	LZR	LZR	LZR	LZR	
10	I	PP	PP/-	(Note 6)	(Note 6)	(Note 6)	-/PP	PD43/PD44 (Note 5)
11	I	PG	PG/-				-/PG	
12		OPC	OPC/-				-/OPC	
13	O	(Note 4)	(Note 4)	(Note 4)	(Note 4)	(Note 4)	(Note 4)	PD47 (Note 5)
14	O	(Note 4)	(Note 4)	(Note 4)	(Note 4)	(Note 4)	(Note 4)	PD47 (Note 5)
15	I	SON	SON	SON	SON	SON	SON	PD03/PD04
16	I		-/SP2	SP2	SP2/SP2	SP2	SP2/-	PD05/PD06
17	I	PC	PC/ST1	ST1	ST1/RS2	RS2	RS2/PC	PD07/PD08
18	I	TL	TL/ST2	ST2	ST2/RS1	RS1	RS1/TL	PD09/PD10
19	I	RES	RES	RES	RES	RES	RES	PD11/PD12
20		DICOM	DICOM	DICOM	DICOM	DICOM	DICOM	
21		DICOM	DICOM	DICOM	DICOM	DICOM	DICOM	
22	O	INP	INP/SA	SA	SA/-		-/INP	PD23
23	O	ZSP	ZSP	ZSP	ZSP	ZSP	ZSP	PD24
24	O	INP	INP/SA	SA	SA/-		-/INP	PD25
25	O	TLC	TLC	TLC	TLC/VLC	VLC	VLC/TLC	PD26
26								
27	I	TLA	(Note 3) TLA	(Note 3) TLA	(Note 3) TLA/TC	TC	TC/TLA	
28		LG	LG	LG	LG	LG	LG	
29								
30		LG	LG	LG	LG	LG	LG	
31								
32								
33	O	OP	OP	OP	OP	OP	OP	
34		LG	LG	LG	LG	LG	LG	
35	I	NP	NP/-	(Note 6)	(Note 6)	(Note 6)	-/NP	PD45/PD46 (Note 5)
36	I	NG	NG/-				-/NG	
(Note 8) 37	I	PP2	PP2/-	(Note 7)	(Note 7)	(Note 7)	-/PP2	PD43/PD44 (Note 5)
(Note 8) 38	I	NP2	NP2/-	(Note 7)	(Note 7)	(Note 7)	-/NP2	PD45/PD46 (Note 5)
39								
40								
41	I	CR	CR/SP1	SP1	SP1/SP1	SP1	SP1/CR	PD13/PD14
42	I	EM2	EM2	EM2	EM2	EM2	EM2	
43	I	LSP	LSP	LSP	LSP/-		-/LSP	PD17/PD18
44	I	LSN	LSN	LSN	LSN/-		-/LSN	PD19/PD20
45	I	LOP	LOP	LOP	LOP	LOP	LOP	PD21/PD22
46		DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	
47		DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	
48	O	ALM	ALM	ALM	ALM	ALM	ALM	
49	O	RD	RD	RD	RD	RD	RD	PD28
50								

Note
1. I: Input signal, O: Output signal
2. P: Position control mode, S: Speed control mode, T: Torque control mode, P/S: Position/speed control change mode, S/T: Speed/torque control change mode, T/P: Torque/position control change mode
3. TLA will be available when TL (External torque limit selection) is enabled with [Pr. PD03] to [Pr. PD22].
4. Output devices are not assigned by default. Assign the output devices with [Pr. PD47] as necessary.
5. This is used with MR-J4-_A_-RJ servo amplifiers with software version B3 or later.
6. This is available as an input device of sink interface. Input devices are not assigned by default. Assign the input devices with [Pr. PD43] to [Pr. PD46] as necessary. Supply + of 24 V DC to CN1-12 pin. Also, this is available with servo amplifiers with software version B3 or later.
7. This is available as an input device of source interface. Input devices are not assigned by default. Assign the input devices with [Pr. PD43] to [Pr. PD46] as necessary.
8. These pins are available for MR-J4-_A_(-RJ) servo amplifiers manufactured in January 2015 or later with software version B7 or later.

3.5 Signal (device) explanations

The pin numbers in the connector pin No. column are those in the initial status.
For the I/O interfaces (symbols in I/O division column in the table), refer to section 3.9.2. The symbols in the control mode field of the table shows the followings.
P: Position control mode
S: Speed control mode
T: Torque control mode
"○" and "△" of the table shows the followings.
○: Usable device by default.
△: Usable device by setting the following parameters.
[Pr. PA04], [Pr. PD03] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]

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

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Forced stop 2</td><td>EM2</td><td>CN1-42</td><td>Turn off EM2 (open between commons) to decelerate the servo motor to a stop with commands.
Turn EM2 on (short between commons) in the forced stop state to reset that state.
The following shows the setting of [Pr. PA04].
<table><tr><th rowspan="2">[Pr. PA04] setting</th><th rowspan="2">EM2/EM1</th><th colspan="2">Deceleration method</th></tr><tr><th>EM2 or EM1 is off</th><th>Alarm occurred</th></tr><tr><td>0 _ _ _</td><td>EM1</td><td>MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.</td><td>MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.</td></tr><tr><td>2 _ _ _</td><td>EM2</td><td>MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.</td><td>MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.</td></tr></table>
EM2 and EM1 are mutually exclusive.
EM2 has the same function as EM1 in the torque control mode.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Forced stop 1</td><td>EM1</td><td>(CN1-42)</td><td>When using EM1, set [Pr. PA04] to "0 _ _ _" to enable EM1.
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.
Turn EM1 on (short between commons) in the forced stop state to reset that state.</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></tr>
<tr><td>Servo-on</td><td>SON</td><td>CN1-15</td><td>Turn SON on to power on the base circuit and make the servo amplifier ready to operate. (servo-on status)
Turn it off to shut off the base circuit and coast the servo motor.
Set "_ _ _ 4" in [Pr. PD01] to switch this signal on (keep terminals connected) automatically in the servo amplifier.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Reset</td><td>RES</td><td>CN1-19</td><td>Turn on RES for more than 50 ms to reset the alarm.
Some alarms cannot be deactivated by RES (Reset). Refer to chapter 8.
Turning RES on in an alarm-free status shuts off the base circuit. The base circuit is not shut off when " _ _ 1 _ " is set in [Pr. PD30].
This device is not designed to make a stop. Do not turn it on during operation.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
</table>

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

Set [Pr. PD01] as indicated below to switch on the signals (keep terminals connected) automatically in the servo amplifier.
<table>
<tr><th rowspan="2">[Pr. PD01]</th><th colspan="2">Status</th></tr>
<tr><th>LSP</th><th>LSN</th></tr>
<tr><td>_ 4 _ _</td><td>Automatic on</td><td></td></tr>
<tr><td>_ 8 _ _</td><td></td><td>Automatic on</td></tr>
<tr><td>_ C _ _</td><td>Automatic on</td><td>Automatic on</td></tr>
</table>
When LSP or LSN is turned off, [AL. 99 Stroke limit warning] occurs, and WNG (Warning) turns on. When using WNG, enable it by the setting of [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]. However, [Pr. PD47] is not available with MR-J4-03A6(-RJ) servo amplifiers.
In the torque control mode, this device cannot be used during normal operation. It can be used during the magnetic pole detection in the linear servo motor control mode and the DD motor control mode. Also, when the magnetic pole detection in the torque control mode is completed, this signal will be disabled.</td><td rowspan="2">DI-1</td><td rowspan="2">○</td><td rowspan="2">○</td><td rowspan="2">△</td></tr>
<tr><td>Reverse rotation stroke end</td><td>LSN</td><td>CN1-44</td></tr>
<tr><td>External torque limit selection</td><td>TL</td><td>CN1-18</td><td>Turning off TL will enable [Pr. PA11 Forward torque limit] and [Pr. PA12 Reverse torque limit], and turning on it will enable TLA (Analog torque limit). For details, refer to section 3.6.1 (5).</td><td>DI-1</td><td>○</td><td>△</td><td></td></tr>
<tr><td>Internal torque limit selection</td><td>TL1</td><td></td><td>To select [Pr. PC35 Internal torque limit 2/internal thrust limit 2], enable TL1 with [Pr. PD03] to [Pr. PD22]. For details, refer to section 3.6.1 (5).</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></tr>
<tr><td>Forward rotation start</td><td>ST1</td><td>CN1-17</td><td rowspan="2">This is used to start the servo motor.
The following shows the directions.
<table>
<tr><th colspan="2">(Note) Input device</th><th rowspan="2">Servo motor starting direction</th></tr>
<tr><th>ST2</th><th>ST1</th></tr>
<tr><td>0</td><td>0</td><td>Stop (servo-lock)</td></tr>
<tr><td>0</td><td>1</td><td>CCW</td></tr>
<tr><td>1</td><td>0</td><td>CW</td></tr>
<tr><td>1</td><td>1</td><td>Stop (servo-lock)</td></tr>
</table>
Note. 0: Off
1: On

If both ST1 and ST2 are switched on or off during operation, the servo motor will be decelerated to a stop according to the [Pr. PC02] setting and servo-locked.
When " _ _ _1" is set in [Pr. PC23], the servo motor is not servo-locked after deceleration to a stop.</td><td rowspan="2">DI-1</td><td rowspan="2"></td><td rowspan="2">○</td><td rowspan="2"></td></tr>
<tr><td>Reverse rotation start</td><td>ST2</td><td>CN1-18</td></tr>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Forward rotation selection</td><td>RS1</td><td>CN1-18</td><td rowspan="2">This is used to select a servo motor torque generation directions.
The following shows the torque generation directions.
<table>
<tr><th colspan="2">(Note) Input device</th><th rowspan="2">Torque generation direction</th></tr>
<tr><th>RS2</th><th>RS1</th></tr>
<tr><td>0</td><td>0</td><td>Torque is not generated.</td></tr>
<tr><td>0</td><td>1</td><td>Forward rotation in power running mode/reverse rotation in regenerative mode</td></tr>
<tr><td>1</td><td>0</td><td>Reverse rotation in power running mode/forward rotation in regenerative mode</td></tr>
<tr><td>1</td><td>1</td><td>Torque is not generated.</td></tr>
</table>
Note. 0: Off
1: On</td><td rowspan="2">DI-1</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">○</td></tr>
<tr><td>Reverse rotation selection</td><td>RS2</td><td>CN1-17</td></tr>
<tr><td>Speed selection 1</td><td>SP1</td><td>CN1-41</td><td rowspan="3">1. For speed control mode
This is used to select the command speed for operation.
<table>
<tr><th colspan="3">(Note) Input device</th><th rowspan="2">Speed command</th></tr>
<tr><th>SP3</th><th>SP2</th><th>SP1</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>VC (Analog speed command)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Pr. PC05 Internal speed command 1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Pr. PC06 Internal speed command 2</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Pr. PC07 Internal speed command 3</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Pr. PC08 Internal speed command 4</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Pr. PC09 Internal speed command 5</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Pr. PC10 Internal speed command 6</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Pr. PC11 Internal speed command 7</td></tr>
</table>
Note. 0: Off
1: On

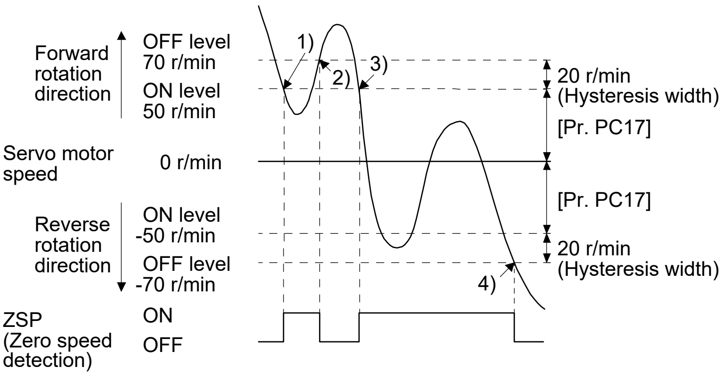
2. For the torque control mode
This is used to select the limit speed for operation.
<table>
<tr><th colspan="3">(Note) Input device</th><th rowspan="2">Speed limit</th></tr>
<tr><th>SP3</th><th>SP2</th><th>SP1</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>VLA (Analog speed limit)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Pr. PC05 Internal speed limit 1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Pr. PC06 Internal speed limit 2</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Pr. PC07 Internal speed limit 3</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Pr. PC08 Internal speed limit 4</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Pr. PC09 Internal speed limit 5</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Pr. PC10 Internal speed limit 6</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Pr. PC11 Internal speed limit 7</td></tr>
</table>
Note. 0: Off
1: On</td><td>DI-1</td><td></td><td>○</td><td>○</td></tr>
<tr><td>Speed selection 2</td><td>SP2</td><td>CN1-16</td><td>DI-1</td><td></td><td>○</td><td>○</td></tr>
<tr><td>Speed selection 3</td><td>SP3</td><td></td><td>DI-1</td><td></td><td>△</td><td>△</td></tr>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Proportion control</td><td>PC</td><td>CN1-17</td><td>Turn PC on to switch the speed amplifier from the proportional integral type to the proportional type.
If the servo motor at a stop is rotated even 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), switching on the PC (Proportion control) upon positioning completion will suppress the unnecessary torque generated to compensate for a position shift.
When the shaft is to be locked for a long time, switch on the PC (Proportion control) and TL (External torque limit selection) at the same time to make the torque less than the rated by TLA (Analog torque limit).
Do not use PC (Proportional control) in the torque control. Doing so may cause the operation to be performed at a speed exceeding the speed limit value.</td><td>DI-1</td><td>○</td><td>△</td><td></td></tr>
<tr><td>Clear</td><td>CR</td><td>CN1-41</td><td>Turn CR on to clear the position control counter droop pulses on its leading edge. The pulse width should be 10 ms or longer.
The delay amount set in [Pr. PB03 Position command acceleration/deceleration time constant] is also cleared. When " _ _ _ 1 " is set to [Pr. PD32], the pulses are always cleared while CR is on.</td><td>DI-1</td><td>○</td><td></td><td></td></tr>
<tr><td>Electronic gear selection 1</td><td>CM1</td><td></td><td rowspan="2">The combination of CM1 and CM2 enables you to select four different electronic gear numerators set in the parameters.
CM1 and CM2 cannot be used in the absolute position detection system.
<table>
<tr><th colspan="2">(Note) Input device</th><th rowspan="2">Electronic gear numerator</th></tr>
<tr><th>CM2</th><th>CM1</th></tr>
<tr><td>0</td><td>0</td><td>Pr. PA06</td></tr>
<tr><td>0</td><td>1</td><td>Pr. PC32</td></tr>
<tr><td>1</td><td>0</td><td>Pr. PC33</td></tr>
<tr><td>1</td><td>1</td><td>Pr. PC34</td></tr>
</table>
Note. 0: Off
1: On</td><td>DI-1</td><td>△</td><td></td><td></td></tr>
<tr><td>Electronic gear selection 2</td><td>CM2</td><td></td><td>DI-1</td><td>△</td><td></td><td></td></tr>
<tr><td>Gain switching</td><td>CDP</td><td></td><td>Turn on CDP to use the values of [Pr. PB29] to [Pr. PB36] and [Pr. PB56] to [Pr. PB60] as the load to motor inertia ratio and gain values.</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></tr>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Control switching</td><td>LOP</td><td>CN1-45</td><td>«Position/speed control change mode»
This is used to select the control mode in the position/speed control switching mode.
<table><tr><th>(Note) LOP</th><th>Control mode</th></tr><tr><td>0</td><td>Position</td></tr><tr><td>1</td><td>Speed</td></tr></table>
Note. 0: Off
1: On
«Speed/torque control change mode»
This is used to select the control mode in the speed/torque control switching mode.
<table><tr><th>(Note) LOP</th><th>Control mode</th></tr><tr><td>0</td><td>Speed</td></tr><tr><td>1</td><td>Torque</td></tr></table>
Note. 0: Off
1: On
«Torque/position control change mode»
This is used to select the control mode in the torque/position control switching mode.
<table><tr><th>(Note) LOP</th><th>Control mode</th></tr><tr><td>0</td><td>Torque</td></tr><tr><td>1</td><td>Position</td></tr></table>
Note. 0: Off
1: On</td><td>DI-1</td><td colspan="3">Refer to Function and application.</td></tr>
<tr><td>Second acceleration/deceleration selection</td><td>STAB2</td><td></td><td>The device allows selection of the acceleration/deceleration time constant at servo motor rotation in the speed control mode or torque control mode. The s-pattern acceleration time constant and deceleration time constant is always uniform.
<table><tr><th>(Note) STAB2</th><th>Acceleration/deceleration time constant</th></tr><tr><td>0</td><td>Pr. PC01 Acceleration time constant
Pr. PC02 Deceleration time constant</td></tr><tr><td>1</td><td>Pr. PC30 Acceleration time constant 2
Pr. PC31 Deceleration time constant 2</td></tr></table>
Note. 0: Off
1: On</td><td>DI-1</td><td></td><td>△</td><td>△</td></tr>
<tr><td>ABS transfer mode</td><td>ABSM</td><td>CN1-17</td><td>This is an ABS transfer mode request device.
When "_ _ _ 1" is set in [Pr. PA03] and absolute position detection system by DIO is selected, CN1-17 pin will become ABSM. (Refer to chapter 12.)</td><td>DI-1</td><td>△</td><td></td><td></td></tr>
<tr><td>ABS request</td><td>ABSR</td><td>CN1-18</td><td>This is an ABS request device.
When "_ _ _ 1" is set in [Pr. PA03] and absolute position detection system by DIO is selected, CN1-18 pin will become ABSR. (Refer to chapter 12.)</td><td>DI-1</td><td>△</td><td></td><td></td></tr>
<tr><td>Fully closed loop selection</td><td>CLD</td><td></td><td>This is used when the semi closed loop control/fully closed loop control switching is enabled with [Pr. PE01].
Turn off CLD to select the semi closed loop control, and turn on CLD to select the fully closed loop control.
This device is not available with MR-J4-03A6(-RJ) servo amplifiers.</td><td>DI-1</td><td>△</td><td></td><td></td></tr>
<tr><td>Motor-side/load-side position deviation counter clear</td><td>MECR</td><td></td><td>Turn on MECR to clear the motor-side/load-side position deviation counter to zero.
- It operates during the fully closed loop control.
- It does not affect the position control droop pulses.
- Turning on this device during the semi closed loop control does not affect the operation.
- Turning on this device while the fully closed loop control error detection function is disabled in [Pr. PE03] does not affect the operation.
This device is not available with MR-J4-03A6(-RJ) servo amplifiers.</td><td>DI-1</td><td>△</td><td></td><td></td></tr>
</table>

(b) Output device

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Malfunction	ALM	CN1-48	When an alarm occurs, ALM will turn off. When an alarm does not occur, ALM will turn on after 2.5 s to 3.5 s after power-on. When [Pr. PD34] is "_ _ 1 _", an alarming or warning will turn off ALM.	DO-1	○	○	○
Dynamic brake interlock	DB		When using the signal, enable it by setting [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]. 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. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.	DO-1	○	○	○
Ready	RD	CN1-49	Enabling servo-on to make the servo amplifier ready to operate will turn on RD.	DO-1	○	○	○
In-position	INP	CN1-22 CN1-24	When the number of droop pulses is in the preset in-position range, INP will turn on. The in-position range can be changed using [Pr. PA10]. When the in-position range is increased, INP may be on during low-speed rotation. INP turns on when servo-on turns on.	DO-1	○		
Speed reached	SA		When the servo motor speed reaches the following range, SA will turn on. Set speed ± ((Set speed × 0.05) + 20) r/min When the preset speed is 20 r/min or less, SA always turns on. SA does not turn on even when the SON (Servo-on) is turned off or the servo motor speed by the external force reaches the preset speed while both ST1 (Forward rotation start) and ST2 (reverse rotation start) are off.	DO-1		○	
Limiting speed	VLC	CN1-25	VLC turns on when speed reaches a value limited with any of [Pr. PC05 Internal speed limit 1] to [Pr. PC11 Internal speed limit 7] or VLA (Analog speed limit). This turns off when SON (Servo-on) turns off.	DO-1			○
Limiting torque	TLC		TLC turns on when a generated torque reaches a value set with any of [Pr. PA11 Forward torque limit], [Pr. PA12 Reverse torque limit], or TLA (Analog torque limit).	DO-1	○	○	

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Zero speed detection	ZSP	CN1-23	ZSP turns on when the servo motor speed is zero speed (50 r/min) or less. Zero speed can be changed with [Pr. PC17].  ZSP will turn on when the servo motor is decelerated to 50 r/min (at 1)), and will turn off when the servo motor is accelerated to 70 r/min again (at 2)). ZSP will turn on when the servo motor is decelerated again to 50 r/min (at 3)), and will turn off when the servo motor speed has reached -70 r/min (at 4)). The range from the point when the servo motor speed has reached on level, and ZSP turns on, to the point when it is accelerated again and has reached off level is called hysteresis width. Hysteresis width is 20 r/min for this servo amplifier.	DO-1	○	○	○
Electromagnetic brake interlock	MBR		When using the device, set operation delay time of the electromagnetic brake in [Pr. PC16]. When a servo-off status or alarm occurs, MBR will turn off.	DO-1	△	△	△
Warning	WNG		When warning has occurred, WNG turns on. When a warning is not occurring, WNG will turn off in 2.5 s to 3.5 s after power-on.	DO-1	△	△	△
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.	DO-1	△	△	△
Alarm code	ACD0 ACD1 ACD2	(CN1-24) (CN1-23) (CN1-22)	To use these signals, set " _ _ _ 1" in [Pr. PD34]. This signal is outputted when an alarm occurs. When an alarm is not occurring, respective ordinary signals are outputted. For details of the alarm codes, refer to chapter 8. When [Pr. PD34] is set to "_ _ _ 1", setting the following will trigger [AL. 37 Parameter error]. ・"_ _ _ 1" is set in [Pr. PA03] and the absolute position detection system by DIO is selected. ・MBR, DB, or ALM is assigned to the CN1-22 pin, CN1-23 pin, or CN1-24 pin.	DO-1	△	△	△
Variable gain selection	CDPS		CDPS turns on during gain switching.	DO-1	△	△	△
Absolute position undetermined	ABSV		ABSV turns on when the absolute position is undetermined.	DO-1	△		
ABS transmission data bit 0	ABSB0	(CN1-22)	This is used to output ABS transmission data bit 0. When "Enabled (absolute position detection system by DIO) (_ _ _ 1)" is selected in [Pr. PA03], the CN1-22 pin will become ABSB0 only during ABS transfer mode. (Refer to chapter 12.)	DO-1	△		
ABS transmission data bit 1	ABSB1	(CN1-23)	This is used to output ABS transmission data bit 1. When "Enabled (absolute position detection system by DIO) (_ _ _ 1)" is selected in [Pr. PA03], the CN1-23 pin will become ABSB1 only during ABS transfer mode. (Refer to chapter 12.)	DO-1	△		
ABS transmission data ready	ABST	(CN1-25)	This is used to output ABS transmission data ready. When "Enabled (absolute position detection system by DIO) (_ _ _ 1)" is selected in [Pr. PA03], CN1-25 pin will become ABST only during ABS transfer mode. (Refer to chapter 12.)	DO-1	△		

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
During tough drive	MTTR		MTTR turns on when the instantaneous power failure tough drive operates while the tough drive function selection is enabled with [Pr. PA20]. This device is not available with MR-J4-03A6(-RJ) servo amplifiers.	DO-1	△	△	△
During fully closed loop control	CLDS		CLDS turns on during fully closed loop control. This device is not available with MR-J4-03A6(-RJ) servo amplifiers.	DO-1	△		

(2) Input signal

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Analog torque limit	TLA	CN1-27	To use the signal in the speed control mode, enable TL (External torque limit selection) with [Pr. PD03] to [Pr. PD22]. When TLA is enabled, torque is limited in the full servo motor output torque range. Apply 0 V to +10 V DC between TLA and LG. Connect the positive terminal of the power supply to TLA. The maximum torque is generated at +10 V. (Refer to section 3.6.1 (5).) If a value equal to or larger than the maximum torque is inputted to TLA, the value is clamped at the maximum torque. Resolution: 10 bits	Analog input	○	△	
Analog torque command	TC		This is used to control torque in the full servo motor output torque range. Apply 0 V to ±8 V DC between TC and LG. The maximum torque is generated at ±8 V. (Refer to section 3.6.3 (1).) The speed at ±8 V can be changed with [Pr. PC13]. If a value equal to or larger than the maximum torque is inputted to TC, the value is clamped at the maximum torque.	Analog input			○
Analog speed command	VC	CN1-2	Apply 0 V to ±10 V DC between VC and LG. Speed set in [Pr. PC12] is provided at ±10 V. (Refer to section 3.6.2 (1).) If a value equal to or larger than the permissible speed is inputted to VC, the value is clamped at the permissible speed. Resolution: 14 bits or equivalent For MR-J4-_A_-RJ 100 W or more servo amplifiers, setting [Pr. PC60] to "_ _ 1 _" increases the analog input resolution to 16 bits. This function is available with servo amplifiers manufactured in November 2014 or later.	Analog input		○	
Analog speed limit	VLA		Apply 0 V to ±10 V DC between VLA and LG. Speed set in [Pr. PC12] is provided at ±10 V. (Refer to section 3.6.3 (3).) If a value equal to or larger than the permissible speed is inputted to VLA, the value is clamped at the permissible speed.	Analog input			○
Forward rotation pulse train Reverse rotation pulse train	PP NP PP2 NP2 PG NG	CN1-10 CN1-35 CN1-37 CN1-38 CN1-11 CN1-36	This is used to enter a command pulse train. 1) For open-collector type The maximum input frequency is 200 kpulses/s. For A-phase/B-phase pulse train, 200 kpulses/s will be the frequency after multiplication by four. a) Sink input interface Input the forward rotation pulse train between PP and DOCOM. Input the reverse rotation pulse train between NP and DOCOM. b) Source input interface Input the forward rotation pulse train between PP2 and PG. Input the reverse rotation pulse train between NP2 and NG. 2) For differential receiver type (max. input frequency: 4 Mpulses/s) The maximum input frequency is 4 Mpulses/s. For A-phase/B-phase pulse train, 4 Mpulses/s will be the frequency after multiplication by four. Input the forward rotation pulse train between PG and PP. Input the reverse rotation pulse train between NG and NP. The command input pulse train form, pulse train logic, and command input pulse train filter are changed in [Pr. PA13]. When the command pulse train is over 1 Mpulse/s and lower than 4 Mpulse/s, set [Pr. PA13] to "_ 0 _ _".	DI-2	○		

(3) Output signal

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Encoder A-phase pulse (differential line driver)	LA LAR	CN1-4 CN1-5	The encoder output pulses set in [Pr. PA15] are outputted in the differential line driver type. In CCW rotation of the servo motor, the encoder B-phase pulse lags the encoder A-phase pulse by a phase angle of π/2. The relation between rotation direction and phase difference of the A-phase and B-phase pulses can be changed with [Pr. PC19]. Depending on the stop position of the servo motor, the encoder output pulse may turn on and off repeatedly even if the servo motor is stopped.	DO-2	○	○	○
Encoder B-phase pulse (differential line driver)	LB LBR	CN1-6 CN1-7					
Encoder Z-phase pulse (differential line driver)	LZ LZR	CN1-8 CN1-9	The encoder zero-point signal is outputted in the differential line driver type. One pulse is outputted per servo motor revolution. This turns on when the zero-point position is reached. (negative logic) The minimum pulse width is about 400 μs. For home position return using this pulse, set the creep speed to 100 r/min or less.	DO-2	○	○	○
Encoder Z-phase pulse (open-collector)	OP	CN1-33	The encoder zero-point signal is outputted in the open-collector type.	DO-2	○	○	○
Analog monitor 1	MO1	CN6-3	This is used to output the data set in [Pr. PC14] to between MO1 and LG in terms of voltage. Output voltage: ±10 V Resolution: 10 bits or equivalent	Analog output	○	○	○
Analog monitor 2	MO2	CN6-2	This signal outputs the data set in [Pr. PC15] to between MO2 and LG in terms of voltage. Output voltage: ±10 V Resolution: 10 bits or equivalent	Analog output	○	○	○

(4) Communication

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
RS-422/RS-485 I/F	SDP SDN RDP RDN	CN3-5 CN3-4 CN3-3 CN3-6	These are terminals for RS-422/RS-485 communication.		○	○	○

(5) Power supply

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Digital I/F power supply input	DICOM	CN1-20 CN1-21	Input 24 V DC (24 V DC ± 10% 500 mA) to I/O interface. The power supply capacity changes depending on the number of I/O interface points to be used. For sink interface, connect + of 24 V DC external power supply. For source interface, connect - of 24 V DC external power supply.		○	○	○
Power input for open-collector sink interface	OPC	CN1-12	When inputting a pulse train in the open-collector type with sink interface, supply this terminal with the positive (+) power of 24 V DC.		○		
			Supply + of 24 V DC to this terminal when using CN1-10 pin and CN1-35 pin by DI. CN1-10 pin and CN1-35 pin are available for MR-J4-_A_-RJ servo amplifiers manufactured in November 2014 or later.			○	○
Digital I/F common	DOCOM	CN1-46 CN1-47	Common terminal of input signal such as EM2 of the servo amplifier. This is separated from LG. For sink interface, connect - of 24 V DC external power supply. For source interface, connect + of 24 V DC external power supply.		○	○	○
15 V DC power supply	P15R	CN1-1	This outputs 15 V DC to between P15R and LG. This is available as power for TC, TLA, VC, or VLA. Permissible current: 30 mA		○	○	○
Control common	LG	CN1-3 CN1-28 CN1-30 CN1-34 CN3-1 CN3-7 CN6-1	This is a common terminal for TLA, TC, VC, VLA, FPA, FPB, OP ,MO1, MO2, and P15R. Pins are connected internally.		○	○	○
Shield	SD	Plate	Connect the external conductive portion of the shielded cable.		○	○	○

3.6 Detailed explanation of signals

3.6.1 Position control mode

POINT

●Adjust the logic of a positioning module and command pulse as follows.

- MELSEC iQ-R series/MELSEC-Q series/MELSEC-L series positioning module

Signal type	Command pulse logic setting	
	Positioning module Pr. 23 setting	MR-J4-_A_(-RJ) servo amplifier [Pr. PA13] setting
Open-collector type	Positive logic	Positive logic (_ _ 0 _)
	Negative logic	Negative logic (_ _ 1 _)
Differential line driver type	Positive logic (Note)	Negative logic (_ _ 1 _)
	Negative logic (Note)	Positive logic (_ _ 0 _)

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

- MELSEC-F series positioning module

Signal type	Command pulse logic setting	
	Positioning module (fixed)	MR-J4-_A_(-RJ) servo amplifier [Pr. PA13] setting
Open-collector Differential line driver	Negative logic	Negative logic (_ _ 1 _)

(1) Pulse train input

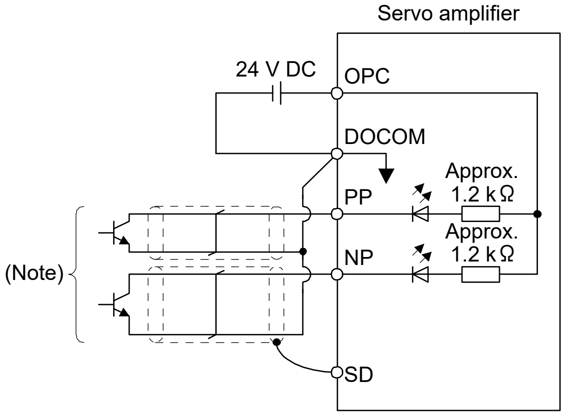
(a) Input pulse waveform selection

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

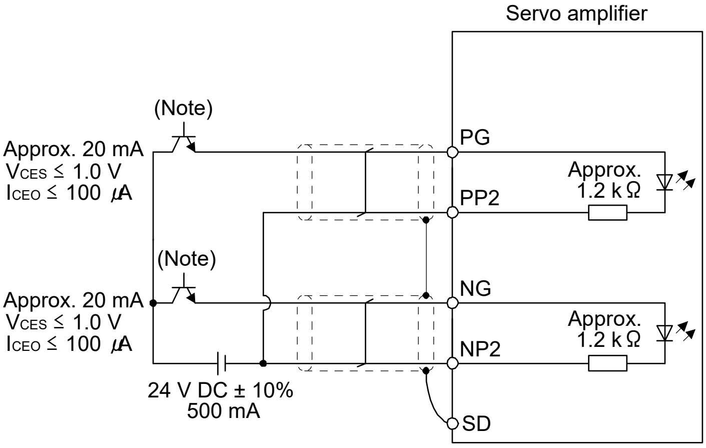
(b) Connection and waveform

1) Open-collector type

Connect as follows.



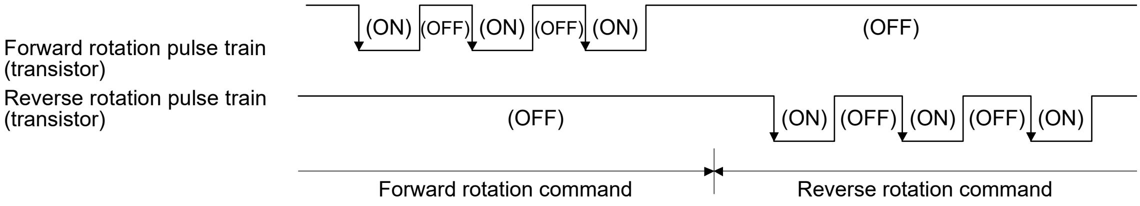
For sink input interface



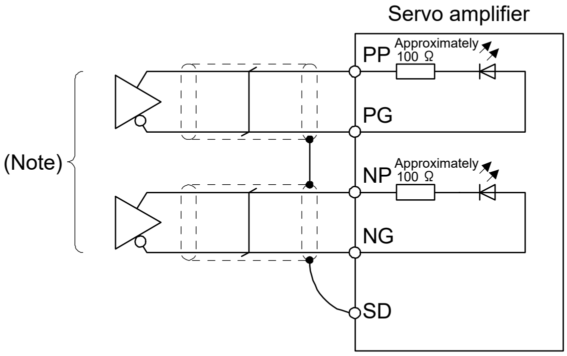
For source input interface

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

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

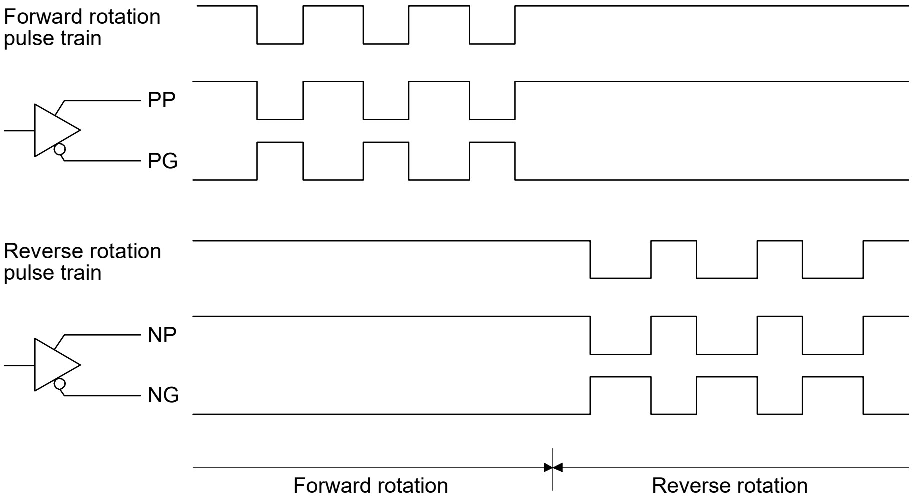


2) Differential line driver type
Connect as follows.



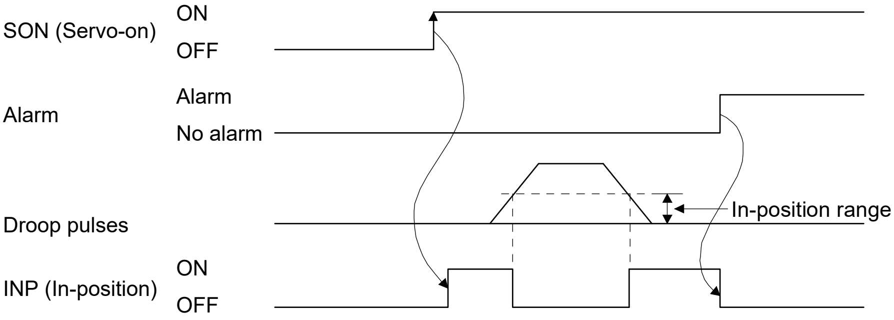
Note. Pulse train input interface is comprised of a photocoupler.
If a resistor is connected to the pulse train signal line, it may malfunction due to reduction in current.

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

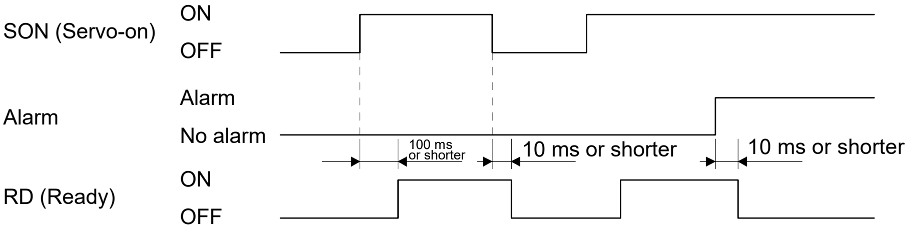


(2) INP (In-position)

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



(3) RD (Ready)



(4) Electronic gear switching

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

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

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

Note. 0: Off
1: On

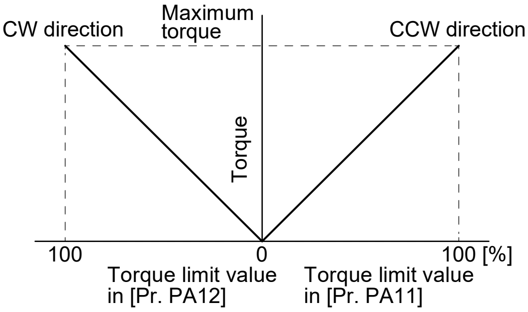
(5) Torque limit

⚠CAUTION

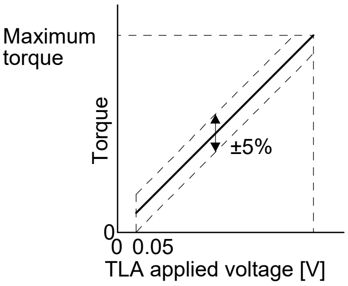
- If the torque limit is canceled during servo-lock, the servo motor may suddenly rotate according to position deviation in respect to the command position.
- When using the torque limit, check that [Pr. PB06 Load to motor inertia ratio/load to motor mass ratio] is set properly. Improper settings may cause an unexpected operation such as an overshoot.

(a) Torque limit and torque

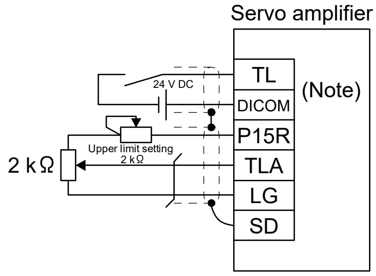
By setting [Pr. PA11 Forward rotation torque limit] or [Pr. PA12 Reverse rotation torque limit], torque is always limited to the maximum value during operation. A relation between the limit value and servo motor torque is as follows.



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



TLA applied voltage vs. torque limit value



Connection example

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

(b) Torque limit value selection

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

Input device (Note 1)		Limit value status			Enabled torque limit value	
TL1	TL				CCW power running/CW regeneration	CW power running/CCW regeneration
0	0				Pr. PA11	Pr .PA12
0	1	TLA	>	Pr. PA11 Pr. PA12	Pr. PA11	Pr. PA12
		TLA	<	Pr. PA11 Pr. PA12	TLA (Note 2)	TLA (Note 3)
1	0	Pr. PC35	>	Pr. PA11 Pr. PA12	Pr. PA11	Pr. PA12
		Pr. PC35	<	Pr. PA11 Pr. PA12	Pr. PC35 (Note 2)	Pr. PC35 (Note 3)
1	1	TLA	>	Pr. PC35	Pr. PC35 (Note 2)	Pr. PC35 (Note 3)
		TLA	<	Pr. PC35	TLA (Note 2)	TLA (Note 3)

Note 1. 0: Off
1: On
2. When "_ 2 _ _" is set in [Pr. PD33], the value set in [Pr. PA11] is applied. [Pr. PD33] is available with servo amplifiers with software version B3 or later.
3. When "_ 1 _ _" is set in [Pr. PD33], the value set in [Pr. PA12] is applied. [Pr. PD33] is available with servo amplifiers with software version B3 or later.

(c) TLC (Limiting torque)

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

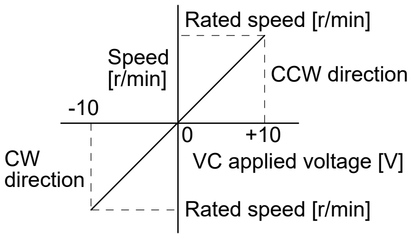
3.6.2 Speed control mode

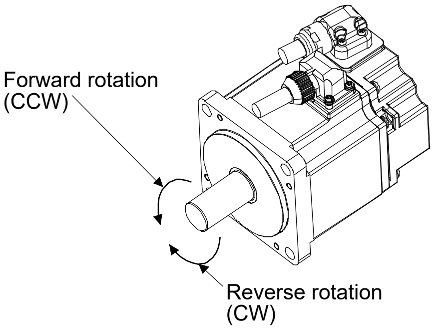
(1) Speed setting

(a) Speed command and speed

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

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



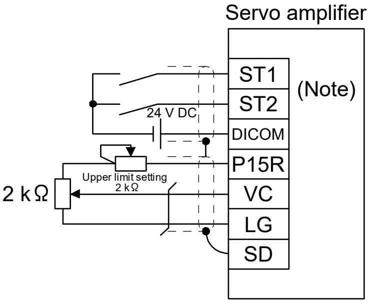


The following table indicates the rotation direction according to ST1 (Forward rotation start) and ST2 (Reverse rotation start) combination.

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

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

Normally, connect as follows.



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

(b) SP1 (Speed selection 1), SP2 (Speed selection 2), and speed command value

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

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

Note. 0: Off
1: On

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

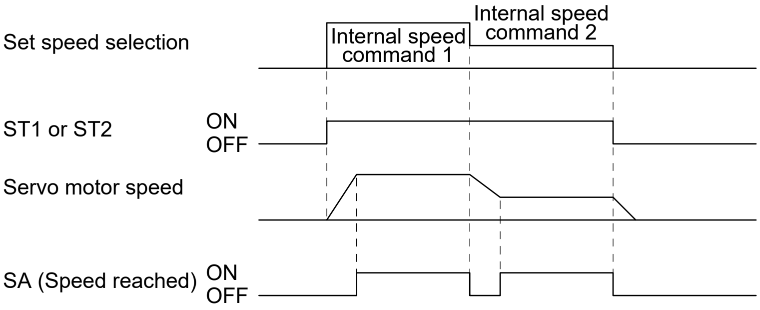
(Note) Input device			Speed command value
SP3	SP2	SP1	
0	0	0	VC (Analog speed command)
0	0	1	Pr. PC05 Internal speed command 1
0	1	0	Pr. PC06 Internal speed command 2
0	1	1	Pr. PC07 Internal speed command 3
1	0	0	Pr. PC08 Internal speed command 4
1	0	1	Pr. PC09 Internal speed command 5
1	1	0	Pr. PC10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

Note. 0: Off
1: On

You can change the speed during rotation. To accelerate/decelerate, set acceleration/deceleration time constant in [Pr. PC01] or [Pr. PC02].
When the internal speed commands are used to command a speed, the speed does not vary with the ambient temperature.

(2) SA (Speed reached)

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



(3) Torque limit

As in section 3.6.1 (5)

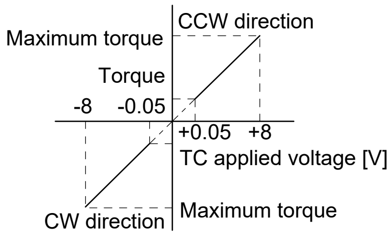
3.6.3 Torque control mode

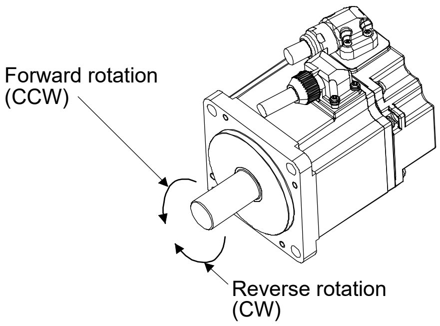
(1) Torque limit

(a) Torque command and torque

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

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





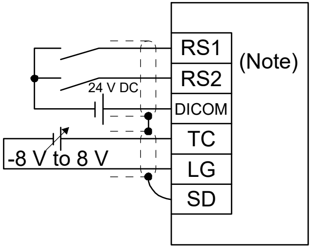
Generated torque command values will vary about 5% relative to the voltage depending on products. The torque may vary if the voltage is low (-0.05 V to 0.05 V) and the actual speed is close to the limit value. In such a case, increase the speed limit value.

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

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

Note. 0: Off
1: On

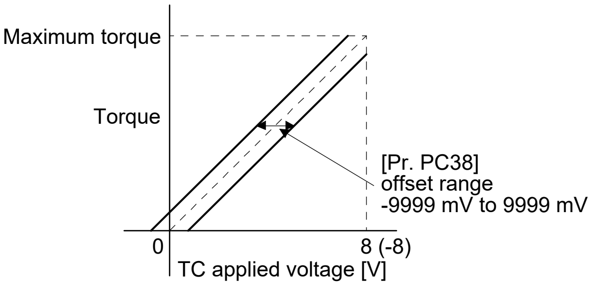
Normally, connect as follows.



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

(b) Analog torque command offset

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



(2) Torque limit

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

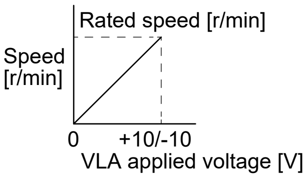
Note that TLA (Analog torque limit) is unavailable.

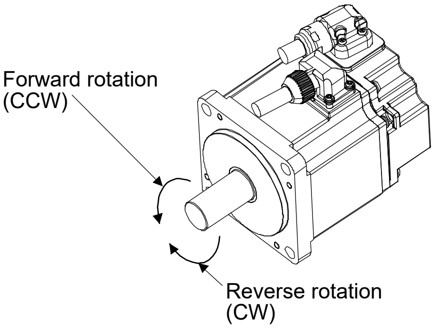
(3) Speed limit

(a) Speed limit value and speed

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

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



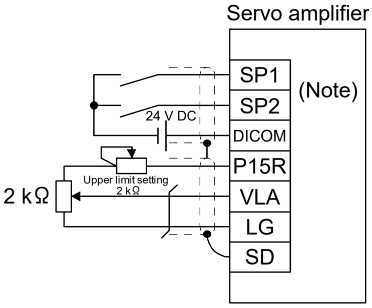


The following table indicates the limit direction according to RS1 (Forward rotation selection) and RS2 (Reverse rotation selection) combination.

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

Note. 0: Off
1: On

Normally, connect as follows.



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

(b) Speed limit value selection

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

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

Note. 0: Off
1: On

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

(c) VLC (Limiting speed)

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

3.6.4 Position/speed control switching mode

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

(1) LOP (control switching)

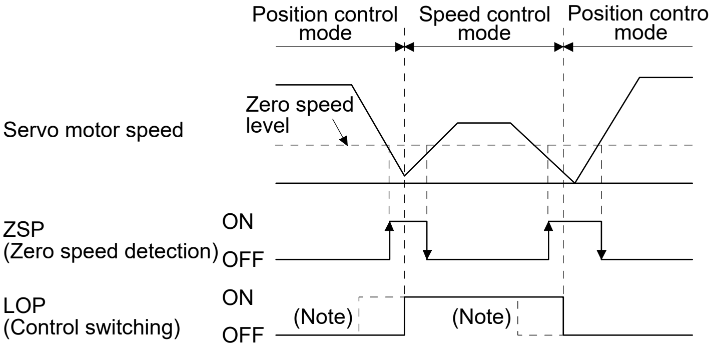
Use LOP (Control switching) to switch between the position control mode and the speed control mode with an external contact. The following shows a relation between LOP and control modes.

LOP (Note 1)	Setting value of [Pr. PD32]	
	0 _ _ _	1 _ _ _ (Note 2)
0	Position control mode	Speed control mode
1	Speed control mode	Position control mode

Note 1. 0: Off
1: On
2. This setting value is available on servo amplifiers with software version D4 or later.

You can switch the control mode in the zero speed status. To ensure safety, switch modes after the servo motor has stopped. When position control mode is switched to speed control mode, droop pulses will be reset.

If LOP is switched on/off at the speed higher than the zero speed, the control mode cannot be changed regardless of the speed. The following shows a switching timing chart.



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

(2) Torque limit in position control mode

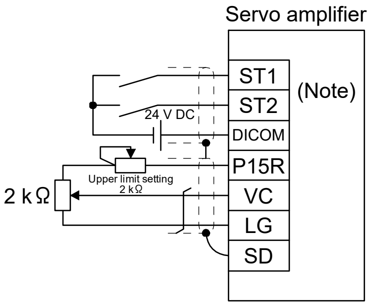
As in section 3.6.1 (5)

(3) Speed setting in speed control mode

(a) Speed command and speed

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

Normally, connect as follows.



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

(b) Speed command value selection

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

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

Note. 0: Off
1: On

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

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

Note. 0: Off
1: On

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

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

(c) SA (Speed reached)
As in section 3.6.2 (2)

3.6.5 Speed/torque control switching mode

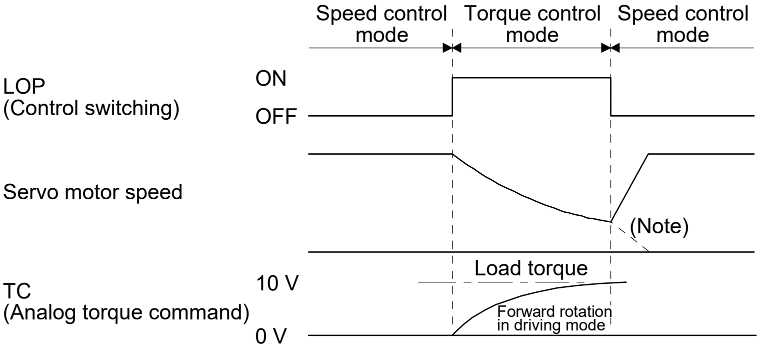
Set " _ _ _ 3" in [Pr. PA01] to switch to the speed/torque control switching mode.

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

LOP (Note 1)	Setting value of [Pr. PD32]	
	0 _ _ _	1 _ _ _ (Note 2)
0	Speed control mode	Torque control mode
1	Torque control mode	Speed control mode

Note 1. 0: Off
1: On
2. This setting value is available on servo amplifiers with software version D4 or later.

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



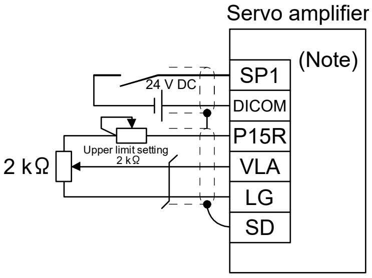
Note. When ST1 (Forward rotation start) and ST2 (Reverse rotation start) are switched off as soon as a mode is switched to the speed control, the servo motor comes to a stop according to the deceleration time constant. A shock may occur at switching control modes.

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

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

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

Normally, connect as follows.



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

(b) Speed limit value selection

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

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

Note. 0: Off
1: On

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

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

(c) VLC (Limiting speed)

As in section 3.6.3 (3) (c)

(5) Torque control in torque control mode

As in section 3.6.3 (1)

(6) Torque limit in torque control mode

As in section 3.6.3 (2)

3.6.6 Torque/position control switching mode

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

(1) LOP (control switching)

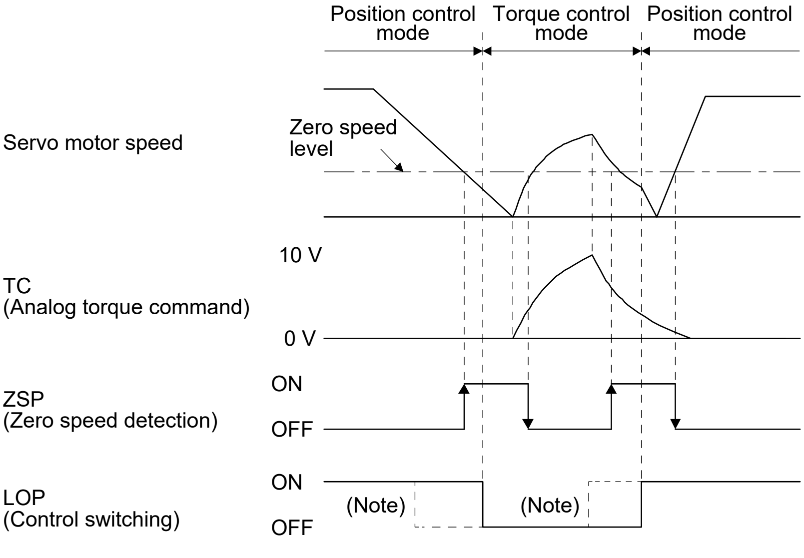
Use LOP (Control switching) to switch between the torque control mode and the position control mode with an external contact. The following shows a relation between LOP and control modes.

LOP (Note 1)	Setting value of [Pr. PD32]	
	0 _ _ _	1 _ _ _ (Note 2)
0	Torque control mode	Position control mode
1	Position control mode	Torque control mode

Note 1. 0: Off
1: On
2. This setting value is available on servo amplifiers with software version D4 or later.

You can switch the control mode in the zero speed status. To ensure safety, switch modes after the servo motor has stopped. When position control mode is switched to torque control mode, droop pulses will be reset.

If LOP is switched on/off at the speed higher than the zero speed, the control mode cannot be changed regardless of the speed. The following shows a switching timing chart.



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

(2) Speed limit in torque control mode

As in section 3.6.3 (3)

(3) Torque control in torque control mode

As in section 3.6.3 (1)

(4) Torque limit in torque control mode

As in section 3.6.3 (2)

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

3.7 Forced stop deceleration function

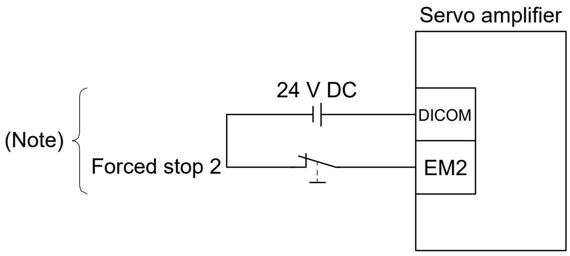
POINT

- ●When alarms not related to the forced stop function occur, control of motor deceleration cannot be guaranteed. (Refer to chapter 8.)
- ●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 SON (Servo-on) on while EM2 (Forced stop 2) is off. If SON (Servo-on) is off, forced stop deceleration, base circuit shut-off delay time, and vertical axis freefall prevention do not function.

3.7.1 Forced stop deceleration function

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

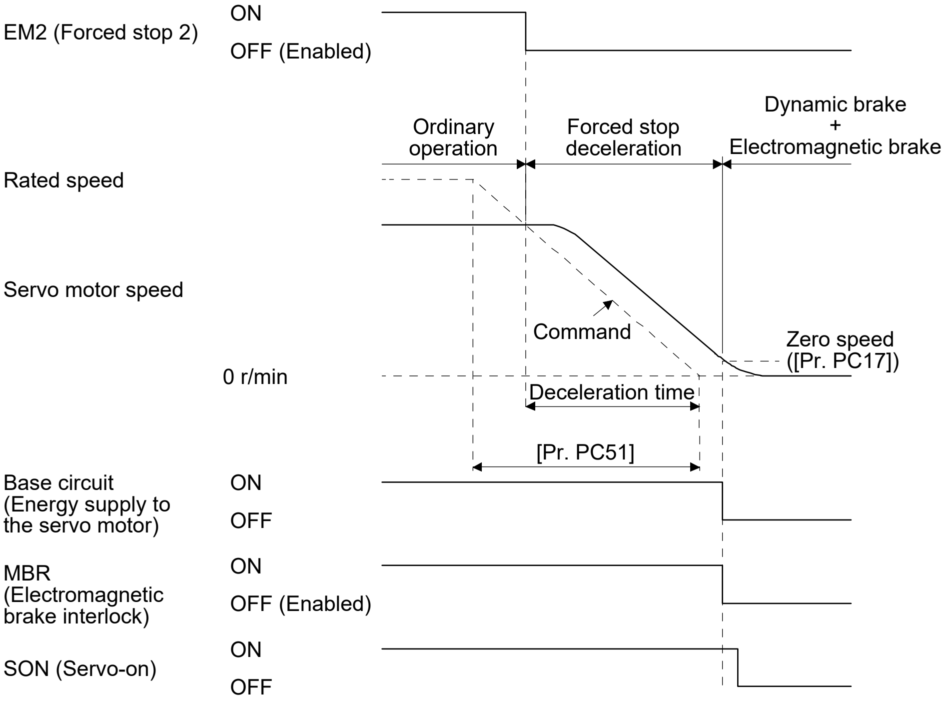
(1) Connection diagram



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

(2) Timing chart

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

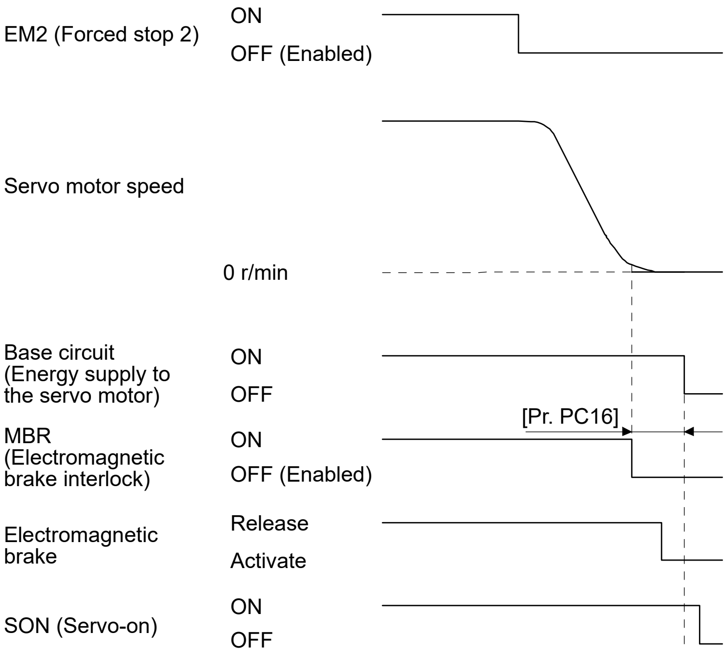


3.7.2 Base circuit shut-off delay time function

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

(1) Timing chart

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



(2) Adjustment

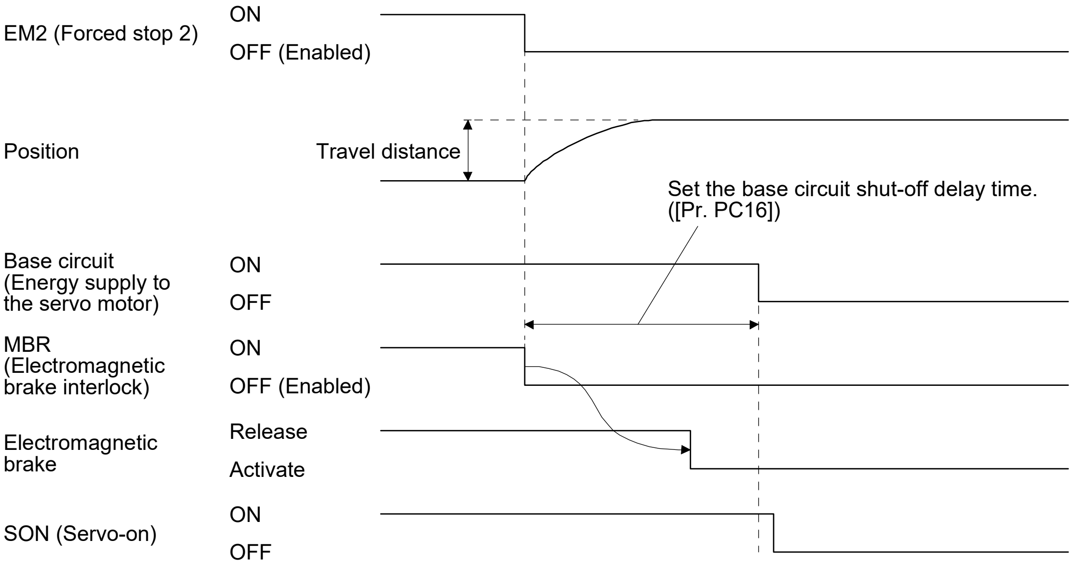
While the servo motor is stopped, turn off EM2 (Forced stop 2), adjust the base circuit shut-off delay time in [Pr. PC16], and set the value to approximately 1.5 times of the smallest delay time in which the servo motor shaft does not freefall.

3.7.3 Vertical axis freefall prevention function

The vertical axis freefall prevention function avoids machine damage by pulling up the shaft slightly like the following case.
When the servo motor is used for operating vertical axis, the servo motor electromagnetic brake and the base circuit shut-off delay time function avoid dropping axis at forced stop. However, those functions may not avoid dropping axis a few μm due to the backlash of the servo motor electromagnetic brake.
The vertical axis freefall prevention function is 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. PC54 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 or an alarm occurred while the servo motor speed is zero speed or less.
- MBR (Electromagnetic brake interlock) is enabled in [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47] while the base circuit shut-off delay time is set in [Pr. PC16].

(1) Timing chart



(2) Adjustment

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

3.7.4 Residual risks of the forced stop function (EM2)

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

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

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

3.8 Alarm occurrence timing chart

⚠CAUTION

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

POINT

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

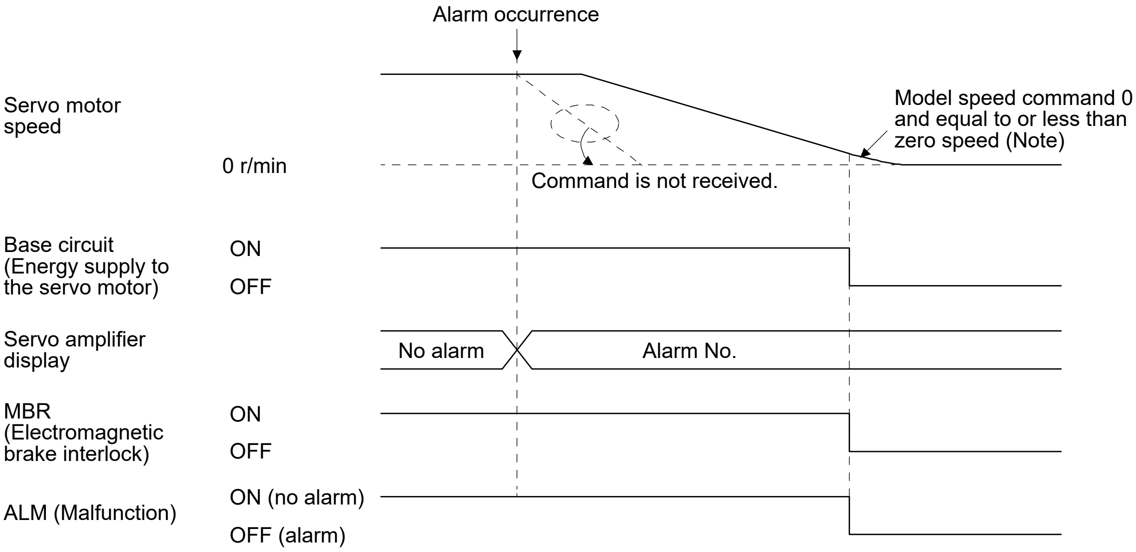
To deactivate an alarm, cycle the control circuit power, push the "SET" button in the current alarm window, or cycle the RES (Reset) However, the alarm cannot be deactivated unless its cause is removed.

3.8.1 When you use the forced stop deceleration function

POINT

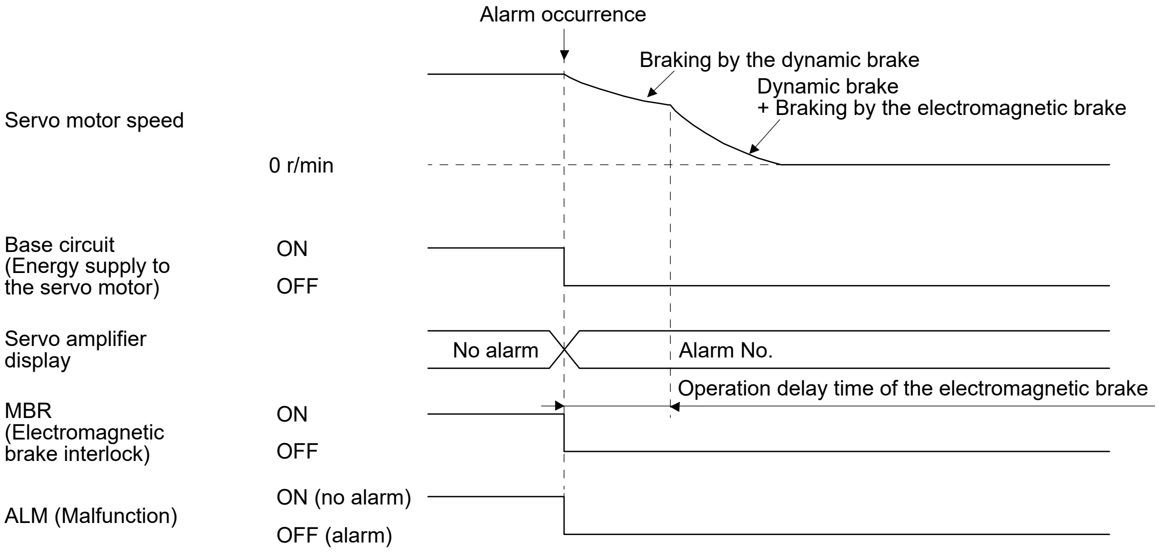
- To enable the function, set "2 _ _ _ (initial value)" in [Pr. PA04].
- Disable the forced stop deceleration function for a machine in which multiple axes are connected together, such as a tandem structure. If an alarm occurs with the forced stop deceleration function disabled, the servo motor will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



3.8.2 When you do not use the forced stop deceleration function

POINT

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

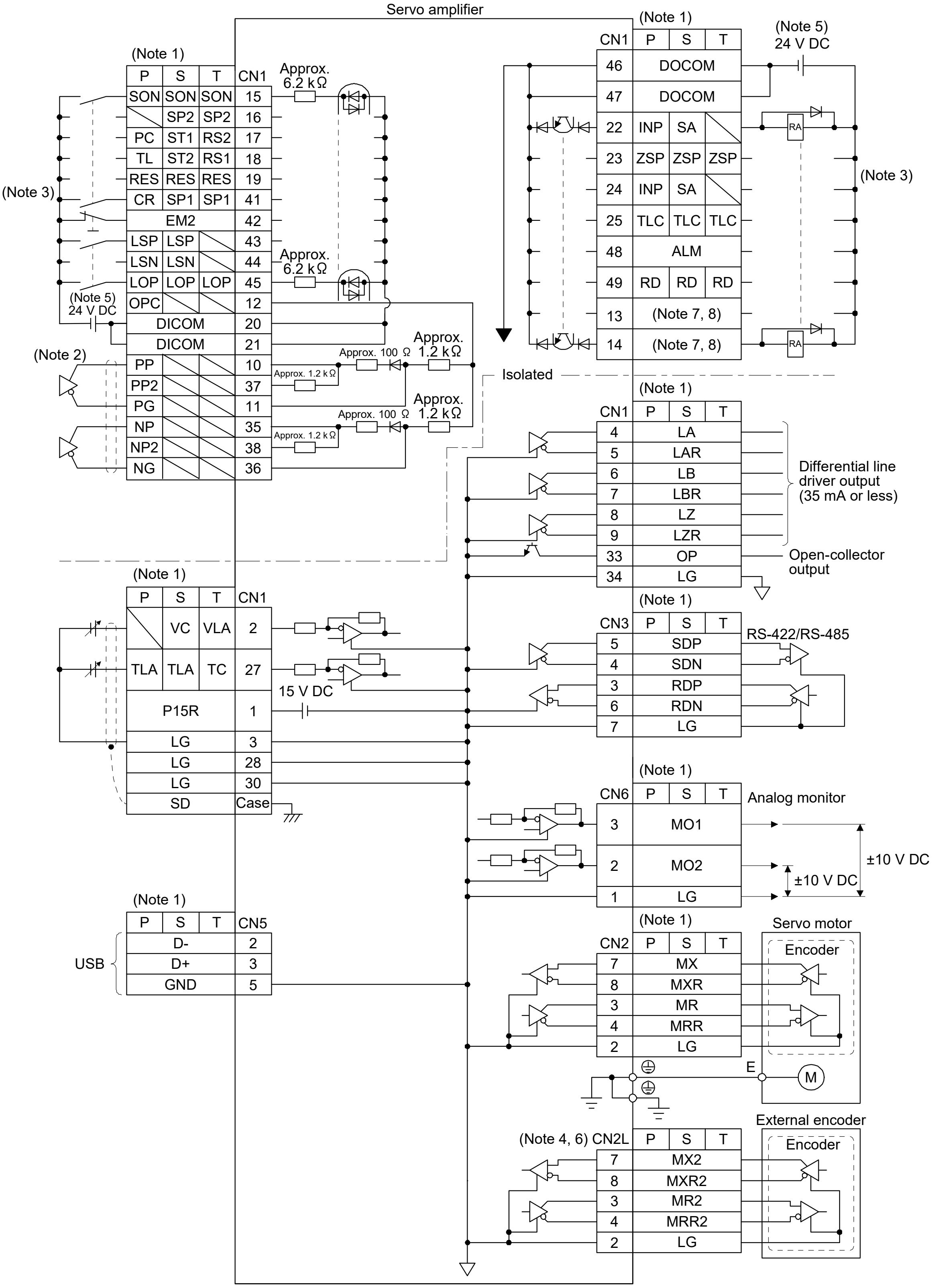
The operation status during an alarm is the same as section 3.8.1 (2).

3.9 Interfaces

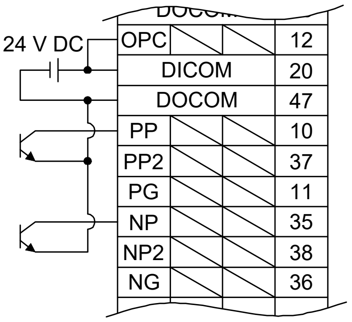
3.9.1 Internal connection diagram

POINT

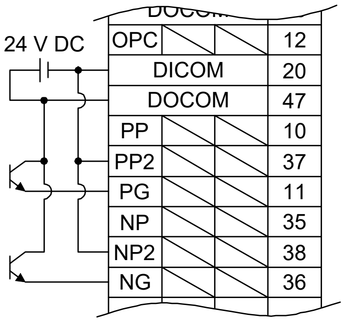
- Refer to section 13.3.1 for the CN8 connector.



Note 1. P: Position control mode, S: Speed control mode, T: Torque control mode
2. This is for the differential line driver pulse train input. For the open-collector pulse train input, connect as follows.



For sink input interface



For source input interface

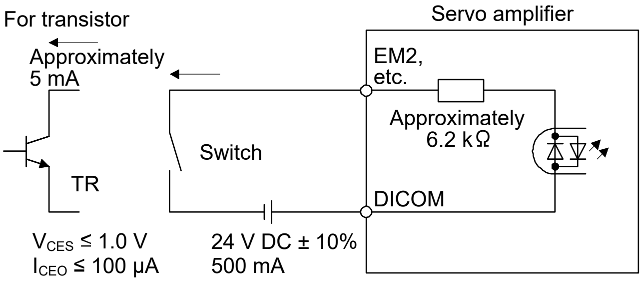
3. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
4. This is for MR-J4-_A_RJ servo amplifier. The MR-J4-_A_ servo amplifier does not have the CN2L connector.
5. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
6. Refer to table 1.1 for connections of external encoders.
7. Output devices are not assigned by default. Assign the output devices with [Pr. PD47] as necessary.
8. This is used with MR-J4-_A_-RJ servo amplifiers with software version B3 or later.

3.9.2 Detailed explanation of interfaces

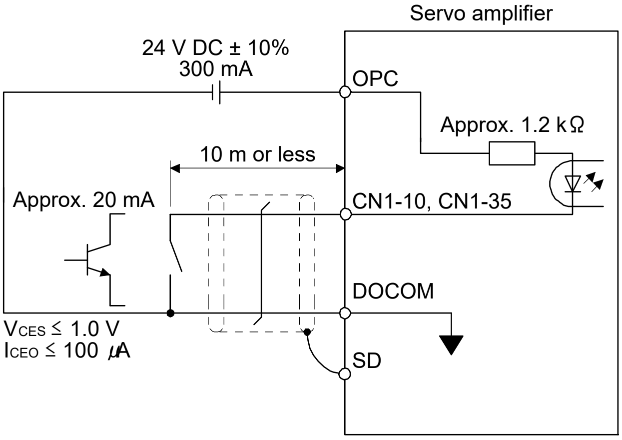
This section provides the details of the I/O signal interfaces (refer to the I/O division in the table) given in section 3.5. Refer to this section and make connection with the external device.

(1) Digital input interface DI-1

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



The following is for when CN1-10 pin and CN1-35 pin are used as digital input interfaces.



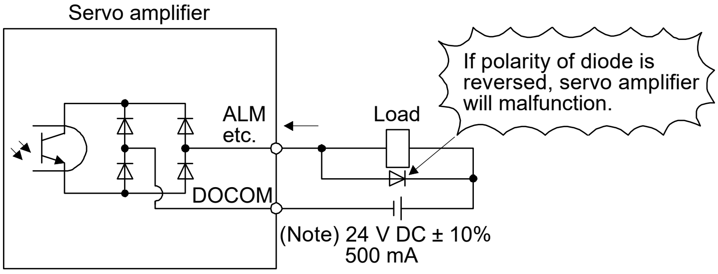
(2) Digital output interface DO-1

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 3.9.3 for source output.



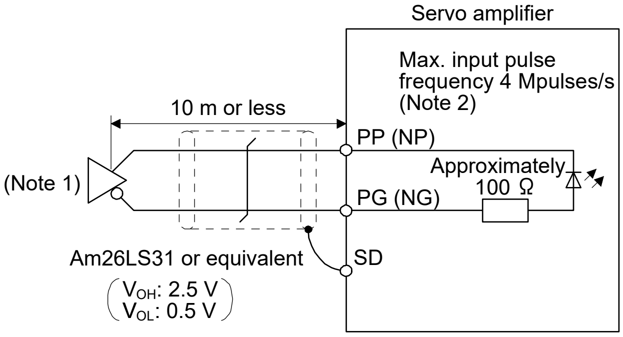
Note. If the voltage drop (maximum of 2.6 V) interferes with the relay operation, apply high voltage (maximum of 26.4 V) from external source.

(3) Pulse train input interface DI-2

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

(a) Differential line driver type

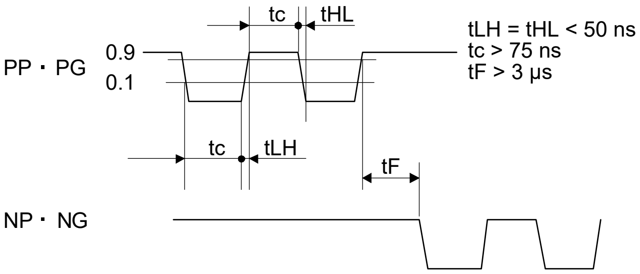
1) Interface



Note 1. Pulse train input interface is comprised of a photocoupler. If a resistor is connected to the pulse train signal line, it may malfunction due to reduction in current.

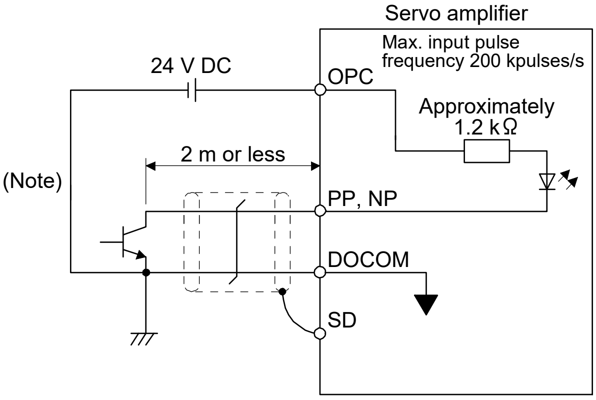
2. When the input pulse frequency is 4 Mpulses/s, set [Pr. PA13] to "_ 0 _ _".

2) Input pulse condition



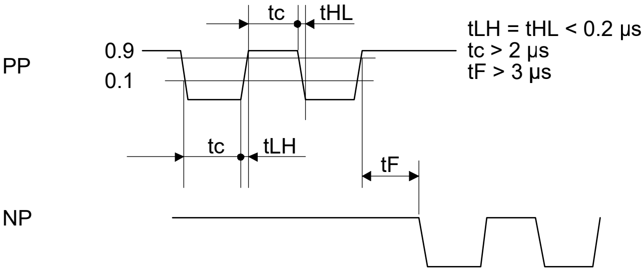
(b) Open-collector type

1) Interface



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

2) Input pulse condition

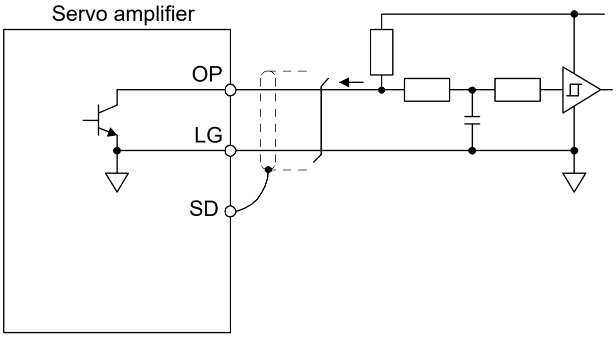


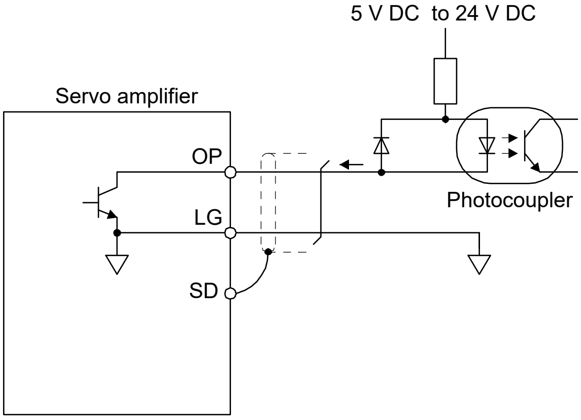
(4) Encoder output pulse DO-2

(a) Open-collector type

Interface

Maximum sink current: 35 mA

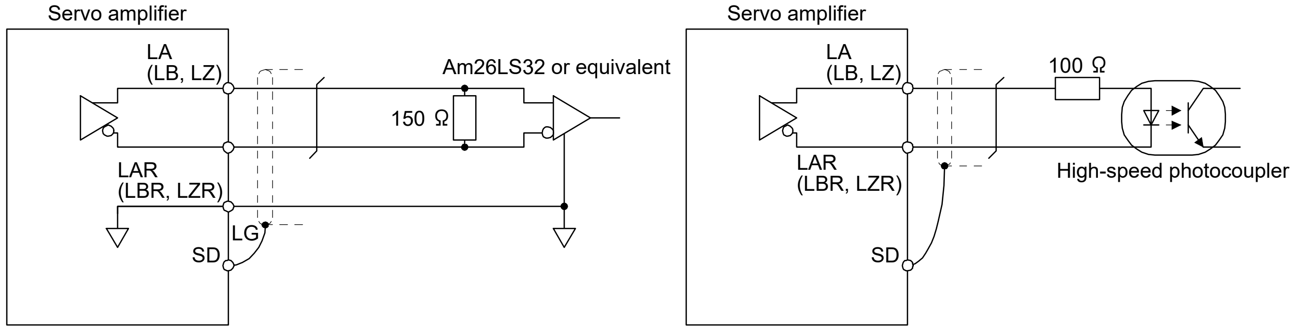




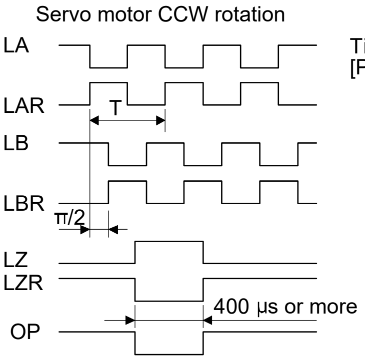
(b) Differential line driver type

1) Interface

Maximum output current: 35 mA



2) Output pulse

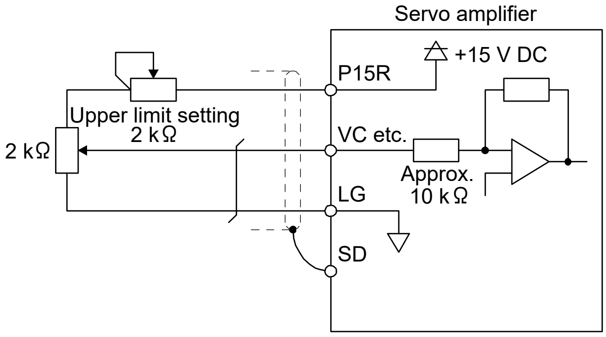


Time cycle (T) is determined by the settings of [Pr. PA15] and [Pr. PC19].

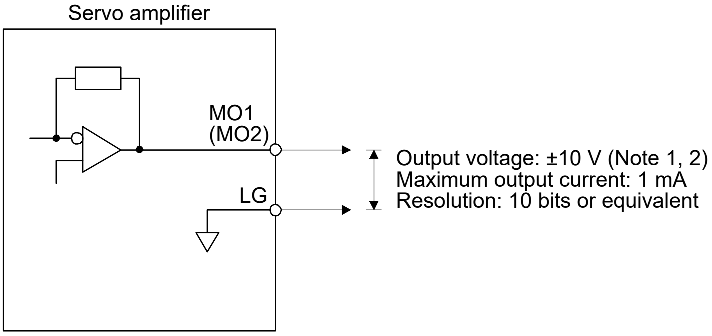
(5) Analog input

Input impedance

10 kΩ to 12 kΩ



(6) Analog output



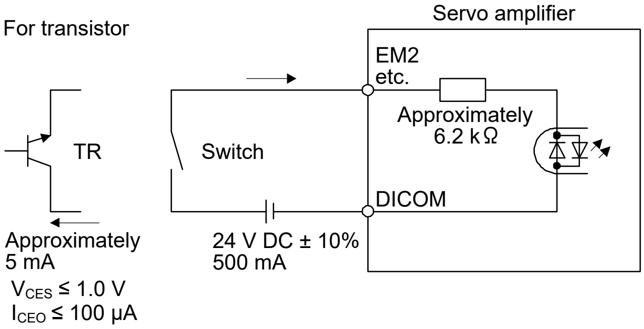
Note 1. Output voltage range varies depending on the monitored signal.
2. For MR-J4-03A6(-RJ) servo amplifiers, the output voltage becomes 5 V ± 4 V.

3.9.3 Source I/O interfaces

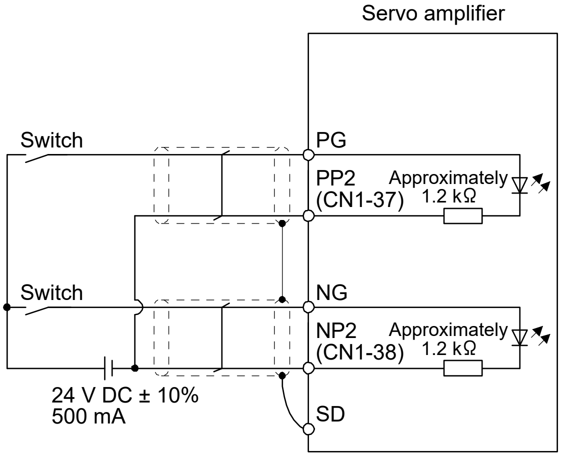
In this servo amplifier, source type I/O interfaces can be used.

(1) Digital input interface DI-1

This is an input circuit whose photocoupler anode side is the input terminal. Transmit signals using source (open-collector) type transistor output, relay switch, etc. Additionally, the CN1-10 and CN1-35 pins cannot be used for source inputs.



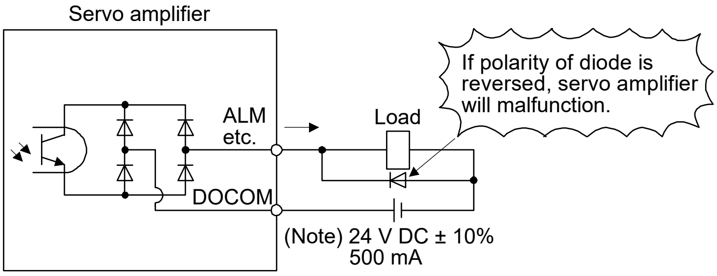
The following shows when the CN1-37 pin and the CN1-38 pin are used as digital input interface:



(2) Digital output interface DO-1

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

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

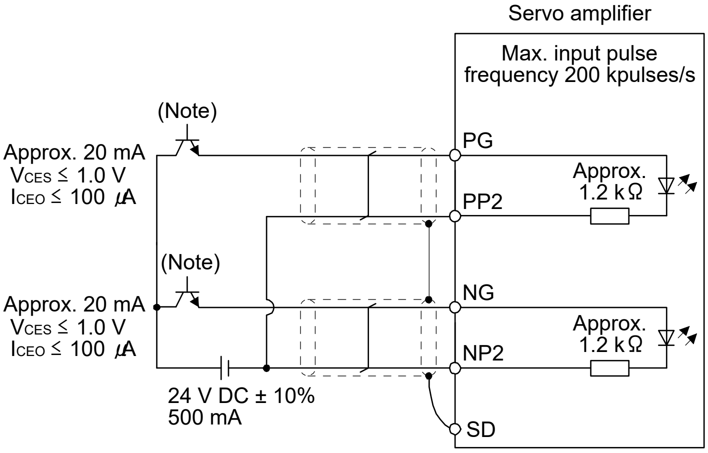


Note. If the voltage drop (maximum of 2.6 V) interferes with the relay operation, apply high voltage (maximum of 26.4 V) from external source.

(3) Pulse train input interface DI-2

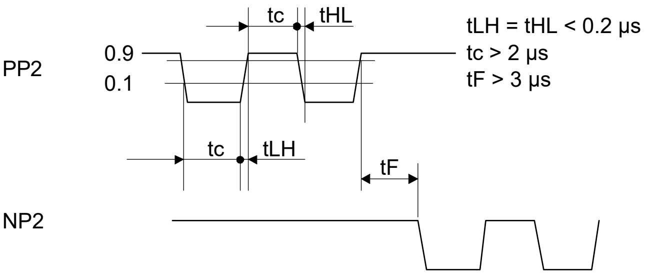
Give a pulse train signal in the open-collector type.

1) Interface



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

2) Input pulse condition



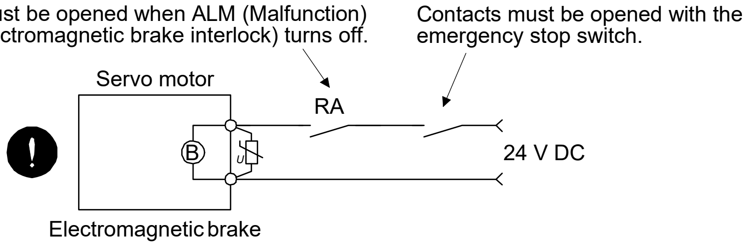
tLH = tHL < 0.2 μs
tc > 2 μs
tF > 3 μs

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.

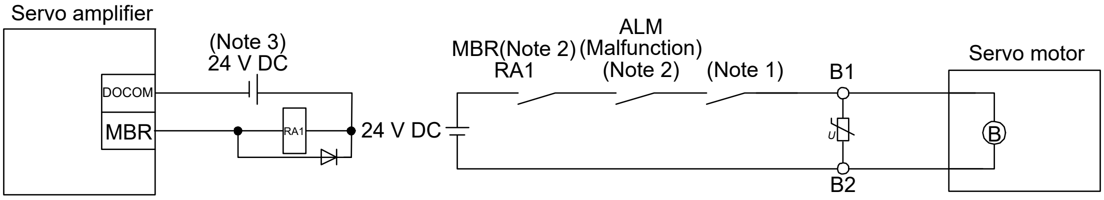
POINT

- 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) The status is base circuit shut-off during RES (Reset) on. When you use the motor in vertical axis system, use MBR (Electromagnetic brake interlock).
3) Turn off SON (Servo-on) after the servo motor stopped.

(1) Connection diagram



Note
1. Create the circuit in order to shut off by interlocking with the emergency stop switch.
2. 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

(a) Enable MBR (Electromagnetic brake interlock) with [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47].

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

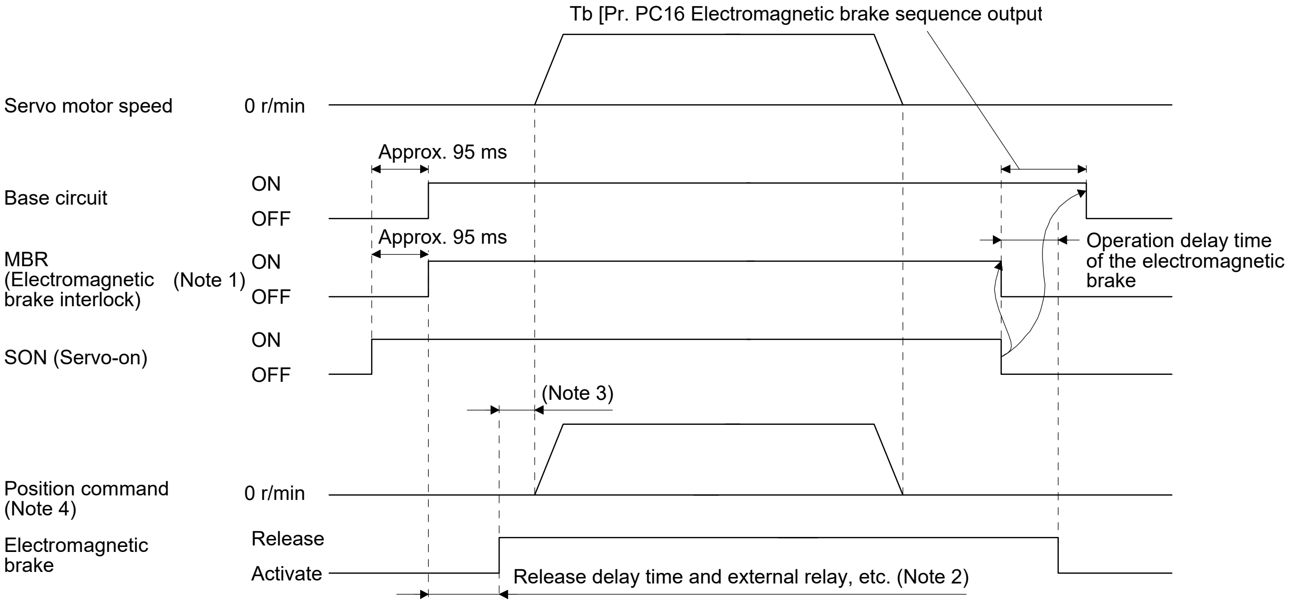
3.10.2 Timing chart

(1) When you use the forced stop deceleration function

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

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

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

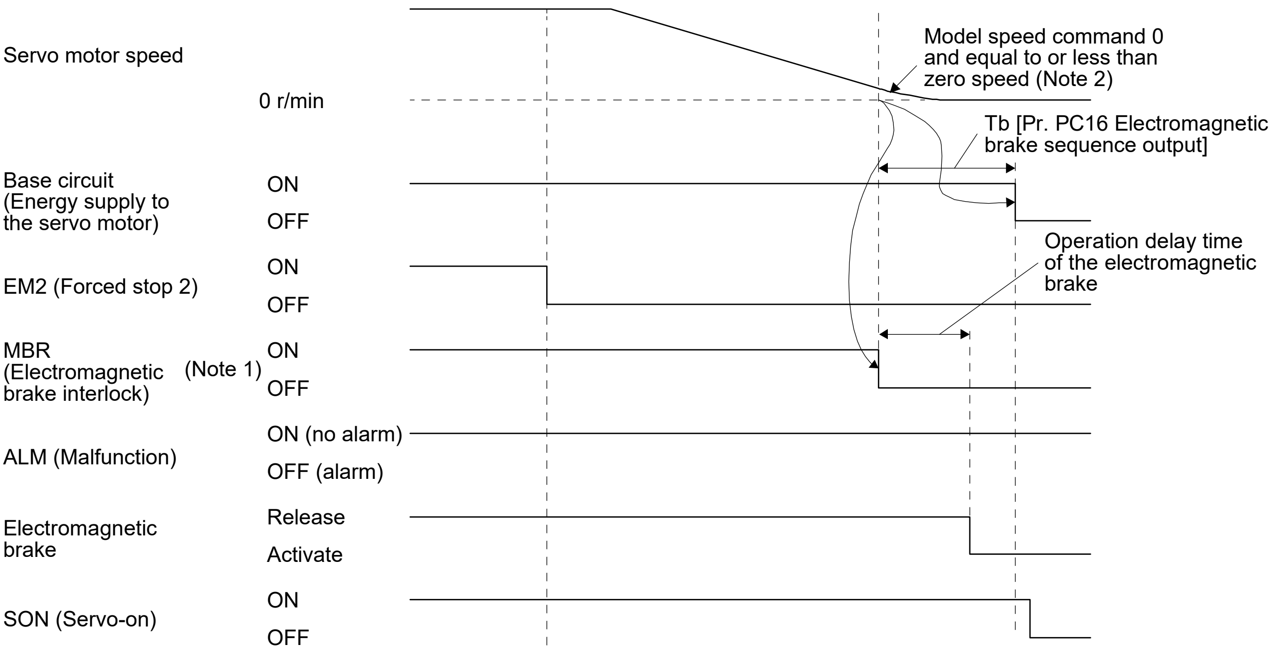


Note 1. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake has been activated.
2. Electromagnetic brake is released after delaying for the release delay time of electromagnetic brake and operation time of external circuit relay. For the release delay time of electromagnetic brake,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

(b) Forced stop 2 on/off

POINT

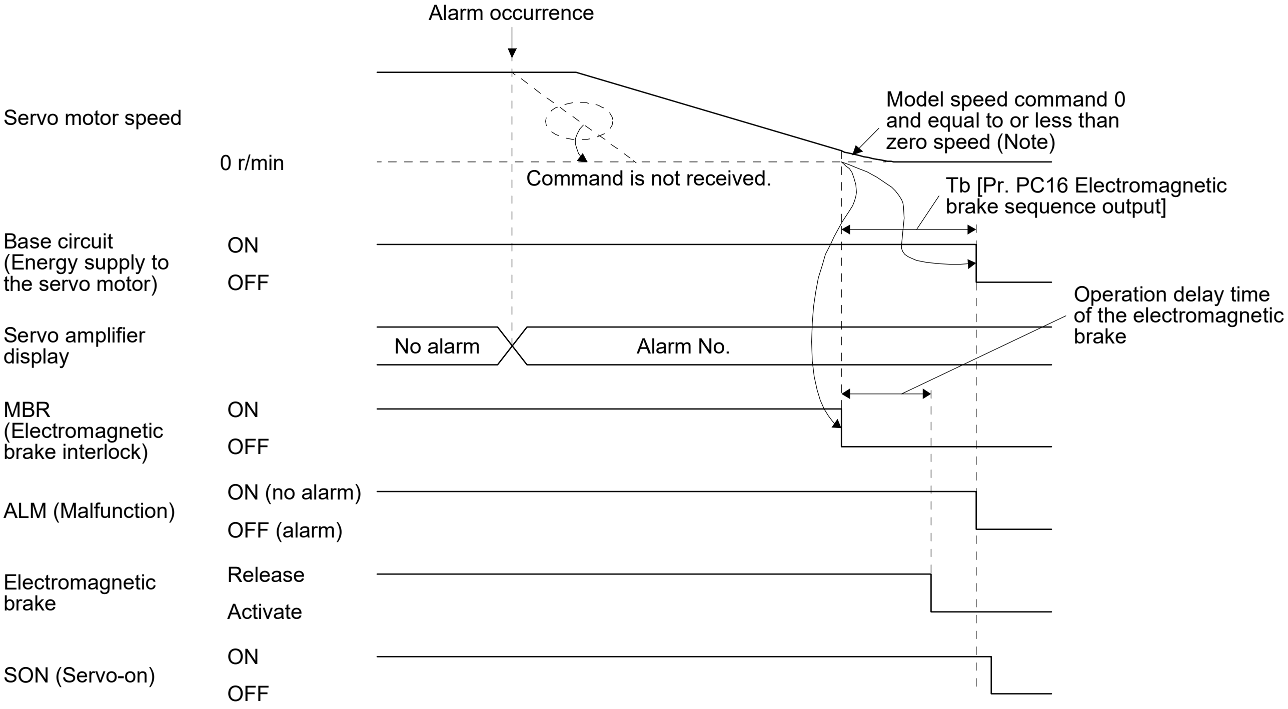
- ●In the torque control mode, the forced stop deceleration function is not available.
- ●Keep SON (Servo-on) on while EM2 (Forced stop 2) is off. If SON (Servo-on) is turned off earlier than EM2 (Forced stop 2), the servo amplifier operates in the same way as (1) (a) in this section.



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

(c) Alarm occurrence

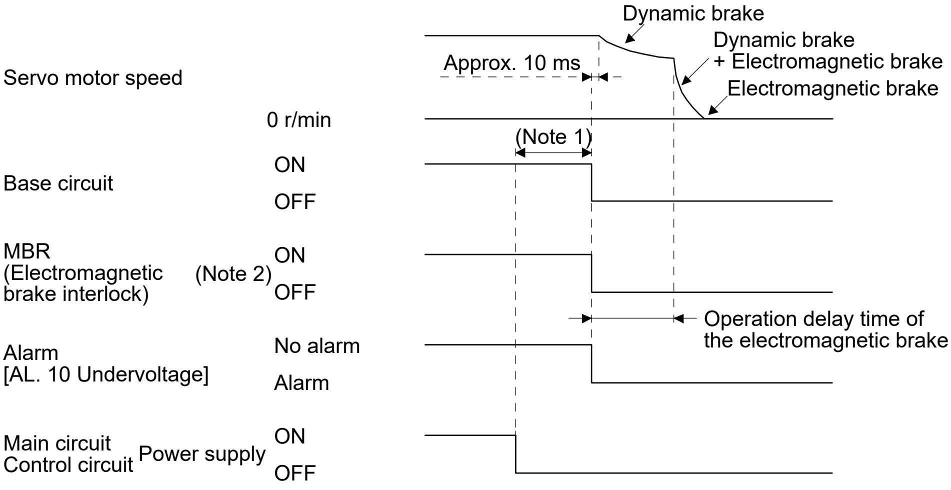
1) When the forced stop deceleration function is enabled



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 3.8.1 (2).

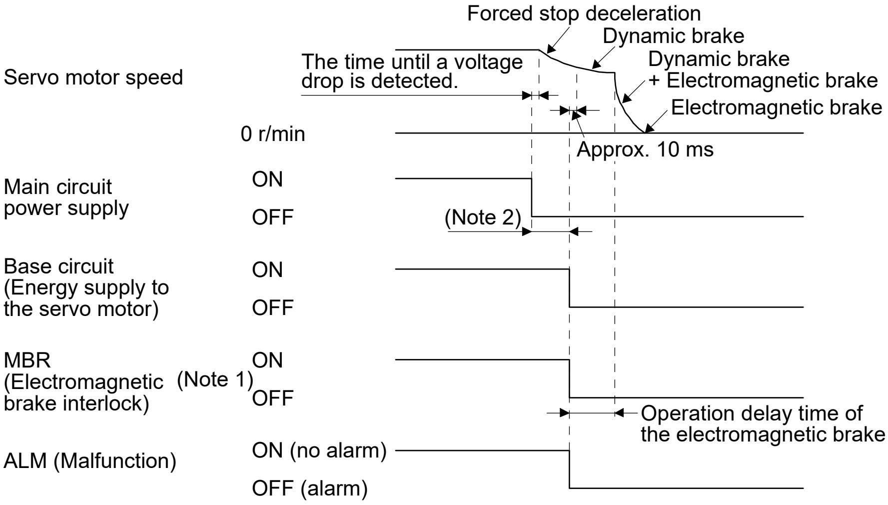
(d) Both main and control circuit power supplies off



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

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

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



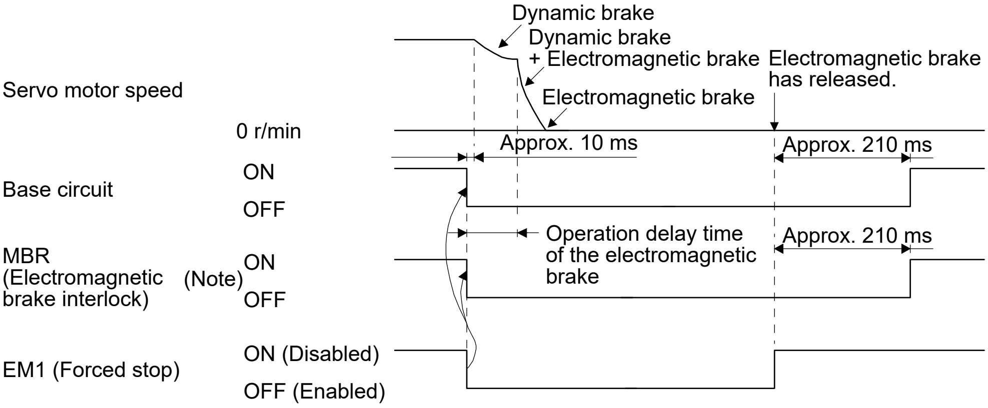
Note 1. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake has been activated.
2. Variable according to the operation status.

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

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

(a) SON (Servo-on) on/off
It is the same as (1) (a) in this section.

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

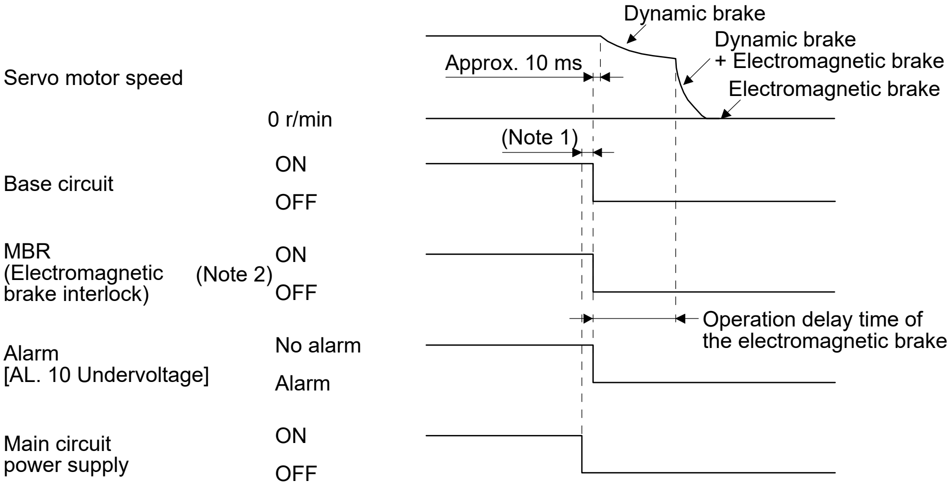


Note. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake has been activated.

(c) Alarm occurrence
The operation status during an alarm is the same as section 3.8.2.

(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

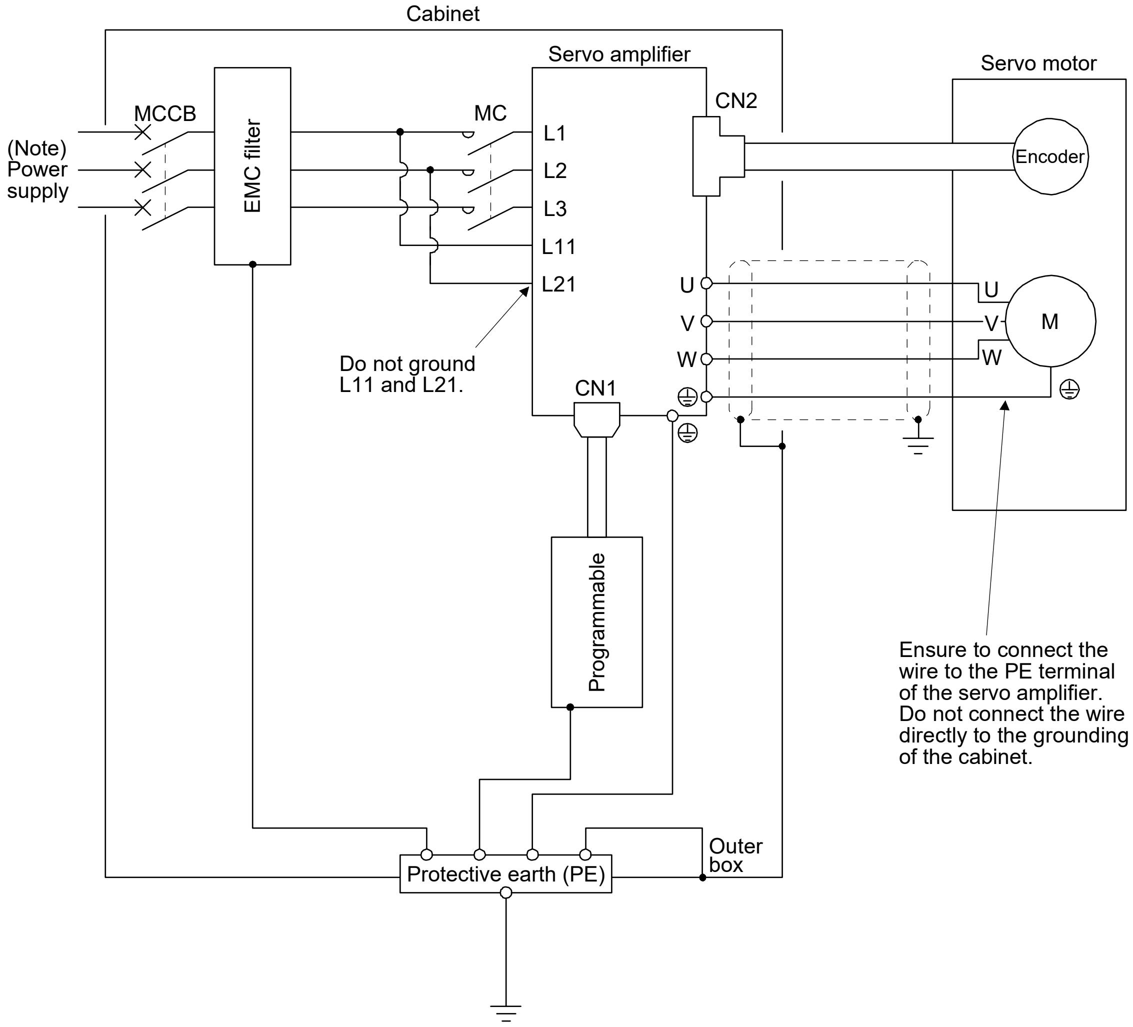


Note 1. Variable according to the operation status.
2. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake has been activated.

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.

MEMO

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

4.1.2 Wiring check

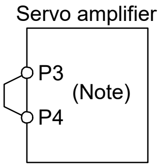
(1) Power supply system wiring

Before switching on the 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.)

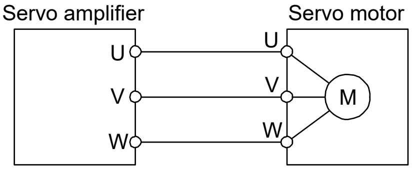
2) Between P3 and P4 should be connected.



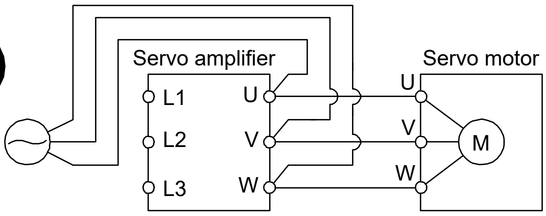
Note. The 100 V class servo amplifiers do not have P3 and P4.

(b) Connection of servo amplifier and servo motor

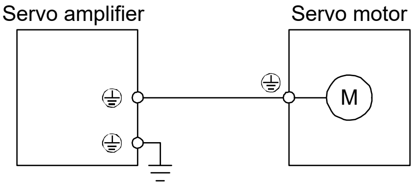
1) The servo amplifier power output (U/V/W) should match in phase with the servo motor power input terminals (U/V/W).



2) The power supplied to the servo amplifier should not be connected to the power outputs (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 option and auxiliary equipment are used

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 should be connected to P+ terminal and C terminal.
- Twisted wires 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 should be connected to P+ terminal and C terminal.
- Twisted wires should be used. (Refer to section 11.2.4.)

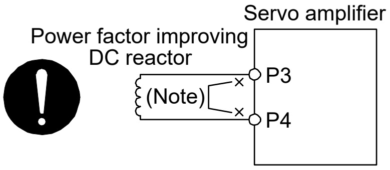
c) When you use a brake unit and power regeneration converter for 5 kW or more servo amplifiers

- 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 or power regeneration converter should be connected to P+ terminal and N- terminal. (Refer to section 11.3 and 11.4.)
- Twisted wires 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 wires of the 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.)

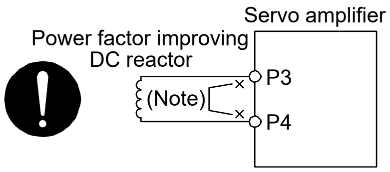
2) 400 V class
  a) When you use a regenerative option for 3.5 kW or less servo amplifiers
    - The lead wire between P+ terminal and D terminal should not be connected.
    - The regenerative option should be connected to P+ terminal and C terminal.
    - Twisted wires should be used. (Refer to section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

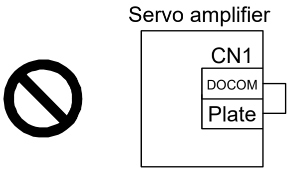
  f) When you use a multifunction regeneration converter
    - For 5 kW or 7 kW servo amplifiers, the lead wire of the built-in regenerative resistor connected to the P+ terminal and C terminal should be connected. (factory-wired)
    - The wire of the multifunction regeneration converter should be connected 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 should be used. (Refer to section 11.2.4.)

(2) I/O signal wiring
   (a) The I/O signals should be connected correctly.
   Use DO forced output to forcibly turn on/off the pins of the CN1 connector. 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 CN1 connector.

   (c) Plate and DOCOM of the CN1 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 in position control mode

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

4.2.1 Power on and off procedures

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

   1) Switch off SON (Servo-on).

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

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

   In the absolute position detection system, first power-on results in [AL. 25 Absolute position erased] and the servo system cannot be switched on. The alarm can be deactivated by then switching power off once and on again.
   Also, if power is switched on at the servo motor speed of 3000 r/min or higher, position mismatch may occur due to external force or the like. Power must therefore be switched on when the servo motor is at a stop.

(2) Power-off

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

2) Switch off SON (Servo-on).

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

4.2.2 Stop

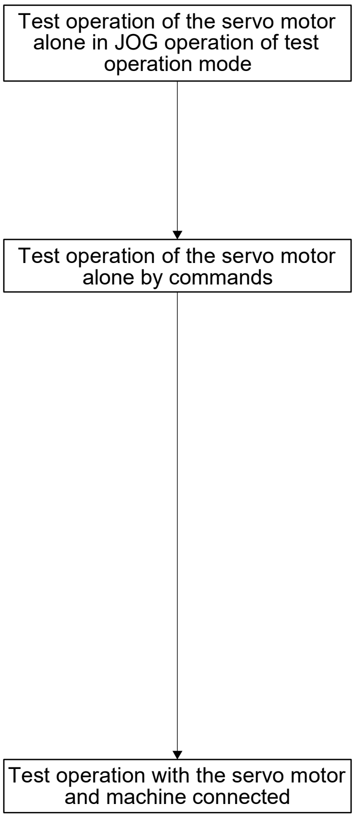
Turn off SON (Servo-on) after the servo motor has stopped, and then switch the power off.
If any of the following situations occurs, the servo amplifier suspends the running of the servo motor and brings it to a stop. Refer to section 3.10 for the servo motor with an electromagnetic brake.

Operation/command	Stopping condition
Switch of SON (Servo-on).	The base circuit is shut off and the servo motor coasts.
Alarm occurrence	The servo motor decelerates to a stop with the command. With some alarms, however, the dynamic brake operates to bring the servo motor to a stop. (Refer to chapter 8. (Note))
EM2 (Forced stop 2) off	The servo motor decelerates to a stop with the command. [AL. E6 Servo forced stop warning] occurs. EM2 has the same function as EM1 in the torque control mode. Refer to section 3.5 for EM1.
STO (STO1, STO2) off	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a stop.
LSP (Forward rotation stroke end) of LSN (Reverse rotation stroke end) off	It will bring the motor to a sudden stop and make it servo-locked. It can be run in the opposite direction.

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

4.2.3 Test operation

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



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

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

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

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

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

4.2.4 Parameter setting

POINT

- ●The following encoder cables are of four-wire type. When using any of these encoder cables, set [Pr. PC22] to "1 _ _ _" to select the four-wire type. Incorrect setting will result in [AL. 16 Encoder initial communication error 1].
  MR-EKCBL30M-L
  MR-EKCBL30M-H
  MR-EKCBL40M-H
  MR-EKCBL50M-H
- ●If using the MR-J4-_A-RJ servo amplifier with the DC power supply input, set [Pr. PC27] to "_ _ _1".

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

4.2.5 Actual operation

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

4.2.6 Trouble at start-up

⚠CAUTION ●Never adjust or change the parameter values extremely as it will make operation unstable.

POINT

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

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

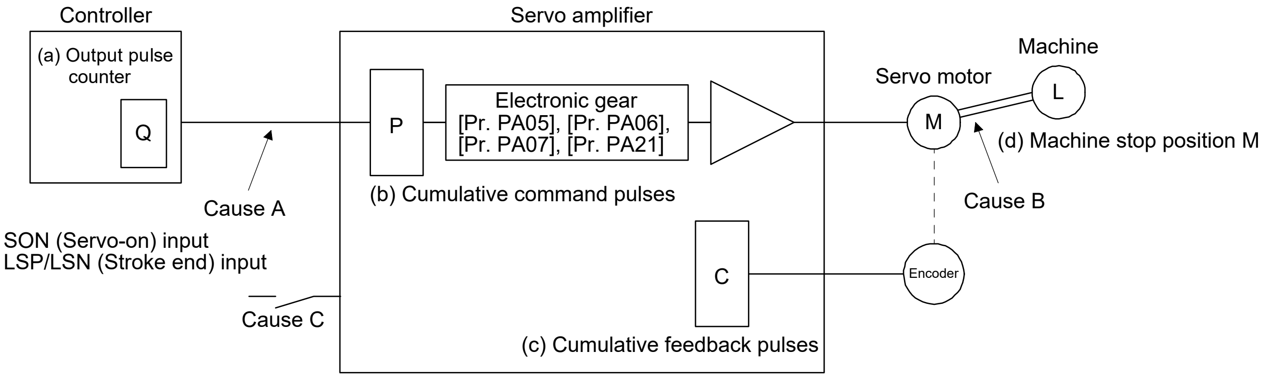
(1) Troubleshooting

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on	· The 5-digit, 7-segment LED is not lit. · The 5-digit, 7-segment LED blinks.	Not improved even if CN1, CN2 and CN3 connectors are disconnected.	1. Power supply voltage fault 2. The servo amplifier is malfunctioning.	
			Improved when CN1 connector is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when CN2 connector is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is malfunctioning.	
			Improved when CN3 connector is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8 (Note)

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

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

(2) How to find the cause of position shift



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

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

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

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

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

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

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

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

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

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

Check for a position mismatch in the following sequence.

1) When $Q \neq P$
   Noise entered the pulse train signal wiring between the controller and servo amplifier, causing command input pulses to be miscounted. (Cause A)
   Make the following check or take the following measures.
   - Check how the shielding is done.
   - Change the open collector type to the differential line driver type.
   - Run wiring away from the power circuit.
   - Install a data line filter. (Refer to section 11.14 (2) (a).)
   - Change the [Pr. PA13 Command pulse input form] setting.

2) When $P \cdot \frac{CMX}{CDV} \neq C$

   During operation, SON (Servo-on), LSP (Forward rotation stroke end), or LSN (Reverse rotation stroke end) was switched off; or CR (Clear) or RES (Reset) was switched on. (Cause C)

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

4.3 Startup in speed control mode

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

4.3.1 Power on and off procedures

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

1) Switch off SON (Servo-on).
2) Make sure that ST1 (Forward rotation start) and ST2 (Reverse rotation start) are off.
3) Switch on the main circuit power supply and control circuit power supply.
   When main circuit power/control circuit power is switched on, the display shows "r (Servo motor speed)", and in 2 s later, shows data.

(2) Power-off
1) Switch off ST1 (Forward rotation start) and ST2 (Reverse rotation start).
2) Switch off SON (Servo-on).
3) Switch off the main circuit power supply and control circuit power supply.

4.3.2 Stop

Turn off SON (Servo-on) 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
Switch of SON (Servo-on).	The base circuit is shut off and the servo motor coasts.
Alarm occurrence	The servo motor decelerates to a stop with the command. With some alarms, however, the dynamic brake operates to bring the servo motor to a stop. (Refer to chapter 8. (Note))
EM2 (Forced stop 2) off	The servo motor decelerates to a stop with the command. [AL. E6 Servo forced stop warning] occurs. EM2 has the same function as EM1 in the torque control mode. Refer to section 3.5 for EM1.
STO (STO1, STO2) off	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a stop.
LSP (Forward rotation stroke end) of LSN (Reverse rotation stroke end) off	It will bring the motor to a sudden stop and make it servo-locked. It can be run in the opposite direction.
Simultaneous on or off of ST1 (Forward rotation start) and ST2 (Reverse rotation start)	The servo motor is decelerated to a stop.

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

4.3.3 Test operation

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

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

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

Test operation of the servo motor alone by commands

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

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

Test operation with the servo motor and machine connected

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

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

4.3.4 Parameter setting

POINT

- ●The following encoder cables are of four-wire type. When using any of these encoder cables, set [Pr. PC22] to "1 _ _ _" to select the four-wire type. Incorrect setting will result in [AL. 16 Encoder initial communication error 1].
  MR-EKCBL30M-L
  MR-EKCBL30M-H
  MR-EKCBL40M-H
  MR-EKCBL50M-H
- ●If using the MR-J4-_A-RJ servo amplifier with the DC power supply input, set [Pr. PC27] to "_ _ _1".

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

4.3.5 Actual operation

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

4.3.6 Trouble at start-up

⚠CAUTION

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

POINT

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

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

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on	・The 5-digit, 7-segment LED is not lit. ・The 5-digit, 7-segment LED blinks.	Not improved even if CN1, CN2, and CN3 connectors are disconnected.	1. Power supply voltage fault 2. The servo amplifier is malfunctioning.	
			Improved when CN1 connector is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when CN2 connector is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is malfunctioning.	
			Improved when CN3 connector is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8 (Note)

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
2	Switch on SON (Servo-on).	Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8 (Note)
		Servo motor shaft is not servo-locked. (Servo motor shaft is free.)	1. Check the display to see if the servo amplifier is ready to operate. 2. Check the external I/O signal indication (section 4.5.7) to see if SON (Servo-on) is on.	1. SON (Servo-on) is not input. (wiring mistake) 2. 24 V DC power is not supplied to DICOM.	Section 4.5.7
3	Switch on ST1 (Forward rotation start) or ST2 (Reverse rotation start).	Servo motor does not rotate.	Call the status display (section 4.5.3) and check the input voltage of VC (Analog speed command).	Analog speed command is 0 V.	Section 4.5.3
			Call the external I/O signal display (section 4.5.7) and check the on/off status of the input signal.	LSP, LSN, ST1, and ST2 are off.	Section 4.5.7
			Check the internal speed commands 1 to 7 ([Pr. PC05] to [Pr. PC11]).	Set value is 0.	Section 5.2.3
			Check the forward rotation torque limit ([Pr. PA11]) and the reverse rotation torque limit ([Pr. PA12]).	Torque limit level is too low as compared to the load torque.	Section 5.2.1
			When TLA (Analog torque limit) is usable, check the input voltage on the status display.	Torque limit level is too low as compared to the load torque.	Section 4.5.3
4	Gain adjustment	Rotation ripples (speed fluctuations) are large at low speed.	Make gain adjustment in the following procedure. 1. Increase the auto tuning response level. 2. Repeat acceleration and deceleration three times or more to complete auto tuning.	Gain adjustment fault	Chapter 6
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	If the servo motor may be run with safety, repeat acceleration and deceleration three times or more to complete auto tuning.	Gain adjustment fault	Chapter 6

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

4.4 Startup in torque control mode

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

4.4.1 Power on and off procedures

(1) Power-on

Switch power on in the following procedure. Always follow this procedure at power-on.

1) Switch off SON (Servo-on).
2) Make sure that RS1 (Forward rotation selection) and RS2 (Reverse rotation selection) are off.
3) Switch on the main circuit power supply and control circuit power supply.
   Data is displayed in 2 s after "U" (Analog torque command) is displayed.

(2) Power-off

1) Switch off RS1 (Forward rotation selection) or RS2 (Reverse rotation selection).
2) Switch off SON (Servo-on).
3) Switch off the main circuit power supply and control circuit power supply.

4.4.2 Stop

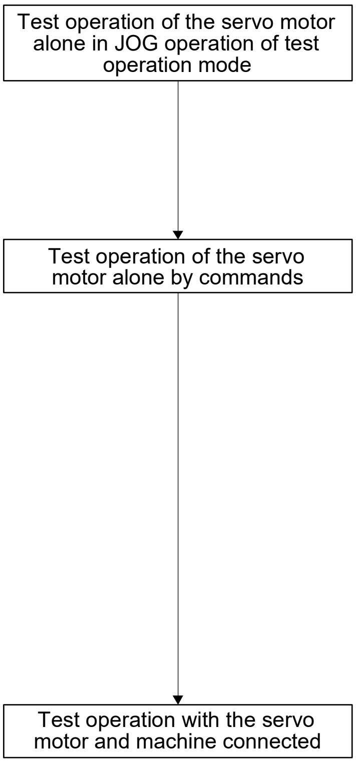
Turn off SON (Servo-on) after the servo motor has stopped, and then switch the power off.
If any of the following situations occurs, the servo amplifier suspends the running of the servo motor and brings it to a stop. Refer to section 3.10 for the servo motor with an electromagnetic brake.

Operation/command	Stopping condition
Switch off SON (Servo-on).	The base circuit is shut off and the servo motor coasts.
Alarm occurrence	The servo motor decelerates to a stop with the command. With some alarms, however, the dynamic brake operates to bring the servo motor to a stop. (Refer to chapter 8. (Note))
EM2 (Forced stop 2) off	This stops the servo motor with the dynamic brake. [AL. E6 Servo forced stop warning] occurs. EM2 has the same function as EM1 in the torque control mode. Refer to section 3.5 for EM1.
STO (STO1, STO2) off	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a stop.
Simultaneous on or off of RS1 (Forward rotation selection) and RS2 (Reverse rotation selection)	The servo motor coasts.

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

4.4.3 Test operation

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



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

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

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

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

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

4.4.4 Parameter setting

POINT

- ●The following encoder cables are of four-wire type. When using any of these encoder cables, set [Pr. PC22] to "1 _ _ _" to select the four-wire type. Incorrect setting will result in [AL. 16 Encoder initial communication error 1].
  MR-EKCBL30M-L
  MR-EKCBL30M-H
  MR-EKCBL40M-H
  MR-EKCBL50M-H
- ●If using the MR-J4-_A-RJ servo amplifier with the DC power supply input, set [Pr. PC27] to "_ _ _1".

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

4.4.5 Actual operation

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

4.4.6 Trouble at start-up

CAUTION

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

POINT

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

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

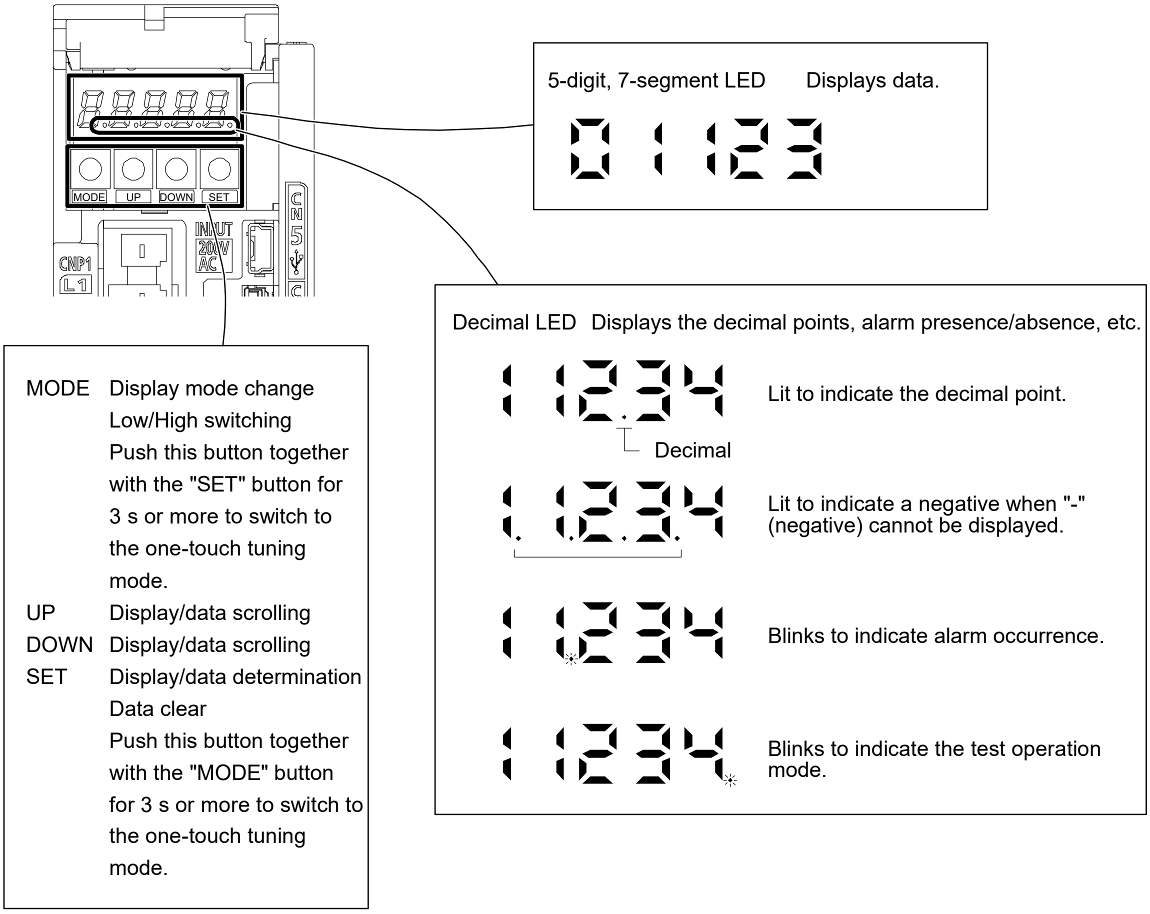
No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on	・The 5-digit, 7-segment LED is not lit. ・The 5-digit, 7-segment LED blinks.	Not improved even if CN1, CN2, and CN3 connectors are disconnected.	1. Power supply voltage fault 2. The servo amplifier is malfunctioning.	
			Improved when CN1 connector is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when CN2 connector is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is malfunctioning.	
			Improved when CN3 connector is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8 (Note)
2	Switch on SON (Servo-on).	Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8 (Note)
		(Servo motor shaft is free.)	Call the external I/O signal display (section 4.5.7) and check the on/off status of the input signal.	1. SON (Servo-on) is not input. (wiring mistake) 2. 24 V DC power is not supplied to DICOM.	Section 4.5.7
3	Switch on RS1 (Forward rotation start) or RS2 (Reverse rotation start).	Servo motor does not rotate.	Call the status display (section 4.5.3) and check the input voltage of TC (Analog torque command).	Analog torque command is 0 V.	Section 4.5.3
			Call the external I/O signal display (section 4.5.7) and check the on/off status of the input signal.	RS1 and RS2 are off.	Section 4.5.7
			Check the internal speed limit 1 to 7 ([Pr. PC05] to [Pr. PC11]).	Set value is 0.	Section 5.2.3
			Check the analog torque command maximum output ([Pr. PC13]) value.	Torque command level is too low as compared to the load torque.	Section 5.2.3
			Check the forward rotation torque limit ([Pr. PA11]) and the reverse rotation torque limit ([Pr. PA12]).	Set value is 0.	Section 5.2.1

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

4.5 Display and operation sections

4.5.1 Summary

The MR-J4-_A_(-RJ) servo amplifier has the display section (5-digit, 7-segment LED) and operation section (4 pushbuttons) for servo amplifier status display, alarm display, parameter setting, etc. Also, press the "MODE" and "SET" buttons at the same time for 3 s or more to switch to the one-touch tuning mode.
The operation section and display data are described below.



5-digit, 7-segment LED Displays data.

MODE	Display mode change Low/High switching Push this button together with the "SET" button for 3 s or more to switch to the one-touch tuning mode.
UP	Display/data scrolling
DOWN	Display/data scrolling
SET	Display/data determination Data clear Push this button together with the "MODE" button for 3 s or more to switch to the one-touch tuning mode.

Decimal LED Displays the decimal points, alarm presence/absence, etc.

Lit to indicate the decimal point.

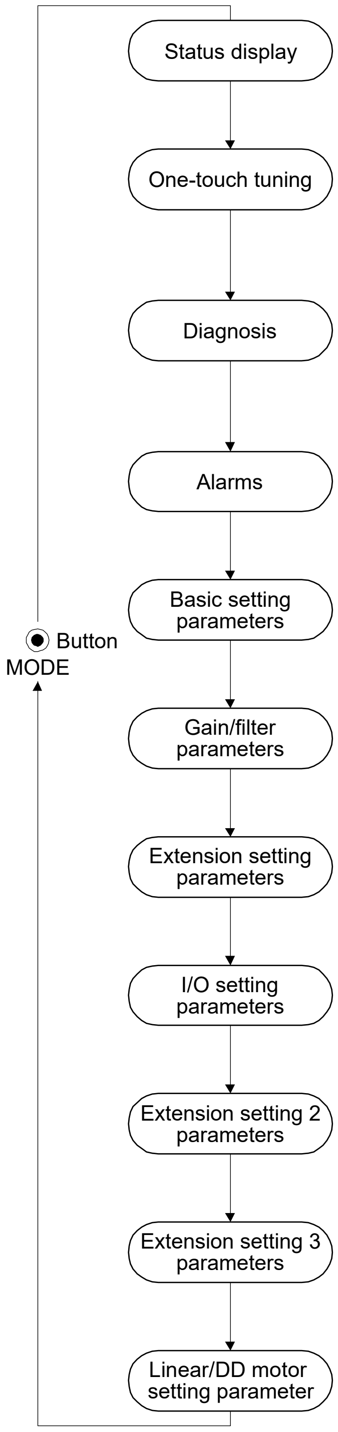
Lit to indicate a negative when "-" (negative) cannot be displayed.

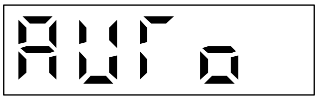
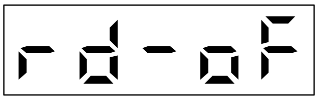
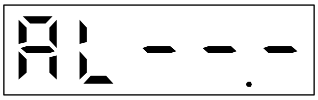
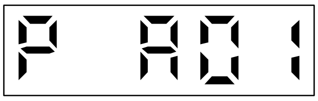
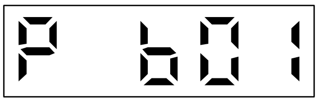
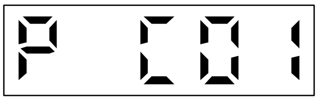
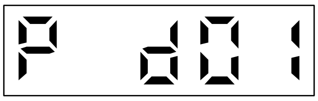
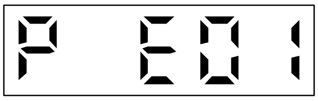
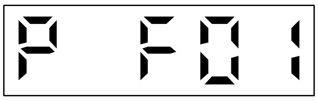
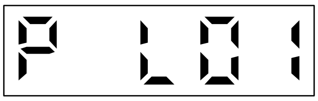
Blinks to indicate alarm occurrence.

Blinks to indicate the test operation mode.

4.5.2 Display flowchart

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



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

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

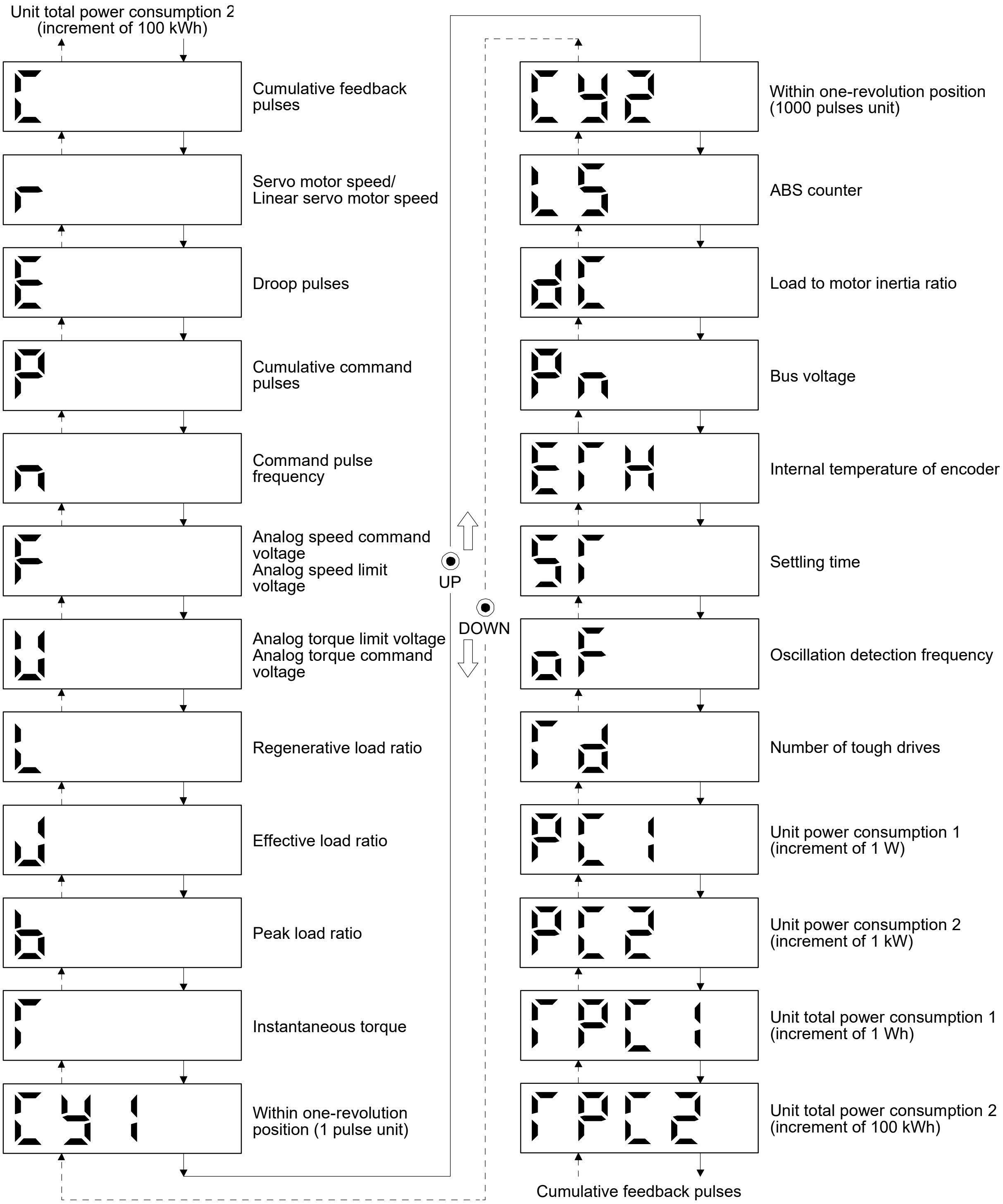
4.5.3 Status display mode

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

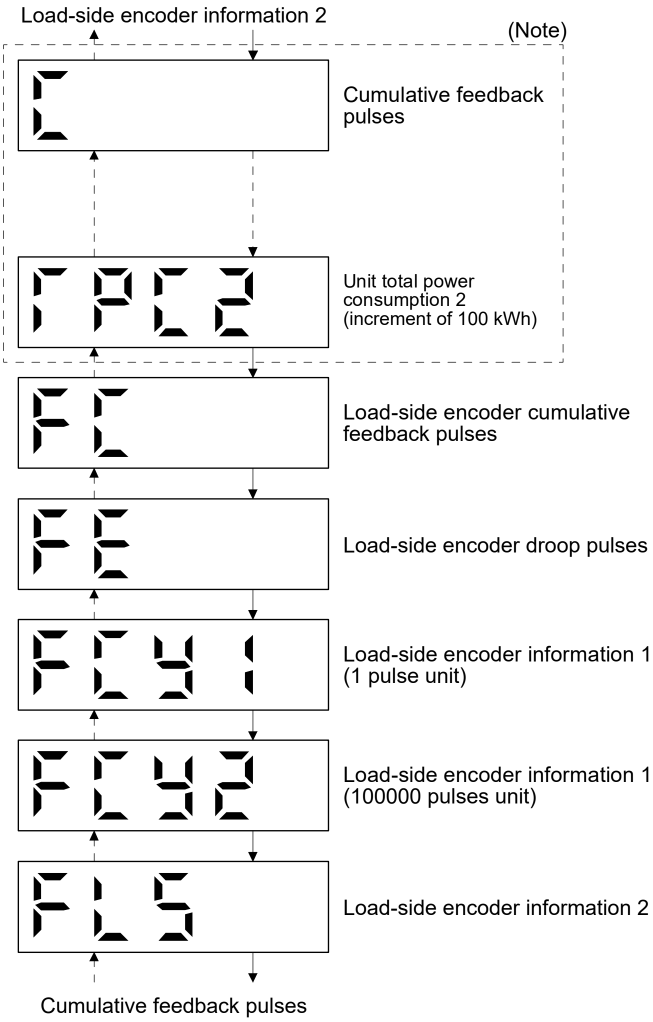
(1) Display transition

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

(a) Standard control mode/DD motor control mode

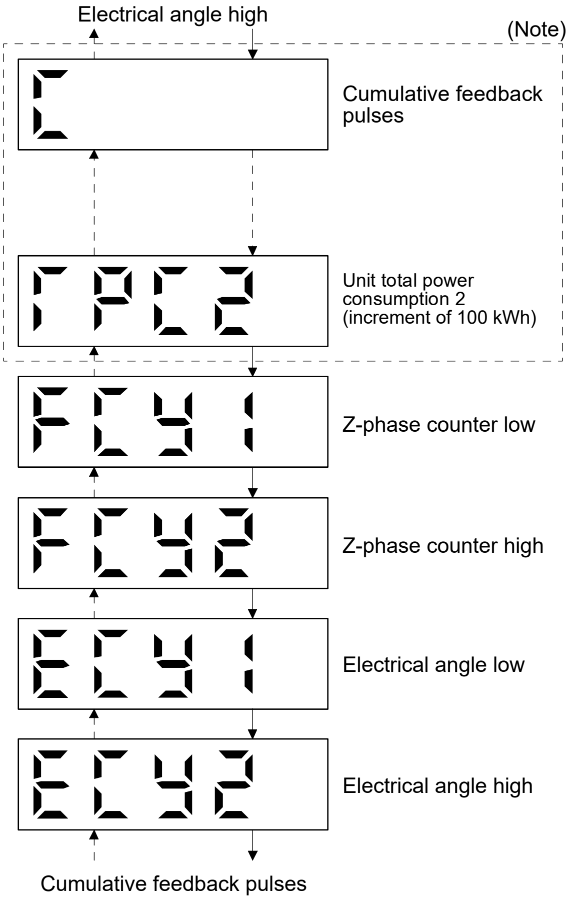


(b) Fully closed loop control mode



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

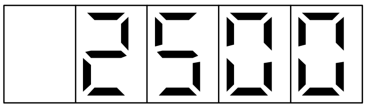
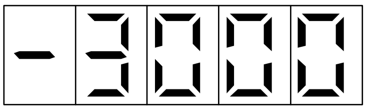
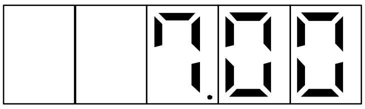
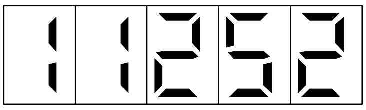
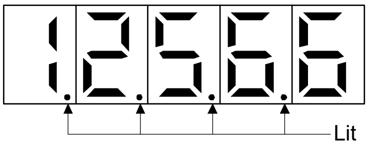
(c) Linear servo motor control mode



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

(2) Display examples

The following table shows the display examples.

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

(3) Status display list

The following table lists the servo statuses that may be shown. Refer to app. 7.3 for the measurement point.

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

Status display	Symbol	Unit	Description
Load to motor inertia ratio	dC	Multiplier	The estimated ratio of the load inertia moment to the servo motor shaft inertia moment is displayed.
Bus voltage	Pn	V	The voltage of main circuit converter (between P+ and N-) is displayed.
Internal temperature of encoder	ETh	°C	Inside temperature of encoder detected by the encoder is displayed.
Settling time	ST	ms	Settling time is displayed. When it exceeds 1000 ms, "1000" will be displayed.
Oscillation detection frequency	oF	Hz	Frequency at the time of oscillation detection is displayed.
Number of tough operations	Td	times	The number of tough drive functions activated is displayed.
Unit power consumption 1 (increment of 1 W)	PC1	W	Unit power consumption is displayed by increment of 1 W. Positive value indicate power running, and negative value indicate regeneration. The values in excess of ±99999 can be counted. However, the counter shows only the lower five digits of the actual value since the servo amplifier display is five digits.
Unit power consumption 2 (increment of 1 kW)	PC2	kW	Unit power consumption is displayed by increment of 1 kW. Positive value indicate power running, and negative value indicate regeneration.
Unit total power consumption 1 (increment of 1 Wh)	TPC1	Wh	Unit total power consumption is displayed by increment of 1 Wh. Positive value is cumulated during power running and negative value during regeneration. The values in excess of ±99999 can be counted. However, the counter shows only the lower five digits of the actual value since the servo amplifier display is five digits.
Unit total power consumption 2 (increment of 100 kWh)	TPC2	100 Wh	Unit total power consumption is displayed by increment of 100 kWh. Positive value is cumulated during power running and negative value during regeneration.
Load-side encoder Cumulative feedback pulses	FC	pulse	Feedback pulses from the load-side encoder are counted and displayed. The values in excess of ±99999 can be counted. However, the counter shows only the lower five digits of the actual value since the servo amplifier display is five digits. Press the "SET" button to reset the display value to zero. The value of minus is indicated by the lit decimal points in the upper four digits.
Load-side encoder Droop pulses	FE	pulse	Droop pulses of the deviation counter between a load-side encoder and a command are displayed. When the count exceeds ±99999, it starts from 0. Negative value is indicated by the lit decimal points in the upper four digits. The display shows the average droop pulses of 128 samplings at the rate of 444 [μs].
Load-side encoder information 1 (1 pulse unit)	FCY1	pulse	The Z-phase counter of a load-side encoder is displayed in the encoder pulse unit. For an incremental linear encoder, the Z-phase counter is displayed. The value is counted up from 0 based on the home position (reference mark). For an absolute position linear encoder, the encoder absolute position is displayed. When the count exceeds 99999, it starts from 0.
Load-side encoder information 1 (100000 pulses unit)	FCY2	100000 pulses	The Z-phase counter of a load-side encoder is displayed by increments of 100000 pulses. For an incremental linear encoder, the Z-phase counter is displayed. The value is counted up from 0 based on the home position (reference mark). For an absolute position linear encoder, the encoder absolute position is displayed. When the count exceeds 99999, it starts from 0.
Load-side encoder information 2	FL5	rev	When an incremental linear encoder is used as the load-side encoder, the display shows 0. When an absolute position linear encoder is used as the load-side encoder, the display shows 0. When a rotary encoder is used as the load-side encoder, the display shows the value of the multi-revolution counter.
Z-phase counter low	FCY1	pulse	The Z-phase counter is displayed in the encoder pulse unit. For an incremental linear encoder, the Z-phase counter is displayed. The value is counted up from 0 based on the home position (reference mark). For an absolute position linear encoder, the encoder absolute position is displayed. When the count exceeds 99999, it starts from 0.
Z-phase counter high	FCY2	100000 pulses	The Z-phase counter is displayed by increments of 100000 pulses. For an incremental linear encoder, the Z-phase counter is displayed. The value is counted up from 0 based on the home position (reference mark). For an absolute position linear encoder, the encoder absolute position is displayed. When the count exceeds 99999, it starts from 0.

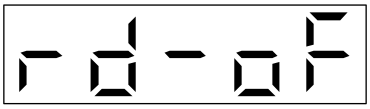
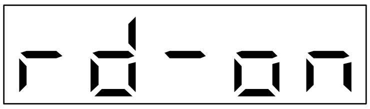
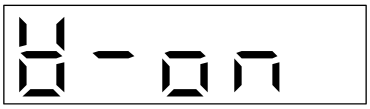
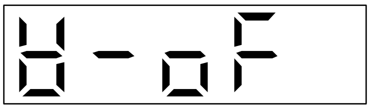
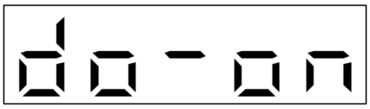
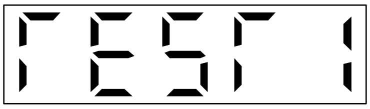
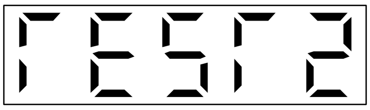
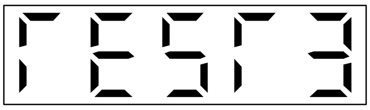
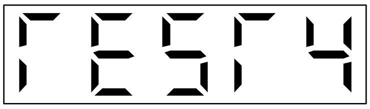
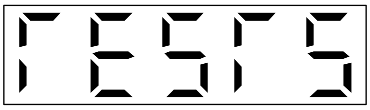
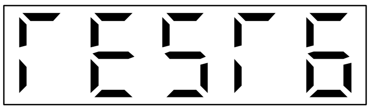
Status display	Symbol	Unit	Description
Electrical angle low	ECY1	pulse	The servo motor electrical angle is displayed.
Electrical angle high	ECY2	100000 pulses	The servo motor electrical angle is displayed by increments of 100000 pulses.

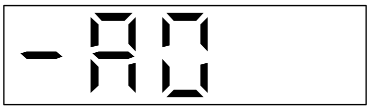
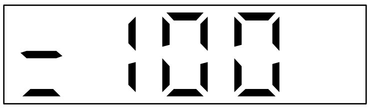
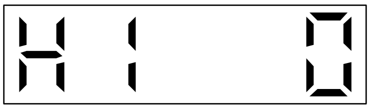
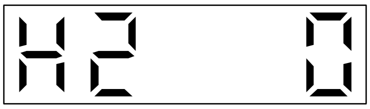
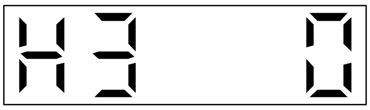
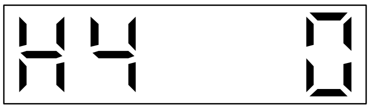
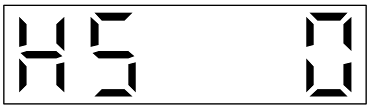
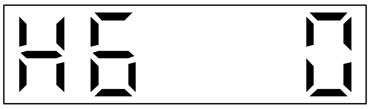
(4) Changing the status display screen

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

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

4.5.4 Diagnostic mode

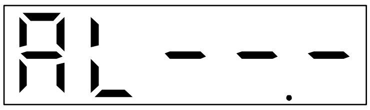
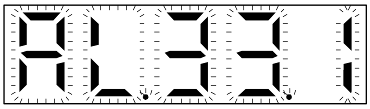
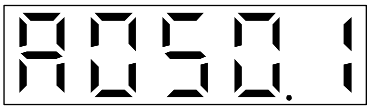
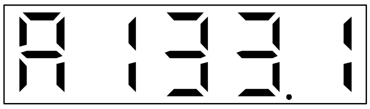
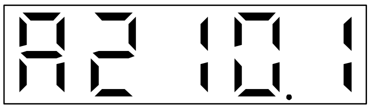
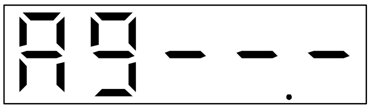
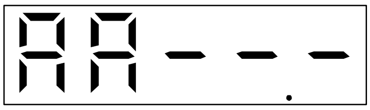
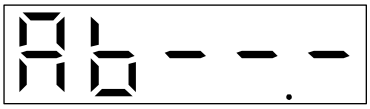
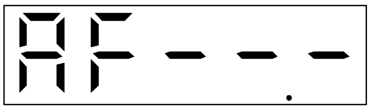
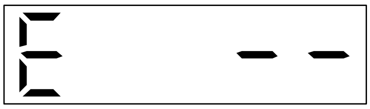
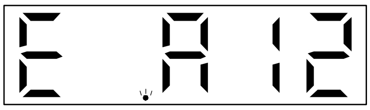
Name		Display	Description
Sequence			Not ready Indicates that the servo amplifier is being initialized or an alarm has occurred.
			Ready Indicates that the servo was switched on after completion of initialization and the servo amplifier is ready to operate.
Drive recorder enabled/disabled display			Drive recorder enabled When an alarm occurs in the status, the drive recorder will operate and write the status of occurrence.
			Drive recorder enabled The drive recorder will not operate on the following conditions. 1. You are using the graph function of MR Configurator2. 2. You are using the machine analyzer function. 3. [Pr. PF21] is set to "-1".
External I/O signal display		Refer to section 4.5.7.	This Indicates the on/off status of external I/O signal. The upper segments correspond to the input signals and the lower segments to the output signals.
Output signal (DO) forced output			This allows digital output signal to be switched on/off forcibly. For details, refer to section 4.5.8.
Test operation mode	JOG operation		JOG operation can be performed when there is no command from an external controller. For details, refer to section 4.5.9 (2).
	Positioning operation		Positioning operation can be performed when there is no command from an external controller. MR Configurator2 is required to perform positioning operation. For details, refer to section 4.5.9 (3).
	Motor-less operation		Without connecting the servo motor, output signals or status display monitoring can be provided in response to the input device as if the servo motor is actually running. For details, refer to section 4.5.9 (4).
	Machine analyzer operation		Merely connecting the servo amplifier allows the resonance point of the mechanical system to be measured. MR Configurator2 is required to perform machine analyzer operation. Refer to section 11.7 for details.
	For manufacturer		This is for manufacturer.
	For manufacturer		This is for manufacturer.

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

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

4.5.5 Alarm mode

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

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

Functions at occurrence of an alarm

(1) Any mode screen displays the current alarm.

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

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

(a) Switch power off, then on.

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

(c) Turn on RES (Reset).

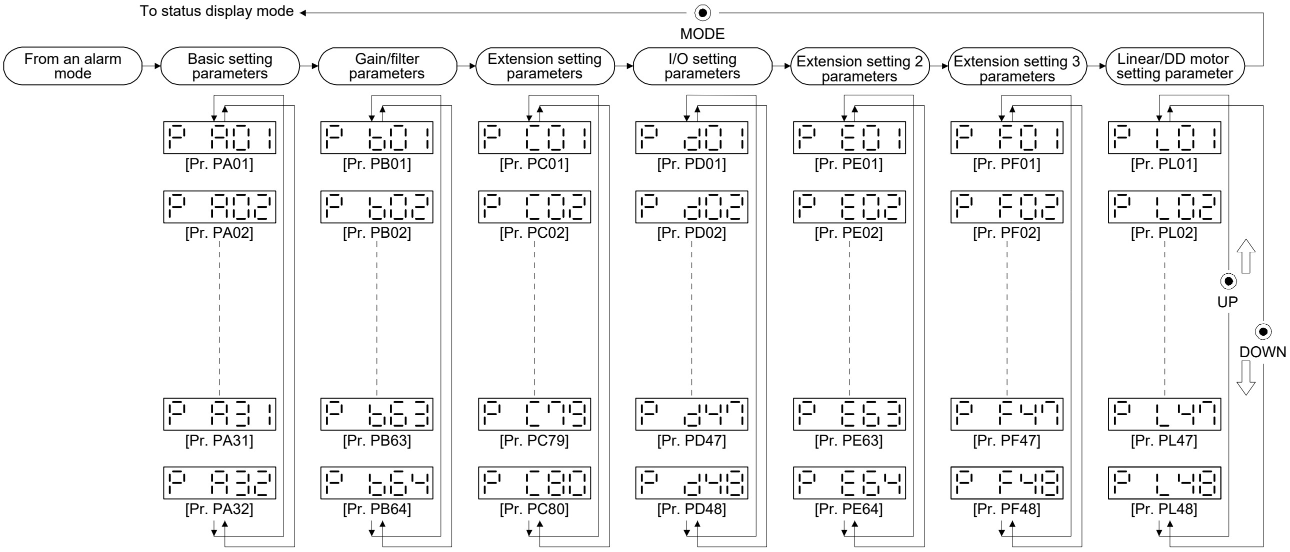
(4) Use [Pr. PC18] to clear the alarm history.

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

4.5.6 Parameter mode

(1) Parameter mode transition

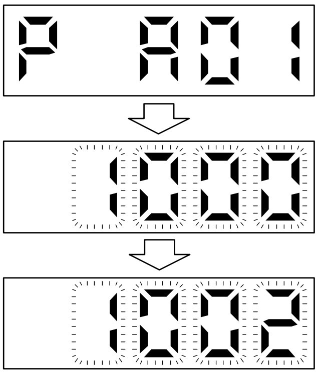
After selecting the corresponding parameter mode with the "MODE" button, pushing the "UP" or "DOWN" button changes the display as shown below.



(2) Operation example

(a) Parameters of 5 or less digits

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



...... The parameter number is displayed.
Press "UP" or "DOWN" to change the number.

Press "SET" twice.

...... The set value of the specified parameter number blinks.

Press "UP" twice.

...... During blinking, the set value can be changed.
Use "UP" or "DOWN".
(_ _ _ 2: Speed control mode)

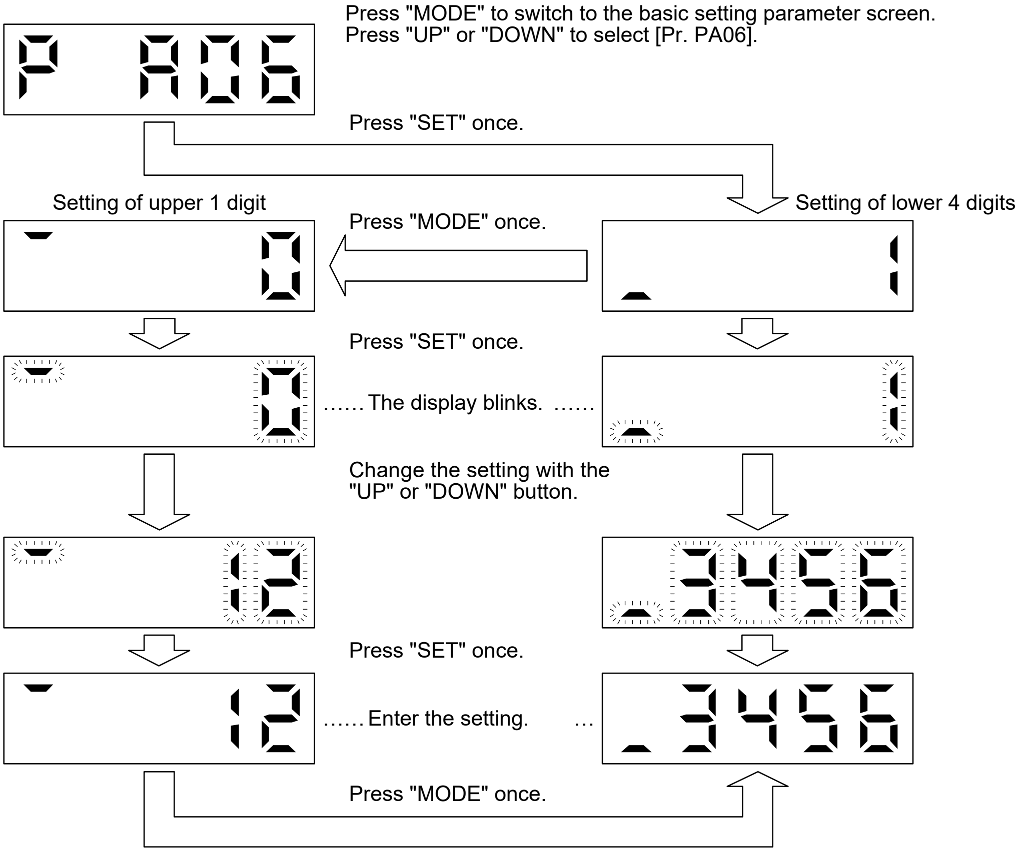
Press "SET" to enter.

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

When changing the [Pr. PA01] setting, change its set value, then switch power off once and switch it on again to enable the new value.

(b) Parameters of 6 or more digits

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



Press "MODE" to switch to the basic setting parameter screen.
Press "UP" or "DOWN" to select [Pr. PA06].

Press "SET" once.

Setting of upper 1 digit

Setting of lower 4 digits

Press "MODE" once.

Press "SET" once.

...... The display blinks. ......

Change the setting with the
"UP" or "DOWN" button.

Press "SET" once.

...... Enter the setting. ...

Press "MODE" once.

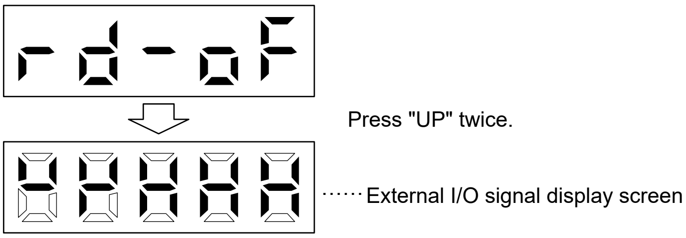
4.5.7 External I/O signal display

POINT
●The I/O signal settings can be changed using the I/O setting parameters [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47].

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

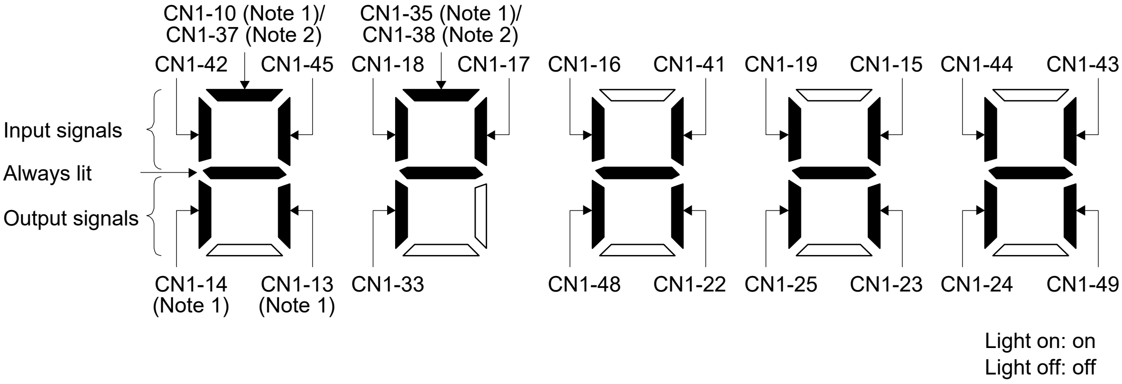
(1) Operation

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



(2) Display definition

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



Note 1. This is used with MR-J4-_A_-RJ servo amplifiers with software version B3 or later.
2. This is available for MR-J4-_A_(-RJ) servo amplifiers manufactured in January 2015 or later with software version B7 or later.

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

(a) Control modes and I/O signals

Connector	Pin No.	Signal input/output (Note 1) I/O	(Note 2) Symbols of I/O signals in control modes						Related parameter
			P	P/S	S	S/T	T	T/P	
CN1	10	I	PP	PP/-	(Note 5)	(Note 5)	(Note 5)	-/PP	PD43/PD44 (Note 4)
	13	O	(Note 3)	(Note 3)	(Note 3)	(Note 3)	(Note 3)	(Note 3)	PD47 (Note 4)
	14	O	(Note 3)	(Note 3)	(Note 3)	(Note 3)	(Note 3)	(Note 3)	PD47 (Note 4)
	15	I	SON	SON	SON	SON	SON	SON	PD03/PD04
	16	I		-/SP2	SP2	SP2/SP2	SP2	SP2/-	PD05/PD06
	17	I	PC	PC/ST1	ST1	ST1/RS2	RS2	RS2/PC	PD07/PD08
	18	I	TL	TL/ST2	ST2	ST2/RS1	RS1	RS1/TL	PD09/PD10
	19	I	RES	RES	RES	RES	RES	RES	PD11/PD12
	22	O	INP	INP/SA	SA	SA/-		-/INP	PD23
	23	O	ZSP	ZSP	ZSP	ZSP	ZSP	ZSP	PD24
	24	O	INP	INP/SA	SA	SA/-		-/INP	PD25
	25	O	TLC	TLC	TLC	TLC/VLC	VLC	VLC/TLC	PD26
	33	O	OP	OP	OP	OP	OP	OP	
	35	I	NP	NP/-	(Note 5)	(Note 5)	(Note 5)	-/NP	PD45/PD46 (Note 4)
	37 (Note 7)	I	PP2	PP2/-	(Note 6)	(Note 6)	(Note 6)	-/PP2	PD43/PD44 (Note 4)
	38 (Note 7)	I	NP2	NP2/-	(Note 6)	(Note 6)	(Note 6)	-/NP2	PD45/PD46 (Note 4)
	41	I	CR	CR/SP1	SP1	SP1/SP1	SP1	SP1/CR	PD13/PD14
	42	I	EM2	EM2	EM2	EM2	EM2	EM2	
	43	I	LSP	LSP	LSP	LSP/-		-/LSP	PD17/PD18
	44	I	LSN	LSN	LSN	LSN/-		-/LSN	PD19/PD20
	45	I	LOP	LOP	LOP	LOP	LOP	LOP	PD21/PD22
	48	O	ALM	ALM	ALM	ALM	ALM	ALM	
	49	O	RD	RD	RD	RD	RD	RD	PD28

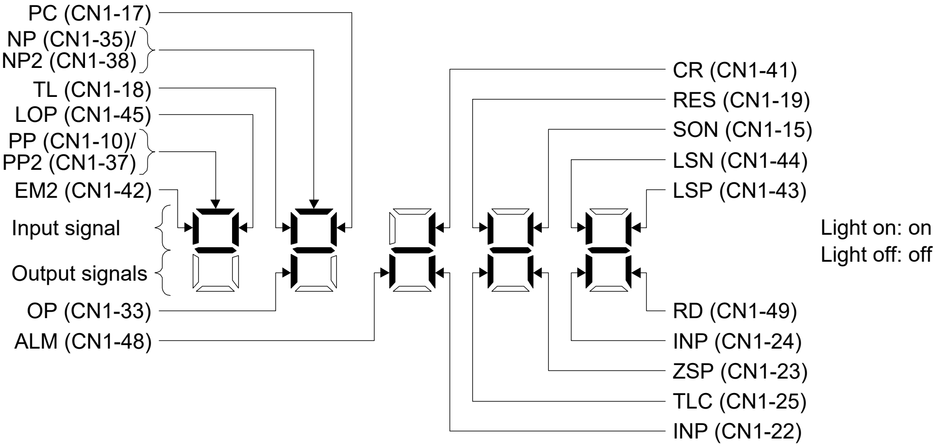
Note
1. I: input signal, O: output signal
2. P: position control mode, S: speed control mode, T: torque control mode
   P/S: position/speed control switching mode, S/T: speed/torque control switching mode, T/P: torque/position switching mode
3. Output devices are not assigned by default. Assign the output devices with [Pr. PD47] as necessary.
4. This is used with MR-J4-_A_-RJ servo amplifiers with software version B3 or later.
5. This is available as an input device of sink interface. Input devices are not assigned by default. Assign the input devices with [Pr. PD43] to [Pr. PD46] as necessary. Supply + of 24 V DC to CN1-12 pin. Also, this is available with servo amplifiers with software version B3 or later.
6. This is available as an input device of source interface. Input devices are not assigned by default. Assign the input devices with [Pr. PD43] to [Pr. PD46] as necessary.
7. These pins are available for MR-J4-_A_(-RJ) servo amplifiers manufactured in January 2015 or later with software version B7 or later.

(b) Symbol and signal names

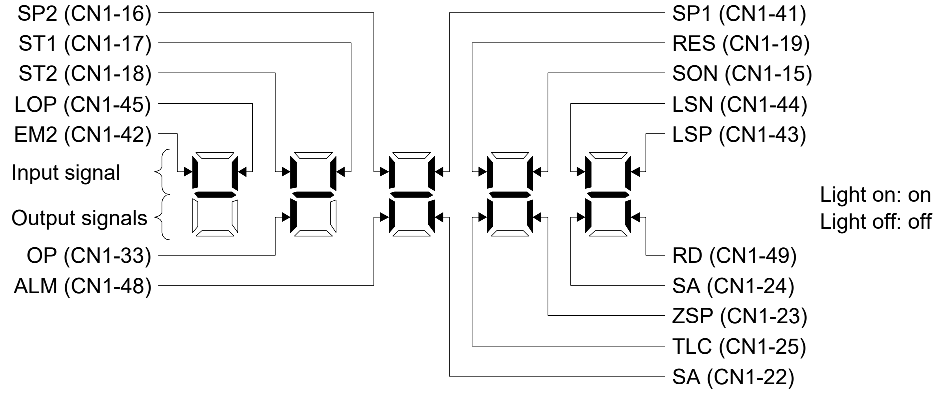
Symbol	Application	Symbol	Application
SON	Servo-on	RES	Reset
LSP	Forward rotation stroke end	EM2	Forced stop 2
LSN	Reverse rotation stroke end	LOP	Control switching
CR	Clear	TLC	Limiting torque
SP1	Speed selection 1	VLC	Limiting speed
SP2	Speed selection 2	RD	Ready
PC	Proportion control	ZSP	Zero speed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

(3) Display data at initial values

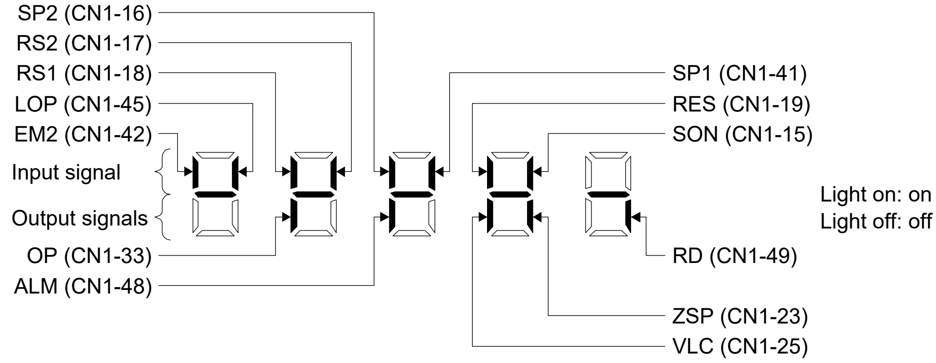
(a) Position control mode



(b) Speed control mode



(c) Torque control mode



4.5.8 Output signal (DO) forced output

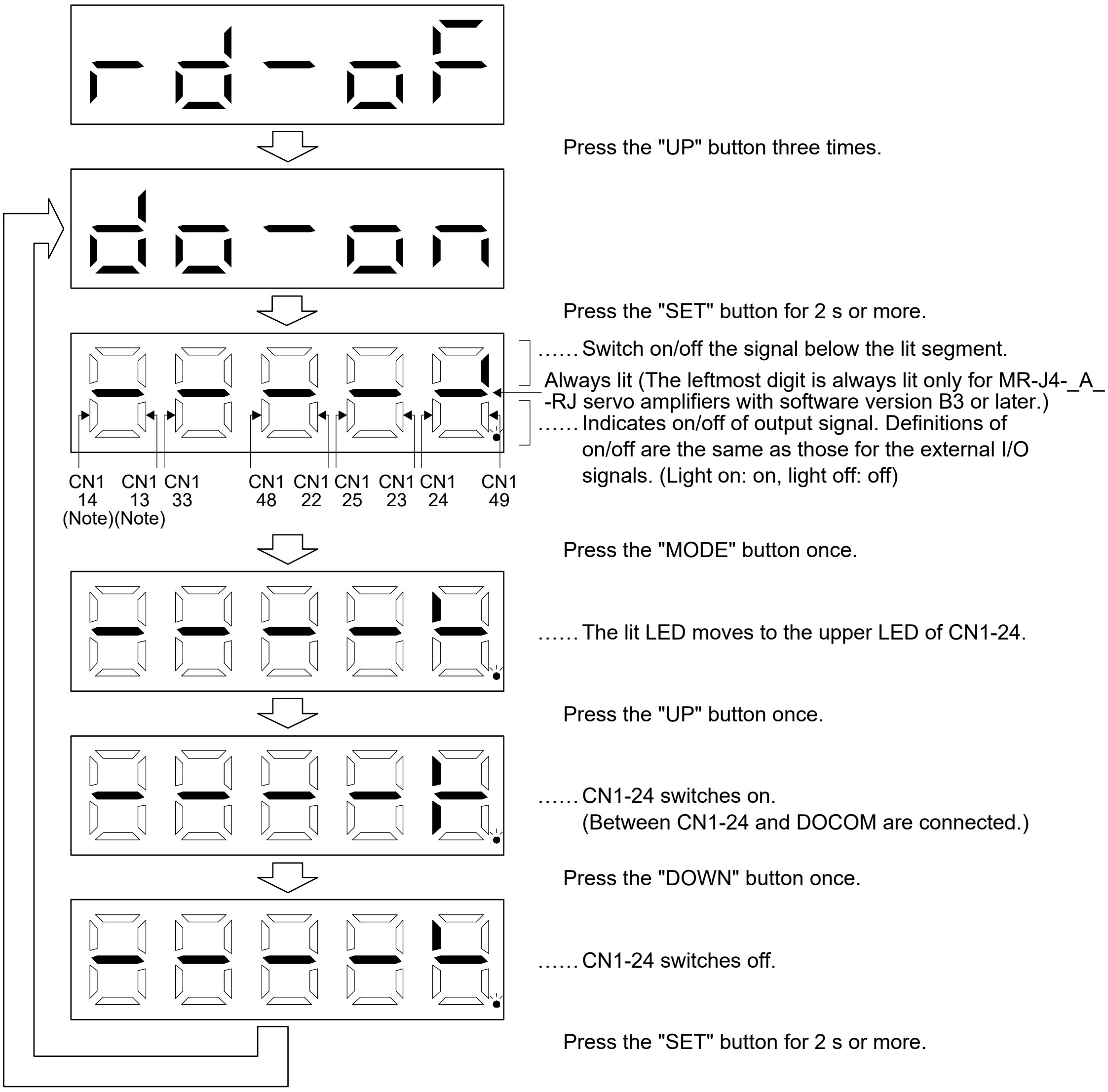
POINT

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

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

Operation

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



Press the "UP" button three times.

Press the "SET" button for 2 s or more.

...... Switch on/off the signal below the lit segment.

Always lit (The leftmost digit is always lit only for MR-J4-_A_-RJ servo amplifiers with software version B3 or later.)

...... Indicates on/off of output signal. Definitions of on/off are the same as those for the external I/O signals. (Light on: on, light off: off)

Press the "MODE" button once.

...... The lit LED moves to the upper LED of CN1-24.

Press the "UP" button once.

...... CN1-24 switches on. (Between CN1-24 and DOCOM are connected.)

Press the "DOWN" button once.

...... CN1-24 switches off.

Press the "SET" button for 2 s or more.

Note. This is used with MR-J4-_A_-RJ servo amplifiers with software version B3 or later.

4.5.9 Test operation mode

⚠CAUTION

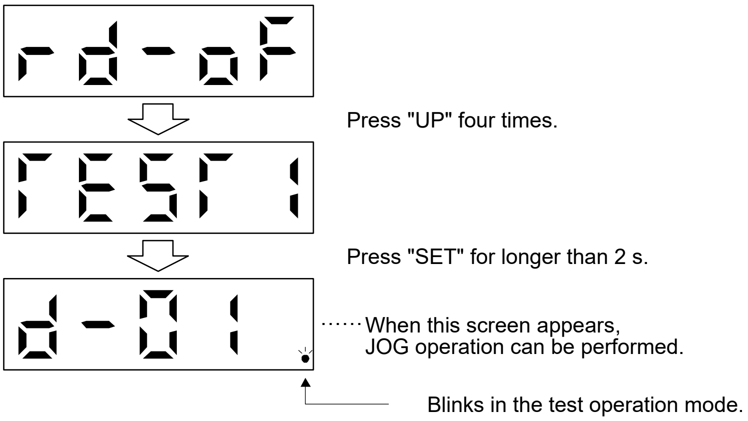
- ●The test operation mode is designed for checking servo operation. Do not use it for actual operation.
- ●If the servo motor operates unexpectedly, use EM2 (Forced stop 2) to stop it.

POINT

- ●Test operation cannot be performed in the absolute position detection system. To perform the test operation, select the incremental system in [Pr. PA03].
- ●MR Configurator2 is required to perform positioning operation.
- ●Test operation cannot be performed if SON (Servo-on) is not turned off.

(1) Mode switching

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



Press "UP" four times.

Press "SET" for longer than 2 s.

When this screen appears, JOG operation can be performed.

Blinks in the test operation mode.

(2) JOG operation

POINT

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

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

(a) Operation

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

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

The following table shows how to use the buttons.

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

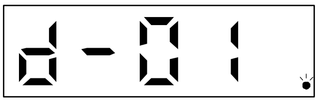
If the USB cable is disconnected during JOG operation using the MR Configurator2, the servo motor decelerates to a stop.

(b) Status display

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

(c) Termination of JOG operation

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

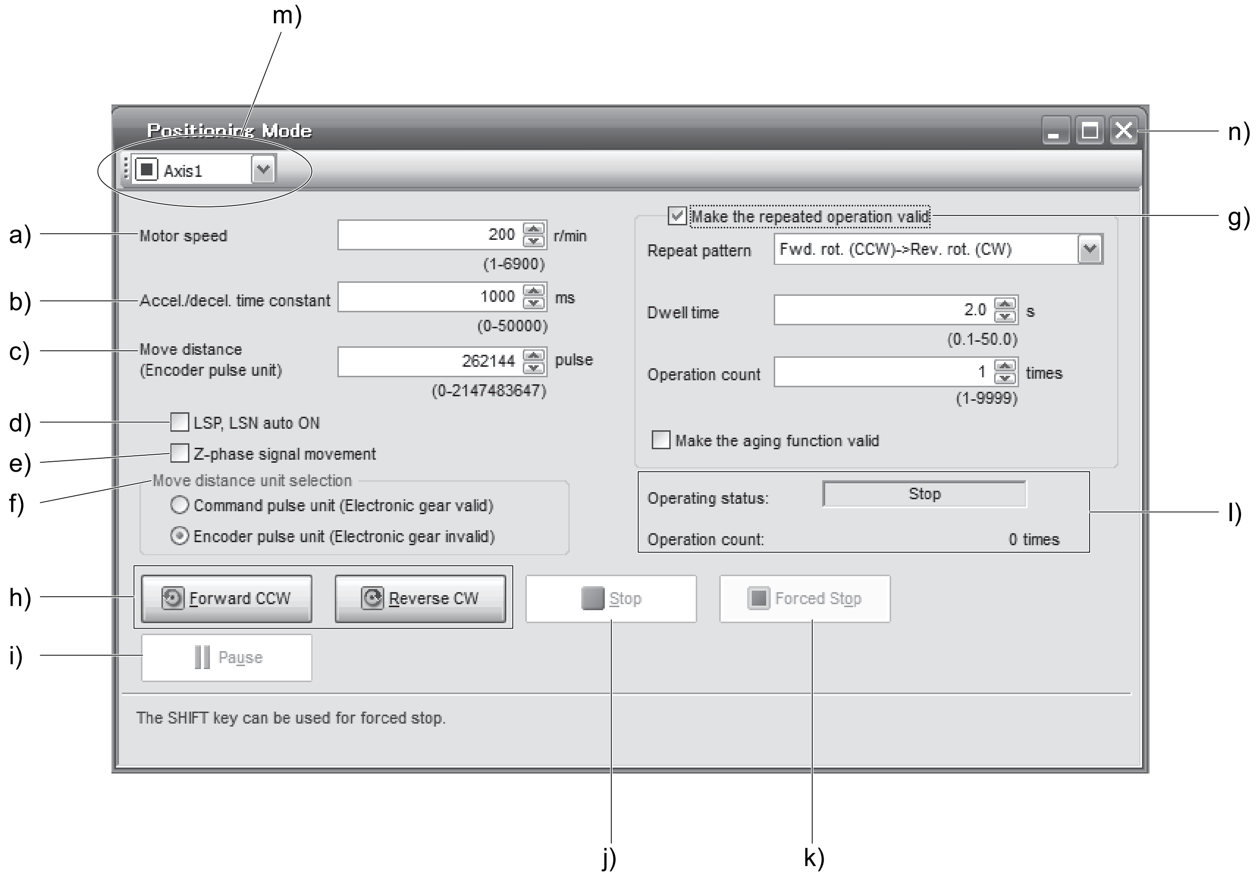


(3) Positioning operation

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

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

(a) Operation



Axis1

Motor speed 200 r/min (1-6900)

Accel./decel. time constant 1000 ms (0-50000)

Move distance (Encoder pulse unit) 262144 pulse (0-2147483647)

☐ LSP, LSN auto ON

☐ Z-phase signal movement

Move distance unit selection
○ Command pulse unit (Electronic gear valid)
● Encoder pulse unit (Electronic gear invalid)

☑ Make the repeated operation valid

Repeat pattern Fwd. rot. (CCW)->Rev. rot. (CW)

Dwell time 2.0 s (0.1-50.0)

Operation count 1 times (1-9999)

☐ Make the aging function valid

Operating status: Stop

Operation count: 0 times

The SHIFT key can be used for forced stop.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(4) Motor-less operation

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

(a) Start of motor-less operation

After setting "_ _ _ 1" in [Pr. PC60], cycle the power. After that, perform external operation as in ordinary operation.

(b) Termination of motor-less operation

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

(5) Program operation

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

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

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

(6) Output signal (DO) forced output

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

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

POINT

- The following parameters are not available with MR-J4-03A6(-RJ) servo amplifiers.
  - [Pr. PA02 Regenerative option]
  - [Pr. PA17 Servo motor series setting]
  - [Pr. PA18 Servo motor type setting]
  - [Pr. PA26 Function selection A-5]
  - [Pr. PC44 Function selection C-9]
  - [Pr. PC45 Function selection C-A]
  - [Pr. PD47 Output device selection 7]
  - [Pr. PE03 Fully closed loop function selection 2]
  - [Pr. PE04 Fully closed loop control - Feedback pulse electronic gear 1 - Numerator]
  - [Pr. PE05 Fully closed loop control - Feedback pulse electronic gear 1 - Denominator]
  - [Pr. PE06 Fully closed loop control - Speed deviation error detection level]
  - [Pr. PE07 Fully closed loop control - Position deviation error detection level]
  - [Pr. PE08 Fully closed loop dual feedback filter]
  - [Pr. PE10 Fully closed loop function selection 3]
  - [Pr. PE34 Fully closed loop control - Feedback pulse electronic gear 2 - Numerator]
  - [Pr. PE35 Fully closed loop control - Feedback pulse electronic gear 2 - Denominator]
  - [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time]
  - [Pr. PF34 RS-422 communication function selection 3]
- Linear servo motor/DD motor setting parameters ([Pr. PL_ _]) cannot be used with MR-J4-03A6(-RJ) servo amplifiers.
- If using the MR-J4-_A-RJ servo amplifier with the DC power supply input, set [Pr. PC27] to "_ _ _1".

5.1 Parameter list

POINT

- ●To enable a parameter whose symbol is preceded by *, cycle the power after setting it.
- ●Abbreviations of operation modes indicate the followings.
  Standard: 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 motor use
  For MR-J4-03A6(-RJ) servo amplifiers, the operation mode is available only in standard (semi closed loop system).
- ●The symbols in the control mode column mean as follows.
  P: Position control mode
  S: Speed control mode
  T: Torque control mode
- ●For servo amplifier with software version B3 or later, the parameter initial values for the manufacturer setting are partially changed.
- ●Setting an out of range value to each parameter will trigger [AL. 37 Parameter error].

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

No.	Symbol	Name	Initial value	Unit	Operation mode				Control mode		
					Standard	Full.	Lin.	D.D.	P	S	T
PA01	*STY	Operation mode	1000h		○	○	○	○	○	○	○
PA02	*REG	Regenerative option	0000h		○	○	○	○	○	○	○
PA03	*ABS	Absolute position detection system	0000h		○	○	○	○	○		
PA04	*AOP1	Function selection A-1	2000h		○	○	○	○	○	○	
PA05	*FBP	Number of command input pulses per revolution	10000		○	○	○	○	○		
PA06	CMX	Electronic gear numerator (command pulse multiplication numerator)	1		○	○	○	○	○		
PA07	CDV	Electronic gear denominator (command pulse multiplication denominator)	1		○	○	○	○	○		
PA08	ATU	Auto tuning mode	0001h		○	○	○	○	○	○	
PA09	RSP	Auto tuning response	16		○	○	○	○	○	○	
PA10	INP	In-position range	100	[pulse]	○	○	○	○	○		
PA11	TLP	Forward rotation torque limit/positive direction thrust limit	100.0	[%]	○	○	○	○	○	○	○
PA12	TLN	Reverse rotation torque limit/negative direction thrust limit	100.0	[%]	○	○	○	○	○	○	○
PA13	*PLSS	Command pulse input form	0100h		○	○	○	○	○		
PA14	*POL	Rotation direction selection/travel direction selection	0		○	○	○	○	○		
PA15	*ENR	Encoder output pulses	4000	[pulse/rev]	○	○	○	○	○	○	○
PA16	*ENR2	Encoder output pulses 2	1		○	○	○	○	○	○	○
PA17	*MSR	Servo motor series setting	0000h				○		○	○	○
PA18	*MTY	Servo motor type setting	0000h				○		○	○	○
PA19	*BLK	Parameter writing inhibit	00AAh		○	○	○	○	○	○	○
PA20	*TDS	Tough drive setting	0000h		○	○	○	○	○	○	○
PA21	*AOP3	Function selection A-3	0001h		○	○	○	○	○	○	
PA22	*PCS	Position control composition selection	0000h		○	○	○	○	○		
PA23	DRAT	Drive recorder arbitrary alarm trigger setting	0000h		○	○	○	○	○	○	○

No.	Symbol	Name	Initial value	Unit	Operation mode				Control mode		
					Standard	Full.	Lin.	D.D.	P	S	T
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				Control mode		
					Standard	Full.	Lin.	D.D.	P	S	T
PB01	FILT	Adaptive tuning mode (adaptive filter II)	0000h		○	○	○	○	○	○	○
PB02	VRFT	Vibration suppression control tuning mode (advanced vibration suppression control II)	0000h		○	○	○	○	○		
PB03	PST	Position command acceleration/deceleration time constant (position smoothing)	0	[ms]	○	○	○	○	○		
PB04	FFC	Feed forward gain	0	[%]	○	○	○	○	○		
PB05		For manufacturer setting	500								
PB06	GD2	Load to motor inertia ratio/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]	○	○	○	○	○	○	

No.	Symbol	Name	Initial value	Unit	Operation mode				Control mode		
					Standard	Full.	Lin.	D.D.	P	S	T
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	VRF1B	Vibration suppression control 1 - Vibration frequency after gain switching	0.0	[Hz]	○	○	○	○	○		
PB34	VRF2B	Vibration suppression control 1 - Resonance frequency after gain switching	0.0	[Hz]	○	○	○	○	○		
PB35	VRF3B	Vibration suppression control 1 - Vibration frequency damping after gain switching	0.00		○	○	○	○	○		
PB36	VRF4B	Vibration suppression control 1 - Resonance frequency damping after gain switching	0.00		○	○	○	○	○		
PB37		For manufacturer setting	1600								
PB38			0.00								
PB39			0.00								
PB40			0.00								
PB41			0000h								
PB42			0000h								
PB43			0000h								
PB44			0.00								
PB45	CNHF	Command notch filter	0000h		○	○	○	○	○		
PB46	NH3	Machine resonance suppression filter 3	4500	[Hz]	○	○	○	○	○	○	○
PB47	NHQ3	Notch shape selection 3	0000h		○	○	○	○	○	○	○
PB48	NH4	Machine resonance suppression filter 4	4500	[Hz]	○	○	○	○	○	○	○
PB49	NHQ4	Notch shape selection 4	0000h		○	○	○	○	○	○	○
PB50	NH5	Machine resonance suppression filter 5	4500	[Hz]	○	○	○	○	○	○	○
PB51	NHQ5	Notch shape selection 5	0000h		○	○	○	○	○	○	○
PB52	VRF21	Vibration suppression control 2 - Vibration frequency	100.0	[Hz]	○	○	○	○	○		
PB53	VRF22	Vibration suppression control 2 - Resonance frequency	100.0	[Hz]	○	○	○	○	○		
PB54	VRF23	Vibration suppression control 2 - Vibration frequency damping	0.00		○	○	○	○	○		
PB55	VRF24	Vibration suppression control 2 - Resonance frequency damping	0.00		○	○	○	○	○		
PB56	VRF21B	Vibration suppression control 2 - Vibration frequency after gain switching	0.0	[Hz]	○	○	○	○	○		
PB57	VRF22B	Vibration suppression control 2 - Resonance frequency after gain switching	0.0	[Hz]	○	○	○	○	○		
PB58	VRF23B	Vibration suppression control 2 - Vibration frequency damping after gain switching	0.00		○	○	○	○	○		
PB59	VRF24B	Vibration suppression control 2 - Resonance frequency damping after gain switching	0.00		○	○	○	○	○		
PB60	PG1B	Model loop gain after gain switching	0.0	[rad/s]	○	○	○	○	○	○	
PB61		For manufacturer setting	0.0								
PB62			0000h								
PB63			0000h								
PB64			0000h								

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

No.	Symbol	Name	Initial value	Unit	Operation mode				Control mode		
					Standard	Full.	Lin.	D.D.	P	S	T
PC01	STA	Acceleration time constant	0	[ms]	○		○	○		○	○
PC02	STB	Deceleration time constant	0	[ms]	○		○	○		○	○
PC03	STC	S-pattern acceleration/deceleration time constant	0	[ms]	○		○	○		○	○
PC04	TQC	Torque command time constant/thrust command time constant	0	[ms]	○		○	○			○
PC05	SC1	Internal speed command 1	100	[r/min]/ [mm/s]	○		○	○		○	
		Internal speed limit 1			○		○	○			○
PC06	SC2	Internal speed command 2	500	[r/min]/ [mm/s]	○		○	○		○	
		Internal speed limit 2			○		○	○			○
PC07	SC3	Internal speed command 3	1000	[r/min]/ [mm/s]	○		○	○		○	
		Internal speed limit 3			○		○	○			○
PC08	SC4	Internal speed command 4	200	[r/min]/ [mm/s]	○		○	○		○	
		Internal speed limit 4			○		○	○			○
PC09	SC5	Internal speed command 5	300	[r/min]/ [mm/s]	○		○	○		○	
		Internal speed limit 5			○		○	○			○
PC10	SC6	Internal speed command 6	500	[r/min]/ [mm/s]	○		○	○		○	
		Internal speed limit 6			○		○	○			○
PC11	SC7	Internal speed command 7	800	[r/min]/ [mm/s]	○		○	○		○	
		Internal speed limit 7			○		○	○			○
PC12	VCM	Analog speed command - Maximum speed	0	[r/min]/ [mm/s]	○		○	○		○	
		Analog speed limit - Maximum speed			○		○	○			○
PC13	TLC	Analog torque/thrust command maximum output	100.0	[%]	○		○	○			○
PC14	MOD1	Analog monitor 1 output	0000h		○	○	○	○	○	○	○
PC15	MOD2	Analog monitor 2 output	0001h		○	○	○	○	○	○	○
PC16	MBR	Electromagnetic brake sequence output	0	[ms]	○	○	○	○	○	○	○
PC17	ZSP	Zero speed	50	[r/min]/ [mm/s]	○	○	○	○	○	○	○
PC18	*BPS	Alarm history clear	0000h		○	○	○	○	○	○	○
PC19	*ENRS	Encoder output pulse selection	0000h		○	○	○	○	○	○	○
PC20	*SNO	Station No. setting	0	[station]	○	○	○	○	○	○	○
PC21	*SOP	RS-422 communication function selection	0000h		○	○	○	○	○	○	○
PC22	*COP1	Function selection C-1	0000h		○	○	○	○	○	○	○
PC23	*COP2	Function selection C-2	0000h		○		○	○		○	○
PC24	*COP3	Function selection C-3	0000h		○	○	○	○	○		
PC25		For manufacturer setting	0000h								
PC26	*COP5	Function selection C-5	0000h		○	○	○	○	○	○	
PC27	*COP6	Function selection C-6	0000h		○	○	○	○	○	○	○
PC28	*COP7	Function selection C-7	0000h				○		○	○	○
PC29	*COP8	Function selection C-8	0000h		○		○	○		○	○
PC30	STA2	Acceleration time constant 2	0	[ms]	○		○	○		○	○
PC31	STB2	Deceleration time constant 2	0	[ms]	○		○	○		○	○
PC32	CMX2	Command input pulse multiplication numerator 2	1		○	○	○	○	○		
PC33	CMX3	Command input pulse multiplication numerator 3	1		○	○	○	○	○		
PC34	CMX4	Command input pulse multiplication numerator 4	1		○	○	○	○	○		
PC35	TL2	Internal torque limit 2/internal thrust limit 2	100.0	[%]	○	○	○	○	○	○	○
PC36	*DMD	Status display selection	0000h		○	○	○	○	○	○	○
PC37	VCO	Analog speed command offset	0	[mV]	○		○	○		○	
		Analog speed limit offset			○		○	○			○

No.	Symbol	Name	Initial value	Unit	Operation mode				Control mode		
					Standard	Full.	Lin.	D.D.	P	S	T
PC38	TPO	Analog torque command offset	0	[mV]	○		○	○			○
		Analog torque limit offset			○	○	○	○		○	
PC39	MO1	Analog monitor 1 offset	0	[mV]	○	○	○	○	○	○	○
PC40	MO2	Analog monitor 2 offset	0	[mV]	○	○	○	○	○	○	○
PC41		For manufacturer setting	0								
PC42			0								
PC43	ERZ	Error excessive alarm level	0	[rev]/[mm]	○	○	○	○	○		
PC44	*COP9	Function selection C-9	0000h			○			○		
PC45	*COPA	Function selection C-A	0000h			○	○		○	○	○
PC46		For manufacturer setting	0								
PC47			0								
PC48			0								
PC49			0								
PC50			0000h								
PC51	RSBR	Forced stop deceleration time constant	100	[ms]	○	○	○	○	○	○	
PC52		For manufacturer setting	0								
PC53			0								
PC54	RSUP1	Vertical axis freefall prevention compensation amount	0	[0.0001 rev]/ [0.01 mm]	○	○	○	○	○		
PC55		For manufacturer setting	0								
PC56			100								
PC57			0000h								
PC58			0								
PC59			0000h								
PC60	*COPD	Function selection C-D	0000h		○				○	○	○
PC61		For manufacturer setting	0000h								
PC62			0000h								
PC63			0000h								
PC64			0000h								
PC65			0000h								
PC66			0								
PC67			0								
PC68			0								
PC69			0								
PC70			0								
PC71			0040h								
PC72			0000h								
PC73	ERW	Error excessive warning level	0	[rev]/[mm]	○	○	○	○	○		
PC74		For manufacturer setting	0000h								
PC75			0000h								
PC76			0000h								
PC77			0000h								
PC78			0000h								
PC79			0000h								
PC80			0000h								

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

No.	Symbol	Name	Initial value	Unit	Operation mode				Control mode		
					Standard	Full.	Lin.	D.D.	P	S	T
PD01	*DIA1	Input signal automatic on selection 1	0000h		○	○	○	○	○	○	○
PD02		For manufacturer setting	0000h								
PD03	*DI1L	Input device selection 1L	0202h		○	○	○	○	○	○	
PD04	*DI1H	Input device selection 1H	0202h		○		○	○			○
PD05	*DI2L	Input device selection 2L	2100h		○	○	○	○	○	○	
PD06	*DI2H	Input device selection 2H	2021h		○		○	○			○
PD07	*DI3L	Input device selection 3L	0704h		○	○	○	○	○	○	
PD08	*DI3H	Input device selection 3H	0707h		○		○	○			○
PD09	*DI4L	Input device selection 4L	0805h		○	○	○	○	○	○	
PD10	*DI4H	Input device selection 4H	0808h		○		○	○			○
PD11	*DI5L	Input device selection 5L	0303h		○	○	○	○	○	○	
PD12	*DI5H	Input device selection 5H	3803h		○		○	○			○
PD13	*DI6L	Input device selection 6L	2006h		○	○	○	○	○	○	
PD14	*DI6H	Input device selection 6H	3920h		○		○	○			○
PD15		For manufacturer setting	0000h								
PD16			0000h								
PD17	*DI8L	Input device selection 8L	0A0Ah		○	○	○	○	○	○	
PD18	*DI8H	Input device selection 8H	0A00h		○		○	○			○
PD19	*DI9L	Input device selection 9L	0B0Bh		○	○	○	○	○	○	
PD20	*DI9H	Input device selection 9H	0B00h		○		○	○			○
PD21	*DI10L	Input device selection 10L	2323h		○	○	○	○	○	○	
PD22	*DI10H	Input device selection 10H	2B23h		○		○	○			○
PD23	*DO1	Output device selection 1	0004h		○	○	○	○	○	○	○
PD24	*DO2	Output device selection 2	000Ch		○	○	○	○	○	○	○
PD25	*DO3	Output device selection 3	0004h		○	○	○	○	○	○	○
PD26	*DO4	Output device selection 4	0007h		○	○	○	○	○	○	○
PD27		For manufacturer setting	0003h								
PD28	*DO6	Output device selection 6	0002h		○	○	○	○	○	○	○
PD29	*DIF	Input filter setting	0004h		○	○	○	○	○	○	○
PD30	*DOP1	Function selection D-1	0000h		○	○	○	○	○	○	○
PD31	*DOP2	Function selection D-2	0000h		○	○	○	○	○		
PD32	*DOP3	Function selection D-3	0000h		○	○	○	○	○		
PD33	*DOP4	Function selection D-4	0000h		○	○	○	○	○	○	○
PD34	*DOP5	Function selection D-5	0000h		○	○	○	○	○	○	○
PD35		For manufacturer setting	0000h								
PD36			0000h								
PD37			0000h								
PD38			0								
PD39			0								
PD40			0								
PD41			0000h								
PD42			0000h								
PD43	*DI11L	Input device selection 11L	0000h		○	○	○	○	○	○	
PD44	*DI11H	Input device selection 11H	3A00h		○		○	○			○
PD45	*DI12L	Input device selection 12L	0000h		○	○	○	○	○	○	
PD46	*DI12H	Input device selection 12H	3B00h		○		○	○			○
PD47	*DO7	Output device selection 7	0000h		○	○	○	○	○	○	○
PD48		For manufacturer setting	0000h								

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

No.	Symbol	Name	Initial value	Unit	Operation mode				Control mode		
					Standard	Full.	Lin.	D.D.	P	S	T
PE01	*FCT1	Fully closed loop function selection 1	0000h			○			○		
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		○	○	○	○	○	○	○

No.	Symbol	Name	Initial value	Unit	Operation mode				Control mode		
					Standard	Full.	Lin.	D.D.	P	S	T
PE42		For manufacturer setting	0								
PE43			0.0								
PE44	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]	○	○	○	○	○		
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				Control mode		
					Standard	Full.	Lin.	D.D.	P	S	T
PF01		For manufacturer setting	0000h								
PF02			0000h								
PF03			0000h								
PF04			0								
PF05			0								
PF06			0000h								
PF07			1								
PF08			1								
PF09	*FOP5	Function selection F-5	0000h		○	○			○	○	○
PF10		For manufacturer setting	0000h								
PF11			0000h								
PF12			10000								
PF13			100								
PF14			100								
PF15	DBT	Electronic dynamic brake operating time	2000	[ms]	○	○			○	○	○
PF16		For manufacturer setting	0000h								
PF17			10								
PF18	*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								
PF29			0000h								
PF30			0								
PF31	FRIC	Machine diagnosis function - Friction judgment speed	0	[r/min]/ [mm/s]	○	○	○	○	○	○	○
PF32		For manufacturer setting	50								
PF33			0000h								
PF34	*SOP3	RS-422 communication function selection 3	0000h		○	○	○	○	○	○	○
PF35		For manufacturer setting	0000h								
PF36			0000h								
PF37			0000h								
PF38			0000h								
PF39			0000h								
PF40			0								
PF41			0								
PF42			0								
PF43			0								
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				Control mode		
					Standard	Full.	Lin.	D.D.	P	S	T
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			0000h								
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	[%]			○	○	○	○	○
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								

5.1.8 Option setting parameters ([Pr. Po_ _])

No.	Symbol	Name	Initial value	Unit	Operation mode				Control mode		
					Standard	Full.	Lin.	DD	P	S	T
Po01		For manufacturer setting	0000h								
Po02	*ODI1	MR-D01 input device selection 1	0302h		○	○	○	○	○	○	○
Po03	*ODI2	MR-D01 input device selection 2	0905h		○	○	○	○	○	○	○
Po04	*ODI3	MR-D01 input device selection 3	2524h		○	○	○	○	○	○	○
Po05	*ODI4	MR-D01 input device selection 4	2026h		○	○	○	○	○	○	○
Po06	*ODI5	MR-D01 input device selection 5	0427h		○	○	○	○	○	○	○
Po07	*ODI6	MR-D01 input device selection 6	0807h		○	○	○	○	○	○	○
Po08	*ODO1	MR-D01 output device selection 1	2726h		○	○	○	○	○	○	○
Po09	*ODO2	MR-D01 output device selection 2	0423h		○	○	○	○	○	○	○
Po10	*OOP1	Function selection O-1	2001h		○	○	○	○			
Po11	*OOP2	Function selection O-2	0000h		○	○	○	○	○	○	○
Po12	*OOP3	Function selection O-3	0000h		○	○	○	○			
Po13	*OMOD1	MR-D01 analog monitor 1 output selection	0000h		○	○	○	○	○	○	○
Po14	*OMOD2	MR-D01 analog monitor 2 output selection	0000h		○	○	○	○	○	○	○
Po15	OMO1	MR-D01 analog monitor 1 offset	0	[mV]	○	○	○	○	○	○	○
Po16	OMO2	MR-D01 analog monitor 2 offset	0	[mV]	○	○	○	○	○	○	○
Po17		For manufacturer setting	0000h								
Po18			0000h								
Po19			0000h								
Po20			0000h								
Po21	OVCO	MR-D01 override offset	0	[mV]	○	○	○	○	○	○	○
Po22	OTLO	MR-D01 override offset	0	[mV]	○	○	○	○	○	○	○
Po23		For manufacturer setting	0000h								
Po24			0000h								
Po25			0000h								
Po26			0000h								
Po27	*ODI7	MR-D01 input device selection 7	2D2Ch								
Po28	*ODI8	MR-D01 input device selection 8	002Eh								
Po29		For manufacturer setting	0000h								
Po30			0000h								
Po31			0000h								
Po32			0000h								

5.2 Detailed list of parameters

POINT

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

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

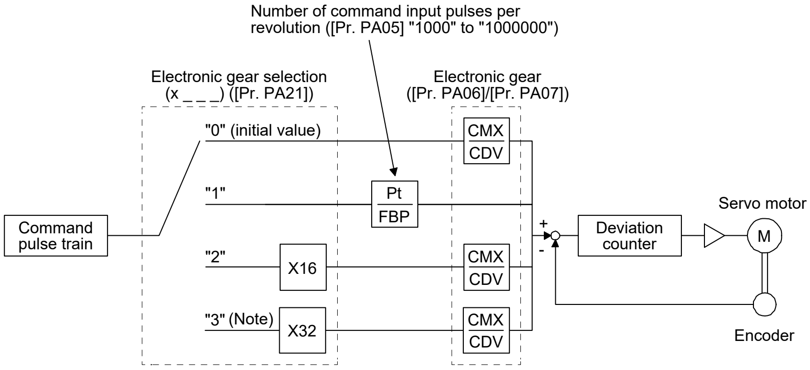
No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PA01 *STY Operation mode	_ _ _ x	Control mode selection Select a control mode. 0: Position control mode 1: Position control mode and speed control mode 2: Speed control mode 3: Speed control mode and torque control mode 4: Torque control mode 5: Torque control mode and position control mode	0h	○	○	○
	_ _ x _	Operation mode selection 0: Standard control mode 1: Fully closed loop control mode 4: Linear servo motor control mode 6: DD motor control mode Setting other than above will trigger [AL. 37 Parameter error]. The linear servo system, direct drive servo system and fully closed loop system are available for the MR-J4-_A_(-RJ) servo amplifiers of which software version is A5 or later. For MR-J4-03A6(-RJ) servo amplifiers, this digit cannot be used when a setting value other than the initial value is set.	0h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		1h			

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PA02 *REG Regenerative option	_ _ x x	Regenerative option Select the regenerative option. Incorrect setting may cause the regenerative option to burn. If a selected regenerative option is not for use with the servo amplifier, [AL. 37 Parameter error] occurs. 00: Regenerative option is not used. ・For the servo amplifier of 100 W, a regenerative resistor is not used. ・For the servo amplifier of 0.2 kW to 7 kW, the built-in regenerative resistor is used. ・The supplied regenerative resistor or a regenerative option is used with the servo amplifier of 11 kW to 22 kW. 01: FR-RC-(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. PC27]. 02: MR-RB032 03: MR-RB12 04: MR-RB32 05: MR-RB30 06: MR-RB50 (Cooling fan is required.) 08: MR-RB31 09: MR-RB51 (Cooling fan is required.) 0B: MR-RB3N 0C: MR-RB5N (Cooling fan is required.) 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 resistor or a regenerative option used with the servo amplifier of 11 kW to 22 kW is cooled by a cooling fan to increase regenerative ability. For MR-J4-03A6(-RJ) servo amplifiers, this digit cannot be used when a setting value other than the initial value is set.	00h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PA03 *ABS Absolute position detection system	_ _ _ x	Absolute position detection system selection Set this digit when using the absolute position detection system in the position control mode. 0: Disabled (incremental system) 1: Enabled (absolute position detection system by DIO) 2: Enabled (absolute position detection system by communication) (available for the software version A3 or later) The absolute position detection system cannot be used when an incremental type linear encoder is used or the semi closed loop/fully closed loop switching is enabled. Enabling the absolute position system will trigger [AL. 37]. There are restrictions when configuring an absolute position detection system. For details, refer to section 12.1.2.	0h	○		
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PA04 *AOP1 Function selection A-1	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _		0h			
	x _ _ _	Forced stop deceleration function selection 0: Forced stop deceleration function disabled (with EM1) 2: Forced stop deceleration function enabled (with EM2) Refer to table 5.1 for details.	2h	○	○	
PA05 *FBP Number of command input pulses per revolution		The servo motor rotates based on set command input pulses. To enable the parameter value, set "Electronic gear selection" to "Number of command input pulses per revolution (1 _ _ _)" of in [Pr. PA21]. "1 _ _ _" cannot be set in [Pr. PA21] in the Linear servo motor control mode. Setting range: 1000 to 1000000	10000	○		

Table 5.1 Deceleration method

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

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
PA06 CMX Electronic gear numerator (command pulse multiplication numerator)		Set the numerator of the electronic gear. To enable the parameter, set "Electronic gear selection" to "Electronic gear (0 _ _ _)", "J3 electronic gear setting value compatibility mode (2 _ _ _)", or "J2S electronic gear setting value compatibility mode (3 _ _ _)" in [Pr. PA21]. For MR-J4-03A6(-RJ) servo amplifiers, "J3 electronic gear setting value compatibility mode (2 _ _ _)" and "J2S electronic gear setting value compatibility mode (3 _ _ _)" cannot be selected. The following shows a standard of the setting range of the electronic gear. $\frac{1}{10} < \frac{CMX}{CDV} < 4000$ If the set value is outside this range, noise may be generated during acceleration/deceleration or operation may not be performed at the preset speed and/or acceleration/deceleration time constants.  Pt (servo motor resolution): 4194304 pulses/rev Note. This parameter is available with servo amplifiers with software version B3 or later. Always set the electronic gear with servo-off state to prevent unexpected operation due to improper setting. Setting range: 1 to 16777215	1	○		
PA07 CDV Electronic gear denominator (command pulse multiplication denominator)		Set the denominator of the electronic gear. To enable the parameter, set "Electronic gear selection" to "Electronic gear (0 _ _ _)", "J3 electronic gear setting value compatibility mode (2 _ _ _)", or "J2S electronic gear setting value compatibility mode (3 _ _ _)" in [Pr. PA21]. For MR-J4-03A6(-RJ) servo amplifiers, "J3 electronic gear setting value compatibility mode (2 _ _ _)" and "J2S electronic gear setting value compatibility mode (3 _ _ _)" cannot be selected. Setting range: 1 to 16777215	1	○		

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

Table 5.2 Gain adjustment mode selection

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

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

Setting range: 0 to 65535</td><td>100
[pulse]</td><td>○</td><td></td><td></td></tr>
<tr><td>PA11
TLP
Forward rotation torque limit/positive direction thrust limit</td><td></td><td>You can limit the torque or thrust generated by the servo motor. Set the parameter referring to section 3.6.1 (5).
When you output torque or thrust as analog monitor output, the larger value of [Pr. PA11 Forward rotation torque limit/positive direction thrust limit value] or [Pr. PA12 Reverse rotation torque limit/negative direction thrust limit value] will be the maximum output voltage (8 V).
Set the parameter on the assumption that the maximum torque or thrust is 100.0 [%]. The parameter is for limiting the torque of the servo motor in the CCW power running or CW regeneration, or limiting the thrust of the linear servo motor in the positive direction power running or negative direction regeneration. Set this parameter to "0.0" to generate no torque or thrust.

