

AC Servo System

MITSUBISHI ELECTRIC SERVO SYSTEM
MELSERVO-J5

MR-MD3 User's Manual

-MR-MD333G
-MR-MD333G-N1

SAFETY PRECAUTIONS

Please read the precautions 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 manual, installation guide, and appended documents carefully. Do not use the equipment until you have a full knowledge of the equipment, safety information, and precautions.

In this manual, the safety precautions are classified into the "WARNING" and "CAUTION" levels.

 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.

Note that even the precautions classified as the "CAUTION" level may lead to a serious consequence depending on conditions.

Please follow the instructions of both levels because they are important to personnel safety.

Forbidden actions and required actions are indicated by the following diagrammatic symbols.

	Indicates a forbidden action. For example, "No Fire" is indicated by  .
	Indicates a required action. For example, grounding is indicated by  .

In this manual, precautions for hazards that can lead to property damage, precautions for other functions, and other information are shown separately in the "POINT" area.

After reading this manual, keep it accessible to the operator.

[Installation/wiring]

WARNING

- To prevent an electric shock, turn off the power and wait for 15 minutes or more before starting wiring and/or inspection.
 - To prevent an electric shock, ground the servo amplifier.
 - To prevent an electric shock, wiring work must be performed by professional engineers.
 - To prevent an electric shock, mount the servo amplifier before wiring.
 - To prevent an electric shock, connect FG of the servo amplifier to the protective earth (PE) terminal of the cabinet, then connect the grounding lead wire to the ground.
 - To prevent an electric shock, do not touch the conductive parts.
-

[Setting/adjustment]

WARNING

- To prevent an electric shock, do not operate the switches with wet hands.
-

[Operation]

WARNING

- To prevent an electric shock, do not operate the switches with wet hands.
-

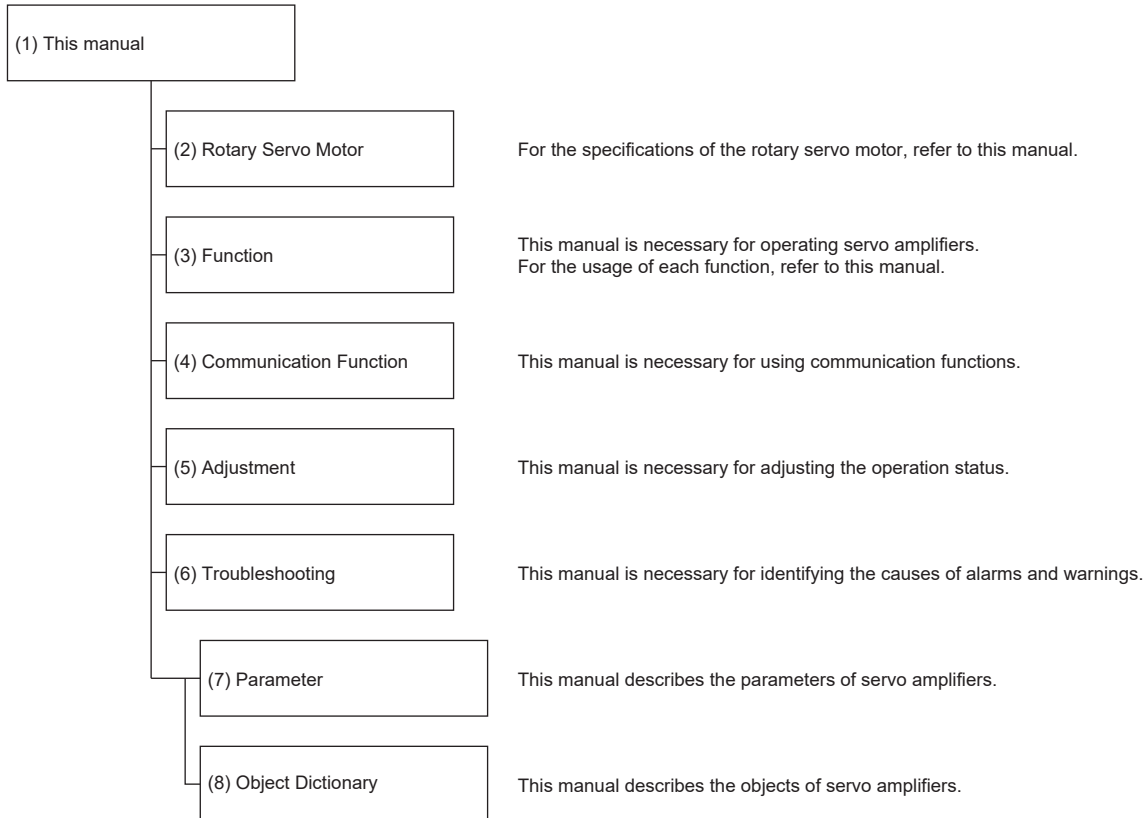
[Maintenance]

WARNING

- To prevent an electric shock, inspection work must be performed by professional engineers.
 - To prevent an electric shock, do not operate the switches with wet hands.
-

ABOUT THE MANUAL

When using the servo for the first time, prepare and use the following related manuals to ensure that the servo is used safely.



No.	Manual name	Manual No.	Applicable models	
			MR-MD333G	MR-MD333G-N1
(1)	MR-MD3 User's Manual	IB(NA)-0300641ENG	○	○
(2)	Rotary Servo Motor User's Manual (For MR-J5)	SH(NA)-030314ENG	○ *1	○ *1
	SERVO MOTOR INSTRUCTION MANUAL (Vol. 3)	SH(NA)-030113ENG	○ *2	○ *2
(3)	MR-J5 User's Manual (Function)	SH(NA)-030300ENG	○	○
(4)	MR-J5-G/MR-J5W-G User's Manual (Communication Function)	SH(NA)-030302ENG	○	—
	MR-J5-G-N1/MR-J5W-G-N1 User's Manual (Communication Function)	SH(NA)-030371ENG	—	○
(5)	MR-J5 User's Manual (Adjustment)	SH(NA)-030306ENG	○	○
(6)	MR-J5 User's Manual (Troubleshooting)	SH(NA)-030312ENG	○	○
(7)	MR-J5-G/MR-J5W-G User's Manual (Parameters)	SH(NA)-030308ENG	○	○
(8)	MR-J5-G/MR-J5W-G User's Manual (Object Dictionary)	SH(NA)-030304ENG	○	—
	MR-J5-G-N1/MR-J5W-G-N1 User's Manual (Object Dictionary)	SH(NA)-030376ENG	—	○

*1 When using an HK-KT servo motor, refer to this manual.

*2 When using an HG-AK servo motor, refer to this manual.

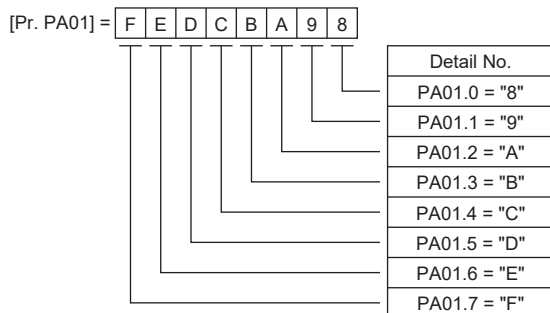
Interpreting servo parameter numbers

For servo parameters in which functions are selected with each hexadecimal digit, the functions are represented by a detail number for each digit.

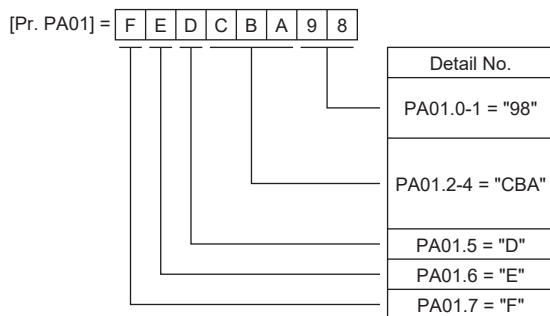
The detail number for the least significant digit is represented in the format [Pr. PA01.0]. In addition, when a servo parameter is set using a combination of multiple digits, the digits are indicated using a hyphen (-), as in [Pr. PA01.0-1].

The following shows an example in which the servo parameter number is PA01 and the setting value is represented by the hexadecimal value "FEDCBA98".

- When setting a servo parameter by configuring each individual digit



- When setting a servo parameter using a combination of multiple digits



For example, if the servo parameter name is "Function selection A-1", the name of the setting digit is "Forced stop deceleration function selection", and the setting digit is the forth last digit in PA04, the servo parameter is expressed as shown below.

[Pr. PA04.3 Forced stop deceleration function selection]

Servo parameter	Symbol	Name	Description
PA04.3	*AOP	Forced stop deceleration function selection	Set whether to enable/disable the forced stop deceleration function. Initial value: 1h (enabled)

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.

Handling the MR-MD333G_ servo amplifier

To prevent damage caused by electrostatic discharge, personnel must take appropriate measures against static electricity before installation and maintenance. Do not directly touch electronic components or the areas around them with your hands. Since the MR-MD333G_ servo amplifier is a bare-board product, directly touching electronic components or the areas around them may cause electrostatic damage due to static electricity from the human body (contact discharge or air discharge).

Wires used for wiring

Wires mentioned in this manual are selected based on an ambient temperature of 40 °C.

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1 SPECIFICATIONS

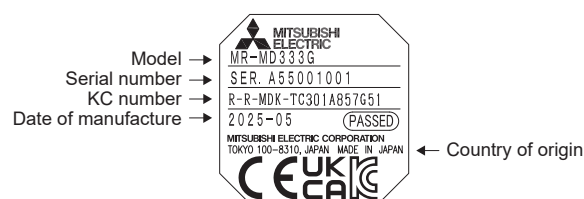
1.1 Overview

MR-MD333G	MR-MD333G-N1
The MR-MD333G servo amplifier is designed to be used in an Ethernet open network with a maximum communication speed of 1 Gbps. One MR-MD333G servo amplifier can drive three servo motors.	The MR-MD333G-N1 servo amplifier is designed to be used with EtherCAT. EtherCAT is an abbreviation of Ethernet for Control Automation Technology. It is open network communication between a master station and slave stations using real-time Ethernet developed by Beckhoff Automation. One MR-MD333G-N1 servo amplifier can drive three servo motors.
	

1.2 Model designation

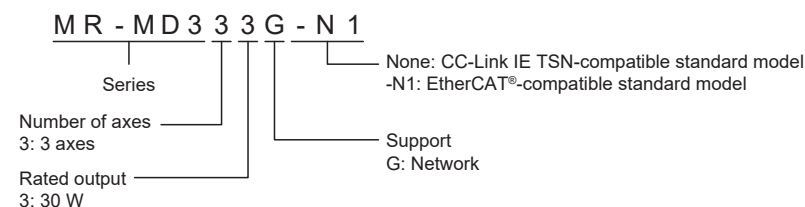
Rating plate

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



Model

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



1.3 Servo amplifier/motor combinations

○: Standard torque

Rotary servo motor			MR-MD333G_ servo amplifier	
			48 V DC	24 V DC
HK-KT_	□40	HK-KT0536E2-S1 *1	○	—
HG-AK_	□25	HG-AK0136_ *2	○ *3	○ *3
		HG-AK0236_ *2	○ *3	○ *3
		HG-AK0336_ *2	○ *3	○ *3

*1 The HK-KT0536E2-S1 servo motor is available on servo amplifiers with firmware version A4 or later.

*2 Use HG-AK servo motors manufactured in June 2020 or later. Otherwise, [AL. 01A.2 Servo motor control mode combination error] occurs.

*3 The torque characteristics of the servo motor are different between 48 V DC and 24 V DC. For details, refer to the following manual.
 SERVO MOTOR INSTRUCTION MANUAL (Vol. 3)

1.4 Servo amplifier standard specifications

Model		MR-MD333G(-N1)
Output	Voltage	3-phase 0 V AC to 39 V AC
	Rated current (each axis) [A]	2.2
Main circuit power supply input	Voltage	DC 24 V/DC 48 V * ⁹
	Rated current	For 24 V DC: 7.6 A For 48 V DC: 3.8 A
	Permissible voltage fluctuation	For 24 V DC: 21.6 V DC to 26.4 V DC For 48 V DC: 40.8 V DC to 55.2 V DC
Control circuit power supply input	Voltage	DC 24 V/DC 48 V
	Rated current	For 24 V DC: 1 A For 48 V DC: 0.5 A
	Permissible voltage fluctuation	For 24 V DC: 21.6 V DC to 26.4 V DC For 48 V DC: 40.8 V DC to 55.2 V DC
	Power consumption [W]	25
Interface power supply	Voltage	24 V DC $\pm 10\%$
	Current capacity [A]	0.5 * ¹
Control method		Sine-wave PWM control, current control method
Dynamic brake		Built-in (electric dynamic brake)
Number of connection nodes		Max. 254 stations * ⁷
CC-Link IE TSN Class B * ⁵ (MR-MD333G)	Communication cycle * ²	125 μ s, 250 μ s, 500 μ s, 1 ms, 1.5 ms, 2 ms, 2.5 ms, 3 ms, 3.5 ms, 4 ms, 4.5 ms, 5 ms, 5.5 ms, 6 ms, 6.5 ms, 7 ms, 7.5 ms, 8 ms * ⁸
	Protocol version * ⁴	1.0/2.0
CC-Link IE TSN Class A * ^{3,5} (MR-MD333G)	Communication cycle	500 μ s to 500 ms
	Protocol version	2.0
CC-Link IE Field Network Basic		Not supported
EtherCAT (MR-MD333G-N1)	Communication cycle * ²	250 μ s, 500 μ s, 1 ms, 2 ms, 4 ms, 8 ms
Communication function	USB	Connection to a personal computer or other devices (MR Configurator2-compatible)
A/B/Z-phase pulse output	MR-MD333G	Available only on A-axis and B-axis (A/B-phase pulse)
	MR-MD333G-N1	Not supported
Analog monitor		Not supported
Fully closed loop control		Not supported
Scale measurement function		Not supported
Protective function		Overcurrent shut-off, regenerative overvoltage shut-off, overload shut-off (electronic thermal), servo motor overheat protection, encoder error protection, undervoltage protection, instantaneous power failure protection, overspeed protection, excessive error protection, magnetic pole detection protection * ⁶ , and linear servo control error protection * ⁶
Satisfied standards	CE marking	EMC: EN IEC 61800-3
	UKCA marking	EMC: BS EN IEC 61800-3
Structure (IP rating)		Board type, natural cooling, open (IP00)
Mass [kg]		0.12

*1 The value 0.5 A is applicable when all I/O signals are used. Reducing the number of I/O points decreases the current capacity.

*2 It depends on the controller specifications and the number of the connected axes.

*3 CC-Link IE TSN Class A is available on servo amplifiers with firmware version A4 or later.

*4 CC-Link IE TSN protocol version 2.0 is available on servo amplifiers with firmware version A4 or later.

*5 The communication speed of 100 Mbps can be used with servo amplifiers with firmware version A4 or later.

*6 The magnetic pole detection protection and the linear servo control error protection are available on servo amplifiers with firmware version A6 or later.

*7 The connection with 121 or more device stations is available when the communication speed is set to 1 Gbps on servo amplifiers with firmware version A8 or later. When the communication speed is set to 100 Mbps, the number of connected device stations should be 120 or less.

*8 The following communication cycles can be used by servo amplifiers with firmware version A8 or later: 1.5 ms, 2.5 ms, 3 ms, 3.5 ms, 4.5 ms, 5 ms, 5.5 ms, 6 ms, 6.5 ms, 7 ms, and 7.5 ms For available communication cycles, refer to the manual of the controller.

*9 The initial setting value is 48 V DC. When using 24 V DC, set [Pr. PC81.3 Main circuit power supply selection] to "1" (24 V DC selected). The main circuit power supply can be set to 24 V DC on servo amplifiers with firmware version A8 or later.

Positioning mode

Point table method (CP)

Item		Description
Command interface		Object dictionary
Operational specification		Positioning by specifying the point table number (255 points)
System		Signed absolute value command method
Position command input	Absolute value command method	Setting in the point table Setting range of feed length for one point: -2147483648 to 2147483647 [μm], -214748.3648 to 214748.3647 [inch], -2147483648 to 2147483647 [pulse], -360.000 to 360.000 [degree]
Speed command input		Set the servo motor speed in the point table. Set the acceleration/deceleration time constants and acceleration/deceleration in the point table. Set the S-pattern acceleration/deceleration time constant in [Pr. PT51]. The speed unit can be selected ([r/min], command unit/s). The acceleration/deceleration unit can be selected ([ms], command unit/s ²).
Torque limit		Setting by the servo parameter or object dictionary
Point table mode (pt)	Each positioning operation	Point table number input method Perform each positioning operation based on the position command and speed command.
	Continuous positioning operation	Varying-speed operation (2 to 255 speeds)/ Continuous positioning operation (2 points to 255 points)/ Continuous operation to the point table selected at startup/ Continuous operation to the point table No. 1
Jog mode (jg)	JOG operation	Perform inching operation with the network communication function based on the speed command.
Homing mode (hm)		For information on the homing method, refer to "Homing mode (hm)" in the following manual.  MR-J5 User's Manual (Function)
Function related to positioning operation		Absolute position detection/external limit switch/software position limit/positioning to home position function, etc.

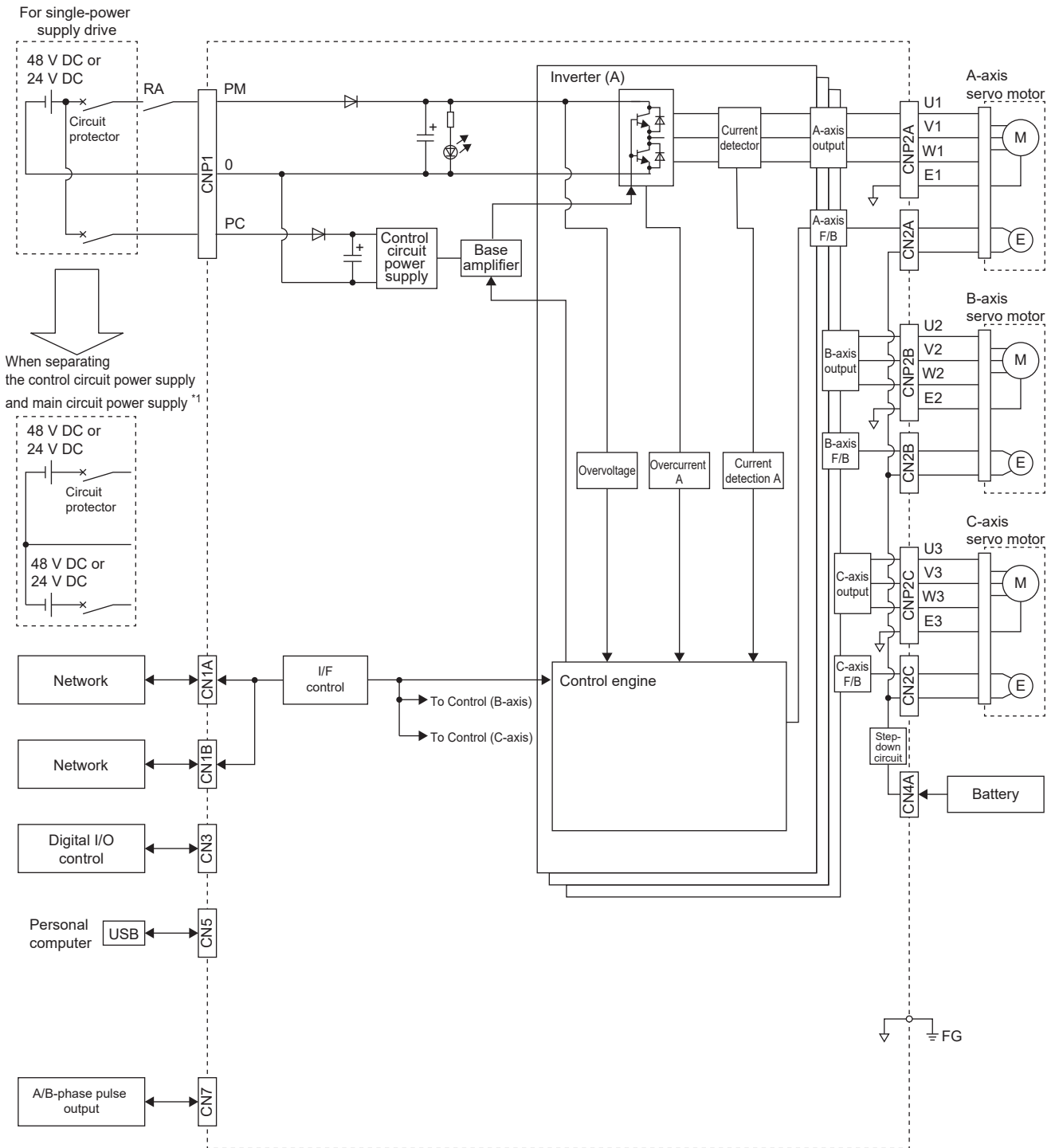
Environment

Item	Operation	Transportation	Storage
Ambient temperature	0 °C to 45 °C (non-freezing) Class 3K3 (IEC 60721-3-3)	-25 °C to 70 °C (non-freezing) Class 2K12 (IEC 60721-3-2)	-25 °C to 70 °C (non-freezing) Class 1K4 (IEC 60721-3-1)
Ambient humidity	5%RH to 95%RH (non-condensing)	5%RH to 95%RH (non-condensing)	5%RH to 95%RH (non-condensing)
Ambience	Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist or dust		
Altitude/ atmospheric pressure	Altitude: 1000 m or less	Transportation conditions: Must be transported by land, sea, or in an aircraft pressurized to 700 hPa or more.	Atmospheric pressure: 700 hPa to 1060 hPa (equivalent to the altitude of -400 m to 3000 m.)
Vibration resistance	Each of the X, Y, and Z directions 10 Hz to 55 Hz, acceleration amplitude 39 m/s ²	2 Hz to 9 Hz, displacement amplitude (half amplitude) 7.5 mm 9 Hz to 200 Hz, acceleration amplitude 20 m/s ² Class 2M3 (IEC 60721-3-2)	2 Hz to 9 Hz, displacement amplitude (half amplitude) 1.5 mm 9 Hz to 200 Hz, acceleration amplitude 5 m/s ² Class 1M2 (IEC 60721-3-1)

1.5 Function block diagram

1

The following shows the function block diagram of this servo amplifier.

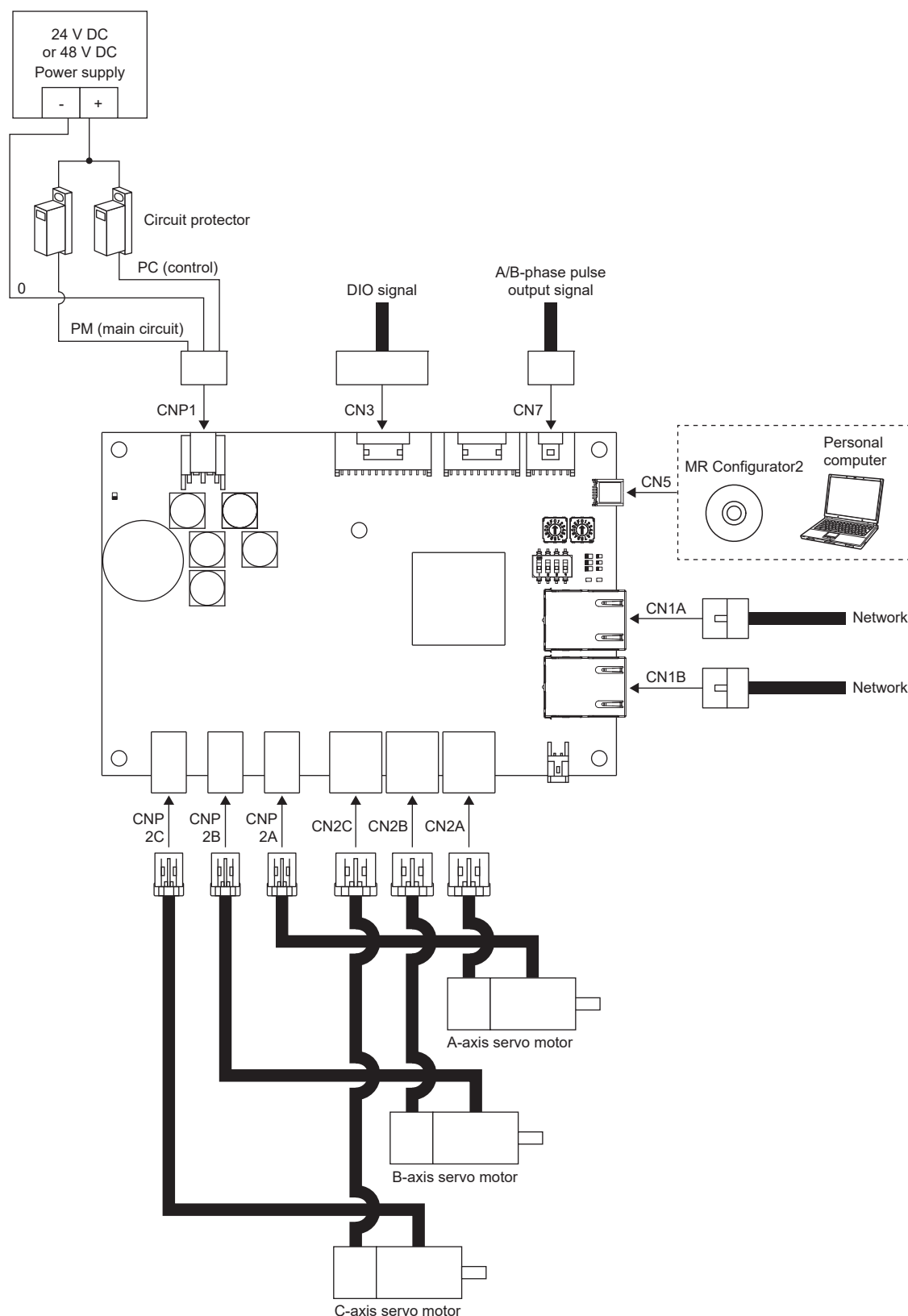


*1 For available combinations of the main circuit power supply and the control circuit power supply, refer to the following.

☞ Page 40 Example power circuit connections

1.6 Configuration including peripheral equipment

- To prevent a malfunction, do not connect these connectors to any network other than the specified network.
- To prevent malfunction, do not connect a servo motor for an incorrect axis to CNP2A, CNP2B, CNP2C, CN2A, CN2B, or CN2C.
- Devices other than the servo amplifier and servo motor are optional or recommended products.



2 FUNCTION

2.1 Restrictions on MR-MD3

2

Restrictions on CC-Link IE TSN

Category	Detailed function	Network communication cycle limit (minimum)
Control mode	Profile position mode (pp)	500 μ s
	Profile velocity mode (pv)	500 μ s
	Profile torque mode (tq)	500 μ s
	Continuous operation to torque control mode (ct)	125 μ s
	Point table method (When [Pr. PA01.0 Control mode selection] is set to "6")	500 μ s
I/O, monitor	A/B/Z-phase output	250 μ s ^{*1}
	Touch probe	250 μ s
—	Command unit selection function (When [Pr. PT01.2 Unit for position data] is set to "2" (degree))	500 μ s
	Command unit selection function (When [Pr. PT01.1 Speed/acceleration/deceleration unit selection] is set to "1" (command unit/s))	250 μ s

*1 When the command unit selection function (when [Pr. PT01.1 Speed/acceleration/deceleration unit selection] is set to "1" (command unit/s)) is used, the A/B/Z-phase output cannot be used.

Restrictions on CC-Link IE TSN Class A

Item	Availability
Control mode	Cyclic synchronous position mode (csp)
	Cyclic synchronous velocity mode (csv)
	Cyclic synchronous torque mode (cst)
	Continuous operation to torque control mode (ct)

Restrictions on EtherCAT

Category	Detailed function	Network communication cycle limit (minimum)
Control mode	Profile position mode (pp)	500 μ s
	Profile velocity mode (pv)	500 μ s
	Profile torque mode (tq)	500 μ s
	Point table method (When [Pr. PA01.0 Control mode selection] is set to "6")	500 μ s
—	Command unit selection function (When [Pr. PT01.2 Unit for position data] is set to "2" (degree))	500 μ s

2.2 Function list

The function list of this servo amplifier is shown in the following table. For details of the functions, refer to each section indicated in the detailed explanation field.

In this section, the servo amplifier names are abbreviated as shown below.

MD3G: MR-MD333G

MD3G-N1: MR-MD333G-N1

Control mode

Function	Detailed function	Description	Ver. *1		Detailed explanation
			MD3G	MD3G-N1	
CiA 402 control mode	Cyclic synchronous position mode (csp)	This function operates the servo motor in the cyclic synchronous position mode.	A0	A2	Refer to "CONTROL MODE" in the following manual.  MR-J5 User's Manual (Function)
	Cyclic synchronous velocity mode (csv)	This function operates the servo motor in the cyclic synchronous velocity mode.	A2	A2	
	Cyclic synchronous torque mode (cst)	This function operates the servo motor in the cyclic synchronous torque mode.	A2	A2	
	Profile position mode (pp)	This function operates the servo motor in the profile position mode.	A2	A2	
	Profile velocity mode (pv)	This function operates the servo motor in the profile velocity mode.	A8	A8	
	Profile torque mode (tq)	This function operates the servo motor in the profile torque mode.	A8	A8	
	Homing mode (hm)	This function operates the servo motor in the homing mode. Or it performs homing.	A0	A2	
Thrust/torque control	Continuous operation to torque control mode (ct)	This function enables smooth switching to torque control from the position control mode or speed control mode without stopping the servo motor. This eliminates rapid changes of speed and torque, contributing to reduction in load to the machine and high-quality product molding.	A4	—	This function is not available for the MR-MD333G_ servo amplifier.
	Cyclic synchronous pressure mode (cspr)	This function inputs the analog signal from a pressure sensor (load cell) to the servo amplifier and controls the target pressure by giving a pressure command from the servo system controller, enabling the actual pressure to be kept constant even when the load fluctuates. This function is available for equipment that requires pressure control, such as a molding machine and bonder.	—	—	
Point table method	Point table mode (pt)	This function operates the servo motor according to the setting values by selecting the point table with preset 255 points.	A2	A2	 MR-J5 User's Manual (Function)
	Jog mode (jg)	This control mode enables movement to a desired position for tasks such as machine adjustments and home positioning.	A2	A2	
Slave axis control	Slave axis torque mode	This control mode drives servo motors by receiving a torque command from the master axis.	—	—	This function is not available for the MR-MD333G_ servo amplifier.
Test operation	Test operation mode	This function requires MR Configurator2 for JOG operation, positioning operation, motor-less operation, DO forced output, and program operation.	A0	A2	 Page 103 Test operation

*1 "Ver." indicates the supported firmware version of the servo amplifier. The functions are available on servo amplifiers with the indicated firmware version or later.

Drive motor

Function	Detailed function	Description	Ver. *1		Detailed explanation
			MD3G	MD3G-N1	
Servo motor	Linear servo motor	Using a linear servo motor and linear encoder enables a linear servo system to be configured.	A6	A6	When using a linear servo motor, contact your local sales office.
	Direct drive motor	Using this function enables a direct drive servo system to be configured to drive a direct drive motor.	A6	A6	When using a direct drive motor, contact your local sales office.
Encoder	High-resolution encoder	A high-resolution encoder with 262144 pulses/rev is used as the encoder of the HG-AK servo motor.	A0	A2	—
		A high-resolution encoder with 67108864 pulses/rev is used as the encoder of the HK-KT servo motor.	A4	A4	
	Batteryless absolute position encoder	This encoder can retain the rotation position of the servo motor without using a battery. Using a servo motor (HK-KT servo motor) with this encoder enables an absolute value detection system to be configured without using a battery.	A4	A4	☞ Page 140 ABSOLUTE POSITION DETECTION SYSTEM

*1 "Ver." indicates the supported firmware version of the servo amplifier. The functions are available on servo amplifiers with the indicated firmware version or later.

Network

Function	Detailed function	Description	Ver. *1		Detailed explanation
			MD3G	MD3G-N1	
Open network (CC-Link series)	CC-Link IE TSN	This function connects the servo amplifier to equipment such as a controller through CC-Link IE TSN.	A0	—	☞ MR-J5-G/MR-J5W-G User's Manual (Communication Function)
	CC-Link IE Field Network Basic	This function connects the servo amplifier to equipment such as a controller through CC-Link IE Field Network Basic.	—	—	This function is not available for the MR-MD333G_ servo amplifier.
Common protocol	SLMP	This function supports SLMP (SeamLess Message Protocol). Servo parameter settings and monitoring are available.	A0	—	☞ MR-J5-G/MR-J5W-G User's Manual (Communication Function)
Remote maintenance	Parameter automatic setting	This function transmits settings such as servo parameters from the controller.	A0	—	☞ MR-J5-G/MR-J5W-G User's Manual (Communication Function)
	Firmware update	This function updates the firmware of the servo amplifier.	A0	A2	Refer to "Firmware update" in the following manual. ☞ MR-J5 User's Manual (Function)
Open network	EtherCAT	This function connects the servo amplifier to equipment such as a controller through EtherCAT communication.	—	A2	☞ MR-J5-G-N1/MR-J5W-G-N1 User's Manual (Communication Function)
	EtherNet/IP	This function connects the servo amplifier to equipment such as a controller through EtherNet/IP communication.	—	—	This function is not available for the MR-MD333G_ servo amplifier.
	PROFINET	This function connects the servo amplifier to equipment such as a controller through PROFINET communication.	—	—	This function is not available for the MR-MD333G_ servo amplifier.
Synchronization	Master-slave operation function	This function transmits the torque of the master axis to a slave axis through driver communication, and controls and operates the slave axis using the torque as a command.	—	—	This function is not available for the MR-MD333G_ servo amplifier.

*1 "Ver." indicates the supported firmware version of the servo amplifier. The functions are available on servo amplifiers with the indicated firmware version or later.

Position detection

Function	Detailed function	Description	Ver. *1		Detailed explanation
			MD3G	MD3G-N1	
Control method	Semi closed loop system	Using a servo motor encoder enables a semi closed loop system to be configured.	A0	A2	—
	Fully closed loop system	Using a load-side encoder enables a fully closed loop system to be configured.	—	—	This function is not available for the MR-MD333G_servo amplifier.
	Scale measurement function	This function connects the scale measurement encoder in the state of the semi closed loop control to transmit the position information of the scale measurement encoder to the controller.	—	—	
Absolute position	Absolute position detection system	Once the home position is set, homing is not required at each power-on.	A0	A2	☞ Page 140 ABSOLUTE POSITION DETECTION SYSTEM

*1 "Ver." indicates the supported firmware version of the servo amplifier. The functions are available on servo amplifiers with the indicated firmware version or later.

Operation function

Function	Detailed function	Description	Ver. *1		Detailed explanation
			MD3G	MD3G-N1	
Stop function	Quick Stop	This function stops the servo motor with a specified method and switches to the servo-off state.	A0	A2	Refer to "Quick stop" in the following manual. IMR-J5 User's Manual (Function)
	Halt	This function stops the servo motor while the servo-on status is maintained.	A0	A2	Refer to "Halt" in the following manual. IMR-J5 User's Manual (Function)
	Stroke limit function	This function uses LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end) to limit the travel interval of the servo motor.	A0	A2	Refer to "Stroke limit function" in the following manual. IMR-J5 User's Manual (Function)
	Software position limit	This function uses servo parameters to limit the travel intervals by address. A function equivalent to the stroke limit function can be set with the servo parameter.	A0	A2	Refer to "Software position limit" in the following manual. IMR-J5 User's Manual (Function)
Command generation	Rotation/travel direction selection	This function sets the rotation direction of the servo motor without changing the command polarity.	A0	A2	Refer to "Rotation/travel direction selection" in the following manual. IMR-J5 User's Manual (Function)
	Electronic gear	This function performs positioning control with the value obtained by multiplying the position command from the upper controller by a set electronic gear ratio.	A0	A2	Refer to "Electronic gear function" in the following manual. IMR-J5 User's Manual (Function)
	Acceleration/deceleration function	This function enables smooth acceleration/deceleration.	A0	A2	Refer to "Acceleration/deceleration function" in the following manual. IMR-J5 User's Manual (Function)
	S-pattern acceleration/deceleration time constant	This function performs smooth acceleration and deceleration.	A0	A2	Refer to "S-pattern acceleration/deceleration time constant" in the following manual. IMR-J5 User's Manual (Function)
	Torque limit	This function limits the servo motor torque.	A0	A2	Refer to "Torque limit" in the following manual. IMR-J5 User's Manual (Function)
	Speed limit	This function limits the servo motor speed in the torque control mode.	A0	A2	Refer to "Speed limit" in the following manual. IMR-J5 User's Manual (Function)
	Command offset	This function compensates for the position/speed/torque/pressure commands by adding a desired amount of offset to the commands.	A0	A2	Refer to "Command offset" in the following manual. IMR-J5 User's Manual (Function)

*1 "Ver." indicates the supported firmware version of the servo amplifier. The functions are available on servo amplifiers with the indicated firmware version or later.