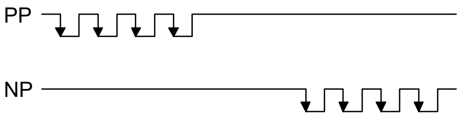
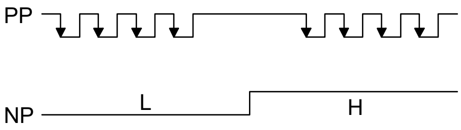
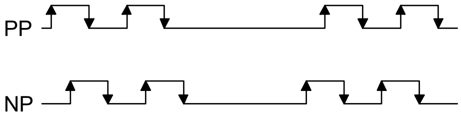
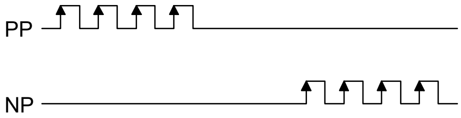
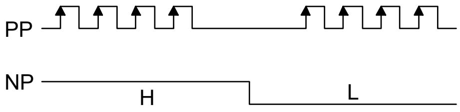
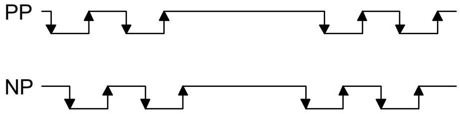
Setting range: 0.0 to 100.0</td><td>100.0
[%]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PA12
TLN
Reverse rotation torque limit/negative direction thrust limit</td><td></td><td>You can limit the torque or thrust generated by the servo motor. Set the parameter referring to section 3.6.1 (5).
When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

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

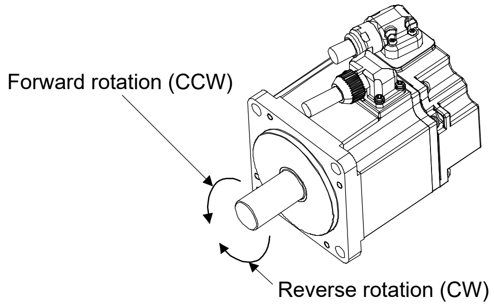
No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PA13 *PLSS Command pulse input form	_ _ _ x	Command input pulse train form selection 0: Forward/reverse rotation pulse train 1: Signed pulse train 2: A-phase/B-phase pulse train (The servo amplifier imports input pulses after multiplying by four.) Refer to table 5.3 for settings.	0h	○		
	_ _ x _	Pulse train logic selection 0: Positive logic 1: Negative logic Choose the right parameter to match the logic of the command pulse train received from a connected controller. Refer to POINT of section 3.6.1 for logic of MELSEC iQ-R series/MELSEC-Q series/MELSEC-L series/MELSEC-F series. Refer to table 5.3 for settings.	0h	○		
	_ x _ _	Command input pulse train filter selection Selecting proper filter enables to enhance noise tolerance. 0: Command input pulse train is 4 Mpulses/s or less. 1: Command input pulse train is 1 Mpulse/s or less. 2: Command input pulse train is 500 kpulses/s or less. 3: Command input pulse train is 200 kpulses/s or less (available for the software version A5 or later) 1 Mpulse/s or lower commands are supported by "1". When inputting commands over 1 Mpulse/s and 4 Mpulses/s or lower, set "0". Incorrect setting may cause the following malfunctions. ・Setting a value higher than actual command will lower noise tolerance. ・Setting a value lower than actual command will cause a position mismatch.	1h	○		
	x _ _ _	For manufacturer setting	0h			

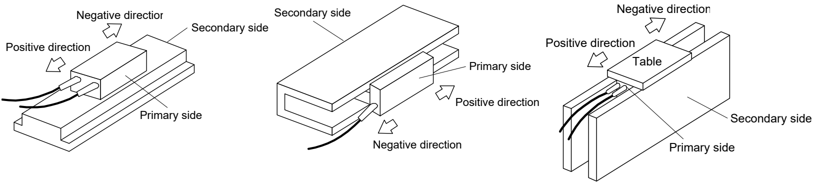
No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PA13 *PLSS Command pulse input form						

Table 5.3 Command input pulse train form selection

Setting value	Pulse train form		Forward rotation (positive direction) command	Reverse rotation (negative direction) command
_ _ 1 0	Negative logic	Forward rotation pulse train (positive direction pulse train) Reverse rotation pulse train (negative direction pulse train)		
_ _ 1 1		Signed pulse train		
_ _ 1 2		A-phase pulse train B-phase pulse train		
_ _ 0 0	Positive logic	Forward rotation pulse train (positive direction pulse train) Reverse rotation pulse train (negative direction pulse train)		
_ _ 0 1		Signed pulse train		
_ _ 0 2		A-phase pulse train B-phase pulse train		

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

<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>PA14
*POL
Rotation direction selection/ travel direction selection</td><td></td><td>Select command input pulses of the rotation direction or the travel direction of the rotary servo motor, the linear servo motor and the direct drive motor.
<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Servo motor rotation direction/ linear servo motor travel direction</th></tr>
<tr><th>When forward rotation pulse is input</th><th>When reverse rotation pulse is input</th></tr>
<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
Setting range: 0, 1</td><td>0</td><td>○</td><td></td><td></td></tr>
<tr><td>PA15
*ENR
Encoder output pulses</td><td></td><td>Set the encoder output pulses from the servo amplifier by using the number of output pulses per revolution, dividing ratio, or electronic gear ratio. (after multiplication by 4)
To set a numerator of the electronic gear, select "A-phase/B-phase pulse electronic gear setting (_ _ 3 _)" of "Encoder output pulse setting selection" in [Pr. PC19].
Refer to app. 15 for details.
The maximum output frequency is 4.6 Mpulses/s. Set the parameter within this range.
Depending on the stop position of the servo motor, the encoder output pulse may turn on and off repeatedly even if the servo motor is stopped.

Setting range: 1 to 4194304</td><td>4000 [pulse/ rev]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PA16
*ENR2
Encoder output pulses 2</td><td></td><td>Set a denominator of the electronic gear for the A/B-phase pulse output.
To set a denominator of the electronic gear, select "A-phase/B-phase pulse electronic gear setting (_ _ 3 _)" of "Encoder output pulse setting selection" in [Pr. PC19].
Refer to app. 15 for details.
The maximum output frequency is 4.6 Mpulses/s. Set the parameter within this range.
Depending on the stop position of the servo motor, the encoder output pulse may turn on and off repeatedly even if the servo motor is stopped.

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

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PA17 *MSR Servo motor series setting		When you use a linear servo motor, select its model from [Pr. PA17] and [Pr. PA18]. Set this and [Pr. PA18] at a time. Refer to the following table for settings. This parameter is not available with MR-J4-03A6(-RJ) servo amplifiers.	0000h	○	○	○

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
LM-K2	LM-K2P1A-01M-2SS1	00B8h	1101h
	LM-K2P1C-03M-2SS1		1301h
	LM-K2P2A-02M-1SS1		2101h
	LM-K2P2C-07M-1SS1		2301h
	LM-K2P2E-12M-1SS1		2501h
	LM-K2P3C-14M-1SS1		3301h
	LM-K2P3E-24M-1SS1		3501h

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PA18 *MTY Servo motor type setting		When you use a linear servo motor, select its model from [Pr. PA17] and [Pr. PA18]. Set this and [Pr. PA17] at a time. Refer to the table of [Pr. PA17] for settings. This parameter is not available with MR-J4-03A6(-RJ) servo amplifiers.	0000h	○	○	○
PA19 *BLK Parameter writing inhibit		Select a reference range and writing range of the parameter. Refer to table 5.4 for settings. Linear servo motor/DD motor setting parameters ([Pr. PL_ _]) cannot be used with MR-J4-03A6(-RJ) servo amplifiers.	00AAh	○	○	○

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

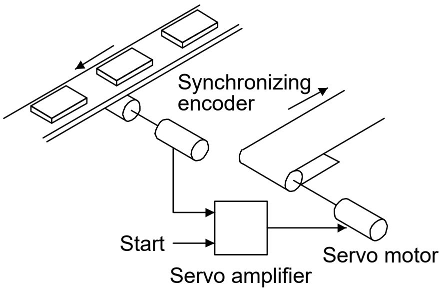
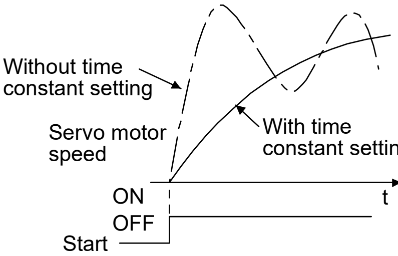
PA19	Setting operation	PA	PB	PC	PD	PE	PF	PL
Other than below	Reading	○						
	Writing	○						
000Ah	Reading	Only 19						
	Writing	Only 19						
000Bh	Reading	○	○	○				
	Writing	○	○	○				
000Ch	Reading	○	○	○	○			
	Writing	○	○	○	○			
00AAh (initial value)	Reading	○	○	○	○	○	○	
	Writing	○	○	○	○	○	○	
00ABh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

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PA20 *TDS Tough drive setting		Alarms may not be avoided with the tough drive function depending on the situations of the power supply and load fluctuation. You can assign MTTR (During tough drive) to the pins CN1-22 to CN1-25, CN1-49, CN1-13, and CN1-14 with [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]. For MR-J4-03A6(-RJ) servo amplifiers, MTTR (during tough drive) cannot be assigned.				
	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Vibration tough drive selection 0: Disabled 1: Enabled Selecting "1" enables to suppress vibrations by automatically changing setting values of [Pr. PB13 Machine resonance suppression filter 1] and [Pr. PB15 Machine resonance suppression filter 2] in case that the vibration exceed the value of the oscillation level set in [Pr. PF23]. To output the oscillation detection alarm as a warning, set [Pr. PF24 Vibration tough drive function selection]. Refer to section 7.3 for details.	0h	○	○	
	_ x _ _	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. In [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time], set the time period until the occurrence of [AL. 10.1 Voltage drop in the control circuit power]. For MR-J4-03A6(-RJ) servo amplifiers, this digit cannot be used when a setting value other than the initial value is set.	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PA21 *AOP3 Function selection A-3	_ _ _ x	One-touch tuning function selection 0: Disabled 1: Enabled When the digit is "0", the one-touch tuning is not available.	1h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _	Electronic gear selection 0: Electronic gear ([Pr. PA06] and [Pr. PA07]) 1: Number of command input pulses per revolution ([Pr. PA05]) 2: J3 electronic gear setting value compatibility mode (Electronic gear ([Pr. PA06] and [Pr. PA07] × 16)) Use this setting value to replace HF/HC/HA series servo motors (262144 pulses/rev) with HG series servo motors (4194304 pulses/rev). When the digit is set to "2", the setting value for the electronic gear set in the MR-J3 servo amplifier can be used. 3: J2S electronic gear setting value compatibility mode (Electronic gear ([Pr. PA06] and [Pr. PA07] × 32)) Use this setting value to replace HC/HA series servo motors (131072 pulses/rev) with HG series servo motors (4194304 pulses/rev). When the digit is set to "3", the setting value for the electronic gear set in the MR-J2S servo amplifier can be used. (available for the software version B3 or later) For MR-J4-03A6(-RJ) servo amplifiers, "2" and "3" cannot be selected for this digit.	0h	○		

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PA22 *PCS Position control composition selection	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Super trace control selection 0: Disabled 2: Enabled This parameter setting is used with servo amplifier with software version B4 or later.	0h	○		
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PA23 DRAT Drive recorder arbitrary alarm trigger setting	_ _ x x	Alarm detail No. setting Set the digits when you execute the trigger with arbitrary alarm detail No. for the drive recorder function. When these digits are "0 0", only the arbitrary alarm No. setting will be enabled.	00h	○	○	○
	x x _ _	Alarm No. setting Set the digits when you execute the trigger with arbitrary alarm No. for the drive recorder function. When "0 0" are set, arbitrary alarm trigger of the drive recorder will be disabled.	00h	○	○	○
		Setting example: To activate the drive recorder when [AL. 50 Overload 1] occurs, set "5 0 0 0". To activate the drive recorder when [AL. 50.3 Thermal overload error 4 during operation] occurs, set "5 0 0 3".				
PA24 AOP4 Function selection A-4	_ _ _ x	Vibration suppression mode selection 0: Standard mode 1: 3 inertia mode 2: Low response mode When you select the standard mode or low response mode, "Vibration suppression control 2" is not available. When you select the 3 inertia mode, the feed forward gain is not available. Before changing the control mode during the 3 inertia mode or low response mode, stop the motor.	0h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PA25 OTHOV One-touch tuning - Overshoot permissible level		Set a permissible value of overshoot amount for one-touch tuning as a percentage of the in-position range. Setting "0" will be 50%. Setting range: 0 to 100	0 [%]	○	○	
PA26 *AOP5 Function selection A-5	_ _ _ x	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, the torque at acceleration is limited to save electric energy charged in the capacitor in the servo amplifier and the time until [AL. 10.2 Voltage drop in the main circuit power] occurs is extended with the instantaneous power failure tough drive function. Consequently, you can set a longer time in [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time]. The torque limit function at instantaneous power failure is enabled when "SEMI-F47 function selection" in [Pr. PA20] is "Enabled (_ 1 _ _)". This parameter setting is used with servo amplifier with software version A6 or later. For MR-J4-03A6(-RJ) servo amplifiers, this digit cannot be used when a setting value other than the initial value is set.	0h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			

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

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PB01 FILT Adaptive tuning mode (adaptive filter II)	_ _ _ x	Filter tuning mode selection Set the adaptive tuning. Select the adjustment mode of the machine resonance suppression filter 1. Refer to section 7.1.2 for details. 0: Disabled 1: Automatic setting (Do not use this in the torque control mode.) 2: Manual setting	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _	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.	0h	○	○	○
PB02 VRFT Vibration suppression control tuning mode (advanced vibration suppression control II)	_ _ _ x	Vibration suppression control 1 tuning mode selection Select the tuning mode of the vibration suppression control 1. Refer to section 7.1.5 for details. 0: Disabled 1: Automatic setting 2: Manual setting	0h	○		
	_ _ x _	Vibration suppression control 2 tuning mode selection Select the tuning mode of the vibration suppression control 2. To enable the setting of this digit, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. Refer to section 7.1.5 for details. 0: Disabled 1: Automatic setting 2: Manual setting	0h	○		
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PB03 PST Position command acceleration/ deceleration time constant (position smoothing)		Set the constant of a primary delay to the position command. You can select a control method from "Primary delay" or "Linear acceleration/deceleration" of "Position acceleration/deceleration filter type selection" in [Pr. PB25]. When the linear acceleration/deceleration is selected, the setting range is 0 ms to 10 ms. Setting of longer than 10 ms will be recognized as 10 ms. When the linear acceleration/deceleration is selected, do not set the "Control mode selection" ([Pr. PA01]) to the setting other than "_ _ _ 0". Doing so will cause the servo motor or linear servo motor to make a sudden stop at the time of position control mode switching or restart. (Example) When a command is given from a synchronizing encoder, synchronous operation will start smoothly even if it start during line operation.   Setting range: 0 to 65535	0 [ms]	○		
PB04 FFC 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. Setting range: 0 to 100	0 [%]	○		

<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="2">PB06
GD2
Load to motor inertia ratio/ load to motor mass ratio</td><td></td><td>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.

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

Setting range: 1.0 to 2000.0</td><td>15.0
[rad/s]</td><td>○</td><td>○</td><td></td></tr>
<tr><td colspan="6">
<table>
<tr><th>Pr. PA08</th><th>This parameter</th></tr>
<tr><td>_ _ _ 0 (2 gain adjustment mode 1 (interpolation mode))</td><td>Manual setting</td></tr>
<tr><td>_ _ _ 1: (Auto tuning mode 1)</td><td rowspan="2">Automatic setting</td></tr>
<tr><td>_ _ _ 2: (Auto tuning mode 2)</td></tr>
<tr><td>_ _ _ 3 (Manual mode)</td><td rowspan="2">Manual setting</td></tr>
<tr><td>_ _ _ 4: (2 gain adjustment mode 2)</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="2">PB08
PG2
Position loop gain</td><td></td><td>Set the gain of the position loop.
Set this parameter to increase the position response to level load disturbance.
Increasing the setting value will also increase the response level to the load disturbance but will be liable to generate vibration and noise.
The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the following table for details.

Setting range: 1.0 to 2000.0</td><td>37.0
[rad/s]</td><td>○</td><td></td><td></td></tr>
<tr><td colspan="6"><table>
<tr><th>Pr. PA08</th><th>This parameter</th></tr>
<tr><td>_ _ _ 0 (2 gain adjustment mode 1 (interpolation mode))</td><td rowspan="3">Automatic setting</td></tr>
<tr><td>_ _ _ 1: (Auto tuning mode 1)</td></tr>
<tr><td>_ _ _ 2: (Auto tuning mode 2)</td></tr>
<tr><td>_ _ _ 3 (Manual mode)</td><td>Manual setting</td></tr>
<tr><td>_ _ _ 4: (2 gain adjustment mode 2)</td><td>Automatic setting</td></tr>
</table></td></tr>
<tr><td>PB09
VG2
Speed loop gain</td><td></td><td>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.

Setting range: 20 to 65535</td><td>823
[rad/s]</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PB10
VIC
Speed integral compensation</td><td></td><td>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.

Setting range: 0.1 to 1000.0</td><td>33.7
[ms]</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PB11
VDC
Speed differential compensation</td><td></td><td>Set the differential compensation.
To enable the setting value, turn on PC (proportional control).

Setting range: 0 to 1000</td><td>980</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PB12
OVA
Overshoot amount compensation</td><td></td><td>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.

Setting range: 0 to 100</td><td>0
[%]</td><td>○</td><td></td><td></td></tr>
<tr><td>PB13
NH1
Machine resonance suppression filter 1</td><td></td><td>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.

Setting range: 10 to 4500</td><td>4500
[Hz]</td><td>○</td><td>○</td><td>○</td></tr>
</table>

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PB14 NHQ1 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. When "Filter tuning mode selection" is set to "Manual setting (_ _ _ 2)" in [Pr. PB01], the setting value will be enabled.					
	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: α = 2 1: α = 3 2: α = 4 3: α = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PB15 NH2 Machine resonance suppression filter 2		Set the notch frequency of the machine resonance suppression filter 2. To enable the setting value, set "Machine resonance suppression filter 2 selection" to "Enabled (_ _ _ 1)" in [Pr. PB16]. Setting range: 10 to 4500	4500 [Hz]	○	○	○
PB16 NHQ2 Notch shape selection 2	Set the shape of the machine resonance suppression filter 2.					
	_ _ _ x	Machine resonance suppression filter 2 selection 0: Disabled 1: Enabled	0h	○	○	○
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: α = 2 1: α = 3 2: α = 4 3: α = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			

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

Table 5.5 Shaft resonance suppression filter setting frequency selection

Setting value	Frequency [Hz]
_ _ 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

PB18 LPF Low-pass filter setting		Set the low-pass filter. The following shows a relation of a required parameter to this parameter. Setting range: 100 to 18000	3141 [rad/s]	○	○	

[Pr. PB23]	[Pr. PB18]
_ _ 0 _ (Initial value)	Automatic setting
_ _ 1 _	Setting value enabled
_ _ 2 _	Setting value disabled

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PB19 VRF11 Vibration suppression control 1 - Vibration frequency		Set the vibration frequency for vibration suppression control 1 to suppress low-frequency machine vibration. When "Vibration suppression control 1 tuning mode selection" is 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. Setting range: 0.1 to 300.0	100.0 [Hz]	○		
PB20 VRF12 Vibration suppression control 1 - Resonance frequency		Set the resonance frequency for vibration suppression control 1 to suppress low-frequency machine vibration. When "Vibration suppression control 1 tuning mode selection" is 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. Setting range: 0.1 to 300.0	100.0 [Hz]	○		
PB21 VRF13 Vibration suppression control 1 - Vibration frequency damping		Set the 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. Setting range: 0.00 to 0.30	0.00	○		
PB22 VRF14 Vibration suppression control 1 - Resonance frequency damping		Set a damping of the resonance frequency for vibration suppression control 1 to suppress low-frequency machine vibration. When "Vibration suppression control 1 tuning mode selection" is 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. Setting range: 0.00 to 0.30	0.00	○		
PB23 VFBF Low-pass filter selection	_ _ _ x	Shaft resonance suppression filter selection Select the shaft resonance suppression filter. 0: Automatic setting 1: Manual setting 2: Disabled When "Machine resonance suppression filter 4 selection" is set to "Enabled (_ _ _ 1)" in [Pr. PB49], the shaft resonance suppression filter is not available.	0h	○	○	○
	_ _ x _	Low-pass filter selection Select the low-pass filter. 0: Automatic setting 1: Manual setting 2: Disabled	0h	○	○	
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

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

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PB29 GD2B Load to motor inertia ratio/ load to motor mass ratio after gain switching		This is used to set the load to motor inertia ratio/load to motor mass ratio for when gain switching is enabled. This parameter is enabled only when "Gain adjustment mode selection" is "Manual mode (_ _ _ 3)" in [Pr. PA08]. Setting range: 0.00 to 300.00	7.00 [Multiplier]	○	○	
PB30 PG2B Position loop gain after gain switching		Set the position loop gain when the gain switching is enabled. When you set a value less than 1.0 rad/s, the value will be the same as [Pr. PB08]. This parameter is enabled only when "Gain adjustment mode selection" is "Manual mode (_ _ _ 3)" in [Pr. PA08]. Setting range: 0.0 to 2000.0	0.0 [rad/s]	○		
PB31 VG2B Speed loop gain after gain switching		Set the speed loop gain when the gain switching is enabled. When you set a value less than 20 rad/s, the value will be the same as [Pr. PB09]. This parameter is enabled only when "Gain adjustment mode selection" is "Manual mode (_ _ _ 3)" in [Pr. PA08]. Setting range: 0 to 65535	0 [rad/s]	○	○	
PB32 VICB Speed integral compensation after gain switching		Set the speed integral compensation when the gain changing is enabled. When you set a value less than 0.1 ms, the value will be the same as [Pr. PB10]. This parameter is enabled only when "Gain adjustment mode selection" is "Manual mode (_ _ _ 3)" in [Pr. PA08]. Setting range: 0.0 to 5000.0	0.0 [ms]	○	○	
PB33 VRF1B 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 "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops. Setting range: 0.0 to 300.0	0.0 [Hz]	○		
PB34 VRF2B Vibration suppression control 1 - Resonance frequency after gain switching		Set the resonance frequency for vibration suppression control 1 when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PB20]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ _ 2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops. Setting range: 0.0 to 300.0	0.0 [Hz]	○		

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PB35 VRF3B Vibration suppression control 1 - Vibration frequency damping after gain switching		Set a damping of the vibration frequency for vibration suppression control 1 when the gain switching is enabled. This parameter will be enabled only when the following conditions are fulfilled. · "Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". · "Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ _ 2)". · "Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops. Setting range: 0.00 to 0.30	0.00	○		
PB36 VRF4B Vibration suppression control 1 - Resonance frequency damping after gain switching		Set a damping of the resonance frequency for vibration suppression control 1 when the gain switching is enabled. This parameter will be enabled only when the following conditions are fulfilled. · "Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". · "Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ _ 2)". · "Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor or linear servo motor stops. Setting range: 0.00 to 0.30	0.00	○		

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

Table 5.6 Command notch filter setting frequency selection

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

Table 5.7 Notch depth selection

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

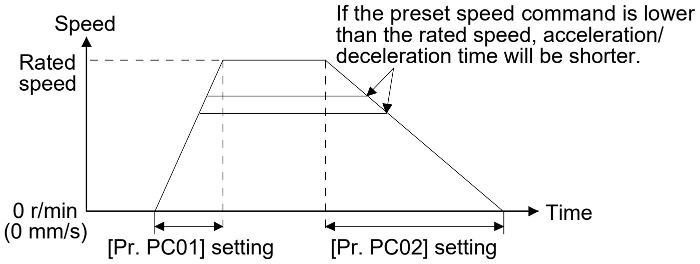
No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PB46 NH3 Machine resonance suppression filter 3		Set the notch frequency of the machine resonance suppression filter 3. To enable the setting value, set "Machine resonance suppression filter 3 selection" to "Enabled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

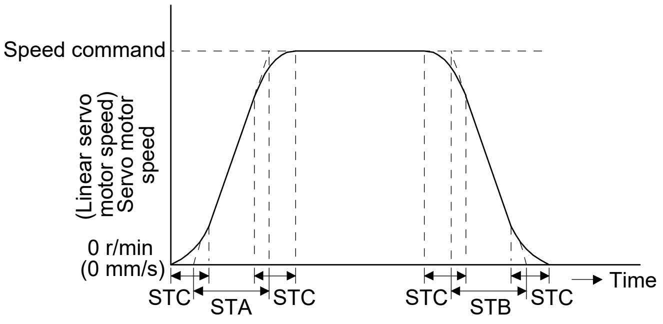
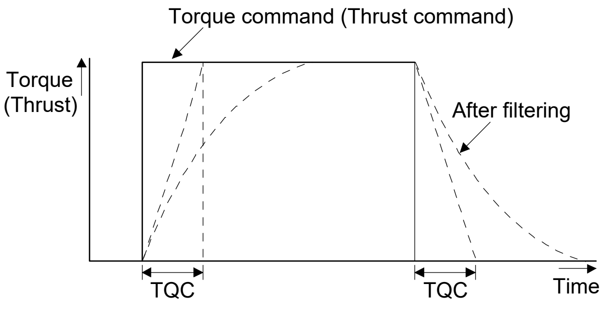
No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PB51 NHQ5 Notch shape selection 5	Set the shape of the machine resonance suppression filter 5. When "Robust filter selection" is "Enabled (_ _ _ 1)" in [Pr. PE41], the machine resonance suppression filter 5 is not available.					
	_ _ _ x	Machine resonance suppression filter 5 selection 0: Disabled 1: Enabled	0h	○	○	○
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: α = 2 1: α = 3 2: α = 4 3: α = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PB52 VRF21 Vibration suppression control 2 - Vibration frequency		Set the vibration frequency for vibration suppression control 2 to suppress low-frequency machine vibration. When "Vibration suppression control 2 tuning mode selection" is 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. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. 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. Setting range: 0.1 to 300.0	100.0 [Hz]	○		
PB53 VRF22 Vibration suppression control 2 - Resonance frequency		Set the resonance frequency for vibration suppression control 2 to suppress low-frequency machine vibration. When "Vibration suppression control 2 tuning mode selection" is 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. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. 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. Setting range: 0.1 to 300.0	100.0 [Hz]	○		
PB54 VRF23 Vibration suppression control 2 - Vibration frequency damping		Set a damping of the vibration frequency for vibration suppression control 2 to suppress low-frequency machine vibration. When "Vibration suppression control 2 tuning mode selection" is 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. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. Refer to section 7.1.5 for details. Setting range: 0.00 to 0.30	0.00	○		
PB55 VRF24 Vibration suppression control 2 - Resonance frequency damping		Set a damping of the resonance frequency for vibration suppression control 2 to suppress low-frequency machine vibration. When "Vibration suppression control 2 tuning mode selection" is 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. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. Refer to section 7.1.5 for details. Setting range: 0.00 to 0.30	0.00	○		

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

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

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

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

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

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC05 SC1 Internal speed command 1 Internal speed limit 1		Set the speed 1 of internal speed commands. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the unit will be r/min or mm/s. When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the unit will be 0.1 r/min or 0.1 mm/s. For example, to set 500.5 r/min while "(_ _ 1 _)" is set in [Pr. PC29], set 5005. If a speed faster than the instantaneous permissible speed is set, the instantaneous permissible speed will be applied. Setting range: 0 to 65535	100 [r/min]/ [mm/s]		○	
		Set the speed 1 of internal speed limits. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the unit will be r/min or mm/s. When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the unit will be 0.1 r/min or 0.1 mm/s. For example, to set 500.5 r/min while "(_ _ 1 _)" is set in [Pr. PC29], set 5005. If a speed faster than the instantaneous permissible speed is set, the instantaneous permissible speed will be applied. Setting range: 0 to 65535				○
PC06 SC2 Internal speed command 2 Internal speed limit 2		Set the speed 2 of internal speed commands. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the unit will be r/min or mm/s. When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the unit will be 0.1 r/min or 0.1 mm/s. For example, to set 500.5 r/min while "(_ _ 1 _)" is set in [Pr. PC29], set 5005. If a speed faster than the instantaneous permissible speed is set, the instantaneous permissible speed will be applied. Setting range: 0 to 65535	500 [r/min]/ [mm/s]		○	
		Set the speed 2 of internal speed limits. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the unit will be r/min or mm/s. When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the unit will be 0.1 r/min or 0.1 mm/s. For example, to set 500.5 r/min while "(_ _ 1 _)" is set in [Pr. PC29], set 5005. If a speed faster than the instantaneous permissible speed is set, the instantaneous permissible speed will be applied. Setting range: 0 to 65535				○
PC07 SC3 Internal speed command 3 Internal speed limit 3		Set the speed 3 of internal speed commands. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the unit will be r/min or mm/s. When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the unit will be 0.1 r/min or 0.1 mm/s. For example, to set 500.5 r/min while "(_ _ 1 _)" is set in [Pr. PC29], set 5005. If a speed faster than the instantaneous permissible speed is set, the instantaneous permissible speed will be applied. Setting range: 0 to 65535	1000 [r/min]/ [mm/s]		○	
		Set speed 3 of internal speed limits. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the unit will be r/min or mm/s. When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the unit will be 0.1 r/min or 0.1 mm/s. For example, to set 500.5 r/min while "(_ _ 1 _)" is set in [Pr. PC29], set 5005. If a speed faster than the instantaneous permissible speed is set, the instantaneous permissible speed will be applied. Setting range: 0 to 65535				○

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC08 SC4 Internal speed command 4 Internal speed limit 4		Set the speed 4 of internal speed commands. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the unit will be r/min or mm/s. When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the unit will be 0.1 r/min or 0.1 mm/s. For example, to set 500.5 r/min while "(_ _ 1 _)" is set in [Pr. PC29], set 5005. If a speed faster than the instantaneous permissible speed is set, the instantaneous permissible speed will be applied. Setting range: 0 to 65535	200 [r/min]/ [mm/s]		○	
		Set the speed 4 of internal speed limits. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the unit will be r/min or mm/s. When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the unit will be 0.1 r/min or 0.1 mm/s. For example, to set 500.5 r/min while "(_ _ 1 _)" is set in [Pr. PC29], set 5005. If a speed faster than the instantaneous permissible speed is set, the instantaneous permissible speed will be applied. Setting range: 0 to 65535				○
PC09 SC5 Internal speed command 5 Internal speed limit 5		Set the speed 5 of internal speed commands. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the unit will be r/min or mm/s. When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the unit will be 0.1 r/min or 0.1 mm/s. For example, to set 500.5 r/min while "(_ _ 1 _)" is set in [Pr. PC29], set 5005. If a speed faster than the instantaneous permissible speed is set, the instantaneous permissible speed will be applied. Setting range: 0 to 65535	300 [r/min]/ [mm/s]		○	
		Set the speed 5 of internal speed limits. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the unit will be r/min or mm/s. When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the unit will be 0.1 r/min or 0.1 mm/s. For example, to set 500.5 r/min while "(_ _ 1 _)" is set in [Pr. PC29], set 5005. If a speed faster than the instantaneous permissible speed is set, the instantaneous permissible speed will be applied. Setting range: 0 to 65535				○
PC10 SC6 Internal speed command 6 Internal speed limit 6		Set the speed 6 of internal speed commands. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the unit will be r/min or mm/s. When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the unit will be 0.1 r/min or 0.1 mm/s. For example, to set 500.5 r/min while "(_ _ 1 _)" is set in [Pr. PC29], set 5005. If a speed faster than the instantaneous permissible speed is set, the instantaneous permissible speed will be applied. Setting range: 0 to 65535	500 [r/min]/ [mm/s]		○	
		Set the speed 6 of internal speed limits. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the unit will be r/min or mm/s. When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the unit will be 0.1 r/min or 0.1 mm/s. For example, to set 500.5 r/min while "(_ _ 1 _)" is set in [Pr. PC29], set 5005. If a speed faster than the instantaneous permissible speed is set, the instantaneous permissible speed will be applied. Setting range: 0 to 65535				○

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC11 SC7 Internal speed command 7 Internal speed limit 7		Set the speed 7 of internal speed commands. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the unit will be r/min or mm/s. When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the unit will be 0.1 r/min or 0.1 mm/s. For example, to set 500.5 r/min while "(_ _ 1 _)" is set in [Pr. PC29], set 5005. If a speed faster than the instantaneous permissible speed is set, the instantaneous permissible speed will be applied. Setting range: 0 to 65535	800 [r/min]/ [mm/s]		○	
		Set the speed 7 of internal speed limits. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the unit will be r/min or mm/s. When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the unit will be 0.1 r/min or 0.1 mm/s. For example, to set 500.5 r/min while "(_ _ 1 _)" is set in [Pr. PC29], set 5005. If a speed faster than the instantaneous permissible speed is set, the instantaneous permissible speed will be applied. Setting range: 0 to 65535				○
PC12 VCM Analog speed command - Maximum speed Analog speed limit - Maximum speed		Set the speed of servo motor or linear servo motor at the maximum voltage (10 V) input to VC (Analog speed command). When "0" is set, the rated speed of the connected servo motor or linear servo motor is used. When you input a command value of the permissible speed or more to VC, the value is clamped at the permissible speed. Setting range: 0 to 50000	0 [r/min]/ [mm/s]		○	
		Set the speed of servo motor or linear servo motor at the maximum voltage (10 V) input to VLA (Analog speed limit). When "0" is set, the rated speed of the connected servo motor or linear servo motor is used. When you input a limit value of the permissible speed or more to VLA, the value is clamped at the permissible speed. Setting range: 0 to 50000				○
PC13 TLC Analog torque/thrust command maximum output		Set the output torque/thrust at the analog torque/thrust command voltage (TC = ±8 V) of +8 V on the assumption that the maximum torque/thrust is 100.0%. For example, set 50.0. The maximum torque or thrust × $\frac{50.0}{100.0}$ is outputted. When you input a command value of the maximum torque/thrust or more to TC, the value is clamped at the maximum torque/thrust. Setting range: 0.0 to 1000.0	100.0 [%]			○

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC14 MOD1 Analog monitor 1 output	_ _ x x	Analog monitor 1 output selection Select a signal to output to MO1 (Analog monitor 1). Refer to app. 7.3 for detection point of output selection. Refer to table 5.8 or table 5.9 for settings.	00h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

Table 5.8 Analog monitor setting value (MR-J4-_A_(-RJ) 100 W or more)

Setting value	Item	Operation mode (Note 1)			
		Standard	Full.	Lin.	DD
_ _ 0 0	(Linear) servo motor speed (±8 V/max. speed)	○	○	○	○
_ _ 0 1	Torque or thrust (±8 V/max. torque or max. thrust) (Note 3)	○	○	○	○
_ _ 0 2	(Linear) servo motor speed (+8 V/max. speed)	○	○	○	○
_ _ 0 3	Torque or thrust (+8 V/max. torque or max. thrust) (Note 3)	○	○	○	○
_ _ 0 4	Current command (±8 V/max. current command)	○	○	○	○
_ _ 0 5	Command pulse frequency (±10 V/±4 Mpulses/s)	○	○	○	○
_ _ 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
DD: Direct drive motor use
2. Encoder pulse unit
3. The larger value of [Pr. PA11] or [Pr. PA12] will be the maximum torque or the maximum thrust.

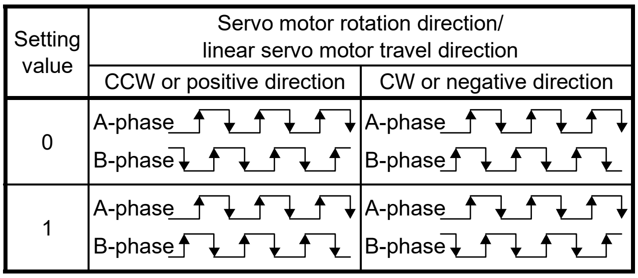
No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC14 MOD1 Analog monitor 1 output		Table 5.9 Analog monitor setting value (MR-J4-03A6(-RJ))				

Table 5.9 Analog monitor setting value (MR-J4-03A6(-RJ))

Setting value	Item
_ _ 0 0	Servo motor speed (5 V ± 3 V/max. speed)
_ _ 0 1	Torque (5 V ± 3 V/max. torque) (Note 2)
_ _ 0 2	Servo motor speed (5 V + 3 V/max. speed)
_ _ 0 3	Torque (5 V + 3 V/max. torque) (Note 2)
_ _ 0 4	Current command (5 V ± 3 V/max. current command)
_ _ 0 5	Command pulse frequency (5 V ± 4 V/±4 Mpulses/s)
_ _ 0 6	Servo motor-side droop pulses (5 V ± 4 V/100 pulses) (Note 1)
_ _ 0 7	Servo motor-side droop pulses (5 V ± 4 V/1000 pulses) (Note 1)
_ _ 0 8	Servo motor-side droop pulses (5 V ± 4 V/10000 pulses) (Note 1)
_ _ 0 9	Servo motor-side droop pulses (5 V ± 4 V/100000 pulses) (Note 1)
_ _ 0 A	Feedback position (5 V ± 4 V/1 Mpulse) (Note 1)
_ _ 0 B	Feedback position (5 V ± 4 V/10 Mpulses) (Note 1)
_ _ 0 C	Feedback position (5 V ± 4 V/100 Mpulses) (Note 1)
_ _ 0 D	Bus voltage (5 V + 4 V/100 V)
_ _ 0 E	Speed command 2 (5 V ± 3 V/max. speed)
_ _ 1 7	Internal temperature of encoder (5 V ± 4 V/±128 °C)

Note 1. Encoder pulse unit
2. The larger value of [Pr. PA11] or [Pr. PA12] will be the maximum torque.

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC15 MOD2 Analog monitor 2 output	_ _ x x	Analog monitor 2 output selection Select a signal to output to MO2 (Analog monitor 2). Refer to app. 7.3 for detection point of output selection. Refer to [Pr. PC14] for settings.	01h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PC16 MBR Electromagnetic brake sequence output		Set the delay time between MBR (Electromagnetic brake interlock) and the base drive circuit is shut-off. For the timing chart of when the servo motor with an electromagnetic brake is used, refer to section 3.10.2. Setting range: 0 to 1000	0 [ms]	○	○	○
PC17 ZSP Zero speed		Set the output range of ZSP (Zero speed detection). ZSP (Zero speed detection) has hysteresis of 20 r/min or 20 mm/s. Setting range: 0 to 10000	50 [r/min]/ [mm/s]	○	○	○
PC18 *BPS Alarm history clear	_ _ _ x	Alarm history clear selection Clear the alarm history. 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.	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC19 *ENRS Encoder output pulse selection	_ _ _ x	Encoder output pulse phase selection Select the encoder pulse direction. 0: A-phase 90° shift in CCW or positive direction 1: A-phase 90° shift in CW or negative direction 	0h	○	○	○
	_ _ x _	Encoder output pulse setting selection Refer to app. 15 for details. 0: Output pulse setting 1: Dividing ratio setting 2: The same output pulse setting as the command pulse 3: A-phase/B-phase pulse electronic gear setting 4: A/B-phase pulse through output setting Depending on the stop position of the servo motor, the encoder output pulse may turn on and off repeatedly even if the servo motor is stopped.	0h	○	○	○
	_ x _ _	Selection of the encoders for encoder output pulse Select 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. This is only for the fully closed loop system. If "1" is set other than in the fully closed loop system, [AL. 37 Parameter error] will occur. Depending on the stop position of the servo motor, the encoder output pulse may turn on and off repeatedly even if the servo motor is stopped.	0h	○		
	x _ _ _	For manufacturer setting	0h			
PC20 *SNO Station No. setting		Set a station No. of the servo amplifier for RS-422 and USB communication. Always set one station to one axis of the servo amplifier. Setting one station number to two or more stations will disable a normal communication. Setting range: 0 to 31	0 [Station]	○	○	○
PC21 *SOP RS-422 communication function selection	Select the details of RS-422 communication function.					
	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	RS-422 communication baud rate selection When using the parameter unit, set "1 _ _ _" in [Pr. PF34]. 0: 9600 [bps] 1: 19200 [bps] 2: 38400 [bps] 3: 57600 [bps] 4: 115200 [bps]	0h	○	○	○
	_ x _ _	RS-422 communication response delay time selection 0: Disabled 1: Enabled (responding after 800 μs or longer delay time)	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			

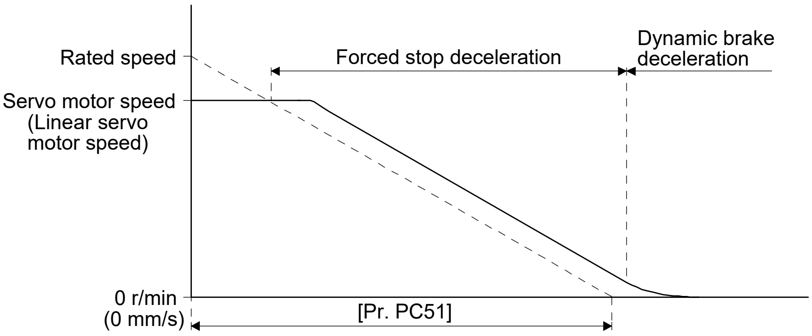
<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="4">PC22
*COP1
Function selection C-1</td><td>_ _ _ x</td><td rowspan="3">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ _ x _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>Encoder cable communication method selection
Select the encoder cable communication method.
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-_A_-RJ).
For MR-J4-03A6(-RJ) servo amplifiers, this digit cannot be used when a setting value other than the initial value is set. Also, it does not comply with encoders of A/B/Z-phase differential output method.</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td rowspan="4">PC23
*COP2
Function selection C-2</td><td>_ _ _ x</td><td>Servo-lock selection at speed control stop
Select the servo-lock selection at speed control stop.
In the speed control mode, the servo motor shaft can be locked to prevent the shaft from being moved by an external force.
0: Enabled (servo-lock)
The operation to maintain the stop position is performed.
1: Disabled (no servo-lock)
The stop position is not maintained.
The control to make the speed 0 r/min or 0 mm/s is performed.</td><td>0h</td><td></td><td>○</td><td></td></tr>
<tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>VC/VLA voltage averaging selection
Select the VC/VLA voltage average.
Set the filtering time when VC (Analog speed command) or VLA (Analog speed limit) is imported.
Set "0" to vary the speed to voltage fluctuation in real time. Increase the set value to vary the speed slower to voltage fluctuation.
<table>
<tr><th>Setting value</th><th>Filtering time [ms]</th></tr>
<tr><td>0</td><td>0</td></tr>
<tr><td>1</td><td>0.444</td></tr>
<tr><td>2</td><td>0.888</td></tr>
<tr><td>3</td><td>1.777</td></tr>
<tr><td>4</td><td>3.555</td></tr>
<tr><td>5</td><td>7.111</td></tr>
</table></td><td>0h</td><td></td><td>○</td><td>○</td></tr>
<tr><td>x _ _ _</td><td>Speed limit selection at torque control
Select the speed limit selection at torque control.
0: Enabled
1: Disabled
Do not use this function except when configuring an external speed loop.</td><td>0h</td><td></td><td></td><td>○</td></tr>
<tr><td rowspan="4">PC24
*COP3
Function selection C-3</td><td>_ _ _ x</td><td>In-position range unit selection
Select a unit of in-position range.
0: Command input pulse unit
1: Servo motor encoder pulse unit</td><td>0h</td><td>○</td><td></td><td></td></tr>
<tr><td>_ _ x _</td><td rowspan="2">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>Error excessive alarm/error excessive warning level unit selection
Select units for error excessive alarm level setting with [Pr. PC43] and for error excessive warning level setting with [Pr. PC73].
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><td>○</td><td></td><td></td></tr>
</table>

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC26 *COP5 Function selection C-5	_ _ _ x	[AL. 99 Stroke limit warning] selection Enable or disable [AL. 99 Stroke limit warning]. 0: Enabled 1: Disabled	0h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PC27 *COP6 Function selection C-6	_ _ _ x	[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 This digit is not available with MR-J4-03A6(-RJ) servo amplifiers. When using the MR-J4-_A-RJ servo amplifier with the DC power supply input, set "1". DC power supply is available with MR-J4-_A-RJ servo amplifiers with software version C2 or later.	0h	○	○	○
	_ _ x _	Main circuit power supply selection Select a voltage to be connected to the main circuit power supply with an MR-J4-03A6(-RJ) servo amplifier. 0: 48 V DC 1: 24 V DC When using 24 V DC for the main circuit power supply, set "1" to this digit. This digit is not available with MR-J4-_A_(-RJ) 100 W or more servo amplifiers. The characteristics of the servo motor vary depending on whether 48 V DC or 24 V DC is used. For details, refer to "Servo Motor Instruction Manual (Vol. 3)".	0h	○	○	○
	_ x _ _	Undervoltage alarm selection Select the alarm and warning for when the bus voltage drops to the undervoltage alarm level. 0: [AL. 10.2] regardless of servo motor speed 1: [AL. E9.1] at servo motor speed 50 r/min (50 mm/s) or less, [AL. 10.2] at over 50 r/min (50 mm/s)	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PC28 *COP7 Function selection C-7	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _		0h			
	x _ _ _	Linear scale multipoint Z-phase input function selection When two or more reference marks exist during the full stroke of the linear encoder, set "1". 0: Disabled 1: Enabled This parameter setting is available with servo amplifiers with software version A5 or later. This digit is not available with MR-J4-03A6(-RJ) servo amplifiers.	0h	○	○	○
PC29 *COP8 Function selection C-8	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Speed command input unit selection Select a speed command input unit. 0: r/min or mm/s 1: 0.1 r/min or 0.1 mm/s This digit is available on servo amplifiers with software version B3 or later.	0h		○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PC30 STA2 Acceleration time constant 2		To enable the parameter, turn on STAB2 (second acceleration/deceleration selection). Set the acceleration time required to reach the rated speed from 0 r/min or 0 mm/s for VC (Analog speed command) and [Pr. PC05 Internal speed command 1] to [Pr. PC11 Internal speed command 7]. Setting range: 0 to 50000	0 [ms]		○	○

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC31 STB2 Deceleration time constant 2		To enable the parameter, turn on STAB2 (second acceleration/deceleration selection). Set the deceleration time required to reach 0 r/min or 0 mm/s from the rated speed for VC (Analog speed command) and [Pr. PC05 Internal speed command 1] to [Pr. PC11 Internal speed command 7]. Setting range: 0 to 50000	0 [ms]		○	○
PC32 CMX2 Commanded pulse multiplication numerator 2		To enable the parameter, select "Electronic gear (0 _ _ _)", "J3 electronic gear setting value compatibility mode (2 _ _ _)", or "J2S electronic gear setting value compatibility mode (3 _ _ _)" of "Electronic gear selection" in [Pr. PA21]. Setting range: 1 to 16777215	1	○		
PC33 CMX3 Commanded pulse multiplication numerator 3		To enable the parameter, select "Electronic gear (0 _ _ _)", "J3 electronic gear setting value compatibility mode (2 _ _ _)", or "J2S electronic gear setting value compatibility mode (3 _ _ _)" of "Electronic gear selection" in [Pr. PA21]. Setting range: 1 to 16777215	1	○		
PC34 CMX4 Commanded pulse multiplication numerator 4		To enable the parameter, select "Electronic gear (0 _ _ _)", "J3 electronic gear setting value compatibility mode (2 _ _ _)", or "J2S electronic gear setting value compatibility mode (3 _ _ _)" of "Electronic gear selection" in [Pr. PA21]. Setting range: 1 to 16777215	1	○		
PC35 TL2 Internal torque limit 2/internal thrust limit 2		Set the parameter on the assumption that the maximum torque or thrust is 100.0%. The parameter is for limiting the torque of the servo motor or the thrust of the linear servo motor. No torque or thrust is generated when this parameter is set to "0.0". When TL1 (Internal torque limit selection) is turned on, Internal torque limits 1 and 2 are compared and the lower value will be enabled. Set the parameter referring to section 3.6.1 (5). Setting range: 0.0 to 100.0	100.0 [%]	○	○	○

<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="3">PC36
*DMD
Status display selection</td><td>_ _ x x</td><td>Status display selection at power-on
Select a status display shown at power-on. Setting "21" to "27" will trigger [AL. 37] in the mode other than the positioning mode.
00: Cumulative feedback pulses
01: Servo motor speed/linear servo motor speed
02: Droop pulses
03: Cumulative command pulses
04: Command pulse frequency
05: Analog speed command voltage (Note 1)
06: Analog torque command voltage (Note 2)
07: Regenerative load ratio
08: Effective load ratio
09: Peak load ratio
0A: Instantaneous torque/thrust
0B: Within one-revolution position/within virtual one-revolution position (1 pulse unit)
0C: Within one-revolution position/within virtual one-revolution position (1000 pulses unit)
0D: ABS counter/virtual ABS counter
0E: Load to motor inertia ratio/load to motor mass ratio
0F: Bus voltage
10: Internal temperature of encoder
11: Settling time
12: Oscillation detection frequency
13: Number of tough operations
14: Unit power consumption (increment of 1 W)
15: Unit power consumption (increment of 1 kW)
16: Unit total power consumption (increment of 1 Wh)
17: Unit total power consumption (increment of 100 kWh)
18: Load-side cumulative feedback pulses (Note 3, 5)
19: Load-side droop pulses (Note 3, 5)
1A: Load-side encoder information 1 (1 pulse unit) (Note 3, 5)
1B: Load-side encoder information 1 (100000 pulses unit) (Note 3, 5)
1C: Load-side encoder ABS counter (Note 3, 5)
1D: Z-phase counter (1 pulse unit) (Note 4, 5)
1E: Z-phase counter (100000 pulses unit) (Note 4, 5)
1F: Electrical angle (1 pulse unit) (Note 4, 5)
20: Electrical angle (100000 pulses unit) (Note 4, 5)
Note 1. It is for the speed control mode. It will be the analog speed limit voltage in the torque control mode.
2. It is for the torque control mode. It will be the analog torque limit voltage in the speed control mode and position control mode.
3. Setting "18 to 1C" will trigger [AL. 37] in the mode other than the fully closed loop control mode.
4. Setting "1D to 20" will trigger [AL. 37] in the mode other than the linear servo motor control mode.
5. This is not available with the MR-J4-03A6(-RJ) servo amplifier.</td><td>00h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ x _ _</td><td>Status display at power-on in corresponding control mode
0: Depends on the control mode<table>
<tr><th>Control mode</th><th>Status display at power-on</th></tr>
<tr><td>Position</td><td>Cumulative feedback pulses</td></tr>
<tr><td>Position/speed</td><td>Cumulative feedback pulses/servo motor speed (linear servo motor speed)</td></tr>
<tr><td>Speed</td><td>Servo motor speed (linear servo motor speed)</td></tr>
<tr><td>Speed/torque</td><td>Servo motor speed (linear servo motor speed)/analog torque (thrust) command voltage</td></tr>
<tr><td>Torque</td><td>Analog torque (thrust) command voltage</td></tr>
<tr><td>Torque/position</td><td>Analog torque (thrust) command voltage/cumulative feedback pulses</td></tr>
</table>1: Depends on the last 2 digits settings of the parameter</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
</table>

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC37 VCO Analog speed command offset/ Analog speed limit offset		Set the offset voltage of VC (Analog speed command). For example, if CCW rotation or positive direction travel is provided by switching on ST1 (Forward rotation start) while applying 0 V to VC, set a negative value. When automatic VC offset is used, the automatically offset value is set to this parameter. (Refer to section 4.5.4.) The initial value is provided before shipment by the automatic VC offset function on condition that the voltage between VC and LG is 0 V. Setting range: -9999 to 9999	The value differs depending on the servo amplifiers. [mV]		○	
		Set the offset voltage of VLA (Analog speed limit). For example, if CCW rotation or positive direction travel is provided by switching on RS1 (Forward rotation selection) while applying 0 V to VLA, set a negative value. When automatic VC offset is used, the automatically offset value is set to this parameter. (Refer to section 4.5.4.) The initial value is provided before shipment by the automatic VC offset function on condition that the voltage between VLA and LG is 0 V. Setting range: -9999 to 9999				○
PC38 TPO Analog torque command offset/ Analog torque limit offset		Set the offset voltage of TC (Analog torque command). Setting range: -9999 to 9999	0 [mV]			○
		Set the offset voltage of TLA (Analog torque limit). Setting range: -9999 to 9999			○	
PC39 MO1 Analog monitor 1 offset		Set the offset voltage of MO1 (Analog monitor 1). Setting range: -9999 to 9999	0 [mV]	○	○	○
PC40 MO2 Analog monitor 2 offset		Set the offset voltage of MO2 (Analog monitor 2). Setting range: -9999 to 9999	0 [mV]	○	○	○
PC43 ERZ Error excessive alarm level		Set an error excessive alarm level. You can change the setting unit with "Error excessive alarm/error excessive warning level unit selection" in [Pr. PC24]. Set this per rev. for rotary servo motors and direct drive motors. Setting "0" will be "3 rev", and setting over 200 rev will be clamped with 200 rev. Set this per mm for linear servo motors. Setting "0" will be 100 mm. For the adjustment method, refer to app. 6. Setting range: 0 to 1000	0 [rev]/ [mm]	○		
PC44 *COP9 Function selection C-9	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _		0h			
	x _ _ _	Load-side encoder cable communication method selection Select the communication method of the encoder cable to be connected to the CN2L connector of MR-J4-_A_-RJ. 0: Two-wire type 1: Four-wire type 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-_A_-RJ will trigger [AL. 37]. This digit is not available with MR-J4-03A6(-RJ) servo amplifiers.	0h	○		

<table>
<tr><th rowspan="2">No./symbol/
name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="4">PC45
*COPA
Function selection C-A</td><td>_ _ _ X</td><td>Encoder pulse count polarity selection
Select a polarity of the linear encoder or load-side encoder.
0: Encoder pulse increases in the servo motor CCW or positive direction.
1: Encoder pulse decreases in the servo motor CCW or positive direction.
This digit is not available with MR-J4-03A6(-RJ) servo amplifiers.</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ _ X _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ X _ _</td><td>Selection of A/B/Z-phase input interface encoder Z-phase connection judgment function
Select the non-signal detection status for the pulse train signal from the A/B/Z-phase input interface encoder used as a linear encoder or load-side encoder.
This function is enabled only when you use an A/B/Z-phase input interface encoder.
This digit is not available with MR-J4-03A6(-RJ) servo amplifiers.
<table>
<tr><th rowspan="2">Setting value</th><th>Detection of disconnection</th><th colspan="2">Alarm status</th></tr>
<tr><th>Z-phase-side non-signal</th><th>Fully closed loop system</th><th>Linear servo system</th></tr>
<tr><td>0</td><td>Enabled</td><td>[AL. 71.6]
(Z-phase)</td><td>[AL. 20.6]
(Z-phase)</td></tr>
<tr><td>1</td><td>Disabled</td><td></td><td></td></tr>
</table>
</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>X _ _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>PC51
RSBR
Forced stop deceleration time constant</td><td></td><td>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 value during forced stop deceleration because the set time is too short, the time to stop will be longer than the set time constant.
・ [AL. 50 Overload alarm 1] or [AL. 51 Overload alarm 2] may occur during forced stop deceleration, depending on the set value.
・After an alarm that leads to a forced stop deceleration, if an alarm that does not lead to a forced stop deceleration occurs or if the control circuit power supply is cut, dynamic braking will start regardless of the deceleration time constant setting.

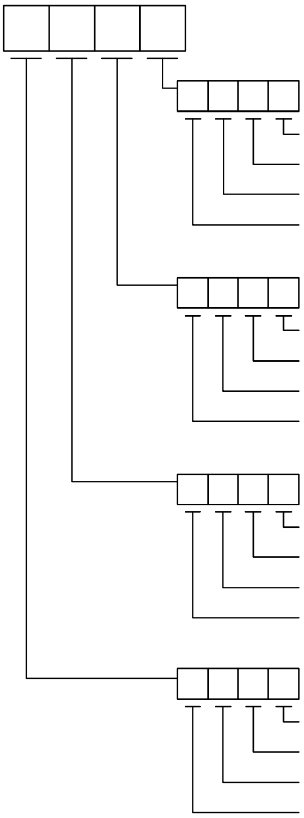
Setting range: 0 to 20000</td><td>100
[ms]</td><td>○</td><td>○</td><td></td></tr>
</table>

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC54 RSUP1 Vertical axis freefall prevention compensation amount		Set the compensation amount of the vertical axis freefall prevention function. Set it per servo motor rotation amount or linear servo motor travel distance. When setting a positive value, the servo motor or linear servo motor moves in the direction set with [Pr. PA14] for the forward rotation pulse input. When setting a negative value, the servo motor or linear servo motor moves in the direction set with [Pr. PA14] for the reverse rotation pulse input. For example, if a positive compensation amount is set when the [Pr. PA14 Rotation direction selection/travel direction selection] setting is "1", compensation will be performed to the CW direction. The vertical axis freefall prevention function is performed when all of the following conditions are met. 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 or an alarm occurred when the servo motor speed is the zero speed or less. 5) MBR (Electromagnetic brake interlock) is enabled with [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47], and the base circuit shut-off delay time is set in [Pr. PC16]. Setting range: -25000 to 25000	0 [0.0001 rev]/ [0.01 mm]	○		
PC60 *COPD Function selection C-D	_ _ _ x	Motor-less operation selection This is used to select the motor-less operation. This is not used in the linear servo motor control mode, fully closed loop control, and DD motor control mode. 0: Disabled 1: Enabled	0h	○	○	○
	_ _ x _	High-resolution analog input selection Select the resolution of VC (analog speed command). When you change parameters, perform offset adjustment with [Pr. PC37 Analog speed command offset]. The offset adjustment can be performed by executing VC automatic offset. Setting "1" while using a servo amplifier other than MR-J4-_A_-RJ, MR-J4-_A_-RU, and MR-J4-_A_-RZ will trigger [AL. 37]. 0: Disabled 1: Enabled This digit is available with servo amplifiers manufactured in November 2014 or later. This digit is not available with MR-J4-03A6(-RJ) servo amplifiers.	0h	○	○	
	_ x _ _	For manufacturer setting	0h			
	x _ _ _	[AL. 9B Error excessive warning] selection 0: [AL. 9B Error excessive warning] disabled 1: [AL. 9B Error excessive warning] enabled This digit is available with servo amplifier with software version B4 or later.	0h	○	○	○
PC73 ERW Error excessive warning level		Set an error excessive warning level. To enable the parameter, select "Enabled (1 _ _ _)" of "[AL. 9B Error excessive warning] selection" in [Pr. PC60]. You can change the setting unit with "Error excessive alarm/error excessive warning level unit selection" in [Pr. PC24]. Set 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. PC73 Error excessive warning level] < [Pr. PC43 Error excessive alarm level] When you set as follows, [AL. 52 Error excessive] will occur earlier than the warning.: [Pr. PC73 Error excessive warning level] ≥ [Pr. PC43 Error excessive alarm level] This parameter is used by servo amplifier with software version B4 or later. Setting range: 0 to 1000	0 [rev]/ [mm]	○		

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

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PD01 *DIA1 Input signal automatic on selection 1	Select input devices to turn on them automatically.					
	_ _ _ x (HEX)	_ _ _ x (BIN): For manufacturer setting	0h			
		_ _ x _ (BIN): For manufacturer setting				
		_ x _ _ (BIN): SON (Servo-on) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	○
		x _ _ _ (BIN): For manufacturer setting				
	_ _ x _ (HEX)	_ _ _ x (BIN): PC (Proportional control) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)	0h	○	○	
		_ _ x _ (BIN): TL (External torque/external thrust limit selection) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	
		_ x _ _ (BIN): For manufacturer setting				
		x _ _ _ (BIN): For manufacturer setting				
	_ x _ _ (HEX)	_ _ _ x (BIN): For manufacturer setting	0h			
		_ _ x _ (BIN): For manufacturer setting				
		_ x _ _ (BIN): LSP (Forward rotation stroke end) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	
		x _ _ _ (BIN): LSN (Reverse rotation stroke end) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	
	x _ _ _ (HEX)	_ _ _ x (BIN): EM2 (Forced stop 2)/EM1 (Forced stop 1) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)	0h	○	○	○
		_ _ x _ (BIN): For manufacturer setting				
		_ x _ _ (BIN): For manufacturer setting				
		x _ _ _ (BIN): For manufacturer setting				

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PD01 *DIA1 Input signal automatic on selection 1	Convert the setting value into hexadecimal as follows.					



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

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

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

Signal name	Initial value BIN	Initial value HEX
EM2 (Forced stop 2)/EM1 (Forced stop 1)	0	0
	0	
	0	
	0	

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

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PD03 *DI1L Input device selection 1L	Any input device can be assigned to the CN1-15 pin.					
	_ _ x x	Position control mode - Device selection Refer to table 5.10.	02h	○	╲	╲
	x x _ _	Speed control mode - Device selection Refer to table 5.10.	02h	╲	○	╲

Table 5.10 Selectable input devices

Setting value	Input device (Note 1)		
	P	S	T
02	SON	SON	SON
03	RES	RES	RES
04	PC	PC	╲
05	TL	TL	╲
06	CR	╲	╲
07	╲	ST1	RS2
08	╲	ST2	RS1
09	TL1	TL1	╲
0A	LSP	LSP	LSP (Note 3)
0B	LSN	LSN	LSN (Note 3)
0D	CDP	CDP	╲
(Note 4) 0E	CLD	╲	╲
(Note 4) 0F	MECR	╲	╲
20	╲	SP1	SP1
21	╲	SP2	SP2
22	╲	SP3	SP3
23	LOP (Note 2)	LOP (Note 2)	LOP (Note 2)
24	CM1	╲	╲
25	CM2	╲	╲
26	╲	STAB2	STAB2

Note
1. P: Position control mode, S: Speed control mode, T: Torque control mode
   The diagonal lines indicate manufacturer settings. Never change the setting.
2. When assigning LOP (Control switching), assign it to the same pin in all control modes.
3. In the torque control mode, this device cannot be used during normal operation. It can be used during the magnetic pole detection in the linear servo motor control mode and the DD motor control mode. Also, when the magnetic pole detection in the torque control mode is completed, this signal will be disabled.
4. It cannot be set with MR-J4-03A6(-RJ) servo amplifiers.

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PD04 *DI1H Input device selection 1H	Any input device can be assigned to the CN1-15 pin.					
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	02h	╲	╲	○
	x x _ _	For manufacturer setting	02h	╲	╲	╲
PD05 *DI2L Input device selection 2L	Any input device can be assigned to the CN1-16 pin.					
	_ _ x x	Position control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	00h	○	╲	╲
	x x _ _	Speed control mode - Device selection Refer to table 5.10 for settings.	21h	╲	○	╲
PD06 *DI2H Input device selection 2H	Any input device can be assigned to the CN1-16 pin.					
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	21h	╲	╲	○
	x x _ _	For manufacturer setting	20h	╲	╲	╲

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PD07 *DI3L Input device selection 3L	Any input device can be assigned to the CN1-17 pin. When "_ _ _ 1" is set in [Pr. PA03] and absolute position detection system by DIO is selected, the CN1-17 pin will become ABSM (ABS transfer mode).					
	_ _ x x	Position control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	04h	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	07h		○	
PD08 *DI3H Input device selection 3H	Any input device can be assigned to the CN1-17 pin.					
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	07h			○
	x x _ _	For manufacturer setting	07h			
PD09 *DI4L Input device selection 4L	Any input device can be assigned to the CN1-18 pin. When "_ _ _ 1" is set in [Pr. PA03] and absolute position detection system by DIO is selected, the CN1-18 pin will become ABSR (ABS transfer request).					
	_ _ x x	Position control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	05h	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	08h		○	
PD10 *DI4H Input device selection 4H	Any input device can be assigned to the CN1-18 pin.					
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	08h			○
	x x _ _	For manufacturer setting	08h			
PD11 *DI5L Input device selection 5L	Any input device can be assigned to the CN1-19 pin.					
	_ _ x x	Position control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	03h	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	03h		○	
PD12 *DI5H Input device selection 5H	Any input device can be assigned to the CN1-19 pin.					
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	03h			○
	x x _ _	For manufacturer setting	38h			
PD13 *DI6L Input device selection 6L	Any input device can be assigned to the CN1-41 pin.					
	_ _ x x	Position control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	06h	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	20h		○	
PD14 *DI6H Input device selection 6H	Any input device can be assigned to the CN1-41 pin.					
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	20h			○
	x x _ _	For manufacturer setting	39h			
PD17 *DI8L Input device selection 8L	Any input device can be assigned to the CN1-43 pin.					
	_ _ x x	Position control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	0Ah	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	0Ah		○	
PD18 *DI8H Input device selection 8H	Any input device can be assigned to the CN1-43 pin.					
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	00h			○
	x x _ _	For manufacturer setting	0Ah			
PD19 *DI9L Input device selection 9L	Any input device can be assigned to the CN1-44 pin.					
	_ _ x x	Position control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	0Bh	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	0Bh		○	

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PD20 *DI9H Input device selection 9H	Any input device can be assigned to the CN1-44 pin.					
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	00h			O
	x x _ _	For manufacturer setting	0Bh			
PD21 *DI10L Input device selection 10L	Any input device can be assigned to the CN1-45 pin.					
	_ _ x x	Position control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	23h	O		
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	23h		O	
PD22 *DI10H Input device selection 10H	Any input device can be assigned to the CN1-45 pin.					
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	23h			O
	x x _ _	For manufacturer setting	2Bh			
PD23 *DO1 Output device selection 1	_ _ x x	Device selection Any output device can be assigned to the CN1-22 pin. When "Enabled (absolute position detection system by DIO) (_ _ _ 1)" is selected in [Pr. PA03], the CN1-22 pin will become ABSB0 (ABS send data bit 0) only during ABS transfer mode. Refer to table 5.11 for settings.	04h	O	O	O
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

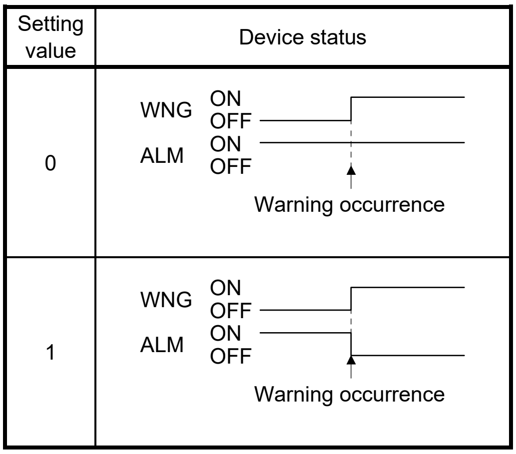
Table 5.11 Selectable output devices

Setting value	Output device (Note 1)		
	P	S	T
_ _ 0 0	Always off	Always off	Always off
_ _ 0 2	RD	RD	RD
_ _ 0 3	ALM	ALM	ALM
_ _ 0 4	INP	SA	Always off
_ _ 0 5	MBR	MBR	MBR
(Note 2) _ _ 0 6	DB	DB	DB
_ _ 0 7	TLC	TLC	VLC
_ _ 0 8	WNG	WNG	WNG
_ _ 0 9	BWNG	BWNG	BWNG
_ _ 0 A	Always off	SA	Always off
_ _ 0 B	Always off	Always off	VLC
_ _ 0 C	ZSP	ZSP	ZSP
(Note 2) _ _ 0 D	MTTR	MTTR	MTTR
_ _ 0 F	CDPS	Always off	Always off
(Note 2) _ _ 1 0	CLDS	Always off	Always off
_ _ 1 1	ABSV	Always off	Always off

Note 1. P: Position control mode, S: Speed control mode, T: Torque control mode
2. It cannot be set with MR-J4-03A6(-RJ) servo amplifiers.

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PD24 *DO2 Output device selection 2	_ _ x x	Device selection Any output device can be assigned to the CN1-23 pin. When "Enabled (absolute position detection system by DIO) (_ _ _ 1)" is selected in [Pr. PA03], the CN1-23 pin will become ABSB1 (ABS send data bit 1) only during ABS transfer mode. Refer to table 5.11 in [Pr. PD23] for settings.	0Ch	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD25 *DO3 Output device selection 3	_ _ x x	Device selection Any output device can be assigned to the CN1-24 pin. Refer to table 5.11 in [Pr. PD23] for settings.	04h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD26 *DO4 Output device selection 4	_ _ x x	Device selection Any output device can be assigned to the CN1-25 pin. When "Enabled (absolute position detection system by DIO) (_ _ _ 1)" is selected in [Pr. PA03], the CN1-25 pin will become ABST (ABS send data ready) only during ABS transfer mode. Refer to table 5.11 in [Pr. PD23] for settings.	07h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD28 *DO6 Output device selection 6	_ _ x x	Device selection Any output device can be assigned to the CN1-49 pin. Refer to table 5.11 in [Pr. PD23] for settings.	02h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD29 *DIF Input filter setting	Select a filter for the input signal.					
	_ _ _ x	Input signal filter selection If external input signal causes chattering due to noise, etc., input filter is used to suppress it. 0: None 1: 0.888 [ms] 2: 1.777 [ms] 3: 2.666 [ms] 4: 3.555 [ms]	4h	○	○	○
	_ _ x _	RES (Reset) dedicated filter selection 0: Disabled 1: Enabled (50 [ms])	0h	○	○	○
	_ x _ _	CR (Clear) dedicated filter selection 0: Disabled 1: Enabled (50 [ms])	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			

<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="4">PD30
*DOP1
Function selection D-1</td><td>_ _ _ x</td><td>Stop method selection for LSP (Forward rotation stroke end) off and LSN (Reverse rotation stroke end) off
Select a stop method for LSP (Forward rotation stroke end) off and LSN (Reverse rotation stroke end) off. Setting "2" or "3" will trigger [AL. 37] in the mode other than the positioning mode.
0: Quick stop
1: Slow stop</td><td>0h</td><td>○</td><td>○</td><td></td></tr>
<tr><td>_ _ x _</td><td>Base circuit status selection for RES (Reset) on
0: Base circuit shut-off
1: No base circuit shut-off</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ x _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>Enabled/disabled selection for a thermistor of servo motor or linear servo motor
0: Enabled
1: Disabled
The setting in this digit will be disabled when using a servo motor or linear servo motor without thermistor.
This parameter is used by servo amplifier with software version A5 or later.</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td rowspan="4">PD31
*DOP2
Function selection D-2</td><td>_ _ _ x</td><td rowspan="2">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ _ x _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ 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.
This parameter is used by servo amplifier with software version B4 or later.</td><td>0h</td><td>○</td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">PD32
*DOP3
Function selection D-3</td><td>_ _ _ x</td><td>CR (Clear) selection
Set CR (Clear).
0: Deleting droop pulses at the leading edge of turning on of CR
1: Continuous deleting of droop pulses while CR is on
2: Disabled (available for the software version B3 or later)</td><td>0h</td><td>○</td><td></td><td></td></tr>
<tr><td>_ _ x _</td><td rowspan="2">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>LOP polarity selection
The relation between LOP and control modes can be set.
When position/speed control switching mode is set
<table>
<tr><th rowspan="2">LOP</th><th colspan="2">Setting value of [Pr. PD32]</th></tr>
<tr><th>0 _ _ _</th><th>1 _ _ _</th></tr>
<tr><td>Off</td><td>Position control mode</td><td>Speed control mode</td></tr>
<tr><td>On</td><td>Speed control mode</td><td>Position control mode</td></tr>
</table>
When speed/torque control switching mode is set
<table>
<tr><th rowspan="2">LOP</th><th colspan="2">Setting value of [Pr. PD32]</th></tr>
<tr><th>0 _ _ _</th><th>1 _ _ _</th></tr>
<tr><td>Off</td><td>Speed control mode</td><td>Torque control mode</td></tr>
<tr><td>On</td><td>Torque control mode</td><td>Speed control mode</td></tr>
</table>
When torque/position control switching mode is set
<table>
<tr><th rowspan="2">LOP</th><th colspan="2">Setting value of [Pr. PD32]</th></tr>
<tr><th>0 _ _ _</th><th>1 _ _ _</th></tr>
<tr><td>Off</td><td>Torque control mode</td><td>Position control mode</td></tr>
<tr><td>On</td><td>Position control mode</td><td>Torque control mode</td></tr>
</table>
This digit is available on servo amplifiers with software version D4 or later.</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
</table>

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PD33 *DOP4 Function selection D-4	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _	Rotation direction selection to enable torque limit/travel direction selection to enable thrust limit Select a direction which enables internal torque limit 2 or external torque limit. Refer to section 3.6.1 (5) for details. 0: Both of "CCW or positive direction" and "CW or negative direction" are enabled. 1: Enabled with "CCW or positive direction" 2: Enabled with "CW or negative direction" This parameter setting is used with servo amplifier with software version B3 or later.	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PD34 *DOP5 Function selection D-5	_ _ _ x	Alarm code output Select output status of alarm codes. Alarm codes are outputted to the pins CN1-22, CN1-23, and CN1-24. 0: Disabled 1: Enabled For details of the alarm codes, refer to chapter 8. When "1" is set for this digit, setting the following will trigger [AL. 37 Parameter error]. ・"_ _ _ 1" is set in [Pr. PA03] and the absolute position detection system by DIO is selected. ・MBR, DB, or ALM is assigned to the CN1-22 pin, CN1-23 pin, or CN1-24 pin.	0h	○	○	○
	_ _ x _	Selection of output device at warning occurrence Select ALM (Malfunction) output status at warning occurrence.  	0h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD43 *DI11L Input device selection 11L	Any input device can be assigned to the CN1-10 pin/CN1-37 pin. Setting "00" will assign PP/PP2 (forward rotation pulse). The parameter is available for the following MR-J4-_A_-RJ servo amplifiers. 1) For 100 W or more CN1-10 pin: Servo amplifiers with software version B3 or later CN1-37 pin: Servo amplifiers manufactured in January 2015 or later with software version B7 or later 2) For 30 W CN1-10 pin/CN1-37 pin: Any software version and production month					
	_ _ x x	Position control mode - Device selection The setting is disabled.	00h			
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	00h		○	

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PD44 *DI11H Input device selection 11H		Any input device can be assigned to the CN1-10 pin/CN1-37 pin. Setting "00" will assign PP/PP2 (forward rotation pulse). The parameter is available for the following MR-J4-_A_-RJ servo amplifiers. 1) For 100 W or more CN1-10 pin: Servo amplifiers with software version B3 or later CN1-37 pin: Servo amplifiers manufactured in January 2015 or later with software version B7 or later 2) For 30 W CN1-10 pin/CN1-37 pin: Any software version and production month				
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	00h			○
	x x _ _	For manufacturer setting	3Ah			
PD45 *DI12L Input device selection 12L		Any input device can be assigned to the CN1-35 pin/CN1-38 pin. Setting "00" will assign NP/NP2 (reverse rotation pulse). The parameter is available for the following MR-J4-_A_-RJ servo amplifiers. 1) For 100 W or more CN1-35 pin: Servo amplifiers with software version B3 or later CN1-38 pin: Servo amplifiers manufactured in January 2015 or later with software version B7 or later 2) For 30 W CN1-35 pin/CN1-38 pin: Any software version and production month				
	_ _ x x	Position control mode - Device selection The setting is disabled.	00h			
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	00h		○	
PD46 *DI12H Input device selection 12H		Any input device can be assigned to the CN1-35 pin/CN1-38 pin. Setting "00" will assign NP/NP2 (reverse rotation pulse/manual pulse generator). The parameter is available for the following MR-J4-_A_-RJ servo amplifiers. 1) For 100 W or more CN1-35 pin: Servo amplifiers with software version B3 or later CN1-38 pin: Servo amplifiers manufactured in January 2015 or later with software version B7 or later 2) For 30 W CN1-35 pin/CN1-38 pin: Any software version and production month				
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	00h			○
	x x _ _	For manufacturer setting	3Bh			
PD47 *DO7 Output device selection 7		Any output device can be assigned to the CN1-13 pin and CN1-14 pin. This parameter is used by MR-J4-_A_-RJ servo amplifier with software version B3 or later. This parameter is not available with MR-J4-03A6(-RJ) servo amplifiers.				
	_ _ x x	Device selection Any output device can be assigned to the CN1-13 pin. Refer to table 5.11 in [Pr. PD23] for settings.	00h	○	○	○
	x x _ _	Device selection Any output device can be assigned to the CN1-14 pin. Refer to table 5.11 in [Pr. PD23] for settings.	00h	○	○	○

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

<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="4">PE01
*FCT1
Fully closed loop function selection 1</td><td>_ _ _ x</td><td>Fully closed loop function selection
The fully closed loop function is selected.
0: Always enabled
1: Switching with CLD (Fully closed loop control selection)
<table>
<tr><th>Selection using the fully closed loop control selection (CLD)</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 setting, select "Fully closed loop control mode (_ _ 1 _)" of "operation mode selection" in [Pr. PA01].
Selecting the "switching with CLD (Fully closed loop control selection)" will trigger [AL. 37] while "absolute position detection system selection" is "Enabled (absolute position detection system by DIO) (_ _ _ 1)" in [Pr. PA03] .
This digit is not available with MR-J4-03A6(-RJ) servo amplifiers.</td><td>0h</td><td>○</td><td></td><td></td></tr>
<tr><td>_ _ x _</td><td rowspan="3">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">PE03
*FCT2
Fully closed loop function selection 2</td><td>_ _ x x</td><td>Fully closed loop control error detection function selection
Select the fully closed loop control error detection function.
This digit is not available with MR-J4-03A6(-RJ) servo amplifiers.

○: Error detection enabled -: Error detection disabled
<table>
<tr><th rowspan="3">Setting value</th><th rowspan="3">Speed deviation error</th><th colspan="3">Position deviation error</th></tr>
<tr><th colspan="2">During servo-on</th><th rowspan="2">During servo-off</th></tr>
<tr><th>With command</th><th>Command 0</th></tr>
<tr><td>_ _ 0 0</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>_ _ 0 1</td><td>○</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>_ _ 0 2</td><td>-</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ _ 0 3</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ _ 1 0</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>_ _ 1 1</td><td>○</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>_ _ 1 2</td><td>-</td><td>-</td><td>○</td><td>-</td></tr>
<tr><td>_ _ 1 3</td><td>○</td><td>-</td><td>○</td><td>-</td></tr>
<tr><td>_ _ 2 0</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>_ _ 2 1</td><td>○</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>_ _ 2 2</td><td>-</td><td>-</td><td>○</td><td>○</td></tr>
<tr><td>_ _ 2 3</td><td>○</td><td>-</td><td>○</td><td>○</td></tr>
</table>
</td><td>03h</td><td>○</td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>Fully closed loop control error reset selection
0: Reset disabled (reset by powering off/on enabled)
1: Reset enabled
This digit is not available with MR-J4-03A6(-RJ) servo amplifiers.</td><td>0h</td><td>○</td><td></td><td></td></tr>
<tr><td>PE04
*FBN
Fully closed loop control - Feedback pulse electronic gear 1 - Numerator</td><td></td><td>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.
This parameter is not available with MR-J4-03A6(-RJ) servo amplifiers.

Setting range: 1 to 65535</td><td>1</td><td>○</td><td></td><td></td></tr>
</table>

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PE05 *FBD Fully closed loop control - Feedback pulse electronic gear 1 - Denominator		Set a denominator of electronic gear for the servo motor encoder pulse at the fully closed loop control. Set the electronic gear so that the number of servo motor encoder pulses for one servo motor revolution is converted to the resolution of the load-side encoder. This parameter is not available with MR-J4-03A6(-RJ) servo amplifiers. Setting range: 1 to 65535	1	○		
PE06 BC1 Fully closed loop control - Speed deviation error detection level		Set [AL. 42.9 Fully closed loop control error by speed deviation] of the fully closed loop control error detection. When the speed deviation between the servo motor encoder and load-side encoder becomes larger than the setting value, the alarm will occur. This parameter is not available with MR-J4-03A6(-RJ) servo amplifiers. Setting range: 1 to 50000	400 [r/min]	○		
PE07 BC2 Fully closed loop control - Position deviation error detection level		Set [AL. 42.8 Fully closed loop control error by position deviation] of the fully closed loop control error detection. When the position deviation between the servo motor encoder and load-side encoder becomes larger than the setting value, the alarm will occur. This parameter is not available with MR-J4-03A6(-RJ) servo amplifiers. Setting range: 1 to 20000	100 [kpulse]	○		
PE08 DUF Fully closed loop dual feedback filter		Set a dual feedback filter band. Refer to section 17.3.1 (7) for details. This parameter is not available with MR-J4-03A6(-RJ) servo amplifiers. Setting range: 1 to 4500	10 [rad/s]	○		
PE10 FCT3 Fully closed loop function selection 3	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Fully closed loop control - Position deviation error detection level - Unit selection 0: 1 kpulse unit 1: 1 pulse unit This digit is not available with MR-J4-03A6(-RJ) servo amplifiers.	0h	○		
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PE34 *FBN2 Fully closed loop control - Feedback pulse electronic gear 2 - Numerator		Set a numerator of electronic gear for the servo motor encoder pulse at the fully closed loop control. Set the electronic gear so that the number of servo motor encoder pulses for one servo motor revolution is converted to the resolution of the load-side encoder. Refer to section 17.3.1 (5) for details. This parameter is not available with MR-J4-03A6(-RJ) servo amplifiers. Setting range: 1 to 65535	1	○		
PE35 *FBD2 Fully closed loop control - Feedback pulse electronic gear 2 - Denominator		Set a denominator of electronic gear for the servo motor encoder pulse at the fully closed loop control. Set the electronic gear so that the number of servo motor encoder pulses for one servo motor revolution is converted to the resolution of the load-side encoder. Refer to section 17.3.1 (5) for details. This parameter is not available with MR-J4-03A6(-RJ) servo amplifiers. Setting range: 1 to 65535	1	○		

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PE41 EOP3 Function selection E-3	_ _ _ x	Robust filter selection 0: Disabled 1: Enabled When you select "Enabled" of this digit, the machine resonance suppression filter 5 set in [Pr. PB51] is not available.	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PE44 LMCP 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 available with servo amplifiers with software version B4 or later. Setting range: 0 to 30000	0 [0.01%]	○		
PE45 LMCN 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 available with servo amplifiers with software version B4 or later. Setting range: 0 to 30000	0 [0.01%]	○		
PE46 LMFLT 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 available with servo amplifiers with software version B4 or later. Setting range: 0 to 30000	0 [0.1 ms]	○		
PE47 TOF 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 available with servo amplifiers with software version B4 or later. Setting range: -10000 to 10000	0 [0.01%]	○	○	○
PE48 *LMOP Lost motion compensation function selection	_ _ _ x	Lost motion compensation selection 0: Disabled 1: Enabled This parameter is available with servo amplifiers with software version B4 or later.	0h	○		
	_ _ x _	Unit setting of lost motion compensation non-sensitive band 0: 1 pulse unit 1: 1 kpulse unit This parameter is available with servo amplifiers with software version B4 or later.	0h	○		
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PE49 LMCD 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 available with servo amplifiers with software version B4 or later. Setting range: 0 to 30000	0 [0.1 ms]	○		

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PE50 LMCT 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 available with servo amplifiers with software version B4 or later. Setting range: 0 to 65535	0 [pulse]/ [kpulse]	○		

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

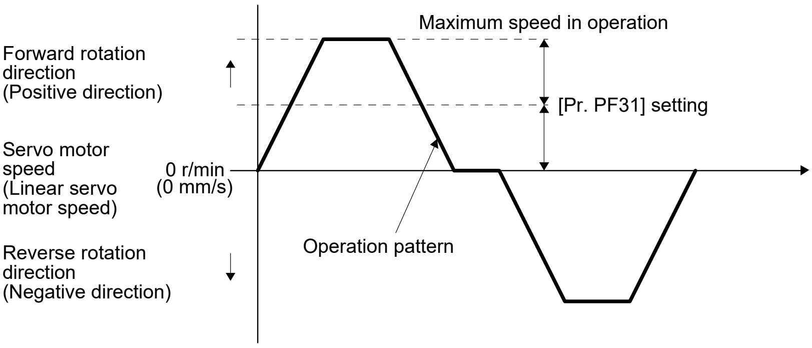
<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="4">PF09
*FOP5
Function selection F-5</td><td>_ _ _ x</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>
<tr><td>HG-AK</td><td>HG-AK0136/HG-AK0236/HG-AK0336</td></tr>
</table>
</td><td>0h</td><td>○</td><td>○</td><td></td></tr>
<tr><td>_ _ x _</td><td rowspan="3">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>PF15
DBT
Electronic dynamic brake operating time</td><td></td><td>Set an operating time for the electronic dynamic brake.

Setting range: 0 to 10000</td><td>2000
[ms]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PF18
*STOD
STO diagnosis error detection time</td><td></td><td>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.

Setting range: 0 to 60</td><td>0
[s]</td><td>○</td><td>○</td><td>○</td></tr>
</table>

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PF21 DRT Drive recorder switching time setting		Set a drive recorder switching time. When a USB communication is cut during using a graph function or a graph function is terminated, the function will be changed to the drive recorder function after the settling time of this parameter. When a value from "1" to "32767" is set, it will switch after the setting value. When "0" is set, it will switch after 600 s. When "-1" is set, the drive recorder function is disabled. Setting range: -1 to 32767	0 [s]	○	○	○
PF23 OSCL1 Vibration tough drive - Oscillation detection level		Set a filter readjustment sensitivity of [Pr. PB13 Machine resonance suppression filter 1] and [Pr. PB15 Machine resonance suppression filter 2] while the vibration tough drive is enabled. However, setting "0" will be 50%. Example: When you set "50" to the parameter, the filter will be readjusted at the time of 50% or more oscillation level. Setting range: 0 to 100	50 [%]	○	○	
PF24 *OSCL2 Vibration tough drive function selection	_ _ _ x	Oscillation detection alarm selection Select alarm or warning when an oscillation continues at a filter readjustment sensitivity level of [Pr. PF23]. The digit is continuously enabled regardless of the vibration tough drive in [Pr. PA20]. 0: [AL. 54 Oscillation detection] will occur at oscillation detection. 1: [AL. F3.1 Oscillation detection warning] will occur at oscillation detection. 2: Oscillation detection function disabled	0h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PF25 CVAT 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 earlier: Setting range 30 ms to 200 ms ・Software version C1 or later: 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 normal power off may occur 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. PA20]. This parameter is not available with MR-J4-03A6(-RJ) servo amplifiers. Setting range: 30 to 500	200 [ms]	○	○	○

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PF31 FRIC 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. Set a larger value than the one set in [Pr. PC17 Zero speed] in this parameter. If the speed is the zero speed or less, the friction estimation process is not performed.  Setting range: 0 to permissible speed	0 [r/min]/ [mm/s]	○	○	○
PF34 *SOP3 RS-422 communi-cation function selection 3	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _		0h			
	x _ _ _	MR-PRU03 selection Select this if using an MR-PRU03. 0: Disabled 1: Enabled This parameter setting is used with servo amplifier with software version B3 or later. This digit is not available with MR-J4-03A6(-RJ) servo amplifiers.	0h	○	○	○

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

> **POINT**
>
> ●Linear servo motor/DD motor setting parameters ([Pr. PL_ _]) cannot be used with MR-J4-03A6(-RJ) servo amplifiers.

<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="4">PL01
*LIT1
Linear servo motor/DD motor function selection 1</td><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><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<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</td><td>3h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>PL02
*LIM
Linear encoder resolution - Numerator</td><td></td><td>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.
Setting range: 1 to 65535</td><td>1000
[μm]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PL03
*LID
Linear encoder resolution - Denominator</td><td></td><td>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.
Setting range: 1 to 65535</td><td>1000
[μm]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td rowspan="4">PL04
*LIT2
Linear servo motor/DD motor function selection 2</td><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 15 and 16 for details of each deviation error.</td><td>3h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ _ x _</td><td rowspan="2">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>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><td>○</td><td>○</td><td>○</td></tr>
</table>

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

<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="5">PL17
LTSTS
Magnetic pole detection - Minute position detection method - Function selection</td><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 5.12 for settings.</td><td>0h</td><td>○</td><td>○</td><td>○</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 5.13 for settings.</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td></td><td>

Table 5.12 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 5.13 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></td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PL18
IDLV
Magnetic pole detection - Minute position detection method - Identification signal amplitude</td><td></td><td>Set an identification signal amplitude used in the minute position detection method.
This parameter is enabled only when the magnetic pole detection is the minute position detection method.
Setting "0" will be 100% amplitude.

Setting range: 0 to 100</td><td>0
[%]</td><td>○</td><td>○</td><td>○</td></tr>
</table>

5.2.8 Option setting parameters ([Pr. Po_ _])

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
Po02 *ODI1 MR-D01 input device selection 1	Any input device can be assigned to the CN10-21 pin and CN10-26 pin.					
	_ _ x x	CN10-21 selection Select an input signal function of the CN10-21 pin. Refer to table 5.14 for settings. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	02h	○	○	○
	x x _ _	CN10-26 selection Select an input signal function of the CN10-26 pin. Refer to table 5.14 for settings. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	03h	○	○	○

Table 5.14 Selectable input devices

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

Note. P: Position control mode, S: Speed control mode, T: Torque control mode
The diagonal lines indicate manufacturer settings. Never change the setting.

No./symbol/ name	Setting digit	Function	Initial value [unit]	P	S	T
Po03 *ODI2 MR-D01 input device selection 2	Any input device can be assigned to the CN10-27 pin and CN10-28 pin.					
	_ _ x x	CN10-27 selection Select an input signal function of the CN10-27 pin. Refer to table 5.14 in [Pr. Po02] for setting values. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	05h	○	○	○
	x x _ _	CN10-28 selection Select an input signal function of the CN10-28 pin. Refer to table 5.14 in [Pr. Po02] for setting values. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	09h	○	○	○

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
Po04 *ODI3 MR-D01 input device selection 3	Any input device can be assigned to the CN10-29 pin and CN10-30 pin.					
	_ _ x x	CN10-28 selection Select an input signal function of the CN10-28 pin. Refer to table 5.14 in [Pr. Po02] for setting values. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	24h	○	○	○
	x x _ _	CN10-30 selection Select an input signal function of the CN10-30 pin. Refer to table 5.14 in [Pr. Po02] for setting values. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	25h	○	○	○
Po05 *ODI4 MR-D01 input device selection 4	Any input device can be assigned to the CN10-31 pin and CN10-32 pin.					
	_ _ x x	CN10-31 selection Select an input signal function of the CN10-31 pin. Refer to table 5.14 in [Pr. Po02] for setting values. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	26h	○	○	○
	x x _ _	CN10-32 selection Select an input signal function of the CN10-32 pin. Refer to table 5.14 in [Pr. Po02] for setting values. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	20h	○	○	○
Po06 *ODI5 MR-D01 input device selection 5	Any input device can be assigned to the CN10-33 pin and CN10-34 pin.					
	_ _ x x	CN10-33 selection Select an input signal function of the CN10-33 pin. Refer to table 5.14 in [Pr. Po02] for setting values. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	27h	○	○	○
	x x _ _	CN10-34 selection Select an input signal function of the CN10-34 pin. Refer to table 5.14 in [Pr. Po02] for setting values. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	04h	○	○	○
Po07 *ODI6 MR-D01 input device selection 6	Any input device can be assigned to the CN10-35 pin and CN10-36 pin.					
	_ _ x x	CN10-35 selection Select an input signal function of the CN10-35 pin. Refer to table 5.14 in [Pr. Po02] for setting values. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	07h	○	○	○
	x x _ _	CN10-36 selection Select an input signal function of the CN10-36 pin. Refer to table 5.14 in [Pr. Po02] for setting values. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	08h	○	○	○

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
Po08 *ODO1 MR-D01 output device selection 1	Any output device can be assigned to the CN10-46 pin and CN10-47 pin.					
	_ _ x x	CN10-46 selection Select an output signal function of the CN10-46 pin. Refer to table 5.15 for settings. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	26h	○	○	○
	x x _ _	CN10-47 selection Select an output signal function of the CN10-47 pin. Refer to table 5.15 for settings. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	27h	○	○	○

Table 5.15 Selectable output devices

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

Note. P: Position control mode, S: Speed control mode, T: Torque control mode
The diagonal lines indicate manufacturer settings. Never change the setting.

No./symbol/ name	Setting digit	Function	Initial value [unit]	P	S	T
Po09 *ODO9 MR-D01 output device selection 2	Any output device can be assigned to the CN10-48 pin and CN10-49 pin.					
	_ _ x x	CN10-48 selection Select an output signal function of the CN10-48 pin. Refer to table 5.15 in [Pr. Po08] for settings. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	23h	○	○	○
	x x _ _	CN10-49 selection Select an output signal function of the CN10-49 pin. Refer to table 5.15 in [Pr. Po08] for settings. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	04h	○	○	○

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
Po11 *OOP2 Function selection O-2	Select the input devices of the analog speed command, analog speed limit and torque limit.					
	_ _ _ x	For manufacturer setting	0h	╲	╲	╲
	_ _ x _	Override input CN1-2/CN20-2 switching selection 0: CN1-2 pin enabled 1: CN20-2 pin enabled Setting "1" when no MR-D01 has been connected will trigger [AL. 37]. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	0h	○	○	○
	_ x _ _	Torque limit CN1-27/CN20-12 switching selection 0: CN1-27 pin enabled 1: CN20-12 pin enabled Setting "1" when no MR-D01 has been connected will trigger [AL. 37]. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	0h	○	○	○
	x _ _ _	For manufacturer setting	0h	╲	╲	╲
Po12 *OOP3 Function selection O-3	Select an alarm code output setting and an M code output setting.					
	_ _ _ x	MR-D01 alarm code output 0: Disabled 1: Enabled Selecting "1" in this digit will output an alarm code when an alarm occurs. This parameter setting is available with servo amplifiers with software version B7 or later. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	0h	○	○	○
	_ _ x _	For manufacturer setting	0h	○	╲	╲
	_ x _ _		0h	╲	╲	╲
	x _ _ _		0h	╲	╲	╲

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
Po13 *OMOD1 MR-D01 analog monitor 1 output selection	Set a signal to output to Analog monitor 1.					
	_ _ x x	Analog monitor 1 output selection Refer to table 5.16 for settings. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	00h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

Table 5.16 Analog monitor setting value

Setting value	Item	Operation mode (Note 1) Standard	Full.	Lin.	DD
_ _ 0 0	(Linear) servo motor speed (±8 V/max. speed)	○	○	○	○
_ _ 0 1	Torque or thrust (±8 V/max. torque or max. thrust) (Note 3)	○	○	○	○
_ _ 0 2	(Linear) servo motor speed (+8 V/max. speed)	○	○	○	○
_ _ 0 3	Torque or thrust (+8 V/max. torque or max. thrust) (Note 3)	○	○	○	○
_ _ 0 4	Current command (±8 V/max. current command)	○	○	○	○
_ _ 0 5	Command pulse frequency (±10 V/±4 Mpulses/s)	○	○	○	○
_ _ 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
DD: Direct drive motor use
2. Encoder pulse unit
3. 8 V is outputted at the maximum torque. However, when [Pr. PA11] and [Pr. PA12] are set to limit torque, 8 V is output at the torque highly limited.

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
Po14 OMOD2 MR-D01 analog monitor 2 output selection	Set a signal to output to Analog monitor 2.					
	_ _ x x	Analog monitor 2 output selection Select a signal to output to MO2 (Analog monitor 2). Refer to [Pr. Po13] for settings. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	00h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
Po15 OMO1 MR-D01 analog monitor 1 offset		This is used to set the offset voltage of MO1 (Analog monitor 1). This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later. Setting range: -9999 to 9999	0 [mV]	○	○	○
Po16 OMO2 MR-D01 analog monitor 2 offset		This is used to set the offset voltage of MO2 (Analog monitor 2). This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later. Setting range: -9999 to 9999	0 [mV]	○	○	○
Po21 OVCO MR-D01 analog speed command offset/Analog speed limit offset		This is used to set the offset voltage of the analog speed command offset and Analog speed limit offset. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later. Setting range: -9999 to 9999	0 [mV]		○	○
Po22 OTLO MR-D01 analog torque limit offset		This is used to set the offset voltage of the analog torque limit. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later. Setting range: -9999 to 9999	0 [mV]	○	○	○
Po27 *ODI7 MR-D01 input device selection 7	Any input device can be assigned to the CN10-18 pin and CN10-19 pin.					
	_ _ x x	CN10-18 selection Select an input signal function of the CN10-18 pin. Refer to table 5.14 in [Pr. Po02] for setting values. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	2Ch	○	○	○
	x x _ _	CN10-19 selection Select an input signal function of the CN10-19 pin. Refer to table 5.14 in [Pr. Po02] for setting values. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	2Dh	○	○	○
Po28 *ODI8 MR-D01 input device selection 8	Any input device can be assigned to the CN10-20 pin.					
	_ _ x x	CN10-20 selection Select an input signal function of the CN10-20 pin. Refer to table 5.14 in [Pr. Po02] for setting values. This parameter setting is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.	2Eh	○	○	○
	x x _ _	For manufacturer setting	00h			

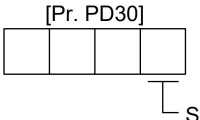
5.3 Stop system when LSP (Forward rotation stroke end) or LSN (Reverse rotation stroke end) is turned off

POINT

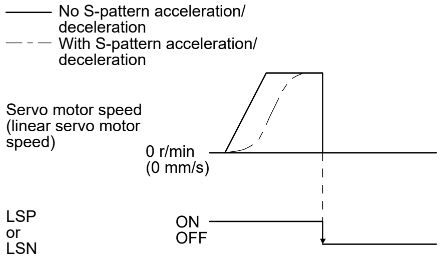
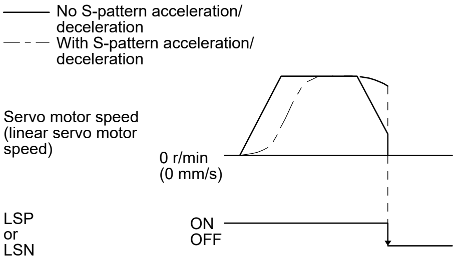
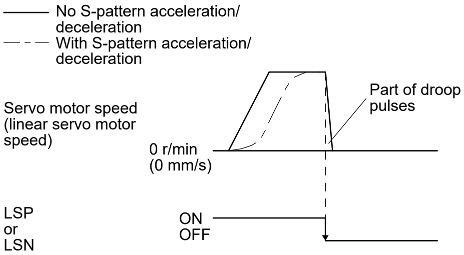
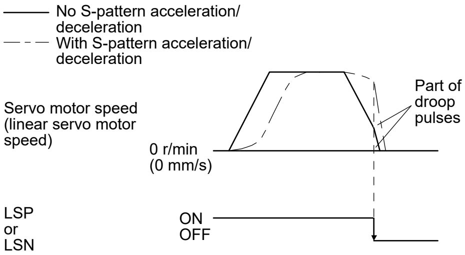
- When LSP/LSN is turned off during forced stop deceleration, the servo motor will stop depending on the setting of [Pr. PD30] as follows.

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

To select how to stop the servo motor when LSP (Forward rotation stroke end) or LSN (Reverse rotation stroke end) is turned off, set the first digit of [Pr. PD30].



Stop method selection for LSP (Forward rotation stroke end) off or LSN (Reverse rotation stroke end) off
0: Quick stop
1: Slow stop

Setting value of [Pr. PD30]	Operation status		Remark
	During rotation at constant speed	During deceleration to a stop	
_ _ _ 0			The servo motor stops after clearing the droop pulses. A difference between the command position and the current position will be generated. Perform home position setting again.
_ _ _ 1 (Note)			The servo motor stops after having traveled for the droop pulses. A difference between the command position and the current position will be generated. Perform home position setting again.

Note. When LSP/LSN is turned off during forced stop deceleration, forced stop deceleration continues.

MEMO

6. NORMAL GAIN ADJUSTMENT

POINT

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

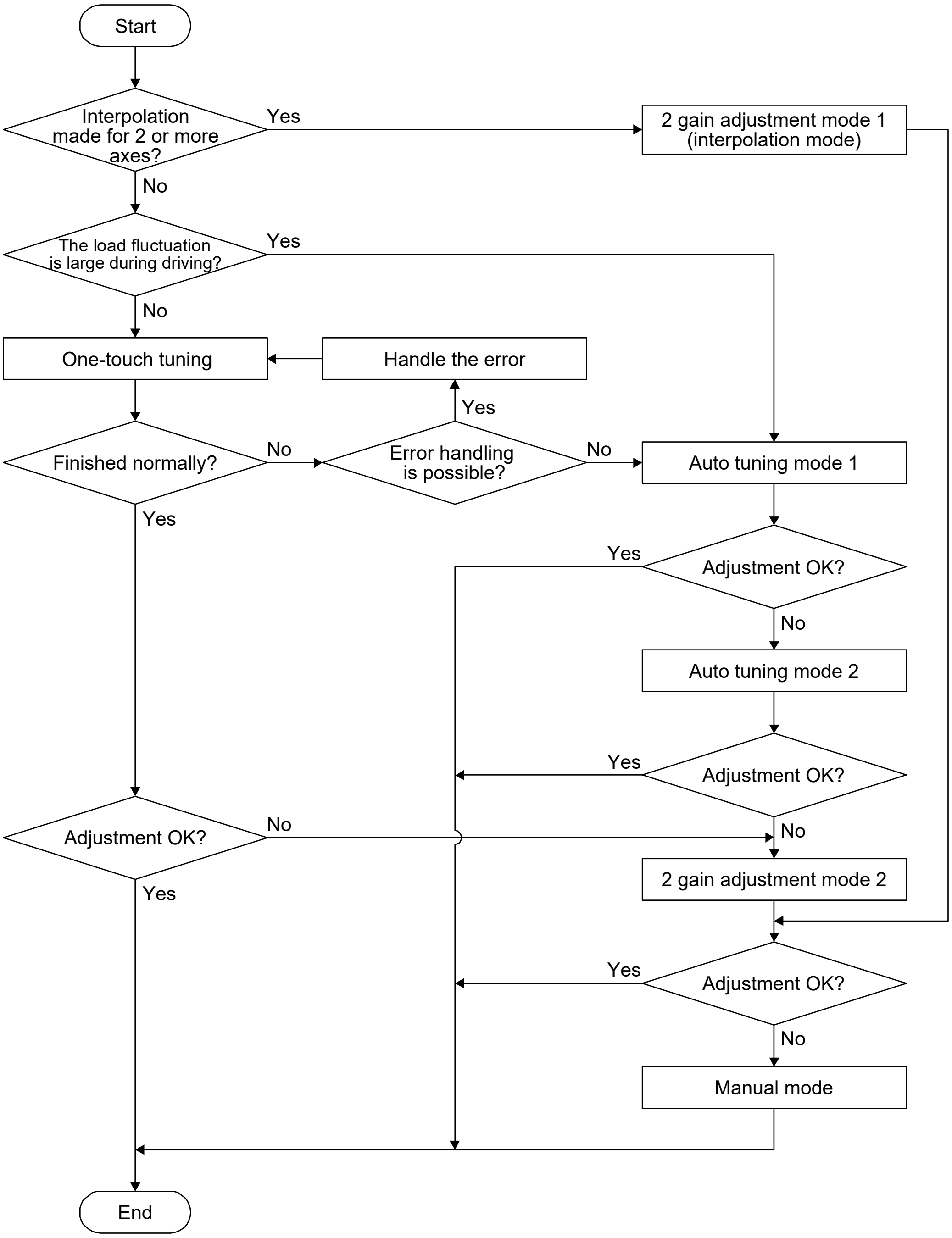
6.1.1 Adjustment on a single servo amplifier

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], 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] will be estimated.
- 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 in the amplifier command method, MR Configurator2 is required.
- For MR-J4-03A6(-RJ) servo amplifier, one-touch tuning by the amplifier command method is not available.

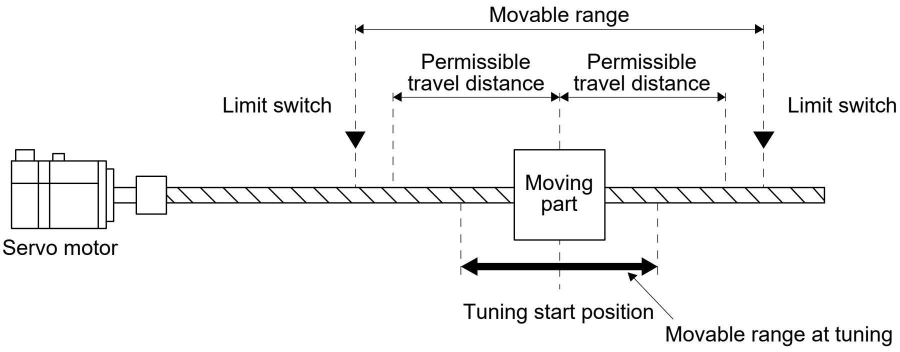
The one-touch tuning includes two methods: the user command method and the amplifier command method.

(1) User command method

You can execute the one-touch tuning with MR Configurator2 or push buttons. The user command method performs one-touch tuning by inputting commands from outside the servo amplifier.

(2) Amplifier command method

You can execute the one-touch tuning with MR Configurator2. 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

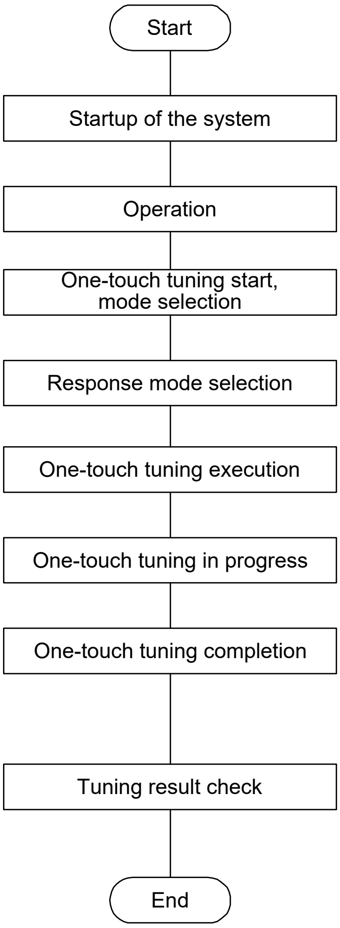
Parameter	Symbol	Name
PA08	ATU	Auto tuning mode
PA09	RSP	Auto tuning response
PB01	FILT	Adaptive tuning mode (adaptive filter II)
PB02	VRFT	Vibration suppression control tuning mode (advanced vibration suppression control II)
PB03	PST	Position command acceleration/ deceleration time constant (position smoothing)
PB06	GD2	Load to motor inertia ratio
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation
PB12	OVA	Overshoot amount compensation
PB13	NH1	Machine resonance suppression filter 1
PB14	NHQ1	Notch shape selection 1
PB15	NH2	Machine resonance suppression filter 2
PB16	NHQ2	Notch shape selection 2
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
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

(a) When you use MR Configurator2

Make one-touch tuning as follows.



Start a system referring to chapter 4.

Rotate the servo motor by a 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.

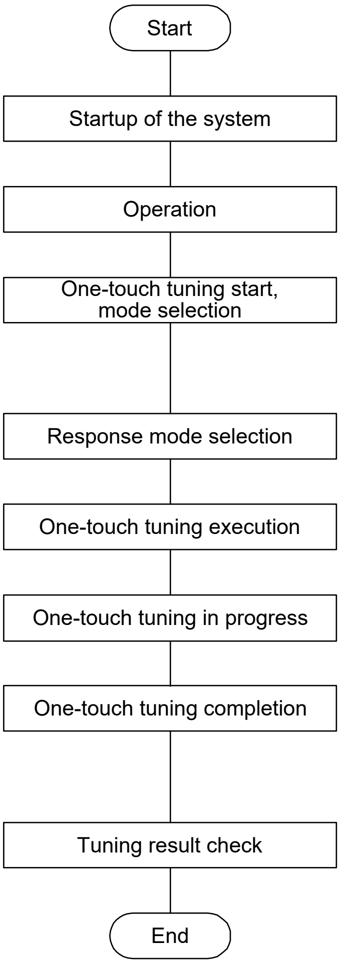
Gains and filters will be adjusted automatically. During processing of tuning, the tuning progress will be displayed in % in MR Configurator2.

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 (1) (e).)

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 (1) (h).)

(b) When you use push buttons

Make one-touch tuning as follows.



Start a system referring to chapter 4.

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

Push the "MODE" button during motor driving to switch to the initial screen ("AUTO.") of the one-touch tuning.
Push the "SET" button for 2 s or more during displaying "AUTO" to switch to the response mode selection ("AUTO.").

Push the "UP" or "DOWN" button to select a response mode from "AUTO.H" (High mode), "AUTO." (Basic mode), or "AUTO.L" (Low mode).

Push the "SET" button to start one-touch tuning. Push the "SET" button during servo motor driving.

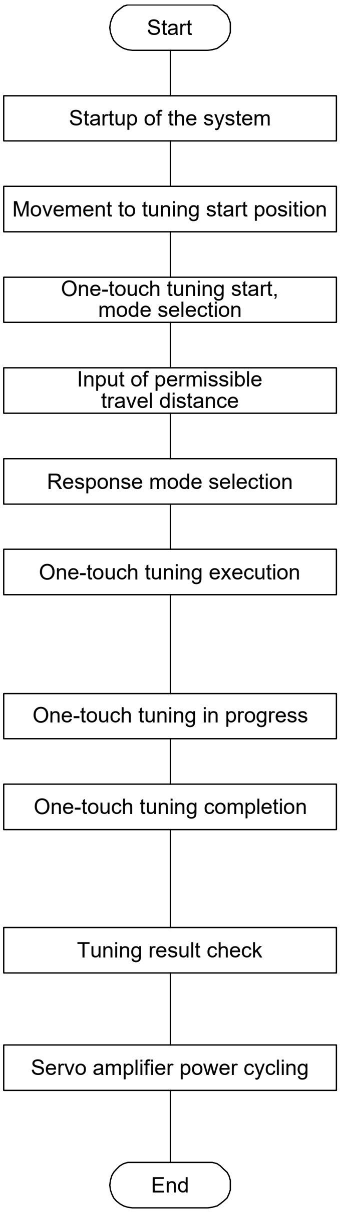
Gains and filters will be adjusted automatically. During processing of tuning, the tuning progress will be displayed in % on the display (five-digit, seven-segment LED).

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 (1) (e) and section 6.2.2 (2) (d).)

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 (2) (g).)

(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 (1) (e).)

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 (1) (h).)

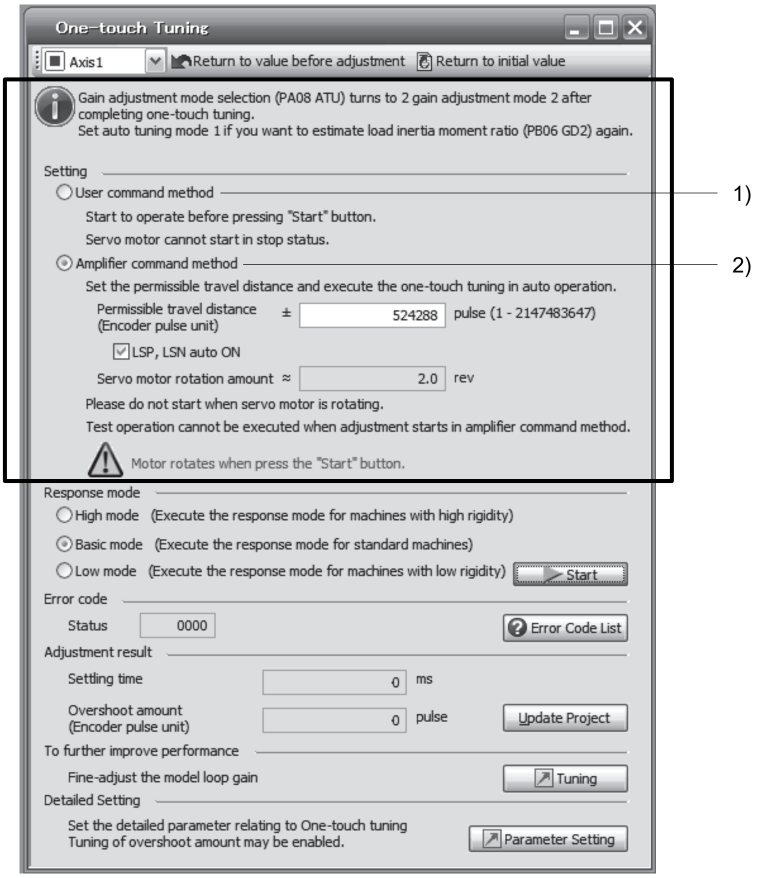
After executing the one-touch tuning, cycling the power of the servo amplifier returns to the state in which control is performed from the controller.

6.2.2 Display transition and operation procedure of one-touch tuning

(1) When you use MR Configurator2

(a) 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.

1) 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.

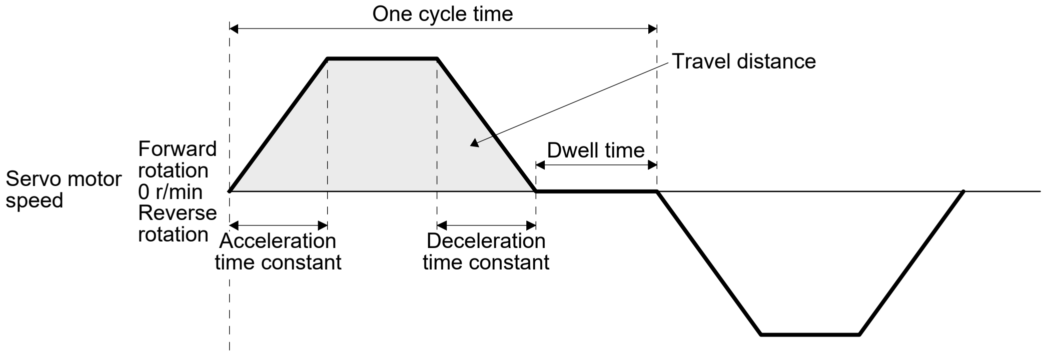


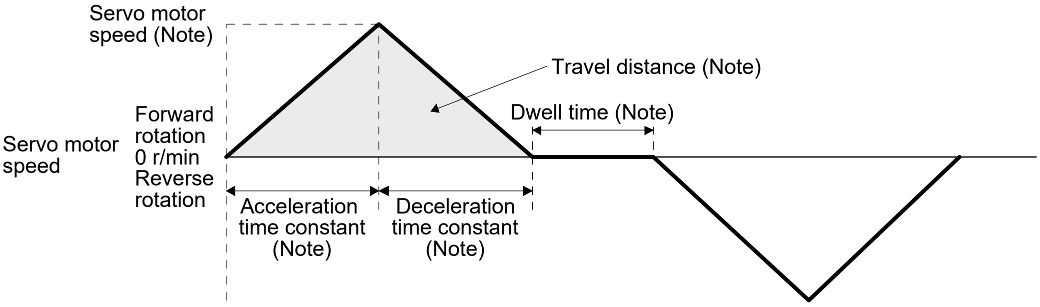
Fig. 6.1 Recommended command for one-touch tuning in the user command method

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 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".

2) 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.



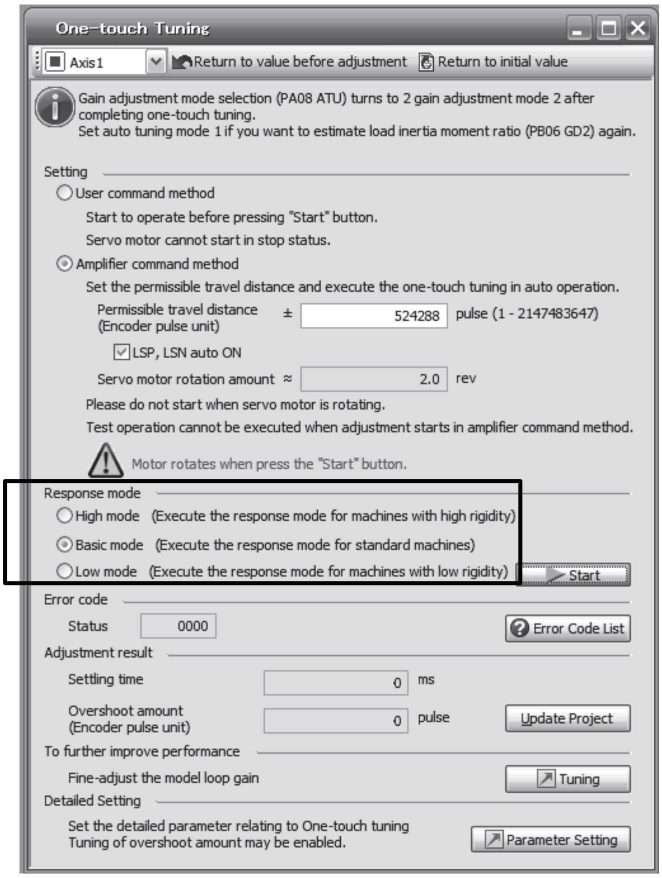
Note. It will be automatically generated in the servo amplifier.

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 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.

(b) 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

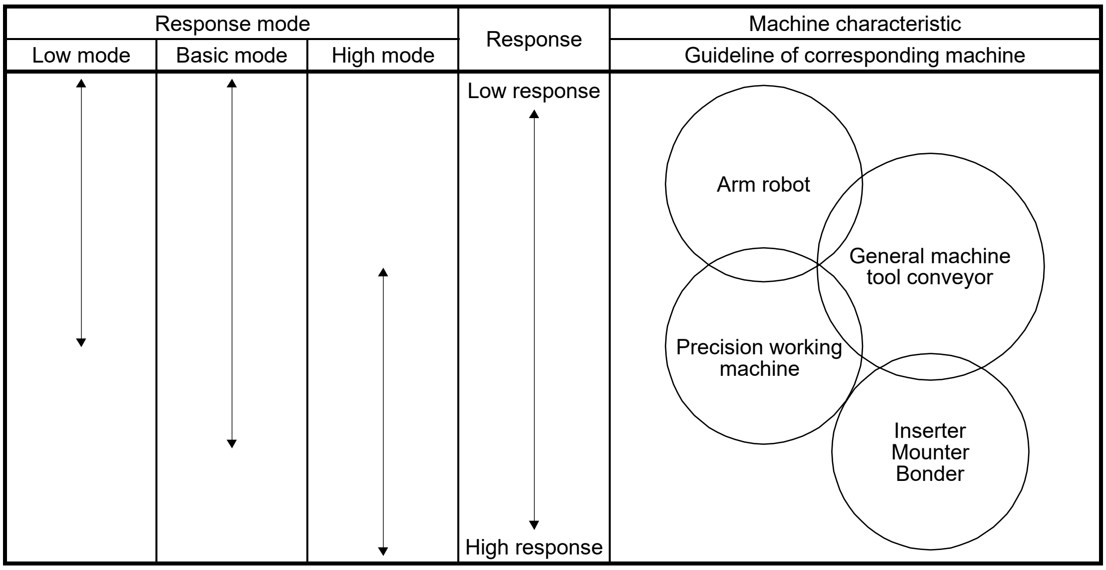
Set the detailed parameter relating to One-touch tuning
Tuning of overshoot amount may be enabled.

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



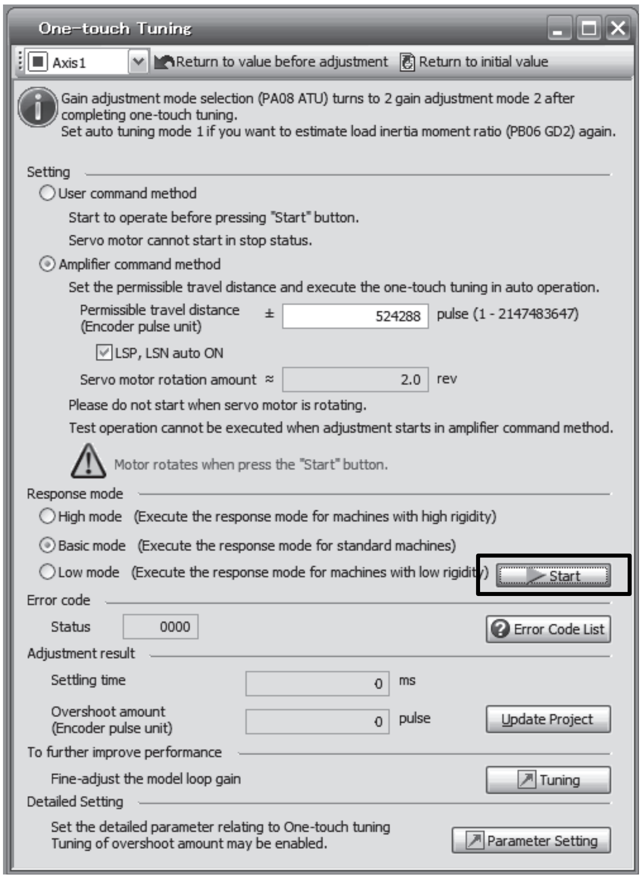
(c) One-touch tuning execution

> 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, LSP, and LSN. When you turn off EM2, LSP, and LSN during one-touch tuning, "C008" will be displayed at status in error code, and the one-touch tuning will be canceled. When setting LSP and LSN to automatic on, enable the check box "LSP, LSN auto ON" in the one-touch tuning window of MR Configurator2.
> - ●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 (1) (b) 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 (1) (e) 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 from the controller, 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)

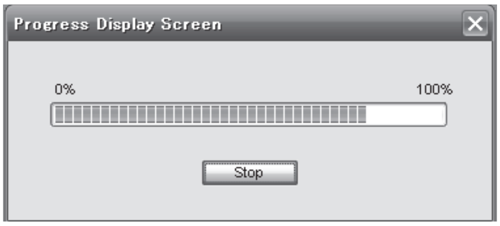
Error code
Status 0000

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

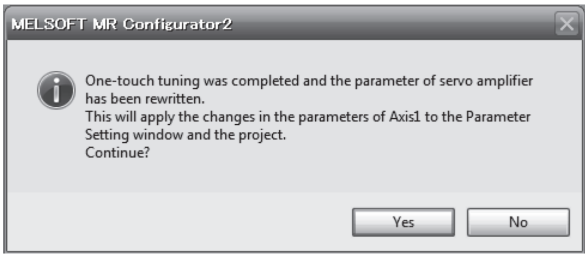
To further improve performance
Fine-adjust the model loop gain

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%.

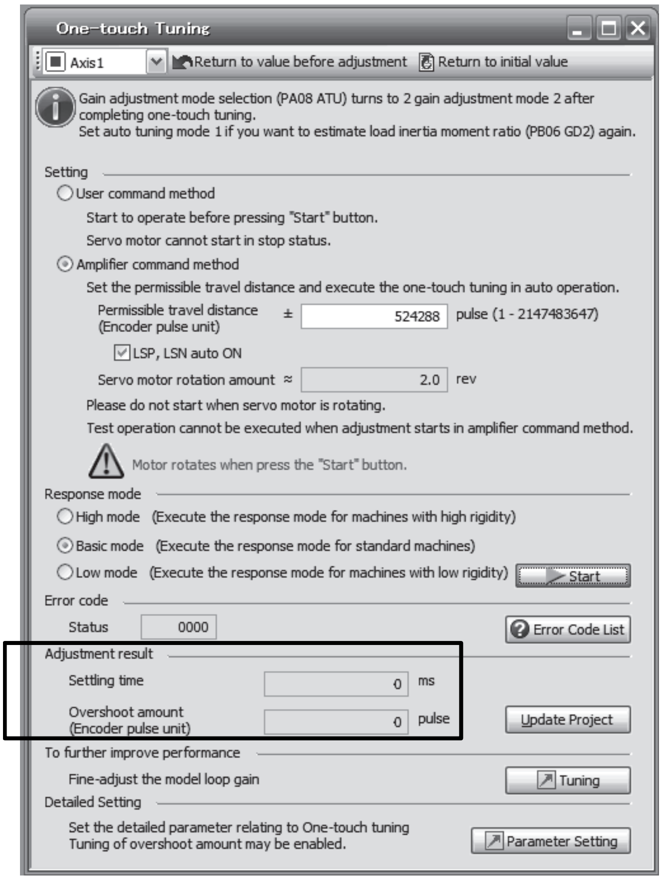


Completing the one-touch tuning will start writing tuning parameters to the servo amplifier, and the following window will be displayed. Select whether or not to reflect the tuning result in the project.



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".



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.

(d) Stop of one-touch tuning

During one-touch tuning, clicking the stop button stops one-touch tuning. If the one-touch tuning is stopped, "C000" will be displayed at status in error code. After the one-touch tuning is stopped, parameters will return to the values at the start of the one-touch tuning. To stop one-touch tuning, and execute it again, stop the servo motor once. In addition, after returning the moving part to the tuning start position, execute it.

(e) If an error occurs

If a tuning error occurs during the one-touch tuning, the 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	The stop button 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, 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]. ・Set [Pr. PB06 Load to motor inertia ratio/load to motor mass ratio] properly with manual setting.

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 (mm/s) 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. The torque limit has been set to 0.	Set the torque limit value to greater than 0.
C008	Stop signal	EM2, LSP, and LSN were 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, LSP, and LSN.
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)".

(f) 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.

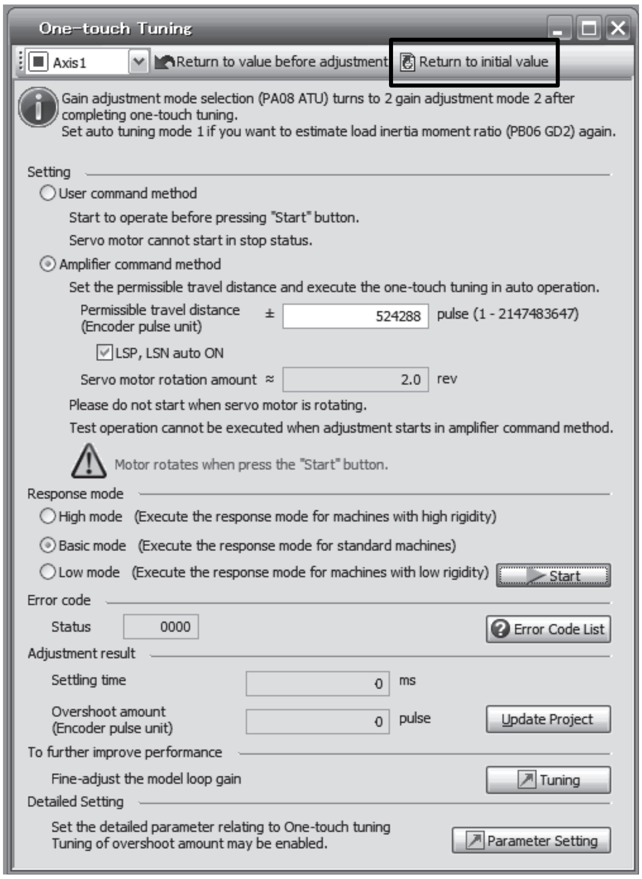
(g) If a warning occurs

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.

(h) 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.

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.

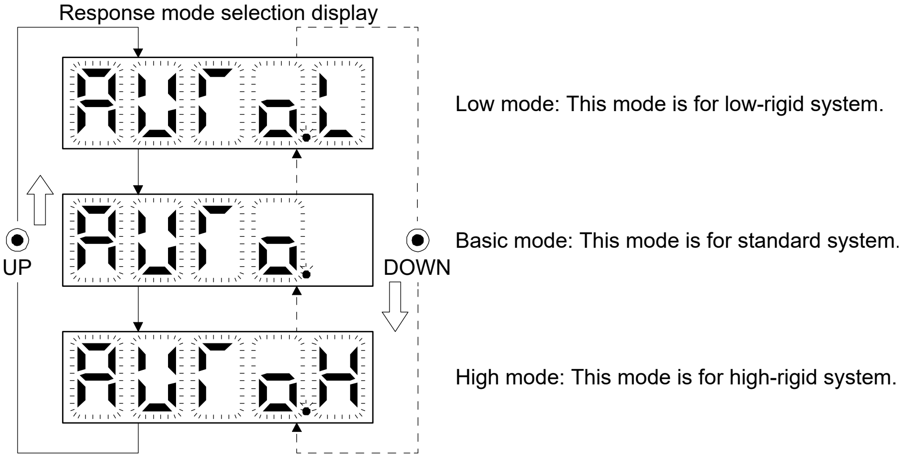
(2) When you use push buttons

POINT

- ●Push the "MODE" and "SET" buttons at the same time for 3 s or more to switch to the response mode selection ("AUTO.") without going through the initial screen of the one-touch tuning ("AUTO").
- ●When you use push buttons, one-touch tuning can be executed in the user command method only. Tuning cannot be executed in the amplifier command method with the buttons.

(a) Response mode selection

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

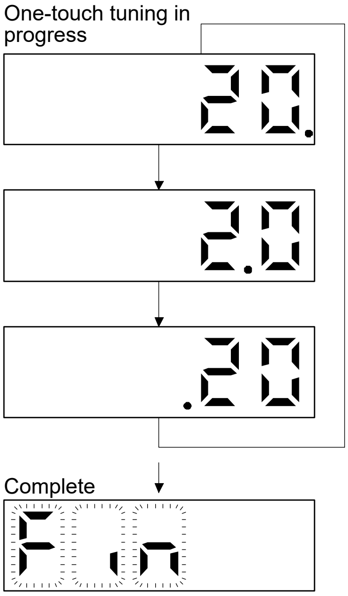


(b) One-touch tuning execution

POINT

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

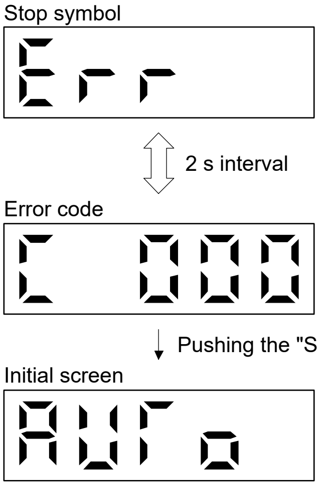
After the response mode is selected in (a), pushing the "SET" button will start one-touch tuning.



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

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

(c) Stop of one-touch tuning

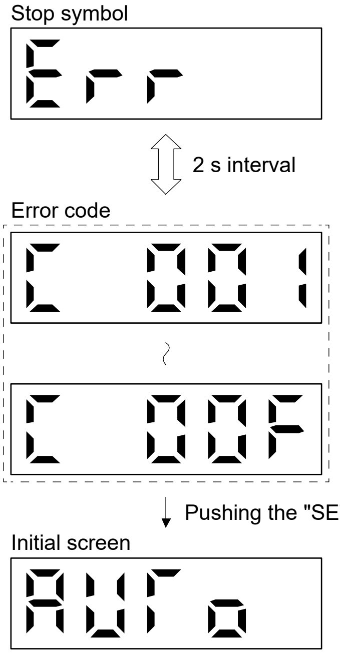


The one-touch tuning mode can be stopped by pushing the "SET" button regardless of displayed item.

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

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

(d) If an error occurs

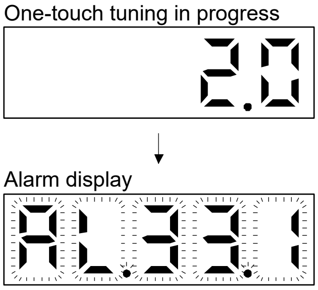


If an error occurs during the one-touch tuning, the tuning will be forcibly terminated and the stop symbol and error code from "C 001" to "C 00F" will be displayed by turns with 2 s interval.

Check the error cause referring to the table 6.2 of (1) (e) in this section.

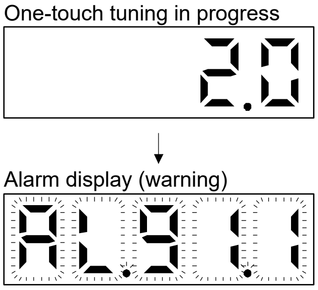
Pushing the "SET" button will switch to the initial screen.

(e) If an alarm occurs



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

(f) If a warning occurs



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

(g) Clearing one-touch tuning

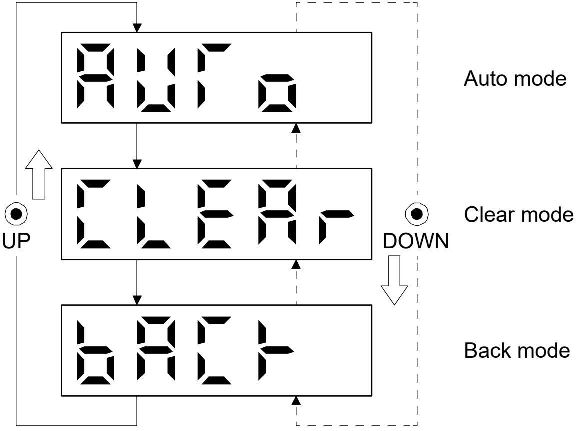
Refer to table 6.1 for the parameters which you can clear.

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

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

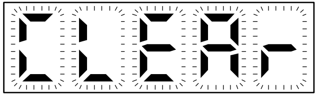
2) Select the clear mode or back mode with the "UP" or "DOWN" button.

One-touch tuning clear mode selection



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

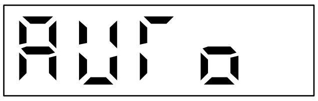
One-touch tuning clear mode display (initializing)



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

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

Initial screen



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

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

(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

5) Single-step feed

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

(d) 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.

(e) When one-touch tuning is started by using communication, if the 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.

(f) 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
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

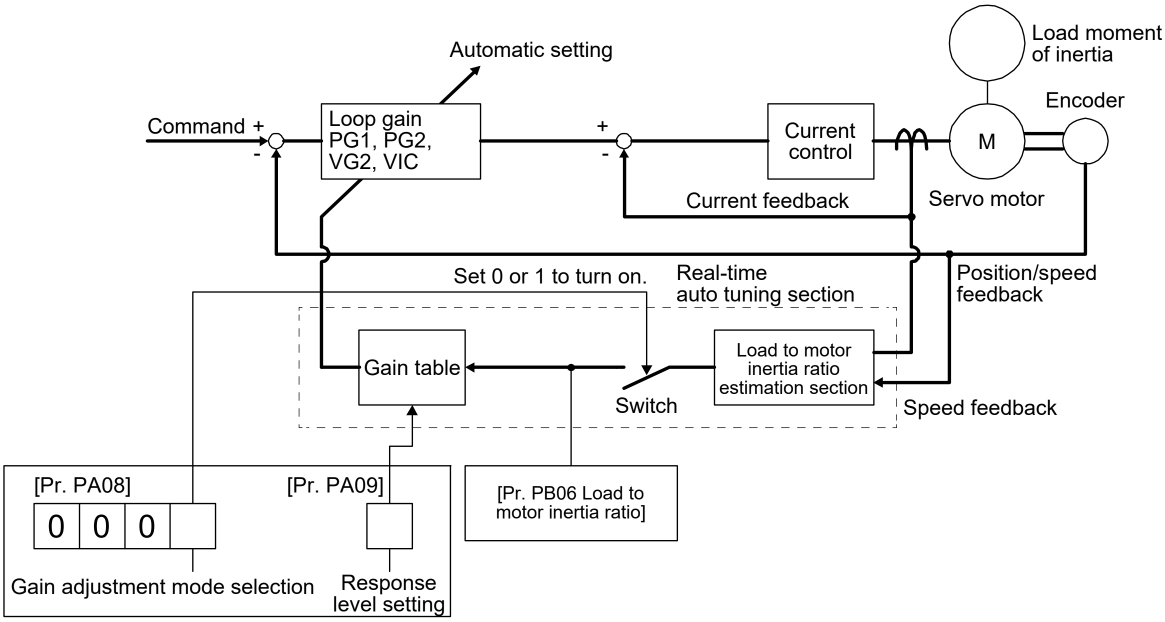
Use the auto tuning mode 2 when proper gain adjustment cannot be made by auto tuning mode 1. Since the load to motor inertia ratio is not estimated in this mode, set the value of a correct load to motor inertia ratio in [Pr. PB06].

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.



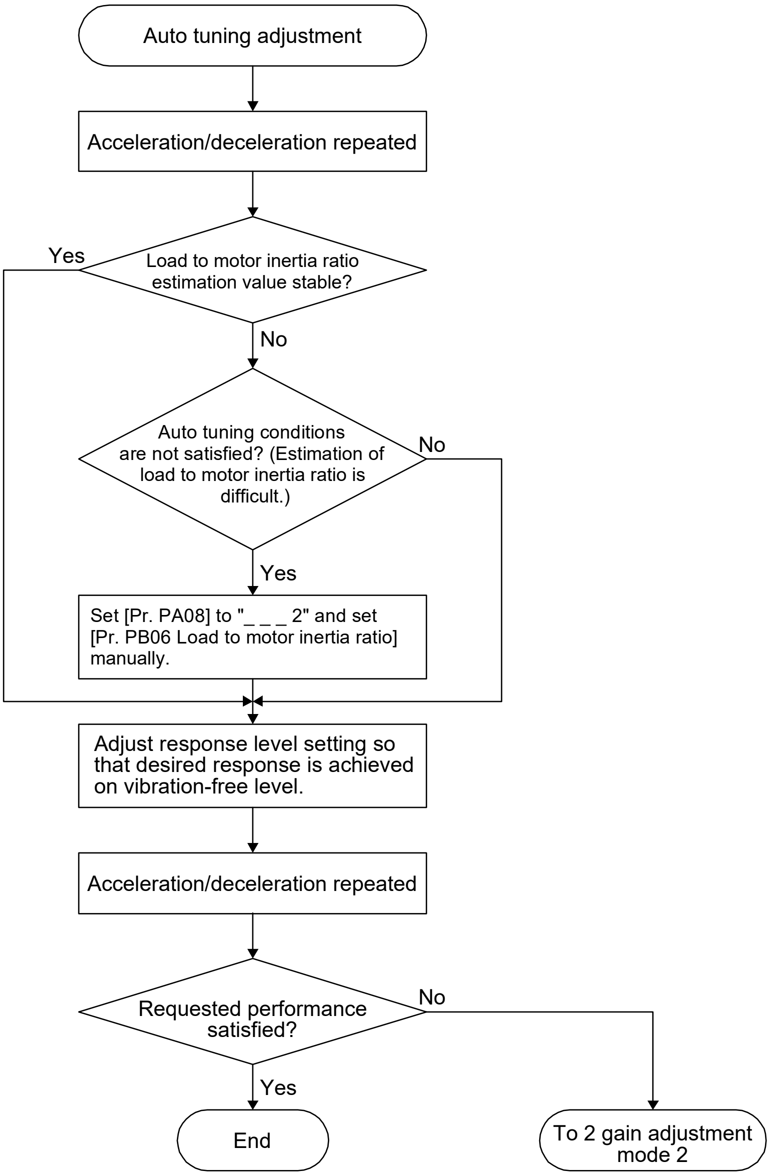
When a servo motor is accelerated/decelerated, the load to motor inertia ratio estimation section always estimates the load to motor inertia ratio from the current and speed of the servo motor. The results of estimation are written to [Pr. PB06 Load to motor inertia ratio]. These results can be confirmed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

POINT

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

6.3.3 Adjustment procedure by auto tuning

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



6.3.4 Response level setting in auto tuning mode

Set the response of the whole servo system by [Pr. PA09]. As the response level setting is increased, 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
PB07	PG1	Model loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

(b) Adjustment procedure

Step	Operation	Description
1	Brief-adjust with auto tuning. Refer to section 6.2.3.	
2	Change the setting of auto tuning to the manual mode ([Pr. PA08]: _ _ _ 3).	
3	Set the estimated value to the load to motor inertia ratio. (If the estimate value with auto tuning is correct, setting change is not required.)	
4	Set a 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
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. (If the estimate value with auto tuning is correct, setting change is not required.)	
4	Set a small value to the model loop gain and the position 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.

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

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

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

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

(2) 2 gain adjustment mode 2

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

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

(a) Automatically adjusted parameter

The following parameters are automatically adjusted by auto tuning.

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

(b) Manually adjusted parameter

The following parameters are adjustable manually.

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

(3) Adjustment procedure of 2 gain adjustment mode

POINT

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

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

Position command frequency

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

7. SPECIAL ADJUSTMENT FUNCTIONS

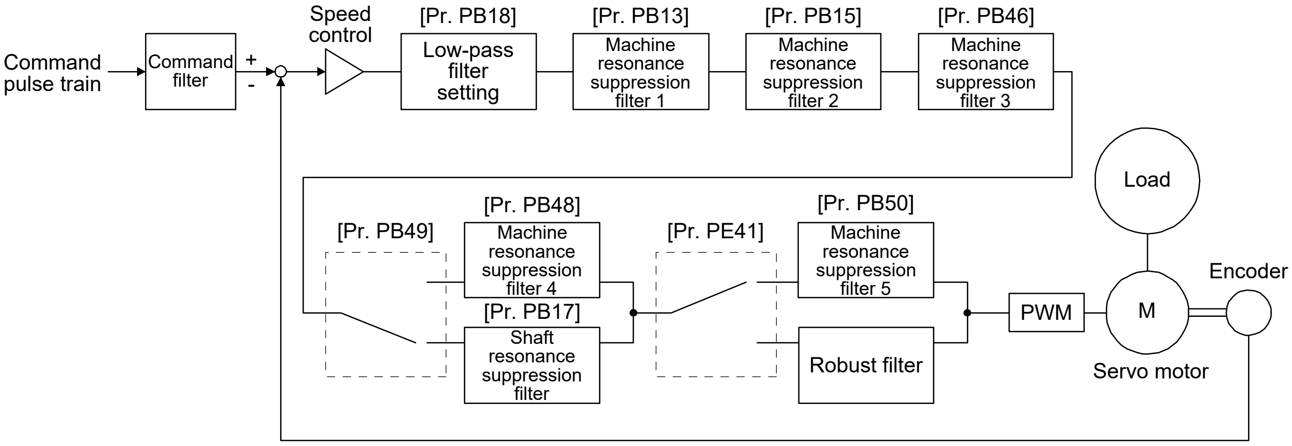
POINT

- ●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

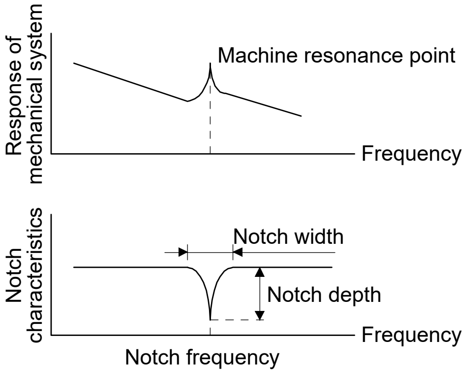
POINT

- ●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]).

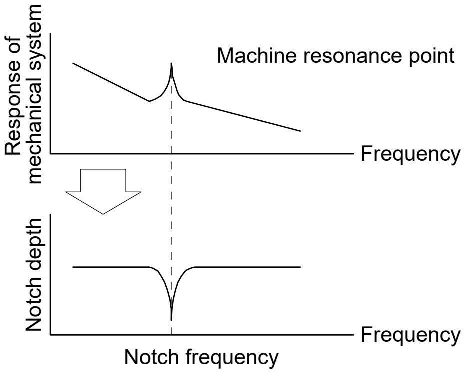
7.1.2 Adaptive filter II

POINT

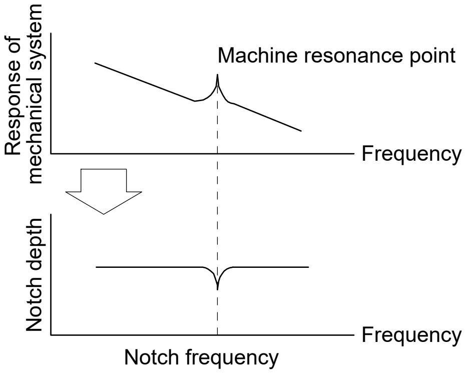
- The machine resonance frequency which adaptive filter II (adaptive tuning) can respond to is about 100 Hz to 2.25 kHz. As for the resonance frequency out of the range, set manually.
- When adaptive tuning is executed, vibration sound increases as an excitation signal is forcibly applied for several 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.



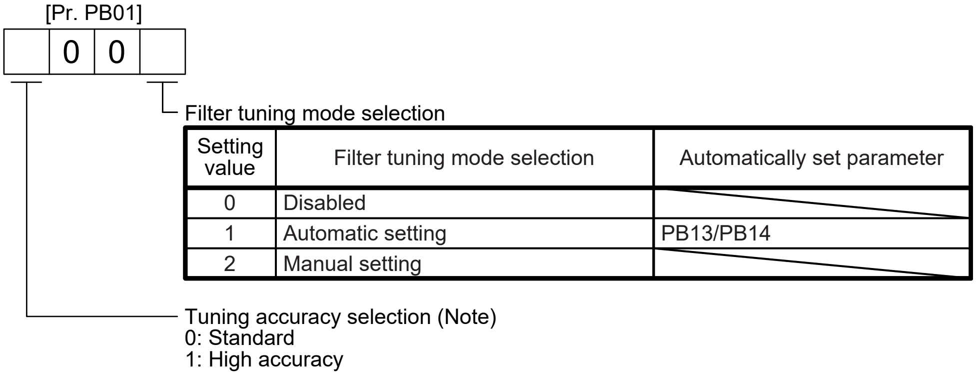
When machine resonance is large and frequency is low



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)].



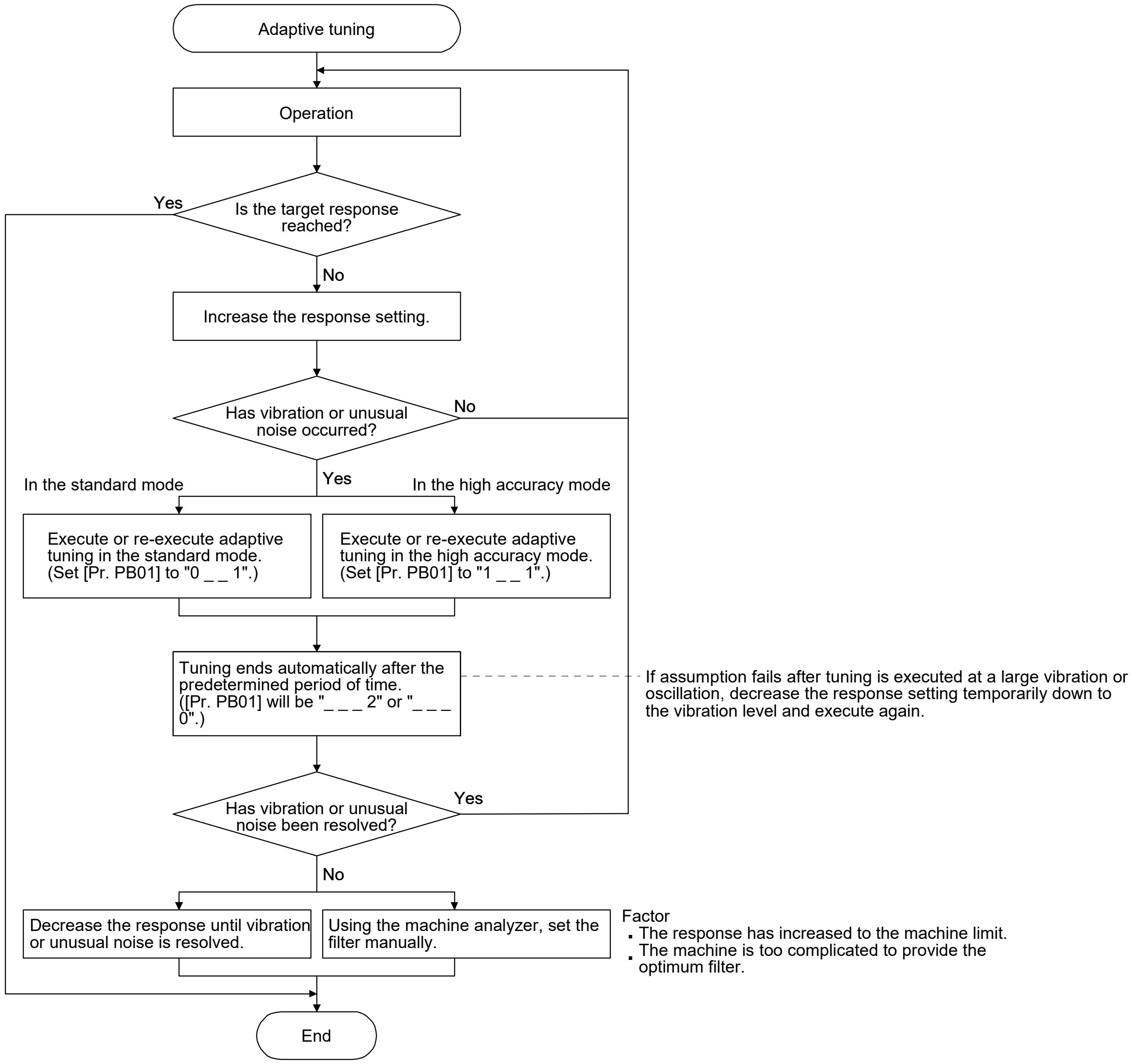
Filter tuning mode selection

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



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 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.

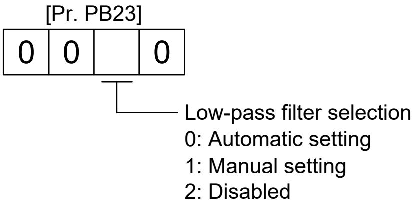
$$\text{Filter frequency ([rad/s])} = \frac{\text{VG2}}{1 + \text{GD2}} \times 10$$

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].



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

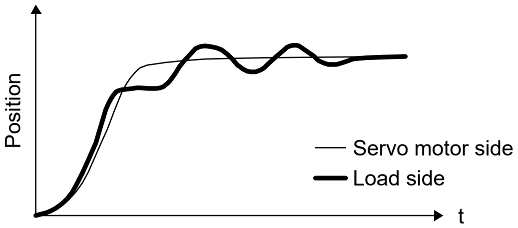
7.1.5 Advanced vibration suppression control II

POINT

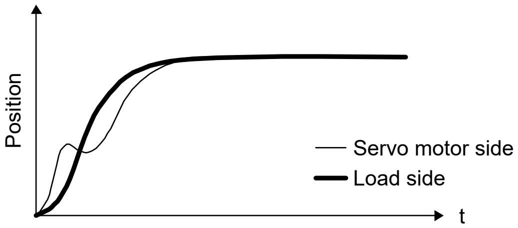
- ●The function is enabled when "Gain adjustment mode selection" in [Pr. PA08] is "Auto tuning mode 2 (_ _ _ 2)", "Manual mode (_ _ _ 3)", or "2 gain adjustment mode 2 (_ _ _ 4)".
- ●The machine resonance frequency supported in the vibration suppression control tuning mode is 1.0 Hz to 100.0 Hz. As for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

(1) Function

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

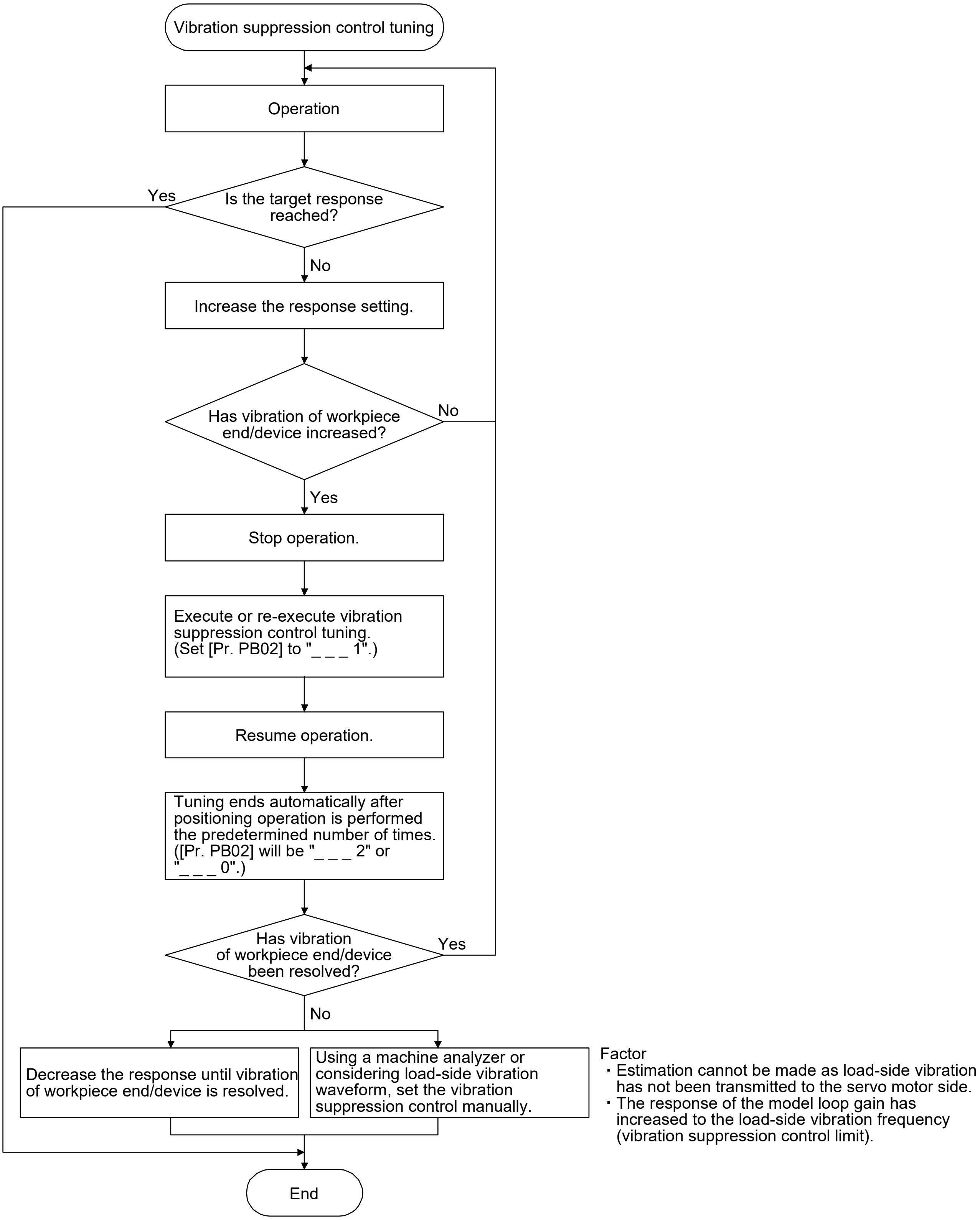
Setting value	Vibration suppression control 1 tuning mode selection	Automatically set parameter
_ _ _ 0	Disabled	
_ _ _ 1	Automatic setting	PB19/PB20/PB21/PB22
_ _ _ 2	Manual setting	

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]

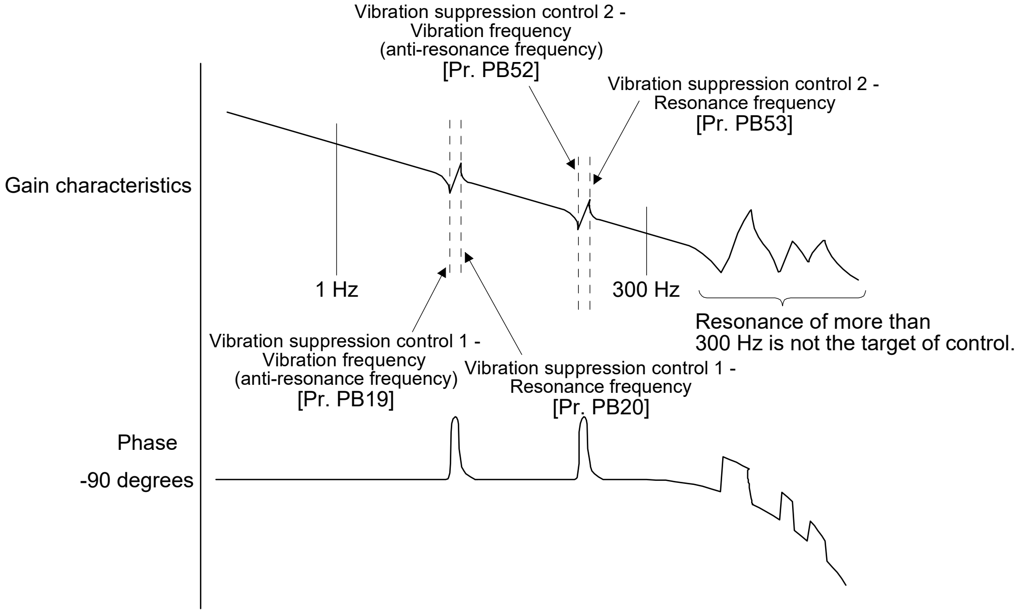
Step 1 Select "Manual setting (_ _ _ 2)" of "Vibration suppression control 1 tuning mode selection" or "Manual setting (_ _ 2 _)" of "Vibration suppression control 2 tuning mode selection" in [Pr. PB02].

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

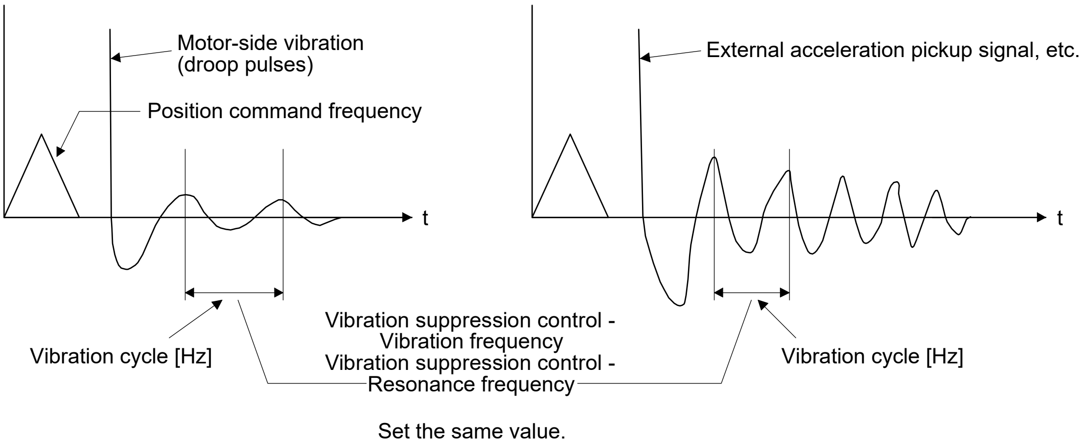
However, the value of [Pr. PB07 Model loop gain], vibration frequency, and resonance frequency have the following usable range and recommended range.

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".

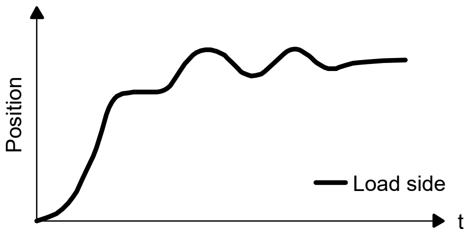
7.1.6 Command notch filter

POINT

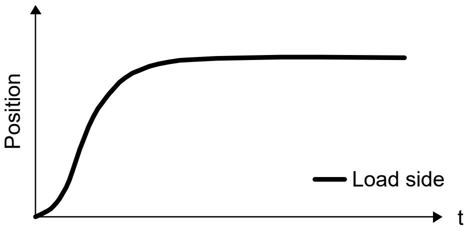
- By using the advanced vibration suppression control II and the command notch filter, the load-side vibration of three frequencies can be suppressed.
- The frequency range of machine vibration, which can be supported by the command notch filter, is between 4.5 Hz and 2250 Hz. Set a frequency close to 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.



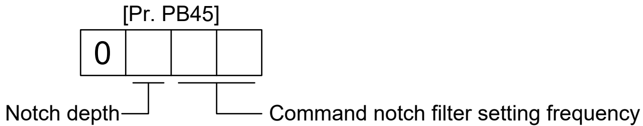
Command notch filter: disabled



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 an input device to switch gains during operation.

7.2.1 Applications

The following shows when you use the function.

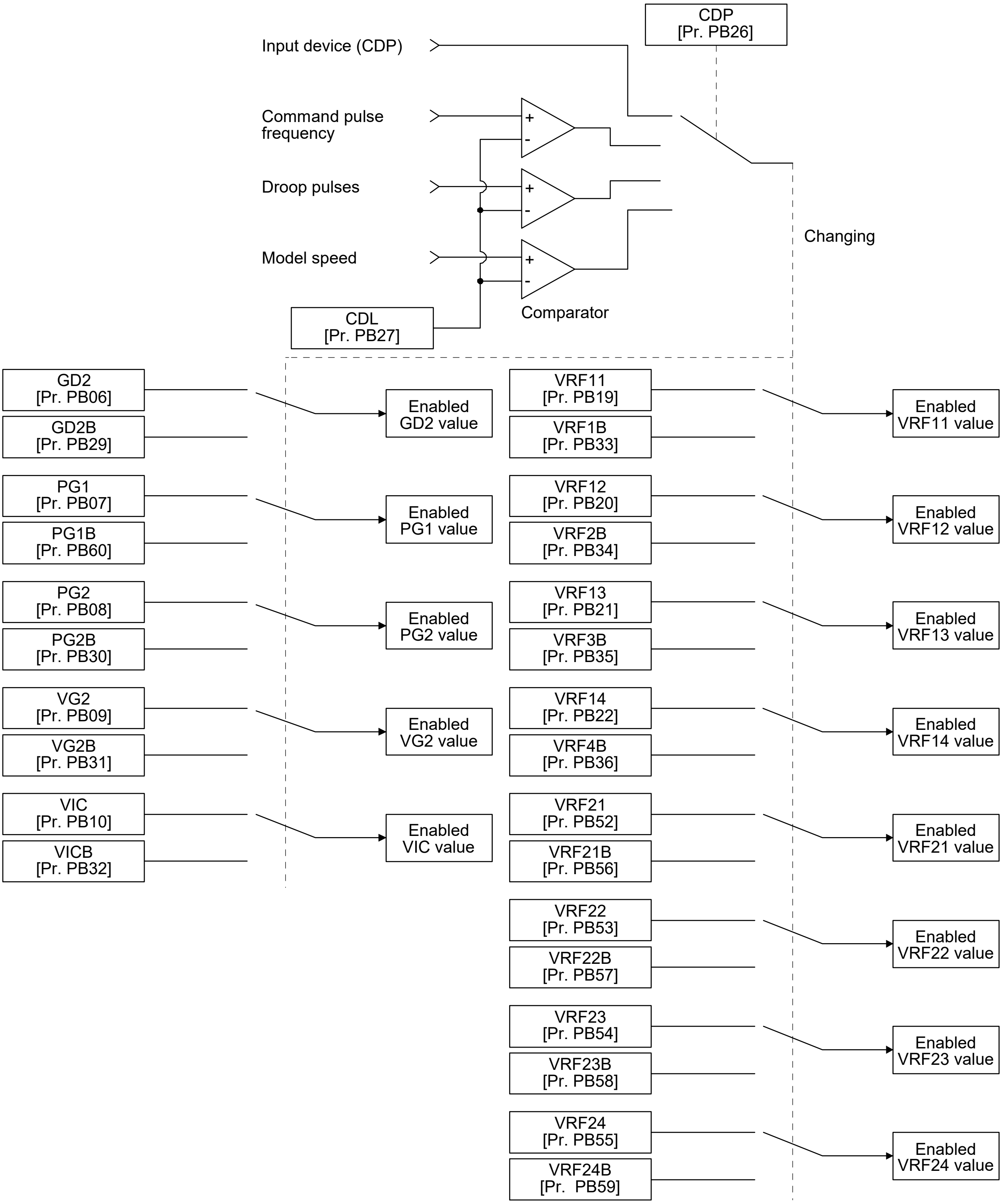
(1) You want to increase the gains during servo-lock but decrease the gains to reduce noise during rotation.

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

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

7.2.2 Function block diagram

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



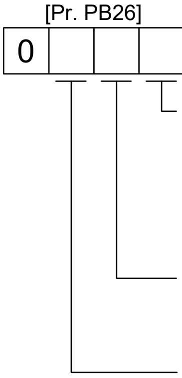
7.2.3 Parameter

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

(1) Parameter for setting gain switching condition

Parameter	Symbol	Name	Unit	Description
PB26	CDP	Gain switching 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: Input device (gain switching (CDP))
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 parameter setting is available with servo amplifiers with software version B4 or later.

(b) [Pr. PB27 Gain switching condition]
Set a level to switch gains with [Pr. PB27] after you select "Command frequency", "Droop pulses", or "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	[r/min]

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

(2) Switchable gain parameter

Loop gain	Before switching			After switching		
	Parameter	Symbol	Name	Parameter	Symbol	Name
Load to motor inertia ratio/ load to motor mass ratio	PB06	GD2	Load to motor inertia ratio/ load to motor mass ratio	PB29	GD2B	Load to motor inertia ratio/ load to motor mass ratio
Model loop gain	PB07	PG1	Model loop gain	PB60	PG1B	Model loop gain after gain switching
Position loop gain	PB08	PG2	Position loop gain	PB30	PG2B	Position loop gain after gain switching
Speed loop gain	PB09	VG2	Speed loop gain	PB31	VG2B	Speed loop gain after gain switching
Speed integral compensation	PB10	VIC	Speed integral compensation	PB32	VICB	Speed integral compensation after gain switching
Vibration suppression control 1 - Vibration frequency	PB19	VRF11	Vibration suppression control 1 - Vibration frequency	PB33	VRF1B	Vibration suppression control 1 - Vibration frequency after gain switching
Vibration suppression control 1 - Resonance frequency	PB20	VRF12	Vibration suppression control 1 - Resonance frequency	PB34	VRF2B	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	VRF3B	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	VRF4B	Vibration suppression control 1 - Resonance frequency damping after gain switching
Vibration suppression control 2 - Vibration frequency	PB52	VRF21	Vibration suppression control 2 - Vibration frequency	PB56	VRF21B	Vibration suppression control 2 - Vibration frequency after gain switching
Vibration suppression control 2 - Resonance frequency	PB53	VRF22	Vibration suppression control 2 - Resonance frequency	PB57	VRF22B	Vibration suppression control 2 - Resonance frequency after gain switching
Vibration suppression control 2 - Vibration frequency damping	PB54	VRF23	Vibration suppression control 2 - Vibration frequency damping	PB58	VRF23B	Vibration suppression control 2 - Vibration frequency damping after gain switching
Vibration suppression control 2 - Resonance frequency damping	PB55	VRF24	Vibration suppression control 2 - Resonance frequency damping	PB59	VRF24B	Vibration suppression control 2 - Resonance frequency damping after gain switching

(a) [Pr. PB06] to [Pr. PB10]
These parameters are the same as in ordinary manual adjustment. Gain switching allows the values of load to motor inertia ratio, position loop gain, model 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 after gain switching]
Set the load to motor inertia ratio after gain switching. If the load to motor inertia ratio does not change, set it to the same value as [Pr. PB06 Load to motor inertia ratio].

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

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

7.2.4 Gain switching procedure

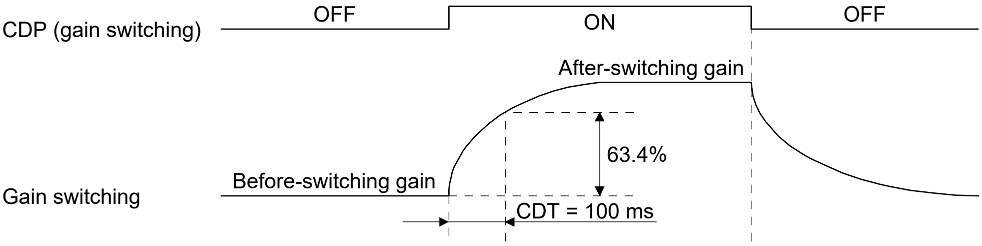
This operation will be described by way of setting examples.

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

(a) Setting 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 input device (CDP) on/off.)	
PB28	CDT	Gain switching time constant	100	[ms]
PB33	VRF1B	Vibration suppression control 1 - Vibration frequency after gain switching	60	[Hz]
PB34	VRF2B	Vibration suppression control 1 - Resonance frequency after gain switching	60	[Hz]
PB35	VRF3B	Vibration suppression control 1 - Vibration frequency damping after gain switching	0.15	
PB36	VRF4B	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

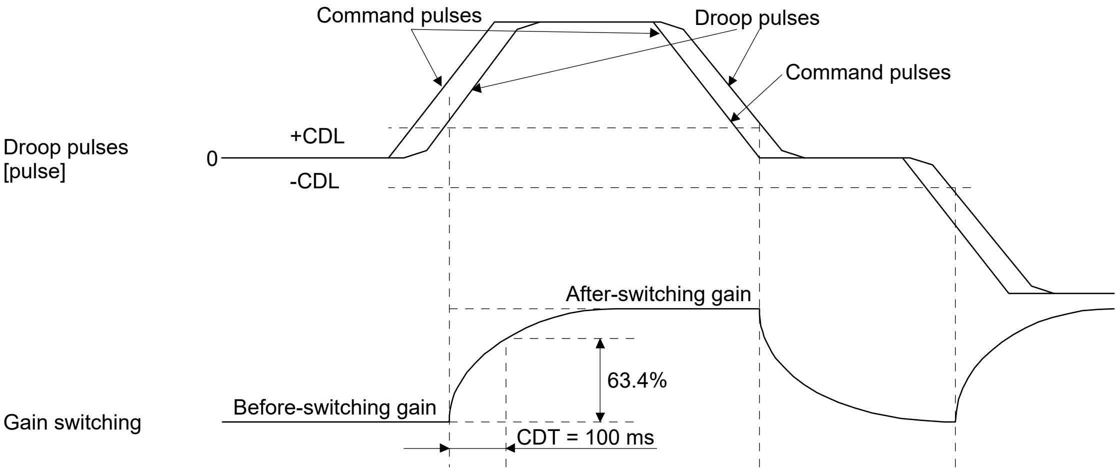
(2) When you choose switching by droop pulses

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



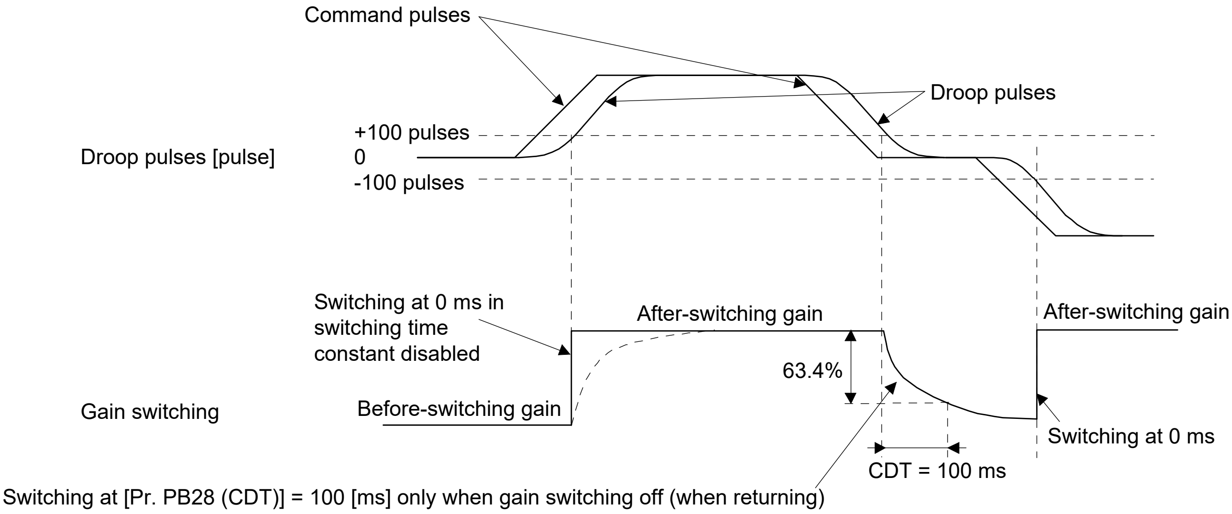
Load to motor inertia ratio	4.00	→	10.00	→	4.00	→	10.00
Position loop gain	120	→	84	→	120	→	84
Speed loop gain	3000	→	4000	→	3000	→	4000
Speed integral compensation	20	→	50	→	20	→	50

(3) When the gain switching time constant is disabled

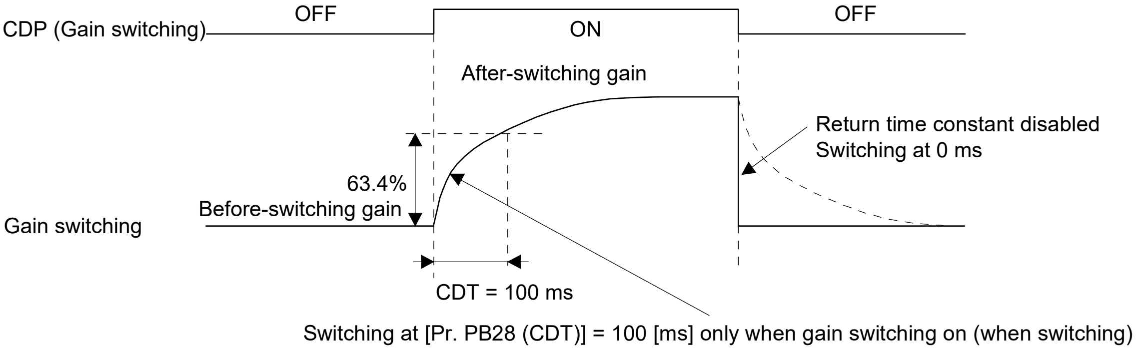
(a) Switching time constant disabled was selected.

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)

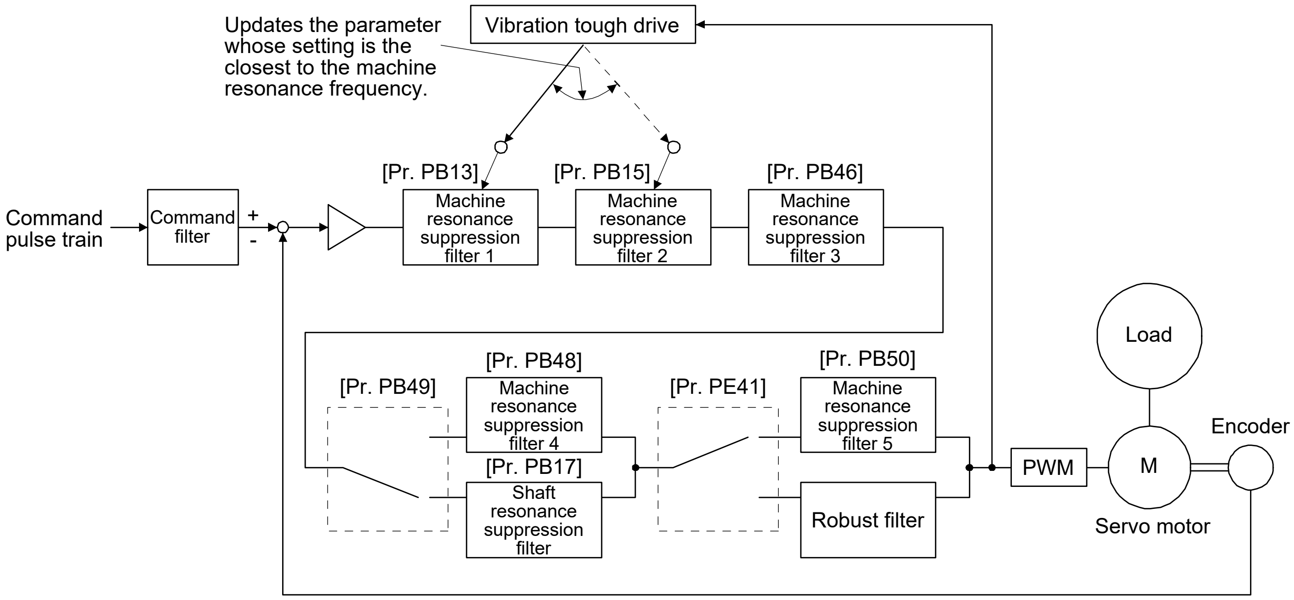
The vibration tough drive function operates when a detected machine resonance frequency is within ±30% for a value set in [Pr. PB13 Machine resonance suppression filter 1] or [Pr. PB15 Machine resonance suppression filter 2].
To set a detection level of the function, set sensitivity in [Pr. PF23 Vibration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

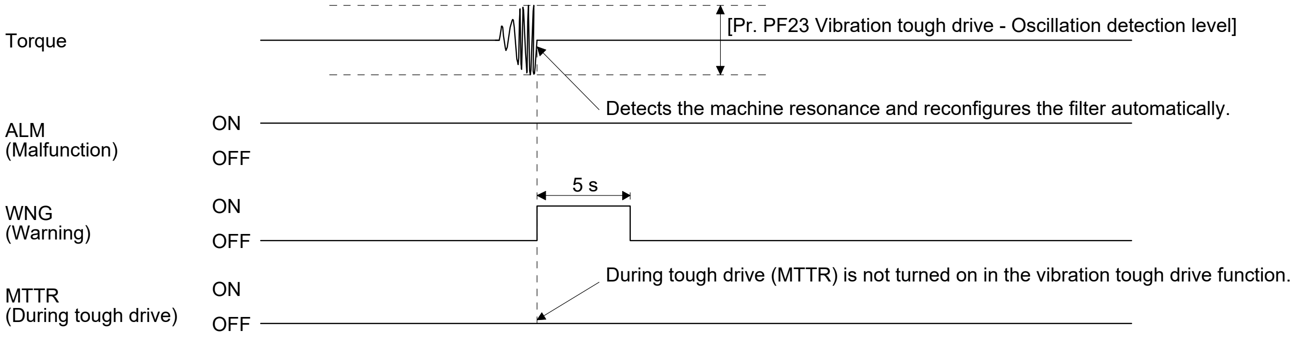
POINT

- 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. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.
- MR-J4-03A6(-RJ) servo amplifier is not compatible with instantaneous power failure tough drive.
- 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 earlier: Setting range 30 ms to 200 ms
  - Software version C1 or later: Setting range 30 ms to 500 ms

  To comply with SEMI-F47 standard, it is unnecessary to change the initial value (200 ms).

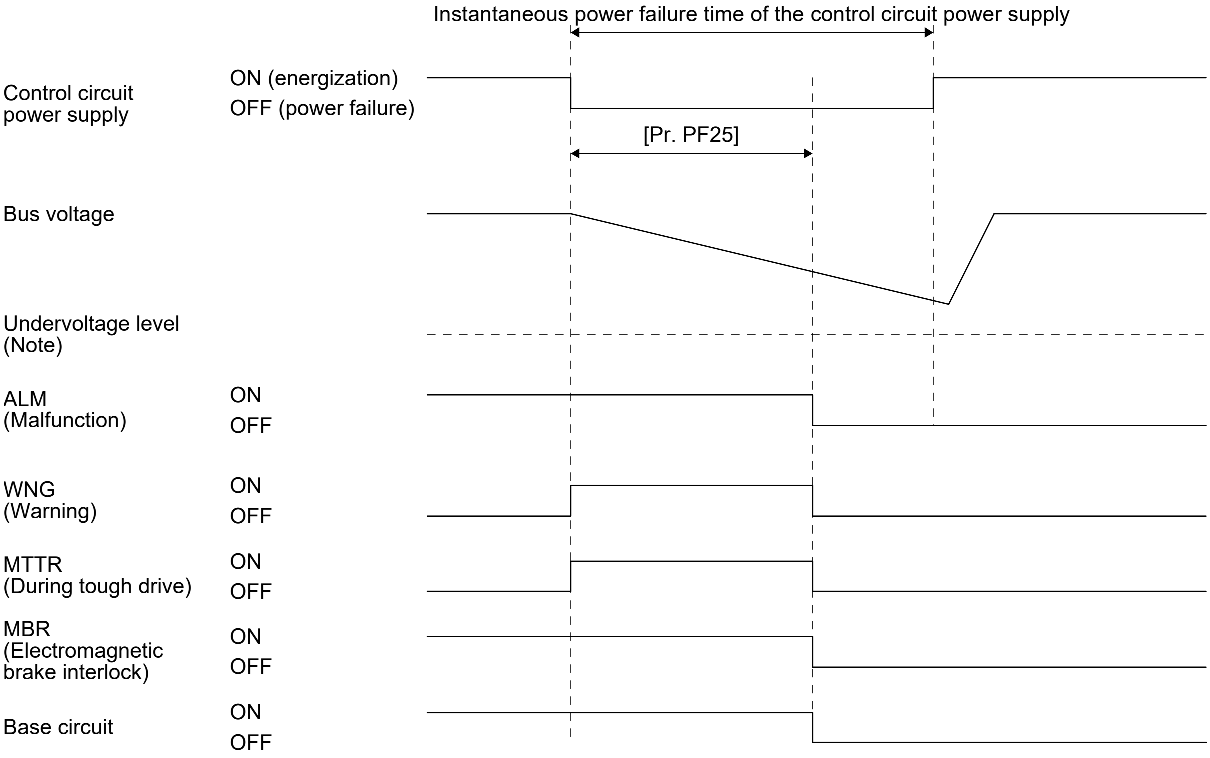
  When the instantaneous power failure time exceeds 200 ms, and if the instantaneous power failure voltage is less than 70 % of the rated input voltage, the power may be turned off normally even if a value larger than 200 ms is set in the parameter.

(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.



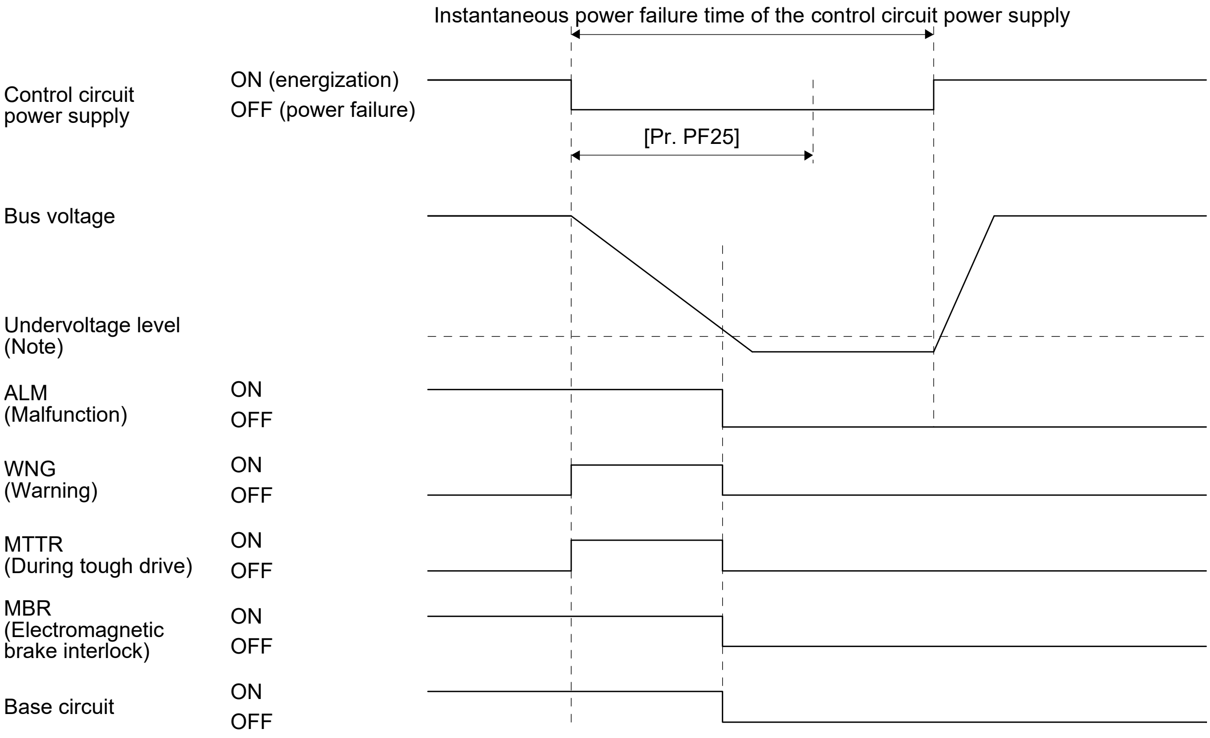
Note. Refer to table 7.1 for the undervoltage level.

(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.

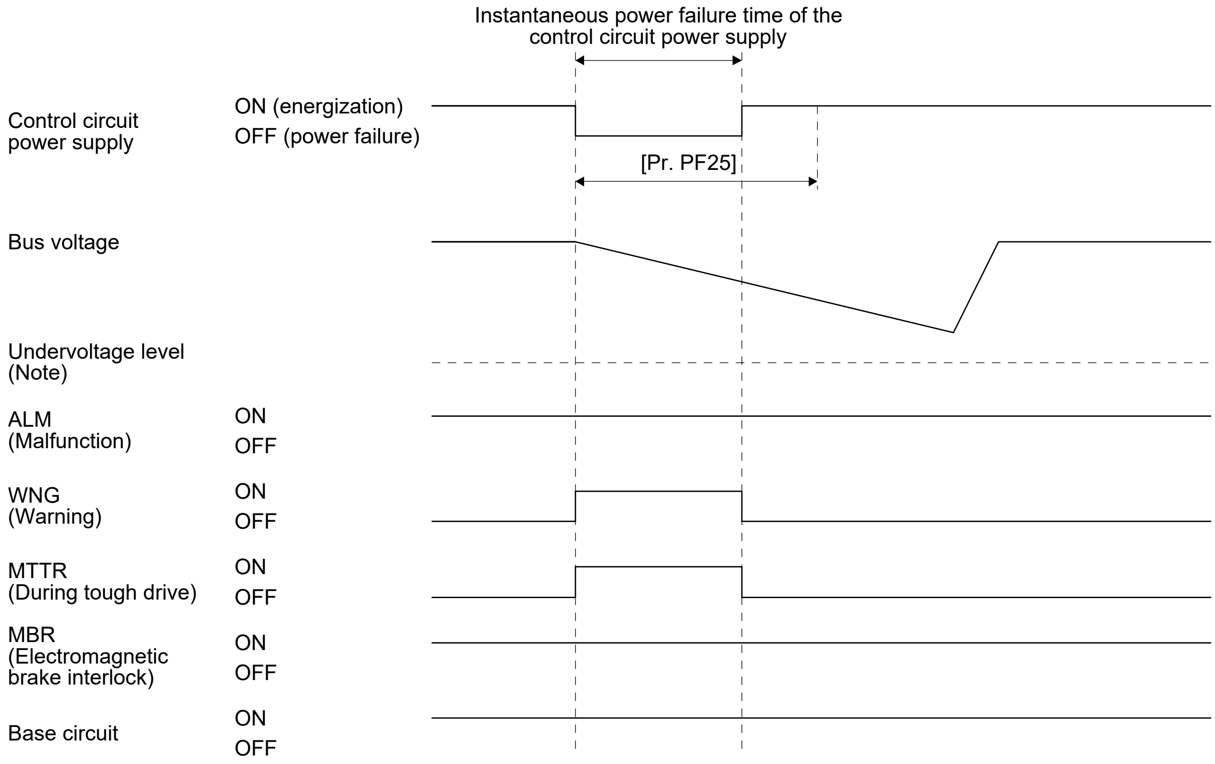
(a) When the bus voltage decrease lower than undervoltage level within the instantaneous power failure time of the control circuit power supply

[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 158 V DC 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 MR-J4-_A_(-RJ) 100 W or more servo amplifier can 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. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]. 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 MR-J4-03A6(-RJ) servo amplifier is not compatible with SEMI-F47 standard.

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 at "Rated voltage × 50% or less". After 200 ms, [AL. 10.1 Voltage drop in the control circuit power] will occur.

(b) [AL. 10.2 Voltage drop in the main circuit power] will occur when bus voltage is as follows.

Table 7.1 Voltages which trigger [AL. 10.2 Voltage drop in the main circuit power]

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

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

(2) Requirements 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-J4-10A(-RJ)	350	250
MR-J4-20A(-RJ)	700	420
MR-J4-40A(-RJ)	1400	630
MR-J4-60A(-RJ)	2100	410
MR-J4-70A(-RJ)	2625	1150
MR-J4-100A(-RJ)	3000	1190
MR-J4-200A(-RJ)	5400	2040
MR-J4-350A(-RJ)	10500	2600
MR-J4-500A(-RJ)	15000	4100
MR-J4-700A(-RJ)	21000	5900
MR-J4-11KA(-RJ)	40000	2600
MR-J4-15KA(-RJ)	50000	3500
MR-J4-22KA(-RJ)	56000	4300
MR-J4-60A4(-RJ)	1900	190
MR-J4-100A4(-RJ)	3500	200
MR-J4-200A4(-RJ)	5400	350
MR-J4-350A4(-RJ)	10500	730
MR-J4-500A4(-RJ)	15000	890
MR-J4-700A4(-RJ)	21000	1500
MR-J4-11KA4(-RJ)	40000	2400
MR-J4-15KA4(-RJ)	50000	3200
MR-J4-22KA4(-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

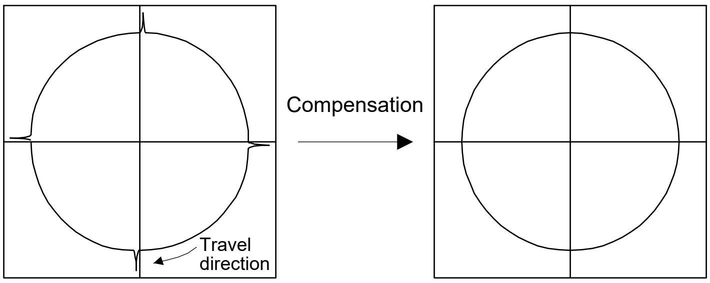
The following functions are not available at model adaptive control disabled.

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.

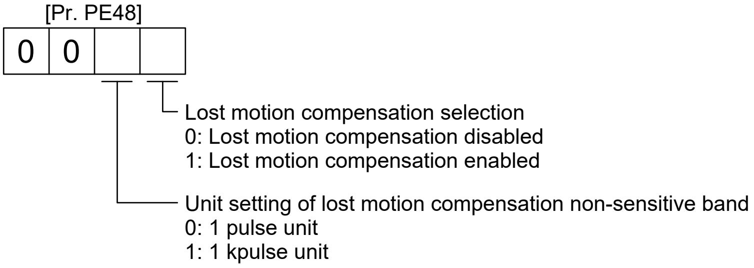
The lost motion compensation function corrects response delays (caused by a non-sensitive band due to friction, twist, expansion, and backlash) caused when the machine travel direction is reversed. This function contributes to improvement for protrusions that occur at a quadrant change and streaks that 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.

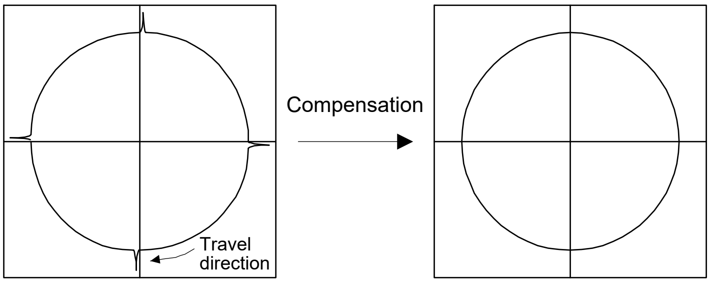
(b) Setting the lost motion compensation
Calculate the friction torque from the measurement result of (2) (a) in this section and set a value twice the friction torque in [Pr. PE44] and [Pr. PE45] as lost motion compensation.

$$\text{Friction torque [\%]} = \frac{\begin{array}{c}|(\text{load current during feed in the forward rotation direction [\%]}) - \\ (\text{load current during feed in the reverse rotation direction [\%]})|\end{array}}{2}$$

(c) Checking protrusions
Drive the servo motor and check that the protrusions are corrected.

(d) Adjusting the lost motion compensation

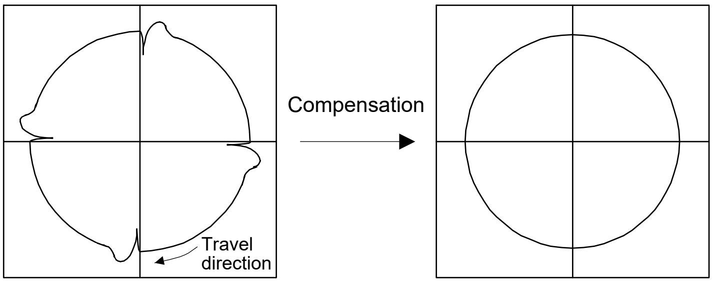
When protrusions still occur, the compensation is insufficient. Increase the lost motion compensation by approximately 0.5% until the protrusions are eliminated. When notches occur, the compensation is excessive. Decrease the lost motion compensation by approximately 0.5% until the notches are eliminated. 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

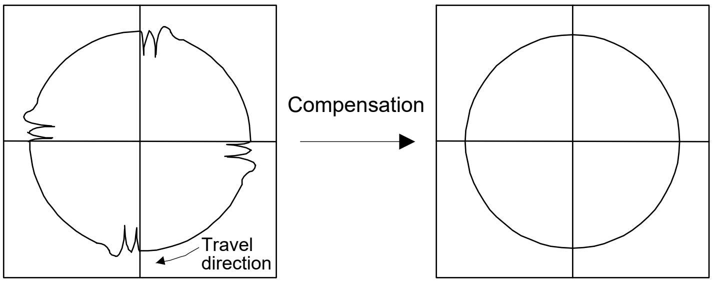
When the machine has low rigidity, the speed loop gain is set lower than the standard setting value, or the servo motor is rotating at high speed, quadrant projections may occur behind the quadrant change points. In this case, you can suppress the quadrant projections by delaying the lost motion compensation 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.



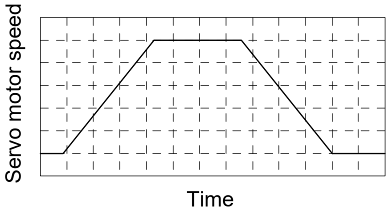
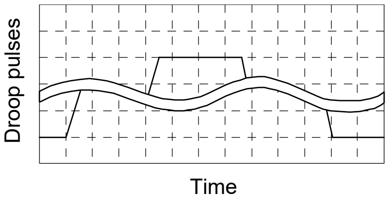
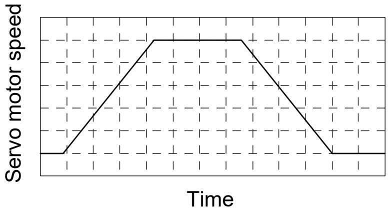
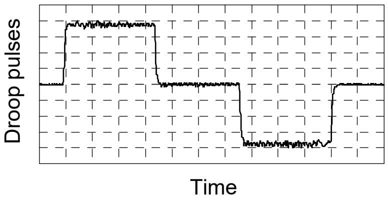
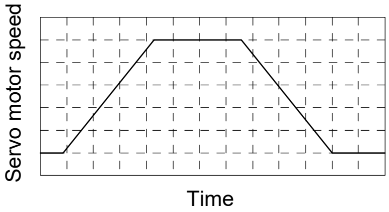
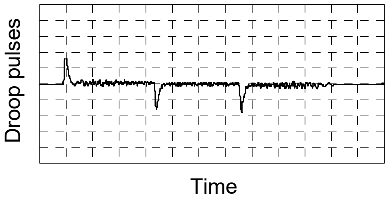
Before timing delay compensation After timing delay compensation

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. PD31] 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. PD31]) 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.

MEMO

8. TROUBLESHOOTING

POINT

- ●Refer to "MELSERVO-J4 Servo Amplifier Instruction Manual (Troubleshooting)" for details of alarms and warnings.
- ●As soon as an alarm occurs, turn SON (Servo-on) off and interrupt the power.
- ●[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 or cycling the power.

Alarm deactivation	Explanation
Alarm reset	1. Turning on RES (Reset) with input device 2. Pushing the "SET" button while the display of the servo amplifier is the current alarm display status 3. Clicking the "Occurred Alarm Reset" button in the "Alarm Display" window of MR Configurator2
Cycling the power	Turning the power off and then turning it on again.

(4) Alarm code
To output alarm codes, set [Pr. PD34] to "_ _ _ 1". Alarm codes are outputted by on/off of bit 0 to bit 2. Warnings ([AL. 91] to [AL. F3]) do not have alarm codes. The alarm codes in the following table will be outputted when they occur. The alarm codes will not be outputted in normal condition.
When using an MR-D01 extension IO unit, you can output alarm codes by setting [Pr. Po12] to "_ _ _ 1". Alarm codes are outputted by on/off of bit 0 to bit 3.

8.2 Alarm list

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation		Alarm code			
						Alarm reset	Cycling the power	ACD3 (Bit 3)	ACD2 (Bit 2)	ACD1 (Bit 1)	ACD0 (Bit 0)
Alarm	10	Undervoltage	10.1	Voltage drop in the control circuit power	EDB	○	○	0	0	1	0
			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		○	0	0	0	0
			12.2	RAM error 2	DB		○				
			12.3	RAM error 3	DB		○				
			12.4	RAM error 4	DB		○				
			12.5	RAM error 5	DB		○				
			12.6	RAM error 6	DB		○				
	13	Clock error	13.1	Clock error 1	DB		○	0	0	0	0
			13.2	Clock error 2	DB		○				
	14	Control process error	14.1	Control process error 1	DB		○	0	0	0	0
			14.2	Control process error 2	DB		○				
			14.3	Control process error 3	DB		○				
			14.4	Control process error 4	DB		○				
			14.5	Control process error 5	DB		○				
			14.6	Control process error 6	DB		○				
			14.7	Control process error 7	DB		○				
			14.8	Control process error 8	DB		○				
			14.9	Control process error 9	DB		○				
			14.A	Control process error 10	DB		○				
			14.B	Control process error 11	DB		○				
	15	Memory error 2 (EEP-ROM)	15.1	EEP-ROM error at power on	DB		○	0	0	0	0
			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		○	0	1	1	0
			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 Type (Note 2, 3)	Alarm deactivation		Alarm code			
						Alarm reset	Cycling the power	ACD3 (Bit 3)	ACD2 (Bit 2)	ACD1 (Bit 1)	ACD0 (Bit 0)
Alarm	17	Board error	17.1	Board error 1	DB		○	0	0	0	0
			17.3	Board error 2	DB		○				
			17.4	Board error 3	DB		○				
			17.5	Board error 4	DB		○				
			17.6	Board error 5	DB		○				
			17.7	Board error 7	DB		○				
			17.8	Board error 6	EDB		○				
			17.9	Board error 8	DB		○				
	19	Memory error 3 (Flash-ROM)	19.1	Flash-ROM error 1	DB		○	0	0	0	0
			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		○	0	1	1	0
			1A.2	Servo motor control mode combination error	DB		○				
			1A.4	Servo motor combination error 2	DB		○				
	1B	Converter alarm	1B.1	Converter unit error	DB		○	0	0	1	0
	1E	Encoder initial communication error 2	1E.1	Encoder malfunction	DB		○	0	1	1	0
			1E.2	Load-side encoder malfunction	DB		○				
	1F	Encoder initial communication error 3	1F.1	Incompatible encoder	DB		○	0	1	1	0
			1F.2	Incompatible load-side encoder	DB		○				
	20	Encoder normal communication error 1	20.1	Encoder normal communication - Receive data error 1	EDB		○	0	1	1	0
			20.2	Encoder normal communication - Receive data error 2	EDB		○				
			20.3	Encoder normal communication - Receive data error 3	EDB		○				
			20.5	Encoder normal communication - Transmission data error 1	EDB		○				
			20.6	Encoder normal communication - Transmission data error 2	EDB		○				
			20.7	Encoder normal communication - Transmission data error 3	EDB		○				
			20.9	Encoder normal communication - Receive data error 4	EDB		○				
			20.A	Encoder normal communication - Receive data error 5	EDB		○				
	21	Encoder normal communication error 2	21.1	Encoder data error 1	EDB		○	0	1	1	0
			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		○				
	24	Main circuit error	24.1	Ground fault detected at hardware detection circuit	DB		○	1	1	0	0
			24.2	Ground fault detected by software detection function	DB	○	○				
	25	Absolute position erased	25.1	Servo motor encoder - Absolute position erased	DB		○	1	1	1	0
			25.2	Scale measurement encoder - Absolute position erased	DB		○				

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation		Alarm code			
						Alarm reset	Cycling the power	ACD3 (Bit 3)	ACD2 (Bit 2)	ACD1 (Bit 1)	ACD0 (Bit 0)
Alarm	27	Initial magnetic pole detection error	27.1	Initial magnetic pole detection - Abnormal termination	DB	○	○	1	1	1	0
			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		○	0	1	1	0
	2A	Linear encoder error 1	2A.1	Linear encoder error 1-1	EDB		○	0	1	1	0
			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		○	1	1	1	0
			2B.2	Encoder counter error 2	EDB		○				
	30	Regenerative error	30.1	Regeneration heat error	DB	○ (Note 1)	○ (Note 1)	0	0	0	1
			30.2	Regeneration signal error	DB	○ (Note 1)	○ (Note 1)				
			30.3	Regeneration feedback signal error	DB	○ (Note 1)	○ (Note 1)				
	31	Overspeed	31.1	Abnormal motor speed	SD	○	○	0	1	0	1
	32	Overcurrent	32.1	Overcurrent detected at hardware detection circuit (during operation)	DB		○	0	1	0	0
			32.2	Overcurrent detected at software detection function (during operation)	DB	○	○				
			32.3	Overcurrent detected at hardware detection circuit (during a stop)	DB		○				
			32.4	Overcurrent detected at software detection function (during a stop)	DB	○	○				
	33	Overvoltage	33.1	Main circuit voltage error	EDB	○	○	1	0	0	1
	34	SSCNET receive error 1	34.1	SSCNET receive data error	SD	○	○				
			34.2	SSCNET connector connection error	SD	○	○				
			34.3	SSCNET communication data error	SD	○	○				
			34.4	Hardware error signal detection	SD	○	○				
			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	○	○	1	1	0	1
	36	SSCNET receive error 2	36.1	Continuous communication data error	SD	○	○				
			36.2	Continuous communication data error (safety observation function)	SD	○	○				

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation		Alarm code			
						Alarm reset	Cycling the power	ACD3 (Bit 3)	ACD2 (Bit 2)	ACD1 (Bit 1)	ACD0 (Bit 0)
Alarm	37	Parameter error	37.1	Parameter setting range error	DB		○	1	0	0	0
			37.2	Parameter combination error	DB		○				
			37.3	Point table setting error	DB		○				
	39	Program error	39.1	Program error	DB		○	0	0	0	0
			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		○	0	0	0	0
	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		○	1	0	0	0
	42	Servo control error (for linear servo motor and direct drive motor)	42.1	Servo control error by position deviation	EDB	(Note 4)	○	0	1	1	0
			42.2	Servo control error by speed deviation	EDB	(Note 4)	○				
			42.3	Servo control error by torque/ thrust deviation	EDB	(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)	○				
			42.9	Fully closed loop control error by speed deviation	EDB	(Note 4)	○				
			42.A	Fully closed loop control error by position deviation during command stop	EDB	(Note 4)	○				
	45	Main circuit device overheat	45.1	Main circuit device overheat error 1	SD	○ (Note 1)	○ (Note 1)	0	0	1	1
			45.2	Main circuit device overheat error 2	SD	○ (Note 1)	○ (Note 1)				
	46	Servo motor overheat	46.1	Abnormal temperature of servo motor 1	SD	○ (Note 1)	○ (Note 1)	0	0	1	1
			46.2	Abnormal temperature of servo motor 2	SD	○ (Note 1)	○ (Note 1)				
			46.3	Thermistor disconnected error	SD	○ (Note 1)	○ (Note 1)				
			46.4	Thermistor circuit error	SD	○ (Note 1)	○ (Note 1)				
			46.5	Abnormal temperature of servo motor 3	DB	○ (Note 1)	○ (Note 1)				
			46.6	Abnormal temperature of servo motor 4	DB	○ (Note 1)	○ (Note 1)				
	47	Cooling fan error	47.1	Cooling fan stop error	SD		○	0	0	1	1
			47.2	Cooling fan speed reduction error	SD		○				
	50	Overload 1	50.1	Thermal overload error 1 during operation	SD	○ (Note 1)	○ (Note 1)	0	0	1	1
			50.2	Thermal overload error 2 during operation	SD	○ (Note 1)	○ (Note 1)				
			50.3	Thermal overload error 4 during operation	SD	○ (Note 1)	○ (Note 1)				
			50.4	Thermal overload error 1 during a stop	SD	○ (Note 1)	○ (Note 1)				
			50.5	Thermal overload error 2 during a stop	SD	○ (Note 1)	○ (Note 1)				
			50.6	Thermal overload error 4 during a stop	SD	○ (Note 1)	○ (Note 1)				

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation		Alarm code			
						Alarm reset	Cycling the power	ACD3 (Bit 3)	ACD2 (Bit 2)	ACD1 (Bit 1)	ACD0 (Bit 0)
Alarm	51	Overload 2	51.1	Thermal overload error 3 during operation	DB	○ (Note 1)	○ (Note 1)	0	0	1	1
			51.2	Thermal overload error 3 during a stop	DB	○ (Note 1)	○ (Note 1)				
	52	Error excessive	52.1	Excess droop pulse 1	SD	○	○	0	1	0	1
			52.3	Excess droop pulse 2	SD	○	○				
			52.4	Error excessive during 0 torque limit	SD	○	○				
			52.5	Excess droop pulse 3	EDB	○	○				
			52.6	Excessive droop pulse at servo-off	SD	○	○				
	54	Oscillation detection	54.1	Oscillation detection error	EDB	○	○	0	0	1	1
	56	Forced stop error	56.2	Over speed during forced stop	EDB	○	○	0	1	1	0
			56.3	Estimated distance over during forced stop	EDB	○	○				
	61	Operation error	61.1	Point table setting error	DB	○	○	0	1	0	1
	63	STO timing error	63.1	STO1 off	DB	○	○	0	1	1	0
			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		○	1	0	0	0
			64.2	Compatibility mode setting error	DB		○				
			64.3	Operation mode setting error	DB		○				
	65	Functional safety unit connection error	65.1	Functional safety unit communication error 1	SD		○	0	0	0	0
			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		○	0	1	1	0
			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		○				

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation		Alarm code			
						Alarm reset	Cycling the power	ACD3 (Bit 3)	ACD2 (Bit 2)	ACD1 (Bit 1)	ACD0 (Bit 0)
Alarm	67	Encoder normal communication error 1 (safety observation function)	67.1	Encoder normal communication - Receive data error 1 (safety observation function)	DB		○	0	1	1	0
			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		○	0	0	0	0
	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	○	○				
	70	Load-side encoder initial communication error 1	70.1	Load-side encoder initial communication - Receive data error 1	DB		○	0	1	1	0
			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		○				

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation		Alarm code			
						Alarm reset	Cycling the power	ACD3 (Bit 3)	ACD2 (Bit 2)	ACD1 (Bit 1)	ACD0 (Bit 0)
Alarm	71	Load-side encoder normal communication error 1	71.1	Load-side encoder normal communication - Receive data error 1	EDB		○	0	1	1	0
			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		○				
	72	Load-side encoder normal communication error 2	72.1	Load-side encoder data error 1	EDB		○	0	1	1	0
			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 5)	○	1	1	1	1
			79.2	Functional safety unit internal error	DB		○				
			79.3	Abnormal temperature of functional safety unit	SD	○ (Note 5)	○				
			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		○	1	0	0	0
			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		○				

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation		Alarm code			
						Alarm reset	Cycling the power	ACD3 (Bit 3)	ACD2 (Bit 2)	ACD1 (Bit 1)	ACD0 (Bit 0)
Alarm	7B	Encoder diagnosis error (safety observation function)	7B.1	Encoder diagnosis error 1 (safety observation function)	DB		○	0	1	1	0
			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 5)	○	0	0	0	0
			7C.2	Functional safety unit communication data error (safety observation function)	SD	○ (Note 5)	○				
	7D	Safety observation error	7D.1	Stop observation error	DB	○ (Note 3)	○	1	1	1	1
			7D.2	Speed observation error	DB	○ (Note 5)	○				
	82	Master-slave operation error 1	82.1	Master-slave operation error 1	EDB	○	○				
	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	○	○	0	0	0	0
			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		○				

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation		Alarm code			
						Alarm reset	Cycling the power	ACD3 (Bit 3)	ACD2 (Bit 2)	ACD1 (Bit 1)	ACD0 (Bit 0)
Alarm	8E	USB communication error/serial communication error/Modbus RTU communication error	8E.1	USB communication receive error/Serial communication receive error	SD	○	○	0	0	0	0
			8E.2	USB communication checksum error/Serial communication checksum error	SD	○	○				
			8E.3	USB communication character error/serial communication character error	SD	○	○				
			8E.4	USB communication command error/Serial communication command error	SD	○	○				
			8E.5	USB communication data number error/Serial communication data number error	SD	○	○				
			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).
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]

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. Reset this while all the safety observation functions are stopped.