Positioning function

Function	Detailed function	Description	Ver. *1		Detailed explanation
			MD3G	MD3G-N1	
Override function	Override function	This function can change the servo motor speed via communication. The value can be changed to 0% to 360% of the set speed.	A4	A4	Refer to "Override function" in the following manual.  MR-J5 User's Manual (Function)
Absolute position	Infinite feed function	In an absolute position detection system, even if the servo motor rotates 32768 rev or more in the same direction, [AL. 0E3.1 Multi-revolution counter travel distance exceeded warning] will not occur and the home position will not be erased. Therefore, the current position will be restored after the power is cycled. When this function is not used, if the servo motor rotates 32768 rev or more in the same direction, [AL. 0E3.1] will occur and the home position will be erased.	A2	A2	Refer to "Infinite feed function" in the following manual.  MR-J5 User's Manual (Function)

*1 "Ver." indicates the supported firmware version of the servo amplifier. The functions are available on servo amplifiers with the indicated firmware version or later.

Control function

Function	Detailed function	Description	Ver. *1		Detailed explanation
			MD3G	MD3G-N1	
Vibration suppression	Advanced vibration suppression control II	This function suppresses vibration and residual vibration at an arm end.	A0	A2	Refer to "Advanced vibration suppression control II" in the following manual. IMR-J5 User's Manual (Adjustment)
	Machine resonance suppression filter	This function decreases the gain of the specific frequency to suppress the resonance of the mechanical system.	A0	A2	Refer to "Machine resonance suppression filter" in the following manual. IMR-J5 User's Manual (Adjustment)
	Shaft resonance suppression filter	When driving the servo motor with a load mounted to the servo motor shaft, resonance due to shaft torsion may generate high frequency mechanical vibration. The shaft resonance suppression filter suppresses this vibration.	A0	A2	Refer to "Shaft resonance suppression filter" in the following manual. IMR-J5 User's Manual (Adjustment)
	Robust filter	This function improves a disturbance response when a response performance cannot be increased because of a large load to motor inertia ratio, such as a roll feed axis.	A0	A2	Refer to "Robust filter" in the following manual. IMR-J5 User's Manual (Adjustment)
	Slight vibration suppression control	This function suppresses vibration of ± 1 pulse generated at each servo motor stop.	A0	A2	Refer to "SLIGHT VIBRATION SUPPRESSION CONTROL" in the following manual. IMR-J5 User's Manual (Adjustment)
Tracking control	Lost motion compensation function	This function reduces the response delay generated when the machine moving direction is reversed.	A0	A2	Refer to "Lost motion compensation function" in the following manual. IMR-J5 User's Manual (Adjustment)
	Super trace control	This function reduces the droop pulses at the rated speed and at the uniform acceleration/deceleration to almost zero.	A0	A2	Refer to "Super trace control" in the following manual. IMR-J5 User's Manual (Adjustment)
	Path tracking model adaptive control	This function reduces tracking errors in reciprocation.	A0	A2	Refer to "Path tracking model adaptive control" in the following manual. IMR-J5 User's Manual (Adjustment)

*1 "Ver." indicates the supported firmware version of the servo amplifier. The functions are available on servo amplifiers with the indicated firmware version or later.

Adjustment function

Function	Detailed function	Description	Ver. *1		Detailed explanation
			MD3G	MD3G-N1	
Automatic adjustment	Quick tuning	This function automatically adjusts the gain at servo-on in a short time without acceleration/deceleration operation of the servo motor. Response without overshoot is possible. This saves gain adjustment time.	A0	A2	Refer to "Quick tuning" in the following manual. MR-J5 User's Manual (Adjustment)
	Auto tuning	This function automatically adjusts the gain to an optimum value even if the load applied to the servo motor shaft varies.	A0	A2	Refer to "ADJUSTMENT FUNCTION TYPES" in the following manual. MR-J5 User's Manual (Adjustment)
	One-touch tuning	Gain adjustment is performed with this function just by pressing buttons on the servo amplifier or by clicking a button once on MR Configurator2. One-touch tuning can also be performed via a network.	A0	A2	Refer to "One-touch tuning" in the following manual. MR-J5 User's Manual (Adjustment)
Custom adjustment	Model adaptive control	This function enables control according to the ideal model that is both stable and highly responsive. This is a two-degrees-of-freedom model adaptive control and can adjust responses to commands and disturbances separately. This function can also be disabled.	A0	A2	Refer to "MODEL ADAPTIVE CONTROL" in the following manual. MR-J5 User's Manual (Adjustment)
	Pressure model adaptive control	This function enables stable and highly responsive pressure control according to the ideal model in which the characteristics of the object to be pressured are incorporated.	—	—	This function is not available for the MR-MD333G_ servo amplifier.
	Gain switching function	This function switches gains during rotation and during stop, and uses an input device to switch gains during operation. It supports the gain switching by rotation direction and the 3-step gain switching. Therefore, more detailed gain switching is available.	A0	A2	Refer to "GAIN SWITCHING FUNCTION" in the following manual. MR-J5 User's Manual (Adjustment)
Adjustment support	Machine analyzer	This function analyzes the frequency characteristics of the mechanical system by simply connecting the servo amplifier to a personal computer with MR Configurator2 installed.	A0	A2	Refer to "Adjustment functions available in combination with MR Configurator2" in the following manual. MR-J5 User's Manual (Adjustment)

*1 "Ver." indicates the supported firmware version of the servo amplifier. The functions are available on servo amplifiers with the indicated firmware version or later.

I/O, monitor

Function	Detailed function	Description	Ver. *1		Detailed explanation
			MD3G	MD3G-N1	
DI/DO	Input signal selection (device selection)	This function assigns input devices such as LSP (Forward rotation stroke end) to certain pins of the connector.	A0	A2	Refer to "Assigning I/O devices" in the following manual. MR-J5 User's Manual (Function)
	Output signal selection (device setting)	This function assigns output devices such as MBR (Electromagnetic brake interlock) to certain pins of the connector.	A0	A2	
	Output signal (DO) forced output	This function forcibly switches the output signals on and off regardless of the servo status. Use this function for purposes such as checking output signal wiring.	A2	A2	Page 110 Output signal (DO) forced output
	A/B/Z-phase output	This function outputs the positions of the encoder and linear encoder in the A/B/Z-phase signal.	A0	—	The MR-MD333G_ servo amplifier can output only the A/B-phase signal. Refer to "A/B/Z-phase pulse output function" in the following manual. MR-J5 User's Manual (Function)
LED	Status display	This function indicates the servo status with the LED mounted on the board.	A0	A2	Page 29 Switch setting and display of the servo amplifier
Analog I/O	High-resolution analog input	When using the MR-J5-G_LL, the analog input resolution is 16 bits.	—	—	This function is not available for the MR-MD333G_ servo amplifier.
	Analog monitor	This function outputs the servo status in voltage in real time.	—	—	
Monitoring	Power monitoring function	This function calculates the running power and the regenerative power from the data in the servo amplifier such as speed and current. The power consumption and other values are displayed on MR Configurator2.	A0	A2	Refer to "MONITORING" in the following manual. MR-J5 User's Manual (Function)
Touch probe	Current position latch function	This function latches the current position when TPR1 (Touch probe 1), TPR2 (Touch probe 2), or TPR3 (Touch probe 3) is turned on.	A2	A2	The MR-MD333G_ servo amplifier supports only the current position latch function using the Z-phase, and the current position latch function using the TPR1 (Touch probe 1)/TPR2 (Touch probe 2)/TPR3 (Touch probe 3) is not available. Refer to "Touch probe" in the following manual. MR-J5 User's Manual (Function)

*1 "Ver." indicates the supported firmware version of the servo amplifier. The functions are available on servo amplifiers with the indicated firmware version or later.

Option

Function	Detailed function	Description	Ver. *1		Detailed explanation
			MD3G	MD3G-N1	
Regenerative capacity enhancement	Regenerative option	Use this function if the built-in regenerative resistor of the servo amplifier does not have sufficient regenerative capacity for the generated regenerative power.	—	—	This function is not available for the MR-MD333G_ servo amplifier.

*1 "Ver." indicates the supported firmware version of the servo amplifier. The functions are available on servo amplifiers with the indicated firmware version or later.

Engineering software

Function	Detailed function	Description	Ver. *1		Detailed explanation
			MD3G	MD3G-N1	
Setup software	MR Configurator2	This software allows configuring servo parameter settings and performing test operation and monitoring with a personal computer.	A8	A8	☞ Page 87 STARTUP

*1 "Ver." indicates the supported firmware version of the servo amplifier. The functions are available on servo amplifiers with the indicated firmware version or later.

Protective function

Function	Detailed function	Description	Ver. *1		Detailed explanation
			MD3G	MD3G-N1	
Alarm	Alarm function	This function displays an alarm or warning when an error occurs during operation. When an alarm occurs, ALM (Malfunction) turns off and stops the servo motor. When a warning occurs, WNG (Warning) will turn on. The servo motor may stop or continue operation depending on the warning.	A0	A2	Refer to "Alarm function" in the following manual. ☞ MR-J5 User's Manual (Function)
Power error detection	Disconnection detection function	This function detects a disconnection in the main circuit power supply input and the servo motor power supply output.	A0	A2	The MR-MD333G_ servo amplifier supports only the output open-phase detection function, and the input open-phase detection function and the servo motor incorrect wiring detection function for the main circuit power supply are not available. Refer to "Disconnection/incorrect wiring detection function" in the following manual. ☞ MR-J5 User's Manual (Function)
Coasting distance reduction	Forced stop deceleration function	This function decelerates the servo motor to a stop when EM2 (Forced stop 2) is turned off or when there is an alarm.	A0	A2	Refer to "Forced stop deceleration function" in the following manual. ☞ MR-J5 User's Manual (Function)
Drop protection	Electromagnetic brake interlock function	This function operates the electromagnetic brake at servo off and error occurrence, and prevents the vertical axis from dropping.	A0	A2	Refer to "Electromagnetic brake interlock function" in the following manual. ☞ MR-J5 User's Manual (Function)
	Vertical axis freefall prevention function	This function moves the axis up by the mechanical backlash amount of the electromagnetic brake to prevent damage to machines.	A0	A2	Refer to "Vertical axis freefall prevention function" in the following manual. ☞ MR-J5 User's Manual (Function)
Braking protection	Electric dynamic brake	During alarm occurrence, this function shorts between the U, V, and W phases of the inverter circuit, and brakes the servo motor.	A0	A2	☞ Page 120 Dynamic brake characteristics

*1 "Ver." indicates the supported firmware version of the servo amplifier. The functions are available on servo amplifiers with the indicated firmware version or later.

Functional safety

Function	Detailed function	Description	Ver. *1		Detailed explanation
			MD3G	MD3G-N1	
Safety sub-function	STO (Safe torque off) (When functional safety parameters are not used)	This servo amplifier supports the STO function for functional safety as per IEC/EN 61800-5-2. This allows a safety system to be easily configured for the equipment.	—	—	This function is not available for the MR-MD333G_servo amplifier.
	STO (Safe torque off) (When functional safety parameters are used)	This function electrically shuts off the servo motor driving energy with input signals from external devices (shut-off by the secondary-side output). This is equivalent to the stop category 0 of IEC/EN 60204-1.	—	—	
	SS1 (Safe stop 1)	This function starts deceleration with input signals from external devices. After the specified time to confirm the motor stop has elapsed, the STO function is executed (SS1). This is equivalent to the stop category 1 of IEC/EN 60204-1.	—	—	
	SS2 (Safe stop 2)	This function starts deceleration with input signals from external devices. After the specified time to confirm the motor stop has elapsed, the SOS function is executed (SS2). This is equivalent to the stop category 2 of IEC/EN 60204-1.	—	—	
	SOS (Safe operating stop)	This function monitors whether the servo motor stops within the prescribed range. Energy is supplied to the servo motor.	—	—	
	SLS (Safely-limited speed)	This function monitors whether the speed is within the prescribed speed limit. If the speed exceeds the specified speed limit, STO will shut off energy.	—	—	
	SSM (Safe speed monitor)	This function outputs signals when the servo motor speed is below the prescribed speed.	—	—	
	SBC (Safe brake control)	This function outputs signals for controlling the external brake.	—	—	
	SDI (Safe direction)	This function monitors whether the servo motor travels in the specified direction. If the servo motor travels in a direction different from the specified direction, STO will shut off energy.	—	—	
	SLI (Safely-limited increment)	This function monitors whether the travel distance of the servo motor is within the specified range. If the travel distance of the servo motor exceeds the specified range, STO will shut off energy.	—	—	
	SLT (Safely-limited torque)	This function monitors whether the torque is below the specified torque. If the torque exceeds the specified torque, STO will shut off energy.	—	—	

*1 "Ver." indicates the supported firmware version of the servo amplifier. The functions are available on servo amplifiers with the indicated firmware version or later.

Instantaneous power failure measures

Function	Detailed function	Description	Ver. *1		Detailed explanation
			MD3G	MD3G-N1	
Tough drive	SEMI-F47 function	This function uses the electrical energy charged in the capacitor to avoid triggering [AL. 010 Undervoltage] even if an instantaneous power failure occurs during operation. Use a 3-phase power supply for the input power supply of the servo amplifier. Using a 1-phase 200 V AC for the input power supply will not comply with the SEMI-F47 standard.	—	—	This function is not available for the MR-MD333G_servo amplifier.
	Tough drive function	This function makes the equipment continue operating even under conditions where an alarm would normally occur. There are two types of tough drive function: the vibration tough drive and the instantaneous power failure tough drive.	A0	A2	The MR-MD333G_servo amplifier supports only the vibration tough drive, and the instantaneous power failure tough drive is not available. Refer to "Tough drive function" in the following manual.  MR-J5 User's Manual (Function)

*1 "Ver." indicates the supported firmware version of the servo amplifier. The functions are available on servo amplifiers with the indicated firmware version or later.

Diagnosis

Function	Detailed function	Description	Ver. *1		Detailed explanation
			MD3G	MD3G-N1	
Drive data diagnosis	Drive recorder	This function continuously monitors the servo status and records the state transition before and after an alarm for a fixed period of time. The recorded data can be checked by clicking the Waveform-Display button on the drive recorder window of MR Configurator2.	A0	A2	Refer to "Drive recorder" in the following manual. MR-J5 User's Manual (Function)
	Graph function	This function obtains the servo status in the graph.	A0	A2	Refer to "Graph function" in the following manual. MR-J5 User's Manual (Function)
		This function obtains a graph by using the trigger synchronized on multiple servo amplifiers via a network.	A0	—	—
Failure diagnosis	Encoder communication diagnosis function	This function diagnoses with MR Configurator2 whether the encoder communication error is caused by the circuit malfunction of the servo amplifier or by the malfunction of the cables/encoder.	—	—	This function is not available for the MR-MD333G_servo amplifier.
Service life diagnosis	Servo amplifier life diagnosis function	This function enables checking of the cumulative energization time and the number of inrush relay on/off times. It gives an indication of the replacement time for parts on the servo amplifier with a service life (such as the capacitor and the relay) before they malfunction. MR Configurator2 is required for this function.	A0	A2	The MR-MD333G_servo amplifier supports only the cumulative energization time function, and the relay usage count display function is not available. Refer to "Servo amplifier life diagnosis function" in the following manual. MR-J5 User's Manual (Function)
	Motor life diagnosis function	This function predicts failures of the equipment and the servo motor based on the machine total travel distance. It gives an indication of the replacement time for the servo motor.	A0	A2	Refer to "Machine diagnosis" in the following manual. MR-J5 User's Manual (Function)
	Machine diagnosis function	This function uses data in the servo amplifier to estimate the friction and vibrational component of the drive system in the equipment and to detect errors in machine parts such as ball screws and bearings.	A0	A2	
		This function automatically sets the thresholds used for detecting errors of machine parts such as ball screws and bearings. It outputs the warning when the friction, vibrational component, or total revolution of the servo motor becomes out of the set threshold. Errors in the machine parts such as ball screws and bearings can be detected automatically.	A0	A2	
		This function estimates wear of gears and loosening of belts (decrease in the belt tension), and detects errors in gears and belts.	—	—	This function is not available for the MR-MD333G_servo amplifier.
System diagnosis	System configuration information	This function uses MR Configurator2 to monitor the servo amplifier model, connected servo motor, encoder, and other information.	A0	A2	Refer to "System configuration display" in the following manual. MR-J5 User's Manual (Function)

*1 "Ver." indicates the supported firmware version of the servo amplifier. The functions are available on servo amplifiers with the indicated firmware version or later.

History

Function	Detailed function	Description	Ver. *1		Detailed explanation
			MD3G	MD3G-N1	
—	Alarm history	This function saves information on alarms that occurred in the servo amplifier. The information is saved in chronological order and used for occasions such as analyzing the cause of an alarm.	A0	A2	Refer to "Alarm history" in the following manual.  MR-J5 User's Manual (Function)

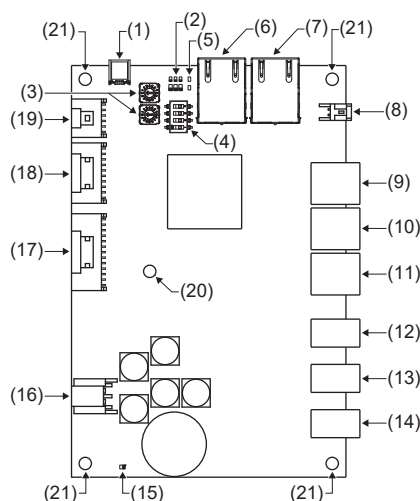
*1 "Ver." indicates the supported firmware version of the servo amplifier. The functions are available on servo amplifiers with the indicated firmware version or later.

2.3 Security

To completely prevent unauthorized access to the system from external devices, the user also must take safety measures. Mitsubishi Electric Corporation cannot be held responsible for any problems caused by unauthorized access.

3 STRUCTURE

3.1 Part name



No.	Name	Application	Detailed explanation
(1)	USB communication connector (CN5)	Connect to a personal computer.	—
(2)	Each status display LED	The chip LEDs indicate the status of each axis of the servo.	☞ Page 29 Switch setting and display of the servo amplifier
(3)	Rotary switches (SW1/SW2) (MR-MD333G)	Set the IP address of the servo amplifier.	
	ID setting switches (SW1/SW2) (MR-MD333G-N1)	Set the node address of the servo amplifier.	
(4)	DIP switches (SW3)	Consist of the test operation switch and disabling control axis switch.	
(5)	Network status display LED	Indicates each network status.	☞ Page 32 Status indication by the LEDs mounted on the board
(6)	Ethernet cable connector (CN1A)	Connect the controller, servo amplifier, or a network device.	☞ Page 31 CN1A/CN1B connector LED
(7)	Ethernet cable connector (CN1B)		
(8)	Battery connector (CN4A)	To configure an absolute position detection system by connecting an HG-AK motor, connect a battery for absolute position data backup.	☞ Page 140 ABSOLUTE POSITION DETECTION SYSTEM
(9)	A-axis encoder connector (CN2A)	Connect the A-axis servo motor encoder.	☞ Page 49 Connectors and pin assignments
(10)	B-axis encoder connector (CN2B)	Connect the B-axis servo motor encoder.	
(11)	C-axis encoder connector (CN2C)	Connect the C-axis servo motor encoder.	
(12)	A-axis servo motor power connector (CNP2A)	Connect the A-axis servo motor.	☞ Page 46 Explanation of power supply system
(13)	B-axis servo motor power connector (CNP2B)	Connect the B-axis servo motor.	
(14)	C-axis servo motor power connector (CNP2C)	Connect the C-axis servo motor.	
(15)	Charge light	When the main circuit is charged, this light is on. While the light is on, do not change the connections of the wires.	☞ Page 32 Status indication by the LEDs mounted on the board
(16)	Main circuit/control circuit power connector (CNP1)	Connect the input power supply.	☞ Page 46 Explanation of power supply system
(17)	DIO connector (CN3)	Connect the digital I/O signals.	☞ Page 49 Connectors and pin assignments
(18)	Manufacturer setting (CN6)	Do not connect anything.	—
(19)	A/B-phase pulse output connector (CN7) *1	Outputs the A/B-phase pulse signal for the A and B axes.	☞ Page 49 Connectors and pin assignments
(20)	Mounting hole	Holes for mounting the servo amplifier. For the four FG holes, use metal studs to ground them.	—
(21)	Mounting hole (FG)		

*1 This connector cannot be used on the MR-MD333G-N1 servo amplifier. Do not connect anything.

3.2 Switch setting and display of the servo amplifier

Switching to the test operation mode and configuring network setting can be done with switches on the servo amplifier.

Switches

If a metal screwdriver touches the conductive areas, the switches may malfunction. Therefore, use an insulated screwdriver instead of the metal screwdriver to operate the rotary switches (SW1/SW2), ID setting switches (SW1/SW2), and DIP switches (SW3).

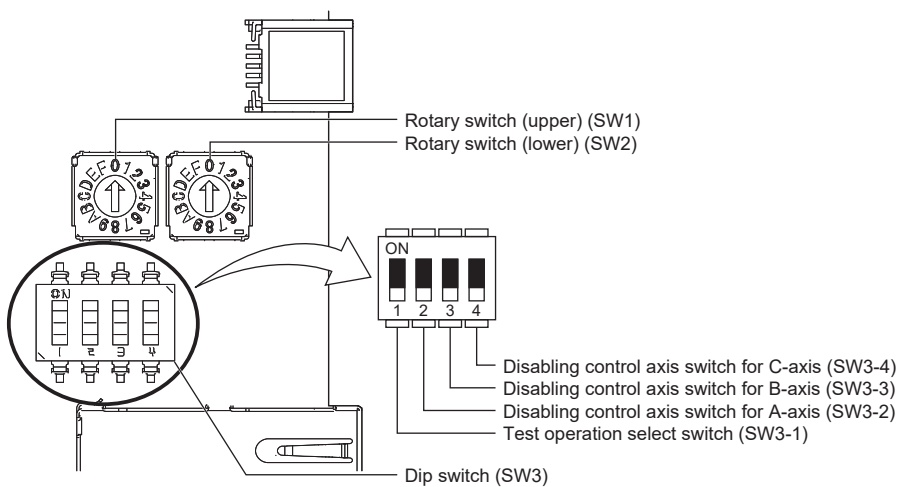
To apply the settings of all switches, cycle the control circuit power supply or reset the software.

The following explains the rotary switches (SW1/SW2), ID setting switches (SW1/SW2), and DIP switches (SW3).

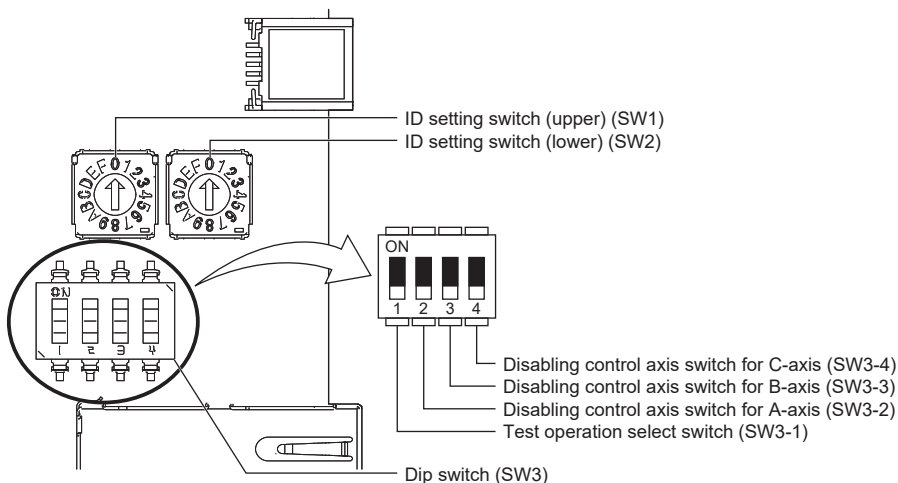
Switch configuration

Do not set the test operation select switch and the disabling control axis switch to ON simultaneously.

■For the MR-MD333G



■For the MR-MD333G-N1



Test operation select switch (SW3-1)

Turning "ON (up)" the test operation select switch enables the test operation mode. In the test operation mode, functions such as JOG operation, positioning operation, and machine analyzer are available using MR Configurator2.

 Page 103 Test operation

Disabling control axis switches (SW3-2, SW3-3, and SW3-4)

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

Rotary switches (SW1/SW2) (for the MR-MD333G)

The IP address can be set with the rotary switches (SW1/SW2) of the servo amplifier. SW1 represents the upper digit and SW2 represents the lower digit. The default setting is 01h.

To apply the settings of the rotary switches, set [Pr. NPA01 IP address setting] to "0" (the rotary switch is used.). To set the IP address without using the rotary switches, set them to 0 and use the engineering software.

For how to set IP addresses, refer to "IP address setting function" in the following manual.

 MR-J5-G/MR-J5W-G User's Manual (Communication Function)

ID setting switches (SW1/SW2) (for the MR-MD333G-N1)

The node address can be set with the ID setting switches (SW1/SW2) of the servo amplifier. SW1 represents the upper digit and SW2 represents the lower digit. The default setting is 01h.

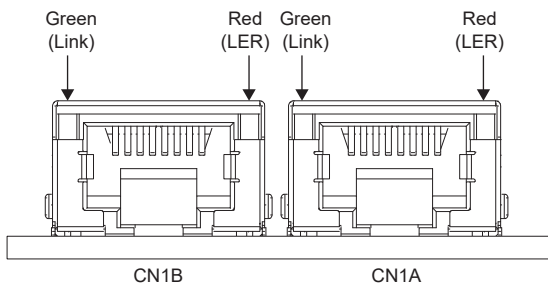
For how to set node addresses, refer to "Node address setting" in the following manual.

 MR-J5-G-N1/MR-J5W-G-N1 User's Manual (Communication Function)

CN1A/CN1B connector LED

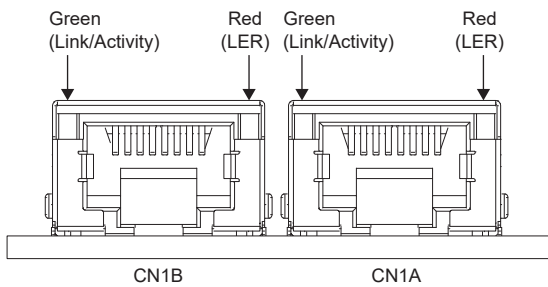
The following shows the LED indication of the CN1A and CN1B connectors.

For the MR-MD333G



LED name	Description
LINK (Green)	On: Linking up
L ER (Red)	On: Indicates that erroneous data is being received.

For the MR-MD333G-N1

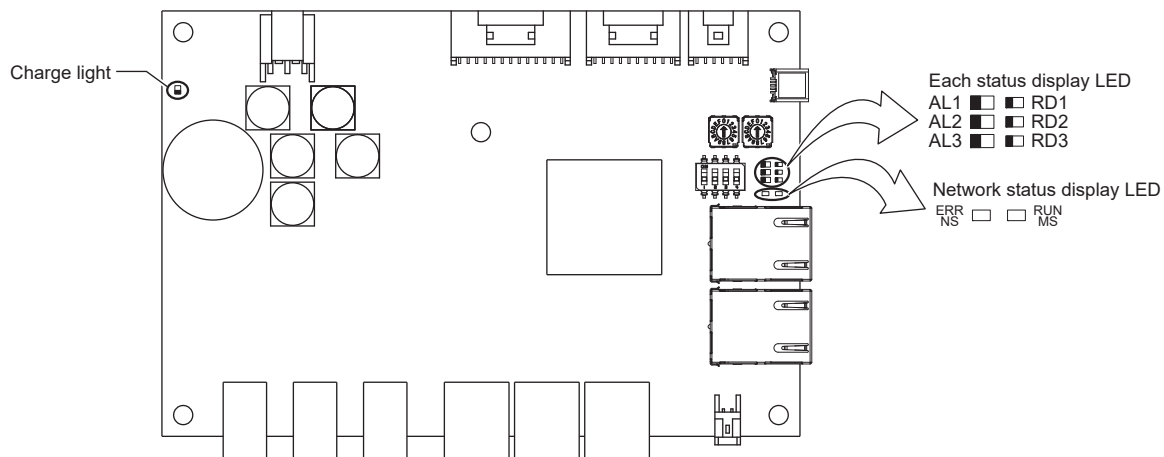


LED name	Description
Link/ActivityLED (Green)	☞ Page 34 LED indication (for the MR-MD333G-N1)
L ER (Red)	Off: Indicates that there are no errors. On: Indicates that erroneous data is being received.

Status indication by the LEDs mounted on the board

Point

For MR-MD333G_ servo amplifiers, whether the test operation mode is enabled or disabled cannot be checked with the status indication by the LEDs mounted on the board. For whether the test operation mode is enabled or disabled, check the status of the test operation select switch (SW3-1).



Name	LED name	Function	Reference
Each status display LED	RD1	Indicates the ready state of the A-axis.	Page 32 Ready state and error state of each axis
	AL1	Indicates the error state of the A-axis.	
	RD2	Indicates the ready state of the B-axis.	
	AL2	Indicates the error state of the B-axis.	
	RD3	Indicates the ready state of the C-axis.	
	AL3	Indicates the error state of the C-axis.	
Network status display LED	RUN MS	The LED statuses (RUN MS and ERR NS) indicate the network status of the servo amplifier.	Page 33 Network statuses
	ERR NS		
Charge light	CHARGE	When the main circuit is charged, this light is on. While the light is on, do not change the connections of the wires.	—

Ready state and error state of each axis

RD_ Green LED	AL_ Red LED	Description
Blinking	Blinking (blinking alternately with RD) *2	Controller disconnected
Blinking	Off	Servo-off state (controller connected)
	Blinking (blinking simultaneously with RD) *2	Servo-off/warning state
	On	Servo-off/alarm state
On	Off	Servo-on state
	Blinking	Servo-on warning state
On	On	Immediately after power-on (initializing) or watchdog state *1
Off	Off	The power has not been supplied to the control circuit or watchdog state *1

*1 During the watchdog state, the indication may be unstable.

*2 The LED blinks in a 4 Hz cycle (every 250 ms).

Network statuses

■For the MR-MD333G

LED name	Description
RUN MS (Green)	Off: Indicates that an alarm has occurred. On: Indicates that the power is on.
ERR NS (Red)	Off: Indicates that no alarms or warnings have occurred. Blinking: Indicates that a warning has occurred. On: Indicates that an alarm has occurred.

■For the MR-MD333G-N1

LED name	Description
RUN MS (Green)	 Page 34 LED indication (for the MR-MD333G-N1)
ERR NS (Red)	

Other status indications

LED indication	Status	Description
RD_ Green LED: Off AL_ Red LED: Blinking	Update in progress	Indicates that a firmware update is in progress.
RD_ Green LED: Off AL_ Red LED: On	Initialization in progress	Indicates that initialization of settings such as parameters is in progress.
RD_ Green LED: Blinking at 1 s intervals AL_ Red LED: Blinking at 500 ms intervals	IP address setting in progress	Indicates that the IP address is being set via a network.

LED indication (for the MR-MD333G-N1)

RUN MS, ERR NS, and Link/Activity LEDs operate in compliance with the EtherCAT standard (ETG.1300 EtherCAT Indicator and Labeling Specification).

LED status definitions

The following shows the LED status definitions.

LED status	Definition
On	The LED is lit steady.
Off	The LED is unlit.
Flickering	The LED turns on and off repeatedly in a 10 Hz cycle (every 50 ms).
Blinking	The LED turns on and off repeatedly in a 2.5 Hz cycle (every 200 ms).
Single flash	The LED turns on for 200 ms and off for 1000 ms repeatedly.
Double flash	The LED repeats the cycle of turning on for 200 ms → off for 200 ms → on for 200 ms → off for 1000 ms.

Details of LED indications

■RUN MS

The RUN MS indicates the EtherCAT communication status (ESM status).

LED		Description
Status	Color	
Off	—	Indicates the power supply being shut off or the Init state.
Blinking	Green	Indicates the Pre-Operational state.
Single flash		Indicates the Safe-Operational state.
On		Indicates the Operational state.

■ERR NS

The ERR NS indicates an error occurrence in EtherCAT communication.

LED		Description
Status	Color	
Off	—	No errors
Blinking	Red	Indicates that the EtherCAT state cannot be changed as instructed from the master station.
Single flash		Indicates that the EtherCAT state has been changed autonomously because of an internal error.
Double flash		Indicates a watchdog error in the Sync manager.
On		Indicates critical errors such as a watchdog timeout.

■Link/Activity LED (OUT port/IN port)

The Link/Activity LEDs indicate the link status of each EtherCAT communication port.

LED		Description
Status	Color	
Off	—	Indicates that the power supply is shut off or the link is not established.
On	Green	Indicates that the link is established but there is no traffic.
Flickering		Indicates that the link is established with traffic.

4 INSTALLATION

Precautions

- Install the servo amplifier on incombustible material. Installing the servo amplifier either directly on or near combustibles may lead to smoke or a fire. In addition, the servo amplifier must be installed in a metal cabinet.
- Provide adequate protection to prevent the following matter from adhering to the servo amplifier: conductive matter such as screws and metal fragments, and combustible matter such as oil.
- Devices such as servo motors may become hot. Take safety measures such as providing covers.
- Do not stack products more than the number specified on the product packages.
- Do not hold the cables or connectors when carrying the servo amplifier. Doing so may cause the servo amplifier to drop.
- To prevent malfunctions, do not drop the servo amplifier or servo motor or subject them to impacts.
- Install the servo amplifier and servo motor in a place that can support their weight as stated in the user's manual.
- Do not get on or put heavy load on the equipment.
- Do not install or operate a servo amplifier that has missing parts or is damaged.
- Do not subject connectors to impacts. Doing so may cause a connection failure, malfunction, or other failures.
- Use the product within the specified environment. For details on the environment, refer to the following.

Page 10 Environment

- To prevent a fire or injury from occurring in the event of an earthquake or other natural disasters, securely install, mount, and wire the servo amplifier as stated in the user's manual.
- When handling the servo amplifier, be careful with the edges of the servo amplifier.
- 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 any residual components from fumigants do not enter our products, or perform disinfection and pest control using a method other than fumigation, such as heat treatment. Perform disinfection and pest control on the wooden packaging materials before packing the products.
- Provide an external emergency stop circuit to stop the operation and shut off the power 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.
- Do not use the servo amplifier in environments where it is exposed to strong magnetic fields, electric fields, or radiation. Doing so may cause an operation failure or malfunction.

4.1 Mounting direction and clearances

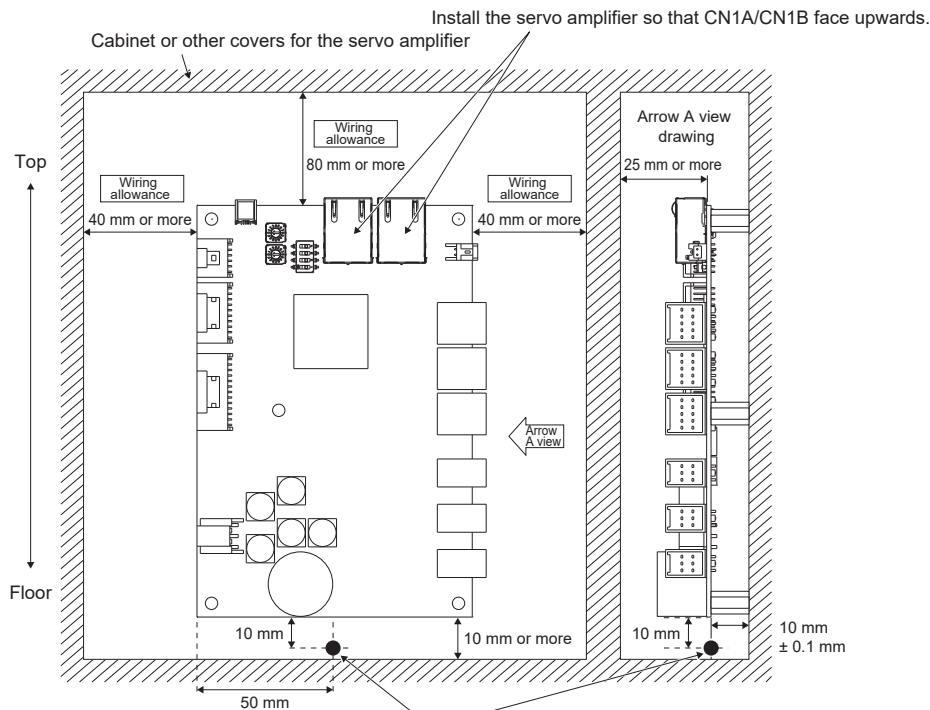
Point

- For board mounting, use M4 screws or studs for securing all the five locations. The tightening torque should be $1.5 \pm 0.2 \text{ N}\cdot\text{m}$.
- Ground the four FG holes among the five mounting holes using metal studs. For FG, refer to the following.
Page 28 Part name
- Make sure that the height difference between all the board mounting locations is within $\pm 0.1 \text{ mm}$.
- When using a washer for board mounting, use one with $\phi 8$ or less.
- When installing the board near any heat generating devices, pay attention to the ambient temperature.
- Since this is a bare-board product, be careful if any noise generating devices are installed nearby. If adverse effects on the servo amplifier are expected, install the noise generating devices as far away from the servo amplifier as possible.
- To ensure vibration resistance, secure the wiring as close to the board as possible. Secure the wiring so that no stress is generated in the connector tilting direction.

Precautions

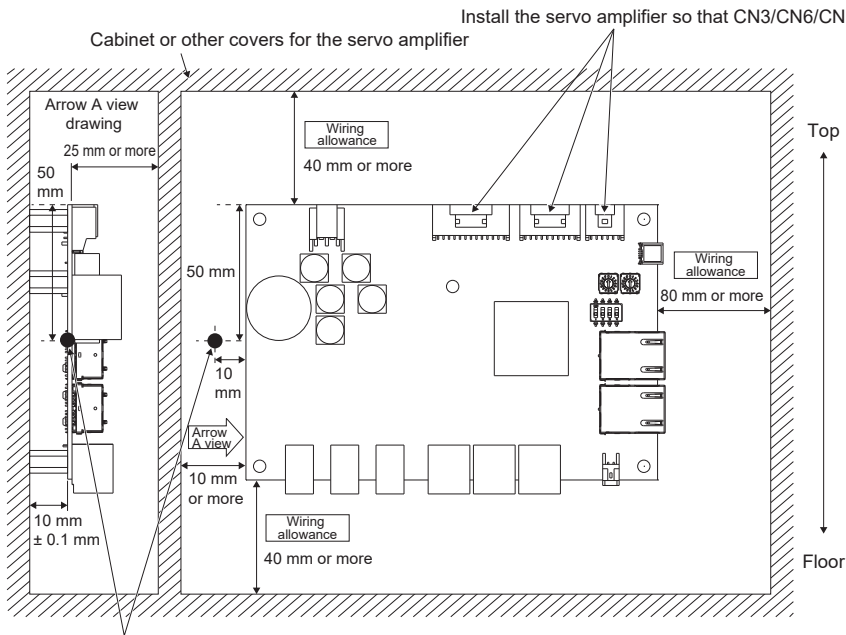
- The servo amplifier must be installed in the specified direction.
- To prevent malfunctions, maintain the specified clearances between the servo amplifier and cabinet walls or other covers for the servo amplifier.
- Circulate air so that the air at the top and bottom of the servo amplifier does not stagnate.
- Depending on the mounting direction, the clearances between the servo amplifier and peripheral devices differ. Check the restrictions for each mounting direction.
- If you are considering installing the servo amplifier in a method other than described in this section, contact your local sales office.

Vertical longitudinal placement



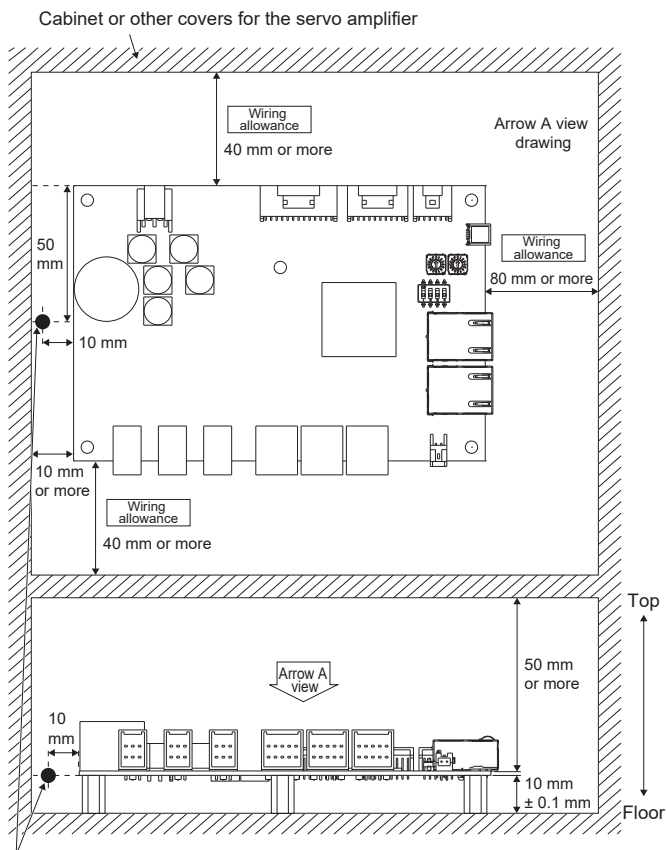
Measure the ambient temperature at ● positions in the drawing.
The temperature at the specified positions should be 45°C or less.

Vertical transverse placement



Measure the ambient temperature at • positions in the drawing.
The temperature at the specified positions should be 45 °C or less.

Horizontal placement



Measure the ambient temperature at • positions in the drawing.
The temperature at the specified positions should be 45 °C or less.

4.2 Keeping out foreign matter

When drilling the cabinet for assembly, prevent drill chips and wire fragments from adhering to the servo amplifier.

Prevent foreign matter such as oil, water, and metallic dust from adhering to the servo amplifier through cooling fans installed in openings in the cabinet or on the ceiling.

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.

4.3 Cable stress

- The method used to clamp the cable must be fully examined so that bending stress and cable's own weight stress are not applied to the cable connection.
- When using this product for applications where the servo motor moves, fix the cable (encoder, power supply, brake) with gentle slack from the connecting part of the connector to prevent stress from being applied to the servo motor connector. Use the optional motor cable/encoder cable within the flex life range.
- Prevent the cable insulator from being cut by sharp chips or from touching and rubbing against the machine corners.
- Prevent the cables from getting stepped on by workers or run over by vehicles.
- When installing this product on a machine where the servo motor moves, make the bend radius as large as possible. For the bending life, contact the manufacturer of the cable used.

Precautions

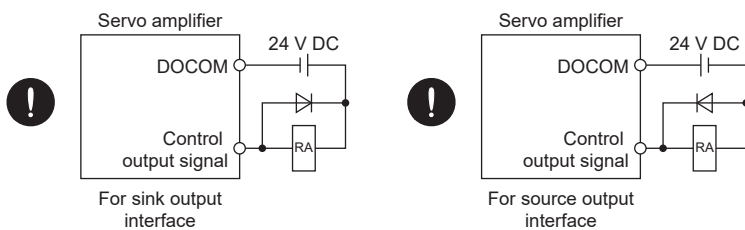
- The cables should not be damaged, stressed, loaded, or pinched.

5 SIGNALS AND WIRING

Precautions

- Insulate the conductive parts of the terminals.
- Before wiring and inspections, turn off the power and wait for 15 minutes or more until the charge light turns off.
- To prevent failures and malfunctions, only the power supply and signal specified in the user's manual should be connected to a corresponding terminal.
- To prevent unexpected operation of the servo motor, wire the equipment correctly and securely.
- Make sure to connect the cables and connectors by using the fixing screws and the locking mechanism. Failure to do so may cause the cables and connectors to disconnect during operation.
- Unless otherwise specified, all connection diagrams in this user's manual are sink interface diagrams.
- Install a surge absorbing diode in the correct direction. Failure to do so may cause the amplifier to malfunction and not to output signals, disabling protective circuits such as the emergency stop.

5

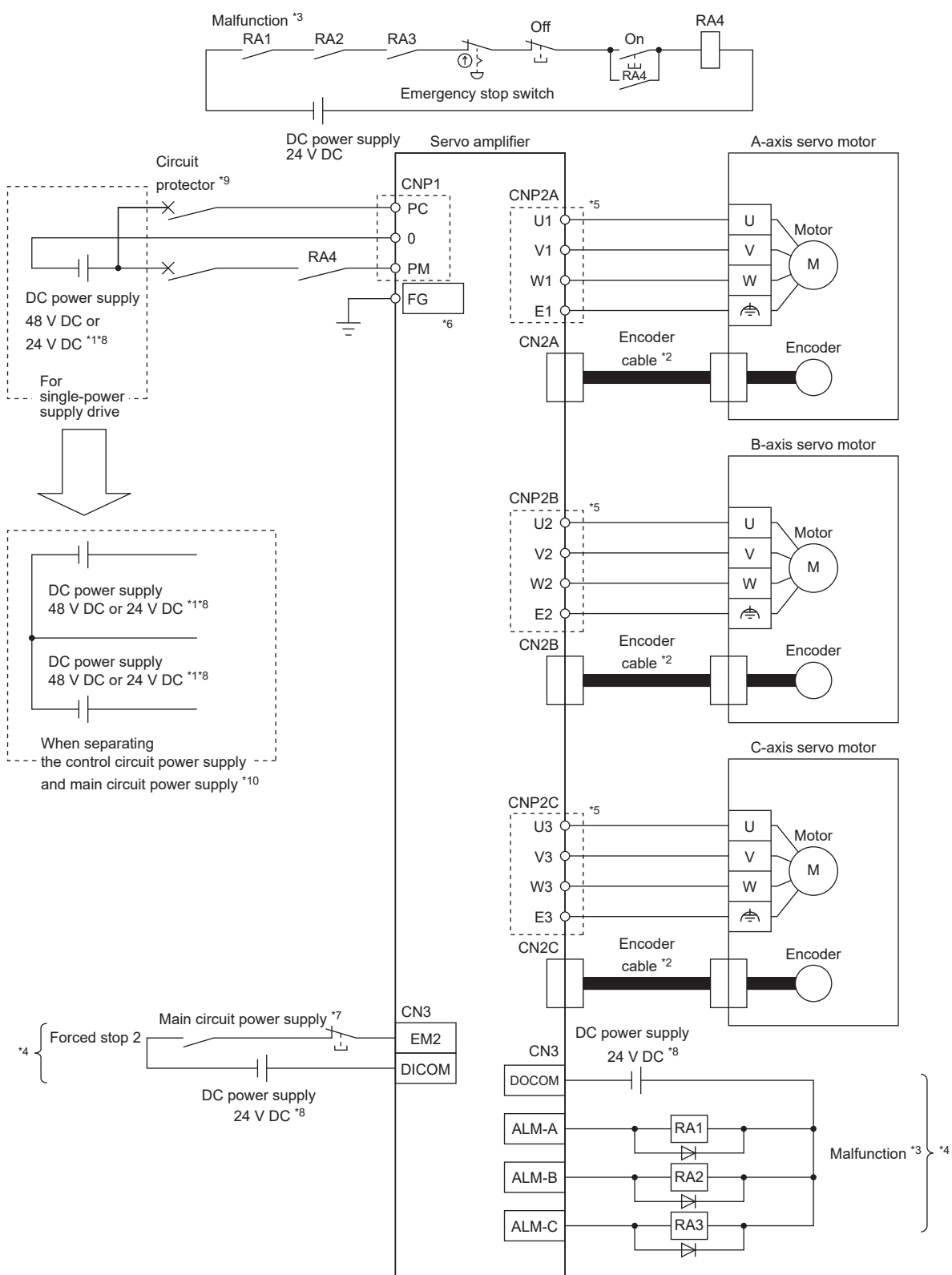


- To prevent malfunctions, do not connect a servo motor for an incorrect axis to CNP2A, CNP2B, or CNP2C of the servo amplifier.
- Make sure that no operation signal is being input to the servo amplifier before resetting an alarm or releasing the emergency stop. Failure to do so may cause an unexpected operation.
- Install the servo amplifier according to the EMC guidelines because electromagnetic interference may affect the electronic equipment used near the servo amplifier.
- To prevent an electric shock or a fire, do not disassemble, repair, or modify the product. Disassembled, repaired, and/or modified products are not covered under warranty.
- Eliminate static electricity before performing actions such as wiring or operating a switch.

5.1 Example power circuit connections

Precautions

- It is recommended to connect a circuit protector between the power supply and the power input terminal (PM/PC) of servo amplifier to establish a configuration where the power supply can be shut off on the servo amplifier's power side. If the servo amplifier malfunctions, a large current flows, causing a fire. A circuit protector can prevent this. When not using a circuit protector, use a power supply with protective functions or configure an external protective circuit.
- Use a configuration that shuts off the main circuit power supply with ALM (Malfunction).
- Check this section and use the correct power supply voltage.
- Do not shut off the control circuit power supply even if an alarm occurs. If the control circuit power supply is shut off, network communication will be interrupted.
- In the torque mode, EM2 functions the same as EM1.
- To prevent malfunctions, avoid bundling the servo amplifier's power lines (input/output) and signal cables together or running them parallel to each other. Separate the power lines from the signal cables.
- Provide adequate protection to prevent an unexpected restart after an instantaneous power failure.
- Configure wiring so that the main circuit power supply is shut off and the servo-on command is turned off after deceleration to a stop due to an alarm occurrence, an enabled servo forced stop, or a quick stop command from the controller.



- *1 For the DC power supply, use a reinforced insulating type power supply.
- *2 For connecting encoder cables, refer to the following.
 Page 63 Connecting the servo amplifier and rotary servo motor
- *3 This circuit is a connection example of stopping all axes when an alarm occurs. If ALM (Malfunction) output is disabled with a parameter, configure a circuit that shuts off the main circuit power after detection of an alarm occurrence on the controller side. For the 24 V DC power supply of this circuit, use a different power supply from the 24 V DC power supply for input/output signals.
- *4 In the case of the sink I/O interface.
- *5 For connections of the servo motor power output lines, refer to the following.
 Page 63 Connecting the servo amplifier and rotary servo motor
 To prevent malfunctions, connect the A-, B-, and C-axes correctly.
- *6 For grounding, connect the wire from FG to the grounding terminal of the cabinet. Although the diagram shows only a single FG, all the four FGs must be grounded by using metal studs. For FG, refer to the following.
 Page 86 Grounding
- *7 To prevent an unexpected restart of the servo amplifier, configure a circuit that turns off EM2 when the main circuit power supply is turned off.
- *8 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. However, for the 24 V DC power supply for input/output signals, use a different power supply from the 24 V DC power supply used for the servo amplifier main circuit power supply and the control circuit power supply.
- *9 It is recommended to use a circuit protector as a protection of wires in case of a short circuit. When not using a circuit protector, use a power supply with protective functions or configure an external protective circuit.
- *10 The available combinations of the main circuit power supply and the control circuit power supply are as follows:

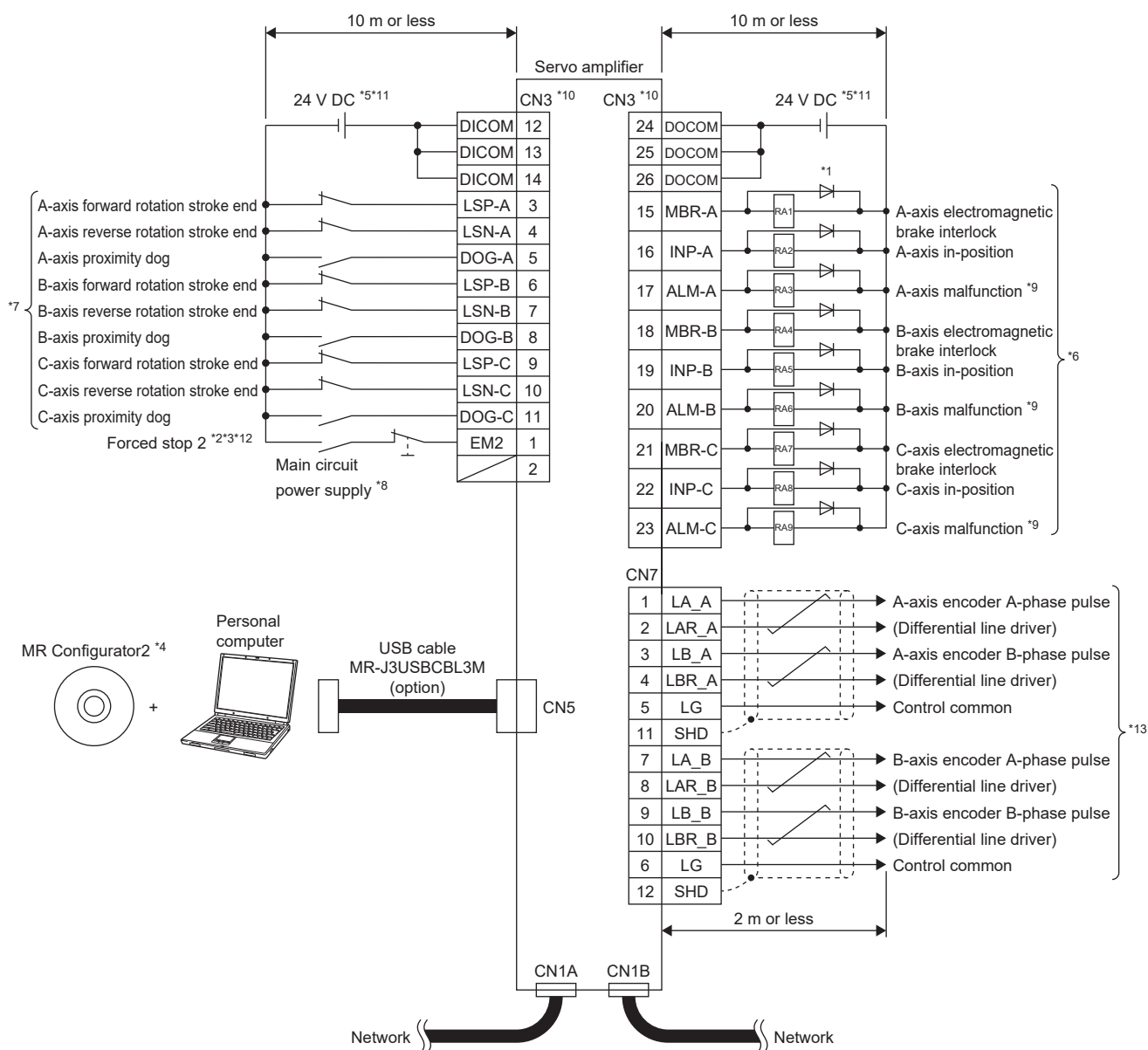
Main circuit power supply	Control circuit power supply	
	24 V DC	48 V DC
24 V DC	Available	Not available
48 V DC	Available	Available

5.2 Example I/O signal connections

Precautions

- Do not connect CN1A and CN1B connectors to a network other than the networks available on this servo amplifier. Doing so may cause a malfunction.
- In the torque mode, EM2 functions the same as EM1.

Sink I/O interface



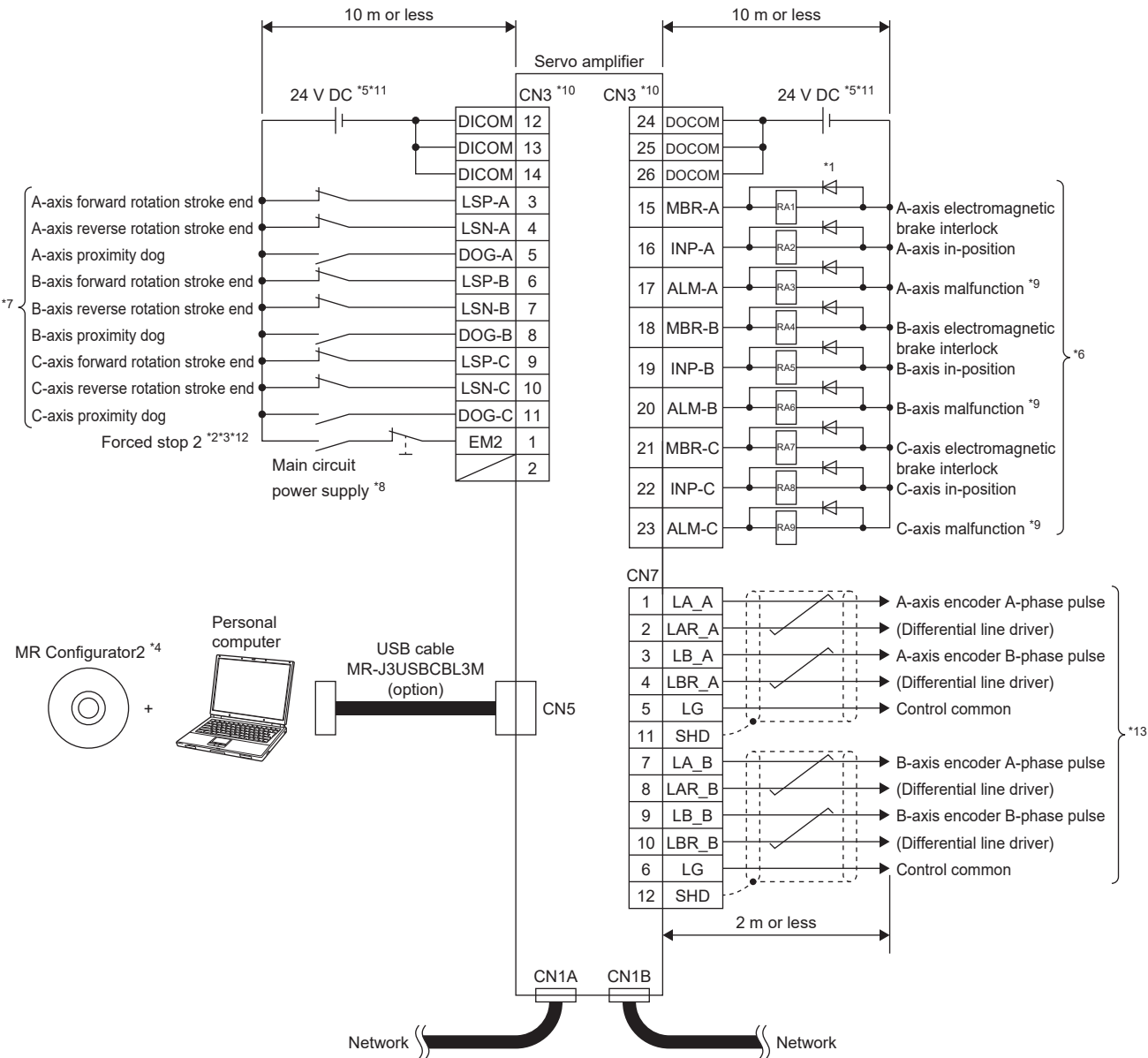
- *1 Connect the diode in the correct direction. If it is connected reversely, the servo amplifier may malfunction and not output signals, disabling protective circuits such as EM2 (Forced stop 2).
- *2 If the controller does not have the forced stop function, install a forced stop 2 switch (normally closed contact).
- *3 When starting operation, turn on EM2 (Forced stop 2), LSP (Forward rotation stroke end), and LSN (Reverse rotation stroke end) (normally closed contact). If FLS (Upper stroke limit) and RLS (Lower stroke limit) are used via a controller, wiring LSP and LSN is unnecessary. In that case, set [Pr. PD41].
- *4 Use SW1DNC-MRC2-__.
- *5 Supply 24 V DC $\pm$ 10% from an external source for interfaces. The current capacity of these power supply depends on the number of inputs/outputs to be connected. For the current required for interfaces, refer to the following.
 Page 60 Digital input interface DI-1
 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.
- *6 The devices of these pins can be changed with servo parameters ([Pr. PD07] to [Pr. PD09]).
- *7 The devices of these pins can be changed with servo parameters ([Pr. PD03] to [Pr. PD05]).
- *8 To prevent an unexpected restart of the servo amplifier, configure a circuit that turns off EM2 when the main circuit power supply is turned off.
- *9 When no alarm is occurring, ALM_ (Malfunction_) is on (normally closed contact).
- *10 The pins with the same signal name are connected in the servo amplifier.
- *11 For source interfaces, the positive and negative outputs of the power supply are reversed as compared with sink interfaces.
- *12 This device is used for forced stop of the servo amplifier. Perform an emergency stop of the whole system on the controller side.
- *13 These signals cannot be used for the MR-MD333G-N1 servo amplifier.

Source I/O interface

Precautions

- For notes, refer to the notes in the following section.

Page 43 Sink I/O interface

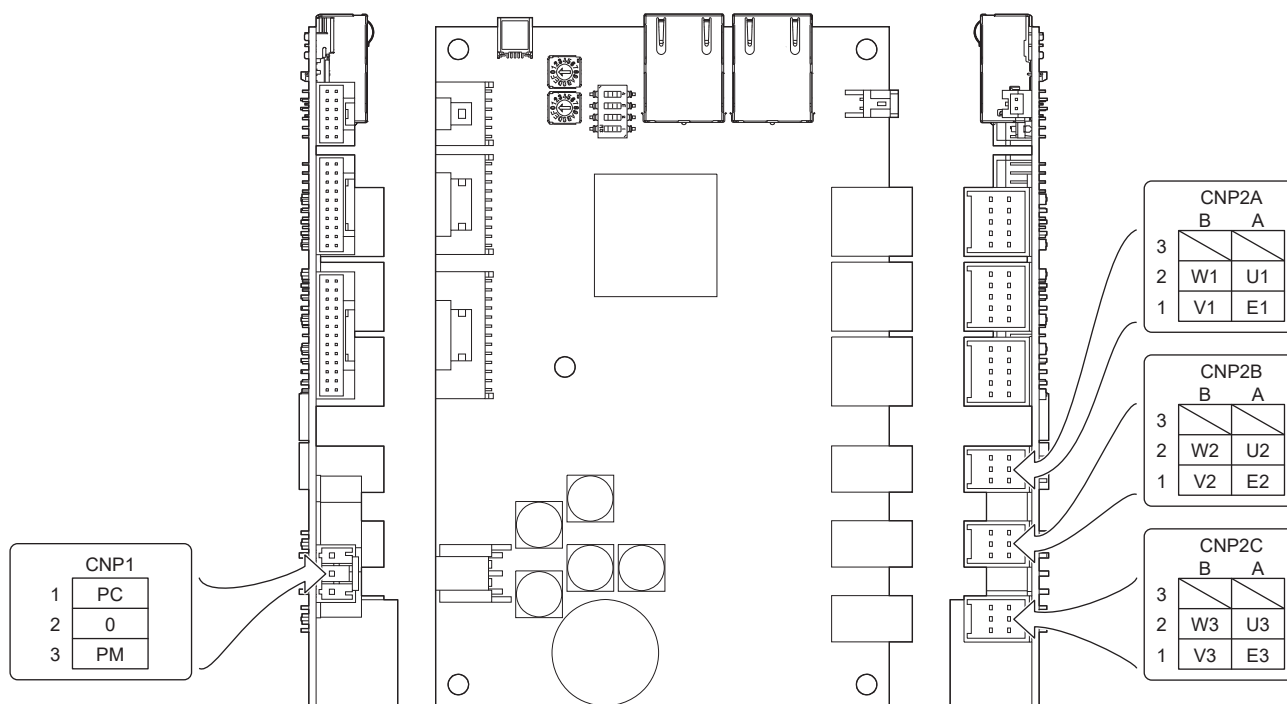


5.3 Explanation of power supply system



The connector housing, connector contact, and crimping tool on the side of the cable to be connected to each connector should be prepared by the customer. For details, refer to the following.

Page 123 Cables and connectors



Symbol	Connector	Connection destination (application)	Description
PC	CNP1	Control circuit power supply/ main circuit power supply	Connect the positive (+) side of the control circuit power supply (48 V DC/24 V DC).
0			Connect the negative (-) side of the control circuit power supply and the main circuit power supply.
PM			Connect the positive (+) side of the main circuit power supply (48 V DC/24 V DC).
U1/V1/W1/E1	CNP2A	A-axis servo motor power output	Connect the servo amplifier power outputs (U/V/W/E) to the servo motor power inputs (U/V/W/⚡) directly. Do not connect a magnetic contactor or the like between the servo amplifier power output and the servo motor power input. Doing so may cause an abnormal operation or malfunction.
U2/V2/W2/E2	CNP2B	B-axis servo motor power output	
U3/V3/W3/E3	CNP2C	C-axis servo motor power output	

Power-on procedure



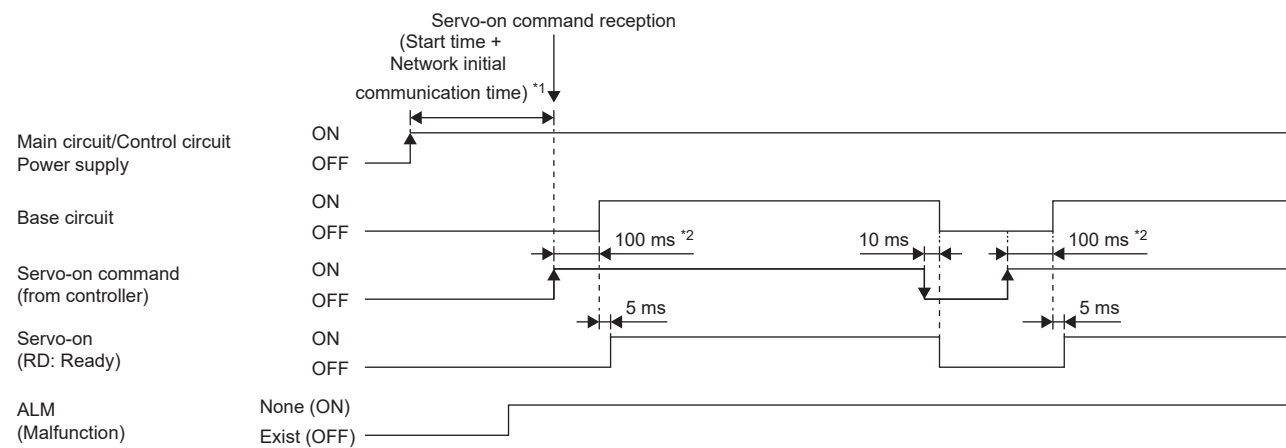
Signals such as output signals may be unstable at power-on.

Power-on procedure

1. For wiring the power supply, refer to the following. Turn off the main circuit power supply immediately when an alarm occurs.
📖 Page 40 Example power circuit connections
2. Switch on the control circuit power supply simultaneously with the main circuit power supply or before switching on the main circuit power supply. If the control circuit power supply is turned on and the servo-on command is transmitted while the main circuit power supply is off, [AL. 0E9 Main circuit off warning] will occur. Turning on the main circuit power supply stops the warning and starts the operation properly.
3. When the main circuit power supply is switched on, the servo amplifier will receive the servo-on command after startup and initial network communication.

The startup time for the MR-MD333G_ servo amplifier is 3.5 s to 4.0 s.

Timing chart



*1 For a linear servo system, this time is 2 s longer.

*2 The time will be longer in the magnetic pole detection of a linear servo motor and direct drive motor.

Wiring CNP1 and CNP2_

CNP1

The connector housing, connector contact, and crimping tool on the side of the cable to be used for wiring the CNP1 connector should be prepared by the customer. For details, refer to the following.

☞ Page 123 Cables and connectors

For the wire sizes, refer to the following.

☞ Page 133 Selection example of wires

CNP2_

For details, refer to the following.

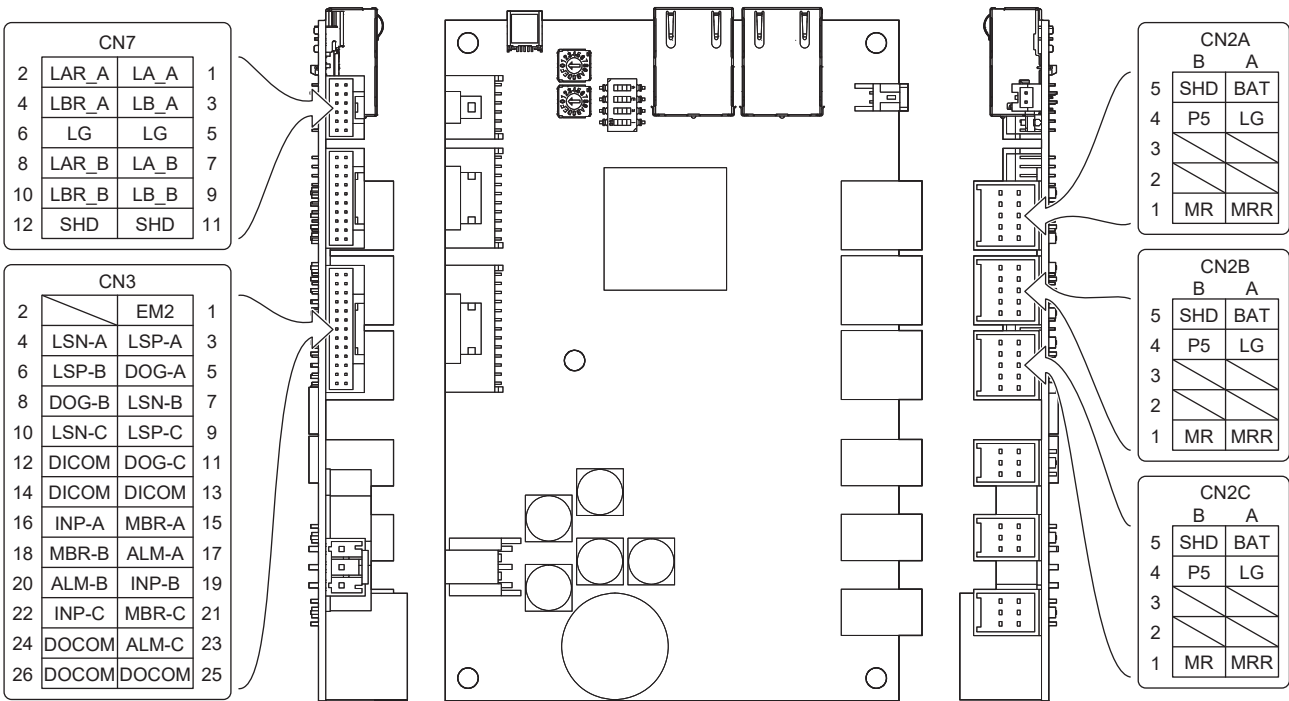
☞ Page 63 Connecting the servo amplifier and rotary servo motor

5.4 Connectors and pin assignments



The connector housing, connector contact, and crimping tool on the side of the cable to be connected to each connector should be prepared by the customer. For details, refer to the following.

➡ Page 123 Cables and connectors



5.5 Signal (device) explanation

For the I/O interfaces (symbols in the "I/O signal interface type" column in the table), refer to the following.

☞ Page 60 Detailed explanation of interfaces

The pin numbers in the "Connector pin No." column are the initial values.

Input device

Input device pins

The following shows input device pins and the servo parameters used for setting devices.

Connector pin No.	Servo parameter	Initially assigned device	I/O signal interface type
CN3-1	—	EM2	DI-1
CN3-3	[Pr. PD03] (A-axis)	LSP-A	
CN3-4	[Pr. PD04] (A-axis)	LSN-A	
CN3-5	[Pr. PD05] (A-axis)	DOG-A	
CN3-6	[Pr. PD03] (B-axis)	LSP-B	
CN3-7	[Pr. PD04] (B-axis)	LSN-B	
CN3-8	[Pr. PD05] (B-axis)	DOG-B	
CN3-9	[Pr. PD03] (C-axis)	LSP-C	
CN3-10	[Pr. PD04] (C-axis)	LSN-C	
CN3-11	[Pr. PD05] (C-axis)	DOG-C	

Availability of input devices

○ and △ in the table indicate the following devices.