6. This alarm will occur only in the J3 compatibility mode.

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	Magnetic pole detection incomplete warning at ABS data transfer request	
	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	Magnetic pole detection incomplete warning at home positioning	
	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)
			99.2	Reverse rotation stroke end off	(Note 4)
			99.4	Upper stroke limit off	
			99.5	Lower stroke limit off	
	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 warning	9C.1	Converter unit warning	
	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	
	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	

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)
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 warning 1 during a stop	
			E1.6	Thermal overload warning 2 during a stop	
			E1.7	Thermal overload warning 3 during a stop	
			E1.8	Thermal overload warning 4 during a stop	
	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 input 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	
	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	

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)
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).

SD: Forced stop deceleration

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

4. Quick stop or slow stop can be selected using [Pr. PD30].

MEMO

9. DIMENSIONS

9.1 Servo amplifier

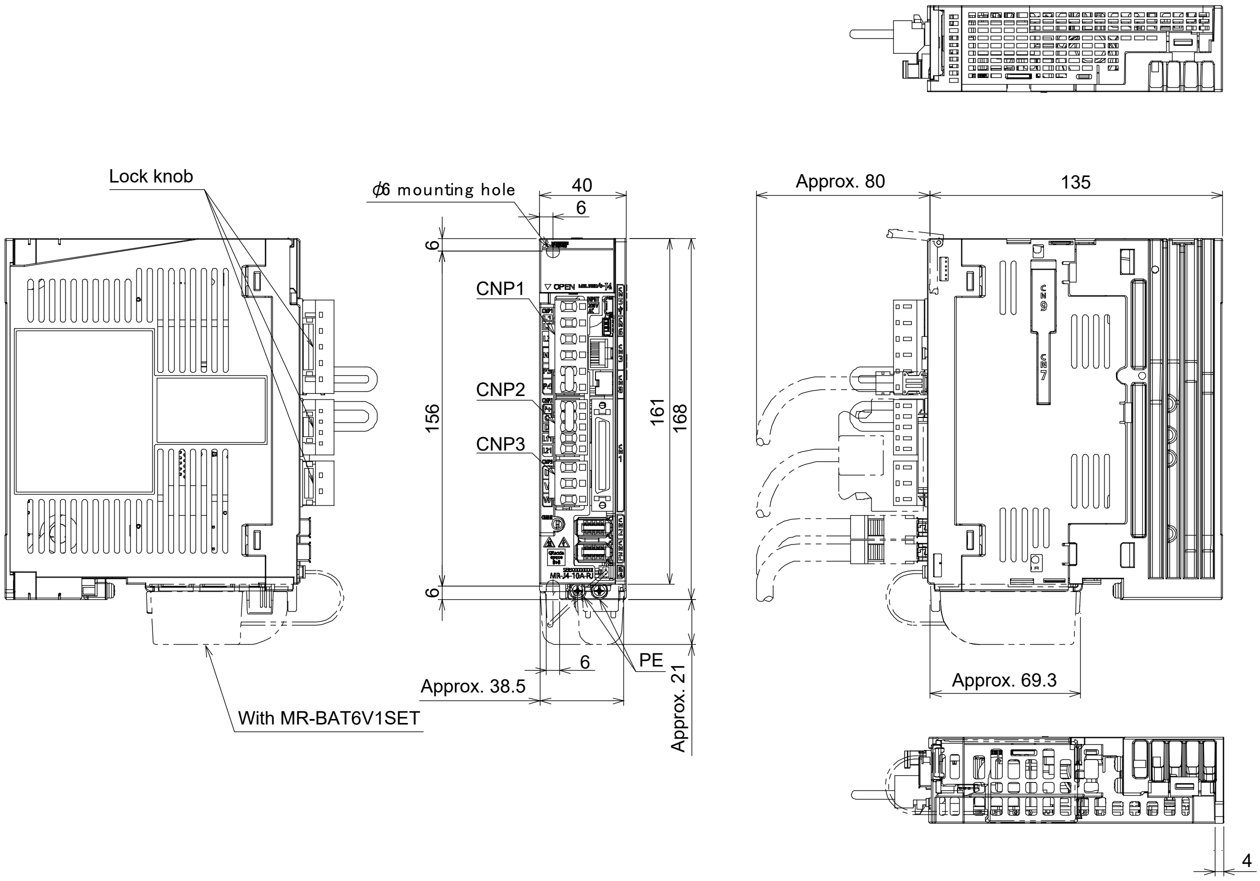
POINT

- ●Only MR-J4-_A_-RJ are shown for dimensions. MR-J4-_A_ does not have CN2L, CN7 and CN9 connectors. The dimensions of MR-J4-_A_ are the same as those of MR-J4-_A_-RJ except CN2L, CN7 and CN9 connectors.

(1) 200 V class

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

[Unit: mm]



Mass: 0.8 [kg]

Mounting screw

Screw size: M5

Tightening torque: 3.24 [N•m]

Terminal

CNP1

L1
L2
L3
N-
P3
P4

CNP2

P+
C
D
L11
L21

CNP3

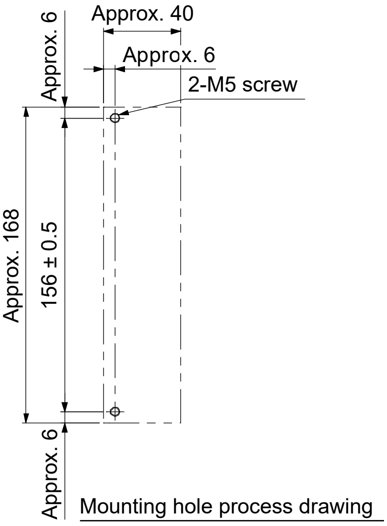
U
V
W

PE

⏚ ⏚

Screw size: M4

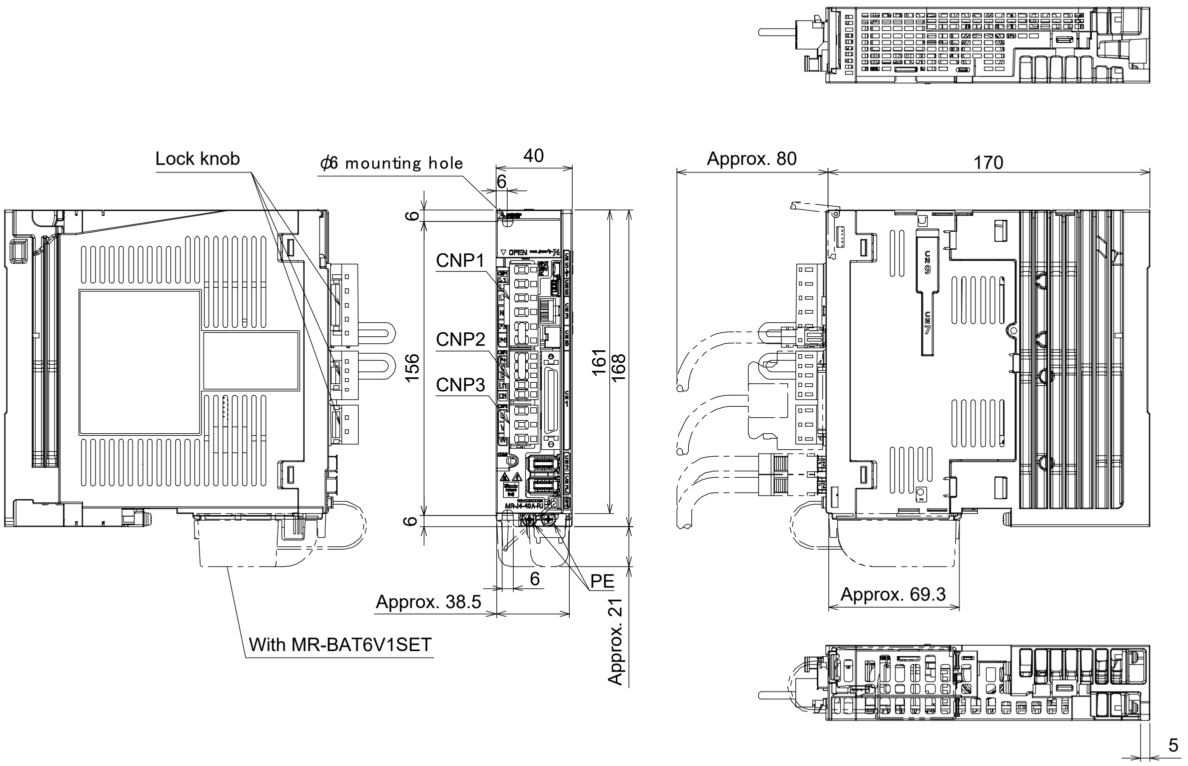
Tightening torque: 1.2 [N•m]



Mounting hole process drawing

(b) MR-J4-40A(-RJ)/MR-J4-60A(-RJ)

[Unit: mm]



Mass: 1.0 [kg]

Terminal

CNP1
- L1
- L2
- L3
- N-
- P3
- P4

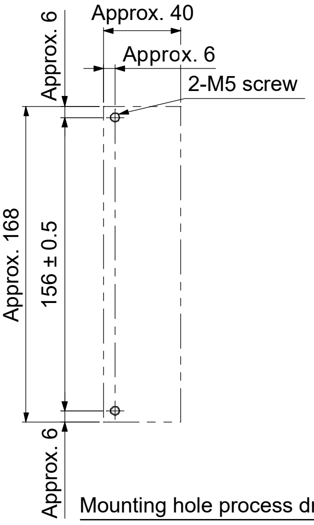
CNP2
- P+
- C
- D
- L11
- L21

CNP3
- U
- V
- W

PE
⏚ ⏚

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

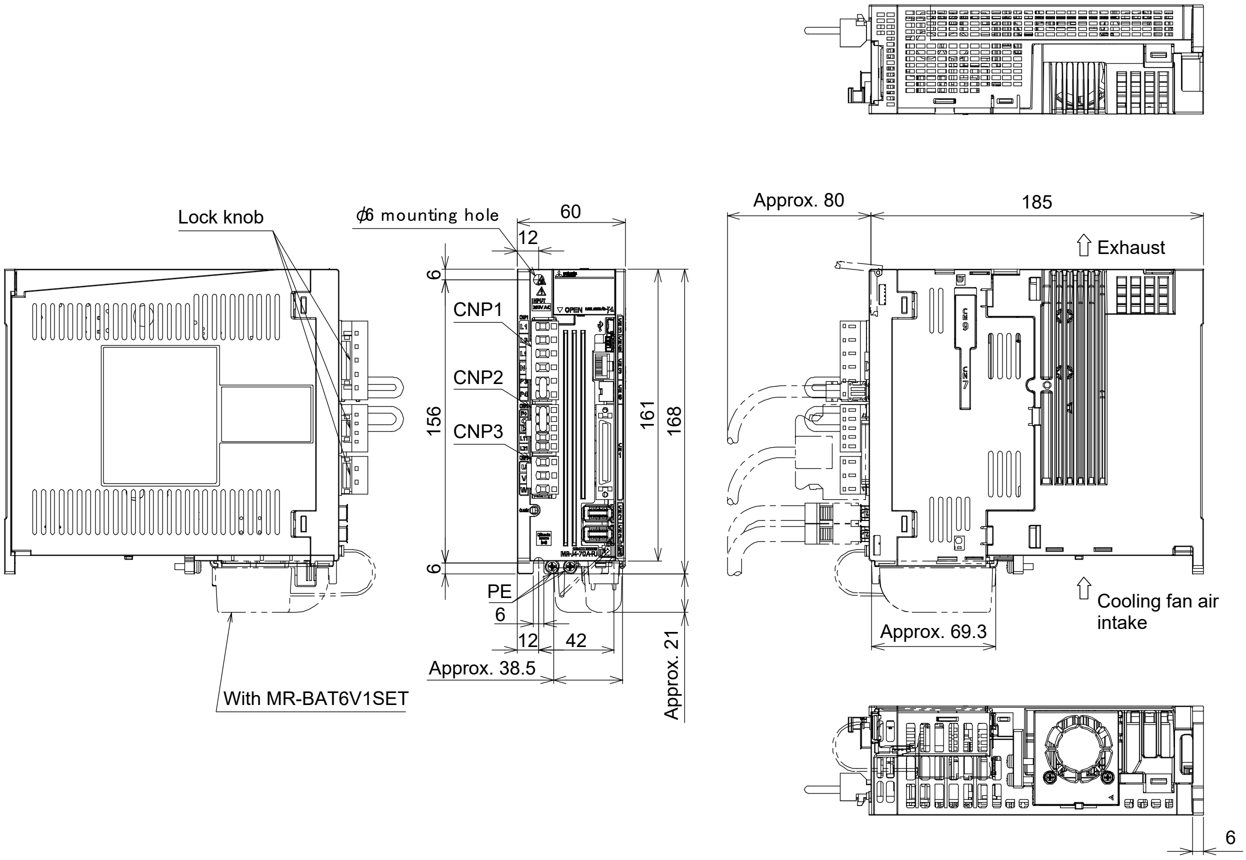
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]



Mounting hole process drawing

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

[Unit: mm]



Mass: 1.4 [kg]

Terminal

CNP1
- L1
- L2
- L3
- N-
- P3
- P4

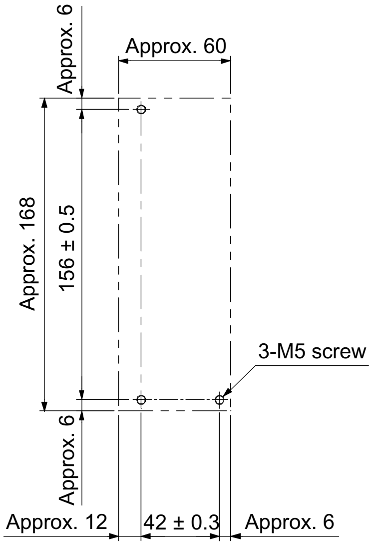
CNP2
- P+
- C
- D
- L11
- L21

CNP3
- U
- V
- W

PE
⏚ ⏚

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

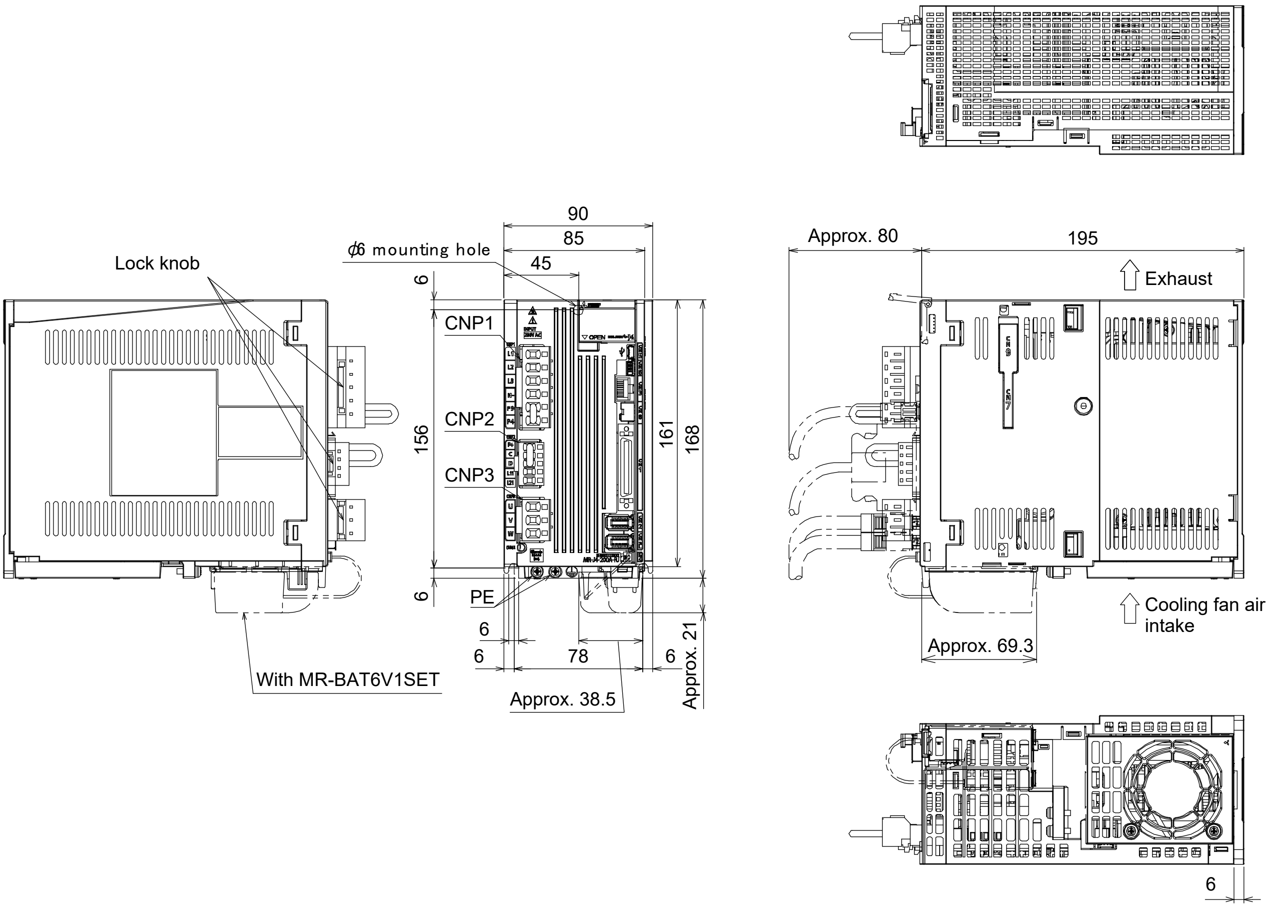
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]



Mounting hole process drawing

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

[Unit: mm]



Mass: 2.1 [kg]

Mounting screw

Screw size: M5

Tightening torque: 3.24 [N•m]

Terminal

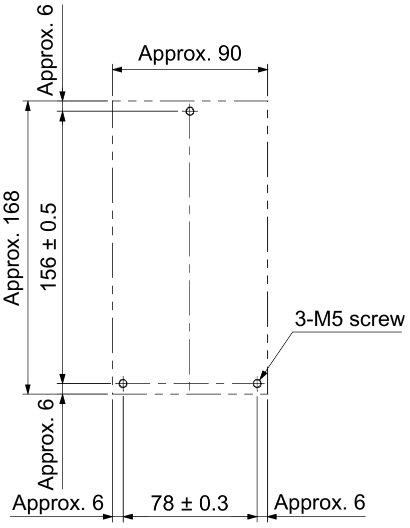
CNP1
- L1
- L2
- L3
- N-
- P3
- P4

CNP2
- P+
- C
- D
- L11
- L21

CNP3
- U
- V
- W

PE
⏚ ⏚

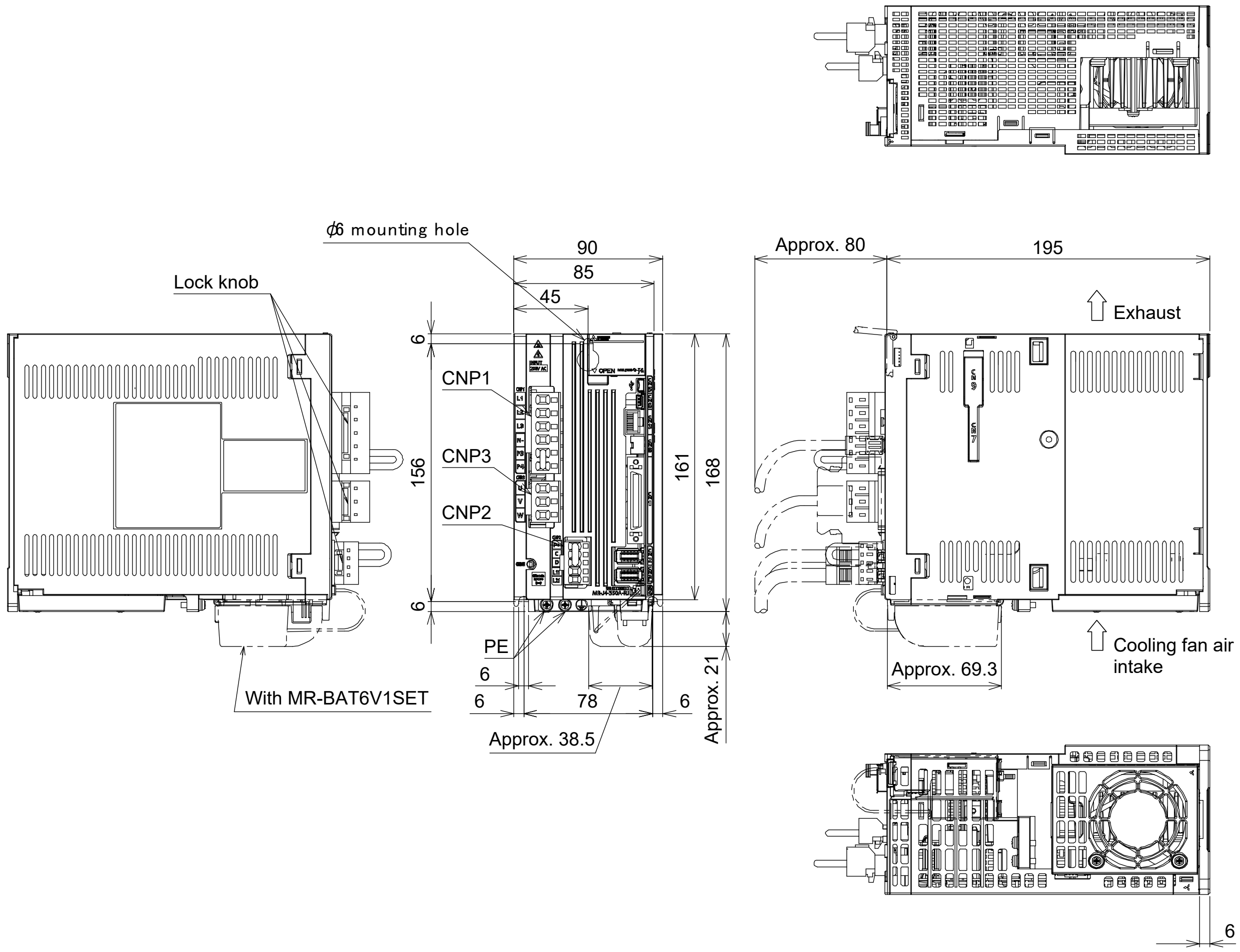
Screw size: M4
Tightening torque: 1.2 [N•m]



Mounting hole process drawing

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

[Unit: mm]



Mass: 2.3 [kg]

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

Terminal

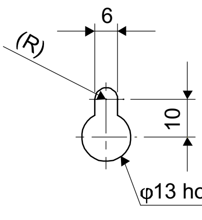
CNP1
- L1
- L2
- L3
- N-
- P3
- P4

CNP3
- U
- V
- W

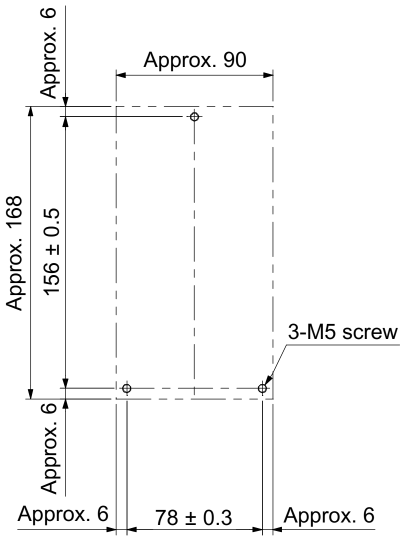
CNP2
- P+
- C
- D
- L11
- L21

PE
- ⏚ ⏚

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



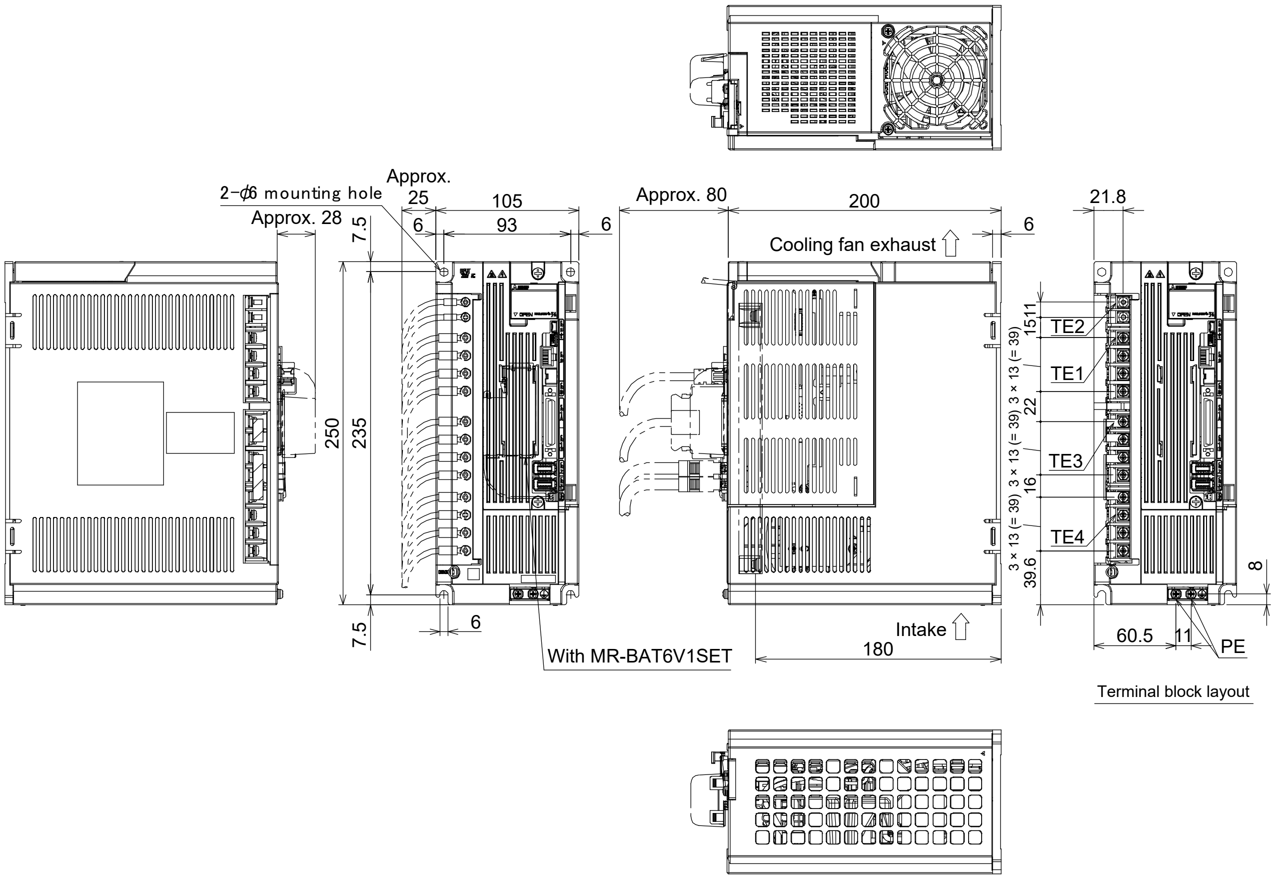
Mounting hole dimensions



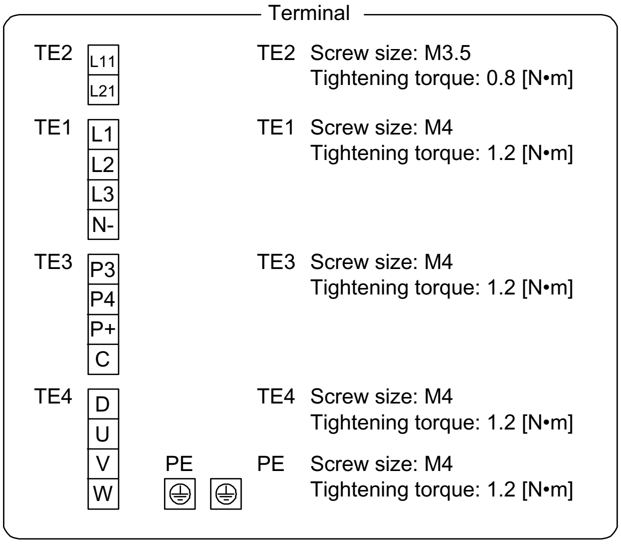
Mounting hole process drawing

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

[Unit: mm]



Mass: 4.0 [kg]



TE2 Screw size: M3.5
Tightening torque: 0.8 [N•m]

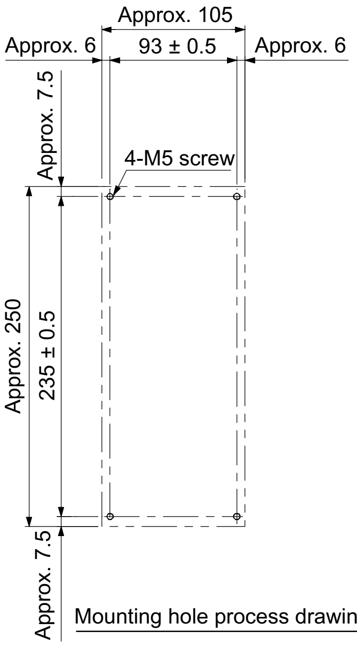
TE1 Screw size: M4
Tightening torque: 1.2 [N•m]

TE3 Screw size: M4
Tightening torque: 1.2 [N•m]

TE4 Screw size: M4
Tightening torque: 1.2 [N•m]

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

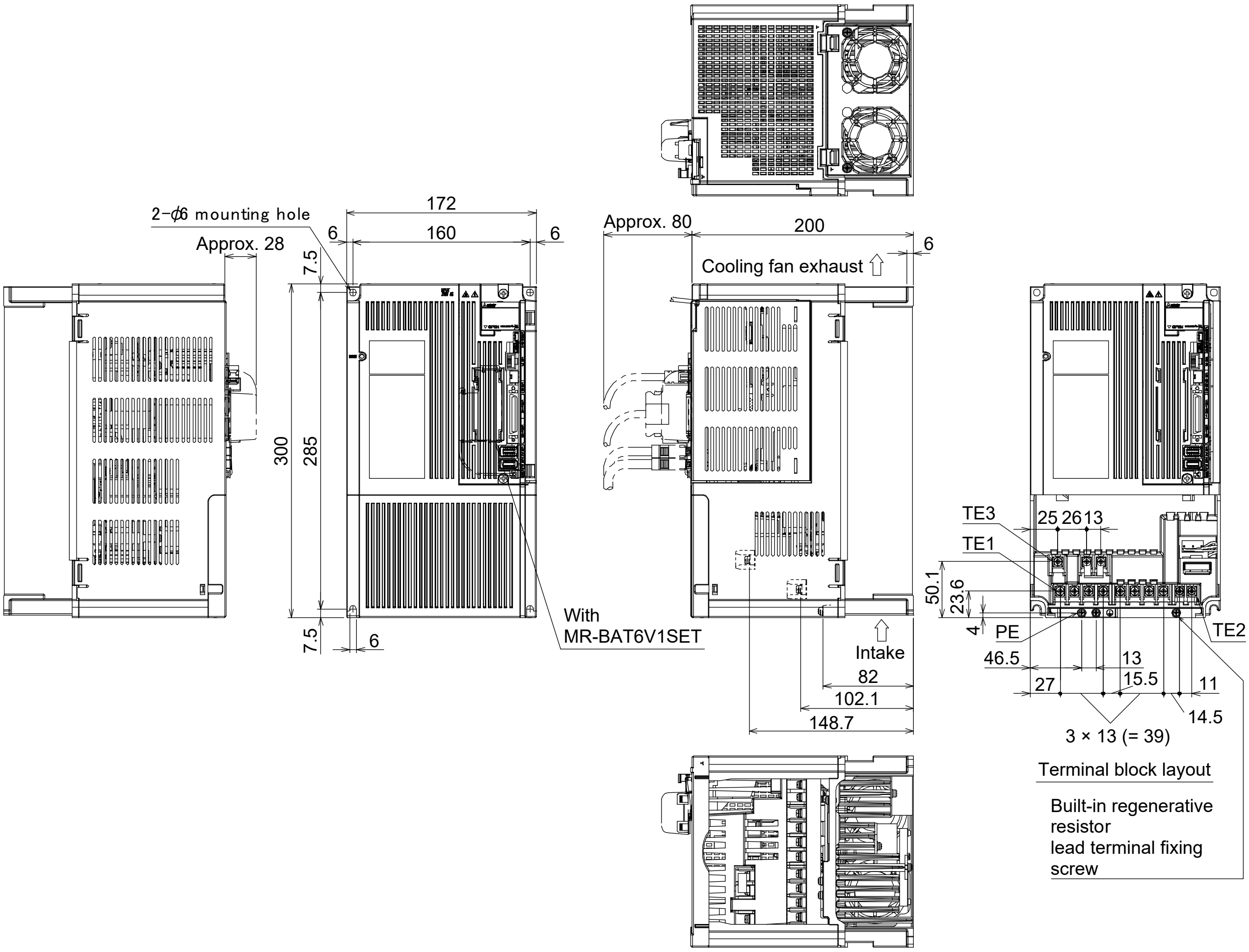
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]



Mounting hole process drawing

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

[Unit: mm]



Mass: 6.2 [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

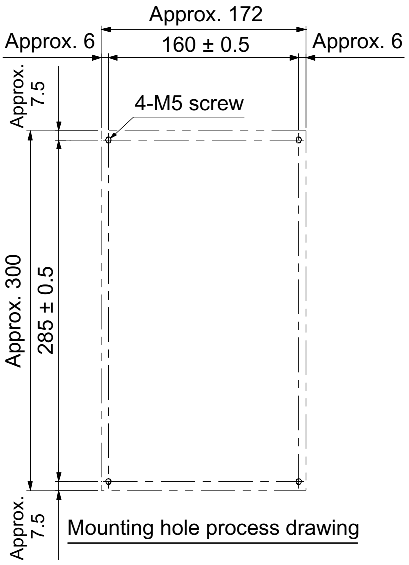
PE ⏚ ⏚

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]

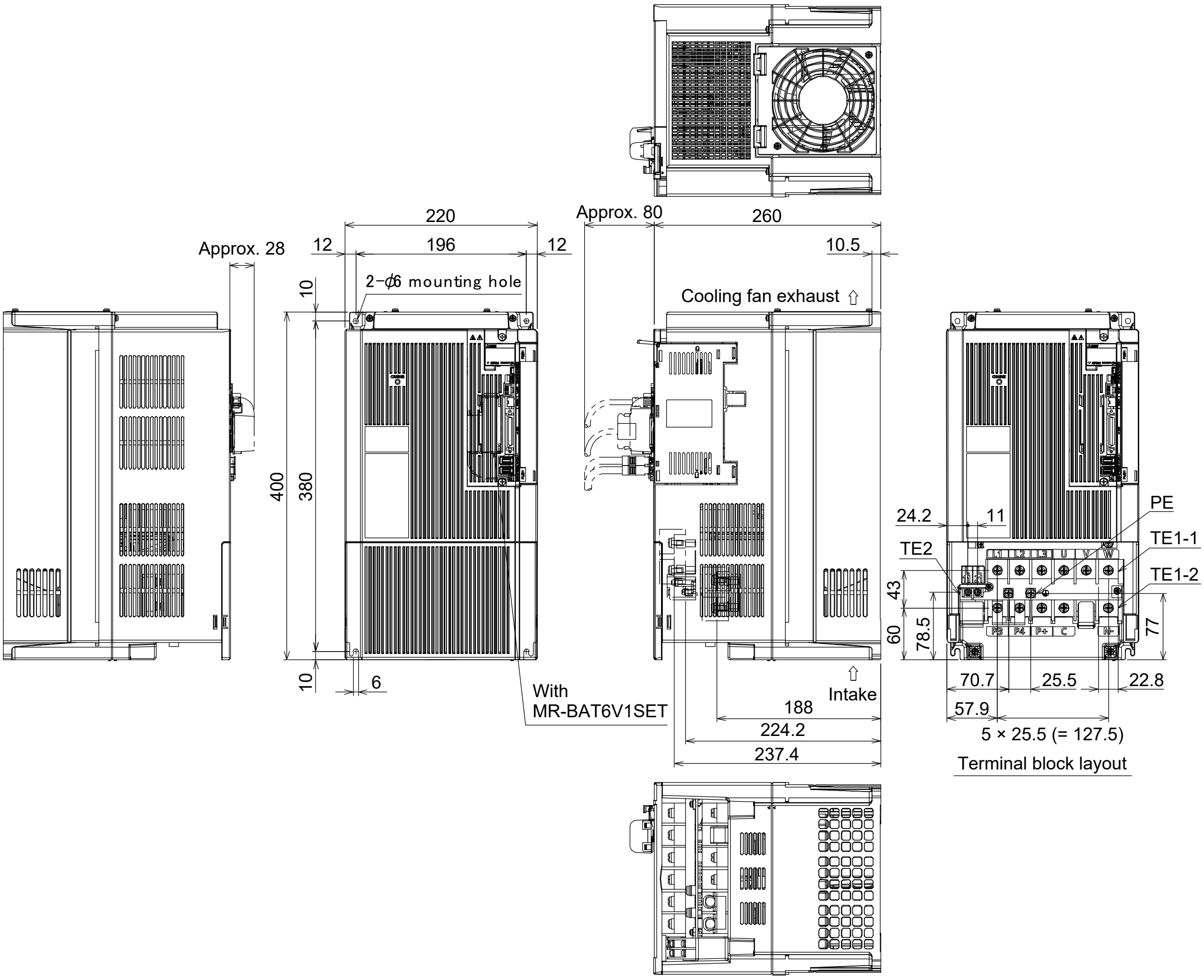
PE Screw size: M4
Tightening torque: 1.2 [N•m]



Mounting hole process drawing

(h) MR-J4-11KA(-RJ)/MR-J4-15KA(-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 ⏚ ⏚

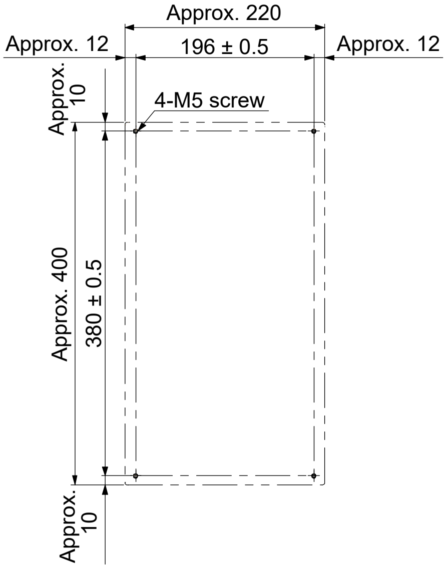
TE1-1 Screw size: M6
Tightening torque: 3.0 [N•m]

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]

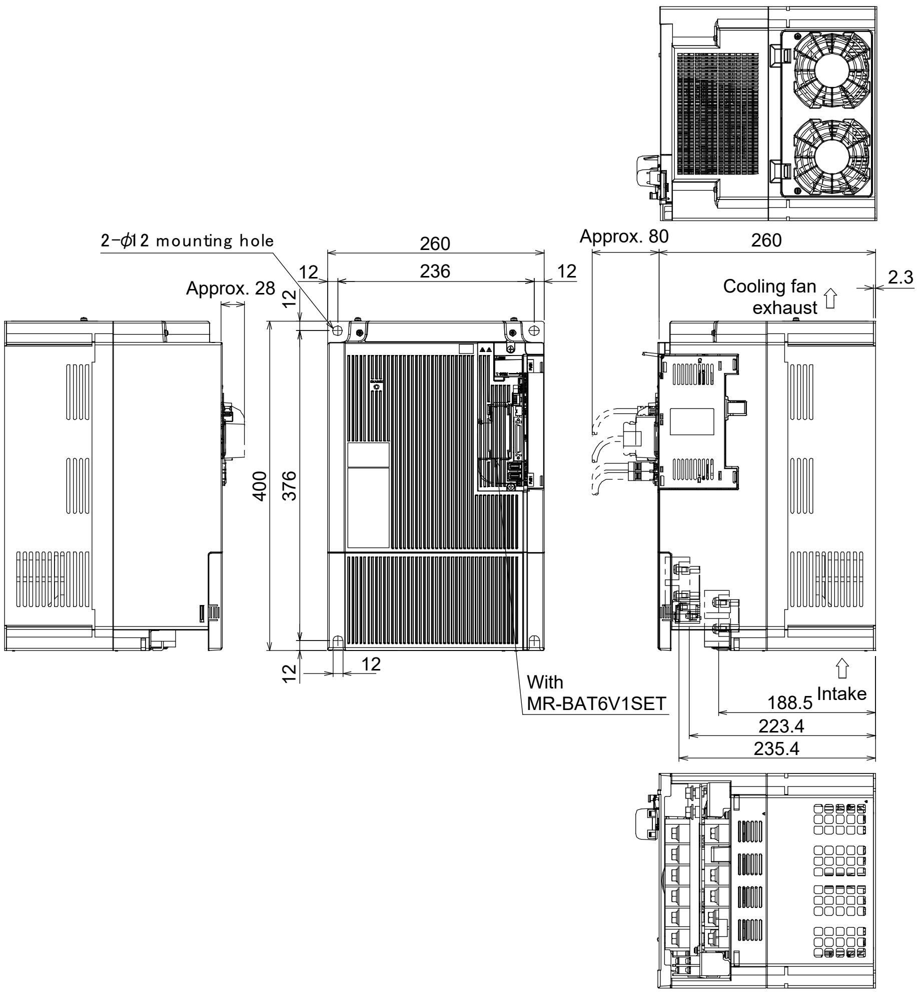
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]

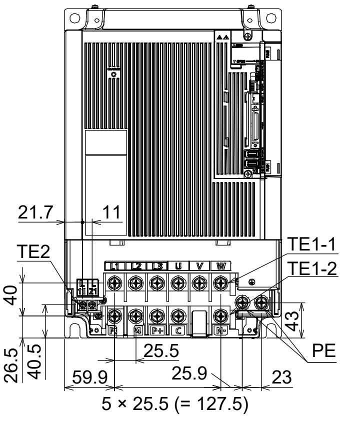


Mounting hole process drawing

(i) MR-J4-22KA(-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- |

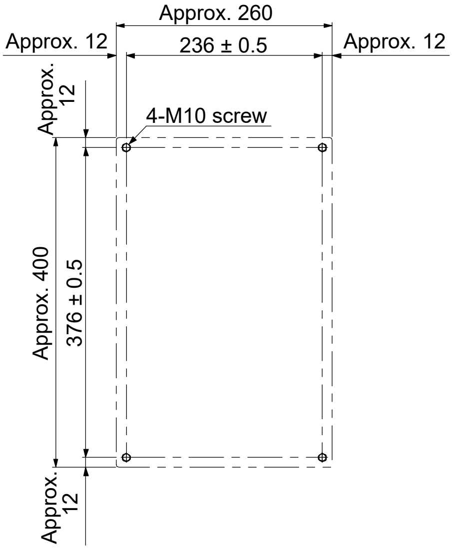
PE | ⏚ | ⏚ | TE2 | L11 | L21 |

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]

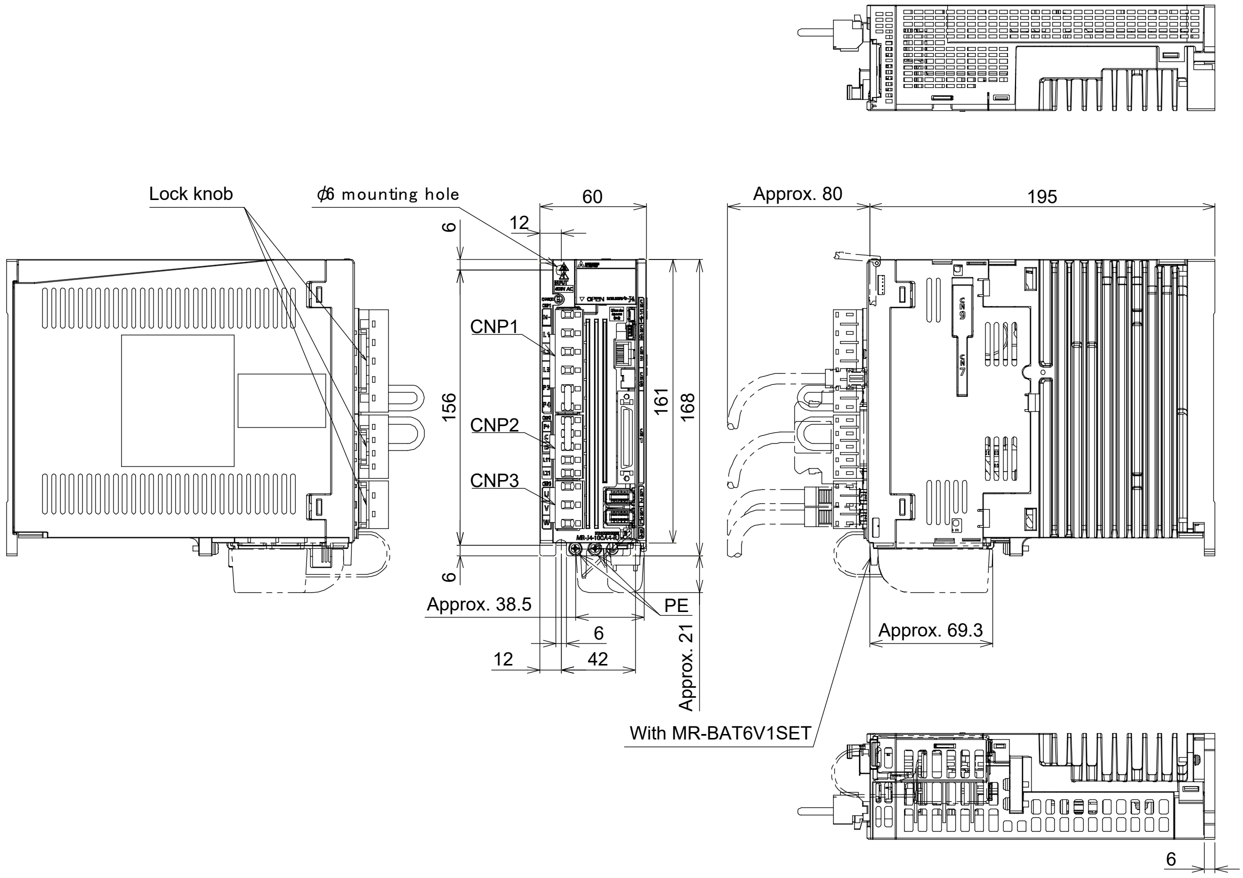


Mounting hole process drawing

(2) 400 V class

(a) MR-J4-60A4(-RJ)/MR-J4-100A4(-RJ)

[Unit: mm]



Mass: 1.7 [kg]

Mounting screw

Screw size: M5

Tightening torque: 3.24 [N•m]

Terminal

CNP1

N-

L1

L2

L3

P3

P4

CNP2

P+

C

D

L11

L21

CNP3

U

V

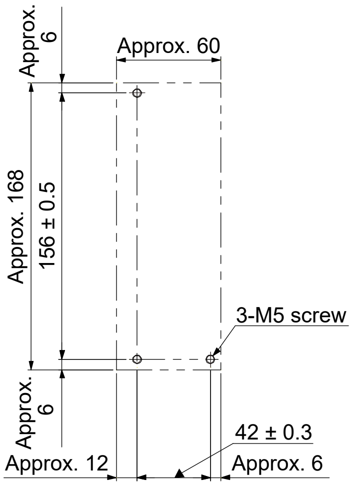
W

PE

⏚ ⏚

Screw size: M4

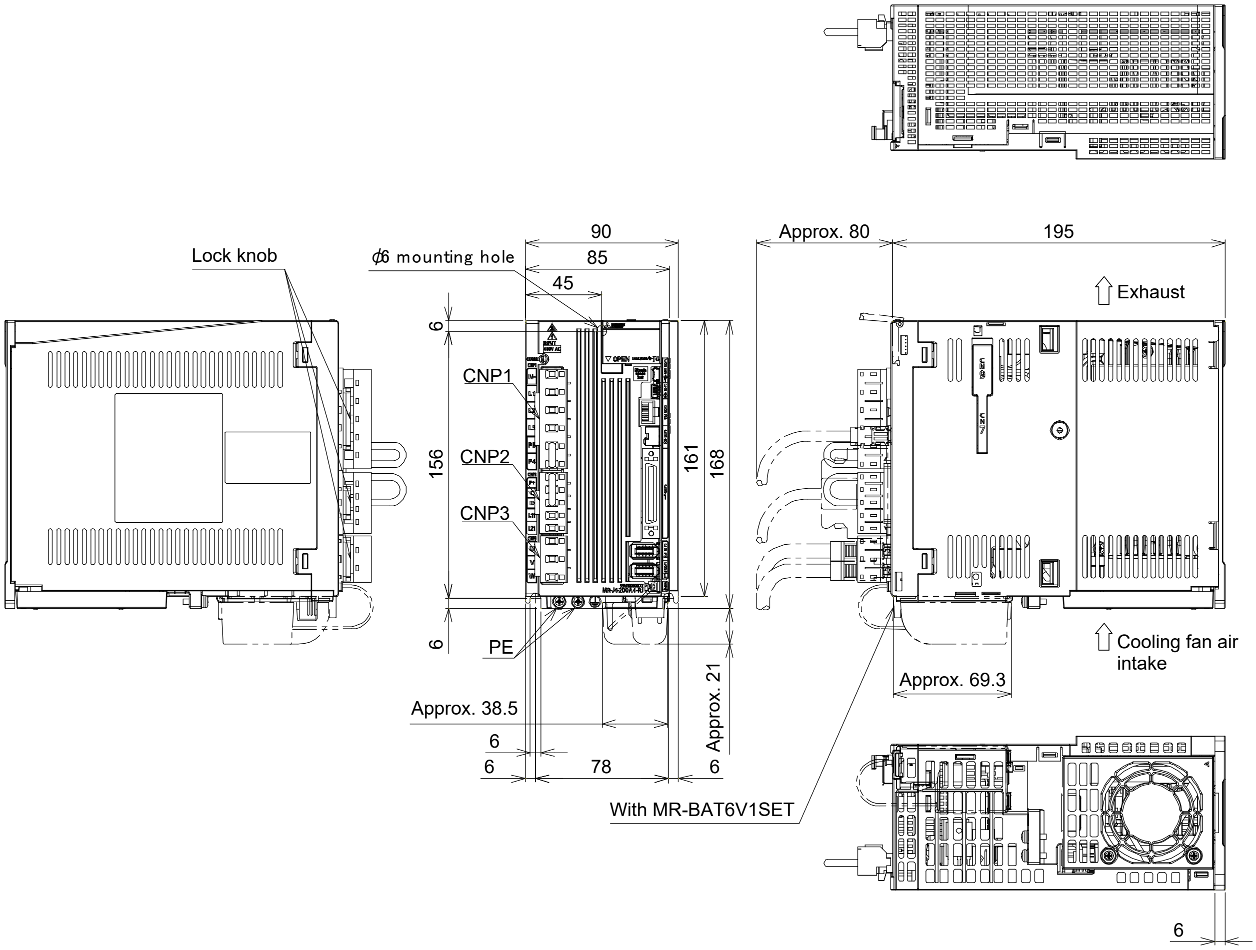
Tightening torque: 1.2 [N•m]



Mounting hole process drawing

(b) MR-J4-200A4(-RJ)

[Unit: mm]



Mass: 2.1 [kg]

Mounting screw

Screw size: M5

Tightening torque: 3.24 [N•m]

Terminal

CNP1

N-
L1
L2
L3
P3
P4

CNP2

P+
C
D
L11
L21

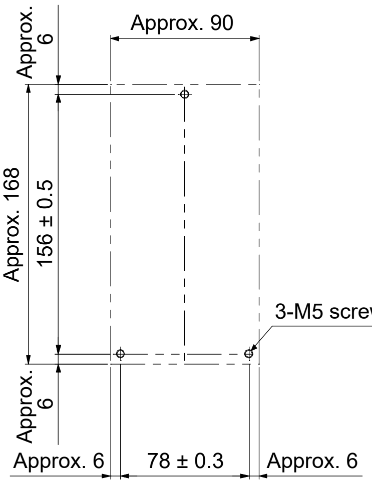
CNP3

U
V
W

PE

⏚ ⏚

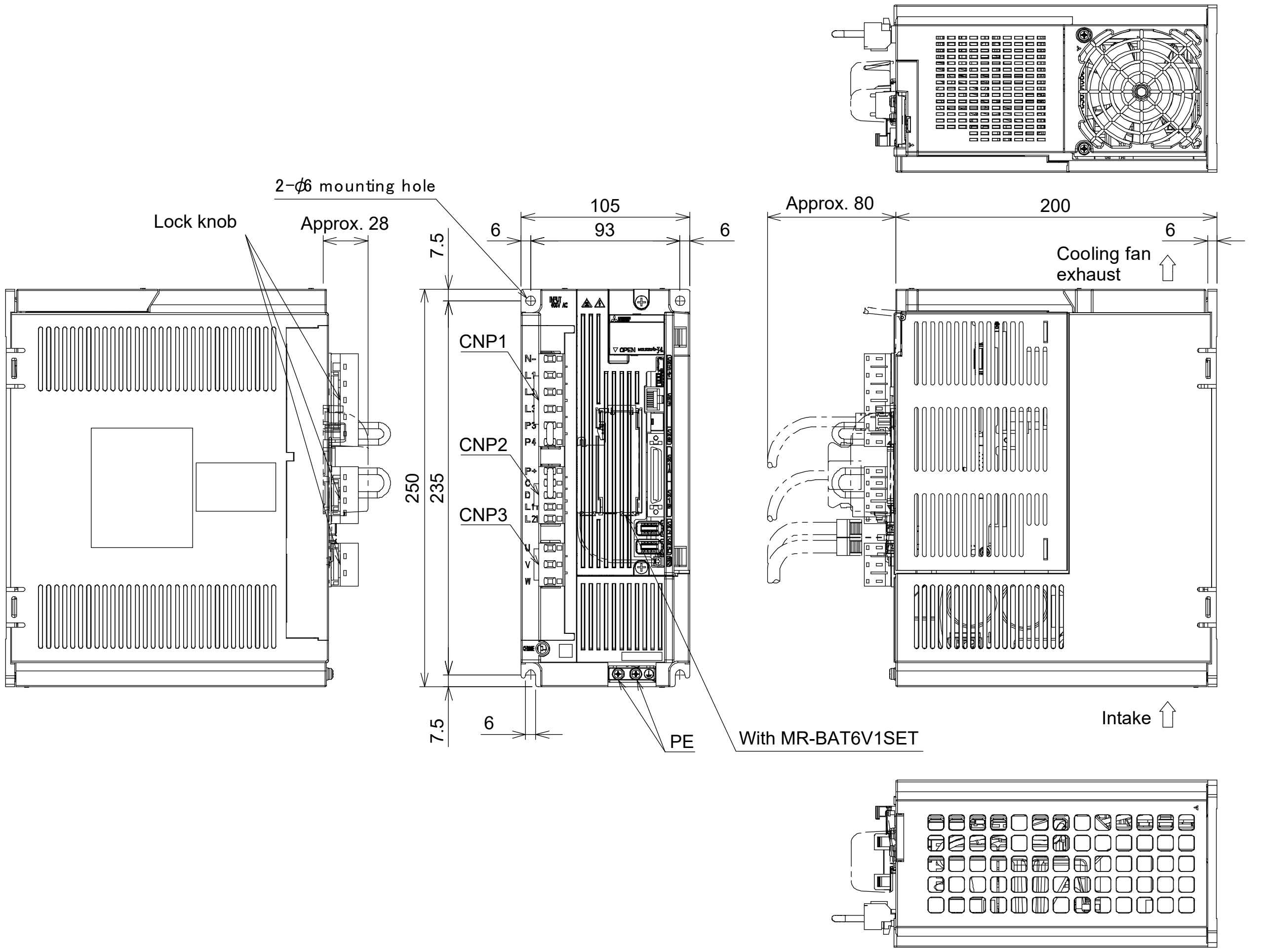
Screw size: M4
Tightening torque: 1.2 [N•m]



Mounting hole process drawing

(c) MR-J4-350A4(-RJ)

[Unit: mm]



Mass: 3.6 [kg]

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

Terminal

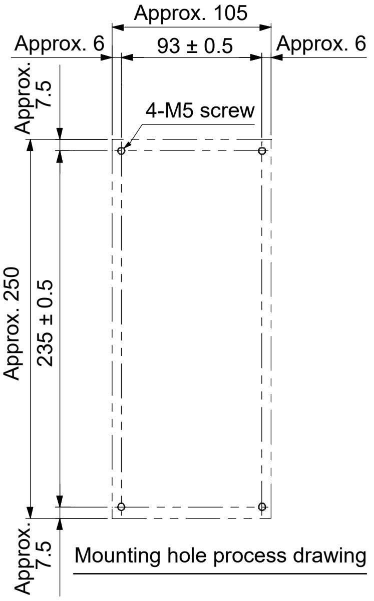
CNP1
- N-
- L1
- L2
- L3
- P3
- P4

CNP2
- P+
- C
- D
- L11
- L21

CNP3
- U
- V
- W

PE
⏚ ⏚

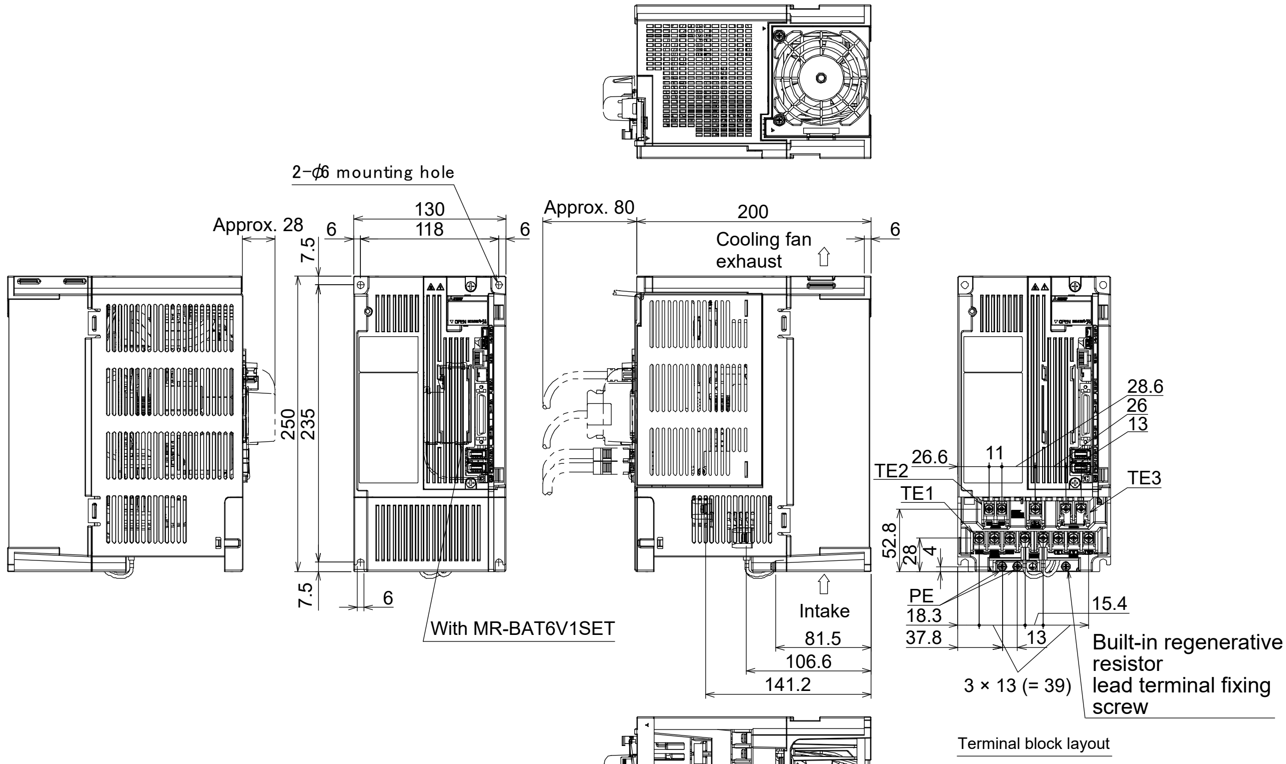
Screw size: M4
Tightening torque: 1.2 [N•m]



Mounting hole process drawing

(d) MR-J4-500A4(-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

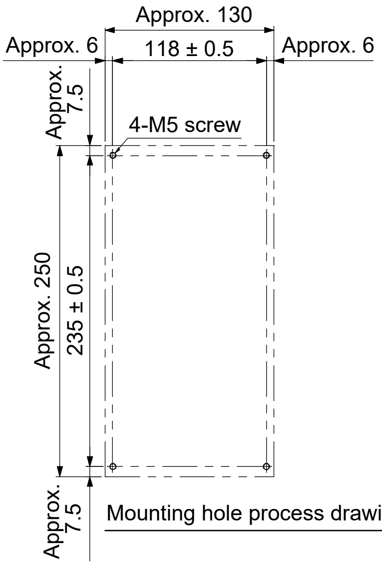
PE ⏚ ⏚

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]

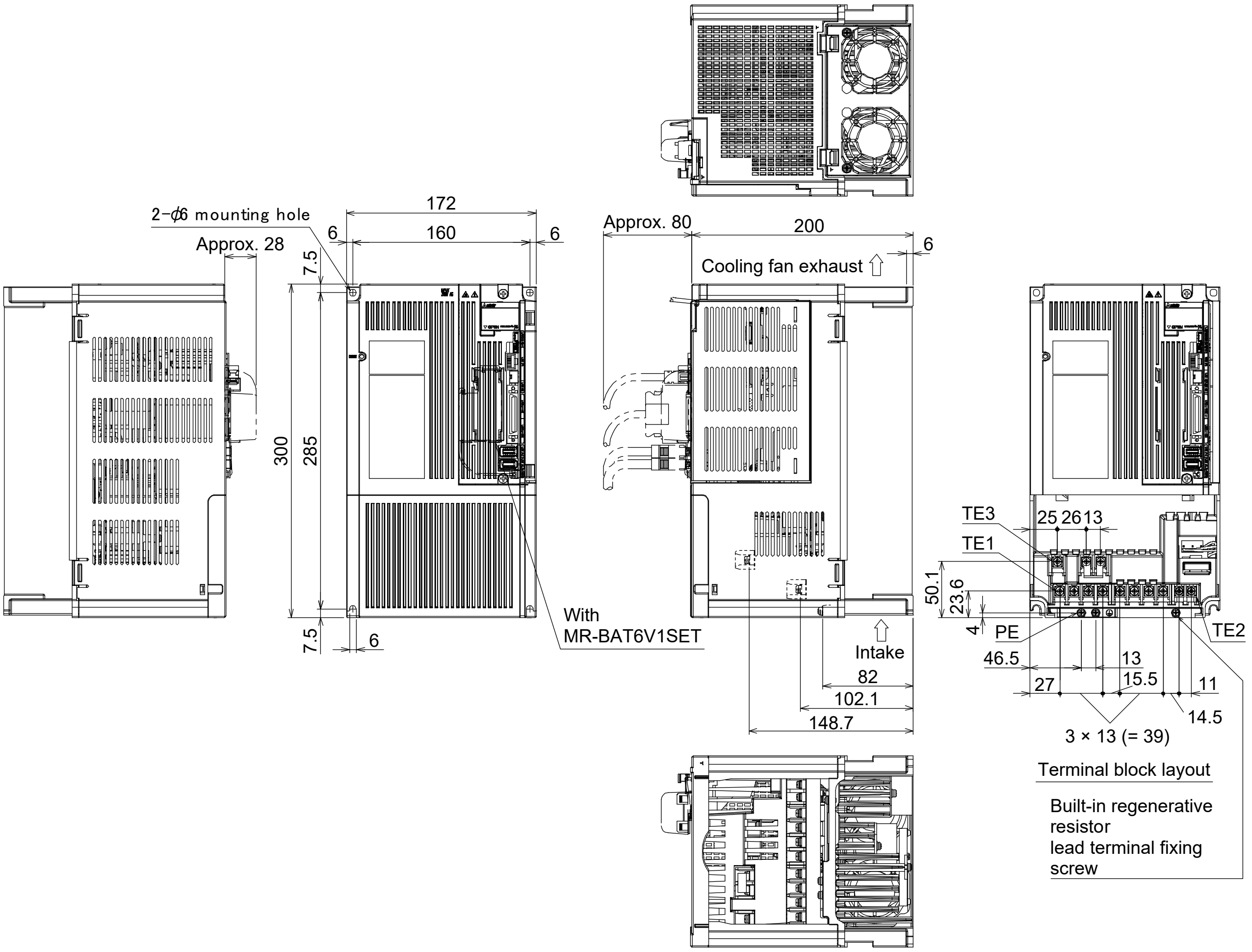
PE Screw size: M4
Tightening torque: 1.2 [N•m]



Mounting hole process drawing

(e) MR-J4-700A4(-RJ)

[Unit: mm]



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

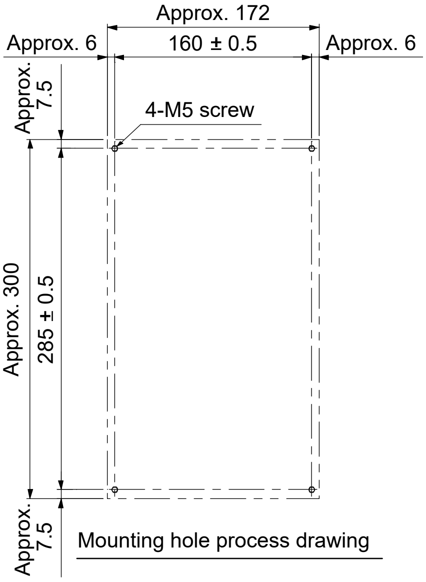
PE ⏚ ⏚

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]

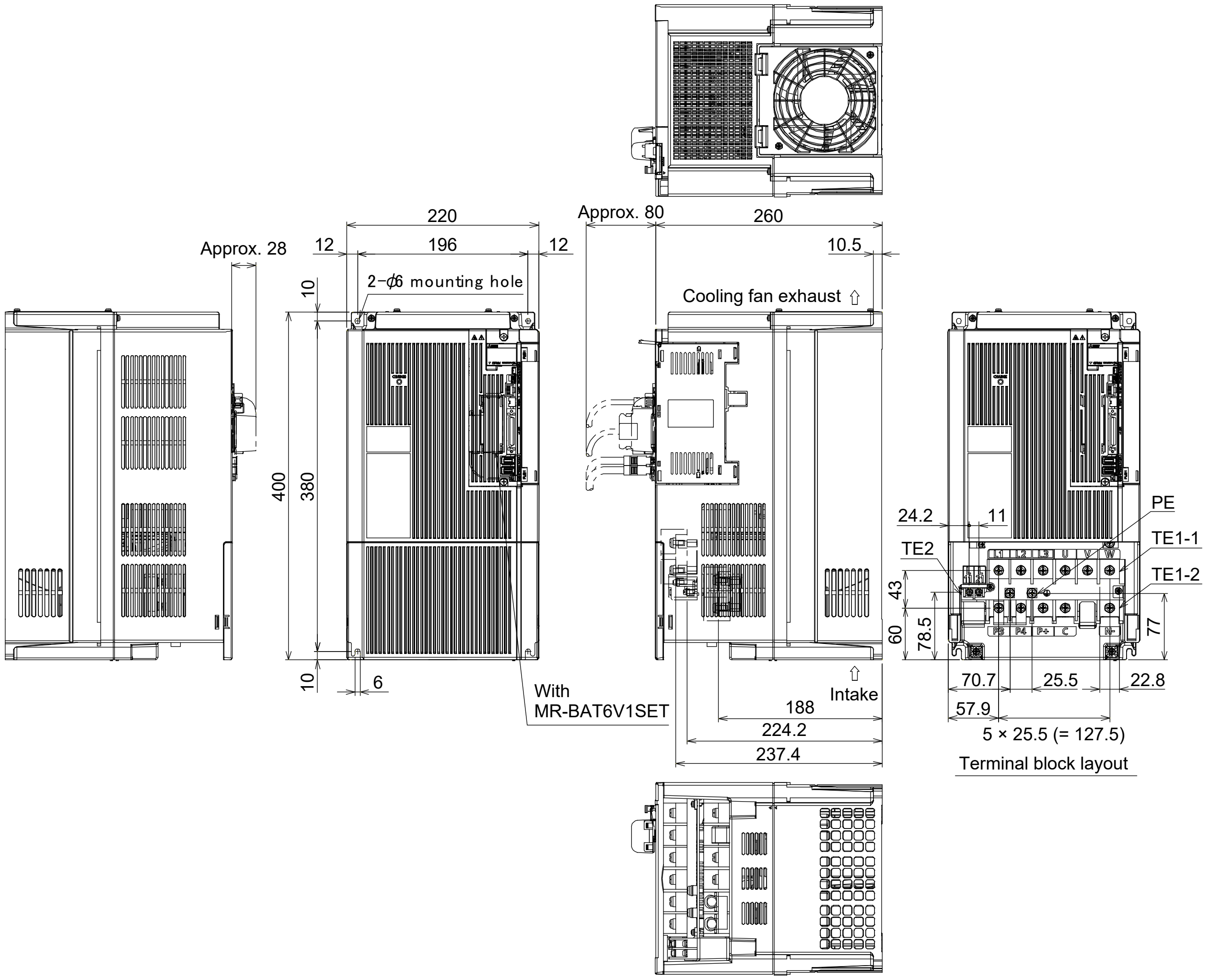
PE Screw size: M4
Tightening torque: 1.2 [N•m]



Mounting hole process drawing

(f) MR-J4-11KA4(-RJ)/MR-J4-15KA4(-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 | ⏚ | ⏚ |

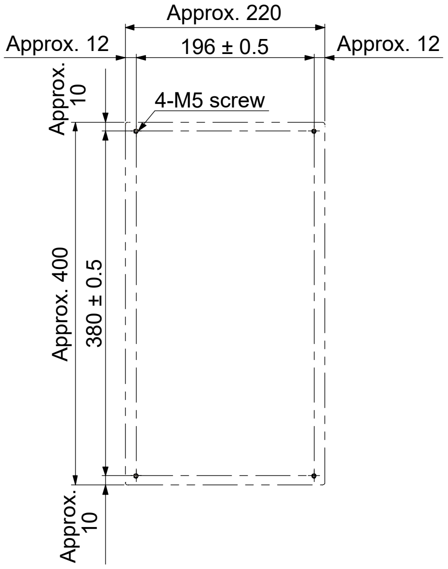
TE1-1 Screw size: M6
Tightening torque: 3.0 [N•m]

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]

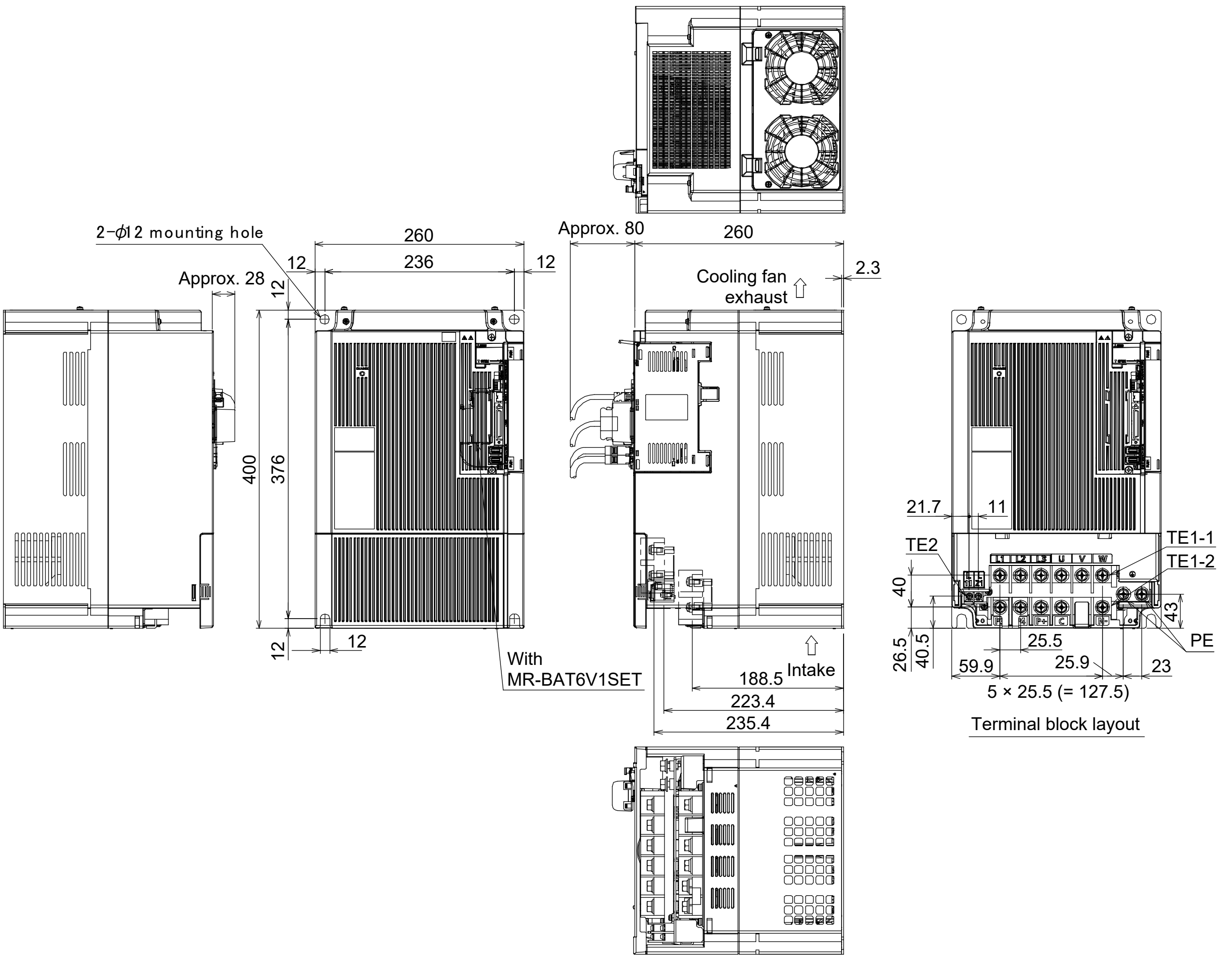
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]



Mounting hole process drawing

(g) MR-J4-22KA4(-RJ)

[Unit: mm]



Mass: 18.2 [kg]

Mounting screw

Screw size: M10

Tightening torque: 3.24 [N•m]

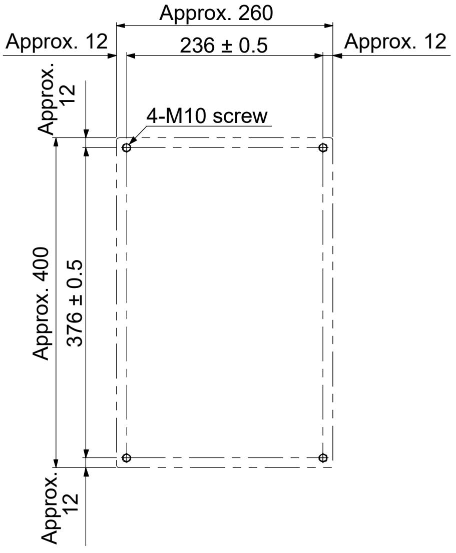
Terminal

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]

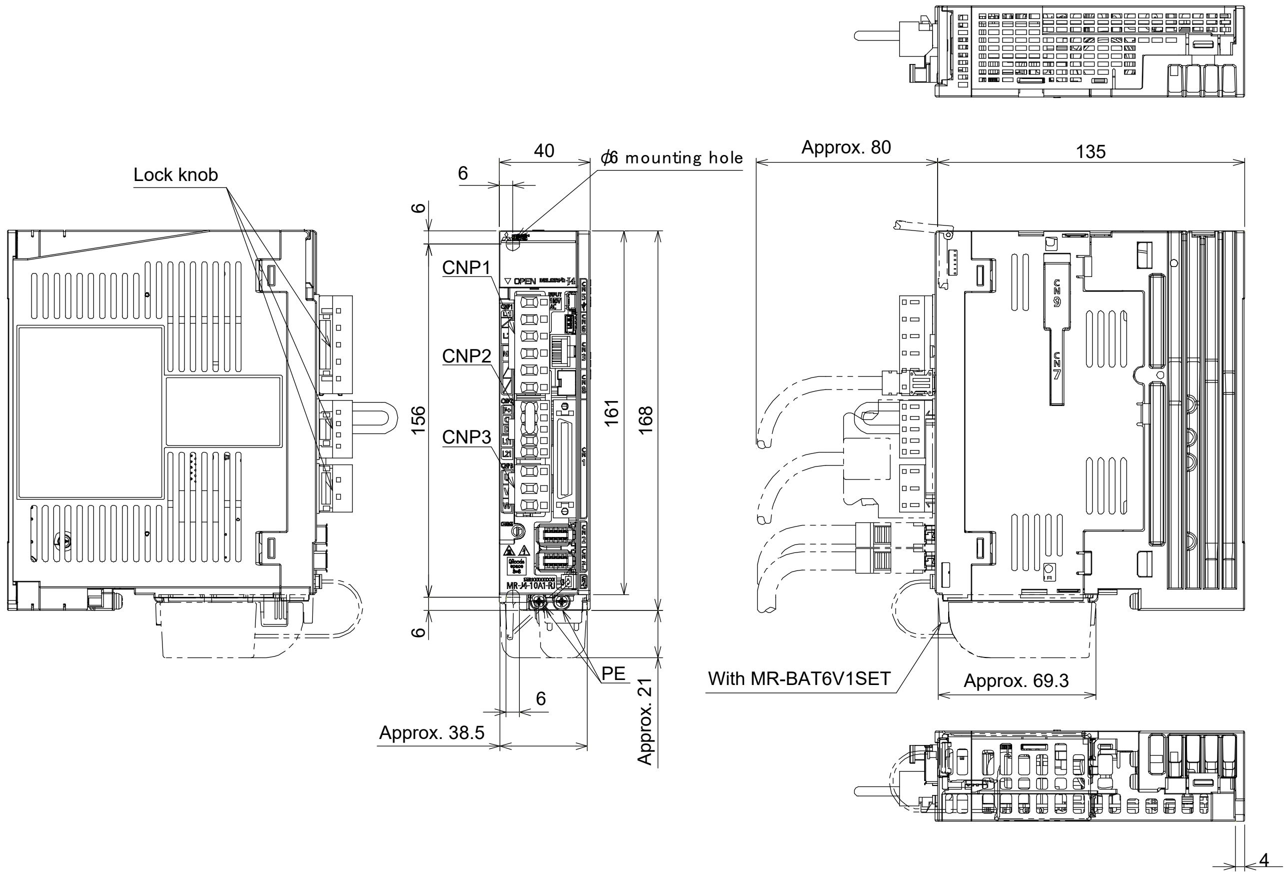


Mounting hole process drawing

(3) 100 V class

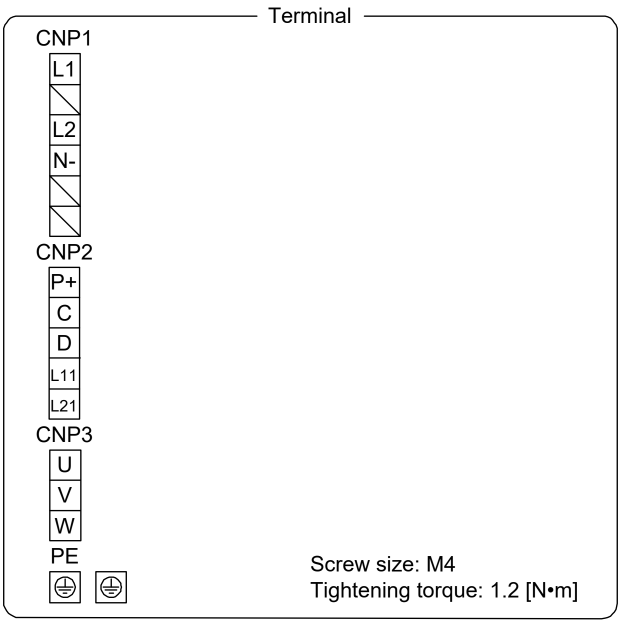
(a) MR-J4-10A1(-RJ)/MR-J4-20A1(-RJ)

[Unit: mm]

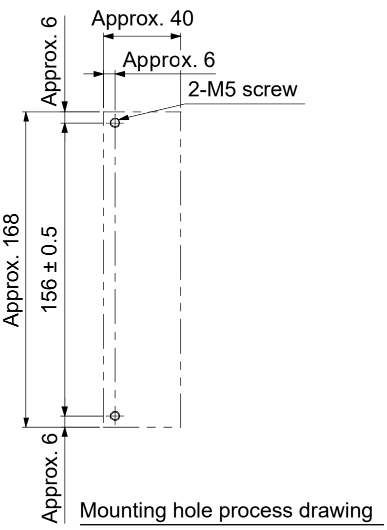


Mass: 0.8 [kg]

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



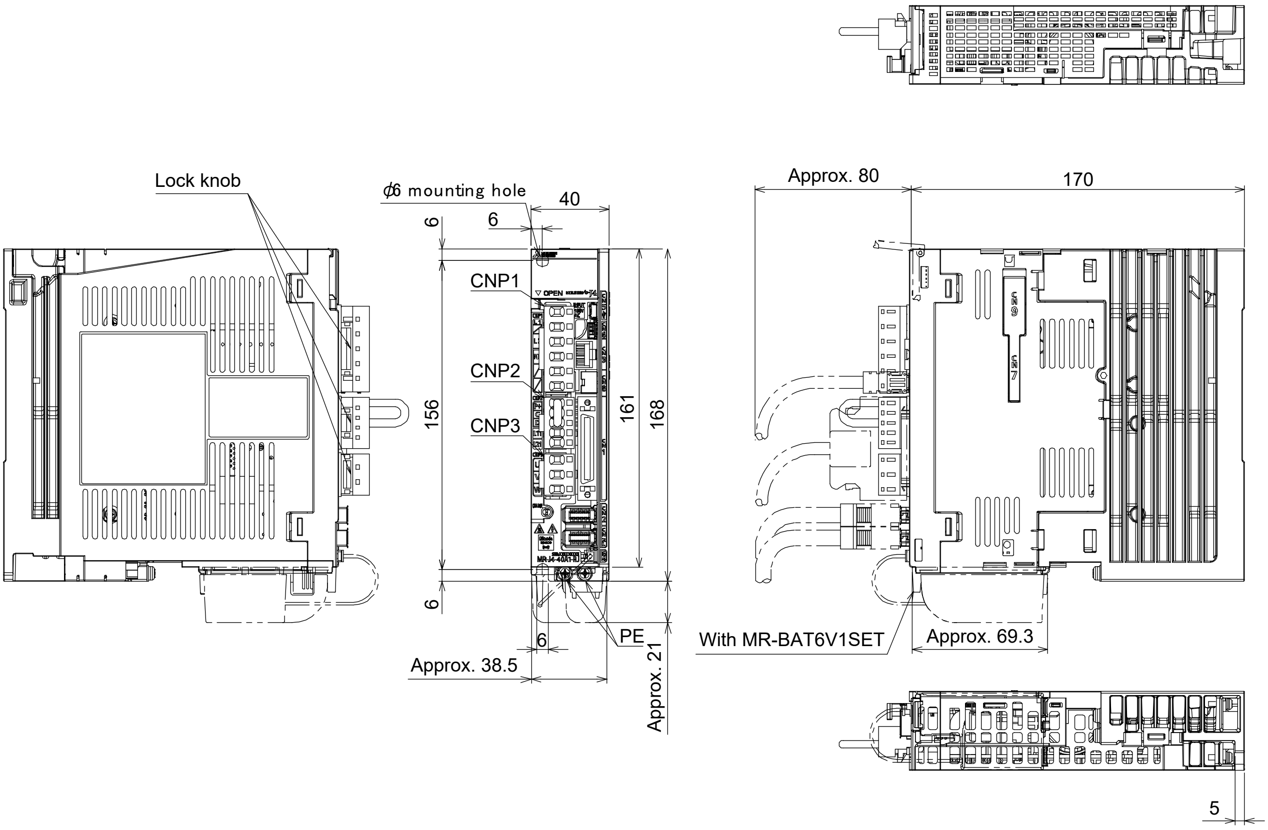
Screw size: M4
Tightening torque: 1.2 [N•m]



Mounting hole process drawing

(b) MR-J4-40A1(-RJ)

[Unit: mm]

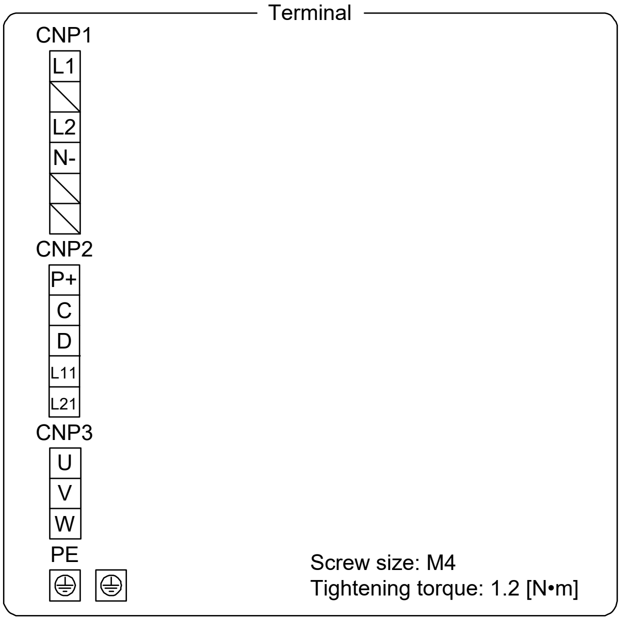


Mass: 1.0 [kg]

Mounting screw

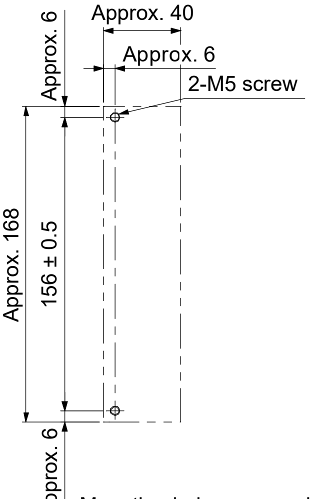
Screw size: M5

Tightening torque: 3.24 [N•m]



Screw size: M4

Tightening torque: 1.2 [N•m]



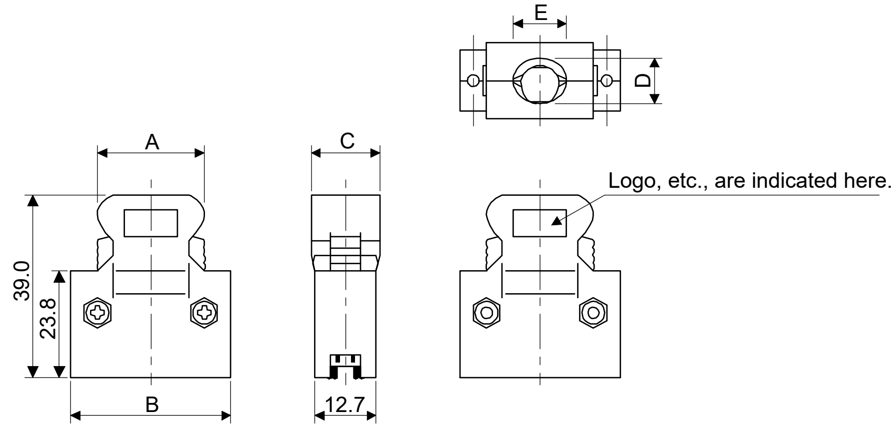
Mounting hole process drawing

9.2 Connector

(1) Miniature delta ribbon (MDR) system (3M)

(2) One-touch lock type

[Unit: mm]

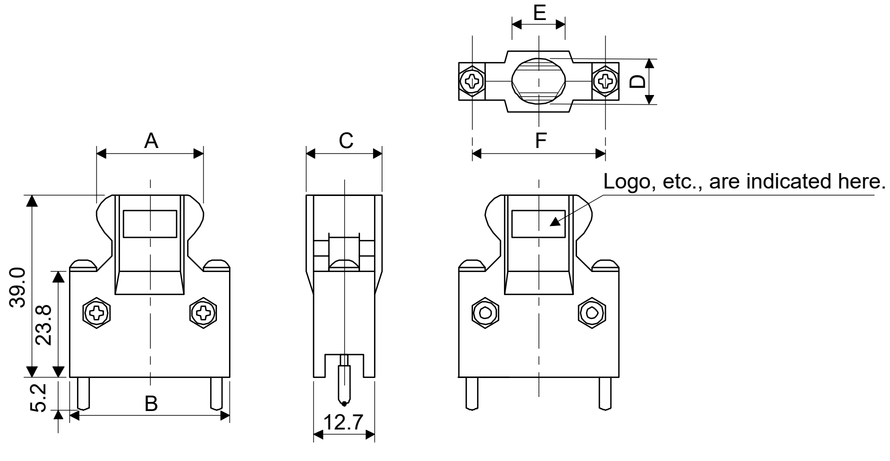


Connector	Shell kit	Variable dimensions				
		A	B	C	D	E
10150-3000PE	10350-52F0-008	41.1	52.4	18.0	14.0	17.0

(b) Jack screw M2.6 type

This is not available as option.

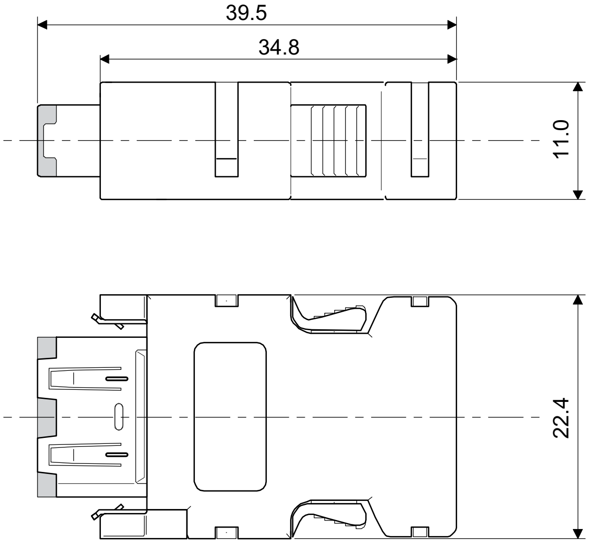
[Unit: mm]



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

(2) 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 15.4 and 16.5.

10.1 Overload protection characteristics

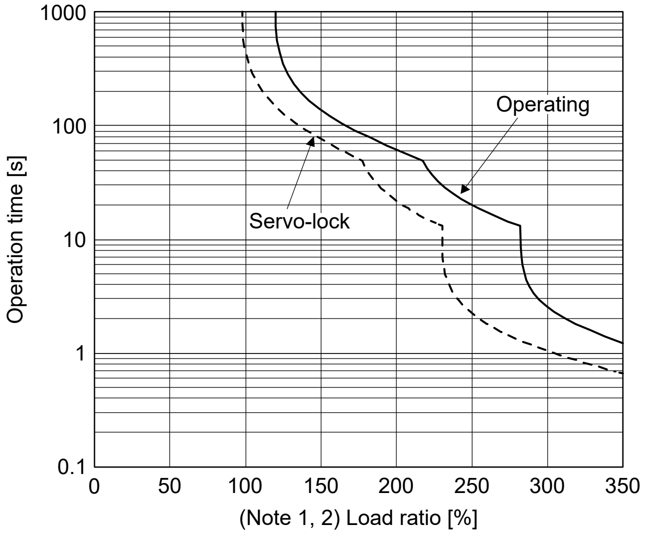
An electronic thermal is built in the servo amplifier to protect the servo motor, servo amplifier and servo motor power wires from overloads.
[AL. 50 Overload 1] occurs if overload operation performed is above the electronic thermal protection curve shown in fig. 10.1 [AL. 51 Overload 2] occurs if the 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.

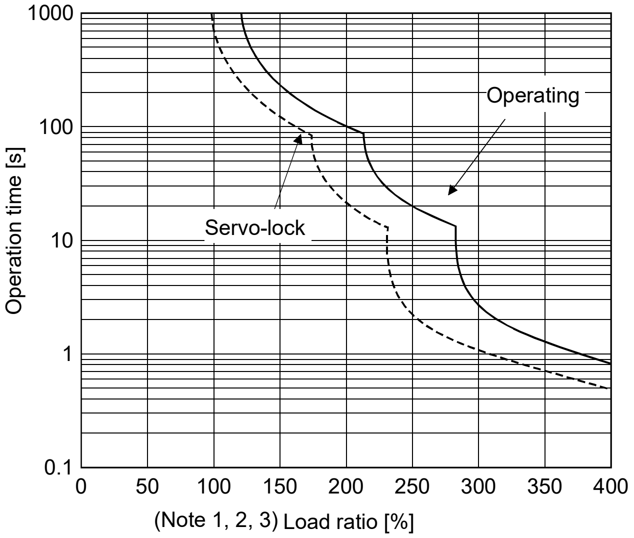
Rotary servo motor						Graph of overload protection characteristics
HG-KR	HG-MR	HG-SR	HG-UR	HG-RR	HG-JR	
053 13	053 13					Characteristics a
23 43 73	23 43 73	51 81 52 102	72		53 (Note) 73 103	Characteristics b
		121 201 152 202 301 352	152 202	103 153 203	73 (Note) 103 (Note) 153 (Note) 203 (Note) 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. The combination is for increasing the maximum torque of the servo motor to 400%.

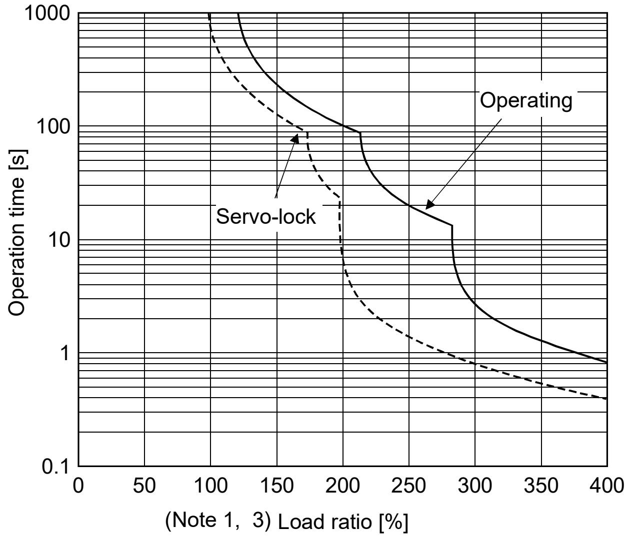
The following graphs show overload protection characteristics.



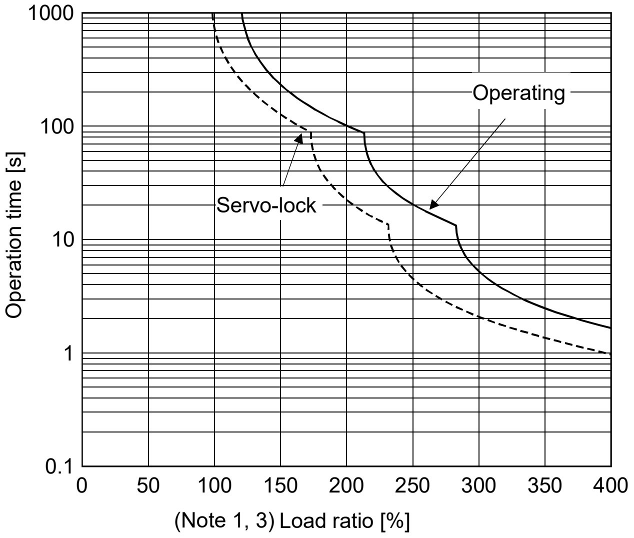
Characteristics a



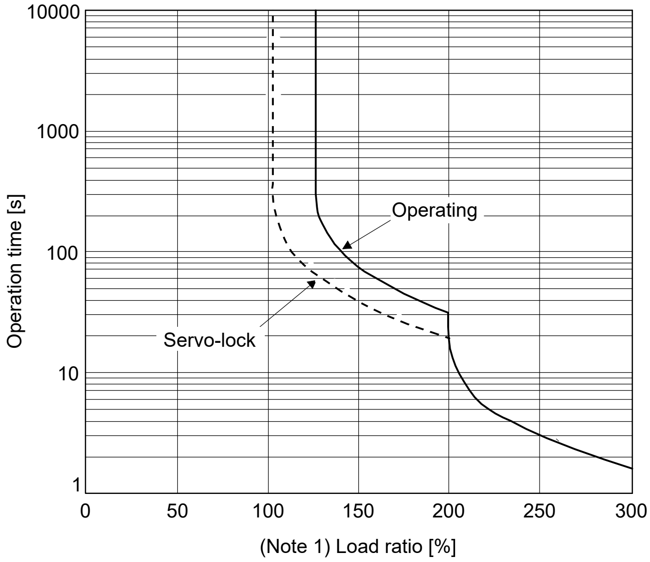
Characteristics b



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 [m^2]
			At rated output	At rated output [Generated heat in the cabinet when cooled outside the cabinet] (Note 3)	With servo-off	
MR-J4-10A(-RJ)	HG-MR053	0.3	25		15	0.5
	HG-MR13	0.3	25		15	0.5
	HG-KR053	0.3	25		15	0.5
	HG-KR13	0.3	25		15	0.5
MR-J4-20A(-RJ)	HG-MR23	0.5	25		15	0.5
	HG-KR23	0.5	25		15	0.5
MR-J4-40A(-RJ)	HG-MR43	0.9	35		15	0.7
	HG-KR43	0.9	35		15	0.7
MR-J4-60A(-RJ)	HG-SR52	1.0	40		15	0.8
	HG-SR51	1.0	40		15	0.8
	HG-JR53	1.0	40		15	0.8
MR-J4-70A(-RJ)	HG-MR73	1.3	50		15	1.0
	HG-KR73	1.3	50		15	1.0
	HG-UR72	1.3	50		15	1.0
	HG-JR73	1.3	50		15	1.0
MR-J4-100A(-RJ)	HG-SR102	1.7	50		15	1.0
	HG-SR81	1.5	50		15	1.0
	HG-JR103	1.7	50		15	1.0
MR-J4-200A(-RJ)	HG-SR152	2.5	90		20	1.8
	HG-SR202	3.5	90		20	1.8
	HG-SR121	2.1	90		20	1.8
	HG-SR201	3.5	90		20	1.8
	HG-RR103	1.7	50		15	1.0
	HG-RR153	2.5	90		20	1.8
	HG-UR152	2.5	90		20	1.8
	HG-JR153	2.5	90		20	1.8
	HG-JR203	3.5	90		20	1.8
MR-J4-350A(-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-J4-500A(-RJ)	HG-SR502	7.5	195		25	3.9
	HG-SR421	6.3	160		25	3.2
	HG-RR353	5.5	135		25	2.7
	HG-RR503	7.5	195		25	3.9
	HG-UR352	5.5	195		25	3.9
	HG-UR502	7.5	195		25	3.9
	HG-JR503	7.5	195		25	3.9
MR-J4-700A(-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-J4-11KA(-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-J4-15KA(-RJ)	HG-JR15K1M	22	640	195	45	13.0
	HG-JR15K1	22	640	195	45	12.8
MR-J4-22KA(-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-J4-60A4(-RJ)	HG-SR524	1.0	40		18	0.8
	HG-JR534	1.0	40		18	0.8
MR-J4-100A4(-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-J4-200A4(-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-J4-350A4(-RJ)	HG-SR3524	5.5	130		20	2.6
	HG-JR3534	5.5	160		20	2.7
MR-J4-500A4(-RJ)	HG-SR5024	7.5	195		25	3.9
	HG-JR5034	7.5	195		25	3.9
MR-J4-700A4(-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-J4-11KA4(-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-J4-15KA4(-RJ)	HG-JR15K1M4	22	640	195	45	13.0
	HG-JR15K14	22	640	195	45	12.8
MR-J4-22KA4(-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-J4-10A1(-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-J4-20A1(-RJ)	HG-MR23	0.5	25		15	0.5
	HG-KR23	0.5	25		15	0.5
MR-J4-40A1(-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.

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

A : Heat dissipation area [m^2]
P : Loss generated in the cabinet [W]
ΔT : Difference between internal and ambient temperatures [°C]
K : Heat dissipation coefficient [5 to 6]

When calculating the heat dissipation area with equation 10.1, assume that P is the sum of all losses generated in the cabinet. Refer to table 10.1 for heat generated by the servo amplifier. "A" indicates the effective area for heat dissipation, but if the cabinet is directly installed on an insulated wall, that extra amount must be added to the cabinet's surface area. The required heat dissipation area will vary with the conditions in the cabinet. If convection in the cabinet is poor and heat builds up, effective heat dissipation will not be possible. Therefore, arrangement of the equipment in the cabinet and the use of a cooling fan should be considered. Table 10.1 contains information on the required heat dissipation area (estimated) of servo amplifier cabinets when operating amplifiers at a rated load in ambient temperatures of 40 °C.

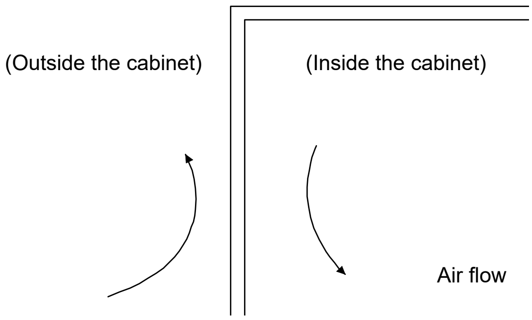


Fig. 10.2 Temperature distribution in an enclosed type cabinet

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 longer than that of normal dynamic brake. For how to set the electronic dynamic brake, refer to [Pr. PF06] and [Pr. PF12].

10.3.1 Dynamic brake operation

(1) Calculation of coasting distance

Fig. 10.3 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use equation 10.2 to calculate an approximate coasting distance to a stop. The dynamic brake time constant τ varies with the servo motor and machine operation speeds. (Refer to (2) (a), (b) 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.

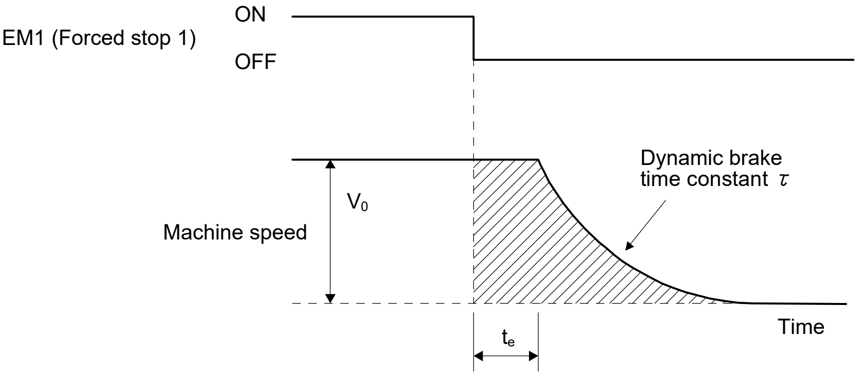


Fig. 10.3 Dynamic brake operation diagram

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

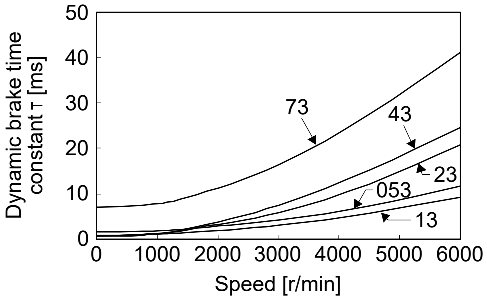
L_{max}: Maximum coasting distance ··· [mm]
V_0: Machine's fast feed speed ··· [mm/min]
J_M: Moment of inertia of the servo motor ··· [$\times 10^{-4}$ kg•m^2]
J_L: Load moment of inertia converted into equivalent value on servo motor shaft ··· [$\times 10^{-4}$ kg•m^2]
τ: Dynamic brake time constant ··· [s]
t_e: Delay time of control section ··· [s]

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

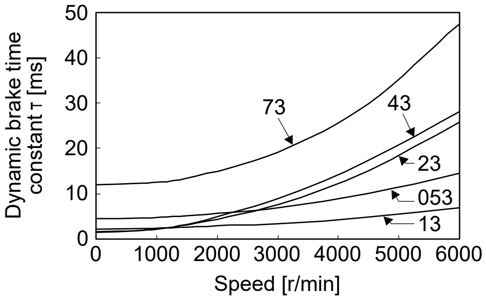
(2) Dynamic brake time constant

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

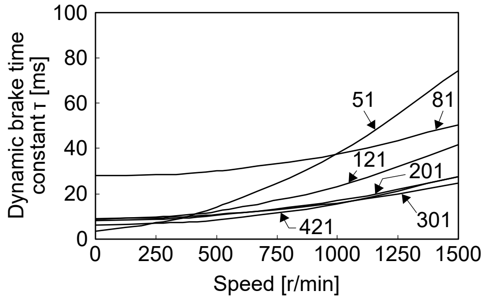
(a) 200 V class



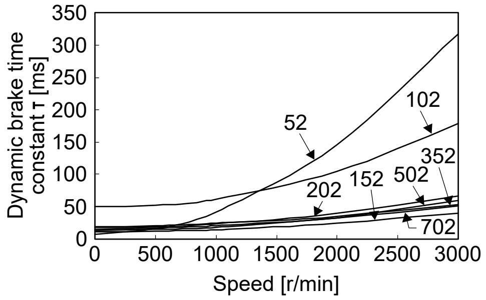
HG-MR series



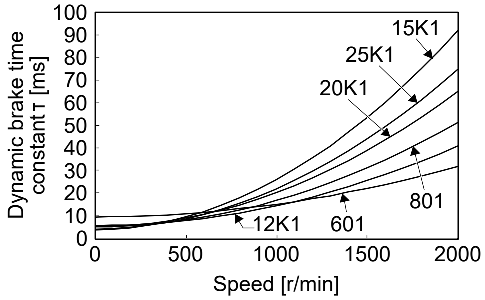
HG-KR series



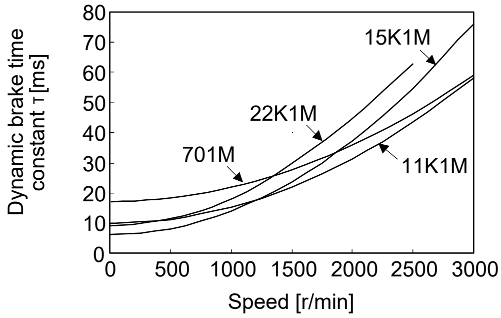
HG-SR 1000 r/min series



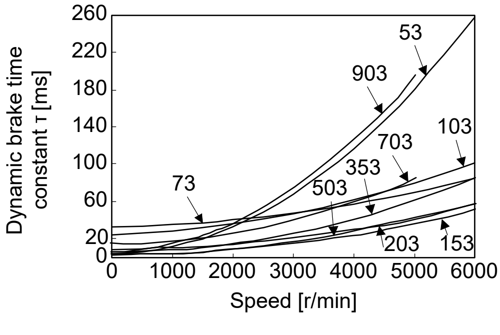
HG-SR 2000 r/min series



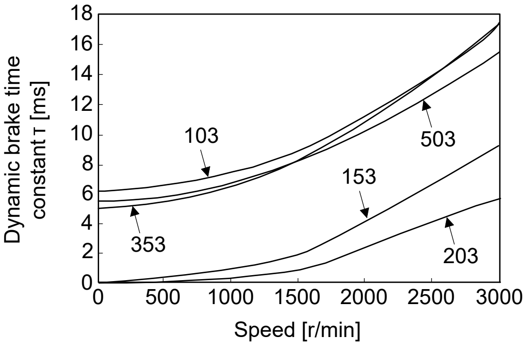
HG-JR1000 r/min series



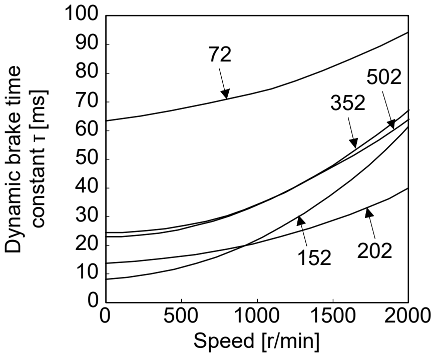
HG-JR1500 r/min series



HG-JR3000 r/min series

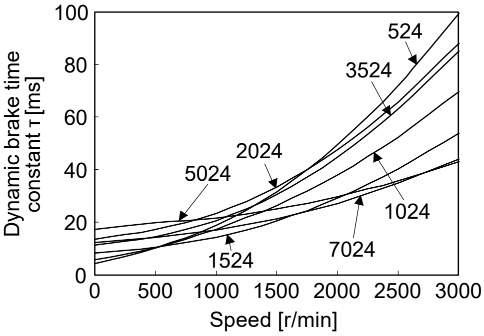


HG-RR series

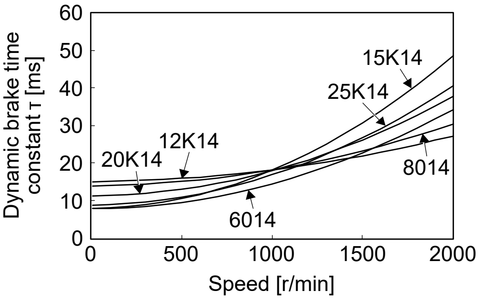


HG-UR series

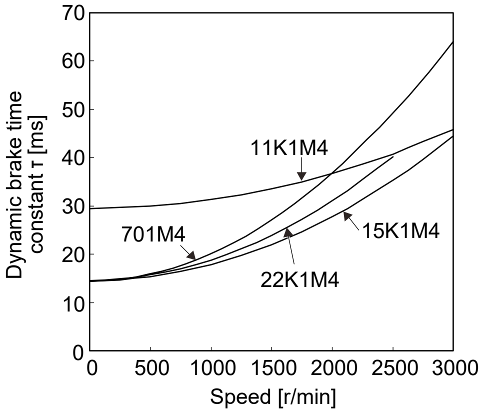
(b) 400 V class



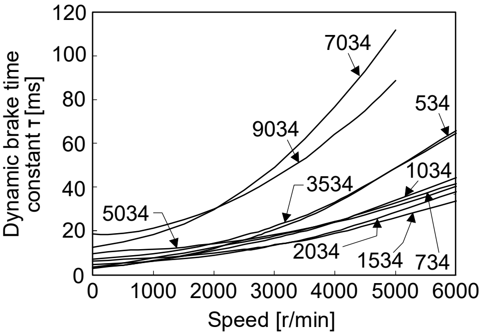
HG-SR series



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.

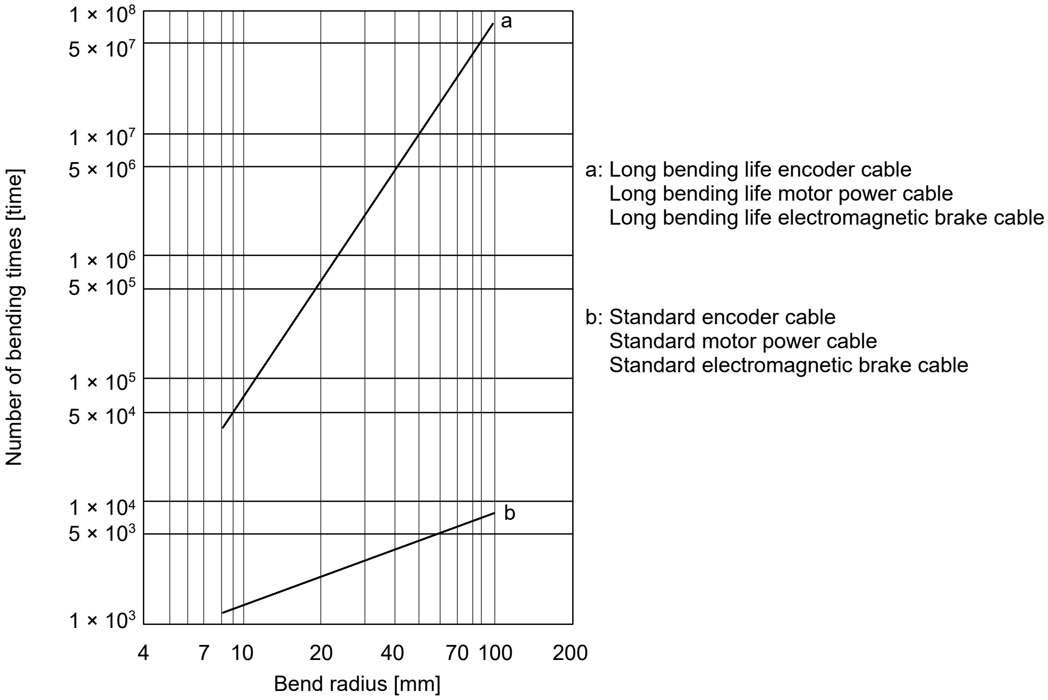
Servo motor	Permissible load to motor inertia ratio [multiplier]
HG-KR053	30
HG-KR13	
HG-KR23	
HG-KR43	
HG-KR73	
HG-MR053	35
HG-MR13	32
HG-MR23	
HG-MR43	
HG-MR73	
HG-SR51	30
HG-SR81	
HG-SR121	
HG-SR201	
HG-SR301	16
HG-SR421	15
HG-SR52	30
HG-SR102	
HG-SR152	21
HG-SR202	
HG-SR352	13 (15)
HG-SR502	
HG-SR702	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.



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

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

(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-J4-60A4(-RJ) MR-J4-100A4(-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-J4-200A4(-RJ)	80 A (attenuated to approx. 5 A in 10 ms)	
MR-J4-350A4(-RJ)	100 A (attenuated to approx. 20 A in 10 ms)	
MR-J4-500A4(-RJ)	65 A (attenuated to approx. 9 A in 20 ms)	41 A (attenuated to approx. 0 A in 3 ms)
MR-J4-700A4(-RJ)	68 A (attenuated to approx. 34 A in 20 ms)	
MR-J4-11KA4(-RJ)	339 A (attenuated to approx. 10 A in 30 ms)	38 A (attenuated to approx. 1 A in 30 ms)
MR-J4-15KA4(-RJ)	339 A (attenuated to approx. 15 A in 30 ms)	
MR-J4-22KA4(-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-J4-10A1(-RJ) MR-J4-20A1(-RJ) MR-J4-40A1(-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 auxiliary 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

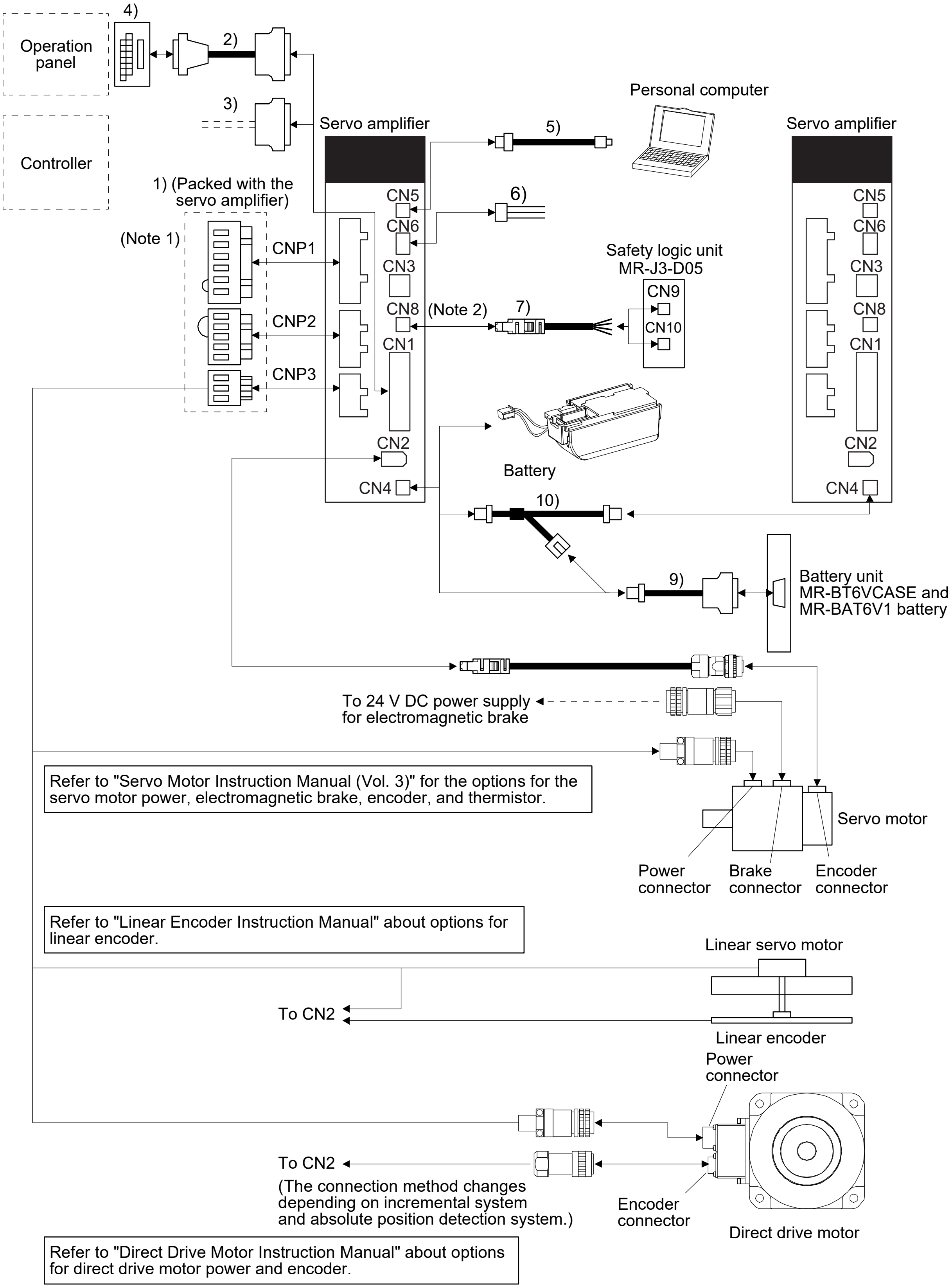
POINT

- 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.

Purchase the cable and connector options indicated in this section.

11.1.1 Combinations of cable/connector sets

For MR-J4-_A_ servo amplifier



Refer to "Servo Motor Instruction Manual (Vol. 3)" for the options for the servo motor power, electromagnetic brake, encoder, and thermistor.

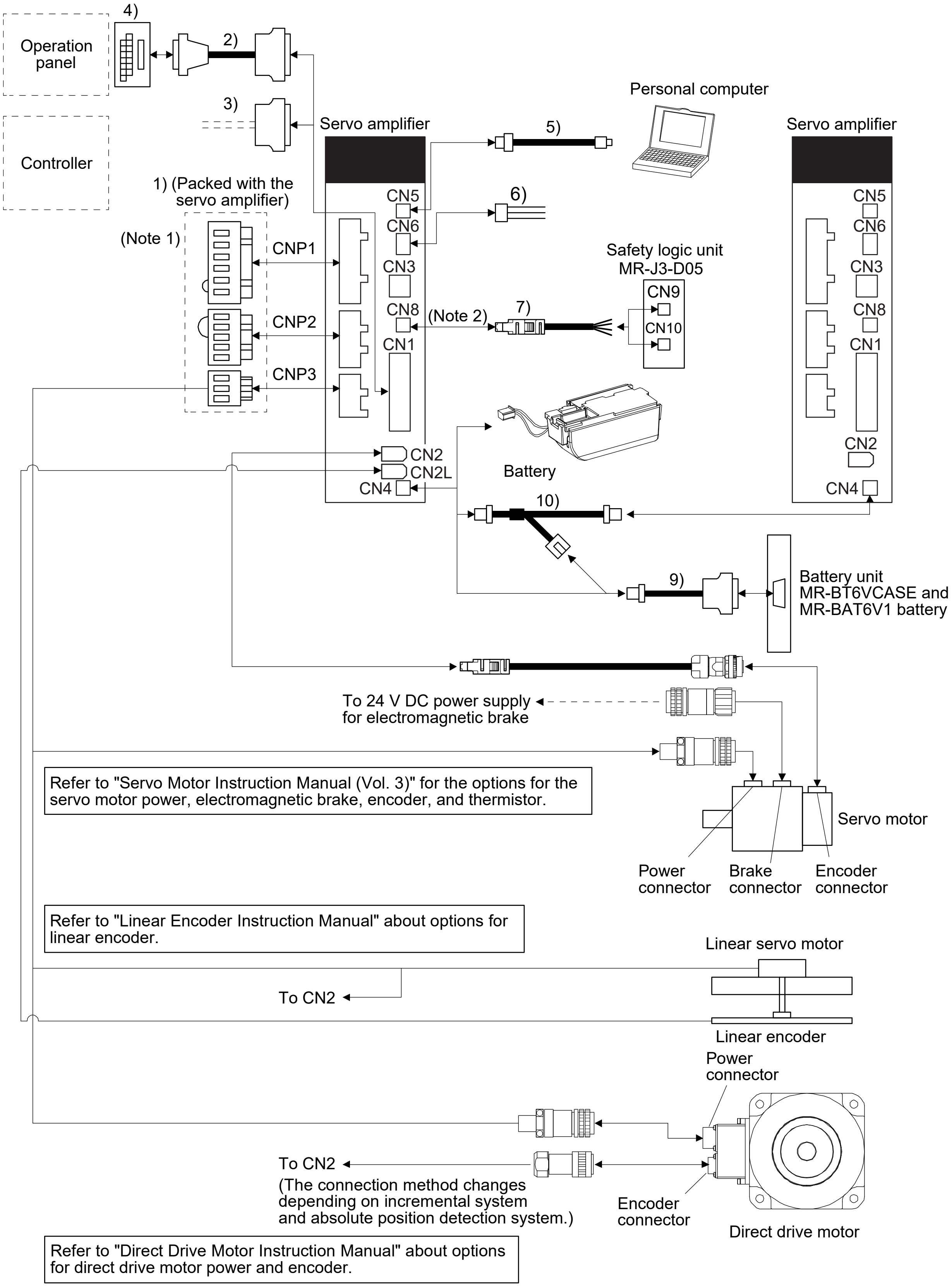
Refer to "Linear Encoder Instruction Manual" about options for linear encoder.

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 a short-circuit connector (8)) supplied with a servo amplifier.

For MR-J4-_A_-RJ servo amplifier

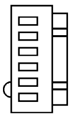
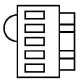
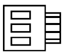
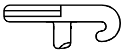
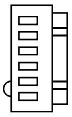
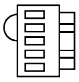
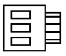
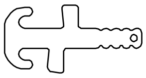
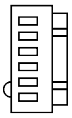
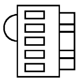
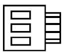
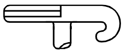
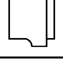


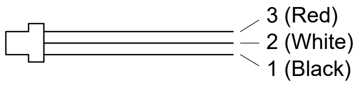
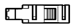
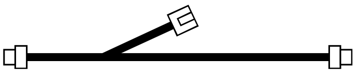
Refer to "Servo Motor Instruction Manual (Vol. 3)" for the options for the servo motor power, electromagnetic brake, encoder, and thermistor.

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 a short-circuit connector (8)) supplied with a servo amplifier.

No.	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) 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 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)	Junction terminal block cable	MR-J2M-CN1TBL_M Cable length: 0.5 m, 1 m (Refer to section 11.6.)	Junction terminal block connector Connector: D7950-B500FL (3M) CN1 connector Connector: 10150-6000EL Shell kit: 10350-3210-000 (3M or equivalent) 	For junction terminal block connection
3)	CN1 connector set	MR-J3CN1	Connector: 10150-3000PE Shell kit: 10350-52F0-008 (3M or equivalent) 	
4)	Junction terminal block	MR-TB50	Refer to section 11.6.	
5)	USB cable	MR-J3USBCBL3M Cable length: 3 m	CN5 connector mini-B connector (5 pins) Personal computer connector A connector 	For connection with PC-AT compatible personal computer

No.	Name	Model	Description	Remark
6)	Monitor cable	MR-J3CN6CBL1M Cable length: 1 m	 CN6 connector Housing: 51004-0300 Terminal: 50011-8100 (Molex)	
7)	STO cable	MR-D05UDL3M-B	Connector set: 2069250-1 (TE Connectivity) 	Connection cable for the CN8 connector
8)	Short-circuit connector			Supplied with servo amplifier
9)	Battery cable	MR-BT6V1CBL_M Cable length: 0.3/1 m (Refer to section 11.1.3.)	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
10)	Junction battery cable	MR-BT6V2CBL_M Cable length: 0.3/1 m (Refer to section 11.1.3.)	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

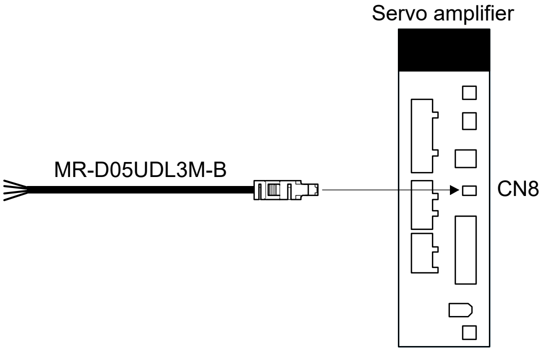
11.1.2 MR-D05UDL3M-B STO cable

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

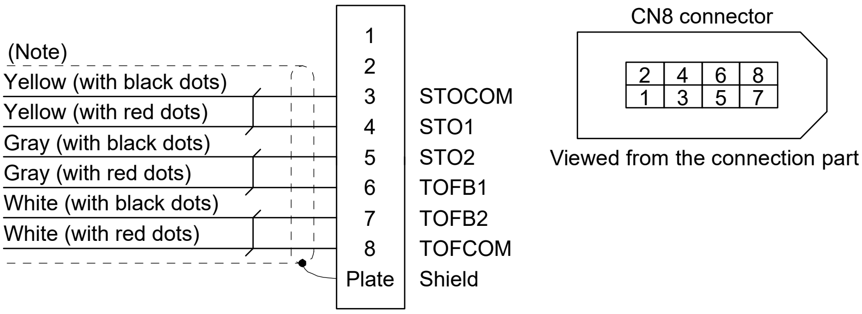
Cable model	Cable length	Cable OD (Note)	Application
MR-D05UDL3M-B	3 m	5.7 mm	Connection cable for the CN8 connector

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 sheath (with red or black dots).

11.1.3 Battery cable/junction battery cable

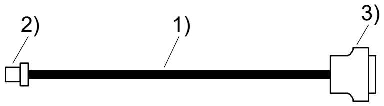
(1) Model explanations

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

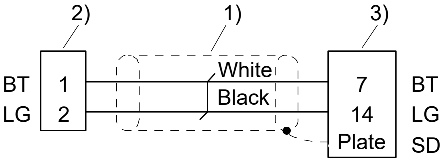
(2) MR-BT6V1CBL_M

(a) Appearance



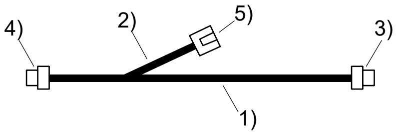
Components	Description
1) Cable	VSVC 7/0.18 × 2C
2) Connector	Housing: PAP-02V-O Contact: SPHD-001G-P0.5 (JST)
3) Connector	Connector: 10114-3000PE Shell kit: 10314-52F0-008 (3M or equivalent)

(b) Internal wiring diagram



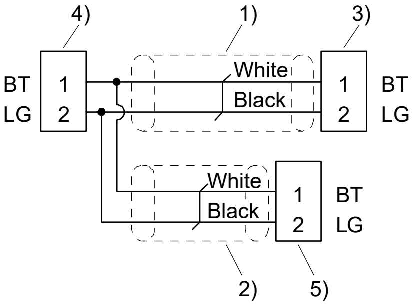
(3) MR-BT6V2CBL_M

(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-J4-10A (-RJ)		30								
MR-J4-20A (-RJ)	10	30	100							
MR-J4-40A (-RJ)	10	30	100							
MR-J4-60A (-RJ)	10	30	100							
MR-J4-70A (-RJ)	20	30	100				300			
MR-J4-100A (-RJ)	20	30	100				300			
MR-J4-200A (-RJ)	100			300				500		
MR-J4-350A (-RJ)	100				300				500	
MR-J4-500A (-RJ)	130					300				500
MR-J4-700A (-RJ)	170					300				500

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

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

(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-J4-60A4(-RJ)	15	100	300						
MR-J4-100A4(-RJ)	15	100	300						
MR-J4-200A4(-RJ)	100			300	500				
MR-J4-350A4(-RJ)	100			300	500				
MR-J4-500A4(-RJ)	130					300	500		
MR-J4-700A4(-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-J4-11KA4(-RJ)	500 (800)	500 (800)	
MR-J4-15KA4(-RJ)	850 (1300)		850 (1300)
MR-J4-22KA4(-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

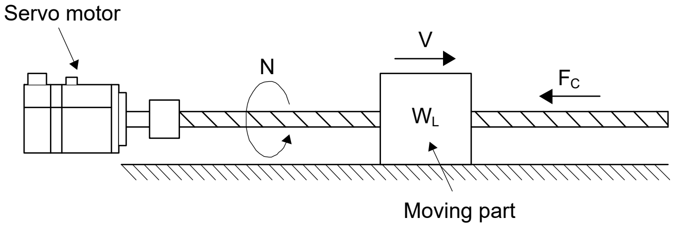
Servo amplifier	Regenerative power [W]		
	Built-in regenerative resistor	MR-RB032 [40 Ω]	MR-RB12 [40 Ω]
MR-J4-10A1(-RJ)		30	
MR-J4-20A1(-RJ)	10	30	100
MR-J4-40A1(-RJ)	10	30	100

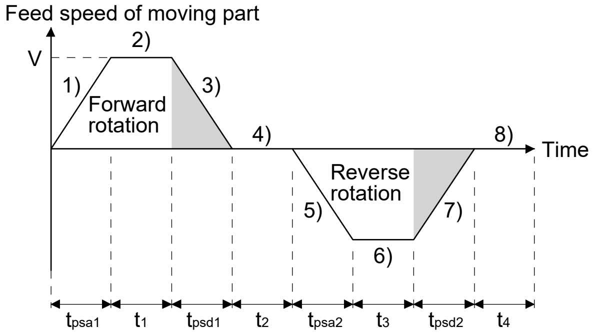
11.2.2 Selection of regenerative option

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-J4-10A(-RJ)	55	9
MR-J4-20A(-RJ)	75	9
MR-J4-40A(-RJ)	85	11
MR-J4-60A(-RJ)	85	11
MR-J4-70A(-RJ)	85	18
MR-J4-100A(-RJ)	85	18
MR-J4-200A(-RJ)	85	36
MR-J4-350A(-RJ)	85	40
MR-J4-500A(-RJ)	90	45
MR-J4-700A(-RJ)	90	70
MR-J4-11KA(-RJ)	90	120
MR-J4-15KA(-RJ)	90	170
MR-J4-22KA(-RJ)	90	250

Servo amplifier	Inverse efficiency [%]	Capacitor charging [J]
MR-J4-60A4(-RJ)	85	12
MR-J4-100A4(-RJ)	85	12
MR-J4-200A4(-RJ)	85	25
MR-J4-350A4(-RJ)	85	43
MR-J4-500A4(-RJ)	90	45
MR-J4-700A4(-RJ)	90	70
MR-J4-11KA4(-RJ)	90	120
MR-J4-15KA4(-RJ)	90	170
MR-J4-22KA4(-RJ)	90	250
MR-J4-10A1(-RJ)	55	4
MR-J4-20A1(-RJ)	75	4
MR-J4-40A1(-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.

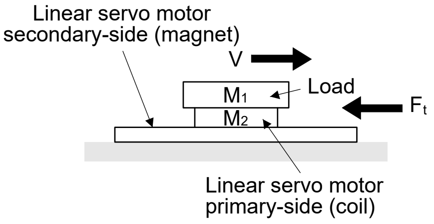
$ER\ [J] = \eta_m \cdot Es - Ec$

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

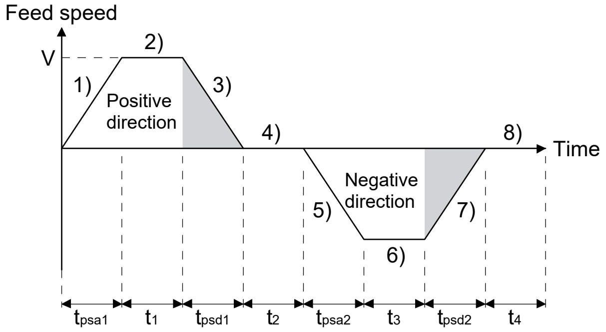
$PR\ [W] = ER/tf$

(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) in 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] = η • Es - Ec

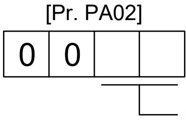
From the total of ER's whose subtraction results are positive and one-cycle period, the power consumption PR [W] of the regenerative option can be calculated with the following equation.

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

11.2.4 Connection of regenerative option

POINT

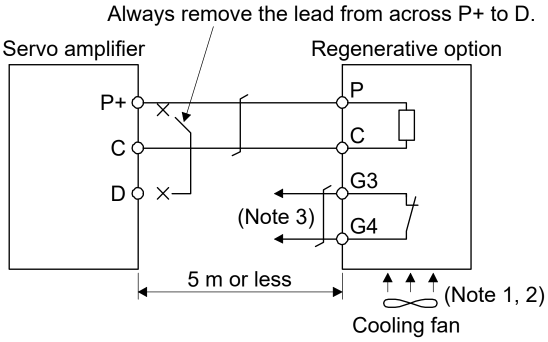
●When the MR-RB50, MR-RB51, MR-RB5N, MR-RB3M-4, MR-RB3G-4, MR-RB5G-4, MR-RB34-4, MR-RB54-4, MR-RB5K-4, or MR-RB6K-4 is used, a cooling fan is required to cool it. The cooling fan should be prepared by the customer.

●For the sizes of wires used for wiring, refer to section 11.9.

The regenerative option generates heat of 100 °C higher than the ambient temperature. Fully consider heat dissipation, installation position, used wires, etc. to place the option. For wiring, use flame-resistant wires or make the wires flame-resistant and keep them away from the regenerative option. Use twisted wires with a maximum length of 5 m for a connection with the servo amplifier.

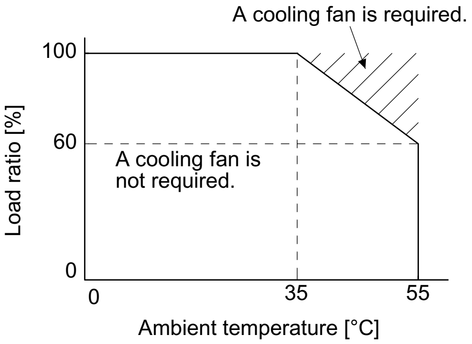
(1) MR-J4-500A(-RJ) or less/MR-J4-350A4(-RJ) or less

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 (92 mm × 92 mm, minimum air flow: 1.0 m^3).

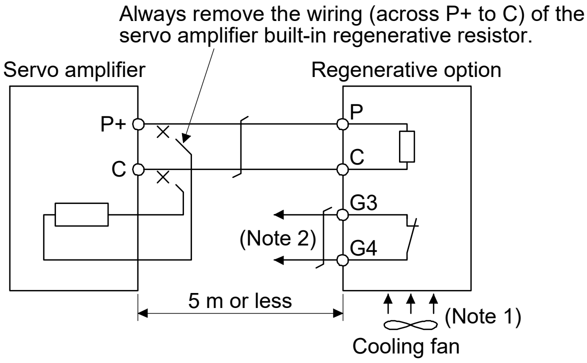
2. When the ambient temperature is more than 55 °C and the regenerative load ratio is more than 60% in MR-RB30, MR-RB-31, MR-RB32 and MR-RB3N, forcefully cool the air with a cooling fan (1.0 m^3/min or more, 92 mm × 92 mm). A cooling fan is not required if the ambient temperature is 35 °C or less. (A cooling fan is required for the shaded area in the following graph.)



3. Make up a sequence which will switch off the magnetic contactor when abnormal heating occurs.
G3-G4 contact specifications
Maximum voltage: 120 V AC/DC
Maximum current: 0.5 A/4.8 V DC
Maximum capacity: 2.4 VA

(2) MR-J4-500A4(-RJ)/MR-J4-700A(-RJ)/MR-J4-700A4(-RJ)

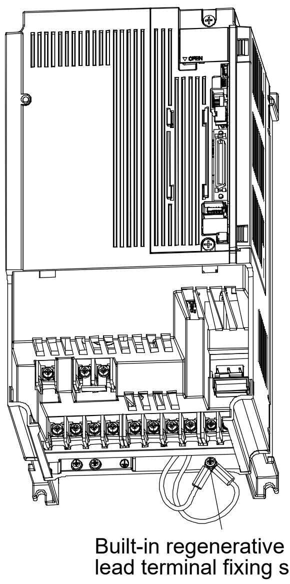
Always remove the wiring (across P+ to C) of the servo amplifier built-in regenerative resistor and fit the regenerative option across P+ to C. G3 and G4 are thermal sensor's terminals. Between G3 and G4 is opened when the regenerative option overheats abnormally.

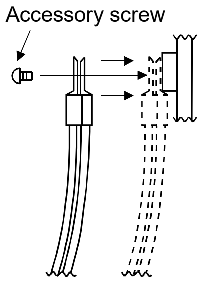


Note 1. When using the MR-RB51, MR-RB34-4, MR-RB54-4, MR-RB3U-4, or MR-RB5U-4, forcibly cool it with a cooling fan (92 mm × 92 mm, minimum air flow: 1.0 m^3).

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.



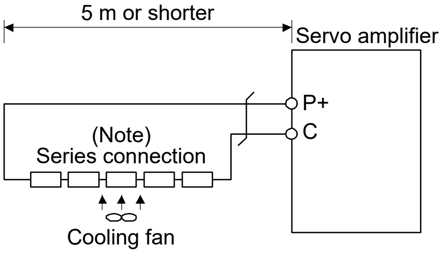


(3) MR-J4-11KA(-RJ) to MR-J4-22KA(-RJ)/MR-J4-11KA4(-RJ) to MR-J4-22KA4(-RJ) (when using the supplied regenerative resistor)

⚠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.

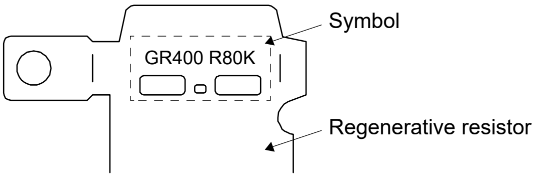
When using the regenerative resistors supplied to the servo amplifier, the specified number of resistors (4 or 5 resistors) must be connected in series. If they are connected in parallel or in less than the specified number, the servo amplifier may become faulty and/or the regenerative resistors burn.
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].



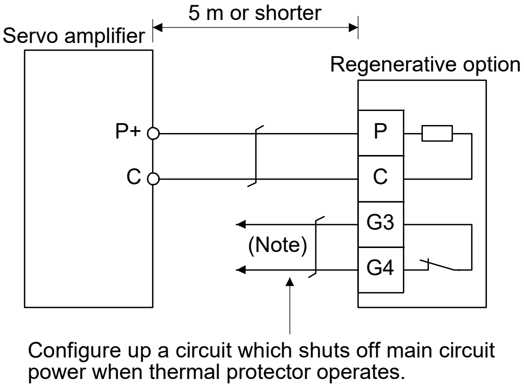
Note. The number of resistors connected in series depends on the resistor type. The thermal sensor is not mounted on the attached regenerative resistor. An abnormal heating of resistor may be generated at a regenerative circuit failure. Install a thermal sensor near the resistor and establish a protective 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-J4-11KA(-RJ)	GRZG400-0.8Ω	GR400 R80K	500	800	3.2	4
MR-J4-15KA(-RJ)	GRZG400-0.6Ω	GR400 R60K	850	1300	3	5
MR-J4-22KA(-RJ)	GRZG400-0.5Ω	GR400 R50K			2.5	
MR-J4-11KA4(-RJ)	GRZG400-2.5Ω	GR400 2R5K	500	800	10	4
MR-J4-15KA4(-RJ) MR-J4-22KA4(-RJ)	GRZG400-2Ω	GR400 2R0K	850	1300	10	5

Note. The following shows an indication example of symbol.



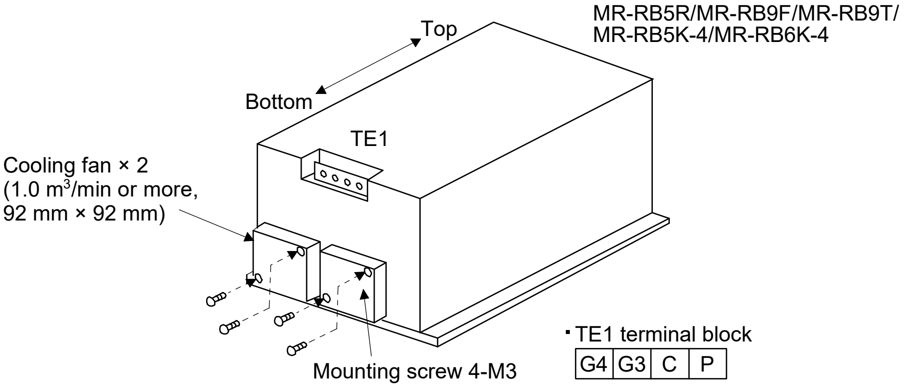
(4) MR-J4-11KA-PX to MR-J4-22KA-PX/MR-J4-11KA-RZ to MR-J4-22KA-RZ/MR-J4-11KA4-PX to MR-J4-22KA4-PX/MR-J4-11KA4-RZ to MR-J4-22KA4-RZ (when using the regenerative option)
The MR-J4-11KA-PX to MR-J4-22KA-PX, MR-J4-11KA-RZ to MR-J4-22KA-RZ, MR-J4-11KA4-PX to MR-J4-22KA4-PX, and MR-J4-11KA4-RZ to MR-J4-22KA4-RZ 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-J4-11KA-PX MR-J4-11KA-RZ	MR-RB5R	3.2	500	800
MR-J4-15KA-PX MR-J4-15KA-RZ	MR-RB9F	3	850	1300
MR-J4-22KA-PX MR-J4-22KA-RZ	MR-RB9T	2.5	850	1300
MR-J4-11KA4-PX MR-J4-11KA4-RZ	MR-RB5K-4	10	500	800
MR-J4-15KA4-PX MR-J4-15KA4-RZ MR-J4-22KA4-PX MR-J4-22KA4-RZ	MR-RB6K-4	10	850	1300

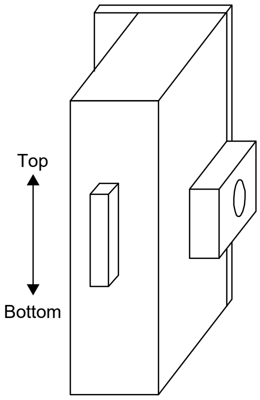
When using cooling fans, install them using the mounting holes provided in the bottom of the regenerative option.



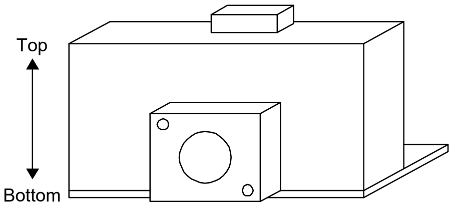
11.2.5 Mounting direction

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

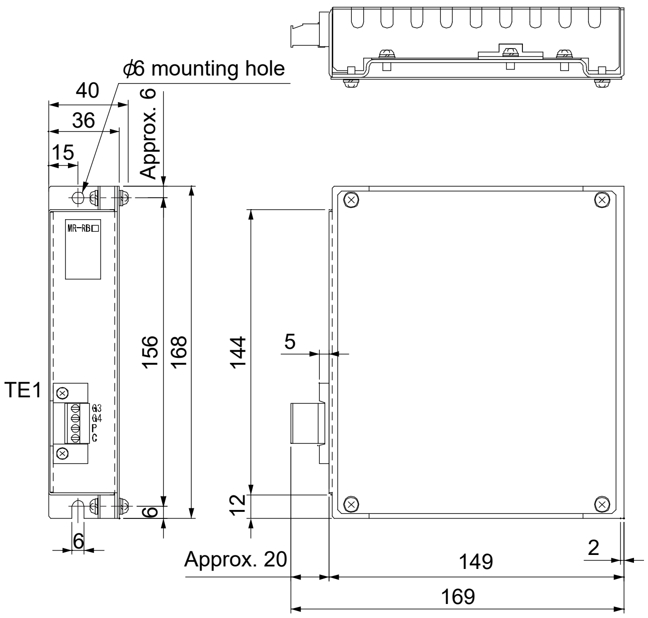


Horizontal installation

11.2.6 Dimensions

(1) MR-RB12

[Unit: mm]



・TE1 terminal

G3
G4
P
C

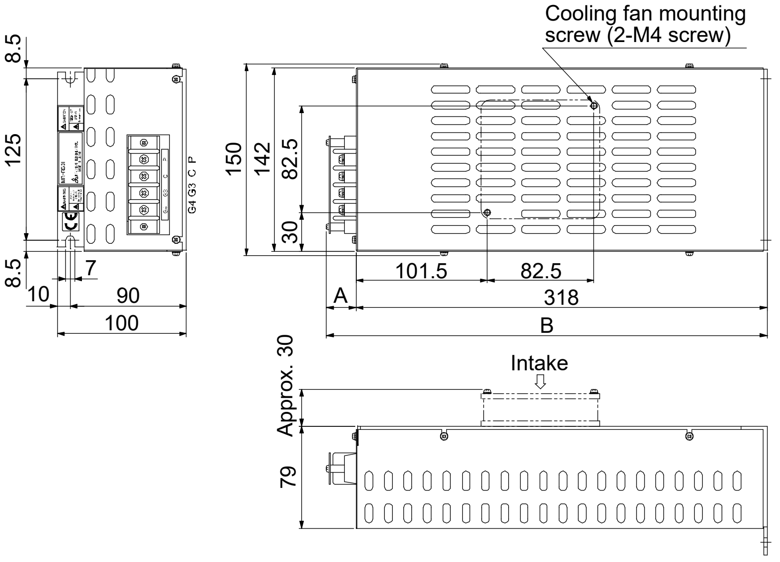
Applicable wire size: 0.2 mm^2 to 2.5 mm^2 (AWG 14 to 12)
Tightening torque: 0.5 to 0.6 [N•m]

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

Mass: 1.1 [kg]

(2) MR-RB30/MR-RB31/MR-RB32/MR-RB3N/MR-RB34-4/MR-RB3M-4/MR-RB3G-4/MR-RB3U-4

[Unit: mm]



・Terminal block

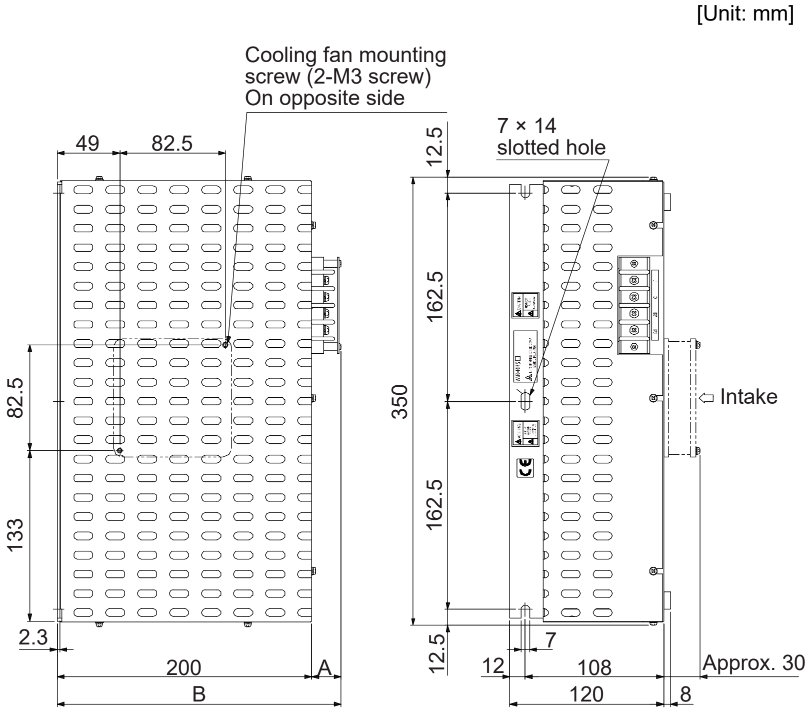
P
C
G3
G4

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

・Mounting screw
Screw size: M5
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



- Terminal block

P
C
G3
G4

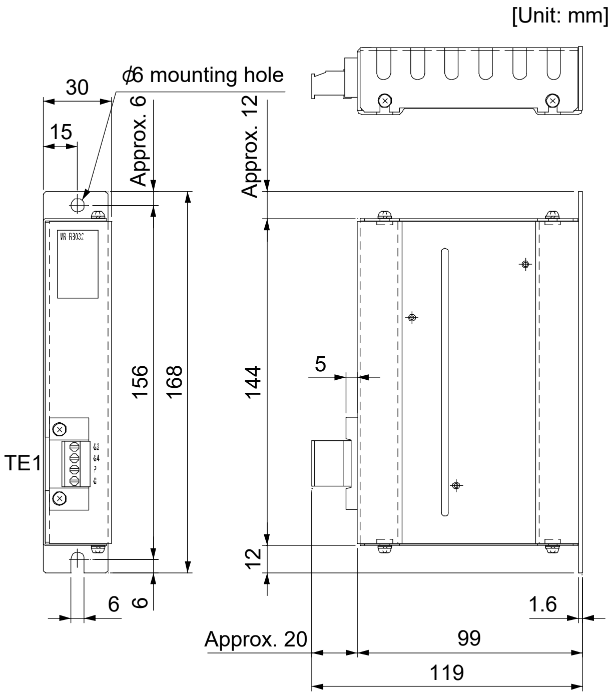
Screw size: M4
Tightening torque: 1.2 [N•m]

- Mounting screw

Screw size: M5
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



- 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]

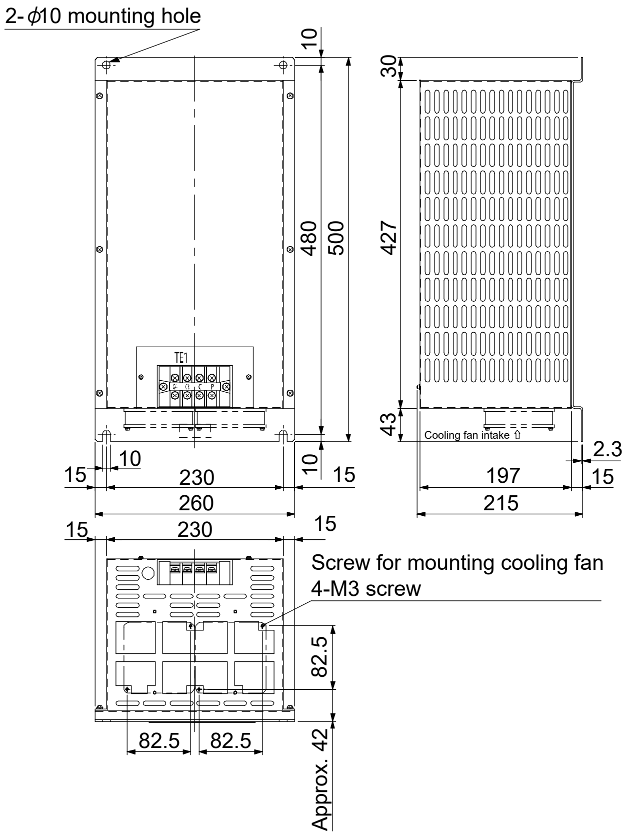
- Mounting screw

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

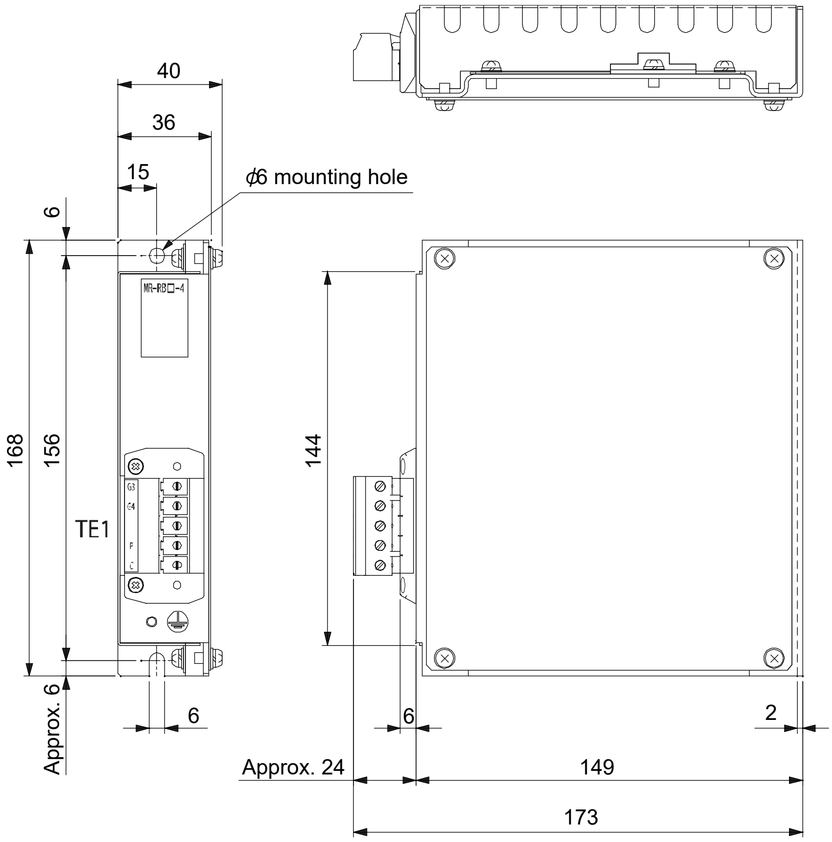
Screw size: M5
Tightening torque: 2.0 [N•m]

- 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

[Unit: mm]



- TE1 terminal

G3
G4
P
C

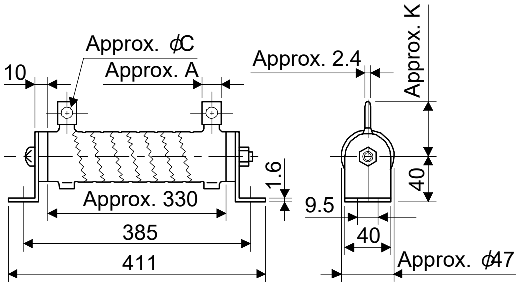
Applicable wire size: AWG 24 to 10
Tightening torque: 0.5 to 0.6 [N•m]

- 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)

[Unit: mm]



Regenerative resistor	Variable dimensions			Mounting screw size	Tightening torque [N•m]	Mass [kg]
	A	C	K			
GRZG400-0.8Ω	10	5.5	39	M8	13.2	0.8
GRZG400-0.6Ω	16	8.2	46			
GRZG400-0.5Ω						
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.
- Temperature of the resistor unit case rises to higher than +100 °C. Keep cables and flammable materials away from the case.
- Ambient temperature condition of the brake unit is between -10 °C to 50 °C. Note that the condition is different from the ambient temperature condition of the servo amplifier (between 0 °C and 55 °C).
- Configure the circuit to shut down the power-supply with the alarm output of the brake unit and the resistor unit under abnormal condition.
- Use the brake unit with a combination indicated in section 11.3.1.
- 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] of the servo amplifier 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-J4-500A(-RJ) (Note 1)
			2 (parallel)	1.98	4	MR-J4-500A(-RJ) MR-J4-700A(-RJ) MR-J4-11KA(-RJ) MR-J4-15KA(-RJ)
	FR-BU2-30K	FR-BR-30K	1	1.99	4	MR-J4-500A(-RJ) MR-J4-700A(-RJ) MR-J4-11KA(-RJ) MR-J4-15KA(-RJ)
	FR-BU2-55K	FR-BR-55K	1	3.91	2	MR-J4-11KA(-RJ) MR-J4-15KA(-RJ) MR-J4-22KA(-RJ)
		MT-BR5-55K	1	5.5	2	MR-J4-22KA(-RJ)
400 V class	FR-BU2-H30K	FR-BR-H30K	1	1.99	16	MR-J4-500A4(-RJ) MR-J4-700A4(-RJ) MR-J4-11KA4(-RJ) (Note 2)
	FR-BU2-H55K	FR-BR-H55K	1	3.91	8	MR-J4-11KA4(-RJ) MR-J4-15KA4(-RJ) MR-J4-22KA4(-RJ)
	FR-BU2-H75K	MT-BR5-H75K	1	7.5	6.5	MR-J4-22KA4(-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

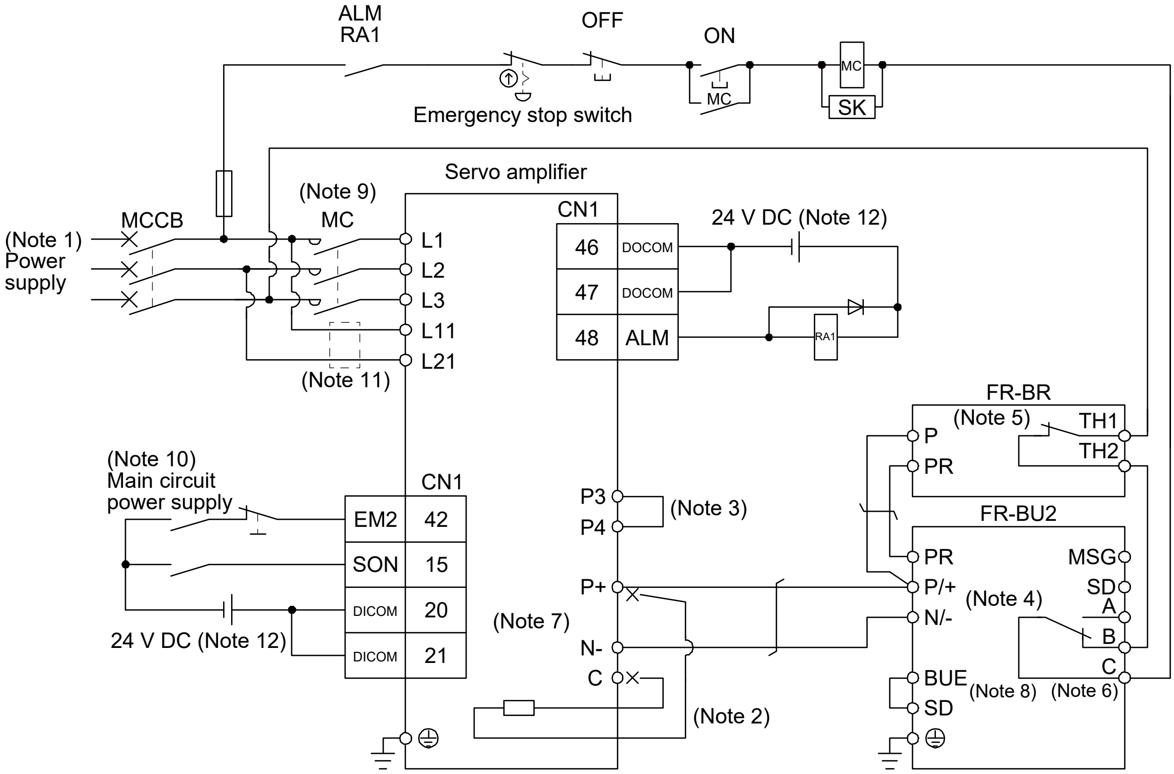
POINT

- EM2 has the same function as EM1 in the torque control mode.
- Connecting PR terminal of the brake unit to 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

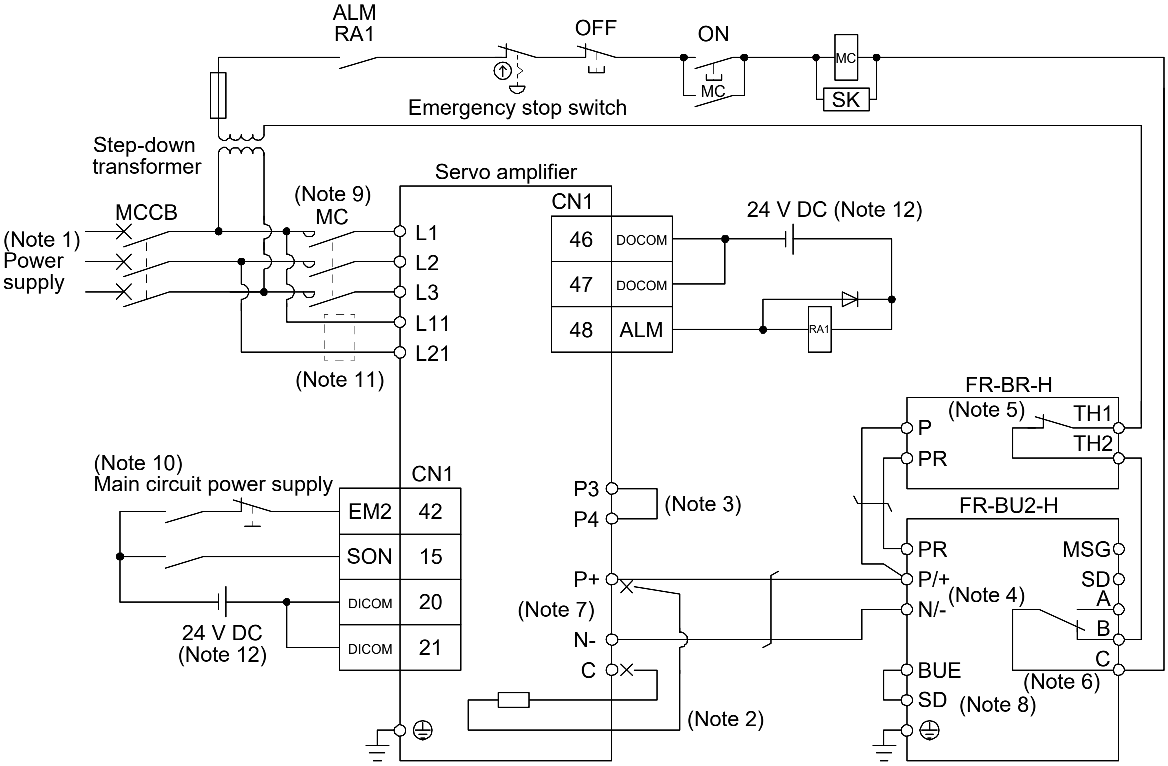
(a) When connecting a brake unit to a servo amplifier

1) 200 V class



Note
1. For 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 up 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

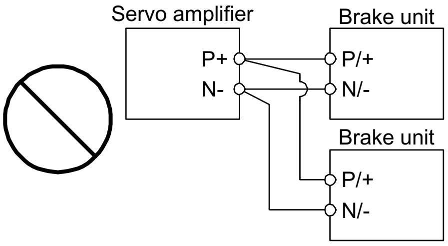


Note
1. For the power supply specifications, refer to section 1.3.
2. For the servo amplifier of 5 kW and 7 kW, always disconnect the lead wire of built-in regenerative resistor, which is connected to P+ and C terminals. For the servo amplifier of 11 kW to 22 kW, do not connect a supplied regenerative 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.

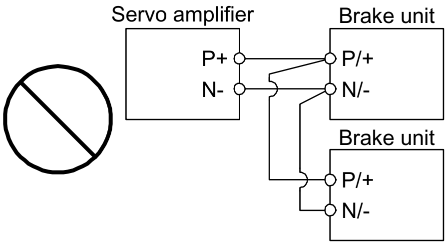
(b) When connecting two brake units to a servo amplifier

POINT

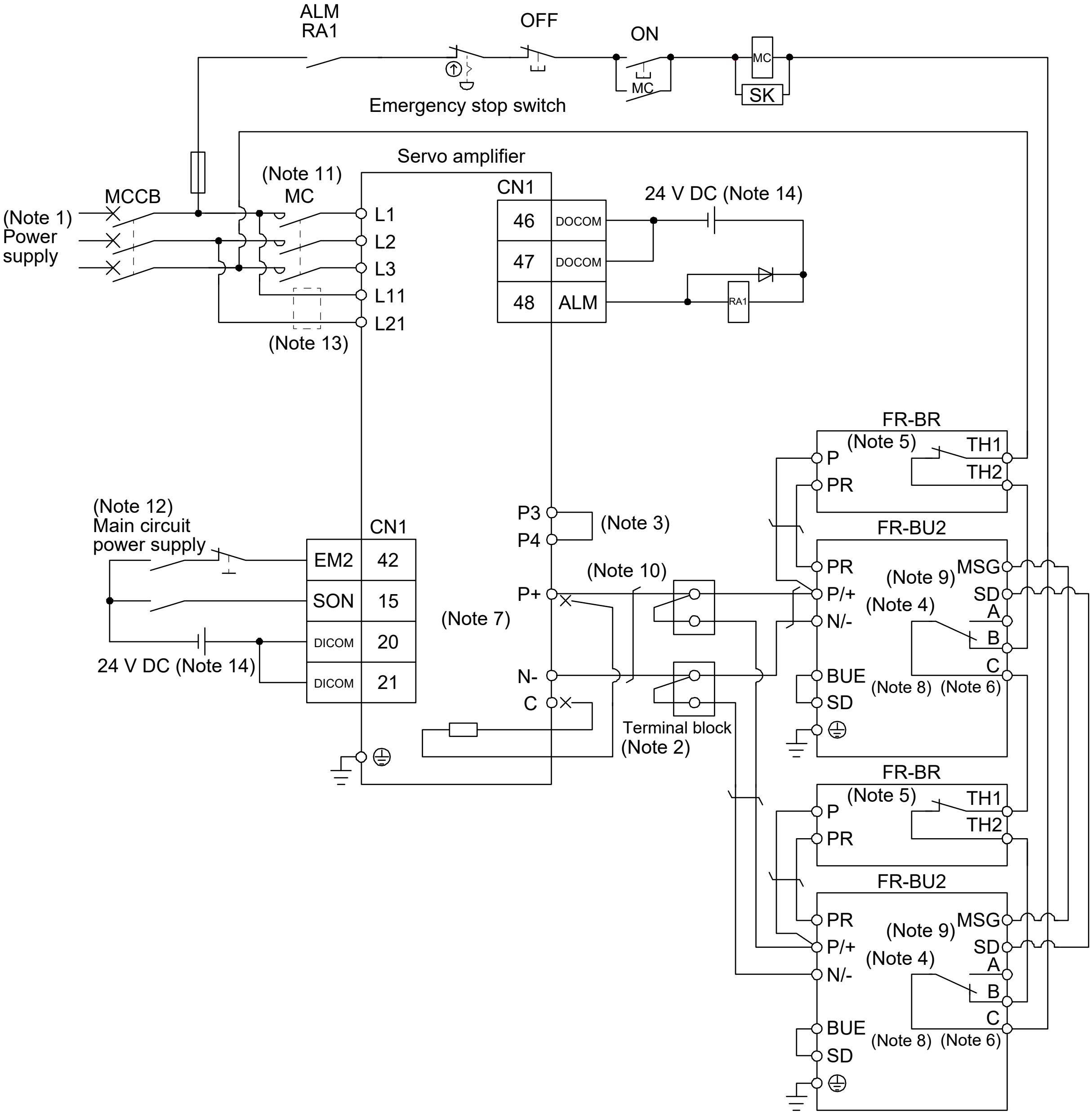
- To use brake units with a parallel connection, use two sets of FR-BU2 brake unit. Combination with other brake unit results in alarm occurrence or malfunction.
- Always connect the terminals for master/slave (MSG to MSG, SD to SD) between the two brake units.
- Do not connect the converter unit and 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



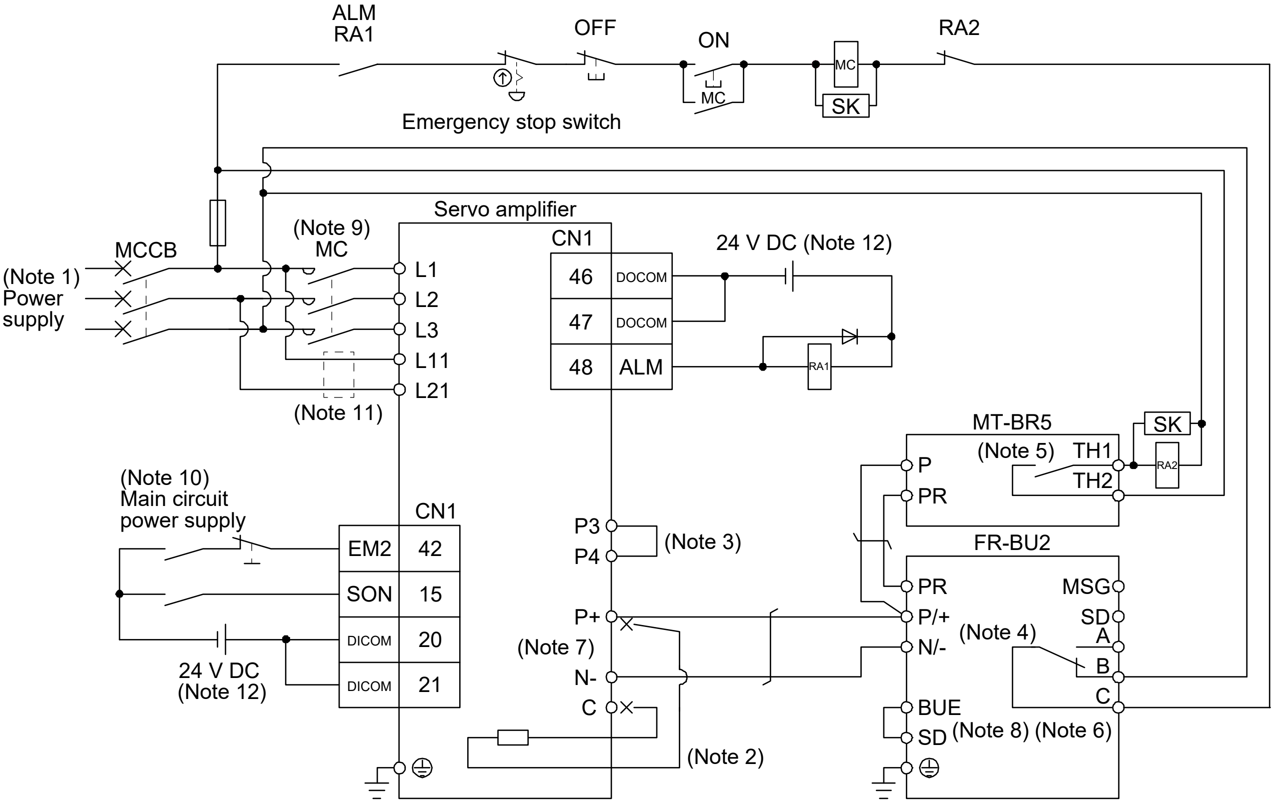
Passing wiring


ALM
RA1
OFF
ON
MC
SK
Emergency stop switch
Servo amplifier
(Note 11)
MC
MCCB
(Note 1)
Power
supply
L1
L2
L3
L11
L21
(Note 13)
CN1
46 DOCOM
47 DOCOM
48 ALM
24 V DC (Note 14)
RA1
FR-BR
(Note 5)
P
PR
TH1
TH2
FR-BU2
PR
P/+
N/-
(Note 9)
(Note 4)
MSG
SD
A
B
C
BUE
SD
(Note 8)
(Note 6)
(Note 12)
Main circuit
power supply
CN1
EM2 42
SON 15
DICOM 20
DICOM 21
24 V DC (Note 14)
P3
P4
(Note 3)
(Note 10)
P+
(Note 7)
N-
C
Terminal block
(Note 2)

Note 1. For 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 the cable to connect the terminal block and the P+ and N- terminals of the servo amplifier, 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 up 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.

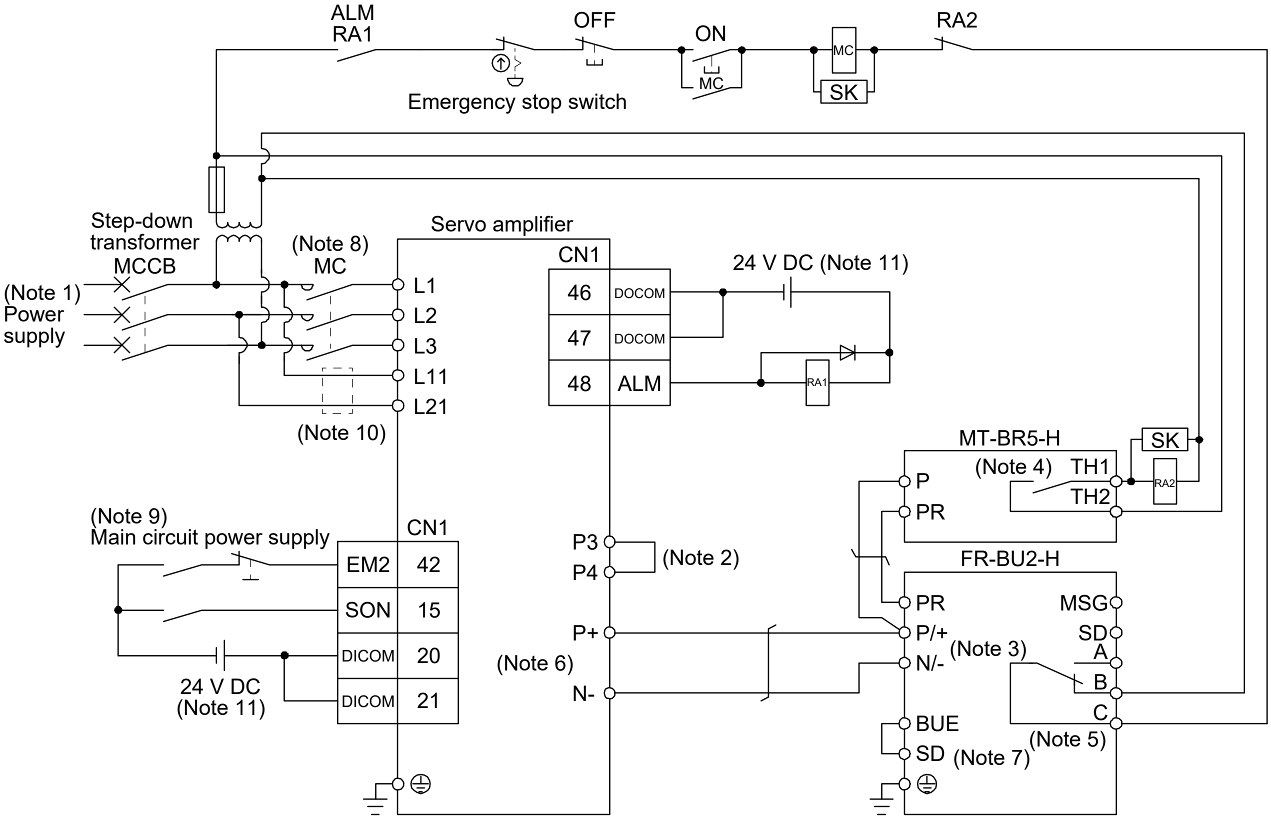
(2) Combination with MT-BR5-(H) resistor unit

(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.

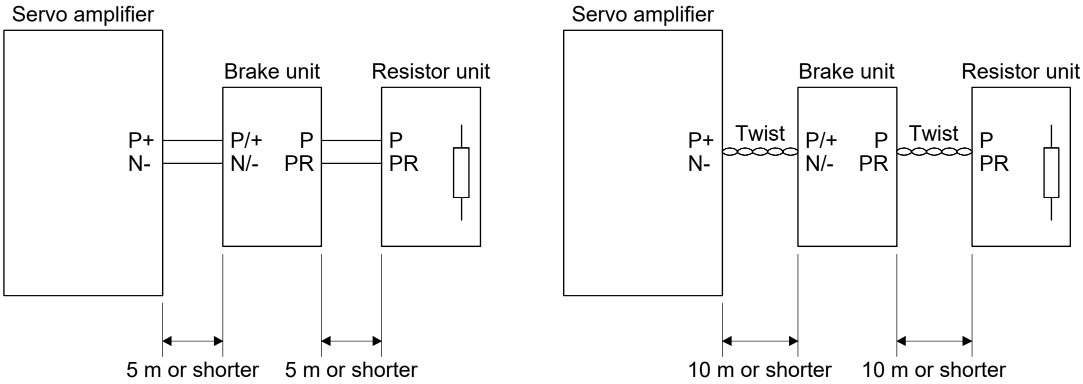
(b) 400 V class



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.

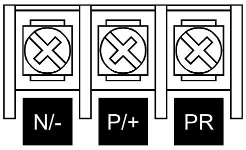


(4) Cables

(a) Cables for the brake unit

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

1) Main circuit terminal



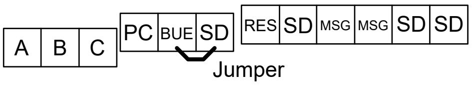
Terminal block

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

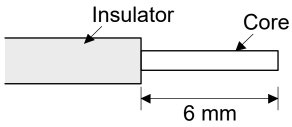
2) Control circuit terminal

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

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

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

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

(a) Recommended crimp terminals

POINT

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

Servo amplifier		Brake unit	Number of connected units	Crimp terminal (Manufacturer)	(Note 1) Applicable tool
200 V class	MR-J4-500A(-RJ)	FR-BU2-15K	1	FVD5.5-S4 (JST)	a
			2	8-4NS (JST) (Note 2)	b
		FR-BU2-30K	1	FVD5.5-S4 (JST)	a
	MR-J4-700A(-RJ)	FR-BU2-15K	2	8-4NS (JST) (Note 2)	b
		FR-BU2-30K	1	FVD5.5-S4 (JST)	a
	MR-J4-11KA(-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-J4-15KA(-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-J4-22KA(-RJ)	FR-BU2-55K	1	FVD14-8 (JST)	d
400 V class	MR-J4-500A4(-RJ)	FR-BU2-H30K	1	FVD5.5-S4 (JST)	a
	MR-J4-700A4(-RJ)	FR-BU2-H30K	1	FVD5.5-S4 (JST)	a
	MR-J4-11KA4(-RJ)	FR-BU2-H30K	1	FVD5.5-6 (JST)	a
		FR-BU2-H55K	1	FVD5.5-6 (JST)	a
	MR-J4-15KA4(-RJ)	FR-BU2-H55K	1	FVD5.5-6 (JST)	a
	MR-J4-22KA4(-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

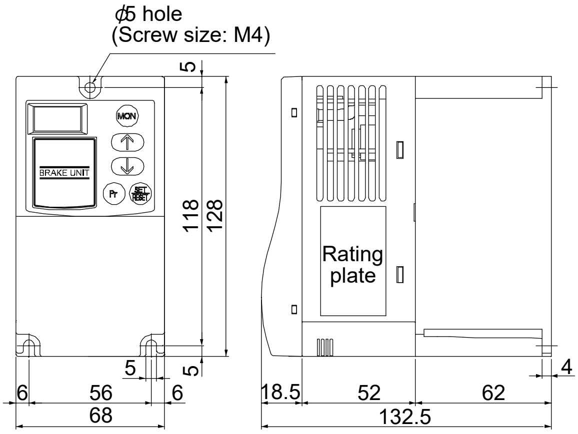
Symbol	Servo amplifier-side crimp terminals				
	Crimp terminal	Applicable tool			Manufacturer
		Body	Head	Dice	
a	FDV5.5-S4 FDV5.5-6	YNT-1210S			JST
b	8-4NS	YHT-8S			
c	FVD8-6	YF-1 E-4	YNE-38	DH-111 DH-121	
d	FVD14-6 FVD14-8	YF-1 E-4	YNE-38	DH-112 DH-122	

11.3.4 Dimensions

(1) FR-BU2-(H) Brake unit

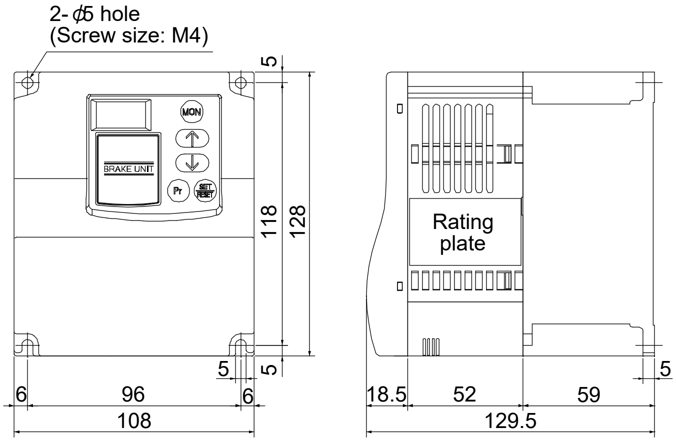
[Unit: mm]

FR-BU2-15K



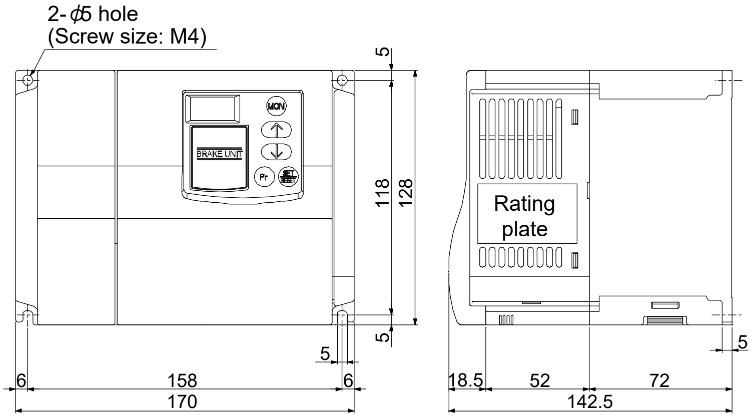
[Unit: mm]

FR-BU2-30K/FR-BU2-H30K



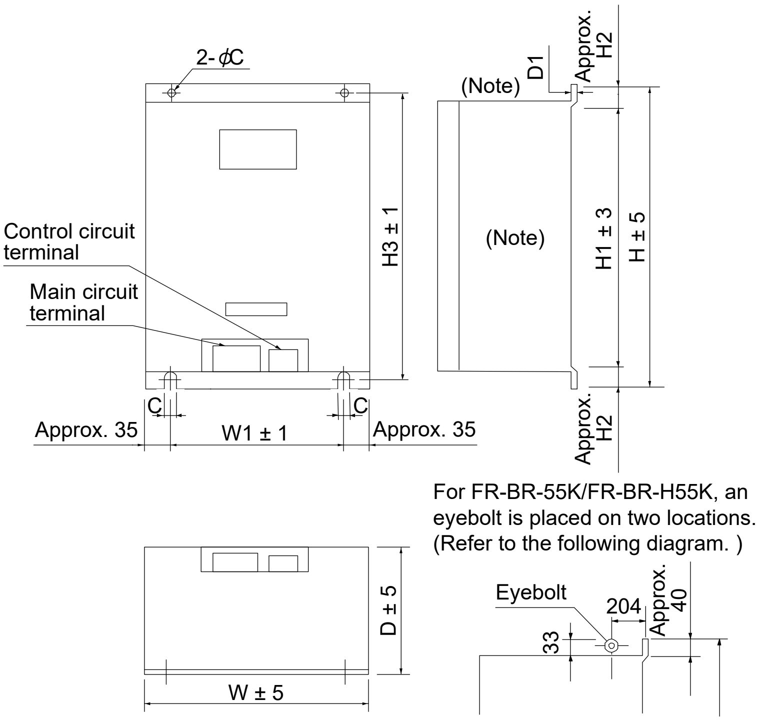
[Unit: mm]

FR-BU2-55K/FR-BU2-H55K/FR-BU2-H75K



(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.)

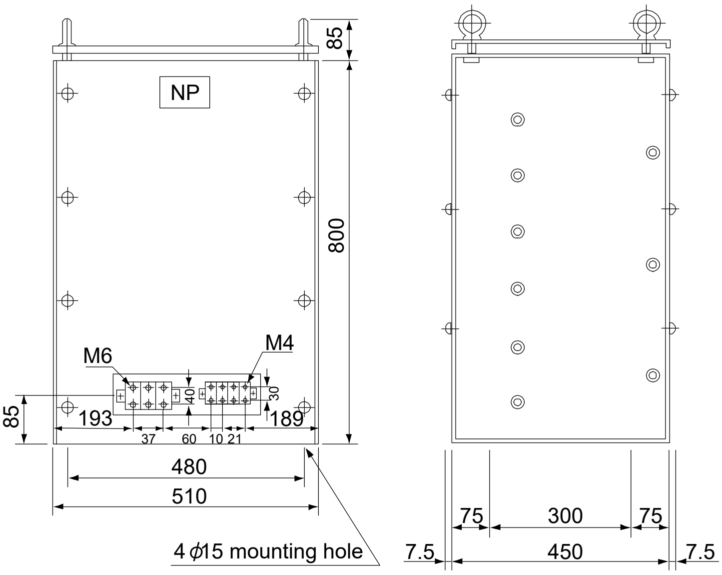
Note. Ventilation ports are provided on both sides and the top. The bottom is open.

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

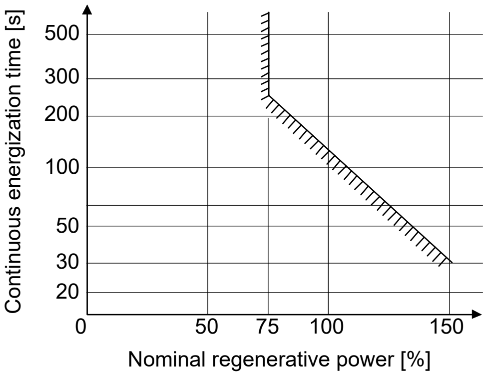
- When using the FR-RC-(H), power regeneration converter, set [Pr. PA04] to "0 0 _ _" to enable EM1 (Forced stop 1).
- When using the FR-RC-(H) power regeneration converter, refer to "Power Regeneration Converter FR-RC Instruction Manual (IB(NA)66330)".

When using the FR-RC-(H) power regeneration converter, set [Pr. PA02] to "_ _ 0 1" and set [Pr. PC27] to "_ _ _ 1".

(1) Selection example

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

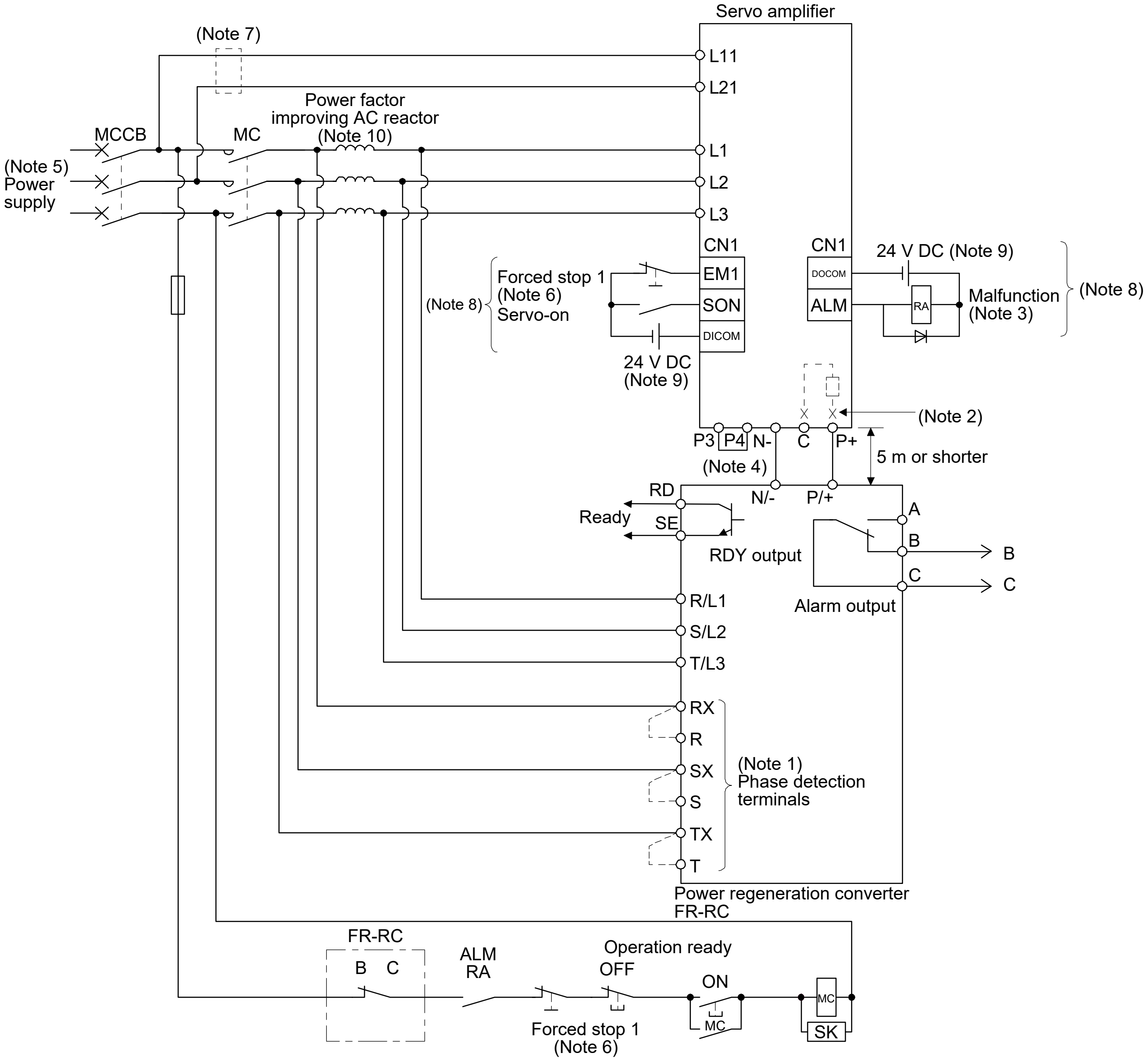
Power regeneration converter	Nominal regenerative power [kW]	Servo amplifier
FR-RC-15K	15	MR-J4-500A(-RJ) MR-J4-700A(-RJ) MR-J4-11KA(-RJ) MR-J4-15KA(-RJ)
FR-RC-30K	30	
FR-RC-55K	55	MR-J4-22KA(-RJ)
FR-RC-H15K	15	MR-J4-500A4(-RJ) MR-J4-700A4(-RJ)
FR-RC-H30K	30	MR-J4-11KA4(-RJ) MR-J4-15KA4(-RJ)
FR-RC-H55K	55	MR-J4-22KA4(-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 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.

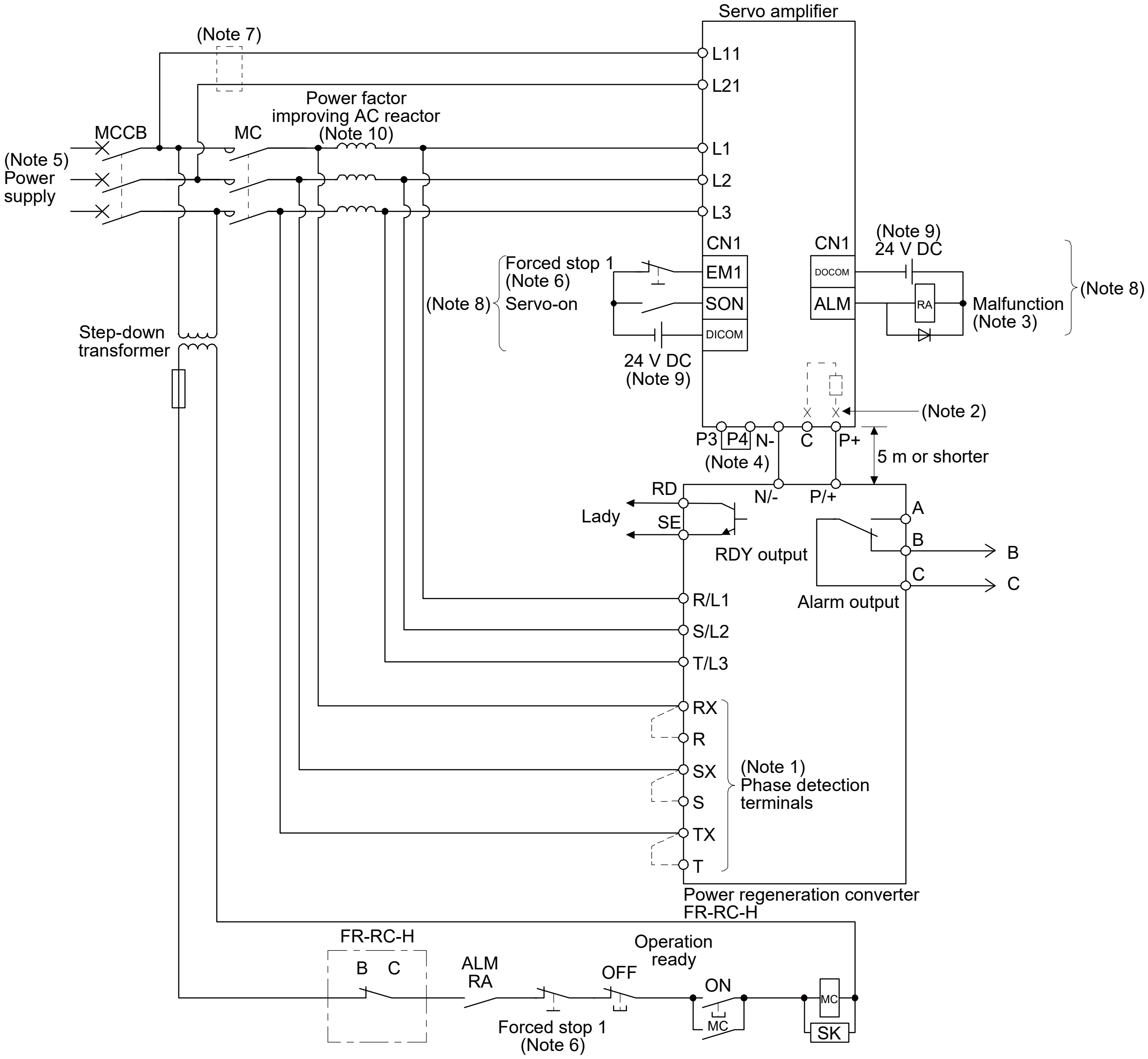
7. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker.

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

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

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.

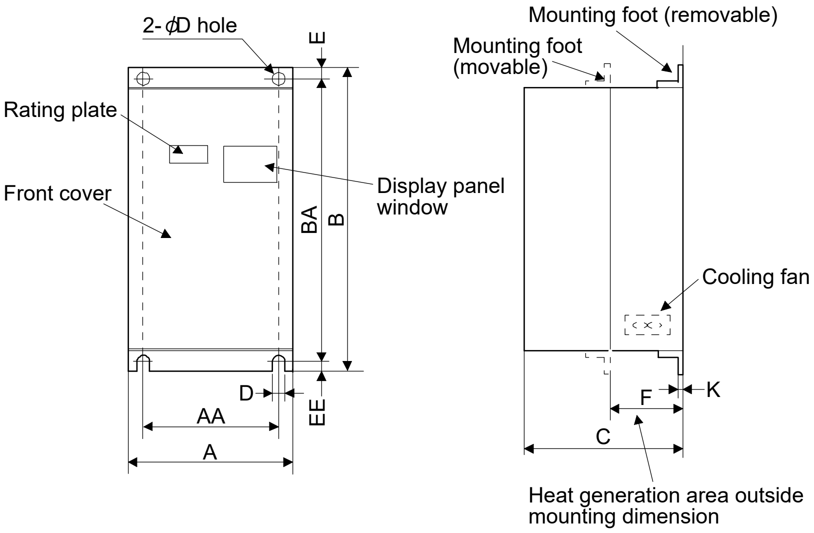
7. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker.

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

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

10. For selection of power factor improving AC reactors, refer to "Power Regeneration Converter FR-RC Instruction Manual (IB(NA)66330)".

(3) Dimensions

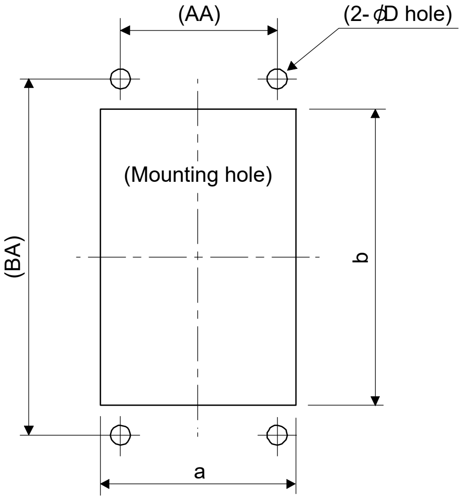


[Unit: mm]

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

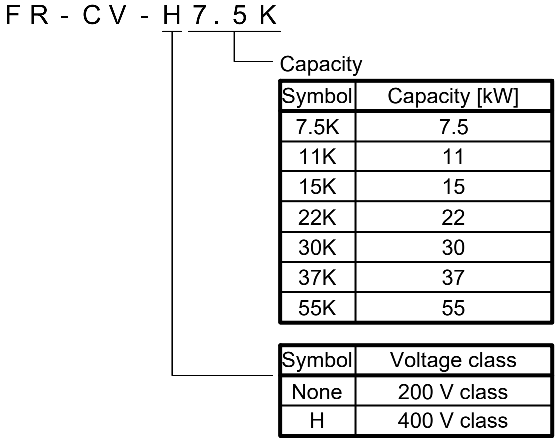
POINT

- 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. PC27] 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.



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 example

(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 than the value of "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

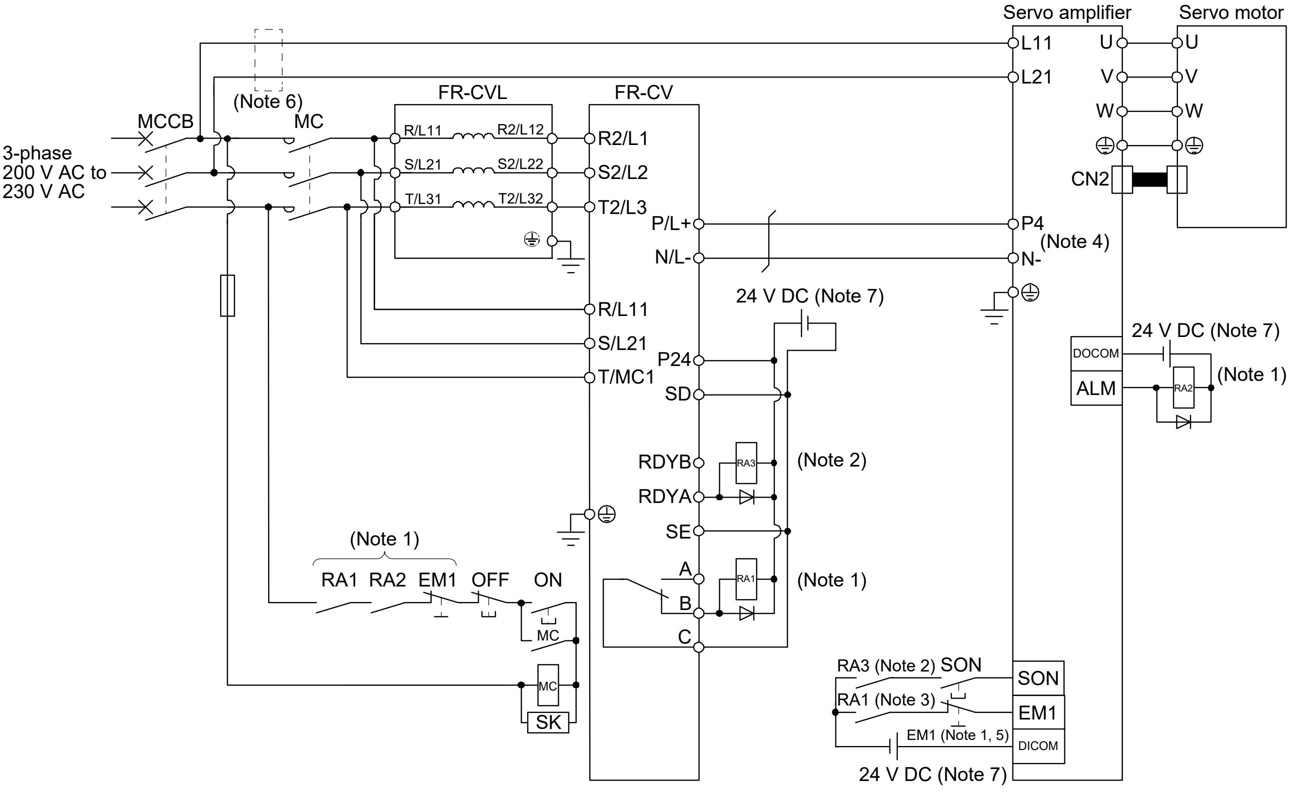
POINT

- 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).



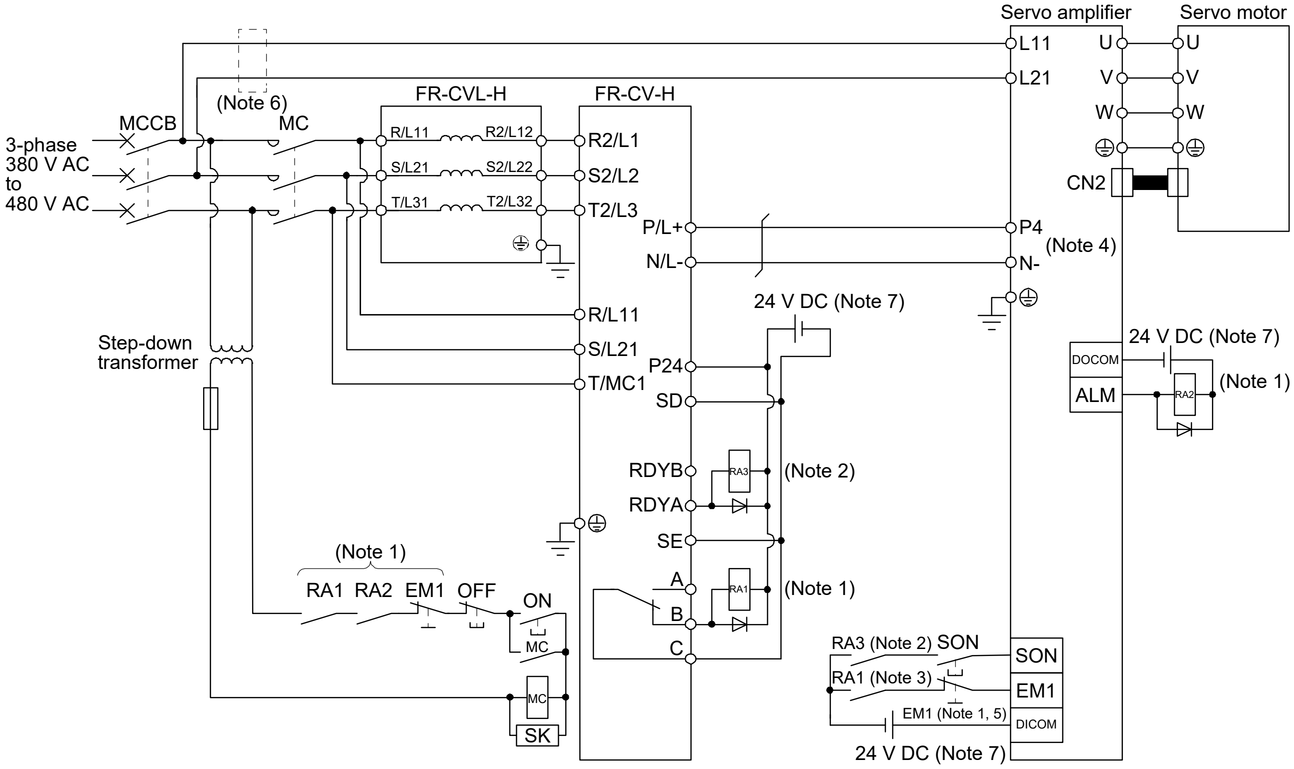
Note 1. Configure a sequence that will shut off main circuit power at the follow cases.
- FR-CV or servo amplifier alarm occurs.
- EM1 (forced stop 1) turns off.

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.
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 forced stop input of the servo amplifier if an alarm occurs in the FR-CV-H.
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.
  Wire type: 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

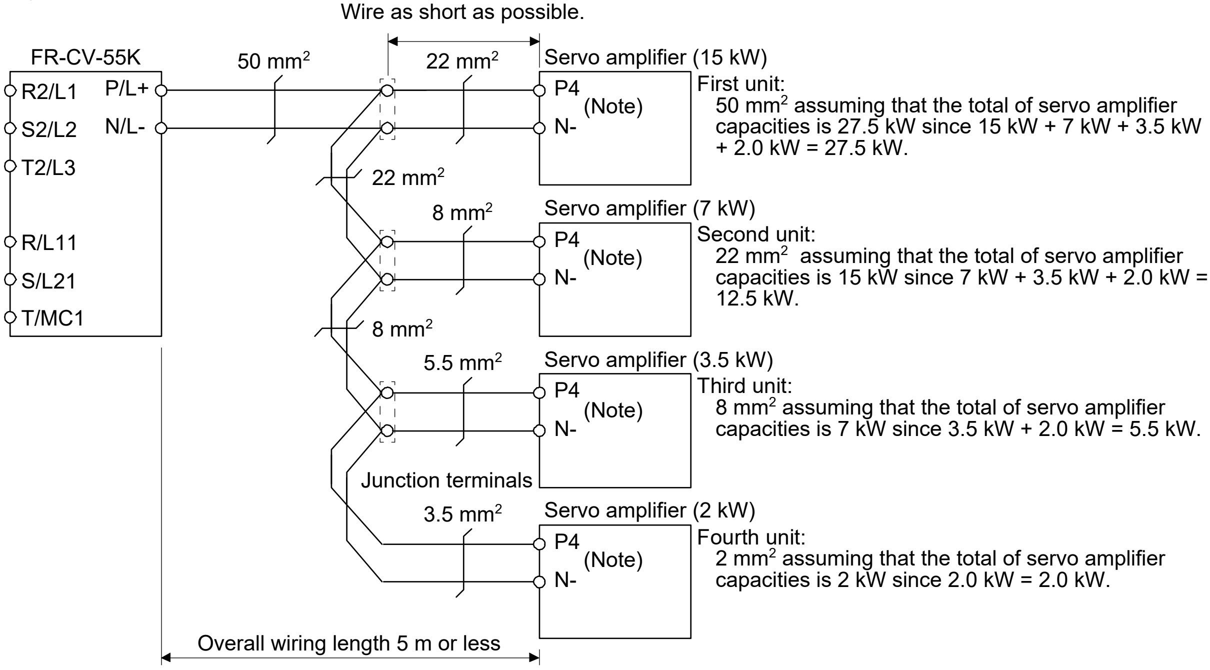
For grounding, use the wire of the size equal to or greater than that indicated in the following table, and make it as short as possible.