○: Devices that can be used in factory settings

△: Devices that become available by servo parameter settings

Device name	Symbol	Availability	I/O signal interface type	Detailed explanation
Forced stop 2	EM2	○	DI-1	☞ Page 51 EM2 (Forced stop 2)
Forced stop 1	EM1	△	DI-1	☞ Page 51 EM1 (Forced stop 1)
Forward rotation stroke end	LSP	○	DI-1	☞ Page 51 LSP (Forward rotation stroke end)/LSN (Reverse rotation stroke end)
Reverse rotation stroke end	LSN	○	DI-1	
Proximity dog	DOG	○	DI-1	☞ Page 51 DOG (Proximity dog)
Proportional control	PC	△	DI-1	☞ Page 52 PC (Proportional control)
Gain switching	CDP	△	DI-1	☞ Page 52 CDP (Gain switching)
Gain switching 2	CDP2	△	DI-1	☞ Page 52 CDP2 (Gain switching 2)

Input device explanation

■EM2 (Forced stop 2)

When EM2 is turned off (open between commons), the servo motor decelerates to a stop with commands.

The forced stop will be deactivated if EM2 is turned on (short between commons) while in the forced stop state.

EM2 and EM1 are mutually exclusive. In the torque mode, EM2 functions the same as EM1.

For details, refer to "Forced stop deceleration function" in the following manual.

MR-J5 User's Manual (Function)

Setting value		EM2/EM1	Deceleration method	
[Pr. PA04.3]	[Pr. PA04.2]		EM2 or EM1 is off	Alarm occurrence
0	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	0	EM2	MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.	MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.
0	1	Neither EM2 nor EM1 is used.	—	MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.
2	1	Neither EM2 nor EM1 is used.	—	MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.

■EM1 (Forced stop 1)

When EM1 is turned off (open between commons), the base circuit shuts off, and the dynamic brake operates to decelerate the servo motor to a stop.

The forced stop will be deactivated if EM1 is turned on (short between commons) while in the forced stop state.

■LSP (Forward rotation stroke end)/LSN (Reverse rotation stroke end)

To operate a servo motor, turn on LSP/LSN. Turn LSP/LSN off to bring the servo motor to a stop and switch it to the servo-lock state.

For information about areas such as the supported control modes, automatic on, and restrictions, refer to "Stroke limit function" in the following user's manual.

MR-J5 User's Manual (Function)

Input device		Operation	
LSP	LSN	CCW direction (positive direction)	CW direction (negative direction)
1 (on)	1 (on)	○	○
0 (off)	1 (on)	—	○
1 (on)	0 (off)	○	—
0 (off)	0 (off)	—	—

■DOG (Proximity dog)

Turning off DOG will detect a proximity dog. The polarity for the proximity dog can be changed with [Pr. PT29.0].

[Pr. PT29.0]	Polarity for proximity dog detection
0	Dog detection with off
1	Dog detection with on

■PC (Proportional control)

Turn PC on to switch the speed amplifier from the proportional integral type to the proportional type.

If a servo motor is rotated even for a pulse due to any external factor while it is at a stop, it generates torque to compensate for a position mismatch. When locking the servo motor shaft mechanically after positioning completes, turn on PC (Proportional control) upon completion of positioning to suppress the unnecessary torque generated for compensation of a position mismatch.

When locking the shaft for a long period of time, set the torque value to be the rated torque or less.

Do not use PC in the torque mode. If PC is used in the torque mode, the servo motor may operate at a speed exceeding the speed limit value.

■CDP (Gain switching)

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 individual gain values.

When both CDP and CDP2 are on, the setting of CDP2 is prioritized.

For details, refer to "GAIN SWITCHING FUNCTION" in the following manual.

 MR-J5 User's Manual (Adjustment)

■CDP2 (Gain switching 2)

Turn on CDP2 to use the values of [Pr. PB67] to [Pr. PB70] as the load to motor inertia ratio and individual gain values.

When both CDP and CDP2 are on, the setting of CDP2 is prioritized.

For details, refer to "GAIN SWITCHING FUNCTION" in the following manual.

 MR-J5 User's Manual (Adjustment)

Output device

Output device pins

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

Connector pin No.	Servo parameter	Initially assigned device	I/O signal interface type
CN3-15	[Pr. PD07] (A-axis)	MBR-A	DO-1
CN3-16	[Pr. PD08] (A-axis)	INP-A	
CN3-17	[Pr. PD09] (A-axis)	ALM-A	
CN3-18	[Pr. PD07] (B-axis)	MBR-B	
CN3-19	[Pr. PD08] (B-axis)	INP-B	
CN3-20	[Pr. PD09] (B-axis)	ALM-B	
CN3-21	[Pr. PD07] (C-axis)	MBR-C	
CN3-22	[Pr. PD08] (C-axis)	INP-C	
CN3-23	[Pr. PD09] (C-axis)	ALM-C	

Availability of output devices

○ and △ in the table indicate the following devices.

○: Devices that can be used in factory settings

△: Devices that become available by servo parameter settings

Device name	Symbol	Availability	I/O signal interface type	Detailed explanation
Electromagnetic brake interlock	MBR	○	DO-1	☞ Page 54 MBR (Electromagnetic brake interlock)
Malfunction	ALM	○	DO-1	☞ Page 54 ALM (Malfunction)
In-position	INP	○	DO-1	☞ Page 54 INP (In-position)
Ready-on	RDY	○	DO-1	☞ Page 54 RDY (Ready-on)
Ready	RD	△	DO-1	☞ Page 54 RD (Ready)
Speed reached	SA	△	DO-1	☞ Page 54 SA (Speed reached)
Limiting speed	VLC	△	DO-1	☞ Page 54 VLC (Limiting speed)
Zero speed detection	ZSP	△	DO-1	☞ Page 55 ZSP (Zero speed detection)
Limiting torque	TLC	△	DO-1	☞ Page 55 TLC (Limiting torque)
Warning	WNG	△	DO-1	☞ Page 55 WNG (Warning)
Battery warning	BWNG	△	DO-1	☞ Page 55 BWNG (Battery warning)
Motor stop warning	WNGSTOP	△	DO-1	☞ Page 55 WNGSTOP (Motor stop warning)
Variable gain enabled	CDPS	△	DO-1	☞ Page 55 CDPS (Variable gain enabled)
Variable gain enabled 2	CDPS2	△	DO-1	☞ Page 55 CDPS2 (Variable gain enabled 2)
Absolute position erased	ABSV	△	DO-1	☞ Page 55 ABSV (Absolute position erased)
Tough drive in progress	MTTR	△	DO-1	☞ Page 55 MTTR (Tough drive in progress)
Coasting ^{*1}	FR	△	DO-1	☞ Page 56 FR (Coasting)
General-purpose output A	DOA	△	DO-1	☞ Page 56 DOA (General-purpose output A)/DOB (General-purpose output B)/DOC (General-purpose output C)
General-purpose output B	DOB	△		
General-purpose output C	DOC	△		

*1 Available on servo amplifiers with firmware version A8 or later.

Output device explanation

■MBR (Electromagnetic brake interlock)

MBR is off in the servo-off state or at an alarm occurrence.

When using this device, set an operation delay time of the electromagnetic brake in [Pr. PC02].

For details, refer to "Electromagnetic brake interlock function" in the following manual.

 MR-J5 User's Manual (Function)

■ALM (Malfunction)

If the protective circuit operates and shuts off the base circuit, ALM turns off.

When no alarm is occurring, ALM turns on in 3.5 s to 4.0 s after power-on.

For details, refer to "Alarm function" in the following manual.

 MR-J5 User's Manual (Function)

■INP (In-position)

When droop pulses are within the in-position range, INP is on. The in-position range can be changed with [Pr. PA10]. When the servo motor is operated at low speed by increasing the in-position range, INP may remain on.

This device cannot be used in the velocity mode or torque mode.

For details, refer to "In-position range setting" in the following manual.

 MR-J5 User's Manual (Function)

■RDY (Ready-on)

When the servo-on reception is ready, RDY turns on.

■RD (Ready)

In the servo-on state, RD turns on.

■SA (Speed reached)

In the servo-off state, SA is off. When the servo motor speed reaches the following range, SA turns on.

Set speed $\pm ((\text{Set speed} \times 0.05) + 20)$ r/min (mm/s)

When the set speed is 20 r/min (mm/s) or less, SA is always on.

This device cannot be used in the position mode and torque mode.

■VLC (Limiting speed)

If the speed reaches the speed limit value in the torque mode, VLC turns on. In the servo-off state, VLC turns off.

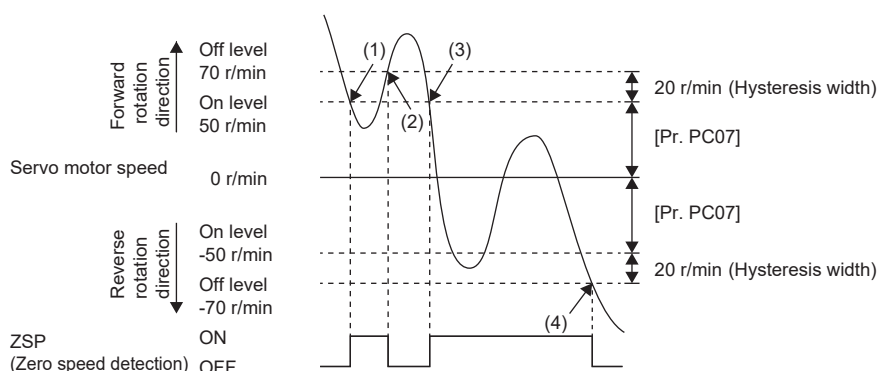
This device cannot be used in the position mode or the velocity mode.

For details, refer to "Speed limit" in the following manual.

 MR-J5 User's Manual (Function)

■ZSP (Zero speed detection)

When the servo motor speed is the zero speed or less, ZSP turns on. The zero speed can be changed with [Pr. PC07]. The following shows an example when the initial value (50) is set in [Pr. PC07].



ZSP turns on when the servo motor speed is reduced to 50 r/min (at (1)), and turns off when the servo motor is increased to 70 r/min again (at (2)).

ZSP turns on when the servo motor is decelerated again to 50 r/min (at (3)), and turns off when the servo motor speed reaches -70 r/min (at (4)).

The range from the point when the servo motor speed has reached the on-level and ZSP turns on, to the point when the speed has increased again and reached the off-level is called a hysteresis width.

The hysteresis width is 20 r/min for this servo amplifier.

When using a linear servo motor, replace [r/min] with [mm/s].

■TLC (Limiting torque)

When the torque limit is reached during torque generation, TLC turns on. In the servo-off state, TLC turns off.

In the torque mode, TLC is off.

For details, refer to "Torque limit" in the following manual.

📖 MR-J5 User's Manual (Function)

■WNG (Warning)

If a warning occurs, WNG turns on. When no warning is occurring, WNG turns off in 3.5 s to 4.0 s after power-on.

■BWNG (Battery warning)

If [AL. 092 Battery cable disconnection warning] or [AL. 09F Battery warning] occurs, BWNG turns on. When no battery warning is occurring, BWNG turns off in 3.5 s to 4.0 s after power-on.

In an absolute position detection system with a battery-less ABS encoder, BWNG is always off.

■WNGSTOP (Motor stop warning)

WNGSTOP will turn on if a warning that the motor cannot be driven occurs. When no motor stop warning is occurring, WNGSTOP turns off in 3.5 s to 4.0 s after power-on.

■CDPS (Variable gain enabled)

When the gain of "Gain switching" is enabled, CDPS is on.

■CDPS2 (Variable gain enabled 2)

When the gain of "Gain switching 2" is enabled, CDPS2 is on.

■ABSV (Absolute position erased)

ABSV turns on when the absolute position is undetermined.

📖 Page 140 ABSOLUTE POSITION DETECTION SYSTEM

■MTTR (Tough drive in progress)

When a tough drive is set to "Enabled" in [Pr. PA20], activating the instantaneous power failure tough drive turns on MTTR.

For details, refer to "Instantaneous power failure tough drive" in the following manual.

📖 MR-J5 User's Manual (Function)

■FR (Coasting)

When the dynamic brake is released and the servo motor is stopped by coasting or in the coasting state, FR turns on.

■DOA (General-purpose output A)/DOB (General-purpose output B)/DOC (General-purpose output C)

The pins to which these devices are assigned can be switched on/off with the object "Digital outputs". For details, refer to "[Digital outputs (Obj. 60FEh)]" in the User's Manual (Object Dictionary).

Output signal

Output signal explanation

■LA/LAR (Encoder A-phase pulse (differential line driver))/LB/LBR (Encoder B-phase pulse (differential line driver))

The encoder output pulses set in [Pr. PA15] and [Pr. PA16] are output in the differential line driver type.

When the servo motor rotates in the CCW direction, the encoder B-phase pulse lags behind the encoder A-phase pulse by a phase of 90 degrees.

The relation between rotation direction and phase difference of the A-phase and B-phase pulses can be changed with the servo parameter [Pr. PC03.0 Encoder output pulse - Phase selection].

Output pulse setting, dividing ratio setting, and electronic gear setting can be selected.

The maximum output frequency is 4.6 Mpulses/s.

For details, refer to "A/B/Z-phase pulse output function" in the following manual.

📖MR-J5 User's Manual (Function)

Power supply

Power supply explanations

■DICOM (Digital I/F power supply input)

Input 24 V DC (24 V DC $\pm$ 10%) for I/O interface. The power supply capacity varies depending on the number of I/O interface points to be used.

For sink interfaces, connect the positive (+) terminal of the 24 V DC external power supply.

For source interfaces, connect the negative (-) terminal of the 24 V DC external power supply.

■DOCOM (Digital output I/F power supply)

Input 24 V DC (24 V DC $\pm$ 10%) for I/O interface. The power supply capacity varies depending on the number of I/O interface points to be used.

For sink interfaces, connect the negative (-) terminal of the 24 V DC external power supply.

For source interfaces, connect the positive (+) terminal of the 24 V DC external power supply.

■LG (Control common)

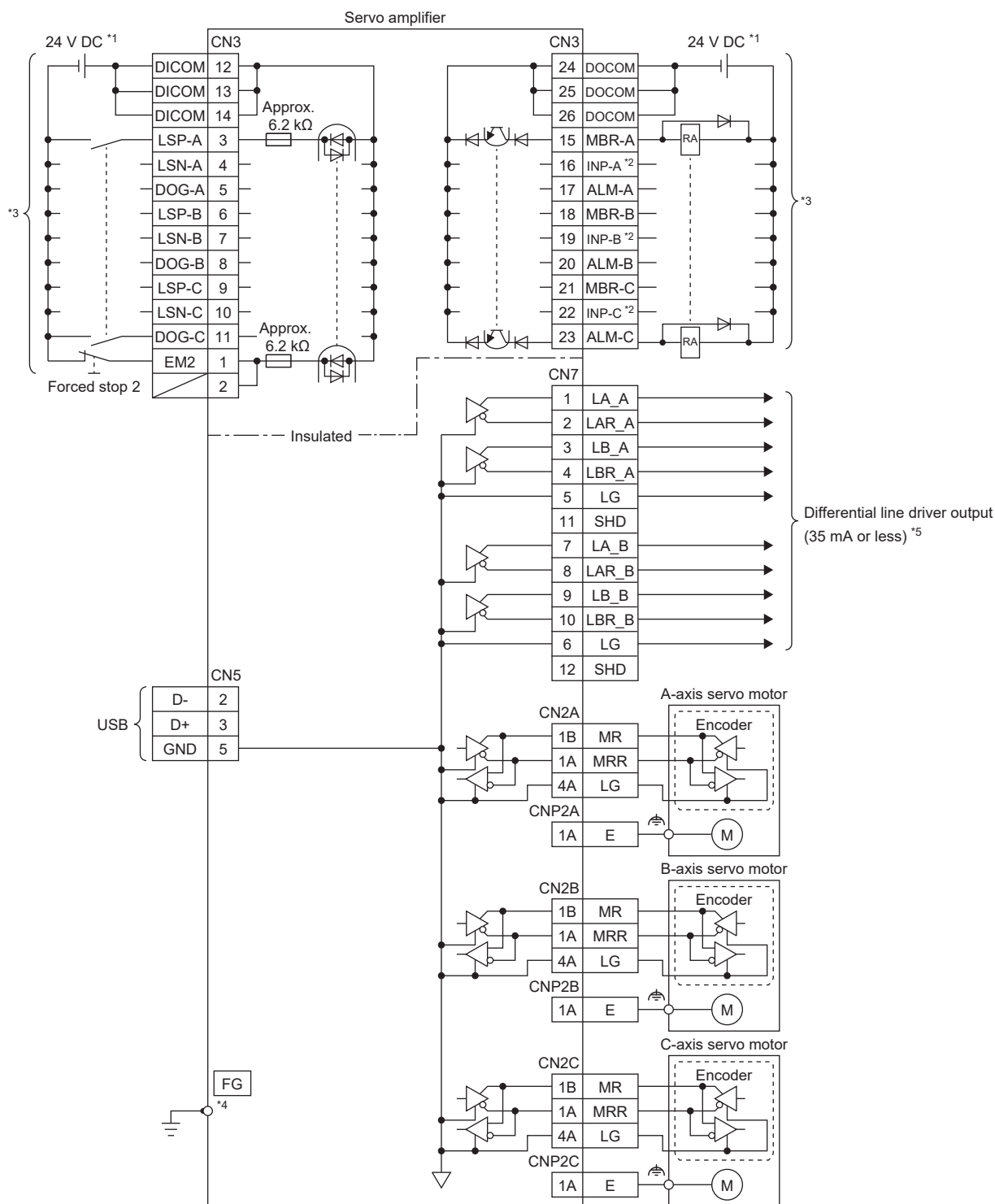
Connect LG to the common on the receiver side.

■SHD (Shield)

Connect the external conductor of a shielded wire to SHD.

5.6 Interface

Internal connection diagram



*1 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.

*2 This signal cannot be used in the velocity mode and torque mode.

*3 In the case of the sink I/O interface. For the source I/O interface, refer to the following.

☞ Page 62 Source I/O interface

*4 Although the diagram shows only a single FG, all the four FGs must be grounded by using metal studs. For FG, refer to the following.

☞ Page 28 Part name

*5 These signals cannot be used for the MR-MD333G-N1 servo amplifier.

Detailed explanation of interfaces

This section describes the details of the I/O signal interfaces (refer to the I/O signal interface type in the table) shown in the following. Refer to this section before connecting I/O signal interfaces to external devices.

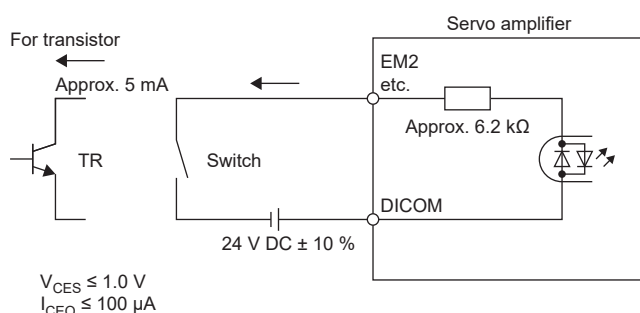
☞ Page 50 Signal (device) explanation

Precautions

Directly connecting the IO power supply to the servo amplifier without connecting an external load to digital output pins will cause the servo amplifier to malfunction. Connect a load to reduce the output current to 40 mA or less.

Digital input interface DI-1

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



For source input, refer to the following.

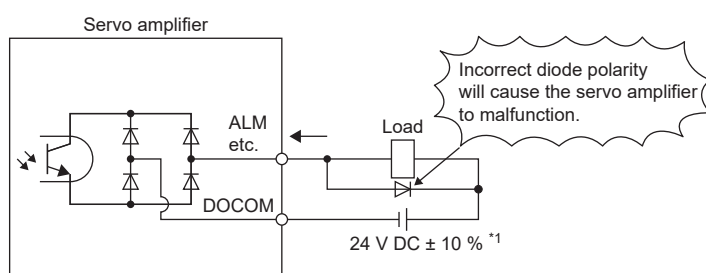
☞ Page 62 Source I/O interface

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 flows 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, inrush current: 100 mA or less) A maximum of 3.0 V voltage drop occurs in the servo amplifier. The following connection diagram is for sink output.



*1 If the voltage drop (a maximum of 3.0 V) interferes with the relay operation, apply high voltage (a maximum of 26.4 V) from an external source.

For source output, refer to the following.

☞ Page 62 Source I/O interface

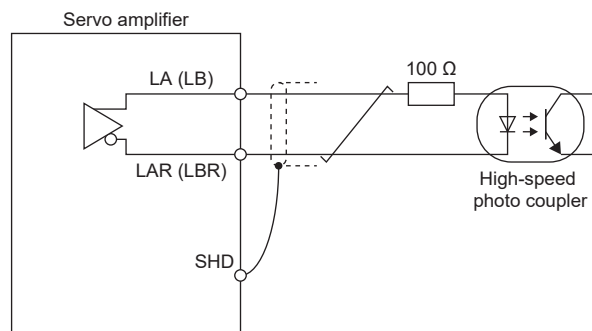
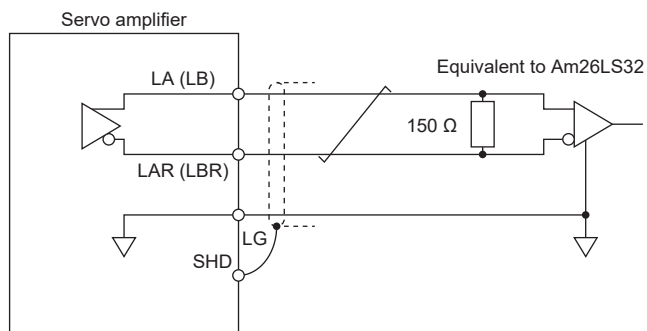
Encoder output pulse DO-2

Precautions

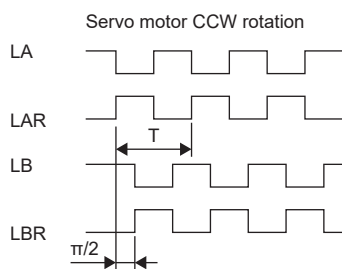
- For the number of encoder output pulses per revolution, do not set a value larger than the resolution of the encoder to be connected. (Related parameters: Pr. PA15, Pr. PA16)
- When connecting an HG-AK servo motor, set a value equal to or less than the resolution of 262144 pulses/rev. If a value exceeding the above resolution is set, the servo amplifier may cause unexpected operations of the connected devices.

■Differential line driver type

- Interface



- Output pulse

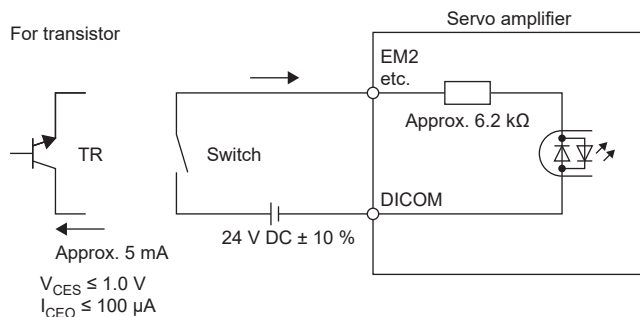


Source I/O interface

For the servo amplifiers described in this manual, source type I/O interfaces can be used.

Digital input interface DI-1

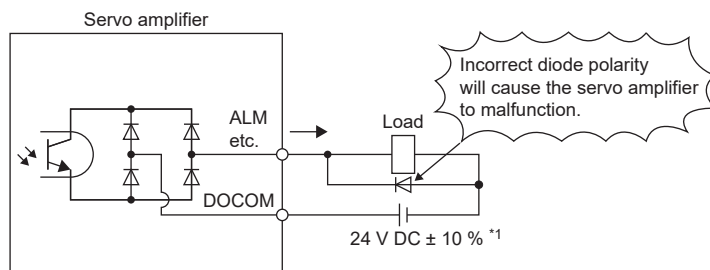
This is an input circuit in which the anode of the photocoupler is the input terminal. Transmit signals from a source (open-collector) type transistor output, relay switch, etc.



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 flows from the output terminal to a load.

A maximum of 3.0 V voltage drop occurs in the servo amplifier.

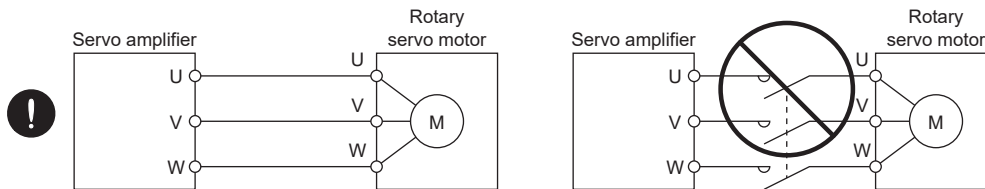


*1 If the voltage drop (a maximum of 3.0 V) interferes with the relay operation, apply high voltage (a maximum of 26.4 V) from an external source.

5.7 Connecting the servo amplifier and rotary servo motor

Precautions

- To prevent abnormal operations and malfunctions, connect the servo amplifier power output (U/V/W) to the rotary servo motor power input (U/V/W) directly. Do not connect a magnetic contactor or the like between the servo amplifier power output and the servo motor power input.



- To prevent malfunctions, do not connect utility power directly to the rotary servo motor.
- Use the rotary servo motor with the specified servo amplifier.
- To prevent malfunctions, eliminate static electricity before wiring, switch operation, or similar operations.

Precautions for wiring

Precautions

- Do not install a power capacitor, surge killer, or radio noise filter (optional FR-BIF(-H)) on the servo amplifier output side.
- To prevent malfunctions, connect the wires to the correct phase terminals (U/V/W) of the servo amplifier and the rotary servo motor.
- For the electromagnetic brake, do not use the 24 V DC interface power supply. To prevent malfunctions, use the power supply designed exclusively for the electromagnetic brake.
- For the selection of a surge absorber for the electromagnetic brake, refer to the chapter of the applicable rotary servo motor series.

📖 Rotary Servo Motor User's Manual (For MR-J5)

📖 SERVO MOTOR INSTRUCTION MANUAL (Vol. 3)

Wiring

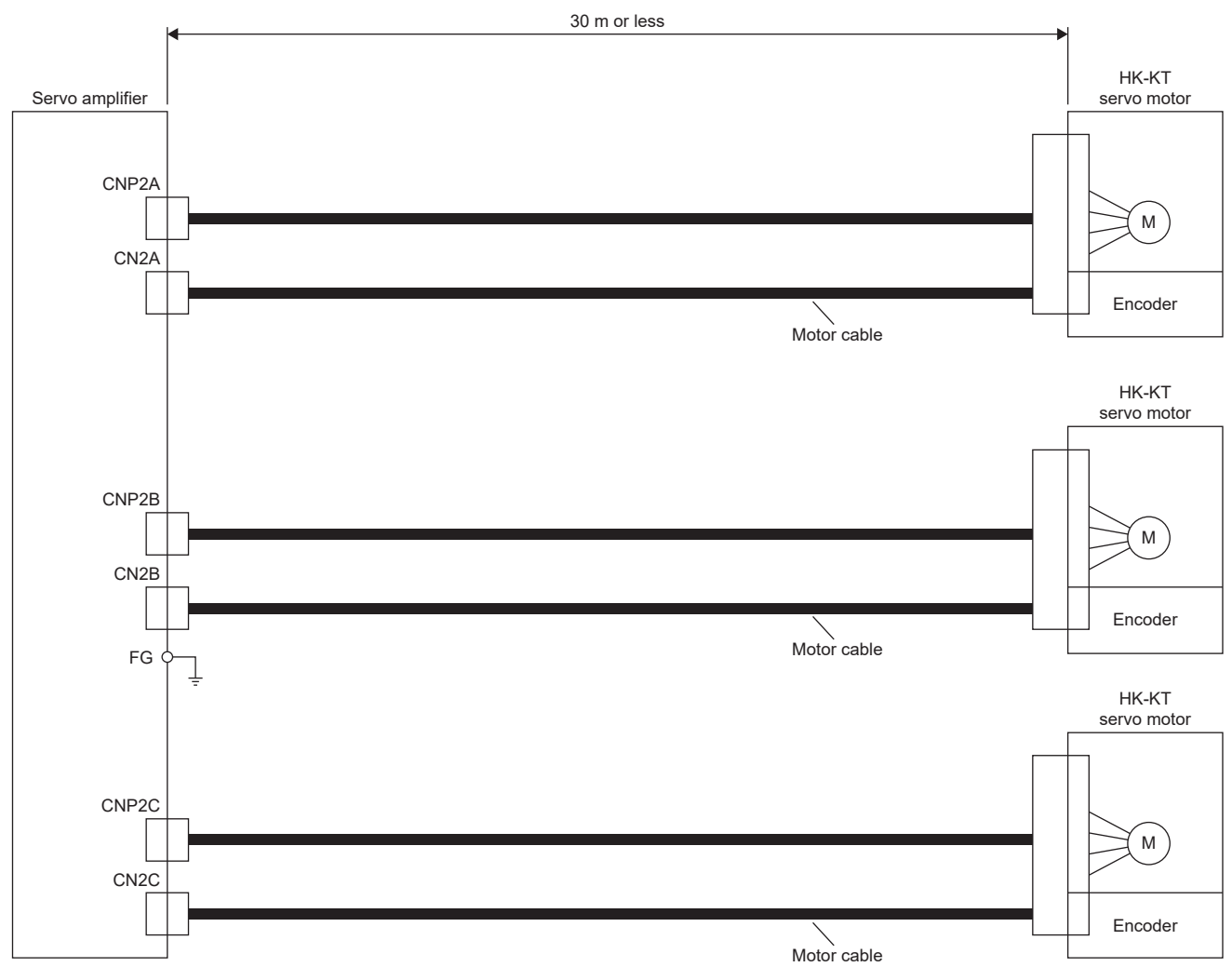
Point

When fabricating a cable, prepare the connector housing, connector contact, and crimping tool by yourself.
Select a wire suitable for the application.

Servo motor	Cable type	Relay	Electromagnetic brake	Connection diagram
HK-KT servo motor	Dual cable	×	×	Page 65 Connection diagram 1
		×	○	Page 66 Connection diagram 2
		○	×	Page 67 Connection diagram 3
		○	○	Page 68 Connection diagram 4
	Single cable	×	×	Page 69 Connection diagram 5
		×	○	Page 70 Connection diagram 6
		○	×	Page 71 Connection diagram 7
		○	○	Page 72 Connection diagram 8
HG-AK servo motor	—	×	×	Page 73 Connection diagram 9
		○	×	Page 74 Connection diagram 10
		○	○	Page 75 Connection diagram 11

HK-KT servo motor

■Connection diagram 1

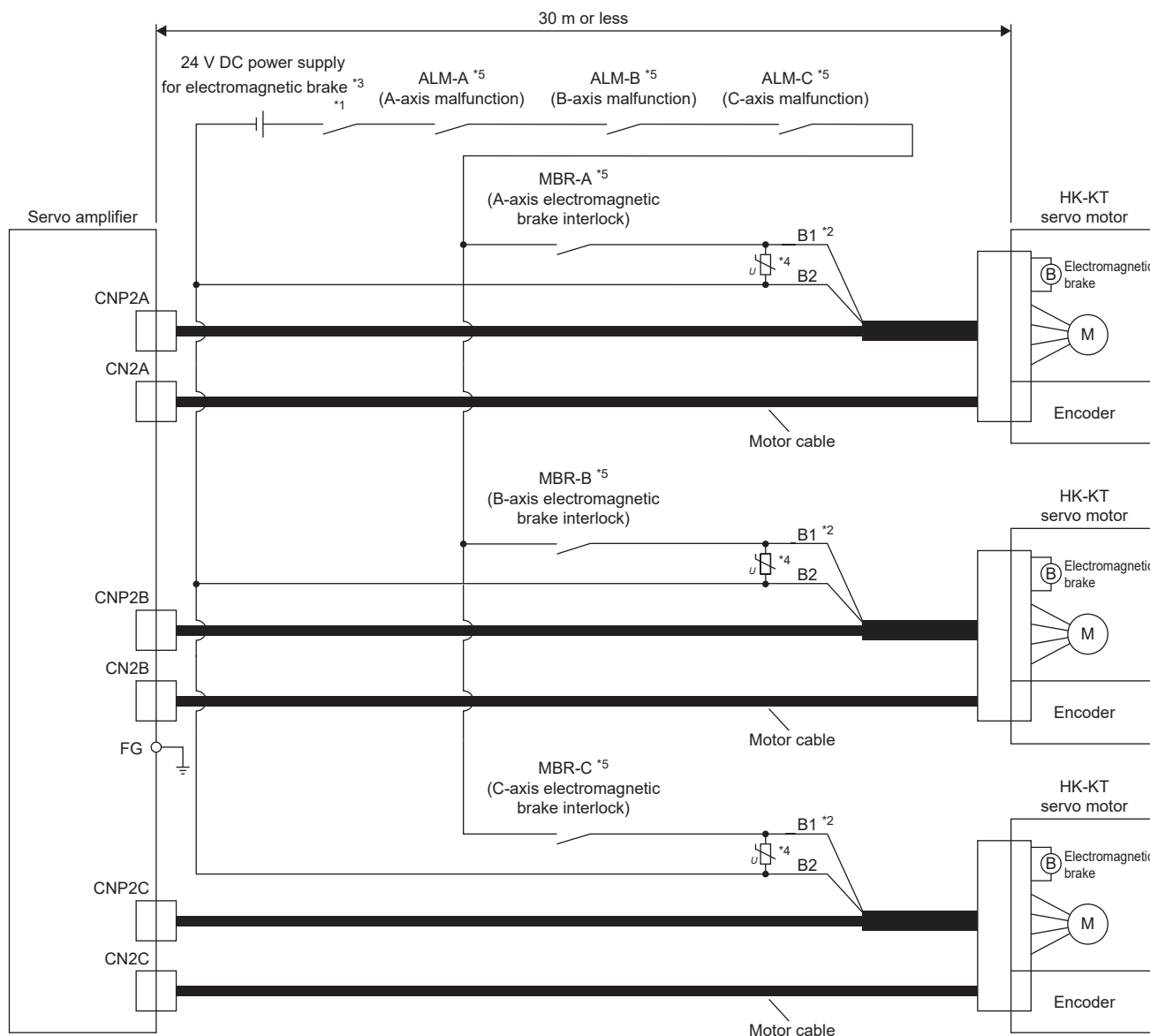


Cable	When using cables manufactured by Mitsubishi Electric System & Service Co., Ltd.	When fabricating a cable
Motor cable	SC-AEP3C_M-_-H-DC	Page 76 Motor cable (dual cable)

For details of the cables manufactured by Mitsubishi Electric System & Service Co., Ltd., refer to the following.

Page 84 Cables manufactured by Mitsubishi Electric System & Service Co., Ltd.

■Connection diagram 2



*1 Configure the circuit so that it shuts off in conjunction with the emergency stop switch.

*2 The electromagnetic brake terminals (B1 and B2) have no polarity.

*3 For the electromagnetic brake, do not use the 24 V DC main circuit power supply/control circuit power supply of the servo amplifier or 24 V DC interface power supply.

*4 Connect a surge absorber as close to the rotary servo motor as possible.

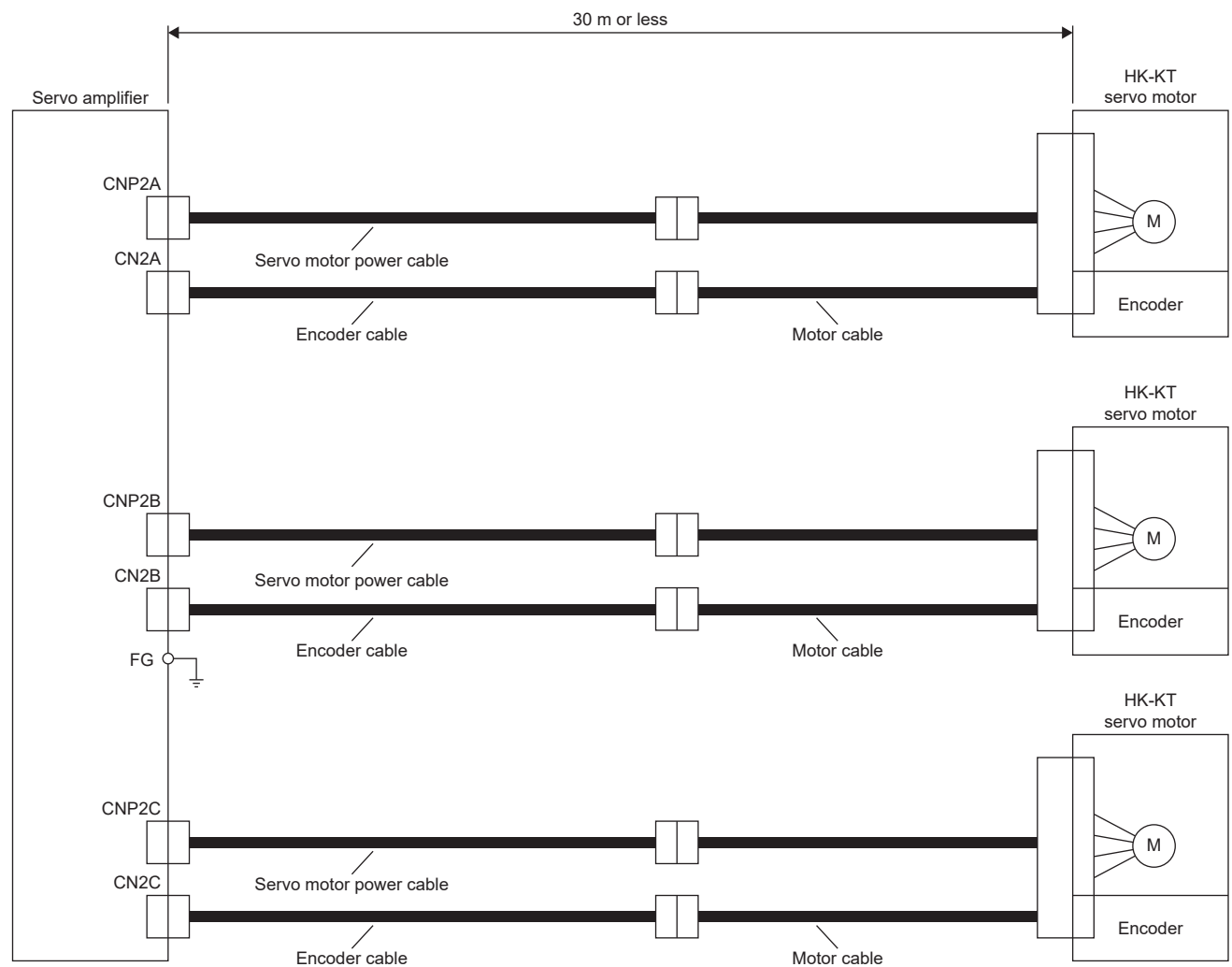
*5 Malfunction of MBR_ or ALM_ causes a malfunction of the brake.

Cable	When using cables manufactured by Mitsubishi Electric System & Service Co., Ltd.	When fabricating a cable
Motor cable	SC-AEPB3C_M_-H-DC	☞ Page 76 Motor cable (dual cable)

For details of the cables manufactured by Mitsubishi Electric System & Service Co., Ltd., refer to the following.

☞ Page 84 Cables manufactured by Mitsubishi Electric System & Service Co., Ltd.

■Connection diagram 3

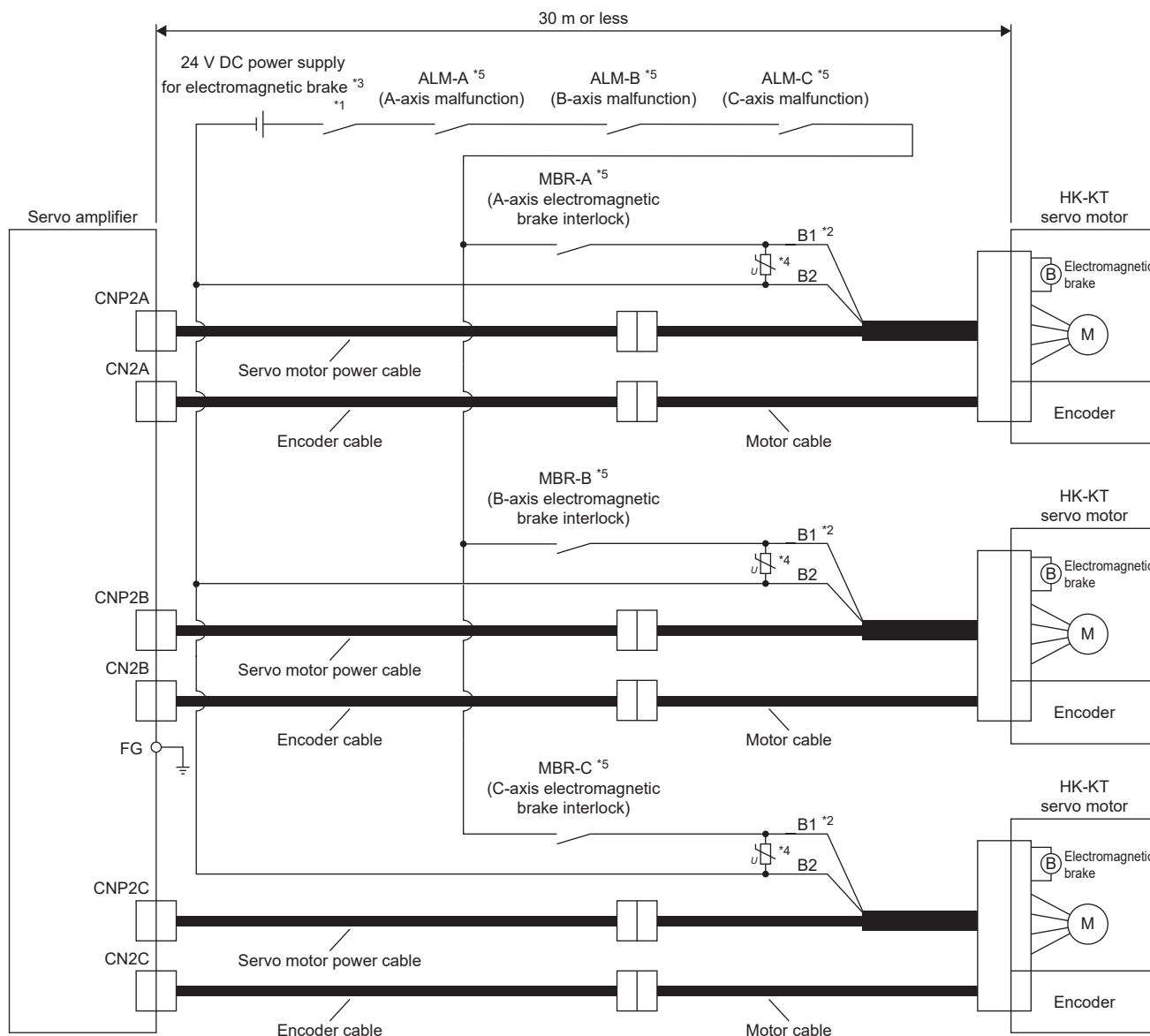


Cable	When using cables manufactured by Mitsubishi Electric System & Service Co., Ltd.	When fabricating a cable
Motor cable	SC-AEP3C_M_-H-DC	☞ Page 76 Motor cable (dual cable)
Encoder cable	SC-ENCBL_M-H-DC	☞ Page 80 Encoder cable
Servo motor power cable	SC-PWCBL_M-H-DC	☞ Page 82 Servo motor power cable

For details of the cables manufactured by Mitsubishi Electric System & Service Co., Ltd., refer to the following.

☞ Page 84 Cables manufactured by Mitsubishi Electric System & Service Co., Ltd.

■Connection diagram 4



*¹ Configure the circuit so that it shuts off in conjunction with the emergency stop switch.

*² The electromagnetic brake terminals (B1 and B2) have no polarity.

*³ For the electromagnetic brake, do not use the 24 V DC main circuit power supply/control circuit power supply of the servo amplifier or 24 V DC interface power supply.

*⁴ Connect a surge absorber as close to the rotary servo motor as possible.

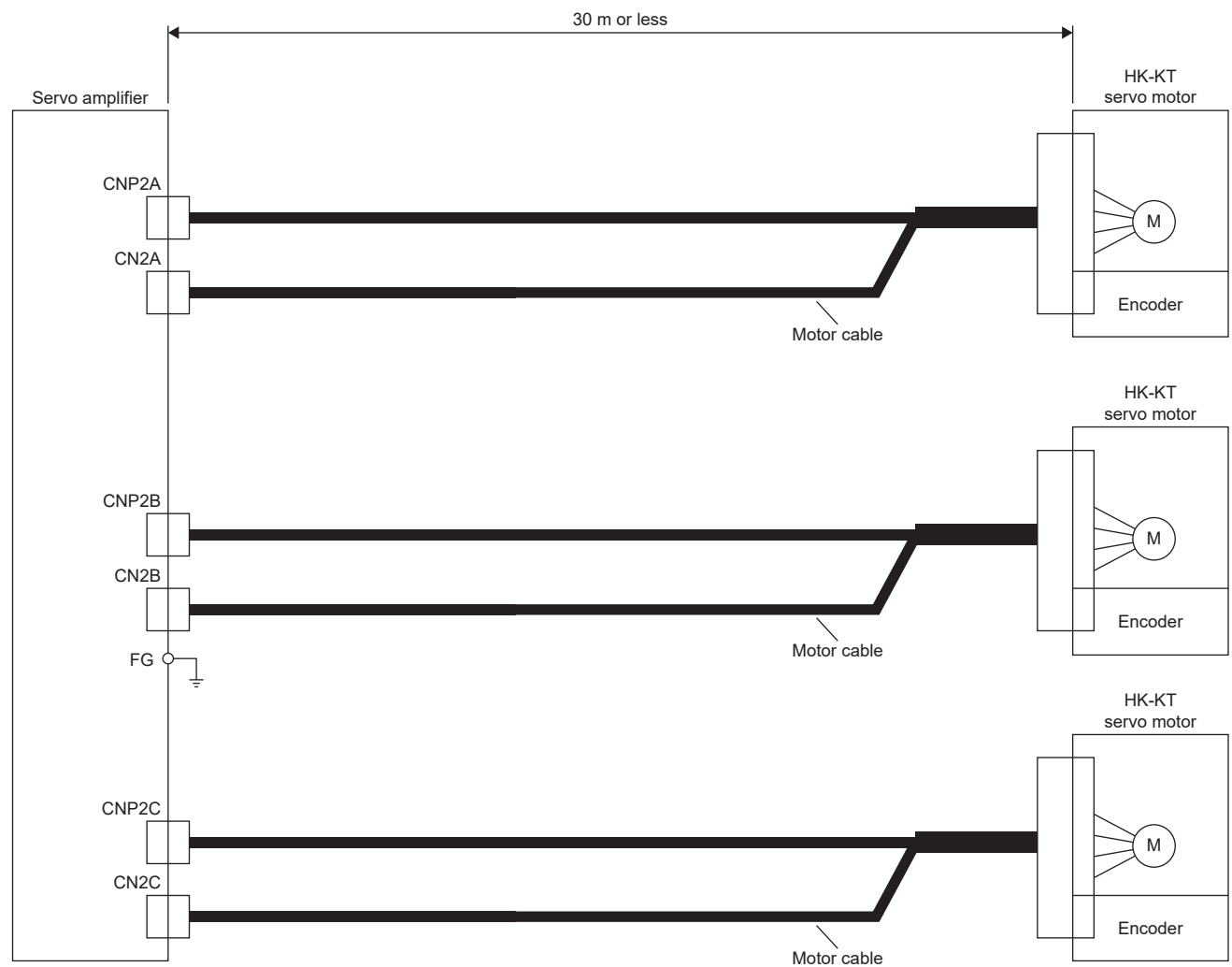
*⁵ Malfunction of MBR_ or ALM_ causes a malfunction of the brake.

Cable	When using cables manufactured by Mitsubishi Electric System & Service Co., Ltd.	When fabricating a cable
Motor cable	SC-AEPB3C_M_-H-DC	☞ Page 76 Motor cable (dual cable)
Encoder cable	SC-ENCBL_M-H-DC	☞ Page 80 Encoder cable
Servo motor power cable	SC-PWCBL_M-H-DC	☞ Page 82 Servo motor power cable

For details of the cables manufactured by Mitsubishi Electric System & Service Co., Ltd., refer to the following.

☞ Page 84 Cables manufactured by Mitsubishi Electric System & Service Co., Ltd.

■Connection diagram 5



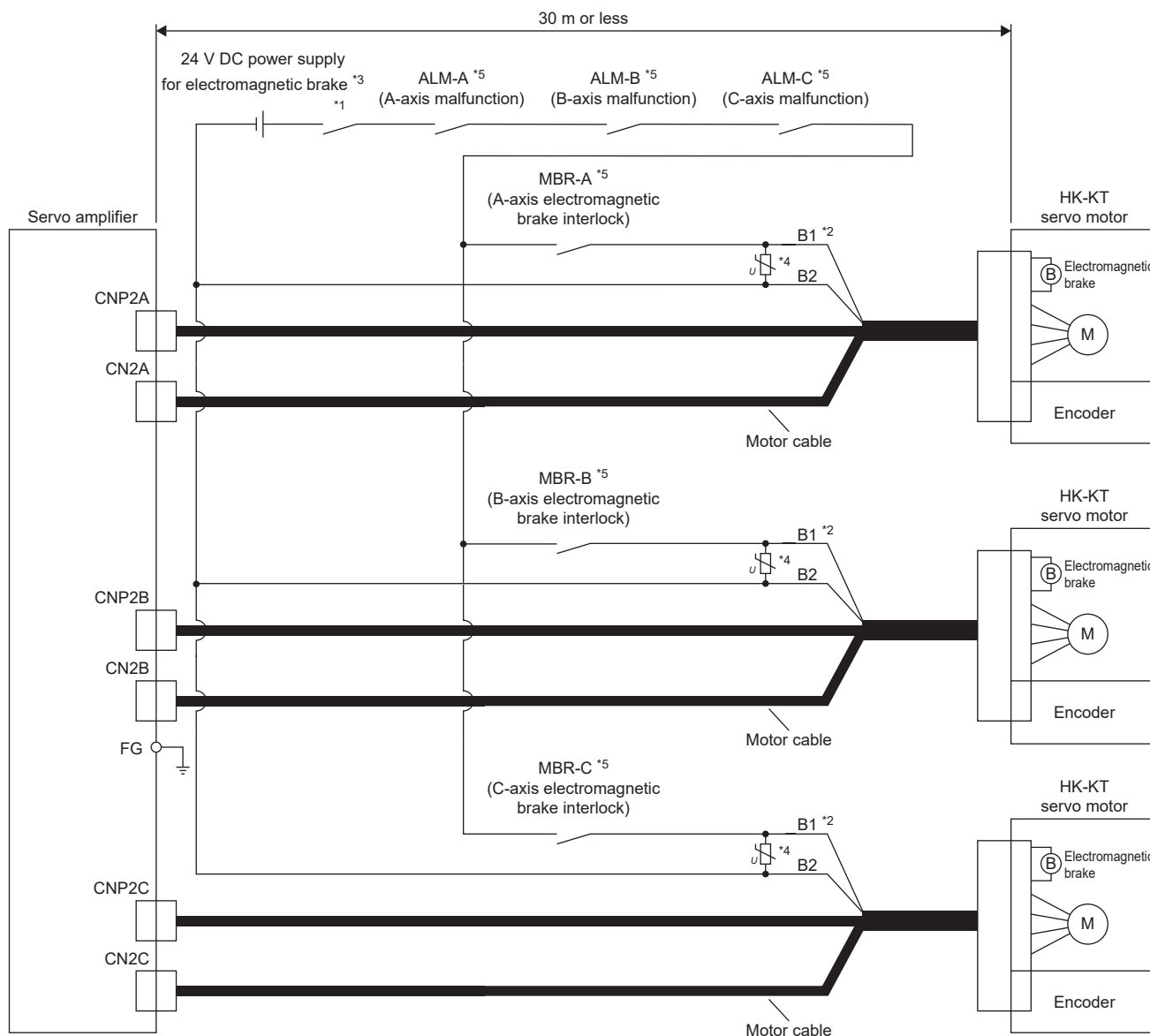
5

Cable	When using cables manufactured by Mitsubishi Electric System & Service Co., Ltd.	When fabricating a cable
Motor cable	SC-AEP4C_M-_-H-DC	—

For details of the cables manufactured by Mitsubishi Electric System & Service Co., Ltd., refer to the following.

☞ Page 84 Cables manufactured by Mitsubishi Electric System & Service Co., Ltd.

■Connection diagram 6



*1 Configure the circuit so that it shuts off in conjunction with the emergency stop switch.

*2 The electromagnetic brake terminals (B1 and B2) have no polarity.

*3 For the electromagnetic brake, do not use the 24 V DC main circuit power supply/control circuit power supply of the servo amplifier or 24 V DC interface power supply.

*4 Connect a surge absorber as close to the rotary servo motor as possible.

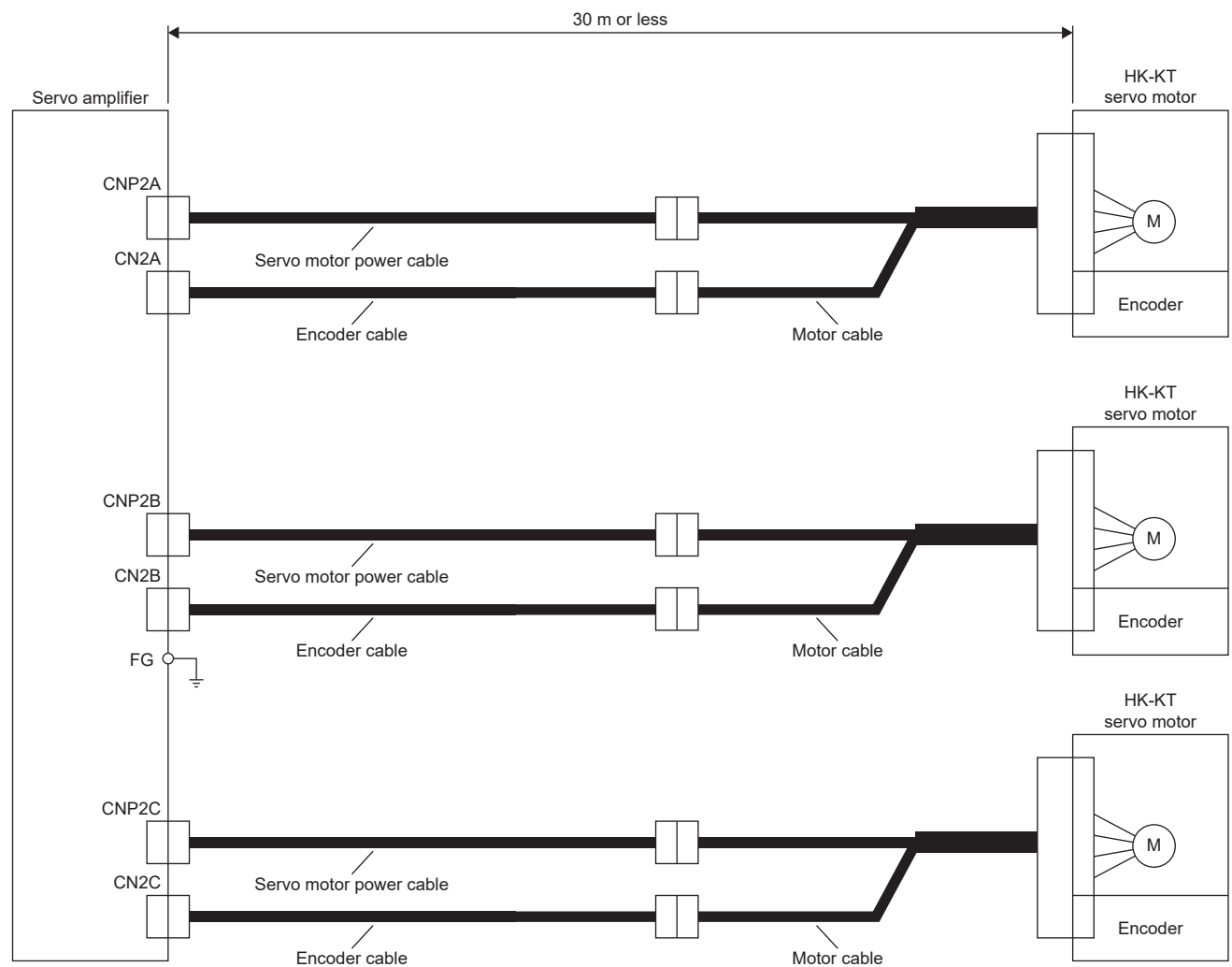
*5 Malfunction of MBR_ or ALM_ causes a malfunction of the brake.

Cable	When using cables manufactured by Mitsubishi Electric System & Service Co., Ltd.	When fabricating a cable
Motor cable	SC-AEPB4C_M_-H-DC	—

For details of the cables manufactured by Mitsubishi Electric System & Service Co., Ltd., refer to the following.

☞ Page 84 Cables manufactured by Mitsubishi Electric System & Service Co., Ltd.

■Connection diagram 7

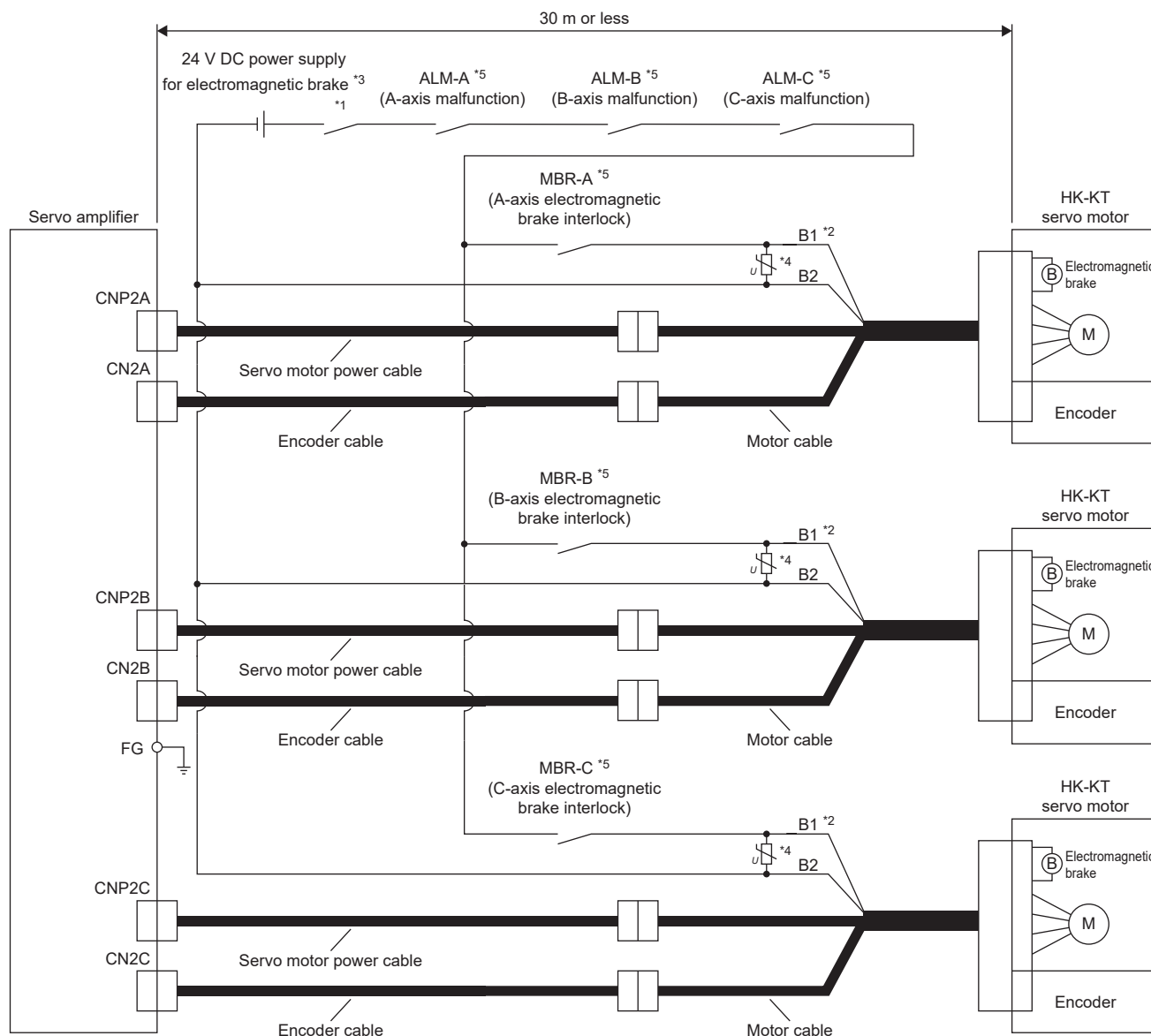


Cable	When using cables manufactured by Mitsubishi Electric System & Service Co., Ltd.	When fabricating a cable
Motor cable	SC-AEP4C_M-_-H-DC	—
Encoder cable	SC-ENCBL_M-H-DC	☞ Page 80 Encoder cable
Servo motor power cable	SC-PWCBL_M-H-DC	☞ Page 82 Servo motor power cable

For details of the cables manufactured by Mitsubishi Electric System & Service Co., Ltd., refer to the following.

☞ Page 84 Cables manufactured by Mitsubishi Electric System & Service Co., Ltd.

■Connection diagram 8



*1 Configure the circuit so that it shuts off in conjunction with the emergency stop switch.

*2 The electromagnetic brake terminals (B1 and B2) have no polarity.

*3 For the electromagnetic brake, do not use the 24 V DC main circuit power supply/control circuit power supply of the servo amplifier or 24 V DC interface power supply.

*4 Connect a surge absorber as close to the rotary servo motor as possible.

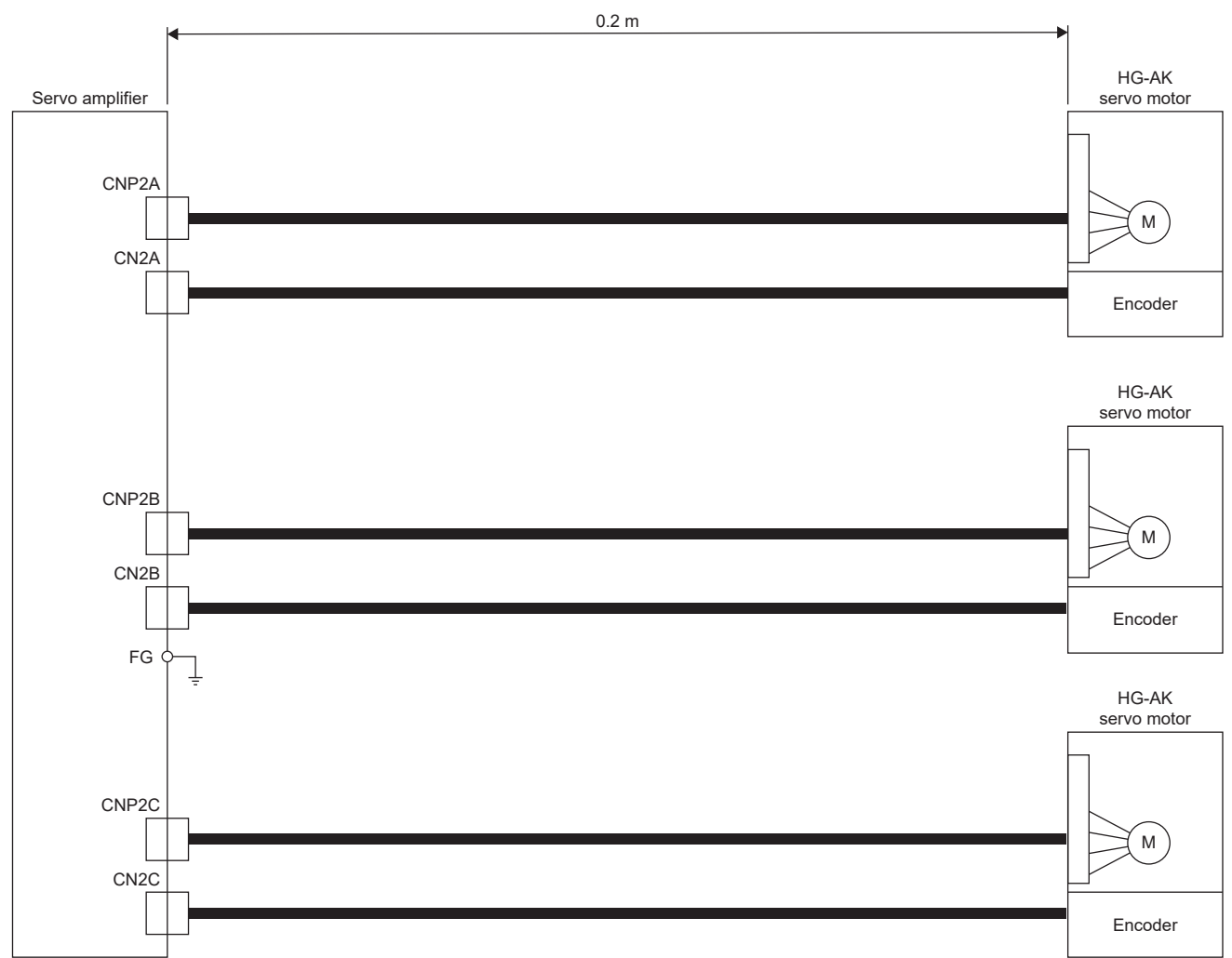
*5 Malfunction of MBR_ or ALM_ causes a malfunction of the brake.

Cable	When using cables manufactured by Mitsubishi Electric System & Service Co., Ltd.	When fabricating a cable
Motor cable	SC-AEPB4C_M_-H-DC	—
Encoder cable	SC-ENCBL_M-H-DC	☞ Page 80 Encoder cable
Servo motor power cable	SC-PWCBL_M-H-DC	☞ Page 82 Servo motor power cable

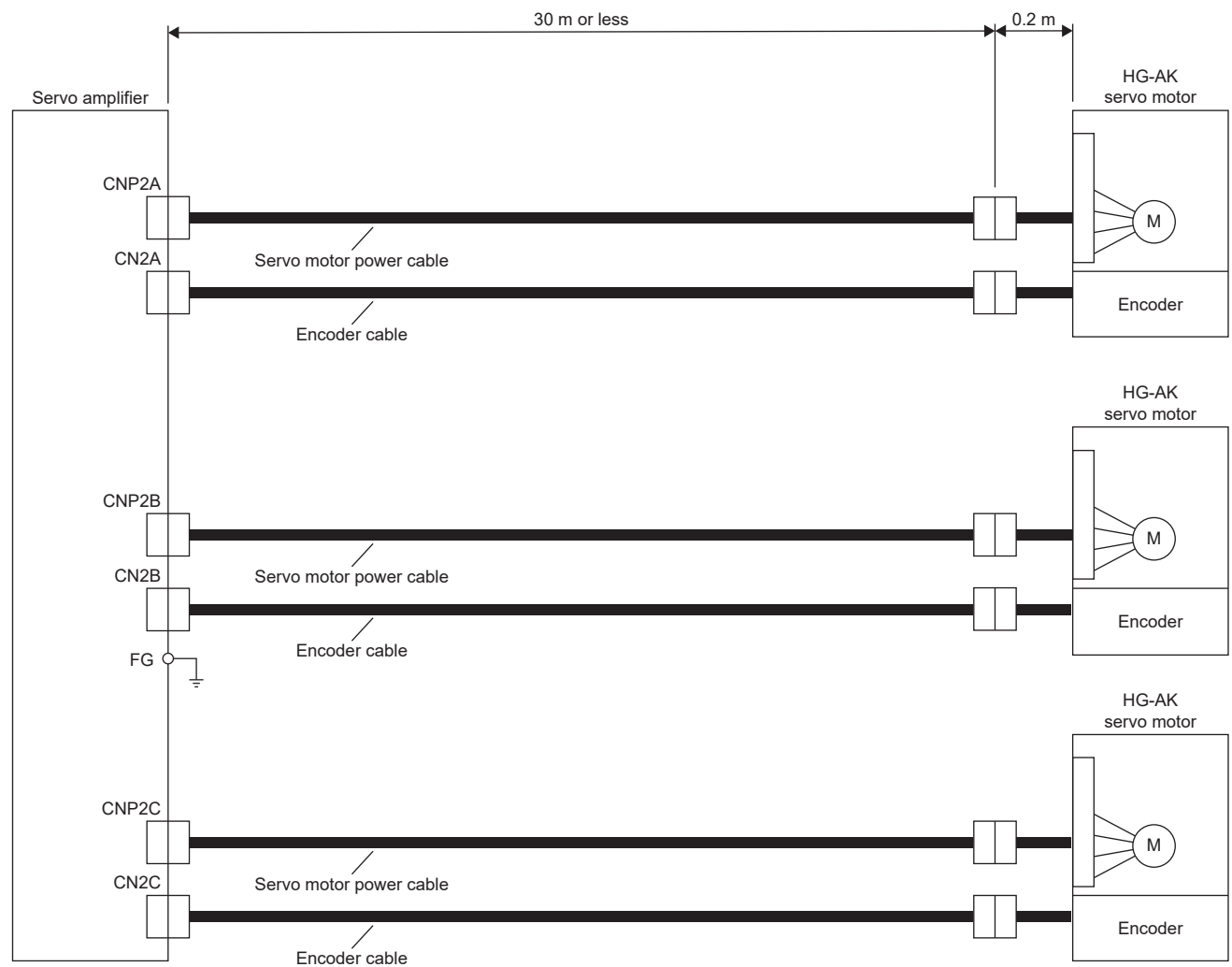
For details of the cables manufactured by Mitsubishi Electric System & Service Co., Ltd., refer to the following.

☞ Page 84 Cables manufactured by Mitsubishi Electric System & Service Co., Ltd.

■Connection diagram 9



■Connection diagram 10

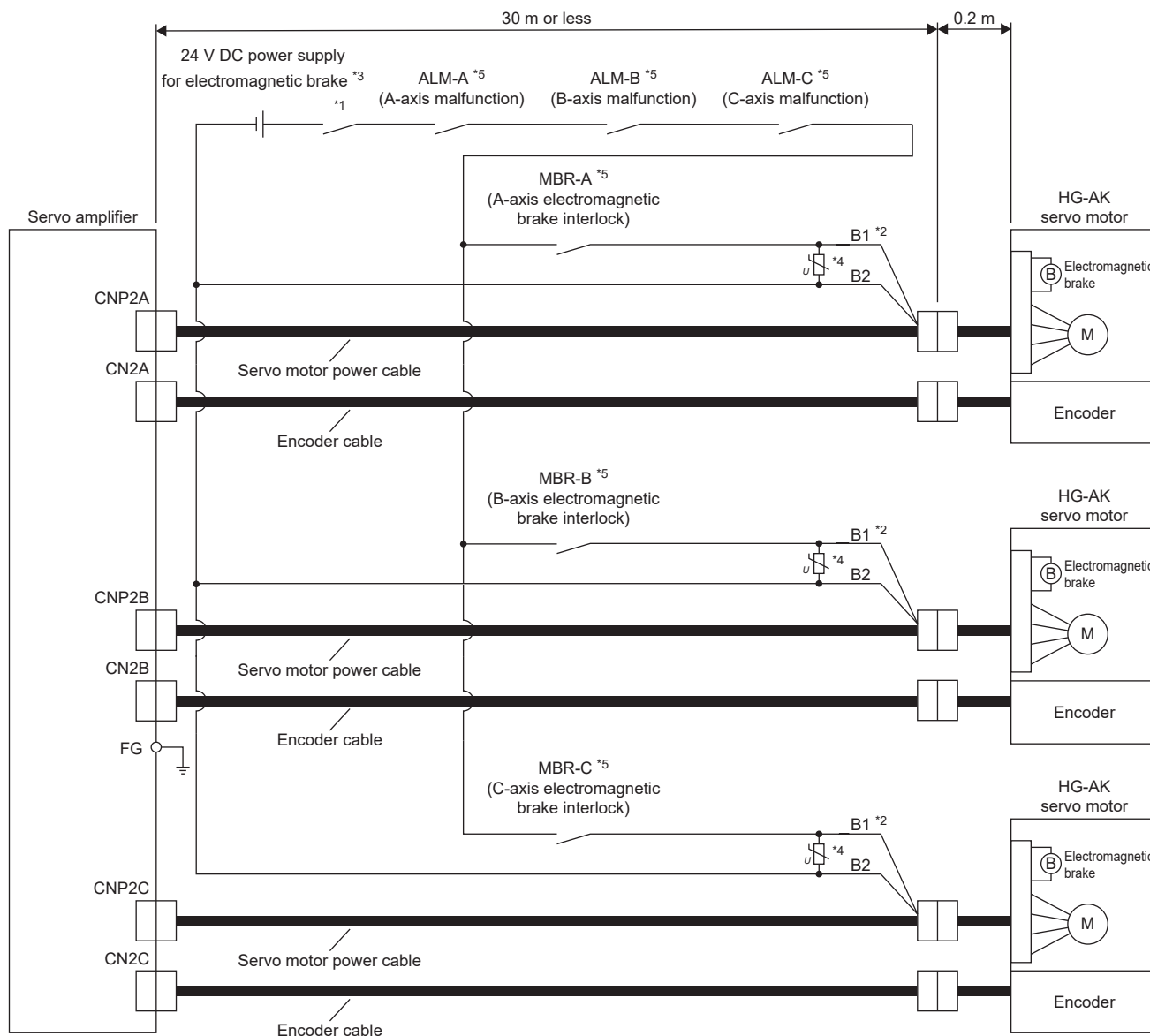


Cable	When using cables manufactured by Mitsubishi Electric System & Service Co., Ltd.	When fabricating a cable
Encoder cable	SC-ENCBL_M-H-DC	☞ Page 80 Encoder cable
Servo motor power cable	SC-PWCBL_M-H-DC	☞ Page 82 Servo motor power cable

For details of the cables manufactured by Mitsubishi Electric System & Service Co., Ltd., refer to the following.