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 mm^2 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.

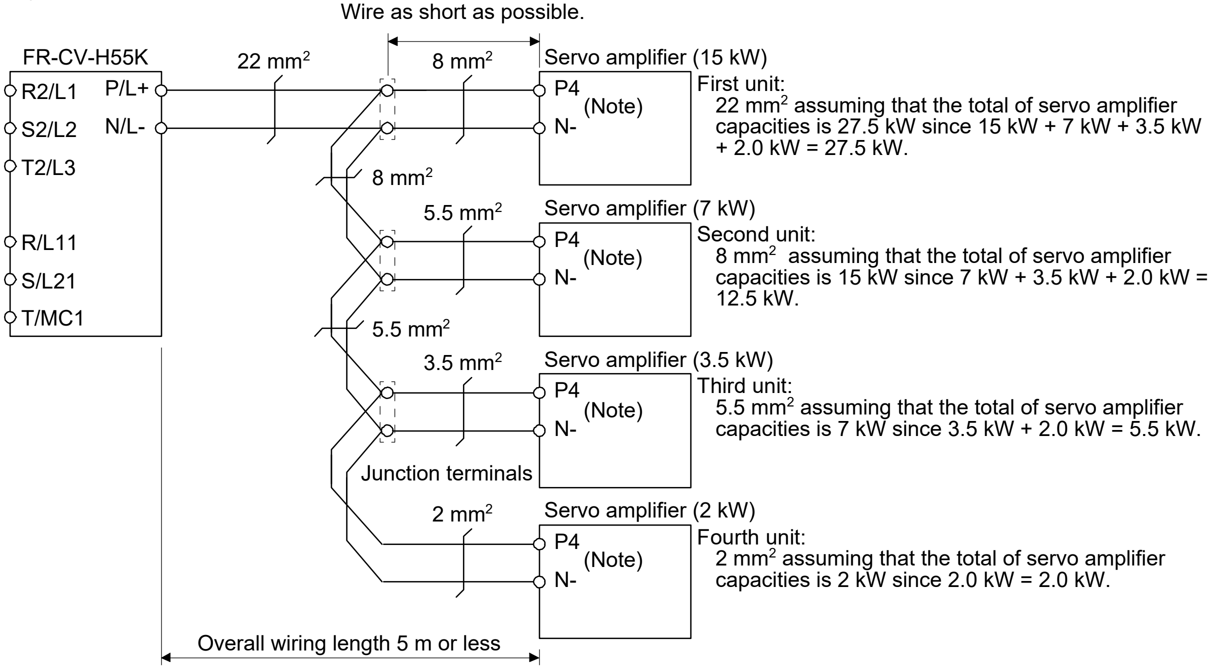
Second unit:
22 mm^2 assuming that the total of servo amplifier capacities is 15 kW since 7 kW + 3.5 kW + 2.0 kW = 12.5 kW.

Third unit:
8 mm^2 assuming that the total of servo amplifier capacities is 7 kW since 3.5 kW + 2.0 kW = 5.5 kW.

Fourth unit:
2 mm^2 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 mm^2 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 mm^2 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 mm^2 assuming that the total of servo amplifier capacities is 7 kW since 3.5 kW + 2.0 kW = 5.5 kW.

Fourth unit:
2 mm^2 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 supply	Rated input AC voltage/frequency		3-phase 200 V AC to 220 V AC, 50 Hz, 200 V AC to 230 V AC, 60 Hz						
	Permissible AC voltage fluctuation		3-phase 170 V AC to 242 V AC, 50 Hz, 170 V AC to 253 V AC, 60 Hz						
	Permissible frequency fluctuation		±5%						
	Power supply capacity (Note 2) [kVA]		17	20	28	41	52	66	100
IP rating (JEM 1030), cooling method			Open type (IP00), forced cooling						
Environment	Ambient temperature		-10 °C to 50 °C (non-freezing)						
	Ambient humidity		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			30 AF 30 A	50 AF 50 A	100 AF 75 A	100 AF 100 A	125AF 125 A	125AF 125 A	225 AF 175 A
Magnetic contactor			S-N20 S-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

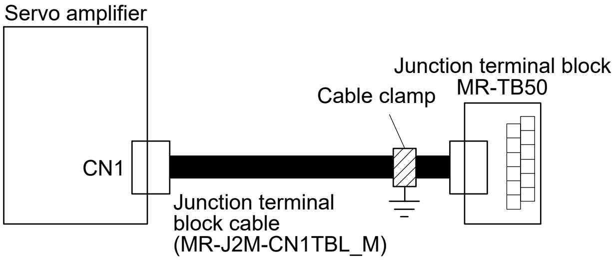
Note 1. This is the time when the protective function of the FR-CV-(H) is activated. The protective function of the servo amplifier is activated in the time indicated in section 10.1.

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 MR-TB50

(1) Usage

Always use the junction terminal block (MR-TB50) with the option cable (MR-J2M-CN1TBL_M) as a set.



Ground the 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) Terminal labels

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

Position control mode

P15R	LG	LAR	LBR	LZR	PG	╲	SON	PC	RES	DICOM	ZSP	TLC	TLA	╲	╲	OP	NP	╲	╲	CR	LSP	LOP	DOCOM	RD
1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49
	LA	LB	LZ	PP	OPC	╲		TL	DICOM	INP	INP	╲	LG	LG	╲	LG	NG	╲	╲	EMG	LSN	DOCOM	ALM	SD
2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50

Speed control mode

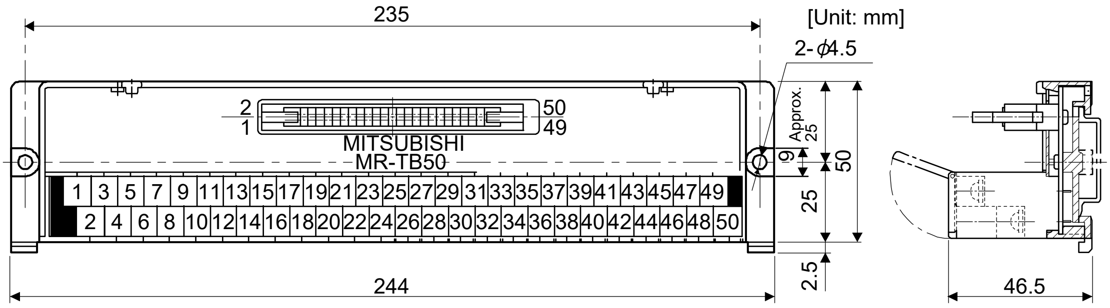
P15R	LG	LAR	LBR	LZR		╲	SON	ST1	RES	DICOM	ZSP	TLC	TLA	╲	╲	OP		╲	╲	SP1	LSP	LOP	DOCOM	RD
1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49
VC	LA	LB	LZ			╲	SP2	ST2	DICOM	SA	SA	╲	LG	LG	╲	LG		╲	╲	EMG	LSN	DOCOM	ALM	SD
2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50

Torque control mode

P15R	LG	LAR	LBR	LZR		╲	SON	SR2	RES	DICOM	ZSP	VLC	TC	╲	╲	OP		╲	╲	SP1		LOP	DOCOM	RD
1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49
VLA	LA	LB	LZ			╲	SP2	RS1	DICOM			╲	LG	LG	╲	LG		╲	╲	EMG		DOCOM	ALM	SD
2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50

(3) Dimensions

[Unit: mm]



Screw size: M3.5

Applicable wire: 2 mm^2

Crimp terminal width: 7.2 mm or less.

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

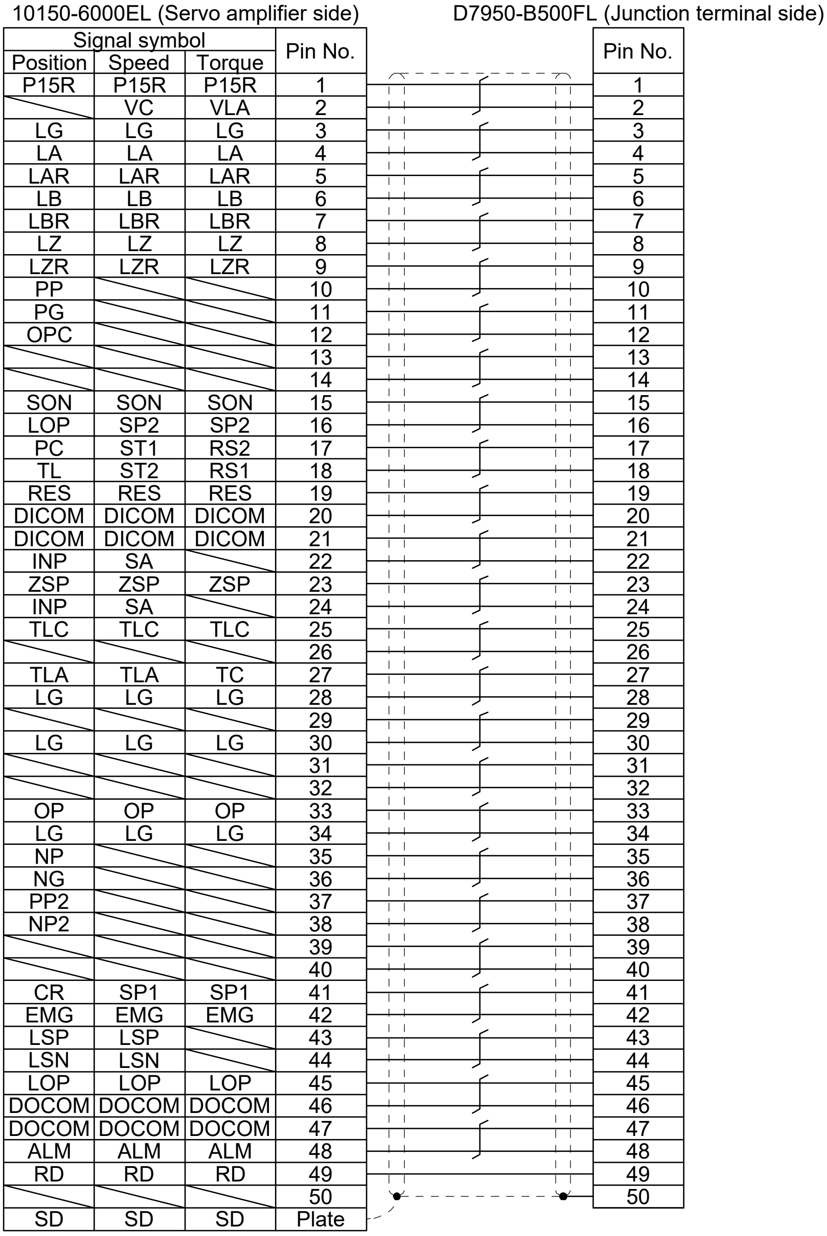
(a) Model explanations

Model: MR-J2M-CN1TBL_M

Symbol	Cable length [m]
05	0.5
1	1

(b) Connection diagram

1) MR-J4-_A_(-RJ) 100 W or more



10150-6000EL (Servo amplifier side)

D7950-B500FL (Junction terminal side)

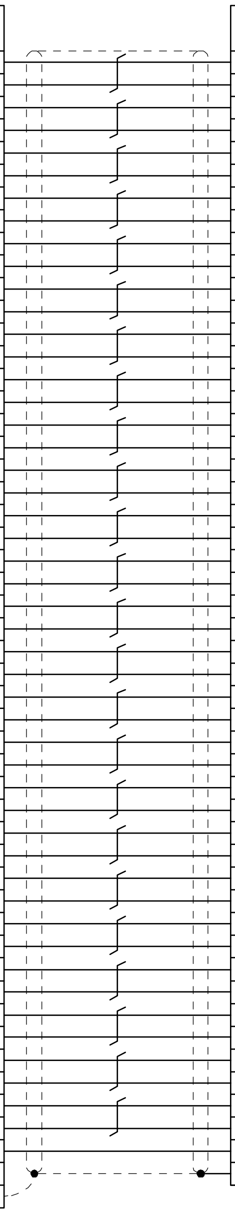
Signal symbol			Pin No.	Pin No.
Position	Speed	Torque		
P15R	P15R	P15R	1	1
	VC	VLA	2	2
LG	LG	LG	3	3
LA	LA	LA	4	4
LAR	LAR	LAR	5	5
LB	LB	LB	6	6
LBR	LBR	LBR	7	7
LZ	LZ	LZ	8	8
LZR	LZR	LZR	9	9
PP			10	10
PG			11	11
OPC			12	12
			13	13
			14	14
SON	SON	SON	15	15
LOP	SP2	SP2	16	16
PC	ST1	RS2	17	17
TL	ST2	RS1	18	18
RES	RES	RES	19	19
DICOM	DICOM	DICOM	20	20
DICOM	DICOM	DICOM	21	21
INP	SA		22	22
ZSP	ZSP	ZSP	23	23
INP	SA		24	24
TLC	TLC	TLC	25	25
			26	26
TLA	TLA	TC	27	27
LG	LG	LG	28	28
			29	29
LG	LG	LG	30	30
			31	31
			32	32
OP	OP	OP	33	33
LG	LG	LG	34	34
NP			35	35
NG			36	36
PP2			37	37
NP2			38	38
			39	39
			40	40
CR	SP1	SP1	41	41
EMG	EMG	EMG	42	42
LSP	LSP		43	43
LSN	LSN		44	44
LOP	LOP	LOP	45	45
DOCOM	DOCOM	DOCOM	46	46
DOCOM	DOCOM	DOCOM	47	47
ALM	ALM	ALM	48	48
RD	RD	RD	49	49
			50	50
SD	SD	SD	Plate	

2) MR-J4-03A6(-RJ)

10150-6000EL (Servo amplifier side)

D7950-B500FL (Junction terminal side)

Signal symbol			Pin No.	Pin No.
Position	Speed	Torque		
P15R	P15R	P15R	1	1
	VC	VLA	2	2
LG	LG	LG	3	3
LA	LA	LA	4	4
LAR	LAR	LAR	5	5
LB	LB	LB	6	6
LBR	LBR	LBR	7	7
LZ	LZ	LZ	8	8
LZR	LZR	LZR	9	9
PP			10	10
PG			11	11
OPC			12	12
SDP	SDP	SDP	13	13
SDN	SDN	SDN	14	14
SON	SON	SON	15	15
LOP	SP2	SP2	16	16
PC	ST1	RS2	17	17
TL	ST2	RS1	18	18
RES	RES	RES	19	19
DICOM	DICOM	DICOM	20	20
DICOM	DICOM	DICOM	21	21
INP	SA		22	22
ZSP	ZSP	ZSP	23	23
INP	SA		24	24
TLC	TLC	TLC	25	25
MO1	MO1	MO1	26	26
TLA	TLA	TC	27	27
LG	LG	LG	28	28
MO2	MO2	MO2	29	29
LG	LG	LG	30	30
TRE	TRE	TRE	31	31
			32	32
OP	OP	OP	33	33
LG	LG	LG	34	34
NP			35	35
NG			36	36
PP2			37	37
NP2			38	38
RDP	RDP	RDP	39	39
RDN	RDN	RDN	40	40
CR	SP1	SP1	41	41
EMG	EMG	EMG	42	42
LSP	LSP		43	43
LSN	LSN		44	44
LOP	LOP	LOP	45	45
DOCOM	DOCOM	DOCOM	46	46
DOCOM	DOCOM	DOCOM	47	47
ALM	ALM	ALM	48	48
RD	RD	RD	49	49
			50	50
SD	SD	SD	Plate	



11.7 MR Configurator2

POINT

●MR-J4-_A_-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-BAT6V1SET-A	Battery	For absolute position data backup	MR-BAT6V1
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-_A_(-RJ) 100 W or more	MR-J4-03A6(-RJ)
MR-BAT6V1SET	○	
MR-BAT6V1BJ	○	
MR-BAT6V1SET-A		○
MR-BT6VCASE	○	

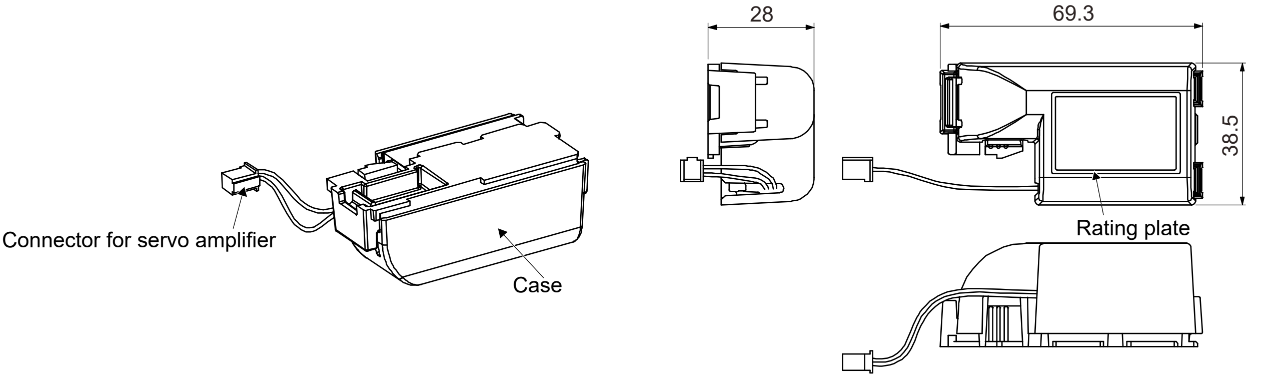
11.8.2 MR-BAT6V1SET battery

POINT

- For the specifications and year and month of manufacture of the built-in MR-BAT6V1 battery, refer to section 11.8.6.

(1) Parts identification and dimensions

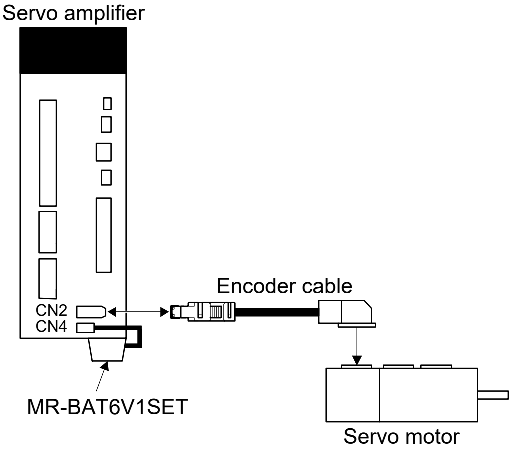
[Unit: mm]



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.

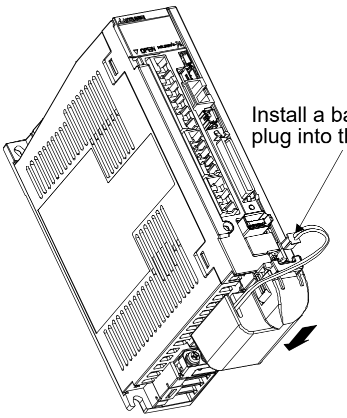
Replace the battery while only control circuit power is on. Replacing battery with the control circuit power on triggers [AL. 9F.1 Low battery]. However, the absolute position data will not be erased.

(a) Battery installation and removal procedure

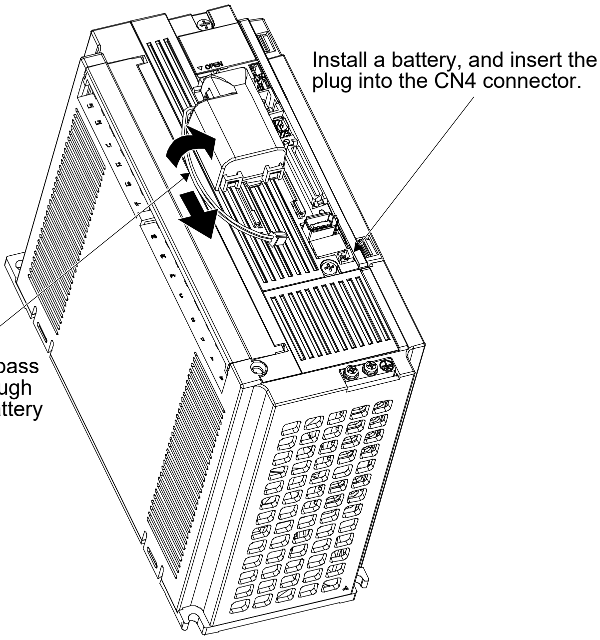
1) Installation procedure

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

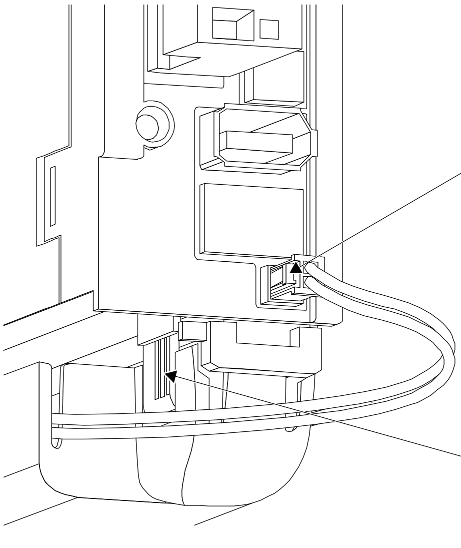


For the servo amplifier
with a battery holder on the front

2) Removal procedure

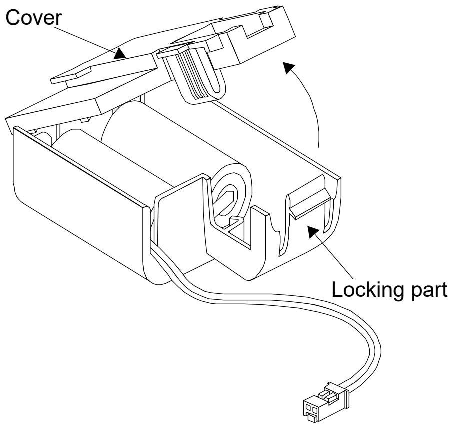
⚠CAUTION

- 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.

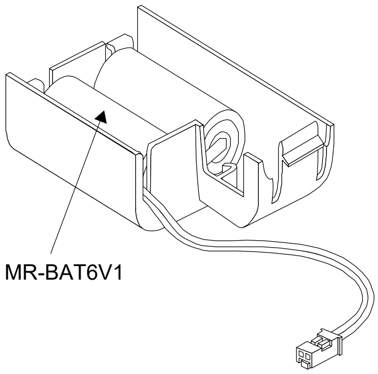


(4) Replacement procedure of the built-in battery

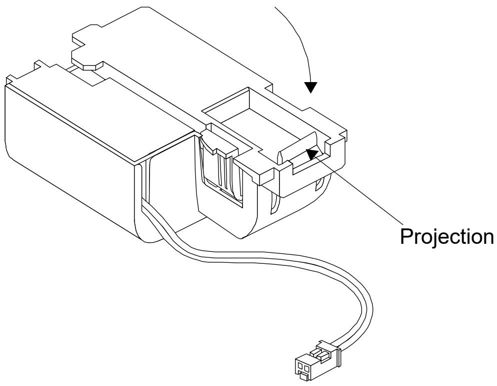
When the MR-BAT6V1SET reaches the end of its life, replace the built-in MR-BAT6V1 battery.



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.

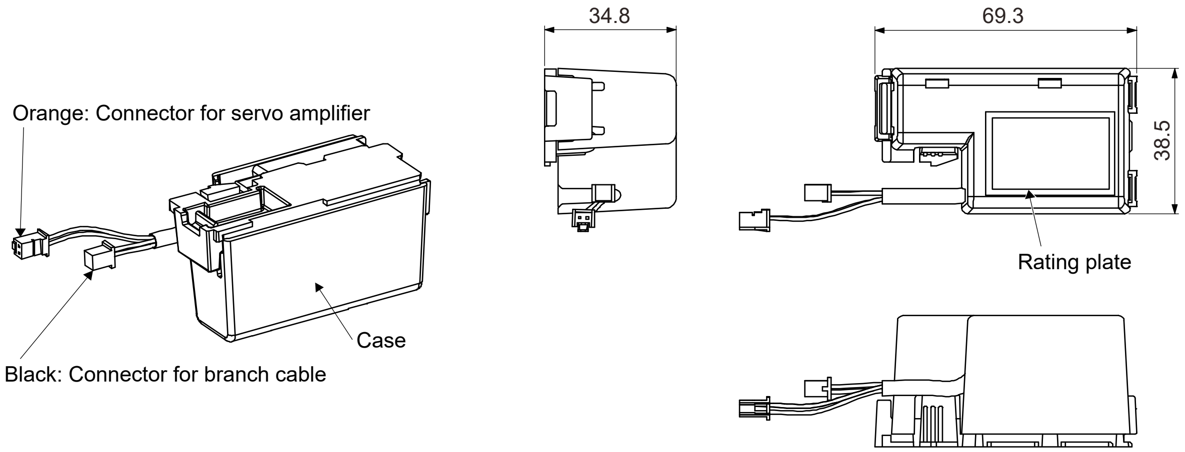
11.8.3 MR-BAT6V1BJ battery for junction battery cable

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.

(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 _ _ _ _ _ _".

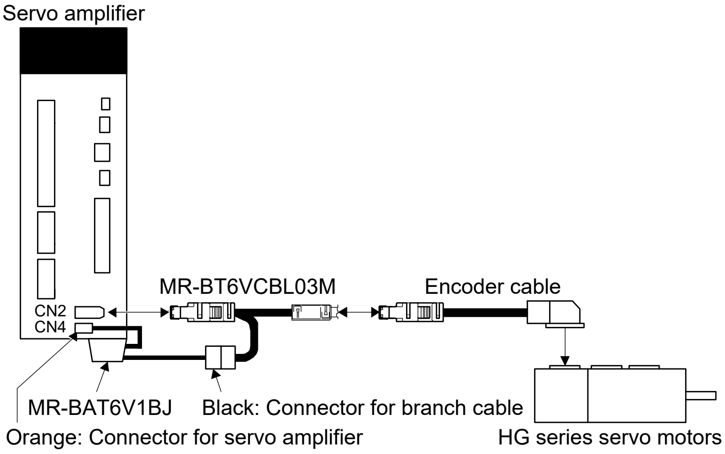
(3) Specification list

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.

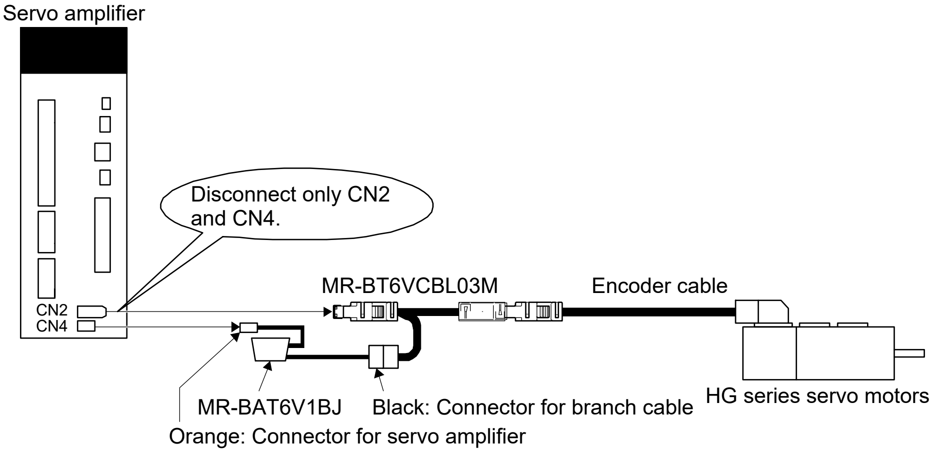


(5) Transporting a servo motor and machine apart

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 11.8.3.

(b) Preparation for replacing MR-BAT6V1BJ

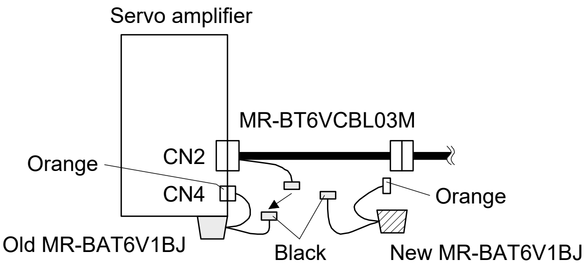
Prepare a new MR-BAT6V1BJ as follows.

Model	Number and use	Remark
MR-BAT6V1BJ	1 for replacement	Battery within two years from the production date.

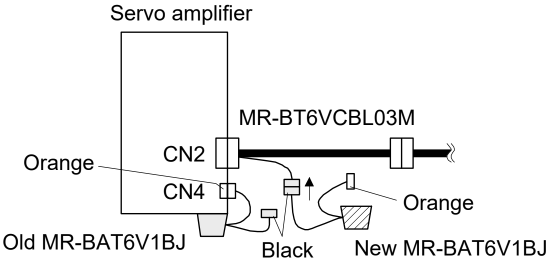
(c) Procedures of replacing MR-BAT6V1BJ

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.

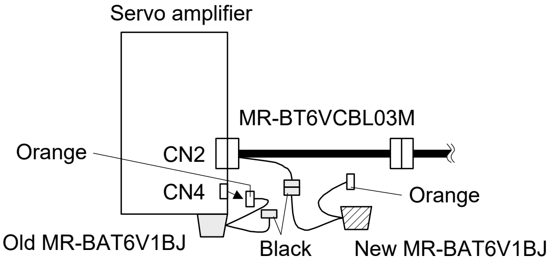
1) Remove the connector for branch cable connection (black) of the old MR-BAT6V1BJ.



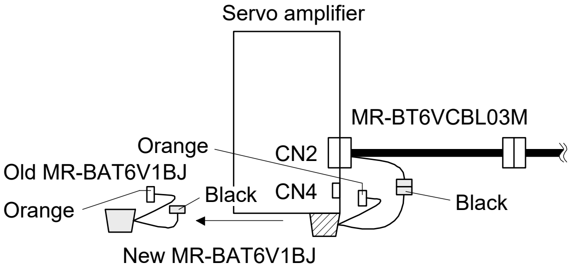
2) Connect the connector for branch cable connection (black) of the new MR-BAT6V1BJ.



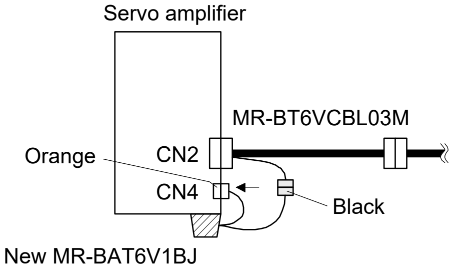
3) Remove the connector for servo amplifier (orange) of the old MR-BAT6V1BJ. When the control circuit power supply is on, performing 3) without [AL. 9F.1 Low battery] will trigger [AL. 9F.1].



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.



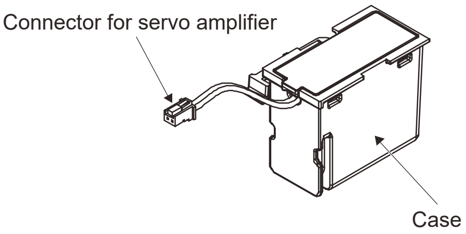
11.8.4 MR-BAT6V1SET-A battery

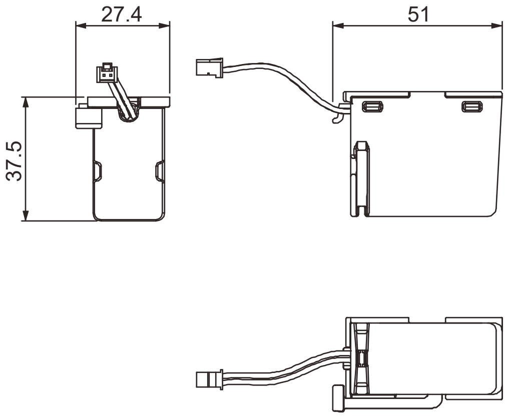
POINT

- ●Use MR-BAT6V1SET-A for MR-J4-03A6(-RJ) servo amplifier. The MR-BAT6V1SET-A cannot be used for MR-J4-_A_(-RJ) 100 W or more servo amplifiers.
- ●For the specifications and year and month of manufacture of the built-in MR-BAT6V1 battery, refer to section 11.8.6.

(1) Parts identification and dimensions

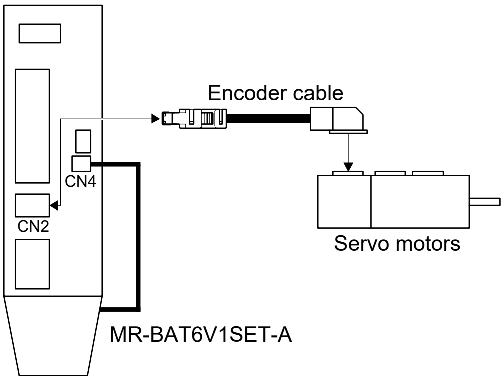
[Unit: mm]





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 supply and wait until the charge lamp turns off. Otherwise, an electric shock may occur. In addition, when confirming whether the charge lamp is off or not, always confirm it from the front of the servo amplifier.

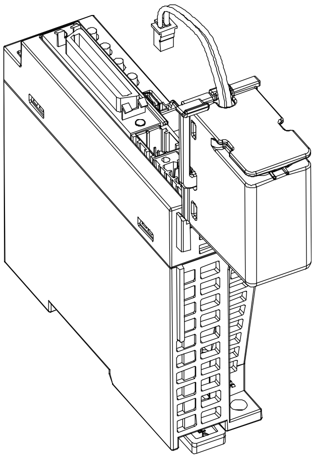
⚠CAUTION	●The internal circuits of the servo amplifier may be damaged by static electricity. Always take the following precautions. · Ground human body and work bench. · Do not touch the conductive areas, such as connector pins and electrical parts, directly by hand.

POINT

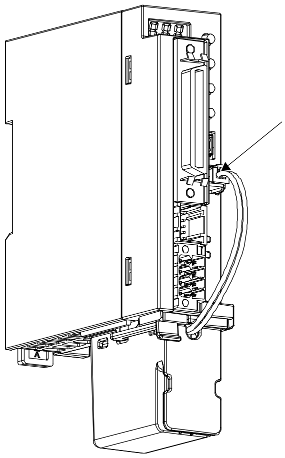
- ●Replacing battery with the control circuit power off will erase the absolute position data.
- ●Before replacing batteries, check that the new battery is within battery life.

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) Installation procedure



Insert the battery along the rails.

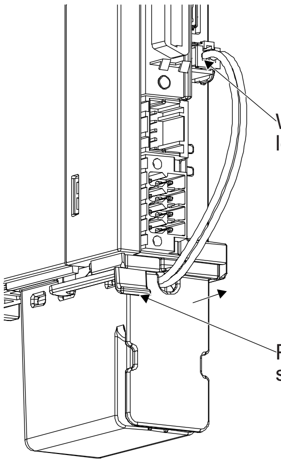


Insert the connector of the battery into CN4.

(b) 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.

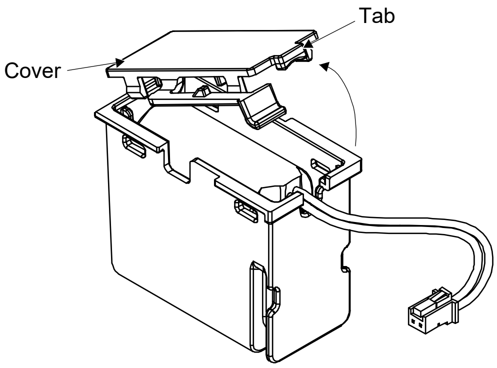


While pressing the lock release lever, pull out the connector.

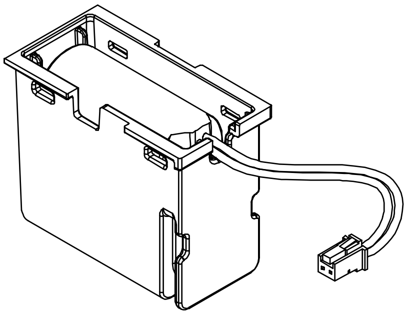
Pull the lock release lever, and slide the battery toward you.

(4) Replacement procedure of the built-in battery

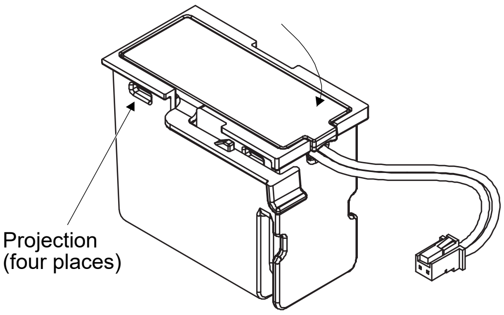
When the MR-BAT6V1SET-A reaches the end of its life, replace the built-in MR-BAT6V1 battery.



1) While pressing the locking part, open the cover.



2) Replace the battery with a new MR-BAT6V1 battery.



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

11.8.5 MR-BT6VCASE battery case

POINT

- ●MR-BT6VCASE cannot be used for MR-J4-03A6(-RJ) servo amplifiers.
- ●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 11.8.6.

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.

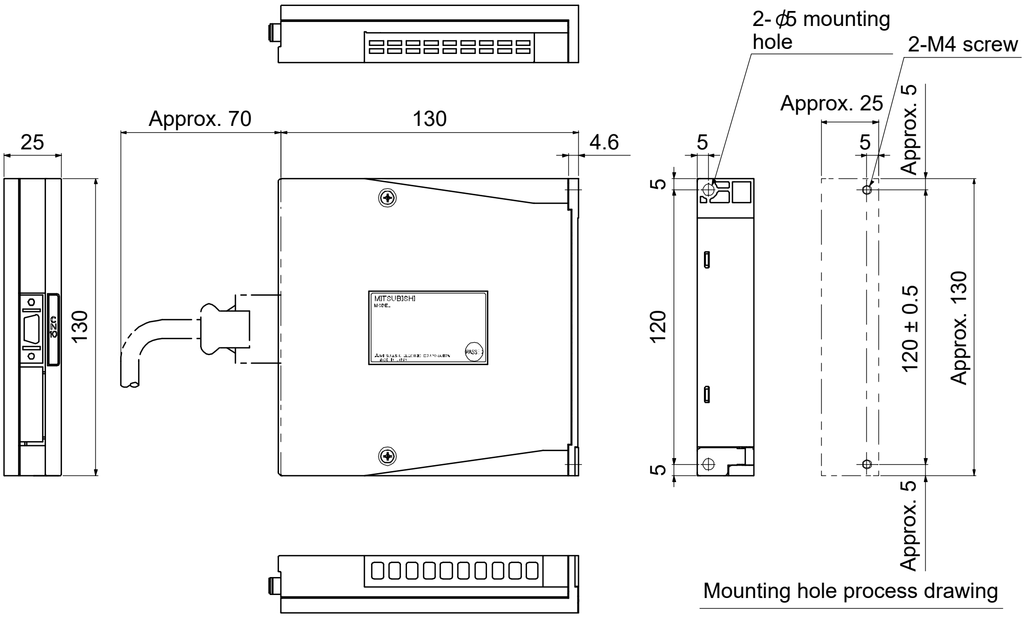
(1) The number of connected servo motors

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]



Mounting screw
Screw size: M4

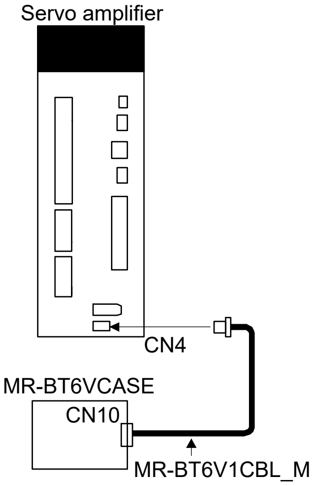
[Mass: 0.18 kg]

(3) Battery mounting

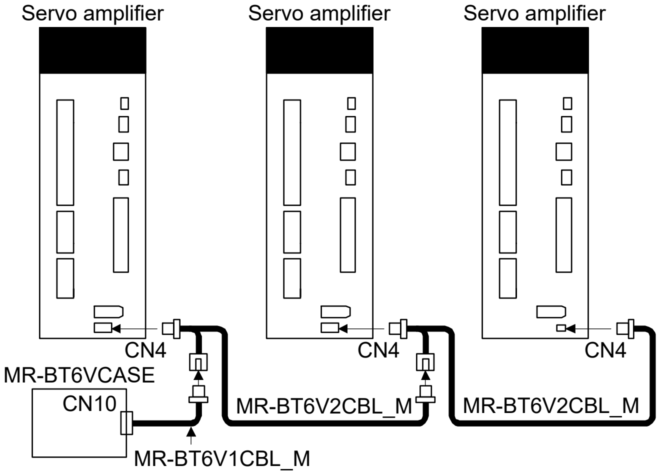
POINT

- 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.

(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.

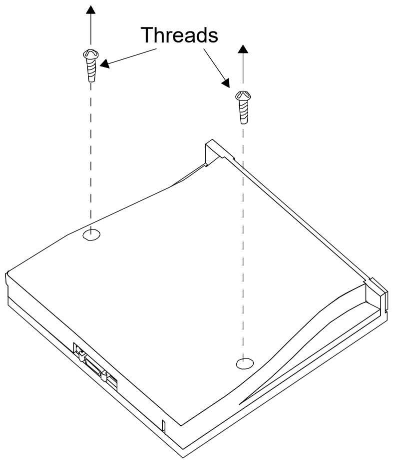
1) Required items

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)

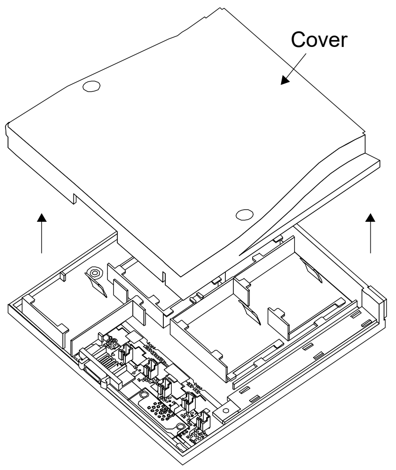
2) Disassembly and assembly of the battery case MR-BT6VCASE

a) Disassembly of the case

MR-BT6VCASE is shipped assembled. To mount MR-BAT6V1 batteries, the case needs to be disassembled.

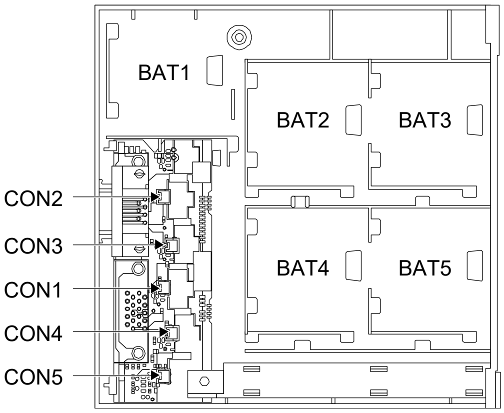


Remove the two screws using a Phillips screwdriver.

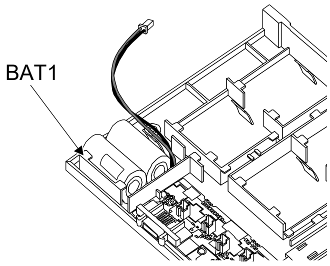


Remove the cover.

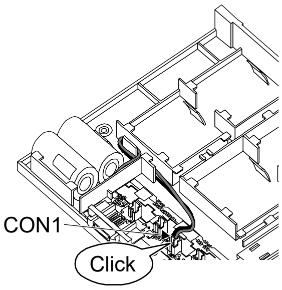
Parts identification



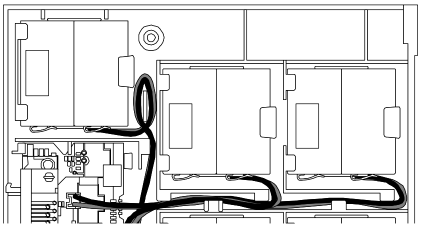
b) Mounting MR-BAT6V1



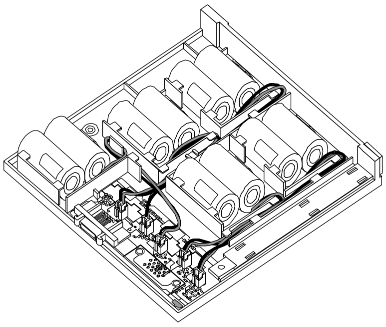
Securely mount an MR-BAT6V1 to the BAT1 holder.



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.



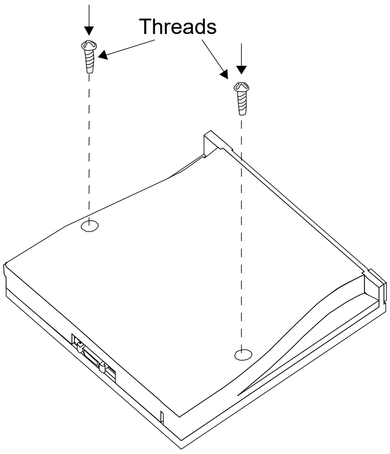
Bring out the lead wire from the space between the ribs, and bend it as shown above to store it in the duct. Connect the lead wire to the connector. Be careful not to get the lead wire caught in the case or other parts.
When the lead wire is damaged, external short circuit may occur, and the battery 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.

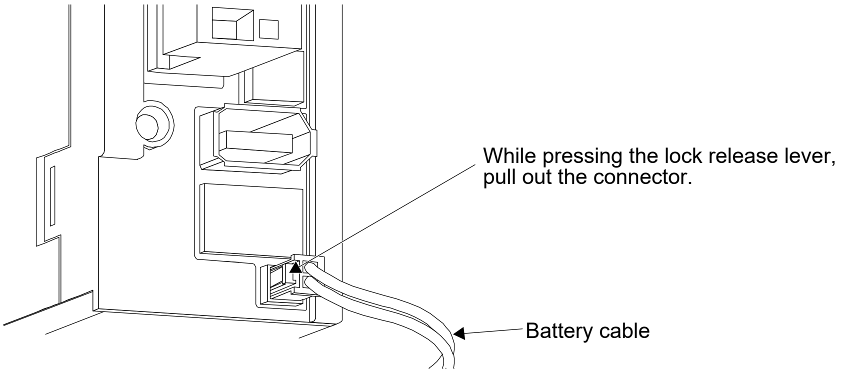


d) Precautions for removal of battery
The connector attached to the MR-BAT6V1 battery has the lock release lever. When removing the connector, pull out the connector while pressing the lock release lever.

3) Battery cable removal

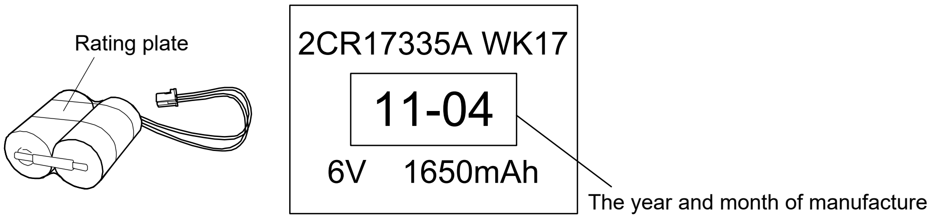
⚠CAUTION

- ●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.



11.8.6 MR-BAT6V1 battery

The MR-BAT6V1 battery is a primary lithium battery for replacing MR-BAT6V1SET-A and MR-BAT6V1SET and a primary lithium 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 an 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

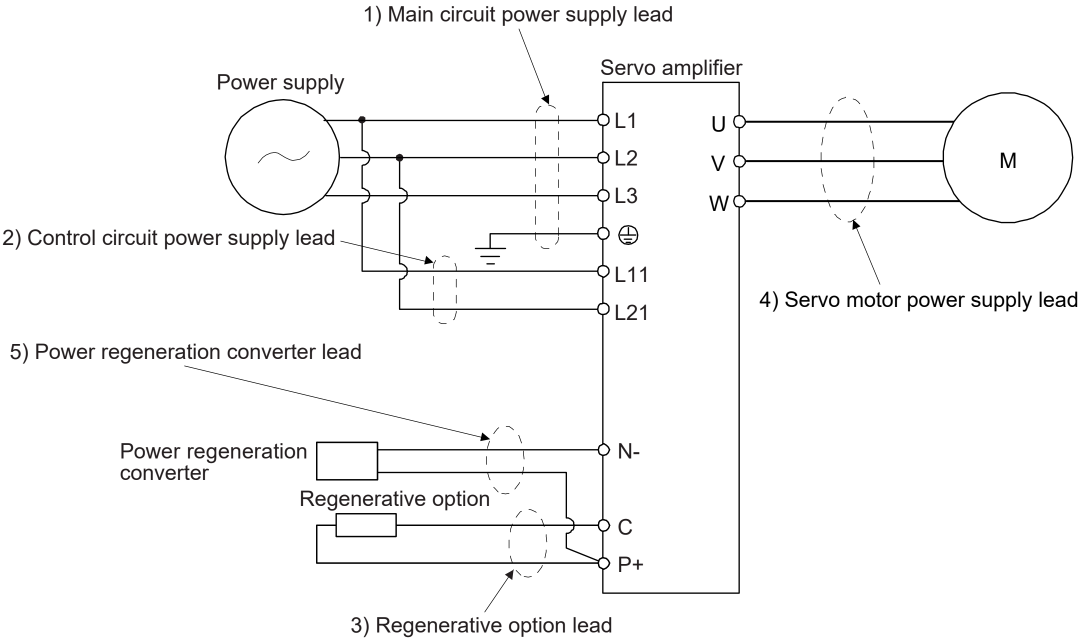
Note. Quality of the batteries degrades by the storage condition. The battery life is 5 years from the production date regardless of the connection status.

11.9 Selection example of wires

POINT

- 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-_A-RJ servo amplifier is used with the DC power supply input, refer to app. 13.3.
- 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-J4-10A(-RJ)	2 (AWG 14)	1.25 to 2 (AWG 16 to 14) (Note 4)	2 (AWG 14)	AWG 18 to 14 (Note 4)
MR-J4-20A(-RJ)				
MR-J4-40A(-RJ)				
MR-J4-60A(-RJ)				
MR-J4-70A(-RJ)				
MR-J4-100A(-RJ)				
MR-J4-200A(-RJ) (3-phase power supply input)				AWG 16 to 10
MR-J4-200A(-RJ) (1-phase power supply input) MR-J4-350A(-RJ)	3.5 (AWG 12)			
MR-J4-500A(-RJ) (Note 2)	5.5 (AWG 10): a	1.25 (AWG 16): a 2 (AWG 14): d (Note 4)	2 (AWG 14): c	2 (AWG 14): c 3.5 (AWG 12): a 5.5 (AWG 10): a
MR-J4-700A(-RJ) (Note 2)	8 (AWG 8): b			2 (AWG 14): c 3.5 (AWG 12): a 5.5 (AWG 10): a 8 (AWG 8): b
MR-J4-11KA(-RJ) (Note 2)	14 (AWG 6): f	1.25 (AWG 16): c 2 (AWG 14): c (Note 4)	3.5 (AWG 12): g	14 (AWG 6): f 55 (AWG 10): g (Note 5) 8 (AWG 8): k
MR-J4-15KA(-RJ) (Note 2)	22 (AWG 4): h		5.5 (AWG 10): g	22 (AWG 4): h 8 (AWG 8): k (Note 5)
MR-J4-22KA(-RJ) (Note 2)	38 (AWG 2): i		5.5 (AWG 10): j	38 (AWG 2): i

Note
1. Alphabets in the table indicate crimping tools. For crimp terminals and applicable tools, refer to (2) in this section.
2. To connect these models to a terminal block, be sure to use the screws that come with the terminal block.
3. The wire size shows applicable size of the servo amplifier connector and terminal block. For wires connecting to the servo motor, refer to "Servo Motor Instruction Manual (Vol. 3)".
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	Wires [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-J4-60A4(-RJ) MR-J4-100A4(-RJ)	2 (AWG 14)	1.25 to 2 (AWG 16 to 14) (Note 4)	2 (AWG 14)	AWG 16 to 14
MR-J4-200A4(-RJ)				
MR-J4-350A4(-RJ)				
MR-J4-500A4(-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-J4-700A4(-RJ) (Note 2)	3.5 (AWG 12): a			5.5 (AWG 10): a
MR-J4-11KA4(-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-J4-15KA4(-RJ) (Note 2)	8 (AWG 8): g		3.5 (AWG 12): d	
MR-J4-22KA4(-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-J4-10A1(-RJ)	2 (AWG 14)	1.25 to 2 (AWG 16 to 14) (Note 2)	2 (AWG 14)	AWG 18 to 14 (Note 2)
MR-J4-20A1(-RJ)				
MR-J4-40A1(-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-_A-RJ servo amplifier is used with the DC power supply input, refer to app. 13.4.

(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-J4-10A(-RJ)	30 A frame 5 A	30 A frame 5 A	240	T	10	300	S-N10 S-T10
MR-J4-20A(-RJ)	30 A frame 5 A	30 A frame 5 A					
MR-J4-40A(-RJ)	30 A frame 10 A	30 A frame 5 A			15		
MR-J4-60A(-RJ)	30 A frame 15 A	30 A frame 10 A			20		
MR-J4-70A(-RJ)	30 A frame 15 A	30 A frame 10 A					
MR-J4-100A(-RJ) (3-phase power supply input)	30 A frame 15 A	30 A frame 10 A					
MR-J4-100A(-RJ) (1-phase power supply input)	30 A frame 15 A	30 A frame 15 A			30		
MR-J4-200A(-RJ)	30 A frame 20 A	30 A frame 20 A			40		S-N20 (Note 3) S-T21
MR-J4-350A(-RJ)	30 A frame 30 A	30 A frame 30 A			70		S-N20 S-T21
MR-J4-500A(-RJ)	50 A frame 50 A	50 A frame 50 A			125		S-N35 S-T35
MR-J4-700A(-RJ)	100 A frame 75 A	60 A frame 60 A			150		S-N50 S-T50
MR-J4-11KA(-RJ)	100 A frame 100 A	100 A frame 100 A			200		
MR-J4-15KA(-RJ)	125 A frame 125 A	125 A frame 125 A			250		S-N65 S-T65
MR-J4-22KA(-RJ)	225 A frame 175 A	225 A frame 175 A			350		S-N95 S-T100
MR-J4-60A4(-RJ)	30 A frame 5 A	30 A frame 5 A	480	T	10	600	S-N10 S-T10
MR-J4-100A4(-RJ)	30 A frame 10 A	30 A frame 5 A			15		
MR-J4-200A4(-RJ)	30 A frame 15 A	30 A frame 10 A			25		
MR-J4-350A4(-RJ)	30 A frame 20 A	30 A frame 15 A			35		S-N20 (Note 3) S-T21
MR-J4-500A4(-RJ)	30 A frame 20 A	30 A frame 20 A			50		
MR-J4-700A4(-RJ)	30 A frame 30 A	30 A frame 30 A			65		S-N20 S-T21
MR-J4-11KA4(-RJ)	50 A frame 50 A	50 A frame 50 A			100		S-N25 S-T35
MR-J4-15KA4(-RJ)	60 A frame 60 A	60 A frame 60 A			150		S-N35 S-T35
MR-J4-22KA4(-RJ)	100 A frame 100 A	100 A frame 100 A			175		S-N50 S-T50
MR-J4-10A1(-RJ)	30 A frame 5 A	30 A frame 5 A	240	T	10	300	S-N10 S-T10
MR-J4-20A1(-RJ)	30 A frame 10 A	30 A frame 10 A			15		
MR-J4-40A1(-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-J4-10A(-RJ)	200 to 240	3-phase	MMP-T32	240	1.6	50
MR-J4-20A(-RJ)					2.5	
MR-J4-40A(-RJ)					4	
MR-J4-60A(-RJ)					6.3	
MR-J4-70A(-RJ)					6.3	
MR-J4-100A(-RJ)					8	
MR-J4-200A(-RJ)					18	
MR-J4-350A(-RJ)					25	25
MR-J4-500A(-RJ)					32	
MR-J4-60A4(-RJ)	380 to 480	3-phase		480Y/277	2.5	50
MR-J4-100A4(-RJ)					4	
MR-J4-200A4(-RJ)					8	
MR-J4-350A4(-RJ)					13	
MR-J4-500A4(-RJ)					18	
MR-J4-700A4(-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-J4-10A(-RJ)	30 A frame 5 A	240	1	300	1	250
MR-J4-20A(-RJ)						
MR-J4-40A(-RJ)						
MR-J4-60A(-RJ)						
MR-J4-70A(-RJ)						
MR-J4-100A(-RJ)						
MR-J4-200A(-RJ)						
MR-J4-350A(-RJ)						
MR-J4-500A(-RJ)						
MR-J4-700A(-RJ)						
MR-J4-11KA(-RJ)						
MR-J4-15KA(-RJ)						
MR-J4-22KA(-RJ)						
MR-J4-60A4(-RJ)	30 A frame 5 A	480	1	600	1	600
MR-J4-100A4(-RJ)						
MR-J4-200A4(-RJ)						
MR-J4-350A4(-RJ)						
MR-J4-500A4(-RJ)						
MR-J4-700A4(-RJ)						
MR-J4-11KA4(-RJ)						
MR-J4-15KA4(-RJ)						
MR-J4-22KA4(-RJ)						
MR-J4-10A1(-RJ)	30 A frame 5 A	240	1	300	1	250
MR-J4-20A1(-RJ)						
MR-J4-40A1(-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 be 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

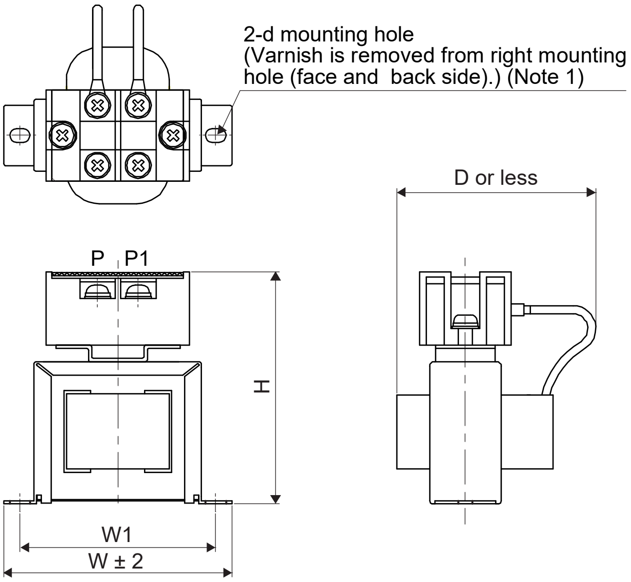


Fig. 11.1

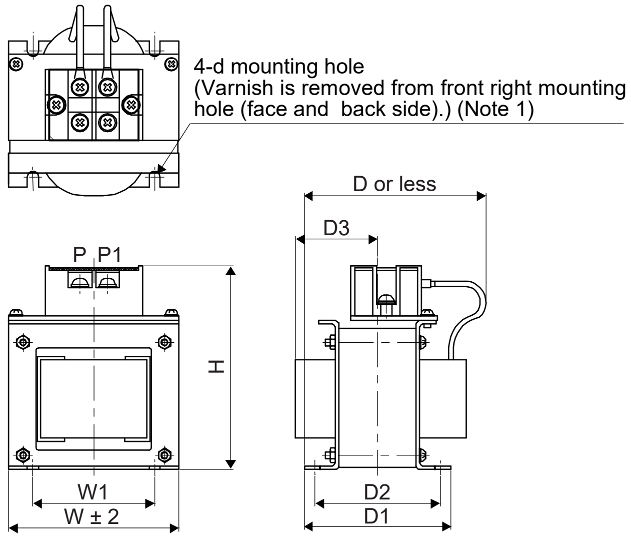
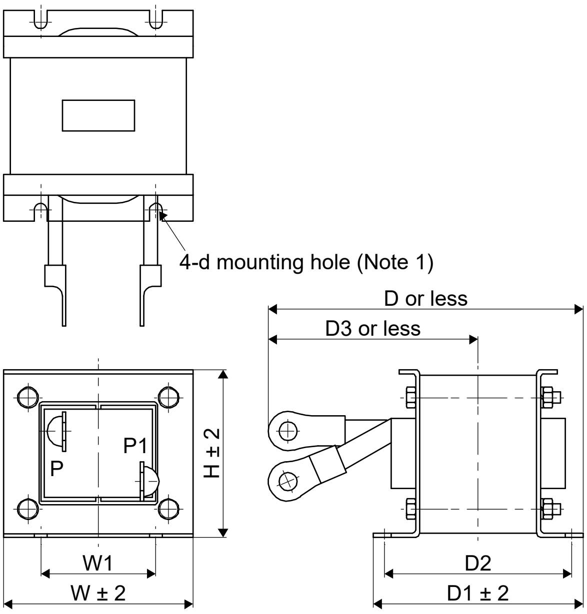


Fig. 11.2



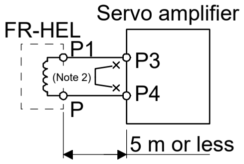


Fig. 11.3

Note 1. Use this for grounding.

2. When using the Power factor improving DC reactor, remove the short bar across P3-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-J4-10A(-RJ) MR-J4-20A(-RJ)	FR-HEL-0.4K	Fig. 11.1	70	60	71	61		21		M4	M4	0.4	2 (AWG 14)
MR-J4-40A(-RJ)	FR-HEL-0.75K		85	74	81	61		21		M4	M4	0.5	
MR-J4-60A(-RJ) MR-J4-70A(-RJ)	FR-HEL-1.5K		85	74	81	70		30		M4	M4	0.8	
MR-J4-100A(-RJ)	FR-HEL-2.2K		85	74	81	70		30		M4	M4	0.9	
MR-J4-200A(-RJ)	FR-HEL-3.7K	Fig. 11.2	77	55	92	82	66	57	37	M4	M4	1.5	
MR-J4-350A(-RJ)	FR-HEL-7.5K		86	60	113	98	81	72	43	M4	M5	2.5	3.5 (AWG 12)
MR-J4-500A(-RJ)	FR-HEL-11K		105	64	133	112	92	79	47	M6	M6	3.3	5.5 (AWG 10)
MR-J4-700A(-RJ)	FR-HEL-15K		105	64	133	115	97	84	48.5	M6	M6	4.1	8 (AWG 8)
MR-J4-11KA(-RJ)	FR-HEL-15K		105	64	133	115	97	84	48.5	M6	M6	4.1	14 (AWG 6)
MR-J4-15KA(-RJ)	FR-HEL-22K	Fig. 11.3	105	64	93	175	117	104	115 (Note 1)	M6	M10	5.6	22 (AWG 4)
MR-J4-22KA(-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.
Wire type: 600 V grade heat-resistant polyvinyl chloride insulated wire (HIV wire)
Construction condition: Single wire set in midair

(2) 400 V class

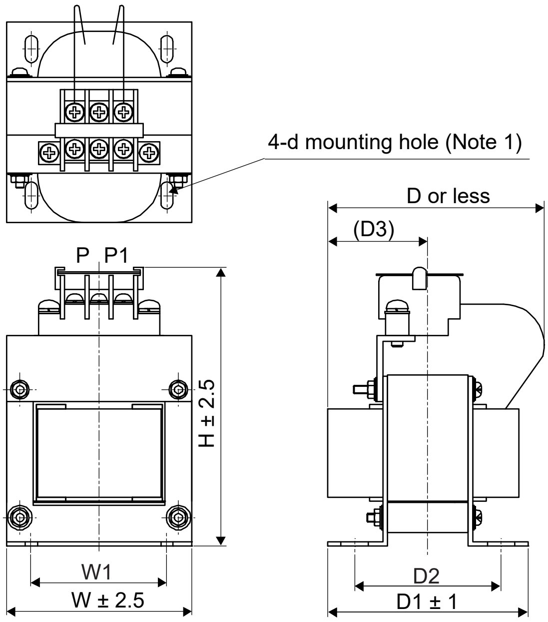


Fig. 11.4

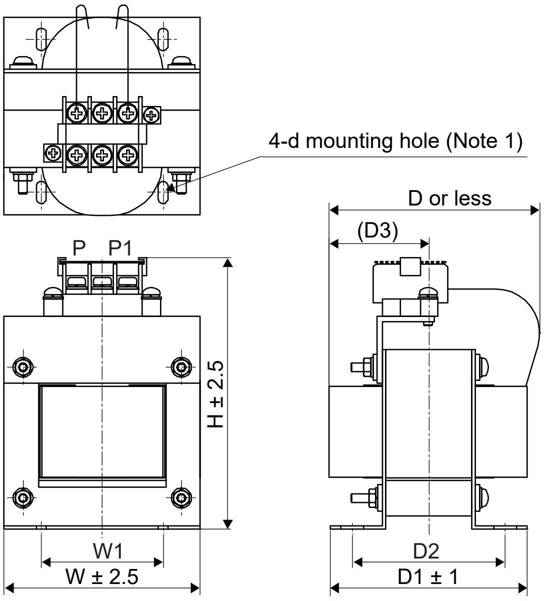


Fig. 11.5

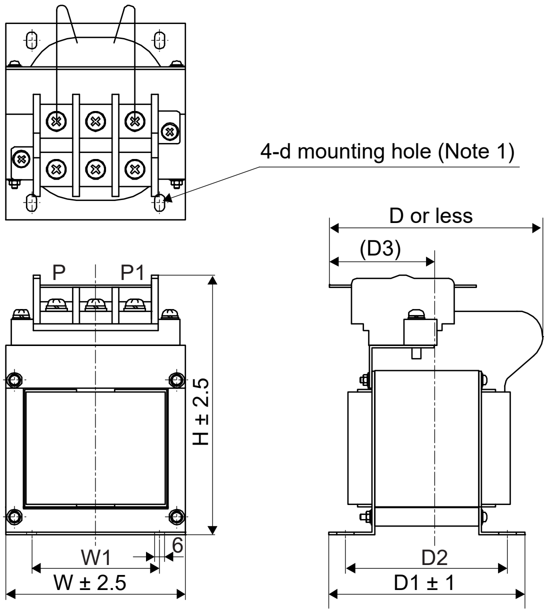
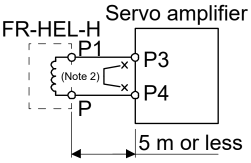


Fig. 11.6



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-J4-60A4(-RJ)	FR-HEL-H1.5K	Fig. 11.4	66	50	100	80	74	54	37	M4	M3.5	1.0	2 (AWG 14)
MR-J4-100A4(-RJ)	FR-HEL-H2.2K		76	50	110	80	74	54	37	M4	M3.5	1.3	2 (AWG 14)
MR-J4-200A4(-RJ)	FR-HEL-H3.7K	Fig. 11.5	86	55	120	95	89	69	45	M4	M4	2.3	2 (AWG 14)
MR-J4-350A4(-RJ)	FR-HEL-H7.5K		96	60	128	105	100	80	50	M5	M4	3.5	2 (AWG 14)
MR-J4-500A4(-RJ)	FR-HEL-H11K		105	75	137	110	105	85	53	M5	M5	4.5	3.5 (AWG 12)
MR-J4-700A4(-RJ)	FR-HEL-H15K	Fig. 11.6	105	75	152	125	115	95	62	M5	M6	5.0	5.5 (AWG 10)
MR-J4-11KA4(-RJ)													8 (AWG 8)
MR-J4-15KA4(-RJ)	FR-HEL-H22K		133	90	178	120	95	75	53	M5	M6	6.0	8 (AWG 8)
MR-J4-22KA4(-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 be about 80%.

When using power factor improving reactors for two servo amplifiers or more, be sure to connect a power factor improving reactor to each servo amplifier. If using only one power factor improving reactor, enough improvement effect of phase factor cannot be obtained unless all servo amplifiers are operated.

(1) 200 V class/100 V class

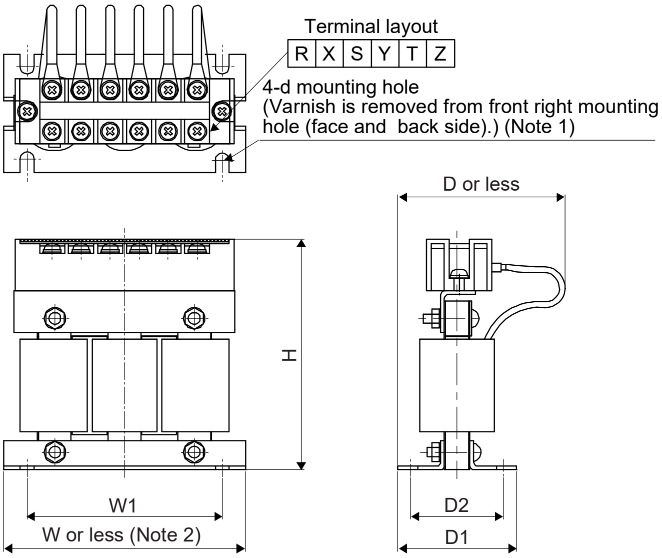
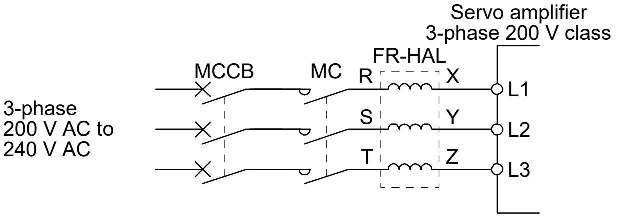
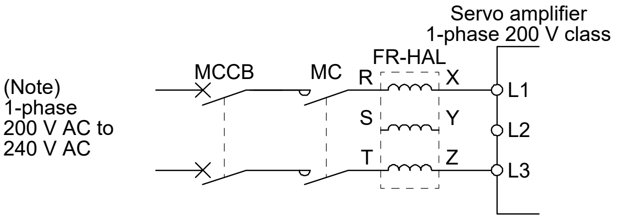
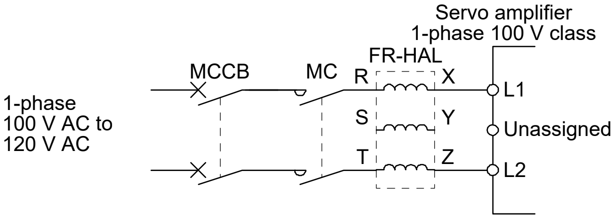


Fig. 11.7







Note 1. Use this hole 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.

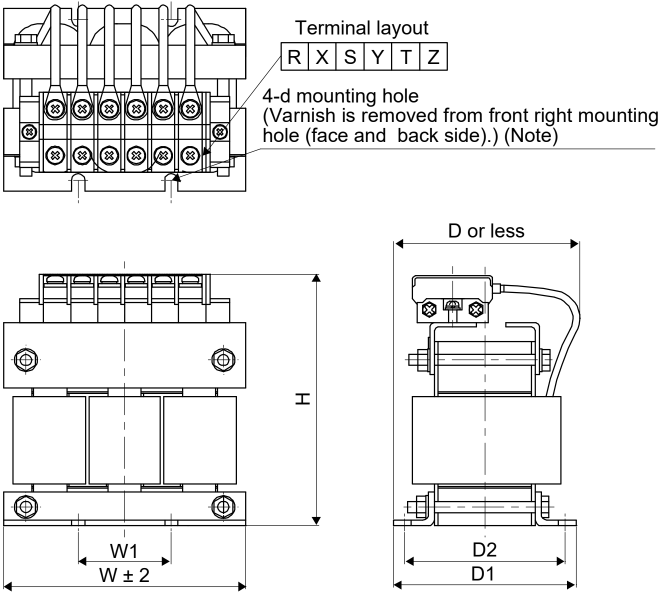


Fig. 11.8

Note. Use this hole for grounding.

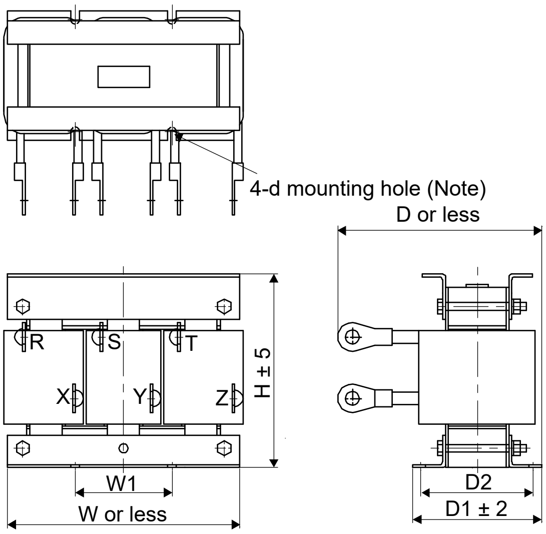


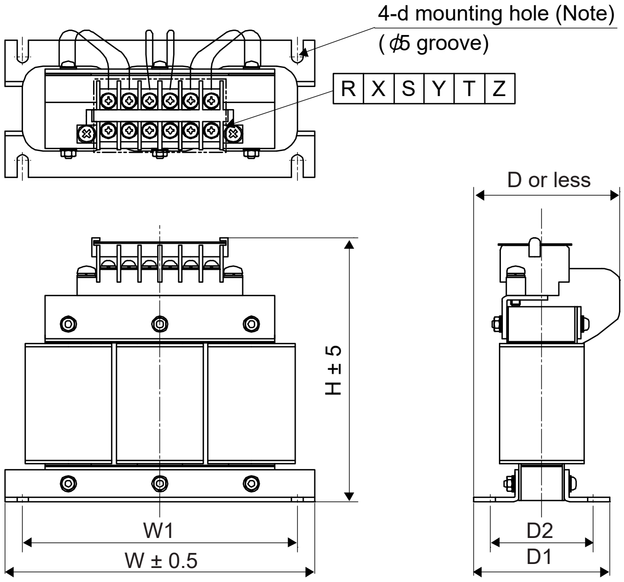
Fig. 11.9

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-J4-10A(-RJ) MR-J4-20A(-RJ)	FR-HAL-0.4K	Fig. 11.7	104	84	99	72	51	40	M5	M4	0.6
MR-J4-40A(-RJ) MR-J4-10A1(-RJ)	FR-HAL-0.75K		104	84	99	74	56	44	M5	M4	0.8
MR-J4-60A(-RJ) MR-J4-70A(-RJ) MR-J4-20A1(-RJ)	FR-HAL-1.5K		104	84	99	77	61	50	M5	M4	1.1
MR-J4-100A(-RJ) (3-phase power supply input) MR-J4-40A1(-RJ)	FR-HAL-2.2K		115 (Note)	40	115	77	71	57	M6	M4	1.5
MR-J4-100A(-RJ) (1-phase power supply input) MR-J4-200A(-RJ) (3-phase power supply input)	FR-HAL-3.7K		115 (Note)	40	115	83	81	67	M6	M4	2.2
MR-J4-200A(-RJ) (1-phase power supply input)	FR-HAL-5.5K		115 (Note)	40	115	83	81	67	M6	M4	2.3
MR-J4-350A(-RJ)	FR-HAL-7.5K	Fig. 11.8	130	50	135	100	98	86	M6	M5	4.2
MR-J4-500A(-RJ)	FR-HAL-11K		160	75	164	111	109	92	M6	M6	5.2
MR-J4-700A(-RJ)	FR-HAL-15K		160	75	167	126	124	107	M6	M6	7.0
MR-J4-11KA(-RJ)	FR-HAL-15K		160	75	167	126	124	107	M6	M6	7.0
MR-J4-15KA(-RJ)	FR-HAL-22K		185 (Note)	75	150	158	100	87	M6	M8	9.0
MR-J4-22KA(-RJ)	FR-HAL-30K	Fig. 11.9	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



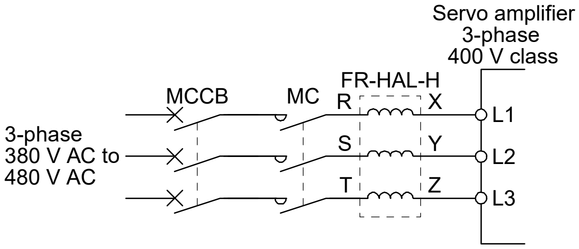


Fig. 11.10

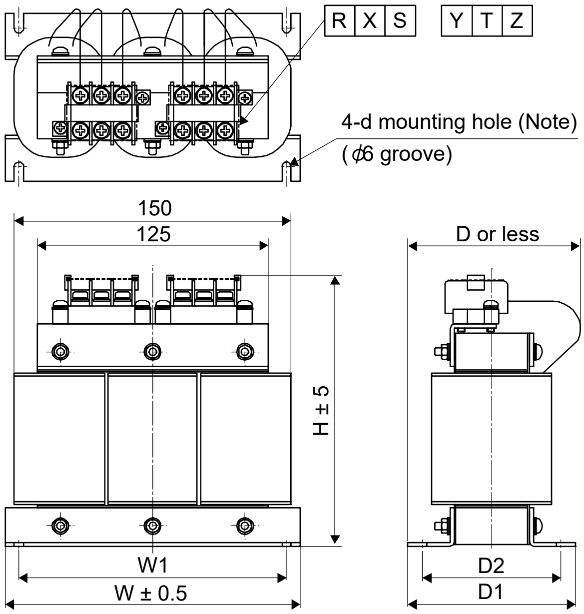


Fig. 11.11

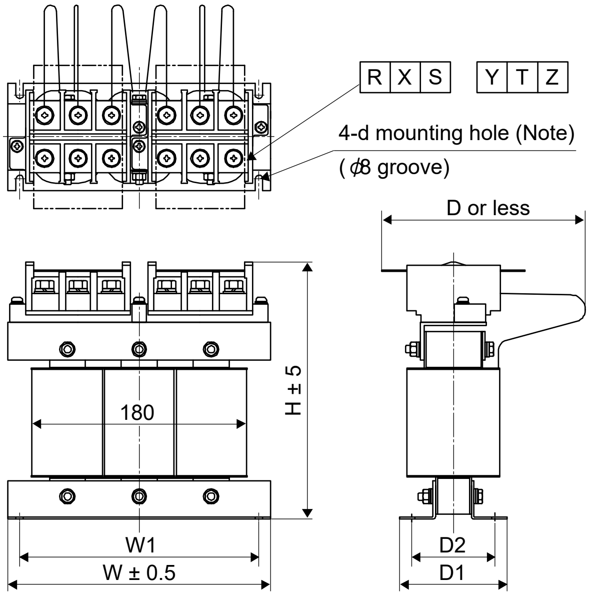


Fig. 11.12

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-J4-60A4(-RJ)	FR-HAL-H1.5K	Fig. 11.10	135	120	115	59	59.6	45	M4	M3.5	1.5
MR-J4-100A4(-RJ)	FR-HAL-H2.2K		135	120	115	59	59.6	45	M4	M3.5	1.5
MR-J4-200A4(-RJ)	FR-HAL-H3.7K		135	120	115	69	70.6	57	M4	M3.5	2.5
MR-J4-350A4(-RJ)	FR-HAL-H7.5K	Fig. 11.11	160	145	142	91	91	75	M4	M4	5.0
MR-J4-500A4(-RJ)	FR-HAL-H11K		160	145	146	91	91	75	M4	M5	6.0
MR-J4-700A4(-RJ) MR-J4-11KA4(-RJ)	FR-HAL-H15K		220	200	195	105	90	70	M5	M5	9.0
MR-J4-15KA4(-RJ)	FR-HAL-H22K	Fig. 11.12	220	200	215	170	90	70	M5	M8	9.5
MR-J4-22KA4(-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 Relays (recommended)

The following relays should be used with the interfaces

Interface	Selection example
Digital input (interface DI-1) Relay used for digital input command signals	To prevent defective contacts , use a relay for small signal (twin contacts). (Ex.) Omron : type G2A , MY
Digital output (interface DO-1) Relay used for digital output signals	Small relay with 12 V DC or 24 V DC of rated current 40 mA or less (Ex.) Omron : type MY

11.14 Noise reduction techniques

Noises are classified into external noises which enter the servo amplifier to cause it to malfunction and those radiated by the servo amplifier to cause peripheral devices to malfunction. Since the servo amplifier is an electronic device which handles small signals, the following general noise reduction techniques are required. Also, the servo amplifier can be a source of noise as its outputs are chopped by high carrier frequencies. If peripheral devices 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.)

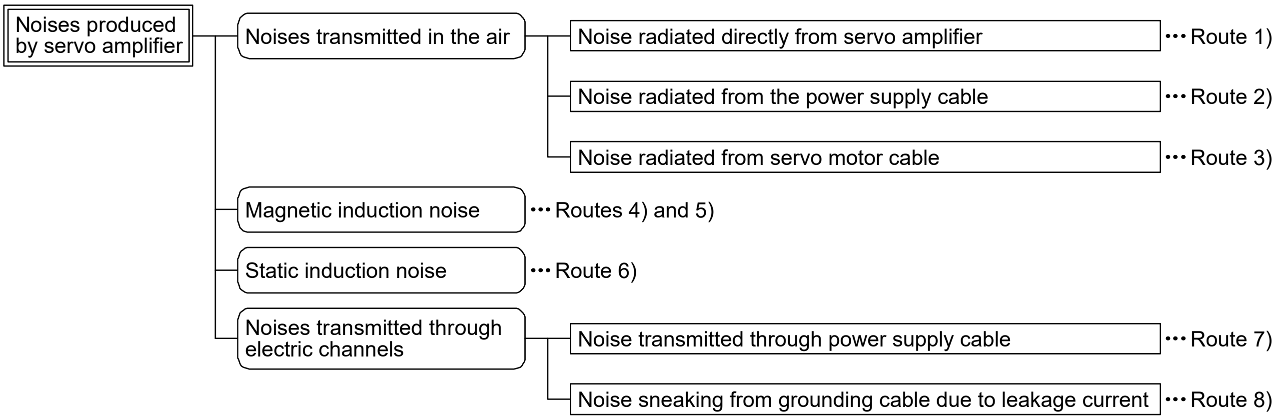
(b) Reduction techniques for external noises that cause the servo amplifier to malfunction

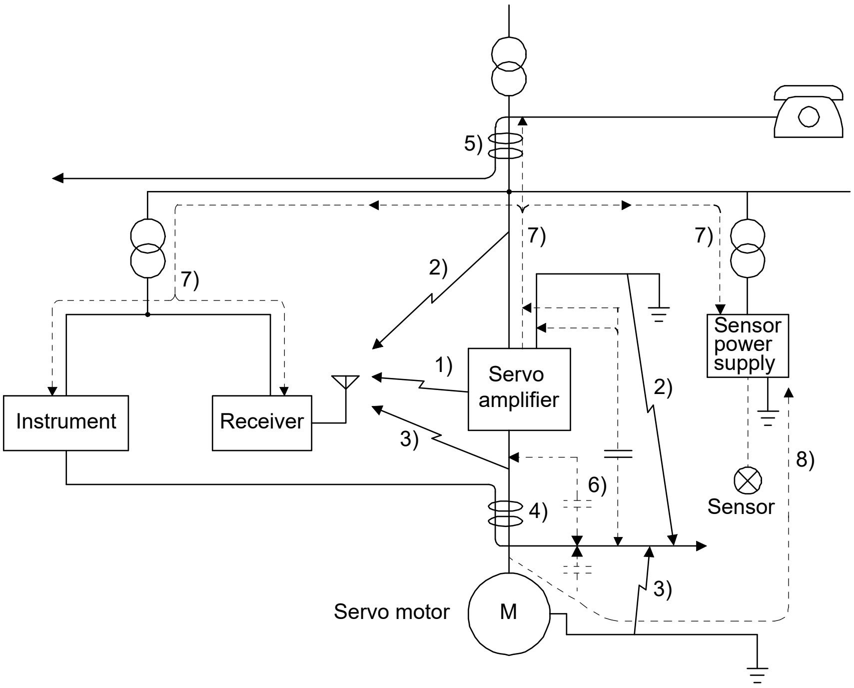
If there are noise sources (such as a magnetic contactor, an electromagnetic brake, and many relays which make a large amount of noise) near the servo amplifier and the servo amplifier may malfunction, the following countermeasures are required.

- 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 devices to malfunction

Noises produced by the servo amplifier are classified into those radiated from the cables connected to the servo amplifier and its main circuits (input and output circuits), those induced electromagnetically or statically by the signal cables of the peripheral devices located near the main circuit cables, and those transmitted through the power supply cables.





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.

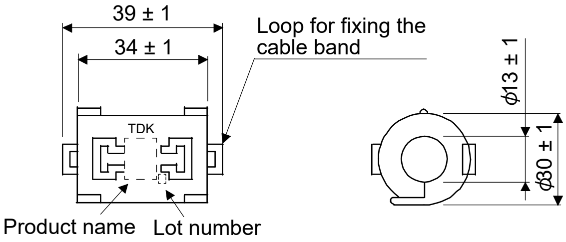
(2) Noise reduction techniques

(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

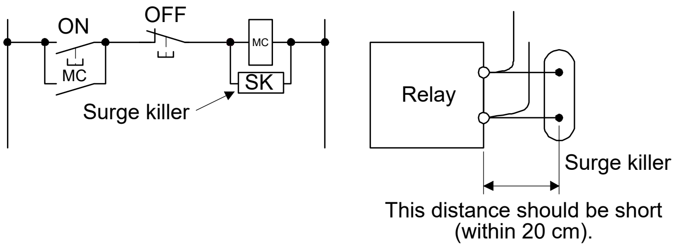
[Unit: mm]



Outline drawing (ZCAT3035-1330)

(b) Surge killer (recommended)

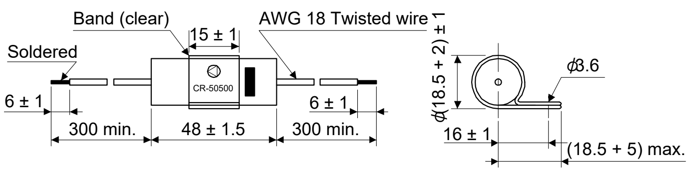
Use of a surge killer is recommended for AC relay, magnetic contactor or the like near the servo amplifier. Use the following surge killer or equivalent.



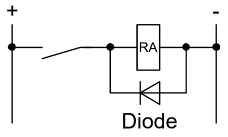
(Ex.) CR-50500 Okaya Electric Industries)

Rated voltage AC [V]	C [μF ± 20%]	R [Ω ± 30%]	Test voltage
250	0.5	50 (1/2 W)	Between terminals: 625 V AC, 50/60 Hz 60 s Between terminal and case: 2000 V AC, 50/60 Hz 60 s

Dimensions [Unit: mm]



Note that a diode should be installed to a DC relay or the like.
Maximum voltage: Not less than 4 times the drive voltage of the relay or the like
Maximum current: Not less than twice the drive current of the relay or the like



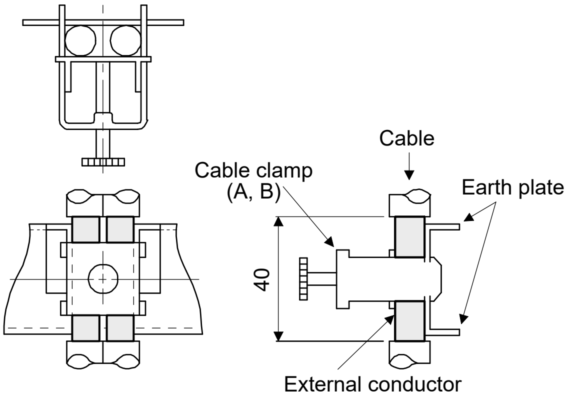
(c) Cable clamp fitting AERSBAN-_SET

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.

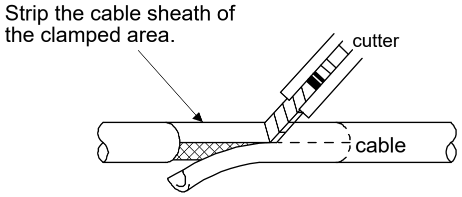
Install the grounding plate near the servo amplifier for the encoder cable. Peel part of the cable sheath to expose the external conductor, and press that part against the grounding plate with the cable clamp. If the cable is thin, clamp several cables in a bunch.

The clamp comes as a set with the grounding plate.

[Unit: mm]



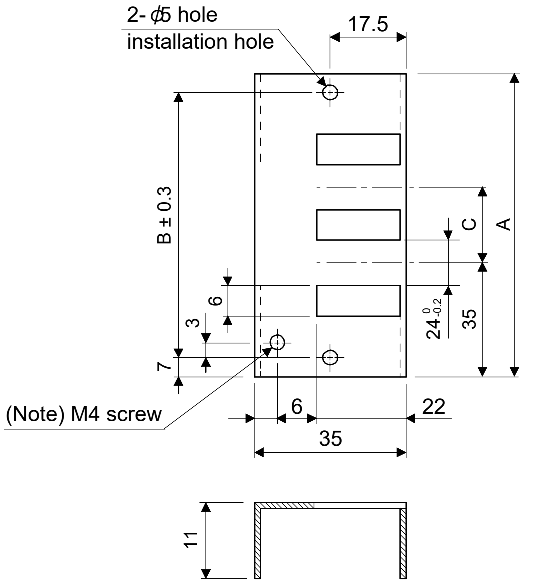
Clamp section diagram



・Dimensions

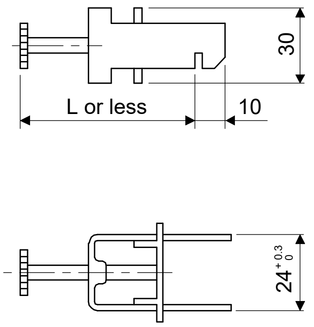
[Unit: mm]

Earth plate



[Unit: mm]

Clamp section diagram



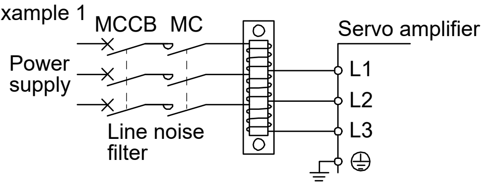
Note. Screw hole for grounding. Connect it to the grounding plate of the cabinet.

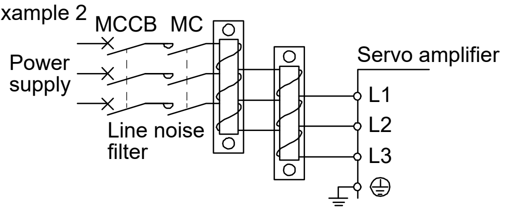
Model	A	B	C	Accessory fittings
AERSBAN-DSET	100	86	30	Clamp A: 2 pcs.
AERSBAN-ESET	70	56		Clamp B: 1 pc.

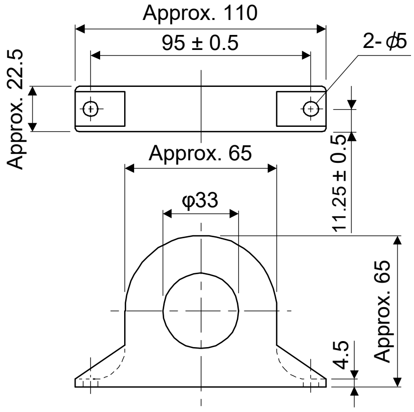
Clamp fitting	L
A	70
B	45

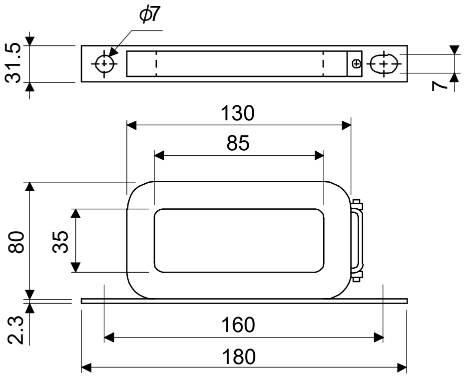
(d) Line noise filter (FR-BSF01/ FR-BLF)

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 mm² (AWG 12) or less))


</td></tr>
<tr><td>FR-BLF (for wire size 5.5 mm² (AWG 10) or more))


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

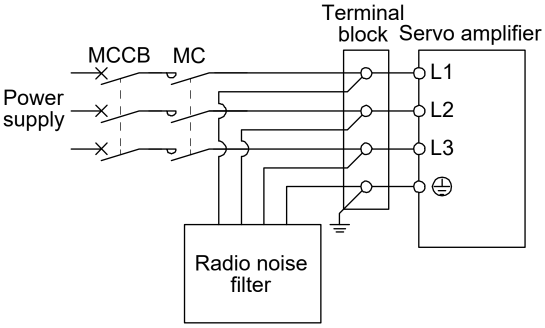
(e) Radio noise filter (FR-BIF(-H))

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.

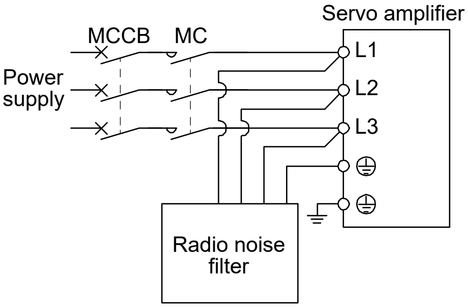
200 V class/100 V class: FR-BIF

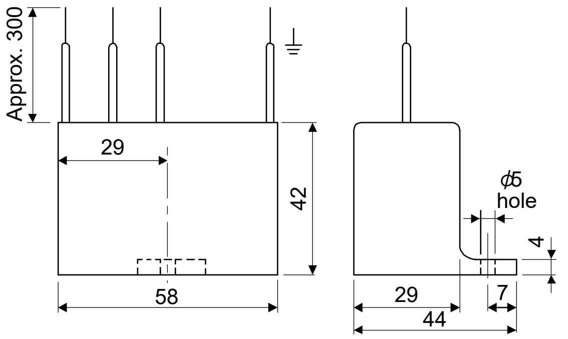
400 V class: FR-BIF-H

<table>
<tr><th>Connection diagram</th><th>Dimensions [Unit: mm]</th></tr>
<tr><td>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-J4-350A(-RJ) or less/MR-J4-350A4(-RJ) or less/MR-J4-40A1(-RJ) or less



・MR-J4-500A(-RJ) or less/MR-J4-500A4(-RJ) or less

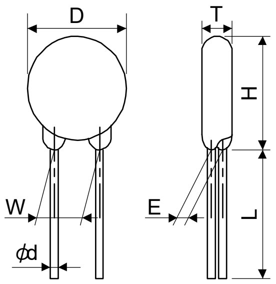

</td>
<td>Leakage current: 4 mA


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

(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 rated					Maximum limit voltage		Static capacity (reference value)	Varistor voltage rating (range) V1 mA
		Permissible circuit voltage		Surge current immunity	Energy immunity	Rated pulse power	[A]	[V]		
		AC [Vrms]	DC [V]	8/20 μs [A]	2 ms [J]	[W]			[pF]	[V]
200 V class/ 100 V class	TND20V-431K	275	350	10000/1 time	195	1.0	100	710	1300	430 (387 to 473)
	TND20V-471K	300	385	7000/2 time	215			775	1200	470 (423 to 517)
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)	φ d ± 0.05 or less	W 1.0 or less
TND20V-431K	21.5	24.5	6.4	3.3	20	0.8	10.0
TND20V-471K			6.6	3.5			
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

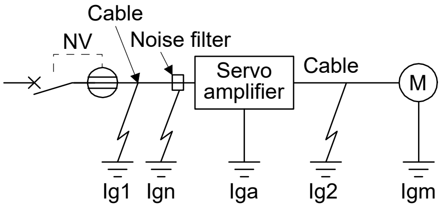
(1) Selection method

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 ≥ 10 • {Ig1 + Ign + Iga + K • (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

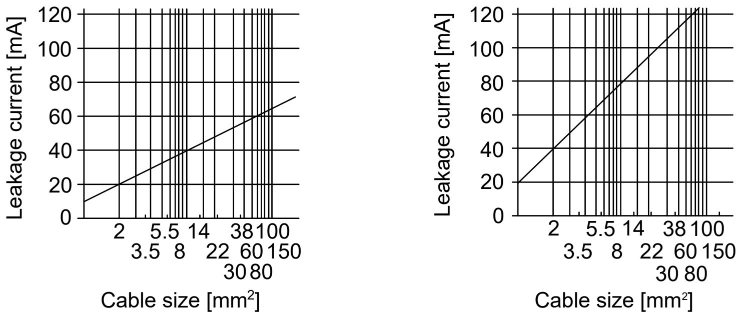
Ig1: Leakage current on the electric channel from the earth-leakage current breaker to the input terminals of the servo amplifier (Found from Fig. 11.13.)

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 Leakage current example (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)

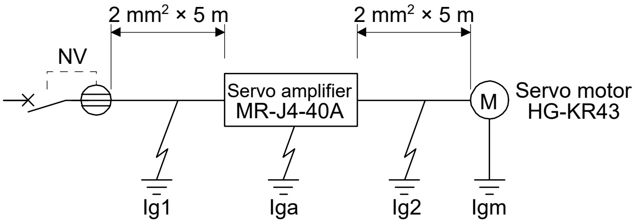
Servo amplifier capacity [kW]	Leakage current [mA]
0.1 to 0.6	0.1
0.75 to 3.5	0.15
5/7	2
11/15	5.5
22	7

Table 11.6 Earth-leakage current breaker selection example

Servo amplifier	Rated sensitivity current of earth-leakage current breaker [mA]
MR-J4-10A(-RJ) to MR-J4-350A(-RJ) MR-J4-60A4(-RJ) to MR-J4-350A4(-RJ) MR-J4-10A1(-RJ) to MR-J4-40A1(-RJ)	15
MR-J4-500A(-RJ) MR-J4-500A4(-RJ)	30
MR-J4-700A(-RJ) MR-J4-700A4(-RJ)	50
MR-J4-11KA(-RJ) to MR-J4-22KA(-RJ) MR-J4-11KA4(-RJ) to MR-J4-22KA4(-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-J4-10A(-RJ) to MR-J4-100A(-RJ)	HF3010A-UN (Note)	10	250	5	3.5
MR-J4-200A(-RJ) MR-J4-350A(-RJ)	HF3010A-UN (Note)	30			5.5
MR-J4-500A(-RJ) MR-J4-700A(-RJ)	HF3040A-UN (Note)	40		6.5	6
MR-J4-11KA(-RJ) MR-J4-15KA(-RJ) MR-J4-22KA(-RJ)	HF3100A-UN (Note)	100			12
MR-J4-60A4(-RJ) MR-J4-100A4(-RJ)	TF3005C-TX	5	500	5.5	6
MR-J4-200A4(-RJ) to MR-J4-700A4(-RJ)	TF3020C-TX	20			
MR-J4-11KA4(-RJ)	TF3030C-TX	30			7.5
MR-J4-15KA4(-RJ)	TF3040C-TX	40			12.5
MR-J4-22KA4(-RJ)	TF3060C-TX	60			
MR-J4-10A1(-RJ) to MR-J4-40A1(-RJ)	HF3010A-UN (Note)	10	250	5	3.5

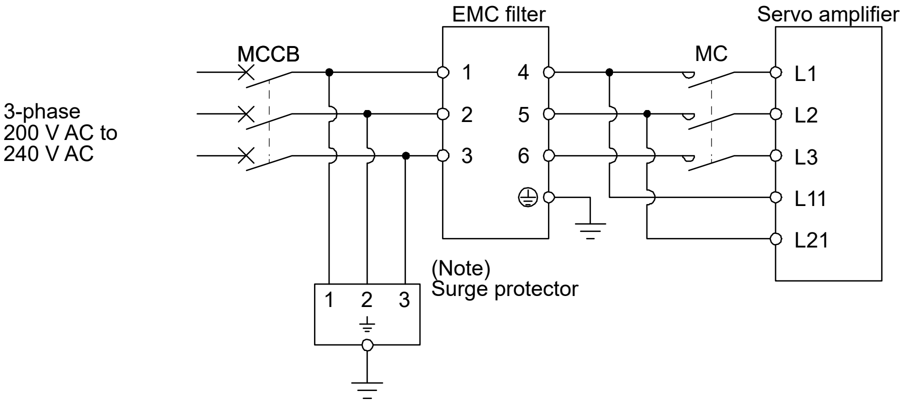
Note. To use any of these EMC filters, the surge protector RSPD-500-U4 (Okaya Electric Industries) is required.

Servo amplifier	Recommended filter (COSEL)				Mass [kg]
	Model	Rated current [A]	Rated voltage [VAC]	Leakage current [mA]	
MR-J4-11KA(-RJ) to MR-J4-22KA(-RJ)	FTB-100-355-L (Note)	100	500	40	5.3
MR-J4-22KA4(-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.

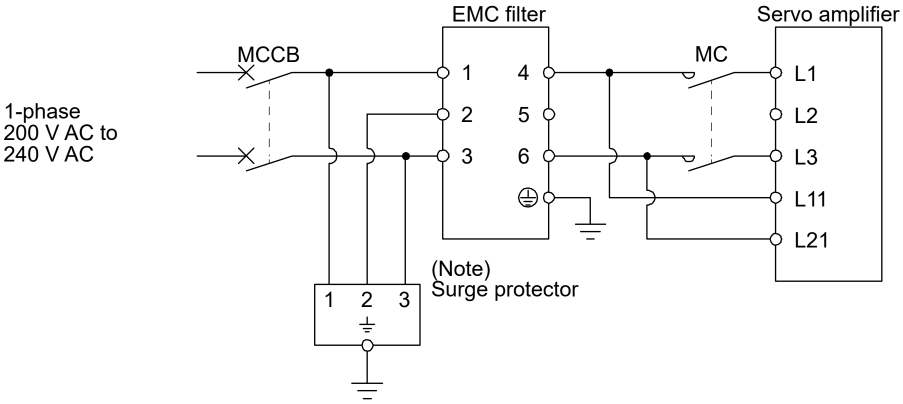
(2) Connection example

(a) For 3-phase 200 V AC to 240 V AC power supply



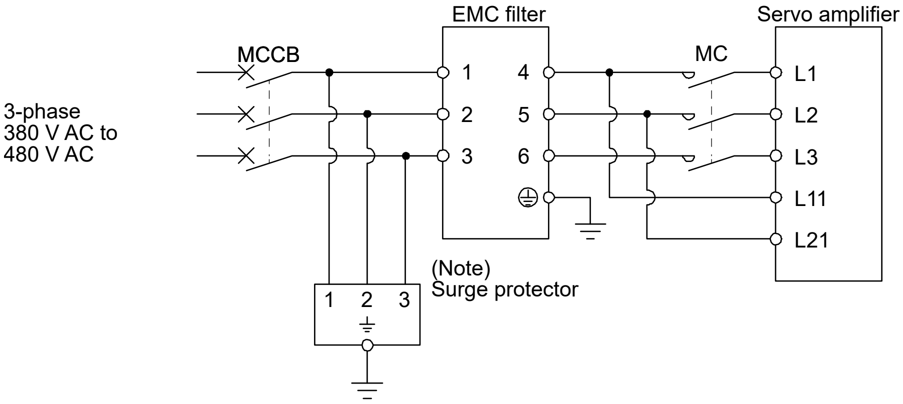
Note. When a surge protector is used.

(b) For 1-phase 200 V AC to 240 V AC power supply



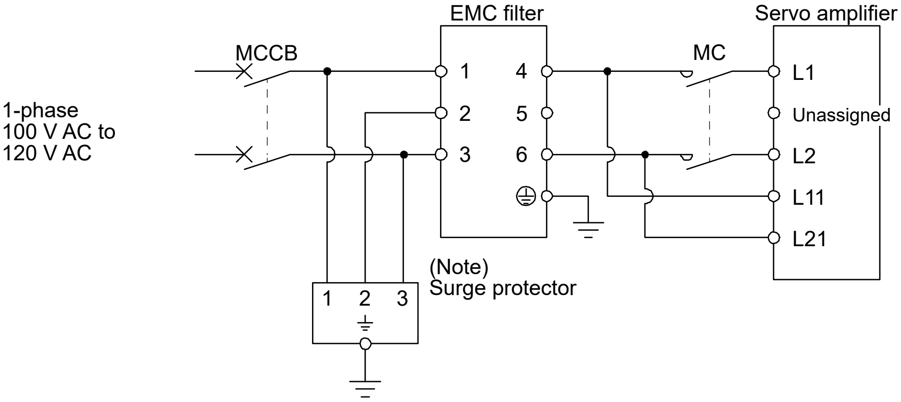
Note. When a surge protector is used.

(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



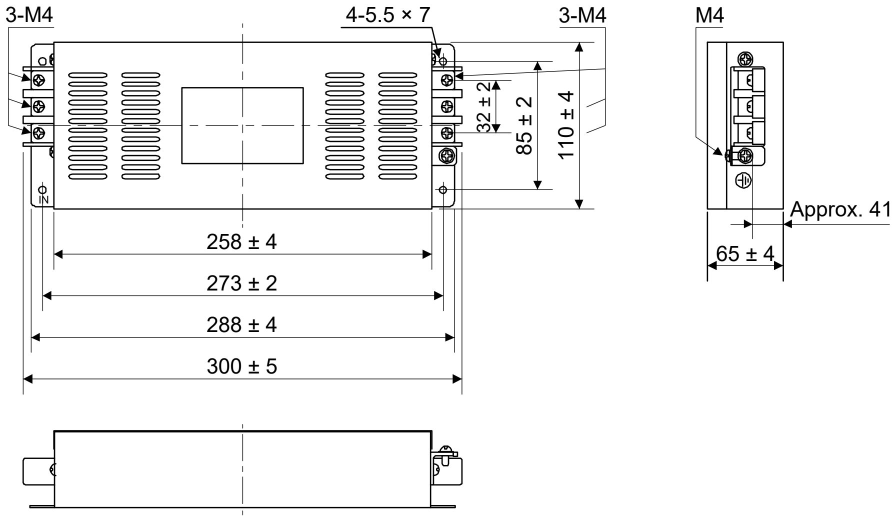
Note. When a surge protector is used.

(3) Dimensions

(a) EMC filter

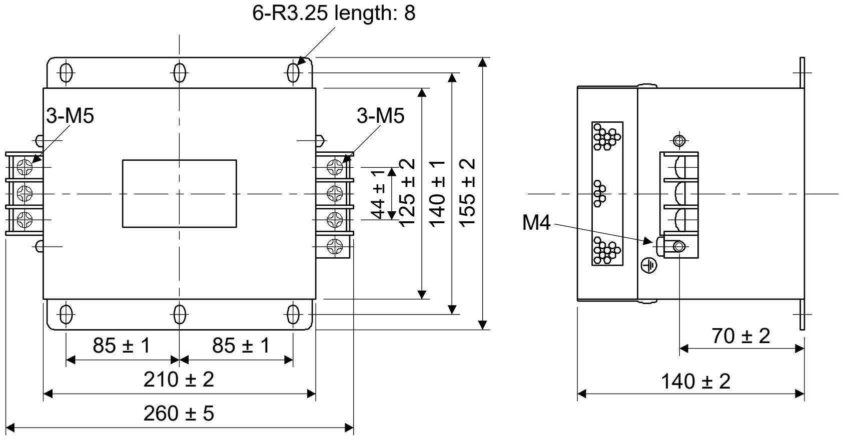
HF3010A-UN

[Unit: mm]



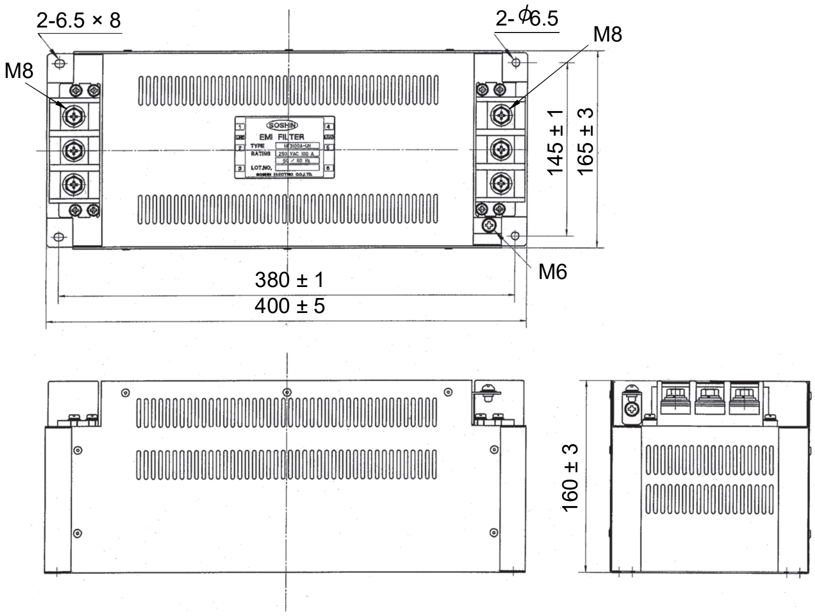
HF3030A-UN/HF-3040A-UN

[Unit: mm]



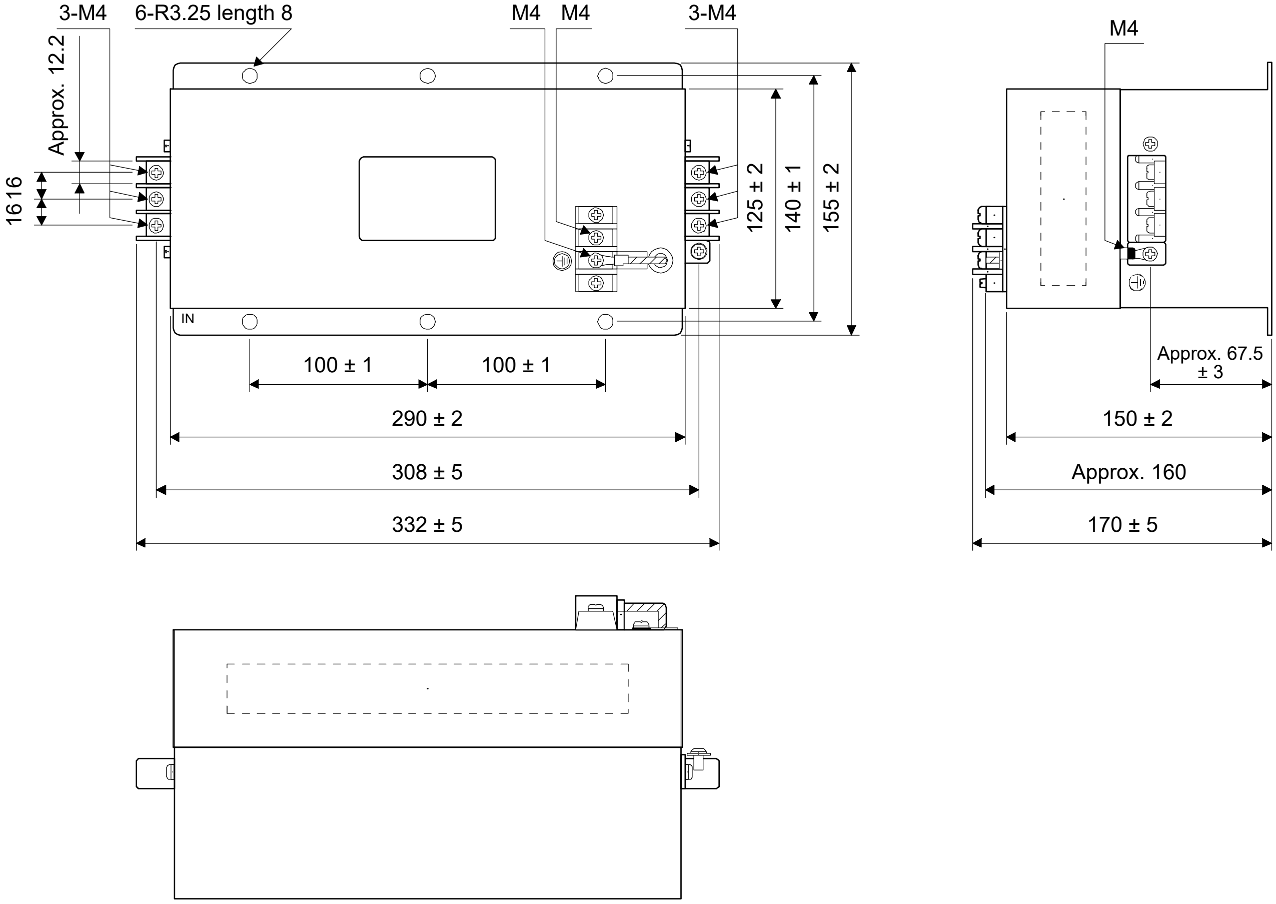
HF3100A-UN

[Unit: mm]



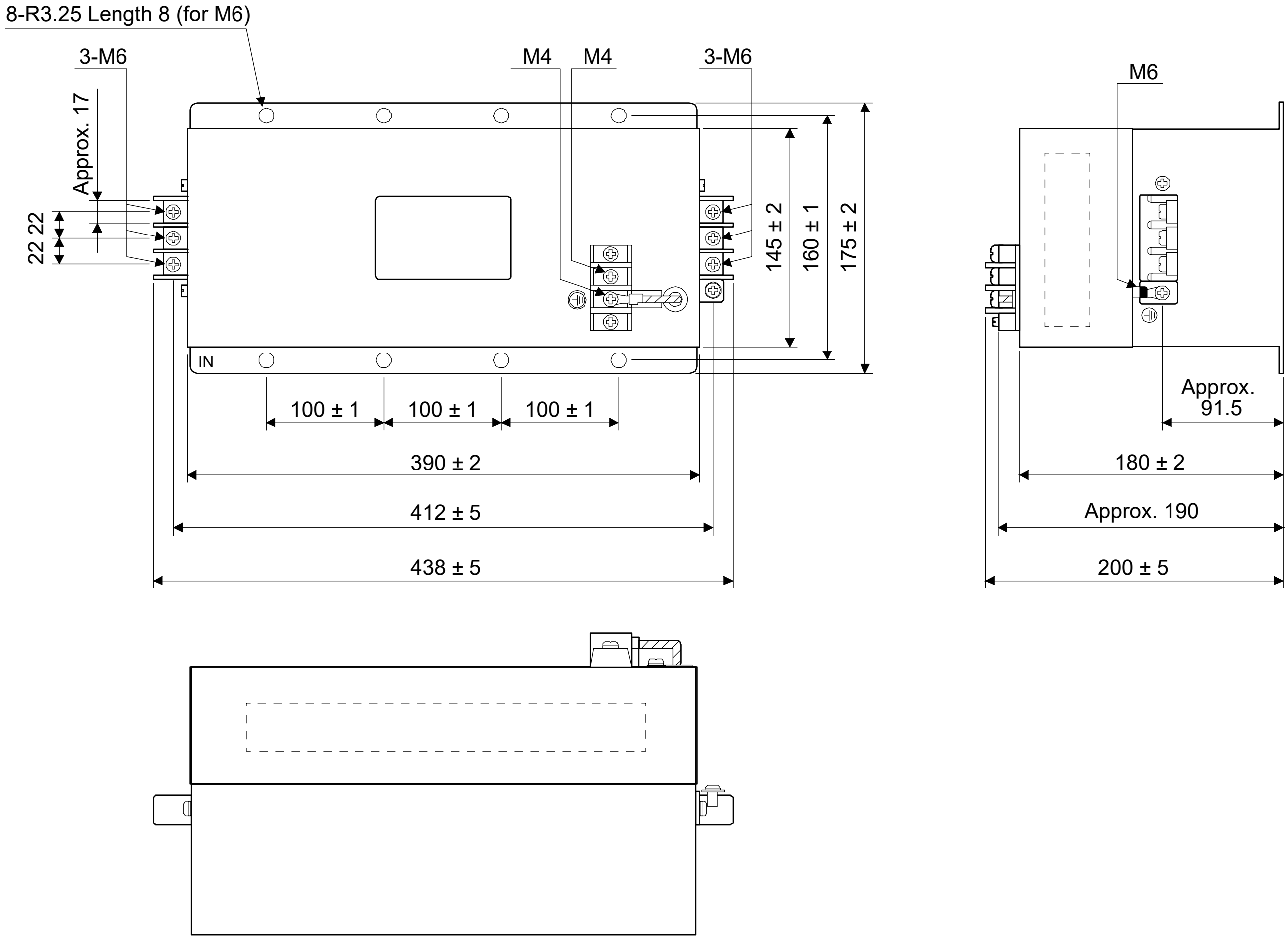
TF3005C-TX/TX3020C-TX/TF3030C-TX

[Unit: mm]



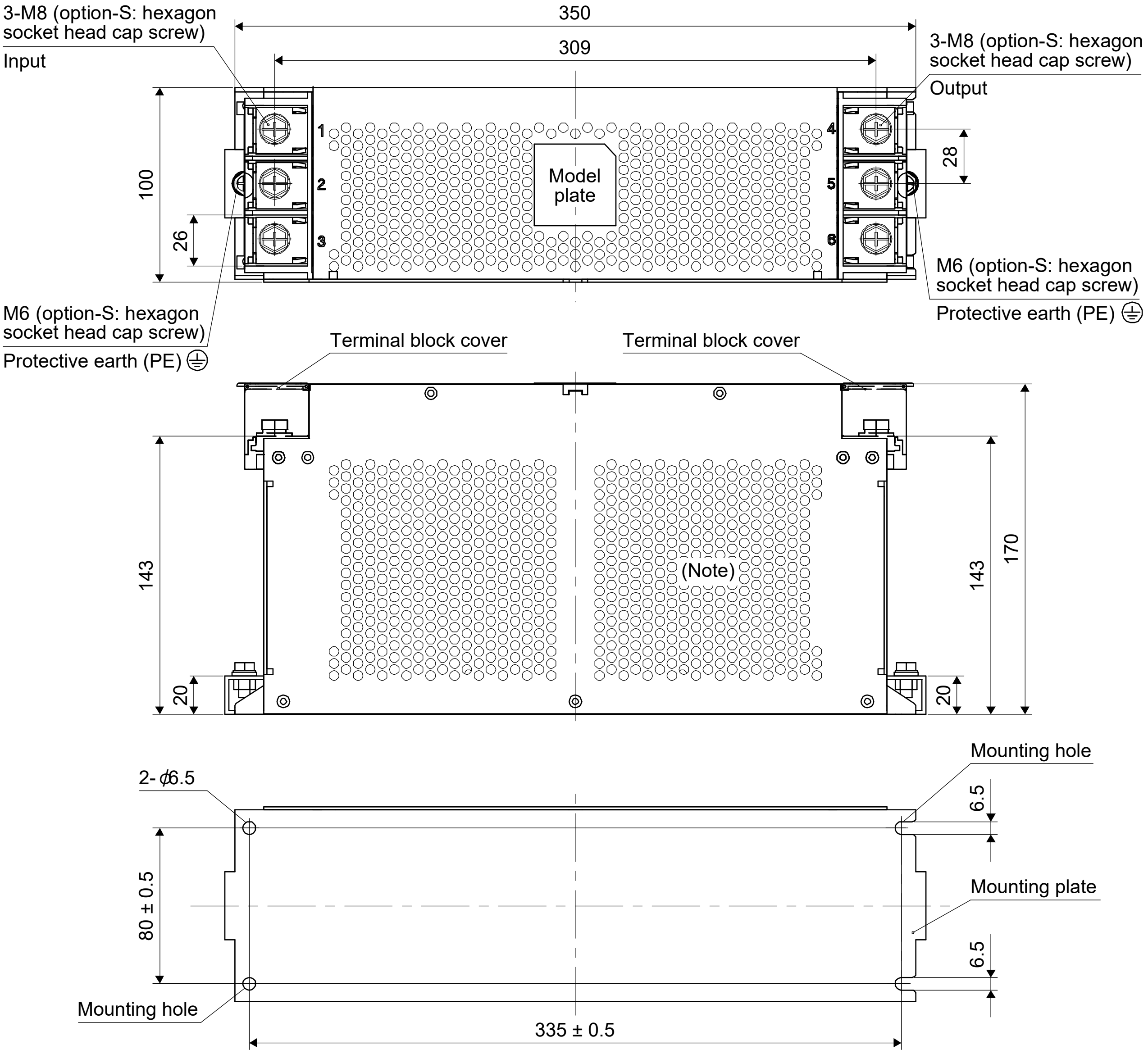
TF3040C-TX/TF3060C-TX

[Unit: mm]



FTB-100-355-L/FTB-80-355-L

[Unit: mm]

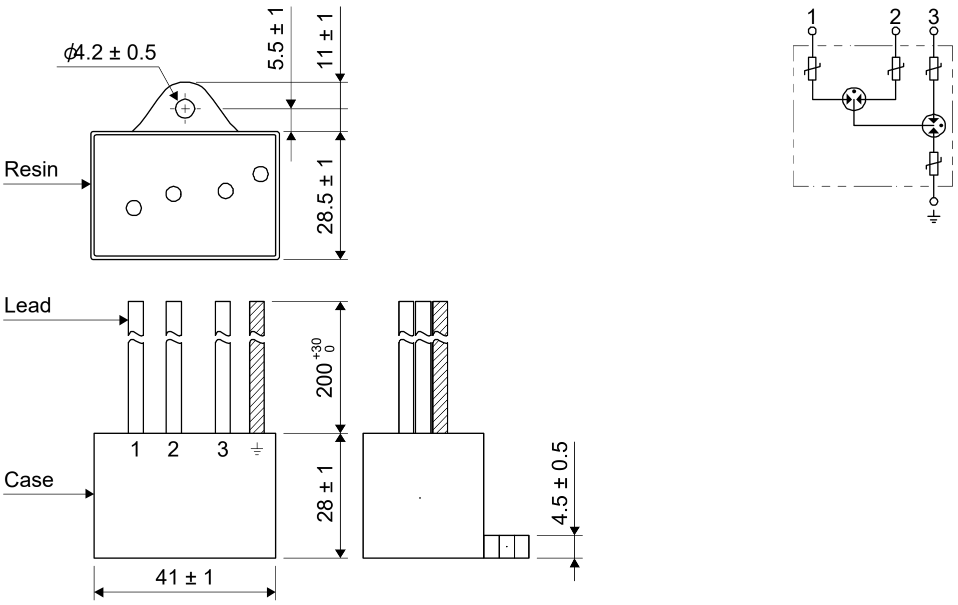


Note. No heat radiation holes on the opposite face.

(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-J4-11KA(-RJ) to MR-J4-22KA(-RJ) and MR-J4-11KA4(-RJ) to MR-J4-22KA4(-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. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]. 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) SON (Servo-on) 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 operates when an alarm or [AL. E6 Servo forced stop warning] occurs, STO (STO1, STO2) is turned off, or the 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.

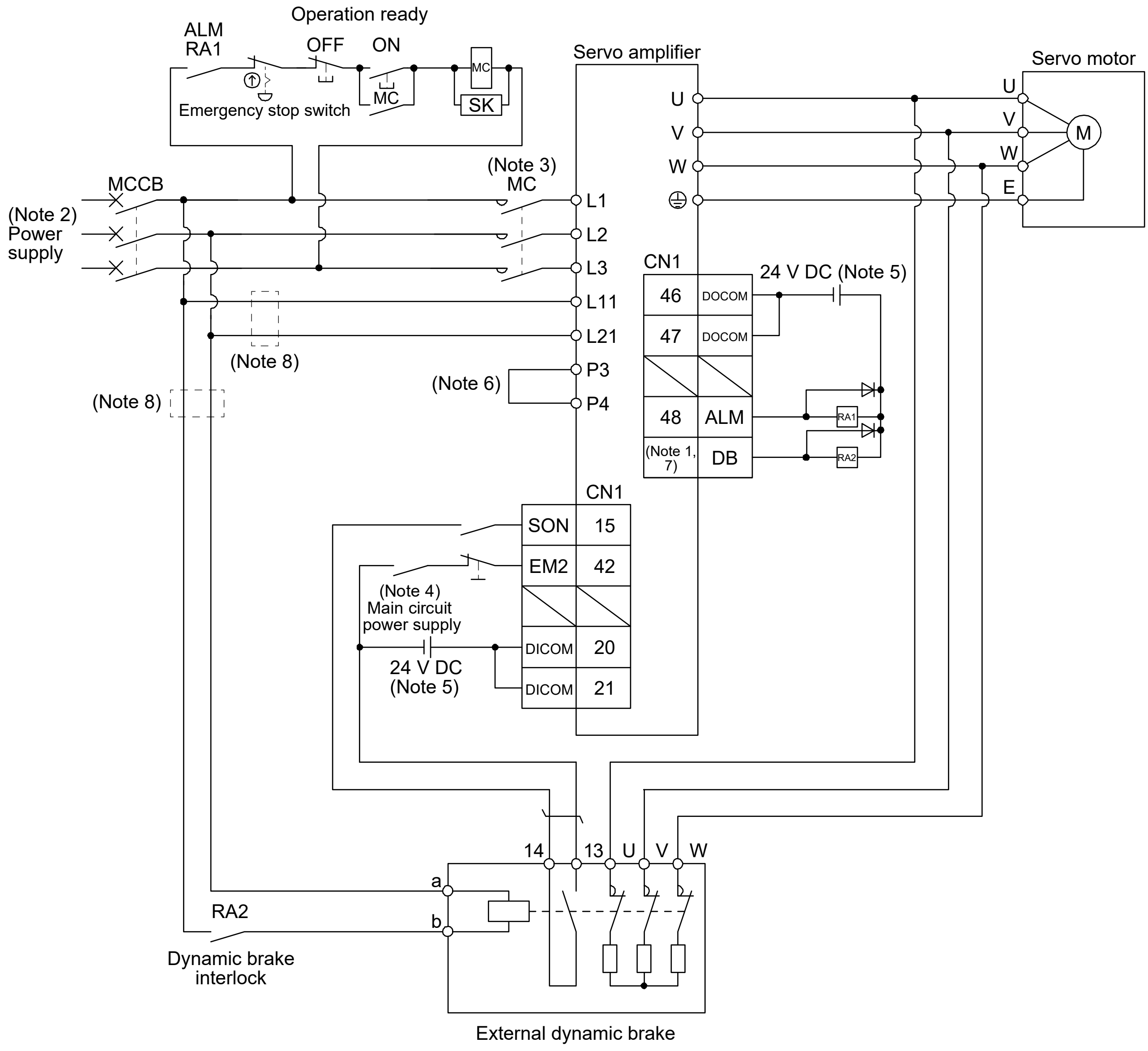
(1) Selection of external dynamic brake

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 CN1-22 to CN1-25, CN1-49, CN1-13, and CN1-14 pins in [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47].

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-J4-11KA(-RJ)	DBU-11K	30 A frame 5 A	240	1	300	1	250
MR-J4-15KA(-RJ)	DBU-15K						
MR-J4-22KA(-RJ)	DBU-22K-R1						
MR-J4-11KA4(-RJ)	DBU-11K-4	30 A frame 5 A	480	1	600	1	600
MR-J4-15KA4(-RJ)	DBU-22K-4						
MR-J4-22KA4(-RJ)							

(2) Connection example

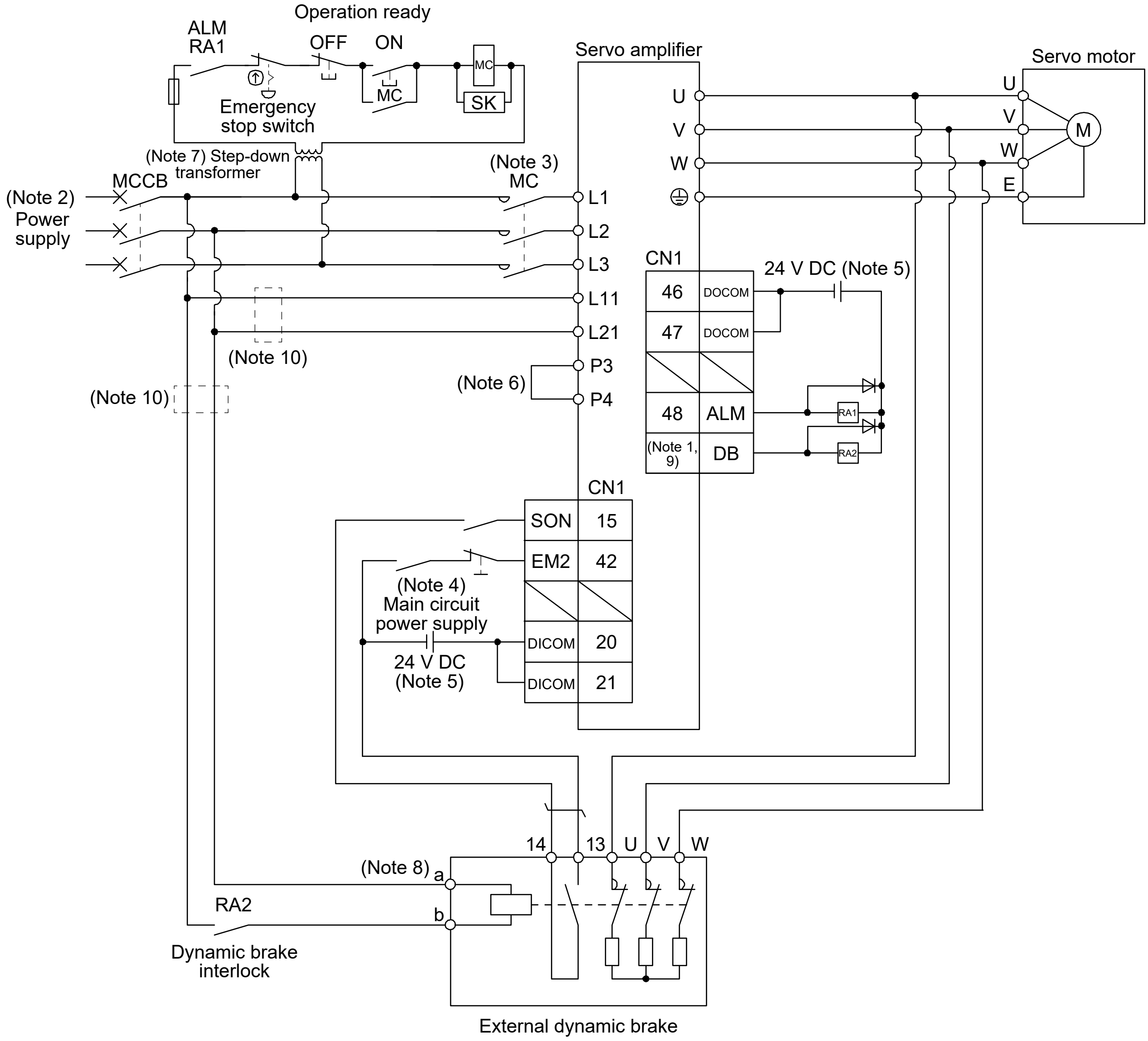
(a) 200 V class



External dynamic brake

Note
1. Assign DB (Dynamic brake interlock) in [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47].
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. Turn off EM2 when the main power circuit power supply is off.
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. 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.
7. The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.
8. 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


Operation ready
ALM
RA1
OFF
ON
MC
MC
SK
Emergency
stop switch
(Note 7) Step-down
transformer
Servo amplifier
Servo motor
U
V
W
U
V
W
E
M
(Note 3)
MC
(Note 2)
Power
supply
MCCB
L1
L2
L3
L11
L21
P3
P4
(Note 10)
(Note 10)
(Note 6)
CN1
46
DOCOM
47
DOCOM
48
ALM
(Note 1, 9)
DB
24 V DC (Note 5)
RA1
RA2
CN1
SON
15
EM2
42
(Note 4)
Main circuit
power supply
DICOM
20
DICOM
21
24 V DC
(Note 5)
14
13
U
V
W
(Note 8)
a
b
RA2
Dynamic brake
interlock
External dynamic brake

Note
1. Assign DB (Dynamic brake interlock) in [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47].
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. Turn off EM2 when the main power circuit power supply is off.
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. 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.
7. Stepdown transformer is required when the coil voltage of the magnetic contactor is 200 V class.
8. 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

9. The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]. Failure to do so will cause the servo amplifier to become servo-off when an instantaneous power failure occurs.
10. 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.)

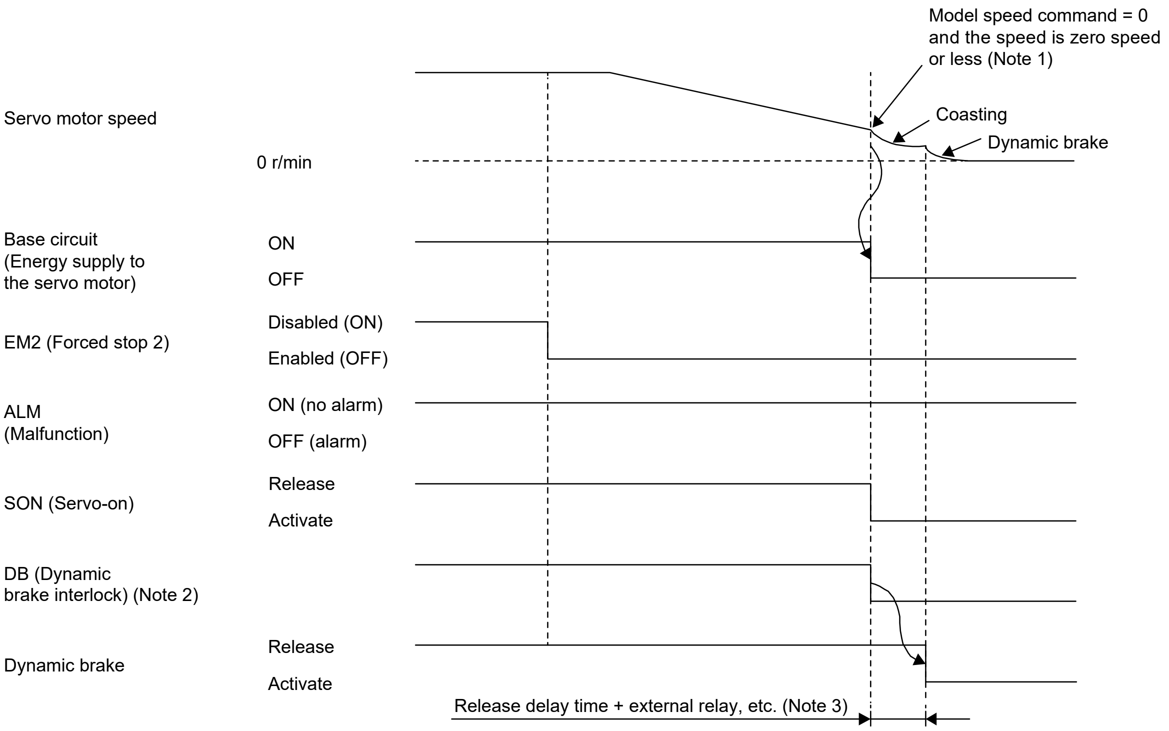
(3) Timing chart

(a) When using the forced stop deceleration function

1) EM2 (Forced stop 2) off

POINT

- Keep SON (Servo-on) on while EM2 (Forced stop 2) is off. When SON (Servo-on) is turned off before EM2 (Forced stop 2), the forced stop deceleration function will not be executed.



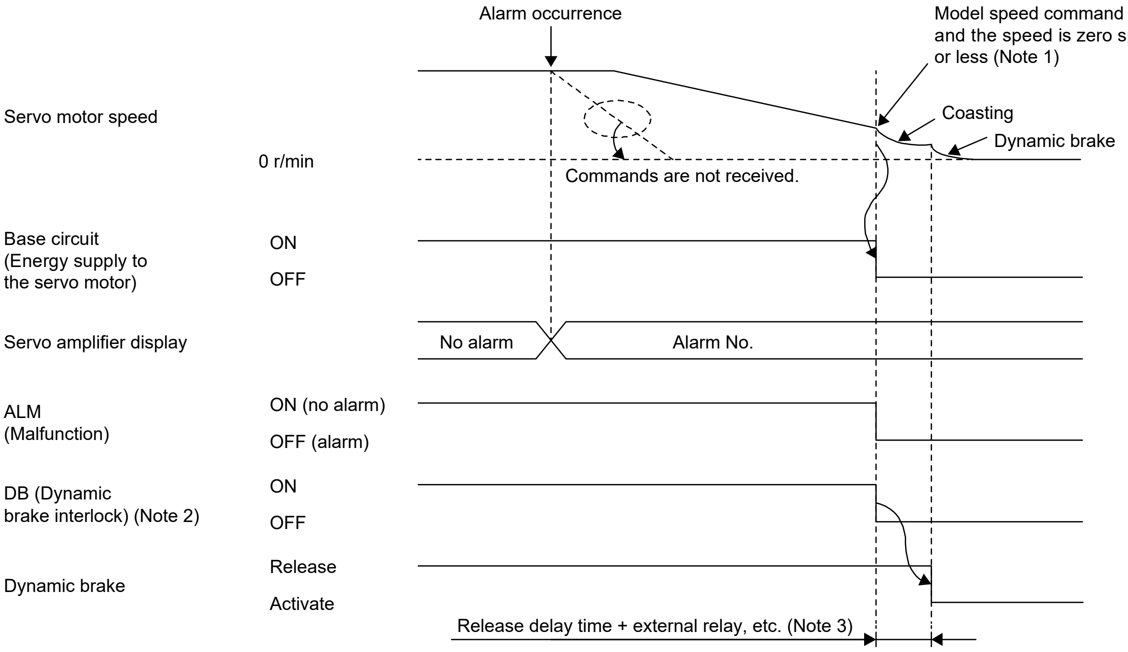
Note 1. The model speed command is a speed command generated in the servo amplifier for forced stop deceleration of the servo motor.

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.

2) Alarm occurrence

a) When the forced stop deceleration function is enabled

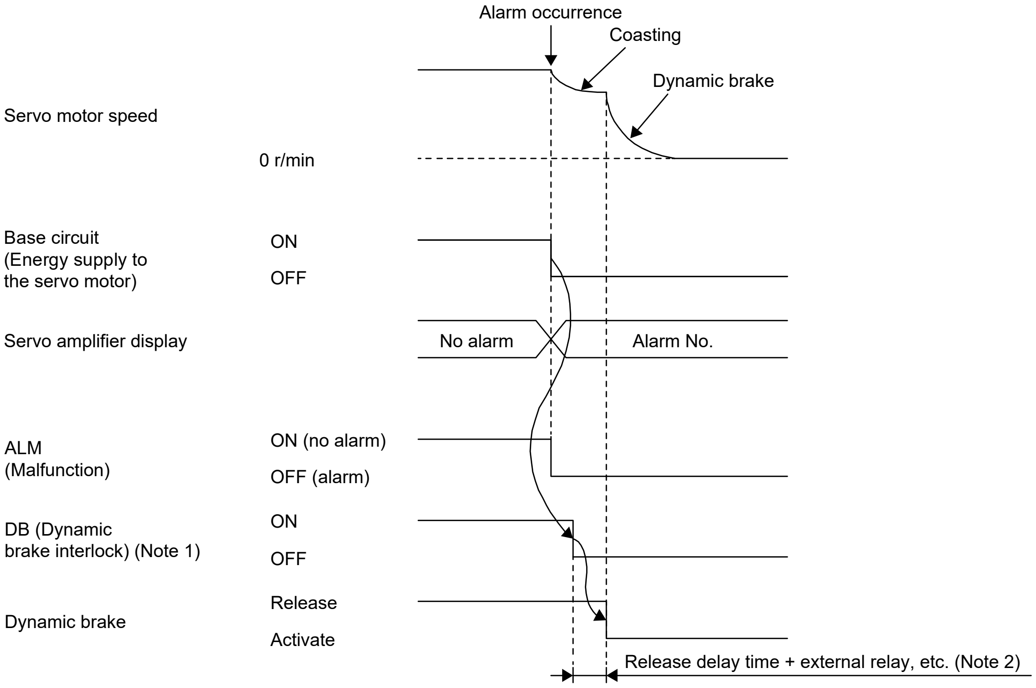


Note 1. The model speed command is a speed command generated in the servo amplifier for forced stop deceleration of the servo motor.

2. ON: Dynamic brake is not activated
OFF: Dynamic brake is activated

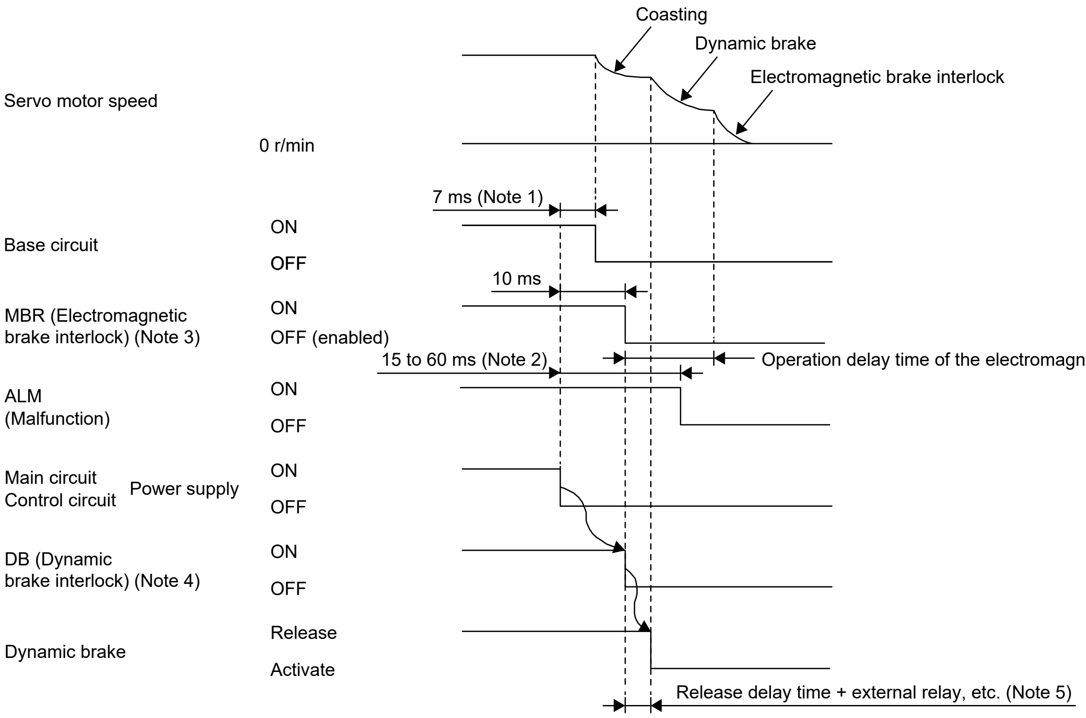
3. There is delay caused by the magnetic contactor built into the external dynamic brake (about 50 ms) and delay caused by the external relay.

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.

3) 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 more faster than normal cases. (Only when DB is assigned as an output signal)

2. The length of time varies depending on the operation status.

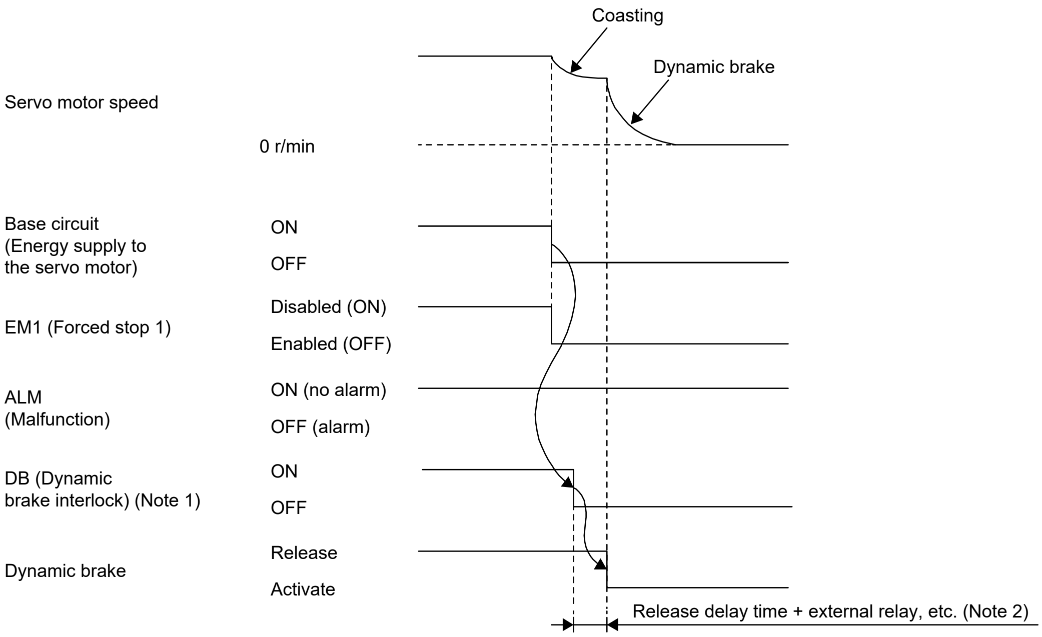
3. ON: Electromagnetic brake is not activated
OFF: Electromagnetic brake is activated

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) 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) 2) b).

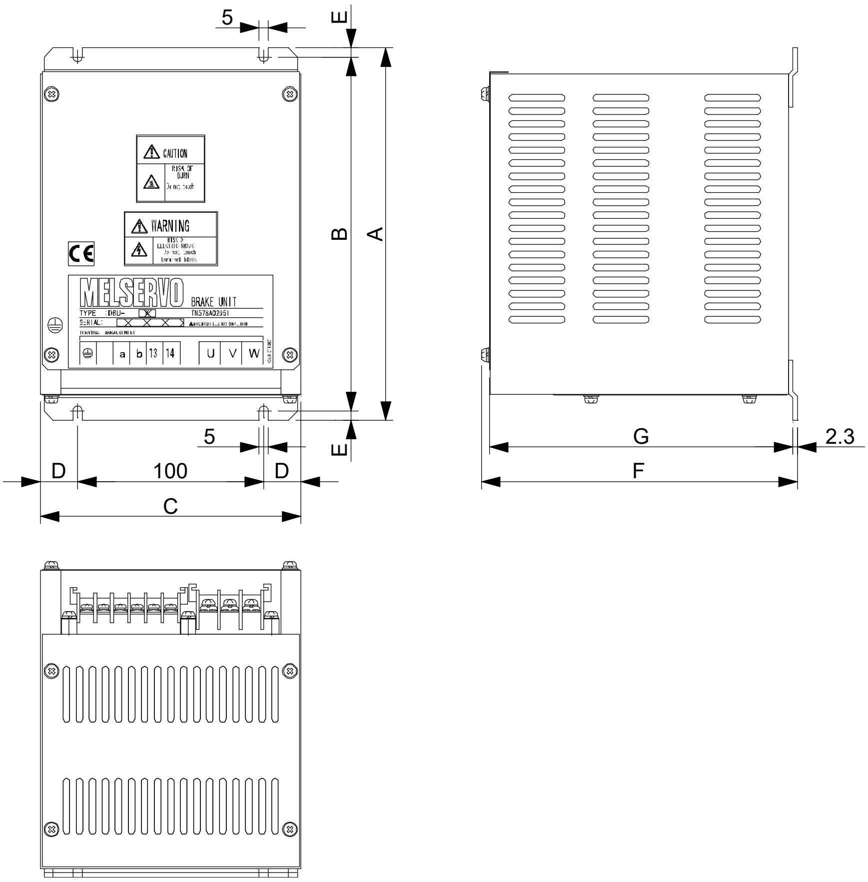
4) When both the main circuit power supply and the control circuit power supply are turned off

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) 3).

(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)

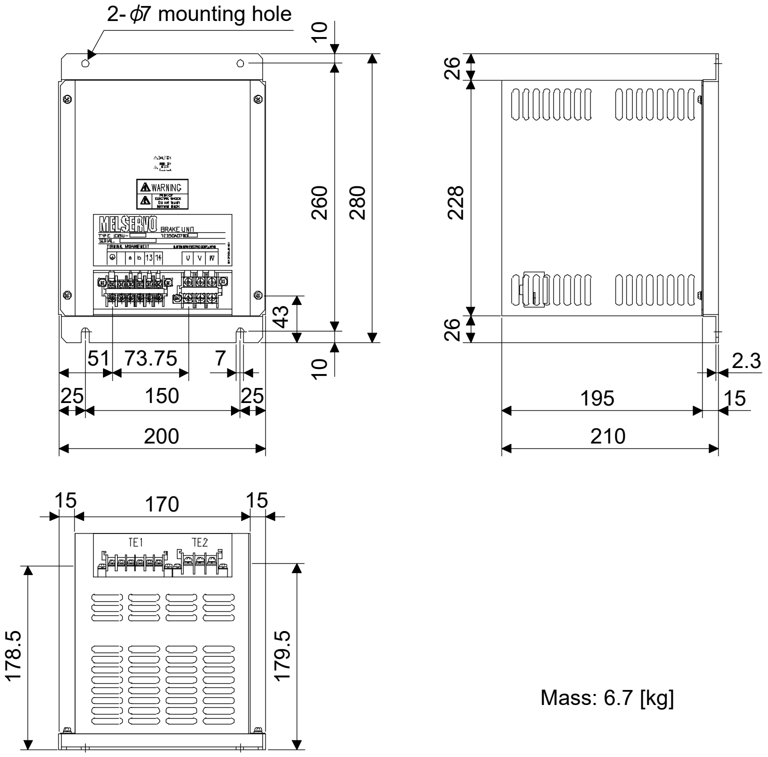
Note. Selection conditions of wire size are as follows.

Wire type: 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

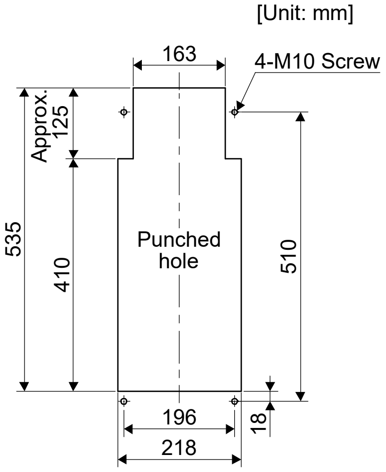
11.18 Panel through attachment (MR-J4ACN15K/MR-J3ACN)

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-J4-11KA(-RJ) to MR-J4-22KA(-RJ) and MR-J4-11KA4(-RJ) to MR-J4-22KA4(-RJ).
The following shows the combinations.

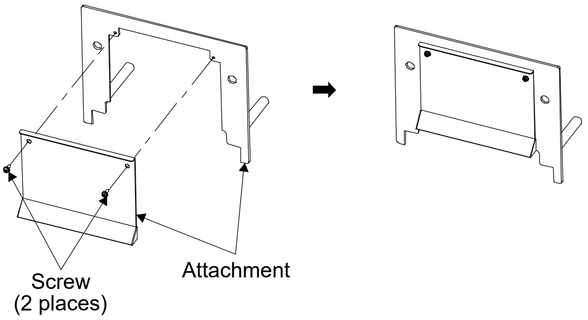
Servo amplifier	Panel through attachment
MR-J4-11KA(-RJ) MR-J4-15KA(-RJ)	MR-J4ACN15K
MR-J4-22KA(-RJ)	MR-J3ACN
MR-J4-11KA4(-RJ) MR-J4-15KA4(-RJ)	MR-J4ACN15K
MR-J4-22KA4(-RJ)	MR-J3ACN

(1) MR-J4ACN15K

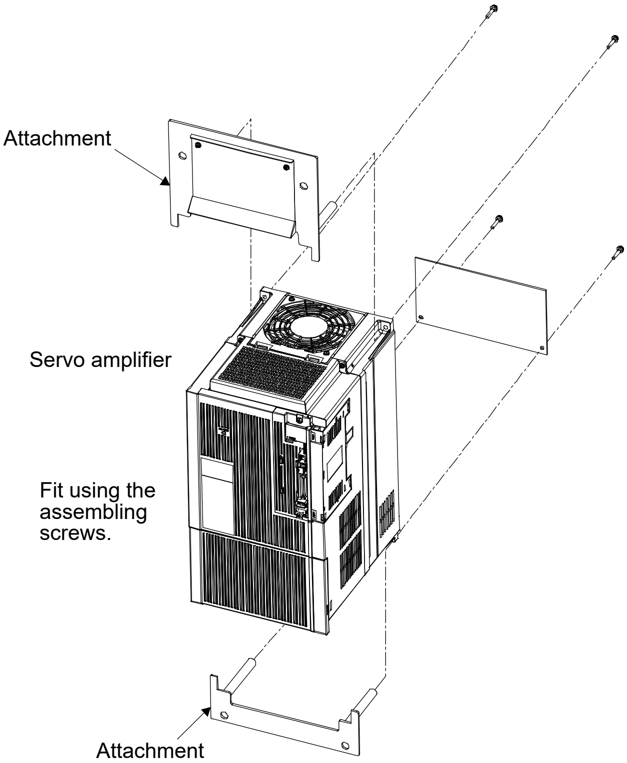
(a) Panel cut dimensions



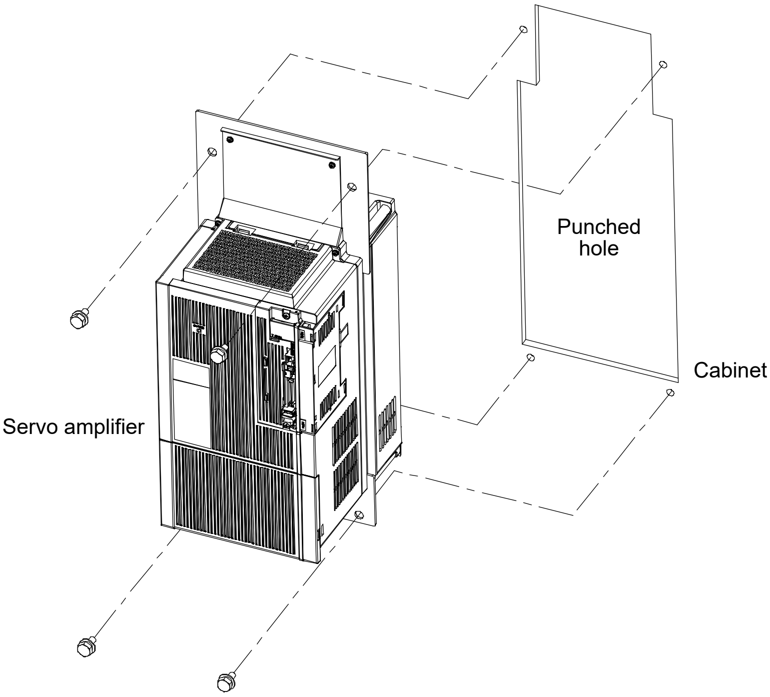
(b) How to assemble the attachment for panel through attachments



(c) Mounting method



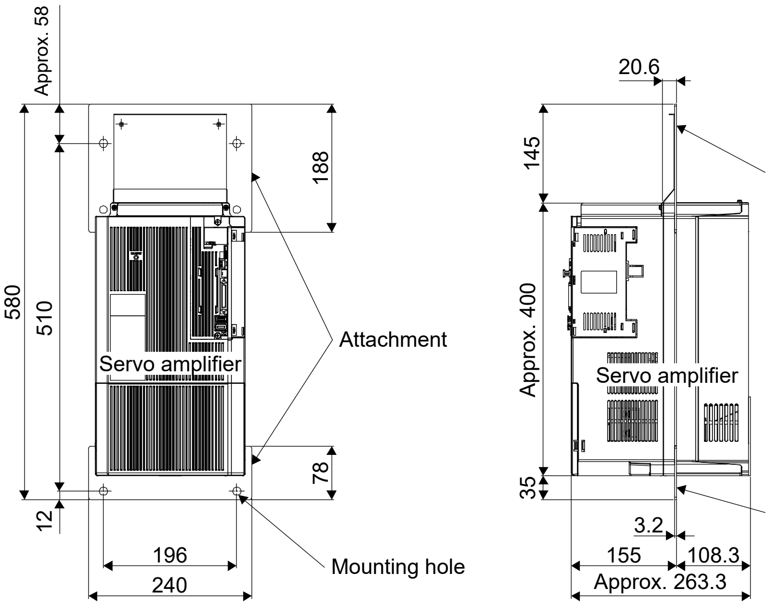
a. Assembling the panel through attachment



b. Mounting it to inside cabinet

(d) Mounting dimensional diagram

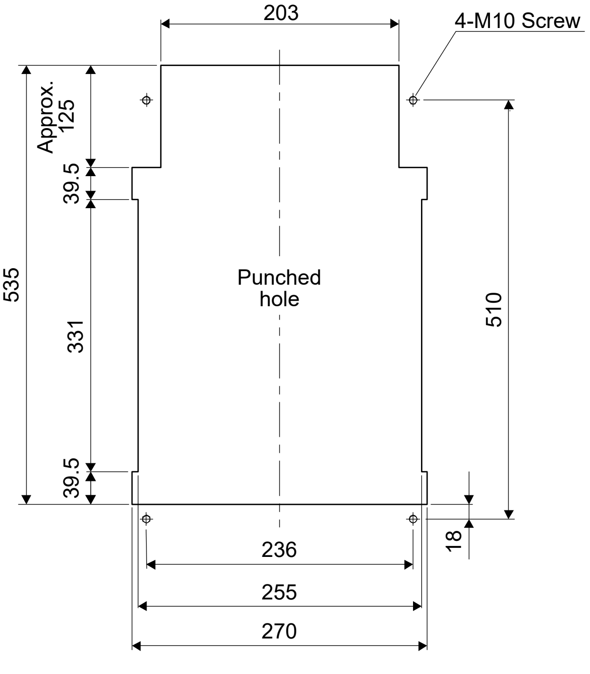
[Unit: mm]



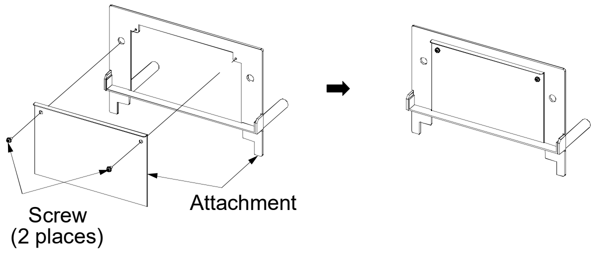
(2) MR-J3ACN

(a) Panel cut dimensions

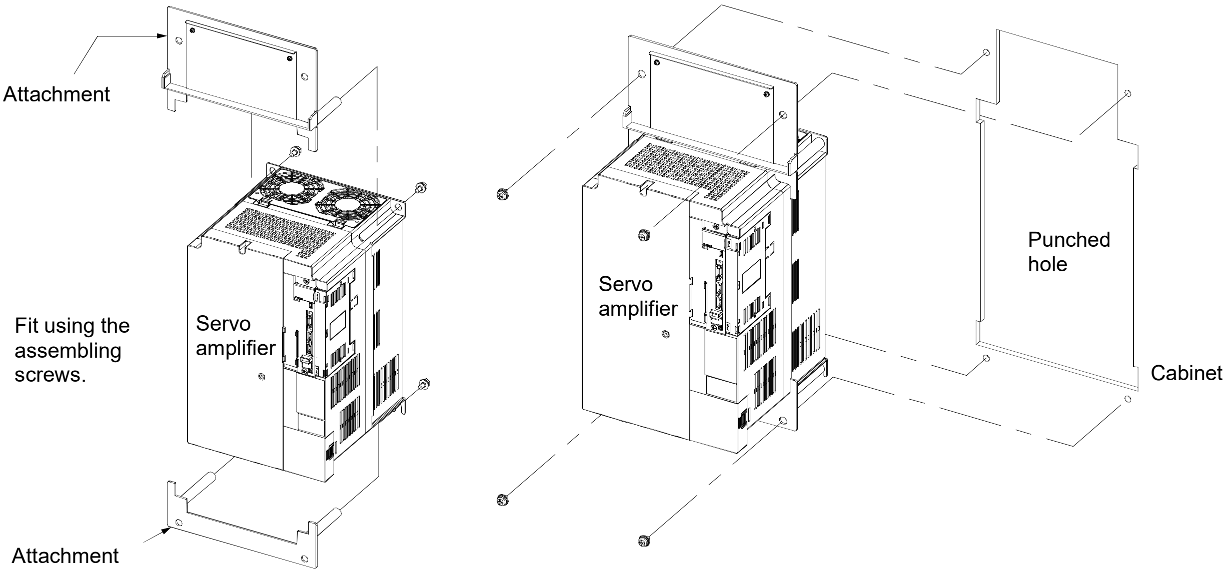
[Unit: mm]



(b) How to assemble the attachment for panel through attachment



(c) Mounting method

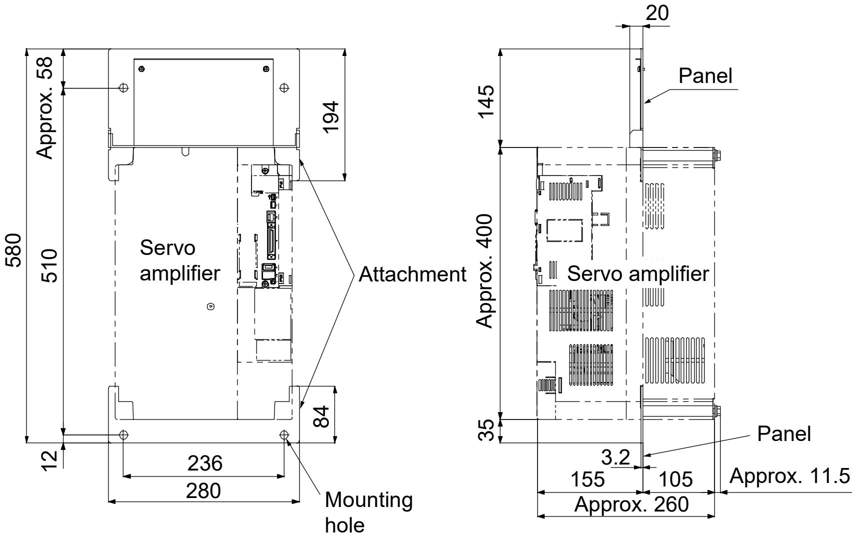


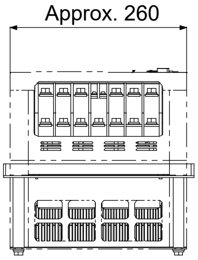
a. Assembling the panel through attachment

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 _ _ _"
- [Pr. PC27]: "_ _ _ 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-J4-500A	HG-SR502
MR-J4-500A	HG-SR502
MR-J4-11KA	HG-JR11K1M
MR-J4-22KA	HG-JR22K1M

(a) Calculate the running power and regenerative power from the servo motor speed and torque with the following formulas.

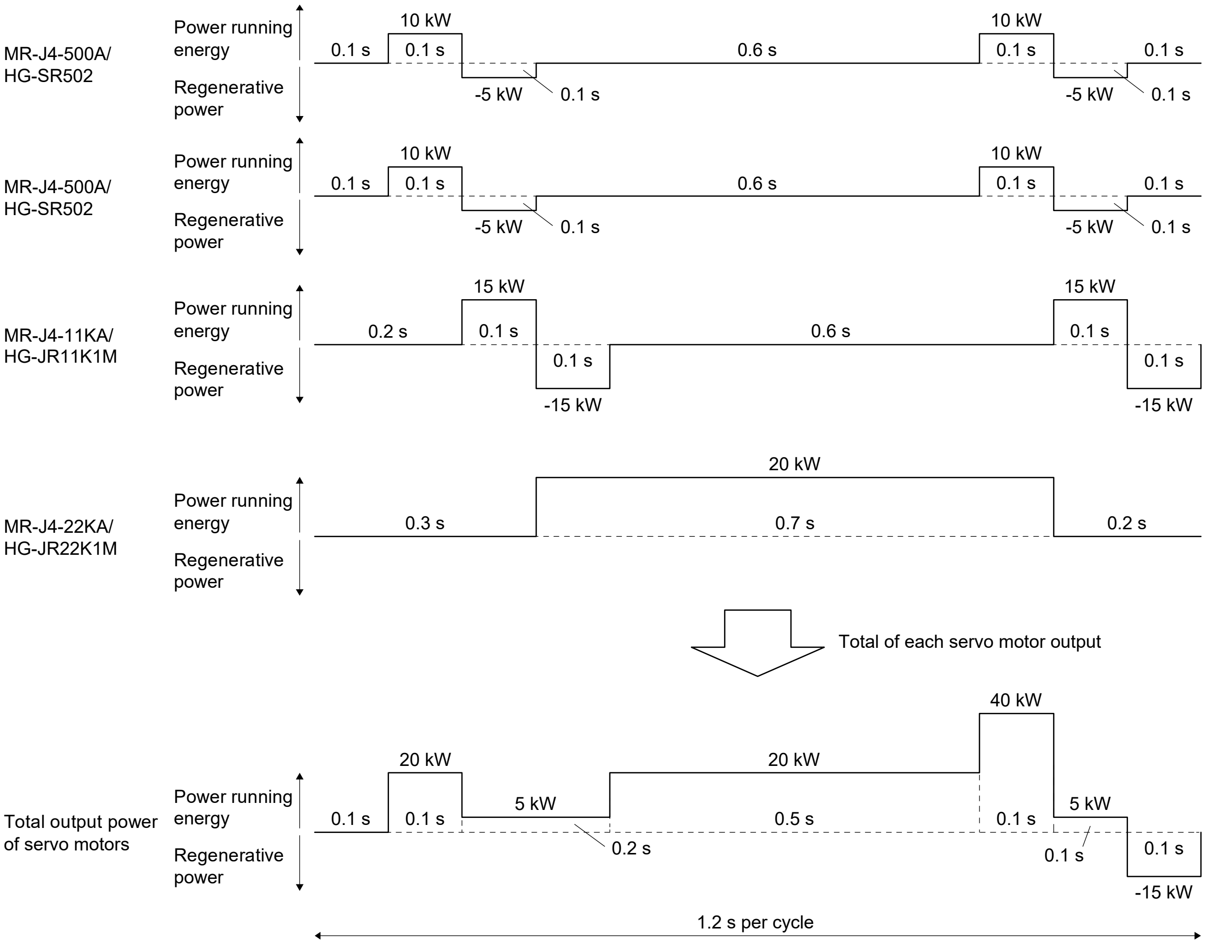
- For rotary servo motors

  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]

$$= \sqrt{(20^2 \times 0.1 + 5^2 \times 0.2 + 20^2 \times 0.5 + 40^2 \times 0.1 + 5^2 \times 0.1 + (-15)^2 \times 0.1)/1.2} = 18.93 \text{ kW}$$

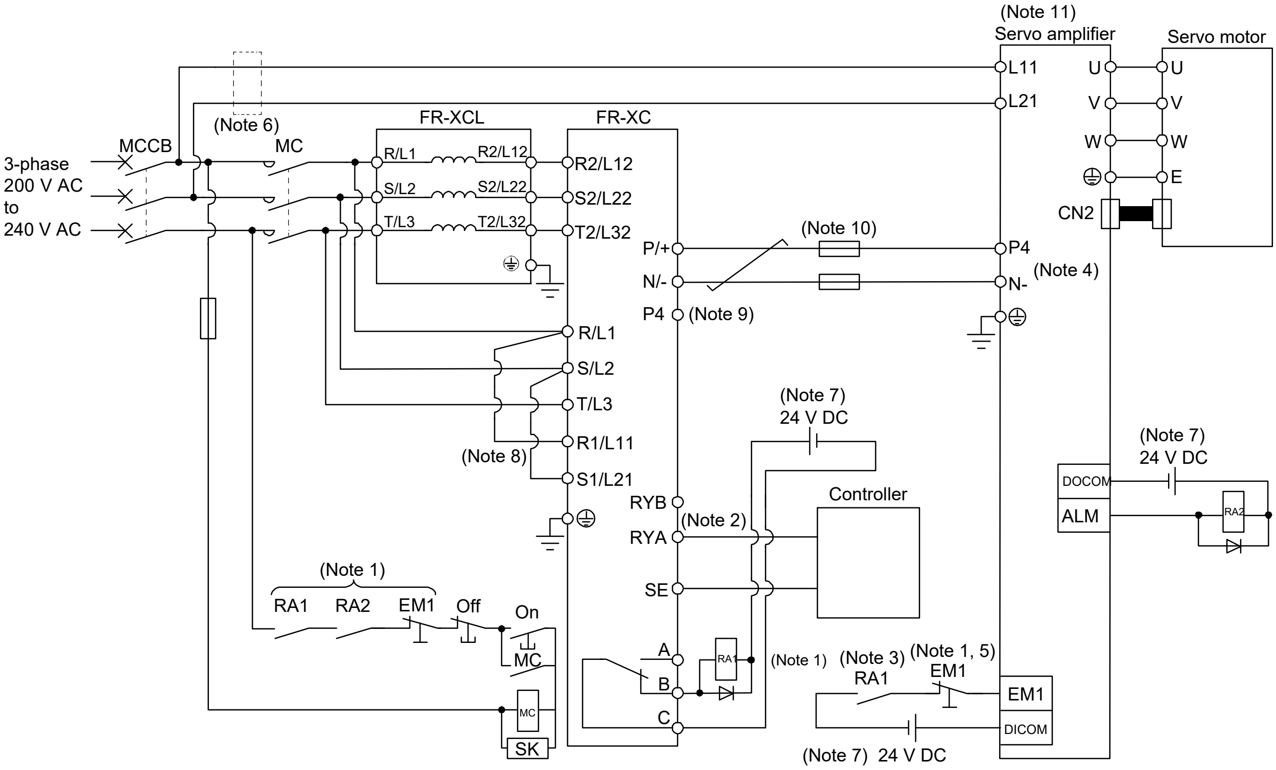
⇒FR-XC-30K or more

- 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

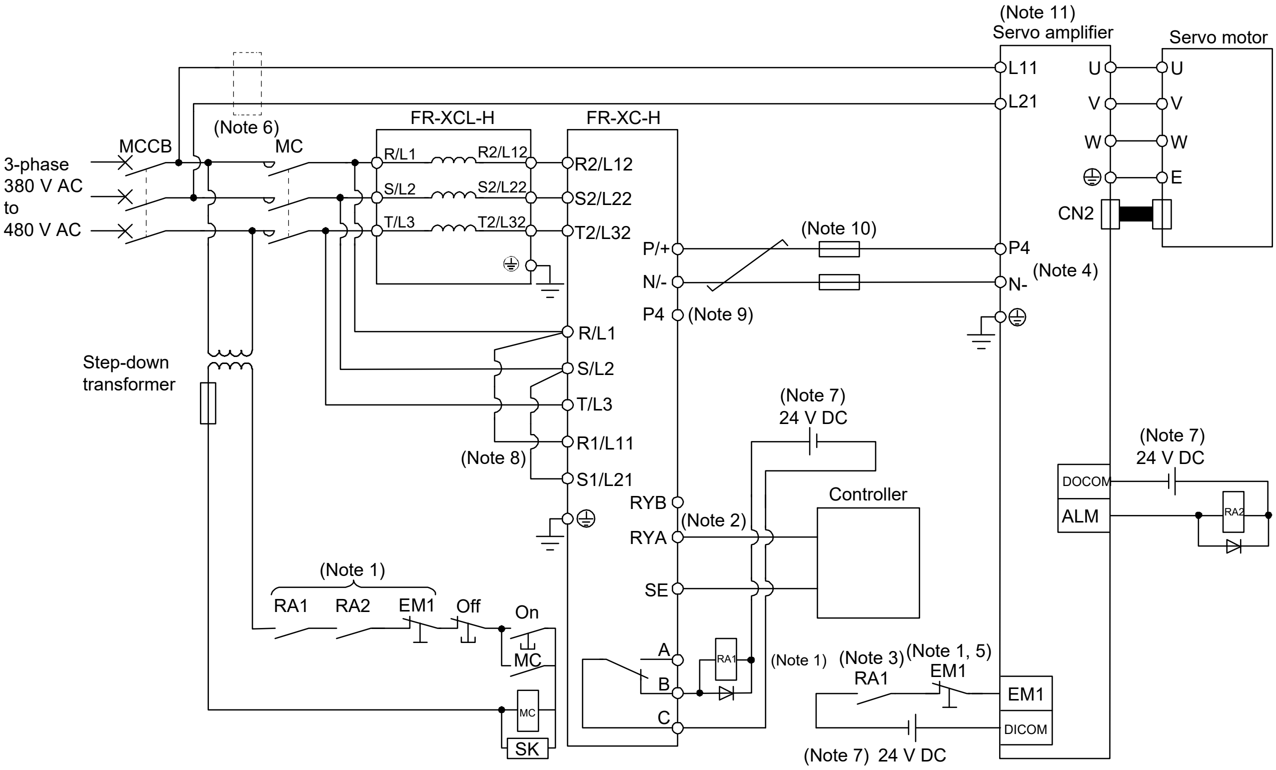
(1) 200 V class



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 _ _ _".
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 _ _ _".
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.

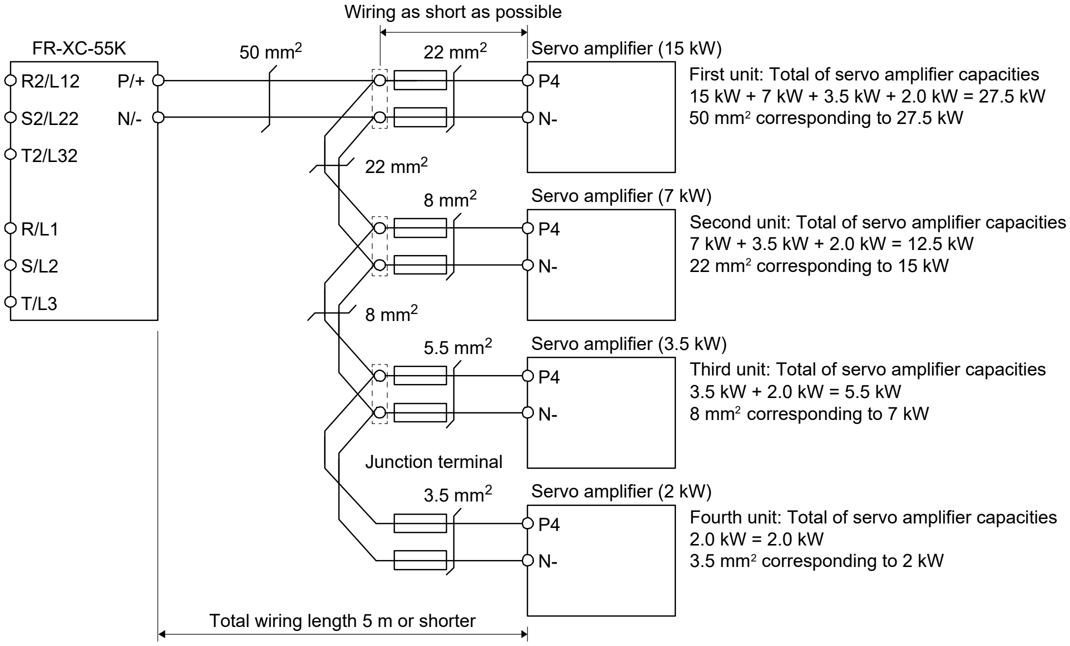
Total capacity of servo amplifiers [kW]	Wire size [mm^2]	
	200 V class	400 V class
1 or less	2 (AWG 14)	2 (AWG 14)
2	3.5 (AWG 12)	2 (AWG 14)
3.5	5.5 (AWG 10)	3.5 (AWG 12)
5	5.5 (AWG 10)	5.5 (AWG 10)
7	8 (AWG 8)	5.5 (AWG 10)
11	14 (AWG 6)	8 (AWG 8)
15	22 (AWG 4)	8 (AWG 8)
18.5	38 (AWG 2)	8 (AWG 8)
22	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.

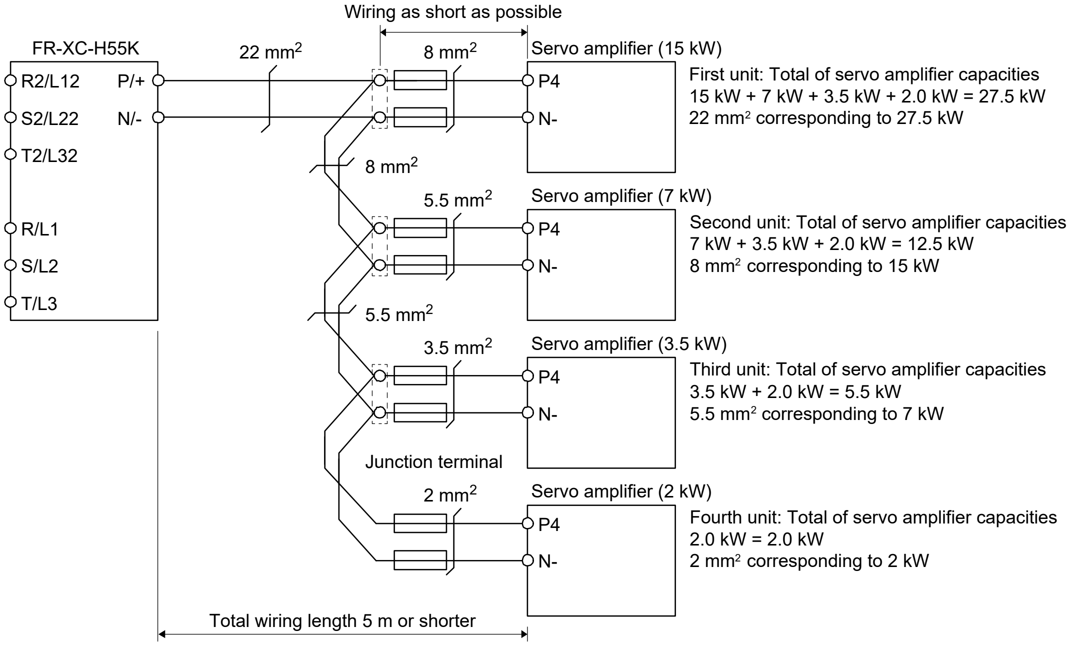
Multifunction regeneration converter	Wire size [mm^2]	
	Rated capacity of multifunction regeneration converter ≥ Total capacity of connected servo amplifiers × 2	Rated capacity of multifunction regeneration converter < Total capacity of connected servo amplifiers × 2
FR-XC-7.5K	8 (AWG 8)	8 (AWG 8)
FR-XC-11K	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



(b) 400 V class



(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 four types of batteries, MR-BAT6V1SET, MR-BAT6V1BJ, MR-BAT6V1SET-A 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 , MR-BAT6V1SET-A 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.
- ●If the following parameters are changed, the home position will be erased at the next power-on. Execute the home position return again after power-on.
  - ･[Pr. PA06 Electronic gear numerator (command pulse multiplication numerator)]
  - ･[Pr. PA07 Electronic gear denominator (command pulse multiplication denominator)]
  - ･[Pr. PA14 Rotation direction selection/travel direction selection]
  - ･[Pr. PT08 Home position return position data]
  - ･[Pr. PT28 Number of stations per rotation]

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 programmable 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 Restrictions

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

(1) Speed control mode and torque control mode

(2) Control switch-over mode (position/speed, speed/torque, and torque/position)

(3) Stroke-less coordinate system, e.g. rotary shaft, infinitely long positioning

(4) Changing electronic gear after home position setting.

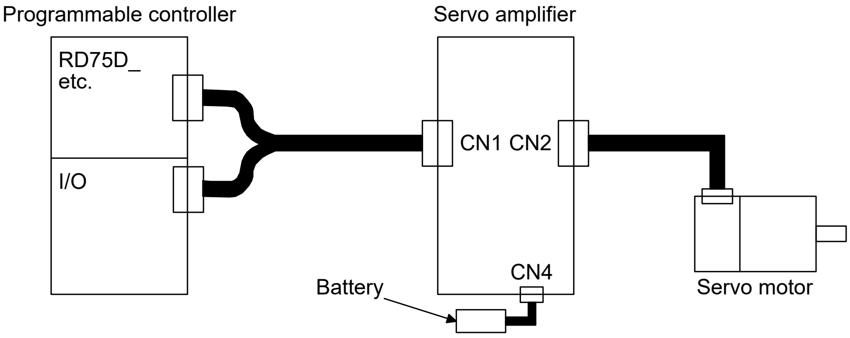
(5) Using alarm code output.

(6) Using incremental value command method ([Pr. PT01] = "_ _ _ 1").
To configure absolute position detection system in incremental value command method, specify the incremental value command with the sub function of the point table or the command in the program. For details, refer to 4.2.2 and 5.2.2 of "MR-J4-_A_(-RJ) Servo Amplifier Instruction Manual (Positioning Mode)".

12.1.3 Structure

The following shows a configuration of the absolute position detection system. Refer to section 11.8 for each battery connection.

Positioning module	I/O module
RD75P4, RD75D4	RX40C7, RX41C4, RX42C4 RY40NT5P, RY41NT2P, RY42NT2P RY40PT5P, RY41PT1P, RY42PT1P
QD75P_N, QD75D_N	QX40, QX41, QX42 QY40, QY41P, QY42P, QY50
LD75P4, LD75D4	LX40C6, LX41C4, LX42C4 LY40NT5P, LY41NT1P, LY42NT1P LY40PT5P, LY41PT1P, LY42PT1P
FX_{2N}-_GM, FX_{2N}-_PG	FX_{2N} series, FX_{0N} series



12.1.4 Parameter setting

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

Set "_ _ _ 1" in [Pr. PA03] to enable the absolute position detection system. Set "_ _ _ 2" when using the ABS transfer system by communication. Refer to section 12.8 for the ABS transfer system by communication.

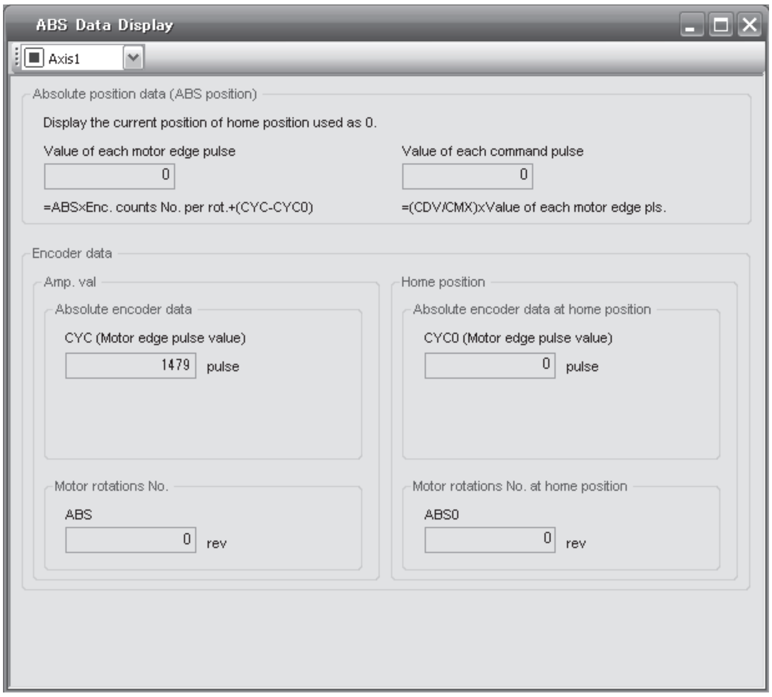
[Pr. PA03]

			1

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

12.1.5 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.



ABS Data Display

Axis1

Absolute position data (ABS position)

Display the current position of home position used as 0.

Value of each motor edge pulse: 0
=ABS×Enc. counts No. per rot.+(CYC-CYC0)

Value of each command pulse: 0
=(CDV/CMX)xValue of each motor edge pls.

Encoder data

Amp. val

Absolute encoder data
CYC (Motor edge pulse value): 1479 pulse

Motor rotations No.
ABS: 0 rev

Home position

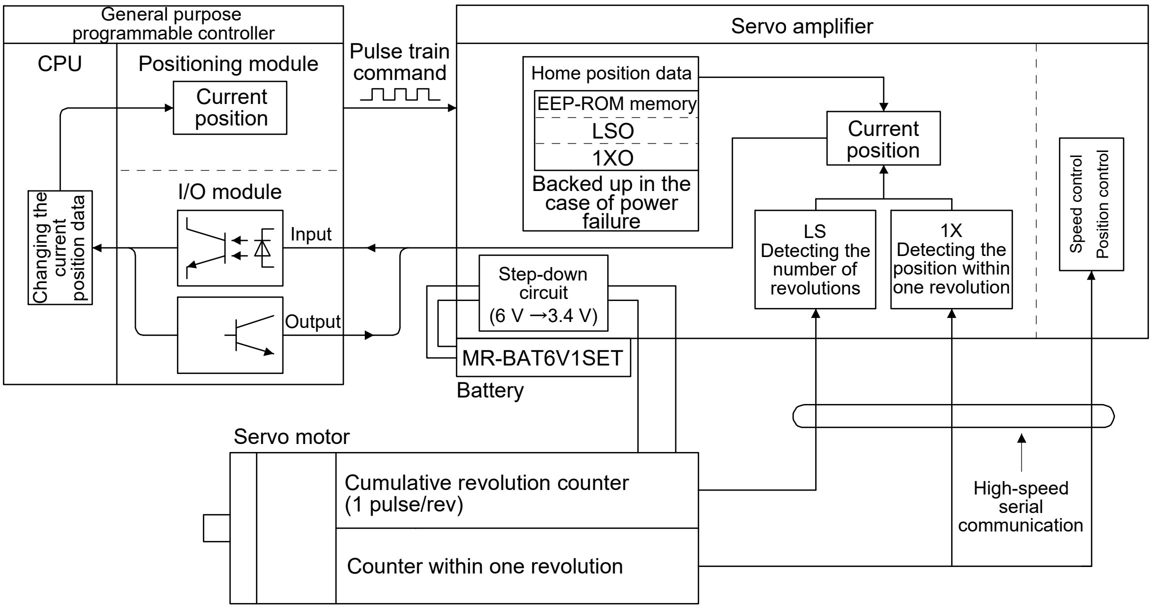
Absolute encoder data at home position
CYC0 (Motor edge pulse value): 0 pulse

Motor rotations No. at home position
ABS0: 0 rev

12.2 Battery

12.2.1 Using MR-BAT6V1SET battery or MR-BAT6V1SET-A 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 or MR-BAT6V1SET-A. 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.

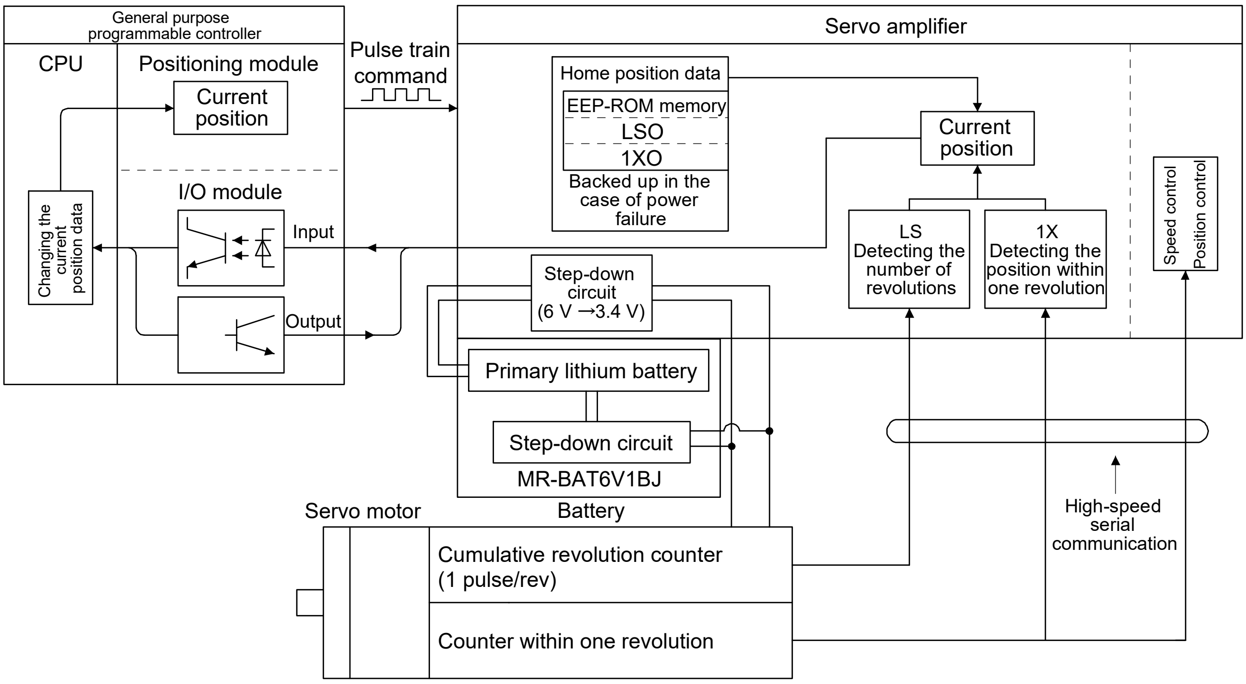
3. The power-on time ratio 25% is equivalent to 8 hours power on for a weekday and off for a weekend.

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.

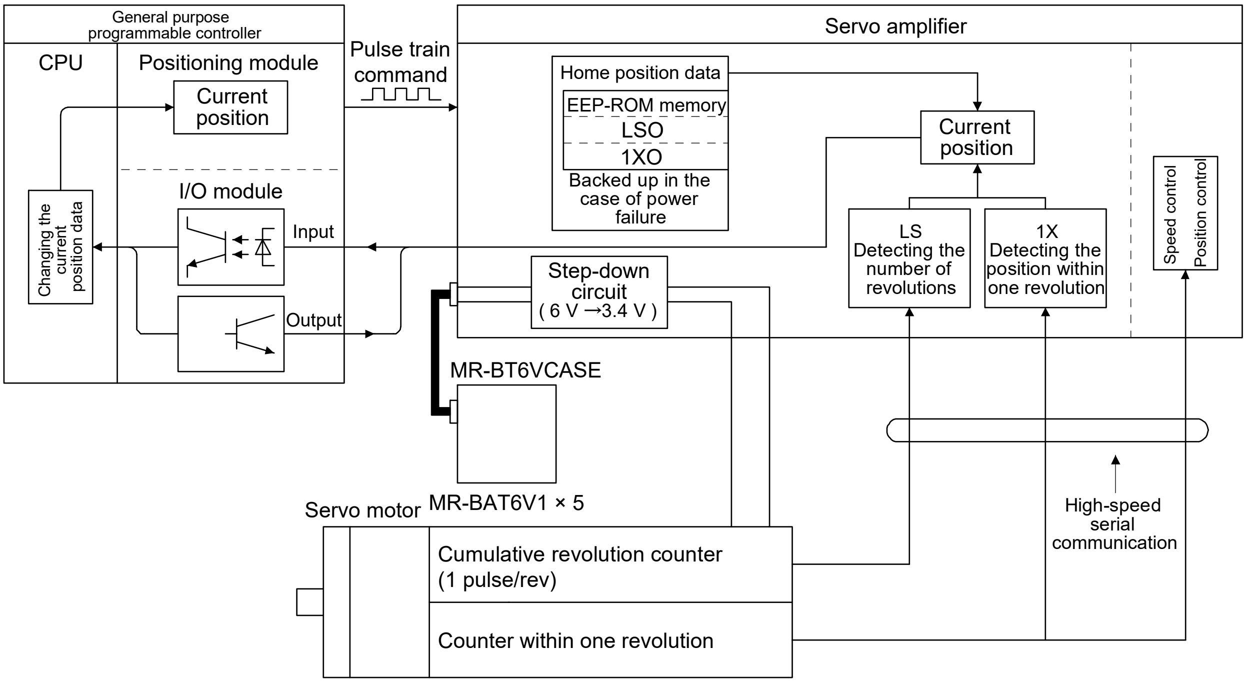
2. The data-holding time by the battery using MR-BAT6V1BJ. Replace the batteries within three years since the operation start regardless of the power supply of the servo amplifier on/off. If the battery is used out of specification, [AL. 25 Absolute position erased] may occur.

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

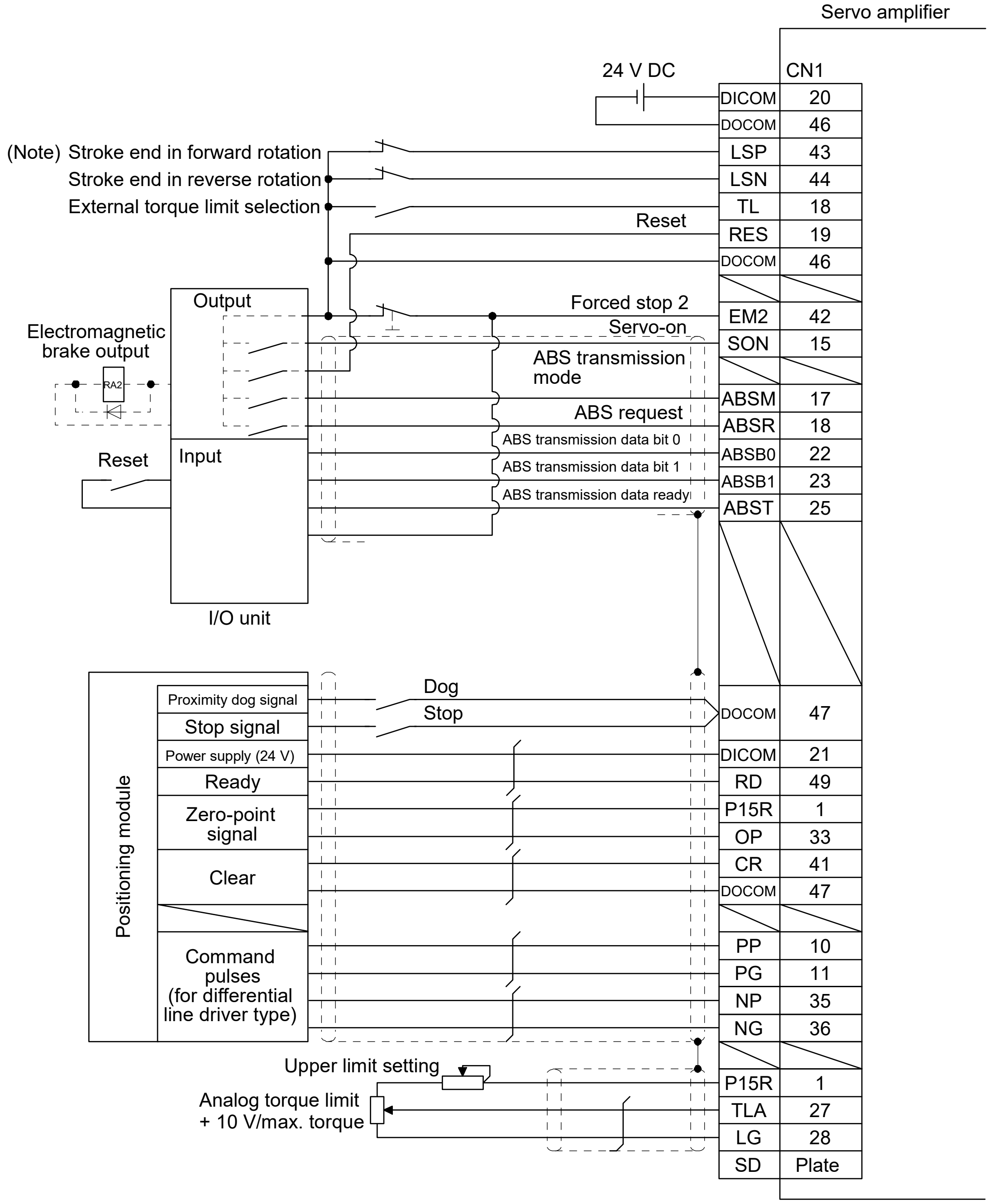
Item		Description
System		Electronic battery backup type
Maximum revolution range		Home position ± 32767 rev.
(Note 1) Maximum speed at power failure [r/min]	Rotary servo motor	6000 (only when acceleration time until 6000 r/min is 0.2 s or more)
	Direct drive motor	500 (only when acceleration time until 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 4)
	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.

12.3 Standard connection example



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

12.4 Signal explanation

When the absolute position data is transferred, the signals of connector CN1 change as described in this section. They return to the previous status on completion of data transfer. The other signals are as described in section 3.5.
For the I/O interfaces (symbols in the I/O Category column in the table), refer to section 3.8.2.

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

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

12.5 Startup procedure

(1) Battery installation.
Refer to section 12.2.

(2) Parameter setting
Set "_ _ _ 1" in [Pr. PA03] of the servo amplifier and switch power off, then on.

(3) Resetting of [AL. 25 Absolute position erased]
After connecting the encoder cable, [AL. 25] occurs at first power-on. Turn off the power, then on to reset the alarm.

(4) Confirmation of absolute position data transfer
When SON is turned on, the absolute position data is transferred to the programmable controller. Transferring the proper absolute position data will trigger the followings.

(a) RD (Ready) turns on.

(b) The absolute position data ready contact of programmable controller turns on.

(c) The MR Configurator2 ABS data display window (refer to section 12.1.5) and programmable controller side ABS data registers show the same value (at the home position address of 0).
If any warning such as [AL. E5 ABS time-out warning] or programmable controller side transfer error occurs, refer to section 12.7 or chapter 8 and take corrective action.

(5) Home position setting
The home position must be set if.

(a) System set-up is performed;

(b) The servo amplifier has been changed;

(c) The servo motor has been changed; or

(d) [AL. 25 Absolute position erased] occurred.

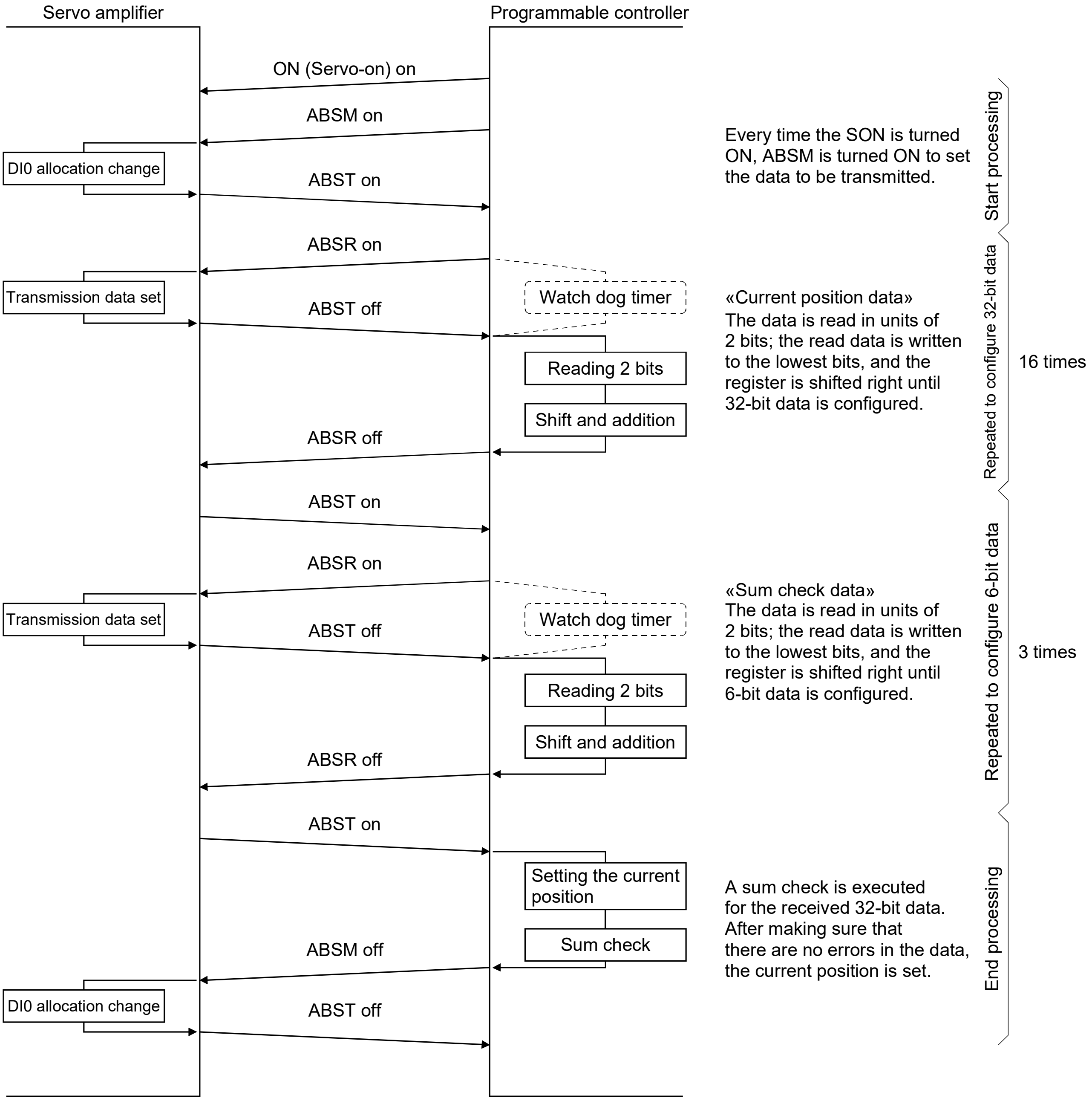
In the absolute position detection system, the absolute position coordinates are made up by making home position setting at the time of system set-up. The motor shaft may operate unexpectedly if positioning operation is performed without home position setting.
Always make home position setting before starting.
For the home position setting method and types, refer to section 12.6.3.

12.6 Absolute position data transfer protocol

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

12.6.1 Data transfer procedure

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

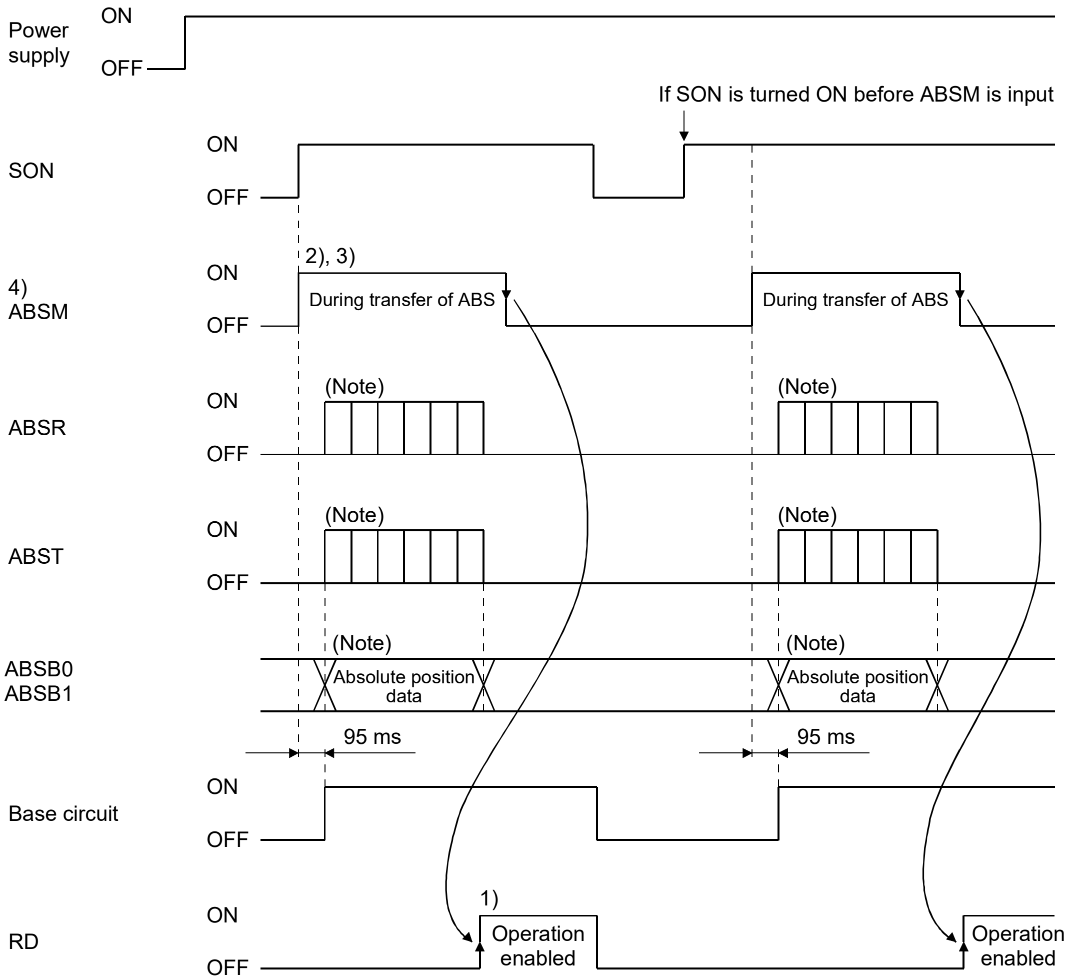


12.6.2 Transfer method

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

(1) At power-on

(a) Timing chart



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

1) After the absolute position data is transmitted, RD turns on by ABSM-off. When RD is on, ABSM-on is not received.

2) Even if SON is turned on before ABSM is turned on, the base circuit is not turned on until ABSM is turned on.
If an alarm has occurred, ABSM is not received. ABSM allows data transmission even while a warning is occurring.

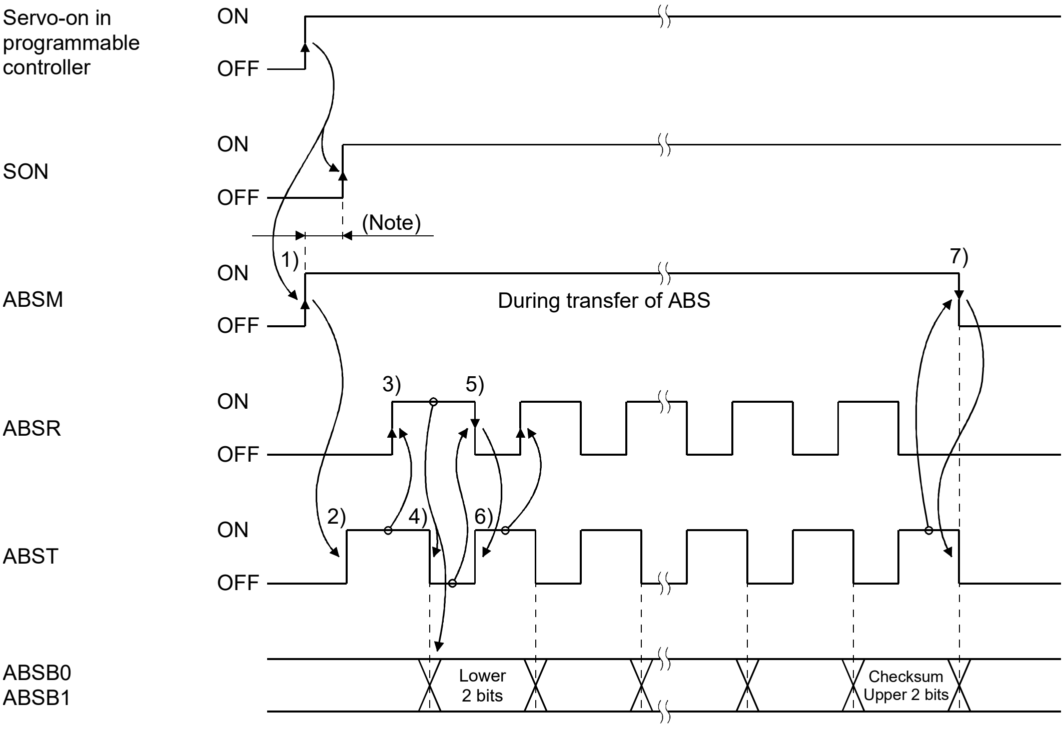
3) If ABSM is turned off during the ABS transfer mode, the ABS transfer mode is interrupted and [AL. E5 ABS time-out warning] occurs.
If SON is turned off, RES is turned on, and EM2 is turned off during the ABS transfer mode, [AL. E5 ABS time-out warning] occurs.

4) Note that if ABSM is turned on for a purpose other than absolute position data transmission, the output signals will be assigned the functions of absolute position data transmission.

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

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

(b) Detailed description of absolute position data transfer



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

1) The programmable controller turns on ABSM and SON at the leading edge of the internal servo-on.
2) In response to ABS transfer mode, the servo detects and calculates the absolute position and turns on ABST to notify the programmable controller that the servo is ready for data transmission.
3) After acknowledging that ABST is turned on, the programmable controller will turn on ABSR.
4) In response to ABSR, the servo outputs the lower 2 bits of the absolute position data and ABST in the off state.
5) After acknowledging that ABST has been turned off, which implies that 2 bits of the absolute position data have been transmitted, the programmable controller reads the lower 2 bits of the absolute position data and then turns off ABSR.
6) The servo turns on ABST so that it can respond to the next request. Steps 3) to 6) are repeated until 32-bit data and the 6-bit checksum have been transmitted.
7) After receiving of the checksum, the programmable controller confirms that the 19th ABST is turned on, and then turns off ABSM. If ABSM is turned off during data transmission, ABSM is interrupted and the [AL. E5 ABS time-out warning] occurs.

(c) Checksum

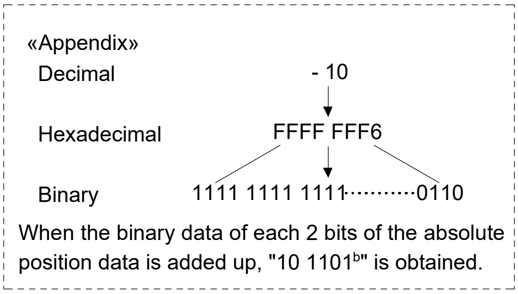
he checksum is the code which is used by the programmable controller to check for errors in the received absolute position data. The 6-bit checksum is transmitted following the 32-bit absolute position data.

At the programmable controller, calculate the sum of the received absolute position data using the ladder program and compare it with the checksum code sent from the servo.

The method of calculating the checksum is shown. Every time the programmable controller receives 2 bits of absolute position data, it adds the data to obtain the sum of the received data. The checksum is 6-bit data.

Example: absolute position data: -10 (FFFFFFF6H)

$$\begin{array}{rr}
 & 10^b \\
 & 01^b \\
 & 11^b \\
 & 11^b \\
 & 11^b \\
 & 11^b \\
 & 11^b \\
 & 11^b \\
 & 11^b \\
 & 11^b \\
 & 11^b \\
 & 11^b \\
 & 11^b \\
 & 11^b \\
 & 11^b \\
 +) & 11^b \\
\hline
 & 101101^b
\end{array}$$



When the binary data of each 2 bits of the absolute position data is added up, "10 1101^b" is obtained.

Therefore, the checksum of "-10" (absolute position data) is "2DH"

(2) Transmission error

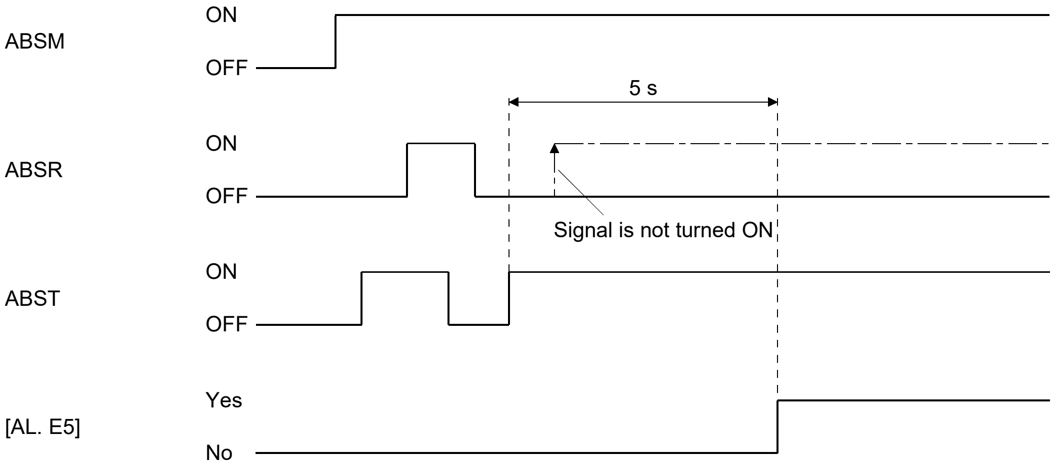
(a) [AL. E5 ABS time-out warning]

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

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

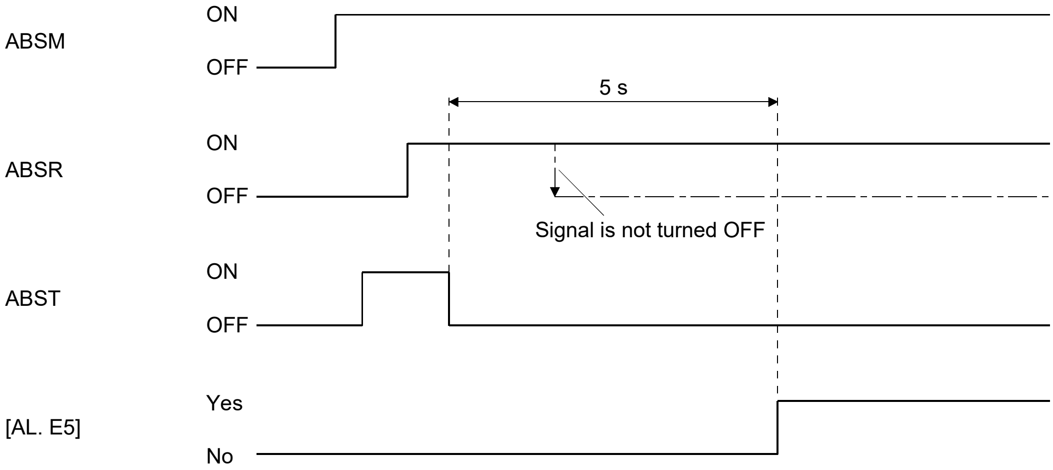
1) ABS request off-time time-out check (applied to 32-bit absolute position data in 2-bit units checksum)

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

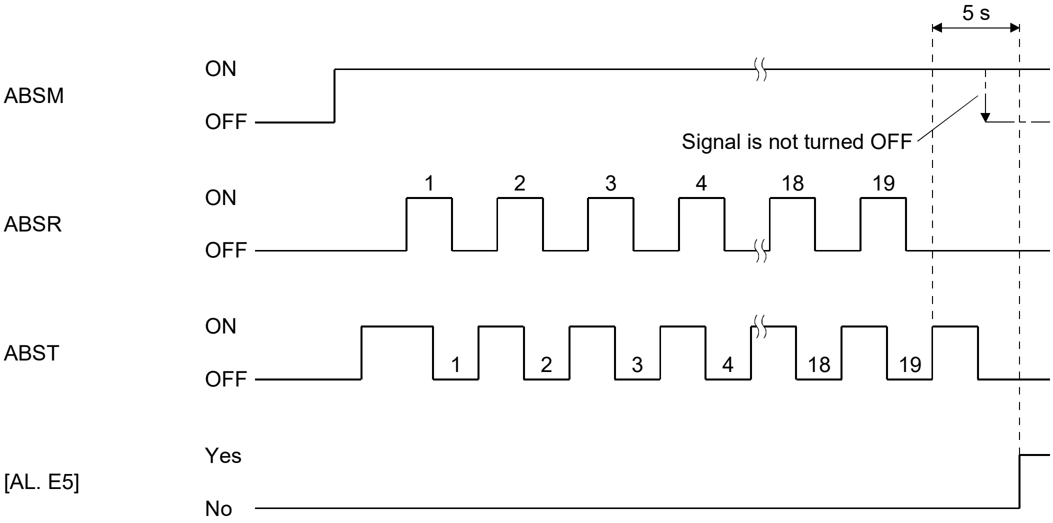


2) ABS request on-time time-out check (applied to 32-bit absolute position data in 2-bit units checksum)

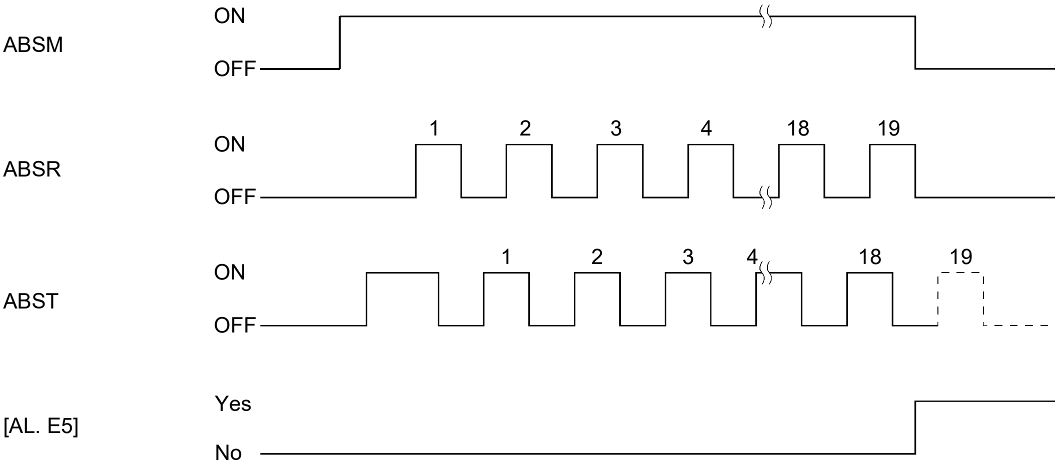
If the ABSR is not turned off by the programmable controller within 5 s after ABST is turned off, this is regarded as the transmission error and [AL. E5 ABS time-out warning] is output.



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

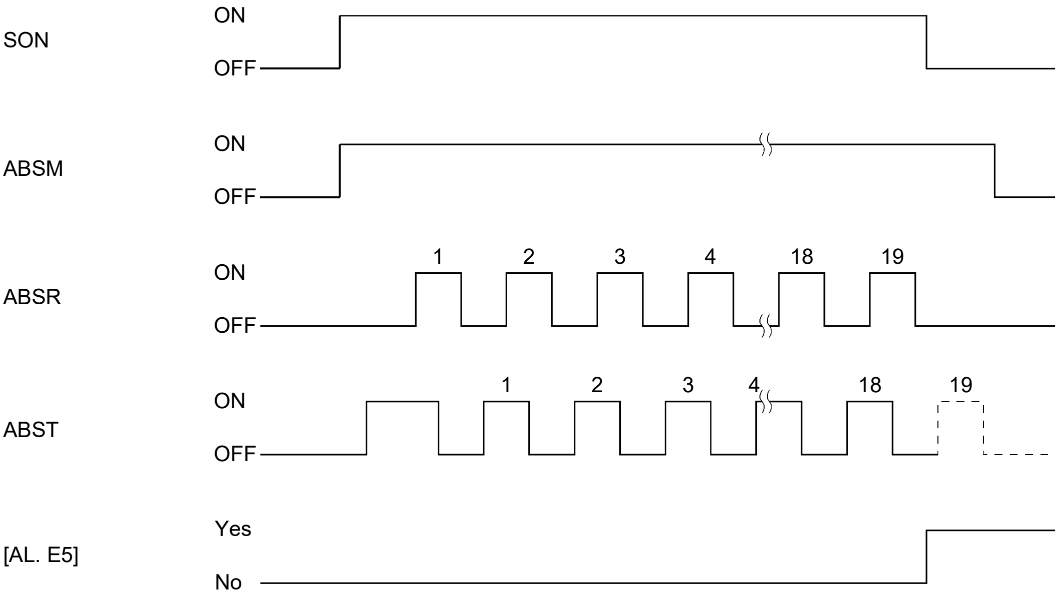


4) ABSM-off check during the ABS transfer
   When the ABSM is turned on to start transferring and then the ABS transfer mode is turned off before the 19th ABS transmission data ready is turned on, [AL. E5 ABS time-out warning] occurs, regarding it as a transfer error.



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

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



(b) Checksum error

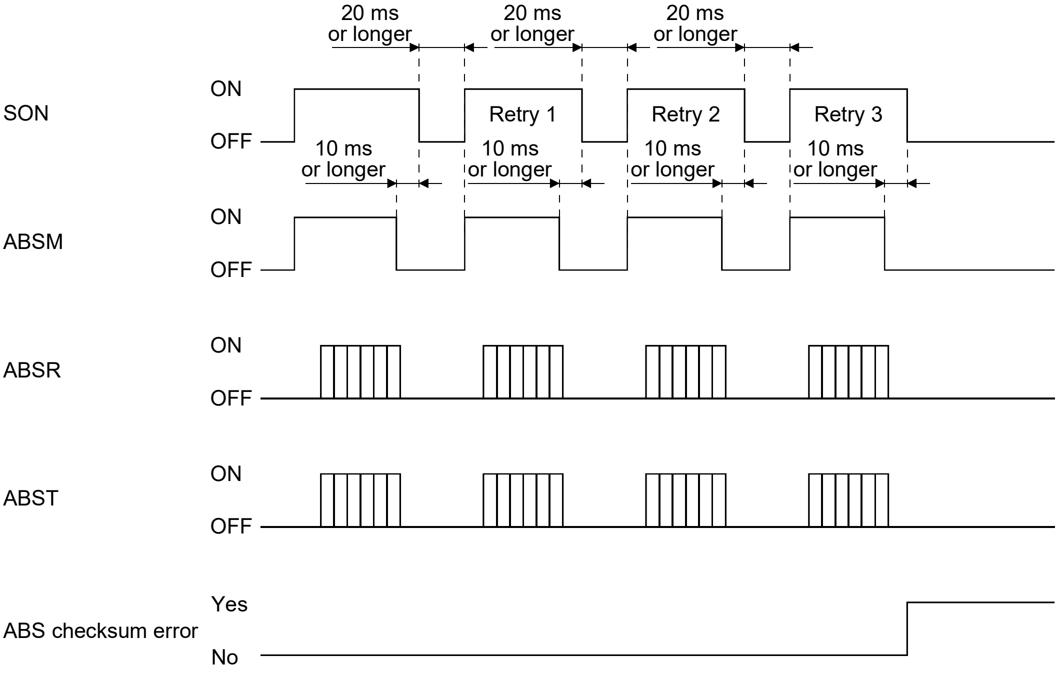
If the checksum error occurs, the programmable controller should retry transmission of the absolute position data.

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

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

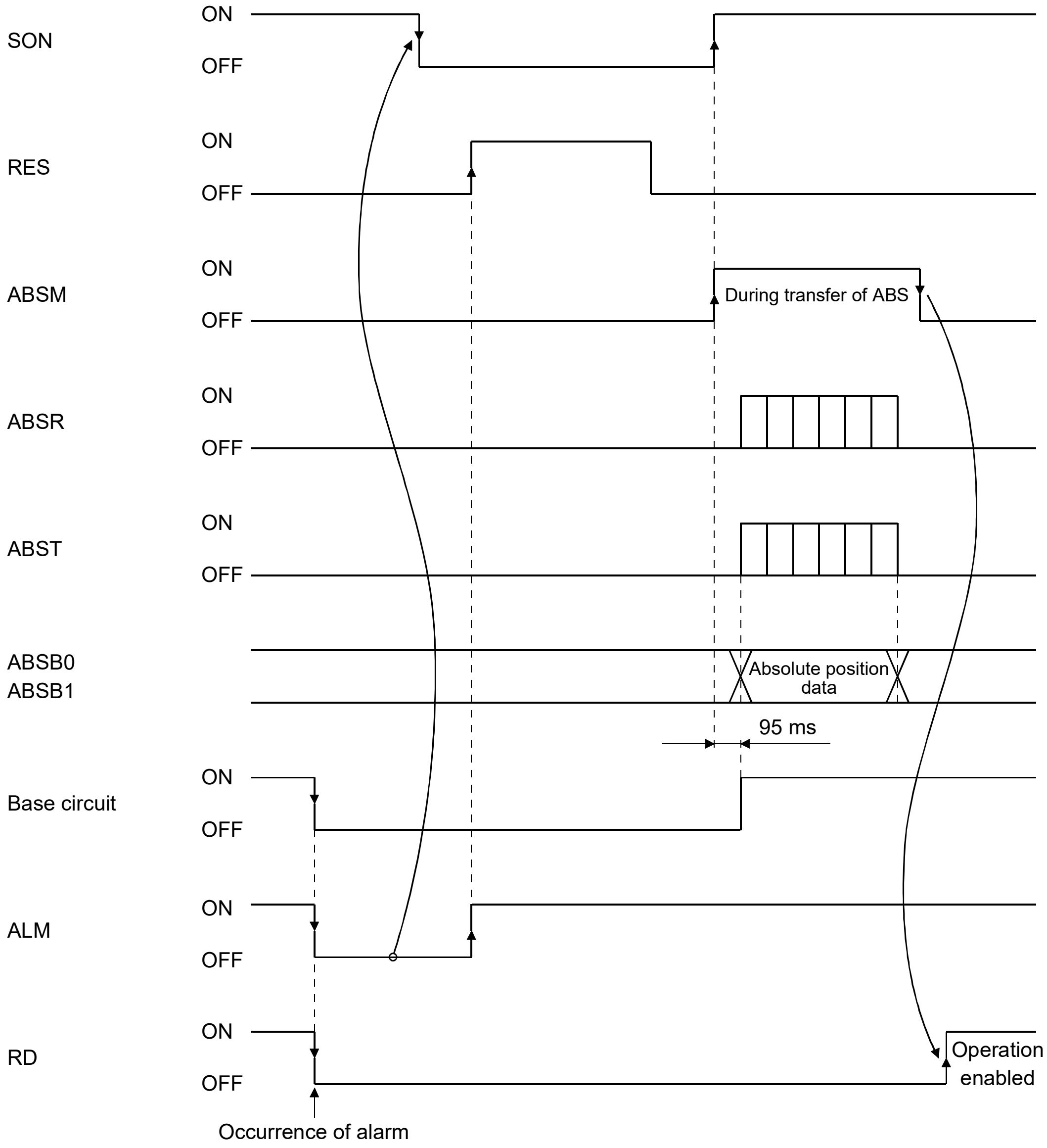
The start command should be interlocked with ABST to disable positioning operation when an checksum error occurs.

The following shows an example of three retries.



(3) At the time of alarm reset

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

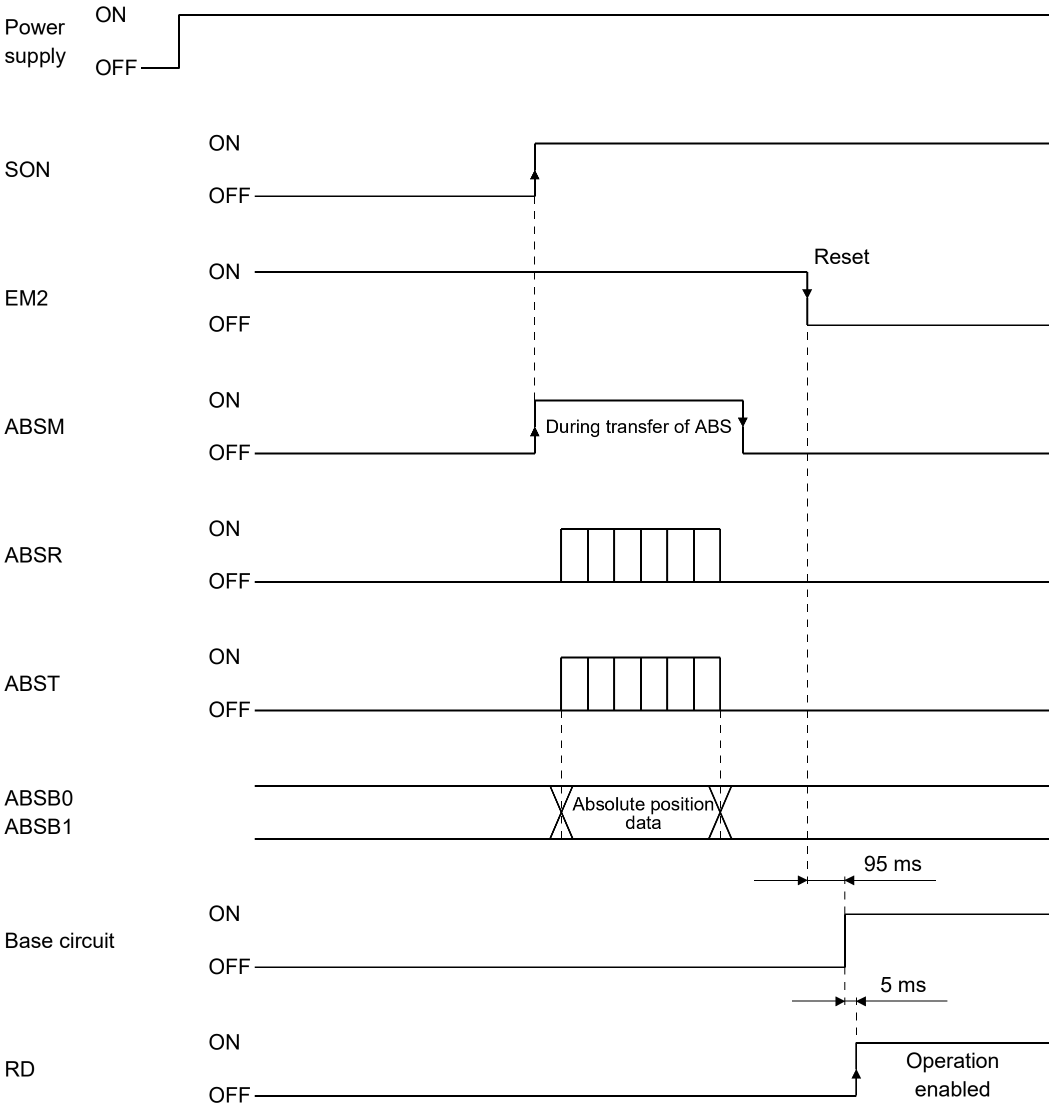


(4) At the time of forced stop reset

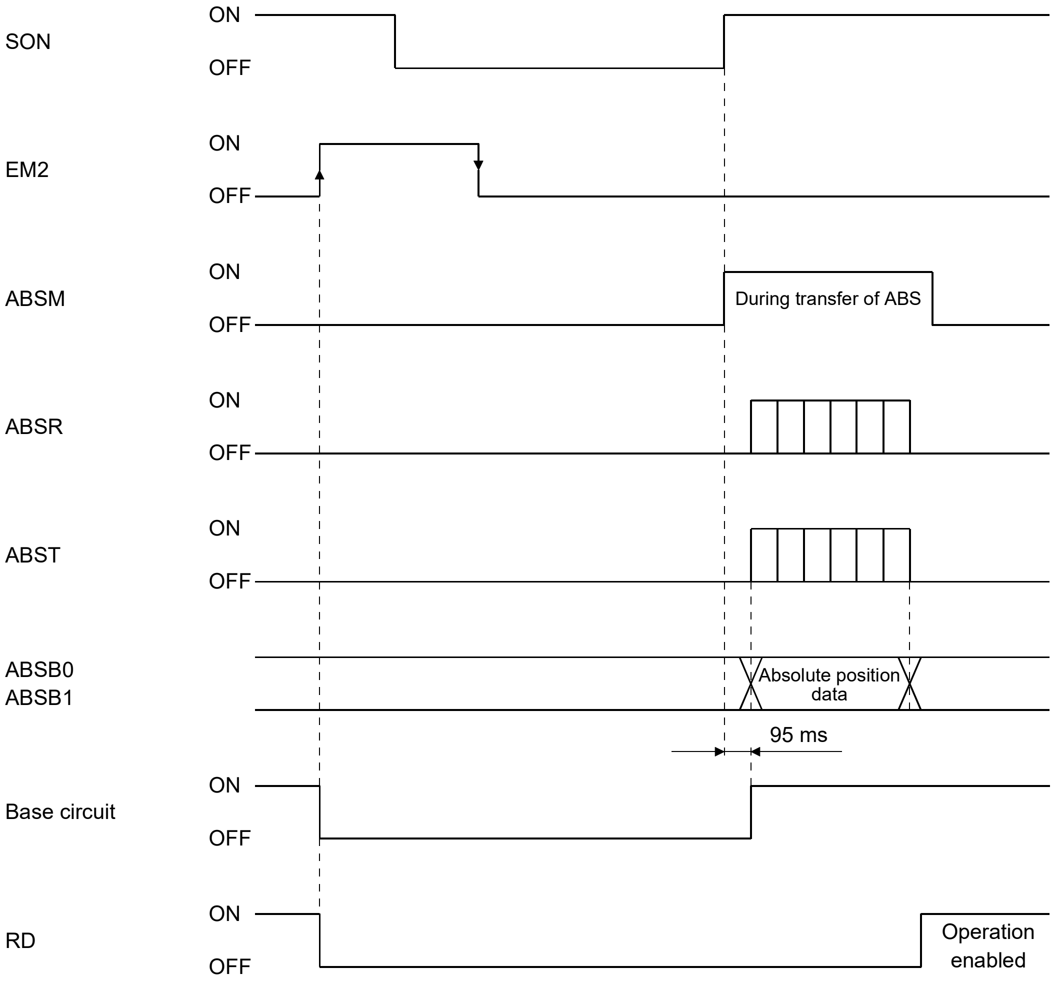
(a) If the power is switched on in the forced stop state

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

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



(b) If forced stop is activated during servo-on
ABSM is permissible while in the forced stop state. In this case, the base circuit and RD are turned on after the forced stop state is reset.



12.6.3 Home position setting

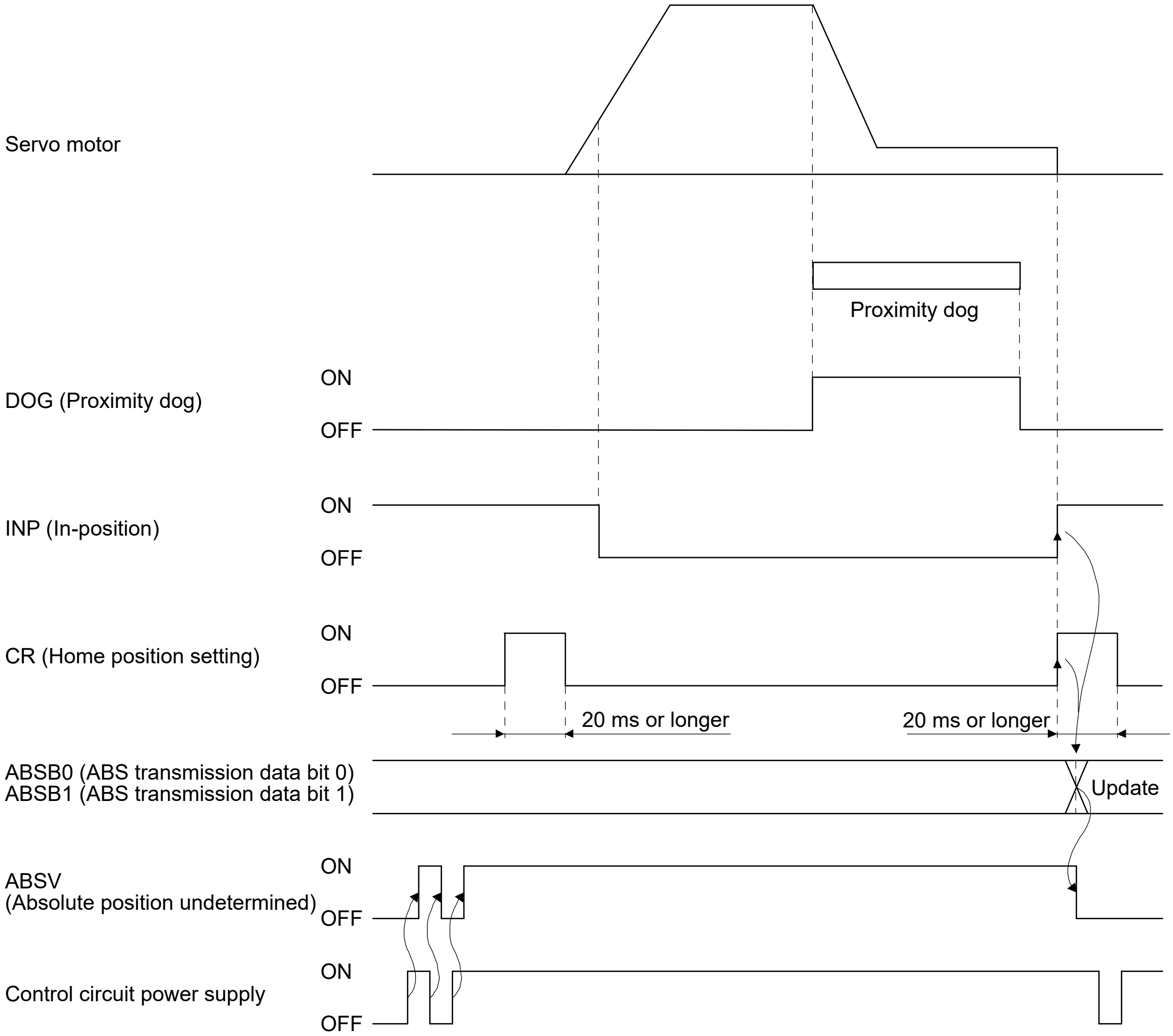
(1) Dog type home position return

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

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

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

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

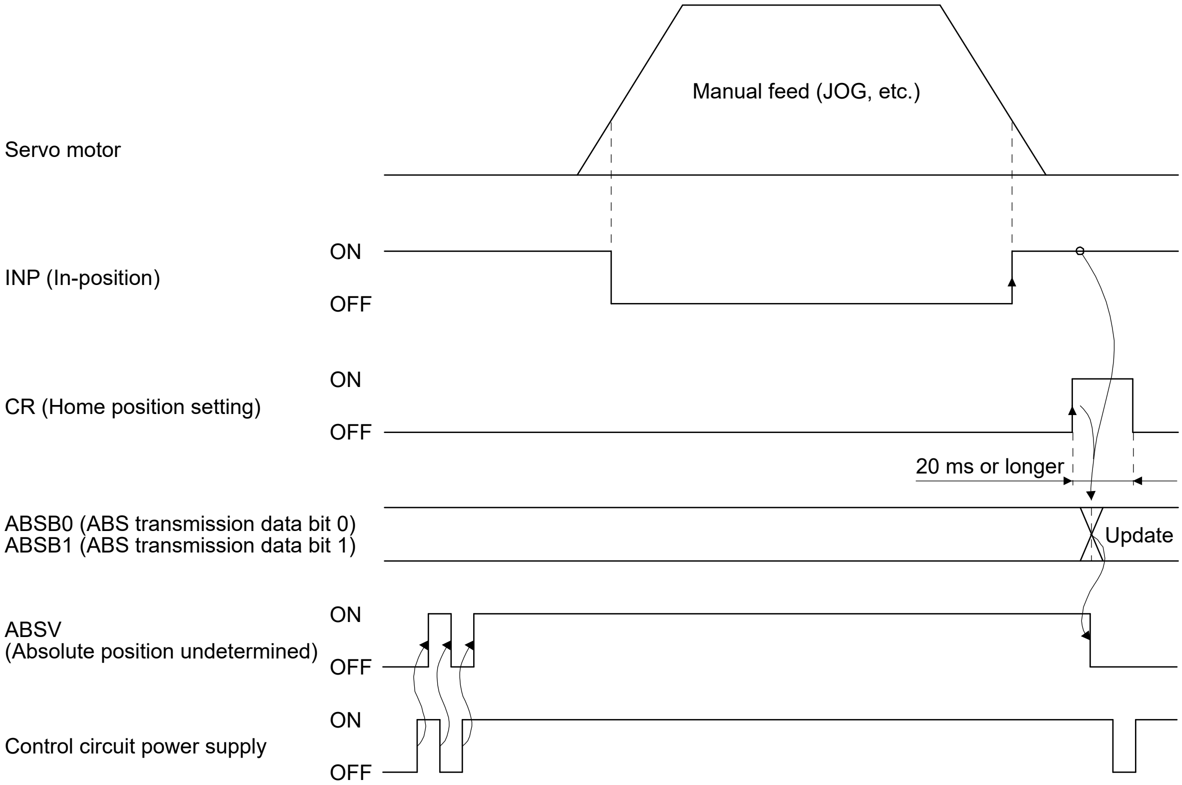


(2) Data set type home position return

POINT

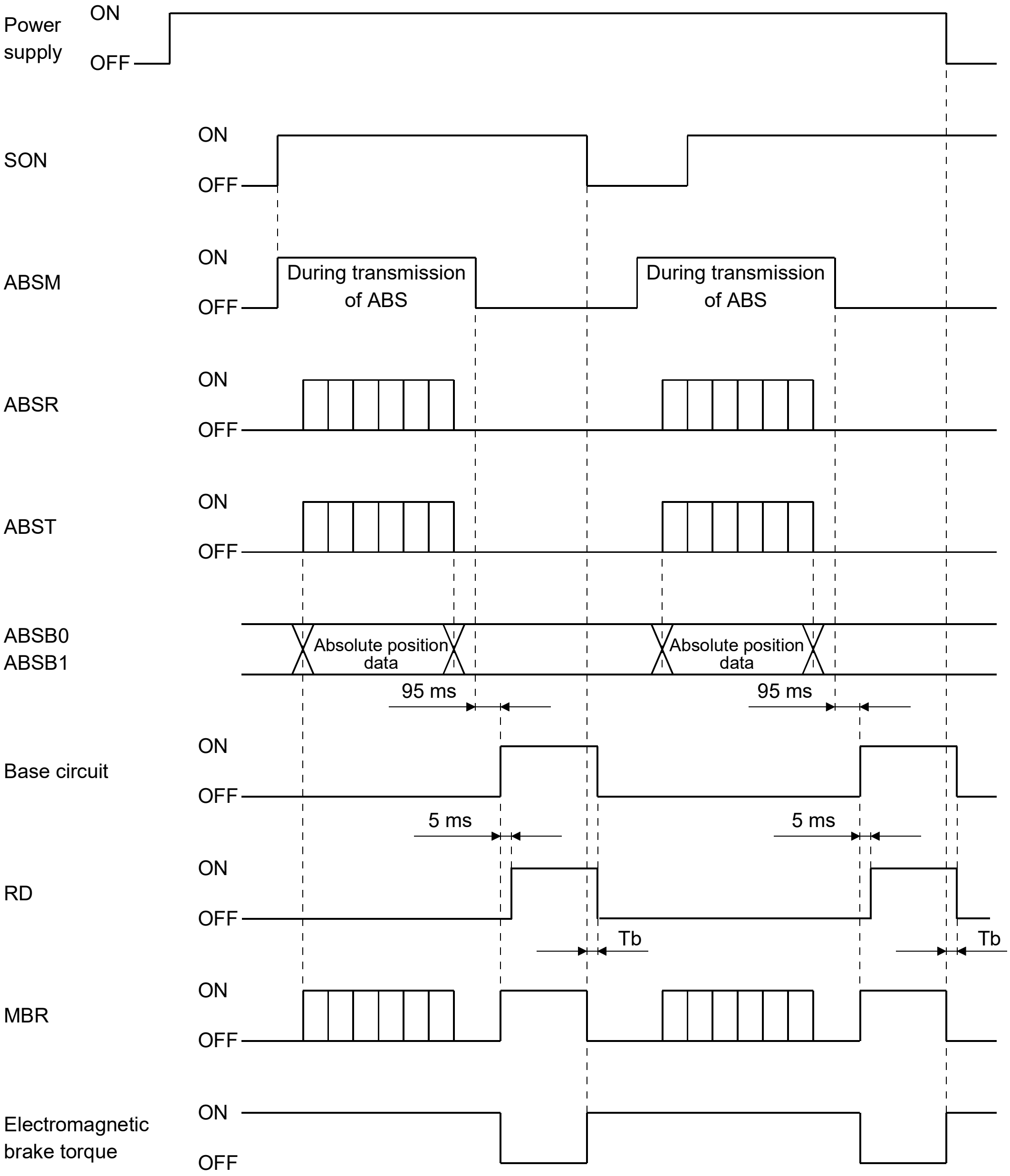
- ●Never make home position setting during command operation or servo motor rotation. It may cause home position sift.
- ●It is possible to execute data set type home position return during the servo off.

Move the machine to the position where the home position is to be set by performing manual operation such as JOG operation. When CR is on for longer than 20 ms, the stop position is stored into the non-volatile memory as the home position absolute position data.
When the servo on, set CR to on after confirming that INP is on. If this condition is not satisfied, [AL. 96 Home position setting warning] will occur, but that warning will be reset automatically by making home position return correctly.
The number of home position setting times is limited to 100,000 times.



12.6.4 Use of servo motor with an electromagnetic brake

The timing charts at power on/off and SON on/off are given below.
Preset [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47] of the servo amplifier to enable MBR. When MBR is set for the CN1-23 pin, turning ABSM on will change the CN1-23 pin to ABSB1 (ABS transmission data bit 1). Therefore, configure an external sequence to generate the electromagnetic brake torque as soon as ABSM and MBR turn off.



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

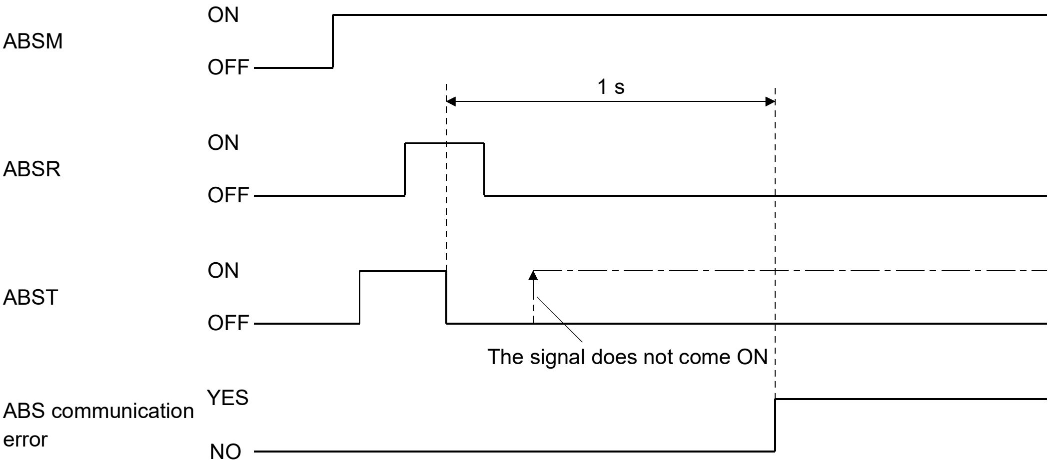
The servo amplifier stops the acceptance of the command pulse when off of LSP or LSN are detected, clears the droop pulses to 0 at the same time, and stops the servo motor. At this time, the programmable controller keeps outputting the command pulse. Since this causes a discrepancy between the absolute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

12.7 Absolute position data transfer errors

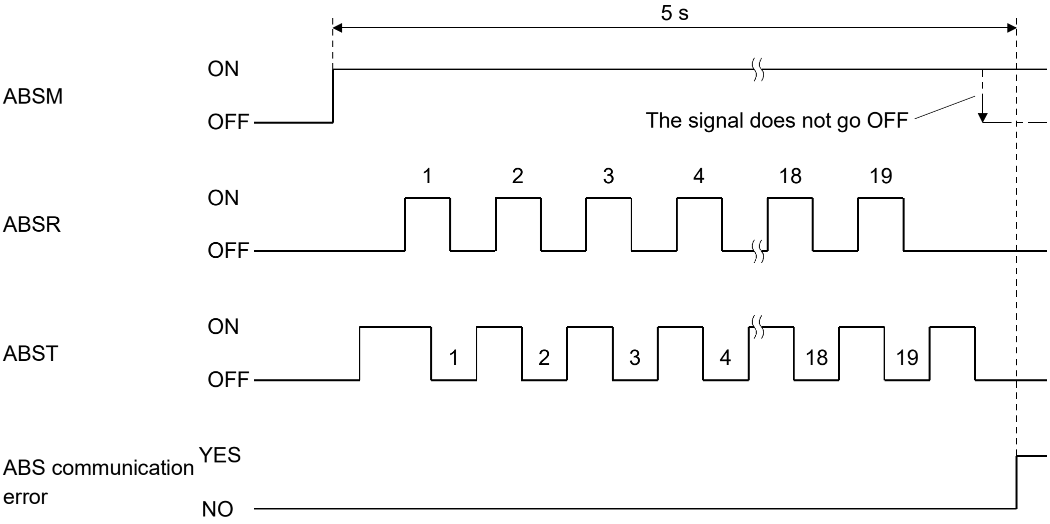
POINT

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

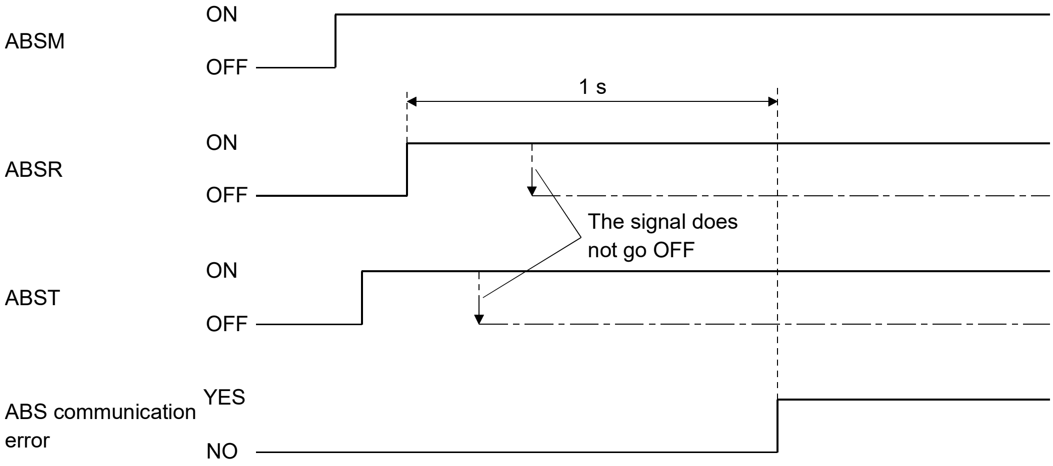
(1) The off period of the ABS transmission data ready signal output from the servo amplifier is checked. If the off period is 1 s or longer, regard as a transfer fault and generate the ABS communication error. Generate the ABS communication error if [AL. E5 ABS time-out warning] is generated at the servo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



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



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



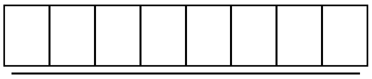
12.8 Communication-based absolute position transfer system

12.8.1 Serial communication command

The following commands are available for reading absolute position data using the serial communication function. When reading data, take care to specify the correct station number of the servo amplifier from where the data will be read.
When the master station sends the data No. to the slave station (servo amplifier), the slave station returns the data value to the master station.

(1) Transmission
Transmit command [0] [2] and data No. [9] [1].

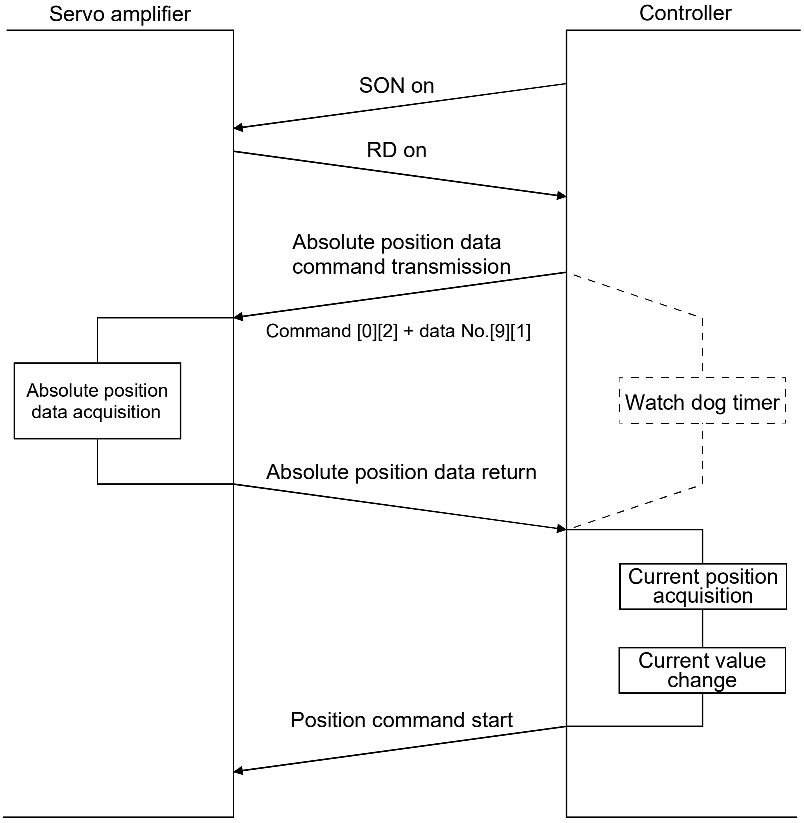
(2) Reply
The absolute position data in the command pulse unit is returned in hexadecimal.



Data 32-bit length (hexadecimal representation)

12.8.2 Absolute position data transfer protocol

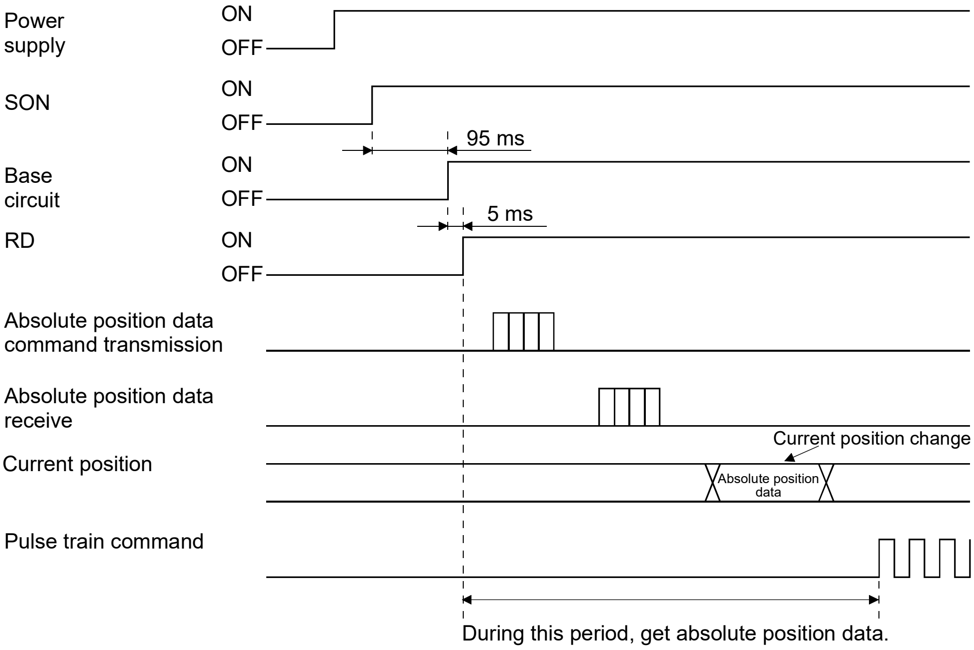
(1) Data transfer procedure
Every time SON turns on at power-on or like, the controller must read the current position data in the servo amplifier. Not performing this operation will cause a position shift.
Time-out monitoring should be performed by the controller.



(2) Transfer method

The following shows a sequence how to turn on the base circuit while it is off state because SON is off, EM2 is off, or an alarm is occurring. In the absolute position detection system, always give the serial communication command to read the current position in the servo amplifier to the controller every time RD turns on. The servo amplifier sends the current position to the controller on receipt of the command. At the same time, this data is set as a position command value in the servo amplifier.

(a) Sequence processing at power-on



1) The base circuit turns on after 95 ms.

2) After the base circuit is turned on, RD turns on.

3) After RD turned on and the controller acquired the absolute position data, give command pulses to the servo amplifier. If the controller gives command pulses before acquiring the absolute position data, a position shift can occur.

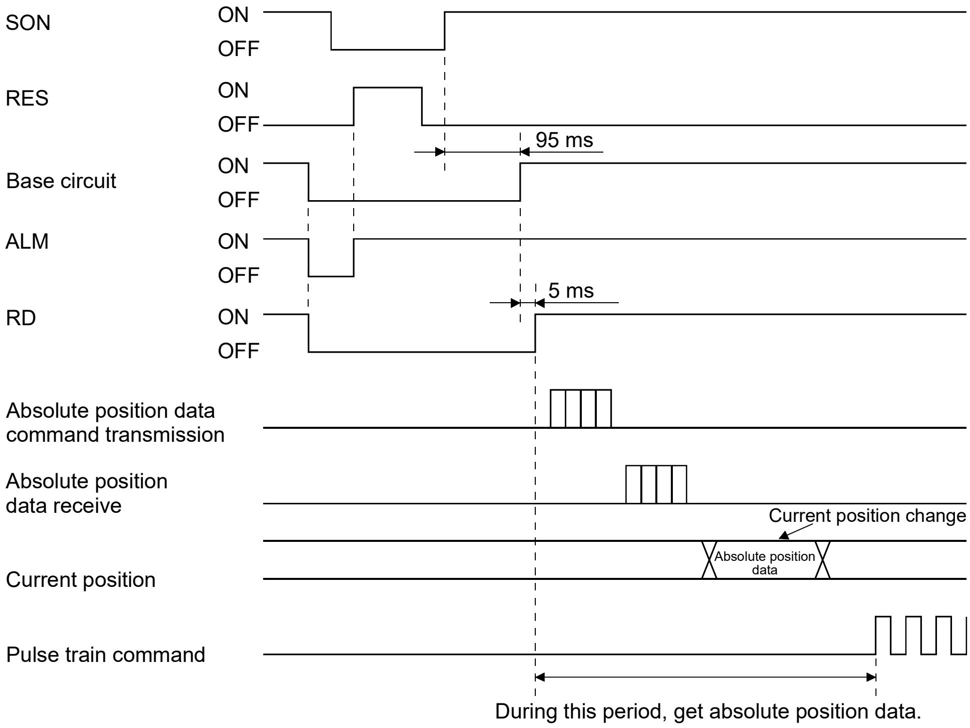
(b) Communication error

If a communication error occurs between the controller and servo amplifier, the servo amplifier sends the error code. The definition of the error code is the same as that of the communication function. Refer to section 14.3.3 for details.

If a communication error has occurred, perform retry operation. If several retries do not result in a normal termination, perform error processing.

(c) At the time of alarm reset

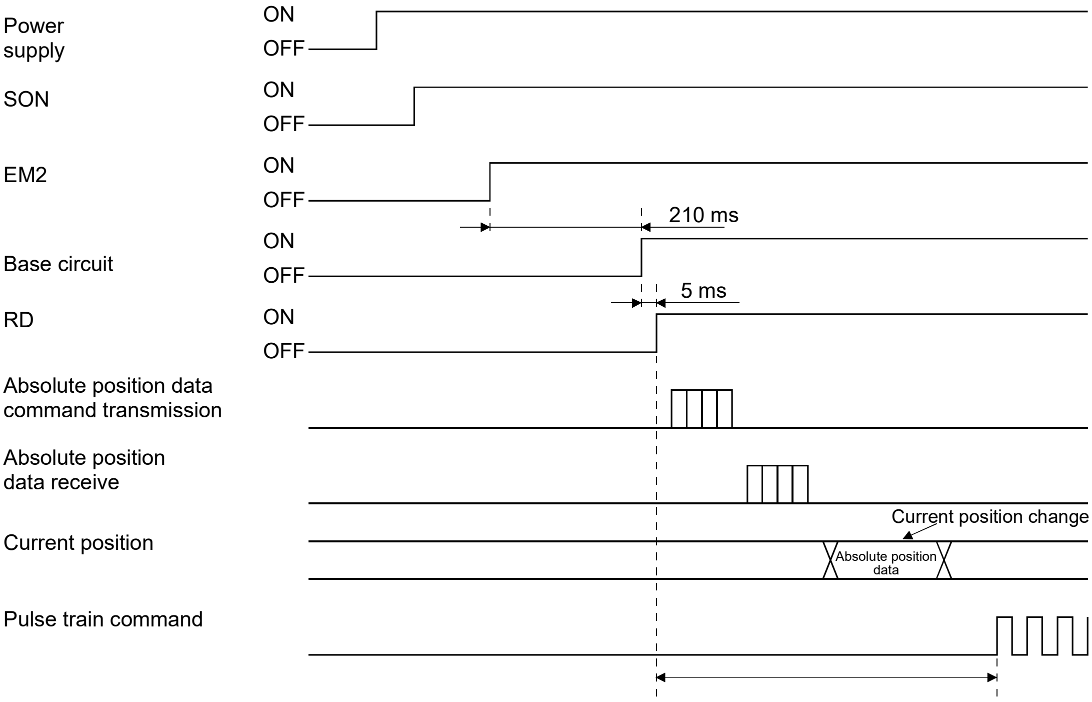
If an alarm has occurred, detect ALM and turn off SON. After removing the alarm occurrence factor and deactivating the alarm, get the absolute position data again from the servo amplifier in accordance with the procedure in (a) in this section.



(d) At the time of forced stop reset

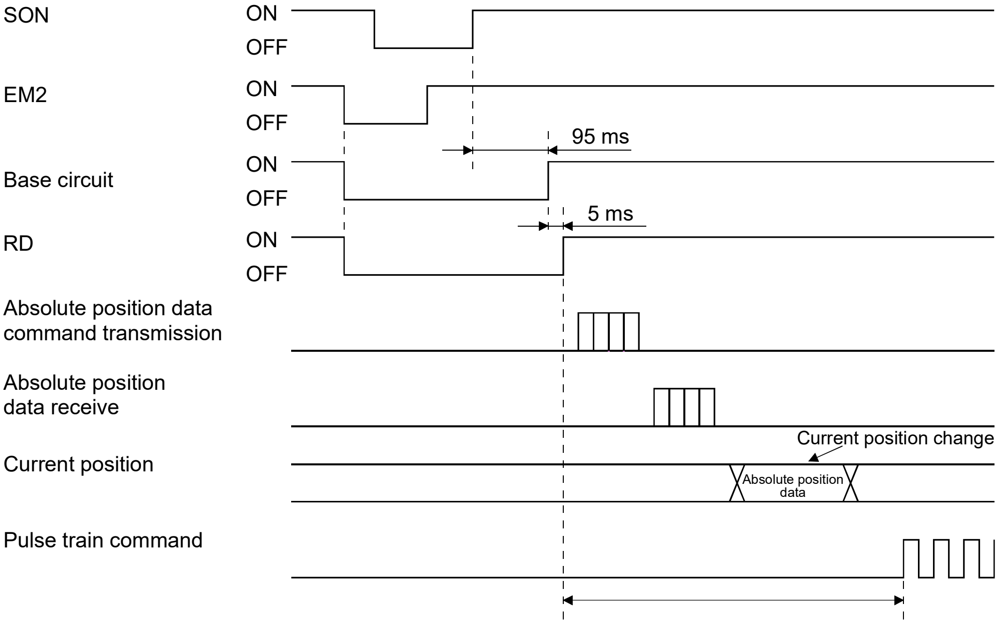
210 ms after the forced stop is deactivated, the base circuit turns on, and RD turns on further 5 ms after that, turns on. Always get the current position data using RD as the trigger before the position command is issued.

1) When power is switched on in a forced stop status



During this period, get absolute position data.

2) When a forced stop is activated during servo on



During this period, get absolute position data.

MEMO

13. USING STO FUNCTION

POINT

- ●In the torque control mode, the forced stop deceleration function is not available.
- ●The MR-J4-03A6(-RJ) servo amplifier is not compatible with the STO function.

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 module in the servo amplifier are shorted and damaged simultaneously, the servo motor may make a half revolution at a maximum.

(11) The STO input signals (STO1 and STO2) must be supplied from one power source. Otherwise, the STO function may not function properly due to a sneak current, failing to bring the STO shut-off state.

(12) For the STO I/O signals of the STO function, supply power by using a safety extra low voltage (SELV) power supply with the reinforced insulation.

13.1.5 Specifications

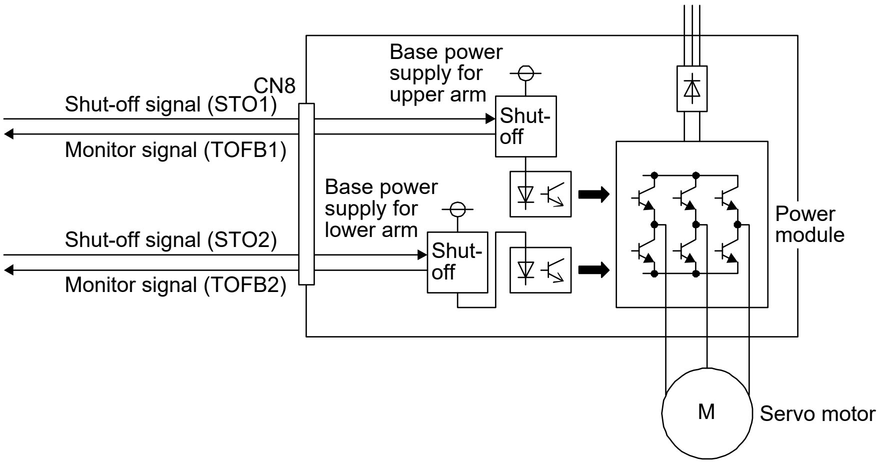
(1) Specifications

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

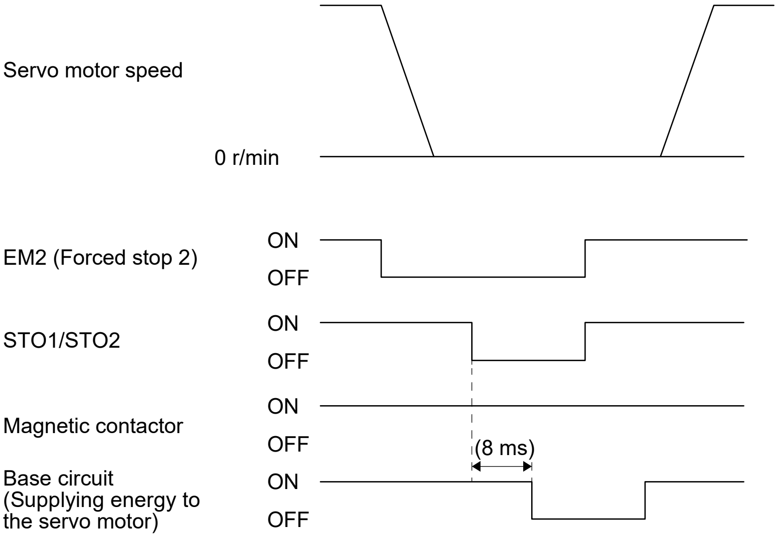
Note 1. This is the value required by safety standards.

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

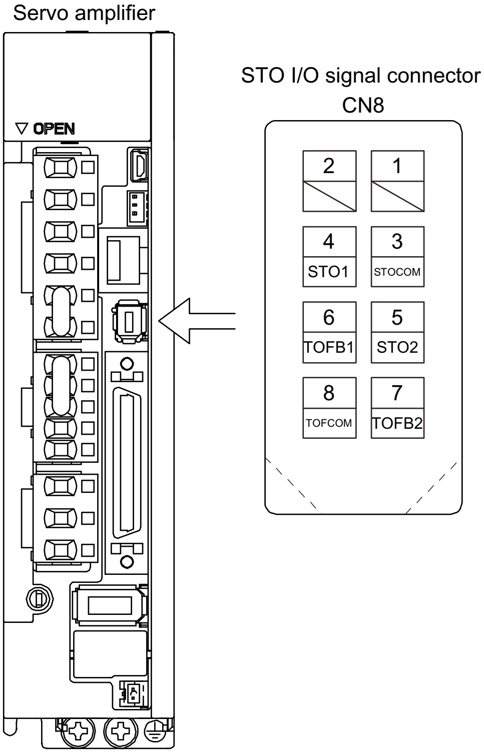
This servo amplifier has alarms and warnings for maintenance that supports the Drive safety function. (Refer to chapter 8.)

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		Status			
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

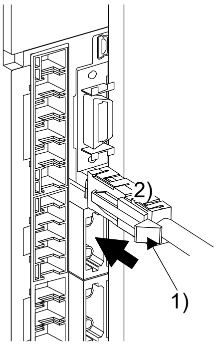
Note. Between TOFB1 and TOFB2 is off, but the servo amplifier is in the STO state.

(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.

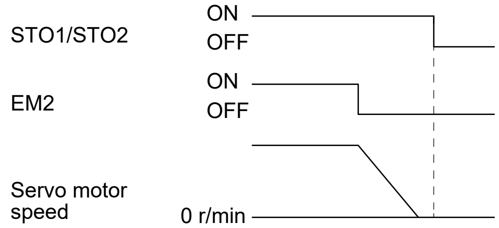


While pressing knob 1) of the STO cable plug in the direction of the arrow, pull out the plug 2).
(This figure shows the MR-J4-_B_(-RJ) servo amplifier. This procedure also applies to the MR-J4-_A_(-RJ) servo amplifier.)

13.3 Connection example

POINT

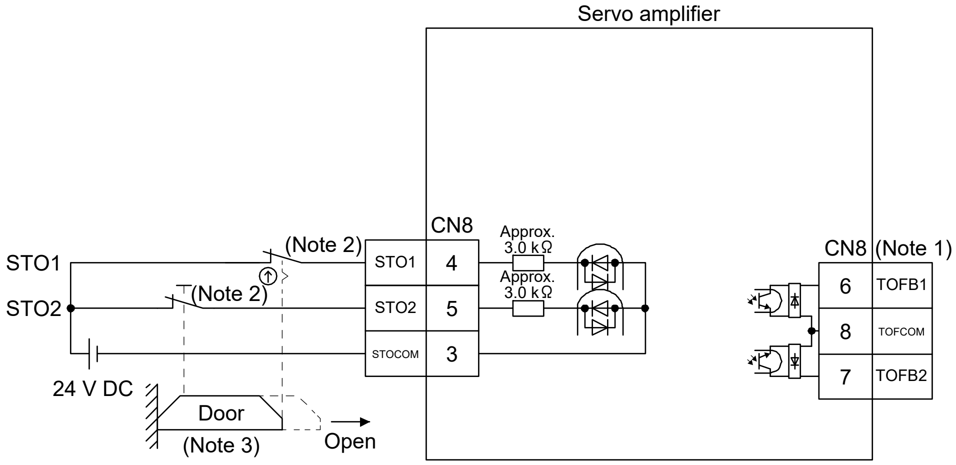
- ●Turn off STO (STO1 and STO2) after the servo motor stops by the servo off state or with forced stop deceleration by turning off EM2 (Forced stop 2). Configure an external sequence that has the timings shown as below using an external device such as the MR-J3-D05 safety logic unit.



- ●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 13.3.3. 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).

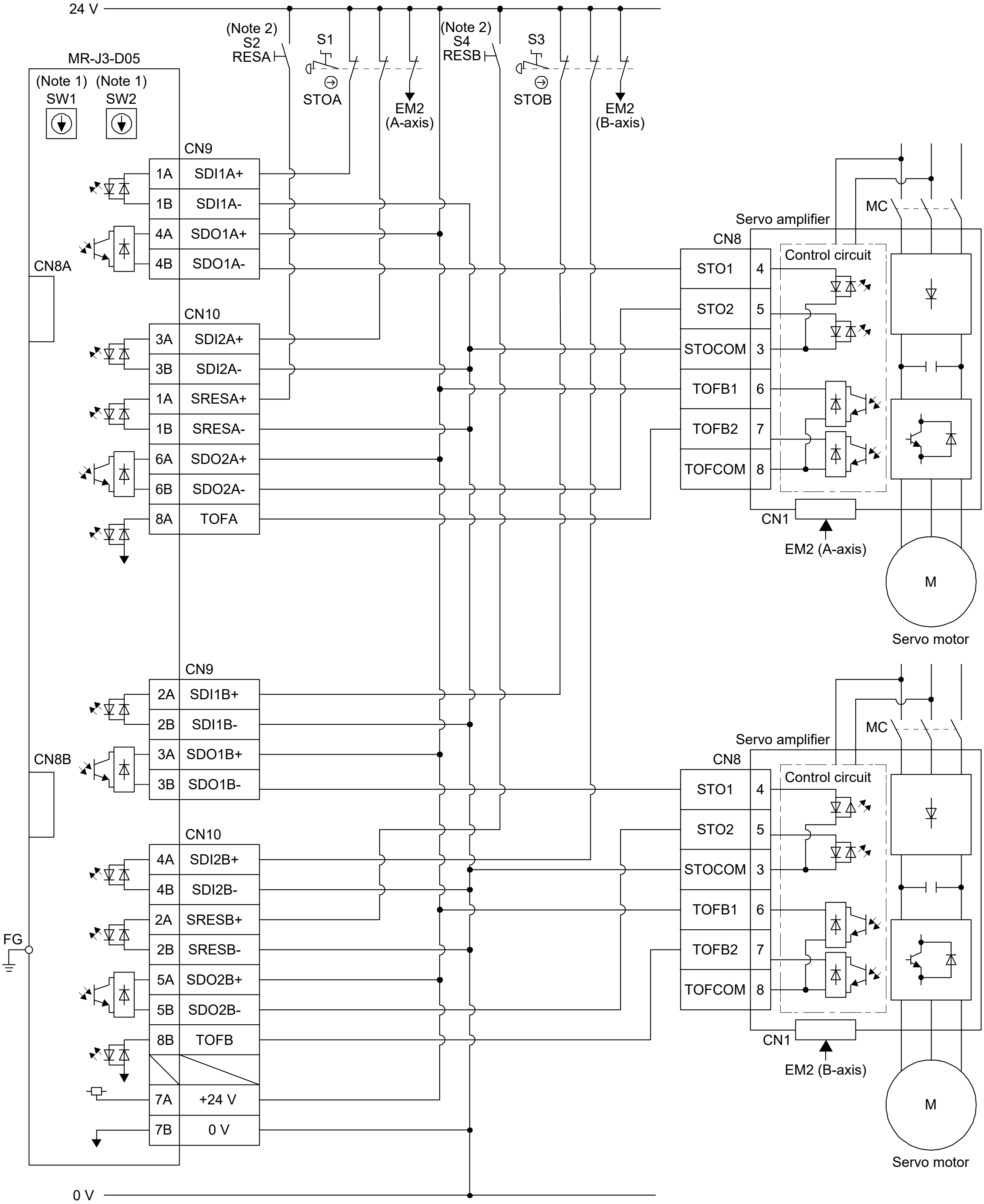
3. Configure the interlock circuit so that the door is open after the servo motor is stopped.

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.

(1) Connection example



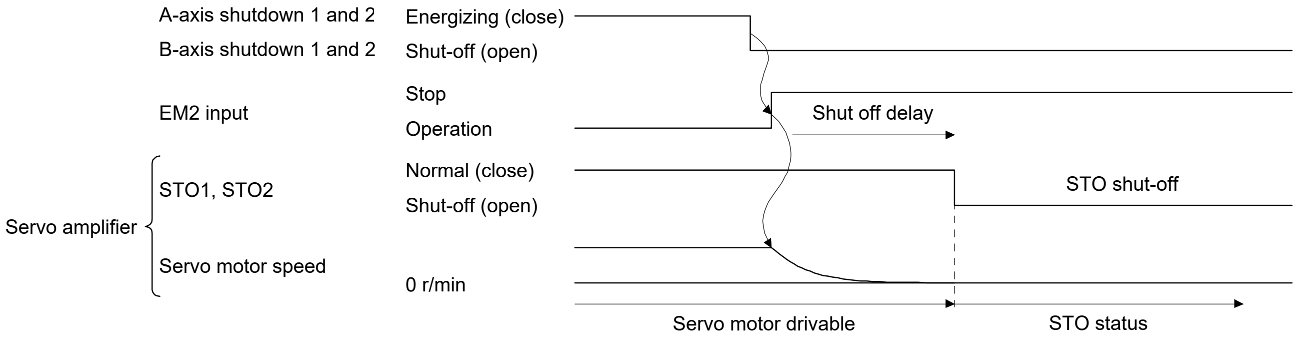
Note 1. Set the delay time of STO output with SW1 and SW2. These switches are located in a recessed area to prevent accidental setting changes.

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.

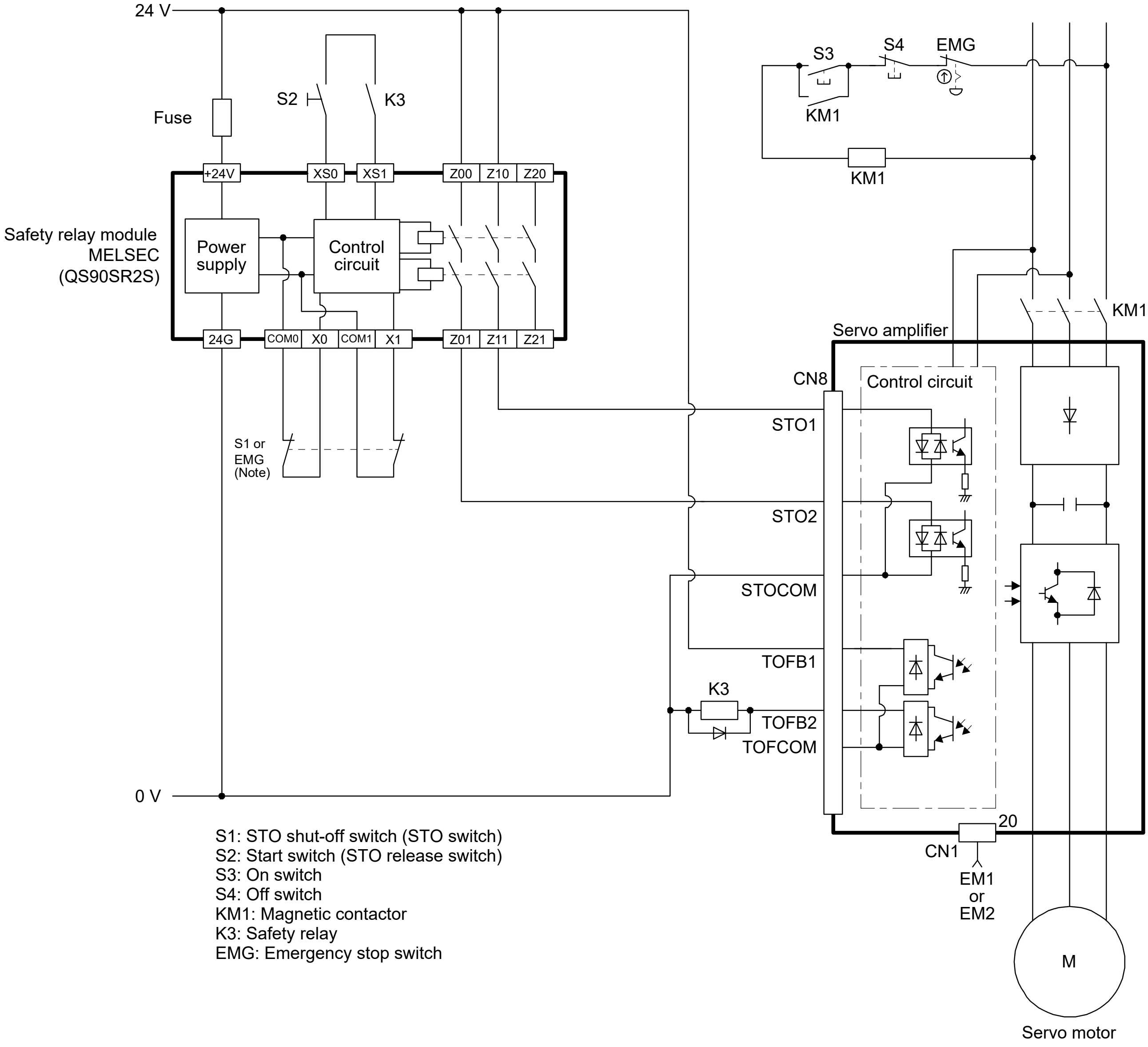


13.3.3 External I/O signal connection example using an external safety relay unit

POINT

- This connection is for source interface. For the other I/O signals, refer to the connection examples in section 3.2.

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.

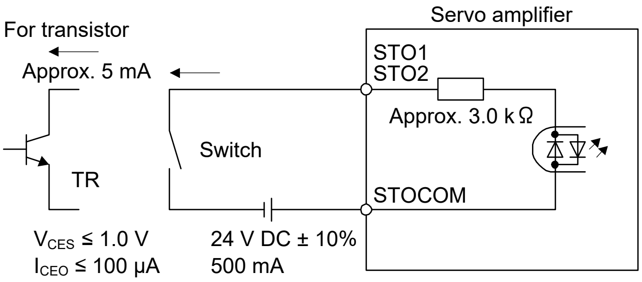
13.4 Detailed description of interfaces

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.



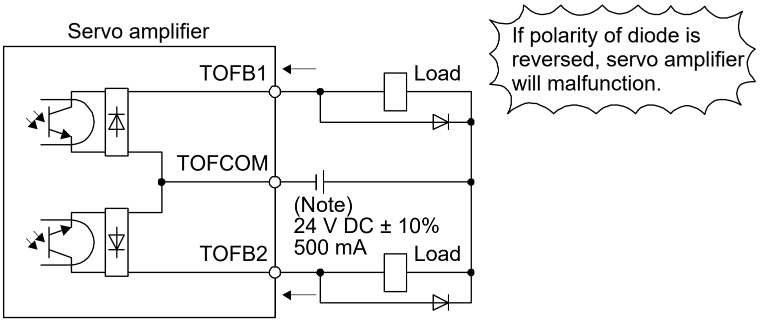
(2) Digital output interface DO-1

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.

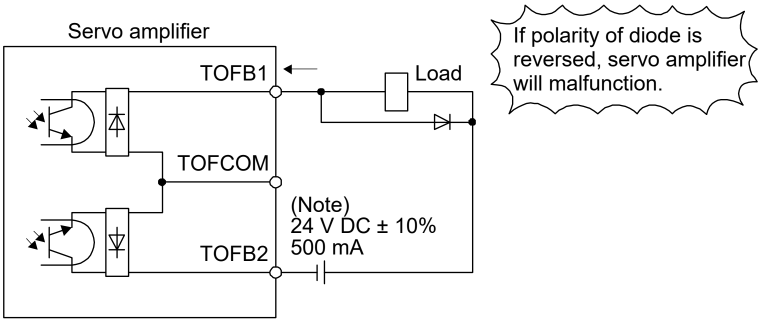
(Rated current: 40 mA or less, maximum current: 50 mA or less, inrush current: 100 mA or less) A maximum of 5.2 V voltage drop occurs in the servo amplifier.

(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



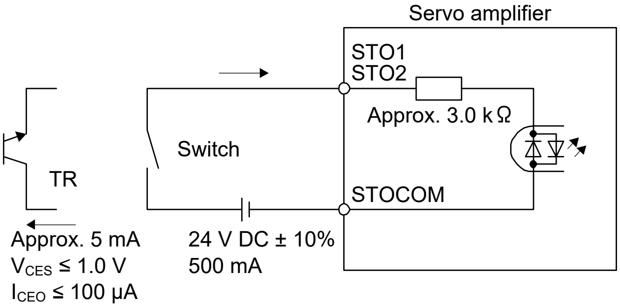
Note. If the voltage drop (maximum of 5.2 V) interferes with the relay operation, apply high voltage (maximum of 26.4 V) from external source.

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 input terminal. Transmit signals from source (open-collector) type transistor output, relay switch, etc.

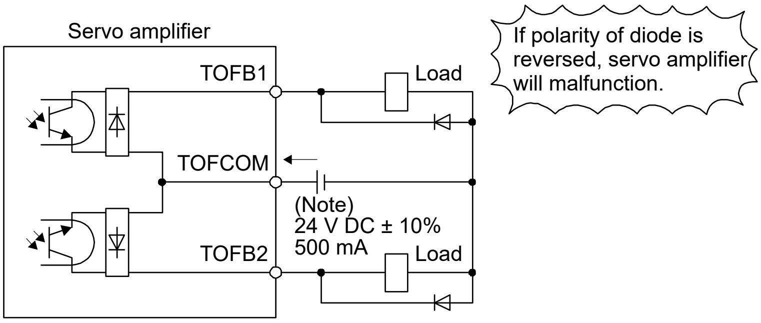


(2) Digital output interface DO-1

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.

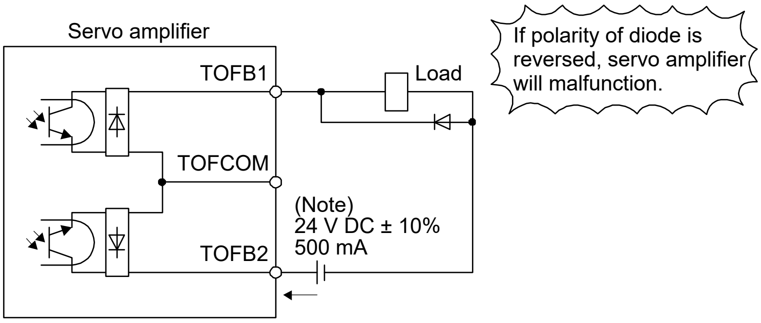
A maximum of 5.2 V voltage drop occurs in the servo amplifier.

(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.

MEMO

14. COMMUNICATION FUNCTION (MITSUBISHI ELECTRIC GENERAL-PURPOSE AC SERVO PROTOCOL)

⚠CAUTION	●The CN3 connector is designed for RS-422/RS-485 communication and parameter unit only. Do not connect the CN3 connector to an Ethernet port, etc. Doing so may cause a malfunction.

POINT

- ●RS-422 serial communication function is supported by servo amplifier with software version A3 or later.
- ●The USB communication function (CN5 connector) and the RS-422 communication function (CN3 connector) are mutually exclusive functions. They cannot be used together.

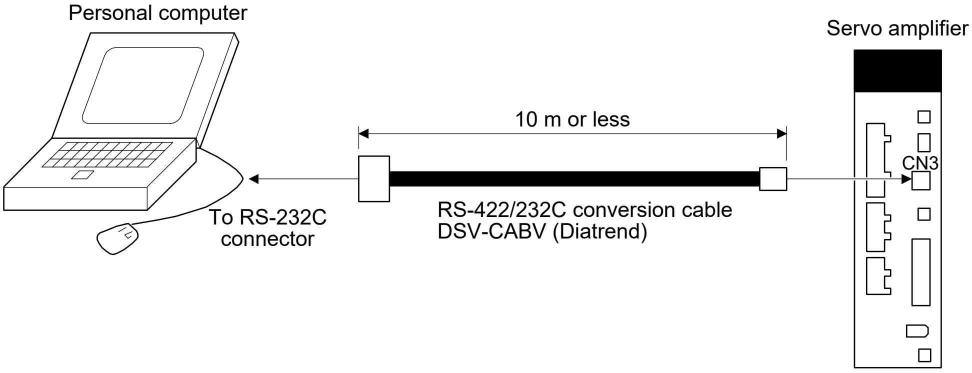
You can operate servo driving, parameter change, monitor function, etc. using RS-422 communication (Mitsubishi Electric general-purpose AC servo protocol) with the servo amplifier.

14.1 Structure

14.1.1 Configuration diagram

(1) Single axis

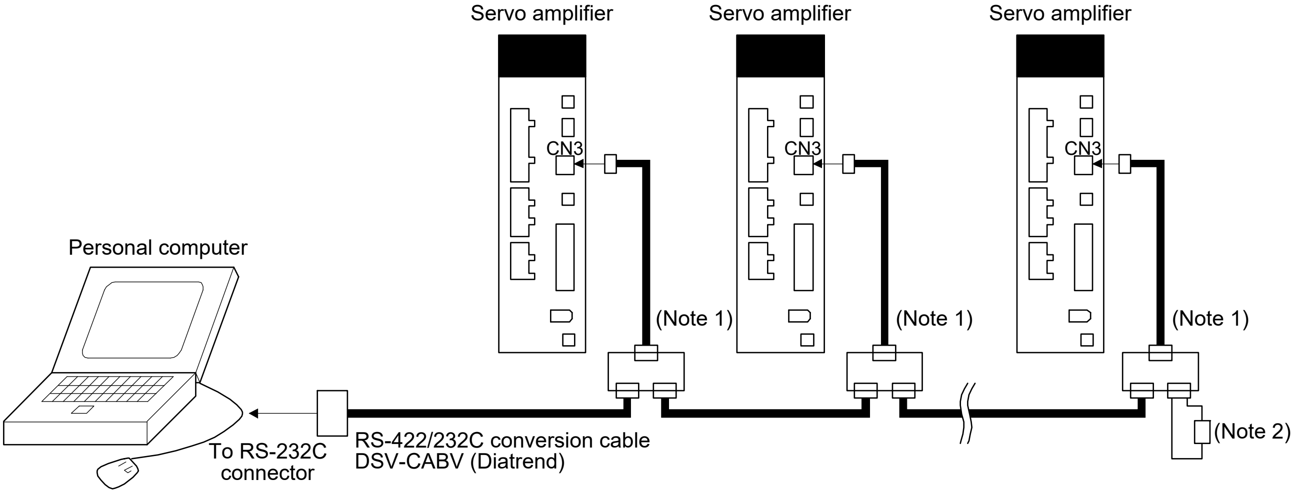
Operate the single-axis servo amplifier. It is recommended to use the following cable.



(2) Multi-drop connection

(a) Diagrammatic sketch

Up to 32 axes of servo amplifiers from stations 0 to 31 can be operated on the same bus.

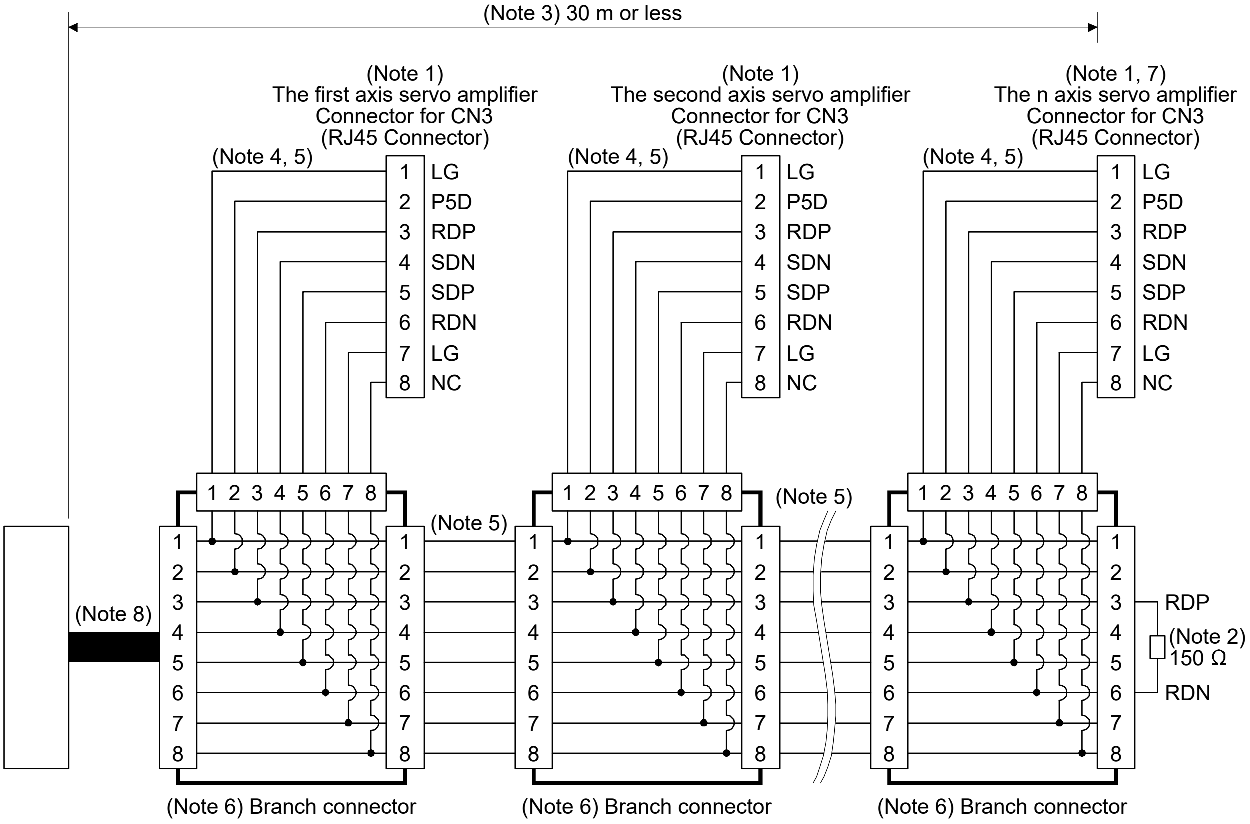


Note 1. The BMJ-8 (Hachiko Electric) is recommended as the branch connector.

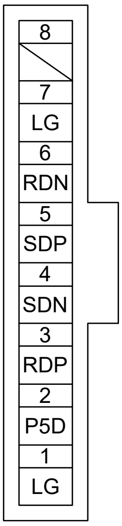
2. The final axis must be terminated between RDP (pin No. 3) and RDN (pin No. 6) on the receiving side (servo amplifier) with a 150 Ω resistor.

(b) Cable connection diagram

Wire the cables as follows.



Note 1. Recommended connector (Hirose Electric)
Plug: TM10P-88P
Connection tool: CL250-0228-1
The following shows pin assignment viewed from connector wiring section.



2. The final axis must be terminated between RDP (pin No. 3) and RDN (pin No. 6) on the receiving side (servo amplifier) with a 150 Ω resistor.
3. The overall length is 30 m or less in low-noise environment.
4. The wiring between the branch connector and servo amplifier should be as short as possible.
5. Use the EIA568-compliant cable (10BASE-T cable, etc.).
6. Recommended branch connector: BMJ-8 (Hachiko Electric)
7. n ≤ 32 (Up to 32 axes can be connected.)
8. RS-422/232C conversion cable DSV-CABV (Diatrend)

14.1.2 Precautions for using RS-422/RS-232C/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.

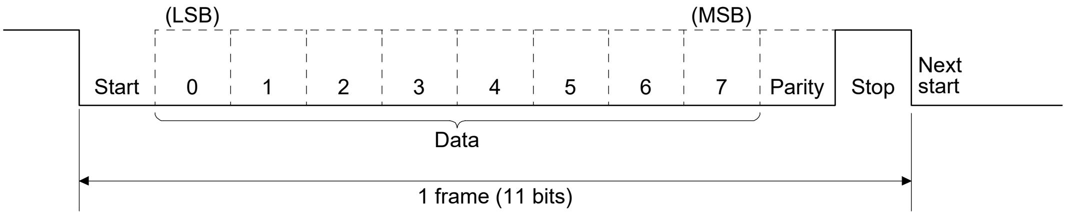
(d) Turn on the power of the servo amplifier and the device.

14.2 Communication specifications

14.2.1 Outline of communication

Receiving a command, this servo amplifier returns data. The device which gives the command (e.g. personal computer) is called a master station and the device (servo amplifier) which returns data in response to the command is called a slave station. When fetching data successively, the master station repeatedly commands the slave station to send data.

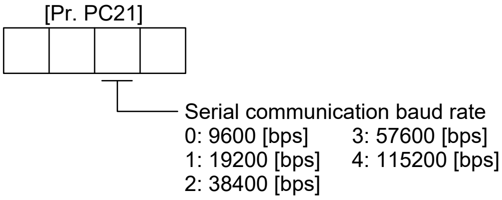
Item	Definition	
Baud rate [bps]	9600/19200/38400/57600/115200 asynchronous system	
Transfer code	Start bit Data bit Parity bit Stop bit	1 bit 8 bits 1 bit (even) 1 bit
Transfer method	Character method	Half-duplex communication method



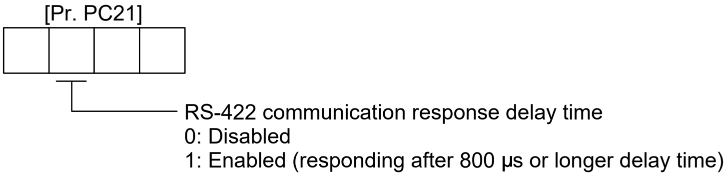
14.2.2 Parameter setting

When the RS-422 communication function is used to operate the servo, set the communication specifications of the servo amplifier with the parameters.
To enable the parameter values, cycle the power after setting.

(1) Serial communication baud rate
Select the communication speed. Match this value to the communication speed of the sending end (master station).



(2) RS-422 communication response delay time
Set the time from when the servo amplifier (slave station) receives communication data to when it returns data. Set "0" to return data in less than 800 μs or "1" to return data in 800 μs or longer.



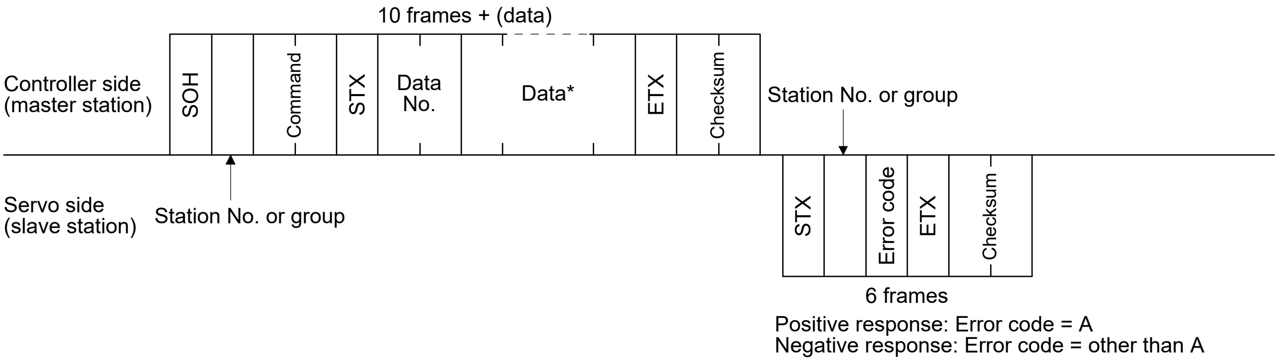
(3) Station No. setting
Set the station No. of the servo amplifier to [Pr. PC20]. The setting range is station No. 0 to 31.

14.3 Protocol

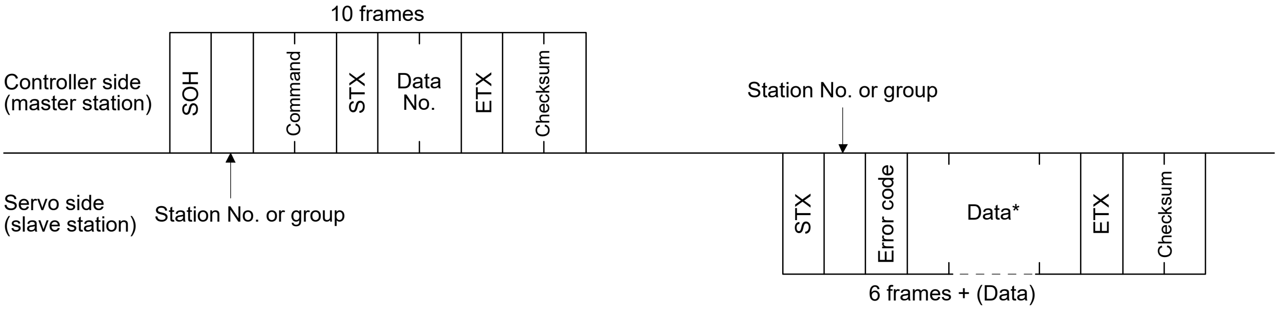
14.3.1 Transmission data configuration

Since up to 32 axes can be connected to the bus, add a station No. or group to the command or data No., etc. to determine the destination servo amplifier of data communication. Set one station No. to one servo amplifier using parameters, and set one group to one station using communication commands. Transmission data is enabled for the servo amplifier of the specified station No. or group.
When "*" is set as the station No. added to the transmission data, the transmission data is enabled for all servo amplifiers connected. However, when return data is required from the servo amplifier in response to the transmission data, set "0" to the station No. of the servo amplifier which must provide the return data.

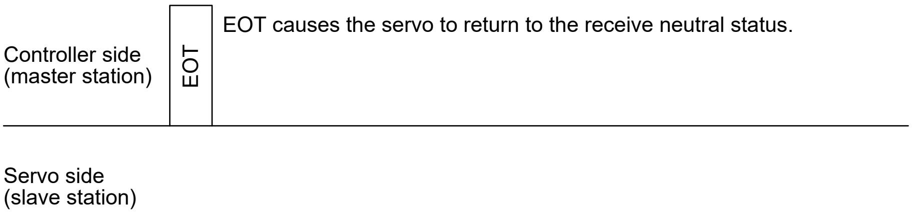
(1) Transmission of data from the controller to the servo



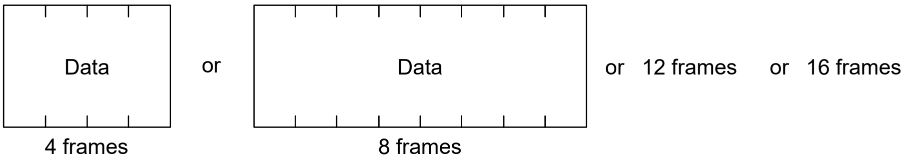
(2) Transmission of data request from the controller to the servo



(3) Recovery of communication status by time-out



(4) Data frames
The data length depends on the command.



14.3.2 Character codes

(1) Control codes

Code name	Hexadecimal (ASCII code)	Description	Personal computer terminal key operation (general)
SOH	01H	start of head	ctrl + A
STX	02H	start of text	ctrl + B
ETX	03H	end of text	ctrl + C
EOT	04H	end of transmission	ctrl + D

(2) Codes for data
ASCII unit codes are used.

b8	0	0	0	0	0	0	0	0
b7	0	0	0	0	1	1	1	1
b6	0	0	1	1	0	0	1	1
b5	0	1	0	1	0	1	0	1

b8 to b5	b4	b3	b2	b1	R C	0	1	2	3	4	5	6	7
	0	0	0	0	0	NUL	DLE	Space	0	@	P	`	p
	0	0	0	1	1	SOH	DC$_1$	!	1	A	Q	a	q
	0	0	1	0	2	STX	DC$_2$	“	2	B	R	b	r
	0	0	1	1	3	ETX	DC$_3$	#	3	C	S	c	s
	0	1	0	0	4			$	4	D	T	d	t
	0	1	0	1	5			%	5	E	U	e	u
	0	1	1	0	6			&	6	F	V	f	v
	0	1	1	1	7			‘	7	G	W	g	w
	1	0	0	0	8			(	8	H	X	h	x
	1	0	0	1	9			)	9	I	Y	i	y
	1	0	1	0	10			*	:	J	Z	j	z
	1	0	1	1	11			+	;	K	[	k	{
	1	1	0	0	12			,	<	L	¥	l	|
	1	1	0	1	13			-	=	M	]	m	}
	1	1	1	0	14			.	>	N	^	n	‾
	1	1	1	1	15			/	?	O	_	o	DEL

(3) Station numbers
You may set 32 station Nos. from station 0 to station 31 and the ASCII unit codes are used to specify the stations.

Station No.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ASCII code	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Station No.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ASCII code	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V

For example, "30H" is transmitted in hexadecimal for the station No. "0" (axis 1).

(4) Groups

Group	a	b	c	d	e	f	All groups
ASCII code	a	b	c	d	e	f	*

For example, transmit "61H" in hexadecimal for group "a".
Set only one servo amplifier for data return processing within one group. If two or more servo amplifiers return data to the controller at the same time, they may fail.

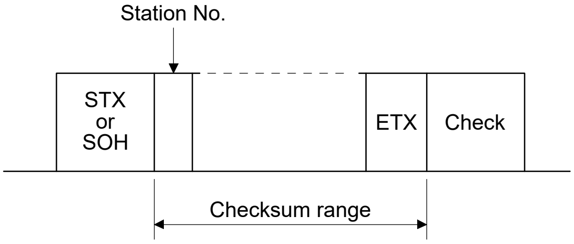
14.3.3 Error codes

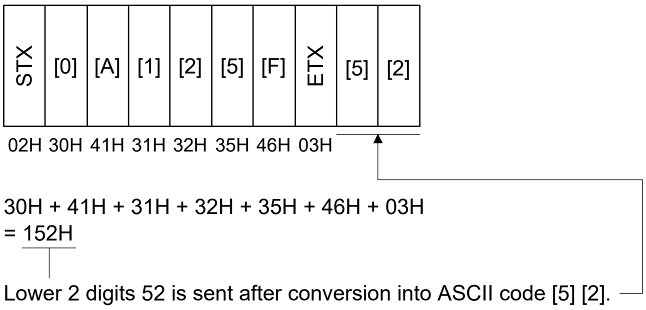
Error codes are used in the following cases and an error code of single-code length is transmitted.
Receiving data from the master station, the slave station sends the error code corresponding to that data to the master station. The error code sent in upper case indicates that the servo is normal and the one in lower case indicates that an alarm occurred.

Error code		Error name	Explanation	Remark
Servo: normal	Servo: alarm			
[A]	[a]	Normal	Data transmitted was processed normally.	Positive response
[B]	[b]	Parity error	Parity error occurred in the transmitted data.	Negative response
[C]	[c]	Checksum error	Checksum error occurred in the transmitted data.	
[D]	[d]	Character error	The transmitted character is out of specifications.	
[E]	[e]	Command error	The transmitted command is out of specifications.	
[F]	[f]	Data No. error	The transmitted data No. is out of specifications.	

14.3.4 Checksum

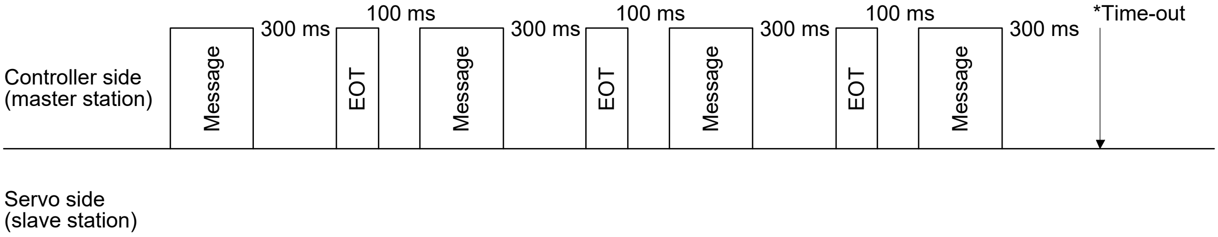
The checksum is an ASCII-coded hexadecimal representing the lower two digits of the sum of ASCII-coded hexadecimal numbers up to ETX, with the exception of the first control code (STX or SOH).





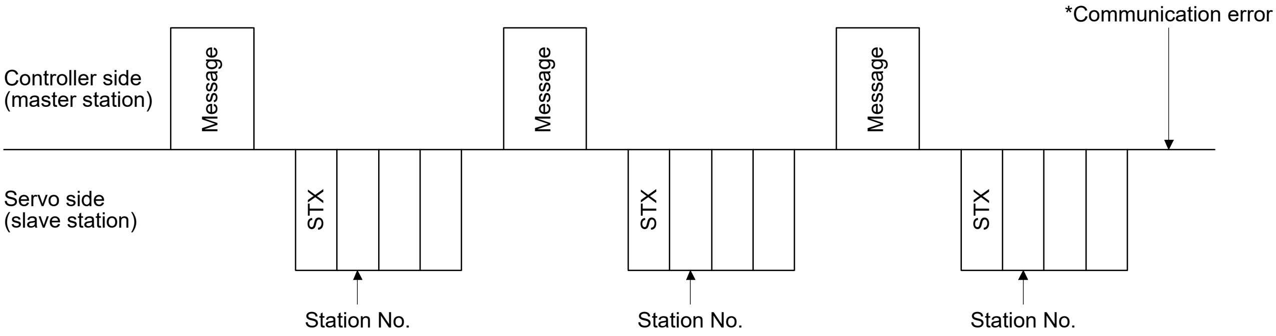
14.3.5 Time-out processing

The master station transmits EOT when the slave station does not start return processing (STX is not received) 300 [ms] after the master station has ended communication processing. 100 ms after that, the master station retransmits the message. Time-out occurs if the slave station does not answer after the master station has performed the above communication processing three times. (communication error)



14.3.6 Retry processing

When a fault occurs in communication between the master and slave stations, the error code in the response data from the slave station is a negative response code ([B] to [F], [b] to [f]). In this case, the master station retransmits the message which was sent at the occurrence of the fault (retry processing). A communication error occurs if the above processing is repeated and results in the error three or more consecutive times.



Similarly, when the master station detects a fault (e.g. checksum, parity) in the response data from the slave station, the master station retransmits the message which was sent at the occurrence of the fault. A communication error occurs if the retry processing is performed three times.

14.3.7 Initialization

After the slave station is switched on, it cannot return to communication until the internal initialization processing terminates. Hence, at power-on, ordinary communication should be started after.

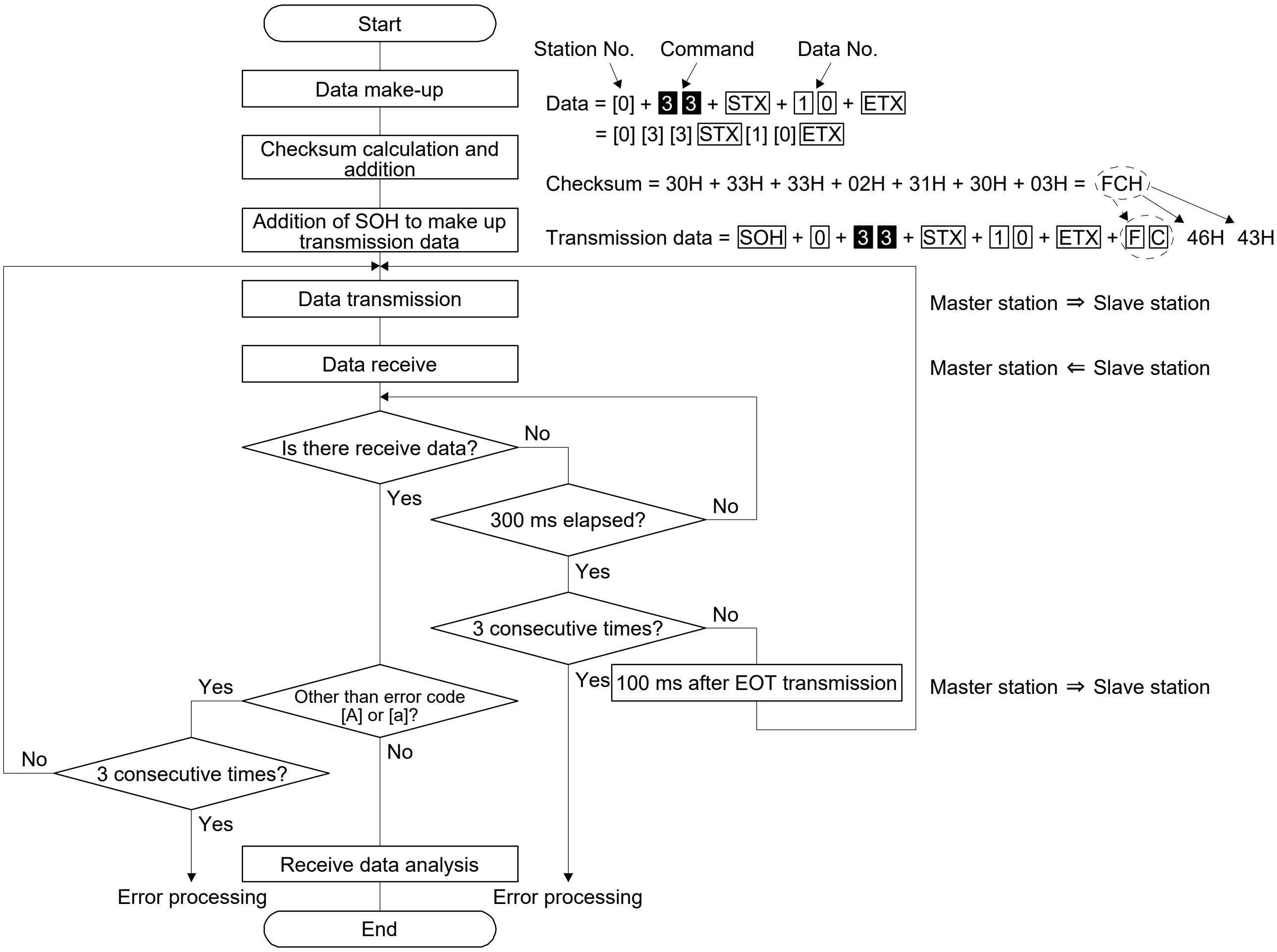
(1) Wait for 3.5 s or longer after the slave station is switched on.

(2) Check that normal communication can be made by reading the parameter or other data which does not pose any safety problems.

14.3.8 Communication procedure example

The following example reads the set value of alarm history (last alarm) from the servo amplifier of station 0.

Data item	Value	Description
Station No.	0	Servo amplifier station 0
Command	3 3	Reading command
Data No.	1 0	Alarm history (last alarm)



14.4 Command and data No. list

POINT

- Even if a command or data No. is the same between different model servo amplifiers, its description may differ.

14.4.1 Reading command

(1) Status display (command [0] [1])

Command	Data No.	Description	Status display	Frame length
[0] [1]	[0] [0]	Status display symbol and unit	Cumulative feedback pulses Motor-side cumu. feedback pulses (after gear)	16
	[0] [1]		Servo motor speed (Note 2) Servo motor speed (Note 2)	
	[0] [2]		Droop pulses Motor-side droop pulses	
	[0] [3]		Cumulative command pulses	
	[0] [4]		Command pulse frequency	
	[0] [5]		Analog speed command voltage Analog speed limit voltage	
	[0] [6]		Analog torque limit voltage Analog torque command voltage	
	[0] [7]		Regenerative load ratio	
	[0] [8]		Effective load ratio	
	[0] [9]		Peak load ratio	
	[0] [A]		Instantaneous torque Instantaneous thrust	
	[0] [B]		Position within one-revolution Motor encoder position within one-revolution Virtual position within one-revolution	
	[0] [C]		ABS counter Motor encoder ABS counter Virtual ABS counter	
	[0] [D]		Load to motor inertia ratio Load to motor mass ratio	
	[0] [E]		Bus voltage	
	[0] [F] (Note 1)		Load-side cumulative feedback pulses	
	[1] [0] (Note 1)		Load-side droop pulses	
	[1] [1] (Note 1)		Load-side encoder information 1 Z-phase counter	
	[1] [2] (Note 1)		Load-side encoder information 2	
	[1] [6] (Note 1)		Temperature of motor thermistor	
	[1] [7] (Note 1)		Motor-side cumu. feedback pulses (before gear)	
	[1] [8] (Note 1)		Electrical angle	
	[1] [E] (Note 1)		Motor-side/load-side position deviation	
	[1] [F] (Note 1)		Motor-side/load-side speed deviation	
	[2] [0]		Internal temperature of encoder	
	[2] [1]		Settling time	
	[2] [2]		Oscillation detection frequency	
	[2] [3]		Number of tough operations	
	[2] [8]		Unit power consumption	
	[2] [9]		Unit total power consumption	

Note 1. This is not available on the MR-J4-03A6(-RJ) servo amplifier.

2. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the decimal point is not used.
When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the decimal point is located in the second digit from the end.

Command	Data No.	Description	Status display	Frame length
[0] [1]	[8] [0]	Status display data value and processing information	Cumulative feedback pulses Motor-side cumu. feedback pulses (after gear)	12
	[8] [1]		Servo motor speed (Note 2) Servo motor speed (Note 2)	
	[8] [2]		Droop pulses Motor-side droop pulses	
	[8] [3]		Cumulative command pulses	
	[8] [4]		Command pulse frequency	
	[8] [5]		Analog speed command voltage Analog speed limit voltage	
	[8] [6]		Analog torque limit voltage Analog torque command voltage	
	[8] [7]		Regenerative load ratio	
	[8] [8]		Effective load ratio	
	[8] [9]		Peak load ratio	
	[8] [A]		Instantaneous torque Instantaneous thrust	
	[8] [B]		Position within one-revolution Motor encoder position within one-revolution Virtual position within one-revolution	
	[8] [C]		ABS counter Motor encoder ABS counter Virtual ABS counter	
	[8] [D]		Load to motor inertia ratio Load to motor mass ratio	
	[8] [E]		Bus voltage	
	[8] [F] (Note 1)		Load-side cumulative feedback pulses	
	[9] [0] (Note 1)		Load-side droop pulses	
	[9] [1] (Note 1)		Load-side encoder information 1 Z-phase counter	
	[9] [2] (Note 1)		Load-side encoder information 2	
	[9] [6] (Note 1)		Temperature of motor thermistor	
	[9] [7] (Note 1)		Motor-side cumu. feedback pulses (before gear)	
	[9] [8] (Note 1)		Electrical angle	
	[9] [E] (Note 1)		Motor-side/load-side position deviation	
	[9] [F] (Note 1)		Motor-side/load-side speed deviation	
	[A] [0]		Internal temperature of encoder	
	[A] [1]		Settling time	
	[A] [2]		Oscillation detection frequency	
	[A] [3]		Number of tough operations	
	[A] [8]		Unit power consumption	
	[A] [9]		Unit total power consumption	

Note 1. This is not available on the MR-J4-03A6(-RJ) servo amplifier.

2. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the decimal point is not used.
When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the decimal point is located in the second digit from the end.

(2) Parameters (command [0] [4], [0] [5], [0] [6], [0] [7], [0] [8], and [0] [9])

Command	Data No.	Description	Frame length
[0] [4]	[0] [1]	Parameter group reading 0000: Basic setting parameters ([Pr. PA_ _]) 0001: Gain/filter parameters ([Pr. PB_ _]) 0002: Extension setting parameters ([Pr. PC_ _]) 0003: I/O setting parameters ([Pr. PD_ _]) 0004: Extension setting 2 parameters ([Pr. PE_ _]) 0005: Extension setting 3 parameters ([Pr. PF_ _]) 000B: Linear servo motor/DD motor setting parameters ([Pr. PL_ _]) (Note)	4
[1] [5]	[0] [1] to [F] [F]	Current values of parameters Reads the current values of the parameters in the parameter group specified with the command [8] [5] + data No. [0] [0]. Before reading the current values, therefore, always specify the parameter group with the command [8] [5] + data No. [0] [0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter No.	12
[1] [6]	[0] [1] to [F] [F]	Upper limit values of parameter setting ranges Reads the permissible upper limit values of the parameters in the parameter group specified with the command [8] [5] + data No. [0] [0]. Before reading the upper limit values, therefore, always specify the parameter group with the command [8] [5] + data No. [0] [0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter No.	12
[1] [7]	[0] [1] to [F] [F]	Lower limit values of parameter setting ranges Reads the permissible lower limit values of the parameters in the parameter group specified with the command [8] [5] + data No. [0] [0]. Before reading the lower limit values, therefore, always specify the parameter group with the command [8] [5] + data No. [0] [0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter No.	12
[0] [8]	[0] [1] to [F] [F]	Parameter symbols Reads the symbols of the parameters in the parameter group specified with the command [8] [5] + data No. [0] [0]. Before reading the symbols, therefore, always specify the parameter group with the command [8] [5] + data No. [0] [0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter No.	12
[0] [9]	[0] [1] to [F] [F]	Writing enable/disable of parameters Reads writing enable/disable of the parameters in the parameter group specified with the command [8] [5] + data No. [0] [0]. Before reading the lower limit values, therefore, always specify the parameter group with the command [8] [5] + data No. [0] [0]. 0000: Writing enabled 0001: Writing disabled	4

Note. This is not available with the MR-J4-03A6(-RJ) servo amplifier.

(3) External I/O signals (command [1] [2])

Command	Data No.	Description	Frame length
[1] [2]	[0] [0]	Input device status	8
	[4] [0]	External input pin status	
	[6] [0]	Status of input device turned on by communication	
	[8] [0]	Output device status	
	[C] [0]	External output pin status	

(4) Alarm history (command [3] [3])

Command	Data No.	Description	Alarm occurrence sequence	Frame length
[3] [3]	[1] [0]	Alarm No. in alarm history	Most recent alarm	4
	[1] [1]		First alarm in past	
	[1] [2]		Second alarm in past	
	[1] [3]		Third alarm in past	
	[1] [4]		Fourth alarm in past	
	[1] [5]		Fifth alarm in past	
	[1] [6]		Sixth alarm in past	
	[1] [7]		Seventh alarm in past	
	[1] [8]		Eighth alarm in past	
	[1] [9]		Ninth alarm in past	
	[1] [A]		Tenth alarm in past	
	[1] [B]		Eleventh alarm in past	
	[1] [C]		Twelfth alarm in past	
	[1] [D]		Thirteenth alarm in past	
	[1] [E]		Fourteenth alarm in past	
	[1] [F]		Fifteenth alarm in past	
	[2] [0]	Alarm occurrence time in alarm history	Most recent alarm	8
	[2] [1]		First alarm in past	
	[2] [2]		Second alarm in past	
	[2] [3]		Third alarm in past	
	[2] [4]		Fourth alarm in past	
	[2] [5]		Fifth alarm in past	
	[2] [6]		Sixth alarm in past	
	[2] [7]		Seventh alarm in past	
	[2] [8]		Eighth alarm in past	
	[2] [9]		Ninth alarm in past	
	[2] [A]		Tenth alarm in past	
	[2] [B]		Eleventh alarm in past	
	[2] [C]		Twelfth alarm in past	
	[2] [D]		Thirteenth alarm in past	
	[2] [E]		Fourteenth alarm in past	
	[2] [F]		Fifteenth alarm in past	
	[4] [0]	Alarm detail No. in alarm history	Most recent alarm	4
	[4] [1]		First alarm in past	
	[4] [2]		Second alarm in past	
	[4] [3]		Third alarm in past	
	[4] [4]		Fourth alarm in past	
	[4] [5]		Fifth alarm in past	
	[4] [6]		Sixth alarm in past	
	[4] [7]		Seventh alarm in past	
	[4] [8]		Eighth alarm in past	
	[4] [9]		Ninth alarm in past	
	[4] [A]		Tenth alarm in past	
	[4] [B]		Eleventh alarm in past	
	[4] [C]		Twelfth alarm in past	
	[4] [D]		Thirteenth alarm in past	
	[4] [E]		Fourteenth alarm in past	
	[4] [F]		Fifteenth alarm in past	

(5) Current alarm (command [0] [2])

Command	Data No.	Description	Frame length
[0] [2]	[0] [0]	Current alarm No.	4

(6) Status display at alarm occurrence (command [3] [5])

Command	Data No.	Description	Status display	Frame length
[3] [5]	[0] [0]	Status display symbol and unit	Cumulative feedback pulses Motor-side cumu. feedback pulses (after gear)	16
	[0] [1]		Servo motor speed (Note 2) Servo motor speed (Note 2)	
	[0] [2]		Droop pulses Motor-side droop pulses	
	[0] [3]		Cumulative command pulses	
	[0] [4]		Command pulse frequency	
	[0] [5]		Analog speed command voltage Analog speed limit voltage	
	[0] [6]		Analog torque limit voltage Analog torque command voltage	
	[0] [7]		Regenerative load ratio	
	[0] [8]		Effective load ratio	
	[0] [9]		Peak load ratio	
	[0] [A]		Instantaneous torque Instantaneous thrust	
	[0] [B]		Position within one-revolution Motor encoder position within one-revolution Virtual position within one-revolution	
	[0] [C]		ABS counter Motor encoder ABS counter Virtual ABS counter	
	[0] [D]		Load to motor inertia ratio Load to motor mass ratio	
	[0] [E]		Bus voltage	
	[0] [F] (Note 1)		Load-side cumulative feedback pulses	
	[1] [0] (Note 1)		Load-side droop pulses	
	[1] [1] (Note 1)		Load-side encoder information 1 Z-phase counter	
	[1] [2] (Note 1)		Load-side encoder information 2	
	[1] [6] (Note 1)		Temperature of motor thermistor	
	[1] [7] (Note 1)		Motor-side cumu. feedback pulses (before gear)	
	[1] [8] (Note 1)		Electrical angle	
	[1] [E] (Note 1)		Motor-side/load-side position deviation	
	[1] [F] (Note 1)		Motor-side/load-side speed deviation	
	[2] [0]		Internal temperature of encoder	
	[2] [1]		Settling time	
	[2] [2]		Oscillation detection frequency	
	[2] [3]		Number of tough operations	
	[2] [8]		Unit power consumption	
	[2] [9]		Unit total power consumption	

Note 1. This is not available on the MR-J4-03A6(-RJ) servo amplifier.

2. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the decimal point is not used. When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the decimal point is located in the second digit from the end.

Command	Data No.	Description	Status display	Frame length
[3] [5]	[8] [0]	Status display data value and processing information	Cumulative feedback pulses Motor-side cumu. feedback pulses (after gear)	12
	[8] [1]		Servo motor speed (Note 2) Servo motor speed (Note 2)	
	[8] [2]		Droop pulses Motor-side droop pulses	
	[8] [3]		Cumulative command pulses	
	[8] [4]		Command pulse frequency	
	[8] [5]		Analog speed command voltage Analog speed limit voltage	
	[8] [6]		Analog torque limit voltage Analog torque command voltage	
	[8] [7]		Regenerative load ratio	
	[8] [8]		Effective load ratio	
	[8] [9]		Peak load ratio	
	[8] [A]		Instantaneous torque Instantaneous thrust	
	[8] [B]		Position within one-revolution Motor encoder position within one-revolution Virtual position within one-revolution	
	[8] [C]		ABS counter Motor encoder ABS counter Virtual ABS counter	
	[8] [D]		Load to motor inertia ratio Load to motor mass ratio	
	[8] [E]		Bus voltage	
	[8] [F] (Note 1)		Load-side cumulative feedback pulses	
	[9] [0] (Note 1)		Load-side droop pulses	
	[9] [1] (Note 1)		Load-side encoder information 1 Z-phase counter	
	[9] [2] (Note 1)		Load-side encoder information 2	
	[9] [6] (Note 1)		Temperature of motor thermistor	
	[9] [7] (Note 1)		Motor-side cumu. feedback pulses (before gear)	
	[9] [8] (Note 1)		Electrical angle	
	[9] [E] (Note 1)		Motor-side/load-side position deviation	
	[9] [F] (Note 1)		Motor-side/load-side speed deviation	
	[A] [0]		Internal temperature of encoder	
	[A] [1]		Settling time	
	[A] [2]		Oscillation detection frequency	
	[A] [3]		Number of tough operations	
	[A] [8]		Unit power consumption	
	[A] [9]		Unit total power consumption	

Note 1. This is not available on the MR-J4-03A6(-RJ) servo amplifier.
2. When "Speed command input unit selection (_ _ 0 _)" is set in [Pr. PC29], the decimal point is not used.
When "Speed command input unit selection (_ _ 1 _)" is set in [Pr. PC29], the decimal point is located in the second digit from the end.

(7) Test operation mode (command [0] [0])

Command	Data No.	Description	Frame length
[0] [0]	[1] [2]	Test operation mode reading 0000: Normal mode (not test operation mode) 0001: JOG operation 0002: Positioning operation 0003: Motor-less operation 0004: Output signal (DO) forced output	4

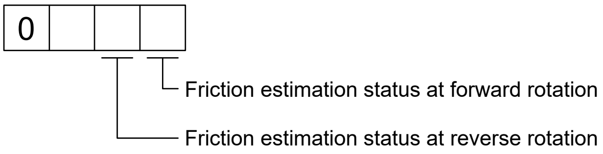
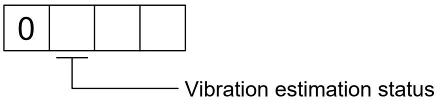
(8) Software version (command [0] [2])

Command	Data No.	Description	Frame length
[0] [2]	[9] [0]	Servo motor-side pulse unit absolute position	8
	[9] [1]	Command unit absolute position	8
	[7] [0]	Software version	16

(9) Group setting (command [1] [F])

Command	Data No.	Description	Frame length
[1] [F]	[0] [0]	Reading the group setting value	4

(10) Machine diagnosis/service life diagnosis (command [0] [2], [0] [0])

Command	Data No.	Description	Frame length
[0] [2]	[6] [0]	Reading the cumulative power-on time The cumulative power-on time (on an hourly basis) is transferred in hexadecimal.	8
	[6] [1]	Reading the number of times that the power is turned on/off The number of times that the power is turned on/off is transferred in hexadecimal.	8
[0] [0]	[4] [1]	Reading the machine diagnostic status The current machine diagnostic status is transferred in hexadecimal.  0: Estimation in progress. (normal) 1: Estimation has finished. (normal) 2: The motor may have rotated more frequently in one direction than the other. (warning) 3: The servo motor speed may be too slow for friction estimation. (warning) 4: The change in the servo motor speed may be too small for friction estimation. (warning) 5: The acceleration/deceleration time constants may be too short for friction estimation. (warning) 6: The operation time may be insufficient. (warning) When warning conditions for 2 to 6 are established at the same time, the smallest number is returned. Once an estimation finishes even after a warning has occurred, the status will change to "Estimation has finished".  0: Estimation in progress. 1: Estimation has finished.	4
	[4] [2]	Reading the static friction at forward rotation torque The static friction at forward rotation torque is transferred in increments of 0.1% in hexadecimal. For example, if the value is 10.0, "0064" is transferred. If the value is -10.0, "FF9C" is transferred.	4
	[4] [3]	Reading the dynamic friction at forward rotation torque (at rated speed) The dynamic friction at forward rotation torque (at rated speed) is transferred in increments of 0.1% in hexadecimal. For example, if the value is 10.0, "0064" is transferred. If the value is -10.0, "FF9C" is transferred.	4
	[4] [4]	Reading the static friction at reverse rotation torque The static friction at reverse rotation torque is transferred in increments of 0.1% in hexadecimal. For example, if the value is 10.0, "0064" is transferred. If the value is -10.0, "FF9C" is transferred.	4

Command	Data No.	Description	Frame length
[0] [0]	[4] [5]	Reading the dynamic friction at reverse rotation torque (at rated speed) The dynamic friction at reverse rotation torque is transferred in increments of 0.1% in hexadecimal. For example, if the value is 10.0, "0064" is transferred. If the value is -10.0, "FF9C" is transferred.	4
	[4] [6]	Reading the vibration frequency during stop/servo-lock The vibration frequency during stop/servo-lock is transferred in increments of 1 Hz in hexadecimal. For example, if the value is 700, "02BC" is transferred.	4
	[4] [7]	Reading the vibration level during stop/servo-lock The vibration level during stop/servo-lock is transferred in increments of 0.1% in hexadecimal. For example, if the value is 50.0, "01F4" is transferred.	4
	[4] [8]	Reading the vibration frequency during operation The vibration frequency during operation is transferred in increments of 1 Hz in hexadecimal. For example, if the value is 700, "02BC" is transferred.	4
	[4] [9]	Reading the vibration level during operation The vibration level during operation is transferred in increments of 0.1% in hexadecimal. For example, if the value is 50.0, "01F4" is transferred.	4

14.4.2 Writing commands

(1) Status display (command [8] [1])

Command	Data No.	Description	Setting range	Frame length
[8] [1]	[0] [0]	Status display data deletion	1EA5	4

(2) Parameters (command [9] [4], [8] [5])

Command	Data No.	Description	Setting range	Frame length
[9] [4]	[0] [1] to [F] [F]	Writing each parameter Writes the values of the parameters in the parameter group specified with the command [8] [5] + data No. [0] [0]. Before writing the values, therefore, always specify the parameter group with the command [8] [5] + data No. [0] [0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter No.	Depending on the parameter	12
[8] [5]	[0] [0]	Parameter group writing 0000: Basic setting parameters ([Pr. PA_ _]) 0001: Gain/filter parameters ([Pr. PB_ _]) 0002: Extension setting parameters ([Pr. PC_ _]) 0003: I/O setting parameters ([Pr. PD_ _]) 0004: Extension setting 2 parameters ([Pr. PE_ _]) 0005: Extension setting 3 parameters ([Pr. PF_ _]) 000B: Linear servo motor/DD motor setting parameters ([Pr. PL_ _]) (Note)	0000 to 0005	4

Note. This is not available with the MR-J4-03A6(-RJ) servo amplifier.

(3) External I/O signals (command [9] [2])

Command	Data No.	Description	Setting range	Frame length
[9] [2]	[6] [0]	Communication input device signal	Refer to section 14.5.5.	8

(4) Alarm history (command [8] [2])

Command	Data No.	Description	Setting range	Frame length
[8] [2]	[2] [0]	Alarm history clear	1EA5	4

(5) Current alarm (command [8] [2])

Command	Data No.	Description	Setting range	Frame length
[8] [2]	[0] [0]	Alarm clear	1EA5	4

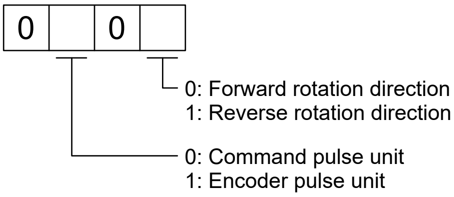
(6) I/O device prohibition (command [9] [0])

Command	Data No.	Description	Setting range	Frame length
[9] [0]	[0] [0]	Turns off the input device, external analog input signal or pulse train input, except EMG, LSP and LSN, independently of the external on/off status.	1EA5	4
	[0] [3]	Disables all output devices (DO).	1EA5	4
	[1] [0]	Cancels the prohibition of the input device, external analog input signal or pulse train input, except EMG, LSP and LSN.	1EA5	4
	[1] [3]	Cancels the prohibition of the output device.	1EA5	4

(7) Operation mode selection (command [8] [B])

Command	Data No.	Description	Setting range	Frame length
[8] [B]	[0] [0]	Selection of test operation mode 0000: Test operation mode cancel 0001: JOG operation 0002: Positioning operation 0004: Output signal (DO) forced output	0000 to 0002, 0004	4

(8) Test operation mode data (command [9] [2], [A] [0])

Command	Data No.	Description	Setting range	Frame length
[9] [2]	[0] [0]	Input signal for test operation	Refer to section 14.5.7.	8
	[A] [0]	Forced output of signal pin	Refer to section 14.5.9.	8
[A] [0]	[1] [0]	Writes the servo motor speed in the test operation mode (JOG operation and positioning operation).	0000 to 7FFF	4
	[1] [1]	Writes the acceleration/deceleration time constant in the test operation mode (JOG operation and positioning operation).	00000000 to 7FFFFFFF	8
	[2] [0]	Sets the travel distance in the test operation mode (Positioning operation).	00000000 to 7FFFFFFF	8
	[2] [1]	Selects the positioning direction of test operation (positioning operation). 	0000 to 0101	4
	[4] [0]	This is a start command for test operation (positioning operation).	1EA5	4
	[4] [1]	This is used to make a temporary stop during test operation (positioning operation). "□" in the data indicates a blank. STOP: Temporary stop GO□□: Restart for remaining distance CLR□: Remaining distance clear	STOP GO□□ CLR□	4

(9) Group setting (command [9] [F])

Command	Data No.	Description	Setting range	Frame length
[9] [F]	[0] [0]	Reading the group setting value	Refer to section 14.5.12.	4

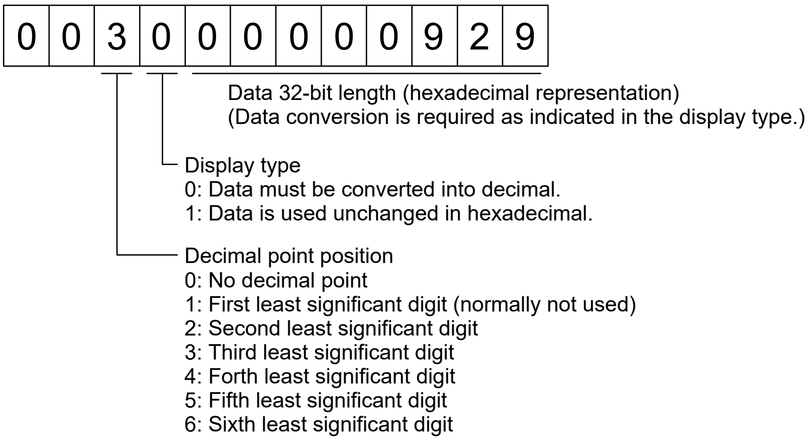
14.5 Detailed explanations of commands

14.5.1 Data processing

When the master station transmits a command data No. or a command + data No. + data to a slave station, the servo amplifier returns a response or data in accordance with the purpose.
When numerical values are represented in these send data and receive data, they are represented in decimal, hexadecimal, etc.
Therefore, data must be processed in accordance with the application.
Since whether data must be processed or not and how to process data depend on the monitoring, parameters, etc., follow the detailed explanation of the corresponding command.
The following methods are how to process send and receive data when reading and writing data.

(1) Processing a read data
When the display type is 0, the eight-character data is converted from hexadecimal to decimal and a decimal point is placed according to the decimal point position information.
When the display type is 1, the eight-character data is used unchanged.

The following example indicates how to process the receive data "003000000929" given to show.
The receive data is as follows.

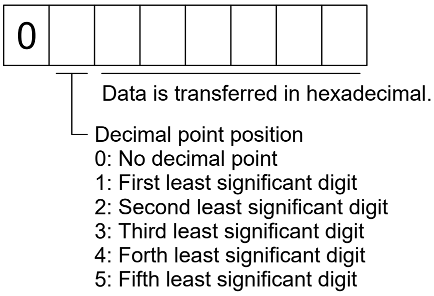


Since the display type is "0" in this case, the hexadecimal data is converted into decimal.
00000929H → 2345
As the decimal point position is "3", a decimal point is placed in the third least significant digit. Hence, "23.45" is displayed.

(2) Writing processed data

When the data to be written is handled as decimal, the decimal point position must be specified. If it is not specified, the data cannot be written. When the data is handled as hexadecimal, specify "0" as the decimal point position.

The data to be sent is the following value.



For example, here is described how to process the set data when a value of "15.5" is sent.

Since the decimal point position is the second least significant digit, the decimal point position data is "2".

As the data to be sent is hexadecimal, the decimal data is converted into hexadecimal.

155 → 9B

Hence, "0200009B" is transmitted.

14.5.2 Status display mode

(1) Reading the status display name and unit

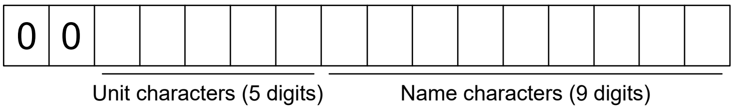
The following shows how to read the status display name and unit.

(a) Transmission

Transmit the command [0] [1] and the data No. corresponding to the status display item to be read. (Refer to section 14.4.1.)

(b) Return

The slave station returns the status display name and unit requested.



(2) Status display data reading

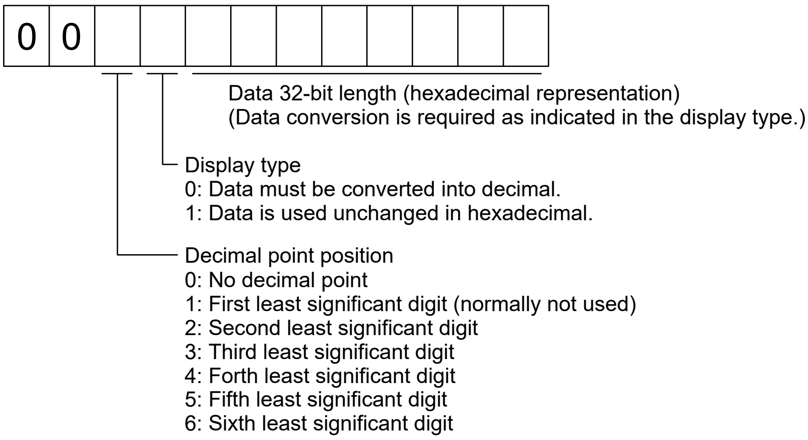
The following shows how to read the status display data and processing information.

(a) Transmission

Transmit the command [0] [1] and the data No. corresponding to the status display item to be read. (Refer to section 14.4.1.)

(b) Return

The slave station returns the status display data requested.



(3) Status display data clear

To clear the cumulative feedback pulse data of the status display, send this command immediately after reading each status display item. The data of the status display item transmitted is cleared to "0".

Command	Data No.	Data
[8] [1]	[0] [0]	1EA5

For example, after sending command [0] [1] and data No. [8] [0] and receiving the status display data, send command [8] [1], data No. [0] [0] and data [1EA5] to clear the cumulative feedback pulse value to "0".

14.5.3 Parameter

(1) Specification of the parameter group

To read or write the parameter settings, etc., the group of the parameters to be operated must be specified in advance. Write data to the servo amplifier as follows to specify the parameter group.

Command	Data No.	Transmission data	Parameter group
[8] [5]	[0] [0]	0000	Basic setting parameters ([Pr. PA_ _])
		0001	Gain/filter parameters ([Pr. PB_ _])
		0002	Extension setting parameters ([Pr. PC_ _])
		0003	I/O setting parameters ([Pr. PD_ _])
		0004	Extension setting 2 parameters ([Pr. PE_ _])
		0005	Extension setting 3 parameters ([Pr. PF_ _])
		000B (Note)	Linear servo motor/DD motor setting parameters ([Pr. PL_ _])

Note. This is not available with the MR-J4-03A6(-RJ) servo amplifier.

(2) Parameter group reading

The following shows how to read the parameter group set with slave station.

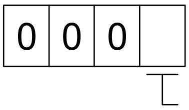
(a) Transmission

Transmit command [0] [4] and data No. [0] [1].

Command	Data No.
[0] [4]	[0] [1]

(b) Return

The slave station returns the preset parameter group.



Parameter group
0: Basic setting parameters ([Pr. PA_ _])
1: Gain/filter parameters ([Pr. PB_ _])
2: Extension setting parameters ([Pr. PC_ _])
3: I/O setting parameters ([Pr. PD_ _])
4: Extension setting 2 parameters ([Pr. PE_ _])
5: Extension setting 3 parameters ([Pr. PF_ _])
B: Linear servo motor/DD motor setting parameters ([Pr. PL_ _])

(3) Reading symbols

The following shows how to read symbols of parameters. Specify a parameter group in advance. (Refer to (1) in this section.)

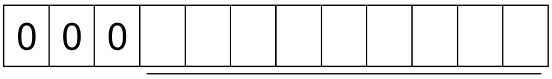
(a) Transmission

Transmit the command [0] [8] and the data No. corresponding to the status display item to be read. (Refer to section 14.4.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter No.

(b) Return

The slave station returns the symbol of the parameter requested.



Symbol characters (9 digits)

(4) Reading the setting

The following shows how to read the parameter setting. Specify a parameter group in advance. (Refer to (1) in this section.)

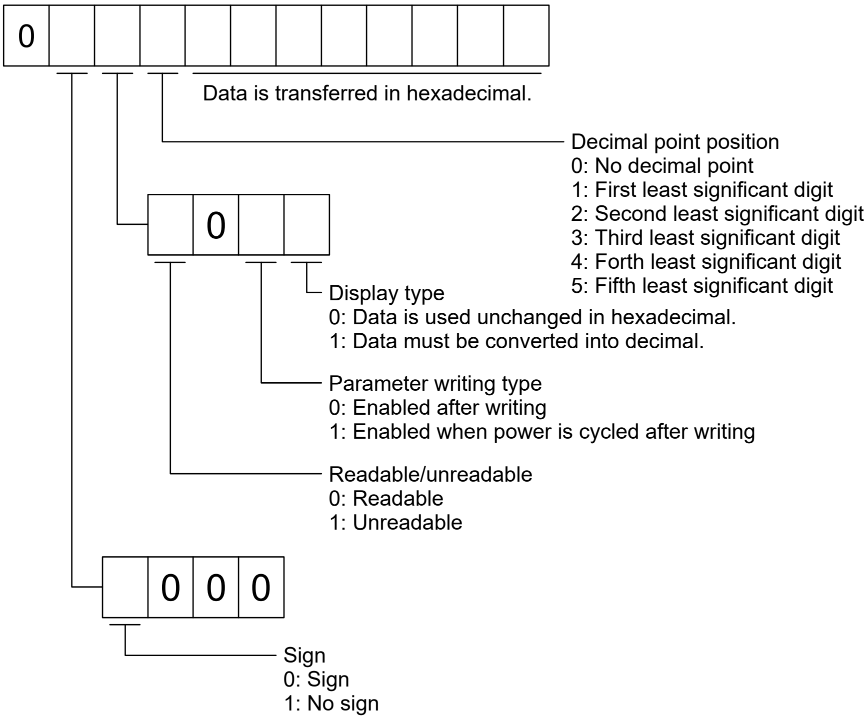
(a) Transmission

Transmit the command [1] [5] and the data No. corresponding to the status display item to be read. (Refer to section 14.4.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter No.

(b) Return

The slave station returns the data and processing information of the parameter No. requested.



For example, data "00120000270F" means 999.9 (decimal display format) and data "000000003ABC" means 3ABC (hexadecimal display format).

When the display type is "0" (hexadecimal) and the decimal point position is other than 0, the display type is a special hexadecimal display format and "F" of the data value is handled as a blank. Data "0001FFFFF053" means 053 (special hexadecimal display format).

"008000000000" is transferred when the parameter that was read is the one inaccessible for reference in the parameter writing inhibit setting of [Pr. PA19].

(5) Reading the setting range

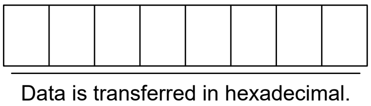
The following shows how to read the parameter setting range. Specify a parameter group in advance. (Refer to (1) in this section.)

(a) Transmission

When reading an upper limit value, transmit the command [1] [6] and the data No. corresponding to the status display item to be read. When reading a lower limit value, transmit the command [1] [7] and the data No. corresponding to the status display item to be read. (Refer to section 14.4.1.)
The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter No.

(b) Return

The slave station returns the data and processing information of the parameter No. requested.



For example, data "FFFFFFEC" means "-20".

(6) Parameters writable/not writable

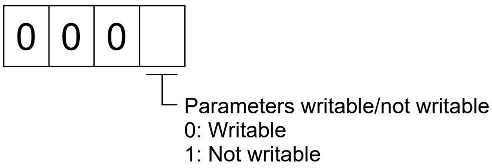
The following describes how to check whether parameters can be written or not. Specify a parameter group in advance. (Refer to (1) in this section.)

(a) Transmission

Transmit the command [0] [9] and the data No. corresponding to the status display item to be read. (Refer to section 14.4.1.)
The data No. is represented in hexadecimal. The decimal converted from the data No. value corresponds to the parameter No.

(b) Return

The slave station returns the data and processing information of the requested parameter No.



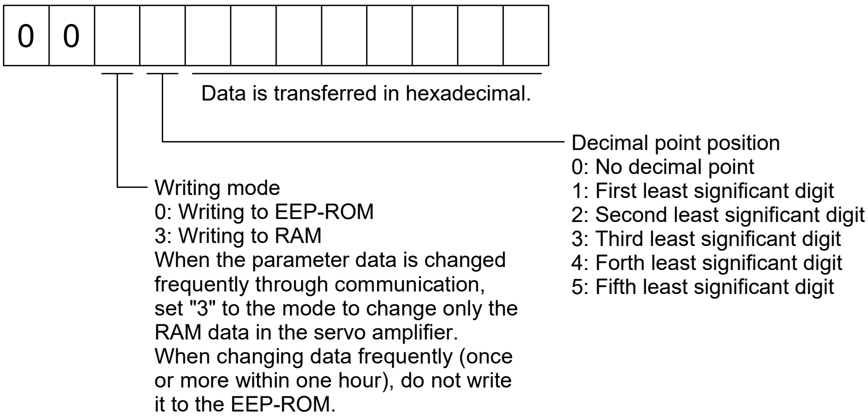
(7) Writing setting values

POINT

- If setting values need to be changed with a high frequency (i.e. one time or more per one hour), write the setting values to the RAM, not the EEP-ROM. The EEPROM has a limitation in the number of write times and exceeding this limitation causes the servo amplifier to malfunction. Note that the number of write times to the EEP-ROM is limited to approximately 100, 000.

Write the parameter setting into EEP-ROM of the servo amplifier. Specify a parameter group in advance. (Refer to (1) in this section.)
Write any value within the setting enabled range. For the setting enabled range, refer to chapter 5 or read the setting range by performing operation in (4) in this section.
Transmit command [9] [4], the data No. , and the set data.
The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter No.
When the data to be written is handled as decimal, the decimal point position must be specified. If it is not specified, the data cannot be written. When the data is handled as hexadecimal, specify "0" as the decimal point position.
Check the writing data is within the upper/lower limit value before writing. To prevent an error, read the parameter data to be written, confirm the decimal point position, and create transmission data.
On completion of writing, read the same parameter data to verify that data has been written correctly.

Command	Data No.	Data
[9] [4]	[0] [1] to [F] [F]	See below.



14.5.4 External I/O signal status (DIO diagnosis)

(1) Reading input device status

The following shows how to read the status of the input devices.

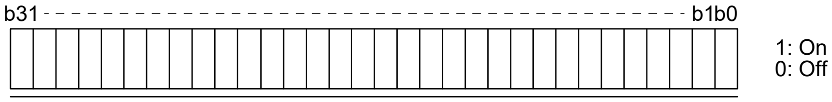
(a) Transmission

Transmit command [1] [2] and data No. [0] [0].

Command	Data No.
[1] [2]	[0] [0]

(b) Return

The slave station returns the status of the input devices.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol	Bit	Symbol	Bit	Symbol	Bit	Symbol
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1/RS2	19		27	CDP
4	TL1	12	ST2/RS1	20	STAB2	28	CLD (Note)
5	PC	13	CM1	21		29	MECR (Note)
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

Note. This is not available with the MR-J4-03A6(-RJ) servo amplifier.

(2) Reading external input pin status

The following shows how to read the on/off status of the external input pins.

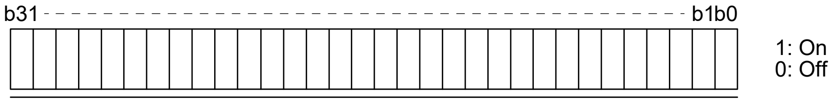
(a) Transmission

Transmit command [1] [2] and data No. [4] [0].

Command	Data No.
[1] [2]	[4] [0]

(b) Return

The on/off status of the input pins are returned.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	CN1 connector pin	Bit	CN1 connector pin	Bit	CN1 connector pin	Bit	CN1 connector pin
0	43	8	18	16		24	
1	44	9	45	17		25	
2	42	10		18		26	
3	15	11		19		27	
4	19	12		20		28	
5	41	13		21		29	
6	16	14		22		30	
7	17	15		23		31	

(3) Reading the status of input devices switched on with communication

The following shows how to read the on/off status of the input devices switched on with communication.

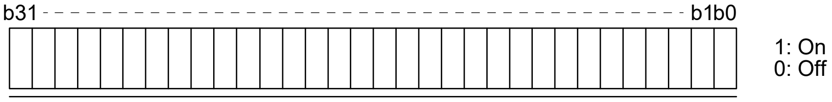
(a) Transmission

Transmit command [1] [2] and data No. [6] [0].

Command	Data No.
[1] [2]	[6] [0]

(b) Return

The slave station returns the status of the input devices.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol	Bit	Symbol	Bit	Symbol	Bit	Symbol
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1/RS2	19		27	CDP
4	TL1	12	ST2/RS1	20	STAB2	28	CLD (Note)
5	PC	13	CM1	21		29	MECR (Note)
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

Note. This is not available with the MR-J4-03A6(-RJ) servo amplifier.

(4) Reading external output pin status

The following shows how to read the on/off status of the external output pins.

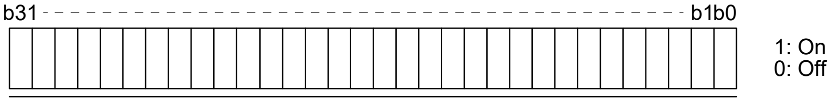
(a) Transmission

Transmit command [1] [2] and data No. [C] [0].

Command	Data No.
[1] [2]	[C] [0]

(b) Return

The slave station returns the status of the output devices.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	CN1 connector pin	Bit	CN1 connector pin	Bit	CN1 connector pin	Bit	CN1 connector pin
0	49	8	14 (Note)	16		24	
1	24	9		17		25	
2	23	10		18		26	
3	25	11		19		27	
4	22	12		20		28	
5	48	13		21		29	
6	33	14		22		30	
7	13 (Note)	15		23		31	

Note. This is available when devices are assigned to the CN1-13 pin and CN1-14 pin with MR-J4-_A_-RJ 100 W or more servo amplifiers with software version B3 or later. This is not available with the MR-J4-03A6(-RJ) servo amplifier.

(5) Reading output device status

The following shows how to read the on/off status of the output devices.

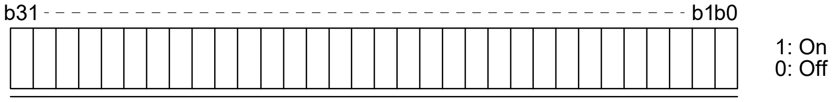
(a) Transmission

Transmit command [1] [2] and data No. [8] [0].

Command	Data No.
[1] [2]	[8] [0]

(b) Return

The slave station returns the status of the input/output devices.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol
0	RD
1	SA
2	ZSP
3	TLC
4	VLC
5	INP
6	
7	WNG

Bit	Symbol
8	ALM
9	OP
10	MBR
11	DB (Note)
12	ACD0
13	ACD1
14	ACD2
15	BWNG

Bit	Symbol
16	
17	
18	
19	
20	
21	
22	
23	

Bit	Symbol
24	
25	CDPS
26	CLDS (Note)
27	ABSV
28	
29	
30	
31	MTTR (Note)

Note. This is not available with the MR-J4-03A6(-RJ) servo amplifier.

14.5.5 Input device on/off

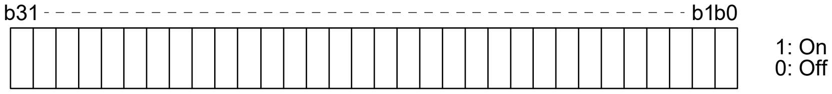
POINT

- ●The on/off status of all devices in the servo amplifier are the status of the data received at last. Therefore, when there is a device which must be kept on, transmit data which turns the device on every time.

Each input device can be switched on/off. However, when the device to be switched off is in the external input signal, also switch off the input signal.

Transmit command [9] [2], data No. [6] [0], and data.

Command	Data No.	Set data
[9] [2]	[6] [0]	See below.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol	Bit	Symbol	Bit	Symbol	Bit	Symbol
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1/RS2	19		27	CDP
4	TL1	12	ST2/RS1	20	STAB2	28	CLD (Note)
5	PC	13	CM1	21		29	MECR (Note)
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

Note. This is not available with the MR-J4-03A6(-RJ) servo amplifier.

14.5.6 Disabling/enabling I/O devices (DIO)

You can disable inputs regardless of the I/O device status. When inputs are disabled, the input signals (devices) are recognized as follows. However, EM2 (Forced stop 2), LSP (Forward rotation stroke end), and LSN (Reverse rotation stroke end) cannot be disabled.

Signal	Status
Input device (DI)	Off
External analog input signal	0 V
Pulse train input	None

(1) Disabling/enabling the input devices (DI), external analog input signals and pulse train inputs except EM2 (Forced stop 2), LSP (Forward rotation stroke end), and LSN (Reverse rotation stroke end). Transmit the following communication commands.

(a) Disabling

Command	Data No.	Data
[9] [0]	[0] [0]	1EA5

(b) Enabling

Command	Data No.	Data
[9] [0]	[1] [0]	1EA5

(2) Disabling/enabling the output devices (DO)
Transmit the following communication commands.

(a) Disabling

Command	Data No.	Data
[9] [0]	[0] [3]	1EA5

(b) Enabling

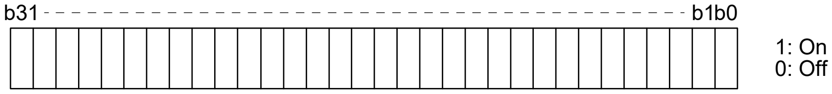
Command	Data No.	Data
[9] [0]	[1] [3]	1EA5

14.5.7 Input devices on/off (test operation)

Each input devices can be turned on/off for test operation. However, when the device to be switched off is in the external input signal, also switch off the input signal.

Transmit command [9] [2], data No. [0] [0], and data.

Command	Data No.	Set data
[9] [2]	[0] [0]	See below.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol	Bit	Symbol	Bit	Symbol	Bit	Symbol
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1	19		27	CDP
4	TL1	12	ST2	20	STAB2	28	CLD (Note)
5	PC	13	CM1	21		29	MECR (Note)
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

Note. This is not available with the MR-J4-03A6(-RJ) servo amplifier.

14.5.8 Test operation mode

POINT

- ●The test operation mode is used to check operation. Do not use it for actual operation.
- ●If communication stops for longer than 0.5 s during test operation, the servo amplifier decelerates to a stop, resulting in servo-lock. To prevent this, continue communication all the time by monitoring the status display, etc.
- ●Even during operation, you can switch the servo amplifier to the test operation mode. In this case, switching to the test operation mode will shut off the base circuit to coast the motor.

(1) How to prepare and cancel the test operation mode

(a) Preparing the test operation mode

Set the test operation mode type with the following procedure.

1) Selection of test operation mode

Send the command [8] [B] + data No. [0] [0] + data to select the test operation mode.

Command	Data No.	Transmission data	Selection of test operation mode
[8] [B]	[0] [0]	0001	JOG operation
		0002	Positioning operation
		0004	Output signal (DO) forced output (Note)

Note. Refer to section 14.5.9 for output signal (DO) forced output.

2) Check of test operation mode

Read the test operation mode set for the slave station, and check that it is set correctly.

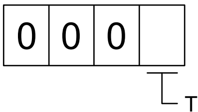
a) Transmission

Transmit command [0] [0] and data No. [1] [2].

Command	Data No.
[0] [0]	[1] [2]

b) Reply

The slave station returns the preset operation mode.



Test operation mode reading
0: Normal mode (not test operation mode)
1: JOG operation
2: Positioning operation
3: Motor-less operation
4: Output signal (DO) forced output

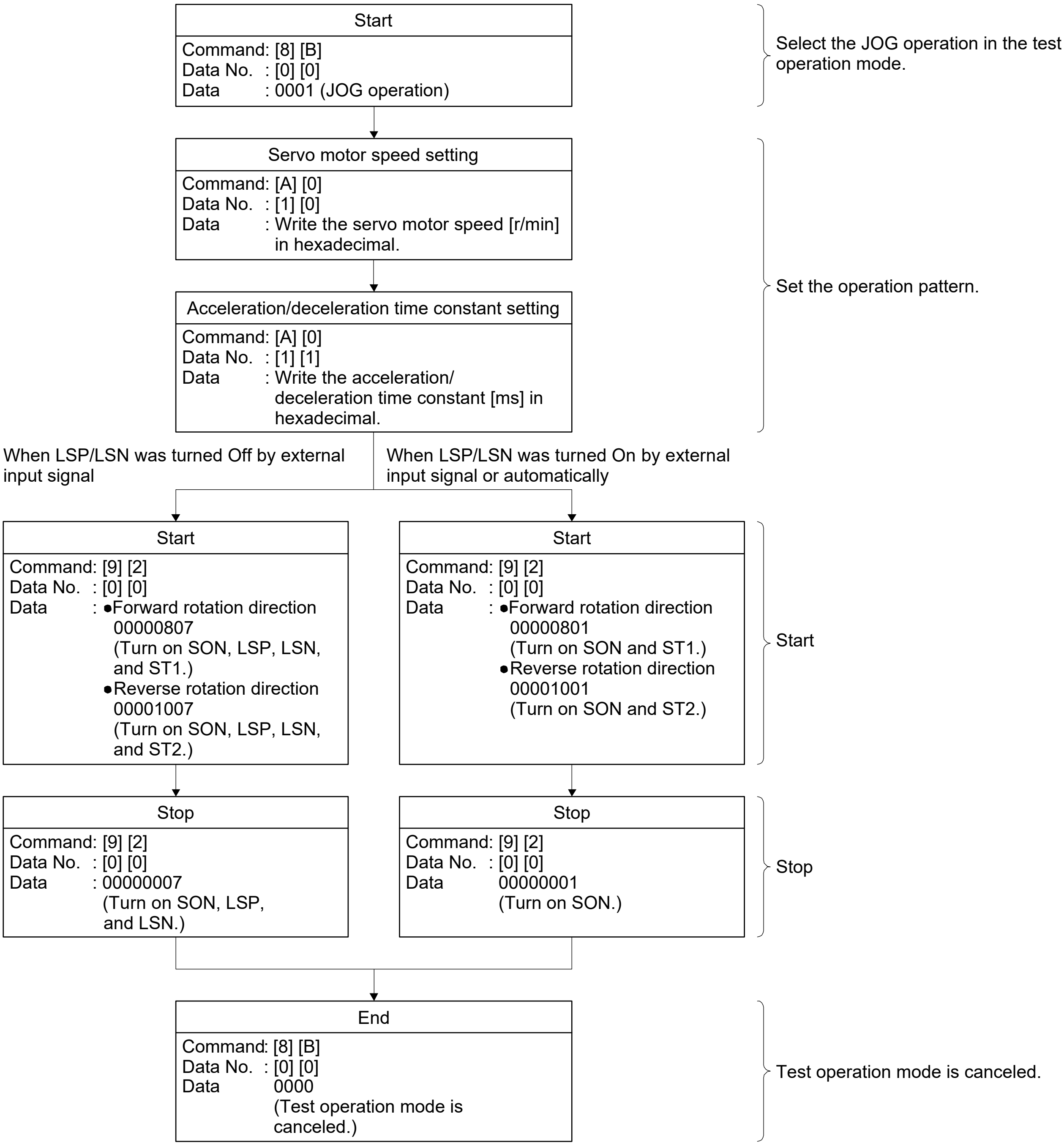
(b) Cancel of test operation mode

To terminate the test operation mode, send the command [8] [B] + data No. [0] [0] + data.

Command	Data No.	Transmission data	Selection of test operation mode
[8] [B]	[0] [0]	0000	Test operation mode cancel

(2) JOG operation

Transmit the command, data No., and data as follows to execute JOG operation.



Start

Command: [8] [B]
Data No. : [0] [0]
Data : 0001 (JOG operation)

Select the JOG operation in the test operation mode.

Servo motor speed setting

Command: [A] [0]
Data No. : [1] [0]
Data : Write the servo motor speed [r/min] in hexadecimal.

Acceleration/deceleration time constant setting

Command: [A] [0]
Data No. : [1] [1]
Data : Write the acceleration/ deceleration time constant [ms] in hexadecimal.

Set the operation pattern.

When LSP/LSN was turned Off by external input signal

Start

Command: [9] [2]
Data No. : [0] [0]
Data : ●Forward rotation direction 00000807 (Turn on SON, LSP, LSN, and ST1.)
●Reverse rotation direction 00001007 (Turn on SON, LSP, LSN, and ST2.)

Stop

Command: [9] [2]
Data No. : [0] [0]
Data : 00000007 (Turn on SON, LSP, and LSN.)

When LSP/LSN was turned On by external input signal or automatically

Start

Command: [9] [2]
Data No. : [0] [0]
Data : ●Forward rotation direction 00000801 (Turn on SON and ST1.)
●Reverse rotation direction 00001001 (Turn on SON and ST2.)

Stop

Command: [9] [2]
Data No. : [0] [0]
Data 00000001 (Turn on SON.)

Start

Stop

End

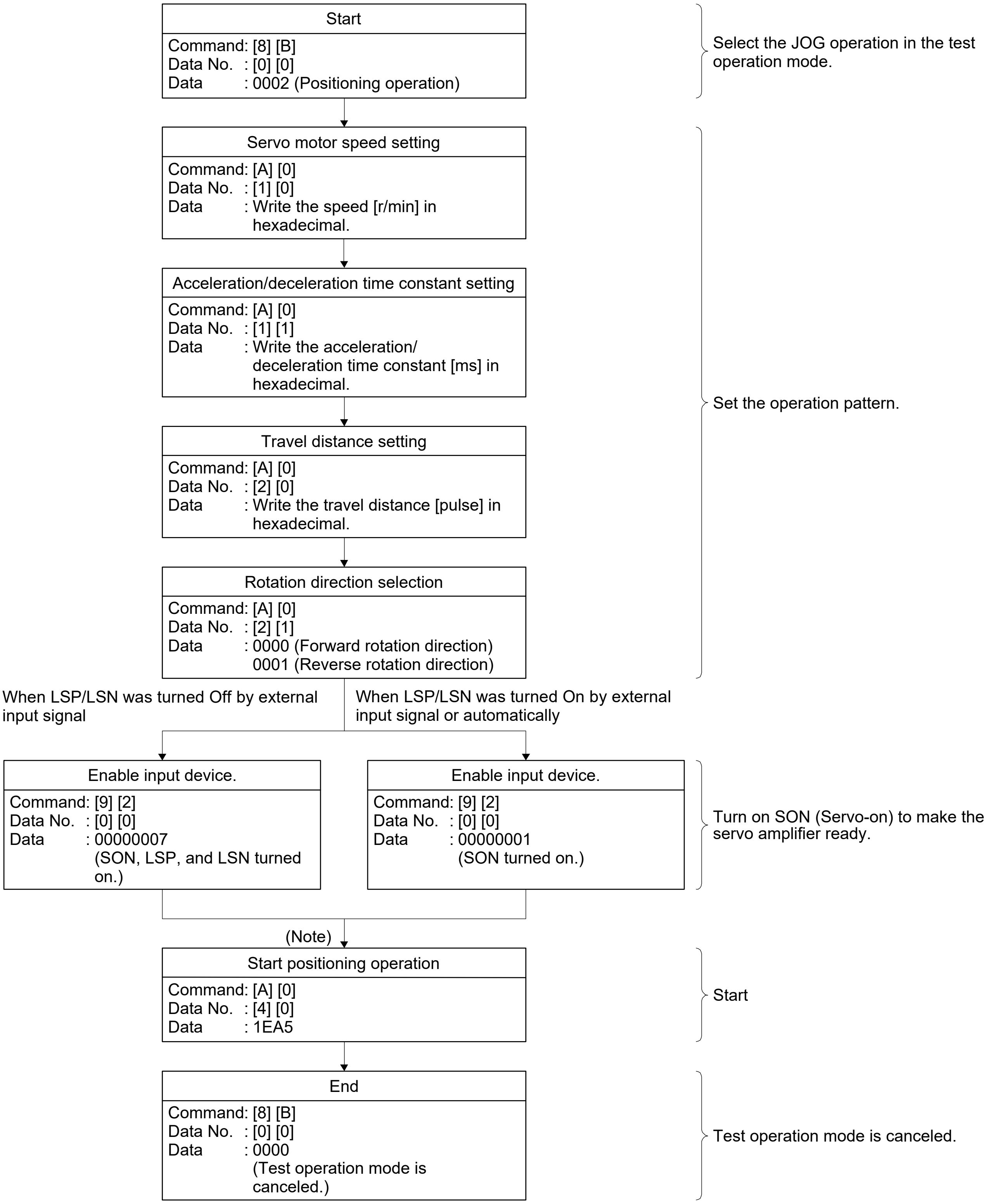
Command: [8] [B]
Data No. : [0] [0]
Data 0000 (Test operation mode is canceled.)

Test operation mode is canceled.

(3) Positioning operation

(a) Operation procedure

Transmit the command, data No., and data as follows to execute positioning operation.



Start

Command: [8] [B]
Data No. : [0] [0]
Data : 0002 (Positioning operation)

Select the JOG operation in the test operation mode.

Servo motor speed setting

Command: [A] [0]
Data No. : [1] [0]
Data : Write the speed [r/min] in hexadecimal.

Acceleration/deceleration time constant setting

Command: [A] [0]
Data No. : [1] [1]
Data : Write the acceleration/ deceleration time constant [ms] in hexadecimal.

Travel distance setting

Command: [A] [0]
Data No. : [2] [0]
Data : Write the travel distance [pulse] in hexadecimal.

Rotation direction selection

Command: [A] [0]
Data No. : [2] [1]
Data : 0000 (Forward rotation direction)
0001 (Reverse rotation direction)

Set the operation pattern.

When LSP/LSN was turned Off by external input signal

Enable input device.

Command: [9] [2]
Data No. : [0] [0]
Data : 00000007
(SON, LSP, and LSN turned on.)

When LSP/LSN was turned On by external input signal or automatically

Enable input device.

Command: [9] [2]
Data No. : [0] [0]
Data : 00000001
(SON turned on.)

Turn on SON (Servo-on) to make the servo amplifier ready.

(Note)

Start positioning operation

Command: [A] [0]
Data No. : [4] [0]
Data : 1EA5

Start

End

Command: [8] [B]
Data No. : [0] [0]
Data : 0000
(Test operation mode is canceled.)

Test operation mode is canceled.

Note. It has 100 ms delay.

(b) Temporary stop/restart/remaining distance clear

Transmit the following command, data No., and data during positioning operation to make deceleration to a stop.

Command	Data No.	Data
[A] [0]	[4] [1]	STOP

Transmit the following command, data No., and data during a temporary stop to restart.

Command	Data No.	(Note) Data
[A] [0]	[4] [1]	GO□□

Note. "□" indicates a blank.

Transmit the following command, data No., and data during a temporary stop to stop positioning operation and erase the travel remaining distance.

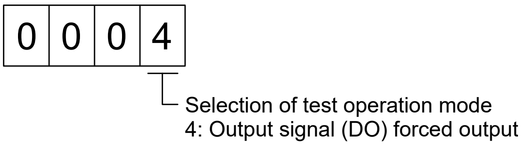
Command	Data No.	(Note) Data
[A] [0]	[4] [1]	CLR□

Note. "□" indicates a blank.

14.5.9 Output signal pin on/off (output signal (DO) forced output)

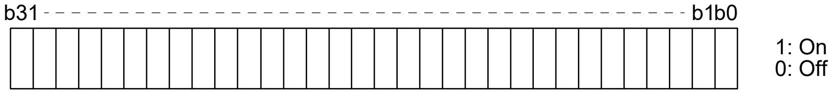
In the test operation mode, the output signal pins can be turned on/off regardless of the servo status. Using command [9] [0], disable the external output signals in advance.

(1) Selecting output signal (DO) forced output in the test operation mode
Transmit command + [8] [B] + data No. [0] [0] + data "0004" to select output signal (DO) forced output.



(2) External output signal on/off
Transmit the following communication commands.

Command	Data No.	Set data
[9] [2]	[A] [0]	See below.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	CN1 connector pin	Bit	CN1 connector pin	Bit	CN1 connector pin	Bit	CN1 connector pin
0	49	8	14 (Note)	16		24	
1	24	9		17		25	
2	23	10		18		26	
3	25	11		19		27	
4	22	12		20		28	
5	48	13		21		29	
6	33	14		22		30	
7	13 (Note)	15		23		31	

Note. The MR-J4-_A_-RJ 100 W or more servo amplifier is available with software version B3 or later. This is not available with the MR-J4-03A6(-RJ) servo amplifier.

(3) Output signal (DO) forced output
Transmit command [8] [B] + data No. [0] [0] + data to stop output signal (DO) forced output.

Command	Data No.	Transmission data	Selection of test operation mode
[8] [B]	[0] [0]	0000	Test operation mode cancel

14.5.10 Alarm history

(1) Alarm No. reading

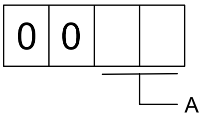
The following shows how to read alarm Nos. which occurred in the past. The numbers of the 0th alarm (last alarm) through the 15th alarm (sixteenth last alarm) can be read.

(a) Transmission

Transmit the command [3] [3] and the data No. corresponding to the status display item to be read. (Refer to section 14.4.1.)

(b) Return

Alarm Nos. corresponding to the data No. is provided.



Alarm No. is transferred in hexadecimal.

For example, "0032" means [AL. 32] and "00FF" means [AL. _ _] (no alarm).

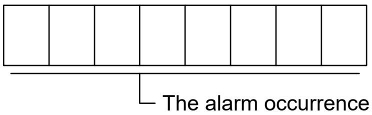
(2) Alarm occurrence time reading

The following shows how to read alarm occurrence times which occurred in the past.
Alarm occurrence time corresponding to the data No. is provided in terms of the total time beginning with operation start, with the minute unit omitted.

(a) Transmission

Transmit the command [3] [3] and the data No. corresponding to the status display item to be read. (Refer to section 14.4.1.)

(b) Return



The alarm occurrence time is transferred in hexadecimal.
Hexadecimal must be converted into decimal.

For example, data "01F5" means that the alarm occurred in 501 hours after starting operation.

(3) Reading alarm detail numbers

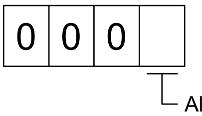
The following describes how to read the detail number of an alarm that has occurred. The detail numbers of the 0th alarm (last alarm) through the 15th alarm (sixteenth last alarm) can be read.

(a) Transmission

Transmit the command [3] [3] and the data No. corresponding to the status display item to be read. (Refer to section 14.4.1.)

(b) Return

The alarm detail number corresponding to the data No. can be obtained.



Alarm detail No. is transferred in hexadecimal.

For example, "0001" means [AL. _ _ .1].

(4) Clearing the alarm history
Alarm history is cleared.
Transmit command [8] [2] and data No. [2] [0].

Command	Data No.	Data
[8] [2]	[2] [0]	1EA5

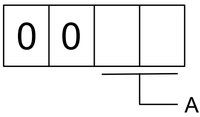
14.5.11 Current alarm

(1) Current alarm reading
The following shows how to read the alarm No. which is occurring currently.

(a) Transmission
Transmit command [0] [2] and data No. [0] [0].

Command	Data No.
[0] [2]	[0] [0]

(b) Return
The slave station returns the alarm currently occurring.



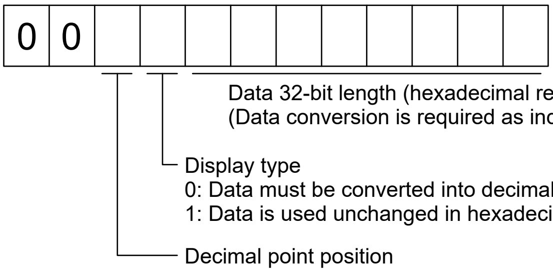
Alarm No. is transferred in hexadecimal.

For example, "0032" means [AL. 32] and "00FF" means [AL. _ _] (no alarm).

(2) Reading status display at alarm occurrence
The following shows how to read the status display data at alarm occurrence. When the data No. corresponding to the status display item is transmitted, the data value and data processing information will be returned.

(a) Transmission
Transmit the command [3] [5] and the data No. corresponding to the status display item to be read. (Refer to section 14.4.1.)

(b) Return
The slave station returns the status display data of requested alarm at occurrence.



Data 32-bit length (hexadecimal representation)
(Data conversion is required as indicated in the display type.)

Display type
0: Data must be converted into decimal.
1: Data is used unchanged in hexadecimal.

Decimal point position
0: No decimal point
1: First least significant digit (normally not used)
2: Second least significant digit
3: Third least significant digit
4: Forth least significant digit
5: Fifth least significant digit
6: Sixth least significant digit

(3) Current alarm reset

As by the reset (RES) on, reset the servo amplifier alarm to make the servo amplifier ready to operate. After removing the cause of the alarm, reset the alarm with no command entered.

Command	Data No.	Data
[8] [2]	[0] [0]	1EA5

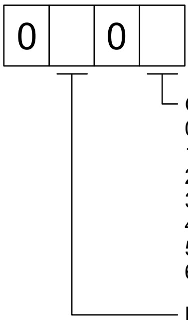
14.5.12 Specifying servo amplifier groups

Each slave station is assigned to a group so that data can be transmitted to multiple slave stations in a group.

(1) Writing group setting values

Write a group setting value to a slave station.
Transmit the command [9] [F] + data No. [0] [0] + data.

Command	Data No.	Data
[9] [F]	[0] [0]	See below.



Group specification
0: No group is specified
1: a Group
2: b Group
3: c Group
4: d Group
5: e Group
6: f Group

Responding command allowance
The digit sets whether data can be returned to the reading command of the master station.
0: Response not allowed
Data cannot be returned
1: Response allowed
Data can be returned

(2) Reading group setting values

Read a group setting value set by a slave station.

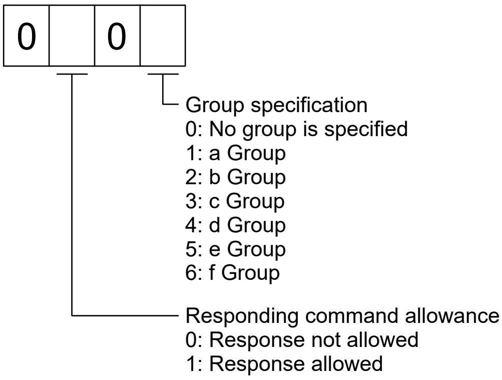
(a) Transmission

Transmit the command [1] [F] + data No. [0] [0].

Command	Data No.
[1] [F]	[0] [0]

(b) Return

A slave station returns a group setting value of the point table requested.



14.5.13 Machine diagnosis/service life diagnosis

(1) Reading machine diagnostic status

The following shows how to read the machine diagnostic status.

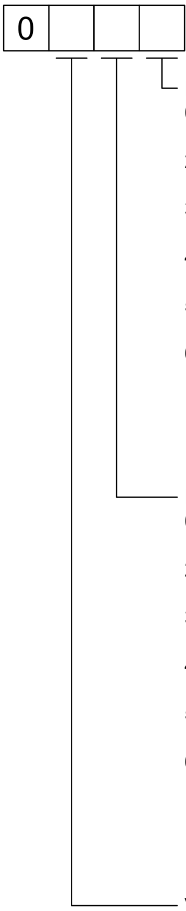
(a) Transmission

Transmit the command [0] [0] + data No. [4] [1].

Command	Data No.
[0] [0]	[4] [1]

(b) Return

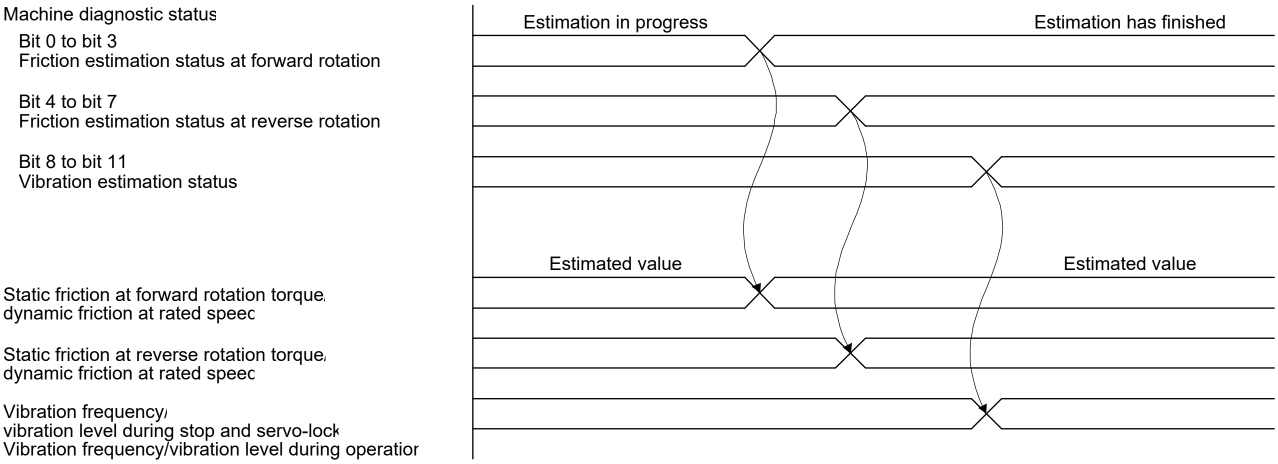
A slave station returns the machine diagnostic status.



Friction estimation status at forward rotation
0: Estimation in progress. (normal)
1: Estimation has finished. (normal)
2: The motor may have rotated more frequently in one direction than the other. (warning)
3: The servo motor speed may be too slow for friction estimation. (warning)
4: The change in the servo motor speed may be too small for friction estimation. (warning)
5: The acceleration/deceleration time constants may be too short for friction estimation. (warning)
6: The operation time may be insufficient. (warning)
When warning conditions for 2 to 6 are established at the same time, the smallest number is returned.
Once an estimation finishes even after a warning has occurred, the status will change to "Estimation has finished".

Friction estimation status at reverse rotation
0: Estimation in progress. (normal)
1: Estimation has finished. (normal)
2: The motor may have rotated more frequently in one direction than the other. (warning)
3: The servo motor speed may be too slow for friction estimation. (warning)
4: The change in the servo motor speed may be too small for friction estimation. (warning)
5: The acceleration/deceleration time constants may be too short for friction estimation. (warning)
6: The operation time may be insufficient. (warning)
When warning conditions for 2 to 6 are established at the same time, the smallest number is returned.
Once an estimation finishes even after a warning has occurred, the status will change to "Estimation has finished".

Vibration estimation status
0: Estimation in progress.
1: Estimation has finished.



14.5.14 Other commands

(1) Servo motor-side pulse unit absolute position

The following shows how to read the absolute position in the servo motor-side pulse unit. Note that overflow will occur in the position of 8192 or more revolutions from the home position.

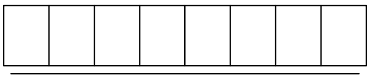
(a) Transmission

Transmit command [0] [2] and data No. [9] [0].

Command	Data No.
[0] [2]	[9] [0]

(b) Return

The slave station returns the requested servo motor-side pulses.



Absolute position is sent back in hexadecimal in the servo motor-side pulse unit.
(Data must be converted into decimal.)

For example, data "000186A0" is 100000 pulses in the motor-side pulse unit.

(2) Command unit absolute position

The following shows how to read the absolute position in the command unit.

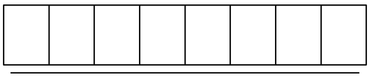
(a) Transmission

Transmit command [0] [2] and data No. [9] [1].

Command	Data No.
[0] [2]	[9] [1]

(b) Return

The slave station returns the requested command pulses.



Absolute position is sent back in hexadecimal in the command unit.
(Data must be converted into decimal.)

For example, data "000186A0" is 100000 pulses in the command unit.

(3) Software version

The following shows how to read the software version of the servo amplifier.

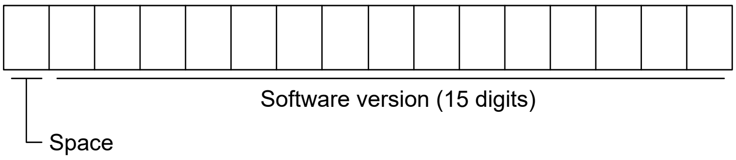
(a) Transmission

Transmit command [0] [2] and data No. [7] [0].

Command	Data No.
[0] [2]	[7] [0]

(b) Return

The slave station returns the requested software version.



15. USING A LINEAR SERVO MOTOR

⚠WARNING

- ●When using the linear servo motor, read "Linear Servo Motor Instruction Manual" and "Linear Encoder Instruction Manual".

POINT

- ●The linear servo system is available for the servo amplifiers of which software version is A5 or later.
- ●The MR-J4-03A6(-RJ) servo amplifier is not compatible with linear servo motor.

15.1 Functions and configuration

15.1.1 Summary

The fields of semiconductor/LCD manufacturing systems, mounters, and others have strong demands for high accuracy, high speed, and efficiency. Therefore, the number of systems using a linear servo motor for a drive axis has been increasing. Since the linear servo system can obtain the characteristics of the high speed and the high acceleration/deceleration greater than the ball screw drive system. The linear servo system also does not have a ball screw wear which is a weak point in the ball screw drive system. This will extend the life of the equipment. In addition, since a response error due to backlash and friction does not occur, you can establish a high-accuracy system.
The following shows the differences between the linear servo motor and the rotary servo motor.

Category	Item		Differences		Remark
			Linear servo motor	Rotary servo motor	
Motor pole adjustment	Magnetic pole detection		Required	Not required (default setting)	Automatically executed at the first servo-on after the power is turned on. For the absolute position linear encoder, [Pr. PL01] can disable the magnetic pole detection. The timing of the magnetic pole detection can be changed with [Pr. PL01]. (Refer to (2) (b) of section 15.3.3.)
Home position return	Reference home position		1048576 pulses unit (initial value)	One servo motor revolution unit	Home position return pitch can be changed with parameter setting. (Refer to section 15.3.3.)
Absolute position detection system	Absolute position encoder battery		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	Not supported	Supported	
		JOG operation	Not supported	Supported	
		Program operation	Supported	Supported	

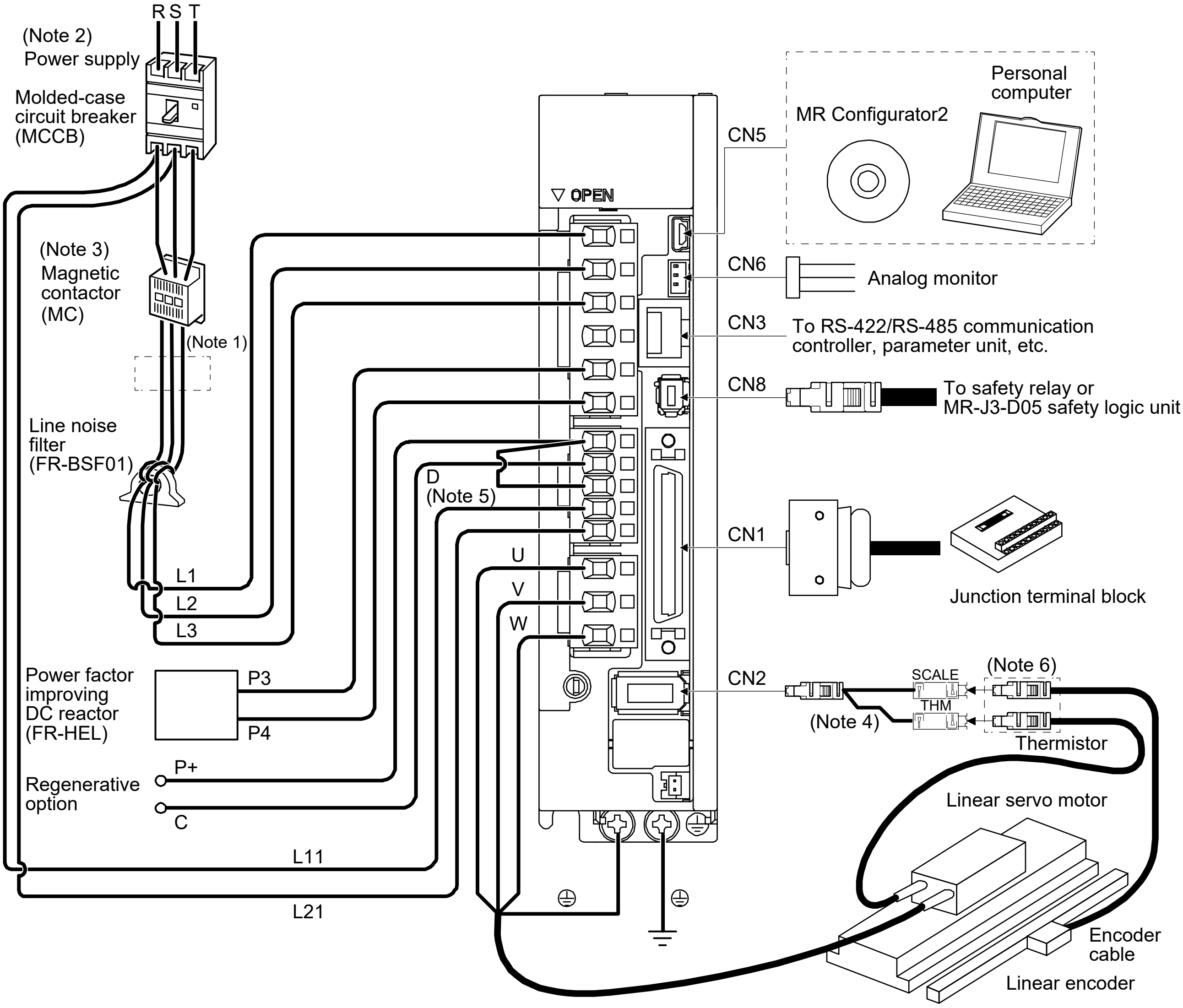
15.1.2 Configuration including peripheral equipment

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

POINT
- Equipment other than the servo amplifier and linear servo motor are optional or recommended products.
- When using the linear servo motor, set [Pr. PA01] to "_ _ 4 _".

(1) MR-J4-_A_

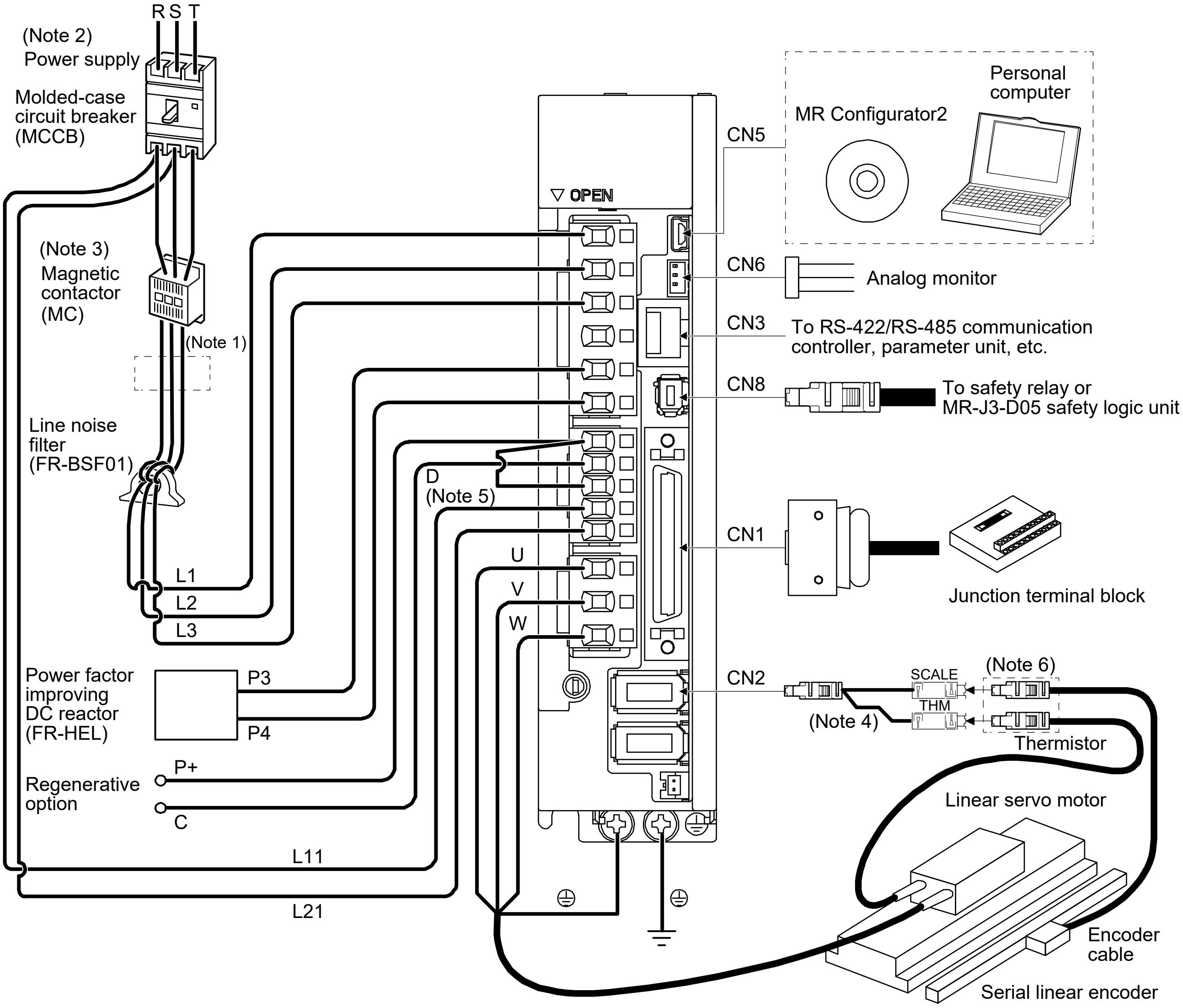
The configuration diagram is an example of MR-J4-20A. When using the other servo amplifiers, the configuration will be the same as rotary servo motors except for connections of linear servo motors and linear encoders. Refer to section 1.8 depending on servo amplifiers you use.



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-J4-200A or less. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open. For the power supply specifications, refer to section 1.3.
3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
4. For the branch cable, use the MR-J4THCBL03M (optional).
5. Always connect between P+ and D terminals. When using the regenerative option, refer to section 11.2.
6. Connect the thermistor to THM of branch cable and connect the encoder cable to SCALE correctly. Incorrect setting will trigger [AL. 16].

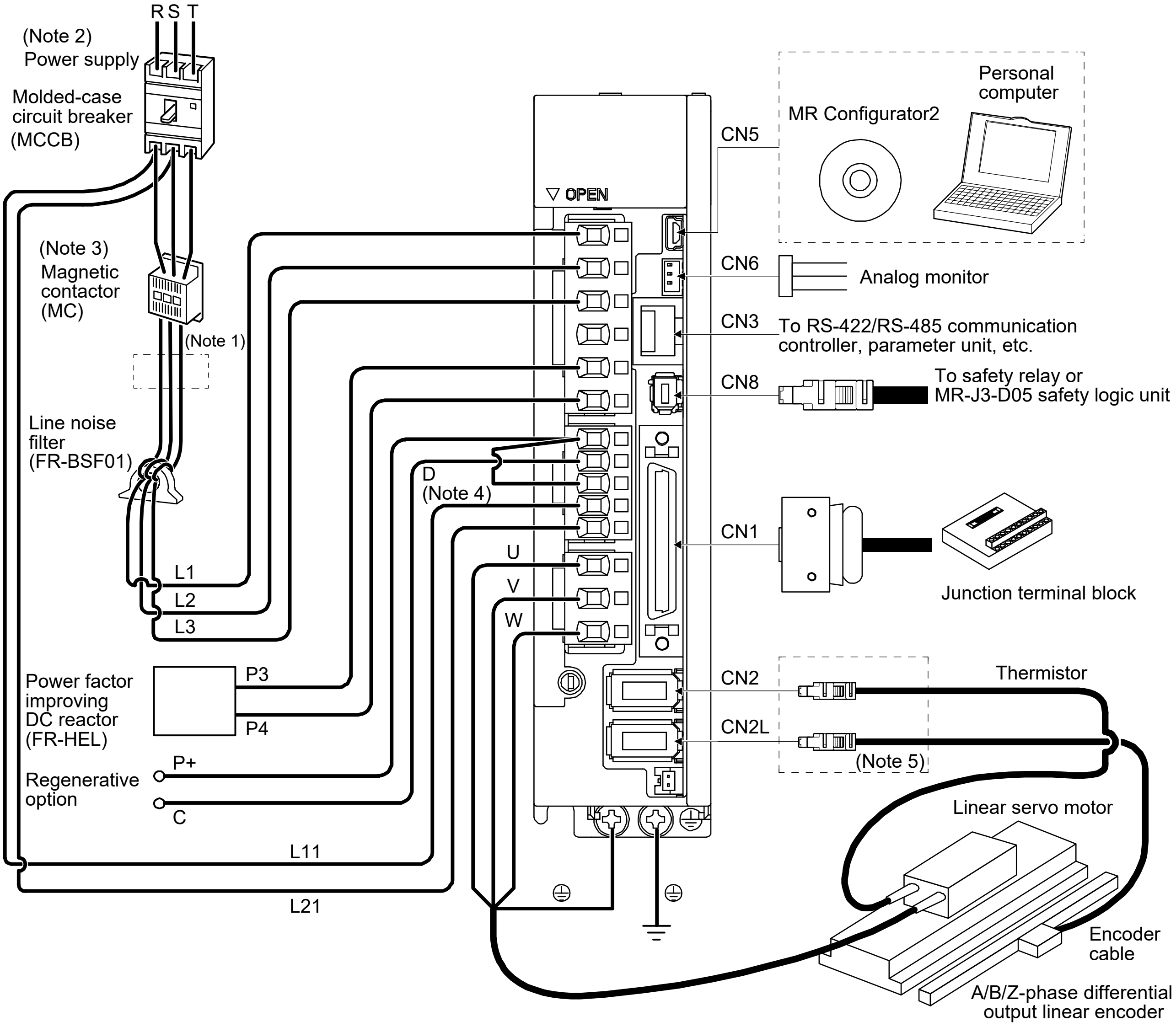
(2) When using serial linear encoder with MR-J4-_A_-RJ

The configuration diagram is an example of MR-J4-20A-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-J4-200A-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. 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-_A_-RJ
The configuration diagram is an example of MR-J4-20A-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-J4-200A-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].

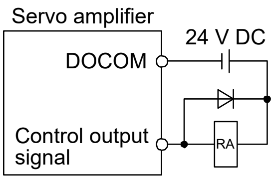
15.2 Signals and wiring

⚠WARNING

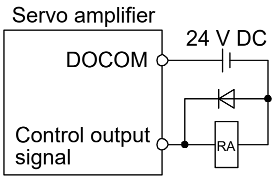
- Any person who is involved in wiring should be fully competent to do the work.
- Before wiring, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. Otherwise, an electric shock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

⚠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.

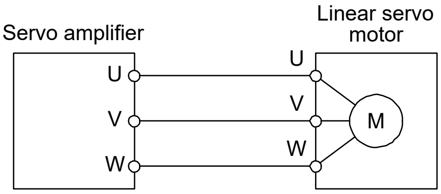


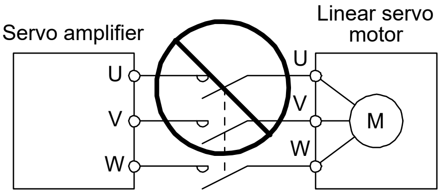
For sink output interface



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

- ●Connecting a linear servo motor of the wrong 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.
- ●Do not modify the equipment.
- ●The cables such as power wires deriving from the primary side cannot stand the long-term bending action. Avoid the bending action by fixing the cables to the moving part, etc. Also, use the cable that stands the long-term bending action for the wiring to the servo amplifier.

This section does not describe the following items. For details of the items, refer to each section of the detailed description field.

Item	Detailed explanation
Input power supply circuit	Section 3.1
Explanation of power supply system	Section 3.3
Signal (device) explanations	Section 3.5
Alarm occurrence timing chart	Section 3.8
Interface	Section 3.9
Grounding	Section 3.11
Display and operation sections	Section 4.5

15.3 Operation and functions

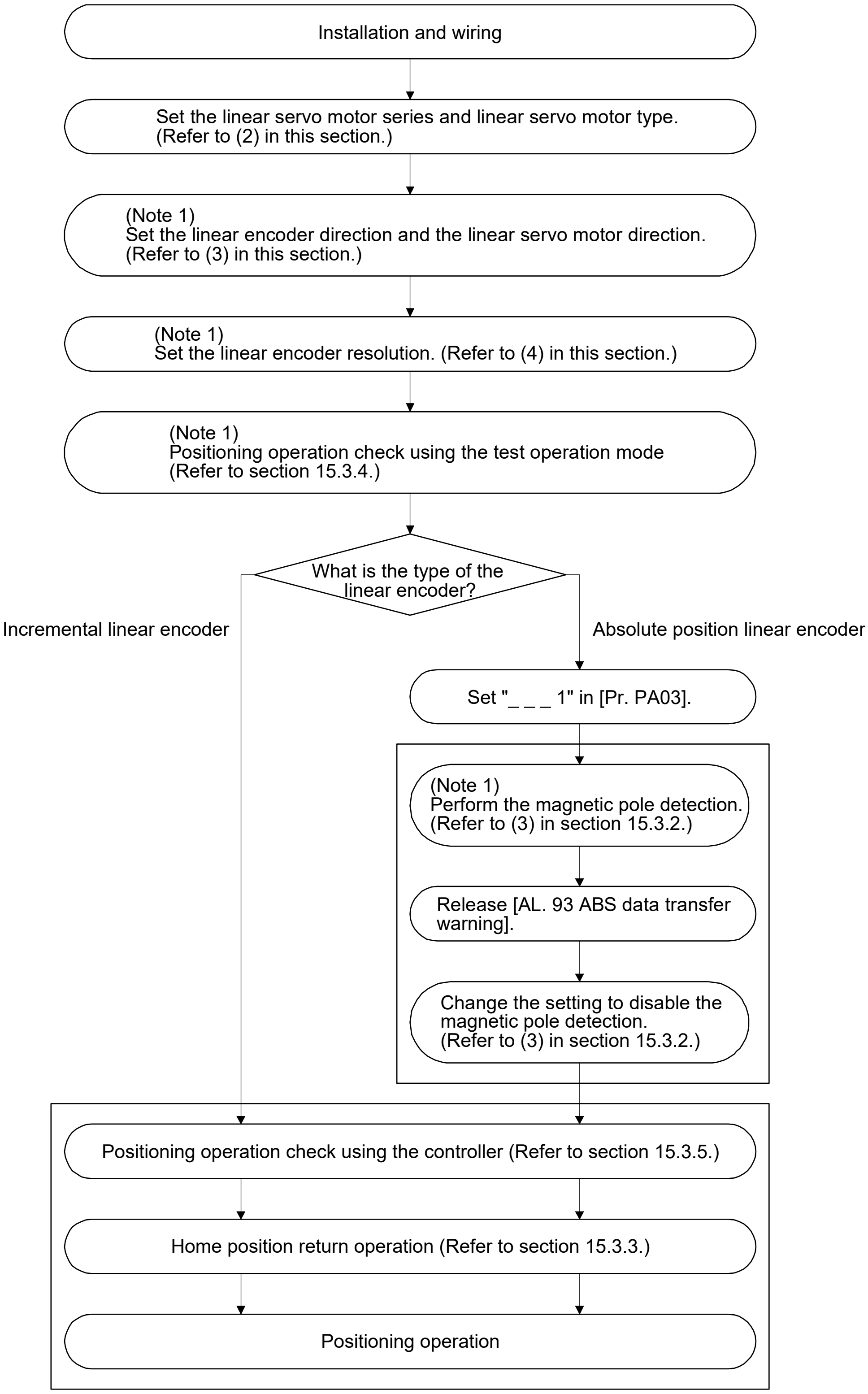
15.3.1 Startup

POINT

- ●When using the linear servo motor, set [Pr. PA01] to "_ _ 4 _".

(1) Startup procedure

Start up the linear servo system in the following procedure.



Note 1. Use MR Configurator2.

2. To cancel [AL. 93 ABS data transfer warning], cycle SON (Servo-on) or set a home position.

(2) Setting of linear servo motor series and linear servo motor type

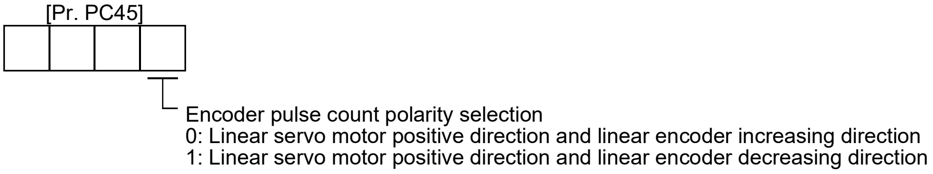
To use the linear servo motor, set the linear servo motor series and linear servo motor type with [Pr. PA17 Servo motor series setting] and [Pr. PA18 Servo motor type setting]. (Refer to section 5.2.1.)

(3) Setting of linear encoder direction and linear servo motor direction

POINT

- If an incorrect value is set for [Pr. PC45], 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. PC45] (Encoder pulse count polarity selection) so that the positive direction of the linear servo motor matches with the increasing direction of the linear encoder feedback.



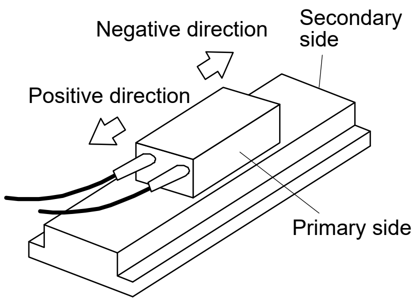
Encoder pulse count polarity selection
0: Linear servo motor positive direction and linear encoder increasing direction
1: Linear servo motor positive direction and linear encoder decreasing direction

(a) Parameter setting method

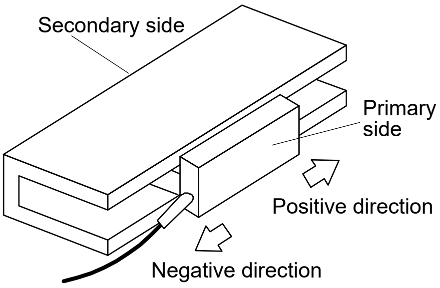
1) Confirm the positive direction of the linear servo motor. [Pr. PA14] determines the relation of the travel direction of the linear servo motor under commands as shown below.

[Pr. PA14] setting	Travel direction of linear servo motor	
	Address increasing command	Address decreasing command
0	Positive direction	Negative direction
1	Negative direction	Positive direction

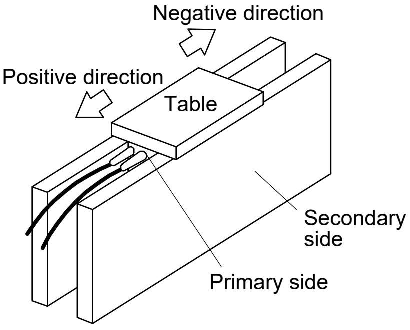
The positive/negative directions of the linear servo motor are as follows.



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. PC45] to "_ _ _ 0". If the positive direction of the linear servo motor does not match with the increasing direction of the linear encoder, set [Pr. PC45] to "_ _ _ 1".

(b) Confirmation method

Confirm the positive direction of the linear servo motor and the increasing direction of the linear encoder in the following procedure.

1) In servo-off status, move the linear servo motor in the positive direction manually.

2) Confirm the motor speed (in the positive and negative directions) at that time with MR Configurator2.

3) When [Pr. PC45] is set to "_ _ _ 0" and the positive direction of the linear servo motor matches with the increasing direction of the linear encoder, if the linear servo motor operates in the positive direction, the motor speed will be a positive value. If the positive direction of the linear servo motor does not match with the increasing direction of the linear encoder, the motor speed will be a negative value. When [Pr. PC45] is set to "_ _ _ 1" and the positive direction of the linear servo motor matches with the increasing direction of the linear encoder, if the linear servo motor operates in the positive direction, the motor speed will be a negative value.

(4) Linear encoder resolution setting

POINT

- ●To enable the parameter values, 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

15.3.2 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.

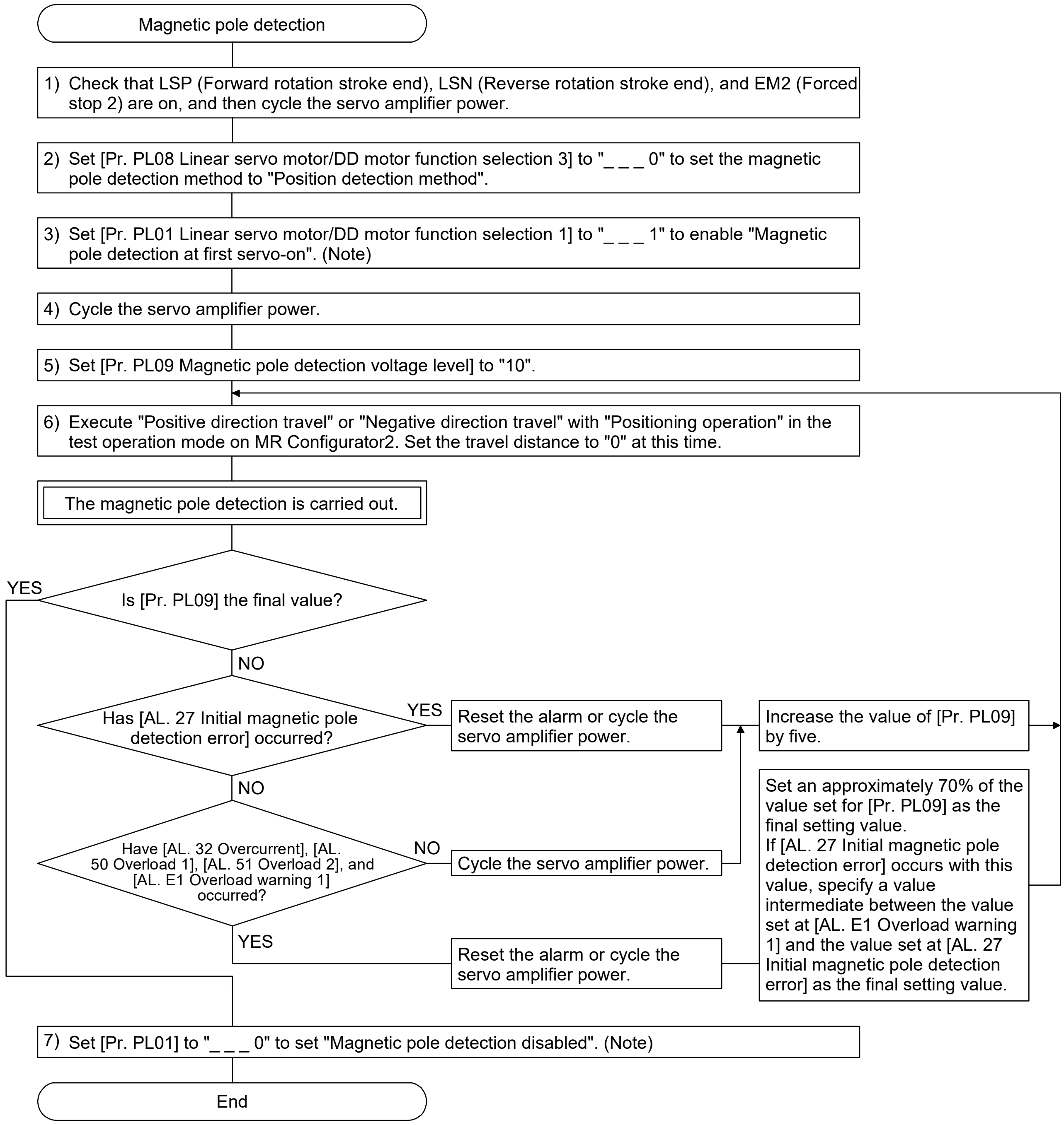
The magnetic pole detection includes the following two methods. Each method has advantages and disadvantages. Select a magnetic pole detection method suitable for your usage.
The position detection method is selected the initial value.

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 long. 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 short. 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 LSP (Forward rotation stroke end), LSN (Reverse rotation stroke end), and EM2 (Forced stop 2) are on, and then cycle the servo amplifier power.

2) Set [Pr. PL08 Linear servo motor/DD motor function selection 3] to "_ _ _ 0" to set the magnetic pole detection method to "Position detection method".

3) Set [Pr. PL01 Linear servo motor/DD motor function selection 1] to "_ _ _ 1" to enable "Magnetic pole detection at first servo-on". (Note)

4) Cycle the servo amplifier power.

5) Set [Pr. PL09 Magnetic pole detection voltage level] to "10".

6) 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.

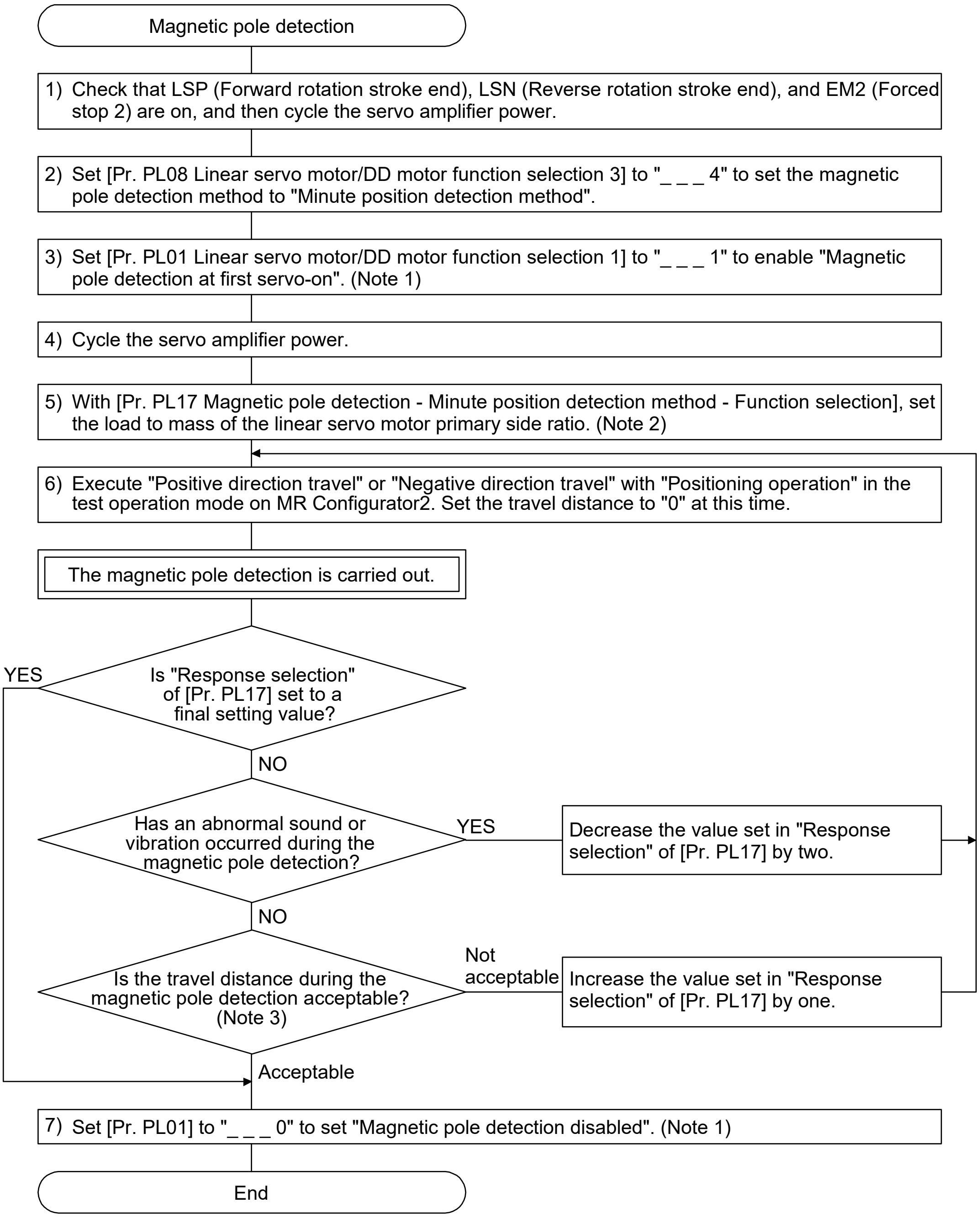
Reset the alarm or cycle the servo amplifier power.

7) 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 LSP (Forward rotation stroke end), LSN (Reverse rotation stroke end), and EM2 (Forced stop 2) are on, and then cycle the servo amplifier power.

2) 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".

3) Set [Pr. PL01 Linear servo motor/DD motor function selection 1] to "_ _ _ 1" to enable "Magnetic pole detection at first servo-on". (Note 1)

4) Cycle the servo amplifier power.

5) 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)

6) 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.

7) 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 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].

(2) Operation at the magnetic pole detection

⚠WARNING

- Note that the magnetic pole detection automatically starts simultaneously with the turning-on of the servo-on command.

⚠CAUTION

- If the magnetic pole detection is not executed properly, the linear servo motor may operate unexpectedly.