☞ Page 84 Cables manufactured by Mitsubishi Electric System & Service Co., Ltd.

■Connection diagram 11



*1 Configure the circuit so that it shuts off in conjunction with the emergency stop switch.

*2 The electromagnetic brake terminals (B1 and B2) have no polarity.

*3 For the electromagnetic brake, do not use the 24 V DC main circuit power supply/control circuit power supply of the servo amplifier or 24 V DC interface power supply.

*4 Connect a surge absorber as close to the rotary servo motor as possible.

*5 Malfunction of MBR_ or ALM_ causes a malfunction of the brake.

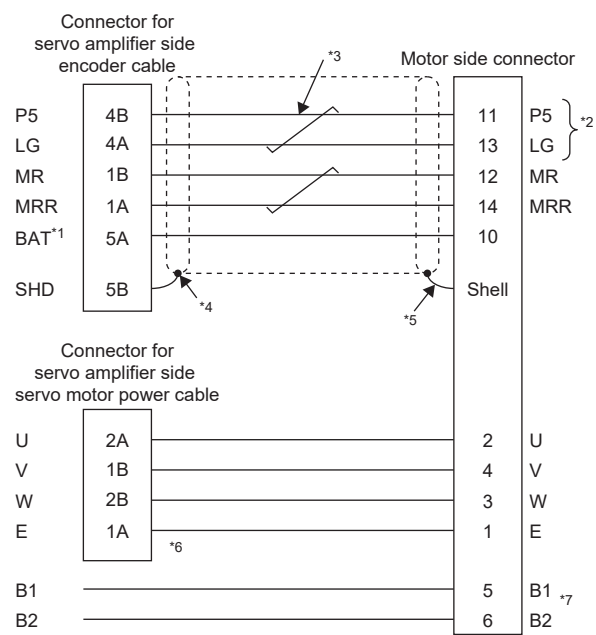
Cable	When using cables manufactured by Mitsubishi Electric System & Service Co., Ltd.	When fabricating a cable
Encoder cable	SC-ENCBL_M-H-DC	☞ Page 80 Encoder cable
Servo motor power cable	SC-PWBKCB_L_M-H-DC	☞ Page 82 Servo motor power cable

For details of the cables manufactured by Mitsubishi Electric System & Service Co., Ltd., refer to the following.

☞ Page 84 Cables manufactured by Mitsubishi Electric System & Service Co., Ltd.

Motor cable (dual cable)

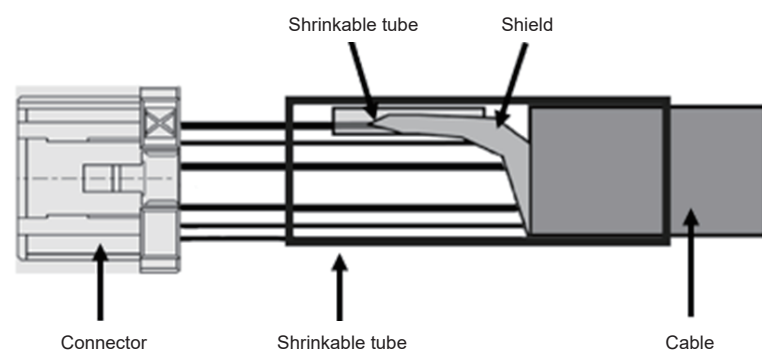
Internal wiring diagram



- *1 Do not connect anything to BAT.
- *2 Determine the number of paired P5 and LG connections according to the cable length and wire conductor resistance. The conductor resistance between the servo amplifier and encoder should be 0.58 Ω or less. An example is shown below.

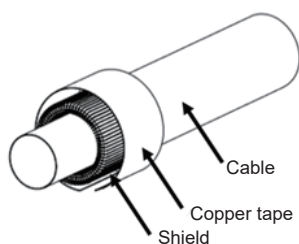
Wire size	Wiring length	Number of paired LG and P5 connections
AWG 22 (Conductor resistance 56 Ω/km or less)	Up to 10 m	1 pair
	Up to 20 m	2 pairs
	Up to 30 m	3 pairs

- *3 Select a shielded twisted pair cable. Connect the twisted pair cable using the correct combination.
- *4 For shielding the cable, it is recommended to twist the shield as shown in the following figure, and then solder the lead wires, etc. to connect them.



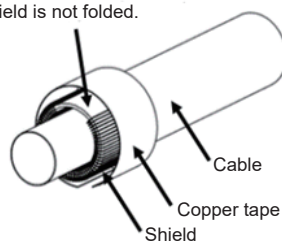
- *5 For shielding the connector, it is recommended to fold the entire cable shield evenly around the cable, wrap it around with copper tape, and then clamp it to the connector housing. If the outer diameter of the cable differs from the recommended outer diameter for the connector, the cable shield and connector housing may not be clamped. For detailed specifications, refer to the catalog issued by the connector manufacturer.

< Example of a non-defective product >



< Example of a defective product >

* The shield is not folded.



*6 The recommended cable varies depending on the length and type of the cable to be fabricated. Check the specifications of the applicable connector and use wires within the specified range.

*7 B1 and B2 are the wiring for electromagnetic brakes. Wire them to use a servo motor with an electromagnetic brake.

Connector for servo amplifier side encoder cable

The following shows the view from the wiring side. Use contacts with gold plating. Do not connect anything to the pins that are marked with a diagonal line.

Tab housing: J21DF-10V-KX-L (JST)

Contact: SJ2F-01GF-P1.0 (JST)

Crimping tool: YRS-8861 (JST)

5B	5A
SHD	BAT
4B	4A
P5	LG
3B	3A
2B	2A
1B	1A
MR	MRR

Servo amplifier side connector for servo motor power cable

The following shows the view from the wiring side. Use contacts with gold plating. Do not connect anything to the pins that are marked with a diagonal line.

Tab housing: J21DF-06V-KX-L (JST)

Contact: SJ2F-21GF-P1.0 (JST)

Crimping tool: YRF-1120 (JST)

3B	3A
2B	2A
W	U
1B	1A
V	E

Motor side connector

■ Load-side lead/opposite to load-side lead

The following shows the view from the wiring side. Do not connect anything to the pins that are marked with a diagonal line.

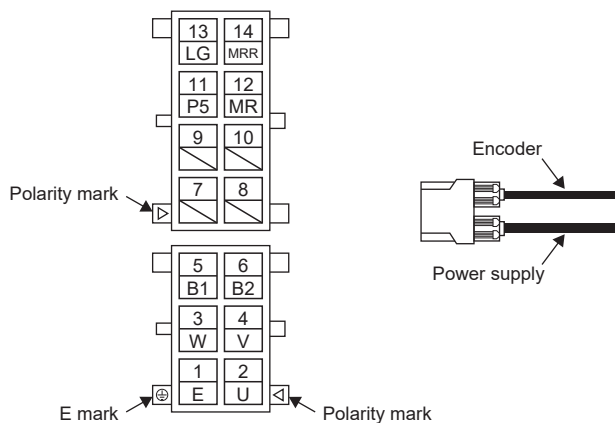
Connector set: MT50W-8D/2D4ES-CVLD(7.5)

Contact (for motor power supply): MT50E-1820SCFA

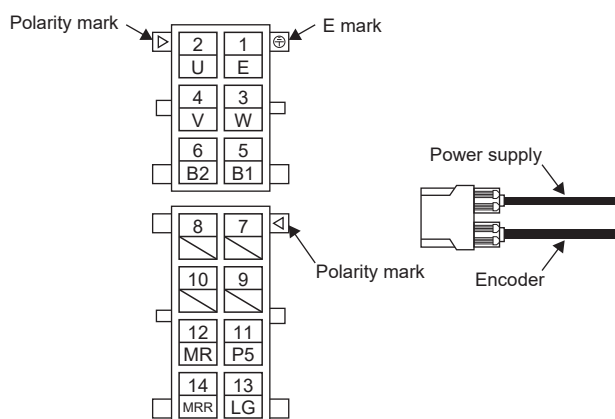
Contact (for encoder and electromagnetic brake): MT50D-2224SCFA

(Hirose Electric)

- Load-side lead



- Opposite to load-side lead



■Vertical lead

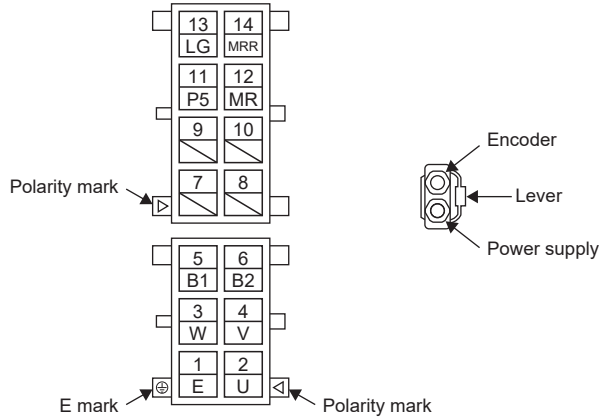
The following shows the view from the wiring side. Do not connect anything to the pins that are marked with a diagonal line.

Connector set: MT50W-8D/2D4ES-CVSD(7.5)

Contact (for motor power supply): MT50E-1820SCFA

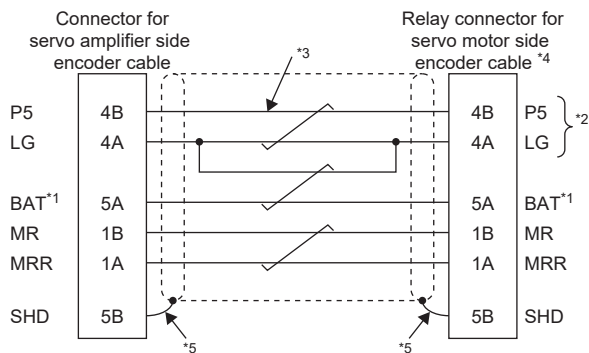
Contact (for encoder and electromagnetic brake): MT50D-2224SCFA

(Hirose Electric)



Encoder cable

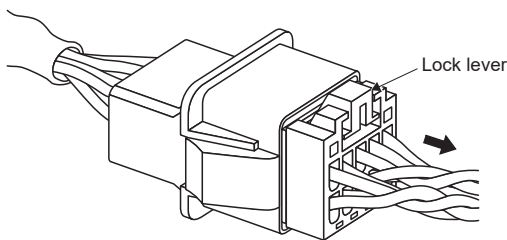
Internal wiring diagram



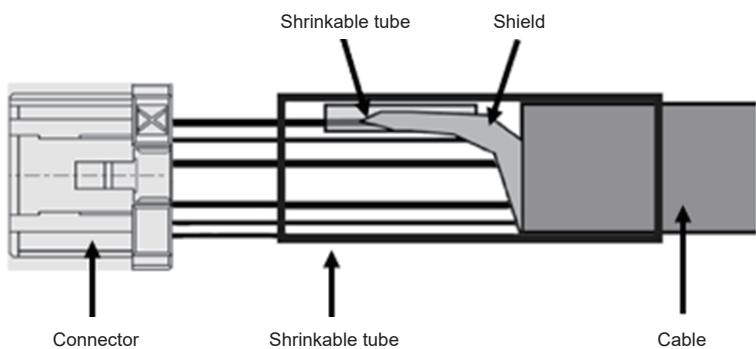
- *1 Wire this signal for use in an absolute position detection system with an HG-AK servo motor. Wiring is not necessary for use in an incremental system.
- *2 Determine the number of paired P5 and LG connections according to the cable length and wire conductor resistance. The conductor resistance between the servo amplifier and encoder should be $0.58\ \Omega$ or less. An example is shown below.

Wire size	Wiring length	Number of paired LG and P5 connections
AWG 22 (Conductor resistance $56\ \Omega/\text{km}$ or less)	Up to 10 m	1 pair
	Up to 20 m	2 pairs
	Up to 30 m	3 pairs

- *3 Select a shielded twisted pair cable. Connect the twisted pair cable using the correct combination.
- *4 Press the lock lever to remove the power connector. There is no need to operate the lock lever on the servo motor power cable.



- *5 For shielding the cable, it is recommended to twist the shield as shown in the following figure, and then solder the lead wires, etc. to connect them.



Connector for servo amplifier side encoder cable

The following shows the view from the wiring side. Use contacts with gold plating. Do not connect anything to the pins that are marked with a diagonal line.

Tab housing: J21DF-10V-KX-L (JST)

Contact: SJ2F-01GF-P1.0 (JST)

Crimping tool: YRS-8861 (JST)

5B	5A
SHD	BAT
4B	4A
P5	LG
3B	3A
2B	2A
1B	1A
MR	MRR

Relay connector for servo motor side encoder cable

The following shows the view from the wiring side. Use contacts with gold plating. Do not connect anything to the pins that are marked with a diagonal line.

Tab housing: J21DPM-10V-KX (JST)

Contact: SJ2M-01GF-M1.0N (JST)

Crimping tool: YRS-8861 (JST)

5A	5B
BAT	SHD
4A	4B
LG	P5
3A	3B
2A	2B
1A	1B
MRR	MR

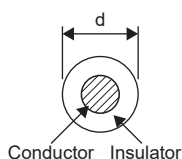
Wire

When wiring the cables, leave the minimum bending radius or more to prevent stress from being applied to the cables.

For the cable bending life, contact the manufacturer.

Length [m]	Core size	Number of core wires	Characteristics of one core wire			Cable OD [mm] *2	Recommended wire model (manufacturer)
			Structure [Wires/mm]	Conductor resistance [Ω /km]	Insulator OD (d) [mm] *1		
1 to 10	AWG 22	6 (3 pairs)	70/0.08	56 or less	1.17	7.1 $\pm$ 0.3	TPE•SVP 70/0.08(AWG#22 or equivalent)-3P KB-2237-2 (Bando Densen) *3
15 to 30	AWG 22	10 (5 pairs)	70/0.08	56 or less	1.17	7.7 $\pm$ 0.3	TPE•SVP 70/0.08(AWG#22 or equivalent)-5P KB-2237-2 (Bando Densen) *3

*1 The following diagram shows (d).

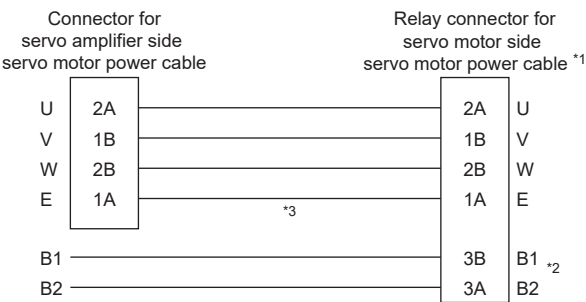


*2 The listed values are the standard OD. The maximum OD is approximately 10% greater for dimensions without tolerances.

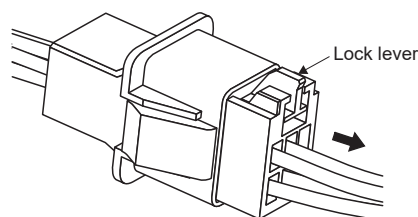
*3 Supplier: Toa Electric Industrial Co. Ltd., Nagoya Branch

Servo motor power cable

Internal wiring diagram



*1 Press the lock lever to remove the power connector. There is no need to operate the lock lever on the servo motor power cable.



*2 B1 and B2 are the wiring for electromagnetic brakes. Wire them to use an HG-AK servo motor with an electromagnetic brake.

*3 High conductor resistance of wiring reduces the speed-torque characteristics. For the recommended wire sizes, refer to the following.

➡ Page 83 Wire

Servo amplifier side connector for servo motor power cable

The following shows the view from the wiring side. Use contacts with gold plating.

Tab housing: J21DF-06V-KX-L (JST)

Contact: SJ2F-21GF-P1.0 (JST)

Crimping tool: YRF-1120 (JST)

3B	3A
2B	2A
W	U
1B	1A
V	E

Servo motor side relay connector for servo motor power cable

The following shows the view from the wiring side. Use contacts with gold plating.

Tab housing: J21DPM-06V-KX (JST)

Contact: SJ2M-21GF-M1.0N (JST)

Crimping tool: YRF-1120 (JST)

3A	3B
B2	B1 *1
2A	2B
U	W
1A	1B
E	V

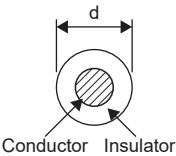
*1 B1 and B2 are the wiring for electromagnetic brakes. Wire them to use an HG-AK servo motor with an electromagnetic brake.

Wire

When wiring the cables, leave the minimum bending radius or more to prevent stress from being applied to the cables.
For the cable bending life, contact the manufacturer.

Length [m]	Core size	Number of core wires	Characteristics of one core wire			Cable OD [mm] ^{*2}	Recommended wire model (manufacturer)
			Structure [Wires/mm]	Conductor resistance [Ω /km]	Insulator OD (d) [mm] ^{*1}		
1 to 30	AWG 19 (0.75 mm ²)	4	150/0.08	29.1 or less	1.63	5.7 $\pm$ 0.5	RMFES-A(CL3X) AWG 19 4 cores (Dyden) ^{*3}

^{*1} The following diagram shows (d).



^{*2} The listed values are the standard OD. The maximum OD is approximately 10% greater for dimensions without tolerances.

^{*3} Supplier: Taisei Co., Ltd.

Cables manufactured by Mitsubishi Electric System & Service Co., Ltd.

For the cable bending life, contact Mitsubishi Electric System & Service Co., Ltd.

Model*1	Cable	Cable length [m]	Electromagnetic brake wire	Cable direction	Bending type
SC-AEP3C_M-A1-H-DC	Motor cable (Dual cable type)	0.5, 1 to 20	×	Load-side lead	Long bending life (for moving parts)
SC-AEP3C_M-A2-H-DC	Motor cable (Dual cable type)	0.5, 1 to 20	×	Opposite to load-side lead	Long bending life (for moving parts)
SC-AEP3C_M-A5-H-DC	Motor cable (Dual cable type)	0.5, 1 to 20	×	Vertical lead	Long bending life (for moving parts)
SC-AEPB3C_M-A2-H-DC	Motor cable (Dual cable type)	0.5, 1 to 20	○	Opposite to load-side lead	Long bending life (for moving parts)
SC-AEPB3C_M-A5-H-DC	Motor cable (Dual cable type)	0.5, 1 to 20	○	Vertical lead	Long bending life (for moving parts)
SC-AEP4C_M-A2-H-DC	Motor cable (Single cable type)	0.5, 1 to 20	×	Opposite to load-side lead	Long bending life (for moving parts)
SC-AEP4C_M-A5-H-DC	Motor cable (Single cable type)	0.5, 1 to 20	×	Vertical lead	Long bending life (for moving parts)
SC-AEPB4C_M-A2-H-DC	Motor cable (Single cable type)	0.5, 1 to 20	○	Opposite to load-side lead	Long bending life (for moving parts)
SC-AEPB4C_M-A5-H-DC	Motor cable (Single cable type)	0.5, 1 to 20	○	Vertical lead	Long bending life (for moving parts)
SC-ENCBL_M-H-DC	Encoder cable	0.5, 1 to 30	—	—	Long bending life (for moving parts)
SC-PWCBL_M-H-DC	Servo motor power cable	0.5, 1 to 30	×	—	Long bending life (for moving parts)
SC-PWBKCBM_M-H-DC	Servo motor power cable	0.5, 1 to 30	○	—	Long bending life (for moving parts)

*1 Replace "_" in the cable model with the listed cable lengths. For cables that are 1 m or longer, lengths are prepared in 1-meter increments.

5.8 Servo motor with an electromagnetic brake

Precautions

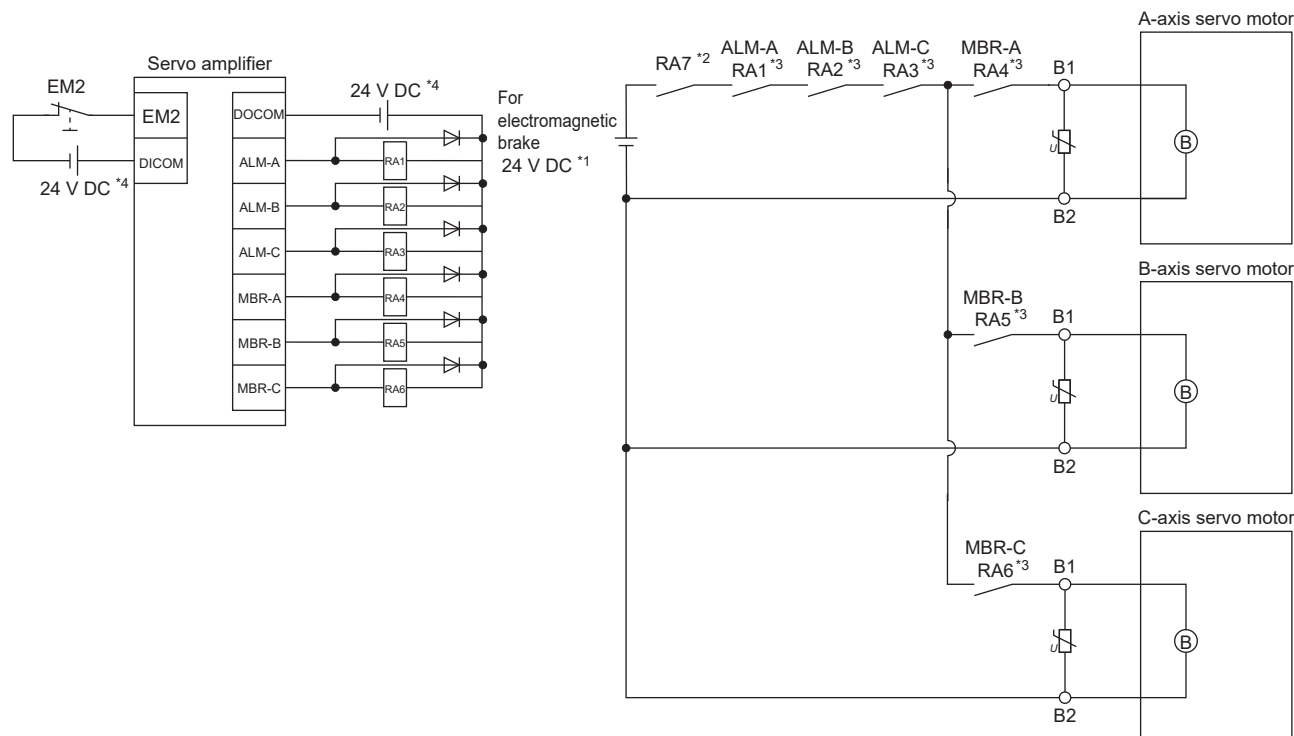
- For specifications such as the power supply capacity and operation delay time of the electromagnetic brake, and for selecting the surge absorber for the electromagnetic brake, refer to "Characteristics of electromagnetic brake" in the following manual.

Rotary Servo Motor User's Manual (For MR-J5)

SERVO MOTOR INSTRUCTION MANUAL (Vol. 3)

- The electromagnetic brake on the servo motor is designed to hold the motor shaft. Do not use it for normal braking.
- Due to incorrect wiring, end of service life, or the mechanical structure (such as when coupled via a timing belt), the electromagnetic brake may be unable to hold the motor shaft. To ensure safety, install a stopper on the machine side.
- If it is assumed that a hazardous situation may arise when the equipment power is off or a product malfunction occurs, use a servo motor with an electromagnetic brake or provide an external brake system for holding purposes to prevent such hazard.
- Configure an electromagnetic brake circuit that works in conjunction with the external emergency stop switch.
- A malfunction of MBR (Electromagnetic brake interlock) or ALM (Malfunction) causes a malfunction of the brake.
- Before operating the servo motor, confirm that the electromagnetic brake operates properly.
- For the power supply of the electromagnetic brake, use a dedicated power supply for the electromagnetic brake.
- When using EM2 (Forced stop 2), use MBR (Electromagnetic brake interlock) for operating the electromagnetic brake.
- When a servo motor with an electromagnetic brake is used, the electromagnetic brake will operate when the power (24 V DC) turns off.
- When using a servo motor with an electromagnetic brake, turn off the servo-on command after the servo motor stops.

Connection diagram



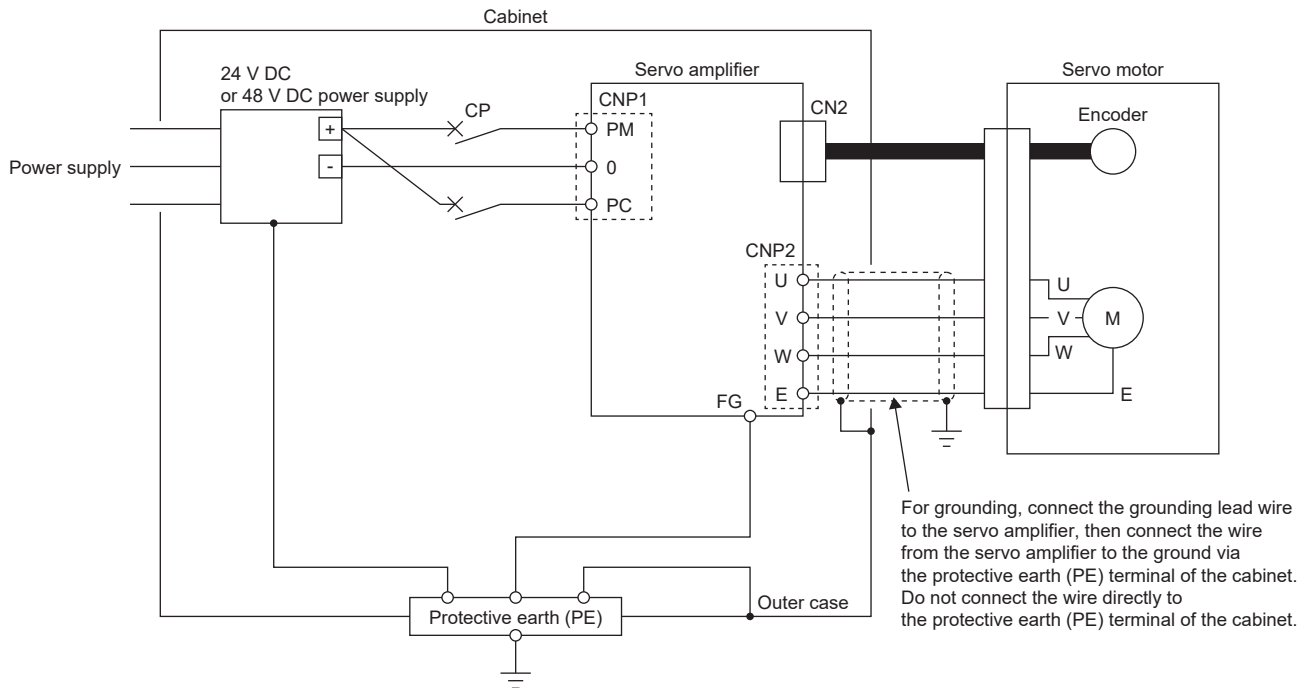
- *1 For the electromagnetic brake, do not use the 24 V DC main circuit power supply/control circuit power supply of the servo amplifier or 24 V DC interface power supply.
- *2 Configure the circuit so that it shuts off in conjunction with the emergency stop switch.
- *3 Malfunction of MBR_ or ALM_ causes a malfunction of the brake.
- *4 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.

5.9 Grounding

The servo amplifier supplies power to the servo motor by switching on and off a power transistor. Depending on the wiring and ground wire 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 perform grounding.

For information on how to comply with the EMC Directive, refer to the following guidelines.

📖 EMC Installation Guidelines



6 STARTUP

Point

- MR-MD333_ servo amplifiers can be set with MR Configurator2 with software version 1.170C or later.
- This chapter explains how to start up the servo amplifier by using MR Configurator2 with software version 1.170C.
- Before starting operation, check each servo parameter. Depending on the machine, an unexpected operation may occur.

Servo parameter setting method

Point

- Servo parameters may be changed by the controller via a network. In this case, take measures such as not turning on the controller or not connecting the network cable to the controller, so that the servo parameter settings are not changed.

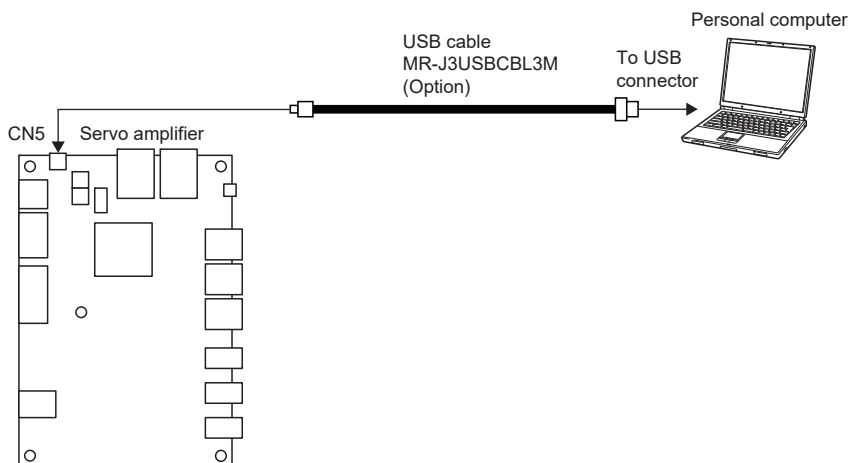
MR Configurator2 is software used for purposes such as servo parameter settings, graph measurement/display, and test operation. This chapter describes the startup procedure of the servo amplifier when it is connected to a personal computer which has MR Configurator2 installed. For details on how to use MR Configurator2, refer to Help in MR Configurator2.

■For USB communication

Point

- Depending on the load on the servo amplifier, the USB communication may be interrupted by operations such as servo parameter settings and drive recorder readout. If the USB communication is interrupted, disconnect and then reconnect the USB cable.

1. Connect the servo amplifier and the personal computer with a USB cable. Turn on the control circuit power supply of the servo amplifier.



2. Start MR Configurator2 and create a new project. For the connection setting, select USB. Select the servo amplifier model.

New Project (Single Axis)

Model: MR-MD333G

Operation mode: [dropdown]

☒ Multi-ax. unification: A Axis

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

☐ Network/controller

☒ The last-used project will be opened whenever the application is restarted

OK Cancel

Switch to Multi-axis Project...

Switch the window by clicking this button when you want to create multi-axis configuration.

3. Select an axis to be connected.

New Project (Single Axis)

Model: MR-MD333G

Operation mode: [dropdown]

☒ Multi-ax. unification: A Axis

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

☐ Network/controller

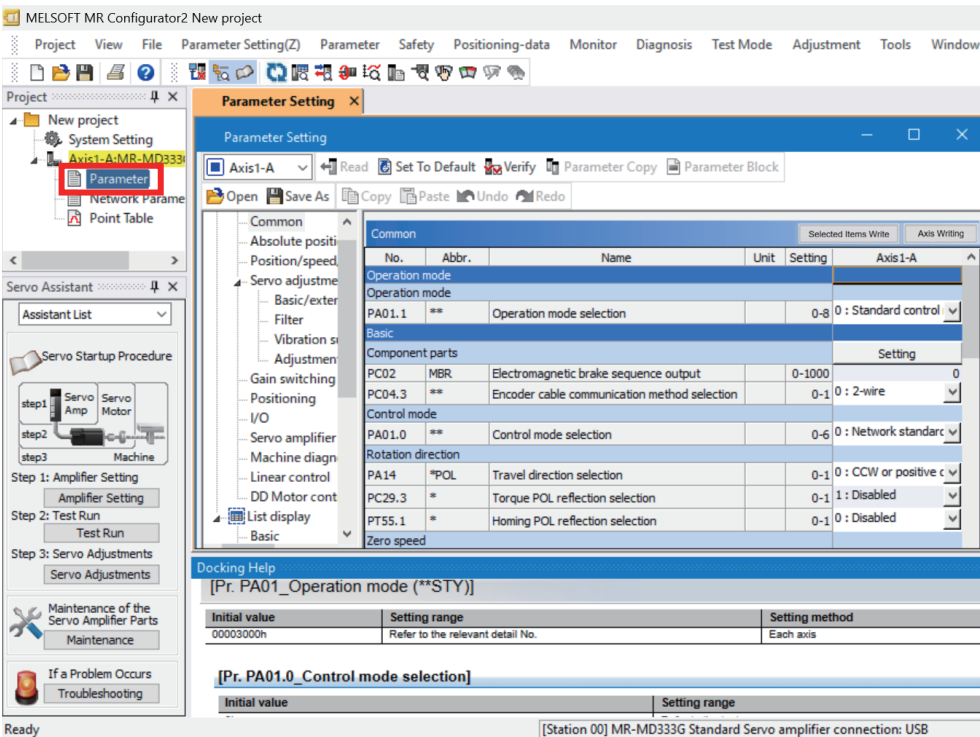
☒ The last-used project will be opened whenever the application is restarted

OK Cancel

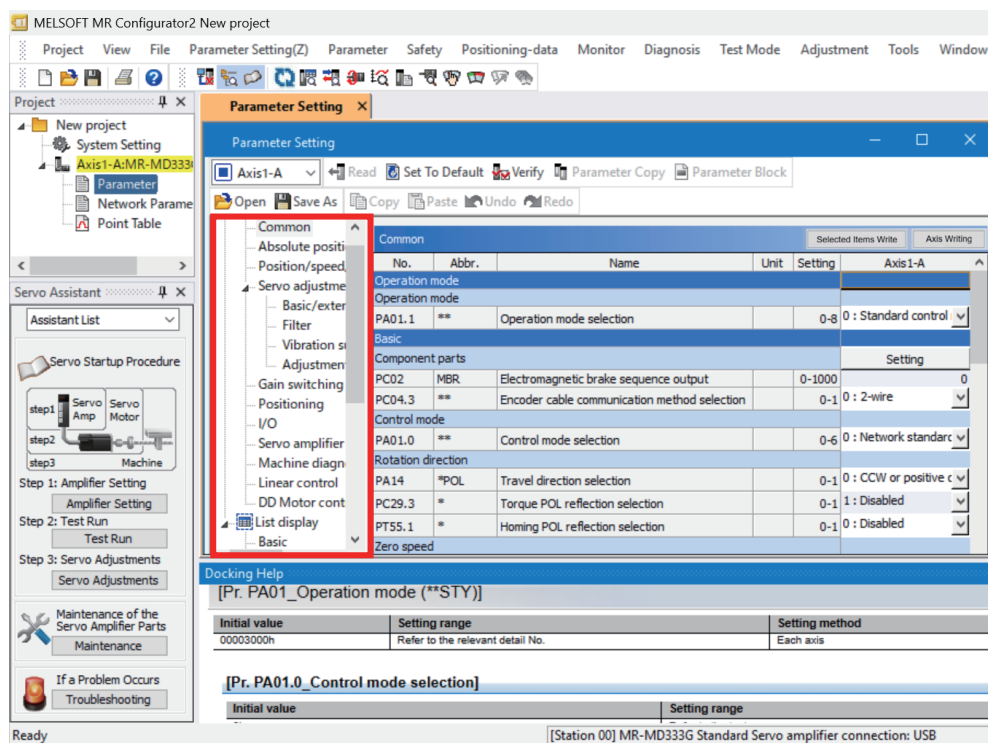
Switch to Multi-axis Project...

Switch the window by clicking this button when you want to create multi-axis configuration.