POINT

- Establish the machine configuration to use LSP (Upper stroke end) and LSN (Lower stroke end). The machine may be damaged due to a collision without LSP and LSN.
- Assign LSP and LSN and perform the magnetic pole detection also in the torque control mode.
- At the magnetic pole detection, whether the linear servo motor moves in the positive or negative direction is unpredictable.
- Depending on the setting value of [Pr. PL09 Magnetic pole detection voltage level], an overload, overcurrent, magnetic pole detection alarm, or others may occur.
- After the magnetic pole detection, check the positioning accuracy with the test operation (positioning operation function) of MR Configurator2.
- When the absolute position linear encoder is used, if a gap is generated to the positional relation between the linear encoder and the linear servo motor, perform the magnetic pole detection again.
- The accuracy of the magnetic pole detection improves with no load.
- 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.

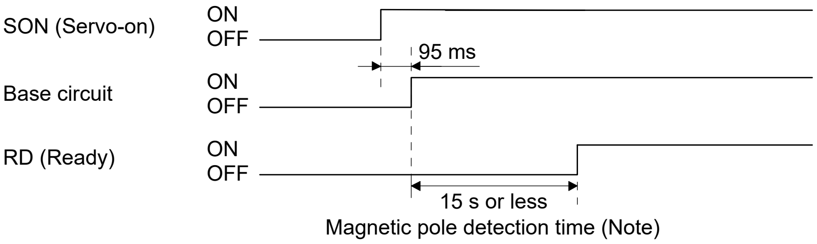
(a) For the incremental linear encoder

POINT

- For the incremental linear encoder, the magnetic pole detection is required every time the power is turned on.

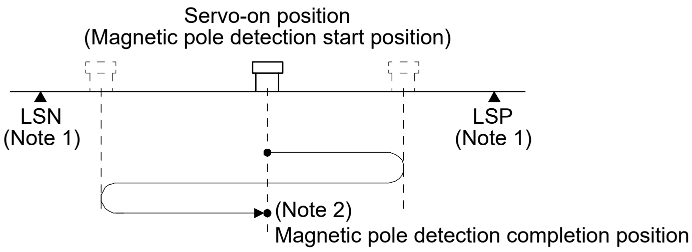
By turning on SON (Servo-on) after power-on, the magnetic pole detection is automatically carried out. Therefore, there is no need to set the parameter (first digit of [Pr. PL01]) for executing the magnetic pole detection.

1) Timing chart



Note. The magnetic pole detection time indicates the operation time when LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end) are on.

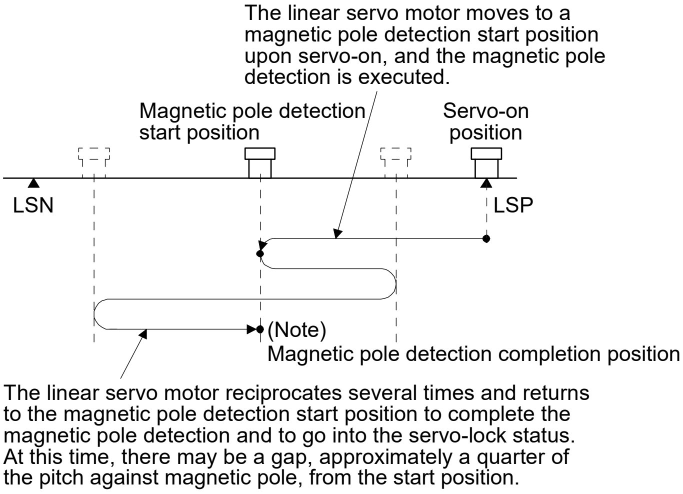
2) Linear servo motor movement (when LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end) are on)



Note 1. When you turn off LSP (Forward rotation stroke end) or LSN (Reverse rotation stroke end) during the magnetic pole detection, the operation of the magnetic pole detection is carried on to the opposite direction. When both LSP and LSN are off, [AL. 27 Initial magnetic pole detection error] occurs.
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 LSP (Forward rotation stroke end) or LSN (Reverse rotation stroke end) is off)
When LSP or LSN is off at servo-on, the magnetic pole detection is carried out as follows.



Note. For the pitch against magnetic pole, refer to (2) (a) 2) Note 2 in this section.

(b) For the absolute position linear encoder

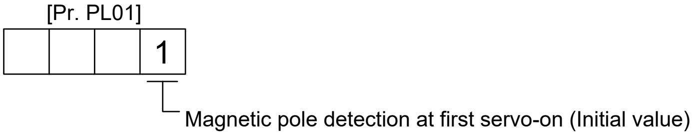
POINT

●The magnetic pole detection is required at the following timing.
- 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.

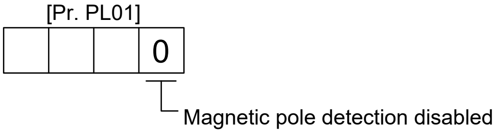
Perform the magnetic pole detection in the following procedure.

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 (2) (a) in this section.)

3) After the completion of the magnetic pole detection, change [Pr. PL01] to "_ _ _ 0" (Magnetic pole detection disabled).



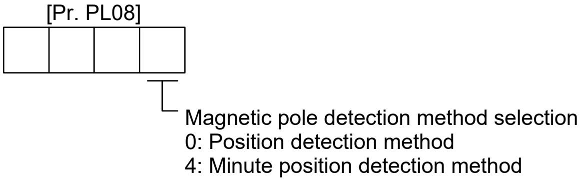
After the magnetic pole detection, by disabling the magnetic pole detection function with [Pr. PL01], the magnetic pole detection after each power-on is not required.

(3) 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).



(4) Setting of the magnetic pole detection voltage level by the position detection method
For the magnetic pole detection by the position detection method, set the voltage level with [Pr. PL09 Magnetic pole detection voltage level]. For the magnetic pole detection by the minute position detection method, the voltage level setting is not required.

(a) Guideline of parameter settings
Set the parameters by referring to the following table.

[Pr. PL09] setting (guide value) 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

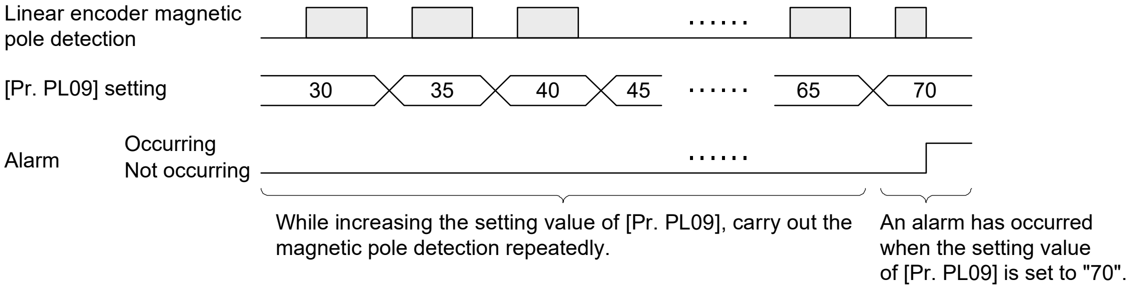
(b) Setting procedure

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

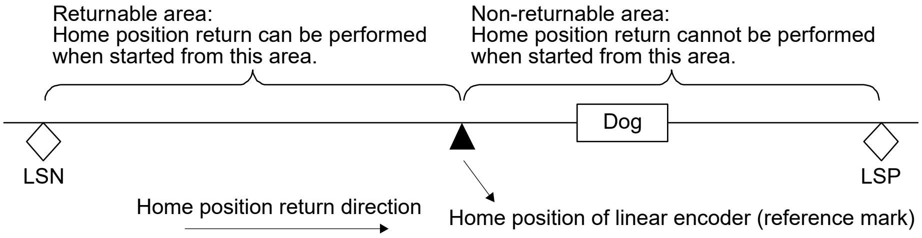


In this example, the final setting value of [Pr. PL09] is 49 (Setting value at the alarm occurrence = 70 × 0.7).

15.3.3 Home position return

POINT

- ●Change the third digit value of [Pr. PL01] according to the linear encoder resolution.
- ●The incremental linear encoder and the absolute position linear encoder have different reference home positions at the home position return.
- ●For the incremental linear encoder, a home position (reference mark) of the linear encoder is necessary in the home position return direction.
- ●When you configure as follows, move the mover to LSN with JOG operation and perform home position to perform it in safe.



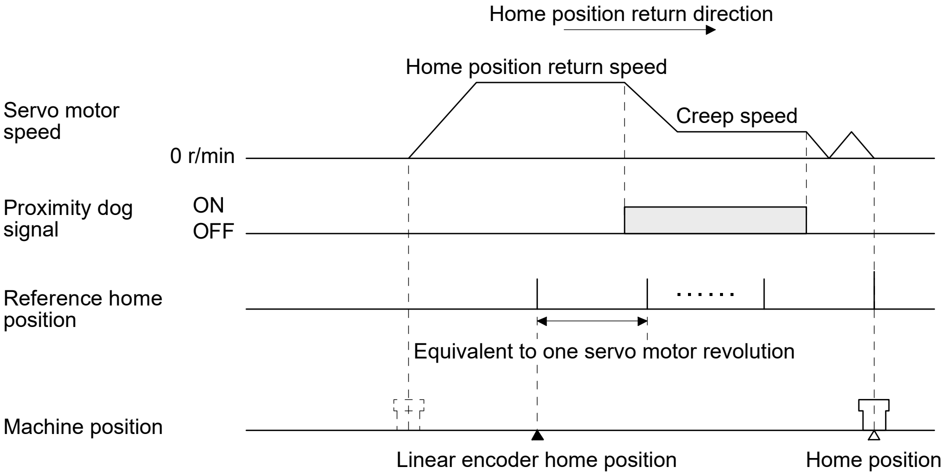
(1) Incremental linear encoder

⚠CAUTION ●If the resolution or the stop interval (the third digit of [Pr. PL01]) of the linear encoder is large, it is very dangerous since the linear servo motor may crash into the stroke end.

(a) When the linear encoder home position (reference mark) exists in the home position return direction

When you use an incremental linear encoder, LZ (Encoder Z-phase pulse) from the servo amplifier will be the home position (reference mark) of the linear encoder.

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. PC28].

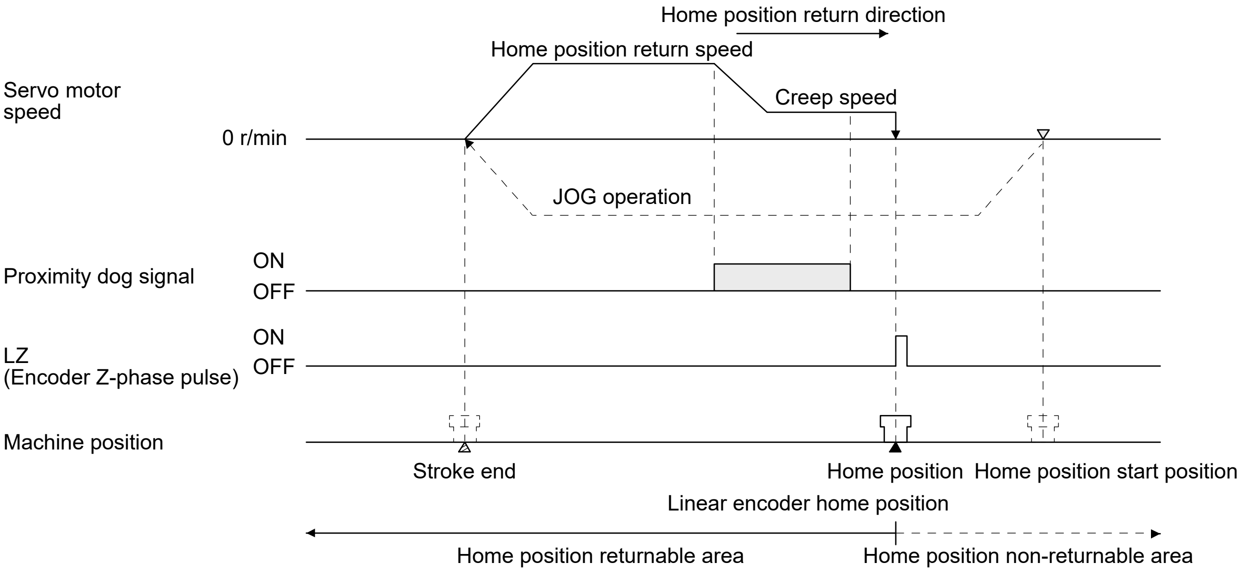


(b) When the linear encoder home position (reference mark) does not exist in the home position return direction

POINT

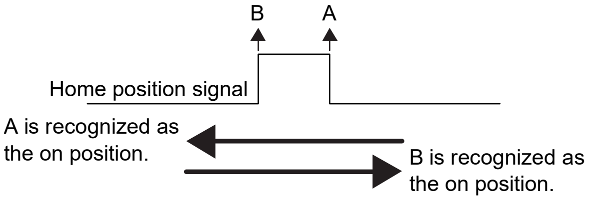
- ●To execute a home position return securely, start a home position return after moving the linear servo motor to the opposite stroke end with JOG operation and others.
- ●Change the third digit value of [Pr. PL01] according to the linear encoder resolution.

The home position return cannot be performed from the position which the home position of the linear encoder does not exist in the home position return direction. Move the mover to the stroke end on the opposite side of the home position return direction with the JOG operation from the controller and others, and then perform a home position return.



(c) Caution for passing the home position (reference mark)
An interval for turning on home position (reference mark) signal of the linear encoder has a certain width. (Specifications differ depending on the linear encoders. For details, refer to "Linear Encoder Instruction Manual".)

Example: When Z-phase is recognized at startup



The position which turns on LZ (Encoder Z-phase pulse) differs depending on the directions of home position passing. When you need to set the home position return completion to the same position each time such as dog type home position return, always start home position return with the same direction.

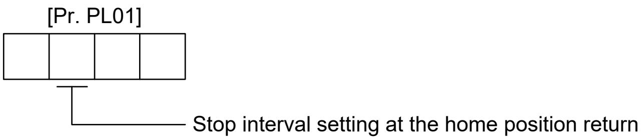
(d) Caution for linear encoder which does not have the home position (reference mark)
The linear encoder which does not have the home position (reference mark), LZ (Encoder Z-phase pulse) of the servo amplifier does not be outputted. It is depending on positioning controllers to use whether LZ (Encoder Z-phase pulse) is necessary or not for home position return. Check the specifications of controllers.

(2) Absolute position linear encoder

POINT

●The data set type home position return can also be carried out.

The home position reference position using an absolute type linear encoder will be per 1048576 pulses based on the linear encoder home position (absolute position data = 0). You can change the stop interval at home position return with the third digit of [Pr. PL01].



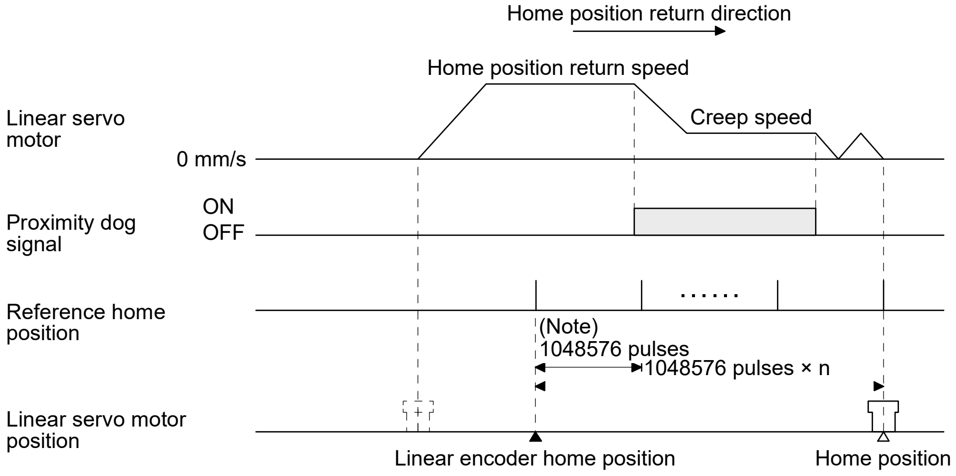
Setting value	Stop interval [pulse]
0	8192
1	131072
2	262144
3	1048576 (initial value)
4	4194304
5	16777216
6	67108864

The following shows the relation between the stop interval at the home position return and the linear encoder resolution. For example, when the linear encoder resolution is 0.001 μm and the parameter for the stop interval at the home position return, [Pr. PL01], is set to "_ 5 _ _" (16777216 pulses), the stop interval is 16.777 mm. The value inside a bold box indicates the recommended stop interval for each linear encoder resolution.

[Unit: mm]

Pr. PL01	Linear encoder resolution [μm] Stop interval [pulse]	0.001	0.005	0.01	0.02	0.05	0.1	0.2	0.5	1	2
_ 0 _ _	8192	0.008	0.041	0.082	0.164	0.410	0.819	1.638	4.096	8.192	16.384
_ 1 _ _	131072	0.131	0.655	1.311	2.621	6.554	13.107	26.214	65.536	131.072	262.144
_ 2 _ _	262144	0.262	1.311	2.621	5.243	13.107	26.214	52.429	131.072	262.144	524.288
_ 3 _ _	1048576	1.049	5.243	10.486	20.972	52.429	104.858	209.715	524.288	1048.576	2097.152
_ 4 _ _	4194304	4.194	20.972	41.943	83.886	209.715	419.430	838.861	2097.152	4194.304	8388.608
_ 5 _ _	16777216	16.777	83.886	167.772	335.544	838.861	1677.722	3355.443	8388.608	16777.216	33554.432
_ 6 _ _	67108864	67.109	335.544	671.089	1342.177	3355.443	6710.886	13421.773	33554.432	67108.864	134217.728

In the case of a proximity dog type home position return, the nearest reference home position after proximity dog off is the home position. The linear encoder home position can be set in any position. LZ (Encoder Z-phase pulse) is outputted based on "Stop interval selection at the home position return" in [Pr. PL01].



Note. Changeable with [Pr. PL01].

15.3.4 Test operation mode in MR Configurator2

⚠CAUTION

- The test operation mode is designed for checking servo operation. It is not for checking machine operation. Do not use this mode with the machine. Always use the linear servo motor alone.
- If the servo motor operates abnormally, use EM2 (Forced stop 2) to stop it.

POINT

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

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

(1) Positioning operation

Positioning operation can be performed when there is no command from the controller. Use this operation with the forced stop reset. This operation may be used independently of whether servo-on, servo-off, or whether a controller is connected or not.

Exercise control on the positioning operation screen of MR Configurator2.

(a) Operation pattern

Item	Initial value	Setting range
Travel distance [pulse]	1048576	0 to 99999999
Speed [mm/s]	10	0 to Maximum speed
Acceleration/deceleration time constant [ms]	1000	0 to 50000
Repeat pattern	Positive direction travel → Negative direction travel	Positive direction travel → Negative direction travel Positive direction travel → Positive direction travel Negative direction travel → Positive direction travel Negative direction travel → Negative direction travel
Dwell time [s]	2.0	0.1 to 50.0
Number of repeats [time]	1	1 to 9999

(b) Operation method

Operation	Screen control
Positive direction travel	Click "Positive Direction Movement".
Negative direction travel	Click "Reverse Direction Movement".
Pause	Click "Pause".
Stop	Click "Stop".
Forced stop	Click "Forced Stop".

(2) Output signal (DO) forced output

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

(3) Program operation

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

Exercise control on the program operation screen of MR Configurator2. For 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".

15.3.5 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].

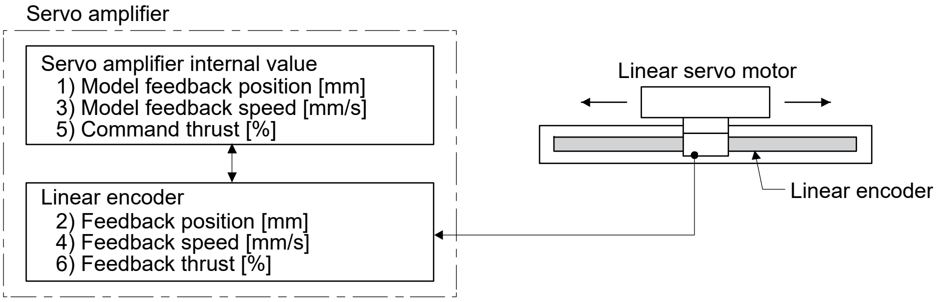
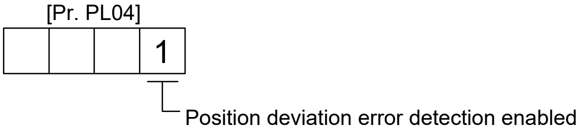


Figure 15.1 Outline of linear servo control error detection function

(a) Position deviation error detection

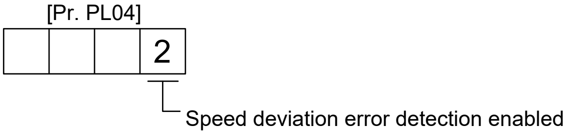
Set [Pr. PL04] to "_ _ _ 1" to enable the position deviation error detection.



When you compare the model feedback position (1)) and the feedback position (2)) in figure 15.1, if the deviation is more than the value of [Pr. PL05 Position deviation error detection level] (1 mm to 1000 mm), [AL. 42.1 Servo control error by position deviation] will occur and the linear servo motor will stop. The initial value of this detection level is 50 mm. Change the set value as necessary.

(b) Speed deviation error detection

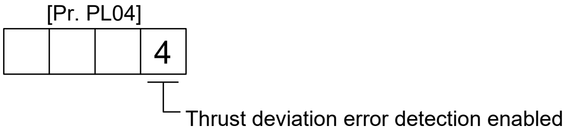
Set [Pr. PL04] to "_ _ _ 2" to enable the speed deviation error detection.



When you compare the model feedback speed (3)) and the feedback speed (4)) in figure 15.1, if the deviation is more than the value of [Pr. PL06 Speed deviation error detection level] (1 mm/s to 5000 mm/s), [AL. 42.2 Servo control error by speed deviation] will occur and the linear servo motor will stop. The initial value of this detection level is 1000 mm/s. Change the set value as necessary.

(c) Thrust deviation error detection level

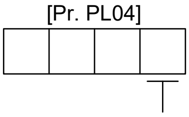
Set [Pr. PL04] to "_ _ _ 4" to enable the thrust deviation error detection.



When you compare the command thrust (5)) and the feedback thrust (6)) in figure 15.1, if the deviation is more than the value of [Pr. PL07 Torque/thrust deviation error detection level] (1% to 1000%), [AL. 42.3 Servo control error by torque/thrust deviation] will occur and the linear servo motor will stop. The initial value of this detection level is 100%. Change the set value as necessary.

(d) Detecting multiple deviation errors

When [Pr. PL04] is set as follows, multiple deviation errors can be detected. For the error detection methods, refer to (1) (a), (b), (c) 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.

15.3.6 Absolute position detection system

When the linear servo motor is used with the absolute position detection system, an absolute position linear encoder is required.

(1) Operating conditions of absolute position detection system

  (a) Use an absolute type linear encoder.

  (b) Perform the magnetic pole detection in the incremental system and disable the magnetic pole detection after the detection.

  (c) Enable the absolute position detection system with [Pr. PA03 Absolute position detection system].

(2) Alarm detection
[AL. 25 Absolute position erased], [AL. 92 Battery cable disconnection warning], [AL. 9F Battery warning], and [AL. E3 Absolute position counter warning] are not provided for the linear servo motor.

(3) Backup
The linear encoder backs up the absolute position data. Therefore, the encoder battery need not be installed to the servo amplifier.

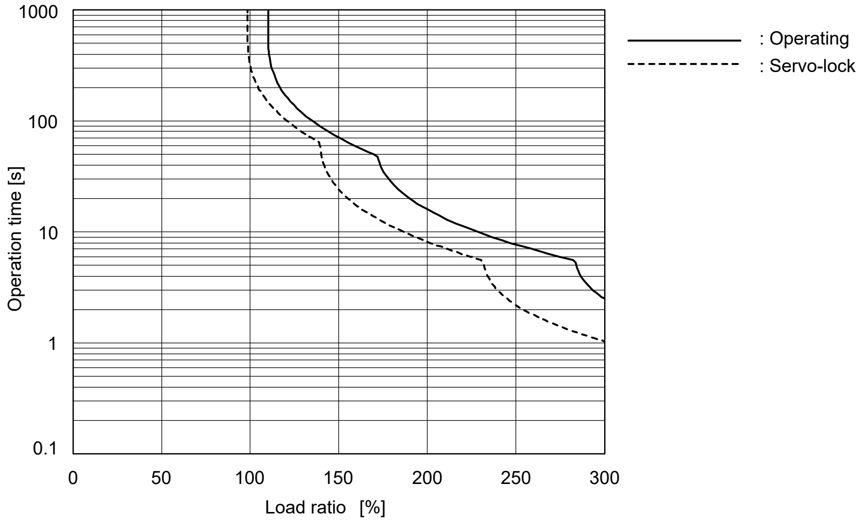
(4) Absolute position data transfer to controller
Refer to section 12.8 for absolute position data transfer to the controller.

15.4 Characteristics

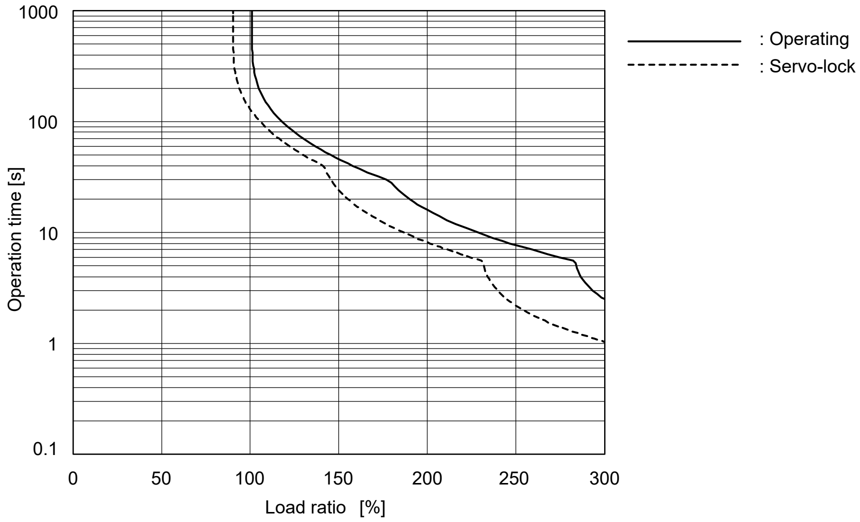
15.4.1 Overload protection characteristics

An electronic thermal is built in the servo amplifier to protect the linear servo motor, servo amplifier and linear servo motor power wires from overloads.
[AL. 50 Overload 1] occurs if overload operation performed is above the electronic thermal protection curve shown in fig. 15.2. [AL. 51 Overload 2] occurs if the maximum current is applied continuously for several seconds due to machine collision, etc. Use the equipment on the left-side area of the continuous or broken line in the graph.
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

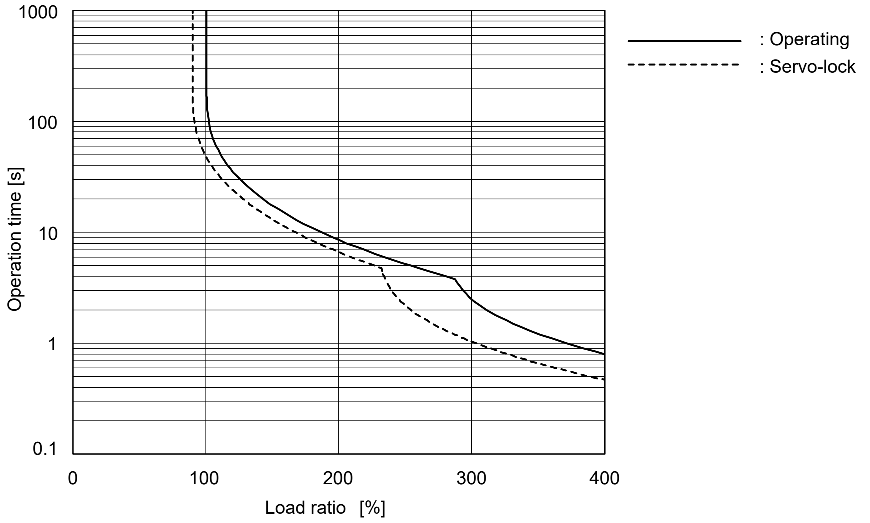


(2) LM-K2 series

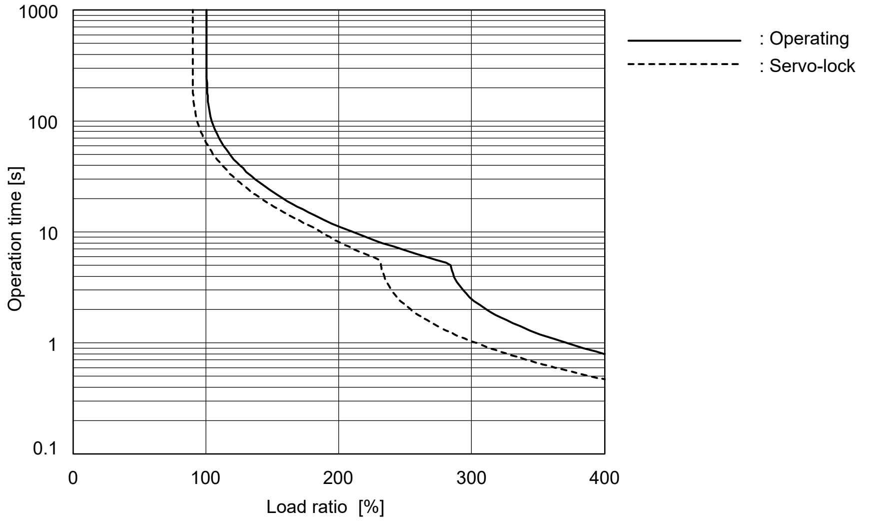


(3) LM-U2 series

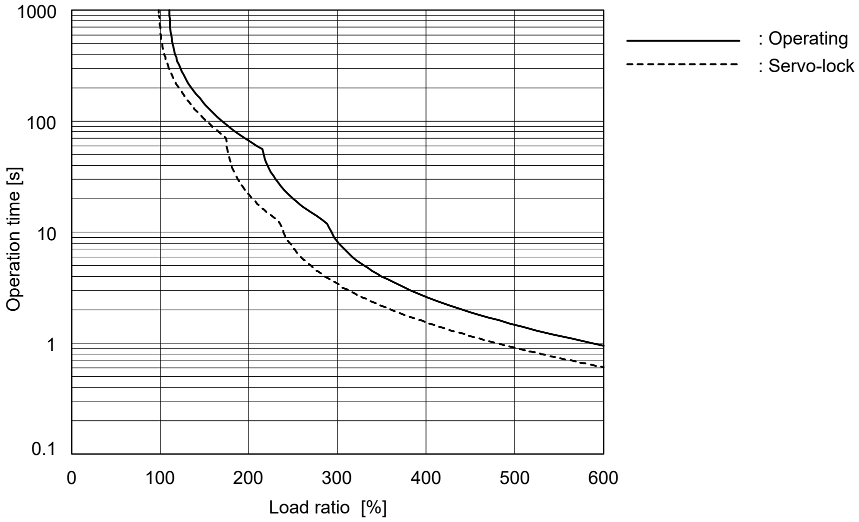
(a) LM-U2PBD-15M-1SS0



(b) Other than LM-U2PBD-15M-1SS0

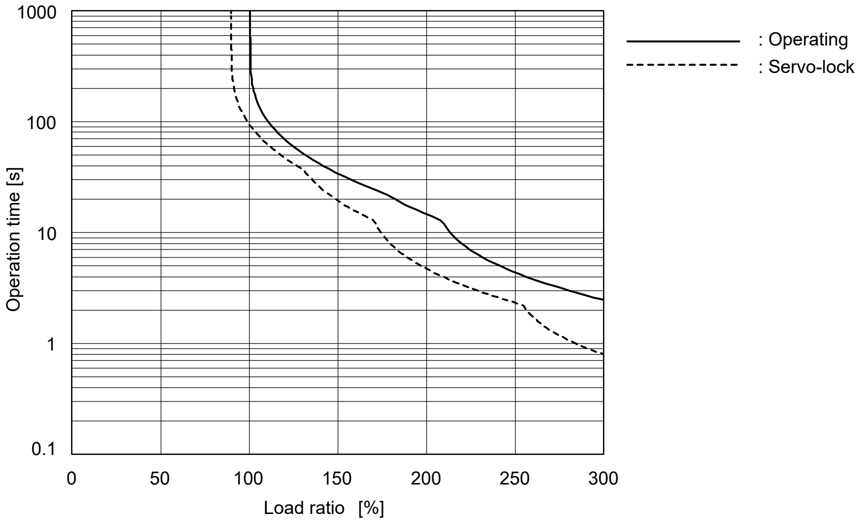


(4) LM-F series (natural cooling)

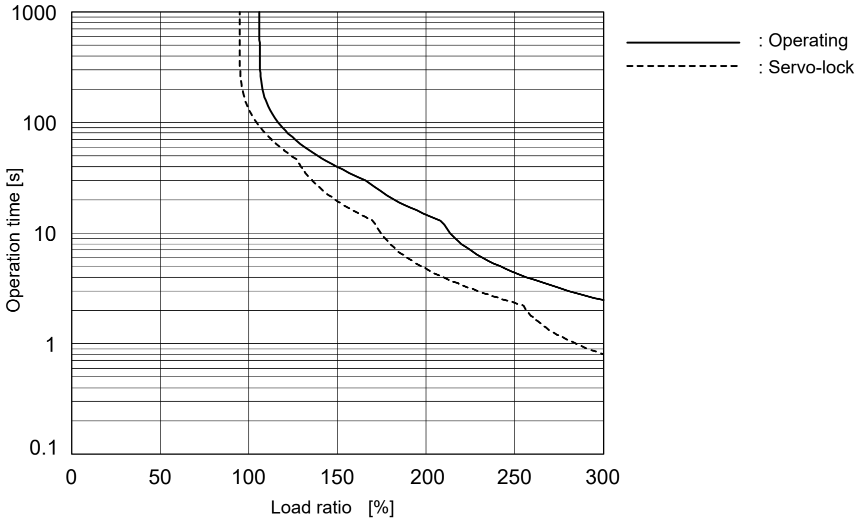


(5) LM-F series (liquid cooling)

(a) LM-FP2B-06M-1SS0 (liquid cooling)



(b) Other than LM-FP2B-06M-1SS0 (liquid cooling)



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 linear servo motor is run at less than the rated speed, the power supply capacity will be smaller than the value in the table, but the servo amplifier's generated heat will not change.
Mounting a heat sink outside of the cabinet enables to reduce heat in the cabinet and design a compact enclosed type cabinet.

Table 15.1 Power supply capacity and generated loss per linear servo motor

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-J4-40A(-RJ) MR-J4-40A1(-RJ)	0.9	35	15	0.7
LM-H3P3A-12P-CSS0		0.9	35	15	0.7
LM-H3P3B-24P-CSS0	MR-J4-70A(-RJ)	1.3	50	15	1.0
LM-H3P3C-36P-CSS0		1.9	75	15	1.5
LM-H3P3D-48P-CSS0	MR-J4-200A(-RJ)	3.5	90	20	1.8
LM-H3P7A-24P-ASS0	MR-J4-70A(-RJ)	1.3	50	15	1.0
LM-H3P7B-48P-ASS0	MR-J4-200A(-RJ)	3.5	90	20	1.8
LM-H3P7C-72P-ASS0		3.8	100	20	1.1
LM-H3P7D-96P-ASS0	MR-J4-350A(-RJ)	5.5	130	20	2.7
LM-U2PAB-05M-0SS0	MR-J4-20A(-RJ) MR-J4-20A1(-RJ)	0.5	25	15	0.5
LM-U2PAD-10M-0SS0	MR-J4-40A(-RJ) MR-J4-40A1(-RJ)	0.9	35	15	0.7
LM-U2PAF-15M-0SS0		0.9	35	15	0.7
LM-U2PBB-07M-1SS0	MR-J4-20A(-RJ) MR-J4-20A1(-RJ)	0.5	25	15	0.5
LM-U2PBD-15M-1SS0	MR-J4-60A(-RJ)	1.0	40	15	0.8
LM-U2PBF-22M-1SS0	MR-J4-70A(-RJ)	1.3	50	15	1.0
LM-U2P2B-40M-2SS0	MR-J4-200A(-RJ)	3.5	90	20	1.8
LM-U2P2C-60M-2SS0	MR-J4-350A(-RJ)	5.5	130	20	2.7
LM-U2P2D-80M-2SS0	MR-J4-500A(-RJ)	7.5	195	25	3.9
LM-FP2B-06M-1SS0	MR-J4-200A(-RJ)	3.5	90	20	1.8
LM-FP2D-12M-1SS0	MR-J4-500A(-RJ)	7.5	195	25	3.9
LM-FP2F-18M-1SS0	MR-J4-700A(-RJ)	10	300	25	6.0
LM-FP4B-12M-1SS0	MR-J4-500A(-RJ)	7.5	195	25	3.9
LM-FP4D-24M-1SS0	MR-J4-700A(-RJ)	10	300	25	6.0
LM-FP4F-36M-1SS0	MR-J4-11KA(-RJ)	14	460	45	9.2
LM-FP4H-48M-1SS0	MR-J4-15KA(-RJ)	18	580	45	11.6
LM-FP5H-60M-1SS0	MR-J4-22KA4(-RJ)	22	640	45	12.8
LM-K2P1A-01M-2SS1	MR-J4-40A(-RJ) MR-J4-40A1(-RJ)	0.9	35	15	0.7
LM-K2P1C-03M-2SS1	MR-J4-200A(-RJ)	3.5	90	20	1.8
LM-K2P2A-02M-1SS1	MR-J4-70A(-RJ)	1.3	50	15	1.0
LM-K2P2C-07M-1SS1	MR-J4-350A(-RJ)	5.5	130	20	2.7
LM-K2P2E-12M-1SS1	MR-J4-500A(-RJ)	7.5	195	25	3.9
LM-K2P3C-14M-1SS1	MR-J4-350A(-RJ)	5.5	130	20	2.7
LM-K2P3E-24M-1SS1	MR-J4-500A(-RJ)	7.5	195	25	3.9

Note 1. 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 are not used.

2. Heat generated during regeneration is not included in the servo amplifier-generated heat. To calculate heat generated by the regenerative option, refer to section 11.2.

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 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.

$$Lmax = V_0 \bullet (0.03 + M \bullet (A + B \bullet V_0^2))$$

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}

15.4.4 Permissible load to motor mass ratio when the dynamic brake is used

Use the dynamic brake under the load to motor mass ratio indicated in the following table. If the ratio is higher than this value, the dynamic brake may burn. If there is a possibility that the ratio may exceed the value, contact your local sales office.
The values of the permissible load to motor mass ratio in the table are the values when the linear servo motor is used at the maximum speed.

Linear servo motor (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 of 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 of dynamic brake = $40 \times 3^2/2^2 = 90$ [times]

16. USING A DIRECT DRIVE MOTOR

⚠CAUTION ●When using the direct drive motor, read "Direct Drive Motor Instruction Manual".

POINT

- ●Refer to section 1.4 for the software version of the servo amplifier that is compatible with the direct drive servo system.
- ●The MR-J4-03A6(-RJ) servo amplifier is not compatible with direct drive motor.

16.1 Functions and configuration

16.1.1 Summary

The fields of semiconductor/LCD manufacturing systems, mounters, and others have strong demands for high accuracy and efficiency. Therefore, the number of systems using a direct drive motor for a drive axis has been increasing. The direct drive servo system includes the following features.

(1) Performance

(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-accuracy indexing.

(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	
Motor pole adjustment	Magnetic pole detection	Required	Not required (default setting)	Automatically executed at the first servo-on after the power is turned on. For the absolute position detection system, [Pr. PL01] can disable the magnetic pole detection. (Refer to (2) (b) of 16.3.3.)
Absolute position detection system	Absolute position encoder battery	Required	Required	
	Absolute position storage unit (MR-BTAS01)	Required	Not required	

16.1.2 Configuration including peripheral equipment

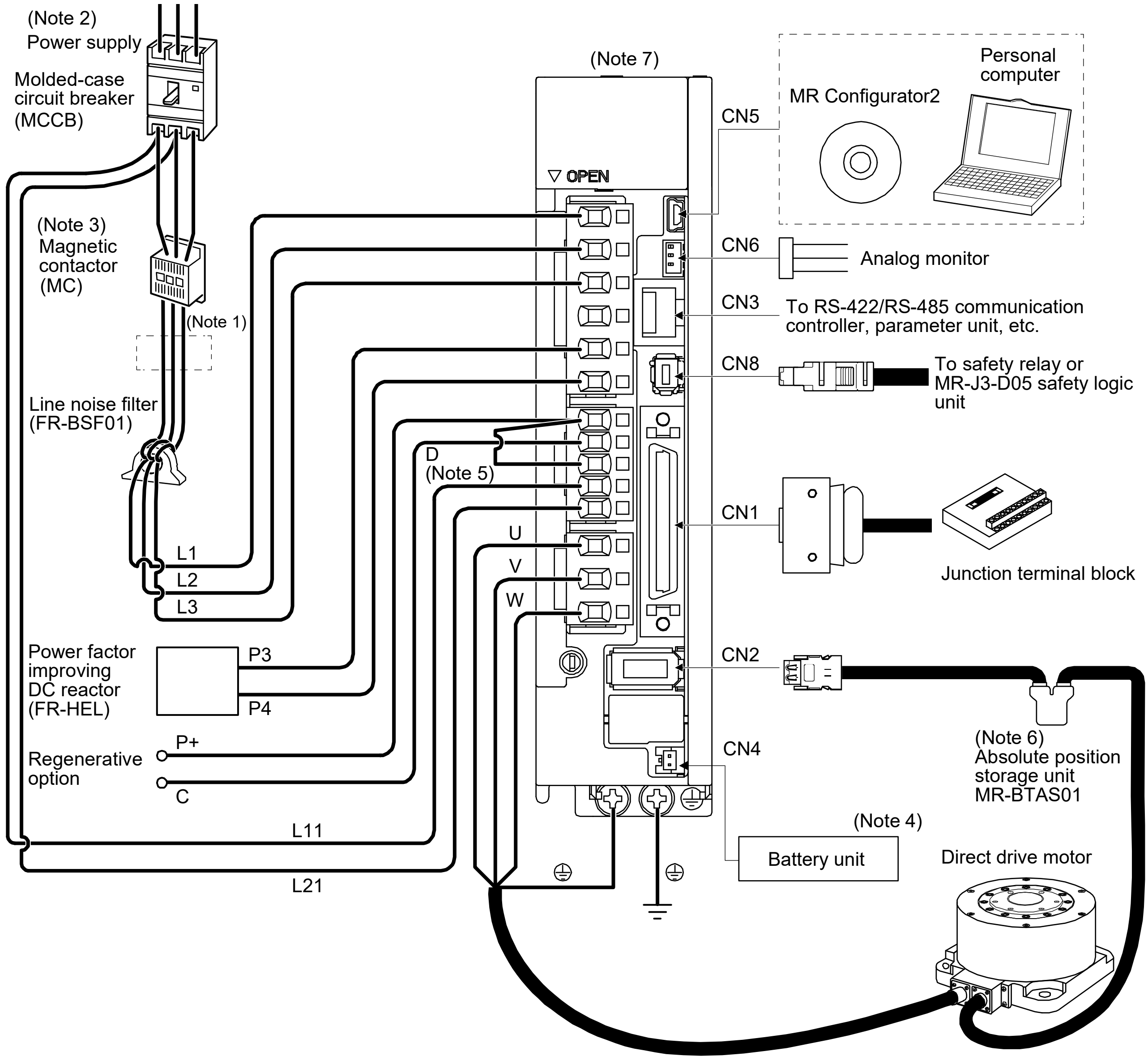
⚠CAUTION

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

POINT

- Equipment other than the servo amplifier and direct drive motor are optional or recommended products.
- When using the direct drive motor, set [Pr. PA01] to "_ _ 6 _".

The configuration diagram is an example of MR-J4-20A. 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-J4-200A(-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 between P+ and D terminals. When using the regenerative option, refer to section 11.2.

6. The absolute position storage unit is used for the absolute position detection system.

7. This is for MR-J4-_A_, MR-J4-_A_-RJ has a CN2L connector. However, CN2L is not used for the direct drive servo system.

16.2 Signals and wiring

⚠WARNING

●Any person who is involved in wiring should be fully competent to do the work.

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

●Ground the servo amplifier and the direct drive motor securely.

●Do not attempt to wire the servo amplifier and direct drive motor until they have been installed. Otherwise, it may cause an electric shock.

●The cables should not be damaged, stressed, loaded, or pinched. Otherwise, it may cause an electric shock.

●To avoid an electric shock, insulate the connections of the power supply terminals.

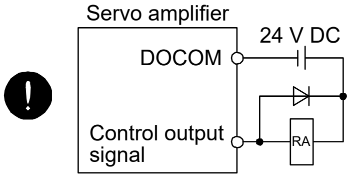
⚠CAUTION

●Wire the equipment correctly and securely. Otherwise, the direct drive motor may operate unexpectedly, resulting in injury.

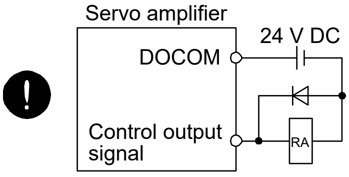
●Connect cables to the correct terminals. Otherwise, a burst, damage, etc. may occur.

●Ensure that polarity (+/-) is correct. Otherwise, a burst, damage, etc. may occur.

●The surge absorbing diode installed to the DC relay for control output should be fitted in the specified direction. Otherwise, the emergency stop and other protective circuits may not operate.



For sink output interface



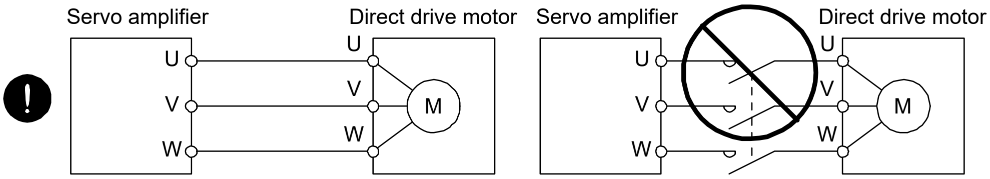
For source output interface

●Use a noise filter, etc. to minimize the influence of electromagnetic interference. Electromagnetic interference may be given to the electronic equipment used near the servo amplifier.

●Do not install a power capacitor, surge killer, or radio noise filter (FR-BIF option) on the power wire of the direct drive motor.

⚠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 direct drive 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.

This section does not describe the following items. For details of the items, refer to each section of the detailed description field.

Item	Detailed explanation
Input power supply circuit	Section 3.1
Explanation of power supply system	Section 3.3
Signal (device) explanations	Section 3.5
Alarm occurrence timing chart	Section 3.8
Interface	Section 3.9
Grounding	Section 3.11
Display and operation sections	Section 4.5
Parameter	Chapter 5
Troubleshooting	Chapter 8

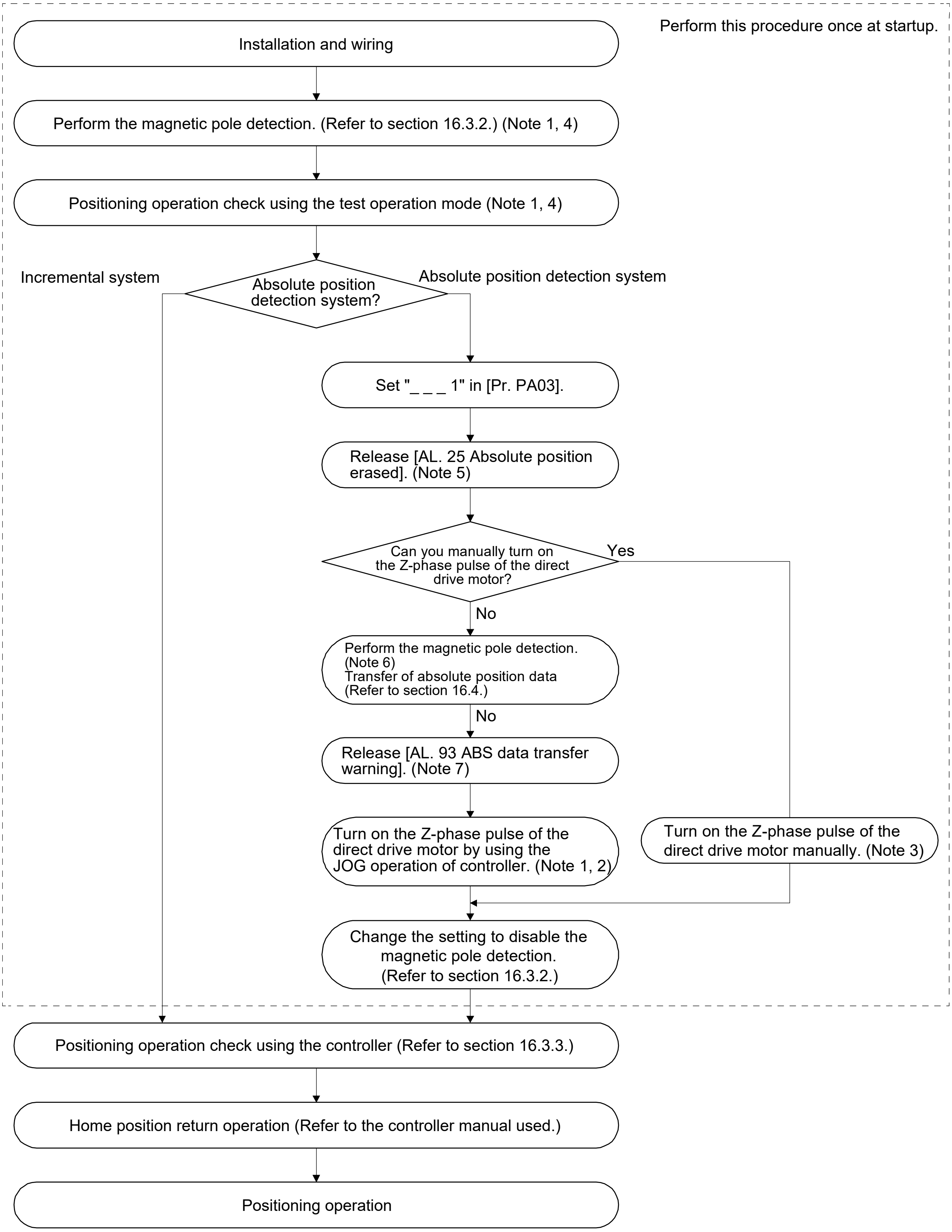
16.3 Operation and functions

POINT

- When using the direct drive motor, set [Pr. PA01] to "_ _ 6 _".
- For the test operation, refer to section 4.2.3, 4.3.3, 4.4.3, and 4.5.9.
- After power on, the Z-phase mark of the direct drive motor must pass the connector area once. In a system which prevents the direct drive motor from making a full rotation, install the direct drive motor in a position where the Z-phase mark can pass over the connector area.

16.3.1 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.

4. Test operation cannot be performed in the absolute position detection system, either. To perform test operation, select "Disabled (incremental system) (_ _ _ 0)" in [Pr. PA03]. Refer to section 16.3.2 (1) for details.

5. After the servo amplifier is connected to the direct drive motor with an encoder cable, [AL. 25 Absolute position erased] will occur at the first power on. Cancel the alarm by turning on/off the power.

6. When the magnetic pole detection is performed with absolute position detection system by DIO transfer, [AL. 93 ABS data transfer warning] will occur. Refer to section 16.4 for details.

7. To cancel [AL. 93 ABS data transfer warning], cycle SON (Servo-on) or set a home position.

16.3.2 Magnetic pole detection

POINT

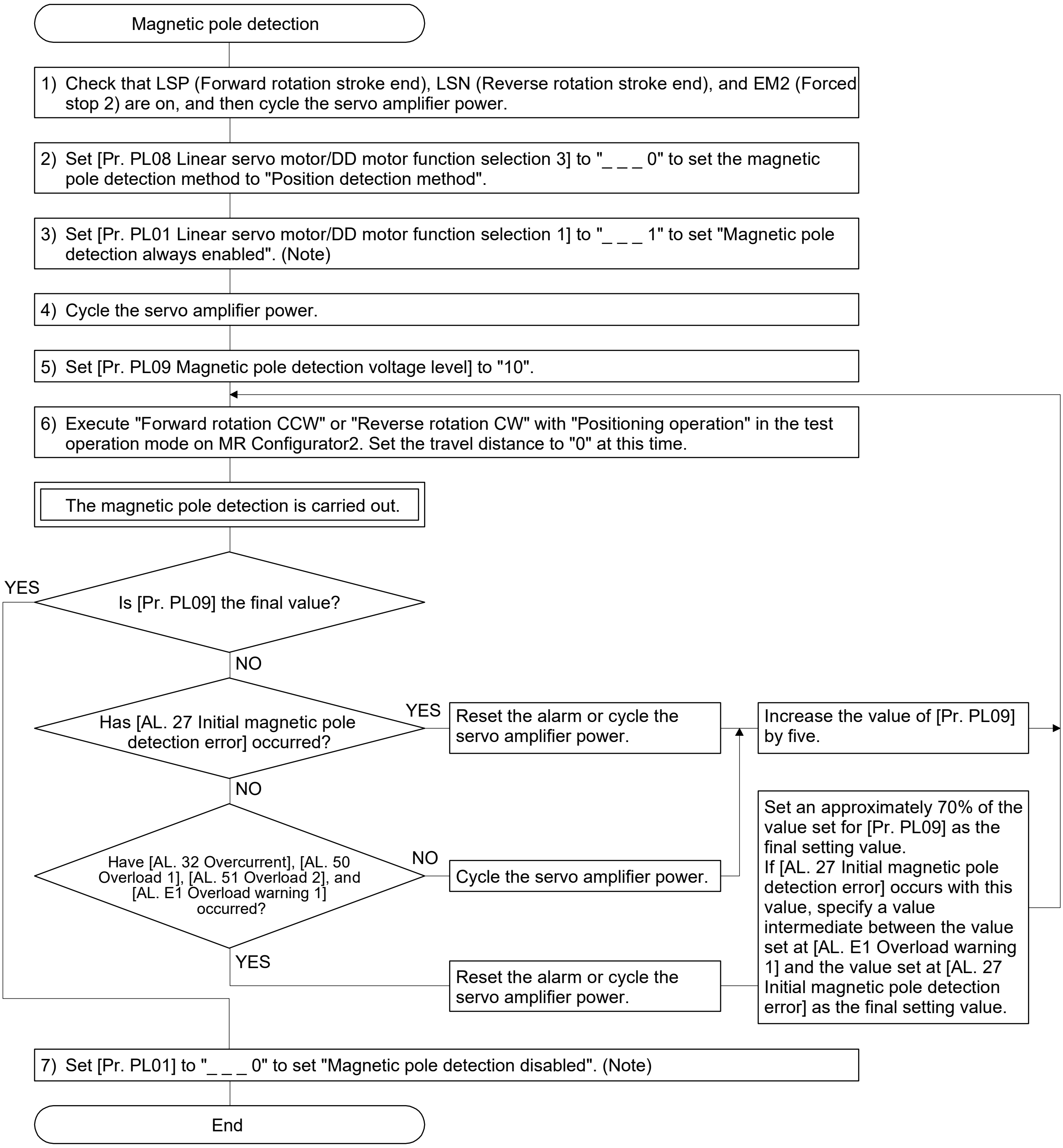
- ●The magnetic pole detection is not required for the configured absolute position detection system where the Z-phase pulse of the direct drive motor can be turned on manually.
  For this operation, always connect the direct drive motor encoder and the servo amplifier and turn on the control circuit power supply of the servo amplifier.
  Perform this operation by considering the safety.
- ●When performing a magnetic pole detection without using LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end), set [Pr. PL08 Linear servo motor/DD motor function selection 3] to "_ 1 _ _" to disable LSP and LSN.
- ●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 LSP (Forward rotation stroke end), LSN (Reverse rotation stroke end), and EM2 (Forced stop 2) are on, and then cycle the servo amplifier power.

2) Set [Pr. PL08 Linear servo motor/DD motor function selection 3] to "_ _ _ 0" to set the magnetic pole detection method to "Position detection method".

3) Set [Pr. PL01 Linear servo motor/DD motor function selection 1] to "_ _ _ 1" to set "Magnetic pole detection always enabled". (Note)

4) Cycle the servo amplifier power.

5) Set [Pr. PL09 Magnetic pole detection voltage level] to "10".

6) Execute "Forward rotation CCW" or "Reverse rotation CW" 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.

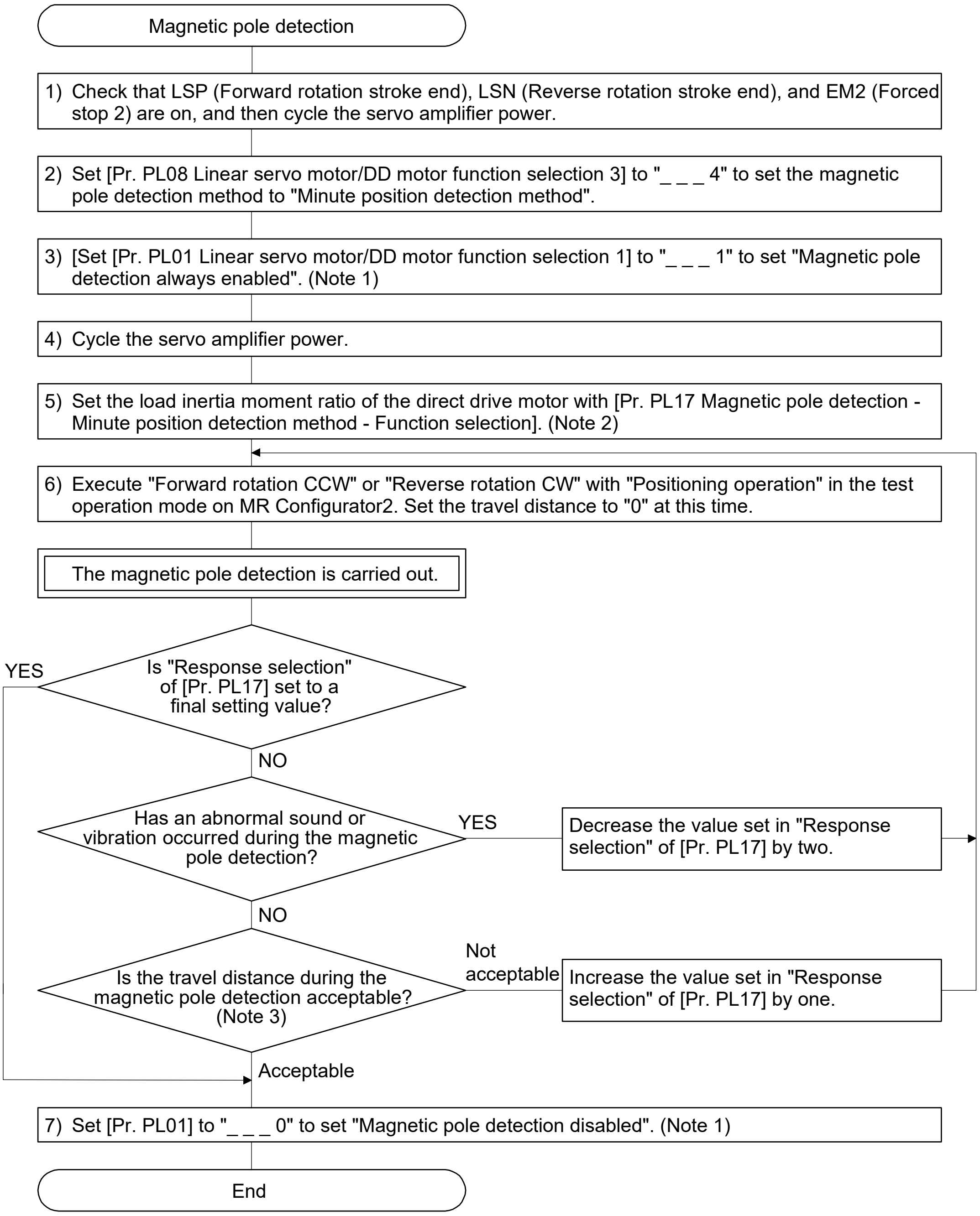
Reset the alarm or cycle the servo amplifier power.

7) 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 LSP (Forward rotation stroke end), LSN (Reverse rotation stroke end), and EM2 (Forced stop 2) are on, and then cycle the servo amplifier power.

2) 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".

3) [Set [Pr. PL01 Linear servo motor/DD motor function selection 1] to "_ _ _ 1" to set "Magnetic pole detection always enabled". (Note 1)

4) Cycle the servo amplifier power.

5) 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)

6) Execute "Forward rotation CCW" or "Reverse rotation CW" 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.

7) 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].

(2) Operation at the magnetic pole detection

⚠WARNING
- ●Note that the magnetic pole detection automatically starts simultaneously with the turning-on of the servo-on command.

⚠CAUTION
- ●If the magnetic pole detection is not executed properly, the direct drive motor may operates unexpectedly.

POINT

- ●Establish the machine configuration to use LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end). The machine may be damaged due to a collision without LSP and LSN.
- ●Assign LSP and LSN and perform the magnetic pole detection also in the torque control mode.
- ●At the magnetic pole detection, whether the motor rotates in the forward or reverse direction is unpredictable.
- ●Depending on the setting value of [Pr. PL09 Magnetic pole detection voltage level], an overload, overcurrent, magnetic pole detection alarm, or others may occur.
- ●After the magnetic pole detection, check the positioning accuracy with the test operation (positioning operation function) of MR Configurator2.
- ●The accuracy of the magnetic pole detection improves with no load.

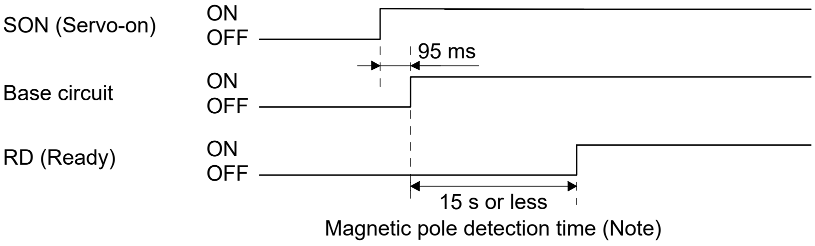
(a) Incremental system

POINT

- ●For the incremental system, the magnetic pole detection is required every time the power is turned on.

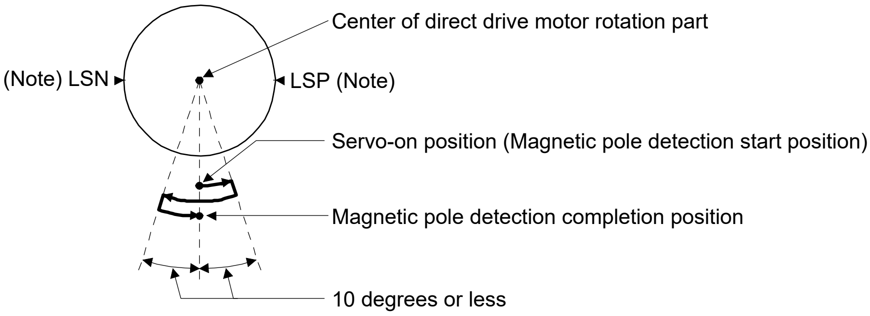
By turning on SON (Servo-on) after power-on, the magnetic pole detection is automatically carried out. Therefore, there is no need to set the parameter (first digit of [Pr. PL01]) for executing the magnetic pole detection.

1) Timing chart



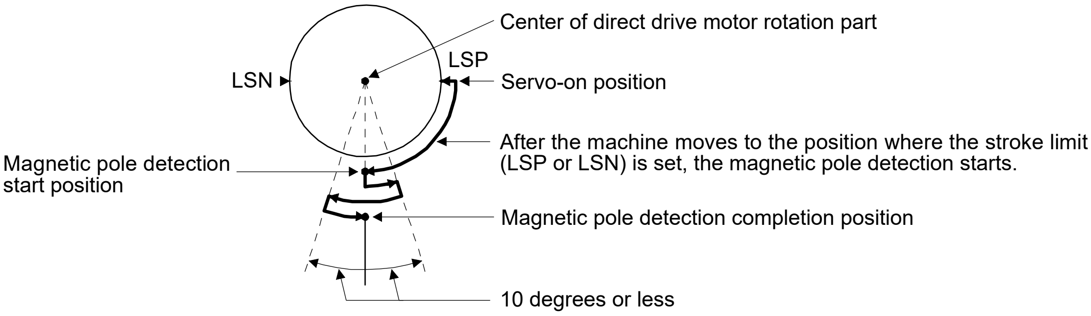
Note. The magnetic pole detection time indicates the operation time when LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end) are on.

2) Direct drive motor movement (when LSP and LSN are on)



Note. When the stroke limit (LSP or LSN) is turned off during the magnetic pole detection, the magnetic pole detection is carried on to the opposite direction. When both LSP and LSN are off, [AL. 27 Initial magnetic pole detection error] occurs.

3) Direct drive motor movement (when LSP or LSN is off)
When LSP or LSN is off at servo-on, the magnetic pole detection is carried out as follows.



(b) Absolute position detection system

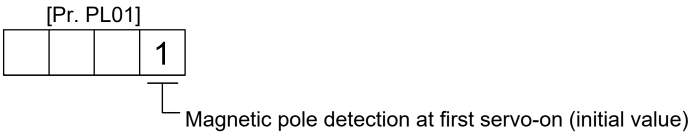
POINT

●The magnetic pole detection is required in the following timings.
  ・System set-up (at the first startup of equipment)
  ・When the Z-phase pulse of the direct drive motor is not turned on at the system setup (When the Z-phase pulse of the direct drive motor can be turned on manually, the magnetic pole detection is not required.)
  ・After a direct drive motor is replaced
  ・When [AL. 25 Absolute position erased] has occurred

●Turn on the Z-phase pulse of the direct drive motor in JOG operation from the controller after the magnetic pole detection.

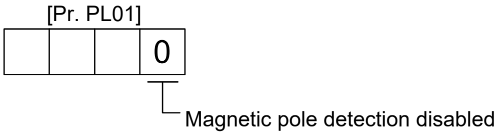
Perform the magnetic pole detection in the following procedure.

1) Set [Pr. PL01 Linear servo motor/DD motor function selection 1] to "_ _ _ 1" (Magnetic pole detection at first servo-on).



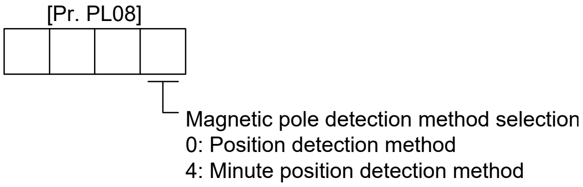
2) Execute the magnetic pole detection. (Refer to (2) (a) in this section.)

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 of the direct drive motor in JOG operation and by disabling the magnetic pole detection function with [Pr. PL01], the magnetic pole detection after each power-on is not required.

(3) Magnetic pole detection method setting
Set the magnetic pole detection method using the first digit of [Pr. PL08] (Magnetic pole detection method selection).



(4) Setting of the magnetic pole detection voltage level by the position detection method
For the magnetic pole detection by the position detection method, set the voltage level with [Pr. PL09 Magnetic pole detection voltage level]. For the magnetic pole detection by the minute position detection method, the voltage level setting is not required.

(a) Guideline of parameter settings
Set the parameters by referring to the following table.

[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	Seldom occurs	Frequently occurs
Magnetic pole detection alarm	Frequently occurs	Seldom occurs
Magnetic pole detection accuracy	Low	High

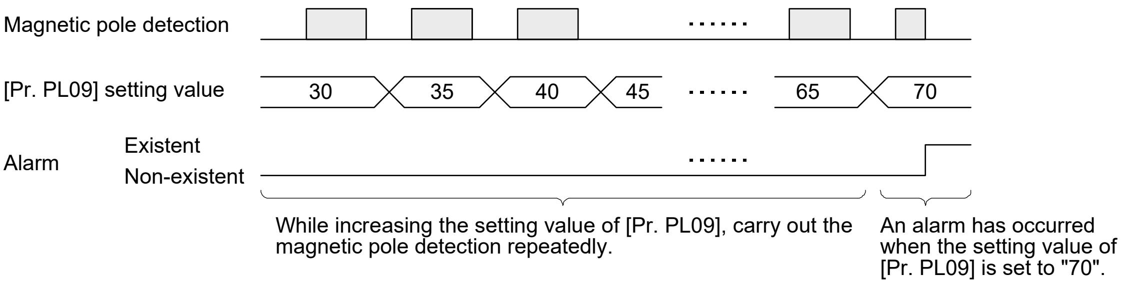
(b) Setting procedure

1) Perform the magnetic pole detection, and increase the setting value of [Pr. PL09 Magnetic pole detection voltage level] until [AL. 50 Overload 1], [AL. 51 Overload 2], [AL. E1 Overload warning 1], and [AL. EC Overload warning 2] occur. Increase the setting value by five as a guide value. When these alarms and warnings occur during the magnetic pole detection by using MR Configurator2, the test operation of MR Configurator2 automatically completes and the servo-off status is established.

2) Specify the setting value that is an approximately 70% of the value set when [AL. 50 Overload 1], [AL. 51 Overload 2], [AL. E1 Overload warning 1], and [AL. EC Overload warning 2] occurred as the final setting value. However, if [AL. 27 Initial magnetic pole detection error] occurs with this value, specify a value intermediate between the value set at [AL. 50 Overload 1], [AL. 51 Overload 2], [AL. E1 Overload warning 1], or [AL. EC Overload warning 2] and the value set at the magnetic pole detection alarm as the final setting value.

3) Perform the magnetic pole detection again with the final setting value.

(c) Setting example



In this example, the final setting value of [Pr. PL09] is 49 (Setting value at the alarm occurrence = 70 × 0.7).

16.3.3 Function

(1) Servo control error detection function

POINT
●For the servo control error detection function, the position and speed deviation error detections are enabled by default. ([Pr. PL04]: _ _ _ 3)

If the servo control gets unstable for some reasons, the direct drive motor may not operate properly. To detect this state and to stop operation, the servo control error detection function is used as a protective function.

The servo control error detection function has three different detection methods: the position deviation, speed deviation, and torque deviation. An error is detected when each method is enabled with [Pr. PL04 Linear servo motor/DD motor function selection 2]. The detection level can be changed with [Pr. PL05], [Pr. PL06], and [Pr. PL07].

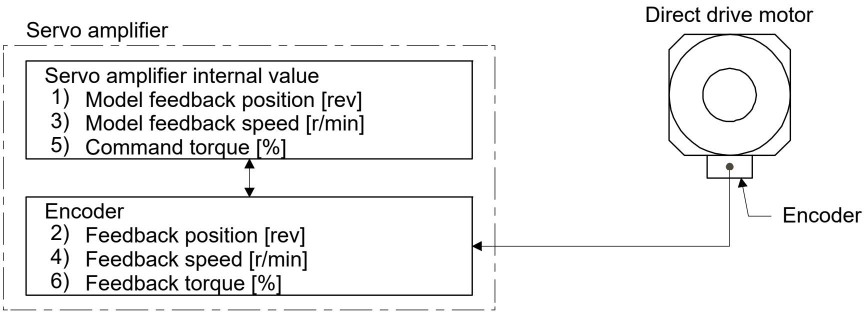
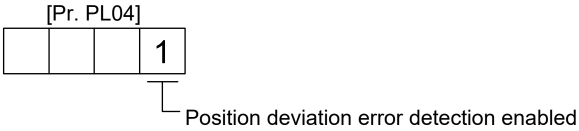


Figure 16.1 Outline of servo control error detection function

(a) Position deviation error detection

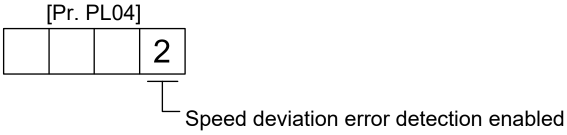
Set [Pr. PL04] to "_ _ _ 1" to enable the position deviation error detection.



When you compare the model feedback position (1)) and the feedback position (2)) in figure 16.1, if the deviation is more than the value of [Pr. PL05 Position deviation error detection level] (1 (0.01 rev) to 1000 (10 rev)), [AL. 42.1 Servo control error by position deviation] will occur and the linear servo motor will stop. The initial value of this detection level is 0.09 rev. Change the set value as necessary.

(b) Speed deviation error detection

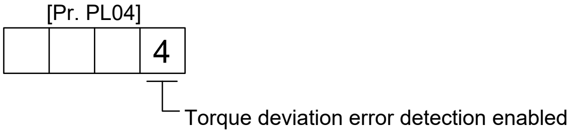
Set [Pr. PL04] to "_ _ _ 2" to enable the speed deviation error detection.



When you compare the model feedback speed (3)) and the feedback speed (4)) in figure 16.1, if the deviation is more than the value of [Pr. PL06 Speed deviation error detection level] (1 r/min to 2000 r/min), [AL. 42.2 Servo control error by speed deviation] will occur and the linear servo motor will stop. The initial value of this detection level is 100 r/min. Change the set value as necessary.

(c) Torque deviation error detection level

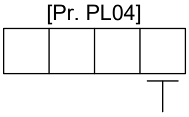
Set [Pr. PL04] to "_ _ _ 4" to enable the torque deviation error detection.



When you compare the command torque (5)) and the feedback torque (6)) in figure 16.1, if the deviation is more than the value of [Pr. PL07 Torque/thrust deviation error detection level] (1% to 1000%), [AL. 42.3 Servo control error by torque/thrust deviation] will occur and the linear servo motor will stop. The initial value of this detection level is 100%. Change the set value as necessary.

(d) Detecting multiple deviation errors

When [Pr. PL04] is set as follows, multiple deviation errors can be detected. For the error detection methods, refer to (1) (a), (b), (c) in this section.



Setting value	Position deviation error detection	Speed deviation error detection	Torque deviation error detection
1	○		
2		○	
3	○	○	
4			○
5	○		○
6		○	○
7	○	○	○

16.4 Absolute position detection system

POINT

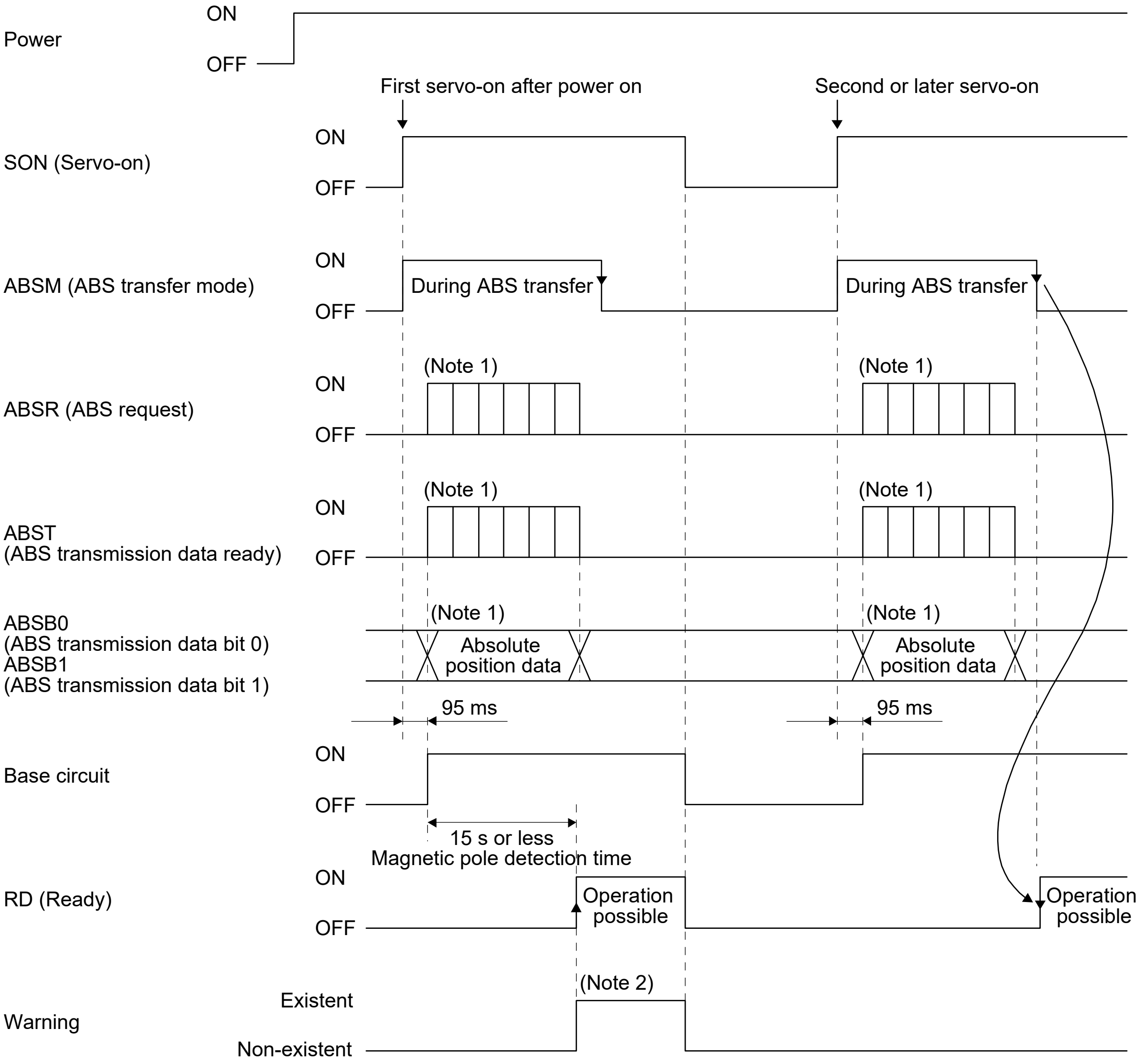
●To configure the absolute position detection system by using the direct drive motor, the battery and the absolute position storage unit (MR-BTAS01) are required.
●For encoder cables and absolute position storage units, refer to "Direct Drive Motor Instruction Manual".
●Replacing the absolute position storage unit (MR-BTAS01) will erase the absolute position. Start up the direct drive motor again and perform home positioning.
●Replace the battery while the control circuit power is on. Replacing the unit during control circuit power supply off will cause [AL. 25 Absolute position erased]. A battery cannot be replaced using battery connection cable (MR-J3BTCBL03M).
●[AL. 25 Absolute position erased] will occur if the encoder cable is disconnected.

When you use the system with absolute position detection system by DIO transfer (set [Pr. PA03] to "_ _ _ 1") with the following conditions, the first servo-on after power on will trigger the magnetic pole detection and [AL. 93 ABS data transfer warning] will occur.

・Magnetic pole detection always enabled (Set [Pr. PL03] to "_ _ _ 1".)
・The Z-phase pulse of the direct drive motor has not turned on.

When the magnetic pole detection is performed with absolute position detection system by DIO transfer, a deviation occurs between absolute position data of the servo amplifier side and controller side. If the operation is continued, positions will be mismatched. Therefore, [AL. 93 ABS data transfer warning] will occur on the servo amplifier side. To cancel [AL. 93 ABS data transfer warning], cycle SON (Servo-on) or set a home position.

Timing chart at power on under the condition of performing magnetic pole detection



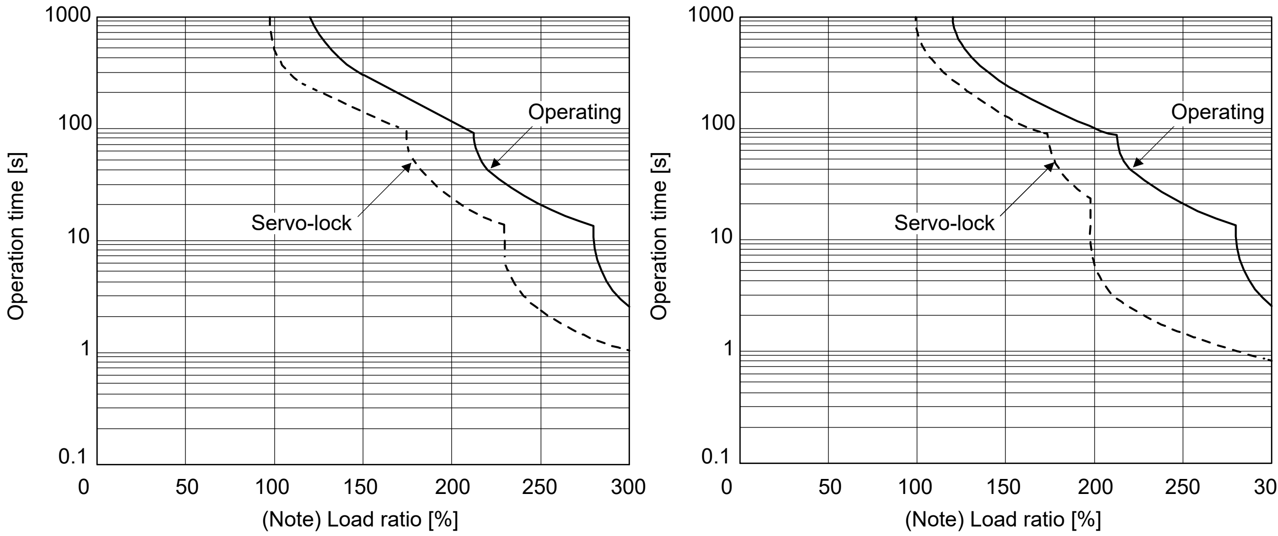
Note 1. Refer to section 12.8.2 (1) (b) for details.
2. Performing the magnetic pole detection triggers [AL. 93 ABS data transfer warning].

For transferring absolute position data to the controller, refer to section 12.8.

16.5 Characteristics

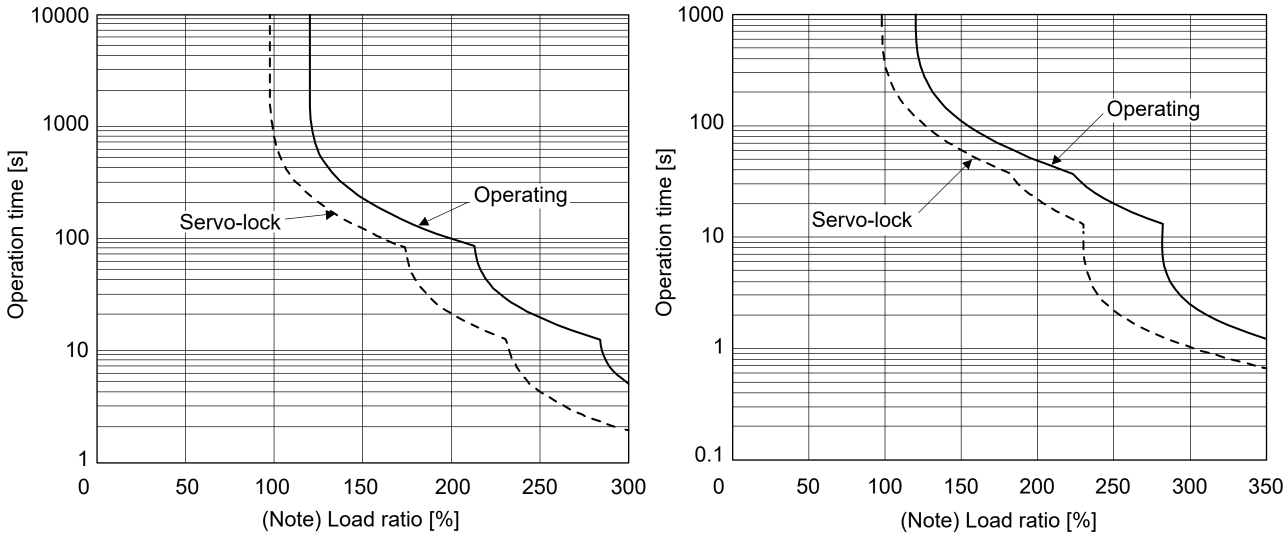
16.5.1 Overload protection characteristics

An electronic thermal is built in the servo amplifier to protect the servo amplifier, direct drive motor, and direct drive motor power wires from overloads.
[AL. 50 Overload 1] occurs if overload operation performed is above the electronic thermal protection curve shown in fig. 16.2. [AL. 51 Overload 2] occurs if the maximum current is applied continuously for several seconds due to machine collision, etc. Use the equipment on the left-side area of the continuous or broken line in the graph.
For the system where the unbalanced torque occurs, such as a vertical axis system, the unbalanced torque of the machine should be kept at 70% or less of the 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 protection.

Fig. 16.2 Electronic thermal protection characteristics

16.5.2 Power supply capacity and generated loss

Table 16.1 indicates servo amplifiers' power supply capacities and losses generated under rated load. For thermal design of an enclosed type cabinet, use the values in the 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 16.1 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-J4-20A(-RJ) MR-J4-20A1(-RJ)	0.25	25	15	0.5
TM-RU2M002C30					
TM-RG2M004E30	MR-J4-20A(-RJ) MR-J4-20A1(-RJ)	0.5	25	15	0.5
TM-RU2M004E30					
TM-RG2M004E30 (Note)	MR-J4-40A(-RJ) MR-J4-40A1(-RJ)	0.7	35	15	0.7
TM-RU2M004E30 (Note)					
TM-RG2M009G30	MR-J4-40A(-RJ) MR-J4-40A1(-RJ)	0.9	35	15	0.7
TM-RU2M009G30					
TM-RFM002C20	MR-J4-20A(-RJ) MR-J4-20A1(-RJ)	0.25	25	15	0.5
TM-RFM004C20	MR-J4-40A(-RJ) MR-J4-40A1(-RJ)	0.38	35	15	0.7
TM-RFM006C20	MR-J4-60A(-RJ)	0.53	40	15	0.8
TM-RFM006E20	MR-J4-60A(-RJ)	0.46	40	15	0.8
TM-RFM012E20	MR-J4-70A(-RJ)	0.81	50	15	1.0
TM-RFM018E20	MR-J4-100A(-RJ)	1.3	50	15	1.0
TM-RFM012G20	MR-J4-70A(-RJ)	0.71	50	15	1.0
TM-RFM048G20	MR-J4-350A(-RJ)	2.7	90	20	1.8
TM-RFM072G20	MR-J4-350A(-RJ)	3.8	110	20	2.2
TM-RFM040J10	MR-J4-70A(-RJ)	1.2	50	15	1.0
TM-RFM120J10	MR-J4-350A(-RJ)	3.4	90	20	1.8
TM-RFM240J10	MR-J4-500A(-RJ)	6.6	160	25	3.2

Note. The combination increases the rated torque and the maximum torque.

16.5.3 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. 16.3 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use equation 16.1 to calculate an approximate coasting distance to a stop. The dynamic brake time constant τ varies with the direct drive motor and machine operation speeds. (Refer to (1) (b) in this section.)

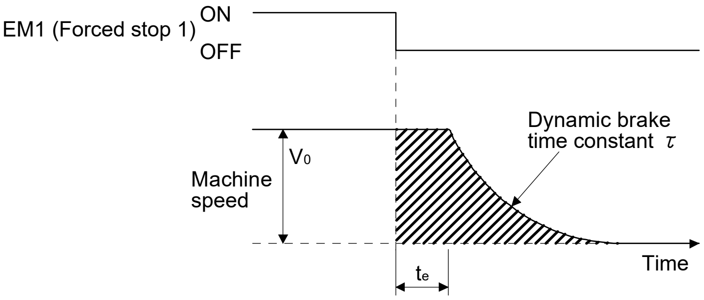


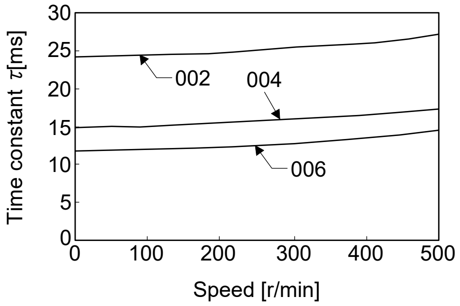
Fig. 16.3 Dynamic brake operation diagram

$$L_{max} = \frac{V_0}{60} \cdot \left\{ t_e + \tau \left(1 + \frac{J_L}{J_M} \right) \right\} \cdots\cdots (16.1)$$

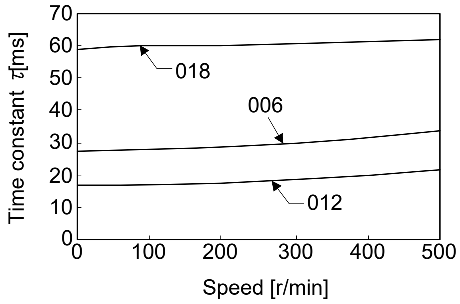
L_{max}: Maximum coasting distance	[mm]
V_0: Machine's fast feed speed	[mm/min]
J_M: Moment of inertia of direct drive motor	[kg•cm^2]
J_L: Load moment of inertia converted into equivalent value on direct drive motor rotor	[kg•cm^2]
τ: Dynamic brake time constant	[s]
t_e: Delay time of control section There is internal relay delay time of about 10 ms.	[s]

(b) Dynamic brake time constant

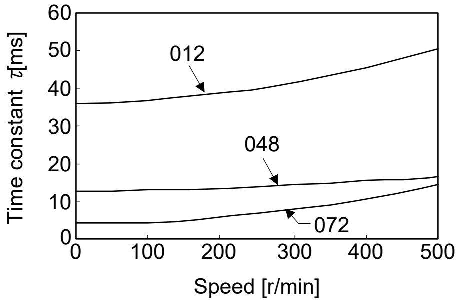
The following shows necessary dynamic brake time constant τ for equation 16.1.



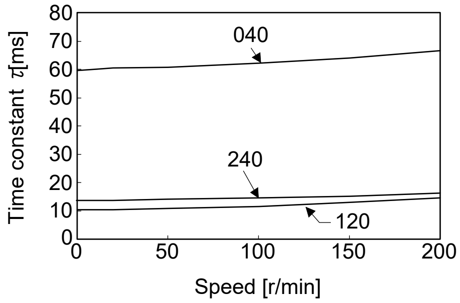
TM-RFM_C20



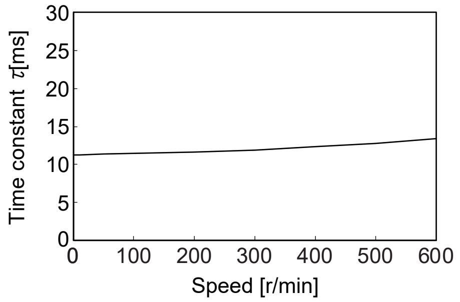
TM-RFM_E20



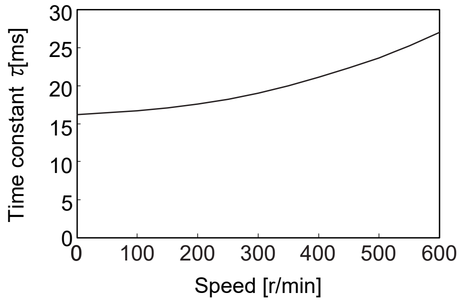
TM-RFM_G20



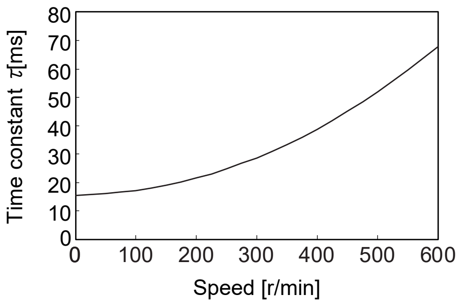
TM-RFM_J10



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 ratio is higher than this value, the dynamic brake may burn. If there is a possibility that the ratio may exceed the value, contact your local sales office.

The values of the permissible load to motor inertia ratio in the table are the values at the maximum rotation speed of the direct drive motor.

The value in the parenthesis shows the value at the rated speed of the direct drive motor.

Direct drive motor	Permissible load to motor inertia ratio [multiplier]
TM-RFM_C20	100 (300)
TM-RFM_E20	
TM-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	

17. FULLY CLOSED LOOP SYSTEM

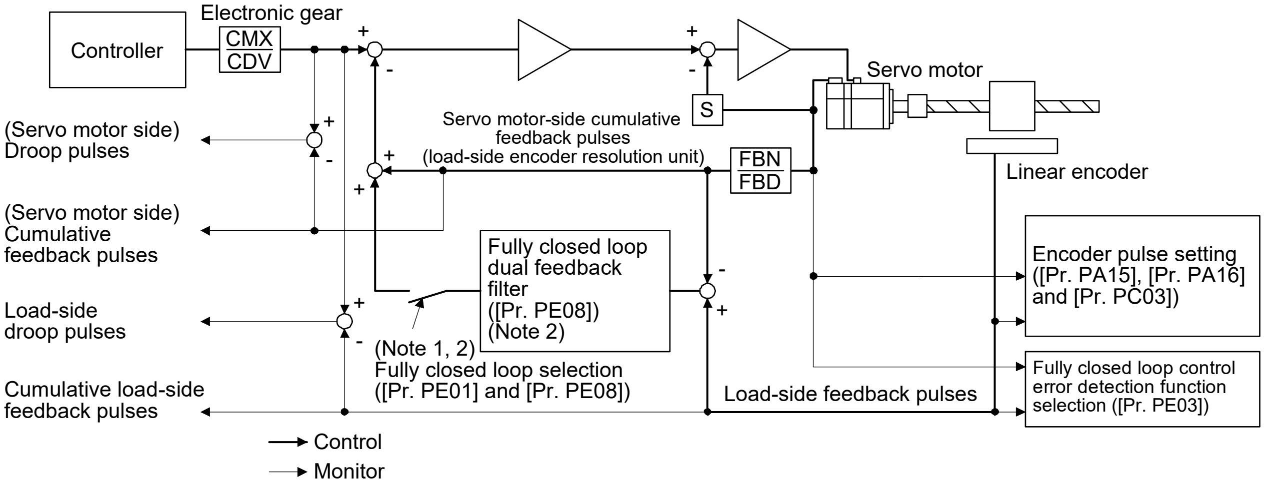
POINT

- The fully closed loop system is available for the servo amplifiers of which software version is A5 or above.
- When fully closed loop control system is used with this servo amplifier, "Linear Encoder Instruction Manual" is needed.
- Fully closed loop control system is available with position control mode.
- When fully closed loop control system is configured with MR-J4-_A_ servo amplifier, the following restrictions will be applied. However, these restrictions will not be applied for MR-J4-_A_-RJ servo amplifiers.
  - A/B/Z-phase differential output method 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 MR-J4-03A6(-RJ) servo amplifier is not compatible with the fully closed loop system.
- The synchronous encoder Q171ENC-W8 can be used with servo amplifiers with software version A8 or later.

17.1 Functions and configuration

17.1.1 Function block diagram

A fully closed loop control block diagram is shown below. The fully closed loop system is controlled in the load-side encoder unit.



Note 1. Switching between semi closed loop control and fully closed loop control can be performed by changing the setting of [Pr. PE01].
When semi closed loop control is selected, a control is always performed on the bases of the position data of the servo motor encoder independently of whether the servo motor is at a stop or running.

2. When the fully closed loop system is enabled in [Pr. PE01], dual feedback control in which the servo motor feedback signal and load-side encoder feedback signal are combined by the dual feedback filter in [Pr. PE08] is performed.
In this case, fully closed loop control is performed when the servo motor is at a stop, and semi closed loop control is performed when the servo motor is operating to improve control performance. When "4500" is set as the filter value of [Pr. PE08 Fully closed loop dual feedback filter], fully closed loop control is always performed.

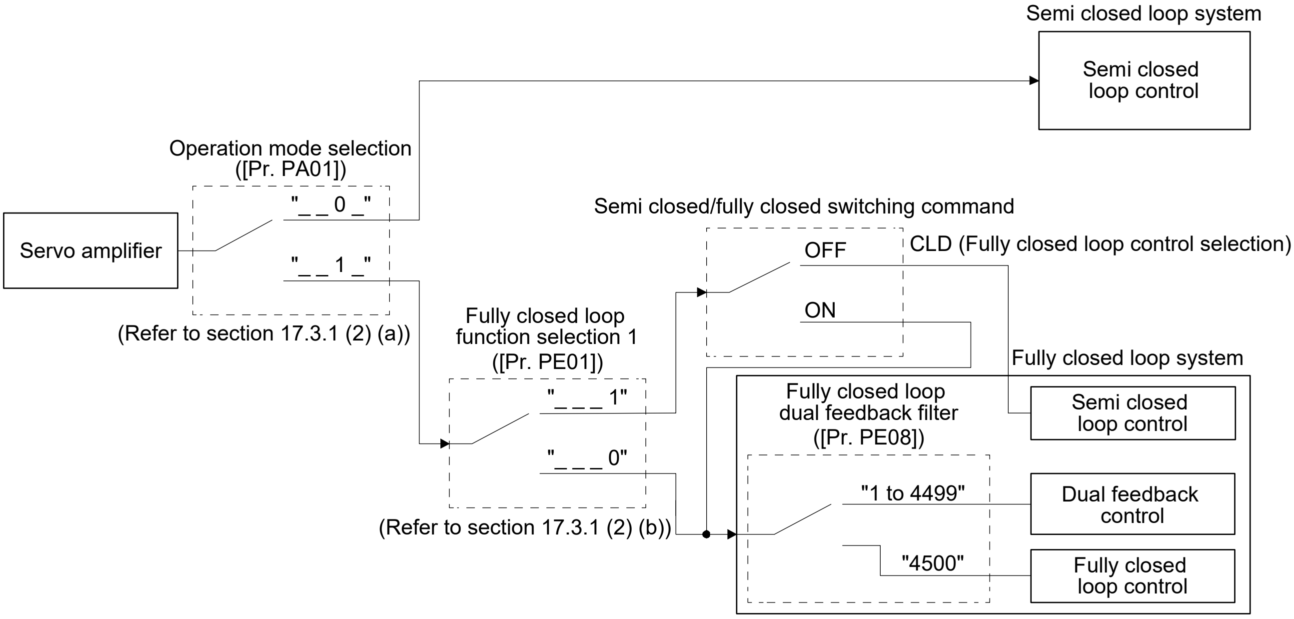
The following table shows the functions of each control mode.

Control	Description	
Semi closed loop control	Feature	Position is controlled according to the servo motor-side data.
	Advantage	Since this control is insusceptible to machine influence (such as machine resonance), the gains of the servo amplifier can be raised and the settling time shortened.
	Disadvantage	If the servo motor side is at a stop, the side may be vibrating or the load-side accuracy not obtained.
Dual feedback control	Feature	Position is controlled according to the servo motor-side data and load-side data.
	Advantage	Control is performed according to the servo motor-side data during operation, and according to the load side-data at a stop in sequence to raise the gains during operation and shorten the settling time. A stop is made with the load-side accuracy.
Fully closed loop control	Feature	Position is controlled according to the load-side data.
	Advantage	The load-side accuracy is obtained not only at a stop but also during operation.
	Disadvantage	Since this control is susceptible to machine resonance or other influences, the gains of the servo amplifier may not rise.

17.1.2 Selecting procedure of control mode

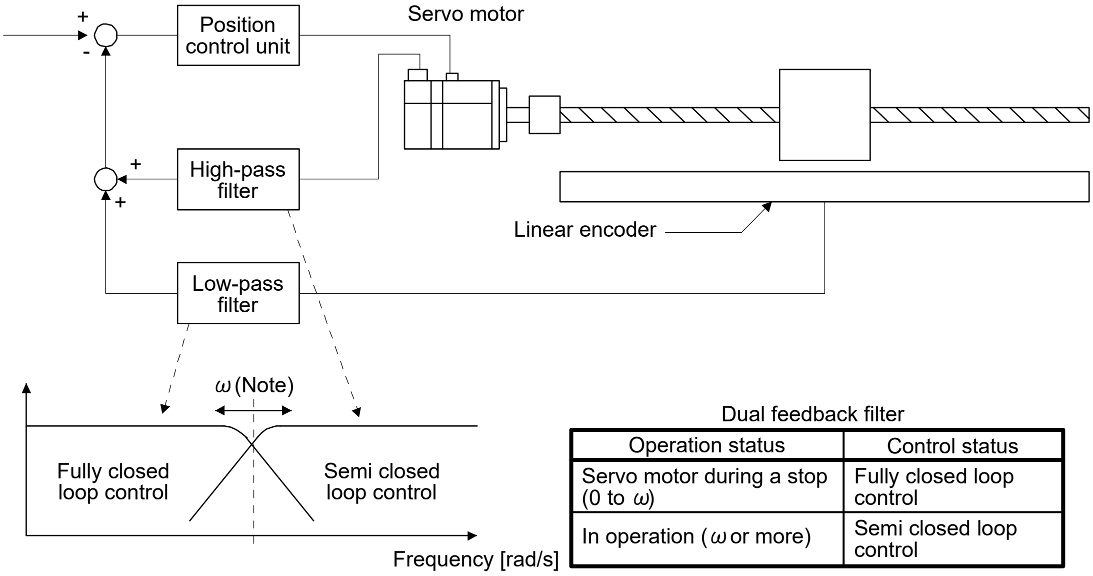
(1) Control mode configuration

In this servo, a semi closed loop system or fully closed loop system can be selected as a control system. In addition, the fully closed loop control and dual feedback control can be selected by the [Pr. PE08] settings on the fully closed loop system.



(2) Dual feedback filter equivalent block diagram

A dual feedback filter equivalent block diagram on the dual feedback control is shown below.



Dual feedback filter

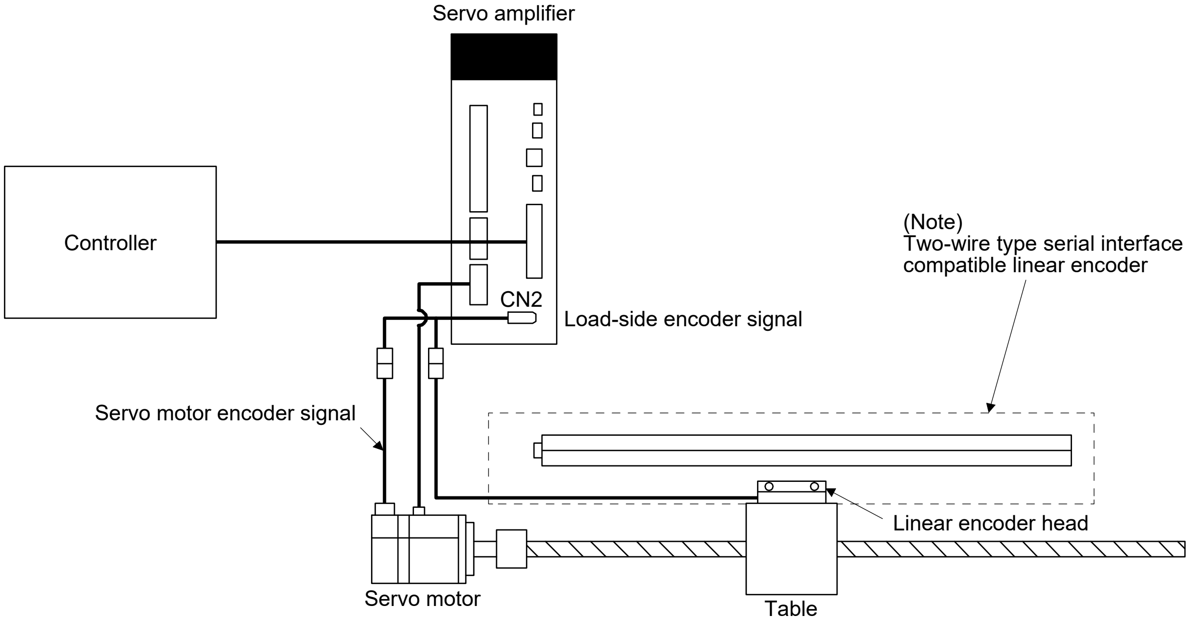
Operation status	Control status
Servo motor during a stop (0 to ω)	Fully closed loop control
In operation (ω or more)	Semi closed loop control

Note. "ω" (a dual feedback filter band) is set by [Pr. PE08].

17.1.3 System configuration

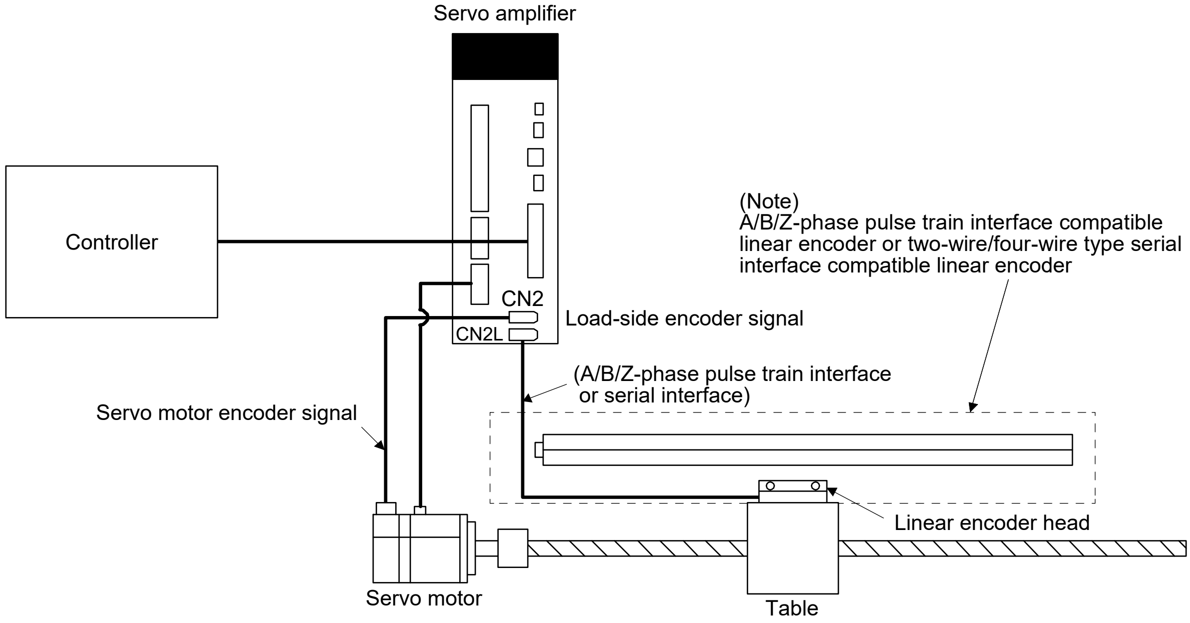
(1) For a linear encoder

(a) MR-J4-_A_ servo amplifier



Note. Applicable for the absolute position detection system when an absolute position linear encoder is used. In that case, a battery is not required.

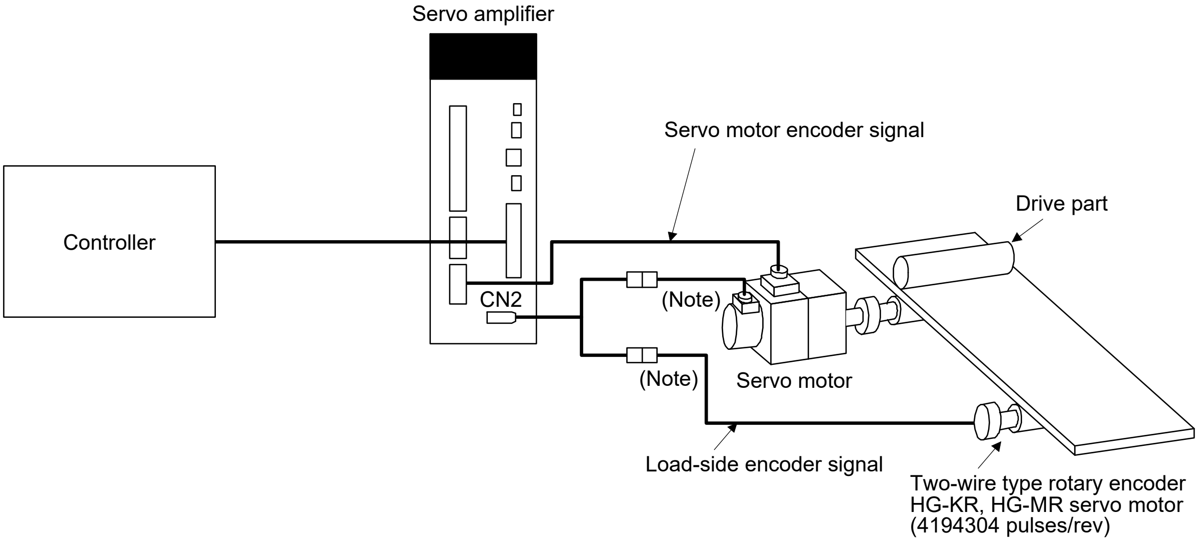
(b) MR-J4-_A_-RJ servo amplifier



Note. Applicable for the absolute position detection system when an absolute position linear encoder is used. In that case, a battery is not required.

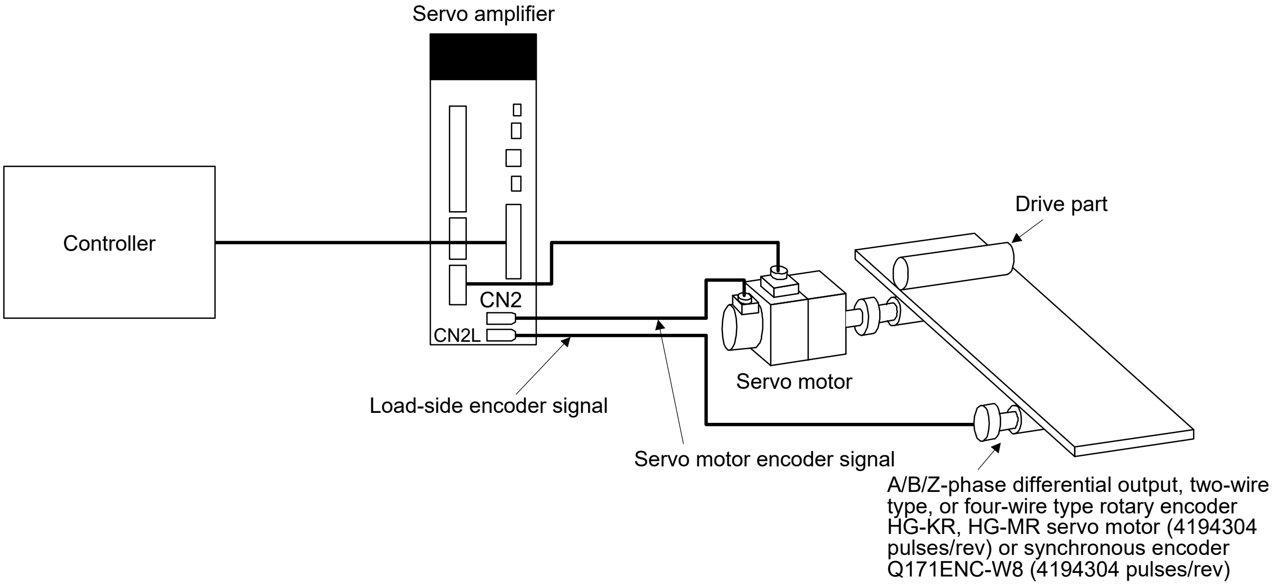
(2) For a rotary encoder

(a) MR-J4-_A_ servo amplifier



Note. Use a two-wire type encoder cable. A four-wire type linear encoder cable cannot be used.

(b) MR-J4-_A_-RJ servo amplifier



17.2 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.

17.2.1 Linear encoder

Refer to "Linear Encoder Instruction Manual" for usable linear encoders.

17.2.2 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-_A_	○	○		
MR-J4-_A_-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".

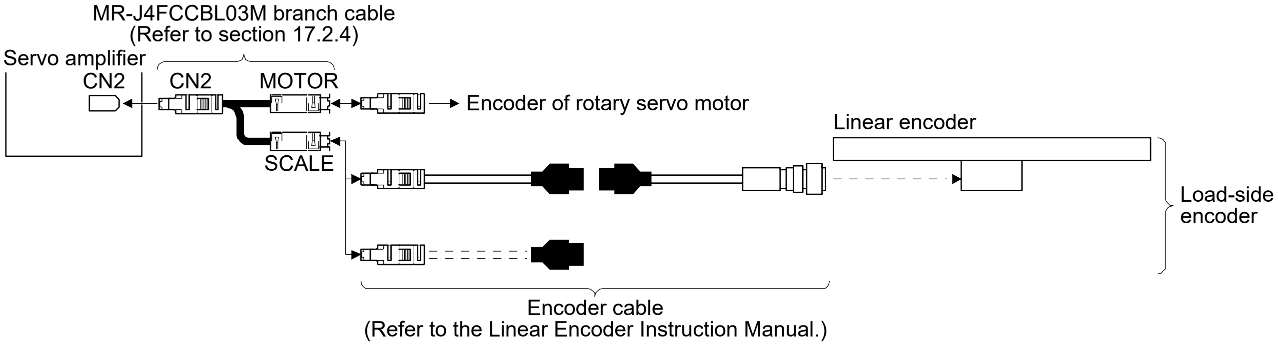
Use a two-wire type encoder cable for MR-J4-_A_ servo amplifiers. Do not use MR-EKCBL30M-L, MREKCBL30M-H, MR-EKCBL40M-H, or MR-EKCBL50M-H as they are four-wire type. If a 30 to 50 m encoder cable is required, fabricate a two-wire type encoder cable by referring to app. 9.

17.2.3 Configuration diagram of encoder cable

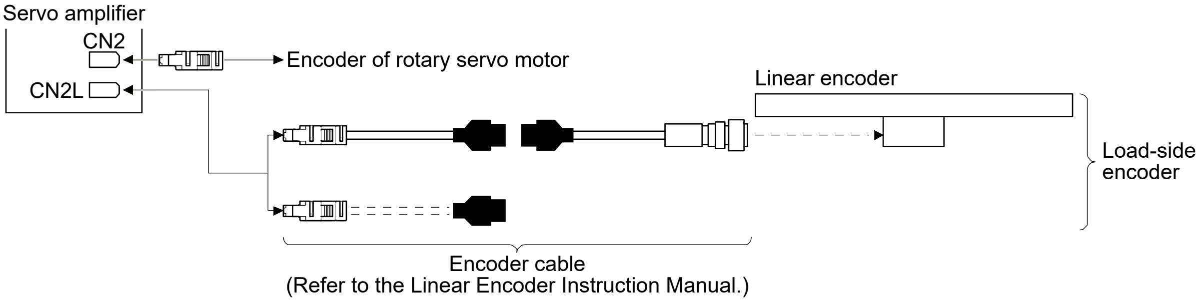
Configuration diagram for servo amplifier and load-side encoder is shown below. Cables used vary, depending on the load-side encoder.

(1) Linear encoder
Refer to Linear Encoder Instruction Manual for encoder cables for linear encoder.

(a) MR-J4-_A_ servo amplifier



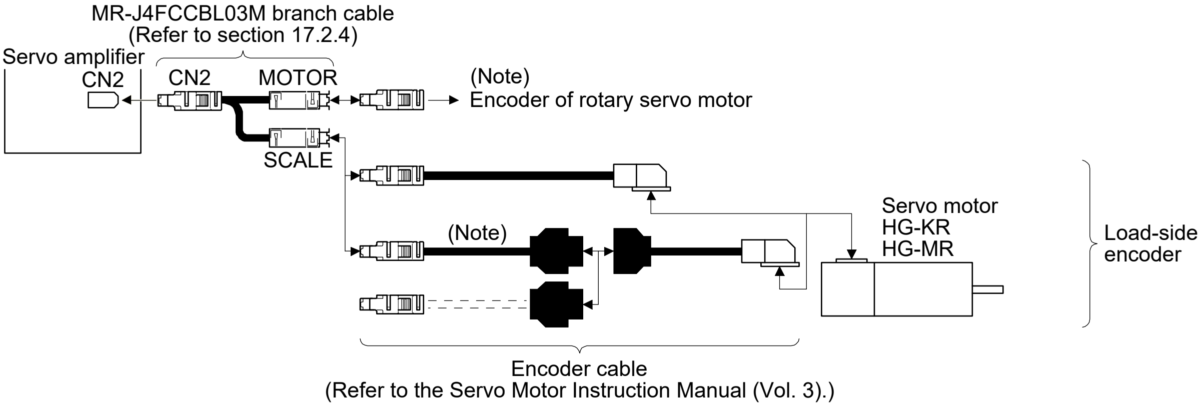
(b) MR-J4-_A_-RJ servo amplifier
You can connect the linear encoder without using a branch cable shown in (a) for MR-J4-_A_-RJ servo amplifier. You can also use a four-wire type linear encoder.



(2) Rotary encoder

Refer to "Servo Motor Instruction Manual (Vol. 3)" for encoder cables for rotary encoders.

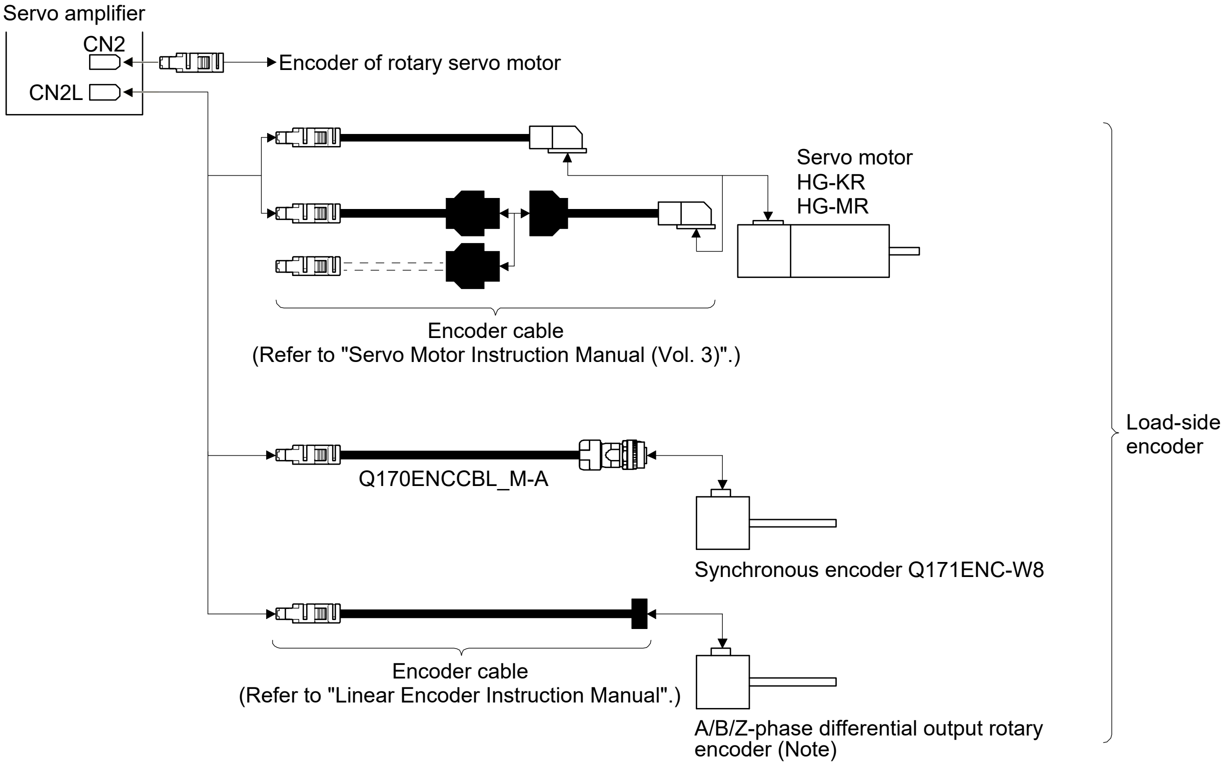
(a) MR-J4-_A_ servo amplifier



Note. Use a two-wire type encoder cable. A four-wire type linear encoder cable cannot be used.

(b) MR-J4-_A_-RJ servo amplifier

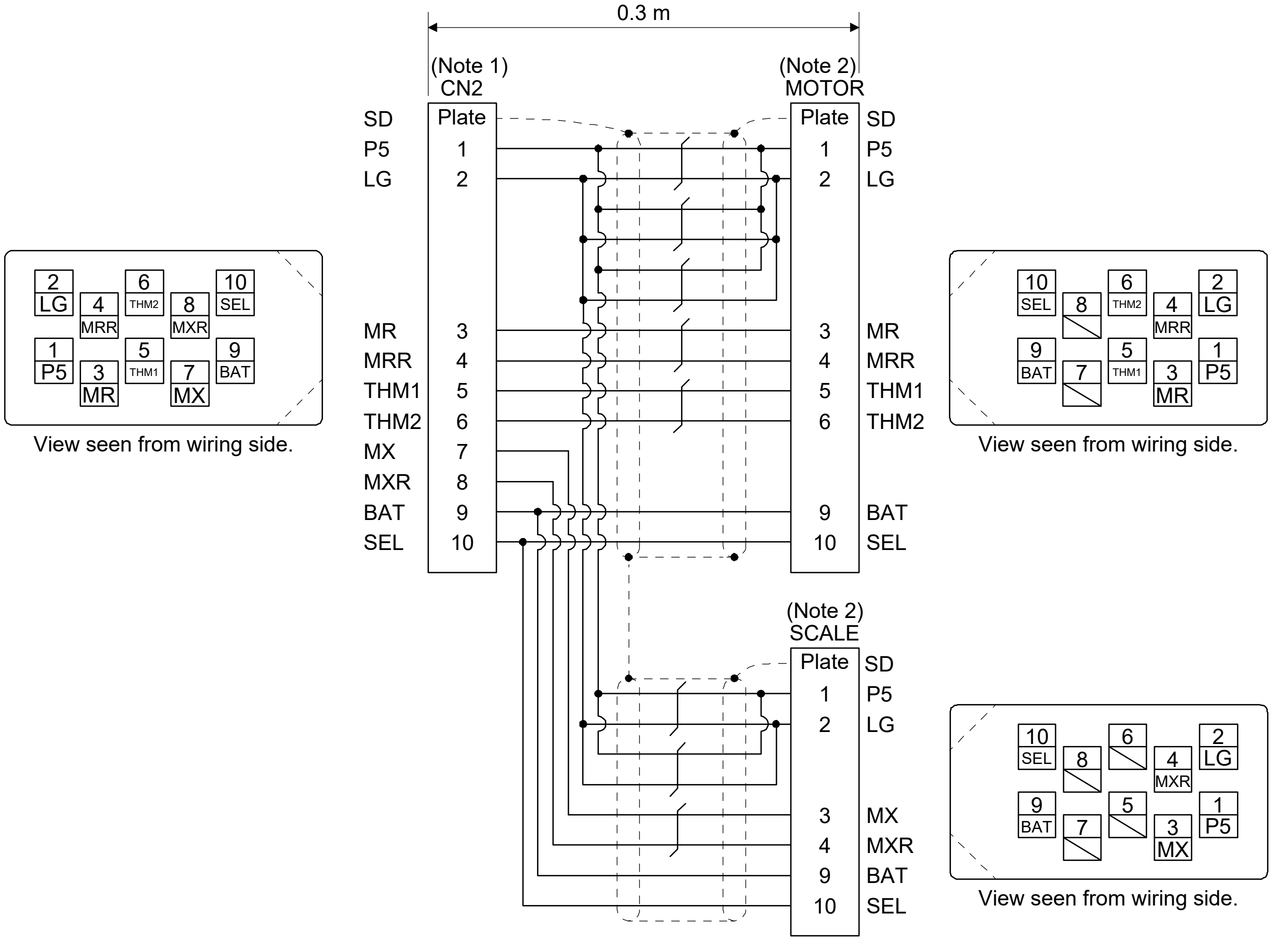
For the MR-J4-_A_-RJ servo amplifier, a rotary encoder can be connected without the branch cable shown in the above (a). In addition, a four-wire type or A/B/Z-phase differential output rotary encoder can also be used.



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".

17.2.4 MR-J4FCCBL03M branch cable

Use MR-J4FCCBL03M branch cable to connect the rotary encoder and the load-side encoder to CN2 connector.
When fabricating the branch cable using MR-J3THMCN2 connector set, refer to "Linear Encoder Instruction Manual".



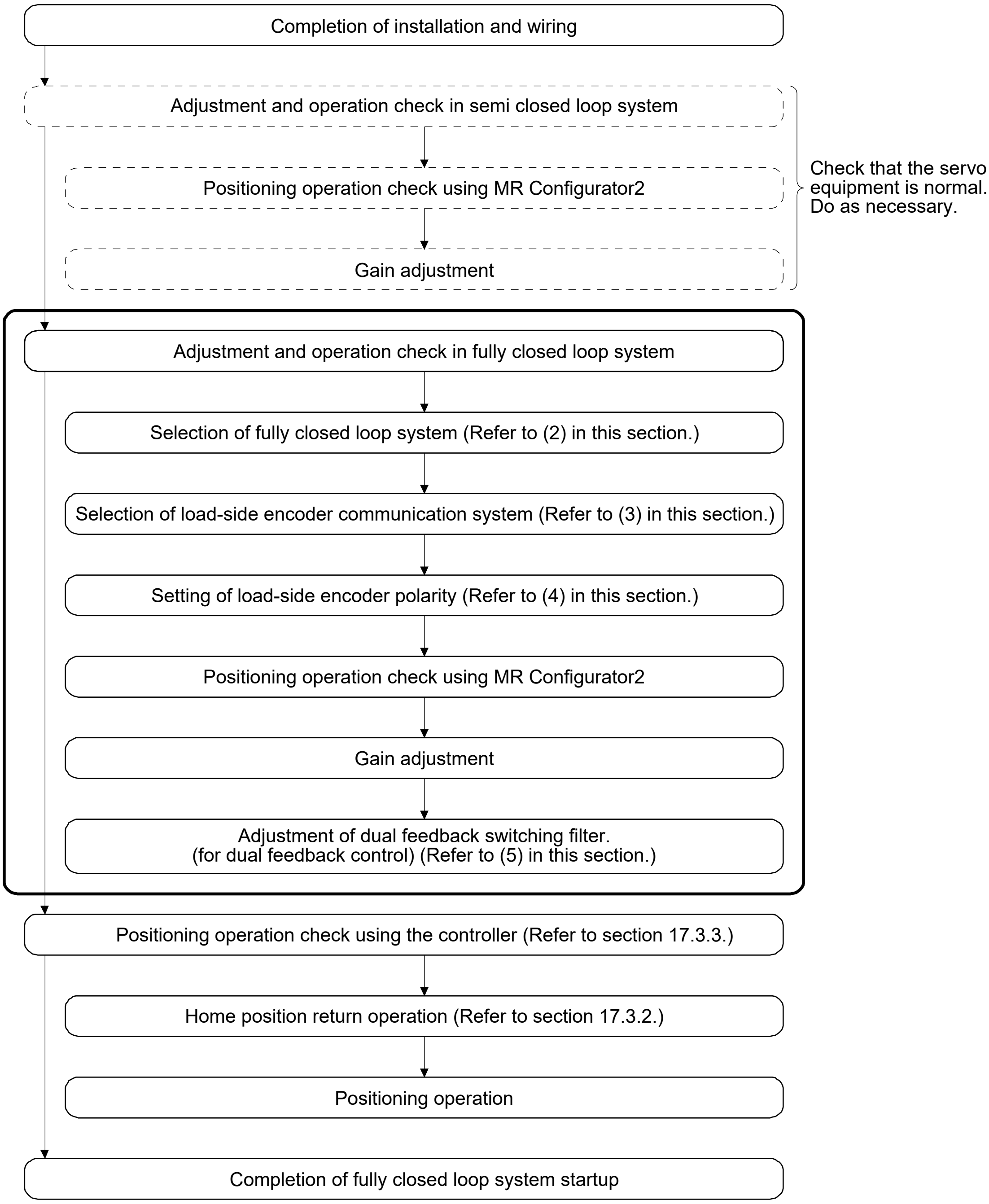
Note 1. Receptacle: 36210-0100PL, shell kit: 36310-3200-008 (3M)
2. Plug: 36110-3000FD, shell kit: 36310-F200-008 (3M)

17.3 Operation and functions

17.3.1 Startup

(1) Startup procedure

Start up the fully closed loop system in the following procedure.



(2) Selection of fully closed loop system

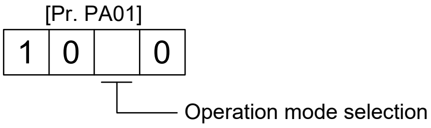
By setting [Pr. PA01], [Pr. PE01] and the control command of controller, the control method can be selected as shown in the following table.

[Pr. PA01]	[Pr. PE01]	Semi closed loop control/fully closed loop control switching signal	Command unit	Control method	Absolute position detection system
"_ _ 0 _" Semi closed loop system (standard control mode)			Servo motor encoder unit	Semi closed loop control	○
"_ _ 1 _" Fully closed loop system (fully closed loop control mode)	"_ _ _ 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.

(1) Operation mode selection

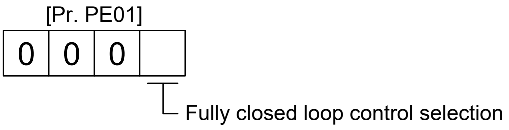
Select a operation mode.



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.



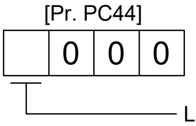
0: Always enabled
1: Switching using the control command of controller (switching between semi closed/fully closed)

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. PC44].



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-_A_-RJ will trigger [AL. 37].

(4) Setting of load-side encoder polarity

⚠CAUTION

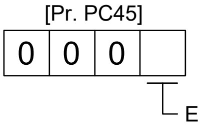
- Do not set an incorrect direction to "Encoder pulse count polarity selection" in [Pr. PC45]. An abnormal operation and a machine collision may occur if an incorrect direction is set, which cause a fault and parts damaged.

POINT

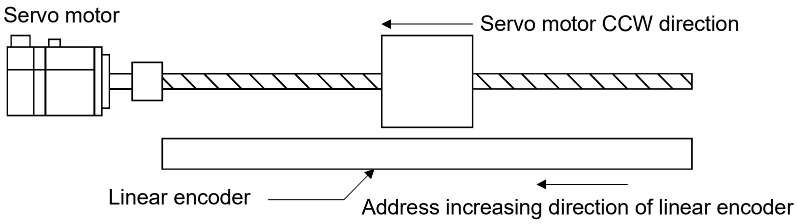
- "Encoder pulse count polarity selection" in [Pr. PC45] is not related to [Pr. PA14 Rotation direction selection]. Make sure to set the parameter according to the relationships between servo motor and linear encoder/rotary encoder.
- Do not set an incorrect direction to "Encoder pulse count polarity selection" in [Pr. PC45]. Doing so may cause [AL. 42 Fully closed loop control error] during the positioning operation.

(a) Parameter setting method

Set the load-side encoder polarity to be connected to CN2L connector in order to match the CCW direction of servo motor and the increasing direction of load-side encoder feedback.



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 into the number of load-side encoder pulses. The relation is as follows.

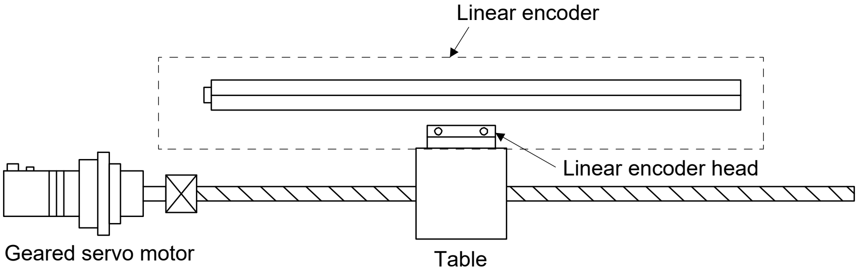
$$\text{Number of load-side encoder pulses per servo motor revolution} = \text{Number of servo motor encoder pulses per servo motor revolution} \times \frac{[\text{Pr. PE04}] \times [\text{Pr. PE34}]}{[\text{Pr. PE05}] \times [\text{Pr. PE35}]}$$

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



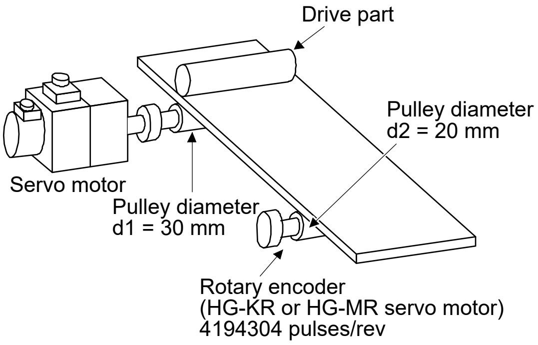
Calculate the number of linear encoder pulses per ball screw revolution.

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 pulses/rev



When the pulley diameters or reduction ratios differ, consider that in calculation.

$$\frac{[\text{Pr. PE04}] \times [\text{Pr. PE34}]}{[\text{Pr. PE05}] \times [\text{Pr. PE35}]} = \frac{4194304 \times 30}{4194304 \times 20} = \frac{1}{1} \times \frac{3}{2}$$

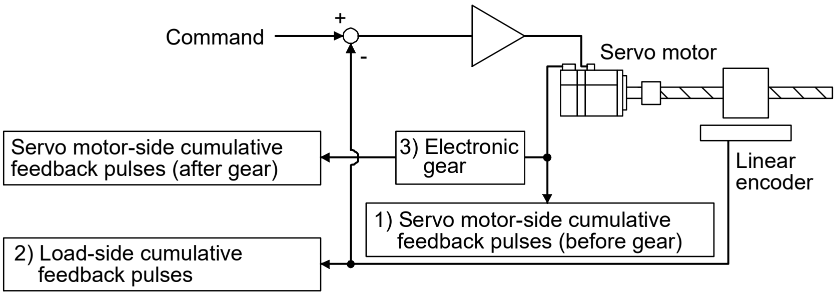
(6) Confirmation of load-side encoder position data

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 17.3.8 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. When it is not counted normally, the following factors can be considered. 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. When it is not cleared, the following factors can be considered. 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

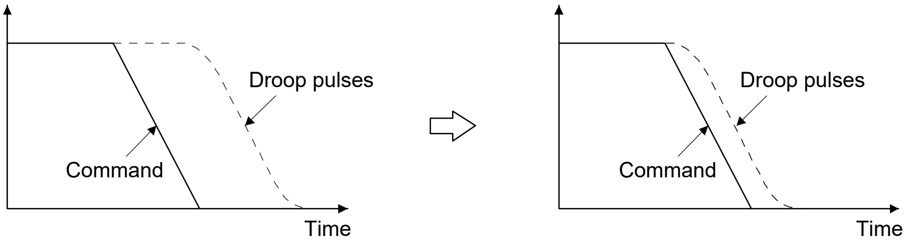
With the initial value (setting = 10) set in [Pr. PE08 Fully closed loop dual feedback filter the dual feedback filter], make gain adjustment by auto tuning, etc. as in semi closed loop control. While observing the servo operation waveform with the graph function, etc. of MR Configurator2, adjust the dual feedback filter.

The dual feedback filter operates as described below depending on the setting.

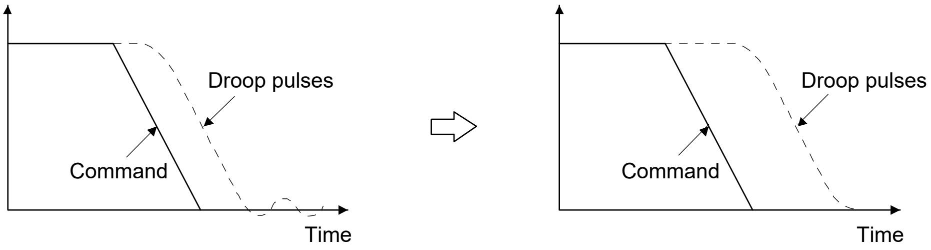
[Pr. PE08] setting	Control mode	Vibration	Settling time
1 to 4499	Dual feedback	Seldom occurs to Frequently occurs	Long to Short
4500	Fully closed loop		

Increasing the dual feedback filter setting shortens the settling time, but increases servo motor vibration since the motor is more likely to be influenced by the load-side encoder vibration. The maximum setting of the dual feedback filter should be less than half of the PG2 setting.

Reduction of settling time: Increase the dual feedback filter setting.



Suppression of vibration: Decrease the dual feedback filter setting.



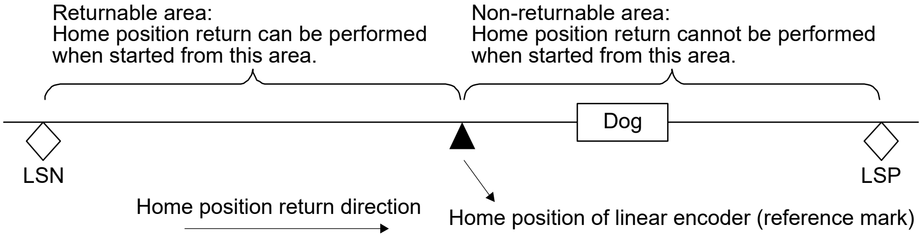
17.3.2 Home position return

(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. For the linear encoder, a home position (reference mark) of the linear encoder is necessary in the home position return direction.

POINT

- When you configure as follows, move the mover to LSN with JOG operation and perform home position to perform it in safe.



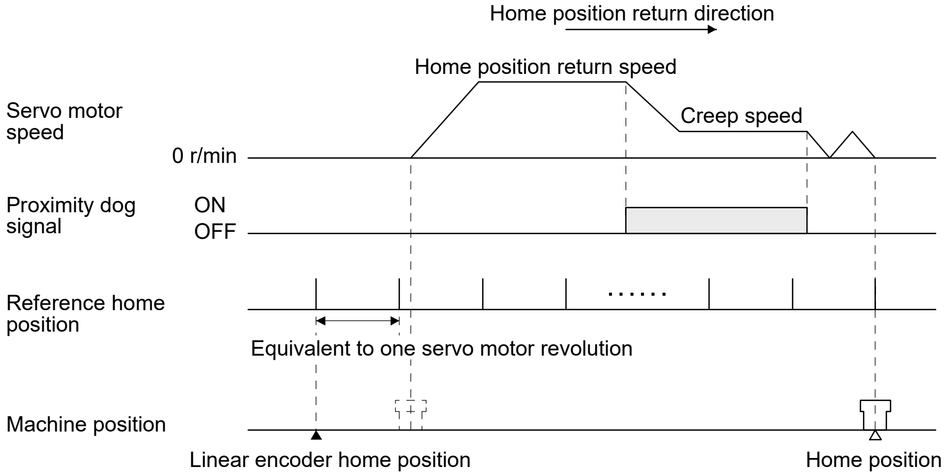
(2) Load-side encoder types and home position return methods

(a) About proximity dog type home position return using absolute type linear encoder

When an absolute type linear encoder is used, the home position standard position is the position per servo motor revolution to the linear encoder home position (absolute position data = 0).

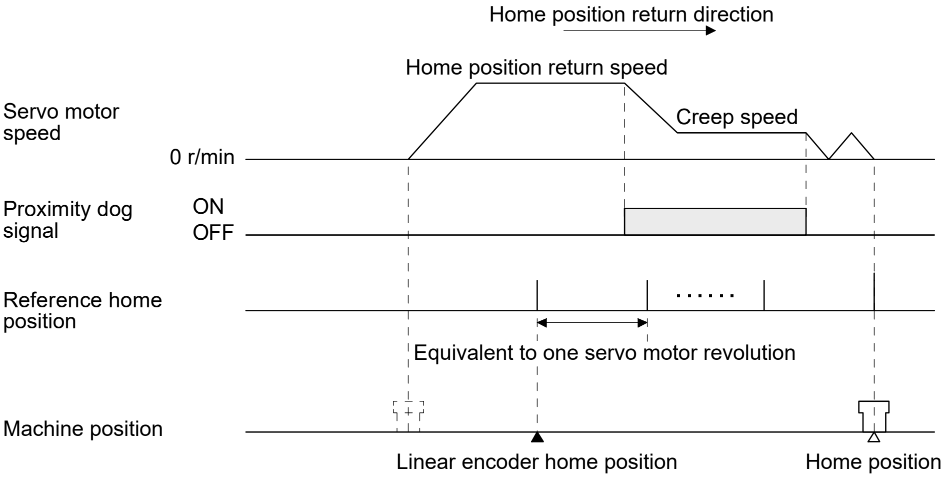
In the case of a proximity dog type home position return, the nearest position after proximity dog off is the home position.

The linear encoder home position may be set in any position.



(b) Home position return using incremental linear encoder

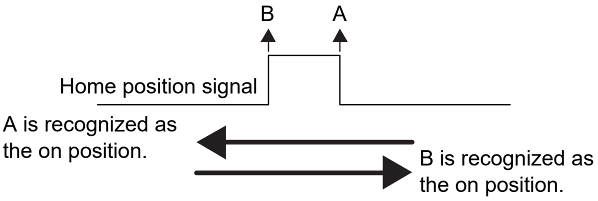
When you use an incremental linear encoder, LZ (Encoder Z-phase pulse) from the servo amplifier will be the home position (reference mark) of the linear encoder. Two or more home positions (reference marks) should not be set. In addition, the home position return cannot be executed without home position (reference mark).



1) Caution for passing the home position (reference mark)

An interval for turning on home position (reference mark) signal of the linear encoder has a certain width. (Specifications differ depending on the linear encoders. For details, refer to "Linear Encoder Instruction Manual".)

Example: When Z-phase is recognized at startup



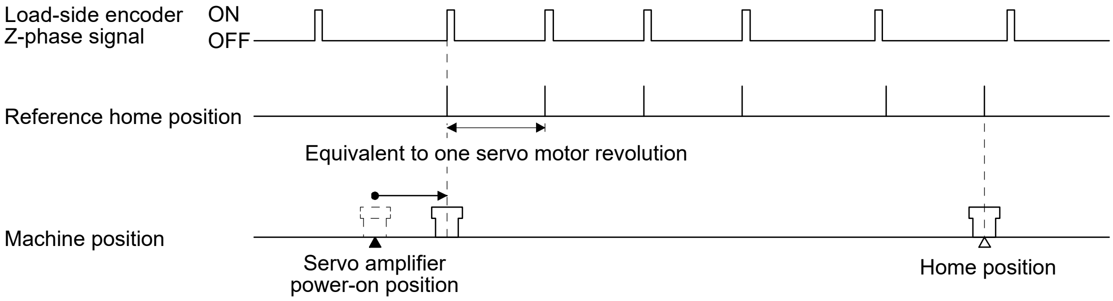
The position which turns on a signal differs depending on the directions of home position passing. When you need to set the home position return completion to the same position each time such as dog type home position return, always start home position return with the same direction.

2) Caution for linear encoder which does not have the home position (Z-phase)

The linear encoder which does not have the home position (Z-phase), LZ (Encoder Z-phase pulse) of the servo amplifier does not be outputted. The home position return can be performed depending on specifications of controllers even if LZ (Encoder Z-phase pulse) is not outputted. Check the controller specifications of the home position return.

(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.



17.3.3 Fully closed loop control error detection functions

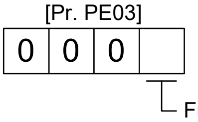
If fully closed loop control becomes unstable for some reason, the speed at servo motor side may increase abnormally. The fully closed loop control error detection function is a protective function designed to pre-detect it and stop operation.

The fully closed loop control error detection function has two 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].

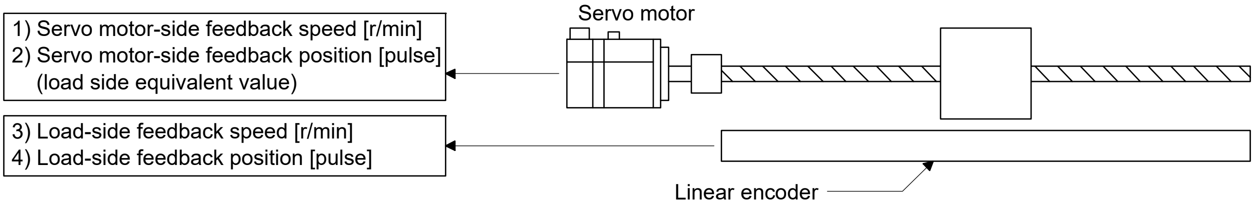
(1) Parameter

The fully closed loop control error detection function is selected.



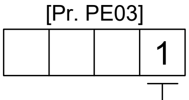
Fully closed loop control error detection function
0: Disabled
1: Speed deviation error detection
2: Position deviation error detection
3: Speed deviation error, position deviation error detection
(Initial value)

(2) Fully closed loop control error detection functions



(a) Speed deviation error detection

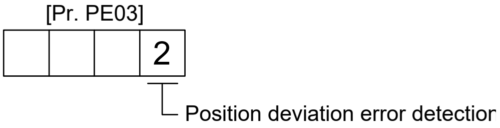
Set [Pr. PE03] to "_ _ _ 1" to enable the speed deviation error detection.



Speed deviation error detection

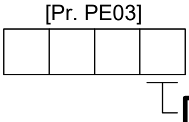
The function compares the servo motor-side feedback speed (1)) and load-side feedback speed (3)). If the deviation is not less than the set value (1 r/min to the permissible speed) of [Pr. PE06 Fully closed loop control speed deviation error detection level], the function generates [AL. 42.2 Servo control error by speed deviation] and stops the motor. The initial value of [Pr. PE06] is 400 r/min. Change the set value as necessary.

(b) Position deviation error detection
Set [Pr. PE03] to "_ _ _ 2" to enable the position deviation error detection.



Comparing the servo motor-side feedback position (2)) and load-side feedback position (4)), if the deviation is not less than the set value (1 kpulses to 20000 kpulses) of [Pr. PE07 Fully closed loop control position deviation error detection level], the function generates [AL. 42.1 Servo control error by position deviation] and stops the motor. The initial value of [Pr. PE07] is 100 kpulses. Change the set value as necessary.

(c) Detecting multiple deviation errors
When setting [Pr. PE03] as shown below, multiple deviation errors can be detected. For the error detection method, refer to (2) (a), (b) in this section.



Setting value	Speed deviation error detection	Position deviation error detection
1	○	
2		○
3	○	○

17.3.4 Auto tuning function

Refer to section 6.3 for the auto tuning function.

17.3.5 Machine analyzer function

Refer to Help of MR Configurator2 for the machine analyzer function of MR Configurator2.

17.3.6 Test operation mode

Test operation mode is enabled by MR Configurator2.
For details on the test operation, refer to section 4.5.9.

Function	Item	Usability	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 4.5.9 (5).
	Program operation	○	
	Output signal (DO) forced output	○	Refer to section 4.5.9 (6).
	Motor-less operation		

17.3.7 Absolute position detection system under fully closed loop system

An absolute type linear encoder is necessary to configure an absolute position detection system under fully closed loop control using a linear encoder. In this case, the encoder battery (MR-BAT6V1SET) need not be installed to the servo amplifier. When an rotary encoder is used, an absolute position detection system can be configured by installing the encoder battery (MR-BAT6V1SET) to the servo amplifier. In this case, the battery life will be shorter because the power consumption is increased as the power is supplied to the two encoders of motor side and load side.
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

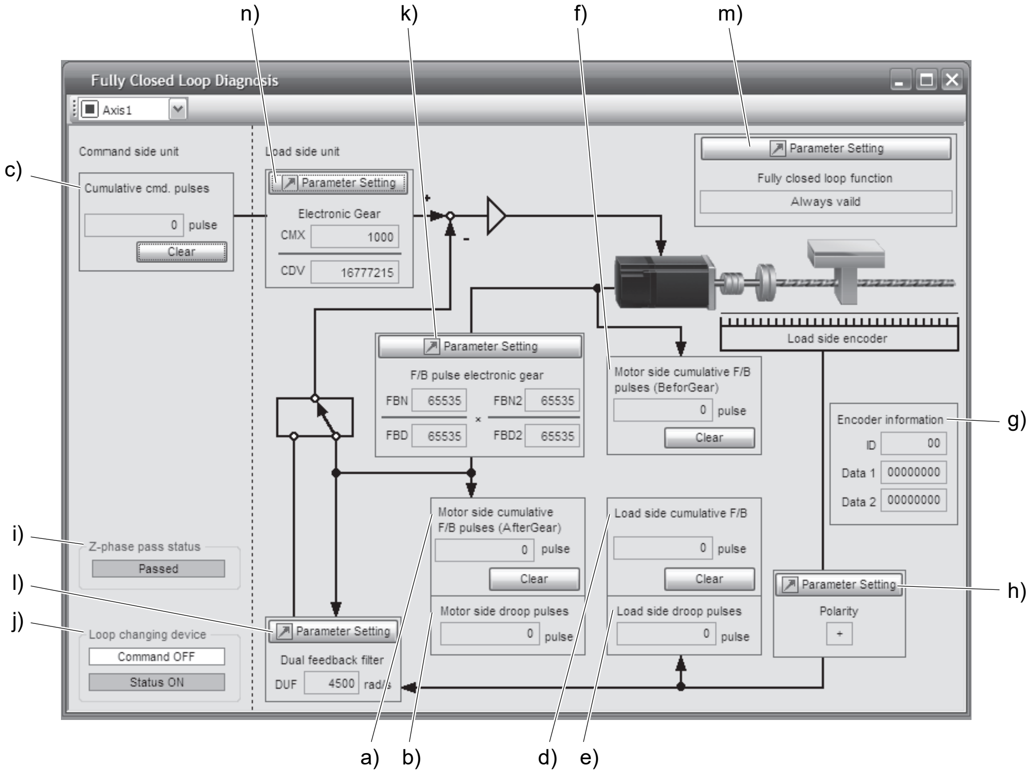
Encoder type	Absolute position detection enabled range
Linear encoder (serial interface)	Movable distance range of linear encoder (within 32-bit absolute position data)

(3) Alarm detection
The absolute position-related alarm ([AL. 25]) and warnings (AL. 92] and [AL. 9F]) are not detected.

(4) Absolute position data transfer to controller
It is the same process as rotary servo motors. (Refer to section 12.8.)

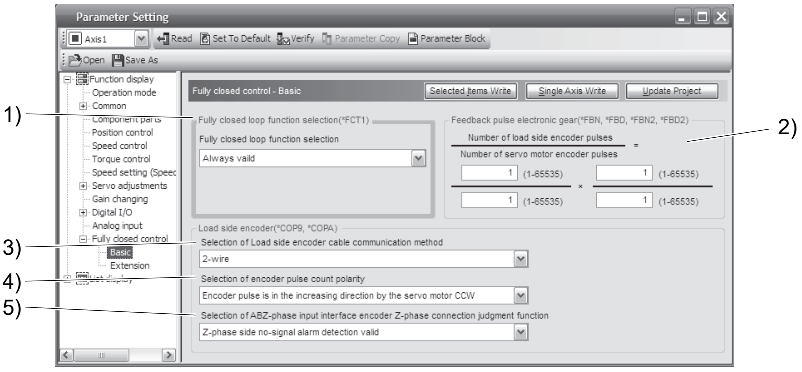
17.3.8 About MR Configurator2

Using MR Configurator2 can confirm if the parameter setting is normal or if the servo motor and the load-side encoder operate properly.
This section explains the fully closed diagnosis screen.
Click "Monitor start" to constantly read the monitor display items from the servo amplifier.
Then, click "Monitor stop" to stop reading. Click "Parameter read" to read the parameter items from the servo amplifier, and then click "Parameter write" to write them.



Cumulative cmd. pulses 0 pulse
Fully closed loop function: Always vaild
CMX 1000
CDV 16777215
FBN 65535
FBD 65535
FBN2 65535
FBD2 65535
Motor side cumulative F/B pulses (BeforGear) 0 pulse
Encoder information ID 00
Data 1 00000000
Data 2 00000000
Motor side cumulative F/B pulses (AfterGear) 0 pulse
Load side cumulative F/B 0 pulse
Motor side droop pulses 0 pulse
Load side droop pulses 0 pulse
Z-phase pass status: Passed
Loop changing device: Command OFF, Status ON
DUF 4500 rad/s
Polarity +

Symbol	Name	Explanation	Unit
a)	Motor-side cumu. feedback pulses (after gear)	Feedback pulses from the servo motor encoder are counted and displayed. (load-side encoder unit) When the set value exceeds 999999999, it starts with 0. Click "Clear" to reset the value to 0. The "-" symbol is indicated for reverse.	pulse
b)	Motor-side droop pulses	Droop pulses of the deviation counter between a servo motor-side position and a command are displayed. The "-" symbol is indicated for reverse.	pulse
c)	Cumulative command pulses	Position command input pulses are counted and displayed. Click "Clear" to reset the value to 0. The "-" symbol is indicated for reverse command.	pulse
d)	Load-side cumulative feedback pulses	Feedback pulses from the load-side encoder are counted and displayed. When the set value exceeds 999999999, it starts with 0. Click "Clear" to reset the value to 0. The "-" symbol is indicated for reverse.	pulse
e)	Load-side droop pulses	Droop pulses of the deviation counter between a load-side position and a command are displayed. The "-" symbol is indicated for reverse.	pulse
f)	Motor-side cumu. feedback pulses (Before Gear)	Feedback pulses from the servo motor encoder are counted and displayed. (Servo motor encoder unit) When the set value exceeds 999999999, it starts with 0. Click "Clear" to reset the value to 0. The "-" symbol is indicated for reverse.	pulse

Symbol	Name	Explanation	Unit
g)	Encoder information	The load-side encoder information is displayed. The display contents differ depending on the load-side encoder type. ・ID: The ID No. of the load-side encoder is displayed. ・Data 1: For the incremental type linear encoder, the counter from powering on is displayed. For the absolute position type linear encoder, the absolute position data is displayed. ・Data 2: For the incremental type linear encoder, the distance (number of pulses) from the reference mark (Z-phase) is displayed. For the absolute position type linear encoder, "00000000" is displayed.	
h)	Polarity	For address increasing direction in the servo motor CCW, it is indicated as "+" and for address decreasing direction in the servo motor CCW, as "-".	
i)	Z-phase pass status	If the fully closed loop system is "disabled", the Z-phase pass status of the servo motor encoder is displayed. If the fully closed loop system is "Enabled" or "Semi closed loop control/fully closed loop control switching", the Z-phase pass status of the load-side encoder is displayed.	
j)	Fully closed loop changing device	Only if the fully closed loop system is "Semi closed loop control/fully closed loop control switching", the device is displayed. The state of the semi closed loop control/fully closed loop control switching signal and the inside state during selection are displayed.	
k)	Parameter (Feedback pulse electronic gear)	The feedback pulse electronic gears ([Pr. PE04], [Pr. PE05], [Pr. PE34], and [Pr. PE35]) are displayed/set for servo motor encoder pulses in this parameter. (Refer to section 17.3.1 (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 function)	The parameter for the fully closed loop control is displayed or set. Click "Parameter setting" button to display the "Fully closed loop control-Basic" window.  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(*COP9, *COPA) 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 function selection ([Pr. PE01]) "Always valid" or "Changing by input signal (CLD)" is selected here. 2) Setting of feedback pulse electronic gear ([Pr. PE04], [Pr. PE05], [Pr. PE34], [Pr. PE35]) Setting of feedback pulse electronic gear 3) Load-side encoder cable communication method selection ([Pr. PC44]) This is used to select a load-side encoder cable to be connected to the CN2L connector. 4) Encoder pulse count polarity selection ([Pr. PC45]) Polarity of the load-side encoder cable information is selected. 5) Selection of A/B/Z-phase input interface encoder Z-phase connection judgment function ([Pr. PC45]) Select the non-signal detection status for the pulse train signal from the A/B/Z-phase input interface encoder used as a linear encoder or load-side encoder. This function is enabled only when you use an A/B/Z-phase input interface encoder.	
n)	Parameter (electronic gear)	Electronic gear ([Pr. PA05], [Pr. PA06], [Pr. PA07], [Pr. PA13], [Pr. PA21]) This is used to set parameters for the electronic gear.	

18. MR-J4-03A6(-RJ) SERVO AMPLIFIER

The following item is the same as 100 W or more MR-J4-_A_(-RJ) servo amplifiers. Refer to the section of the detailed explanation field for details.

Item	Detailed explanation
Parameter	Chapter 5
Normal gain adjustment	Chapter 6
Special adjustment function	Chapter 7
Troubleshooting	Chapter 8
Absolute position detection system	Chapter 12

Note. Refer to section 18.5.4 when operating one-touch tuning by using push button switch.

18.1 Functions and configuration

18.1.1 Summary

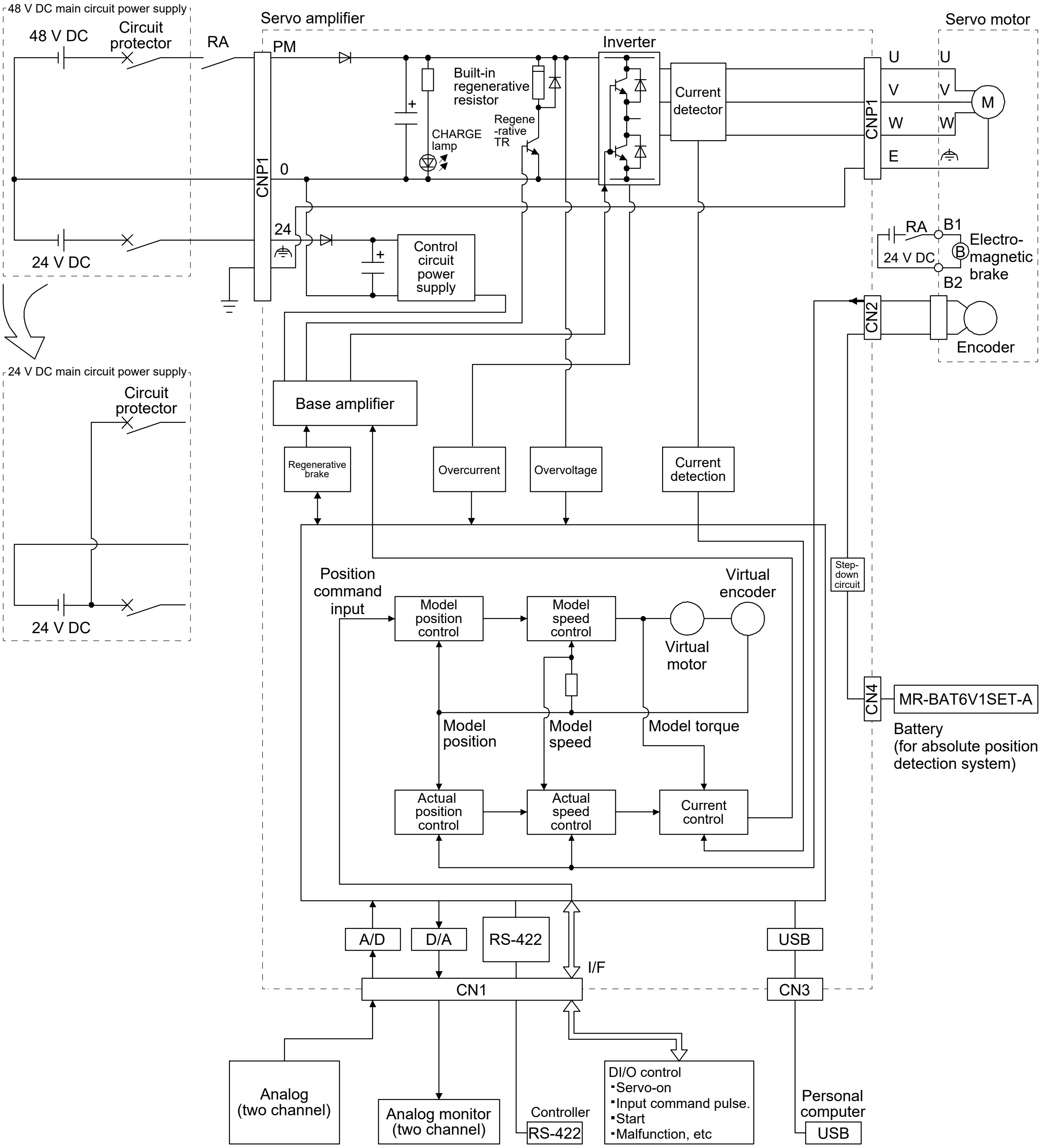
MR-J4-03A6(-RJ) servo amplifier is MELSERVO-J4 series 48 V DC and 24 V DC power compatible ultra-small capacity servo amplifier.
The servo amplifier has position, speed, and torque control modes. In the position control mode, the maximum pulse train of 4 Mpulses/s is supported. Further, it can perform operation with the control modes switched, e.g. position/speed control, speed/torque control and torque/position control. Hence, it is applicable to a wide range of fields, not only precision positioning and smooth speed control of machine tools and general industrial machines but also line control and tension control.
With one-touch tuning and real-time auto tuning, you can automatically adjust the servo gains according to the machine.

The following shows the differences with 100 W or more MR-J4-_A_(-RJ) servo amplifier.

Category	Item	Differences		Related parameter
		MR-J4-_A_(-RJ) 100 W or more	MR-J4-03A6(-RJ)	
Power supply	Main circuit power supply	200 V AC/400 V AC/ 100 V AC	48 V DC/24 V DC	[Pr. PC27]
	Control circuit power supply	200 V AC/400 V AC/ 100 V AC	24 V DC	
Functional safety	STO function	Compatible		
Encoder	Encoder resolution	4194304 pulses/rev	262144 pulses/rev	
Status display	7-segment LED display digits	5-digits	3-digits	[Pr. PC36]
Analog monitor output	Output voltage range	± 10 V	5 V ± 4 V	[Pr. PC14]/[Pr. PC15]
Dynamic brake	Stop system	Stop with dynamic brake	Stop with electronic dynamic brake	[Pr. PF09]/[Pr. PF15]
Regenerative option	Regenerative option selection	Compatible		[Pr. PA02]
Operation mode	Fully closed loop control mode	Compatible		[Pr. PA01]
	Linear servo motor control mode	Compatible		
	DD motor control mode	Compatible		
Function	SEMI-F47 function	Compatible		[Pr. PA20]/[Pr. PF25]
	J3A electronic gear setting value compatibility mode	Compatible		[Pr. PA21]
	Instantaneous power failure tough drive	Compatible		[Pr. PA20]/[Pr. PF25]
	Parameter unit	Compatible		[Pr. PF34]

18.1.2 Function block diagram

The function block diagram of this servo is shown below.



18.1 3 Servo amplifier standard specifications

Model		MR-J4-03A6(-RJ)
Rated output		30 W
Output	Rated voltage	3-phase 13 V AC
	Rated current [A]	2.4
Main circuit power supply input	Voltage	48 V DC/24 V DC (Note 5)
	Rated current	For 48 V DC: 1.2 A For 24 V DC: 2.4 A
	Permissible voltage fluctuation	For 48 V DC: 40.8 V DC to 55.2 V DC For 24 V DC: 21.6 V DC to 26.4 V DC
	Power supply capacity	Refer to section 18.7.2.
	Inrush current	Refer to section 18.7.4.
Control circuit power supply input	Voltage	24 V DC
	Rated current [A]	0.2
	Permissible voltage fluctuation	21.6 V DC to 26.4 V DC
	Power consumption [W]	5.0
	Inrush current [A]	Refer to section 18.7.4.
Interface power supply	Voltage	24 V DC ± 10%
	Current capacity [A]	0.3 (Note 1)
Control method		Sine-wave PWM control, current control method
Permissible regenerative power of servo amplifier built-in regenerative resistor [W]		0.7
Dynamic brake (Note 4)		Built-in (electronic dynamic brake)
Communication function		USB: connection to a personal computer or others (MR Configurator2-compatible) RS-422: 1: n communication (up to 32 axes)
Encoder output pulses		Compatible (A/B/Z-phase pulse)
Analog monitor		Two channels
Position control mode	Max. input pulse frequency	4 Mpulses/s (for differential receiver) (Note 3), 200 kpulses/s (for open collector)
	Positioning feedback pulse	Encoder resolution (resolution per servo motor revolution): 18 bits
	Command pulse multiplying factor	Electronic gear A:1 to 16777215, B:1 to 16777215, 1/10 < A/B < 4000
	In-position range setting	0 pulse to ±65535 pulses (command pulse unit)
	Error excessive	±3 rotation (this can be changed from parameter setting)
	Torque limit	Set by parameter setting or external analog input (0 V DC to +10 V DC/maximum torque)
Speed control mode	Speed control range	Analog speed command 1: 2000, internal speed command 1: 5000
	Analog speed command input	0 to ±10 V DC/rated speed (The speed at 10 V is changeable with [Pr. PC12].)
	Speed fluctuation ratio	±0.01% or less (load fluctuation 0% to 100%), 0% (power fluctuation ±10%), ±0.2% or less (ambient temperature 25 °C ± 10 °C) when using analog speed command
	Torque limit	Set by parameter setting or external analog input (0 V DC to +10 V DC/maximum torque)
Torque control mode	Analog torque command input	0 V DC to ±8 V DC/maximum torque (input impedance 10 kΩ to 12 kΩ)
	Speed limit	Set by parameter setting or external analog input (0 V DC to 10 V DC/rated speed)
Protective functions		Overcurrent shut-off, regenerative overvoltage shut-off, overload shut-off (electronic thermal), servo motor overheat protection, encoder error protection, regenerative error protection, undervoltage protection, instantaneous power failure protection, overspeed protection, and error excessive protection

Model			MR-J4-03A6(-RJ)
Compliance with global standards	CE marking		LVD: EN 61800-5-1/EN 60950-1, EMC: EN 61800-3
	UKCA marking		LVD: BS EN 61800-5-1/BS EN 60950-1, EMC: BS EN IEC 61800-3
	UL standard		UL 508C (NMMS2)
Structure (IP rating)			Natural cooling, open (IP20)
Close mounting			Possible (Note 2)
DIN rail mounting (width: 35 mm)			Possible
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); no corrosive gas, inflammable gas, oil mist or dust
	Altitude		1000 m or less above sea level
	Vibration resistance		5.9 m/s^2, at 10 Hz to 55 Hz (directions of X, Y and Z axes)
Mass [kg]			0.2

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 temperatures 45 ˚C or lower.
3. 1 Mpulse/s or lower commands are supported in the initial setting. When inputting commands over 1 Mpulse/s to 4 Mpulses/s or lower, change the setting in [Pr. PA13].
4. This is an electronic dynamic brake. This will not operate during control circuit power supply off. In addition, It may not operate depending on alarms and warnings. Refer to chapter 8 for details.
5. Initial value is the 48 V DC setting. To use with 24 V DC, set [Pr. PC27] to "_ 1 _ _". The characteristics of the servo motor vary depending on whether 48 V DC or 24 V DC is used. For details, refer to "Servo Motor Instruction Manual (Vol. 3)".

18.1.4 Combinations of servo amplifiers and servo motors

Servo amplifier	Servo motor
MR-J4-03A6(-RJ)	HG-AK0136 HG-AK0236 HG-AK0336

18.1.5 Function list

The following table lists the functions of MR-J4-03A6(-RJ) servo amplifier. For details of the functions, refer to each section indicated in the detailed explanation field.

Function	Description	Detailed explanation
Model adaptive control	This realizes a high response and stable control following the ideal model. The two-degree-of-freedom-model model adaptive control enables you to set a response to the command and response to the disturbance separately. Additionally, this function can be disabled. Refer to section 7.5 for disabling this function.	
Position control mode	This servo amplifier is used as a position control servo.	Section 18.3.5 (1) Section 3.6.1 Section 4.2
Speed control mode	This servo amplifier is used as a speed control servo.	Section 18.3.5 (2) Section 3.6.2 Section 4.3
Torque control mode	This servo amplifier is used as a torque control servo.	Section 18.3.5 (3) Section 3.6.3 Section 4.4
Position/speed control switch mode	Using an input device, control can be switched between position control and speed control.	Section 3.6.4
Speed/torque control switch mode	Using an input device, control can be switched between speed control and torque control.	Section 3.6.5
Torque/position control switch mode	Using an input device, control can be switched between torque control and position control.	Section 3.6.6
Positioning mode	Positioning mode is compatible with MR-J4-03A6-RJ servo amplifier. For details, refer to "MR-J4-_A_-RJ Servo Amplifier Instruction Manual (Positioning Mode)".	
High-resolution encoder	High-resolution encoder of 262144 pluses/rev is used for the encoder of the rotary servo motor compatible with the MR-J4-03A6(-RJ) servo amplifier.	
Absolute position detection system	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/stop, and can use input devices to switch gains during operation.	Section 7.2
Advanced vibration suppression control II	This function suppresses vibration at the arm end or residual vibration.	Section 7.1.5
Machine resonance suppression filter	This is a filter function (notch filter) which decreases the gain of the specific frequency to suppress the resonance of the mechanical system.	Section 7.1.1
Shaft resonance suppression filter	When a load is mounted to the servo motor shaft, resonance by shaft torsion during driving may generate a mechanical vibration at high frequency. The shaft resonance suppression filter suppresses the vibration.	Section 7.1.3
Adaptive filter II	Servo amplifier detects mechanical resonance and sets filter characteristics automatically to suppress mechanical vibration.	Section 7.1.2
Low-pass filter	Suppresses high-frequency resonance which occurs as servo system response is increased.	Section 7.1.4
Machine analyzer function	Analyzes the frequency characteristic of the mechanical system by simply connecting an MR Configurator2 installed personal computer and servo amplifier. MR Configurator2 is necessary for this function.	
Robust filter	This function provides better disturbance response in case low response level that load to motor inertia ratio is high for such as roll send axes.	[Pr. PE41]
Slight vibration suppression control	Suppresses vibration of ±1 pulse generated at a servo motor stop.	[Pr. PB24]
Electronic gear	Input pulses can be multiplied by 1/10 to 4000.	[Pr. PA06] [Pr. PA07]
S-pattern acceleration/ deceleration time constant	Speed can be increased and decreased smoothly.	[Pr. PC03]

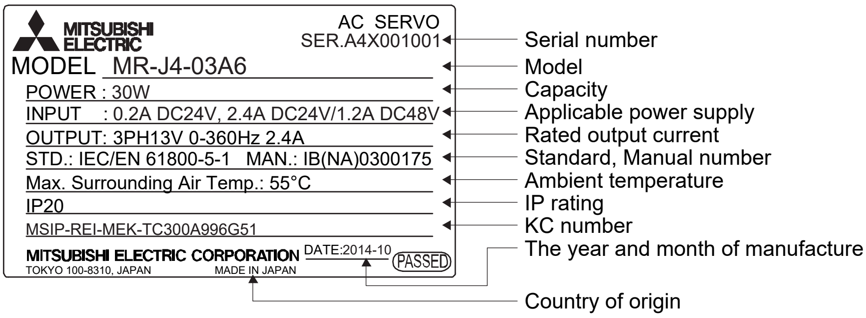
Function	Description	Detailed explanation
Auto tuning	Automatically adjusts the gain to optimum value if load applied to the servo motor shaft varies.	Section 6.3
Brake unit	This is not available with MR-J4-03A6(-RJ) servo amplifier.	
Power regeneration converter	This is not available with MR-J4-03A6(-RJ) servo amplifier.	
Regenerative option	This is not available with MR-J4-03A6(-RJ) servo amplifier.	
Alarm history clear	Alarm history is cleared.	[Pr. PC18]
Input signal selection (device settings)	ST1 (Forward rotation start), ST2 (Reverse rotation start), and SON (Servo-on) and other input device can be assigned to specified pins.	[Pr. PD03] to [Pr. PD22]
Output signal selection (device settings)	The output devices including MBR (Electromagnetic brake interlock) can be assigned to certain pins of the CN1 connector.	[Pr. PD23] to [Pr. PD26] [Pr. PD28]
Output signal (DO) forced output	Output signal can be forced on/off independently of the servo status. Use this function for checking output signal wiring, etc.	Section 18.5.9
Restart after instantaneous power failure	This is not available with MR-J4-03A6(-RJ) servo amplifier.	
Command pulse selection	Command pulse train form can be selected from among three different types.	[Pr. PA13]
Torque limit	Servo motor torque can be limited to any value.	Section 3.6.1 (5) [Pr. PA11] [Pr. PA12]
Speed limit	Servo motor speed can be limited to any value.	Section 3.6.3 (3) [Pr. PC05] to [Pr. PC11]
Status display	Servo status is shown on the 3-digit, 7-segment LED display	Section 18.5.3
External I/O signal display	On/off statuses of external I/O signals are shown on the display.	Section 18.5.8
Automatic VC offset	Voltage is automatically offset to stop the servo motor if it does not come to a stop when VC (Analog speed command) or VLA (Analog speed limit is 0 V.	Section 18.5.5
Alarm code output	If an alarm has occurred, the corresponding alarm number is outputted in 3-bit code.	Chapter 8
Test operation mode	Jog operation, positioning operation, motor-less operation, DO forced output, and program operation MR Configurator2 is required for the positioning operation and program operation.	Section 18.5.10
Analog monitor output	Servo status is outputted in terms of voltage in real time.	Section 18.6 (3)
MR Configurator2	Using a personal computer, you can perform the parameter setting, test operation, monitoring, and others.	Section 11.7
Linear servo system	This is not available with MR-J4-03A6(-RJ) servo amplifier.	
Direct drive servo system	This is not available with MR-J4-03A6(-RJ) servo amplifier.	
Fully closed loop system	This is not available with MR-J4-03A6(-RJ) servo amplifier.	
One-touch tuning	Gain adjustment is performed just by one click on a certain button on MR Configurator2 or operation section.	Section 6.2 Section 18.5.4
SEMI-F47 function	This is not available with MR-J4-03A6(-RJ) servo amplifier.	
Tough drive function	This function makes the equipment to continue operating even under the condition that an alarm occurs. MR-J4-03A6(-RJ) servo amplifier is compatible with vibration tough drive. This is not compatible with instantaneous power failure tough drive.	Section 7.3.1
Drive recorder function	This function continuously monitors the servo status and records the status transition before and after an alarm for a fixed period of time. You can check the recorded data on the drive recorder window on MR Configurator2 by clicking the "Graph" button. However, the drive recorder will not operate on the following conditions. 1. You are using the graph function of MR Configurator2. 2. You are using the machine analyzer function. 3. [Pr. PF21] is set to "-1".	[Pr. PA23]
STO function	This is not available with MR-J4-03A6(-RJ) servo amplifier.	

Function	Description	Detailed explanation
Servo amplifier life diagnosis function	Cumulative operation time can be checked. This function gives an indication of the replacement time for parts of the servo amplifier including a capacitor before they malfunction. MR Configurator2 is necessary for this function.	
Power monitoring function	This function calculates the power running energy and the regenerative power from the data in the servo amplifier such as speed and current. Power consumption and others are displayed on MR Configurator2.	
Machine diagnosis function	From the data in the servo amplifier, this function estimates the friction and vibrational component of the drive system in the equipment and recognizes an error in the machine parts, including a ball screw and bearing. MR Configurator2 is necessary for this function.	
Lost motion compensation function	This function improves the response delay occurred when the machine moving direction is reversed.	Section 7.6
Super trace control	This function sets constant and uniform acceleration/deceleration droop pulses to almost 0.	Section 7.7
High-resolution analog input	This is not available with MR-J4-03A6(-RJ) servo amplifier.	

18.1.6 Model definition

(1) Rating plate

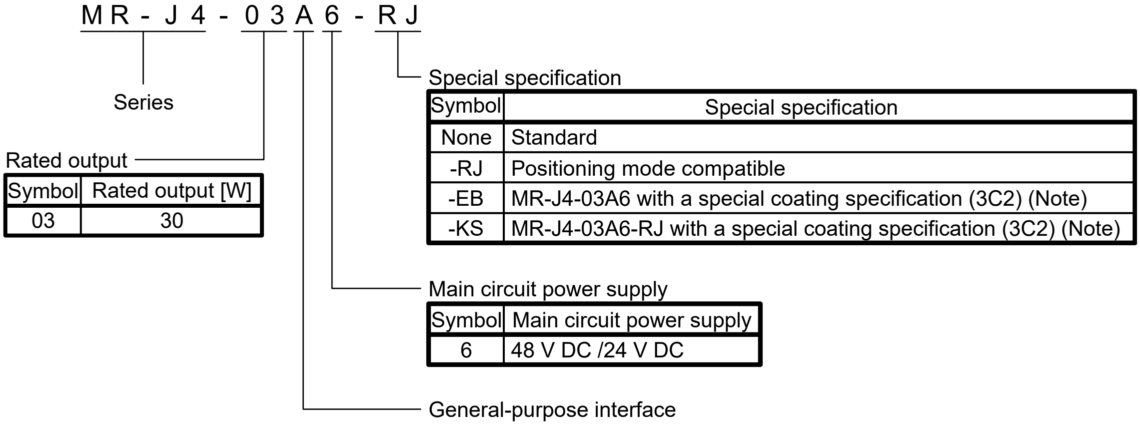
The following shows an example of rating plate for explanation of each item.



MITSUBISHI ELECTRIC
AC SERVO
SER.A4X001001
MODEL MR-J4-03A6
POWER : 30W
INPUT : 0.2A DC24V, 2.4A DC24V/1.2A DC48V
OUTPUT: 3PH13V 0-360Hz 2.4A
STD.: IEC/EN 61800-5-1 MAN.: IB(NA)0300175
Max. Surrounding Air Temp.: 55°C
IP20
MSIP-REI-MEK-TC300A996G51
MITSUBISHI ELECTRIC CORPORATION DATE:2014-10 PASSED
TOKYO 100-8310, JAPAN MADE IN JAPAN

(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 [W]
03	30

Special specification

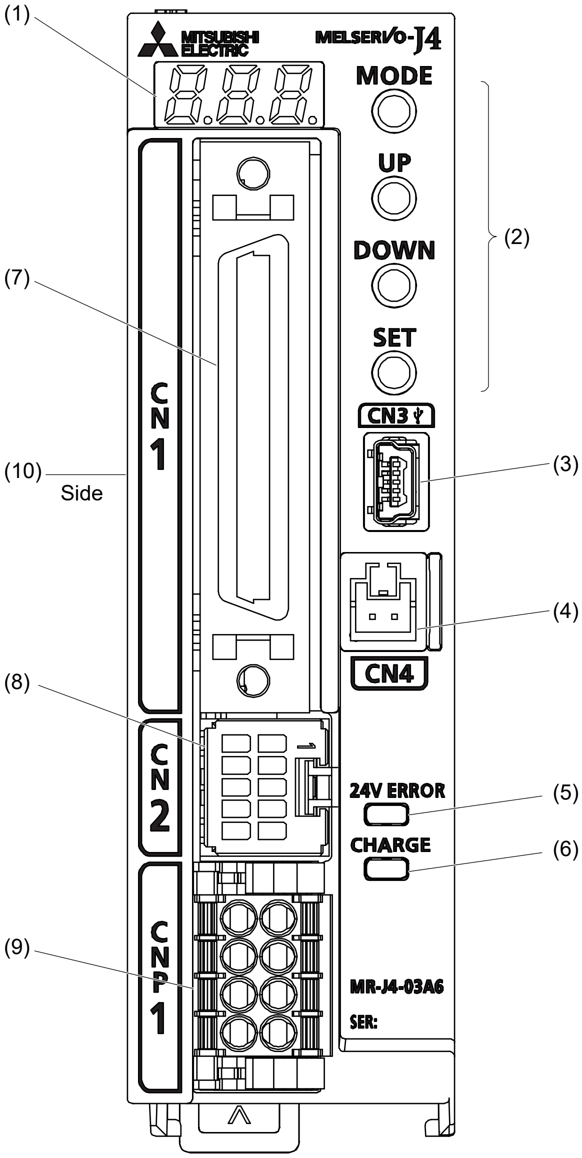
Symbol	Special specification
None	Standard
-RJ	Positioning mode compatible
-EB	MR-J4-03A6 with a special coating specification (3C2) (Note)
-KS	MR-J4-03A6-RJ with a special coating specification (3C2) (Note)

Main circuit power supply

Symbol	Main circuit power supply
6	48 V DC /24 V DC

Note. Type with a specially-coated servo amplifier board (IEC 60721-3-3:1994 Class 3C2).
Refer to app. 10.3 for details.

18.1.7 Parts identification

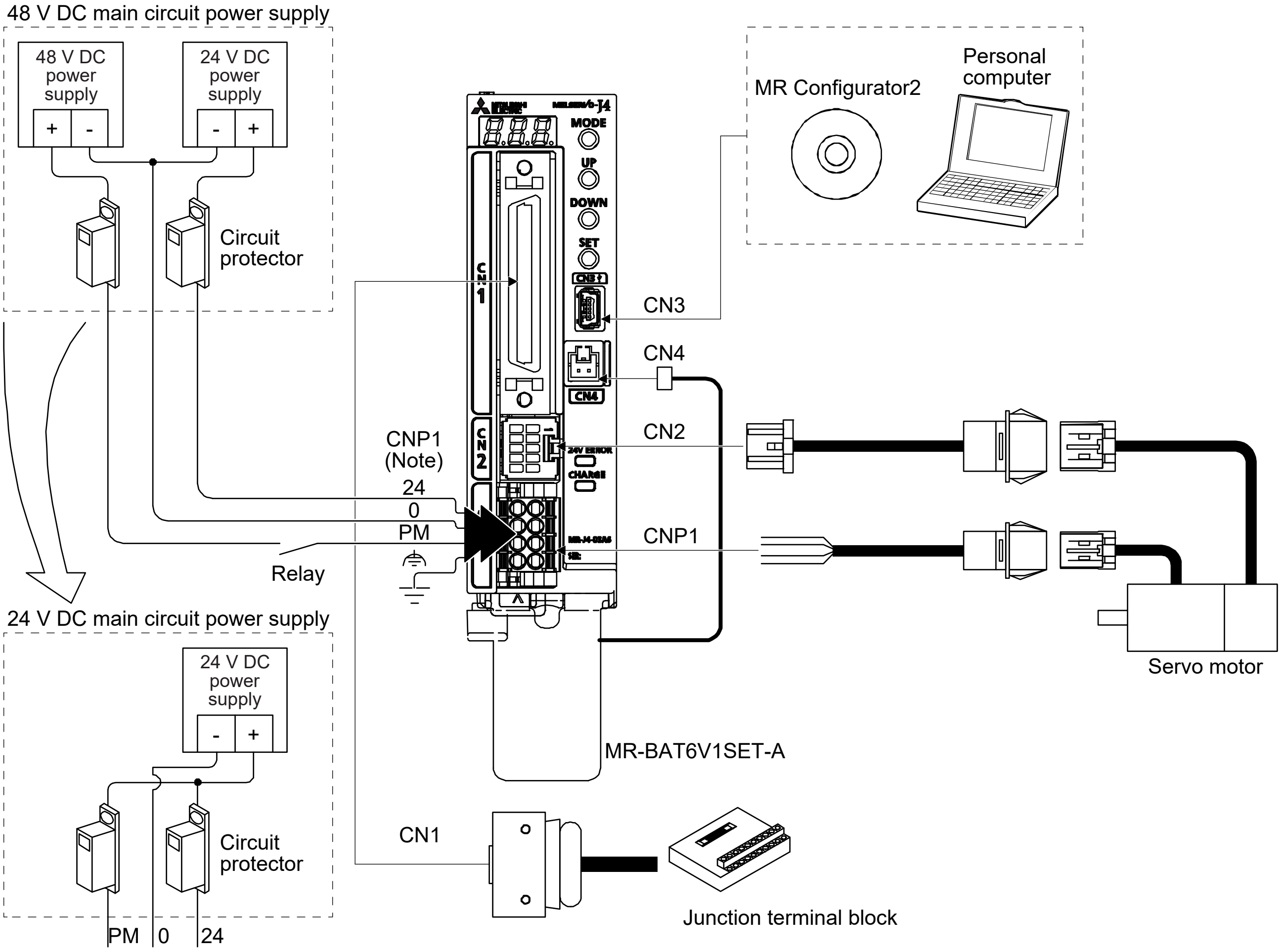


No.	Name/Application	Detailed explanation
(1)	Display The 3-digit, 7-segment LED shows the servo status and the alarm number.	Section 18.5
(2)	Operation section Used to perform status display, diagnostic, alarm, and parameter setting operations. Push the "MODE" and "SET" buttons at the same time for 3 s or more to switch to the one-touch tuning mode. ○ MODE — Used to change the mode. Push this button together with the "SET" button for 3 s or more to switch to the one-touch tuning mode. ○ UP ○ DOWN — Used to change the display or data in each mode. ○ SET — Used to set data. Push this button together with the "MODE" button for 3 s or more to switch to the one-touch tuning mode.	Section 18.5
(3)	USB communication connector (CN3) Connect the personal computer.	Section 11.7
(4)	Battery connector (CN4) Connect the battery for absolute position data backup.	Section 18.9
(5)	Control circuit power voltage error lamp (24 V ERROR) When a voltage value of the control circuit power voltage (24 V DC) is out of permissible range, this will light in yellow.	Section 18.4.3
(6)	Charge lamp (CHARGE) When the main circuit is charged, this will light up. While this lamp is lit, do not reconnect the cables.	
(7)	I/O signal connector (CN1) Connect digital I/O signal, analog input signal, analog monitor output signal, and RS-422 communication controller.	Section 18.3.5 Section 18.3.6
(8)	Encoder connector (CN2) Connect the servo motor encoder.	Section 18.3.6
(9)	Power and servo motor power output connector (CNP1) Connect input power and servo motor.	Section 18.3.1 Section 18.3.2
(10)	Rating plate	Section 18.1.6 (1)

18.1.8 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.



Note. Refer to section 18.3.2 for details.

18.2 Installation

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

⚠CAUTION

- ●Stacking in excess of the specified number of product packages is not allowed.
- ●Do not hold the cables or connectors when carrying the servo amplifier. Otherwise, it may drop.
- ●Install the equipment on incombustible material. Installing them directly or close to combustibles will lead to a fire.
- ●Install the servo amplifier and the servo motor in a load-bearing place in accordance with the Instruction Manual.
- ●Do not get on or put heavy load on the equipment. Otherwise, it may cause injury.
- ●Use the equipment within the specified environment. For the environment, refer to section 18.1.3.
- ●Provide an adequate protection to prevent screws and other conductive matter, oil and other combustible matter from entering the servo amplifier.
- ●Do not block the intake and exhaust areas of the servo amplifier. Otherwise, it may cause a malfunction.
- ●Do not drop or strike the servo amplifier. Isolate it from all impact loads.
- ●Do not install or operate the servo amplifier which has been damaged or has any parts missing.
- ●When the equipment has been stored for an extended period of time, contact your local sales office.
- ●When handling the servo amplifier, be careful about the edged parts such as corners of the servo amplifier.
- ●The servo amplifier must be installed in a metal cabinet.
- ●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.
- ●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.

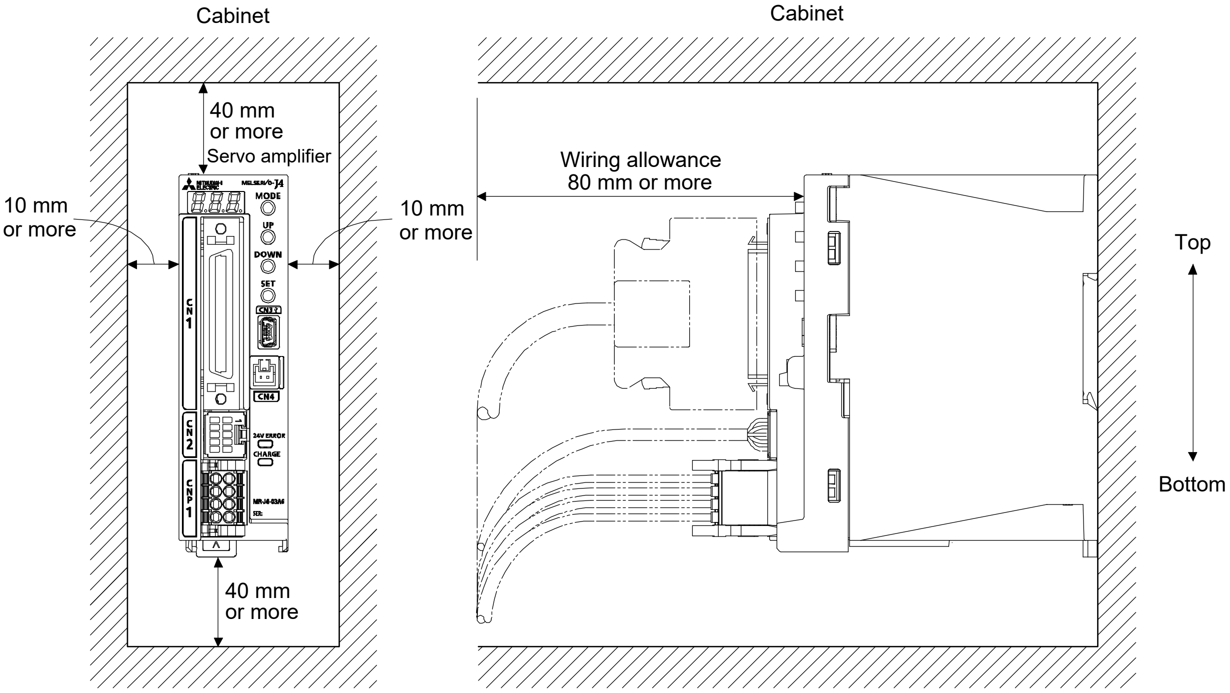
The following item is the same as 100 W or more MR-J4-_A_(-RJ) servo amplifiers. Refer to the section of the detailed explanation field for details.

Item	Detailed explanation
Keep out foreign materials	Section 2.2
Encoder cable stress	Section 2.3
Inspection items	Section 2.4
Parts having service life	Section 2.5

18.2.1 Installation direction and clearances

When using heat generating equipment, 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.

(1) Installation of one servo amplifier

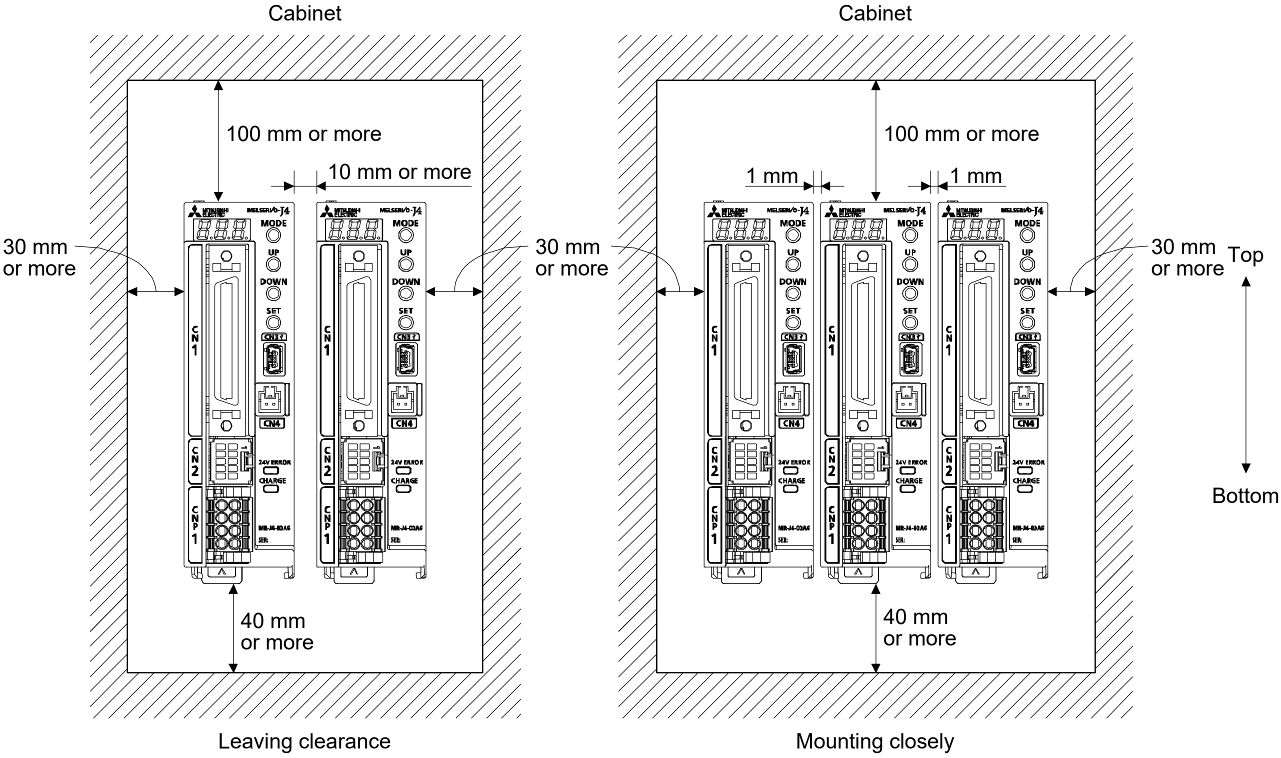


(2) Installation of two or more servo amplifiers

POINT

- You can install MR-J4-03A6(-RJ) servo amplifiers without clearances between them. When closely mounting the servo amplifiers, operate them at the ambient temperatures of 0 °C to 45 °C.

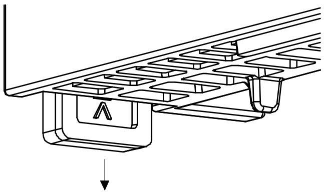
Leave a large clearance between the top of the servo amplifier and the cabinet walls, and install a cooling fan to prevent the internal temperature of the cabinet from exceeding the environment. When mounting the servo amplifiers closely, leave a clearance of 1 mm between the adjacent servo amplifiers in consideration of mounting tolerances. In this case, operate at the ambient temperatures 0 °C to 45 °C.



18.2.2 Installation by DIN rail

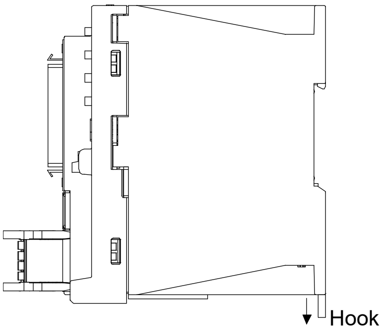
⚠CAUTION

- To mount the servo amplifier to DIN rail, pull down the tab of hook. The hook may come off when the tab is pushed down from the back side of the servo amplifier.

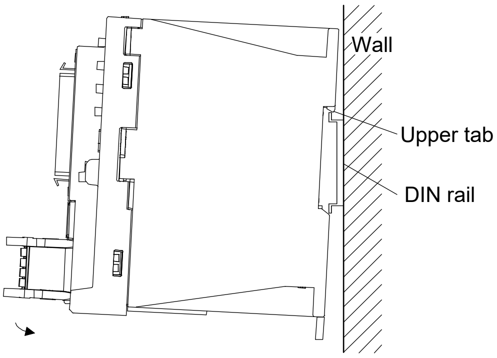


The following explains mounting and removing procedure of servo amplifier using DIN rail.

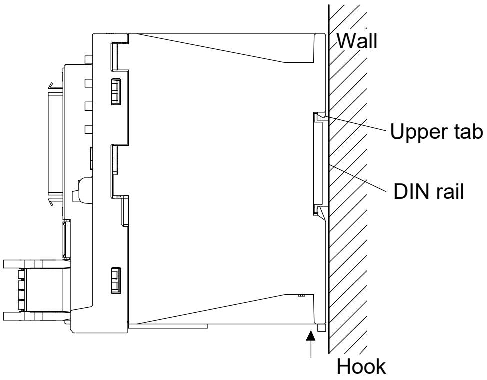
Mounting servo amplifier to DIN rail



1) Pull down the hook.

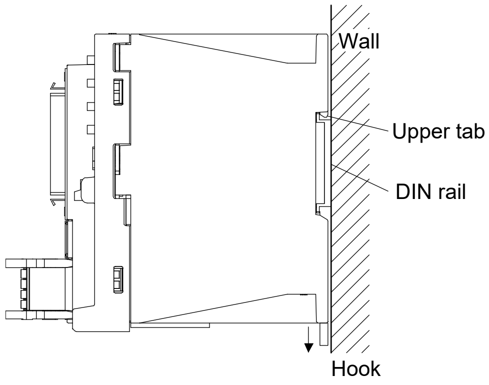


2) Hang the upper tab on the back of the servo amplifier to the upper tab of DIN rail, and push toward to the wall.

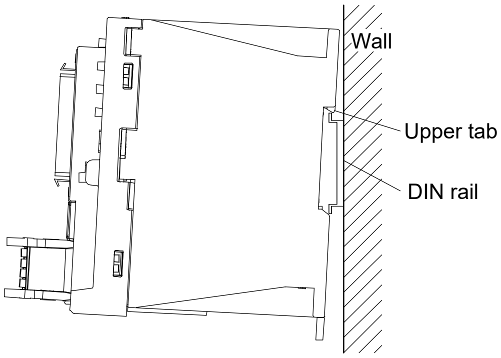


3) Push up the hook, and fix the servo amplifier.

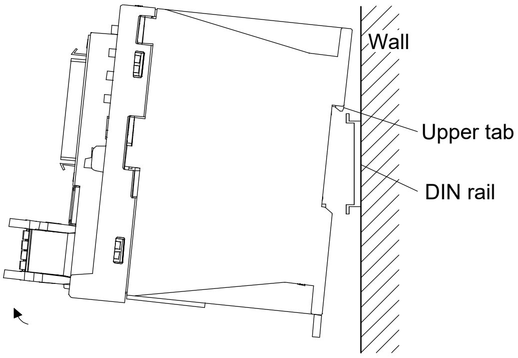
Removing servo amplifier from DIN rail



1) Pull down the hook.



2) Pull the servo amplifier forward.



3) Lift up and remove the servo amplifier.

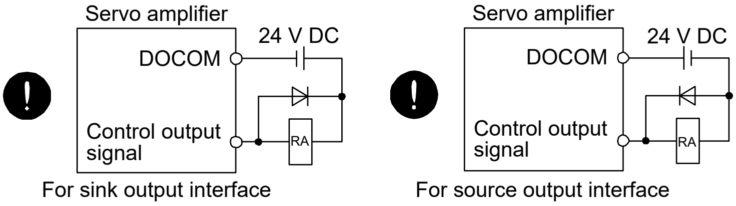
18.3 Signals and wiring

⚠WARNING

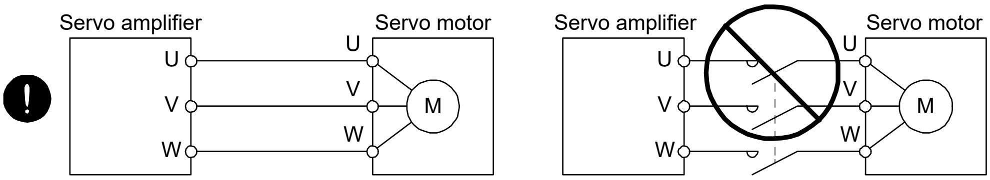
- A person who is involved in wiring should be fully competent to do the work.
- Before wiring, turn off the power and check to see if the charge lamp turned off. Otherwise, an electric shock may occur. In addition, when confirming whether the charge lamp is off or not, always confirm it from the front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

⚠CAUTION

- 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.



- Use a noise filter, etc. to minimize the influence of electromagnetic interference. Electromagnetic interference may be given to the electronic equipment used near the servo amplifier.
- Do not install a power capacitor, surge killer or radio noise filter (optional FR-BIF) with the power line of the servo motor.
- Do not modify the equipment.
- 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.

The items in the following table are the same as those for MR-J4-_A_(-RJ) servo amplifiers of 100 W or more. Refer to the section of the detailed explanation field for details.

Item	Detailed explanation
Detailed explanation of signals	Section 3.6
Forced stop deceleration function	Section 3.7
Servo motor with an electromagnetic brake	Section 3.10

18.3.1 Input power supply circuit

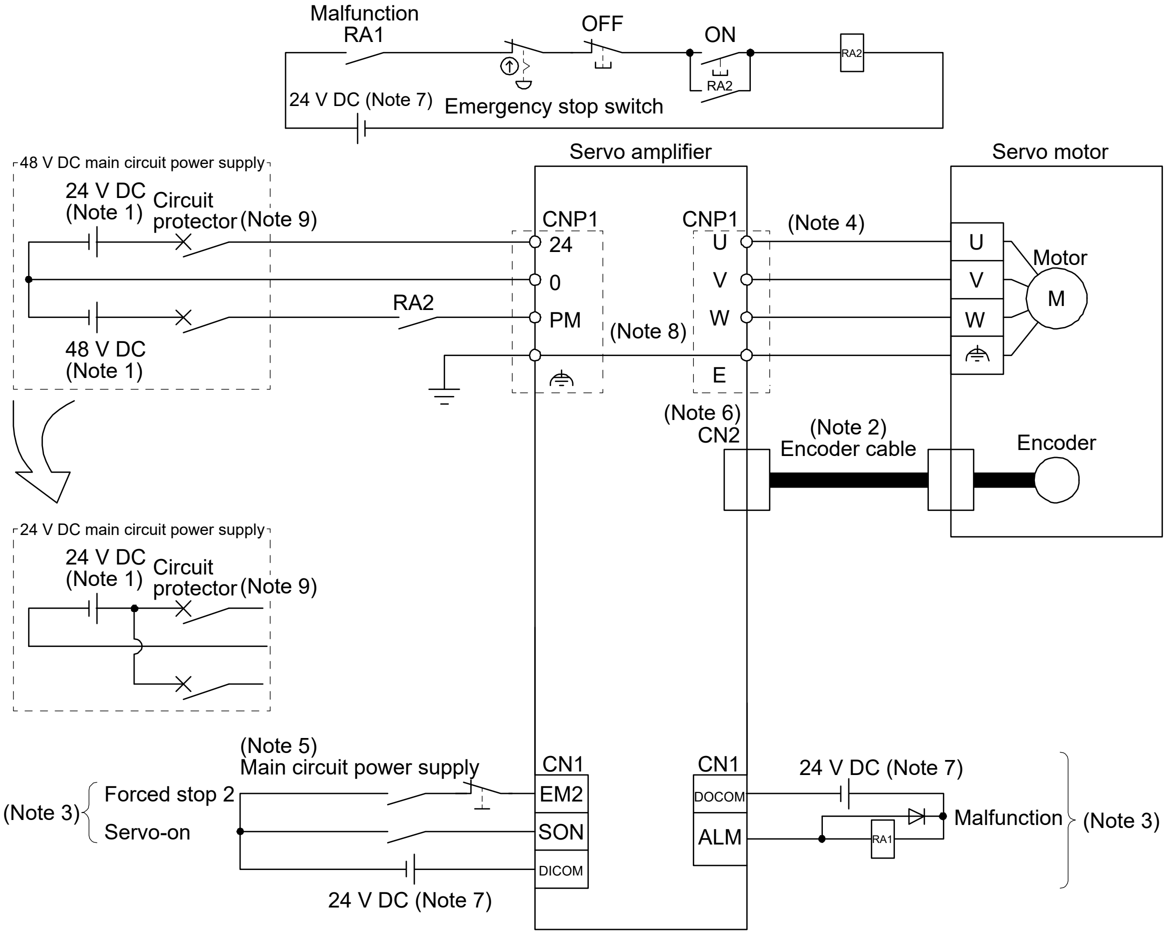
⚠CAUTION

- Connect a circuit protector between the power supply and power supply voltage input terminals (24/PM) 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 circuit protector 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 built-in regenerative resistor.
- Check the servo amplifier model, and then input proper voltage to the servo amplifier power supply. If input voltage exceeds the upper limit of the specification, the servo amplifier will break down.
- Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.

POINT

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

Configure the wirings so that the main circuit power supply is shut off and SON (Servo-on) is turned off after deceleration to a stop due to an alarm occurring, enabled servo forced stop, etc.

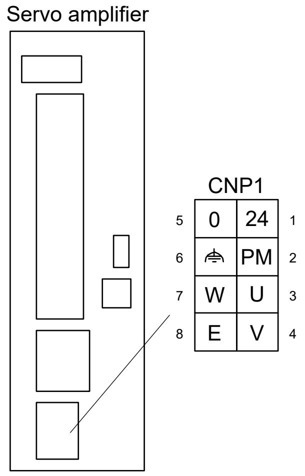


Note 1. Use reinforced insulating type for 24 V DC and 48 V DC power supply.

2. For the encoder cable, use of the option cable is recommended. For selecting cables, refer to "Servo Motor Instruction Manual (Vol. 3)".
3. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
4. For connecting servo motor power wires, refer to "Servo Motor Instruction Manual (Vol. 3)".
5. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
6. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the servo amplifier may cause a malfunction.
7. The illustration of the 24 V DC power supply is divided between input signal, output signal, and external emergency stop circuit for convenience. However, they can be configured by one. For 24 V DC power for I/O signal, use power other than 24 V DC power of servo amplifier control circuit power supply.
8. The noiseless grounding (⏚) terminals and E terminals are connected in the servo amplifier. Be sure to ground from the noiseless grounding (⏚) terminal of CNP1 to the grounding terminal of the cabinet.
9. Circuit protectors are required for protection of power supplies, wires, servo amplifiers and others. When not using a circuit protector, configure an external protective circuit such as a power supply with protection function.

18.3.2 Explanation of power supply system

(1) Pin assignment



(2) Detailed explanation

<table>
<tr><th>Symbol</th><th>Connection target
(application)</th><th>Description</th></tr>
<tr><td>24</td><td rowspan="3">Control circuit power supply/main circuit power supply</td><td>Used to connect + of the control circuit power supply (24 V DC).</td></tr>
<tr><td>PM</td><td>Used to connect + of the main circuit power supply (48 V DC/24 V DC).
Set [Pr. PC27] according to the specification of main circuit power supply.
<table>
<tr><th>Parameter
Main circuit power supply</th><th>[Pr. PC27 function selection C-6] setting value</th></tr>
<tr><td>48 V DC</td><td>_ _ 0 _ (Initial value)</td></tr>
<tr><td>24 V DC</td><td>_ _ 1 _</td></tr>
</table></td></tr>
<tr><td>0</td><td>Switch off - of the control circuit power supply and main circuit power supply.</td></tr>
<tr><td>⏚</td><td>Noiseless grounding</td><td>Connect to the grounding terminal of the cabinet to ground.</td></tr>
<tr><td>U/V/W/E</td><td>Servo motor power output</td><td>Connect the servo amplifier power output (U/V/W/E) 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>
</table>

(3) Wiring CNP1

POINT

- ●For the wire sizes used for wiring, refer to section 18.8.3.

Use the servo amplifier power connector for wiring CNP1.

(a) Connector

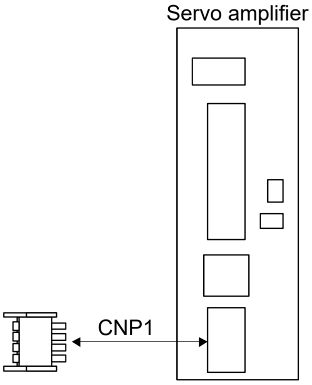


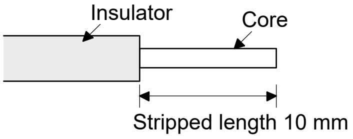
Table 18.1 Connector and applicable wire

Connector	Receptacle assembly	Applicable wire size	Stripped length [mm]	Manufacturer
CNP1	DFMC 1,5/ 4-ST-3,5-LR or equivalent	AWG 24 to 16	10	Phoenix Contact

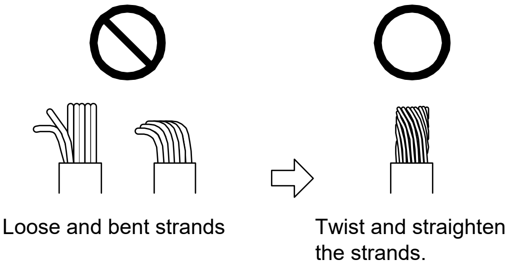
(b) Cable connection procedure

1) Fabrication on cable insulator

Refer to table 18.1 for stripped length of cable insulator. The appropriate stripped length of cables depends on their type, etc. Set the length considering their status.



Twist strands lightly and straighten them as follows.



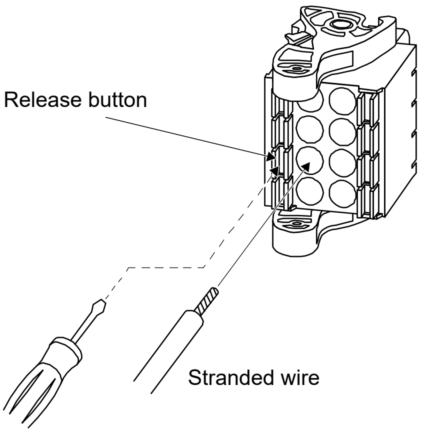
You can also use a ferrule to connect with the connectors. When you use a ferrule, use the following ferrules and crimp terminal.

Servo amplifier	Wire size	Ferrule model (Phoenix Contact)	Crimp terminal (Phoenix Contact)
MR-J4-03A6(-RJ)	AWG 24	AI0.25-10YE	CRIMPFOX6
	AWG 22	AI0.34-10TQ	
	AWG 20	AI0.5-10WH	
	AWG 18	AI0.75-10GY	
	AWG 16	AI1.5-10BK	

2) Inserting wire

When using solid wire, insert the wire to the end. When using stranded wire, insert the wire to the end with pushing down the release button with a small flat head screwdriver, etc.

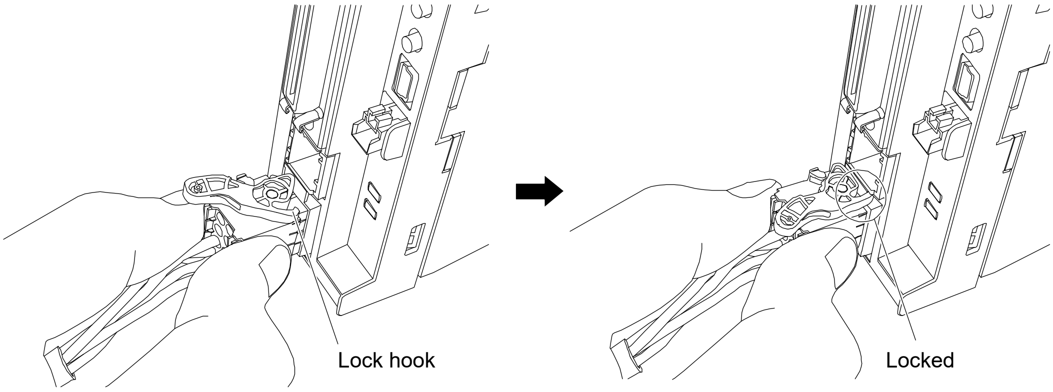
The following show a connection example when using stranded wire to the CNP 1 connector.



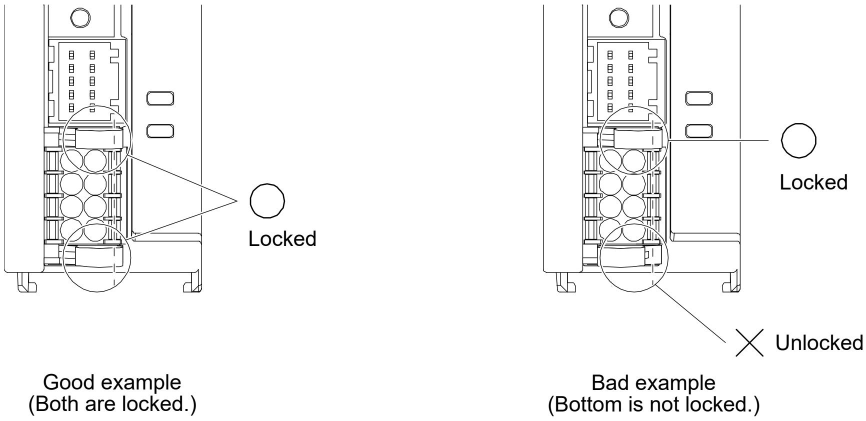
(c) Mounting connector

1) Mounting

Fit the CNP1 connector when the servo amplifier is fixed. While pushing the connector, make sure that the connector is locked to the top and bottom of the socket. After that, check that the connector cannot be pulled out.



Refer to the following example for a status of lock.



Good example
(Both are locked.)

Bad example
(Bottom is not locked.)

2) Disconnection

Pull out the CNP1 connector after unlocking the top and bottom of the connector.

18.3.3 Selection of main circuit power supply/control circuit power supply

The inrush current at power on will be large because a resistance for protecting inrush current is not built-in in the main circuit power supply of the servo amplifier. The main circuit capacitor capacity of the servo amplifier is approximately 270 µF. When the load characteristic (overcurrent protection criteria) of the power unit is current fold back method, the power cannot be started. Be careful when selecting a power. Especially when the power is turned ON/OFF on the power unit output side, approximately 100 µs to 300 µs instantaneous current will flowed at power on due to capacitor charge. Therefore, a power unit such as one which operates overcurrent at 1 ms or less cannot be used.
A circuit to protect inrush current at power on is built-in in the control circuit power supply of servo amplifier. In addition, when using main circuit power supply and control circuit power supply, use a reinforced insulating type.

18.3.4 Power-on sequence

POINT

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

(1) Power-on procedure

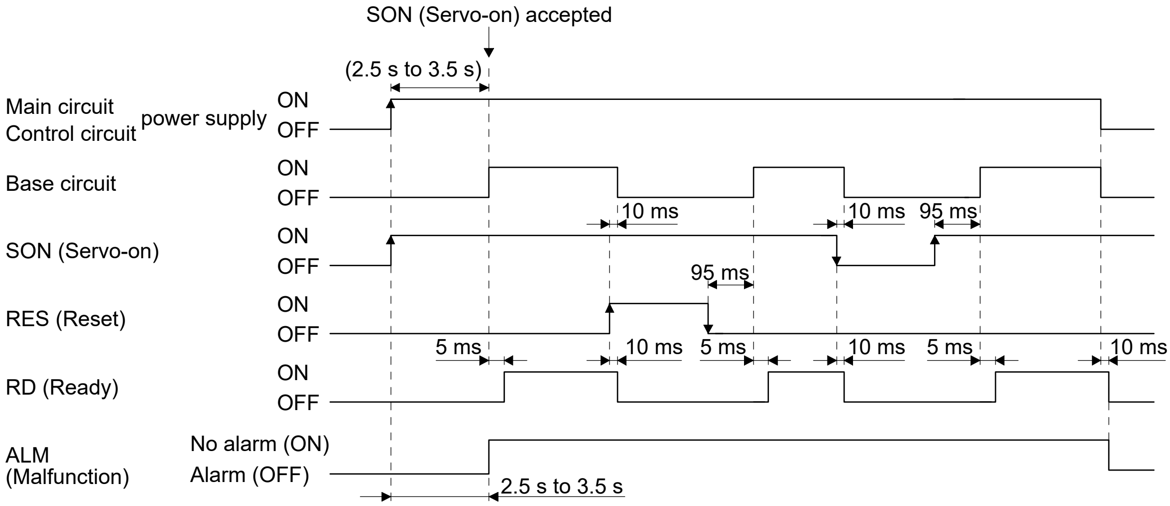
1) When wiring the power supply, use a circuit protector for the power supply (24/PM). Configure up an external sequence so that the relay connected to PM turns off when an alarm occurs.

2) Switch on the control circuit power supply (24/0) simultaneously with the main circuit power supply (PM/0) or before switching on the main circuit power supply. If the main circuit power supply is not on, the display shows the corresponding warning. However, by switching on the main circuit power supply, the warning disappears and the servo amplifier will operate properly.

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

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

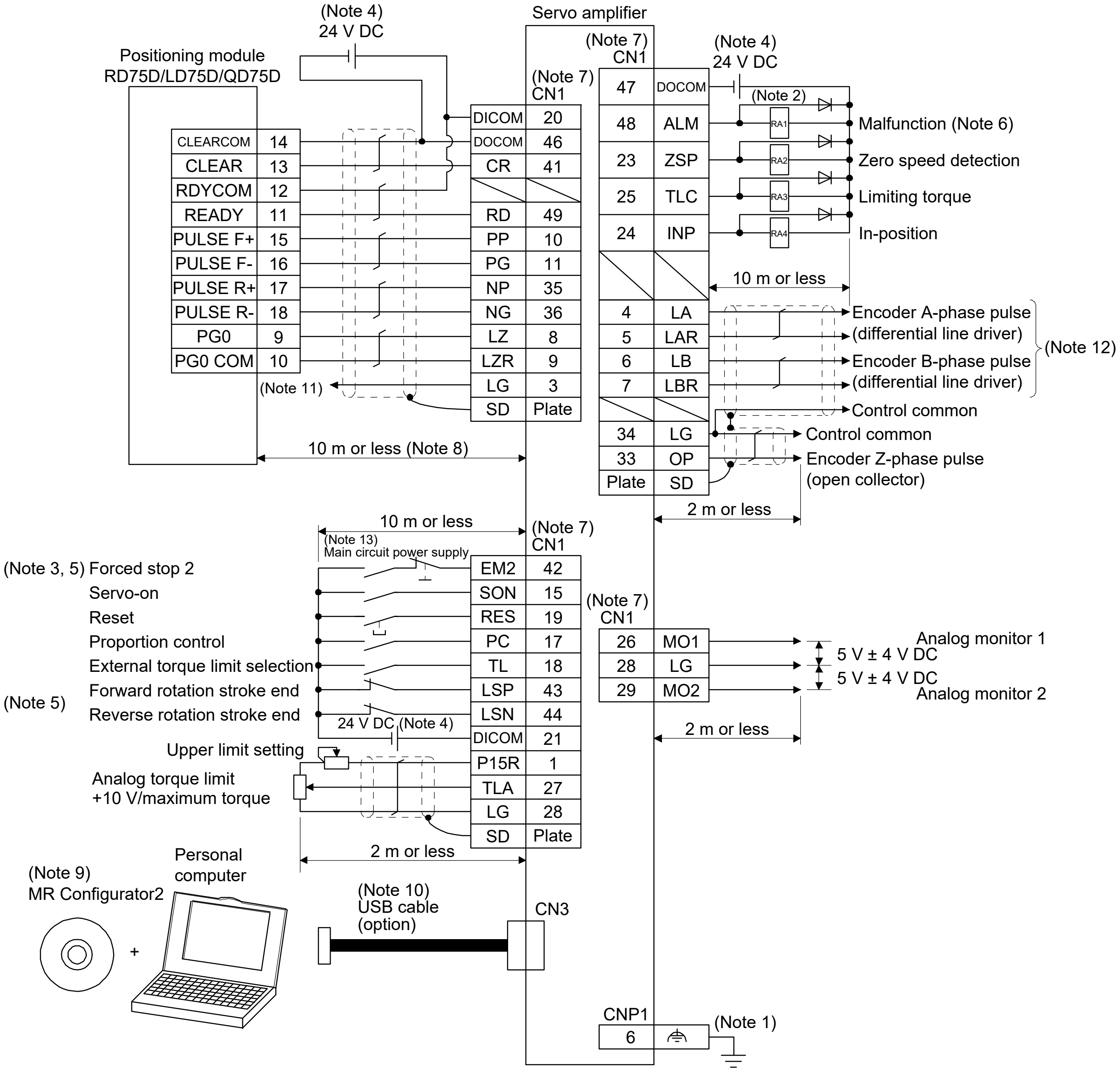
(2) Timing chart



18.3.5 I/O signal connection example

(1) Position control mode

(a) For sink I/O interface

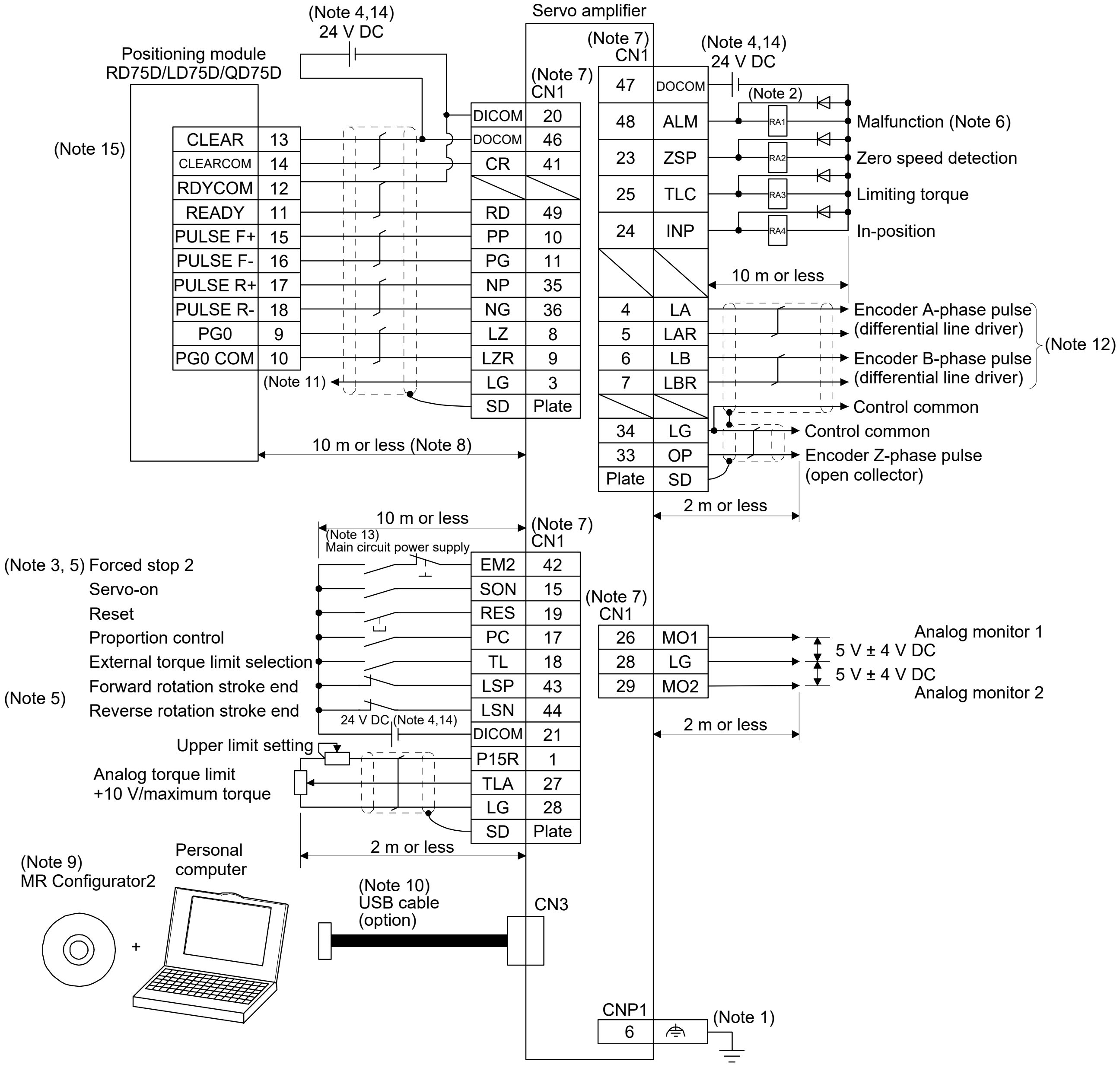


Note

1. To prevent an electric shock, always connect the CNP1 noiseless grounding terminal (⏚marked) of the servo amplifier to the grounding terminal (PE) of the cabinet.
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity is up to 300 mA. 300 mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.9.2 (1) that gives the current value necessary for the interface. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one. For 24 V DC power for I/O signal, use power other than 24 V DC power of servo amplifier control circuit power supply.
5. When starting operation, always turn on EM2 (Forced stop 2), LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end). (Normally closed contact)
6. ALM (Malfunction) turns on in normal alarm-free condition. When this signal (normally closed contact) is switched off (at occurrence of an alarm), the output of the programmable controller should be stopped by the sequence program.
7. The pins with the same signal name are connected in the servo amplifier.
8. This length applies to the command pulse train input in the differential line driver type. It is 2 m or less in the open-collector type.
9. Use SW1DNC-MRC2-_. (Refer to section 11.7.)
10. The USB communication function and RS-422 communication function are mutually exclusive. They cannot be used together.
11. This connection is not necessary for RD75D, LD75D and QD75D. However, to enhance noise tolerance, it is recommended to connect LG of servo amplifier and control common depending on the positioning module.
12. When a command cable for connection with the controller side malfunctions due to disconnection or noise, a position mismatch can occur. To avoid the position mismatch, check Encoder A-phase pulse and Encoder B-phase pulse on the controller side.
13. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
14. Plus and minus of the power of source interface are the opposite of those of sink interface.
15. CLER and CLEARCOM of source interface are interchanged to sink interface.

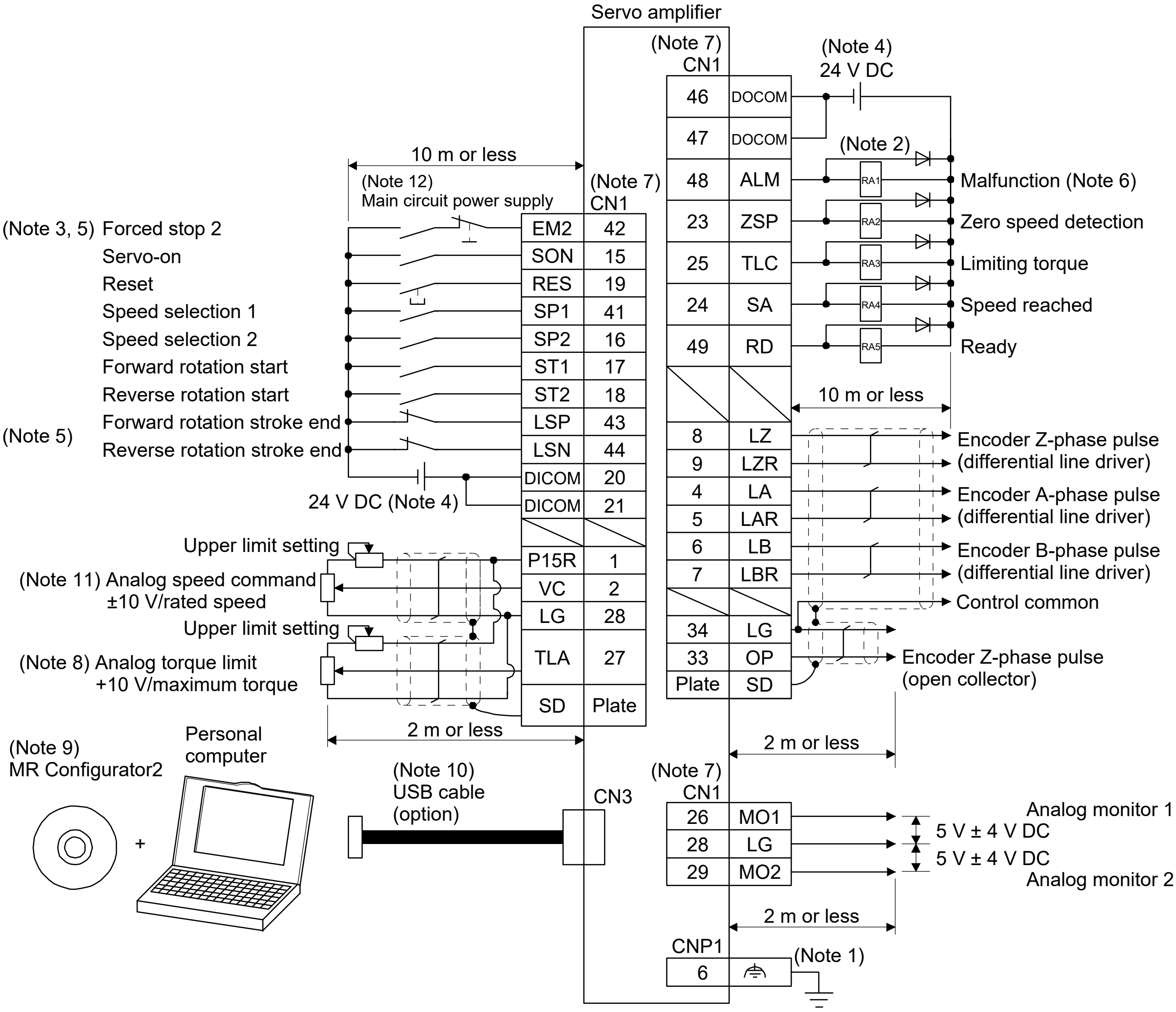
(b) For source I/O interface

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



(2) Speed control mode

(a) For sink I/O interface



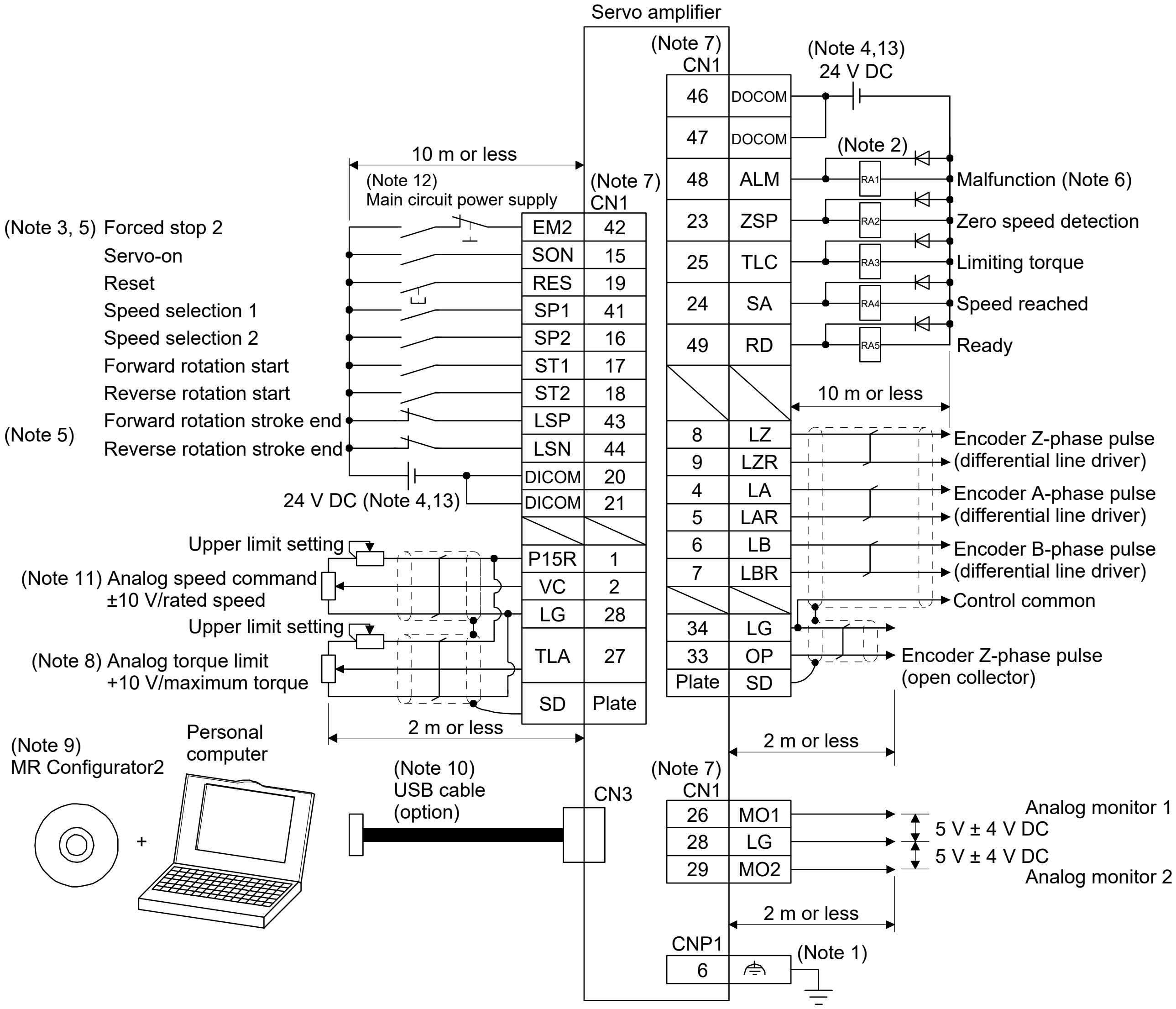
Note 1. To prevent an electric shock, always connect the CNP1 noiseless grounding terminal (⏚marked) of the servo amplifier to the grounding terminal (PE) of the cabinet.

2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity is up to 300 mA. 300 mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.9.2 (1) that gives the current value necessary for the interface. A 24 V DC power supply can be used for both input signal and output signal.
5. When starting operation, always turn on EM2 (Forced stop 2), LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end). (Normally closed contact)
6. ALM (Malfunction) turns on in normal alarm-free condition. (Normally closed contact)
7. The pins with the same signal name are connected in the servo amplifier.
8. TLA will be available when TL (External torque limit selection) is enabled with [Pr. PD03] to [Pr. PD22]. (Refer to section 3.6.1 (5).)
9. Use SW1DNC-MRC2-_. (Refer to section 11.7.)
10. The USB communication function and RS-422 communication function are mutually exclusive. They cannot be used together.
11. Use an external power supply when inputting a negative voltage.
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. Plus and minus of the power of source interface are the opposite of those of sink interface.

(b) For source I/O interface

POINT

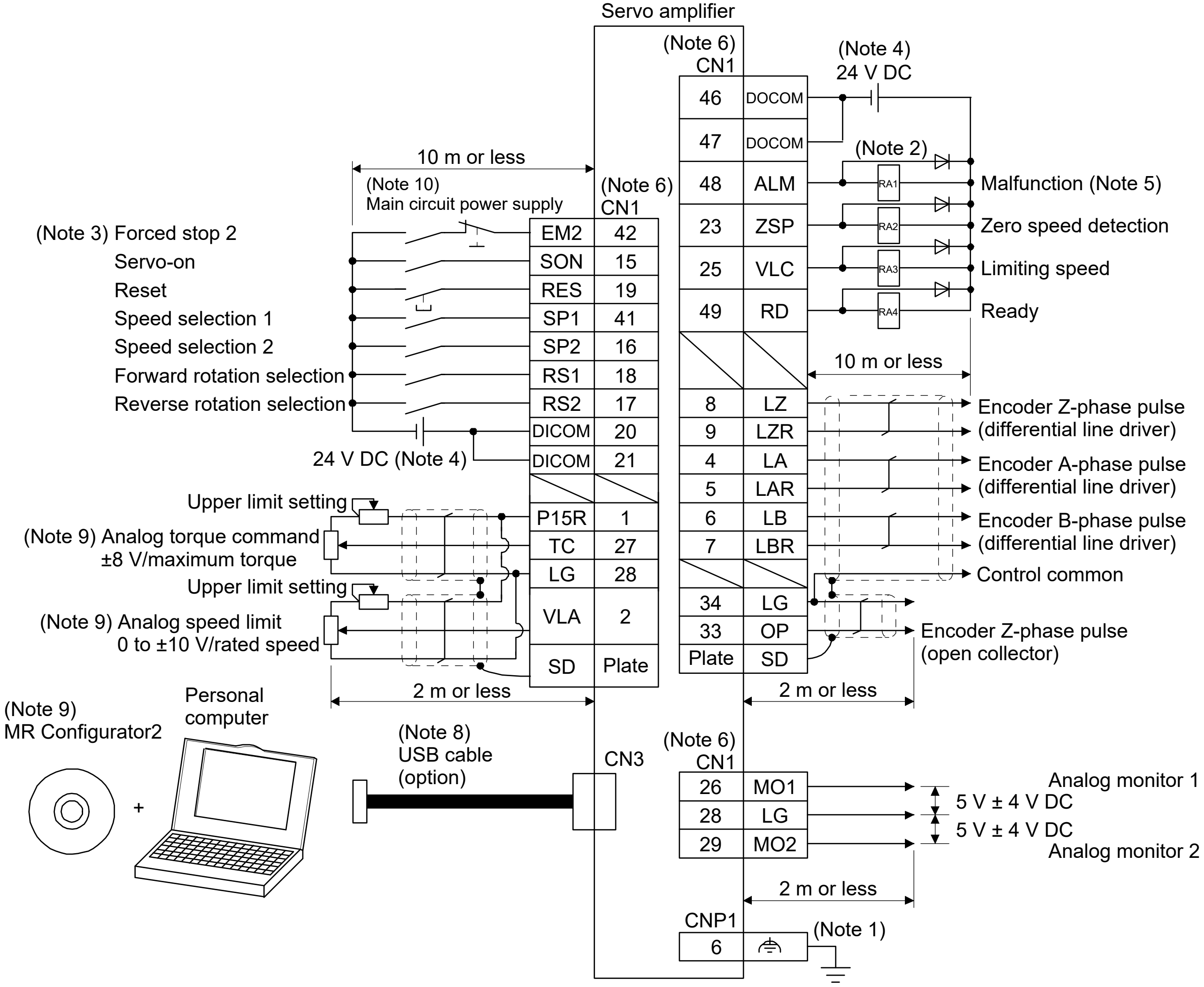
- For notes, refer to (2) (a) in this section.



(3) Torque control mode

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

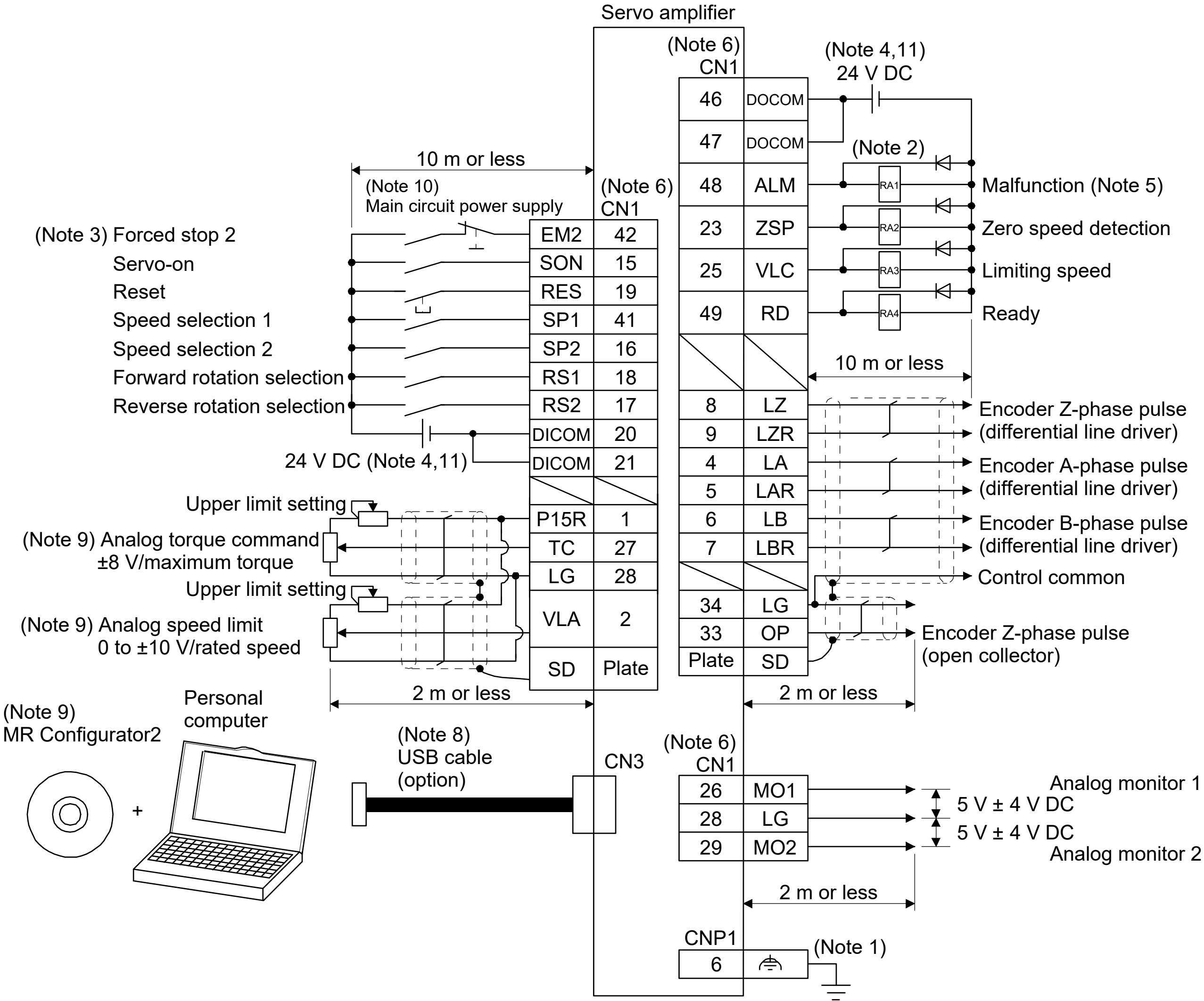
(a) For sink I/O interface



Note 1. To prevent an electric shock, always connect the CNP1 noiseless grounding terminal (⏚ marked) of the servo amplifier to the grounding terminal (PE) of the cabinet.
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity is up to 300 mA. 300 mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.9.2 (1) that gives the current value necessary for the interface. A 24 V DC power supply can be used for both input signal and output signal.
5. ALM (Malfunction) turns on in normal alarm-free condition. (Normally closed contact)
6. The pins with the same signal name are connected in the servo amplifier.
7. Use SW1DNC-MRC2-_. (Refer to section 11.7.)
8. The USB communication function and RS-422 communication function are mutually exclusive. They cannot be used together.
9. Use an external power supply when inputting a negative voltage.
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. Plus and minus of the power of source interface are the opposite of those of sink interface.

(b) For source I/O interface

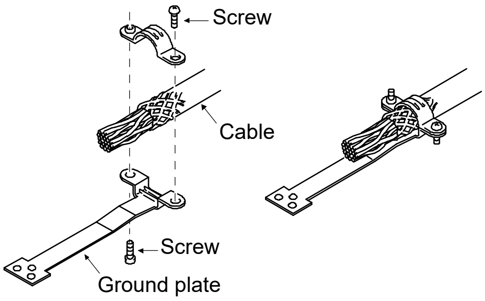
POINT
●For notes, refer to (3) (a) in this section.

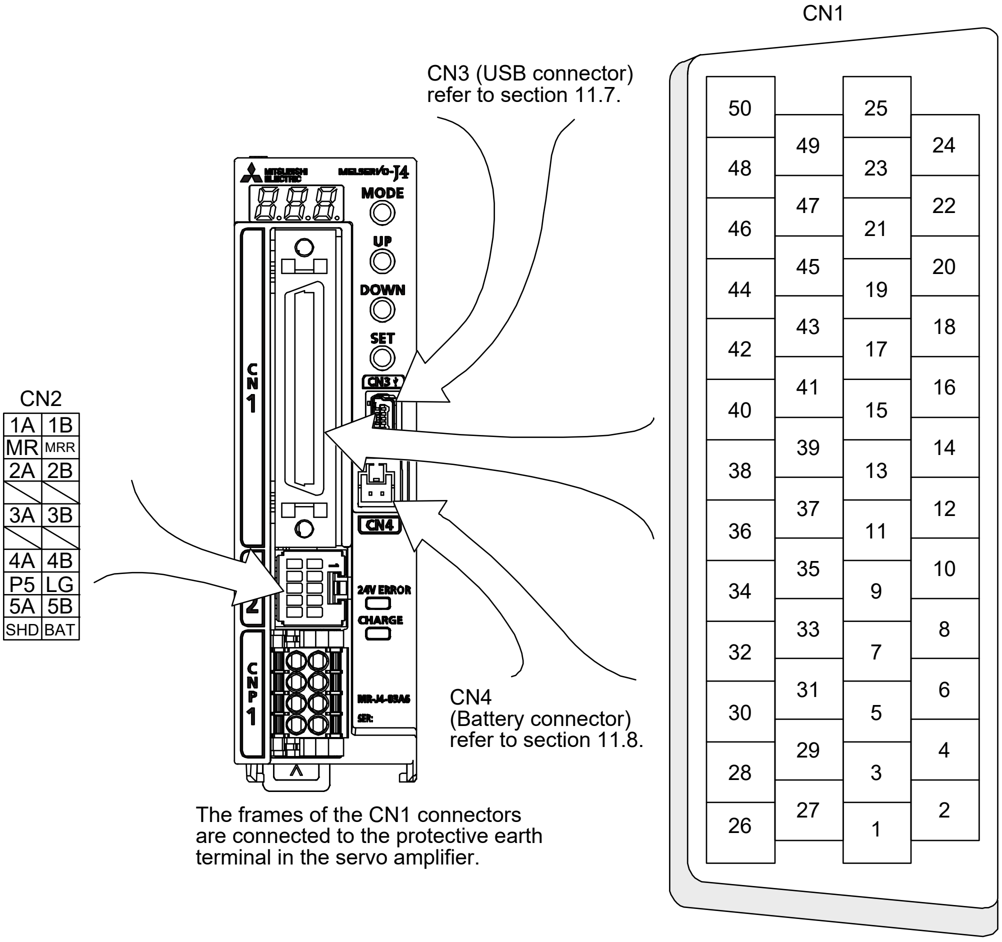


18.3.6 Connectors and pin assignment

POINT

- ●The pin assignment of the connectors is as viewed from the cable connector wiring section.
- ●For the CN1 connector, securely connect the external conductor of the shielded cable to the ground plate and fix it to the connector shell.





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

Pin No.	(Note 1) I/O	(Note 2) I/O signals in control modes						Related parameter
		P	P/S	S	S/T	T	T/P	
1		P15R	P15R	P15R	P15R	P15R	P15R	
2	I		-/VC	VC	VC/VLA	VLA	VLA/-	
3		LG	LG	LG	LG	LG	LG	
4	O	LA	LA	LA	LA	LA	LA	
5	O	LAR	LAR	LAR	LAR	LAR	LAR	
6	O	LB	LB	LB	LB	LB	LB	
7	O	LBR	LBR	LBR	LBR	LBR	LBR	
8	O	LZ	LZ	LZ	LZ	LZ	LZ	
9	O	LZR	LZR	LZR	LZR	LZR	LZR	
10	I	PP	PP/-	(Note 4)	(Note 4)	(Note 4)	-/PP	PD43/PD44
11	I	PG	PG/-				-/PG	
12		OPC	OPC/-				-/OPC	
13	O	SDP	SDP	SDP	SDP	SDP	SDP	
14	O	SDN	SDN	SDN	SDN	SDN	SDN	
15	I	SON	SON	SON	SON	SON	SON	PD03/PD04
16	I		-/SP2	SP2	SP2/SP2	SP2	SP2/-	PD05/PD06
17	I	PC	PC/ST1	ST1	ST1/RS2	RS2	RS2/PC	PD07/PD08
18	I	TL	TL/ST2	ST2	ST2/RS1	RS1	RS1/TL	PD09/PD10
19	I	RES	RES	RES	RES	RES	RES	PD11/PD12
20		DICOM	DICOM	DICOM	DICOM	DICOM	DICOM	
21		DICOM	DICOM	DICOM	DICOM	DICOM	DICOM	
22	O	INP	INP/SA	SA	SA/-		-/INP	PD23
23	O	ZSP	ZSP	ZSP	ZSP	ZSP	ZSP	PD24
24	O	INP	INP/SA	SA	SA/-		-/INP	PD25
25	O	TLC	TLC	TLC	TLC/VLC	VLC	VLC/TLC	PD26
26	O	MO1	MO1	MO1	MO1	MO1	MO1	PC14
27	I	TLA	(Note 3) TLA	(Note 3) TLA	(Note 3) TLA/TC	TC	TC/TLA	
28		LG	LG	LG	LG	LG	LG	
29	O	MO2	MO2	MO2	MO2	MO2	MO2	PC15
30		LG	LG	LG	LG	LG	LG	
31	I	TRE	TRE	TRE	TRE	TRE	TRE	
32								
33	O	OP	OP	OP	OP	OP	OP	
34		LG	LG	LG	LG	LG	LG	
35	I	NP	NP/-	(Note 4)	(Note 4)	(Note 4)	-/NP	PD45/PD46
36	I	NG	NG/-				-/NG	
37	I	PP2	PP2/-	(Note 5)	(Note 5)	(Note 5)	-/PP2	PD43/PD44
38	I	NP2	NP2/-	(Note 5)	(Note 5)	(Note 5)	-/NP2	PD45/PD46
39	I	RDP	RDP	RDP	RDP	RDP	RDP	
40	I	RDN	RDN	RDN	RDN	RDN	RDN	
41	I	CR	CR/SP1	SP1	SP1/SP1	SP1	SP1/CR	PD13/PD14
42	I	EM2	EM2	EM2	EM2	EM2	EM2	
43	I	LSP	LSP	LSP	LSP/-		-/LSP	PD17/PD18
44	I	LSN	LSN	LSN	LSN/-		-/LSN	PD19/PD20
45	I	LOP	LOP	LOP	LOP	LOP	LOP	PD21/PD22
46		DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	
47		DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	
48	O	ALM	ALM	ALM	ALM	ALM	ALM	
49	O	RD	RD	RD	RD	RD	RD	PD28
50								

Note 1. I: input signal, O: output signal
2. P: position control mode, S: speed control mode, T: torque control mode, P/S: position/speed control switching mode, S/T: speed/torque control switching mode, T/P: torque/position control switching mode
3. TLA will be available when TL (External torque limit selection) is enabled with [Pr. PD03] to [Pr. PD22].
4. This is available as an input device of sink interface. Input devices are not assigned by default. Assign the input devices with [Pr. PD43] to [Pr. PD46] as necessary. When using this pin by DI, supply + of 24 V DC to CN1-12 pin.
5. This is available as an input device of source interface. Input devices are not assigned by default. Assign the input devices with [Pr. PD43] to [Pr. PD46] as necessary.

18.3.7 Signal (device) explanations

The pin numbers in the connector pin No. column are those in the initial status.
For the I/O interfaces (symbols in I/O division column in the table), refer to section 3.9.2. The symbols in the control mode field of the table shows the followings.
P: Position control mode
S: Speed control mode
T: Torque control mode
"○" and "△" of the table shows the followings.
○: Usable device by default.
△: Usable device by setting the following parameters.
[Pr. PA04], [Pr. PD03] to [Pr. PD26], [Pr. PD28]

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

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Forced stop 2	EM2	CN1-42	For details of device, refer to section 3.5.1 (1) (a).	DI-1	○	○	○
Forced stop 1	EM1	(CN1-42)		DI-1	△	△	△
Servo-on	SON	CN1-15		DI-1	○	○	○
Reset	RES	CN1-19		DI-1	○	○	○
Forward rotation stroke end	LSP	CN1-43		DI-1	○	○	△
Reverse rotation stroke end	LSN	CN1-44					
External torque limit selection	TL	CN1-18		DI-1	○	△	
Internal torque limit selection	TL1			DI-1	△	△	△
Forward rotation start	ST1	CN1-17		DI-1		○	
Reverse rotation start	ST2	CN1-18					
Forward rotation selection	RS1	CN1-18		DI-1			○
Reverse rotation selection	RS2	CN1-17					
Speed selection 1	SP1	CN1-41		DI-1		○	○
Speed selection 2	SP2	CN1-16		DI-1		○	○
Speed selection 3	SP3			DI-1		△	△
Proportional control	PC	CN1-17		DI-1	○	△	
Clear	CR	CN1-41		DI-1	○		
Electronic gear selection 1	CM1			DI-1	△		
Electronic gear selection 2	CM2			DI-1	△		
Gain switching	CDP			DI-1	△	△	△
Control switching	LOP	CN1-45		DI-1	Refer to function and application column		

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Second acceleration/ deceleration selection	STAB2		For details of device, refer to section 3.5.1 (1) (a).	DI-1		△	△
ABS transfer mode	ABSM	CN1-17		DI-1	△		
ABS request	ABSR	CN1-18		DI-1	△		

(b) Output device

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Malfunction	ALM	CN1-48	For details of device, refer to section 3.5.1 (1) (b).	DO-1	○	○	○
Ready	RD	CN1-49		DO-1	○	○	○
In-position	INP	CN1-22		DO-1	○		
Speed reached	SA	CN1-24		DO-1		○	
Limiting speed	VLC	CN1-25		DO-1			○
Limiting torque	TLC			DO-1	○	○	
Zero speed detection	ZSP	CN1-23		DO-1	○	○	○
Electromagnetic brake interlock	MBR			DO-1	△	△	△
Warning	WNG			DO-1	△	△	△
Battery warning	BWNG			DO-1	△	△	△
Alarm code	ACD0	(CN1-24)		DI-1	△	△	△
	ACD1	(CN1-23)					
	ACD2	(CN1-22)					
Variable gain selection	CDPS			DO-1	△	△	△
Absolute position undetermined	ABSV			DO-1	△		
ABS transmission data bit 0	ABSB0	(CN1-22)		DO-1	△		
ABS transmission data bit 1	ABSB1	(CN1-23)		DO-1	△		
ABS transmission data ready	ABST	(CN1-25)		DO-1	△		

(2) Input signal

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Analog torque limit	TLA	CN1-27	Refer to section 3.5 (2) for details of signal.	Analog input	○	△	
Analog torque command	TC			Analog input			○
Analog speed command	VC	CN1-2		Analog input		○	
Analog speed limit	VLA			Analog input			○
Forward rotation pulse train Reverse rotation pulse train	PP NP PP2 NP2 PG NG	CN1-10 CN1-35 CN1-37 CN1-38 CN1-11 CN1-36		DI-2	○		

(3) Output signal

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Encoder A-phase pulse (differential line driver)	LA LAR	CN1-4 CN1-5	Refer to section 3.5 (3) for details of signal.	DO-2	○	○	○
Encoder B-phase pulse (differential line driver)	LB LBR	CN1-6 CN1-7					
Encoder Z-phase pulse (differential line driver)	LZ LZR	CN1-8 CN1-9		DO-2	○	○	○
Encoder Z-phase pulse (open-collector)	OP	CN1-33		DO-2	○	○	○
Analog monitor 1	MO1	CN1-26	This is used to output the data set in [Pr. PC14] to between MO1 and LG in terms of voltage. Output voltage: 5 V ± 4 V Resolution: 10 bits or equivalent	Analog output	○	○	○
Analog monitor 2	MO2	CN1-29	This signal outputs the data set in [Pr. PC15] to between MO2 and LG in terms of voltage. Output voltage: 5 V ± 4 V Resolution: 10 bits or equivalent	Analog output	○	○	○

(4) Communication

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

(5) Power supply

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Digital I/F power supply input	DICOM	CN1-20 CN1-21	Input 24 V DC (24 V DC ± 10% 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 the 24 V DC external power supply.		○	○	○
Open-collector sink interface power supply input	OPC	CN1-12	When inputting a pulse train in the open-collector type with sink interface, supply this terminal with the positive (+) power of 24 V DC.		○		
			Supply + of 24 V DC to this terminal when using CN1-10-pin and CN1-35-pin by DI.			○	○
Digital I/F common	DOCOM	CN1-46 CN1-47	Common terminal of input signal such as EM2 of the servo amplifier. This is separated from LG. For sink interface, connect - of 24 V DC external power supply. For source interface, connect + of the 24 V DC external power supply.		○	○	○
15 V DC power supply	P15R	CN1-1	This outputs 15 V DC to between P15R and LG. This is available as power for TC, TLA, VC, or VLA. Permissible current: 30 mA		○	○	○
Control common	LG	CN1-3 CN1-28 CN1-30 CN1-34	Common terminal of TLA/TC/VC/VLA/OP/MO1/MO2/P15R. Pins are connected internally.		○	○	○
Shield	SD	Plate	Connect the external conductor of the shielded wire.		○	○	○

18.3.8 Alarm occurrence timing chart

⚠CAUTION

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

POINT

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

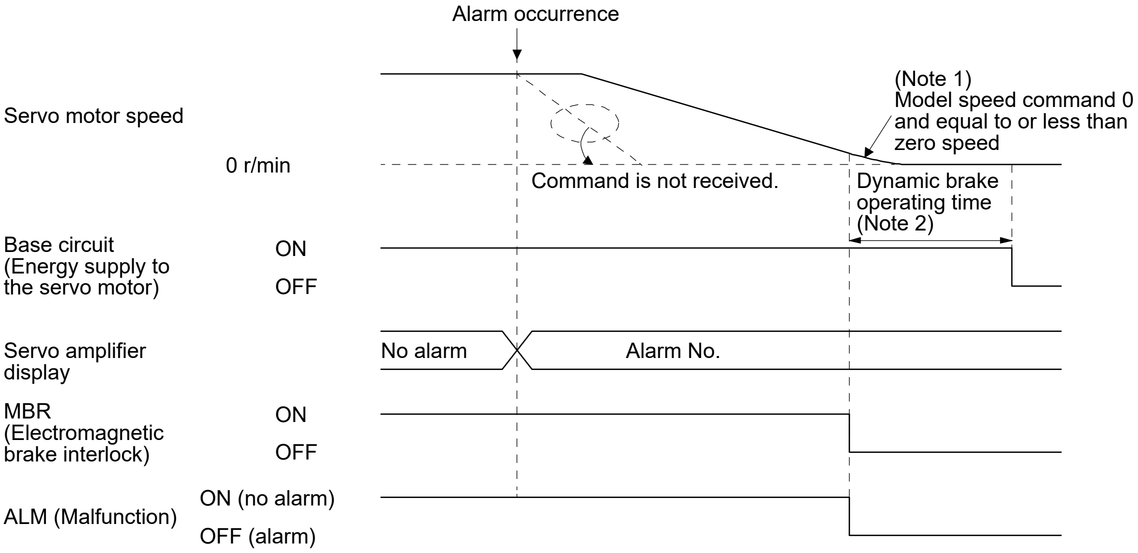
To deactivate an alarm, cycle the control circuit power, push the "SET" button in the current alarm window, or cycle the RES (Reset). However, the alarm cannot be deactivated unless its cause is removed.

(1) When you use the forced stop deceleration function

POINT

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

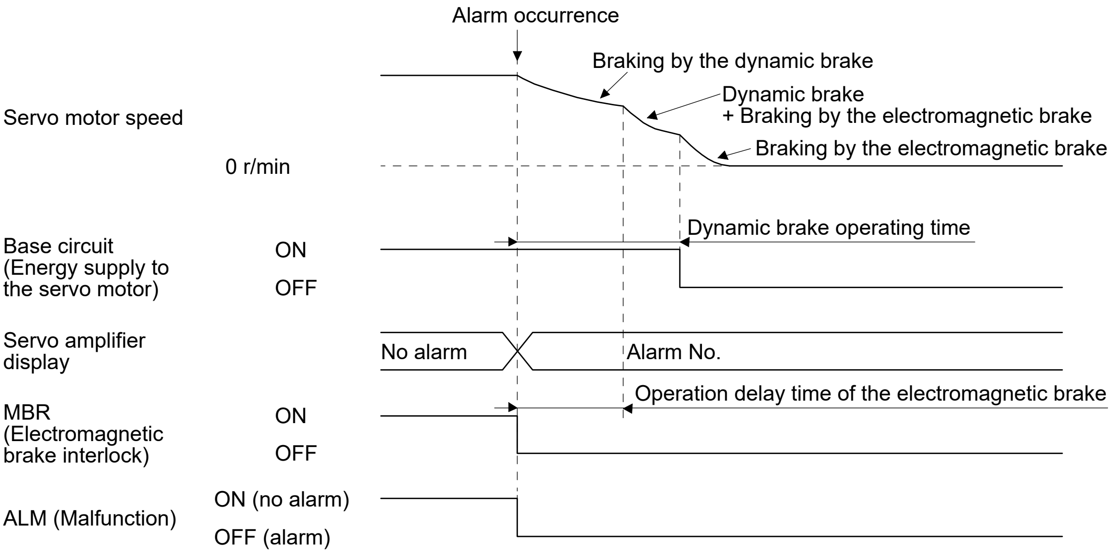
(a) When the forced stop deceleration function is enabled



Note 1. The model speed command is a speed command generated in the servo amplifier for forced stop deceleration of the servo motor.

2. If the servo motor speed is 5 r/min or higher, the electric dynamic brake will operate continuously for the time period set by [Pr. PF15].

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



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

POINT

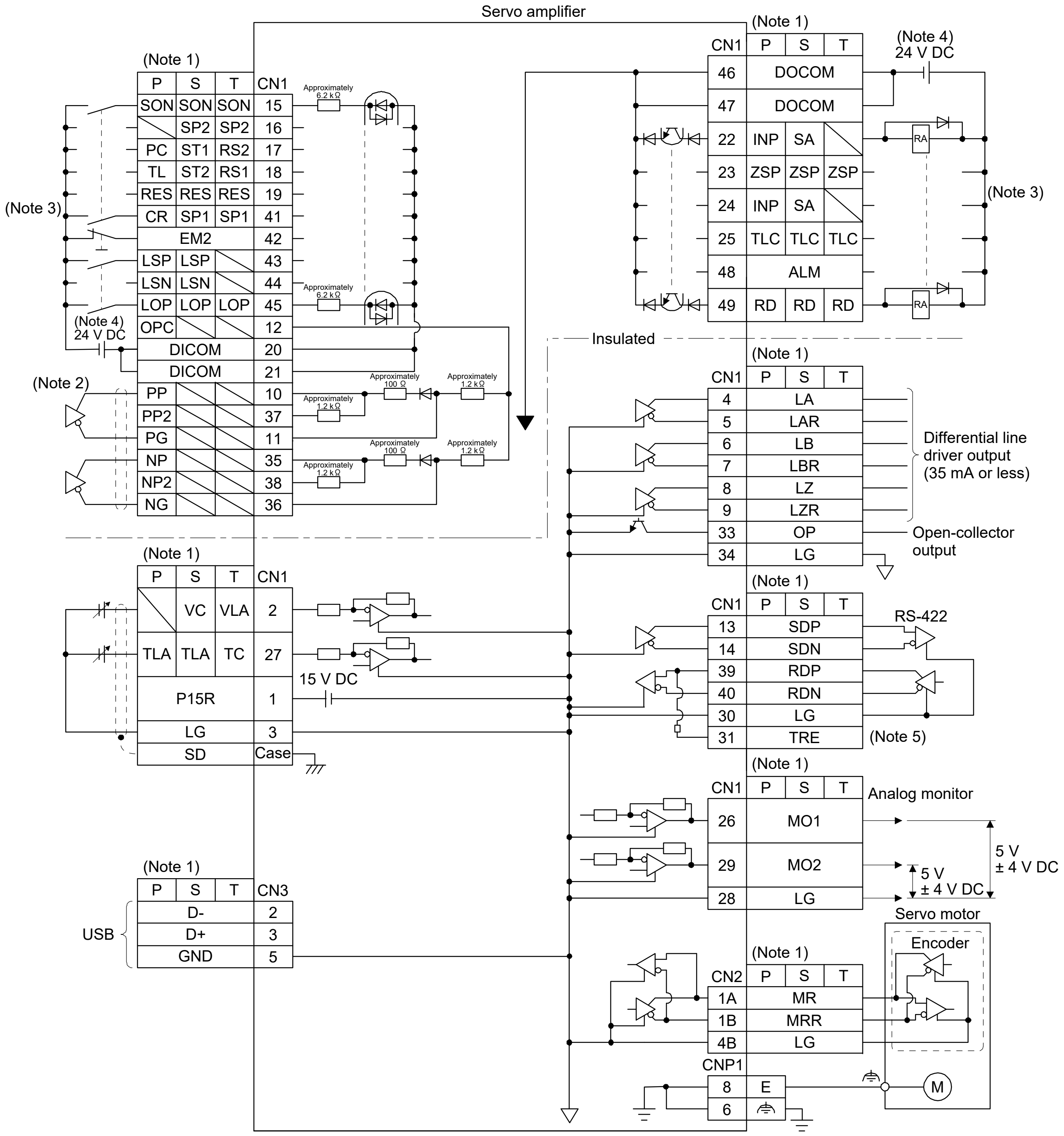
- To disable the function, set "0 _ _ _" in [Pr. PA04].

The operation status during an alarm is the same as (1) (b) in this section.

18.3.9 Interfaces (Internal connection diagram)

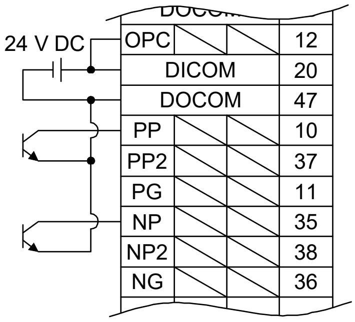
The items in the following table are the same as those for MR-J4-_A_(-RJ) servo amplifiers of 100 W or more. Refer to the section of the detailed explanation field for details.

Item	Detailed explanation
Detailed explanation of interfaces	Section 3.9.2
Source I/O interface	Section 3.9.3

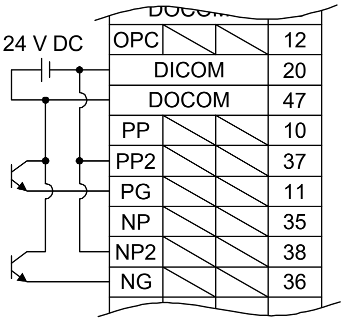


Note 1. P: position control mode, S: speed control mode, T: torque control mode

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



For sink input interface



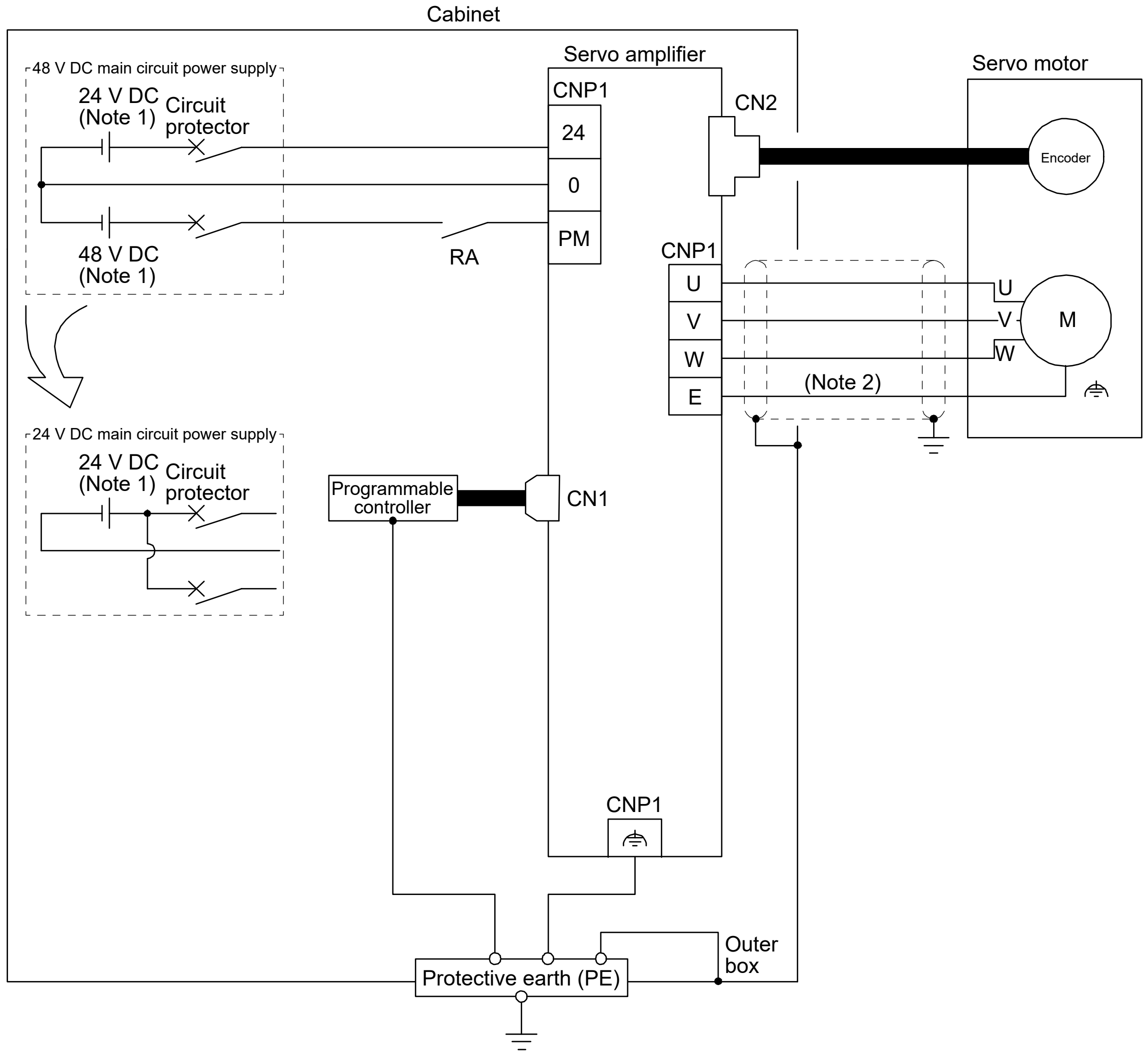
For source input interface

3. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
4. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
   For 24 V DC power for I/O signal, use power other than 24 V DC power of servo amplifier control circuit power supply.
5. To use the RS-422 communication function, connect between TRE and RDN of the final axis servo amplifier. (Refer to section 18.9.)

18.3.10 Grounding

⚠WARNING
- Ground the servo amplifier and servo motor securely.
- To prevent an electric shock, always connect the noiseless grounding terminal (marked⏚) of the servo amplifier to the grounding terminal 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 1. For power supply specifications, refer to section 18.1.3.
2. Connect ⏚ of servo motor to E of the CNP1 connector. Do not connect the wire directly to the grounding terminal of the cabinet.

18.4 Startup

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

⚠CAUTION
- ●Before starting operation, check the parameters. Improper settings may cause some machines to operate unexpectedly.
- ●The servo amplifier and servo motor 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.

The items in the following table are the same as those for MR-J4-_A_(-RJ) servo amplifiers of 100 W or more. Refer to the section of the detailed explanation field for details.

Item	Detailed explanation
Startup in position control mode	Section 4.2
Startup in speed control mode	Section 4.3
Startup in torque control mode	Section 4.4

18.4.1 Startup procedure

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

01. Wiring check	Check that the servo amplifiers and servo motors are wired correctly. (Refer to section 18.4.3.)
02. Setting of main circuit power supply selection	Set the main circuit power supply selection (48 V DC or 24 V DC) to servo amplifier. Set [Pr. PC27] according to the flow of 02-1 to 02-4. Set this setting only when using 24 V DC. (The initial value of the main circuit power supply selection is 48 V DC. When using 48 V DC, turn the control circuit power supply on and move on to procedure 03.)
1. Turning on of control circuit power supply	To set the parameter to servo amplifier, turn on the control circuit power supply. At this time, do not turn on the main circuit power supply.
2. Setting of 24 V DC main circuit power supply with [Pr. PC27]	Set [Pr. PC027] setting to "_ 1 _ _".
3. Turning off of control circuit power supply	To reflect the parameter setting, turn off the control circuit power supply.
4. Turning on of control circuit power supply Check of [Pr. PC27]	Turn on the control circuit power supply on again, and check that [Pr. PC27] is changed to "24 V DC (_ 1 _ _)". At this time, do not turn on the main circuit power supply.
03. Recheck of main circuit power supply voltage and wiring	Make sure that the main circuit power supply voltage of the servo amplifier to be turned on matches with the voltage set by [Pr. PC27] and that the servo amplifiers and servo motors are wired correctly by visual inspection, DO forced output function (section 18.5.9), etc.
04. Surrounding environment check	Check the surrounding environment of the servo amplifier and servo motor. (Refer to section 18.4.4.)
05. Turning on of main circuit power supply	Turn on the main circuit power.
06. Parameter setting	Set the parameters as necessary, such as the used operation mode. (Refer to sections 18.6, 4.2.4, 4.3.4, and 4.4.4.)
07. Test operation of the servo motor alone in test operation mode	For the test operation, with the servo motor disconnected from the machine and operated at the speed as low as possible, check whether the servo motor rotates correctly. (Refer to sections 4.2.3, 4.3.3, and 4.4.3.)
08. Test operation of the servo motor alone by command	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.
09. 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.
10. Gain adjustment	Make gain adjustment to optimize the machine motions. (Refer to chapter 6.)
11. Actual operation	
12. Stop	Stop giving commands and stop operation. Other conditions that stop the servo motor are mentioned in sections 4.2.2, 4.3.2, and 4.4.2.

18.4.2 Troubleshooting when "24 V ERROR" lamp turns on

(1) When overvoltage is applied to the control circuit in the servo amplifier, power supply to the circuit will be shut off and the "24 V ERROR" lamp will turn on. Then, the 3-digit, 7-segment LED on display will turn off. Immediately turn off the power and check the wiring, etc. to the main circuit power supply (48 V DC).

(2) If the "24 V ERROR" lamp turns on with the 3-digit, 7-segment LED on, the control circuit power supply voltage (24 V DC) may be failure. Check that the voltage of the control circuit power supply is 21.6 V DC or more.

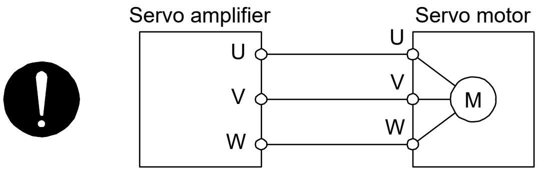
18.4.3 Wiring check

(1) Power supply system wiring
Before switching on the main circuit and control circuit power supplies, check the following items.

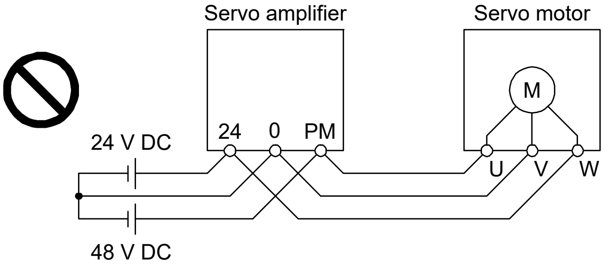
(a) Power supply system wiring
The power supplied to the power input terminals (24/0/PM) of the servo amplifier should satisfy the defined specifications. (Refer to section 18.1.3.)

(b) Connection of servo amplifier and servo motor

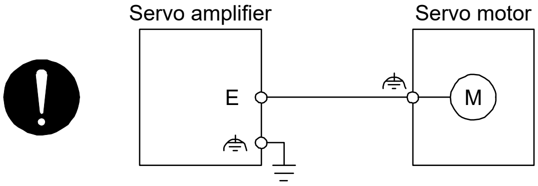
1) The servo amplifier power output (U/V/W) should match in phase with the servo motor power input terminals (U/V/W).



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



3) The noiseless grounding terminal (⏚) of the servo motor should be connected to the E terminal of the servo amplifier.



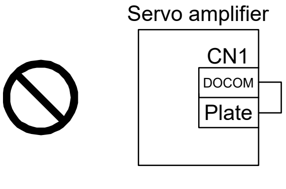
4) The CN2 connector of the servo amplifier should be connected to the encoder of the servo motor securely using the encoder cable.

(2) I/O signal wiring

(a) The I/O signals should be connected correctly.
Use DO forced output to forcibly turn on/off the pins of the CN1 connector. You can use this function to check the wiring. In this case, switch on the control circuit power supply only.
For details of I/O signal connection, refer to section 18.3.5.

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

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



18.4.4 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.

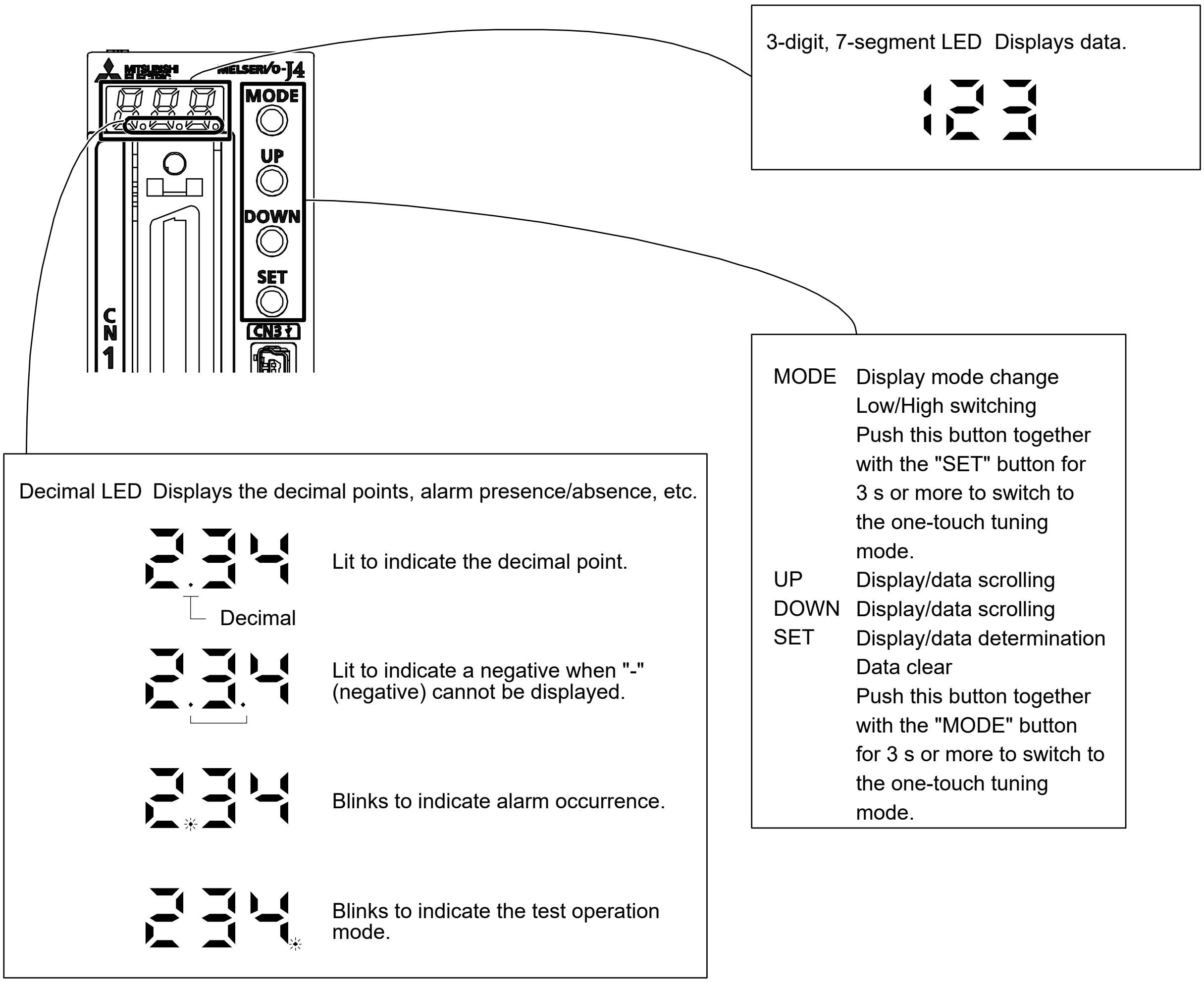
(2) Environment

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

18.5 Display and operation sections

18.5.1 Summary

MR-J4-03A6(-RJ) servo amplifier has the display section (3-digit, 7-segment LED) and operation section (4 push buttons) for servo amplifier status display, alarm display, parameter setting, etc. Also, press the "MODE" and "SET" buttons at the same time for 3 s or more to switch to the one-touch tuning mode.
The operation section and display data are described below.



3-digit, 7-segment LED Displays data.

Decimal LED Displays the decimal points, alarm presence/absence, etc.

Lit to indicate the decimal point.

Lit to indicate a negative when "-" (negative) cannot be displayed.

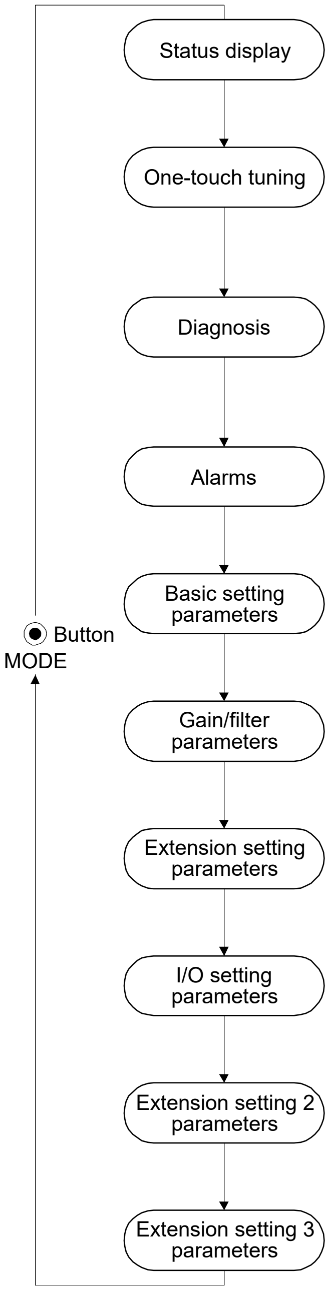
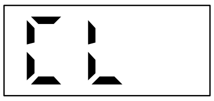
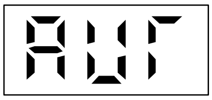
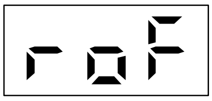
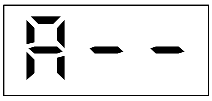
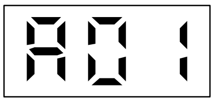
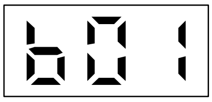
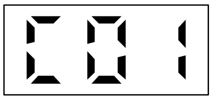
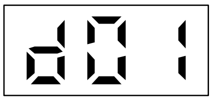
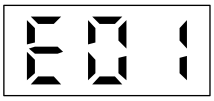
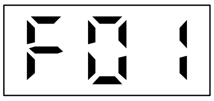
Blinks to indicate alarm occurrence.

Blinks to indicate the test operation mode.

MODE	Display mode change Low/High switching Push this button together with the "SET" button for 3 s or more to switch to the one-touch tuning mode.
UP	Display/data scrolling
DOWN	Display/data scrolling
SET	Display/data determination Data clear Push this button together with the "MODE" button for 3 s or more to switch to the one-touch tuning mode.

18.5.2 Display flowchart

Press the "MODE" button once to shift to the next display mode. Refer to section 18.5.3 and later for the description of the corresponding display mode.
To refer to and set the gain/filter parameters, extension setting parameters and I/O setting parameters, enable them with [Pr. PA19 Parameter writing inhibit].

Display mode transition	Initial screen	Function	Reference
		Servo status display. "CL" appears at power-on. (Note)	Section 18.5.3
		One-touch tuning Select this when performing the one-touch tuning.	Section 6.2 Section 18.5.4
		Sequence display, external signal display, output signal (DO) forced output, test operation, software version display, VC automatic offset, servo motor series ID display, servo motor type ID display, servo motor encoder ID display, drive recorder enabled/disabled display.	Section 18.5.5
		Current alarm display, alarm history display, parameter error number display.	Section 18.5.6
		Display and setting of basic setting parameters.	Section 18.5.7
		Display and setting of gain/filter parameters.	
		Display and setting of extension setting parameters.	
		Display and setting of I/O setting parameters.	
		Display and setting of extension setting 2 parameters.	
		Display and setting of extension setting 3 parameters.	

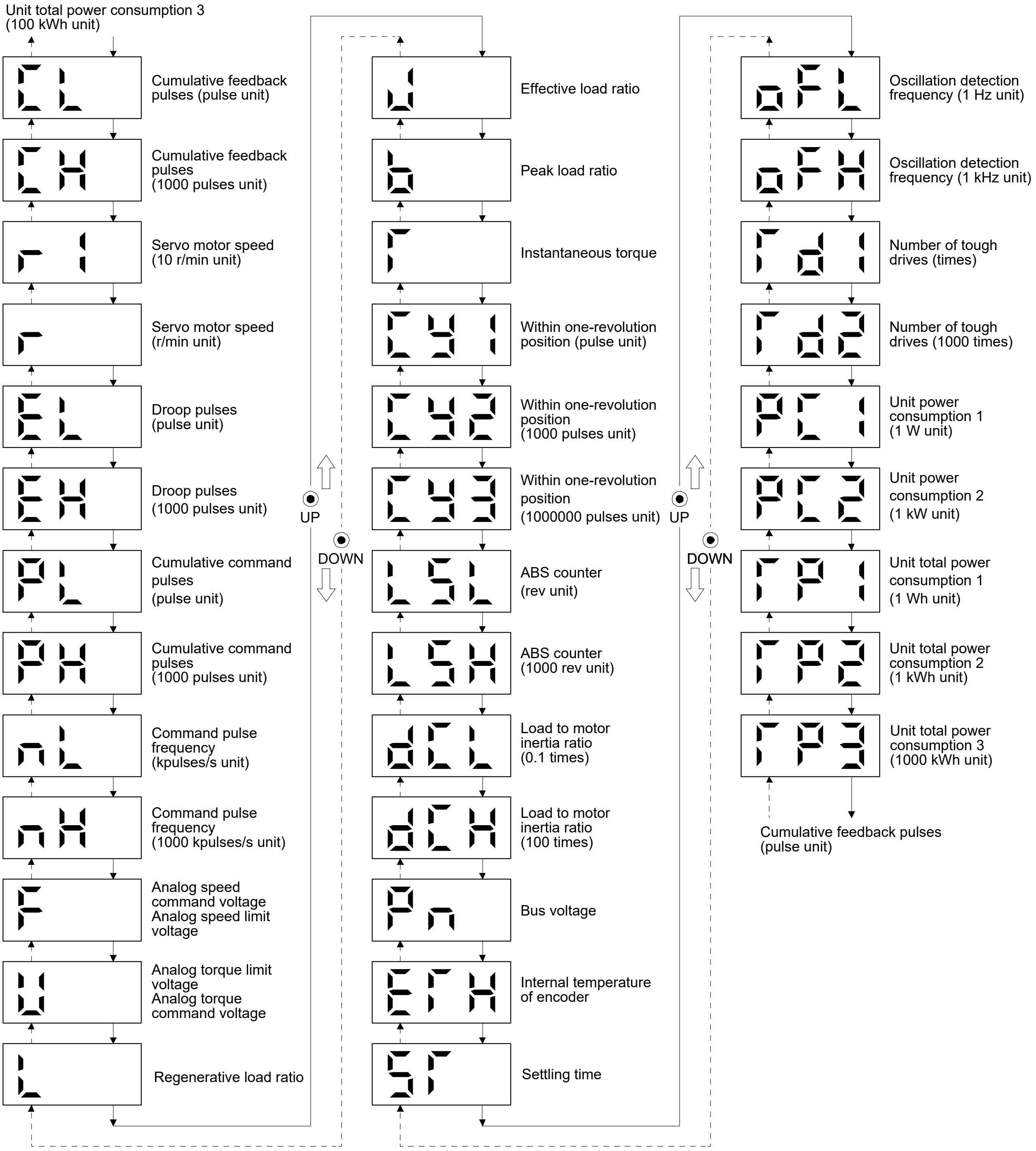
Note. When the axis name is set to the servo amplifier with MR Configurator2, the axis name is displayed and the servo status is then displayed.

18.5.3 Status display mode

The servo status during operation is shown on the 3-digit, 7-segment LED display. Press the "UP" or "DOWN" button to change display data as desired. When the required data is selected, the corresponding symbol is displayed. Press the "SET" button to display that data. At only power-on, however, data appears after the symbol of the status display selected in [Pr. PC36] has been shown for 2 s.

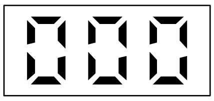
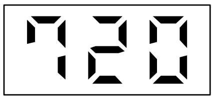
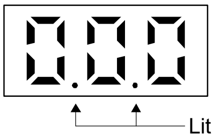
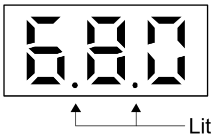
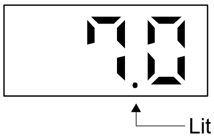
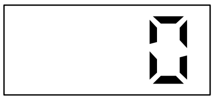
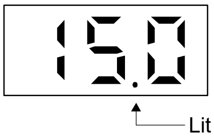
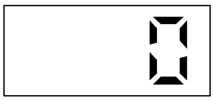
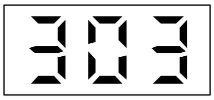
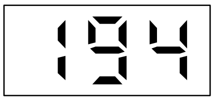
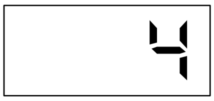
(1) Display transition

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



(2) Display examples

The following table shows the display examples.

Item	Status		Displayed data
			Servo amplifier display
Cumulative feedback pulses	720000 pulses	pulse unit	
		1000 pulses unit	
	-680000 pulses	pulse unit	 The negative value is indicated by the lit decimal points in the upper two digits.
		1000 pulses unit	 The negative value is indicated by the lit decimal points in the upper two digits.
Load to motor inertia ratio	7.0 times	0.1 times	 At this time, the decimal point in the second digit blinks.
		100 times	 "0" in 100 times display.
	15.0 times	0.1 times	 At this time, the decimal point in the second digit blinks.
		100 times	 "0" in 100 times display.
Position within one-revolution	4194303 pulses	pulse unit	
		1000 pulses unit	
		1000000 pulses unit	

(3) Status display list

The following table lists the servo statuses that may be shown. Refer to app. 8.3 (2) for the measurement point.

Status display	Symbol	Unit	Description
Cumulative feedback pulses (1 pulse unit)	CL	pulse	Feedback pulses from the servo motor encoder are counted and displayed. When the count exceeds ±999, it starts from 0. Negative value is indicated by the lit decimal points in the upper two digits. Press the "SET" button to reset the display value to zero. The internal counter subtracts 500000000 when the number exceeds 2000000000. In addition, The internal counter adds 500000000 when the number exceeds -2000000000.
Cumulative feedback pulses (1000 pulses unit)	Ch	1000 pulses	
Servo motor speed (10 r/min unit)	r1	10 r/min	The servo motor speed is displayed. Negative value is indicated by the lit decimal points in the upper two digits. Displays by 10 r/min unit.
Servo motor speed (1 r/min unit)	r	r/min	The servo motor speed is displayed. Negative value is indicated by the lit decimal points in the upper two digits.
Droop pulses (1 pulse unit)	EL	pulse	The numbers of droop pulses in the deviation counter are displayed. When the count exceeds ±999, it starts from 0. The number of pulses is displayed in the units of encoder pulses. Negative value is indicated by the lit decimal points in the upper two digits.
Droop pulses (1000 pulses unit)	Eh	1000 pulses	
Cumulative command pulses (1 pulse unit)	PL	pulse	Position command input pulses are counted and displayed. As the value displayed is not yet multiplied by the electronic gear (CMX/CDV), it may not match the indication of the cumulative feedback pulses. When the count exceeds ±999, it starts from 0. Negative value is indicated by the lit decimal points in the upper two digits. Press the "SET" button to reset the display value to zero.
Cumulative command pulses (1000 pulses unit)	Ph	1000 pulses	
Command pulse frequency (1 kpulse/s unit)	nL	kpulse/s	The frequency of position command input pulses is counted and displayed. The value displayed is not multiplied by the electronic gear (CMX/CDV).
Command pulse frequency (1000 kpulses/s unit)	nh	1000 kpulses/s	
Analog speed command voltage Analog speed limit voltage	F	V	1) Torque control mode Input voltage of VLA (Analog speed limit) voltage is displayed. Negative value is indicated by the lit decimal points in the upper two digits. 2) Speed control mode Input voltage of VC (Analog speed command) voltage is displayed. Negative value is indicated by the lit decimal points in the upper two digits.
Analog torque command voltage Analog torque limit voltage	U	V	1) Position control mode and speed control mode Voltage of TLA (Analog torque limit) voltage is displayed. Negative value is indicated by the lit decimal points in the upper two digits. 2) Torque control mode Voltage of TC (Analog torque command) voltage is displayed. Negative value is indicated by the lit decimal points in the upper two digits.
Regenerative load ratio	L	%	The ratio of regenerative power to permissible regenerative power is displayed in %.
Effective load ratio	J	%	The continuous effective load current is displayed. The effective value in the past 15 s is displayed relative to the rated current of 100 %.
Peak load ratio	b	%	The maximum occurrence torque is displayed. The highest value in the past 15 s is displayed relative to the rated torque of 100 %.
Instantaneous torque	T	%	The instantaneous torque is displayed. The value of torque being occurred is displayed in real time considering a rated torque as 100%.
Within one-revolution position (1 pulse unit)	Cy1	pulse	Position within one revolution is displayed in encoder pulses. When the count exceeds 999, it starts from 0. When the servo motor rotates in the CCW direction, the value is added.
Within one-revolution position (1000 pulses unit)	Cy2	1000 pulses	The within one-revolution position is displayed in 1000 pulse increments of the encoder. When the count exceeds 999, it starts from 0. When the servo motor rotates in the CCW direction, the value is added.

Status display	Symbol	Unit	Description
Within one-revolution position (1000000 pulses unit)	Cy3	1000000 pulses	The within one-revolution position is displayed in 1000000 pulse increments of the encoder. When the count exceeds 999, it starts from 0. When the servo motor rotates in the CCW direction, the value is added.
ABS counter (1 rev unit)	LSL	rev	The travel distance from the home position is displayed as multi-revolution counter value of the absolution position encoder in the absolution position detection system. Negative value is indicated by the lit decimal points in the upper two digits.
ABS counter (1000 rev unit)	LSh	1000 rev	
Load to motor inertia ratio (0.1 times)	dCL	0.1 times	The estimated ratio of the load inertia moment to the servo motor shaft inertia moment is displayed.
Load to motor inertia ratio (100 times)	dCh	100 times	
Bus voltage	Pn	V	The voltage of main circuit converter is displayed. It is displayed rounding off 0.1 V unit.
Internal temperature of encoder	ETh	°C	Inside temperature of encoder detected by the encoder is displayed.
Settling time	ST	ms	Displays settling time. When it exceeds 999 ms, "999" will be displayed.
Oscillation detection frequency (1 Hz unit)	oFL	Hz	Frequency at the time of oscillation detection is displayed.
Oscillation detection frequency (1 kHz unit)	oFh	kHz	
Number of tough drive operations (times)	Td1	times	The number of tough drive functions activated is displayed.
Number of tough drive operations (1000 times)	Td2	1000 times	
Unit power consumption 1 (1 W unit)	PC1	W	Unit power consumption is displayed by increment of 1 W. Positive value indicate power running, and negative value indicate regeneration. The values in excess of ±999 can be counted. However, the counter shows only the lower 3-digits of the actual value since the servo amplifier display is 3-digits. Negative value is indicated by the lit decimal points in the upper two digits.
Unit power consumption 2 (1 kW unit)	PC2	kW	Unit power consumption is displayed by increment of 1 kW. Positive value indicate power running, and negative value indicate regeneration. The values in excess of ±99 can be counted. However, the counter shows only the lower 3-digits of the actual value since the servo amplifier display is 3-digits. Negative value is indicated by the lit decimal points in the upper two digits.
Unit total power consumption 1 (1 Wh unit)	TP1	Wh	Unit total power consumption is displayed by increment of 1 Wh. Positive value is cumulated during power running and negative value during regeneration. The values in excess of ±999 can be counted. However, the counter shows only the lower 3-digits of the actual value since the servo amplifier display is 3-digits. Negative value is indicated by the lit decimal points in the upper two digits.
Unit total power consumption 2 (1 kWh unit)	TP2	kWh	Unit total power consumption is displayed by increment of 1 kWh. Positive value is cumulated during power running and negative value during regeneration. The values in excess of ±999 can be counted. However, the counter shows only the lower 3-digits of the actual value since the servo amplifier display is 3-digits. Negative value is indicated by the lit decimal points in the upper two digits.
Unit total power consumption 3 (1000 kWh unit)	TP3	1000 kWh	Unit total power consumption is displayed by increment of 1000 kWh. Positive value is cumulated during power running and negative value during regeneration. The values in excess of ±99 can be counted. However, the counter shows only the lower 3-digits of the actual value since the servo amplifier display is 3-digits. Negative value is indicated by the lit decimal points in the upper two digits.

(4) Changing the status display screen

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

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

18.5.4 One-touch tuning

The contents mentioned in this section is an operation method only for executing one-touch tuning in the user command method on MR-J4-03A6(-RJ) servo amplifier by using push button. Refer to section 6.2 for details of one-touch tuning.

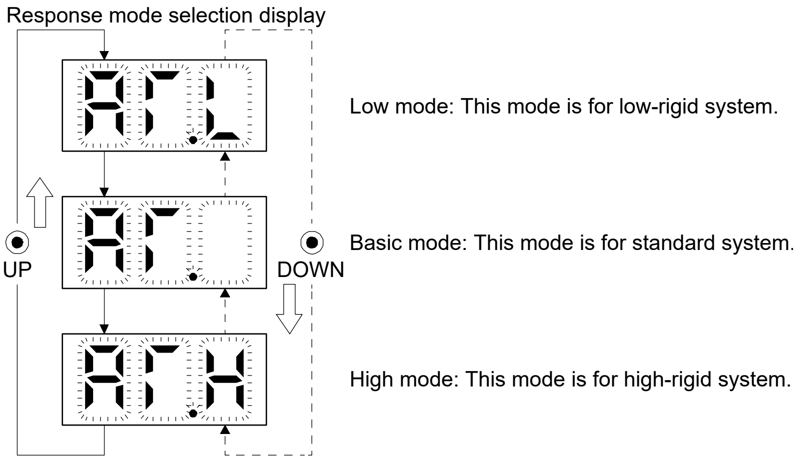
POINT

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

Push the "MODE" button during motor driving to switch to the initial screen ("AT") of the one-touch tuning. Push the "SET" button for 2 s or more during displaying "AT" to switch to the response mode selection ("AT.").

(1) Response mode selection

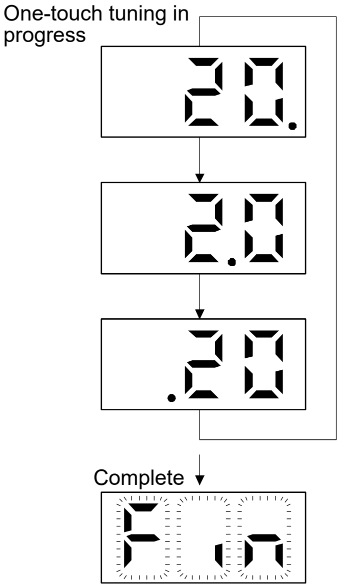
Select a response mode of the one-touch tuning from 3 modes with "UP" or "DOWN". Refer to section 6.2.2 (1) (a) for a guideline of response mode.



(2) One-touch tuning execution

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

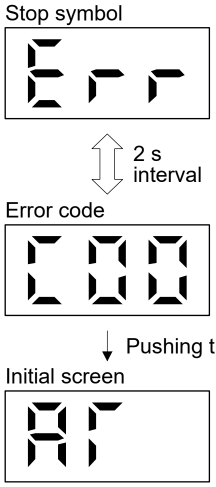
After the response mode is selected in (1), pushing the "SET" button will start one-touch tuning.



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

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

(3) Stop of one-touch tuning

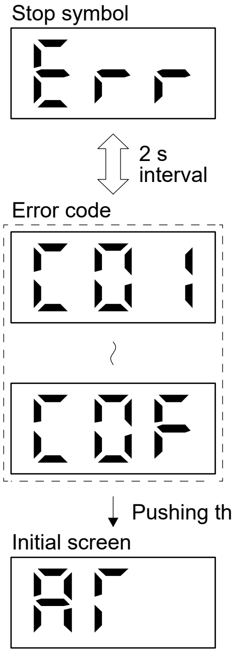


The one-touch tuning mode can be stopped by pushing the "SET" button regardless of displayed item.

The stop symbol and error code "C 00" (cancel during tuning) will be displayed by turns with 2 s interval.

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

(4) If an error occurs

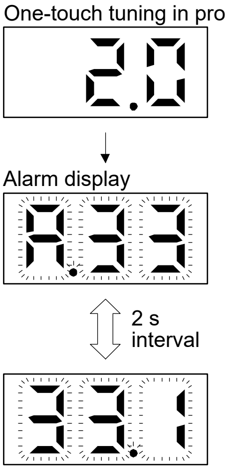


If an error occurs during the one-touch tuning, the tuning will be forcibly terminated and the stop symbol and error code from "C 01" to "C 0F" will be displayed by turns with 2 s interval.

Check the error cause referring to the table 6.2 of (1) (d) of section 6.2.2.

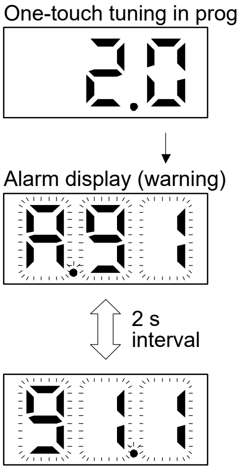
Pushing the "SET" button will switch to the initial screen.

(5) If an alarm occurs



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

(6) If a warning occurs

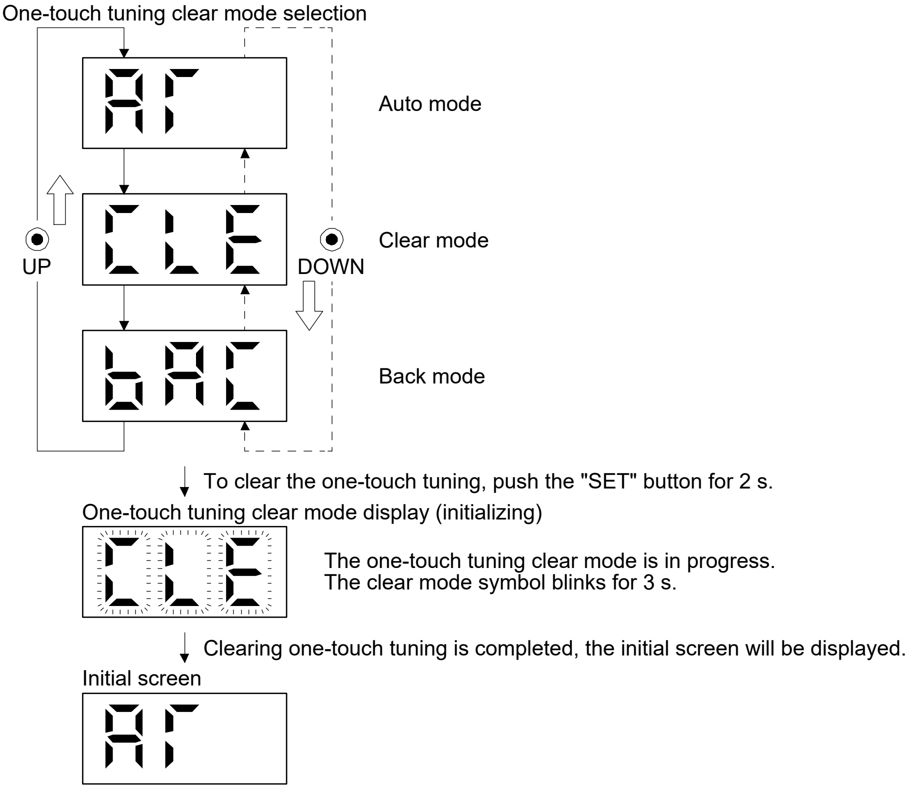


If a warning occurs during the one-touch tuning, the alarm No. of the warning will be displayed. When the warning is one which continue the motor driving, the one-touch tuning will be continued.

(7) Clearing one-touch tuning
Refer to table 6.1 of section 6.2 for the parameters which you can clear.
You can initialize the parameters changed by the one-touch tuning with the clear mode. You can reset the parameters to before tuning with the back mode.

(a) Push the "MODE" button to switch to the initial screen ("AT") of the one-touch tuning.

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

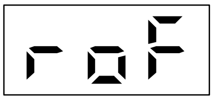
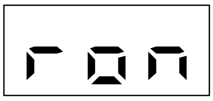
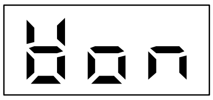
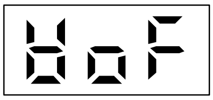
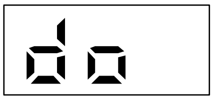
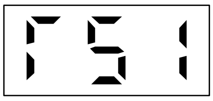
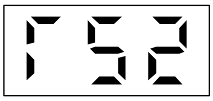
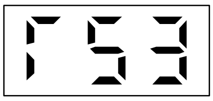
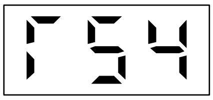
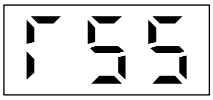


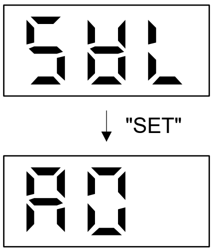
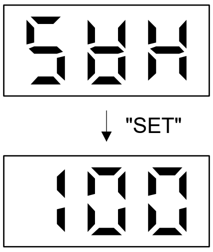
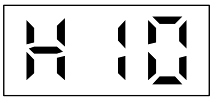
To clear the one-touch tuning, push the "SET" button for 2 s.

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

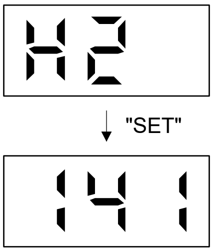
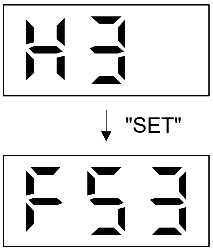
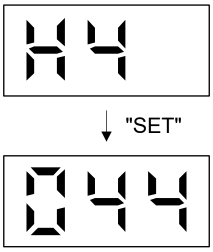
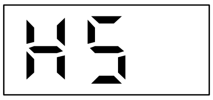
Clearing one-touch tuning is completed, the initial screen will be displayed.

18.5.5 Diagnostic mode

Name		Display	Description
Sequence			Not ready Indicates that the servo amplifier is being initialized or an alarm has occurred.
			Ready Indicates that the servo was switched on after completion of initialization and the servo amplifier is ready to operate.
Drive recorder enabled/disabled display			Drive recorder enabled When an alarm occurs in the status, the drive recorder will operate and write the status of occurrence.
			Drive recorder disabled The drive recorder will not operate on the following conditions. 1. You are using the graph function of MR Configurator2. 2. You are using the machine analyzer function. 3. [Pr. PF21] is set to "-1".
External I/O signal display		Refer to section 18.5.8.	This indicates the on/off status of external I/O signal. The upper segments correspond to the input signals and the lower segments to the output signals.
Output signal (DO) forced output			This allows digital output signal to be switched on/off forcibly. For details, refer to section 18.5.9.
Test operation mode	JOG operation		JOG operation can be performed when there is no command from an external controller. For details, refer to section 18.5.10 (2).
	Positioning operation		Positioning operation can be performed when there is no command from an external controller. MR Configurator2 is required to perform positioning operation. For details, refer to section 4.5.9 (3).
	Motor-less operation		Without connecting the servo motor, output signals or status display monitoring can be provided in response to the input device as if the servo motor is actually running. For details, refer to section 4.5.9 (4).
	Machine analyzer operation		Merely connecting the servo amplifier allows the resonance point of the mechanical system to be measured. MR Configurator2 is required to perform machine analyzer operation. Refer to section 11.7 for details.
	For manufacturer adjustment		This is for manufacturer adjustment.

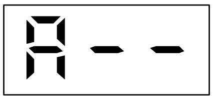
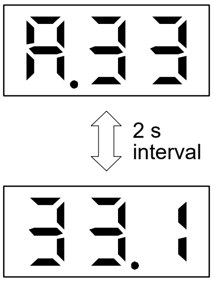
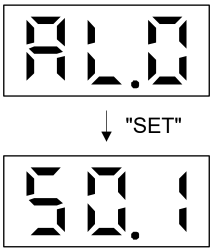
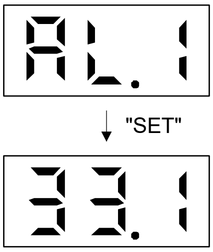
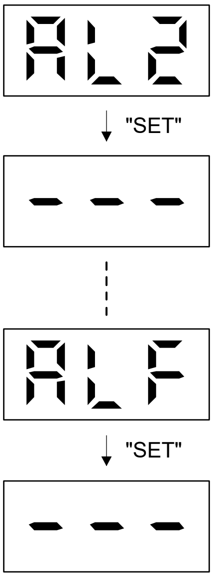
Name	Display	Description
Software version: lower		Indicates the version of the software. The software version is displayed while the "SET" button is pressed and held. Press the "MODE" button to shift to the next display mode. Press the "UP" or "DOWN" button to shift to the next diagnosis menu.
Software version: upper		Indicates the system number of the software. The software system number is displayed while the "SET" button is pressed and held. Press the "MODE" button to shift to the next display mode. Press the "UP" or "DOWN" button to shift to the next diagnosis menu.
Automatic VC offset		If offset voltages in the analog circuits inside and outside the servo amplifier cause the servo motor to rotate slowly at VC (Analog speed command) or VLA (Analog speed limit) of 0 V, this function automatically makes zero-adjustment of offset voltages. When using this function, enable the function in the following procedure. When it is enabled, [Pr. PC37] value changes to the automatically adjusted offset voltage. 1) Press the "SET" button once. 2) Set the number in the first digit to "1" with "UP" button. 3) Press the "SET" button. This function cannot be used if the input voltage of VC or VLA is -0.4 V or less, or +0.4 V or more. (Note)

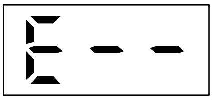
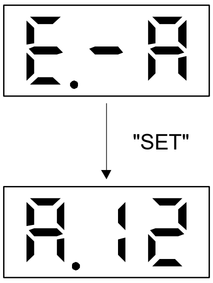
Note. Even if VC automatic offset is performed and 0 V is input, the servo motor may not completely stop due to an internal error. To stop completely, turn off the ST1 or ST2.

Name	Display	Description
Servo motor series ID		Displays the series ID of the servo motor currently connected. Press the "SET" button to show the lower 3 digits of servo motor series ID. For indication details, refer to app. 1 of "Servo Motor Instruction Manual (Vol. 3)". Press the "UP" or "DOWN" button to shift to the next diagnosis menu.
Servo motor type ID		Displays the type ID of the servo motor currently connected. Press the "SET" button to show the lower 3 digits of servo motor type ID. For indication details, refer to app. 1 of "Servo Motor Instruction Manual (Vol. 3)". Press the "UP" or "DOWN" button to shift to the next diagnosis menu.
Servo motor encoder ID		Displays the encoder ID of the servo motor currently connected. Press the "SET" button to show the lower 3 digits of servo motor encoder ID. For indication details, refer to app. 1 of "Servo Motor Instruction Manual (Vol. 3)". Press the "UP" or "DOWN" button to shift to the next diagnosis menu.
For manufacturer adjustment		This is for manufacturer adjustment.

18.5.6 Alarm mode

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

Name	Display	Description
Current alarm		Indicates no occurrence of an alarm.
		Indicates the occurrence of [AL. 33.1 Main circuit voltage error]. Blinks at alarm occurrence. The alarm number and detail number are displayed alternately by intervals of 2 s.
Alarm history		Indicates that the last alarm is [AL. 50.1 Thermal overload error 1 during operation]. When an alarm is recorded to alarm history, the second digit decimal point blinks. Press and hold the "SET" button to show the detail number of [AL. 50].
		Indicates the second last alarm is [AL. 33.1 Main circuit voltage error]. When an alarm is recorded to alarm history, the second digit decimal point blinks. Press and hold the "SET" button to show the detail number of [AL. 33].
		Indicates that there is no third alarm in the past. If there is no alarm history, the display will be as shown as in the left, when the "SET" button is pressed. Indicates that there is no sixteenth alarm in the past.

Name	Display	Description
Parameter error No.		This indicates no occurrence of [AL. 37 Parameter error].
		The parameter error number is displayed. The parameter group in which the parameter error has occurred is displayed. Press and hold the "SET" button to show the parameter number with the error. The display example on the left is when the data of [Pr. PA12 reverse rotation torque limit] becomes error. The parameter number is displayed by ascending order when several parameter errors occurred at the same time.

Functions at occurrence of an alarm

(1) Any mode screen displays the current alarm.

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

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

    (a) Switch power off, then on.

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

    (c) Turn on RES (Reset).

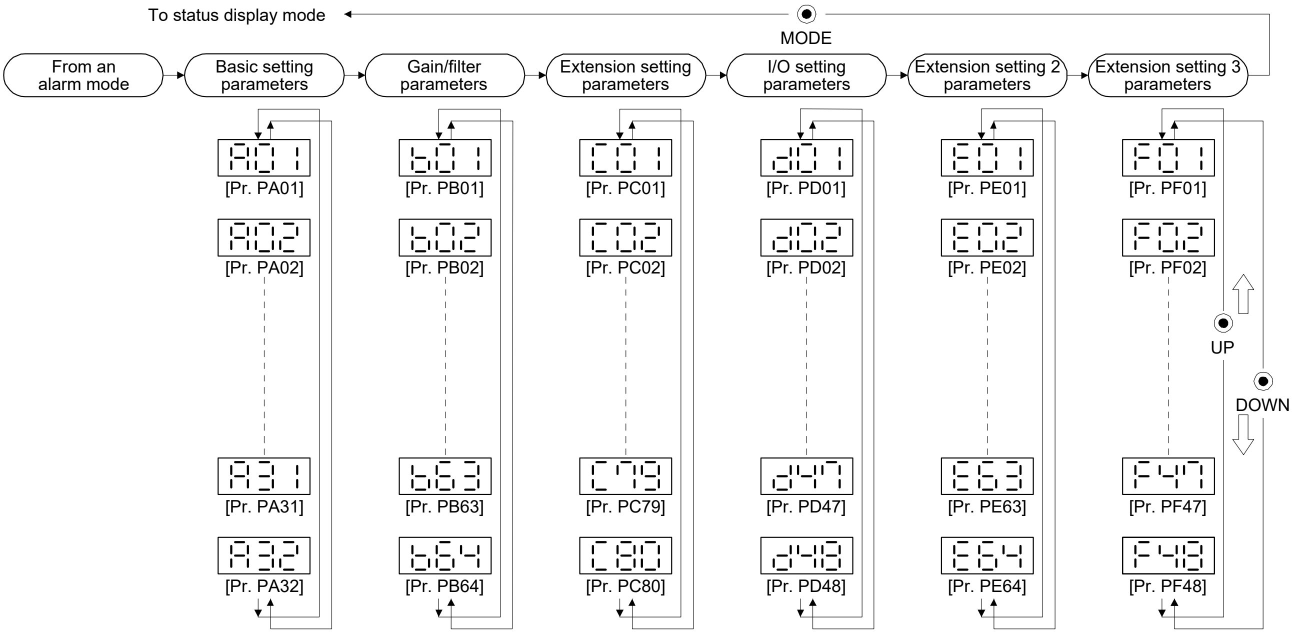
(4) Use [Pr. PC18] to clear the alarm history.

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

18.5.7 Parameter mode

(1) Parameter mode transition

After selecting the corresponding parameter mode with the "MODE" button, pressing the "UP" or "DOWN" button changes the display as follows.



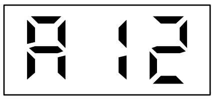
(2) Operation example

(a) Parameters of 3 or less decimal digits.

The following example gives the operation procedure to change [Pr. PA Reverse rotation torque limit].

Press "MODE" to switch to the basic setting parameter screen.

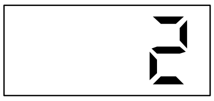
Parameter number selection



Press "UP" or "DOWN" to select parameter number.

Press "SET" to display the item to set to the selected parameter number.

Parameter contents display



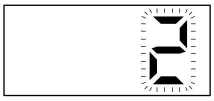
Press "UP" or "DOWN" to shift to the setting display of the next parameter number.

Press the "MODE" button to shift to the next display.

Press the "SET" button once to display the setting.

Press the "SET" button once when the setting is displayed. The setting blinks and is possible to be changed.

Changing the parameter contents

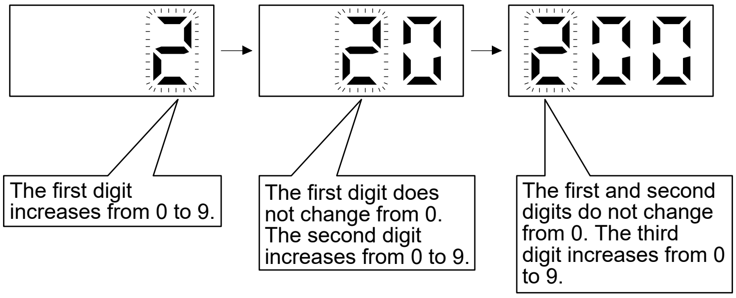


Press "UP" or "DOWN" to change the value and press "SET" to fix the setting. The setting will be displayed as it is after the setting is fixed.

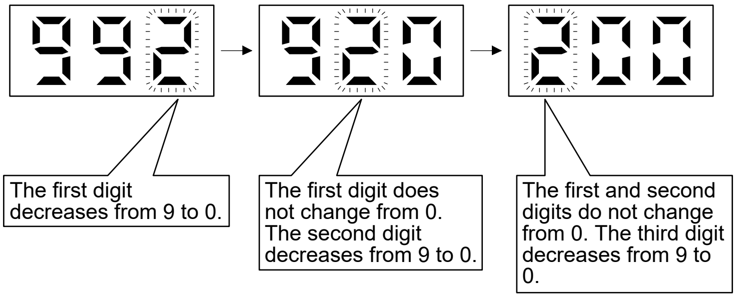
To cancel the setting data, press "MODE" for 2 s while the display is blinking. The setting before the change will be displayed.

Press and hold "UP" or "DOWN" to change the data continuously. In that case, only the highest digit changes.

Example of pressing and holding the "UP" button



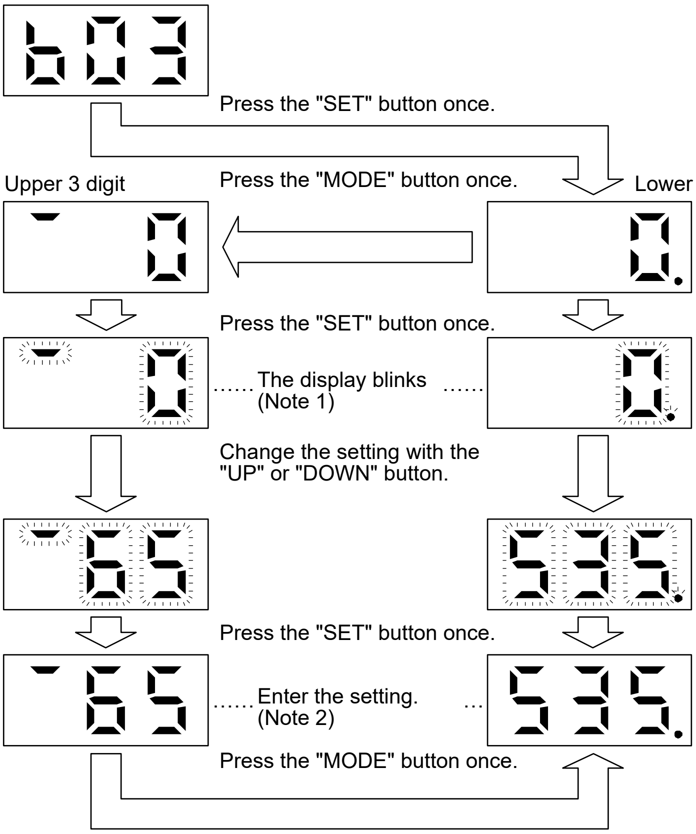
Example of pressing and holding the "DOWN" button



(b) Parameters of 4 to 6 decimal digits

The following example gives the operation procedure to change [Pr. PB03 Positioning command acceleration/deceleration time constants (position smoothing)] to "65535".

Press "MODE" to switch to the gain/filter setting parameter screen.
Press "UP" or "DOWN" to select [Pr. PB03].



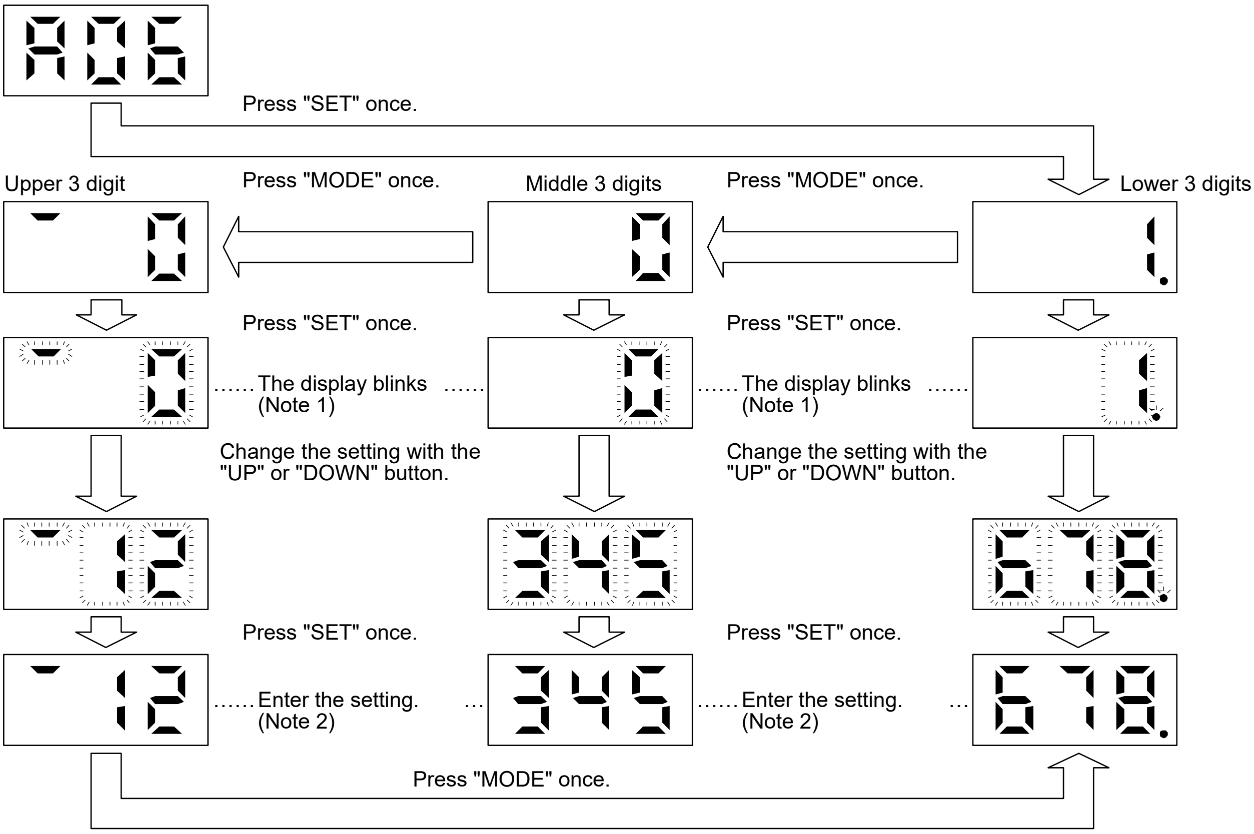
Note 1. Pressing the "SET" button in either upper or lower 3-digit display makes the display blink.
2. Pressing the "SET" button in either upper or lower 3-digit display fix the setting.

The display can be switched between upper and lower 3-digit by pressing the "MODE" button.
Switching the display between upper and lower 3-digit is also possible by pressing the "MODE" button while the display is blinking.
The changed value will be canceled when "MODE" is pressed for 2 s or more while blinking.
To shift to the next parameter number, press the "UP" or "DOWN" button.
To change the screen to the other, press "UP" or "DOWN" to change the screen to other parameter number display screen and press "MODE".

(c) Parameters of 7 or more decimal digits

The following example gives the operation procedure to change the [Pr. PA06 Electronic gear numerator (command pulse multiplication numerator)] to "12345678".

Press "MODE" to switch to the basic setting parameter screen.



Note 1. Pressing the "SET" button in upper, middle, or lower 3-digit display makes the display blink.

2. Pressing the "SET" button in upper, middle, or lower 3-digit display fix the setting.

The display can be switched among upper, middle, and lower 3-digits by pressing the "MODE" button.

Switching the display between upper, middle, and lower 3-digit is also possible by pressing the "MODE" button while the display is blinking.

The changed value will be canceled when "MODE" is pressed for 2 s or more while blinking.

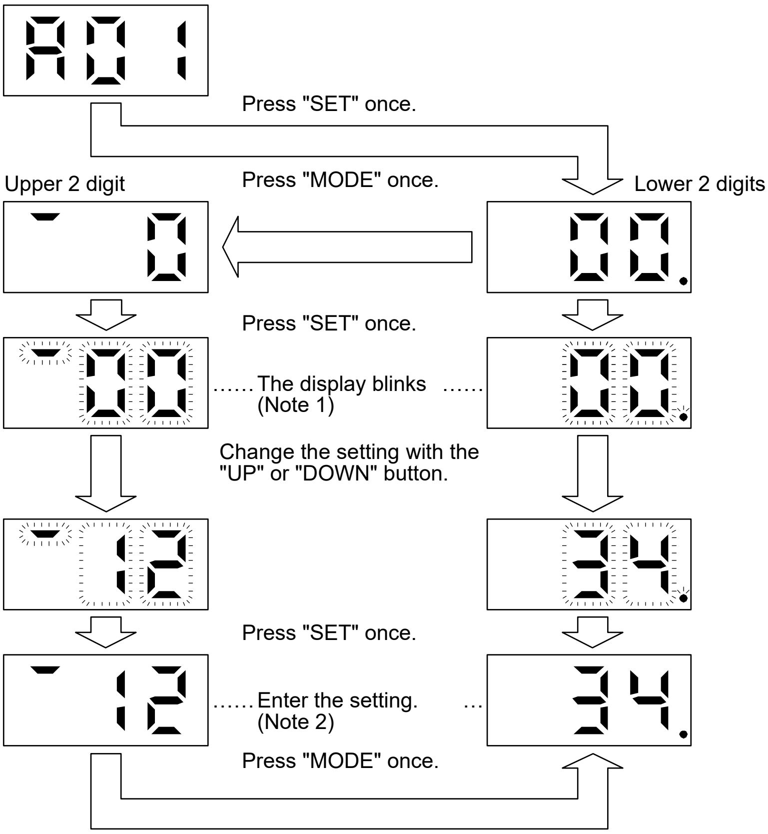
To shift to the next parameter number, press the "UP" or "DOWN" button.

To change the screen to the other, press "UP" or "DOWN" to change the screen to other parameter number display screen and press "MODE".

(d) Parameter of hexadecimal

The following example gives the operation procedure to change the [Pr. PA01 Operation mode] to "1234".

Press "MODE" to switch to the basic setting parameter screen.
Press "UP" or "DOWN" to select [Pr. PA01].



Note 1. Pressing the "SET" button in upper, middle, or lower 2-digit display makes the display blink.
2. Pressing the "SET" button in upper, middle, or lower 2-digits display fix the setting.

The display can be switched among upper, middle, and lower 2-digits by pressing the "MODE" button.

Switch the display between upper, middle, and lower 2-digit is also possible by pressing the "MODE" button while the display is blinking.

The changed value will be canceled when "MODE" is pressed for 2 s or more while blinking.

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

To change the screen to the other, press "UP" or "DOWN" to change the screen to other parameter number display screen and press "MODE".

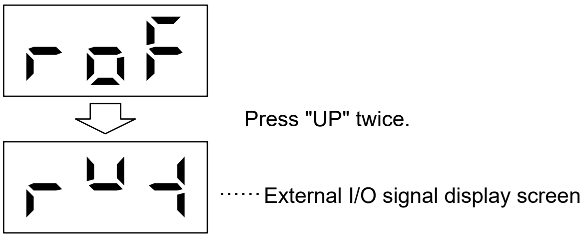
18.5.8 External I/O signal display

POINT
●The I/O signal settings can be changed using the I/O setting parameters [Pr. PD03] to [Pr. PD26], and [Pr. PD28].

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

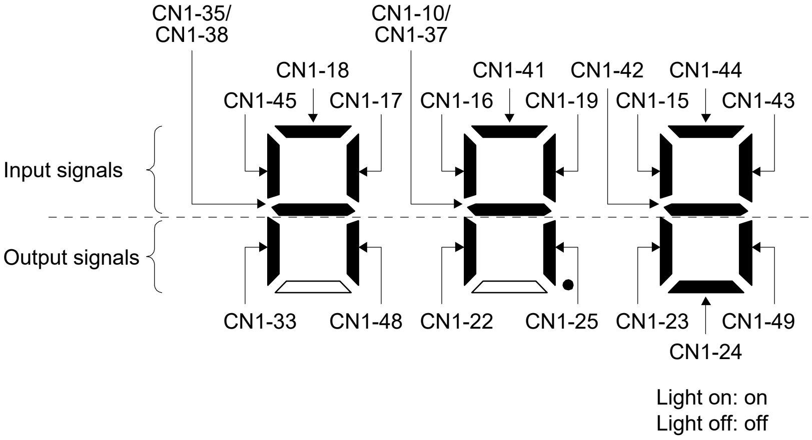
(1) Operation

The display screen at power-on. Use the "MODE" button to display the diagnostic screen.



(2) Display definition

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



The LED segment corresponding to the pin is lit to indicate on, and is extinguished to indicate off. The decimal point in the second digit blinks continuously. The signals corresponding to the pins in the respective control modes are indicated as follows:

(a) Control modes and I/O signals

Connector	Pin No.	Signal input/output (Note 1) I/O	(Note 2) Symbols of I/O signals in control modes						Related parameter
			P	P/S	S	S/T	T	T/P	
CN1	10	I	PP	PP/-	(Note 3)	(Note 3)	(Note 3)	-/PP	PD43/PD44
	15	I	SON	SON	SON	SON	SON	SON	PD03/PD04
	16	I		-/SP2	SP2	SP2/SP2	SP2	SP2/-	PD05/PD06
	17	I	PC	PC/ST1	ST1	ST1/RS2	RS2	RS2/PC	PD07/PD08
	18	I	TL	TL/ST2	ST2	ST2/RS1	RS1	RS1/TL	PD09/PD10
	19	I	RES	RES	RES	RES	RES	RES	PD11/PD12
	22	O	INP	INP/SA	SA	SA/-		-/INP	PD23
	23	O	ZSP	ZSP	ZSP	ZSP	ZSP	ZSP	PD24
	24	O	INP	INP/SA	SA	SA/-		-/INP	PD25
	25	O	TLC	TLC	TLC	TLC/VLC	VLC	VLC/TLC	PD26
	33	O	OP	OP	OP	OP	OP	OP	
	35	I	NP	NP/-	(Note 3)	(Note 3)	(Note 3)	-/NP	PD45/PD46
	37	I	PP2	PP2/-	(Note 4)	(Note 4)	(Note 4)	-/PP2	PD43/PD44
	38	I	NP2	NP2/-	(Note 4)	(Note 4)	(Note 4)	-/NP2	PD45/PD46
	41	I	CR	CR/SP1	SP1	SP1/SP1	SP1	SP1/CR	PD13/PD14
	42	I	EM2	EM2	EM2	EM2	EM2	EM2	
	43	I	LSP	LSP	LSP	LSP/-		-/LSP	PD17/PD18
	44	I	LSN	LSN	LSN	LSN/-		-/LSN	PD19/PD20
	45	I	LOP	LOP	LOP	LOP	LOP	LOP	PD21/PD22
	48	O	ALM	ALM	ALM	ALM	ALM	ALM	
	49	O	RD	RD	RD	RD	RD	RD	PD28

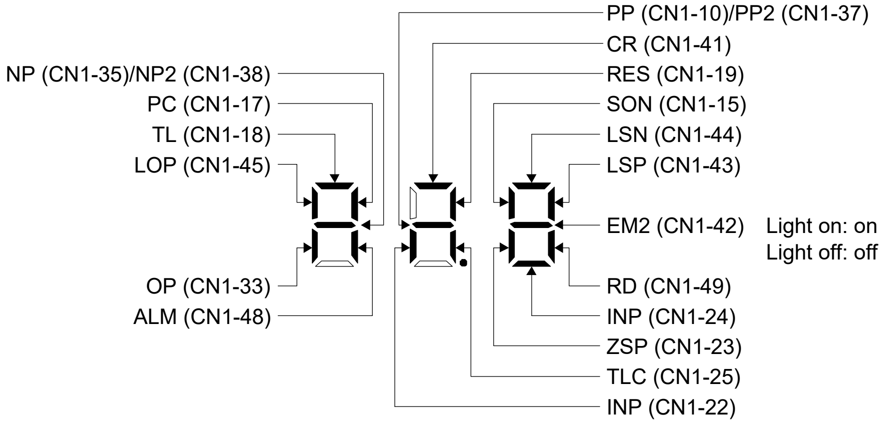
Note 1. I: input signal, O: output signal
2. P: position control mode, S: speed control mode, T: torque control mode
P/S: position/speed control switching mode, S/T: speed/torque control switching mode, T/P: torque/position switching mode
3. This is available as an input device of sink interface. Input devices are not assigned by default. Assign the input devices with [Pr. PD43] to [Pr. PD46] as necessary. Supply + of 24 V DC to CN1-12 pin.
4. This is available as an input device of source interface. Input devices are not assigned by default. Assign the input devices with [Pr. PD43] to [Pr. PD46] as necessary.

(b) Symbol and signal names

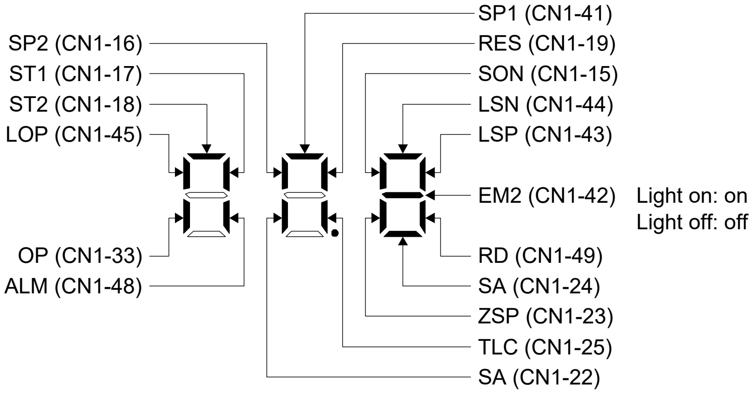
Symbol	Signal name	Symbol	Signal name
SON	Servo-on	RES	Reset
LSP	Forward rotation stroke end	EM2	Forced stop 2
LSN	Reverse rotation stroke end	LOP	Control switching
CR	Clear	TLC	Limiting torque
SP1	Speed selection 1	VLC	Limiting speed
SP2	Speed selection 2	RD	Ready
PC	Proportional control	ZSP	Zero speed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

(3) Display data at initial values

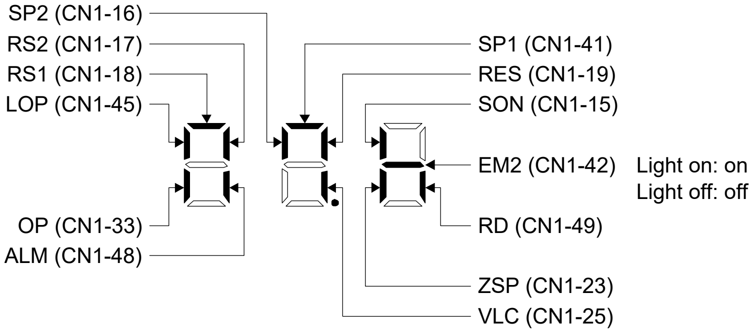
(a) Position control mode



(b) Speed control mode



(c) Torque control mode



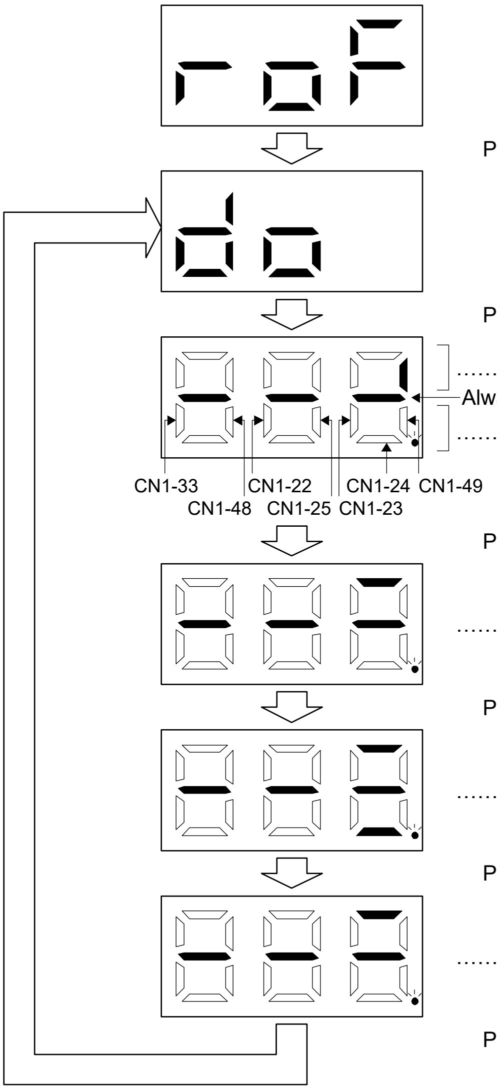
18.5.9 Output signal (DO) forced output

POINT

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

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

The following shows the display at power-on. Use the "MODE" button to display the diagnostic screen.



Press the "UP" button three times.

Press the "SET" button for 2 s or more.

…… Switch on/off the signal below the lit segment.

…… Indicates on/off of output signal. Definitions of on/off are the same as those for the external I/O signals. (Light on: on, light off: off)

Press the "MODE" button once.

…… The lit LED moves to the upper LED of CN1-24.

Press the "UP" button once.

…… CN1-24 switches on.
(Between CN1-24 and DOCOM are connected.)

Press the "DOWN" button once.

…… CN1-24 switches off.

Press the "SET" button for 2 s or more.

18.5.10 Test operation mode

⚠CAUTION

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

POINT

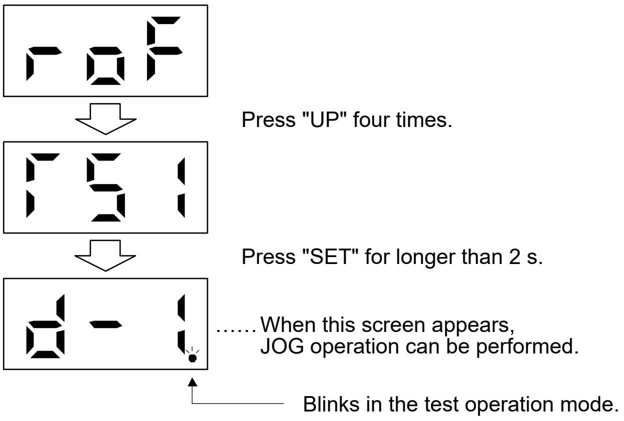
- ●Test operation cannot be performed in the absolute position detection system. To perform the test operation, select the incremental system in [Pr. PA03].
- ●MR Configurator2 is required to perform positioning operation.
- ●Test operation cannot be performed if SON (Servo-on) is not turned off.

The items in the following table are the same as those for MR-J4-_A_(-RJ) servo amplifiers of 100 W or more. Refer to the section of the detailed explanation field for details.

Item	Detailed explanation
Positioning operation	Section 4.5.9 (3)
Motor-less operation	Section 4.5.9 (4)
Program operation	Section 4.5.9 (5)
Output signal (DO) forced output	Section 4.5.9 (6)

(1) Mode switching

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



Press "UP" four times.

Press "SET" for longer than 2 s.

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

Blinks in the test operation mode.

(2) JOG operation

POINT

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

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

(a) Operation/drive

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

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

The following table shows how to use the buttons.

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

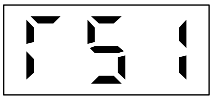
If the USB cable is disconnected during JOG operation using the MR Configurator2, the servo motor decelerates to a stop.

(b) Status display

Press the "MODE" button in the JOG operation-ready status to call the status display screen. When the JOG operation is performed using the "UP" or "DOWN" button, the servo status is displayed during the JOG operation. Every time the "MODE" button is pushed, the next status display screen appears. When one cycle of the screen display is complete, it returns to the JOG operation-ready status screen. Refer to section 18.5.3 for details of status display. Note that the status display screen cannot be changed by the, "UP" or "DOWN" button during the JOG operation.

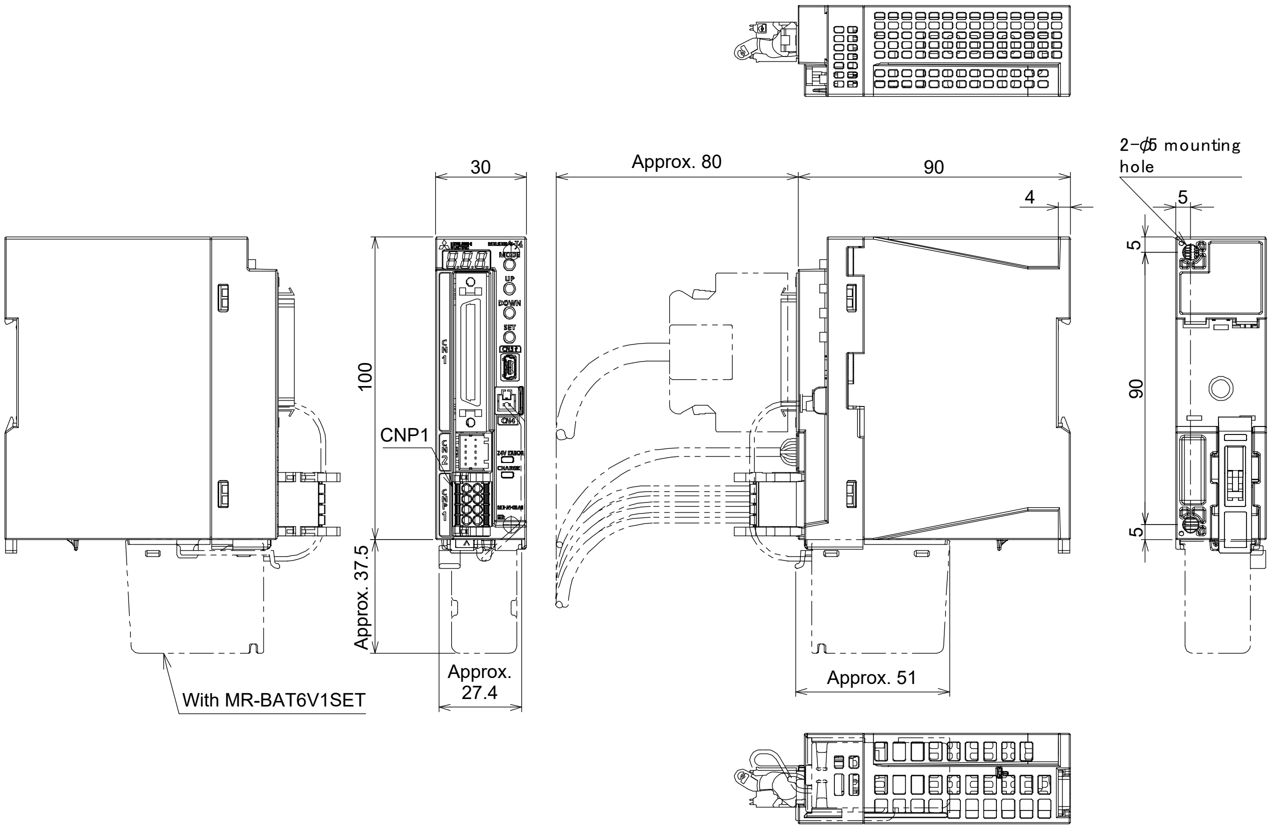
(c) Termination of JOG operation

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



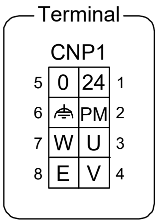
18.6 Dimensions

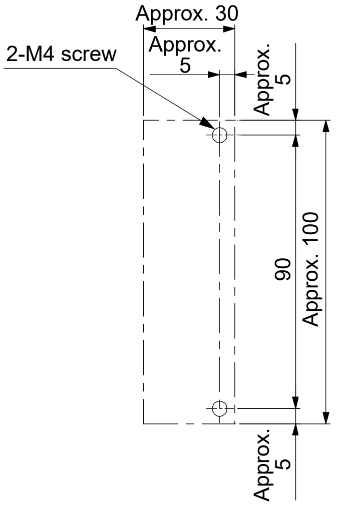
[Unit: mm]



Mass: 0.2 [kg]

Mounting screw
Screw size: M4
Tightening torque: 1.24 [N•m]





Mounting hole process drawing

18.7 Characteristics

The items in the following table are the same as those for MR-J4-_A_(-RJ) servo amplifiers of 100 W or more. Refer to the section of the detailed explanation field for details.

Item	Detailed explanation
Cable bending life	Section 10.4

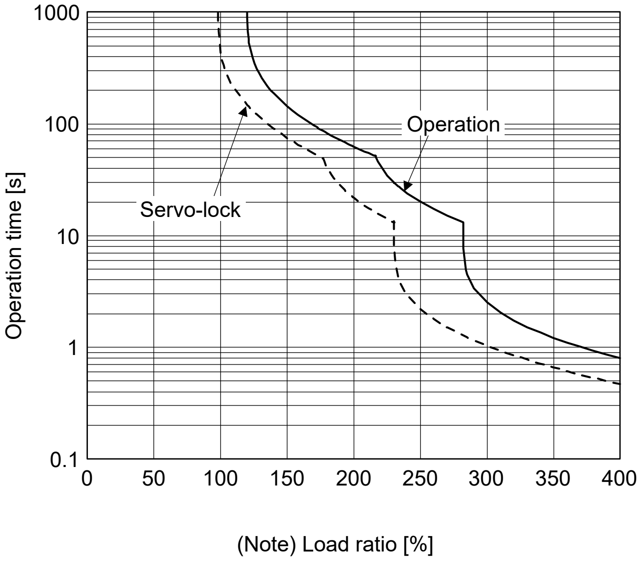
18.7.1 Overload protection characteristics

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. 18.1. [AL. 51 Overload 2] occurs if the maximum current is applied continuously for several seconds due to machine collision, etc. Use the equipment on the left-side area of the continuous or broken line in the graph.

For the system where the unbalanced torque occurs, such as a vertical axis system, the unbalanced torque of the machine should be kept at 70% or less of the rated torque.

This servo amplifier has servo motor overload protective function. (The servo motor overload current (full load current) is set on the basis of 120% rated current of the servo amplifier.)



HG-AK0136/HG-AK0236/HG-AK0336

Note. If operation that generates torque more than 100% of the rating is performed with an abnormally high frequency in a servo motor stop status (servo-lock status) or in a 50 r/min or less low-speed operation status, the servo amplifier may malfunction regardless of the electronic thermal protection.

Fig. 18.1 Electronic thermal protection characteristics

18.7.2 Power supply capacity and generated loss

Table 18.4 indicates the required power supply capacities for main circuit and losses generated under rated load of the servo amplifier. 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 operated under the rated speed, required power supply capacities for main circuit will be less than the value of the table.

Table 18.4 Power supply capacity and generated loss per servo amplifier

Servo motor	Main circuit (48 V DC/24 V DC) Required power supply capacity [W]	Servo amplifier-generated heat [W] (Note)	
		At rated output	With servo-off
HG-AK0136	230	6	1
HG-AK0236	360	9	1
HG-AK0336	480	13	1

Note. Heat generated during regeneration is not included in the servo amplifier-generated heat.

18.7.3 Dynamic brake characteristics

POINT

- ●The dynamic brake of MR-J4-03A6(-RJ) is an electronic type.
- ●Do not use dynamic brake to stop in a normal operation as it is the function to stop in emergency.
- ●Be sure to enable EM1 (Forced stop 1) after servo motor stops when using EM1 (Forced stop 1) frequently in other than emergency.
- ●The time constant "τ" for the electronic dynamic brake will be shorter than that of normal dynamic brake. Therefore, coasting distance will be longer than that of normal dynamic brake. For how to set the electronic dynamic brake, refer to [Pr. PF09] and [Pr. PF15].

(1) Dynamic brake operation

(a) Calculation of coasting distance

Fig. 18.2 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use equation 18.1 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 (1) (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.

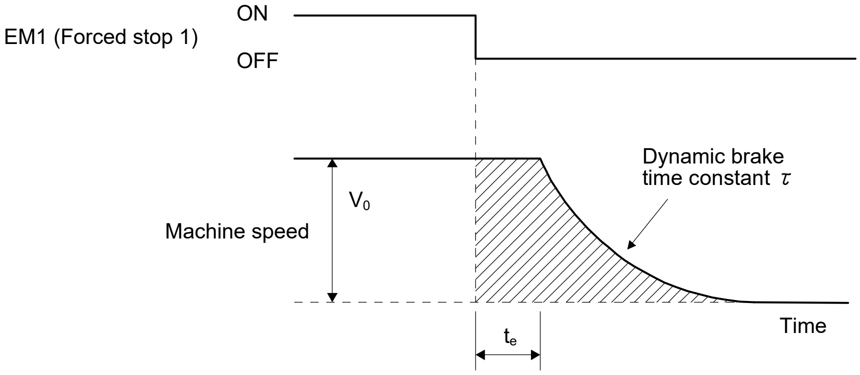


Fig. 18.2 Dynamic brake operation diagram

$$L_{max} = \frac{V_0}{60} \cdot \left\{ t_e + \tau \left(1 + \frac{J_L}{J_M} \right) \right\} \cdots\cdots (18.1)$$

L_{max}: Maximum coasting distance ···································· [mm]

V_0: Machine's fast feed speed ···································· [mm/min]

J_M: Moment of inertia of the servo motor ···································· [× 10^{-4} kg•m^2]

J_L: Load moment of inertia converted into equivalent value on servo motor shaft ············ [× 10^{-4} kg•m^2]

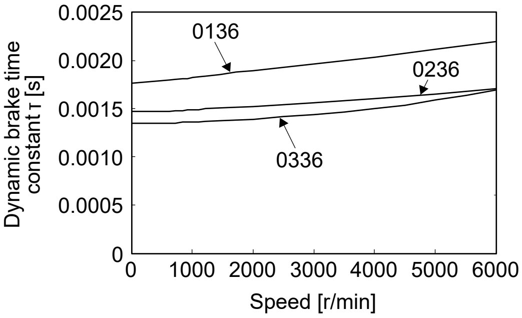
τ: Dynamic brake time constant[s]

t_e: Delay time of control section ···································· [s]

The processing delay time about 3.5 ms.

(b) Dynamic brake time constant

The following shows necessary dynamic brake time constant τ for equation 18.1.



HG-AK series

(2) Permissible load to motor inertia when the dynamic brake is used

Use the dynamic brake under the load to motor inertia ratio indicated in the following table. If the ratio is higher than this value, the servo amplifier may burn. If there is a possibility that the ratio may exceed the value, contact your local sales office.

The values of the permissible load to motor inertia ratio in the table are the values at the maximum rotation speed of the servo motor.

Servo motor	Permissible load to motor inertia ratio [multiplier]
HG-AK0136	30
HG-AK0236	
HG-AK0336	

18.7.4 Inrush currents at power-on of main circuit and control circuit

POINT

- ●The inrush current values can change depending on frequency of turning on/off the power and ambient temperature.

Since large inrush currents flow in the power supplies, use circuit protector. For circuit protectors, it is recommended that the inertia delay type, which is not tripped by an inrush current, be used. Refer to section 18.8.4 for details of the circuit protector.

This following table indicates the inrush current (reference data) when the power of output side of power unit is turned on in the conditions: main circuit of 55.2 V DC, control circuit of 26.4 V DC, and wiring length of 1 m.

Servo amplifier	Inrush current	
	Main circuit power supply (PM/0)	Control circuit power supply (24/0)
MR-J4-03A6(-RJ)	70 A (attenuated to approx. 0 A in 1 ms)	0.5 A (attenuated to approx. 0 A in 60 ms)

18.8 Options and peripheral equipment

⚠WARNING ●Before connecting options and peripheral equipment, turn off the power and wait until the charge lamp turns off. Otherwise, an electric shock may occur. In addition, when confirming whether the charge lamp is off or not, always confirm it from the front of the servo amplifier.

⚠CAUTION ●Use the specified peripheral equipment and options to prevent a malfunction or a fire.

POINT

●We recommend using HIV wires to wire the servo amplifiers, options, and peripheral equipment. Therefore, the recommended wire sizes may differ from those used for the previous servo amplifiers.

The items in the following table are the same as those for MR-J4-_A_(-RJ) servo amplifiers of 100 W or more. Refer to the section of the detailed explanation field for details.

Item	Detailed explanation
Junction terminal block MR-TB50	Section 11.6
MR Configurator2	Section 11.7
Battery	Section 11.8
Relay (recommended)	Section 11.13
Noise reduction techniques	Section 11.14

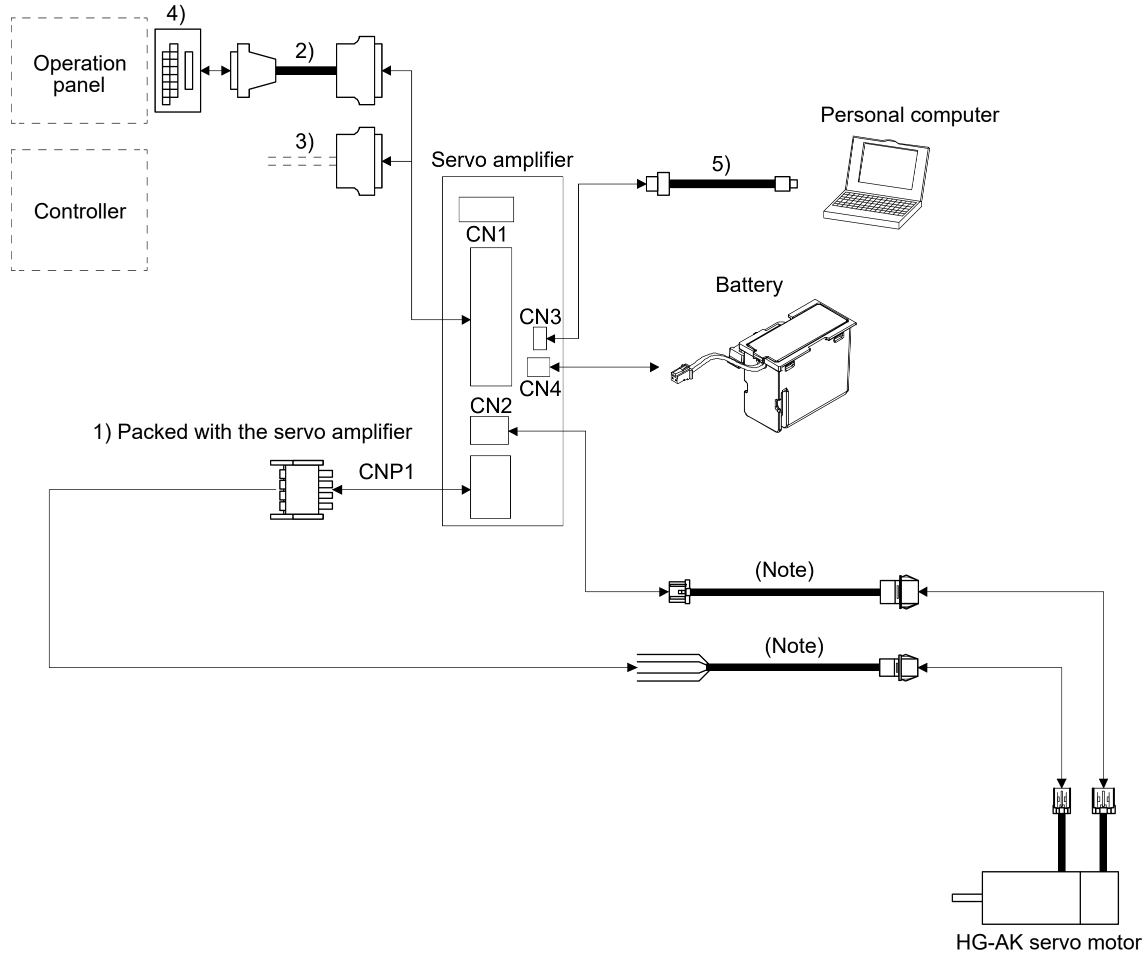
18.8.1 Cable/connector sets

POINT

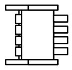
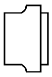
●The IP rating indicated for cables and connectors is their protection against ingress of dust and raindrops when they are connected to a servo amplifier or servo motor. If the IP rating of the cable, connector, servo amplifier and servo motor vary, the overall IP rating depends on the lowest IP rating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

Purchase the cable and connector options indicated in this section.

18.8.2 Combinations of cable/connector sets



Note. Refer to "Servo Motor Instruction Manual (Vol. 3)" for servo motor power cables and encoder cables.

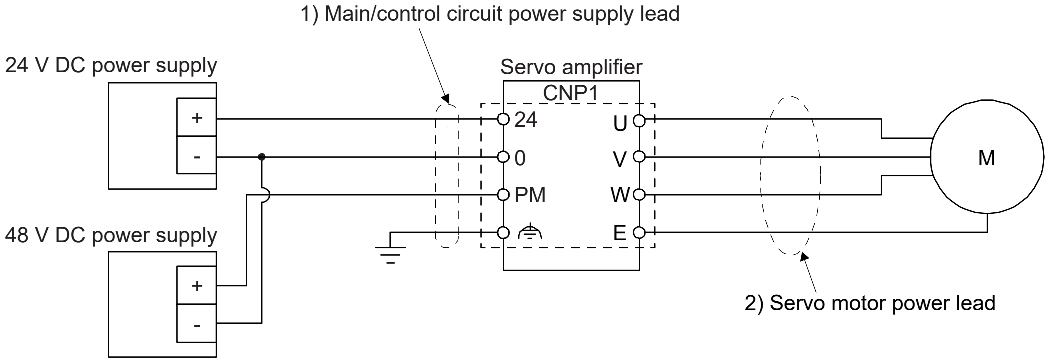
No.	Name	Model	Description	Remark
1)	CNP1 connector		 Model: DFMC 1,5/ 4-ST-3,5-LR or equivalent (Phoenix Contact) Applicable wire size: AWG 24 to 16 Insulator OD: to 2.9 mm	Supplied with servo amplifier
2)	Junction terminal block cable	MR-J2M-CN1TBL_M Cable length: 0.5 m, 1 m (Refer to section 11.6.)	Junction terminal block connector Connector: D7950-B500FL (3M) CN1 connector Connector: 10150-6000EL Shell kit: 10350-3210-000 (3M or equivalent) 	For junction terminal block connection
3)	CN1 connector set	MR-J3CN1	Connector: 10150-3000PE Shell kit: 10350-52F0-008 (3M or equivalent) 	
4)	Junction terminal block	MR-TB50	Refer to section 11.6.	
5)	USB cable	MR-J3USBCBL3M Cable length: 3 m	CN5 connector mini-B connector (5-pins) Personal computer connector A connector 	For connection with PC-AT compatible personal computer

18.8.3 Selection example of wires

POINT

- 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.
- Selection conditions of wire size are as follows.
  Construction condition: Single wire set in midair
  Wire length: 30 m or less
  The voltage drops because of the cable conductor resistance. Especially for main circuit/control circuit power supply wiring, wire to secure the required input voltage at servo amplifier input section. It is recommended that the cable length be as short as possible.

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



The following shows the wire size selection example.

Table 18.5 Wire size selection example 1 (HIV wire)

Servo amplifier	Wire [mm²]	
	1) 24/0/PM/⏚	2) U/V/W/E (Note)
MR-J4-03A6(-RJ)	AWG 16	AWG 19

Note. The wire size shows applicable size of the servo amplifier connector and terminal block. For wires connecting to the servo motor, refer to "Servo Motor Instruction Manual (Vol. 3)".

18.8.4 Circuit protector

Power supply specification	Circuit protector (Note)
Control circuit power supply (24 V DC)	CP30-BA 1P 1-M 1A
Main circuit power supply (48 V DC)	CP30-BA 1P 1-M 3A
Main circuit power supply (24 V DC)	CP30-BA 1P 1-M 5A

Note. For operation characteristics, use an intermediate speed type.

18.9 Communication function (Mitsubishi Electric general-purpose AC servo protocol)

POINT

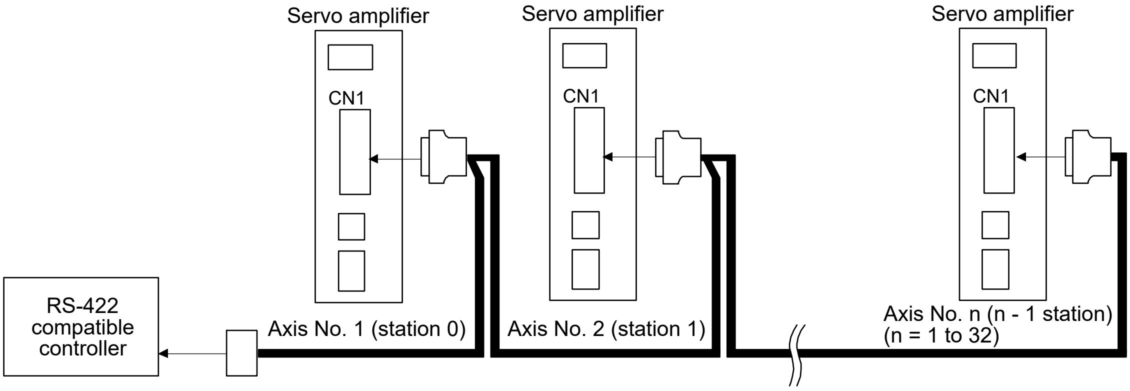
- ●The USB communication function and RS-422 communication function are mutually exclusive. They cannot be used together.

With MR-J4-03A6(-RJ) servo amplifier, driving servo, changing parameters, operating motor function, etc. is possible using RS-422 communication (Mitsubishi Electric general-purpose AC servo protocol).
In this section, only the configuration of operating RS-422 communication function with MR-J4-03A6(-RJ) servo amplifier is described. Refer to chapter 14 for details of the communication specification and protocol, etc.

(1) Configuration diagram

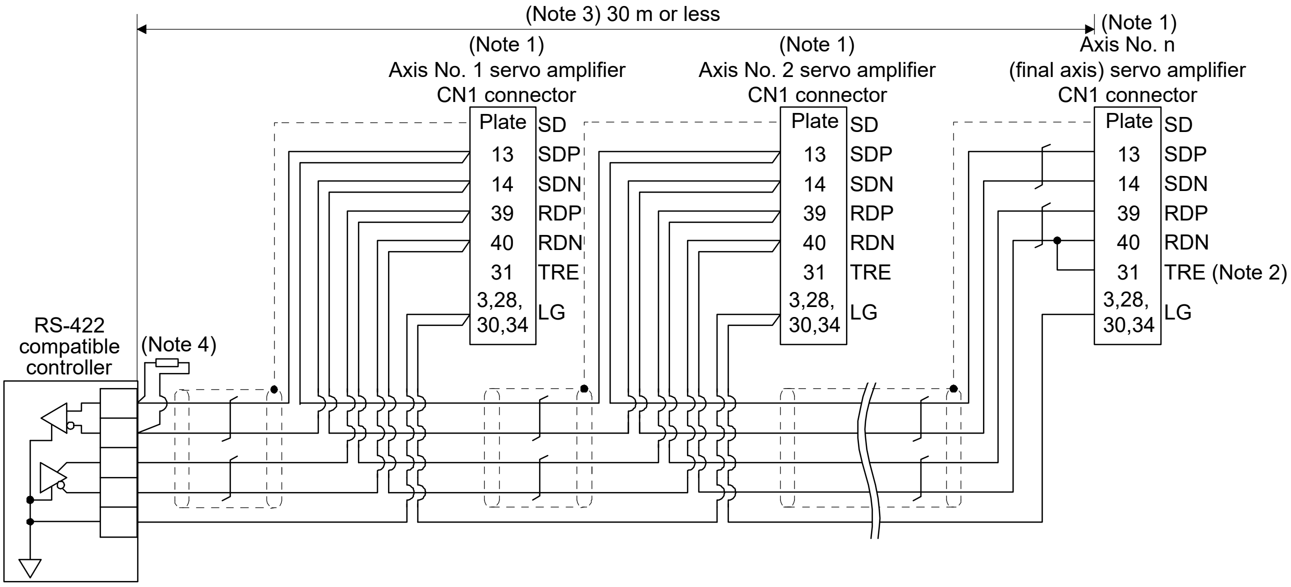
(a) Diagrammatic sketch

Up to 32 axes of servo amplifiers from stations 0 to 31 can be operated on the same bus.



(b) Cable connection diagram

Wire the cables as follows.



Note 1. Connector set MR-J3CN1 (3M or equivalent)
Connector: 10150-3000PE
Shell kit: 10350-52F0-008
2. Connect between TRE and RDN of the final axis servo amplifier.
3. The overall length is 30 m or less in low-noise environment.
4. If the RS-422 compatible controller does not have a termination resistor, terminate it with a 150 Ω resistor.

19. MR-D01 EXTENSION I/O UNIT

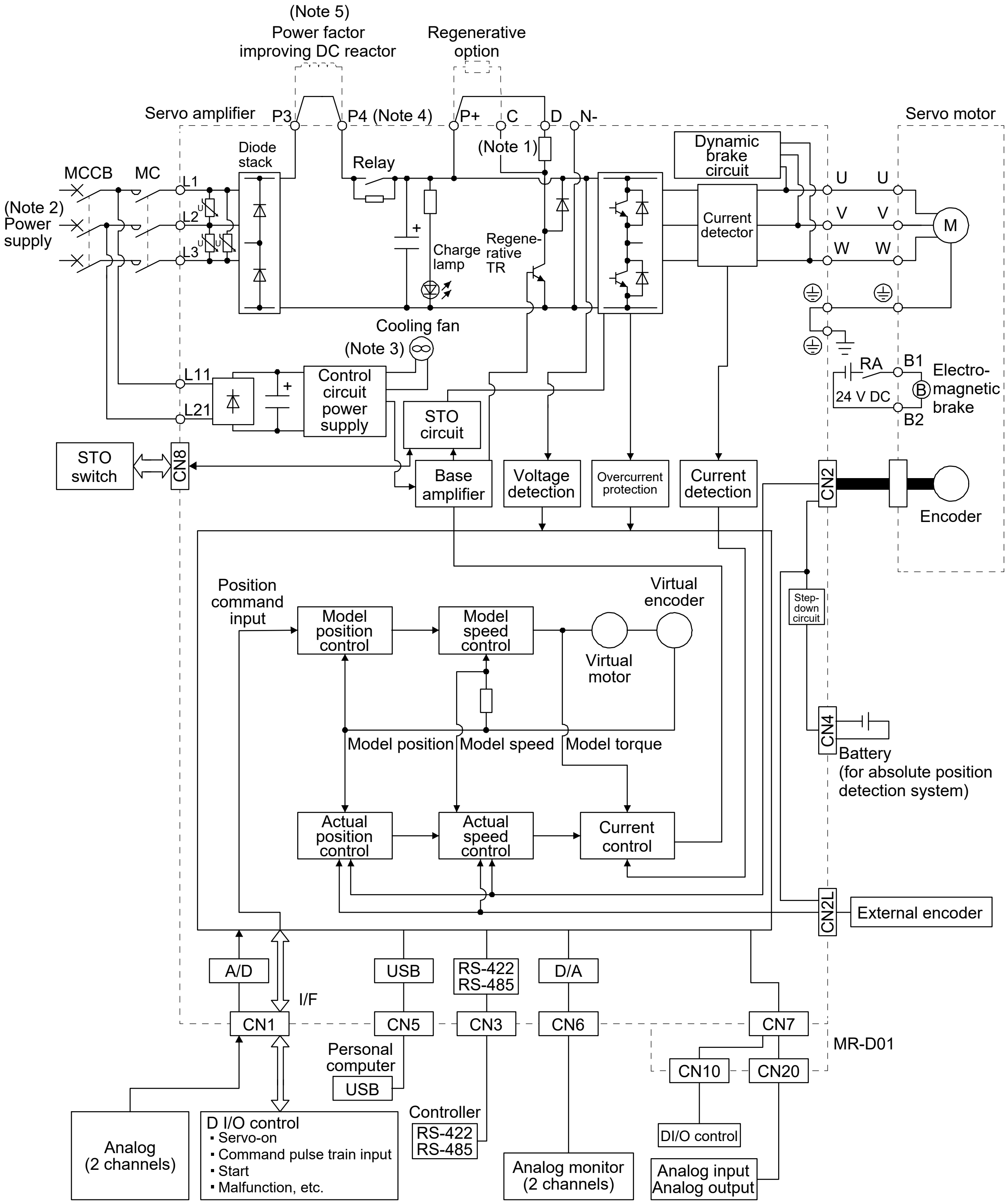
MR-D01 is an extension I/O unit that can extend the input/output signals of MR-J4-_A_-RJ servo amplifiers.

POINT

- ●MR-D01 is used with servo amplifiers with software version B7 or later.
- ●MR-D01 is available with MR-J4-_A_-RJ servo amplifiers with software version B7 or later.
- ●MR-D01 cannot be used with the MR-J4-_A_ servo amplifier.
- ●MR-D01 cannot be used with the MR-J4-DU_A_(-RJ) drive unit.
- ●MR-D01 cannot be used with MR-J4-03A6(-RJ) servo amplifiers.

19.1 Function block diagram

The function block diagram of this servo is shown below.
The following illustration is an example of MR-J4-20A-RJ.



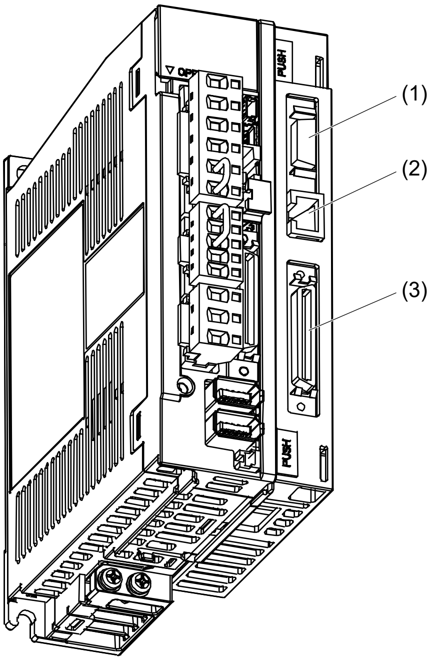
Note 1. The built-in regenerative resistor is not provided for MR-J4-10A-RJ.
2. For power supply specifications, refer to section 1.3.
3. Servo amplifiers MR-J4-70A-RJ or more have a cooling fan.
4. MR-J4 servo amplifier has P3 and P4 in the upstream of the inrush current suppression circuit. They are different from P1 and P2 of MR-J3 servo amplifiers.
5. 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.

19.2 Structure

19.2.1 Parts identification

(1) Interface

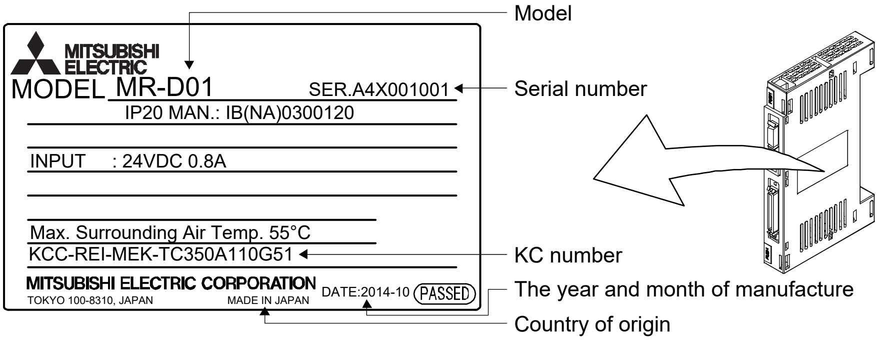
The following figure shows the interface of when MR-D01 is connected to MR-J4-20A-RJ. For servo amplifiers, refer to section 1.7.1.



No.	Name/Application	Detailed explanation
(1)	Analog input signal connector (CN20) Connect analog input signals of analog torque limit and override.	Section 19.5.1
(2)	Manufacturer setting connector (CN30) This connector is attached on the MR-D01, but not for use.	
(3)	I/O signal connector (CN10) Connect digital I/O signal and analog output signal.	Section 19.5.1

(2) Rating plate

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



19.2.2 Installation and removal of the MR-D01 extension I/O unit

⚠WARNING	●Before installing or removing MR-D01, 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.

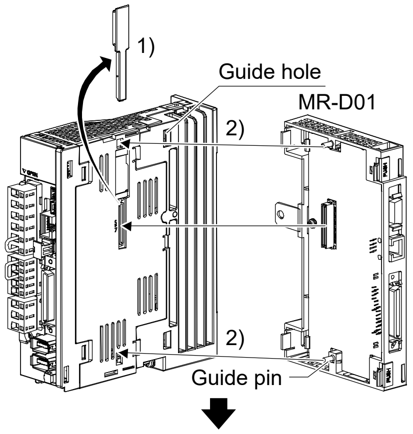
⚠CAUTION	●Avoid installing and removing MR-D01 repeatedly. Any contact failure of the connector may be caused. ●Avoid unsealing MR-D01 to be free of dust and dirt against the connector except installing. Make sure to use the pre-packing when storing. ●Avoid using MR-D01 of which the hook and knobs for fixing are damaged. Any contact failure of the connector may be caused. ●When mounting/dismounting MR-D01 to/from MR-J4-500A-RJ to MR-J4-22KA-RJ and MR-J4-350A4-RJ to MR-J4-22KA4-RJ servo amplifiers, avoid dropping out the installing screw inside it. Otherwise, it may cause a malfunction. ●When mounting MR-D01 to MR-J4-500A-RJ to MR-J4-22KA-RJ and MR-J4-350A4-RJ to MR-J4-22KA4-RJ servo amplifiers, avoid damaging the control board by the fixing plate. Otherwise, it may cause a malfunction. ●Make sure to tighten MR-D01 with the enclosed installing screws when installing.

POINT

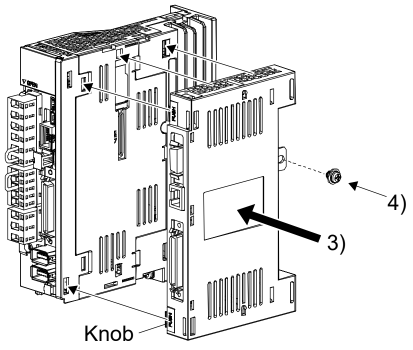
●The internal circuits of the servo amplifier and MR-D01 may be damaged by static electricity. Always take the following precautions.
- Ground human body and work bench.
- Do not touch the conductive areas, such as connector pins and electrical parts, directly by hand.

(1) For MR-J4-200A(4)-RJ or less and MR-J4-350A-RJ

(a) Installation of MR-D01

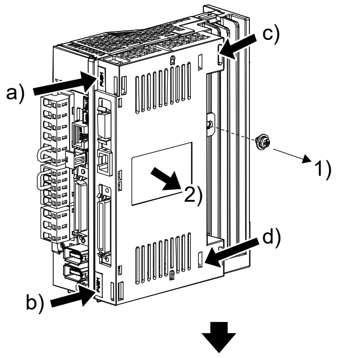


1) Remove the covers of CN7 and CN9 connectors.
   Make sure to store the removed cover.
2) Find the guide hole on the side of the servo amplifier. To the guide hole, insert the MR-D01's guide pins.

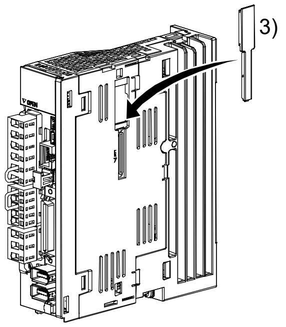


3) Push the four corners of the side of MR-D01 simultaneously to the servo amplifier until the four knobs click so that the CN7 connector is connected straight.
4) Tighten the unit with the enclosed installing screw (M4).

(b) Removal of MR-D01



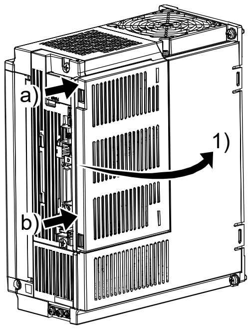
1) Remove the installing screw.
2) Keep pushing the knobs (a), b), c), d)) and pull out MR-D01 to the arrow direction. Avoid pulling out MR-D01 while it is tightened with the installation screw.



3) After removing MR-D01, make sure to cap the CN7 and CN9 connectors to avoid dust and dirt.

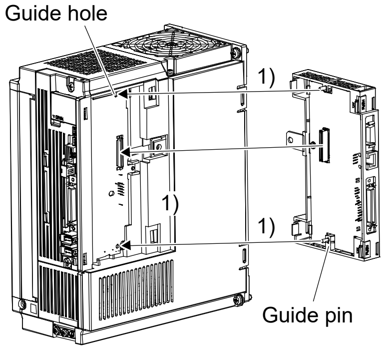
(2) MR-J4-500A-RJ to MR-J4-700A-RJ and MR-J4-350A4-RJ to MR-J4-700A4-RJ

(a) Removal of the side cover

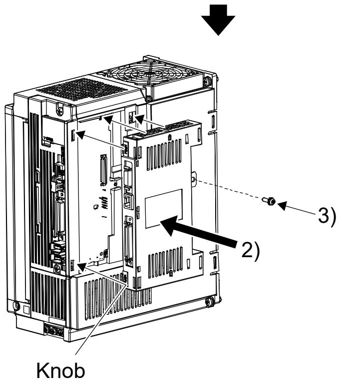


1) Keep pushing the knobs (a), b)) and pull out the side cover to the arrow direction.

(b) Installation of MR-D01

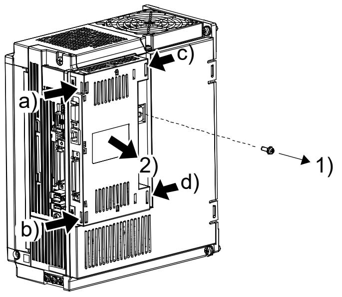


1) Find the guide hole on the side of the servo amplifier. To the guide hole, insert the MR-D01's guide pins.



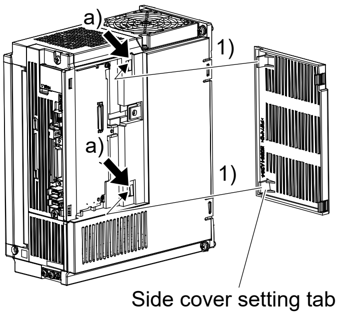
2) Push the four corners of the side of MR-D01 simultaneously to the servo amplifier until the four knobs click so that the CN7 connector is connected straight.
3) Tighten the unit with the enclosed installing screw (M4).

(c) Removal of MR-D01

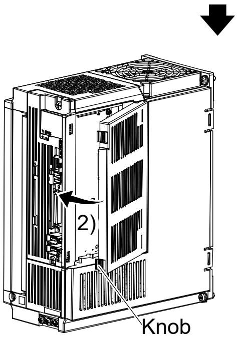


1) Remove the installing screw.
2) Keep pushing the knobs (a), b), c), d)) and pull out MR-D01 to the arrow direction. Avoid pulling out MR-D01 while it is tightened with the installation screw.

(d) Installation of the side cover



1) Insert the side cover setting tabs into the sockets a) of the servo amplifier.



2) Push the side cover at the supporting point a) until the knobs click.

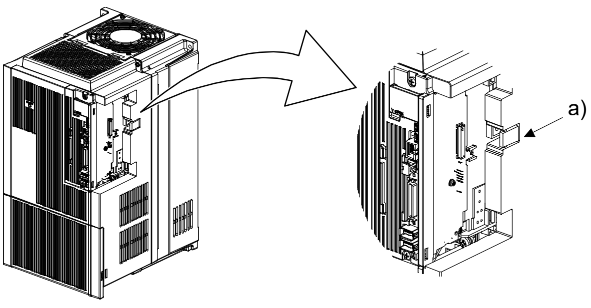
(3) MR-J4-11KA(4)-RJ to MR-J4-22KA(4)-RJ

⚠CAUTION
- Avoid touching any remained burr after cutting off the part a) of the case. Otherwise, it may cause injury.

The installing screw holes for the MR-J4-11KA(4)-RJ to MR-J4-22KA(4)-RJ are covered and the screw holes for mounting are not shown at shipping. When installing the unit for the first time, cut off the part a) of the case after removing the side cover.

When cutting off the part a), avoid damaging the case of the servo amplifier. After cutting off it, inside of the servo amplifier has been exposed even though the side cover and the unit are installed. Avoid unwanted parts from entering through the opened area into the servo amplifier.

For installing or removing the unit, refer to (2) in this section. The side cover structure is the same for MR-J4-11KA(4)-RJ to MR-J4-22KA(4)-RJ and for this unit. Install or remove the side cover with the same way as for the unit.



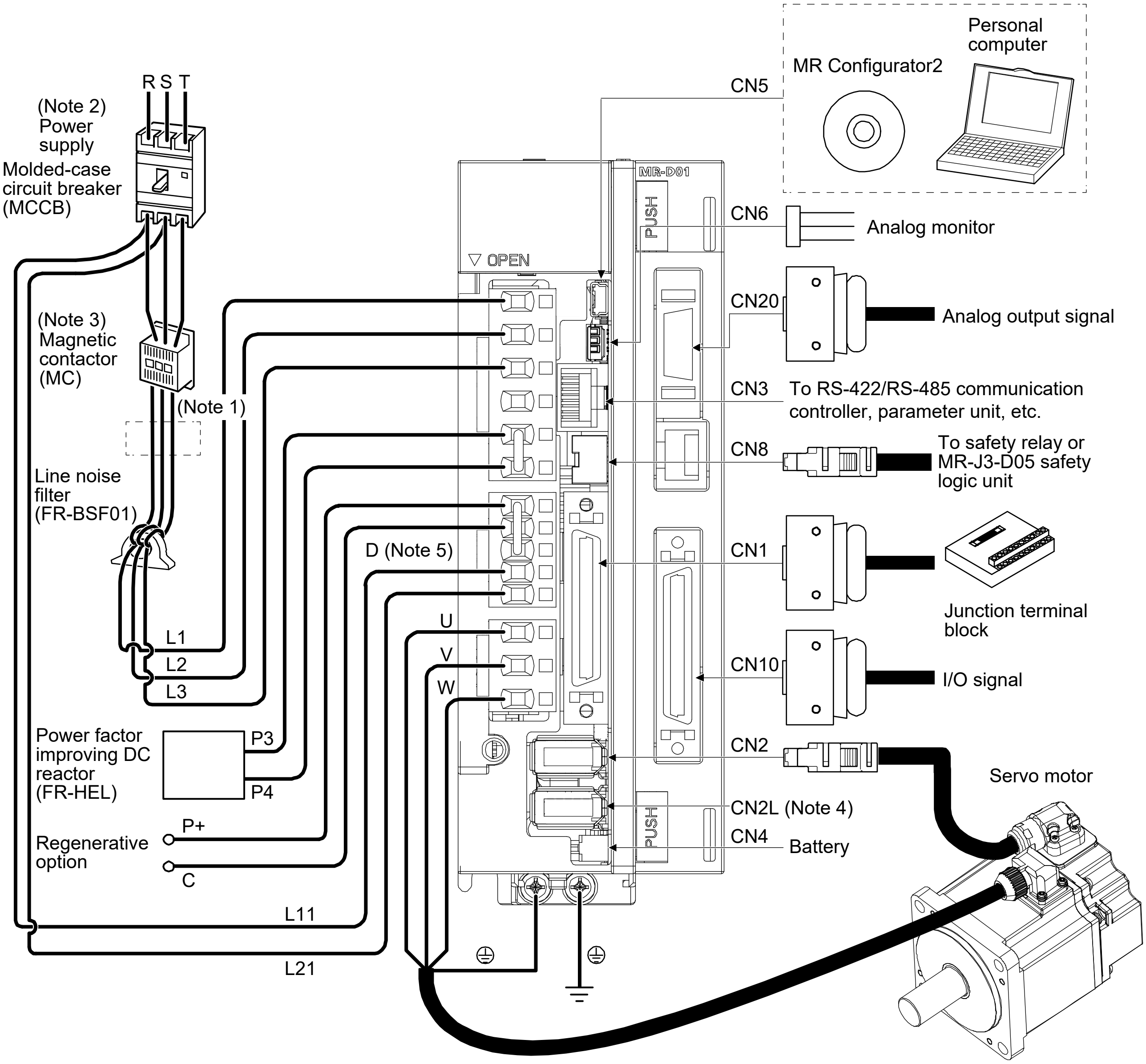
19.3 Configuration including peripheral equipment

⚠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.

The following figure shows the interface of when MR-D01 is connected to MR-J4-20A-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. For power supply specifications, refer to section 1.3.

3. Depending on the main circuit voltage and operation pattern, a bus voltage may drop, causing dynamic brake deceleration during forced stop deceleration. When dynamic brake deceleration is not required, delay the time to turn off the magnetic contactor.

4. When using an MR-J4-_A-RJ servo amplifier in the linear servo system or in the fully closed loop system, connect an external encoder to this connector. Refer to Table 1.1 and "Linear Encoder Instruction Manual" for the compatible external encoders.

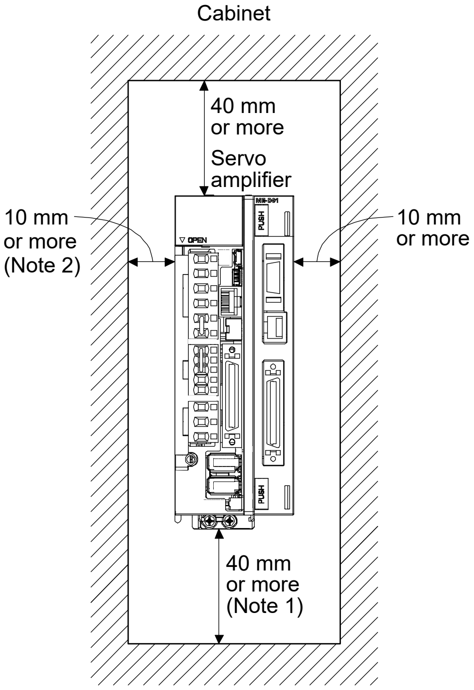
5. Always connect between P+ and D terminals. When using the regenerative option, refer to section 11.2.

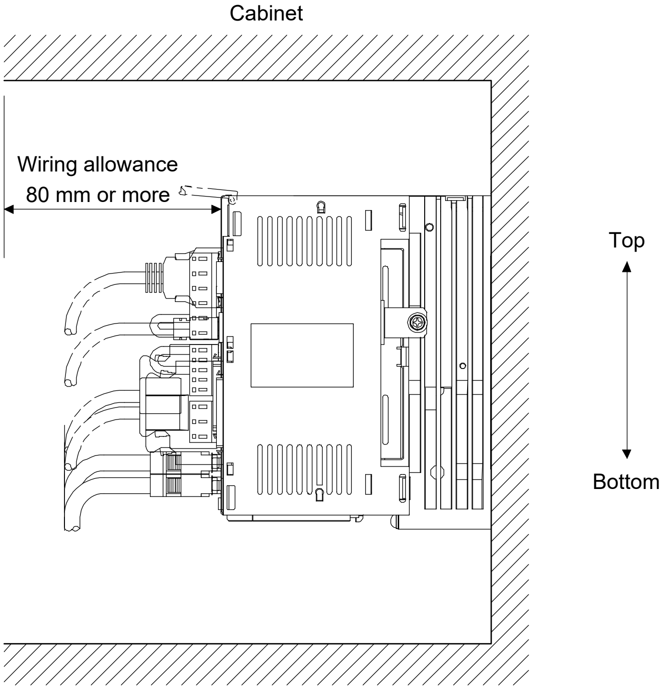
19.4 Installation direction and clearances

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

(1) Installation clearances of the servo amplifier

(a) Installation of one servo amplifier





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

2. To install the MR-J4-500A-RJ, leave a clearance of 25 mm or more between the left side and the wall.

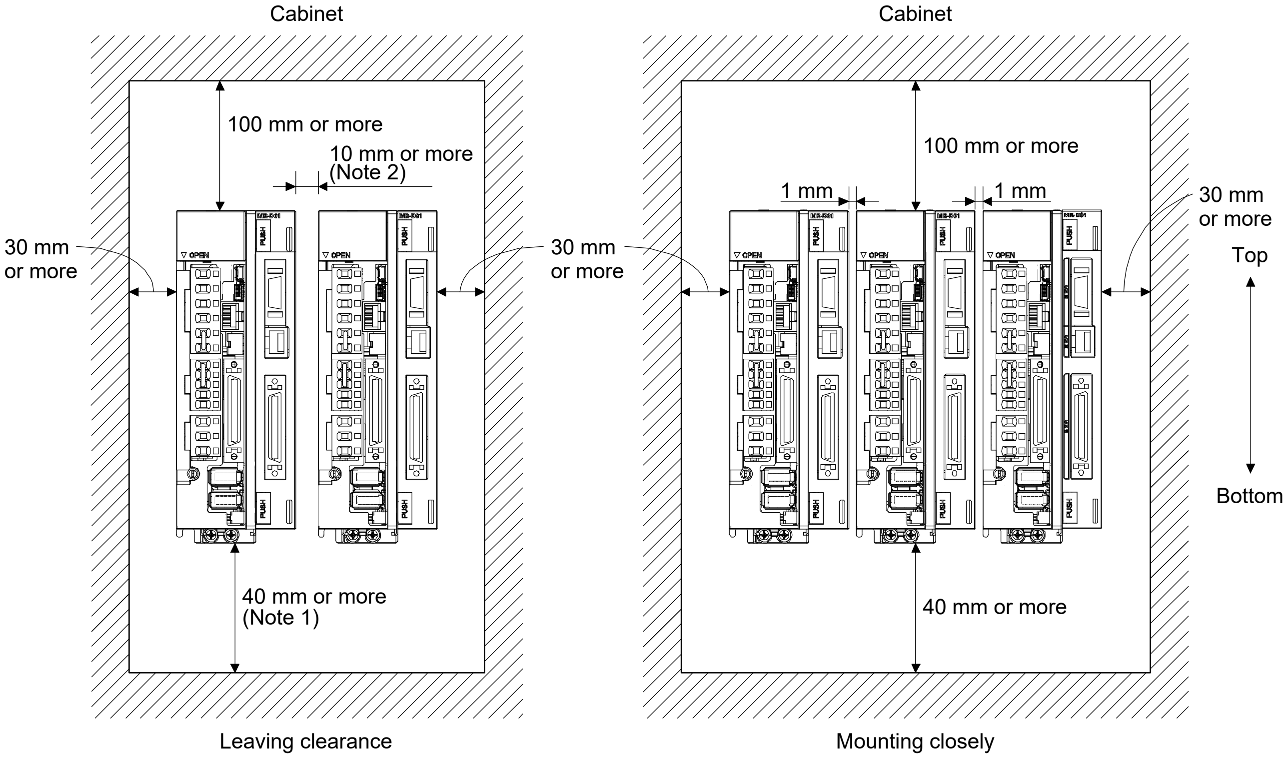
(b) Installation of two or more servo amplifiers

POINT

- ●Close mounting is possible depending on the capacity of the servo amplifier. For the possibility of close mounting, refer to section 1.3.
- ●When mounting the servo amplifiers closely, do not install the servo amplifier whose depth is larger than that of the left side servo amplifier since CNP1, CNP2, and CNP3 connectors cannot be disconnected.

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 environmental conditions.

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, operate the servo amplifiers at the ambient temperature of 0 °C to 45 °C or at 75% or less of the effective load ratio.



Leaving clearance

Mounting closely

Note 1. For the 11 kW to 22 kW servo amplifiers, the clearance between the bottom and the ground will be 120 mm or more.
2. To install the MR-J4-500A-RJ, leave a clearance of 25 mm or more between the MR-J4-500A-RJ and the left side servo amplifier.

(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.

19.5 Signals and wiring

POINT

- Input signals of the servo amplifier are valid even when the MR-D01 has been connected. When the same input devices have been assigned to the servo amplifier and MR-D01 and both input signals are turned on, the input signal that has turned on first is enabled. Even though turning off one of the input signals that have been turned on is attempted, the input signal cannot be turned off. Refer to the following table for details. The following table shows ST1 (Forward rotation start) as an example.

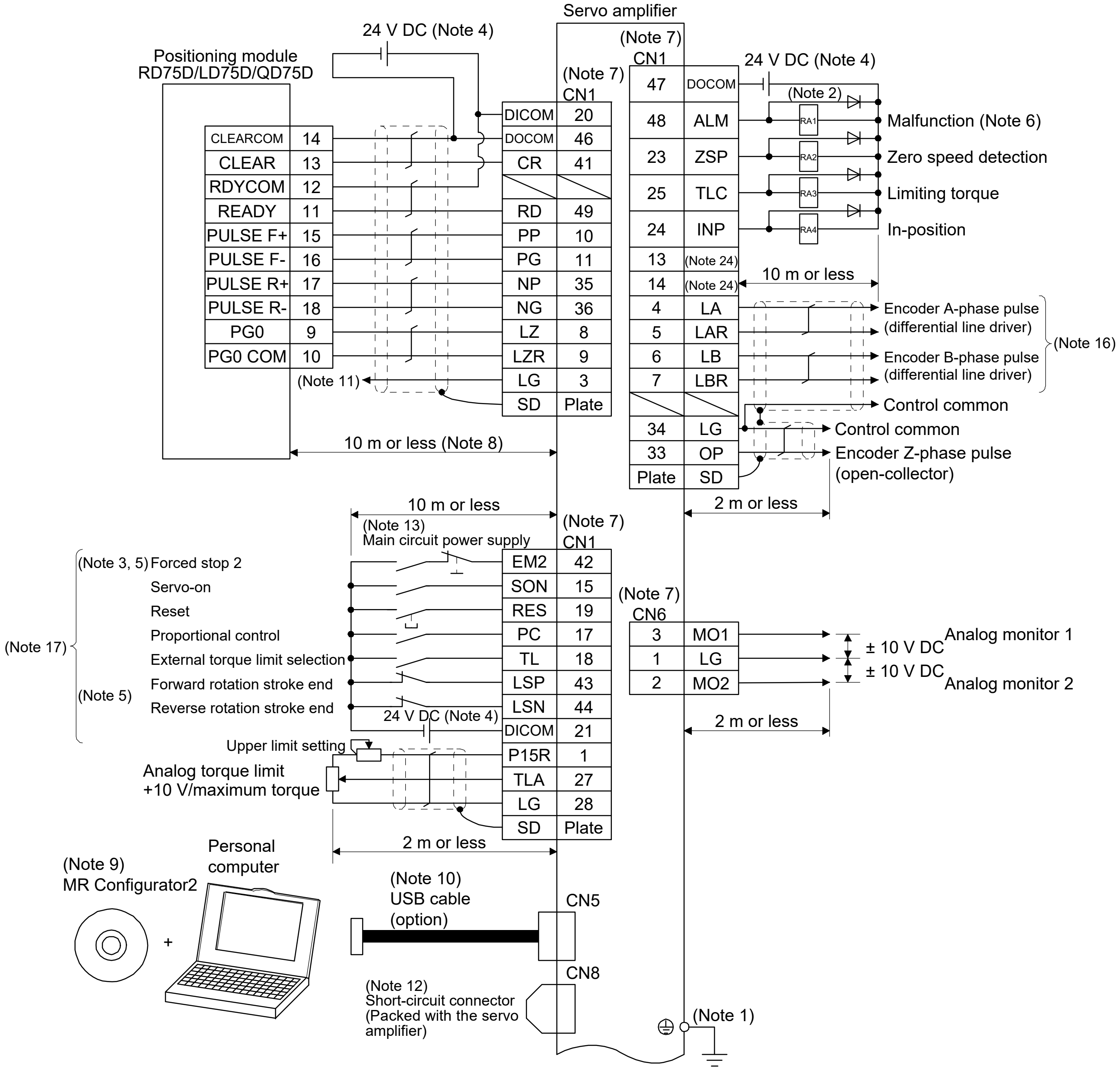
Device	(Note) Servo amplifier	(Note) MR-D01	Servo motor
ST1	0	0	Stop
	0	1	Forward rotation
	1	0	Forward rotation
	1	1	Forward rotation

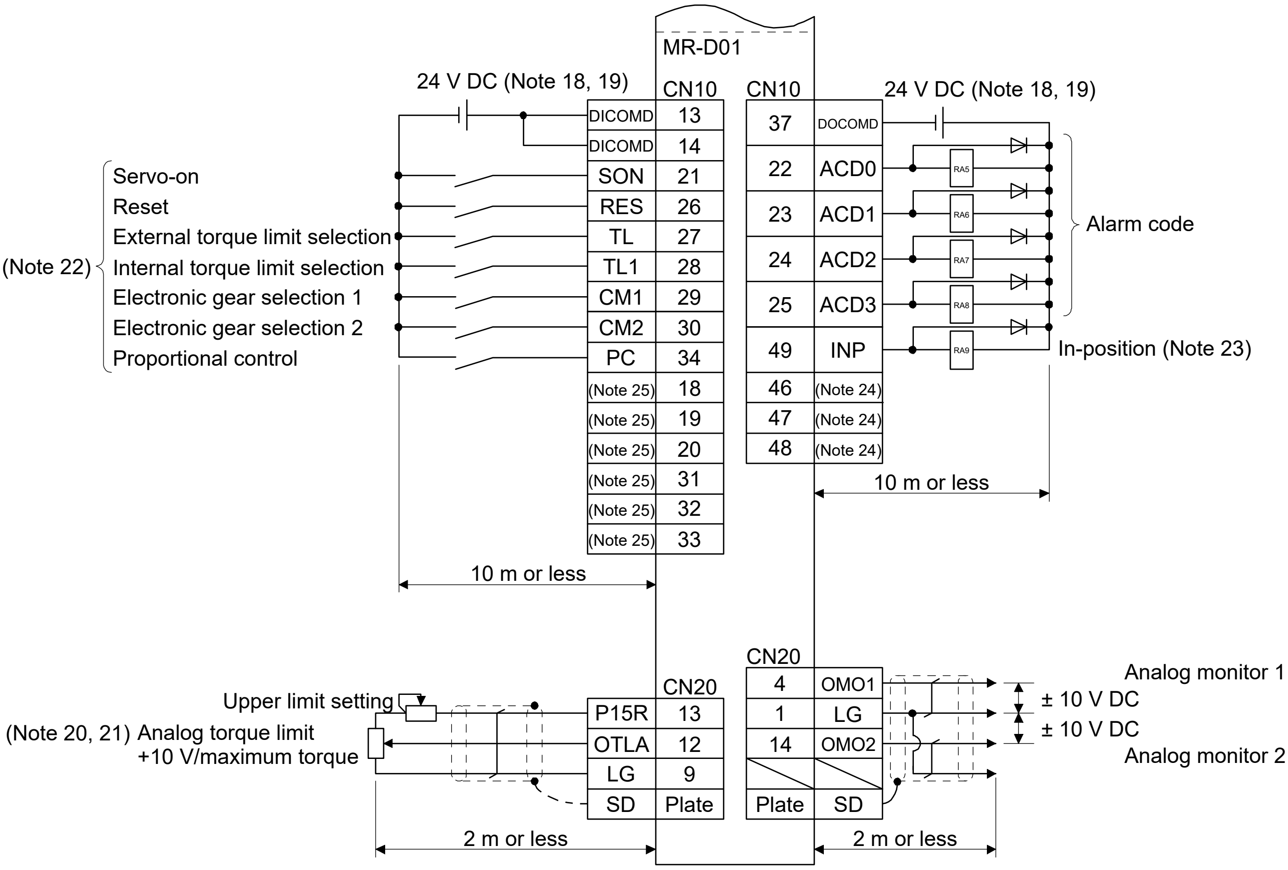
Note. 0: Off
1: On

19.5.1 I/O Signal Connection Example

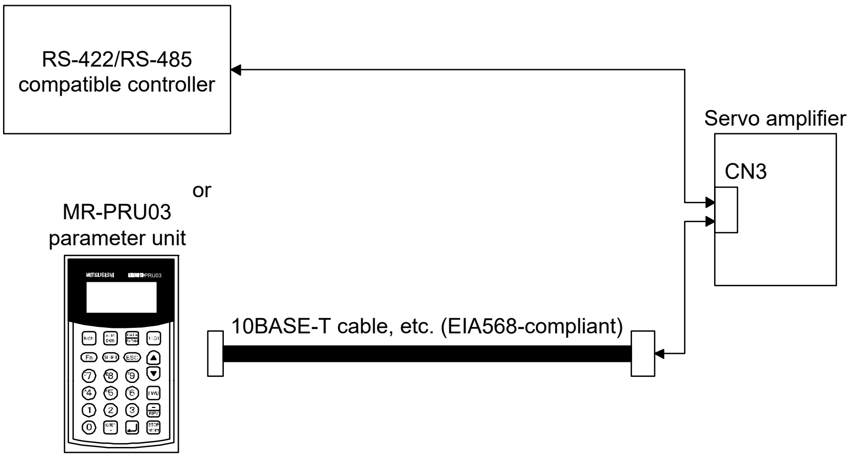
(1) Position control mode

(a) For sink I/O interface




MR-D01
24 V DC (Note 18, 19)
CN10
CN10
24 V DC (Note 18, 19)
DICOMD 13
DICOMD 14
SON 21
RES 26
TL 27
TL1 28
CM1 29
CM2 30
PC 34
(Note 25) 18
(Note 25) 19
(Note 25) 20
(Note 25) 31
(Note 25) 32
(Note 25) 33
37 DOCOMD
22 ACD0
23 ACD1
24 ACD2
25 ACD3
49 INP
46 (Note 24)
47 (Note 24)
48 (Note 24)
RA5
RA6
RA7
RA8
RA9
Servo-on
Reset
External torque limit selection
(Note 22)
Internal torque limit selection
Electronic gear selection 1
Electronic gear selection 2
Proportional control
Alarm code
In-position (Note 23)
10 m or less
10 m or less
CN20
CN20
Upper limit setting
(Note 20, 21) Analog torque limit
+10 V/maximum torque
P15R 13
OTLA 12
LG 9
SD Plate
4 OMO1
1 LG
14 OMO2
Plate SD
Analog monitor 1
± 10 V DC
± 10 V DC
Analog monitor 2
2 m or less
2 m or less

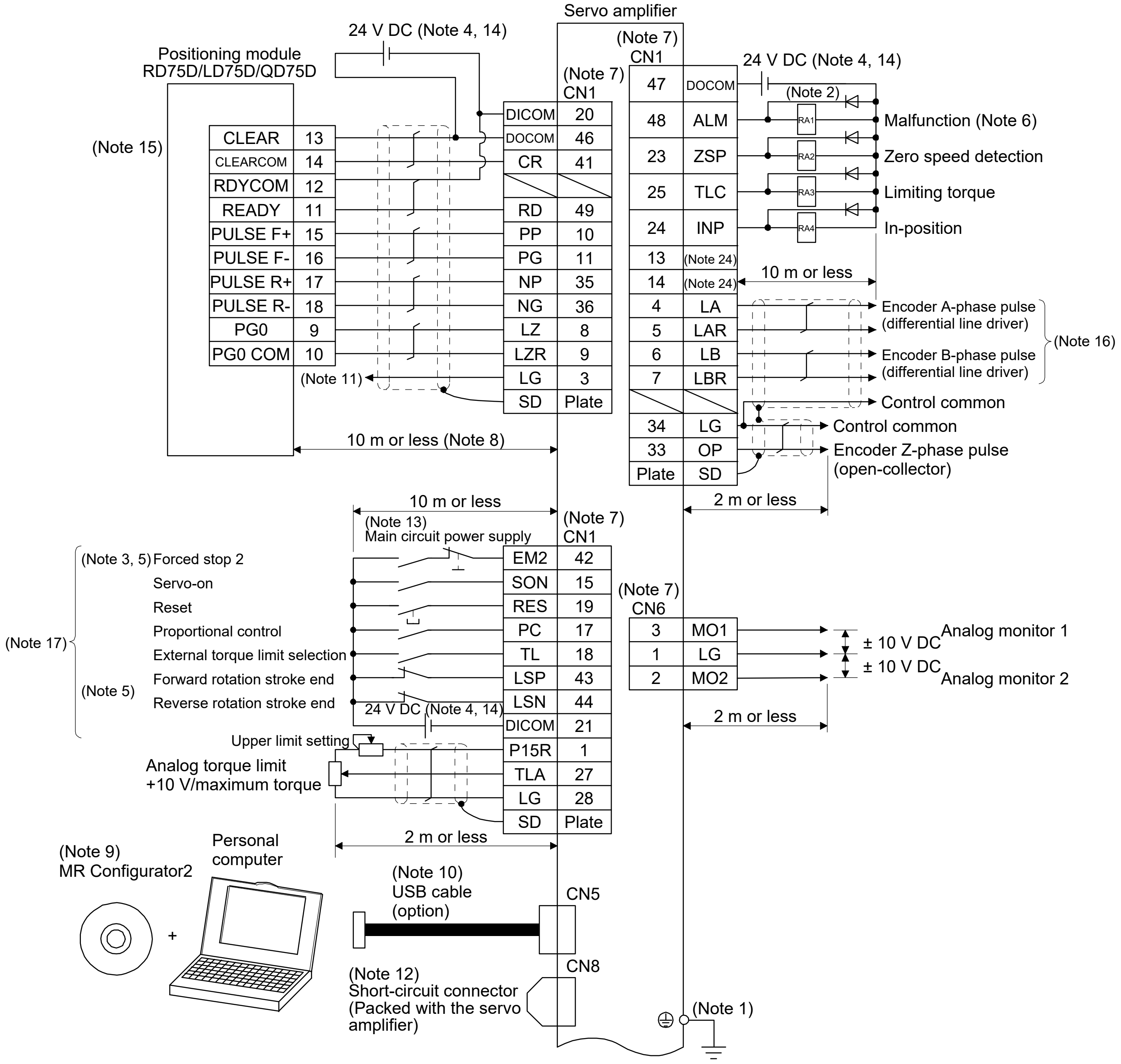
Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the servo amplifier to the protective earth (PE) of the cabinet.
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity of these power supplies must be 500 mA or lower. 500 mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points.
Refer to section 3.9.2 (1) that gives the current value necessary for the interface. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
5. When starting operation, always turn on EM2 (Forced stop 2), LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end). (Normally closed contact)
6. ALM (Malfunction) turns on in normal alarm-free condition. (Normally closed contact) When this signal is switched off (at occurrence of an alarm), the output of the programmable controller should be stopped by the sequence program.
7. The pins with the same signal name are connected in the servo amplifier.
8. This length applies to the command pulse train input in the differential line driver type. It is 2 m or less in the open-collector type.
9. Use SW1DNC-MRC2-_. (Refer to section 11.7.)
10. Controllers or parameter units can also be connected via the CN3 connector with the RS-422/RS-485 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422/RS-485 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.

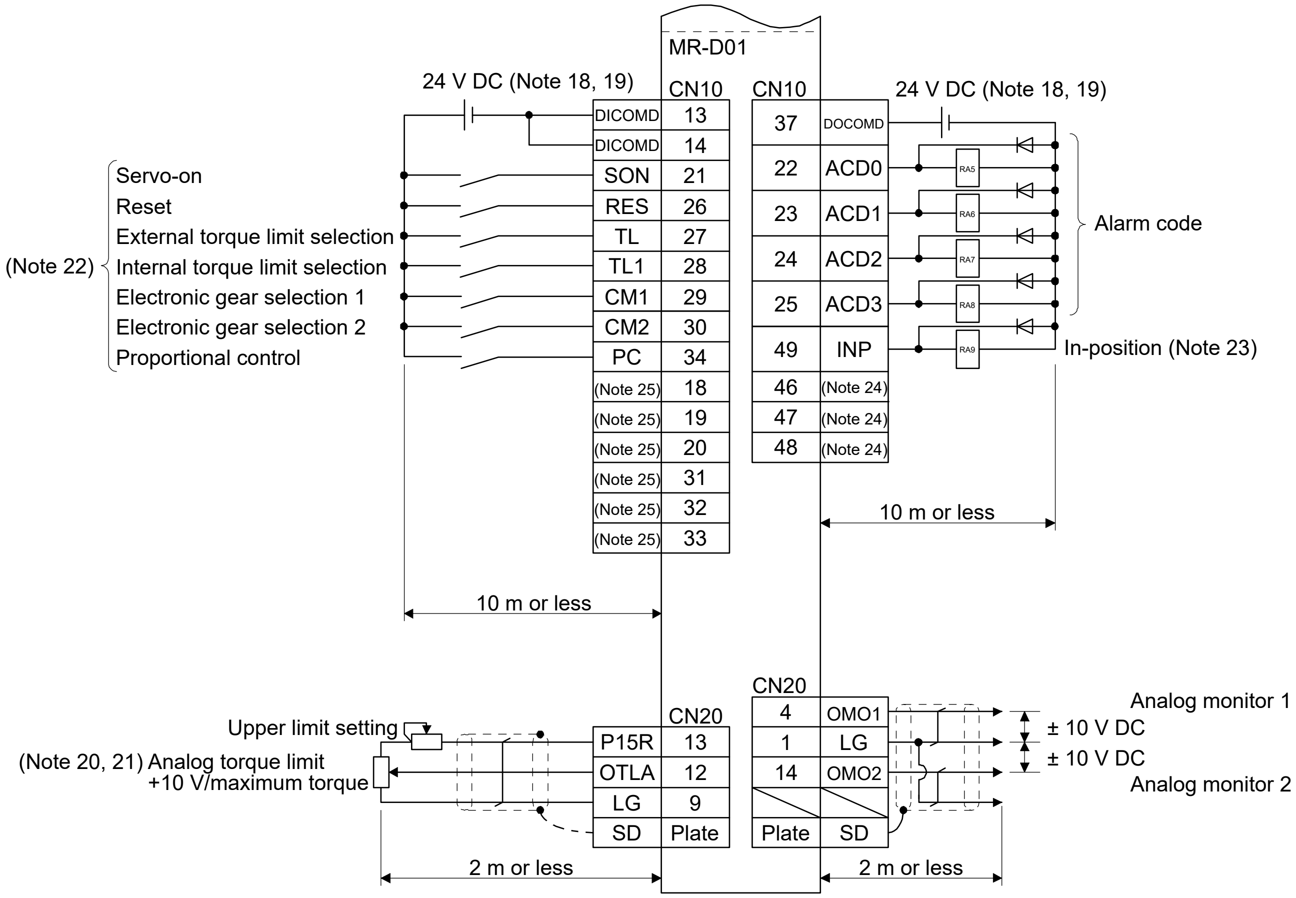


11. This connection is not necessary for RD75D, LD75D, and QD75D. However, to enhance noise tolerance, it is recommended to connect LG of servo amplifier and control common depending on the positioning module.
12. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
13. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
14. Plus and minus of the power of source interface are the opposite of those of sink interface.
15. CLEAR and CLEARCOM of source interface are interchanged to sink interface.
16. Disconnection of the command cable connected to the controller, or noise may cause a position mismatch. To avoid the position mismatch, check encoder A-phase pulse and encoder B-phase pulse on the controller side.
17. The devices can be changed by [Pr. PD03] to [Pr. PD14], [Pr. PD17] to [Pr. PD22], and [Pr. PD43] to [Pr. PD46].
18. Supply 24 V DC ± 10% to interfaces of the MR-D01 from outside. The total current capacity of these power supplies must be 800 mA or lower. 800 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. For the amperage required for interfaces, refer to section 3.9.2 (1).
19. As the 24 V DC for the input/output signals, one 24 V DC power supply can be used to supply to the servo amplifier and MR-D01. In this case, select an appropriate power supply capacity depending on the number of points of the input/output signals to be used.
20. The CN1-27 pin and CN20-12 pin are exclusive. The CN1-27 pin is set by default. Select this item with [Pr. Po11].
21. OTLA will be available when TL (External torque limit selection) is enabled with [Pr. Po02] to [Pr. Po07], [Pr. Po27], and [Pr. Po28]. (Refer to section 19.5.3 (5).)
22. The devices can be changed by [Pr. Po02] to [Pr. Po07].
23. The device can be changed by [Pr. Po08] and [Pr. Po09].
24. Output devices are not assigned by default. Assign the output devices with [Pr. PD47], [Pr. Po08], and [Pr. Po09] as necessary.
25. Input devices are not assigned by default. Assign the input devices with [Pr. Po05], [Pr. Po06], [Pr. Po27], and [Pr. Po28] as necessary.

(b) For source I/O interface

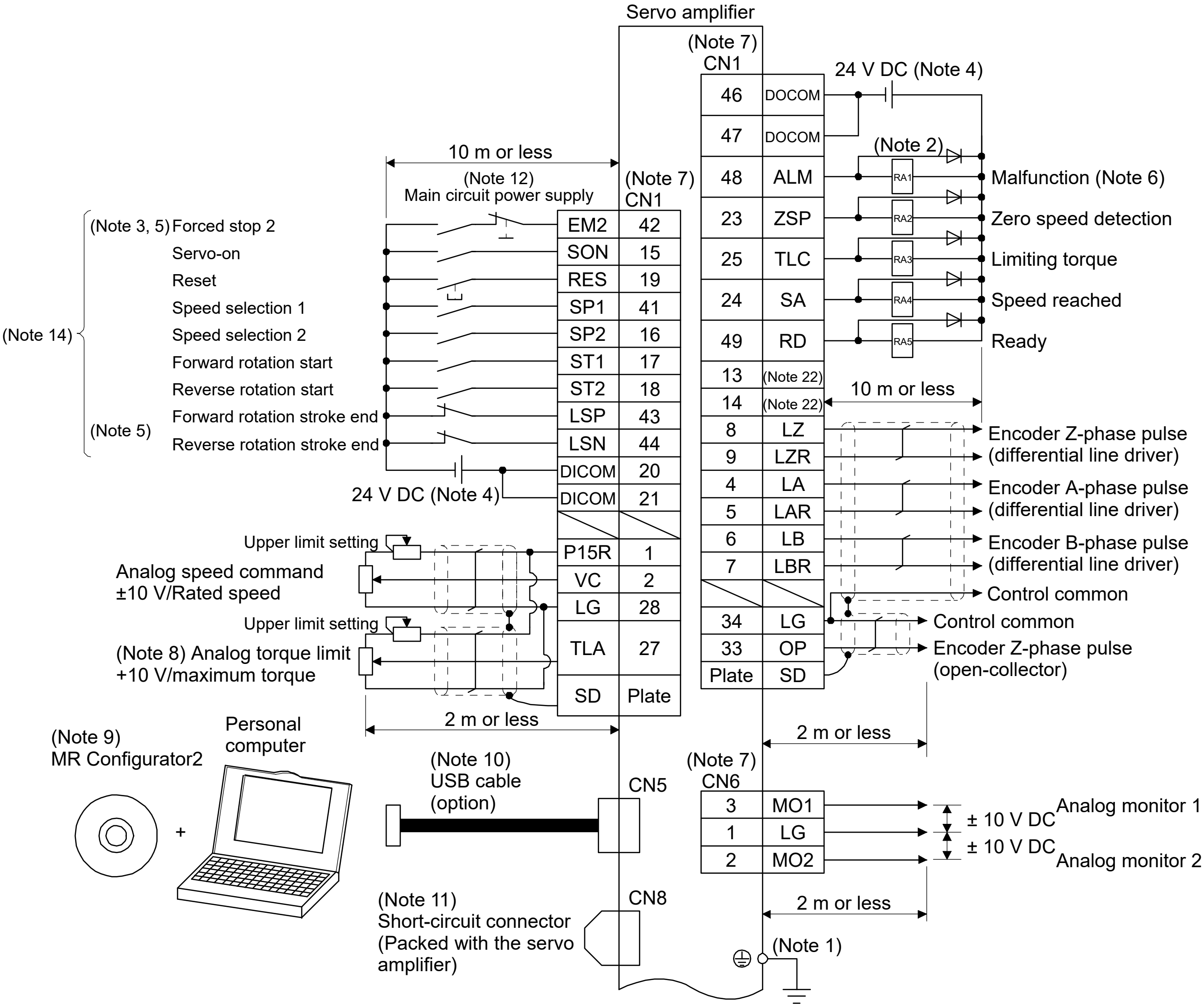
POINT
●For notes, refer to (1) (a) in this section.