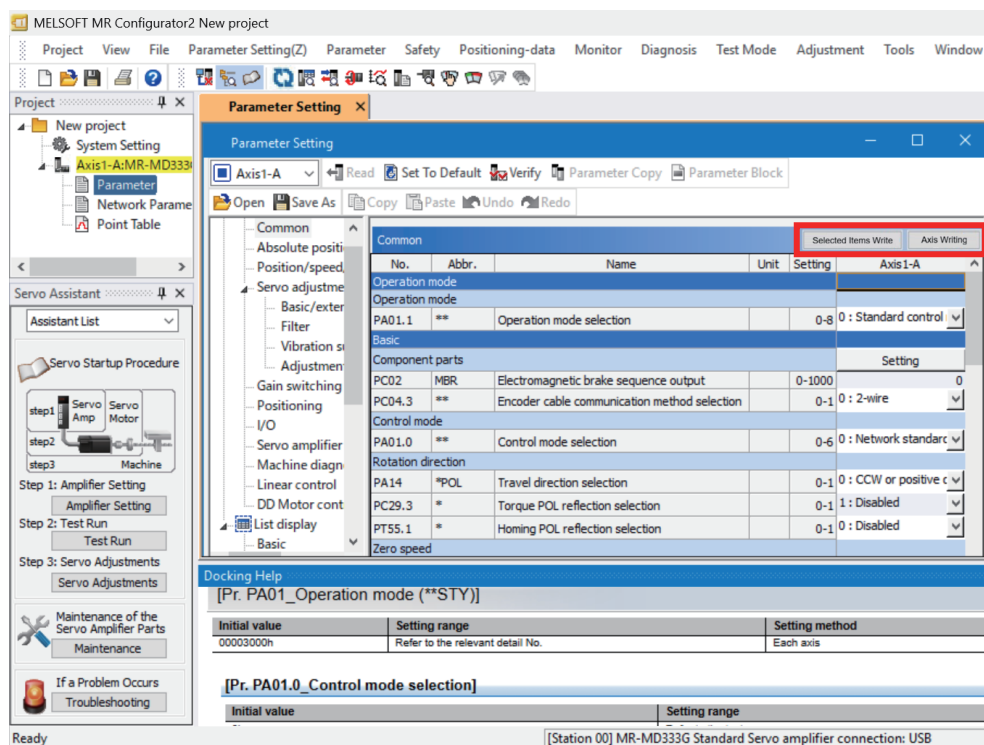
4. Selecting "Parameter" from the project tree opens the "Parameter Setting" window.



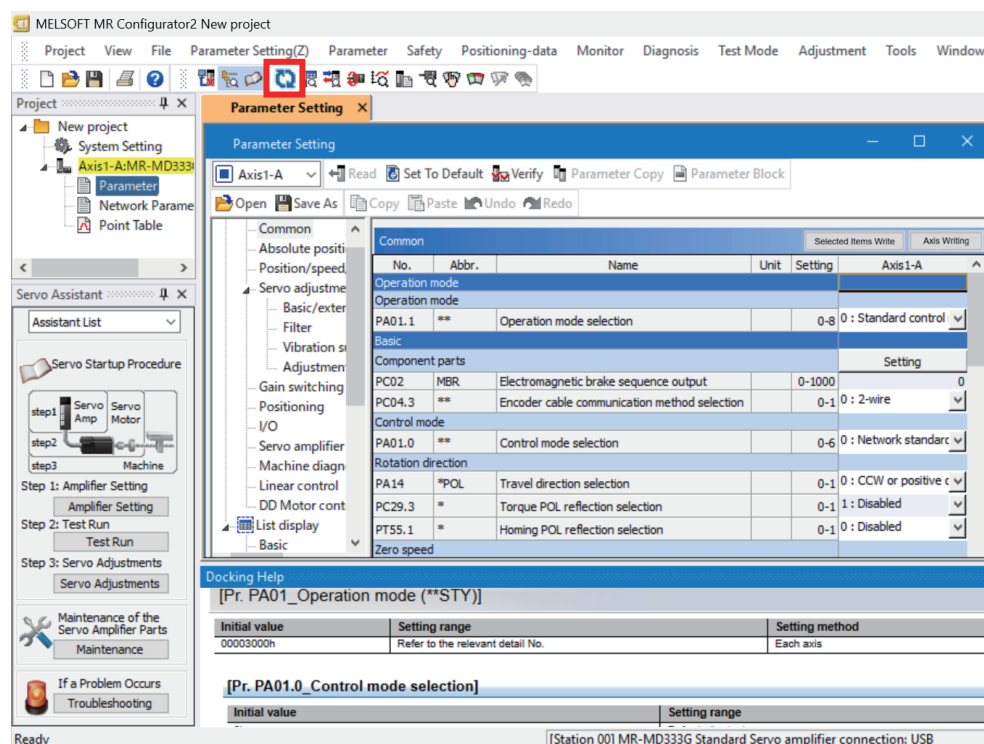
5. Select the group which the servo parameter to be set belongs to in the selection tree of the "Parameter Setting" window.



6. After changing the servo parameter, click "Selected Items Write" or "Axis Writing".



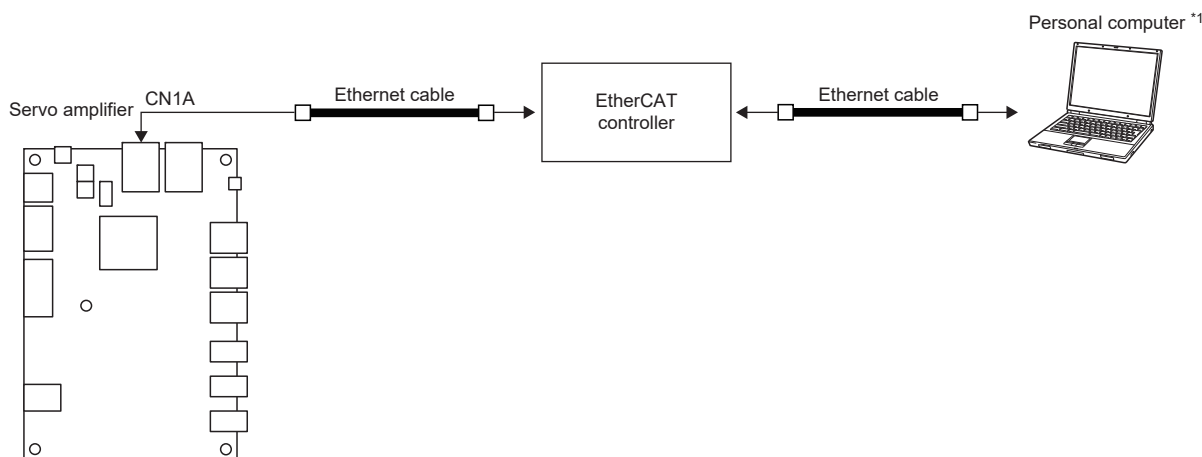
7. Abbreviated servo parameters prefixed with * and servo parameters marked with ** are enabled after the power is cycled or a software reset is performed. Click the software reset button in MR Configurator2 to perform the software reset.



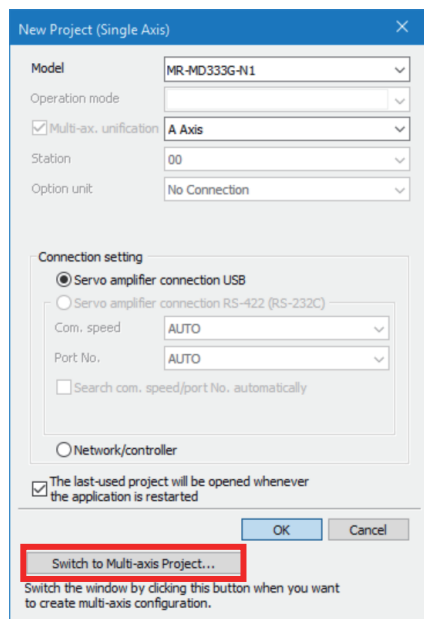
■For EoE communication

EoE communication is available on servo amplifiers with firmware version A8 or later and MR Configurator2 with software version 1.170C or later.

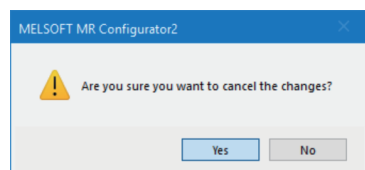
1. Connect the servo amplifier to the EtherCAT controller and the EtherCAT controller to the personal computer using an Ethernet cable between each equipment. Turn on the control circuit power supply of the servo amplifier. Establish the EoE communication between the EtherCAT controller and servo amplifier according to the manual of the EtherCAT controller to be used.



- *1 When using a personal computer as the EtherCAT controller, connect the servo amplifier and the personal computer with an Ethernet cable.
2. Start MR Configurator2 and create a new project. Select the servo amplifier model. Click the "Switch to Multi-axis Project" button.



3. When the message "Are you sure you want to cancel the changes?" appears, click the "Yes" button.



4. Select "EtherCAT" for the connection network. Only "UDP" can be selected for the protocol. Set the time-out and retry as required. Set the servo amplifier and its IP address for the servo amplifier configuration. The axis number can be set as desired.

New Project (Multi-axis)

Connection Network: EtherCAT

Via: None

PC side I/F: Ethernet

Connection I/F: Ethernet

Protocol: UDP

Time-out: 1 s (1-15)

Retry: 0 times (0-3)

Servo Amplifier Configuration

Axis	Model	IP address
1-A	MR-MD333G-N1	192.168.3.1
1-B	MR-MD333G-N1	-
1-C	MR-MD333G-N1	-

* The copied/pasted/deleted data includes not only the model of the servo amplifier but also the set data (servo parameter, etc.).

☒ The last-used project will be opened whenever the application is restarted.

Communication Test OK Cancel

Switch to Single Axis Project (Servo Amplifier Direct Connection)...

For Multi-axis Project, the setting value (like parameter) of servo amplifier is not read. Execute reading from servo amplifier on each corresponding screen.

5. Selecting "Parameter" from the project tree opens the "Parameter Setting" window.

MELSOFT MR Configurator2 New project

Project View File Parameter Setting(Z) Parameter Safety Positioning-data Monitor Diagnosis Test Mode Adjustment Tools Window

Project: New project

System Setting

Axis 1-A: MR-MD333G-N1

Parameter

Network Param

Point Table

Servo Assistant

Assistant List

Servo Startup Procedure

step1 Servo Amp Servo Motor

step2 Machine

Step 1: Amplifier Setting

Amplifier Setting

Step 2: Test Run

Test Run

Step 3: Servo Adjustments

Servo Adjustments

Maintenance of the Servo Amplifier Parts

Maintenance

If a Problem Occurs

Troubleshooting

Parameter Setting

Axis 1-A

Read Set To Default Verify Parameter Copy Parameter Block

Open Save As Copy Paste Undo Redo

No.	Abbr.	Name	Unit	Setting	Axis 1-A
Operation mode					
Operation mode					
PA01.1	**	Operation mode selection		0-8	0 : Standard control
Basic					
Component parts					
PC02	MBR	Electromagnetic brake sequence output		0-1000	0
PC04.3	**	Encoder cable communication method selection		0-1	0 : 2-wire
Control mode					
PA01.0	**	Control mode selection		0-6	0 : Network standard
Rotation direction					
PA14	*POL	Travel direction selection		0-1	0 : CCW or positive c
PC29.3	*	Torque POL reflection selection		0-1	1 : Disabled
PT55.1	*	Homing POL reflection selection		0-1	0 : Disabled
Zero speed					

Docking Help

[Pr. PA01_Operation mode (**STY)]

Initial value	Setting range	Setting method
00003000h	Refer to the relevant detail No.	Each axis

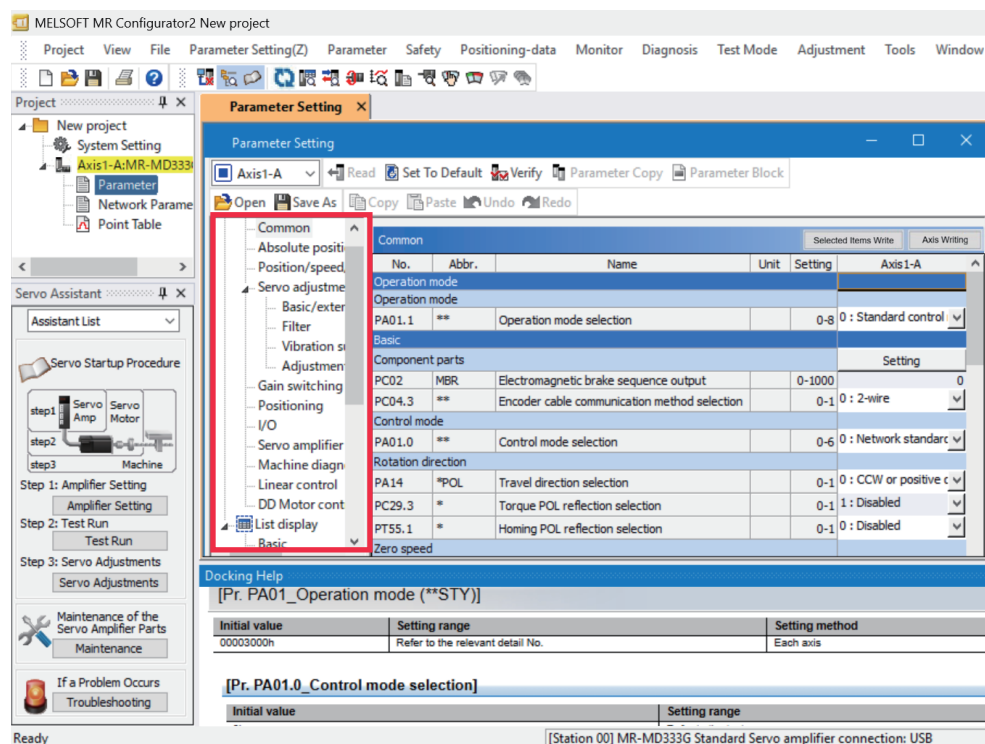
[Pr. PA01.0_Control mode selection]

Initial value	Setting range

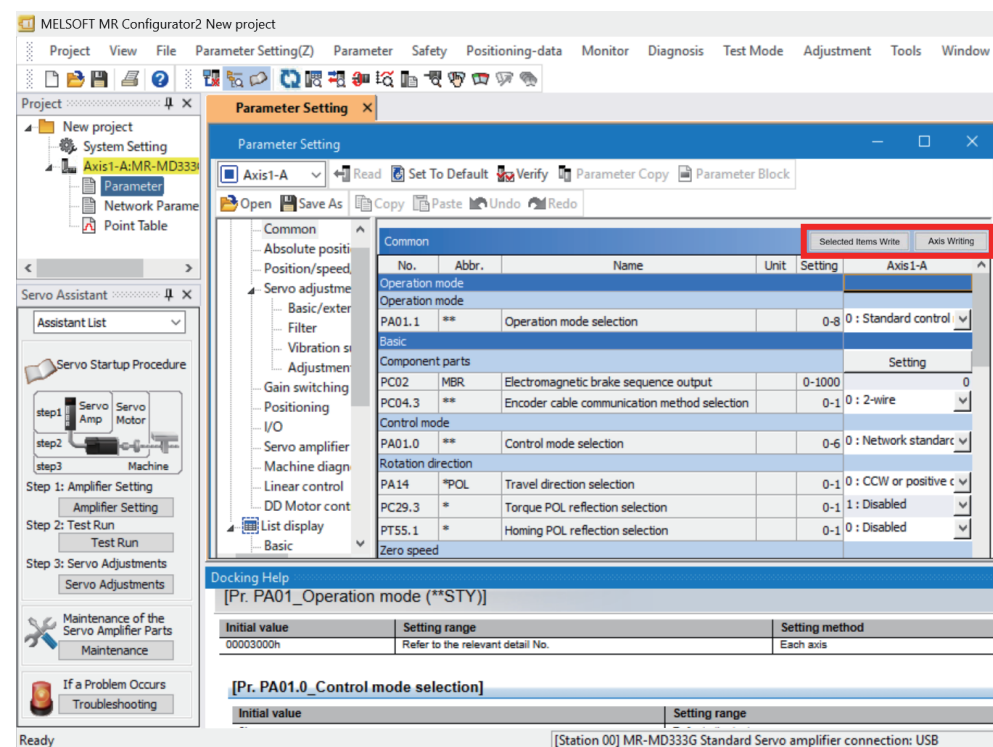
[Station 00] MR-MD333G Standard Servo amplifier connection: USB

Ready

6. Select the group which the servo parameter to be set belongs to in the selection tree of the "Parameter Setting" window.



7. After changing the servo parameter, click "Selected Items Write" or "Axis Writing".



8. Abbreviated servo parameters prefixed with * and servo parameters marked with ** are enabled after the power is cycled or a software reset is performed. Click the software reset button in MR Configurator2 to perform the software reset.

MELSOFT MR Configurator2 New project

Project View File Parameter Setting(Z) Parameter Safety Positioning-data Monitor Diagnosis Test Mode Adjustment Tools Window

Parameter Setting

Axis1-A

Read Set To Default Verify Parameter Copy Parameter Block

Open Save As Copy Paste Undo Redo

Common

No.	Abbr.	Name	Unit	Setting	Axis Writing
Operation mode					
Operation mode					
PA01.1	**	Operation mode selection		0-8	0 : Standard control
Basic					
Component parts					
PC02	MBR	Electromagnetic brake sequence output		0-1000	0
PC04.3	**	Encoder cable communication method selection		0-1	0 : 2-wire
Control mode					
PA01.0	**	Control mode selection		0-6	0 : Network standard
Rotation direction					
PA14	*POL	Travel direction selection		0-1	0 : CCW or positive c
PC29.3	*	Torque POL reflection selection		0-1	1 : Disabled
PT55.1	*	Homing POL reflection selection		0-1	0 : Disabled
Zero speed					

Docking Help

[Pr. PA01_Operation mode (**STY)]

Initial value	Setting range	Setting method
00003000h	Refer to the relevant detail No.	Each axis

[Pr. PA01.0_Control mode selection]

Initial value	Setting range
-	-

Ready

[Station 00] MR-MD333G Standard Servo amplifier connection: USB

6.1 Turning on the servo amplifier for the first time

Point

- For the controller settings, refer to the relevant controller manual.
- For the gain adjustment, refer to the following manual.

IMR-J5 User's Manual (Adjustment)

When turning on the servo amplifier for the first time, follow the steps below.

Step	Description	Reference
1. Installation	Install a servo amplifier.	Page 35 INSTALLATION
2. Connecting the power circuit	Connect the power circuit.	Page 40 Example power circuit connections
3. Connecting I/O signals	Connect I/O signals.	Page 43 Example I/O signal connections
4. Connecting to a servo motor	Connect the servo amplifier to a servo motor.	Page 63 Connecting the servo amplifier and rotary servo motor
5. Connecting options	Connect options.	Page 123 OPTIONS AND PERIPHERAL EQUIPMENT
6. Other precautions	When using an absolute position detection system, perform wiring and settings as necessary.	Page 140 ABSOLUTE POSITION DETECTION SYSTEM
7. Wiring check	Check that the servo amplifier and the servo motor are wired correctly by visually inspecting them or by using a method such as the DO forced output function.	Page 96 Wiring check
8. Checking the surrounding environment	Check the surrounding environment of the servo amplifier and servo motor.	Page 98 Surrounding environment
9. Main circuit power supply voltage setting	When using the main circuit power supply input with 24 V DC, set [Pr. PC81.3 Main circuit power supply selection].	Page 98 Main circuit power supply voltage setting
10. Rechecking the main circuit power supply voltage and wiring	Check that the voltage of the main circuit power supply for the servo amplifier is the voltage set with [Pr. PC81.3 Main circuit power supply selection], and check that the servo amplifier and the servo motor are wired correctly by visually inspecting them or by using a method such as the DO forced output function.	Page 103 Test operation
11. Test operation of the servo motor alone in test operation mode	With the servo motor disconnected from the machine, operate the servo motor at the lowest speed possible, and check whether the servo motor operates correctly.	Page 99 Test operation of the servo motor alone in test operation mode
12. Equipment configuration setting	Set each servo parameter according to the equipment configuration.	Page 100 Equipment configuration setting
13. Controller-related setting	Perform necessary settings according to commands from the controller.	Page 100 Controller-related setting
14. Operation by controller command	Operate the servo motor at the lowest speed possible by giving commands to the servo amplifier from the controller, and check whether the servo motor operates correctly.	Page 101 Operation by controller command
15. Actual operation	—	—

Wiring check

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

Power supply system wiring

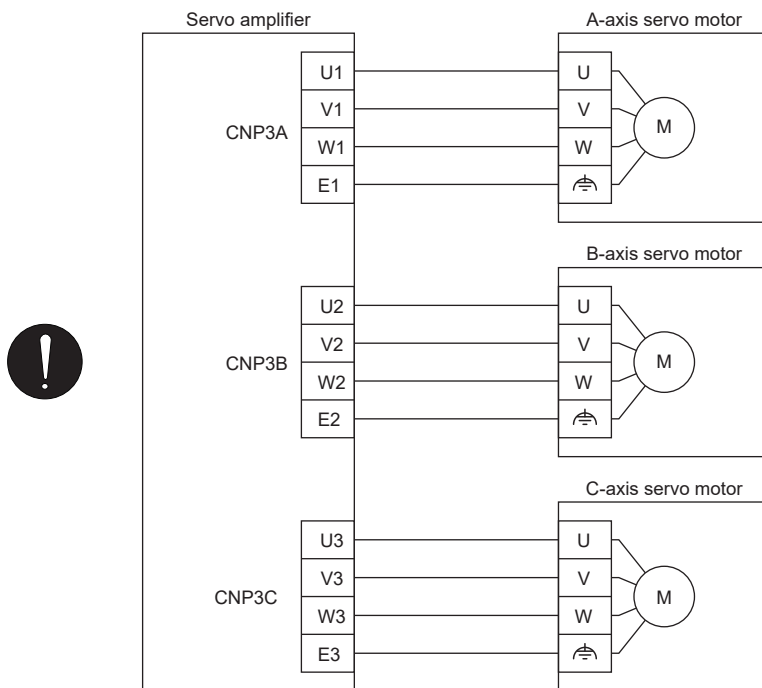
■Power supply system wiring

Check that the power supplied to the power input terminals (PM/PC/0) of the servo amplifier satisfies the defined specifications. For specifications of the power supply, refer to the following.

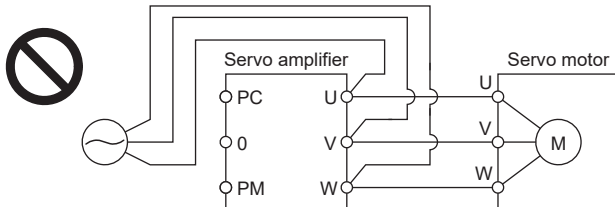
📖 Page 9 Servo amplifier standard specifications

■Connecting the servo amplifier to the servo motor

Check that each connector and servo motors are connected as follows: the CNP3A connector and the A-axis servo motor, the CNP3B connector and the B-axis servo motor, and the CNP3C connector and the C-axis servo motor. Also, check that the phases (U/V/W) of the servo amplifier power outputs and the phases (U/V/W) of the servo motor power inputs match with each other. Check that the grounding terminal of the servo motor is connected to the grounding terminal of the CNP3A/CNP3B/CNP3C connectors.



- Check that the power to be supplied to the servo amplifier is not connected to the power outputs (U/V/W). Otherwise, the servo amplifier and servo motor will malfunction.



- Check that the CN2A/CN2B/CN2C connectors of the servo amplifier are securely connected to the encoder of the servo motor using a motor cable or encoder cable.

I/O signal wiring

- Check that I/O signals are connected correctly.

If the DO forced output mode is used, the pins of the CN3 connector can be forcibly switched on/off. This mode is used to check the wiring. In this case, switch on the control circuit power supply only. For information on connecting I/O signals, refer to the following.

 Page 43 Example I/O signal connections

- Check that a voltage exceeding 24 V DC has not been applied to the pins of the CN3 connector.

Surrounding environment

Check the following items regarding the surrounding environment of the servo amplifier and servo motor.

Cable routing

- Check that the wiring cables have not been subjected to undue force.
- Check that the cables are used within their bending life. For the bending life, contact the manufacturer of the cable used.
- Check that the connector of the servo motor has not been subjected to undue force.

Environment

Check that signal cables and power cables have not been shorted by wire offcuts and metallic dust.

Main circuit power supply voltage setting

For the servo amplifier, set the main circuit power supply selection (48 V DC or 24 V DC). When using 24 V DC, perform the procedure shown in this section. The main circuit power supply selection is set to 48 V DC by default.

Step	Description
1. Turning on the control circuit power supply	Turn on the control circuit power supply to configure the servo amplifier's parameter setting. At this time, do not turn on the main circuit power supply.
2. Setting the main circuit power supply 24 V DC using [Pr. PC81.3]	Change [Pr. PC81.3 Main circuit power supply selection] to "1" (24 V DC selected).
3. Turning off the control circuit power supply	To apply the set parameters, turn off the control circuit power supply once.
4. Turning on the control circuit power supply and checking [Pr. PC81.3]	Turn on the control circuit power supply, and confirm that [Pr. PC81.3 Main circuit power supply selection] has changed to "1" (24 V DC selected) as set. At this time, do not turn on the main circuit power supply.

Test operation of the servo motor alone in test operation mode

Point

- If the servo motor operates in an unintended manner, stop the servo motor with EM2 (Forced stop 2).

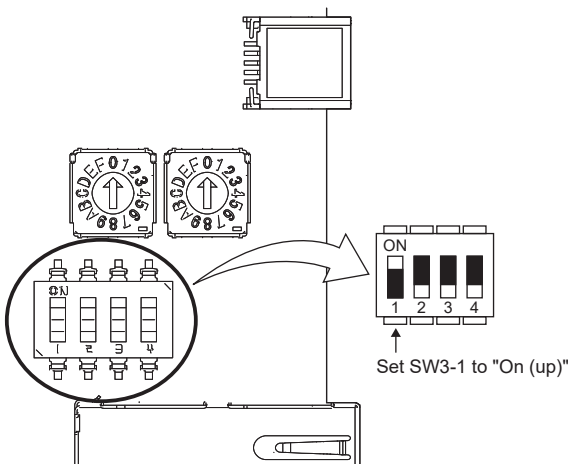
Check that the servo amplifier and servo motor operate normally. With the servo motor disconnected from the machine, use the test operation mode and check whether the servo motor operates correctly. This section describes how to check the servo motor operation in the JOG operation. The test operation also includes the positioning operation and program operation.

☞ Page 103 Test operation

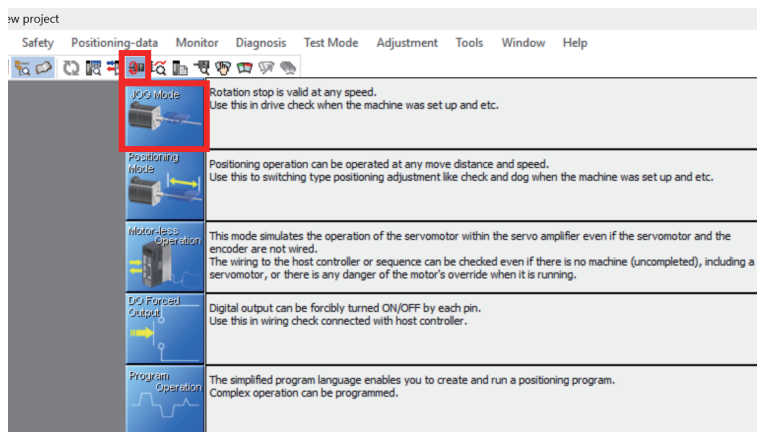
In the linear servo motor control mode, the JOG operation cannot be performed. Check the linear servo motor operation status by using the positioning operation or by other means.

☞ Page 105 Motor driving by test operation

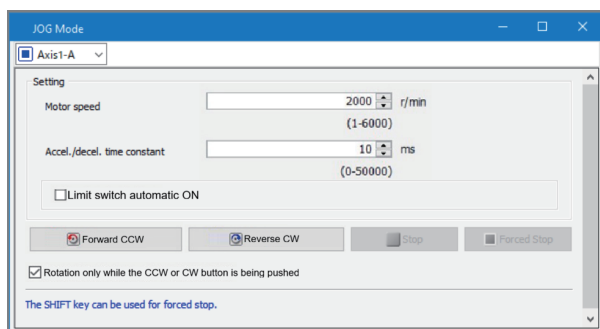
1. Turn off the power.
2. Turn "ON (up)" the test operation select switch (SW3-1).



3. Power on the servo amplifier.
4. Open the "JOG Mode" window of MR Configurator2.



- To operate the servo motor, input the motor speed and acceleration/deceleration time constants, then click "Forward CCW" or "Reverse CW". The servo motor operates only while the button is being clicked. Give a low speed command at first and check the operation status.



- After the test operation is complete, turn off the power and return the test operation select switch (SW3-1) to "OFF (down)".

Equipment configuration setting

Set the servo parameters for each function according to the equipment configuration. For details, refer to the following manual.

MR-J5 User's Manual (Function)

Item	Description
Rotation/travel direction selection	To change the rotation/travel direction (POL), change the servo parameter.
Stroke limit function	Limit switches can be used to limit travel intervals of the servo motor. Configure the settings according to the connection method of the limit switch.
In-position setting	Positioning completion status can be checked with in-position. Set this as necessary.
Forced stop deceleration function	This function stops the servo motor at EM2 (Forced stop 2) off. Configure settings such as the deceleration time constant.
Vertical axis freefall prevention function	For vertical axes, this function pulls up the shaft slightly. When using a servo motor with an electromagnetic brake for a vertical axis, configure settings as required.

Controller-related setting

Refer to either of the following manuals according to the network to be connected.

Servo amplifier	Network	Reference
MR-MD333G	CC-Link IE TSN	Refer to "Startup" in the following manual. MR-J5-G/MR-J5W-G User's Manual (Communication Function)
MR-MD333G-N1	EtherCAT	Refer to "Startup" in the following manual. MR-J5-G-N1/MR-J5W-G-N1 User's Manual (Communication Function)

Set the servo parameters using the controller according to the control mode to be used.

Item	Description	Reference
Network standard mode	This mode operates in the modes such as csp/csv/cst specified in CiA 402.	Refer to "CONTROL MODE" in the following manual. MR-J5 User's Manual (Function)
Positioning mode (point table method)	This mode operates the servo motor according to the setting values by selecting the point table with preset 255 points.	Refer to "POSITIONING MODE (POINT TABLE METHOD) (CP)" in the following manual. MR-J5 User's Manual (Function)

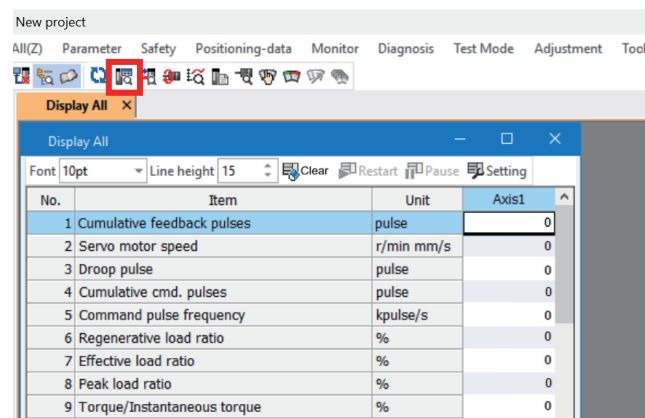
Set each servo parameter that is necessary for the operation using controller commands.

Item	Description	Reference
Command unit selection function	This function allows you to select the unit of speed command. The initial setting for the unit of speed command is pulses/s.	Refer to "Command unit select function" in the following manual. MR-J5 User's Manual (Function)
Electronic gear setting	Configure the settings related to the controller command unit and amplifier command unit.	Refer to "Electronic gear function" in the following manual. MR-J5 User's Manual (Function)
Homing	To perform homing with the function of the amplifier without using the homing function of the controller, configure the necessary settings.	Refer to "CONTROL MODE" in the following manual. MR-J5 User's Manual (Function)

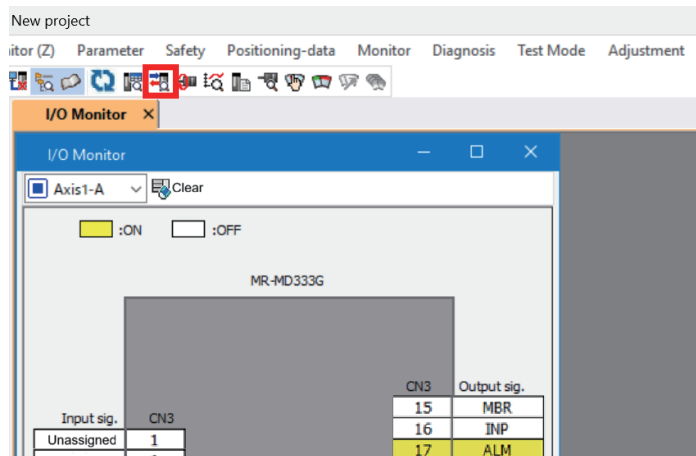
Operation by controller command

Confirm that the servo motor operates correctly under the commands from the controller. Give a low speed command at first to check the servo motor operations such as the rotation direction. If the servo motor does not operate in the intended direction, check the input signal.

1. Display the "Display All" window in MR Configurator2. Confirm that there is no error in the items such as servo motor speed and load ratio.



2. Display the "I/O Monitor" window. Confirm that there is no error in the I/O signals.



6.2 Precautions for startup

Precautions for power-on

- If an absolute position detection system with a rotary servo motor is used, [AL. 025 Absolute position erased] occurs when the power is turned on for the first time, and the servo motor cannot be changed to servo-on state. Cycle the power once to deactivate the alarm.
- If the power is turned on while the servo motor is being rotated by an external force, an alarm may occur. Make sure that the servo motor is not rotating before turning on the power. In addition, refer to the manual for the servo motor or encoder used.

Stop

If any of the following situations occur, the servo amplifier suspends and stops the operation of the servo motor. If the servo motor is operated by the network command, the servo motor may be stopped by the controller command.

Operation/command	Stop status
Alarm occurrence	The servo motor decelerates to a stop. There are also alarms that activate and stop the dynamic brake. For details of alarms, refer to the following manual.  MR-J5 User's Manual (Troubleshooting)
EM2 (Forced stop 2) off	The servo motor decelerates to a stop. [AL. 0E6 Servo forced stop warning] occurs. In the torque mode, EM2 functions the same as EM1.
Limit switch off	If LSP (Forward rotation stroke end), LSN (Reverse rotation stroke end), FLS (Upper stroke limit), or RLS (Lower stroke limit) is turned off, the servo motor will stop slowly and enters the servo-lock state. Operation in the opposite direction is possible.

Precautions for network disconnection

To turn off the system power and disconnect the servo amplifier from the network, specific procedures may be required. For details, refer to "Disconnecting the communication" in the following manual.

 MR-J5-G/MR-J5W-G User's Manual (Communication Function)

 MR-J5-G-N1/MR-J5W-G-N1 User's Manual (Communication Function)

6.3 Troubleshooting at startup

Investigation by using MR Configurator2

The reason why the servo motor does not rotate can be investigated via MR Configurator2.

The cause why the servo motor fails to rotate is acquired from the servo amplifier of the target axis, and displayed in the "No Motor Rotation" window.

The window will remain blank when no cause exists. "- - -" is displayed when off-line or the cause cannot be acquired.

6.4 Copying settings

The set parameters can be copied from a servo amplifier to another servo amplifier. Use this function when replacing a servo amplifier in operating equipment with another servo amplifier, or when starting up multiple pieces of equipment with the same configuration.

Restrictions

■The following data is not duplicated. Set them as required after the duplication.

Item	Description
Homing	The information about the home position is not duplicated. Execute homing again.
Machine service life diagnosis	Machine service life diagnosis information may not be duplicated. Refer to "Machine diagnosis" in the following manual, and perform required settings.  MR-J5 User's Manual (Function)

■The following data is not duplicated.

- Alarm history data
- Drive recorder data

Duplication using MR Configurator2

1. The data set in MR Configurator2 can be saved as a project.
2. To copy the project to a different servo amplifier, open the project and then connect the servo amplifier and a personal computer via a USB cable. Turn on the control circuit power supply of the servo amplifier.
3. Write the required data in MR Configurator2. After the writing is completed, cycle the power or reset the software as necessary.