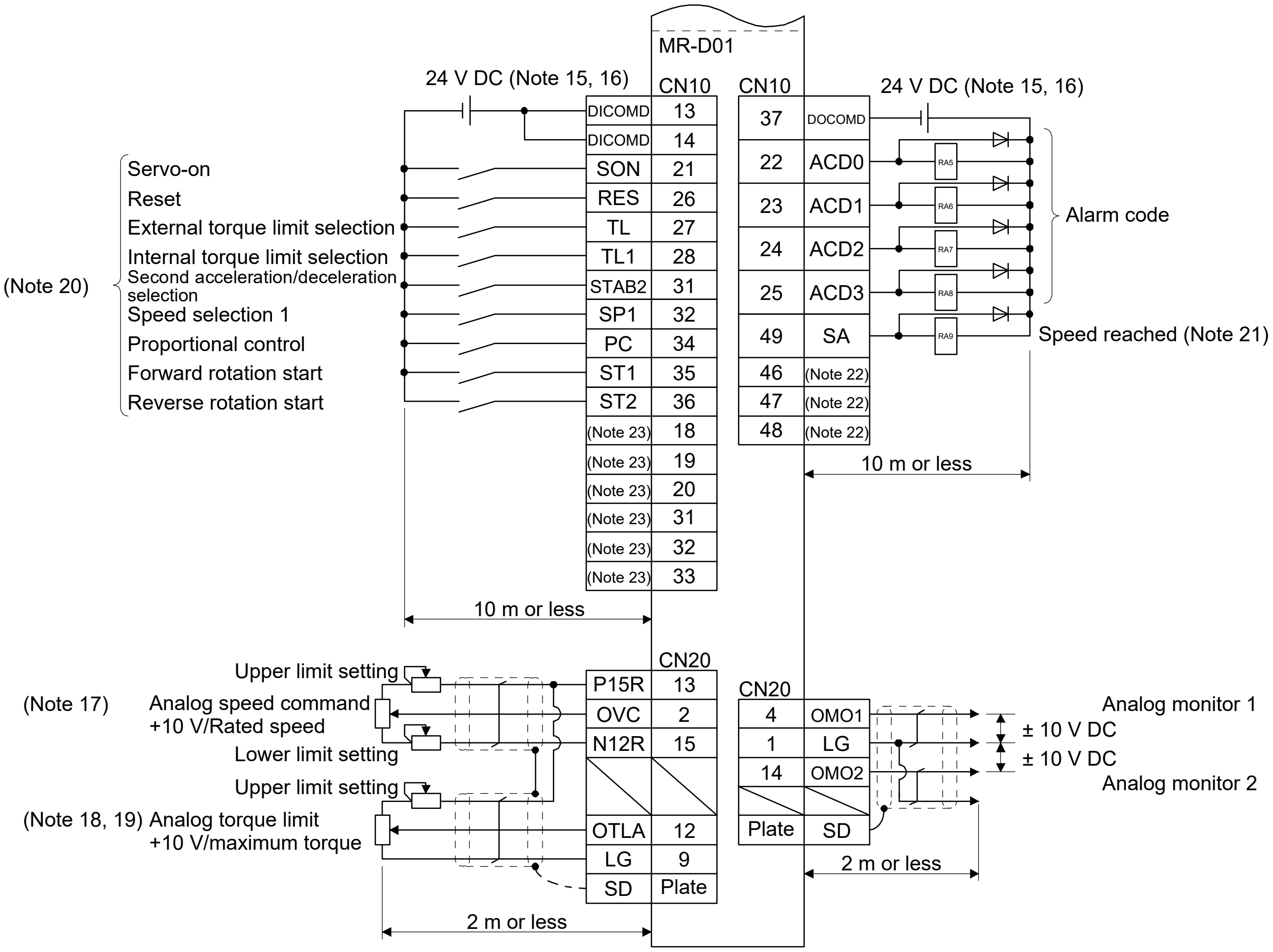



MR-D01
24 V DC (Note 18, 19)
CN10
CN10
24 V DC (Note 18, 19)
DICOMD 13
DICOMD 14
Servo-on
Reset
External torque limit selection
(Note 22)
Internal torque limit selection
Electronic gear selection 1
Electronic gear selection 2
Proportional control
SON 21
RES 26
TL 27
TL1 28
CM1 29
CM2 30
PC 34
(Note 25) 18
(Note 25) 19
(Note 25) 20
(Note 25) 31
(Note 25) 32
(Note 25) 33
37 DOCOMD
22 ACD0
23 ACD1
24 ACD2
25 ACD3
49 INP
46 (Note 24)
47 (Note 24)
48 (Note 24)
RA5
RA6
RA7
RA8
RA9
Alarm code
In-position (Note 23)
10 m or less
10 m or less
CN20
CN20
Upper limit setting
(Note 20, 21) Analog torque limit
+10 V/maximum torque
P15R 13
OTLA 12
LG 9
SD Plate
4 OMO1
1 LG
14 OMO2
Plate SD
Analog monitor 1
± 10 V DC
± 10 V DC
Analog monitor 2
2 m or less
2 m or less

(2) Speed control mode

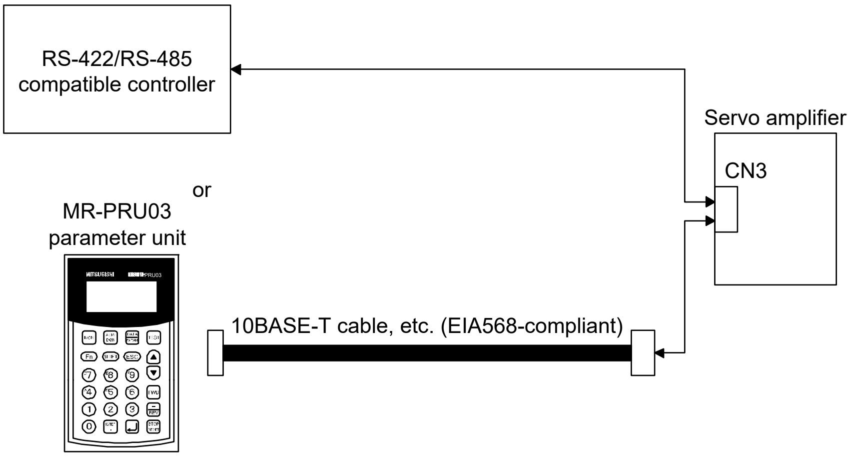
(a) For sink I/O interface




MR-D01
24 V DC (Note 15, 16)
CN10
CN10
24 V DC (Note 15, 16)
DICOMD 13
DICOMD 14
SON 21
RES 26
TL 27
TL1 28
STAB2 31
SP1 32
PC 34
ST1 35
ST2 36
(Note 23) 18
(Note 23) 19
(Note 23) 20
(Note 23) 31
(Note 23) 32
(Note 23) 33
37 DOCOMD
22 ACD0
23 ACD1
24 ACD2
25 ACD3
49 SA
46 (Note 22)
47 (Note 22)
48 (Note 22)
RA5
RA6
RA7
RA8
RA9
Alarm code
Speed reached (Note 21)
(Note 20)
Servo-on
Reset
External torque limit selection
Internal torque limit selection
Second acceleration/deceleration selection
Speed selection 1
Proportional control
Forward rotation start
Reverse rotation start
10 m or less
10 m or less
Upper limit setting
(Note 17)
Analog speed command +10 V/Rated speed
Lower limit setting
Upper limit setting
(Note 18, 19) Analog torque limit +10 V/maximum torque
CN20
P15R 13
OVC 2
N12R 15
OTLA 12
LG 9
SD Plate
CN20
4 OMO1
1 LG
14 OMO2
Plate SD
Analog monitor 1
± 10 V DC
± 10 V DC
Analog monitor 2
2 m or less
2 m or less

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

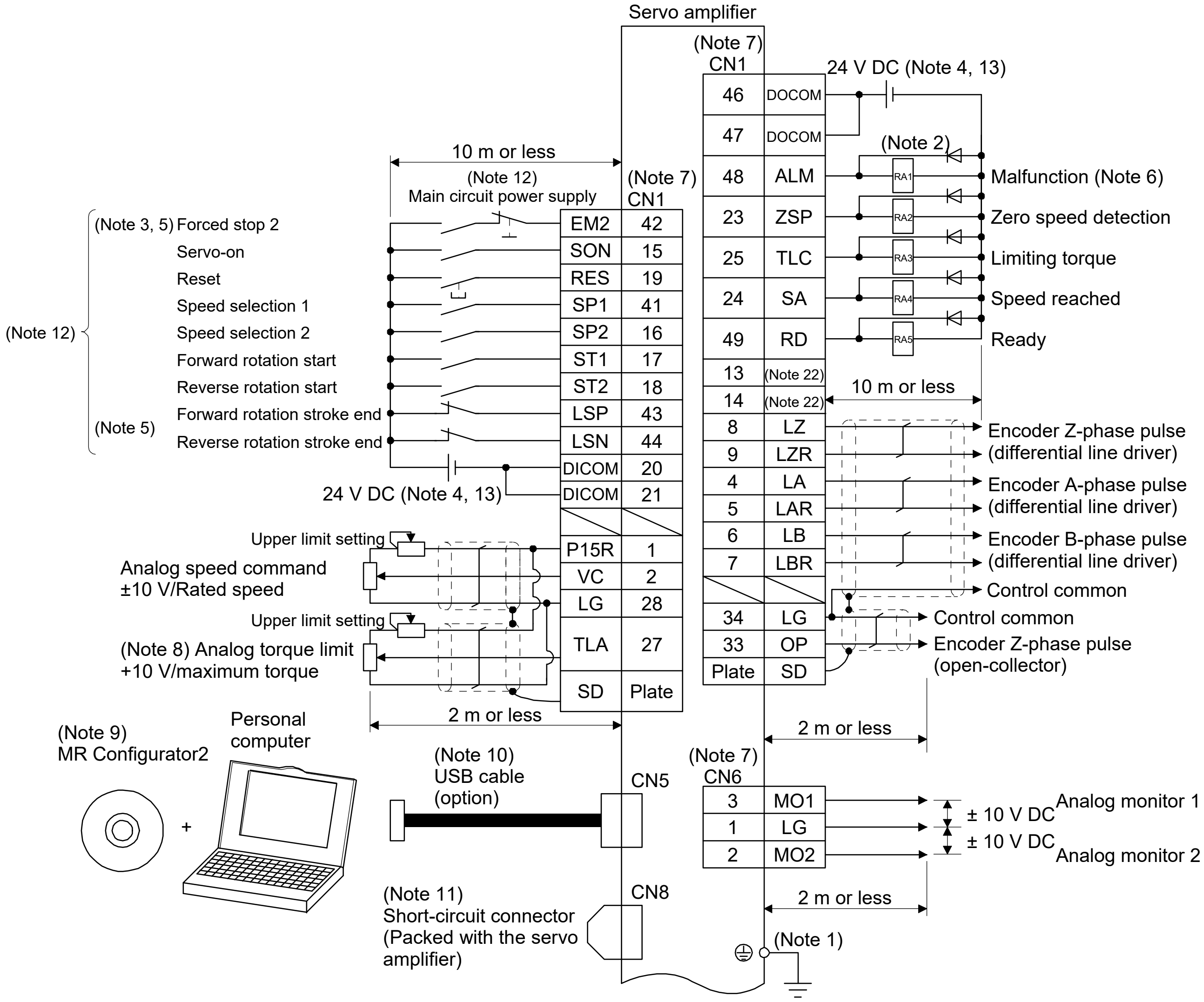
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity of these power supplies must be 500 mA or lower. 500 mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.9.2 (1) that gives the current value necessary for the interface. A 24 V DC power supply can be used for both input signal and output signal.
5. When starting operation, always turn on EM2 (Forced stop 2), LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end). (Normally closed contact)
6. ALM (Malfunction) turns on in normal alarm-free condition. (Normally closed contact)
7. The pins with the same signal name are connected in the servo amplifier.
8. TLA will be available when TL (External torque limit selection) is enabled with [Pr. PD03] to [Pr. PD22]. (Refer to section 3.6.1 (5).)
9. Use SW1DNC-MRC2-_. (Refer to section 11.7.)
10. Controllers or parameter units can also be connected via the CN3 connector with the RS-422/RS-485 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422/RS-485 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.

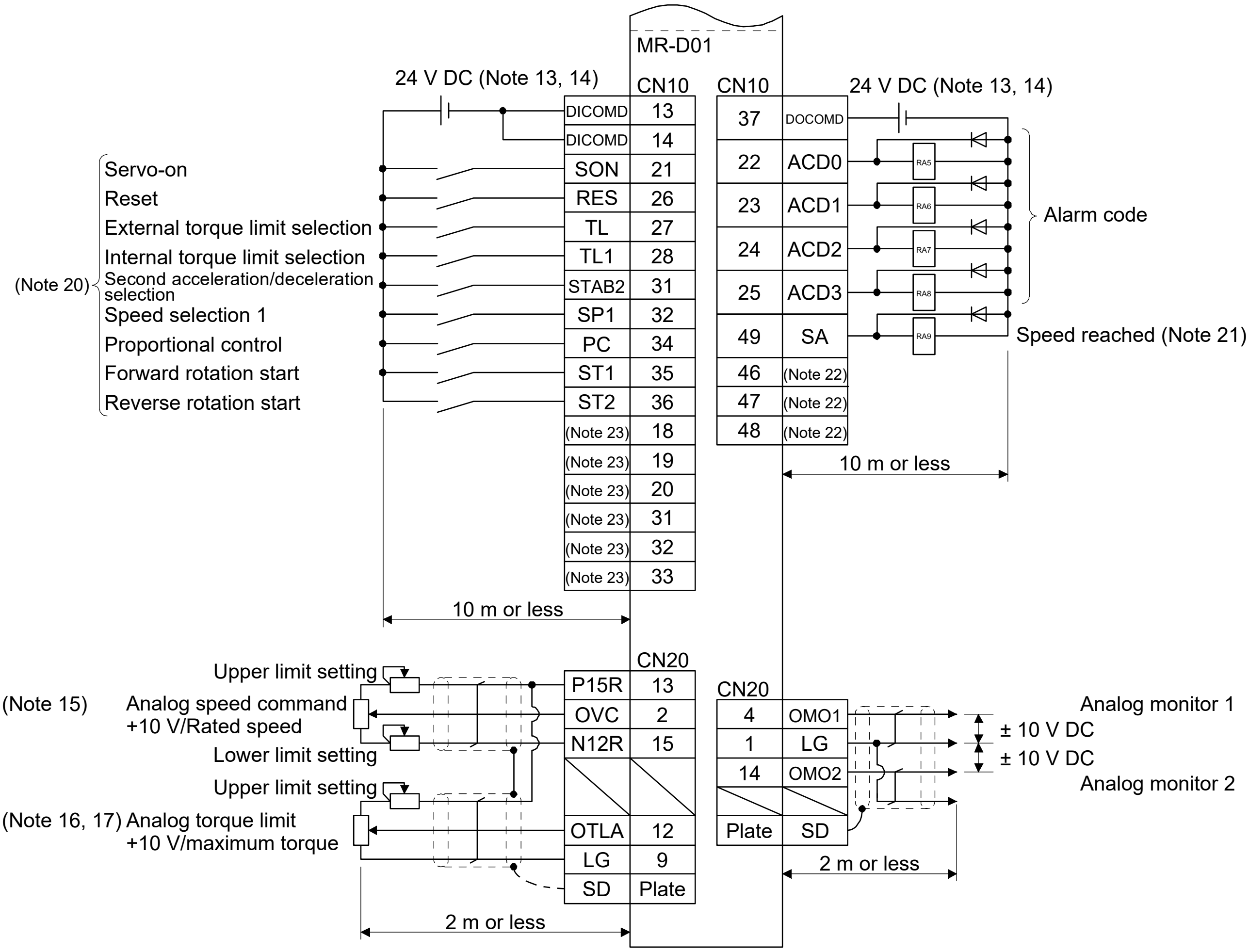


11. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
12. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
13. Plus and minus of the power of source interface are the opposite of those of sink interface.
14. The devices can be changed by [Pr. PD03] to [Pr. PD14], [Pr. PD17] to [Pr. PD22], and [Pr. PD43] to [Pr. PD46].
15. Supply 24 V DC ± 10% to interfaces of the MR-D01 from outside. The total current capacity of these power supplies must be 800 mA or lower. 800 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. For the amperage required for interfaces, refer to section 3.9.2 (1).
16. As the 24 V DC for the input/output signals, one 24 V DC power supply can be used to supply to the servo amplifier and MR-D01. In this case, select an appropriate power supply capacity depending on the number of points of the input/output signals to be used.
17. The CN1-2 pin and CN20-2 pin are exclusive. The CN1-2 pin is set by default. Select this item with [Pr. Po11].
18. The CN1-27 pin and CN20-12 pin are exclusive. The CN1-27 pin is set by default. Select this item with [Pr. Po11].
19. OTLA will be available when TL (External torque limit selection) is enabled with [Pr. Po02] to [Pr. Po07], [Pr. Po27], and [Pr. Po28]. (Refer to section 11.5.3 (6).)
20. The devices can be changed by [Pr. Po02] to [Pr. Po07].
21. The device can be changed by [Pr. Po08] and [Pr. Po09].
22. Output devices are not assigned by default. Assign the output devices with [Pr. PD47], [Pr. Po08], and [Pr. Po09] as necessary.
23. Input devices are not assigned by default. Assign the input devices with [Pr. Po05], [Pr. Po06], [Pr. Po27], and [Pr. Po28] as necessary.

(b) For source I/O interface

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

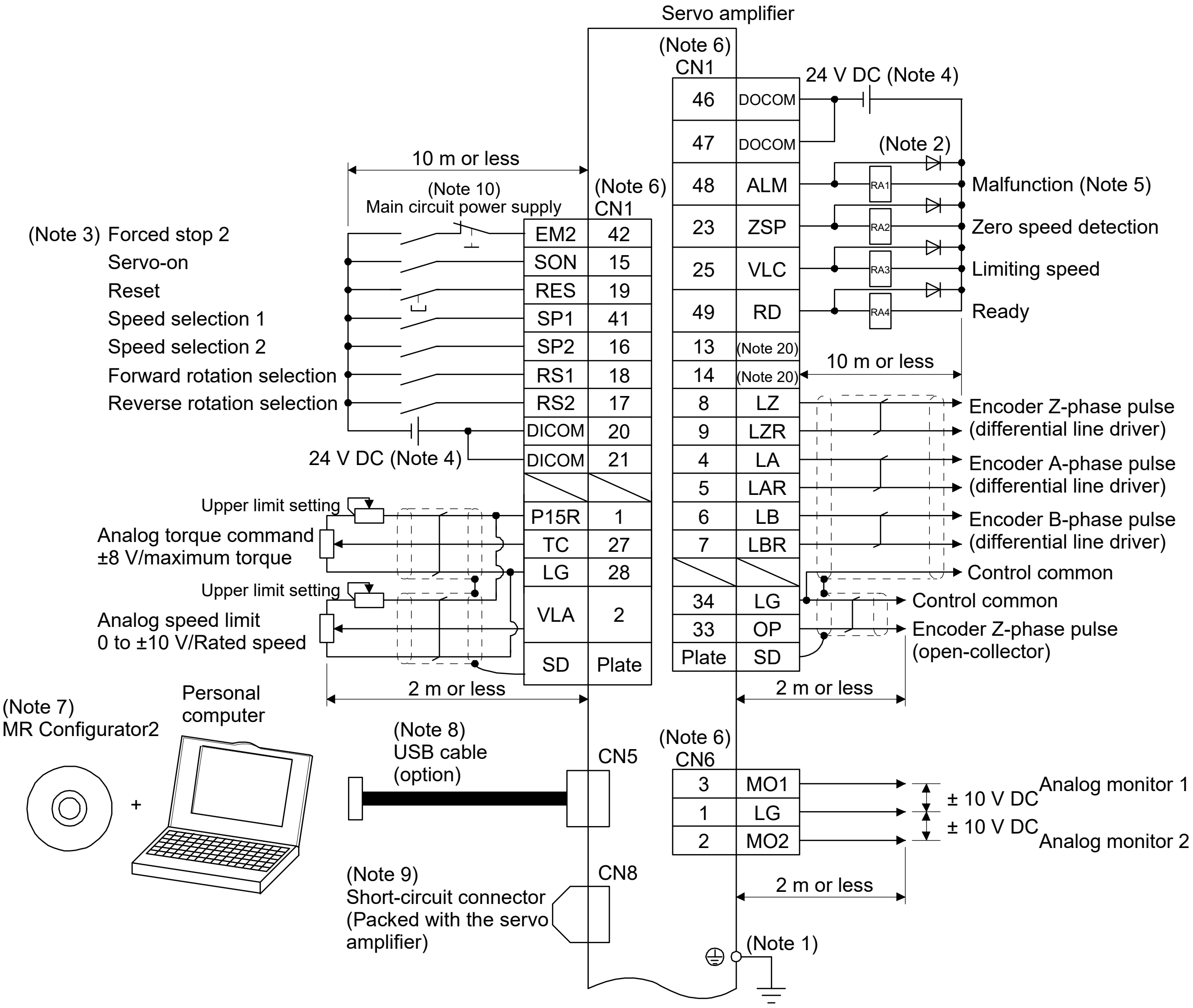


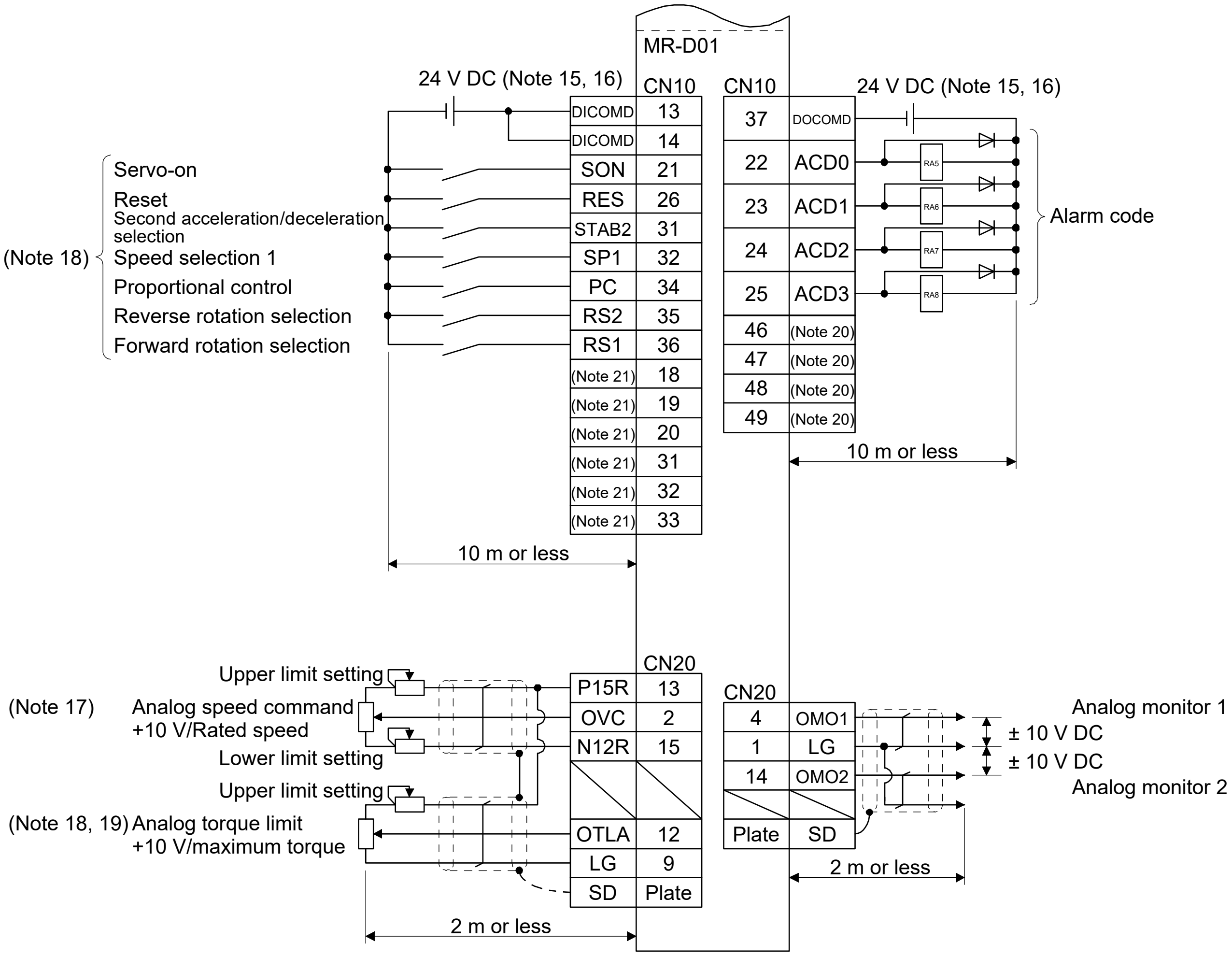

MR-D01
24 V DC (Note 13, 14)
CN10
CN10
24 V DC (Note 13, 14)
DICOMD 13
DICOMD 14
SON 21
RES 26
TL 27
TL1 28
STAB2 31
SP1 32
PC 34
ST1 35
ST2 36
(Note 23) 18
(Note 23) 19
(Note 23) 20
(Note 23) 31
(Note 23) 32
(Note 23) 33
37 DOCOMD
22 ACD0
23 ACD1
24 ACD2
25 ACD3
49 SA
46 (Note 22)
47 (Note 22)
48 (Note 22)
RA5
RA6
RA7
RA8
RA9
Alarm code
Speed reached (Note 21)
Servo-on
Reset
External torque limit selection
Internal torque limit selection
(Note 20)
Second acceleration/deceleration selection
Speed selection 1
Proportional control
Forward rotation start
Reverse rotation start
10 m or less
10 m or less
CN20
CN20
Upper limit setting
(Note 15)
Analog speed command
+10 V/Rated speed
Lower limit setting
Upper limit setting
(Note 16, 17)
Analog torque limit
+10 V/maximum torque
P15R 13
OVC 2
N12R 15
OTLA 12
LG 9
SD Plate
4 OMO1
1 LG
14 OMO2
Plate SD
Analog monitor 1
± 10 V DC
± 10 V DC
Analog monitor 2
2 m or less
2 m or less

(3) Torque control mode

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

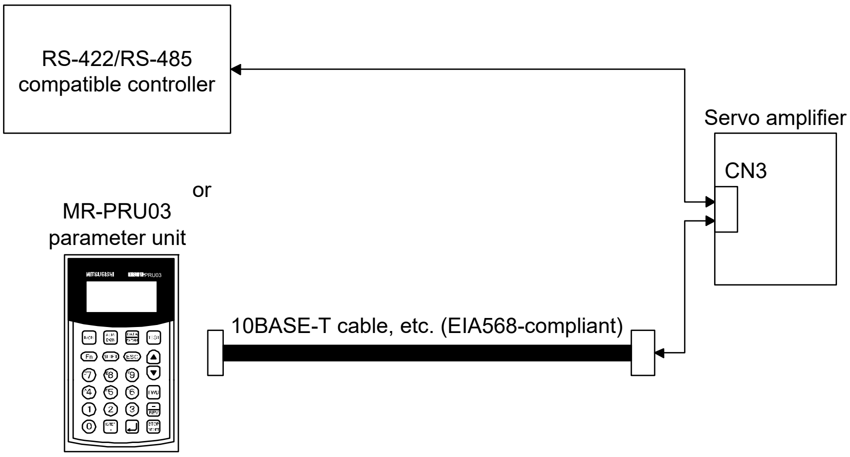
(a) For sink I/O interface




MR-D01
24 V DC (Note 15, 16)
CN10
CN10
24 V DC (Note 15, 16)
DICOMD 13
DICOMD 14
(Note 18)
Servo-on
SON 21
Reset
RES 26
Second acceleration/deceleration selection
STAB2 31
Speed selection 1
SP1 32
Proportional control
PC 34
Reverse rotation selection
RS2 35
Forward rotation selection
RS1 36
(Note 21) 18
(Note 21) 19
(Note 21) 20
(Note 21) 31
(Note 21) 32
(Note 21) 33
10 m or less
37 DOCOMD
22 ACD0
23 ACD1
24 ACD2
25 ACD3
RA5
RA6
RA7
RA8
Alarm code
46 (Note 20)
47 (Note 20)
48 (Note 20)
49 (Note 20)
10 m or less
CN20
Upper limit setting
(Note 17)
Analog speed command
+10 V/Rated speed
Lower limit setting
P15R 13
OVC 2
N12R 15
Upper limit setting
(Note 18, 19)
Analog torque limit
+10 V/maximum torque
OTLA 12
LG 9
SD Plate
2 m or less
CN20
4 OMO1
1 LG
14 OMO2
Plate SD
Analog monitor 1
± 10 V DC
± 10 V DC
Analog monitor 2
2 m or less

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

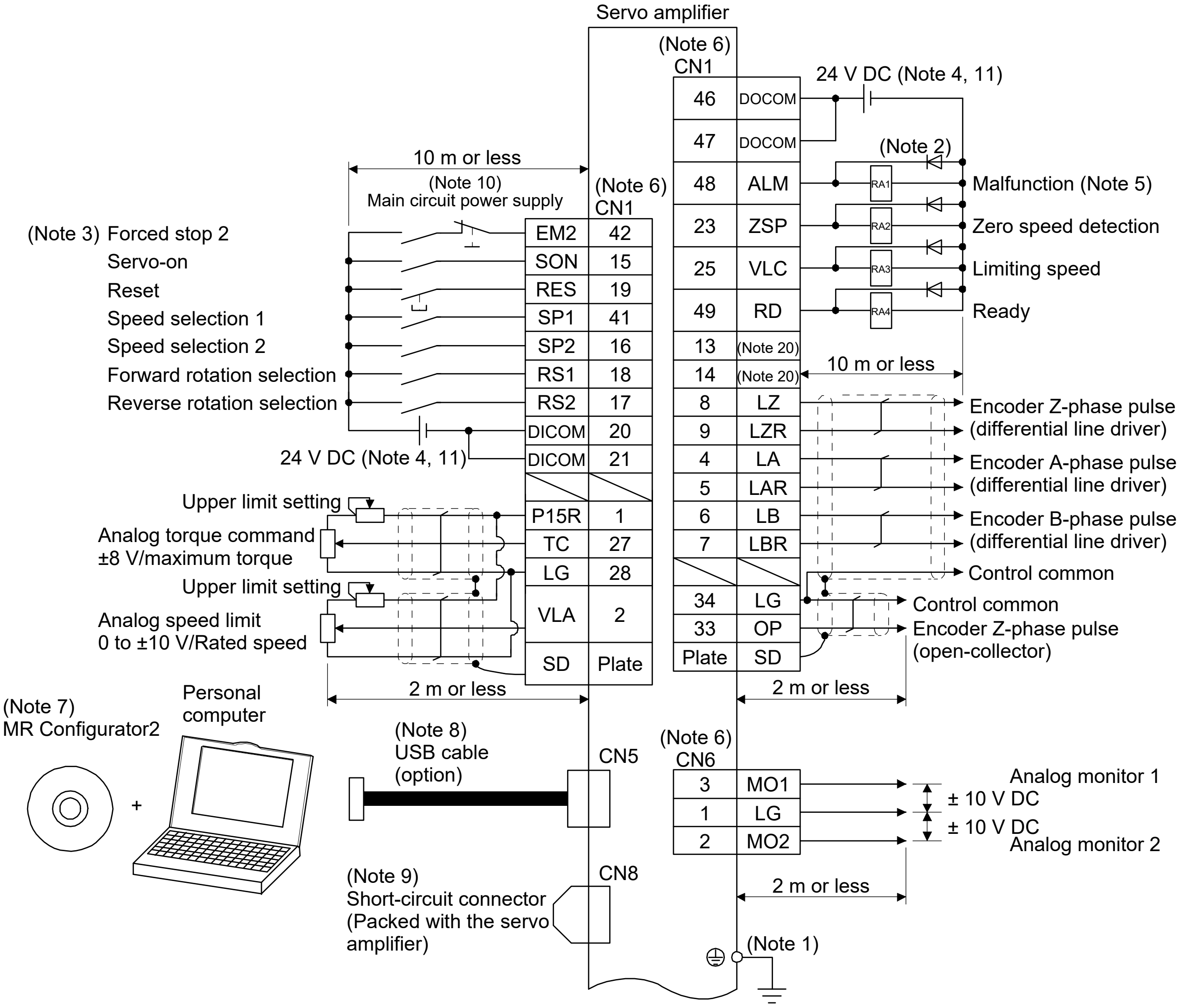
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity of these power supplies must be 500 mA or lower. 500 mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.9.2 (1) that gives the current value necessary for the interface. A 24 V DC power supply can be used for both input signal and output signal.
5. ALM (Malfunction) turns on in normal alarm-free condition. (Normally closed contact)
6. The pins with the same signal name are connected in the servo amplifier.
7. Use SW1DNC-MRC2-_. (Refer to section 11.7.)
8. Controllers or parameter units can also be connected via the CN3 connector with the RS-422/RS-485 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422/RS-485 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.

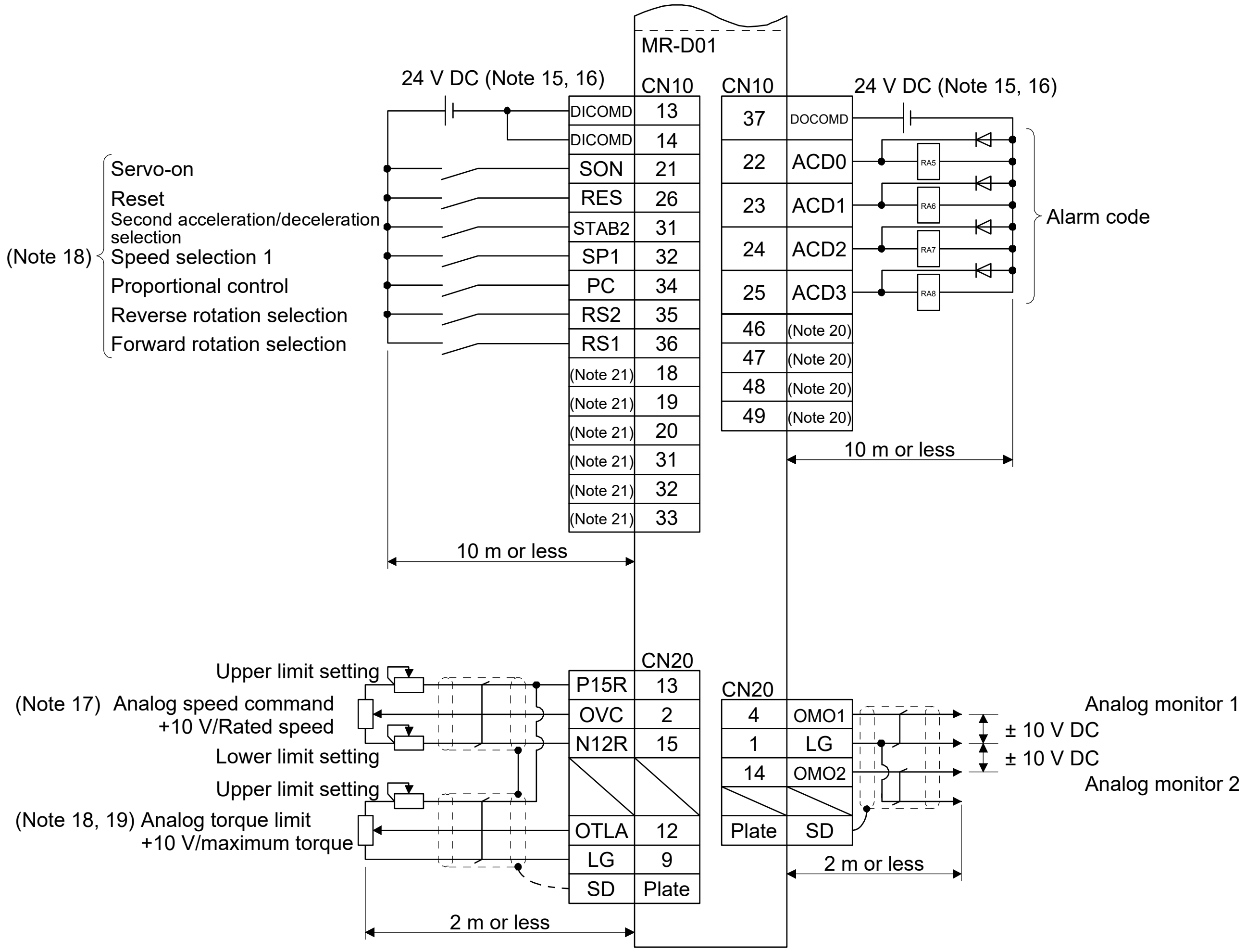


9. When not using the STO function, attach the short-circuit connector came with a servo amplifier.
10. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the servo amplifier.
11. Plus and minus of the power of source interface are the opposite of those of sink interface.
12. The devices can be changed by [Pr. PD03] to [Pr. PD14], [Pr. PD17] to [Pr. PD22], and [Pr. PD43] to [Pr. PD46].
13. Supply 24 V DC ± 10% to interfaces of the MR-D01 from outside. The total current capacity of these power supplies must be 800 mA or lower. 800 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. For the amperage required for interfaces, refer to section 3.9.2 (1).
14. As the 24 V DC for the input/output signals, one 24 V DC power supply can be used to supply to the servo amplifier and MR-D01. In this case, select an appropriate power supply capacity depending on the number of points of the input/output signals to be used.
15. The CN1-2 pin and CN20-2 pin are exclusive. The CN1-2 pin is set by default. Select this item with [Pr. Po11].
16. The CN1-27 pin and CN20-12 pin are exclusive. The CN1-27 pin is set by default. Select this item with [Pr. Po11].
17. OTLA will be available when TL (External torque limit selection) is enabled with [Pr. Po02] to [Pr. Po07], [Pr. Po27], and [Pr. Po28]. (Refer to section 11.5.3 (6).)
18. The devices can be changed by [Pr. Po02] to [Pr. Po07].
19. The device can be changed by [Pr. Po08] and [Pr. Po09].
20. Output devices are not assigned by default. Assign the output devices with [Pr. PD47], [Pr. Po08], and [Pr. Po09] as necessary.
21. Input devices are not assigned by default. Assign the input devices with [Pr. Po05], [Pr. Po06], [Pr. Po27], and [Pr. Po28] as necessary.

(b) For source I/O interface

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




MR-D01
24 V DC (Note 15, 16)
CN10
CN10
24 V DC (Note 15, 16)
DICOMD 13
DICOMD 14
SON 21
RES 26
STAB2 31
SP1 32
PC 34
RS2 35
RS1 36
(Note 21) 18
(Note 21) 19
(Note 21) 20
(Note 21) 31
(Note 21) 32
(Note 21) 33
37 DOCOMD
22 ACD0
23 ACD1
24 ACD2
25 ACD3
46 (Note 20)
47 (Note 20)
48 (Note 20)
49 (Note 20)
RA5
RA6
RA7
RA8
Alarm code
(Note 18)
Servo-on
Reset
Second acceleration/deceleration selection
Speed selection 1
Proportional control
Reverse rotation selection
Forward rotation selection
10 m or less
10 m or less
CN20
CN20
Upper limit setting
(Note 17) Analog speed command +10 V/Rated speed
Lower limit setting
Upper limit setting
(Note 18, 19) Analog torque limit +10 V/maximum torque
P15R 13
OVC 2
N12R 15
OTLA 12
LG 9
SD Plate
4 OMO1
1 LG
14 OMO2
Plate SD
Analog monitor 1
± 10 V DC
± 10 V DC
Analog monitor 2
2 m or less
2 m or less

19.5.2 Connectors and pin assignment

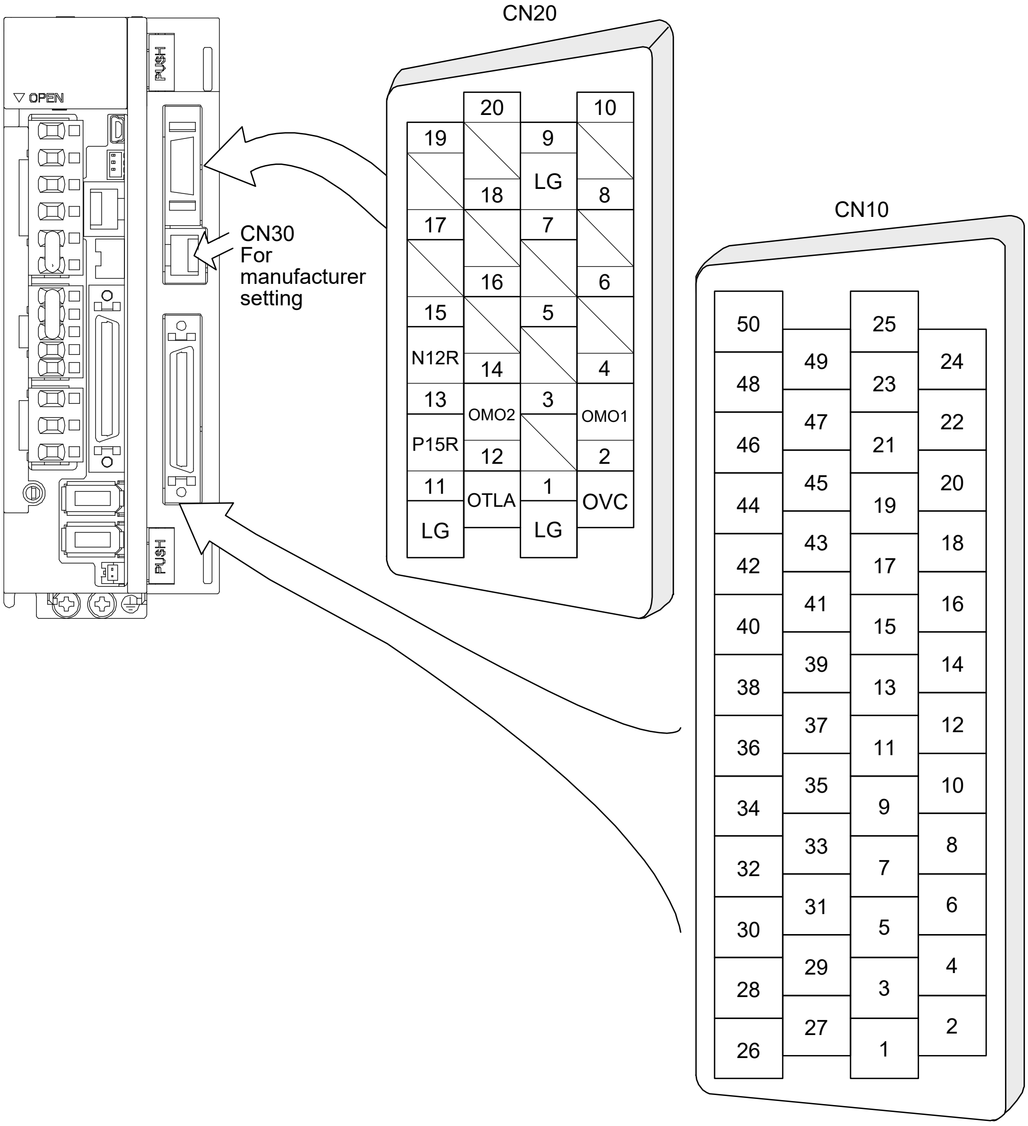
POINT

- The pin assignment of the connectors is as viewed from the cable connector wiring section.
- The CN30 connector is for manufacturer setting. This connector is attached on the MR-D01 servo amplifier, but not for use.
- For the pin assignment of the CN10 connector, refer to (2) in this section.

For details of each signal (device), refer to section 19.5.3.

(1) Pin assignment

The following shows the front view of the servo amplifier for when MR-J4-10A-RJ and MR-D01 are used.



For the pin assignment, refer to (2) in this section.

(2) Pin assignment of the CN10 connector

Pin No.	(Note 1) I/O	(Note 2) I/O signals in control modes			Related parameter
		P	S	T	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13		DICOMD	DICOMD	DICOMD	
14		DICOMD	DICOMD	DICOMD	
15					
16					
17					
18					Po27
19					Po27
20					Po28
21	I	SON	SON	SON	Po02
22	O	ACD0	ACD0	ACD0	
23	O	ACD1	ACD1	ACD1	
24	O	ACD2	ACD2	ACD2	
25	O	ACD3	ACD3	ACD3	
26	I	RES	RES	RES	Po02
27	I	TL	TL		Po03
28	I	TL1	TL1		Po03
29	I	CM1			Po04
30	I	CM2			Po04
31	I		STAB2	STAB2	Po05
32	I		SP1	SP1	Po05
33					Po06
34	I	PC	PC		Po06
35	I		ST1	RS2	Po07
36	I		ST2	RS1	Po07
37		DOCOMD	DOCOMD	DOCOMD	
38					
39					
40					
41					
42					
43					
44					
45					
46					Po08
47					Po08
48					Po09
49	O	INP	SA		Po09
50		SD	SD	SD	

Note 1. I: Input signal, O: Output signal

2. P: Position control mode
S: Speed control mode
T: Torque control mode

19.5.3 Signal (device) explanations

This section describes the signals (devices) of the MR-D01 extension I/O unit.
The connector pin No. column in the table lists the pin Nos. which devices are assigned to by default.
For the I/O interfaces (symbols in the I/O division column in the table), refer to section 19.5.4 (2).
The symbols in the control mode field of the table shows the followings.
P: Position control mode
S: Speed control mode
T: Torque control mode
"○" and "△" of the table shows the followings.
○: Usable device by default.
△: Usable device by setting the following parameters.
[Pr. Po02] to [Pr. Po09], [Pr. Po27], and [Pr. Po28]

(1) I/O device

(a) Input device

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Servo-on	SON	CN10-21	Same as when a servo amplifier is used alone. Refer to section 3.5 (1) (a).	DI-1	○	○	○
Reset	RES	CN10-26		DI-1	○	○	○
Forward rotation stroke end	LSP			DI-1	△	△	△
Reverse rotation stroke end	LSN						
External torque limit selection	TL	CN10-27		DI-1	○	○	
Internal torque limit selection	TL1	CN10-28		DI-1	○	○	
Forward rotation start	ST1	CN10-35		DI-1		○	
Reverse rotation start	ST2	CN10-36					
Forward rotation selection	RS1	CN10-36		DI-1			○
Reverse rotation selection	RS2	CN10-35					
Speed selection 1	SP1	CN10-32		DI-1		○	○
Speed selection 2	SP2			DI-1		△	△
Speed selection 3	SP3			DI-1		△	△
Proportional control	PC	CN10-34		DI-1	○	○	
Clear	CR			DI-1	△		
Electronic gear selection 1	CM1	CN10-29		DI-1	○		
Electronic gear selection 2	CM2	CN10-30		DI-1	○		
Gain switching	CDP			DI-1	△	△	
Control switching	LOP			DI-1	Refer to function and application column		
Second acceleration/deceleration selection	STAB2	CN10-31		DI-1		○	○
Fully closed loop selection	CLD			DI-1	△		
Motor-side/load-side deviation counter clear	MECR			DI-1	△		

(b) Output device

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Malfunction	ALM		Same as when a servo amplifier is used alone. Refer to section 3.5 (1) (b).	DO-1	△	△	△
Dynamic brake interlock	DB			DO-1	△	△	△
Ready	RD			DO-1	△	△	△
In-position	INP	CN10-49		DO-1	○		
Speed reached	SA	CN10-49		DO-1		○	
Limiting speed	VLC			DO-1			△
Limiting torque	TLC			DO-1	△	△	
Zero speed detection	ZSP			DO-1	△	△	△
Electromagnetic brake interlock	MBR			DO-1	△	△	△
Warning	WNG			DO-1	△	△	△
Battery warning	BWNG			DO-1	△	△	△
Alarm code 0	ACD0	(CN10-22)	To use these signals, set [Pr. Po12] to "_ _ _ 1". For details of the alarm codes, refer to chapter 8.	DO-1	△	△	△
Alarm code 1	ACD1	(CN10-23)		DO-1			
Alarm code 2	ACD2	(CN10-24)		DO-1			
Alarm code 3	ACD3	(CN10-25)		DO-1			
Absolute position undetermined	ABSV		Same as when a servo amplifier is used alone. Refer to section 3.5 (1) (b).	DO-1	△		
During tough drive	MTTR			DO-1	△	△	△
During fully closed loop control	CLDS			DO-1	△		

(2) Input signal

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Analog torque limit	OTLA	CN20-12	To use this signal, set [Pr. Po11] to "_ 1 _ _". When OTLA is enabled, torque is limited in the full servo motor output torque range. Apply 0 V to +10 V DC between OTLA and LG. Connect + of the power supply to OTLA. The maximum torque is generated at +10 V. Resolution: 12 bits	Analog input	○	○	○
Analog torque command	OTC		To use this signal, set [Pr. Po11] to "_ 1 _ _". This is used to control torque in the full servo motor output torque range. Apply 0 V to ±8 V DC between OTC and LG. The maximum torque is generated at ±8 V. (Refer to section 3.6.3 (1).) The torque at ±8 V can be changed with [Pr. PC13]. If a value equal to or larger than the maximum torque is input to OTC, the value is clamped at the maximum torque.	Analog input			○
Analog speed command	OVC	CN20-2	To use this signal, set [Pr. Po11] to "_ _ 1 _". The signal controls the servo motor setting speed by applying -10 V to +10 V DC to between OVC and LG. The percentage will be 0% with -10 V, 100% with 0 V, and 200% with +10 V to the servo motor setting speed. Resolution: 12 bits	Analog input		○	
Analog speed limit	OVLA		To use this signal, set [Pr. Po11] to "_ _ 1 _". Apply 0 V to ±10 V DC between OVLA and LG. Speed set in [Pr. PC12] is provided at ±10 V. (Refer to section 3.6.3 (3).) If a limited value equal to or larger than the permissible speed is input to OVLA, the value is clamped at the permissible speed.	Analog input			○

(3) Output signal

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Analog monitor 1	OMO1	CN20-4	This signal outputs the data set in [Pr. Po13] to between OMO1 and LG in terms of voltage. Resolution: 12 bits or equivalent	Analog output	○	○	○
Analog monitor 2	OMO2	CN20-14	This signal outputs the data set in [Pr. Po14] to between OMO2 and LG in terms of voltage. Resolution: 12 bits or equivalent	Analog output	○	○	○

(4) Power supply

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
MR-D01 digital I/F power supply input	DICOMD	CN10-13 CN10-14	Input 24 V DC (24 V DC ± 10% 500 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 the 24 V DC external power supply.		○	○	○
MR-D01 digital I/F power supply input	DOCOMD	CN10-37	Common terminal of input signals such as SON, RES, and others 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 the 24 V DC external power supply.		○	○	○
15 V DC power supply	P15R	CN20-13	This outputs 15 V DC to between P15R and LG. This is available as the power for TC/TLA/VC/VLA. Permissible current: 30 mA		○	○	○
-12 V DC power supply	N12R	CN20-15	This outputs -12 V DC to between N12R and LG. This is available as the power for VC. However, the voltage varies within the range of -12 V to -15 V. Permissible current: 30 mA		○	○	○
Control common	LG	CN20-1 CN20-9	Common terminal of OTLA, OVC, OMO1, OMO2, P15R, and N12R. Pins are connected internally.		○	○	○
Shield	SD	CN10-50 Plate	Connect the external conductor of the shielded wire.		○	○	○

(5) Torque limit

⚠CAUTION

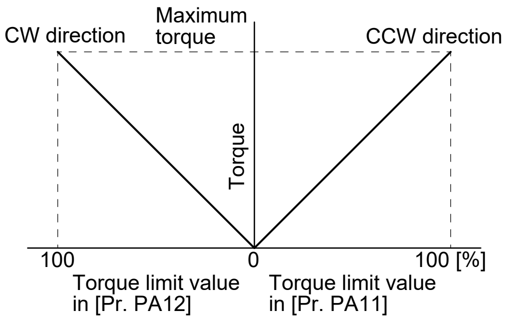
- If the torque limit is canceled during servo-lock, the servo motor may suddenly rotate according to position deviation in respect to the command position.
- When using the torque limit, check that [Pr. PB06 Load to motor inertia ratio] is set properly. Improper settings may cause an unexpected operation such as an overshoot.

POINT

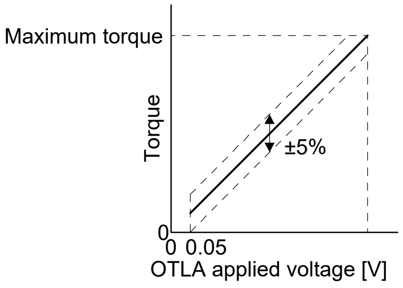
- To use OTLA (Analog torque limit), set [Pr. Po11] to "_ 1 _ _".

(a) Torque limit and torque

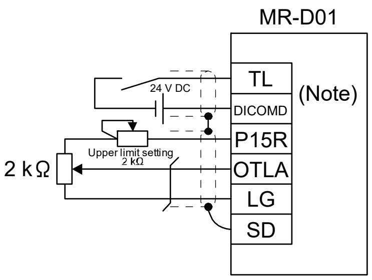
By setting [Pr. PA11 Forward rotation torque limit] or [Pr. PA12 Reverse rotation torque limit], torque is always limited to the maximum value during operation. A relation between the limit value and servo motor torque is as follows.



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



OTLA applied voltage vs. torque limit value



Connection example

Note. This diagram shows sink I/O interface. For source I/O interface, refer to section 19.5.4 (5).

(b) Torque limit value selection

The following shows how to select a torque limit using TL (External torque limit selection) from [Pr. PA11 Forward torque limit] or [Pr. PA12 Reverse torque limit] and OTLA (Analog torque limit). When TL1 (Internal torque limit selection) is enabled with [Pr. Po02] to [Pr. Po07], [Pr. Po27], and [Pr. Po28], you can select [Pr. PC35 internal torque limit 2/Internal thrust limit 2].

However, if [Pr. PA11] and [Pr. PA12] value is less than the limit value selected by TL/TL1, [Pr. PA11] and [Pr. PA12] value will be enabled.

Input device (Note 1)		Limit value status			Enabled torque limit value	
TL1	TL				CCW power running/ CW regeneration	CW power running/ CCW regeneration
0	0				Pr. PA11	Pr. PA12
0	1	OTLA	>	Pr. PA11 Pr. PA12	Pr. PA11	Pr. PA12
		OTLA	<	Pr. PA11 Pr. PA12	OTLA (Note 2)	OTLA (Note 3)
1	0	Pr. PC35	>	Pr. PA11 Pr. PA12	Pr. PA11	Pr. PA12
		Pr. PC35	<	Pr. PA11 Pr. PA12	Pr. PC35 (Note 2)	Pr. PC35 (Note 3)
1	1	OTLA	>	Pr. PC35	Pr. PC35 (Note 2)	Pr. PC35 (Note 3)
		OTLA	<	Pr. PC35	OTLA (Note 2)	OTLA (Note 3)

Note 1. 0: Off
1: On
2. When [Pr. PD33] is set to "_ 2 _ _", the value in [Pr. PA11] is applied.
3. When [Pr. PD33] is set to "_ 1 _ _", the value in [Pr. PA12] is applied.

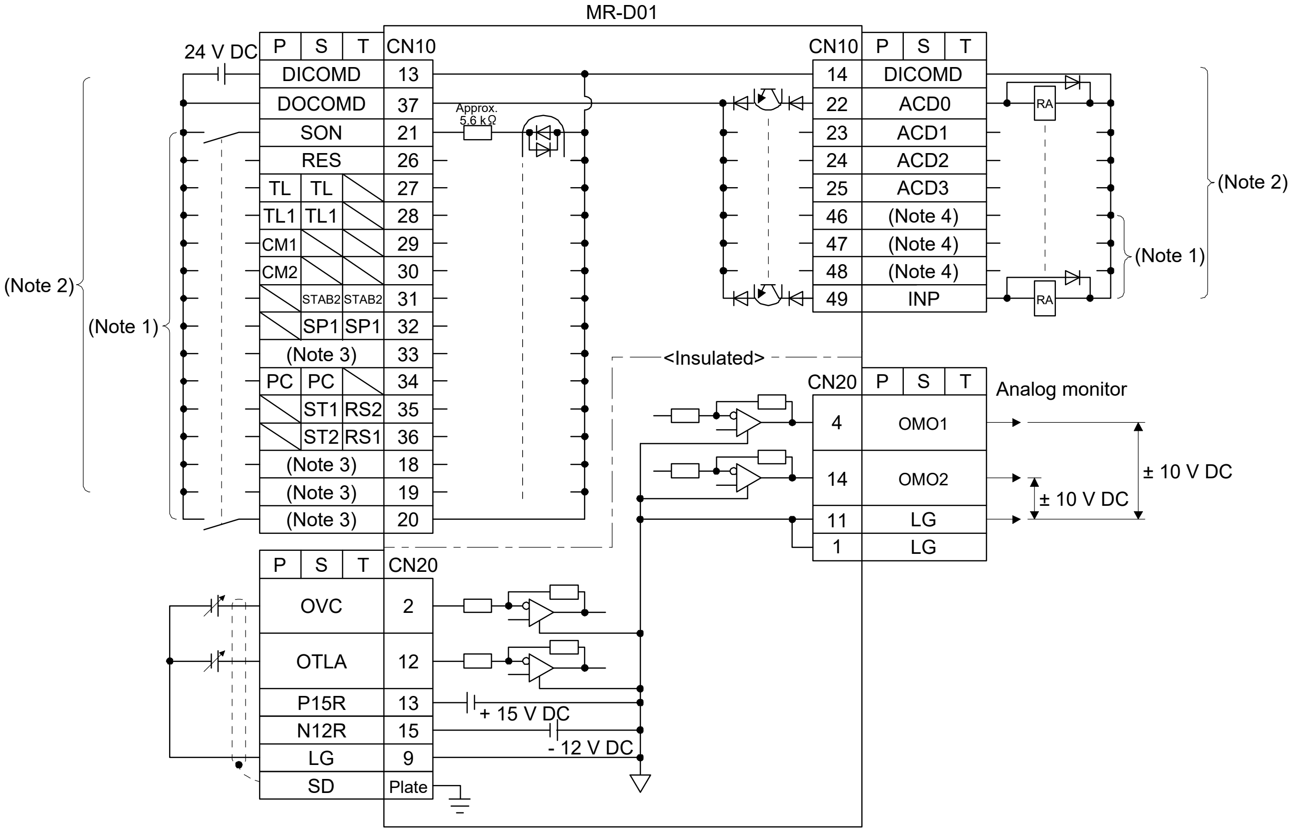
(c) TLC (Limiting torque)

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

19.5.4 Interface

(1) Internal connection diagram

The following shows an example of internal connection diagram of the position control mode. For the internal connection diagram of the servo amplifier, refer to section 3.9.1.



Note 1. The devices can be changed by [Pr. Po02] to [Pr. Po09], [Pr. Po27], and [Pr. Po28].

2. This diagram shows sink I/O interface. For source I/O interface, refer to (5) in this section.

3. Input devices are not assigned by default. Assign the input devices with [Pr. Po06], [Pr. Po27], and [Pr. Po28] as necessary.

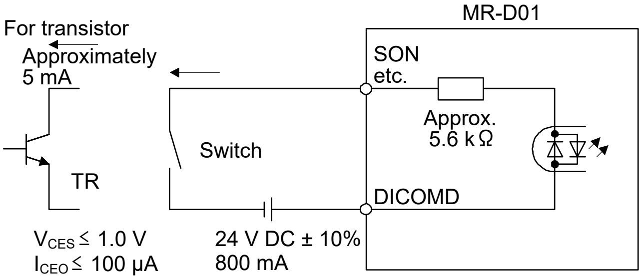
4. Output devices are not assigned by default. Assign the output devices with [Pr. Po08] and [Pr. Po09] as necessary.

(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 19.5.3. Refer to the following and make connection with the external device.

(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. The following is a connection diagram for sink input.



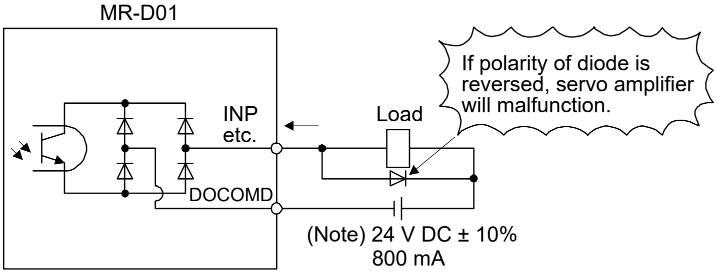
(b) Digital output interface DO-1

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 servo amplifier.

The following shows a connection diagram for sink output.

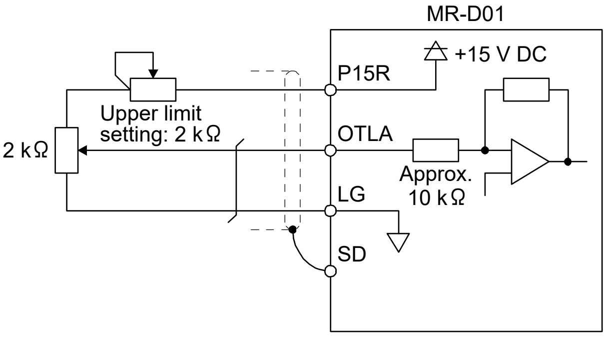


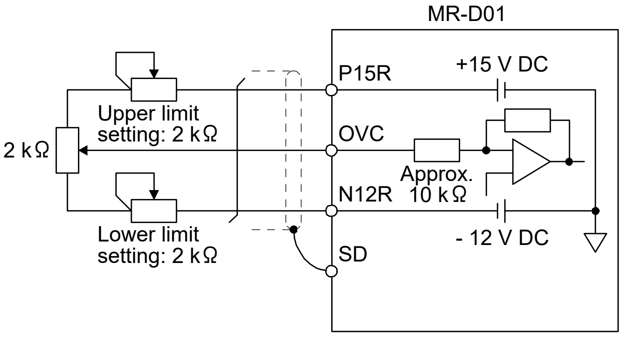
Note. If the voltage drop (maximum of 2.6 V) interferes with the relay operation, apply a high voltage (maximum of 26.4 V) from an external source.

(3) Analog input

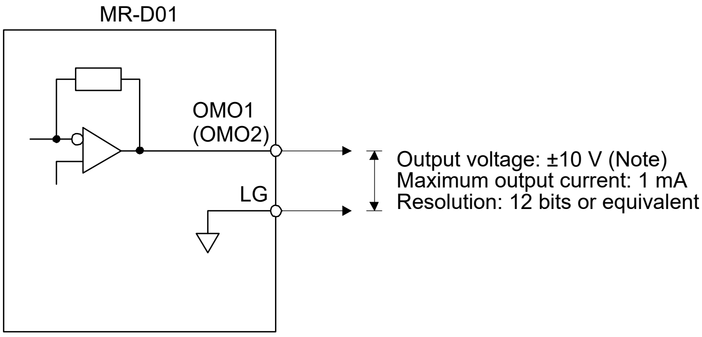
Input impedance

10 kΩ to 12 kΩ





(4) Analog output



Output voltage: ±10 V (Note)
Maximum output current: 1 mA
Resolution: 12 bits or equivalent

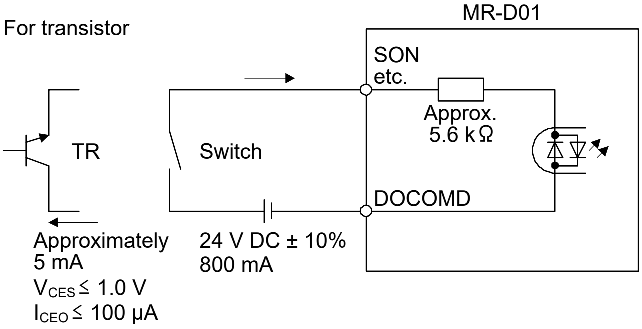
Note. Output voltage range varies depending on the monitored signal. When connecting analog output to an external device, use the withstand voltage of 15 V DC or higher.

(5) Source I/O interface

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

(a) Digital input interface DI-1

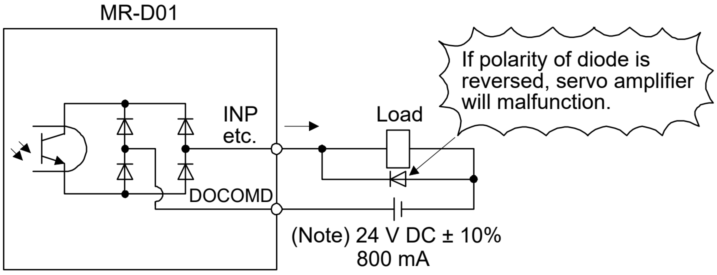
This is an input circuit in which the anode of the photocoupler is the input terminal. Transmit signals from a source (open-collector) type transistor output, relay switch, etc.



(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, the current will flow from the output terminal to a load.

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



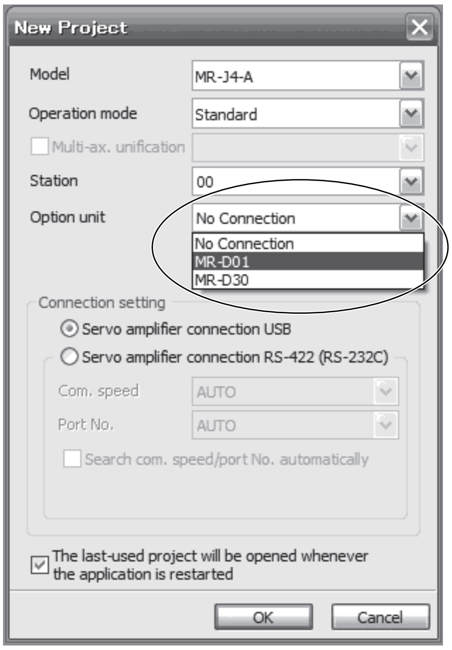
Note. If the voltage drop (maximum of 2.6 V) interferes with the relay operation, apply a high voltage (maximum of 26.4 V) from an external source.

19.6 Monitor display with MR Configurator2

The following shows how to display the input/output monitor with MR Configurator2 when MR-D01 has been connected.

(1) Initial setting

When MR-D01 has been connected, click "MR-D01" from the "Option unit" menu in the creating new project window of MR Configurator2.



New Project

Model: MR-J4-A

Operation mode: Standard

☐ Multi-ax. unification

Station: 00

Option unit: No Connection

Connection setting

● Servo amplifier connection USB

○ Servo amplifier connection RS-422 (RS-232C)

Com. speed: AUTO

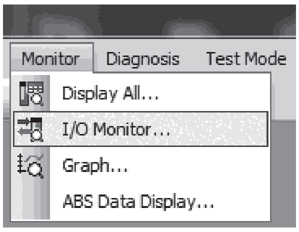
Port No.: AUTO

☐ Search com. speed/port No. automatically

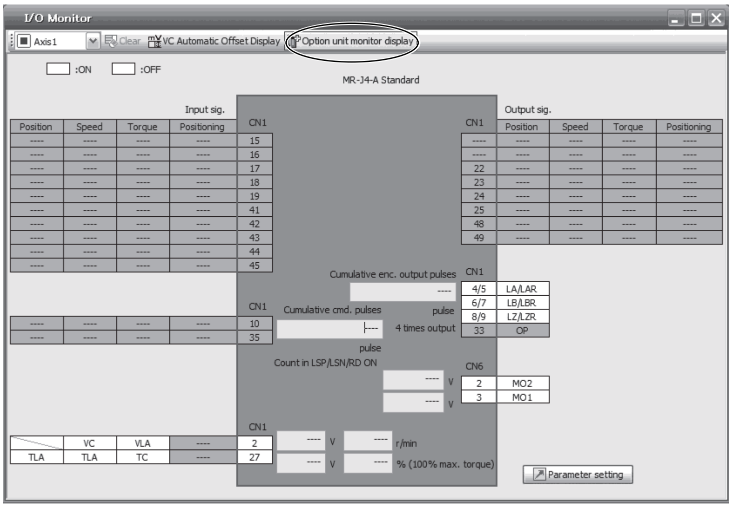
☑ The last-used project will be opened whenever the application is restarted

(2) How to open the optional unit monitor window

Click "Monitor" in the menu bar and "I/O Monitor" from the menu.



The following window is displayed. Click "Option unit monitor" in the menu bar.



Position	Speed	Torque	Positioning	CN1
----	----	----	----	15
----	----	----	----	16
----	----	----	----	17
----	----	----	----	18
----	----	----	----	19
----	----	----	----	41
----	----	----	----	42
----	----	----	----	43
----	----	----	----	44
----	----	----	----	45
----	----	----	----	10
----	----	----	----	35

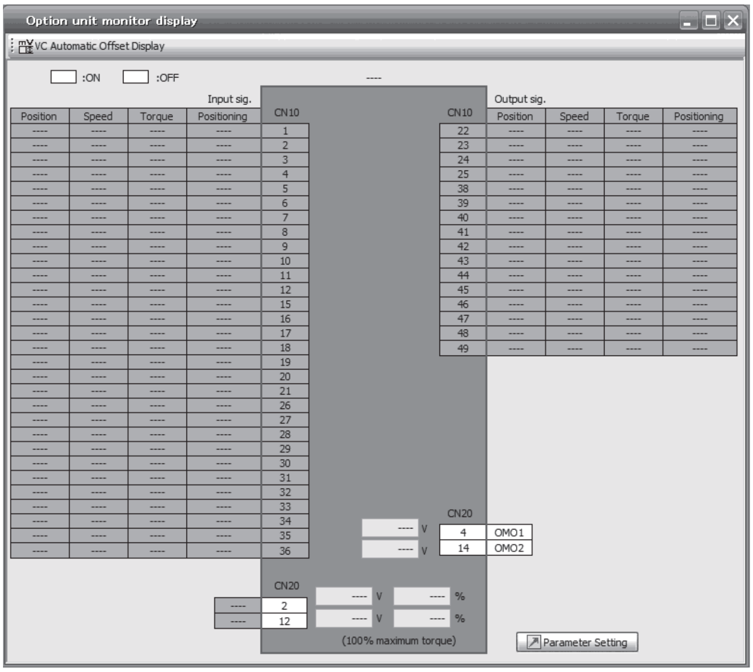
CN1	Position	Speed	Torque	Positioning
----	----	----	----	----
----	----	----	----	----
22	----	----	----	----
23	----	----	----	----
24	----	----	----	----
25	----	----	----	----
48	----	----	----	----
49	----	----	----	----

CN1	
4/5	LA/LAR
6/7	LB/LBR
8/9	LZ/LZR
33	OP

CN6	
2	MO2
3	MO1

				CN1
	VC	VLA	----	2
TLA	TLA	TC	----	27

The following window is displayed. The input/output monitor on the MR-D01 side can be checked.



Position	Speed	Torque	Positioning	CN10
----	----	----	----	1
----	----	----	----	2
----	----	----	----	3
----	----	----	----	4
----	----	----	----	5
----	----	----	----	6
----	----	----	----	7
----	----	----	----	8
----	----	----	----	9
----	----	----	----	10
----	----	----	----	11
----	----	----	----	12
----	----	----	----	15
----	----	----	----	16
----	----	----	----	17
----	----	----	----	18
----	----	----	----	19
----	----	----	----	20
----	----	----	----	21
----	----	----	----	26
----	----	----	----	27
----	----	----	----	28
----	----	----	----	29
----	----	----	----	30
----	----	----	----	31
----	----	----	----	32
----	----	----	----	33
----	----	----	----	34
----	----	----	----	35
----	----	----	----	36

CN10	Position	Speed	Torque	Positioning
22	----	----	----	----
23	----	----	----	----
24	----	----	----	----
25	----	----	----	----
38	----	----	----	----
39	----	----	----	----
40	----	----	----	----
41	----	----	----	----
42	----	----	----	----
43	----	----	----	----
44	----	----	----	----
45	----	----	----	----
46	----	----	----	----
47	----	----	----	----
48	----	----	----	----
49	----	----	----	----

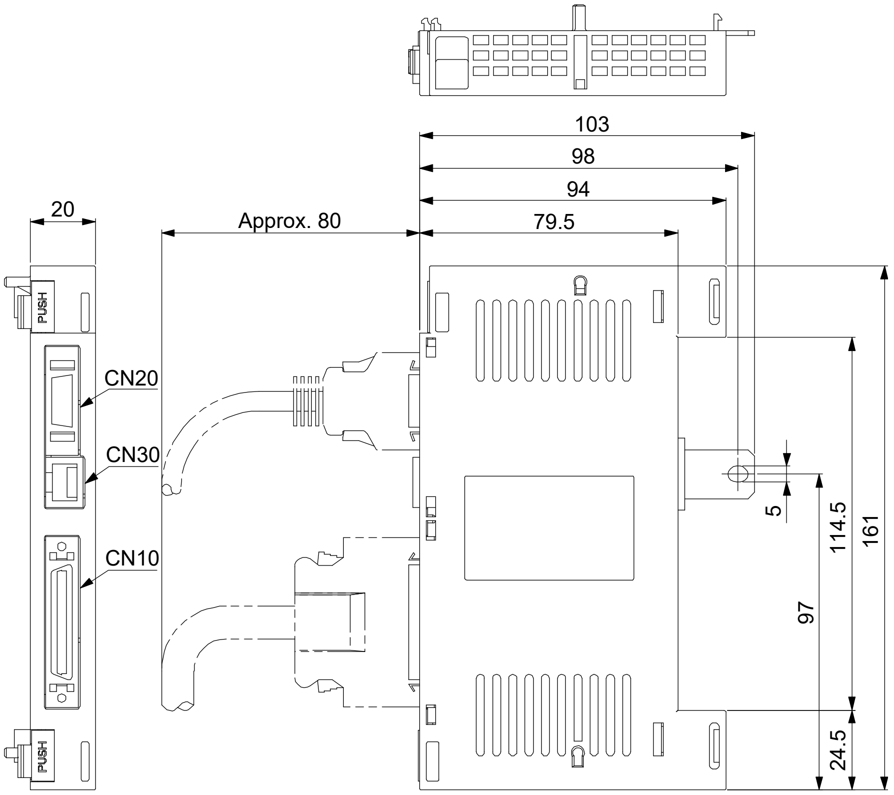
CN20	
4	OMO1
14	OMO2

	CN20
----	2
----	12

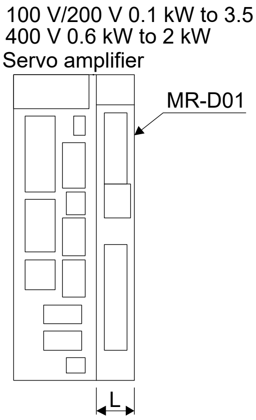
19.7 Dimensions

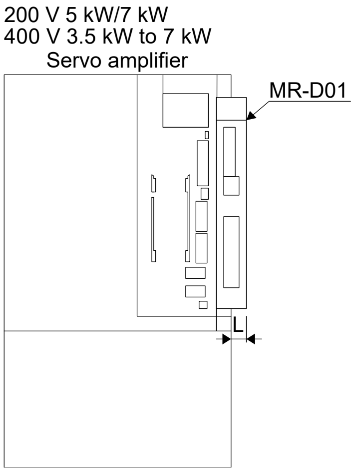
19.7.1 MR-D01 extension I/O unit

[Unit: mm]



19.7.2 When an MR-D01 extension IO unit is connected to a servo amplifier

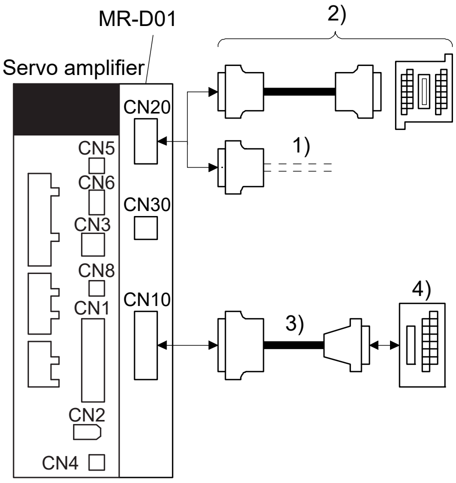


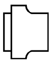
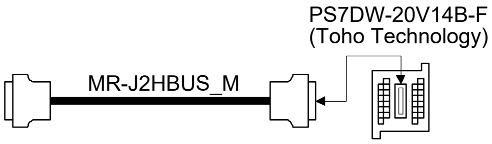


Servo amplifier	L [mm]
MR-J4-10A1-RJ to MR-J4-40A1-RJ MR-J4-10A-RJ to MR-J4-100A-RJ MR-J4-60A4-RJ to MR-J4-100A4-RJ	20
MR-J4-200A-RJ/MR-J4-350A-RJ MR-J4-200A4-RJ	15
MR-J4-500A-RJ/MR-J4-700A-RJ MR-J4-350A4-RJ to MR-J4-700A4-RJ	10
MR-J4-11KA-RJ to MR-J4-22KA-RJ MR-J4-11KA4-RJ to MR-J4-22KA4-RJ	0

19.8 Options peripheral equipment

19.8.1 Combinations of cable/connector sets

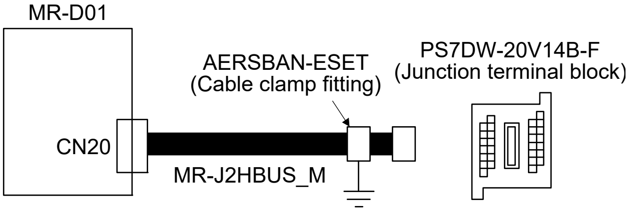


No.	Product name	Model	Description	Application
1)	Connector set	MR-CCN1	 Connector: 10120-3000PE Shell kit: 10320-52F0-008 (3M or equivalent)	
2)	Junction terminal block (recommended)		 Junction terminal block PS7DW-20V14B-F is not option. For using the junction terminal block, option MR-J2HBUS_M is necessary. Refer to section 19.8.2 for details.	
3)	Junction terminal block cable	MR-J2M-CN1TBL_M Cable length: 0.5, 1 m (Refer to section 19.9.3.)	Junction terminal block connector Connector: D7950-B500FL (3M) CN10 connector Connector: 10150-6000EL Shell kit: 10350-3210-000 (3M or equivalent) 	For junction terminal block connection
4)	Junction terminal block	MR-TB50	Refer to section 19.8.3.	

19.8.2 PS7DW-20V14B-F (Junction terminal block) (recommended)

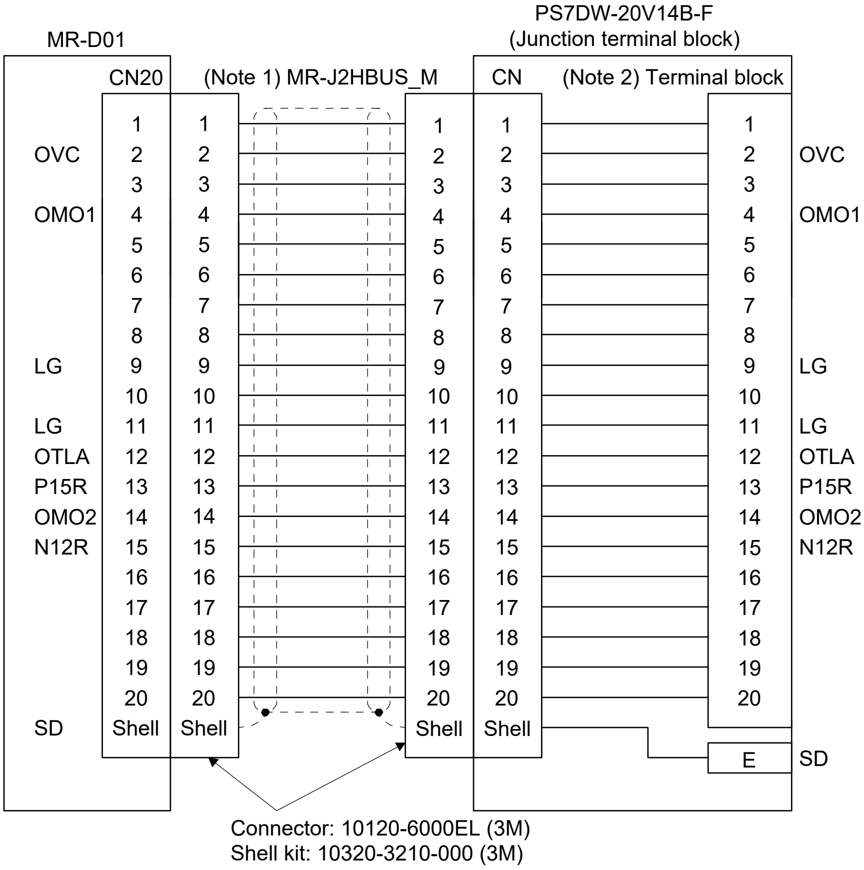
(1) Usage

Always use the PS7DW-20V14B-F (Junction terminal block) (Toho Technology)) with the option cable (MR-J2HBUS_M) as a set. A connection example is shown below.



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

(2) Connection of MR-J2HBUS_M cable and junction terminal block

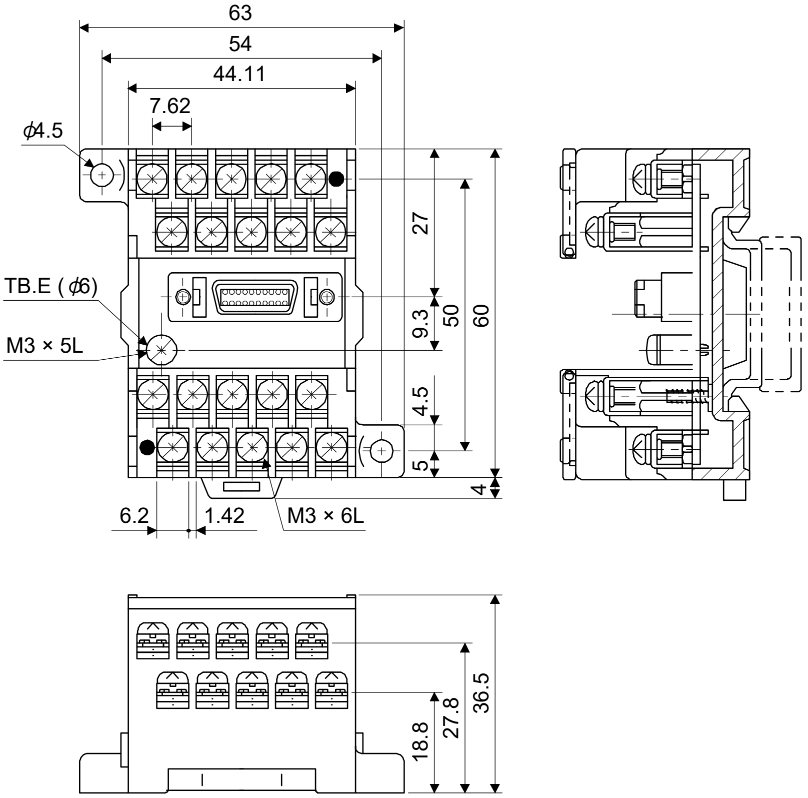


Note 1. Symbol indicating cable length is put in _.
05: 0.5 m
1: 1 m
5: 5 m

2. Do not connect anything to the terminal where no signal has been assigned.

(3) Dimensions of junction terminal block

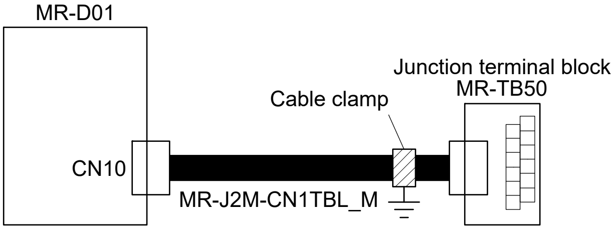
[Unit: mm]



19.8.3 MR-TB50 (Junction terminal block)

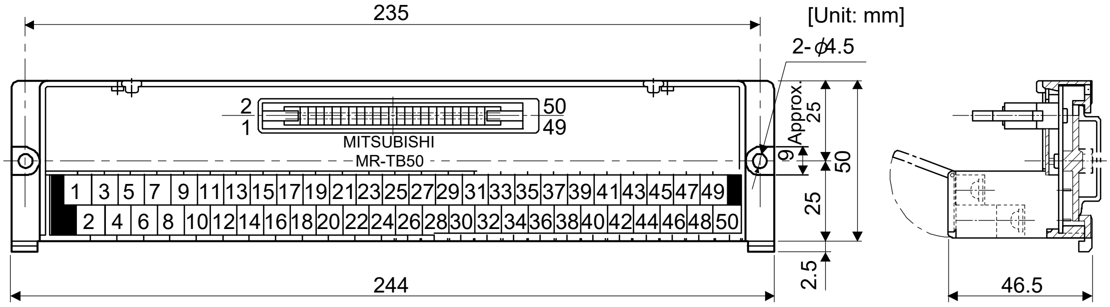
(1) Usage

Always use MR-TB50 (Junction terminal block) with MR-J2M-CN1TBL_M (Junction terminal block cable) as a set.



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

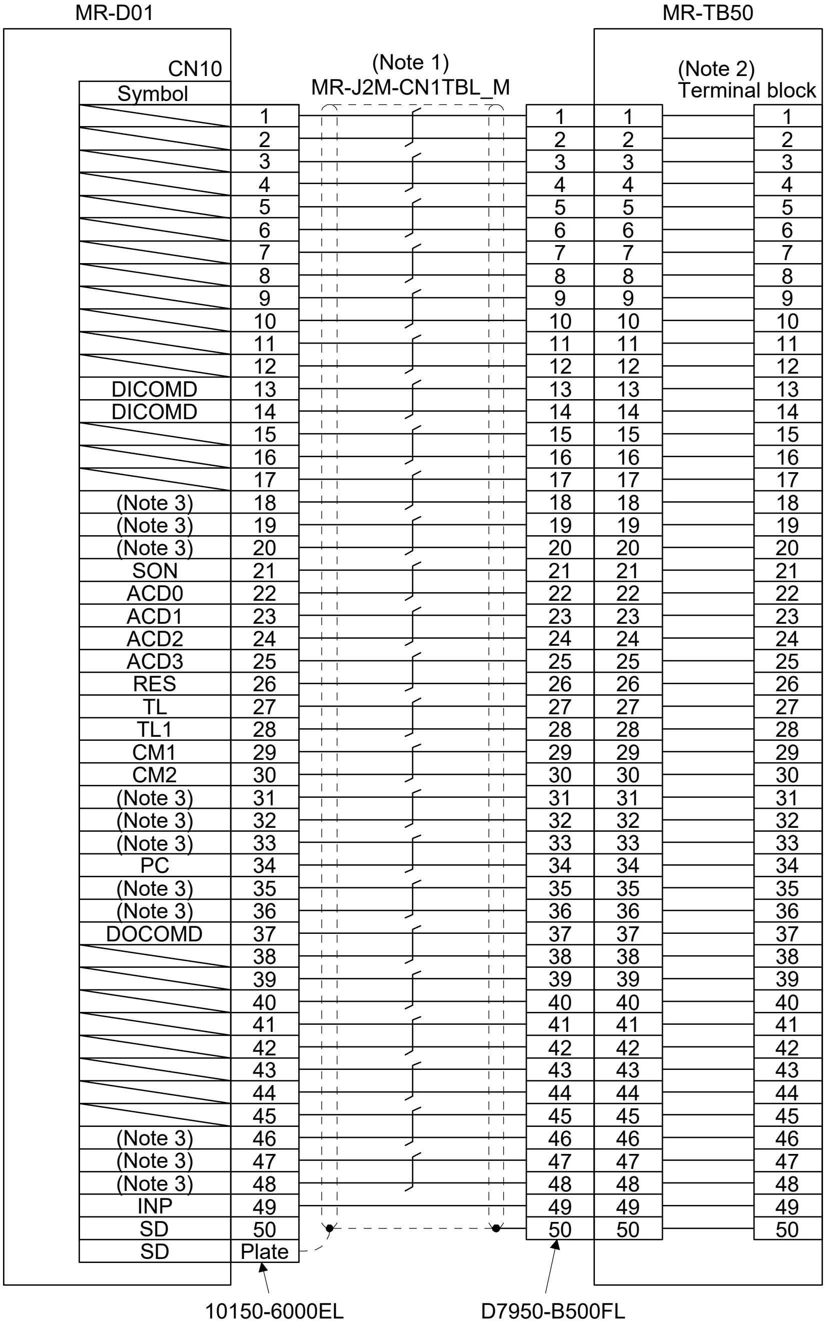
(2) Dimensions of MR-TB50



Screw size: M3.5
Applicable wire: 2 mm^2
Crimp terminal width: 7.2 mm or less

(3) Connection diagram of MR-J2M-CN1TBL_M cable and MR-TB50

The following connection diagram shows for position control mode as an example.



Note 1. Symbol indicating cable length is put in _.
05: 0.5 m
1: 1 m
2. Do not connect anything to the terminal where no signal has been assigned.
3. Output devices are not assigned by default. Assign the output devices with [Pr. Po05] to [Pr. Po09], [Pr. Po27], and [Pr. Po28] as necessary.

APPENDIX

App. 1 Peripheral equipment manufacturer (for reference)

Manufacturer names given in the table are as of September 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 Ltd. Company
TDK	TDK Corporation
Molex	Molex Japan LLC
Toho Technology	Toho Technology Corp., Kyoto Factory
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		

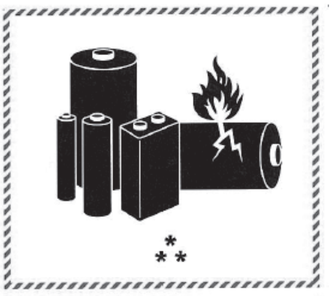
(b) Transportation of lithium metal batteries packed with or contained in equipment

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

Symbol for the new EU Battery Directive (2006/66/EC) that is plastered to general-purpose AC servo battery is explained here.

Note. This symbol 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 switching 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 and guidelines mentioned in this Instruction Manual and the requirements mentioned 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.

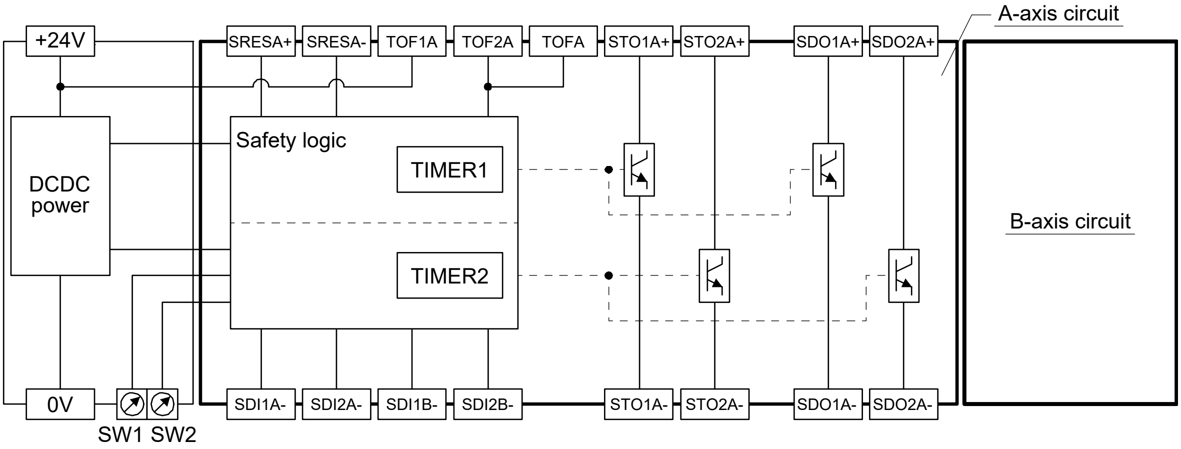
(7) Perform all risk assessments and safety level certification to the machine or the system as a whole.
It is recommended that a Certification Body final safety certification of the system be used.

(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.

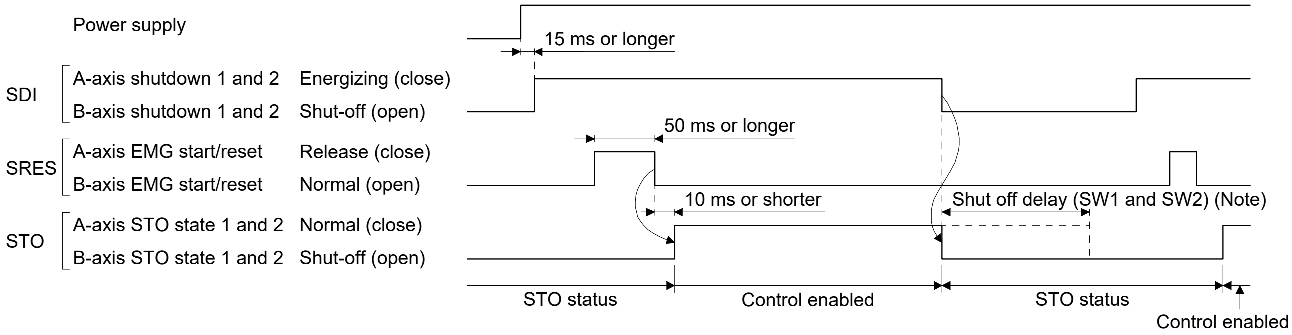
(9) If the upper and lower power module in the servo amplifier are shorted and damaged simultaneously, the servo motor may make a half revolution at a maximum.

App. 5.5 Block diagram and timing chart

(1) Function block diagram



(2) Operation sequence



Note. Refer to App. 5.10.

App. 5.6 Maintenance and disposal

MR-J3-D05 is equipped with LED displays to check errors for maintenance.
Please dispose this unit according to your local laws and regulations.

App. 5.7 Functions and configuration

App. 5.7.1 Summary

MR-J3-D05 has two systems in which the each system has SS1 function (delay time) and output of STO function.

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 type		Photocoupler insulation, open-collector type Permissible current: 40 mA/1 output, Inrush current: 100 mA/1 output
Delay time setting		A-axis: Select from 0 s, 1.4 s, 2.8 s, 5.6 s, 9.8 s, or 30.8 s. B-axis: Select from 0 s, 1.4 s, 2.8 s, 9.8 s, or 30.8 s. Accuracy: ±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 [year] (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.

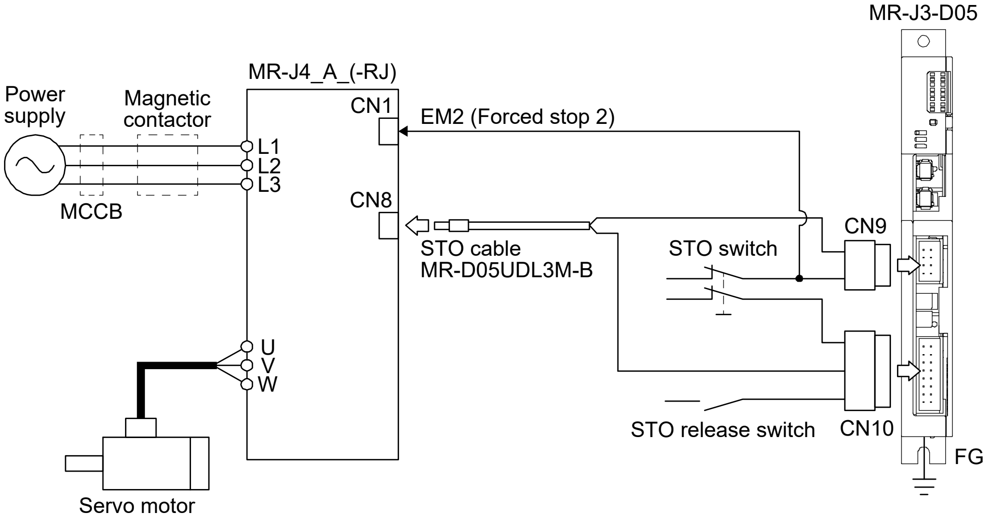
4. For the test pulse input, contact your local sales office.

App. 5.7.3 When using MR-J3-D05 with an MR-J4 series servo amplifier

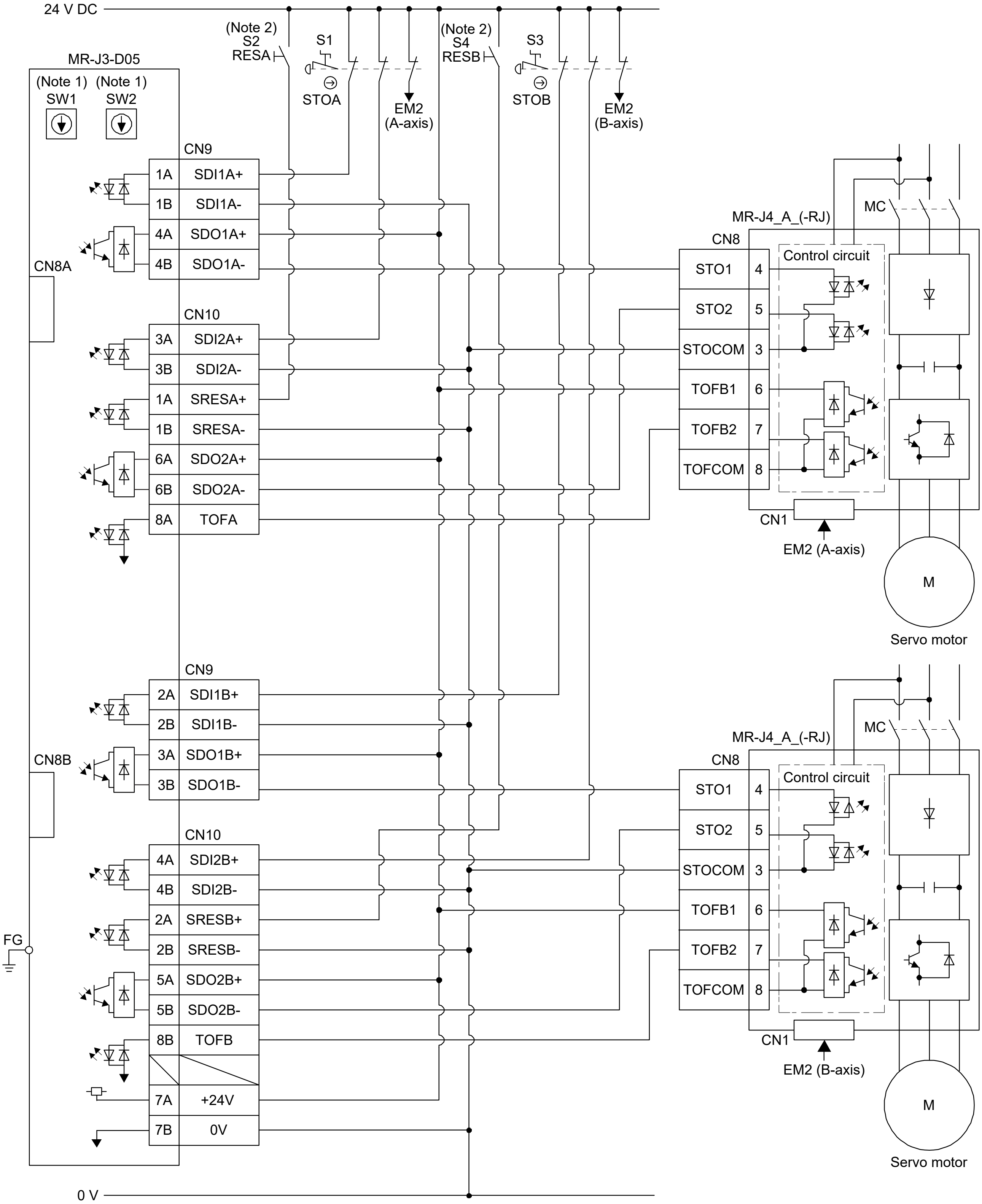
(1) System configuration diagram

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.	

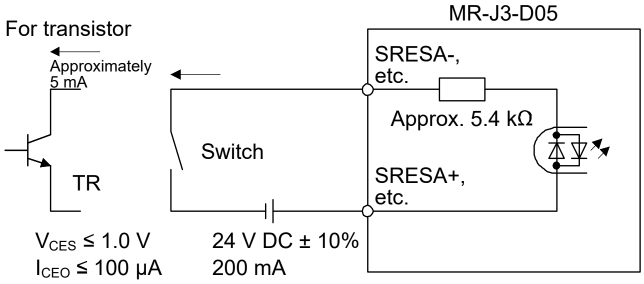
App. 5.8.2 Interfaces

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

(1) Sink I/O interface (CN9, CN10 connector)

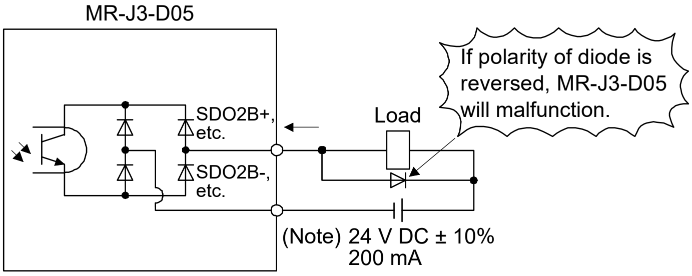
(a) Digital input interface DI-1

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.

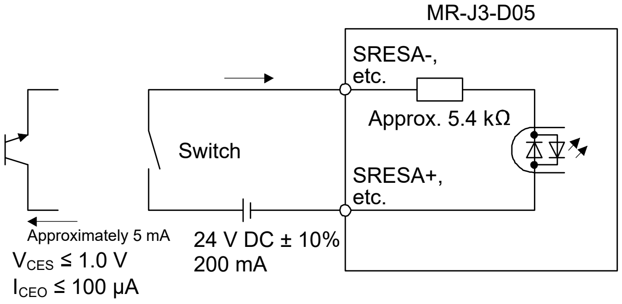


Note. If the voltage drop (maximum of 2.6 V) interferes with the relay operation, apply high voltage (maximum of 26.4 V) from external source.

(2) Source I/O interfaces (CN9, CN10 connector)

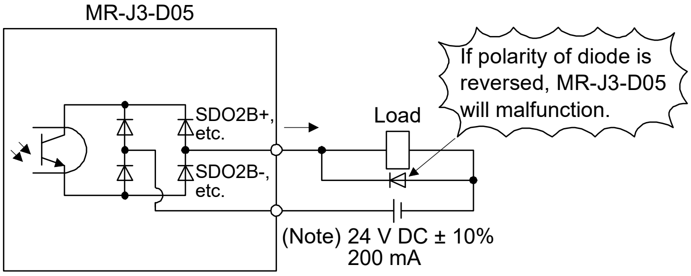
(a) Digital input interface DI-1

This is an input circuit whose photocoupler anode side is 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.

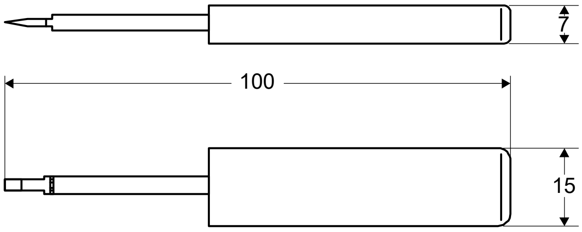
(2) Connecting wires

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]

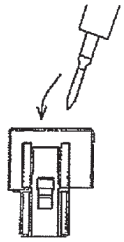


Mass: Approx. 20 g

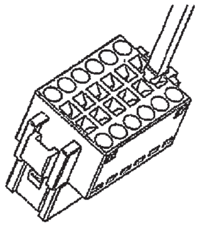
2) Connecting wires

a) Confirm the model number of the housing, contact and tool to be used.

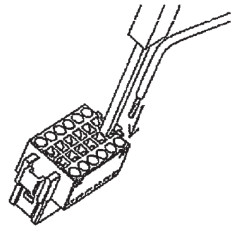
b) Insert the tool diagonally into the receptacle assembly.



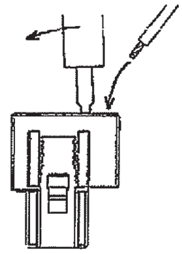
c) Insert the tool until it hits the surface of the receptacle assembly. At this stage, the tool is vertical to the receptacle assembly.



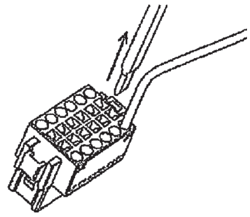
d) Insert wires in the wiring hole till the end. The wires should be slightly twisted in advance to prevent it from being loose.



It is easy to insert the wire if the wire is inserted diagonally while twisting the tool.



e) Remove the tool.

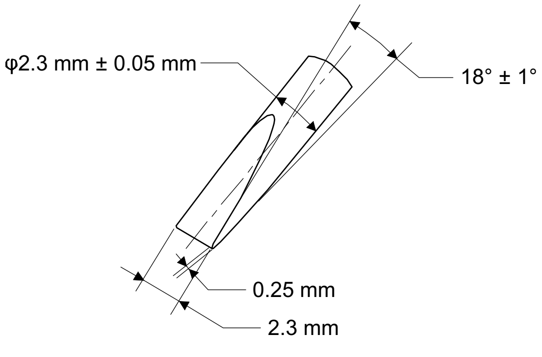


(b) Using a screwdriver

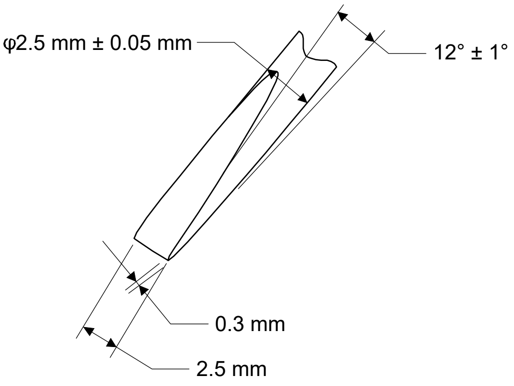
To avoid damaging housings and springs when wiring with screwdriver, do not put excessive force. Be cautious when connecting.

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

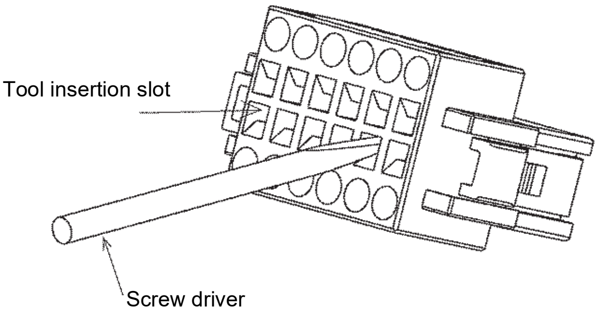
2) Connecting wires

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.

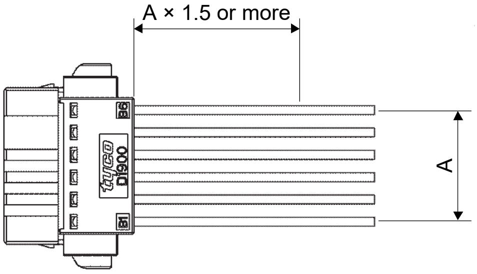
(4) Compatible wire

Compatible wire size is listed below.

Wire size	
mm^2	AWG
0.22	24
0.34	22
0.50	20

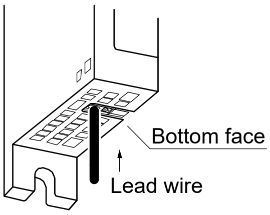
(5) Others

(a) Fix a cable tie keeping a distance of "A" × 1.5 or longer 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



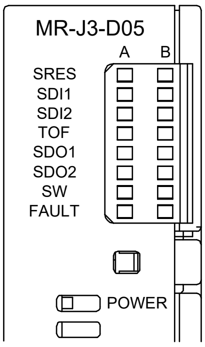
Wire range

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	Description	LED	
		Column A	Column B
SRES	Monitor LED for start/reset Off: The start/reset is off. (The switch contact is opened.) On: The start/reset is on. (The switch contact is closed.)	A-axis	B-axis
SDI1	Monitor LED for shut-off 1 Off: The shut-off 1 is off. (The switch contact is closed.) On: The shut-off 1 is on. (The switch contact is opened.)		
SDI2	Monitor LED for shut-off 2 Off: The shut-off 2 is off. (The switch contact is closed.) On: The shut-off 2 is on. (The switch contact is opened.)		
TOF	Monitor LED for STO state Off: Not in STO state On: In STO state		
SDO1	Monitor LED for SDO1 Off: Not in STO state On: In STO state		
SDO2	Monitor LED for SDO2 Off: Not in STO state On: In STO state		
SW	Monitor LED for confirming shutdown delay setting Off: The settings of SW1 and SW2 do not match. On: The settings of SW1 and SW2 match.		
FAULT	FAULT LED Off: Normal operation (STO monitoring state) On: Fault has occurred.		
POWER	Power supply Off: Power is not supplied to MR-J3-D05. On: Power is being supplied to MR-J3-D05.		

App. 5.10 Rotary switch setting

Rotary switch is used to shut off the power after control stop by SS1 function.
Set the delay time for STO output after the STO shut-off switch is pressed. Set the same setting for SW1 and SW2. The delay time is set according to the rotary switch setting as shown in the following table.
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

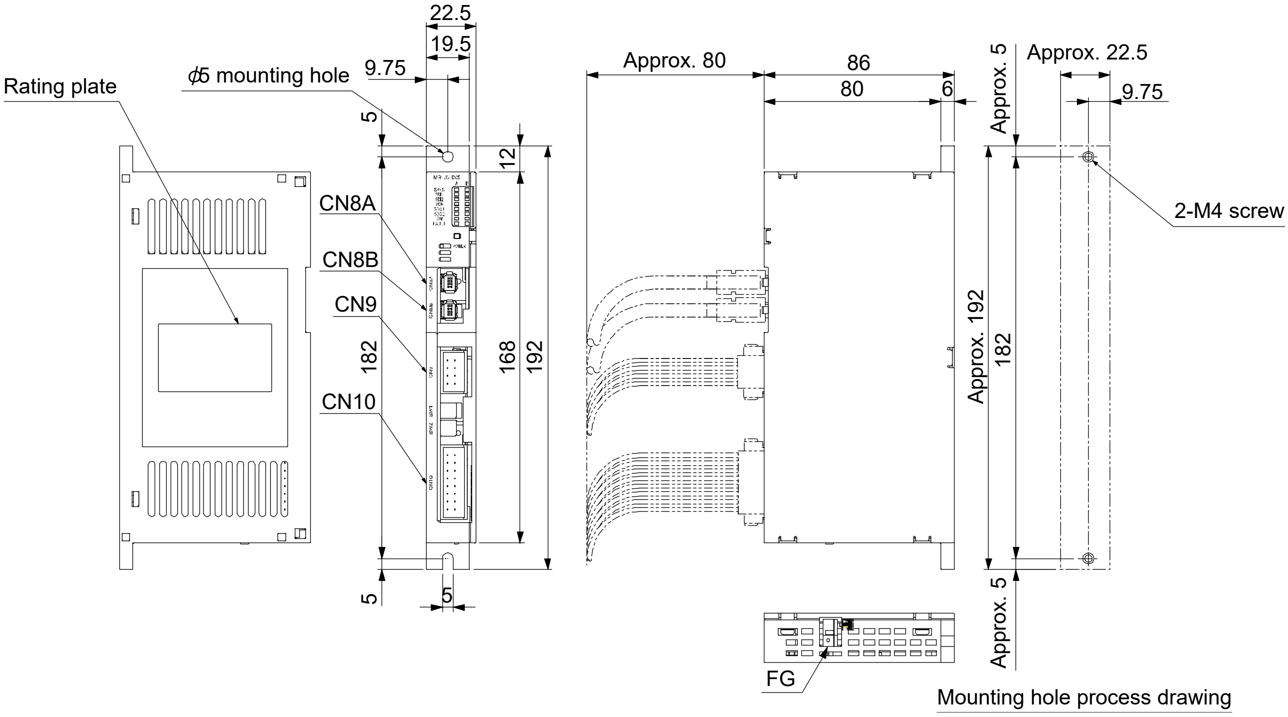
App. 5.11 Troubleshooting

When power is not supplied or FAULT LED turns on, refer the following table and take the appropriate action.

Event	Description	Cause	Action
Power is not supplied.	Power LED does not turn on although power is supplied.	1. 24 V DC power supply is malfunctioning.	Replace the 24 V DC power supply.
		2. Wires between MR-J3-D05 and 24 V DC power supply are disconnected or are in contact with other wires.	Check the wiring.
		3. MR-J3-D05 is malfunctioning.	Replace the MR-J3-D05.
FAULT LED is on.	FAULT LED of A-axis or B-axis is on, and will not turn off.	1. The delay time settings are not matched.	Check the settings of the rotary switch.
		2. Switch input error	Check the wiring or sequence of the input signals.
		3. TOF signal error	Check the connection with the servo amplifier.
		4. MR-J3-D05 is malfunctioning.	Replace the MR-J3-D05.

App. 5.12 Dimensions

[Unit: mm]



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 +24V	7B 0V
8A TOFA	8B TOFB

Mounting screw

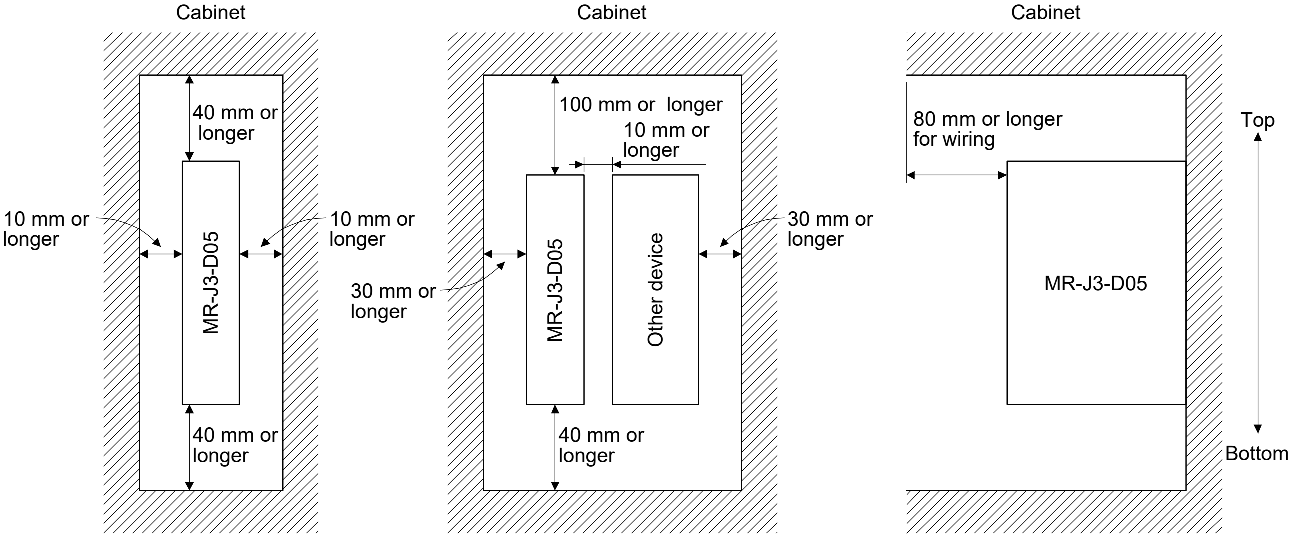
Screw size: M4

Tightening torque: 1.2 N•m

Mass: 0.2 [kg]

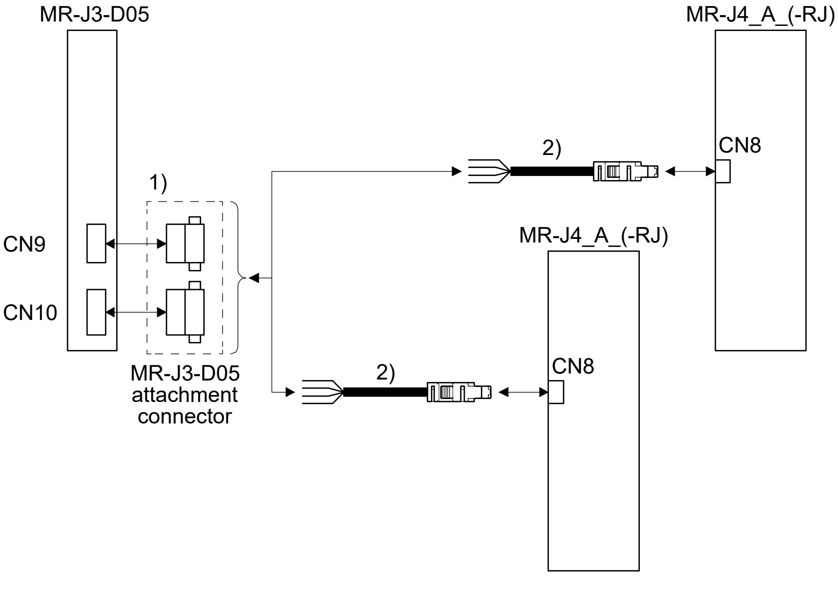
App. 5.13 Installation

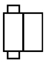
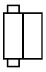
Follow the instructions in this section and install MR-J3-D05 in the specified direction. Leave clearances between MR-J3-D05 and other equipment including the cabinet.



App. 5.14 Combinations of cable/connector

POINT
●MR-D05UDL_M (STO cable) for MR-J3 series cannot be used.



No.	Name	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. 6 How to adjust the error excessive alarm level

The error excessive alarm level can be adjusted as required.

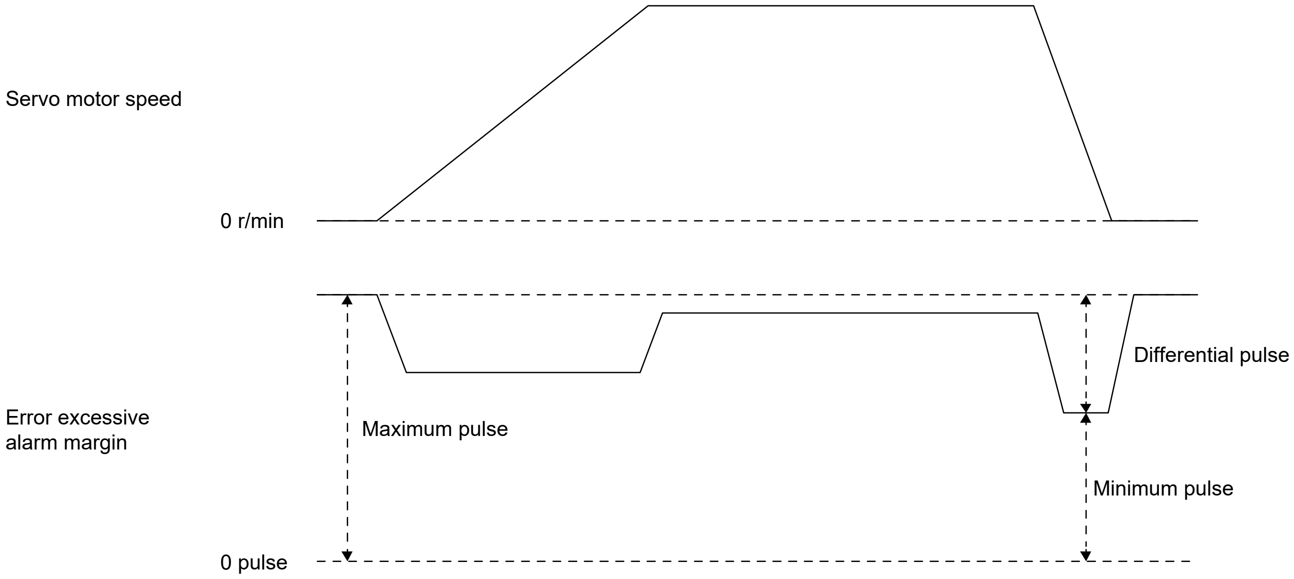
(1) Parameters

The error excessive alarm level can be increased with the following parameters.

Parameter	Symbol	Name	Setting range	Unit
PC43	ERZ	Error excessive alarm level	0 to 1000	[rev or mm]
PC24 "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. PC43] and " x _ _ _ " of [Pr. PC24] so that the following formula is satisfied.

[Pr. PC43] × Unit set with "x _ _ _" of [Pr. PC24] > 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 Analog monitor

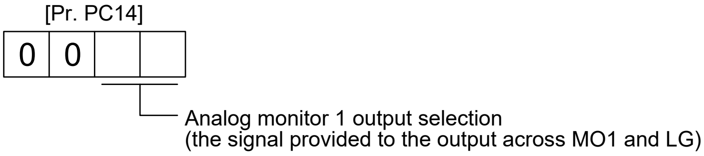
POINT

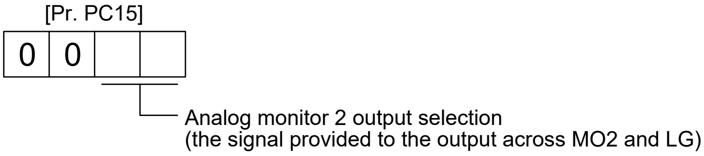
- ●A voltage of analog monitor output may be irregular at power-on.

The servo status can be output to two channels in terms of voltage.

App. 7.1 Setting

Change the following digits of [Pr. PC14] and [Pr. PC15].





[Pr. PC39] and [Pr. PC40] can be used to set the offset voltages to the analog output voltages. The setting range is between -9999 mV and 9999 mV.

Parameter	Description	Setting range [mV]
PC39	This is used to set the offset voltage of MO1 (Analog monitor 1).	-9999 to 9999
PC40	This is used to set the offset voltage of MO2 (Analog monitor 2).	

App. 7.2 Set content

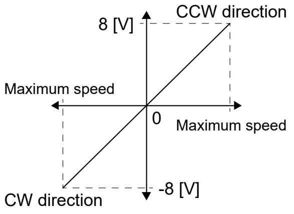
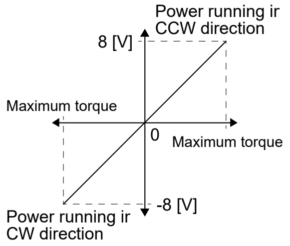
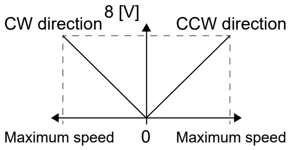
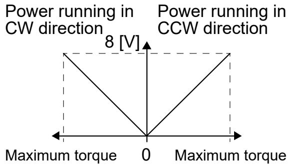
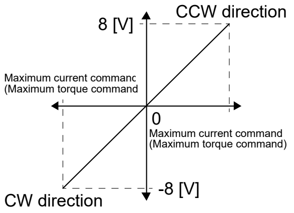
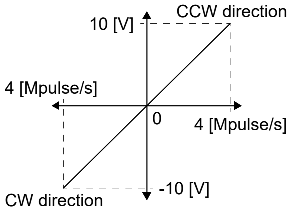
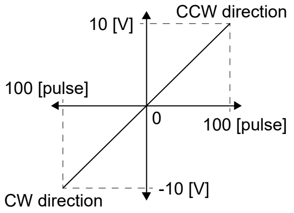
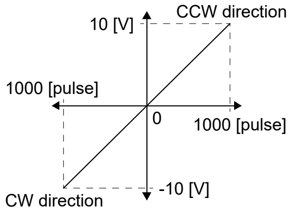
POINT

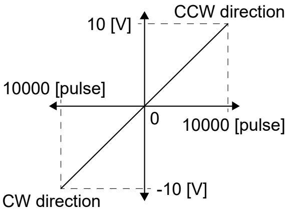
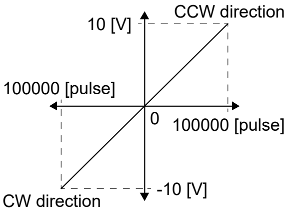
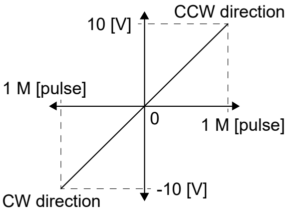
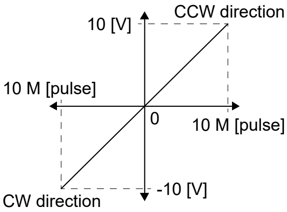
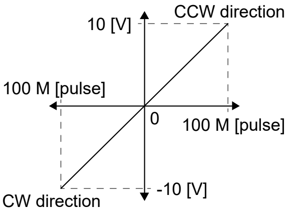
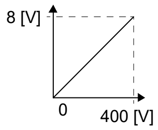
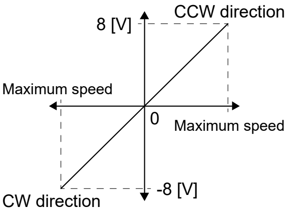
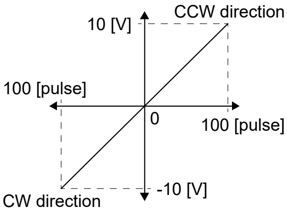
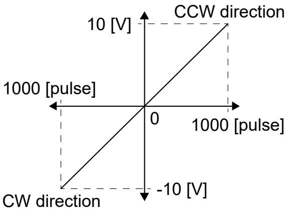
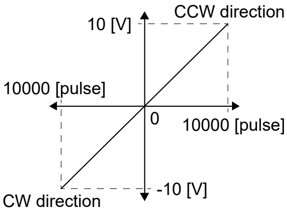
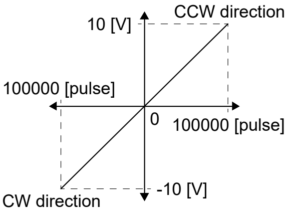
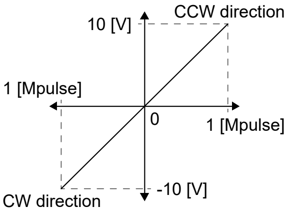
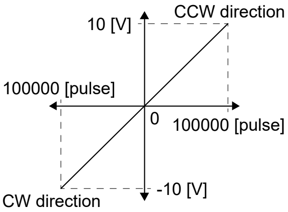
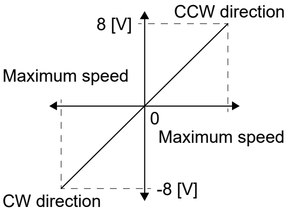
- When you use a linear servo motor, replace the following words in the left to the words in the right.

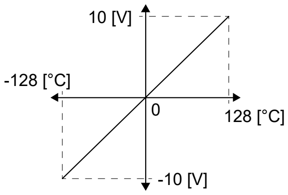
(servo motor) speed	→(linear servo motor) speed
CCW direction	→Positive direction
CW direction	→Negative direction
Torque	→Thrust

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. PC14] and [Pr. PC15] value.
Refer to App. 7.3 for the detection point.

(1) MR-J4-_A_(-RJ) 100 W or more

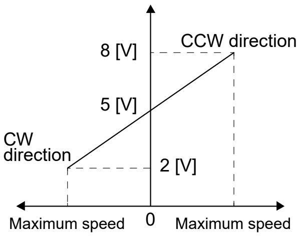
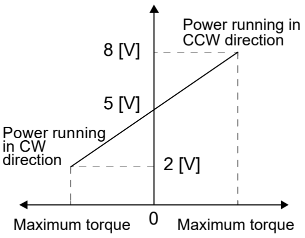
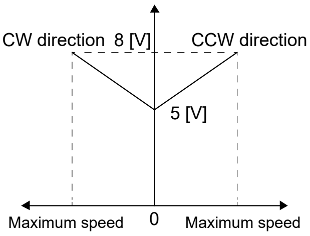
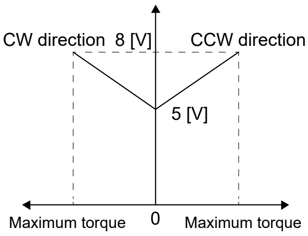
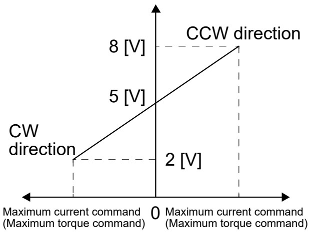
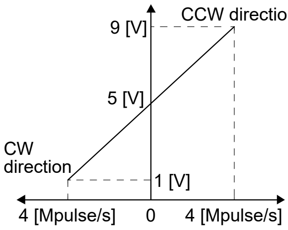
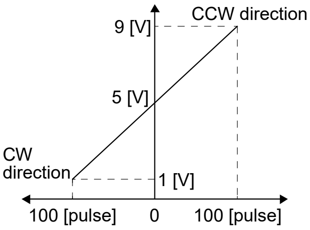
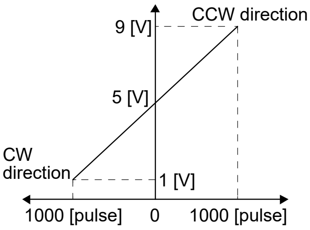
Setting value	Output item	Description	Setting value	Output item	Description
00	Servo motor speed/ Linear servo motor speed		01	Torque/Thrust (Note 8)	
02	Servo motor speed/ Linear servo motor speed		03	Torque/Thrust (Note 8)	
04	Current command (Note 8)		05	Command pulse frequency (±10 V/±4 Mpulses/s)	
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)	

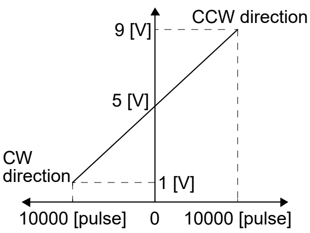
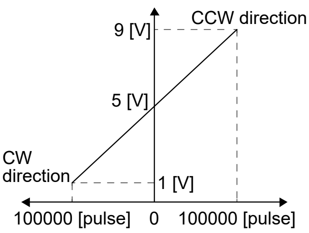
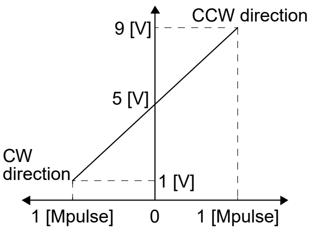
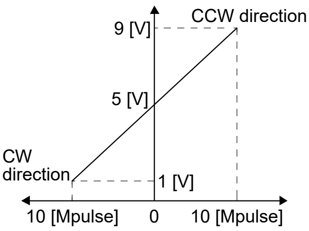
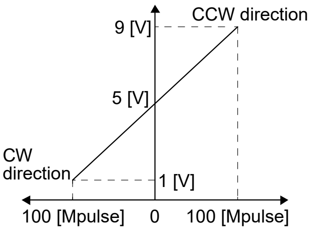
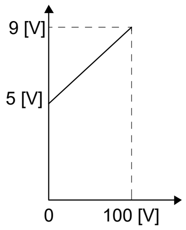
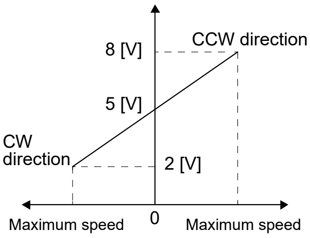
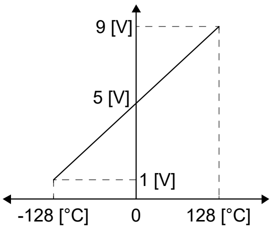
Setting value	Output item	Description	Setting value	Output item	Description
08	Servo motor-side droop pulses (Note 1, 3, 5, 6) (±10 V/10000 pulses)		09	Servo motor-side droop pulses (Note 1, 3, 5, 6) (±10 V/100000 pulses)	
0A	Feedback position (Note 1, 2, 3) (±10 V/1 Mpulse)		0B	Feedback position (Note 1, 2, 3) (±10 V/10 Mpulse)	
0C	Feedback position (Note 1, 2, 3) (±10 V/100 Mpulse)		0D	Bus voltage (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)	

Setting value	Output item	Description
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. 7.4 for details.

(2) MR-J4-03A6(-RJ)

Setting value	Output item	Description	Setting value	Output item	Description
00	Servo motor speed (5 V ± 3 V/max. speed)		01	Torque (Note 5) (5 V ± 3 V/max. torque)	
02	Servo motor speed (5 V + 3 V/max. speed)		03	Torque (Note 5) (5 V + 3 V/max. torque)	
04	Current command (Note 5) (5 V ± 3 V/max. current command)		05	Command pulse frequency (5 V ± 4 V/±4 Mpulses/s)	
06	Servo motor-side droop pulses (Note 1, 2, 3) (5 V ± 4 V/100 pulses)		07	Servo motor-side droop pulses (Note 1, 2, 3) (5 V ± 4 V/1000 pulses)	

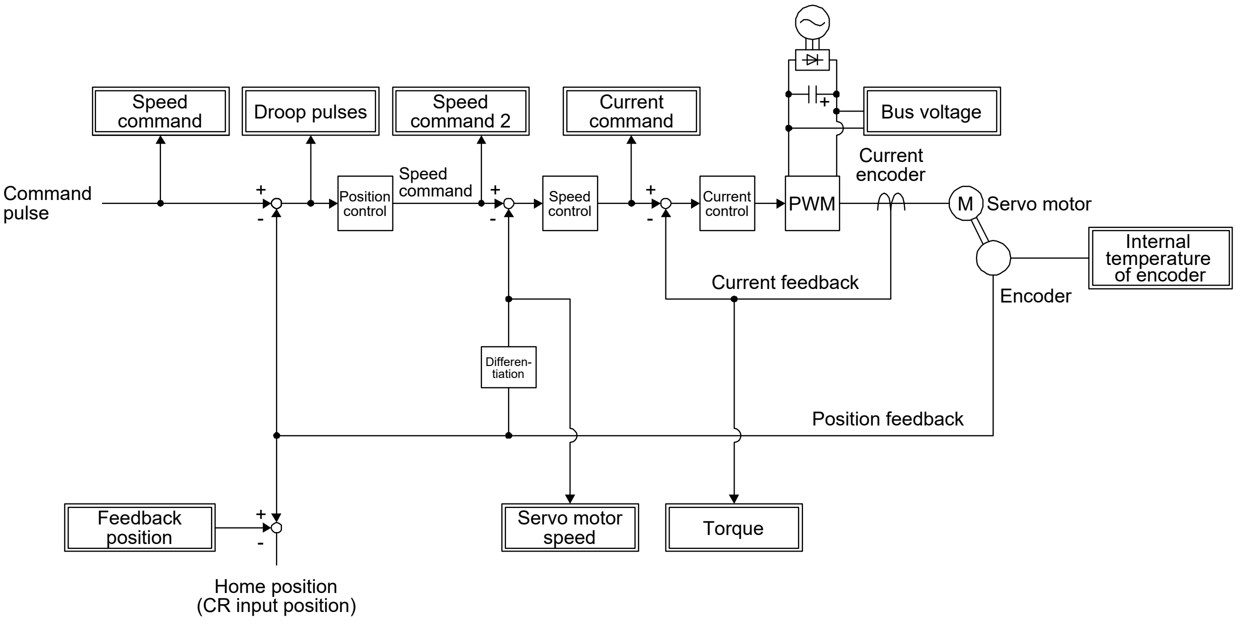
Setting value	Output item	Description	Setting value	Output item	Description
08	Servo motor-side droop pulses (Note 1, 2, 3) (5 V ± 4 V/10000 pulses)		09	Servo motor-side droop pulses (Note 1, 2, 3) (5 V ± 4 V/100000 pulses)	
0A	Feedback position (Note 1, 2, 4) (5 V ± 4 V/1 Mpulse)		0B	Feedback position (Note 1, 2, 4) (5 V ± 4 V/10 Mpulses)	
0C	Feedback position (Note 1, 2, 4) (5 V ± 4 V/100 Mpulses)		0D	Bus voltage (5 V + 4 V/100 V)	
0E	Speed command 2 (Note 2) (5 V ± 3 V/max. speed)		17	Internal temperature of encoder (5 V ± 4 V/±128 °C)	

Note 1. Encoder pulse unit.
2. This cannot be used in the torque control mode.
3. This cannot be used in the speed control mode.
4. Available in position control mode
5. For details on the maximum current command (maximum torque) for ±5 V, refer to app. 7.4 for details.

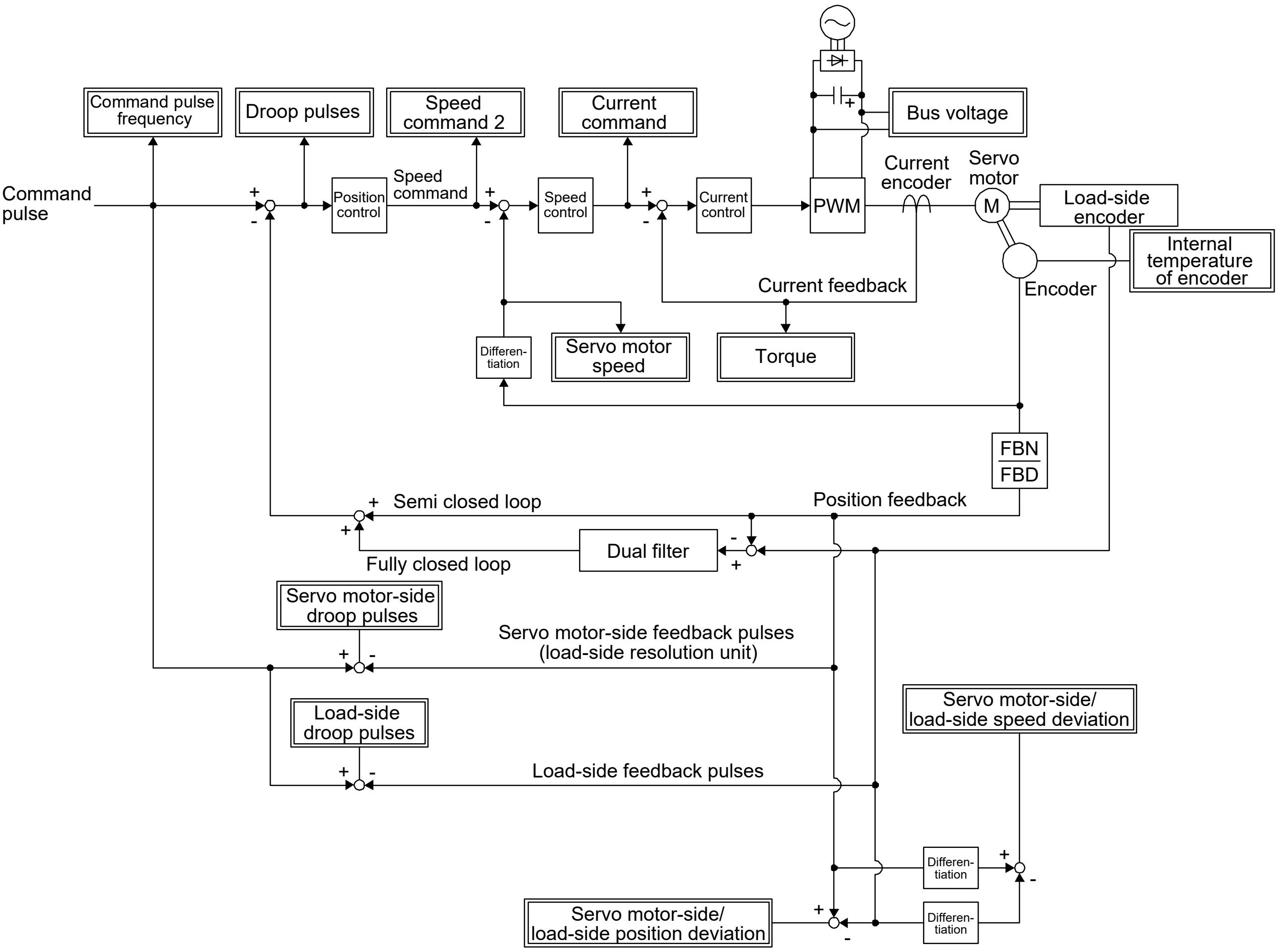
App. 7.3 Analog monitor block diagram

App. 7.3.1 MR-J4-_A_(-RJ) 100 W or more

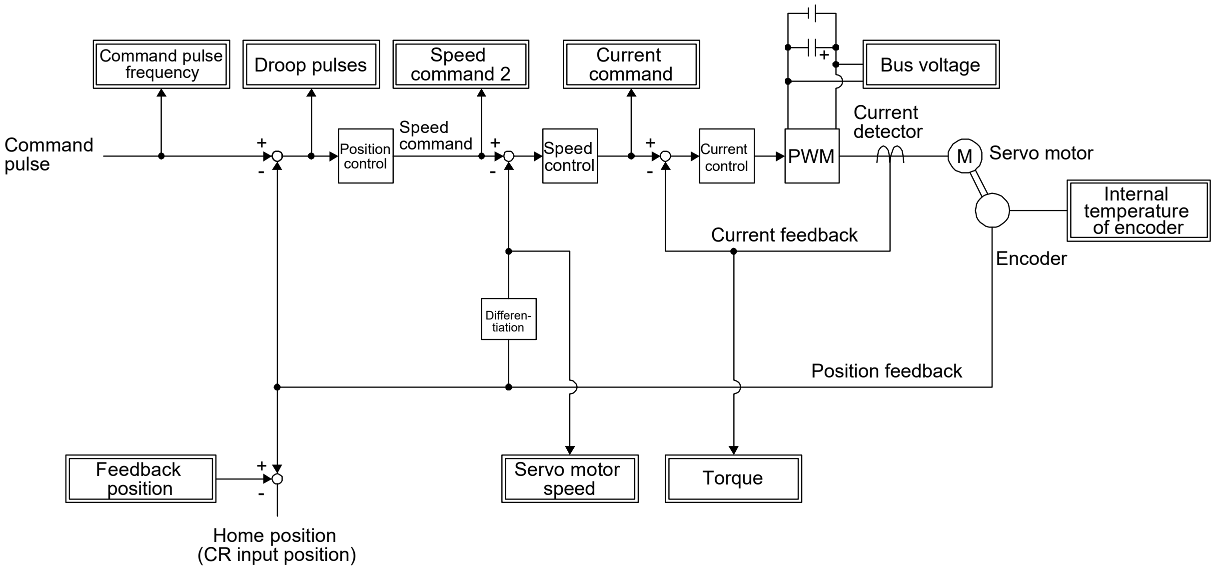
(1) Semi closed loop control



(2) Fully closed loop control



App. 7.3.2 MR-J4-03A6(-RJ)



App. 7.4 Values of the maximum current command (maximum torque) when the analog monitor is at the maximum/minimum voltage

Values of the maximum current command (maximum torque) when the analog monitor is at the maximum/minimum voltage are listed.
The current command (torque) outputs the maximum current command (maximum torque) at ±8 V (5 V ± 3 V for MR-J4-03A6). 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. 7.4.1 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

Servo motor		Servo amplifier/drive unit	Maximum current command (maximum torque) [%]
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
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. 7.4.2 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. 7.4.3 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. 7.4.4 Direct drive motor

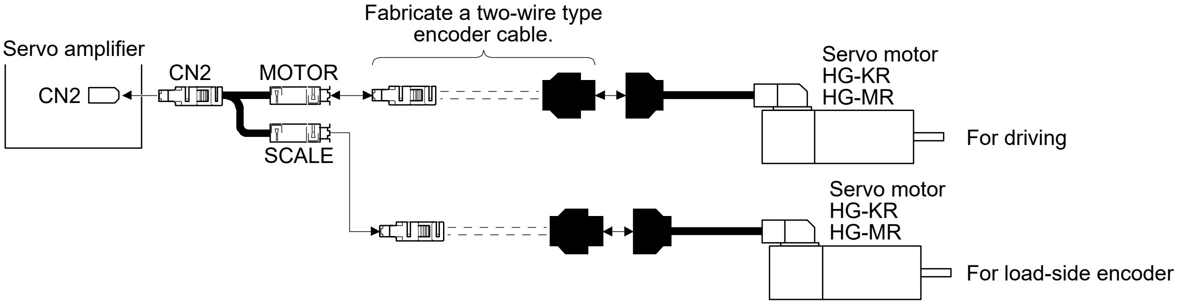
(1) 200 V/100 V class

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

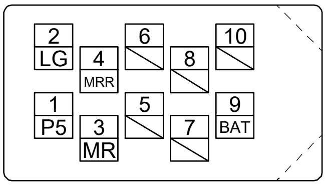
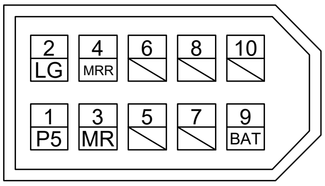
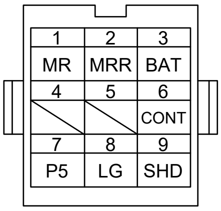
App. 8 Two-wire type encoder cable for HG-MR/HG-KR

Use a two-wire type encoder cable for the fully closed loop control by the MR-J4-_A_ servo amplifiers.
For MR-EKCBL_M-_ encoder cables for HG-MR and HG-KR, up to 20 m cables are two-wire type. 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.

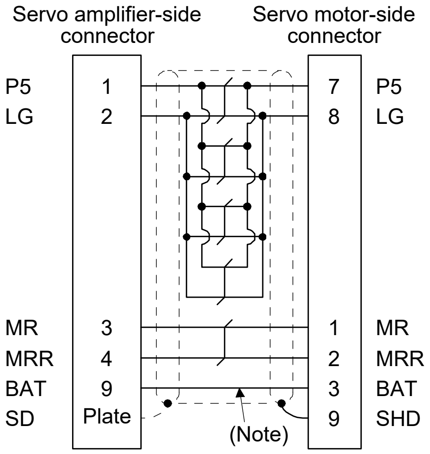
App. 8.1 Configuration diagram



App. 8.2 Connector set

<table>
<tr><th>Connector set</th><th colspan="2">1) Servo amplifier-side connector</th><th>2) Servo motor-side connector</th></tr>
<tr><td>MR-ECNM</td>
<td>Receptacle: 36210-0100PL
Shell kit: 36310-3200-008
(3M)

View seen from wiring side. (Note)</td>
<td>Connector set: 54599-1019
(Molex)
or

View seen from wiring side. (Note)</td>
<td>Housing: 1-172161-9
Connector pin: 170359-1
(TE Connectivity or equivalent)
Cable clamp: MTI-0002
(Toa Electric Industrial)

View seen from wiring side.</td></tr>
<tr><td></td><td colspan="2">Note. ▨ Do not connect anything to the pins shown as. Especially, pin 10 is provided for manufacturer adjustment. If it is connected with any other pin, the servo amplifier cannot operate normally.</td><td></td></tr>
</table>

App. 8.3 Internal wiring diagram



Note. Always make connection for use in an absolute position detection system. Wiring is not necessary for use in an incremental system.

App. 9 How to replace servo amplifier without magnetic pole detection

⚠CAUTION	●Be sure to write the magnetic pole information of the servo amplifier before the replacement to the servo amplifier after the replacement. If the information before and after replacement are 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-A" 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-A" for model, and select "Linear" for operation mode.

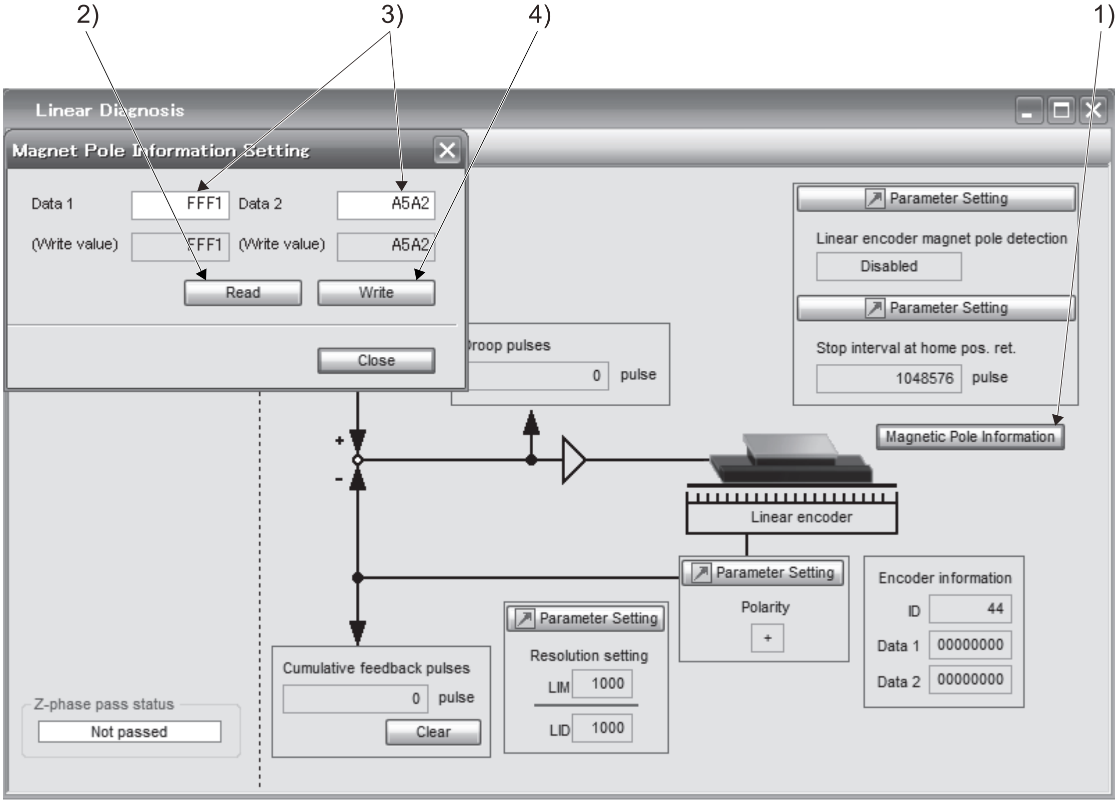
2) Check that the personal computer is connected with the servo amplifier, and select "Diagnosis" and then "Linear diagnosis".

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

Droop pulses 0 pulse

Linear encoder magnet pole detection: Disabled

Stop interval at home pos. ret. 1048576 pulse

Polarity: +

Encoder information
ID 44
Data 1 00000000
Data 2 00000000

Resolution setting
LIM 1000
LID 1000

Cumulative feedback pulses 0 pulse

Z-phase pass status: Not passed

App. 10 Special specification

App. 10.1 Amplifiers without dynamic brake

App. 10.1.1 Summary

This section explains servo amplifiers without a dynamic brake. The things not explained in this section will be the same as MR-J4-_A_(-RJ).

App. 10.1.2 Model

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

MR-J4-60A4-ED

Series

Special specifications

Symbol	Special specifications
ED	MR-J4_-A_ without a dynamic brake
RU	MR-J4-_A_-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. 10.1.3 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-_A_-ED MR-J4-_A_-RU	[Pr. PF09]	_ _ _ 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.

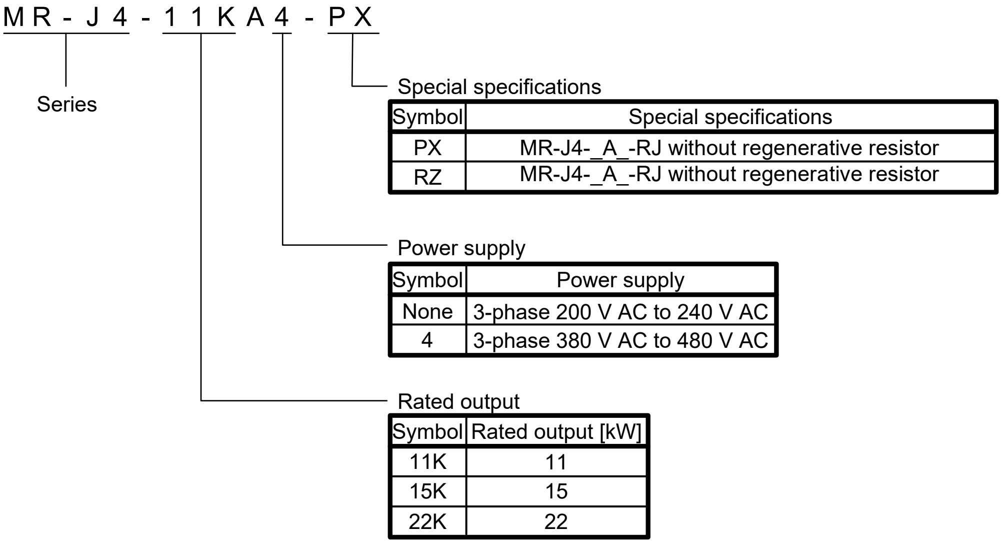
App. 10.2 Without regenerative resistor

App. 10.2.1 Summary

This section explains servo amplifiers without a regenerative resistor. The things not explained in this section will be the same as MR-J4-_A_(-RJ).

App. 10.2.2 Model

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



MR-J4-11KA4-PX

Series

Special specifications

Symbol	Special specifications
PX	MR-J4-_A_-RJ without regenerative resistor
RZ	MR-J4-_A_-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. 10.2.3 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. 10.3 Special coating-specification product (IEC 60721-3-3: 1994 Class 3C2)

App. 10.3.1 Summary

This section explains servo amplifiers with a special coating specification. Items not given in this section will be the same as MR-J4-_A_(-RJ).

App. 10.3.2 Model

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

MR-J4-60A4-EB

Series

Rated output

Symbol	Rated output [kW]
03	0.03
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
6	48 V DC/24 V DC

Special specifications

Symbol	Special specifications
EB	MR-J4-_A_ with a special coating specification (3C2)
KS	MR-J4-_A_-RJ with a special coating specification (3C2)

App. 10.3.3 Specifications

(a) 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.

(b) 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.

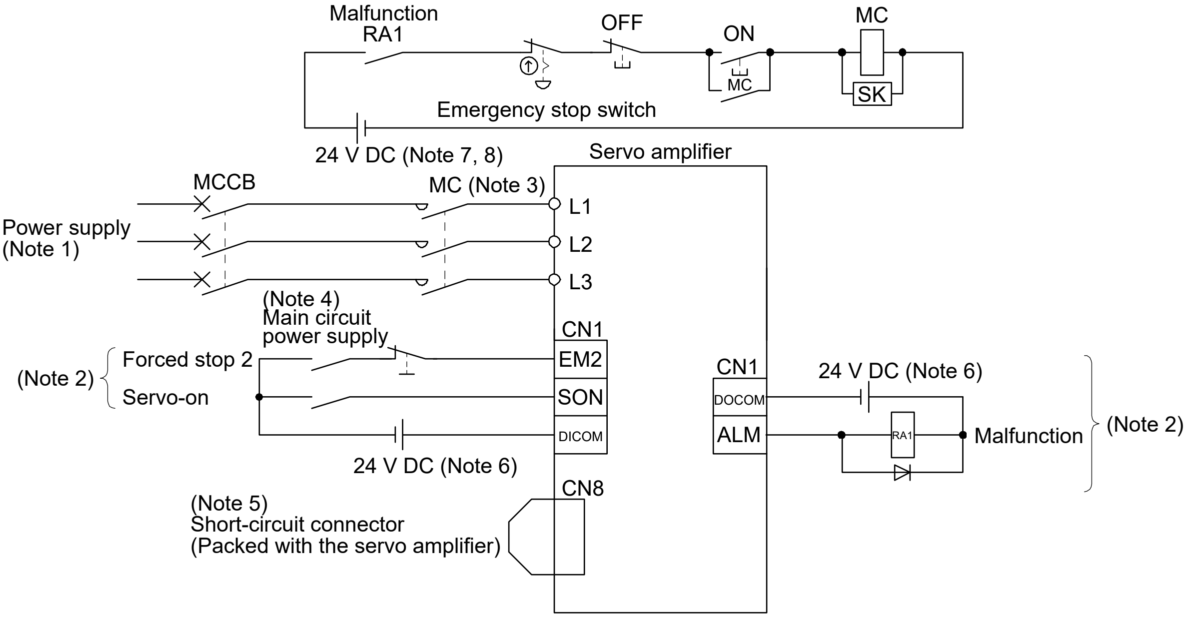
Environmental parameter	Unit	3C2	
		Mean value	Maximum value
a) Sea salt	None	Salt mist	
b) Sulfur dioxide	cm^3/m^3	0.11	0.37
c) Hydrogen sulfide	cm^3/m^3	0.071	0.36
d) Chlorine	cm^3/m^3	0.034	0.1
e) Hydrogen chloride	cm^3/m^3	0.066	0.33
f) Hydrogen fluoride	cm^3/m^3	0.012	0.036
g) Ammonia	cm^3/m^3	1.4	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. 11 Driving on/off of main circuit power supply with DC power supply

App. 11.1 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.

App. 11.2 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-J4-10A(-RJ)	SD-N11
MR-J4-20A(-RJ)	
MR-J4-40A(-RJ)	
MR-J4-60A(-RJ)	
MR-J4-70A(-RJ)	
MR-J4-100A(-RJ)	
MR-J4-200A(-RJ)	SD-N21
MR-J4-350A(-RJ)	
MR-J4-500A(-RJ)	SD-N35
MR-J4-700A(-RJ)	SD-N50
MR-J4-11KA(-RJ)	
MR-J4-15KA(-RJ)	SD-N65
MR-J4-22KA(-RJ)	SD-N95

Servo amplifier	Magnetic contactor
MR-J4-60A4(-RJ)	SD-N11
MR-J4-100A4(-RJ)	
MR-J4-200A4(-RJ)	
MR-J4-350A4(-RJ)	SD-N21
MR-J4-500A4(-RJ)	
MR-J4-700A4(-RJ)	
MR-J4-11KA4(-RJ)	SD-N25
MR-J4-15KA4(-RJ)	SD-N35
MR-J4-22KA4(-RJ)	SD-N50
MR-J4-10A1(-RJ)	SD-N11
MR-J4-20A1(-RJ)	
MR-J4-40A1(-RJ)	

App. 12 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. 12.1 Target models

MR-J4 series AC servo amplifiers (excluding MR-J4-03A6(-RJ) and MR-J4W2-0303B6)

App. 12.2 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. 12.3 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. 12.4 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. 12.5 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. 12.6 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

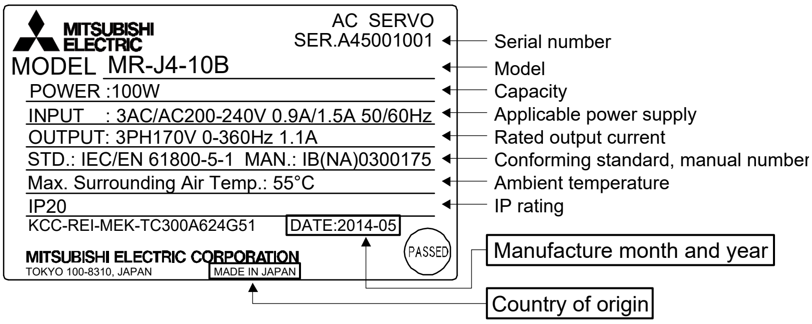


Fig. app. 4 Indication example on the rating plate

App. 13 When using the servo amplifier with the DC power supply input

POINT

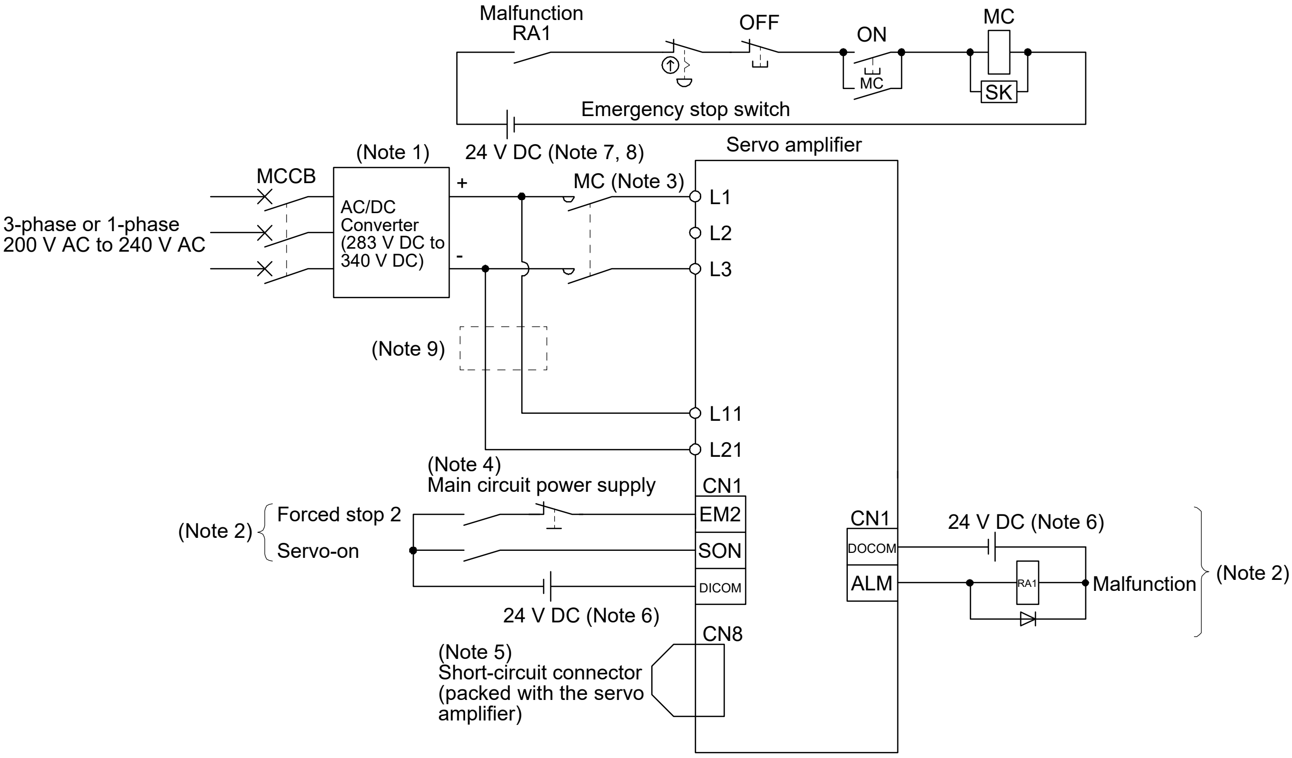
- ●The DC power supply input is available with MR-J4-_A-RJ servo amplifiers with software version C2 or later.
- ●When using the MR-J4-_A-RJ servo amplifier with the DC power supply input, set [Pr. PC27] to "_ _ _ 1".

App. 13.1 Connection example

⚠CAUTION ●Ensure that polarity (+/-) is correct. Otherwise, a burst, damage, etc. may occur.

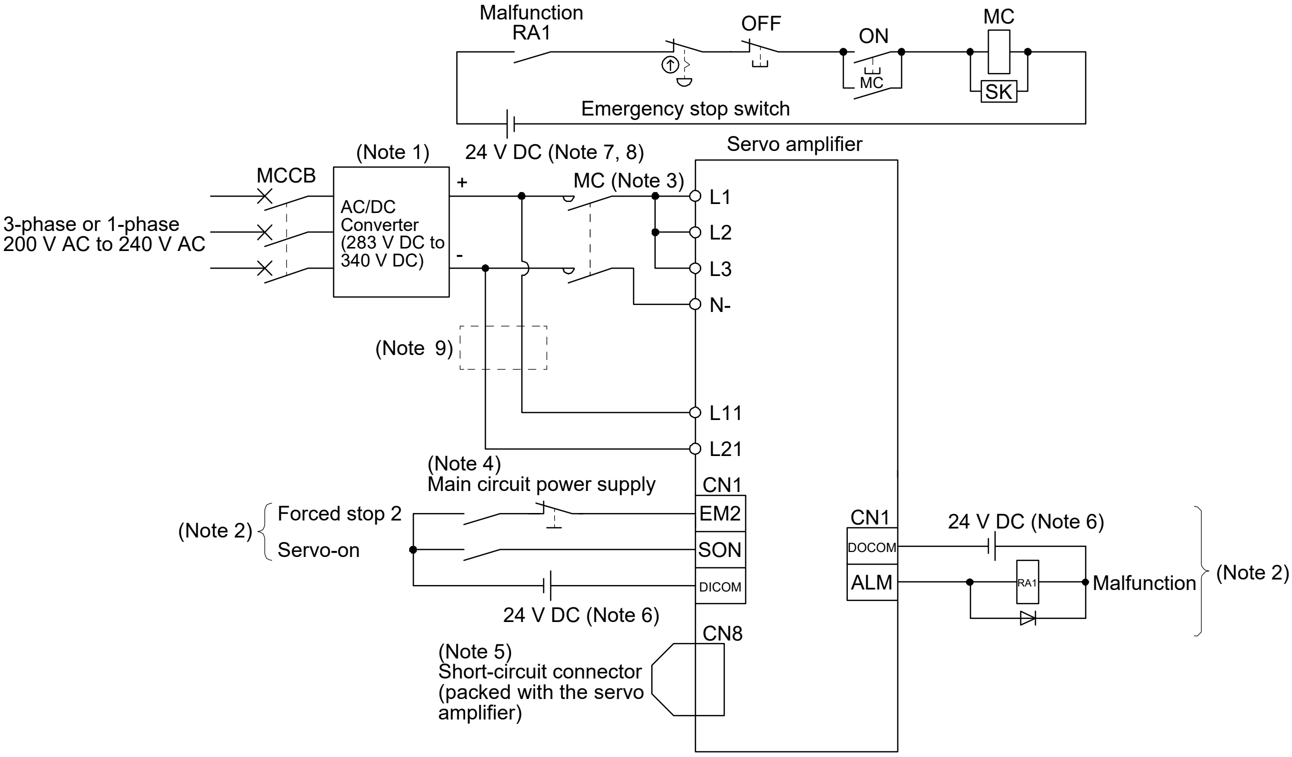
For the signal and wirings not given in this section, refer to section 3.1.1 to 3.1.3.

(1) MR-J4-10A-RJ to MR-J4-100A-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 3.9.3.
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, 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. When wires used for L11 and L21 are thinner than wires used for L1 and L3, use a fuse. (Refer to app. 13.4.)

(2) MR-J4-200A-RJ to MR-J4-22KA-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 3.9.3.
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. When wires used for L11 and L21 are thinner than wires used for L1/L2/L3, and N-, use a fuse. (Refer to app. 13.4.)

App. 13.2 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. 13.3 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-J4-10A-RJ	2 (AWG 14)	1.25 to 2 (AWG 16 to 14)
MR-J4-20A-RJ		
MR-J4-40A-RJ		
MR-J4-60A-RJ		
MR-J4-70A-RJ		
MR-J4-100A-RJ		
MR-J4-200A-RJ MR-J4-350A-RJ	3.5 (AWG 12)	
MR-J4-500A-RJ (Note 2)	5.5 (AWG 10): a	1.25 (AWG 16): a 2 (AWG 14): d
MR-J4-700A-RJ (Note 2)	8 (AWG 8): b	
MR-J4-11KA-RJ (Note 2)	14 (AWG 6): e	1.25 (AWG 16): c 2 (AWG 14): c
MR-J4-15KA-RJ (Note 2)	22 (AWG 4): f	
MR-J4-22KA-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. 13.4 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-J4-10A-RJ	30 A frame 5 A	30 A frame 5 A	240	T	10	400	DUD-N30
MR-J4-20A-RJ	30 A frame 5 A	30 A frame 5 A					
MR-J4-40A-RJ	30 A frame 10 A	30 A frame 5 A			15		
MR-J4-60A-RJ	30 A frame 15 A	30 A frame 10 A			20		
MR-J4-70A-RJ	30 A frame 15 A	30 A frame 10 A					
MR-J4-100A-RJ (3-phase power supply input)	30 A frame 15 A	30 A frame 10 A					
MR-J4-100A-RJ (1-phase power supply input)	30 A frame 15 A	30 A frame 15 A					
MR-J4-200A-RJ	30 A frame 20 A	30 A frame 20 A			30		
MR-J4-350A-RJ	30 A frame 30 A	30 A frame 30 A			40		
MR-J4-500A-RJ	50 A frame 50 A	50 A frame 50 A			60		DUD-N60
MR-J4-700A-RJ	100 A frame 75 A	60 A frame 60 A			80		
MR-J4-11KA-RJ	100 A frame 100 A	100 A frame 100 A			125		DUD-N120
MR-J4-15KA-RJ	125 A frame 125 A	125 A frame 125 A			175		
MR-J4-22KA-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-J4-10A-RJ	1	400	1	400
MR-J4-20A-RJ				
MR-J4-40A-RJ				
MR-J4-60A-RJ				
MR-J4-70A-RJ				
MR-J4-100A-RJ				
MR-J4-200A-RJ				
MR-J4-350A-RJ				
MR-J4-500A-RJ				
MR-J4-700A-RJ				
MR-J4-11KA-RJ				
MR-J4-15KA-RJ				
MR-J4-22KA-RJ				

App. 14 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. 5 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

物质名称 阈值 基准 部件名称		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

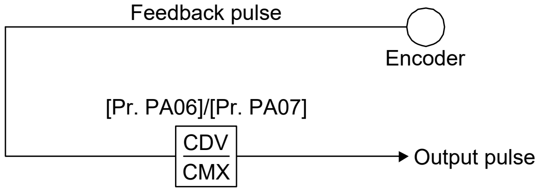
15	该标志表示在中国制造/销售的产品中含有特定有害物质。 只要遵守本产品的安全及使用方面的注意事项，从生产日算起的环保使用期限内不会造成环境污染或对人体、财产产生深刻的影响。
e	该标志表示制造的产品中不含有特定有害物质。

App. 15 Encoder output pulse setting method

POINT

- Depending on the stop position of the servo motor, 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.

REVISIONS

*The manual number is given on the bottom left of the back cover.

Revision Date	*Manual Number	Revision	
Mar. 2012	SH(NA)030107ENG-A	First edition	
Jun. 2012	SH(NA)030107ENG-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 (1)	The diagram is changed.
		Section 1.2 (2)	The diagram is changed.
		Section 1.3	The table and Note are changed.
		Section 1.5	The item of detailed explanation is changed.
		Section 1.8	Note is changed.
		Chapter 2	CAUTION is changed.
		Section 2.4	POINT is changed to CAUTION.
		Section 2.5	The explanation of relay lifetime is changed.
		Chapter 3	The sentences are added to CAUTION.
		Section 3.1	The sentences are added to CAUTION. The sentences are changed.
		Section 3.1 (1)	Note 10 is added.
		Section 3.1 (2)	Note 10 is added.
		Section 3.1 (3)	Note 10 is added.
		Section 3.1 (4)	Note 10 is added.
		Section 3.2.1 (1)	Note 9, 12, 13, 14, and 15 are changed and added.
		Section 3.2.1 (2)	The diagram is added.
		Section 3.2.2 (1)	Note 9, 12, 13, and 14 are changed and added.
		Section 3.2.2 (2)	Added.
		Section 3.2.3 (1)	Note 7, 10, 11, and 12 are changed and added.
		Section 3.2.3 (2)	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)	The sentences are added to TLA, TC, VC, VLA, PP, NP, PG, and NG.
		Section 3.5 (4)	"Available in the future" is deleted.
		Section 3.9.1	The part of diagram is changed.
		Section 3.9.2 (1)	The sentences are changed.
		Section 3.9.2 (2)	The sentences are added.
		Section 3.9.3 (1)	The sentences are added.
		Section 3.9.3 (2)	The sentences are added.
		Section 4.1.2 (1) (b) 4)	Added.
		Section 4.2.2	Note is added.
		Section 4.3.2	Note is added.
		Section 4.4.2	"EM2 (Forced stop 2) off" in the table is changed. Note is added.
		Section 4.5.6	POINT is deleted.
		Section 4.5.9 (4)	(a) is deleted
		Section 5.1.1	PA25 is changed from "For manufacturer setting".
		Section 5.1.3	PC21 is changed from "For manufacturer setting".
		Section 5.1.6	PF09 and PF15 are changed from "For manufacturer setting".
		Section 5.2.1	The setting value is added to PA03, the diagram of PA06 is changed, and PA25 is added.

Revision Date	*Manual Number	Revision	
Jun. 2012	SH(NA)030107ENG-B	Section 5.2.3	The sentences are added to PC12 and PC13, PC21 is added, and the sentences are added to the initial value in PC37.
		Section 5.2.6	PF09 and PF15 are added.
		Section 7.3.1	The sentences are added to POINT.
		Chapter 8	The sentences of the electronic dynamic brake are added. The serial communication is added to [AL. 8A] and [AL. 8E]. The name of [AL. E1] is changed.
		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)	CAUTION is changed.
		Section 11.7 (2)	Note is added.
		Section 12.3	The sentences are added to POINT.
		Section 12.8.4	The sentences are changed.
		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 13.4.1 (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.
		Chapter 14	Added.
		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.
		Appendix. 7.14	POINT is changed.
		Appendix. 8	TUV certificate of MR-J4 series is added.
Jul. 2012	SH(NA)030107ENG-C	Section 3.2.1 (2)	The part of diagram is changed.
		Section 3.2.2 (2)	The part of diagram is changed.
		Section 3.2.3 (2)	The part of diagram is changed.
Sep. 2012	SH(NA)030107ENG-D	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)030107ENG-E	HG-JR, HG-UR, HG-RR servo motor, 11 kW to 22 kW servo amplifier, and MR-J4-_A-RJ servo amplifier are added.	
		Safety 4 (1)	Two items are added to CAUTION.
		Safety Instructions 4 (2)	The diagram in CAUTION is changed.
		COMPLIANCE WITH CE MARKING	The reference is changed.

Revision Date	*Manual Number	Revision	
Feb. 2013	SH(NA)030107ENG-E	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 connector, Note 5 and 6 are added.
		Section 1.2 (2)	CN2L connector, Note 3 and 4 are added.
		Section 1.2 (3)	11 kW to 22 kW and Note 5 are added.
		Section 1.3	Note 3 is changed. Note 10 and 11 kW to 22 kW are added. A part of specifications is added and changed.
		Section 1.4	POINT is added. The table of combination is changed.
		Section 1.5	Function item is added.
		Section 1.6 (2)	Table is changed and added.
		Section 1.7.1 (1)	Table item (17), (18), 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)	11 kW to 22 kW are added.
		Section 1.7.2	The sentences are added.
		Section 1.8 (1) to (4)	CN2L connector and Note 4 are added.
		Section 1.8 (5), (4)	11 kW to 22 kW are 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 of CAUTION is changed. POINT is added.
		Section 3.1	CAUTION is added.
		Section 3.1 (1) to (4)	The connection diagram is changed. Note 11 is added.
		Section 3.1 (5)	Newly added.
		Section 3.2.1 (1)	The connection diagram is changed. Note 3 and 4 are changed.
		Section 3.2.1 (2)	The connection diagram is changed.
		Section 3.2.2 (1)	The connection diagram is changed. Note 3 and 4 are changed.
		Section 3.2.2 (2)	The connection diagram is changed.
		Section 3.2.3 (1)	The connection diagram is changed. Note 3 and 4 are changed.
		Section 3.2.3 (2)	The connection diagram is changed.
		Section 3.3.1	The table is changed.
		Section 3.3.2	POINT is added.
		Section 3.3.2 (2)	Note is added.
		Section 3.4	Note 1, 2, and CN2L are added.
		Section 3.5 (1) (a)	The content is added. The sentences are added.
		Section 3.5 (1) (b)	The item is added.
		Section 3.6.1 (5)	The connection diagram is changed.
		Section 3.6.2 (1)	The connection diagram is changed.
		Section 3.6.3 (1), (3)	The connection diagram is changed.
		Section 3.6.4 (3) (a)	The connection diagram is changed.
		Section 3.6.5 (4) (a)	The connection diagram is changed.
		Section 3.6.6 (1)	Note is added.
		Section 3.7.3	The content is added.
		Section 3.9.1	Note 4 and 5 are added. The connection diagram is changed.
		Section 3.10.1 (1)	The connection diagram is changed.
		Section 3.10.2 (1) (b)	The content is changed.
		Section 4.1.2 (1) (b) 5)	Newly added.
		Section 4.1.2 (1) (c)	4) is added.
		Section 4.5.1	The explanation is added.
		Section 4.5.2	The display content is added.
		Section 4.5.3 (1)	The display content is added.
		Section 4.5.3 (3)	The display content is added.
		Section 4.5.4	Note is added.
		Section 4.5.6	The display content is added.
		Section 4.5.9 (2) (b)	The sentences are changed.
		Section 4.5.9 (3)	The sentences are changed.
		Section 4.5.9 (3) (a) d)	The sentences are changed.
		Section 4.5.9 (4)	The sentences are changed.
		Chapter 5	CAUTION is added. POINT is added.

Revision Date	*Manual Number	Revision	
Feb. 2013	SH(NA)030107ENG-E	Section 5.1.1	[Pr. PA17], [Pr. PA18], and [Pr. PA26] are added. [Pr. PA27] is changed. The operation mode is added.
		Section 5.1.3	[Pr. PC44] and [Pr. PC45] are added. The operation mode is added.
		Section 5.1.1 to 5.1.6	The operation mode is added.
		Section 5.1.6	The name of [Pr. PF25] is changed.
		Section 5.2.1	The content of [Pr. PA01] is added. The sentences of [Pr. PA05] are added. [Pr. PA02], [Pr. PA13] and [Pr. PA19] are changed. The name of [Pr. PA20] is changed.
		Section 5.2.2	The sentences of [Pr. PB17] is changed.
		Section 5.2.3	The setting of [Pr. PC19] is changed. The sentences of [Pr. PC20] is changed. The explanation of [Pr. PC22] is changed. The sentences of [Pr. PC35], [Pr. PC43], and [Pr. PC60] are added. [Pr. PC36] and [Pr. PC27] are changed. [Pr. PC44] and [Pr. PC45] are added. The contents of Note 3 and 4 are added.
		Section 5.2.4	The content of [Pr. PD01] is added. [Pr. PD03], Note 3, and content are added. The content of [Pr. PD23] is added. The content of [Pr. PD30] is changed.
		Section 5.2.5	[Pr. PE01], [PR. PE03] to [Pr.PE08], [Pr. PE10], [Pr. PE34], [Pr. PE35], and [Pr. PE39] are added.
		Section 5.2.6	The name of [Pr. PF25] is changed.
		Section 5.2.7	Newly added.
		Section 6.2.2	The display of MR Configurator2 is changed.
		Section 6.2.2 (1) (b)	POINT is added.
		Section 6.2.2 (1) (d)	The table is changed.
		Section 6.2.2 (1) (e)	The sentences are added.
		Section 6.2.2 (2)	POINT is added.
		Section 6.2.2 (2) (b)	POINT is added.
		Section 6.3.1 (1)	The content of POINT is changed.
		Section 6.3.4	The table is changed.
		Section 7.1.5 (4)	The content of POINT is changed.
		Section 7.3.2	CAUTION is deleted.
		Section 7.4	Newly added.
		Chapter 8	The operation mode is added. [AL. 93] and [AL. 96.4] are added.
		Section 8.1	The name of [AL. F0.1] is changed.
		Section 9.1	POINT is added.
		Section 9.1 (1) to (7)	The connection diagram is changed.
		Section 9.1 (8), (9)	Newly added.
		Chapter 10	POINT is added.
		Section 10.1	The table is added. The graph is changed and added. Note 3 is added.
		Section 10.2 (1)	Note 3 and content are added to the table. Partially changed.
		Section 10.3.1 (1)	The appended sentence is added.
		Section 10.3.1 (2)	The content is added.
		Section 10.3.2	Note 2 and content are added to the table.
		Section 10.5	The sentences are added. The content of the table is added.
		Chapter 11	POINT is added.
		Section 11.1.1	The diagram is changed and added.
		Section 11.2.1	The content of the table is added. Note 2 is added.
		Section 11.2.2 (1) (b)	The content of the table is added.
		Section 11.2.3	[Pr. PA02] is changed.
		Section 11.2.4 (3), (4)	Newly added.
		Section 11.2.5 (5), (6)	Newly added.
Aug. 2013	SH(NA)030107ENG-F	Safety Instructions 4 (1)	A sentence is changed. An item is deleted.
		Section 1.1	Table 1.1 is changed.
		Section 1.6 (1)	The content is changed.
		Section 1.7.1	The content of the table is changed. Note 2 is added.
		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 3.5 (2)	The sentences are added to Function and application of forward rotation pulse train/reverse rotation pulse train.

Revision Date	*Manual Number	Revision	
Aug. 2013	SH(NA)030107ENG-F	Section 3.9.1	Note 6 is added.
		Section 5.1.3	Analog torque/thrust limit maximum output of [Pr. PC13] is deleted.
		Section 5.2.1	The sentences are added to [Pr. PA13].
		Section 5.2.3	Analog torque/thrust limit maximum output of [Pr. PC13] is deleted.
		Section 5.2.6	[Pr. PF23] is partly added.
		Section 7.1.4 (4)	POINT is deleted. Table is added.
		Section 7.3.2	POINT is added.
		Section 7.4 (3)	Newly 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	Note 4 is partly changed. POINT is added.
		Section 11.4 (2)	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 6 is added.
		Section 14.1.1 (2) (b)	Note 1 is partly added.
		Section 15.1.2 (1)	Note 6 is added.
		Section 15.1.2 (2)	The content is changed.
		Section 15.1.2 (3)	Newly added.
		Section 16.3.2	POINT is added.
		Section 17.1.3 (2) (a)	Note is added.
		Section 17.1.3 (2) (b)	The diagram is changed.
		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)030107ENG-G	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 changed.
		Section 1.7.1 (2)	Newly 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 3.3.3 (1) (c)	Newly added.
		Section 3.3.3 (2) (a)	The content of the table is added.
		Section 3.10.2 (1) (a)	The content of the diagram is changed.
		Section 4.1	POINT is added.
		Section 4.1.2 (1) (c) 1) c)	The content is added.
		Section 4.1.2 (1) (c) 2)	Newly added.
		Section 4.1.2 (2) (c) 1) c)	The content is added.
		Section 5.2.1	A sentence is added to [Pr. PA01]. [Pr. PA02] The content is changed. [Pr. PA17] The content is added. [Pr. PA20] The content is changed.

Revision Date	*Manual Number	Revision	
Oct. 2013	SH(NA)030107ENG-G	Section 5.2.3	[Pr. PC14] The content is changed.
		Chapter 6	POINT is added.
		Section 6.2	POINT is added.
		Chapter 7	POINT is added.
		Section 7.1.1 (1)	The content of the table is changed.
		Section 7.1.3	POINT is added.
		Section 7.1.4 (1)	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), (d)	The sentences are changed and note is added.
		Chapter 8	The POINT is added. The content of the table is changed. Note 2 of alarm table is changed. Note 2 of warning table is changed.
		Section 9.1 (2)	Newly added.
		Section 10.1	The table is newly added.
		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. POINT 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 (2), (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) 1), 2)	The content is added.
		Section 11.5.2 (4) (b) 2)	Newly added.
		Section 11.5.2 (6)	The content is added.
		Section 11.8	POINT is 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)	Newly 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.

Revision Date	*Manual Number	Revision	
Oct. 2013	SH(NA)030107ENG-G	Section 11.15 (1)	The graph 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 15.1.2 (1) to (3)	The sentences are added.
		Section 15.4.1	The sentences are added.
		Section 15.4.2	The content of the table is added.
		Section 15.4.3	The content of the table is added.
		Section 17.1.1	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 (1) (a)	Note is added.
		App. 4.4 (1) (b)	Newly added.
		App. 4.4 (2)	Note is added.
		App. 4.4 (3)	Note is 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. 4.8.2 (2)	Newly added.
		App. 4.8.3	The content of the table is added.
		App. 4.8.3 (2)	Newly added.
		App. 11 (2)	Note 7 is added.
Mar. 2014	SH(NA)030107ENG-H	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.
		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 (1) (d)	Newly added.
		Section 3.3.3 (2) (a)	The content is added.
		Section 3.7.1	The title is changed.
		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 5.2.1	The content of [Pr. PA13] is added.
		Section 5.2.3	The content of [Pr. PC14] is added.
		Section 5.2.5	[Pr. PE39] is deleted.
		Section 7.1.1 (1)	Caution for the table is changed.
		Section 7.2.3 (1)	The title is changed.

Revision Date	*Manual Number	Revision	
Mar. 2014	SH(NA)030107ENG-H	Section 7.3	The sentences are added.
		Section 7.3.1 (2)	Caution for the table is changed.
		Section 7.4	POINT is changed. Sentences are added.
		Chapter 8	POINT is added.
		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 11.4 (2) (a)	The sentences are added to Note 4.
		Section 11.4 (2) (b)	The sentences are added to Note 4.
		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 11.12 (1)	Figure is added. The content of the table is added.
		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) 1)	The title is changed. The content of the table is changed.
		App. 4.2.3 (1) (b) 3)	Newly added.
		App. 4.4 (2)	Note 1 and 2 are 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. 4.8.3	The content of the table is changed.
		App. 10	Newly added.
Jan. 2015	SH(NA)030107ENG-J	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	The content of the table is changed. 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 3.2	Note is changed.
		Section 3.4	The content of the table is changed.
		Section 3.5	The content of the table is changed.
		Section 3.9.1	The diagram is changed. Note is added.
		Section 3.10.1	CAUTION is added.
		Section 4.5.4	The content of the table is changed.

Revision Date	*Manual Number	Revision	
Jan. 2015	SH(NA)030107ENG-J	Section 4.5.7	POINT is changed.
		Section 4.5.7 (2)	The diagram is changed. Note is added.
		Section 4.5.7 (2) (a)	The content of the table is changed. Note is added.
		Section 4.5.8	The diagram is changed. Note 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 11.1.3	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 14.5.4 (4) (b)	Note is added.
		Section 14.5.9 (2)	Note is added.
		Section 15.1.2	The sentences are changed.
		Section 15.3.2	POINT is added.
		Section 15.4.2	The content of the table is changed.
		Section 16.1.2	The sentences are changed.
		Section 16.3.2	POINT is added.
		Section 16.5.1	The sentences are changed.
		Section 16.5.2	The content of the table is changed.
		App. 4	The content of the section is changed.
Apr. 2015	SH(NA)030107ENG-K	MR-J4-03A6(-RJ) servo amplifier is added.	
		Safety Instructions	Partially changed.
		About the manuals	Partially added.
		Section 1.2	Partially changed.
		Section 1.3	Partially added and partially changed.
		Section 1.5	Partially added.
		Section 1.6 (2)	Partially changed.
		Section 1.7	Partially added and partially changed.
		Section 1.8	Partially changed.
		Section 3.2.1	Partially changed.
		Section 3.2.2	Partially changed.

Revision Date	*Manual Number	Revision	
Apr. 2015	SH(NA)030107ENG-K	Section 3.2.3	Partially changed.
		Section 3.3.3	Partially changed.
		Section 3.4	Partially added and partially changed.
		Section 3.5	Partially added and partially changed.
		Section 3.6.1	POINT is partially changed.
		Section 3.6.1 (1)	Partially added and partially changed.
		Section 3.6.3 (3)	Partially added and partially changed.
		Section 3.7	POINT is partially added.
		Section 3.8.1	Partially added and partially changed.
		Section 3.9.1	Partially changed.
		Section 3.9.2	Partially added and partially changed.
		Section 3.9.3	Partially added and partially changed.
		Section 4.2.6	Partially changed.
		Section 4.3.6	Partially changed.
		Section 4.4.6	Partially changed.
		Section 4.5.3 (3)	Partially changed.
		Section 4.5.4	Partially changed.
		Section 4.5.7	Partially added and partially changed.
		Chapter 5	POINT is added.
		Section 5.1	POINT is partially added.
		Section 5.1.3	Pr. PC28 is added.
		Section 5.1.4	Pr. PD43 to Pr. PD46 are added.
		Section 5.2.1	Pr. PA01 to Pr. PA02 are partially added and partially changed. Pr. PA06 to Pr. PA07 are partially added. Pr. PA12 to Pr. PA13 are partially changed. Pr. PA17 to Pr. PA21 are partially added. Pr. PA26 is partially added.
		Section 5.2.3	Pr. PC14 is partially added and partially changed. Pr. PC15 is partially changed. Pr. PC19 to Pr. PC20 are partially changed. Pr. PC22 is partially added. Pr. PC27 is partially added and partially changed. Pr. PC28 is added. Pr. PC36 is partially added and partially changed. Pr. PC44 to Pr. PC45 are partially added. Pr. PC60 is partially added and partially changed.
		Section 5.2.4	Pr. PD01 is partially added. Pr. PD03 to Pr. PD28 are partially added and partially changed. Pr. PD43 to Pr. PD46 are added. Pr. PD47 is partially added and partially changed.
		Section 5.2.5	Pr. PE01 is partially added. Pr. PE03 to Pr. PE10 are partially added. Pr. PE34 to Pr. PE35 are partially added.
		Section 5.2.6	Pr. PF09 is partially added. Pr. PF25 is partially added. Pr. PF34 is partially added.
		Section 5.2.7	POINT is added. Pr. PL17 is partially changed.
		Section 7.3.2	POINT is partially added.
		Section 7.4	POINT is partially added and partially changed.
		Section 8.2	Partially added.
		Section 8.3	Partially added.
		Section 9.1	POINT is partially changed.
		Section 9.1 (1) (a) to (e)	The dimensions are changed.
		Section 9.1 (2) (a) to (b)	The dimensions are changed.
		Section 9.1 (3) (a) to (b)	The dimensions are changed.
		Section 10.1	Partially changed.
		Section 10.3.1 (2)	Partially changed.
		Section 11.1.1	Partially changed.
		Section 11.3.2	Partially changed.
		Section 11.6 (4)	Partially added and partially changed.

Revision Date	*Manual Number	Revision	
Apr. 2015	SH(NA)030107ENG-K	Section 11.7	Partially changed.
		Section 11.8	The contents are entirely changed.
		Section 11.9 (1)	Partially changed.
		Section 11.12	Partially changed.
		Section 11.14 (2) (b)	Partially changed.
		Section 12.1	The contents are entirely changed.
		Section 12.2	The contents are entirely changed.
		Chapter 13	POINT is partially added.
		Section 13.3.3	Partially changed.
		Chapter 14	The title is changed. Partially changed.
		Section 14.3.3	Partially changed.
		Section 14.4.1	Partially added.
		Section 14.4.2	Partially added.
		Section 14.5.2	Partially changed.
		Section 14.5.3	Partially changed.
		Section 14.5.4	Partially added and partially changed.
		Section 14.5.5	Partially added.
		Section 14.5.7	Partially added.
		Section 14.5.9	Partially changed.
		Section 14.5.10	Partially changed.
		Section 14.5.11	Partially changed.
		Section 14.5.12	Partially changed.
		Chapter 15	POINT is partially added.
		Section 15.1.1	Partially changed.
		Section 15.1.2	Partially changed.
		Chapter 16	POINT is partially added.
		Section 16.1.1	Partially changed.
		Section 16.1.2	Partially changed.
		Section 16.5.1	Partially changed.
		Chapter 17	Partially added.
		Section 17.3.1	Partially changed.
		Section 17.3.2	Partially changed.
		Section 17.3.6	Partially changed.
		Section 17.3.7	Partially changed.
		Chapter 18	Newly added as MR-J4-03A6 servo amplifier.
		App. 4	The contents are entirely changed.
		App. 7	Partially added and partially changed.
		App. 11	Newly added.
Sep. 2015	SH(NA)030107ENG-L	MR-J4-100A(-RJ)/MR-J4-200A(-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.	
		Safety Instructions	Partially changed.
		«About the manual»	Partially added and partially changed.
		Chapter 1	POINT is partially changed.
		Section 1.3	Partially added and partially changed.
		Section 1.4	POINT is added.
		Section 1.5	Partially added and partially changed.
		Section 1.6 (2)	Partially added.
		Section 1.7	Partially changed.
		Section 1.8 (1)	Partially changed.
		Section 2.5	Partially changed.
		Section 2.6	Newly added.
		Chapter 3	CAUTION is partially changed.
		Section 3.1	POINT is partially changed.
		Section 3.1.1 (2)	Partially changed.
		Section 3.2.1	Partially changed.
		Section 3.2.2	Partially changed.
		Section 3.2.3	Partially changed.
		Section 3.3.1	Partially changed.

Revision Date	*Manual Number	Revision	
Sep. 2015	SH(NA)030107ENG-L	Section 3.4	POINT is partially added. Partially added and partially changed.
		Section 3.5	Partially added and partially changed.
		Section 3.6.1	Partially added and partially changed.
		Section 3.9.1	Partially changed.
		Section 3.9.2	Partially changed.
		Section 3.9.3	Partially added and partially changed.
		Section 4.5.3	Partially changed.
		Section 4.5.7	Partially added and partially changed.
		Chapter 5	POINT is partially changed.
		Section 5.1	POINT is partially changed.
		Section 5.1.2	Partially changed.
		Section 5.1.6	[Pr. PF18] is added.
		Section 5.1.8	Newly added.
		Section 5.2.1	Partially added and partially changed.
		Section 5.2.2	Partially added and partially changed.
		Section 5.2.3	Partially changed.
		Section 5.2.4	Partially added and partially changed.
		Section 5.2.5	Partially changed.
		Section 5.2.6	[Pr. PF18] is added. Partially added and partially changed.
		Section 5.2.7	POINT is partially changed. Partially changed.
		Section 5.2.8	Newly added.
		Section 6.2	The contents are entirely changed.
		Section 6.3.1	Partially changed.
		Section 6.4	Partially changed.
		Section 6.5	Partially changed.
		Section 7.1.1	Partially changed.
		Section 7.1.5	Partially changed.
		Section 7.2.3	Partially added.
		Section 7.3.2	POINT is partially added and partially changed.
		Section 7.4	POINT is partially changed.
		Chapter 8	Partially changed.
		Section 8.1	Partially added.
		Section 8.2	Partially added and partially changed.
		Section 8.3	Partially changed.
		Section 9.1	POINT is partially changed.
		Section 10.2	Partially changed.
		Section 10.5	Partially changed.
		Section 11.1.1	Partially changed.
		Section 11.2.2	Partially changed.
		Section 11.2.3	Partially changed.
		Section 11.3.3	Partially changed.
		Section 11.4	Partially changed.
		Section 11.5.2	Partially added and partially changed.
		Section 11.6	Partially changed.
		Section 11.7	Partially changed.
		Section 11.7.2	Partially changed.
		Section 11.8.3	POINT is partially changed.
		Section 11.8.4	POINT is partially changed.
		Section 11.8.5	POINT is partially changed.
		Section 11.9	Partially changed.
		Section 11.10	Partially added and partially changed.
		Section 11.11	Partially changed.
		Section 11.12	Partially added and partially changed.
		Section 11.14	Partially changed.
		Section 11.15	Partially changed.
		Section 11.16	Partially changed.
		Section 12.2.3	Partially changed.

Revision Date	*Manual Number	Revision	
Sep. 2015	SH(NA)030107ENG-L	Section 12.3	Partially changed.
		Chapter 13	POINT is partially changed.
		Section 13.1.1	Partially changed.
		Section 13.1.5	Partially added and partially changed.
		Section 13.3.1	Partially added.
		Section 13.3.2	Partially changed.
		Section 13.3.3	Partially changed.
		Chapter 14	The title is changed.
		Section 14.1.1	Partially changed.
		Section 14.3	Partially changed.
		Section 14.4	Partially changed.
		Section 14.5	Partially changed.
		Chapter 15	POINT is partially changed.
		Section 15.1.1	Partially changed.
		Section 15.1.2	Partially changed.
		Section 15.3.3	Partially added.
		Chapter 16	POINT is partially changed.
		Section 16.1.2	Partially changed.
		Chapter 17	POINT is partially changed.
		Section 17.1.2	Partially changed.
		Chapter 18	The title is changed.
		Section 18.1.1	Partially changed.
		Section 18.1.3	Partially changed.
		Section 18.1.4	Partially changed.
		Section 18.1.5	Partially changed.
		Section 18.1.6	Partially added.
		Section 18.2.1	Partially changed.
		Section 18.3.1	Partially added and partially changed.
		Section 18.3.2	Partially changed.
		Section 18.3.5	Partially changed.
		Section 18.3.6	Partially added and partially changed.
		Section 18.3.7	Partially changed.
		Section 18.3.9	Partially changed.
		Section 18.4.1	Partially changed.
		Section 18.5.1	Partially changed.
		Section 18.5.4	Partially changed.
		Section 18.5.8	Partially added and partially changed.
		Section 18.7.3	Partially changed.
		Section 18.7.4	Partially changed.
		Section 18.8.3	Partially changed.
		Section 18.9	The title is changed.
		Chapter 19	Newly added.
		App. 1	Partially added and partially changed.
		App. 2	The contents are entirely changed.
		App. 4	The contents are entirely changed.
		App. 5	Partially changed.
		App. 8	Partially changed.
		App. 11	Partially added.
Feb. 2016	SH(NA)030107ENG-M	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.
		Chapter 14	CAUTION is added.
		Section 18.3.6	Partially changed.
		App. 6	Partially added.
		App. 12	Newly added.
May 2016	SH(NA)030107ENG-N	The adaptive filter II is improved, and the DC power supply input is added.	
		3. To prevent injury, note the following 4. Additional instructions	Partially changed.

Revision Date	*Manual Number	Revision	
May 2016	SH(NA)030107ENG-N	(2)Wiring	Partially added.
		(5)Corrective actions	Partially added.
		(6)Maintenance, inspection and parts replacement	Partially added and partially changed.
		About the manuals	Partially added.
		Section 1.3 (1)	Partially added and partially changed.
		Section 1.5	Partially added and partially changed.
		Section 1.7	Partially changed.
		Section 1.8	Partially added.
		Section 2.4	Partially added.
		Section 3.1	Partially added and partially changed.
		Section 3.3.1	Partially added.
		Section 3.3.3	Partially added.
		Section 3.5 (1) (b)	Partially changed.
		Chapter 4	Partially changed.
		Section 5.1.2	Partially changed.
		Section 5.1.3	Partially changed.
		Section 5.2.1	[Pr. PA25] is partially changed.
		Section 5.2.2	[Pr. PB01] is partially added.
		Section 5.2.3	[Pr. PC03], [Pr. PC18], [Pr. PC26] and [Pr. PC27] are partially changed.
		Section 5.2.5	Partially added and partially changed.
		Section 6.2.2 (1) (c)	POINT is partially changed.
		Section 7.1.2	Partially added and the diagrams are partially changed.
		Section 7.2.3 (1) (b)	Partially changed.
		Section 7.3.2	POINT is added.
		Section 7.6	Partially changed.
		Chapter 8	Partially added and partially changed.
		Section 10.5	POINT is 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	The diagrams are partially changed.
		Section 11.8.3	Partially changed.
		Section 11.8.6	Partially changed.
		Section 11.9	Partially changed.
		Section 11.10	POINT is added.
		Section 11.14	Partially changed.
		Section 11.16	The contents are entirely changed.
		Section 13.1.5	Partially changed.
		Section 13.3.2	The diagram is partially changed.
		Section 14.5.3	Partially changed.
		Section 18.4	Partially changed.
		Chapter 19	Partially added and partially changed.
		Section 19.3	Partially changed.
		Section 19.5	Partially changed.
		Section 19.8.1	Partially changed.
		App. 4	The contents are entirely changed.
		App. 5.7.3 (2)	The diagram is partially changed.
		App. 13	Newly added.
Mar. 2017	SH(NA)030107ENG-P	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.
		Section 1.5	Partially changed.
		Section 3.5	Partially changed.

Revision Date	*Manual Number	Revision	
Mar. 2017	SH(NA)030107ENG-P	Section 3.6.1	Partially changed.
		Chapter 5	POINT is partially changed.
		Section 5.2.3	[Pr. PC27] is partially changed.
		Section 5.2.4	[Pr. PD33] and [Pr. PD34] are partially changed.
		Section 6.2	POINT is partially added.
		Section 6.2.3	Partially added.
		Section 10.1	Partially changed.
		Section 11.1.1	Partially changed.
		Section 11.1.3	Partially changed.
		Section 11.2.3	Partially changed.
		Section 11.5.2	Partially changed.
		Section 11.7	Partially changed.
		Section 11.8.3	Partially changed.
		Section 11.8.6	Partially changed.
		Section 11.10	Partially added.
		Section 11.17	The diagram is partially changed.
		Section 13.3.3	The diagram is partially changed.
		Section 15.3.3	The diagram is partially changed.
		Chapter 16	POINT is partially changed.
		Section 16.5.1	Partially added.
		Section 16.5.2	Partially added.
		Section 16.5.3	Partially added.
		Section 17.3.2	Partially changed.
		Section 18.1.3	Partially changed.
		Chapter 19	POINT is partially changed.
		App. 4.2.3	Partially changed.
		App. 4.4	Partially added.
		App. 5.7.2	Partially changed.
		App. 6	Partially added and a diagram is changed.
		App. 7.2	Partially added.
		App. 7.3	Partially added.
		App. 7.4	Newly Added.
		App. 13	POINT is partially changed.
		App. 14	Added.
Oct. 2017	SH(NA)030107ENG-Q	TM-RG2M002C30 and 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 1.5	Partially changed.
		Section 1.6	Partially changed.
		Chapter 2	CAUTION is partially changed.
		Section 2.6	Partially changed.
		Chapter 3	CAUTION is partially changed.
		Section 3.3.3	Partially changed.
		Section 3.6.1	Partially added.
		Section 3.7	Partially added.
		Section 3.8.1	Partially changed.
		Chapter 4	CAUTION is partially changed.
		Section 4.2.2	Partially changed.
		Section 4.3.2	Partially changed.
		Section 4.4.2	Partially changed.
		Section 4.5.9	Partially changed.
		Section 5.2.1	Partially changed.
		Section 5.2.2	Partially changed.
		Section 5.2.6	Partially changed.

Revision Date	*Manual Number	Revision	
Oct. 2017	SH(NA)030107ENG-Q	Chapter 6	POINT is partially added.
		Section 6.2.2	Partially changed.
		Section 7.1.5	Partially changed.
		Section 8.2	Partially added.
		Section 10.1	Partially changed.
		Section 10.3	CAUTION is added.
		Section 11.2.2	Partially changed.
		Section 11.7.2	Partially changed.
		Section 11.8.4	Partially changed.
		Section 11.17	Partially changed.
		Chapter 12	POINT is partially added.
		Section 12.1.2	Partially changed.
		Section 15.2	POINT is partially added.
		Section 15.3.4	Partially changed.
		Section 16.2	CAUTION is partially changed.
		Section 16.3.2	Partially changed.
		Section 16.5.1	Partially changed.
		Section 16.5.2	Partially changed.
		Section 16.5.3	CAUTION is added.
		Section 18.7.1	Partially changed.
		Section 19.5.3	Partially changed.
		App. 1	Partially changed.
		App. 2	Partially changed.
		App. 4.1	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. 7.2	Partially changed.
		App. 7.4	Partially changed.
		App. 7.4.4	Partially changed.
Feb. 2018	SH(NA)030107ENG-R	FR-CV-H7.5K, FR-CV-H11K, and FR-CV-H15K are added.	
		Section 3.7	POINT is added.
		Section 3.7.1 (2)	The diagram is changed.
		Section 3.7.2 (1)	The diagram is changed.
		Section 3.7.3 (1)	The diagram is changed.
		Section 3.8.1	POINT is partially changed.
		Section 3.8.1 (1)	Note 2 is deleted. The diagram is changed.
		Section 3.10.2 (1) (a)	The diagram is changed.
		Section 3.10.2 (1) (b)	POINT is added. The diagram is changed.
		Section 3.10.2 (1) (c)	The contents are entirely changed.
		Section 5.1	POINT is partially changed.
		Section 5.2.3	The sentences are added to PC16. PC19 is partially changed.
		Section 11.2.2	The contents are entirely 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 18.2	CAUTION is added.
		App. 4.7	POINT is partially changed.
		App. 5.10	The table is changed.
		App. 15	Added.
Nov. 2020	SH(NA)030107ENG-S	The dimensions of MR-J4-500A(4)(-RJ), MR-J4-700A(4)(-RJ), and MR-J4-22KA(4)(-RJ) are changed.	
		Section 9.1	The diagrams are changed.
Sep. 2021	SH(NA)030107ENG-T	4. Additional instructions (4) Usage Partially changed.	
		Section 1.3	Partially changed.

Revision Date	*Manual Number	Revision	
Sep. 2021	SH(NA)030107ENG-T	Section 1.5	Partially changed.
		Section 1.7.1	Partially changed.
		Section 2.5	Partially changed.
		Section 3.1	POINT is added, partially added.
		Section 3.4	Partially changed.
		Section 3.6	Partially changed.
		Section 3.7	Partially changed.
		Section 3.10	Partially changed.
		Section 3.11	Partially changed.
		Section 4.5.9	POINT is partially changed.
		Section 5.1.3	Partially added.
		Section 5.2	Partially added and partially changed.
		Section 6.4	Partially changed.
		Section 7.1.5 (3)	Partially changed.
		Section 7.2.4 (3)	Partially changed.
		Section 7.3.2	POINT is partially changed.
		Section 7.5	POINT is partially changed.
		Chapter 8	Partially changed.
		Section 9.1	The diagrams are changed.
		Section 10.2	Partially 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 11.7	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 13.2.2 (2)	Partially changed.
		Section 14.3.2 (4)	Partially changed.
		Section 14.4.1	Partially added and partially changed.
		Section 14.5.2 (1)	Partially changed.
		Section 14.5.3 (6)	Added.
		Section 14.5.10	Partially added and partially changed.
		Section 14.5.12	Added.
		Section 14.5.13	Added.
		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.
		Section 16.5.3	POINT is changed.
		Chapter 17	POINT is added.
		Section 17.2	Partially added and partially changed.
		Section 17.3.1 (5)	Partially changed.
		Section 18.1.7	Partially changed.
		Section 18.3.2 (1) (b)	Partially changed.
		Section 18.5.3 (3)	Partially changed.
		Section 18.5.10	POINT is partially changed.
		Section 18.6	The diagram is changed.
		Section 19.5.3 (5) (a)	Partially changed.
		Appendix. 1	Partially added and partially changed.

Revision Date	*Manual Number	Revision
Sep. 2021	SH(NA)030107ENG-T	Appendix. 3 Partially changed. Appendix. 4 Partially added and partially changed. Appendix. 7.4 Partially added and partially changed. Appendix. 8 Partially changed. Appendix. 10.1.3 Partially changed. Appendix. 13.4 Partially changed. Appendix. 15 Partially added and partially changed. Appendix. 16 Added.
Jun. 2024	SH(NA)030107ENG-U	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 3.5, Section 3.10, Section 4.2.4, Section 4.3.4, Section 4.4.4, Chapter 5, Section 5.2, Section 10.1, Section 10.2, Section 13.1, Section 15.4, Section 16.5, Section 18.1.3, Section 18.1.6, Section 18.3.9, Section 18.7.2, Appendix 5, Appendix 6, Appendix 11, Appendix 12, Appendix 15

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;

1. a failure caused by your improper storing or handling, carelessness or negligence, etc., and a failure caused by your hardware or software problem
2. a failure caused by any alteration, etc. to the Product made on your side without our approval
3. 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
4. a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
5. any replacement of consumable parts (battery, fan, smoothing capacitor, etc.)
6. 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
7. 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
8. 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.

(3) Mitsubishi Electric shall have no responsibility or liability for any problems involving programmable controller trouble and system trouble caused by DoS attacks, unauthorized access, computer viruses, and other cyberattacks.

SH(NA)030107ENG-U(2406)MEE
MODEL: MR-J4-A INSTRUCTIONMANUAL
MODEL CODE:1CW804

MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE: TOKYO BLDG., 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
NAGOYA WORKS: 1-14, YADA-MINAMI 5-CHOME, HIGASHI-KU, NAGOYA 461-8670, JAPAN