6.5 Test operation

Using the test operation function enables the machine operation to be checked before the actual operation. With a personal computer and MR Configurator2, operations such as the JOG operation, positioning operation, output signal forced output, and program operation can be performed.

Precautions

- The test operation mode is designed for checking servo operation. This mode is not for checking machine operation. Do not use this mode with the machine. Use this mode only with the servo motor.

Execution method

Test operation mode is enabled by MR Configurator2. To set to the normal operation mode again after executing the test operation mode, cycle the power or reset the software.

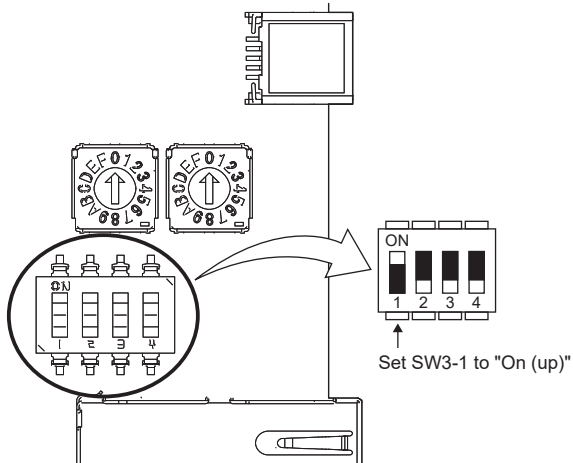
- Perform the test operation after the forced stop has been released. For details of the forced stop, refer to "Forced stop deceleration function" in the following manual.

 MR-J5 User's Manual (Function)

Test operation mode

Setting the servo amplifier to the test operation mode enables the test operation while the personal computer and servo amplifier are connected via a USB cable.

1. Turn off the power.
2. Turn "ON (up)" the test operation select switch (SW3-1).

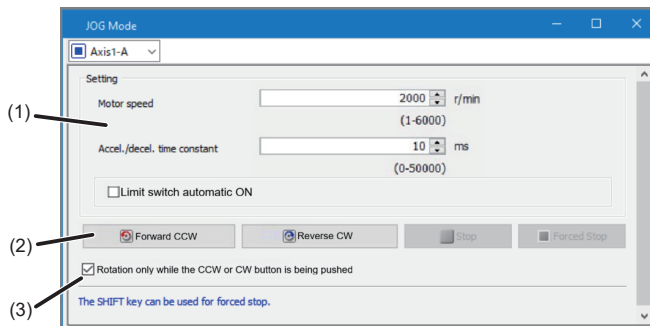


3. Power on the servo amplifier.
4. Use MR Configurator2 to perform the test operation.
➡ Page 105 Motor driving by test operation
5. After the test operation is complete, turn off the power and return the test operation select switch (SW3-1) to "OFF (down)".

Motor driving by test operation

JOG operation

The JOG operation can be performed when there is no command from the controller. The motor can be operated at a specified speed. Operate the motor using the "JOG Mode" window of MR Configurator2.



■Motor operation setting (1)

Set the motor speed and acceleration/deceleration time constants for JOG operation. When changing the speed to the permissible speed, set the speed with [Pr. PA28.4 Speed range limit selection].

■Limit switch automatic ON (2)

The JOG operation can be performed when the limit switch is not connected. Exercise caution to avoid a collision while performing the operation.

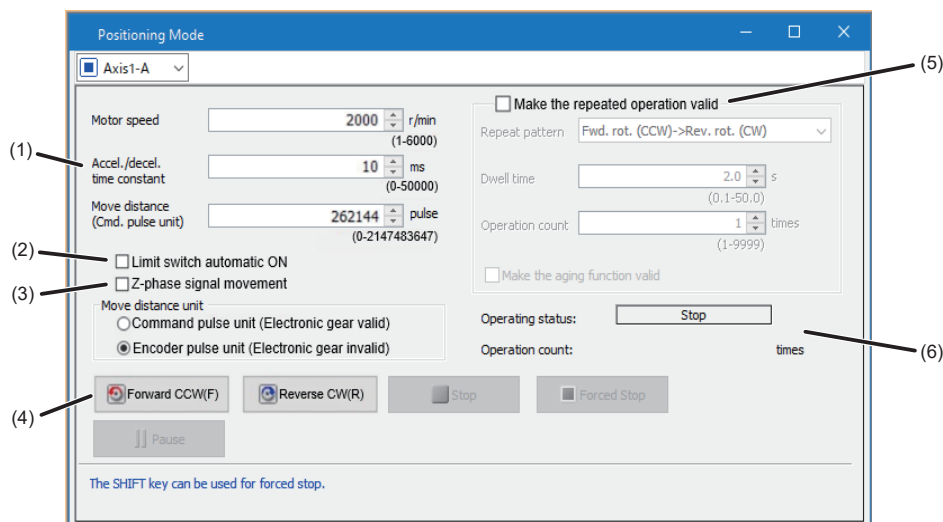
■Operation (3)

The servo motor can be started, paused, stopped, or forcibly stopped. Clicking "Forward CCW" or "Reverse CW" starts the operation.

When "Rotation only while the CCW or CW button is being pushed" is not selected, clicking "Forward CCW" or "Reverse CW" will perform operation until "Stop" or "Forced Stop" is clicked.

Positioning operation

Positioning operation can be performed without the controller. Operate the motor using the "Positioning Mode" window of MR Configurator2.



■Motor operation setting (1)

Set the motor speed, acceleration/deceleration time constants, and travel distance in the positioning operation mode. When changing the speed to the permissible speed, set the speed with [Pr. PA28.4 Speed range limit selection].

■Limit switch (2)

Select "Limit switch automatic ON" to perform the positioning operation when the limit switch is not connected. Exercise caution to avoid a collision while performing the operation.

■Move until Z-phase signal (3)

When "Z-phase signal movement" is selected, the servo motor moves until the first Z-phase signal after positioning operation.

■Operation (4)

The servo motor can be started, paused, stopped, or forcibly stopped. Clicking "Operation Start" starts the operation in the specified operation condition.

■Repeat operation (5)

Selecting "Make the repeated operation valid" enables the repeat operation. Selecting "Make the aging function valid" enables the continuous operation until "Stop" or "Forced Stop" is clicked. Set the repeat pattern, the dwell time, and the number of operations.

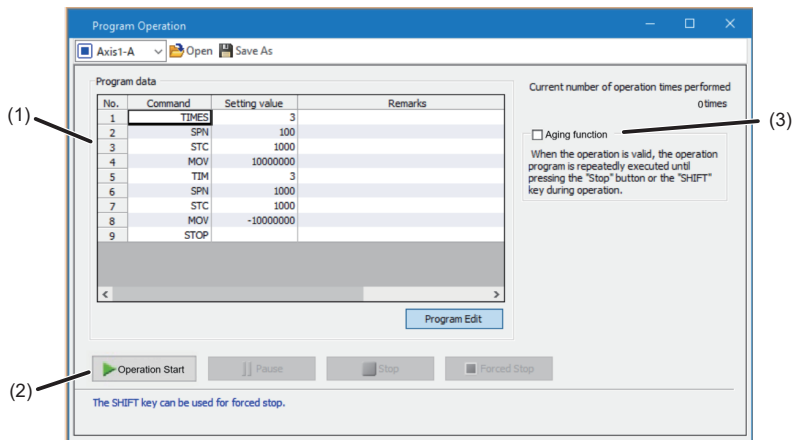
■Operation status (6)

The operation status during the repeat operation and the number of operations are displayed.

Program operation

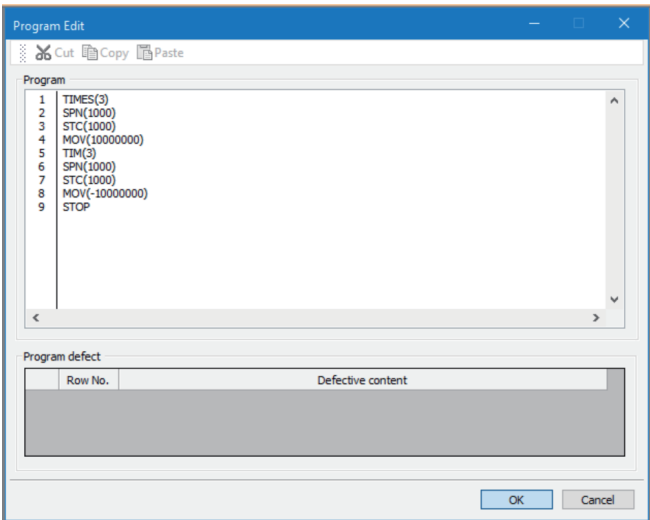
The positioning operation using multiple operation patterns can be performed without a controller. Operate the motor using the "Program Operation" window of MR Configurator2. For details, refer to Help of MR Configurator2.

- Open the "Program Operation" window of MR Configurator2.



No.	Item	Screen operation
(1)	Program display	Displays the program. To edit the display item, click "Program Edit".
(2)	Operation	The servo motor can be started, paused, stopped, or forcibly stopped. Clicking "Operation Start" starts the operation.
(3)	Repeat execution	Displays the number of execution times. Selecting "Aging function" enables the repeated operation of the operation program.

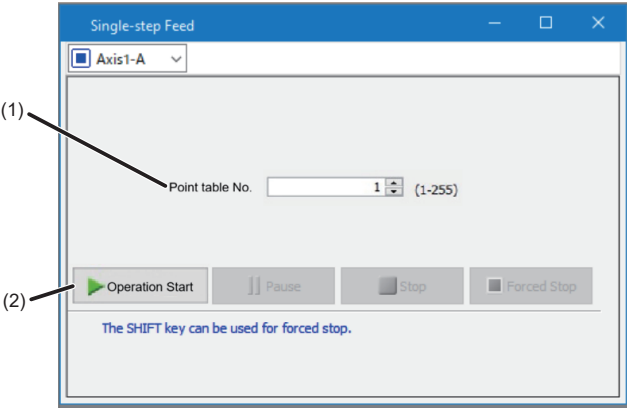
- Clicking "Program Edit" in the "Program Operation" window opens the "Program Edit" window. Input the program and click "OK". For program commands, refer to Help of MR Configurator2.



Single-step feed

This function enables test operation in accordance with the point table. Configure the settings of the point table operation in advance. For the point table operation, refer to "POSITIONING MODE (POINT TABLE METHOD) (CP)" in the following manual.

MR-J5 User's Manual (Function)



No.	Item	Screen operation
(1)	Point table No.	Specify the point table number to be operated.
(2)	Operation	The servo motor can be started, paused, stopped, or forcibly stopped. Clicking "Operation Start" starts the operation in accordance with the point table.

Motor-less operation

Point

- The motor-less operation cannot be used in the linear servo motor control mode or direct drive motor control mode.

Without connecting a servo motor to the servo amplifier, output signals or status displays can be provided in response to the controller commands as if the servo motor is actually running. This operation can be used to check the sequence of a controller. Use this operation after the forced stop has been released. Use this operation with the servo amplifier connected to the controller.

To perform the motor-less operation, set [Pr. PC05.0 Motor-less operation selection] to "1" (enabled). To terminate the motor-less operation, set [Pr. PC05.0] to "0" (disabled).

To apply the motor-less operation settings, cycle the power or reset the software.

Load conditions

The operation is performed in the following conditions. Note that the conditions may differ from those of actual machines.

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

6

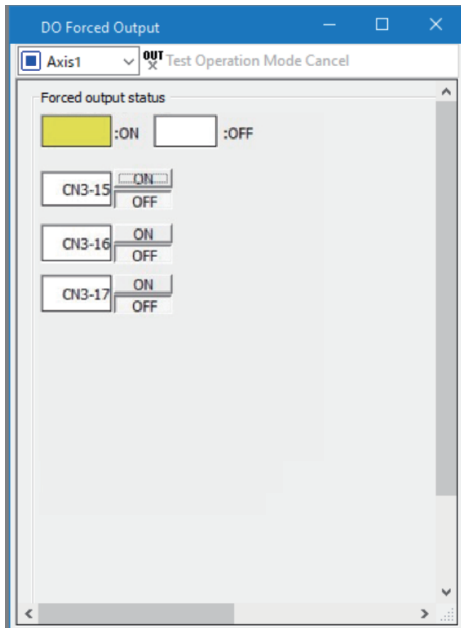
Alarm

In the motor-less operation, some alarms and warnings are not generated. The following are examples of alarms which do not occur.

- [AL. 016 Encoder initial communication error 1]
- [AL. 01E Encoder initial communication error 2]
- [AL. 01F Encoder initial communication error 3]
- [AL. 020 Encoder normal communication error 1]
- [AL. 021 Encoder normal communication error 2]
- [AL. 025 Absolute position erased]
- [AL. 092 Battery cable disconnection warning]
- [AL. 09F Battery warning]

Output signal (DO) forced output

This function forcibly switches the output signals on and off regardless of the servo status. Use this function for purposes such as checking output signal wiring. Operate this function on the "DO Forced Output" window of MR Configurator2.



Each output signal can be turned on/off by clicking the ON/OFF button next to its name. After checking, click "Test Operation Mode Cancel" and terminate the output signal (DO) forced output.

6.6 Servo amplifier setting initialization

Servo amplifier settings can be initialized by using the engineering software (MR Mode Change packed with MR Configurator2).

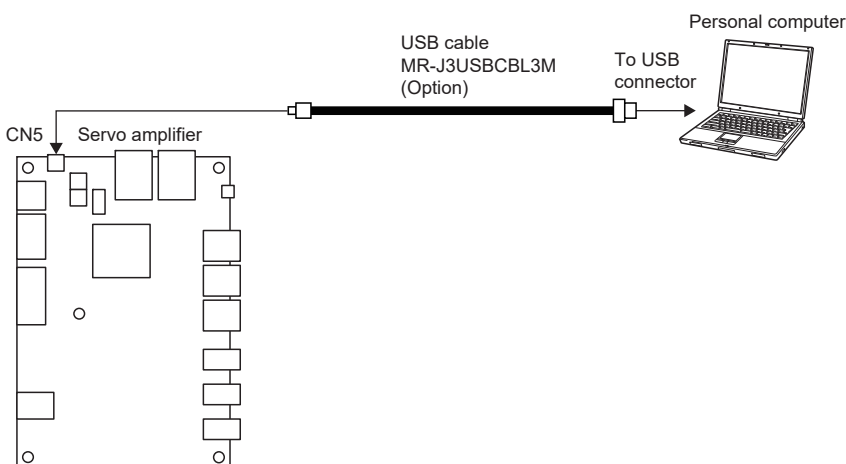
However, information related to the servo amplifier including power-on cumulative time is not initialized.

Point

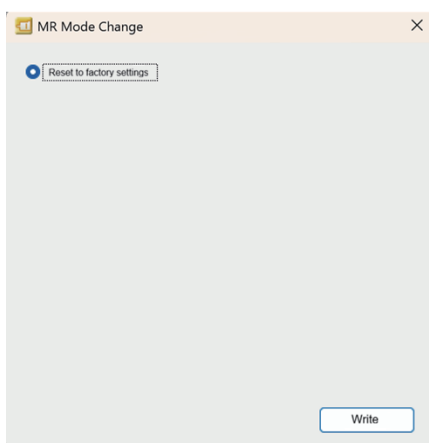
- The memory area of the servo amplifier has a limited service life. Do not use this function frequently.
- Execute the initialization with the servo amplifier disconnected from the network and directly connected to MR Mode Change via a USB cable.

Initialization procedure by MR Mode Change

Open MR Mode Change and use a USB cable to connect the servo amplifier that will be initialized to a personal computer. Turn on the control circuit power supply of the servo amplifier.



Confirm that "Reset to factory settings" is selected, then click "Write". After the writing is completed, cycle the power or reset the software.



Cycling the power or resetting the software initializes the setting of the servo amplifier at startup. Confirm that the initialization has been completed by reading the settings from the servo amplifier.

7 MAINTENANCE AND INSPECTION

7.1 Inspection item

Precautions

- Do not disassemble, repair, or modify the product.
- To prevent a malfunction, do not perform an insulation resistance test (megger test) on the servo amplifier.

Periodic inspection

Perform the following inspections.

- Check the cables for scratches or cracks. Inspect them periodically according to operating conditions, especially when the servo motor is movable.
- Check that connectors are securely connected to the servo amplifier.
- Check that no wires are coming out from the connectors.
- Check for dust accumulation on the servo amplifier.
- Check for unusual noise generated from the servo amplifier.
- Make sure that the emergency stop circuit operates properly such that the operation can be stopped immediately and power is shut off by the emergency stop switch.

7.2 Consumable parts

This section describes the service life of parts. The service life varies depending on the operating methods and environment. If any fault is found in a part, it is necessary to replace it immediately regardless of its service life.

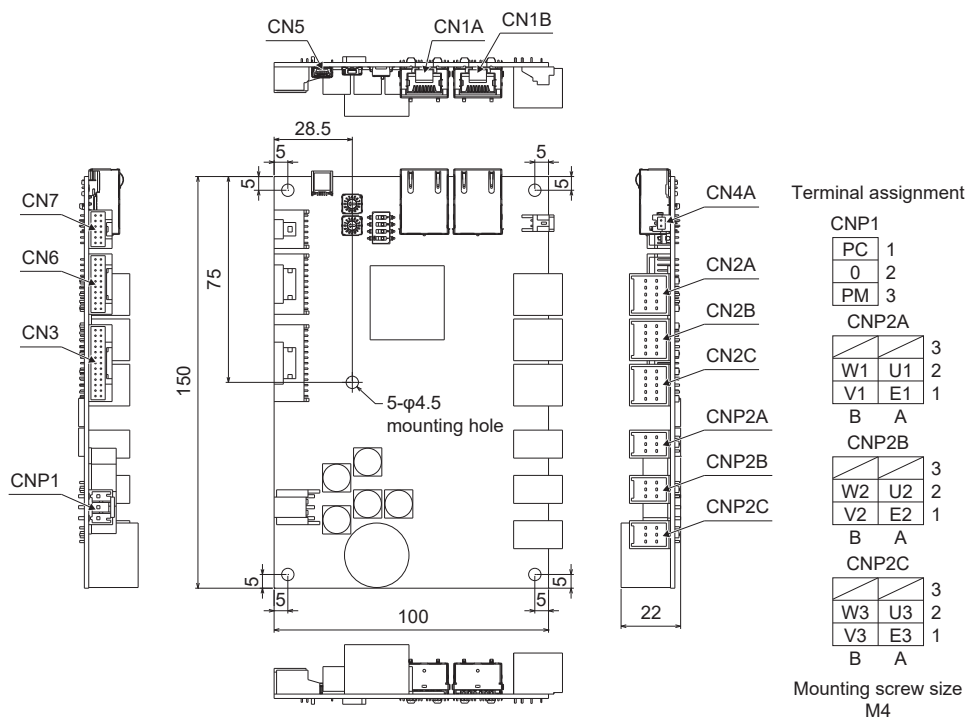
Part name	Guideline of life
Smoothing capacitor	10 years
Absolute position battery	Refer to the following.  Page 140 ABSOLUTE POSITION DETECTION SYSTEM

Smoothing capacitor

The capacitor will reach the end of its service life in 10 years of continuous operation in an air-conditioned environment (with an ambient temperature of 40°C or less at altitudes of 1000 m or less). Ripple currents or other factors will deteriorate the characteristics of the smoothing capacitor. The service life of the capacitor greatly varies depending on ambient temperature and operating conditions.

8 DIMENSIONS

[Unit: mm]



9 CHARACTERISTICS

9.1 Overload protection characteristics

Overview

An electronic thermal is built in the servo amplifier to protect the servo motor, servo amplifier, and servo motor power cables from overloads. In this section, overload protection characteristics refer to the overload protection characteristics of servo amplifiers and servo motors.

Operation exceeding the overload protection characteristics described in this section will cause [AL. 050 Overload 1] or [AL. 051 Overload 2]. Use the equipment within the overload protection level indicated on the left side of the continuous or dotted lines in the following graphs.

For machines where unbalanced torque occurs, such as a vertical axis system, the unbalanced torque should be kept at 70% or lower of the rated torque.

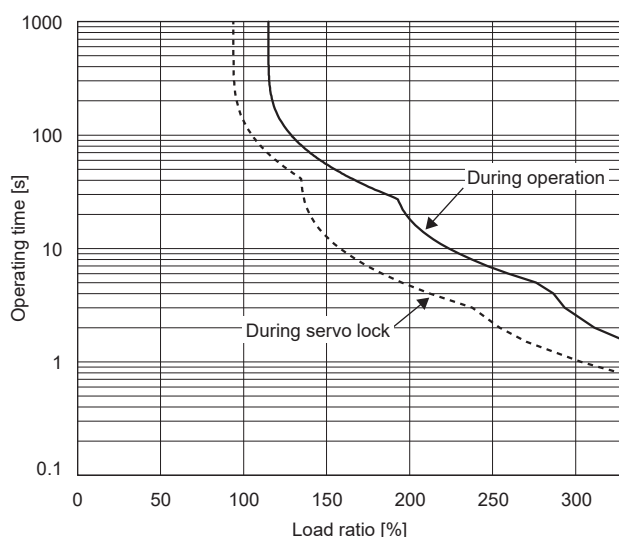
This servo amplifier has a servo motor overload protection function. (The servo motor overload current is set on based on 120% of the rated current (full load current).)

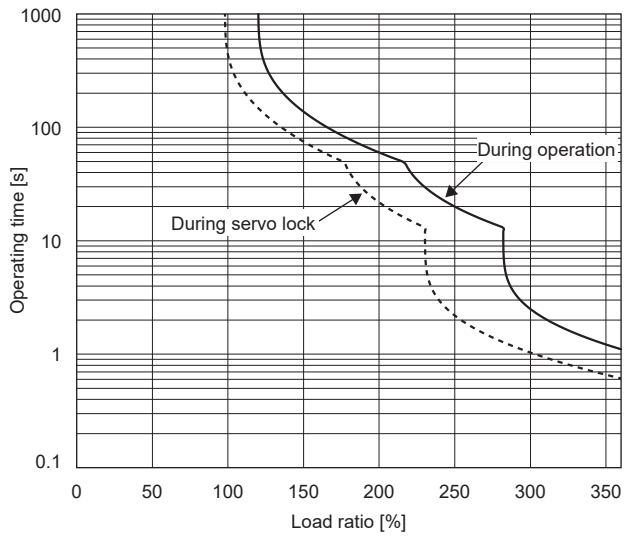
The servo amplifier may malfunction regardless of the electronic thermal protection if torque exceeding 100% of the rated torque is generated too frequently while the servo motor is stopped (servo-lock status) or being operated at low speeds of 50 r/min or less.

Graph of overload protection characteristics

The following shows servo motors and corresponding graphs of overload protection characteristics. The overload protection characteristics depend on the servo motor.

■HK-KT0536E2-S1



■HG-AK0136/HG-AK0236/HG-AK0336

9.2 Power supply capacity and generated loss

Calculate the generated losses under rated load and the main circuit power supply capacities of servo amplifiers according to this section. The obtained values vary depending on the number and capacities of servo motors to be connected. For the thermal design of an enclosed type cabinet, use the values calculated by taking into consideration the worst operating conditions including environments and operation patterns. The actual amount of generated heat depends on the frequency of operation and will be between the "At rated output" and "At servo-off" values. The values in the table are for operating the servo motor at the rated speed. When the servo motor is operated at a speed less than the rated speed in an operation where the axes do not move simultaneously, the main circuit power supply capacity is smaller than the value shown in the table.

Method for calculating main circuit power supply capacity

Calculate the power supply capacity for one servo amplifier from the following tables.

- Power supply capacity for one servo amplifier at rated output

Servo amplifier	Main circuit power supply capacity [W]	
	In normal state	At peak
MR-MD333G_	Total power supply capacity of connected servo motors	Three times the power supply capacity in the normal state

- Power supply capacity of the servo amplifier when one servo motor is operated at rated output

Servo motor	Main circuit power supply capacity [W]
HK-KT0536E2-S1	145
HG-AK0136	35
HG-AK0236	55
HG-AK0336	80

The following shows a calculation example for the main circuit power supply capacity.

Main circuit power supply capacity [W] = Total power supply capacity of connected servo motors

Ex.

When the MR-MD333G_ servo amplifier is operated with one HG-AK0136 and two HG-AK0336 servo motors connected, the power supply capacity of each servo motor is as follows:

HG-AK0136 = 35 [W]

HG-AK0336 = 80 [W]

Main circuit power supply capacity [W] = 35 + 80 + 80 = 195 [W]

Method for calculating heat generated by the servo amplifier

Calculate the heat generated by a single servo amplifier from the following tables.

- Heat generated by a single servo amplifier at rated output

Servo amplifier	Servo amplifier-generated heat [W] ^{*1}	
	At rated output	At servo-off
MR-MD333G_	The value obtained by adding the heat generated by the servo amplifier in the servo-off state to the sum of heat generated by the servo amplifier for each servo motor connected	8

^{*1} The heat generated by the servo amplifier do not take into account the heat generated during regeneration.

- Heat generated by the servo amplifier when one servo motor is operated at rated output

Servo motor	Servo amplifier-generated heat [W]
HK-KT0536E2-S1	14
HG-AK0136	2
HG-AK0236	4
HG-AK0336	7

The following shows a calculation example for heat generated by the servo amplifier.

Ex.

Heat generated by the servo amplifier at rated output [W] = Sum of heat generated by the servo amplifier + Heat generated at servo-off

When the MR-MD333G_ servo amplifier is operated with one HG-AK0136 and two HG-AK0336 servo motors connected, the heat generated by the servo amplifier for each servo motor is as follows:

HG-AK0136 = 2 [W]

HG-AK0336 = 7 [W]

Heat generated by the servo amplifier at servo-off = 8 [W]

Heat generated by the servo amplifier at rated output [W] = (2 + 7 + 7) + 8 = 24 [W]

9.3 Dynamic brake characteristics

Point

- The dynamic brake of the MR-MD333G_ servo amplifier is an electric dynamic brake.
- The dynamic brake is a function for emergency stop and should not be used to stop normal operations.
- When using EM1 (Forced stop 1) frequently in non-emergency situations, enable EM1 (Forced stop 1) after the servo motor has stopped completely.
- The time constant "τ" for the electronic dynamic brake will be shorter than that of the normal dynamic brake. Therefore, the coasting distance will be shorter than that of a normal dynamic brake. For how to set the electronic dynamic brake, refer to [Pr. PF06] and [Pr. PF12] in the following manual.

MR-J5-G/MR-J5W-G User's Manual (Parameters)

Precautions on dynamic brake characteristics

The electronic dynamic brake is set to operate in the initial state for the following servo motors.

Series	Servo motor
HK-KT	HK-KT0536E2-S1
HG-AK	HG-AK0136/HG-AK0236/HG-AK0336

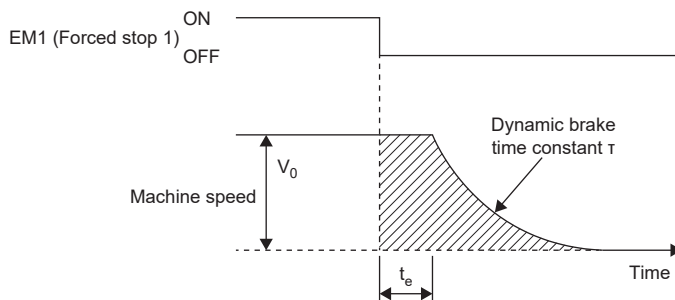
Dynamic brake operation

Calculation of coasting distance

The following figure shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use the equation (10.2) to calculate the approximate coasting distance to a stop. The dynamic brake time constant "τ" varies depending on the servo motor model and its operation speed.

Page 121 Dynamic brake time constant

A working part typically has a friction force. Therefore, the actual coasting distance will be shorter than the maximum coasting distance calculated with the following equation.



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

$L_{\max}$: Maximum coasting distance [mm]

V_0 : Machine's fast feed speed [mm/min]

J_M : Moment of inertia of the servo motor [$\times 10^{-4}$ kg·m²]

J_L : Load moment of inertia converted into equivalent value on servo motor shaft [$\times 10^{-4}$ kg·m²]

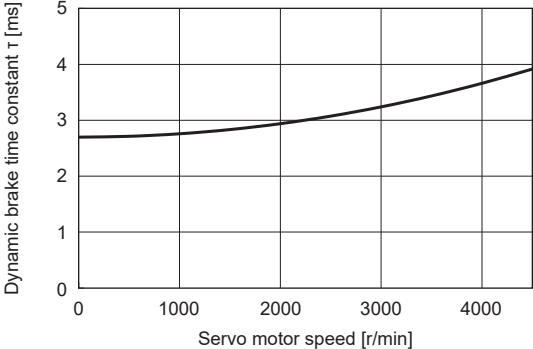
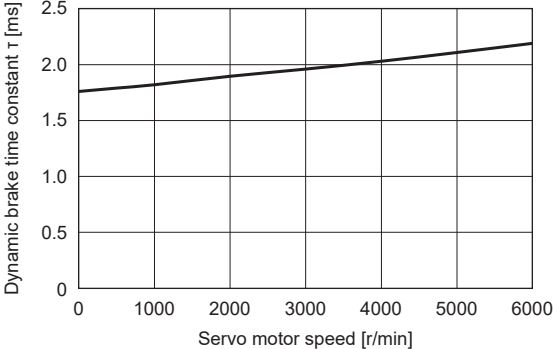
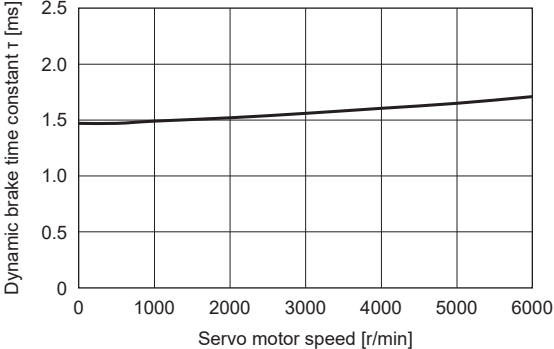
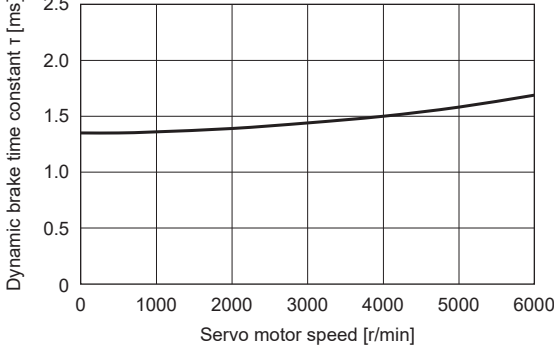
τ : Dynamic brake time constant [s]

t_e : Delay time of control section [s]

There is an approximately 10 ms process delay.

Dynamic brake time constant

The following shows dynamic brake time constant "τ" that is necessary to calculate the equation (10.2).

Servo motor	Waveform																
HK-KT0536E2-S1	 <table border="1"><caption>Approximate data for HK-KT0536E2-S1</caption><thead><tr><th>Servo motor speed [r/min]</th><th>Dynamic brake time constant τ [ms]</th></tr></thead><tbody><tr><td>0</td><td>2.7</td></tr><tr><td>1000</td><td>2.8</td></tr><tr><td>2000</td><td>3.0</td></tr><tr><td>3000</td><td>3.3</td></tr><tr><td>4000</td><td>3.7</td></tr><tr><td>4500</td><td>4.0</td></tr></tbody></table>	Servo motor speed [r/min]	Dynamic brake time constant τ [ms]	0	2.7	1000	2.8	2000	3.0	3000	3.3	4000	3.7	4500	4.0		
Servo motor speed [r/min]	Dynamic brake time constant τ [ms]																
0	2.7																
1000	2.8																
2000	3.0																
3000	3.3																
4000	3.7																
4500	4.0																
HG-AK0136	 <table border="1"><caption>Approximate data for HG-AK0136</caption><thead><tr><th>Servo motor speed [r/min]</th><th>Dynamic brake time constant τ [ms]</th></tr></thead><tbody><tr><td>0</td><td>1.8</td></tr><tr><td>1000</td><td>1.85</td></tr><tr><td>2000</td><td>1.9</td></tr><tr><td>3000</td><td>1.95</td></tr><tr><td>4000</td><td>2.05</td></tr><tr><td>5000</td><td>2.15</td></tr><tr><td>6000</td><td>2.2</td></tr></tbody></table>	Servo motor speed [r/min]	Dynamic brake time constant τ [ms]	0	1.8	1000	1.85	2000	1.9	3000	1.95	4000	2.05	5000	2.15	6000	2.2
Servo motor speed [r/min]	Dynamic brake time constant τ [ms]																
0	1.8																
1000	1.85																
2000	1.9																
3000	1.95																
4000	2.05																
5000	2.15																
6000	2.2																
HG-AK0236	 <table border="1"><caption>Approximate data for HG-AK0236</caption><thead><tr><th>Servo motor speed [r/min]</th><th>Dynamic brake time constant τ [ms]</th></tr></thead><tbody><tr><td>0</td><td>1.5</td></tr><tr><td>1000</td><td>1.5</td></tr><tr><td>2000</td><td>1.55</td></tr><tr><td>3000</td><td>1.6</td></tr><tr><td>4000</td><td>1.65</td></tr><tr><td>5000</td><td>1.7</td></tr><tr><td>6000</td><td>1.7</td></tr></tbody></table>	Servo motor speed [r/min]	Dynamic brake time constant τ [ms]	0	1.5	1000	1.5	2000	1.55	3000	1.6	4000	1.65	5000	1.7	6000	1.7
Servo motor speed [r/min]	Dynamic brake time constant τ [ms]																
0	1.5																
1000	1.5																
2000	1.55																
3000	1.6																
4000	1.65																
5000	1.7																
6000	1.7																
HG-AK0336	 <table border="1"><caption>Approximate data for HG-AK0336</caption><thead><tr><th>Servo motor speed [r/min]</th><th>Dynamic brake time constant τ [ms]</th></tr></thead><tbody><tr><td>0</td><td>1.4</td></tr><tr><td>1000</td><td>1.4</td></tr><tr><td>2000</td><td>1.45</td></tr><tr><td>3000</td><td>1.5</td></tr><tr><td>4000</td><td>1.55</td></tr><tr><td>5000</td><td>1.65</td></tr><tr><td>6000</td><td>1.7</td></tr></tbody></table>	Servo motor speed [r/min]	Dynamic brake time constant τ [ms]	0	1.4	1000	1.4	2000	1.45	3000	1.5	4000	1.55	5000	1.65	6000	1.7
Servo motor speed [r/min]	Dynamic brake time constant τ [ms]																
0	1.4																
1000	1.4																
2000	1.45																
3000	1.5																
4000	1.55																
5000	1.65																
6000	1.7																

Permissible load to motor inertia when the dynamic brake is used

Use the dynamic brake with the load to motor inertia ratio equal to or less than that indicated in the following table. If the ratio is higher than this value, the servo amplifier and servo motor may burn.

The value of the permissible load to motor inertia ratio in the table is given for the maximum speed of the servo motor.

Servo motor	Permissible load to motor inertia ratio [times]
HK-KT0536E2-S1	30
HG-AK0136	
HG-AK0236	
HG-AK0336	

9.4 Inrush currents at power-on of main circuit and control circuit

Point

- The inrush current values may fluctuate depending on the power-on frequency and ambient temperature.

Since a large inrush current flows at power supply, when a circuit protector is used, it is recommended to use a medium-speed type or inertial delay type which is not tripped by the inrush current. For details of the circuit protector, refer to the following.

 Page 139 Circuit protector (CP)

The following shows the inrush currents (reference values) when the power supply is turned on at the output side of the DC power supply under the following conditions: a wiring length of 1 m with main circuit 55.2 V DC and control circuit 55.2 V DC or main circuit 26.4 V DC and control circuit 26.4 V DC.

Servo amplifier	Voltage condition	Inrush current	
		Main circuit power supply (PM/0)	Control circuit power supply (PC/0)
MR-MD333G_	Main circuit power supply: 55.2 V DC Control circuit power supply: 55.2 V DC	250 A (attenuated to 1 A or less in 650 μ s)	8 A (attenuated to 1 A or less in 1 μ s)
	Main circuit power supply: 26.4 V DC Control circuit power supply: 26.4 V DC	125 A (attenuated to 1 A or less in 325 μ s)	4 A (attenuated to 1 A or less in 1 μ s)

10 OPTIONS AND PERIPHERAL EQUIPMENT

Precautions

- To prevent an electric shock or a fire, correctly wire options, peripheral equipment, etc. in the correct combination.

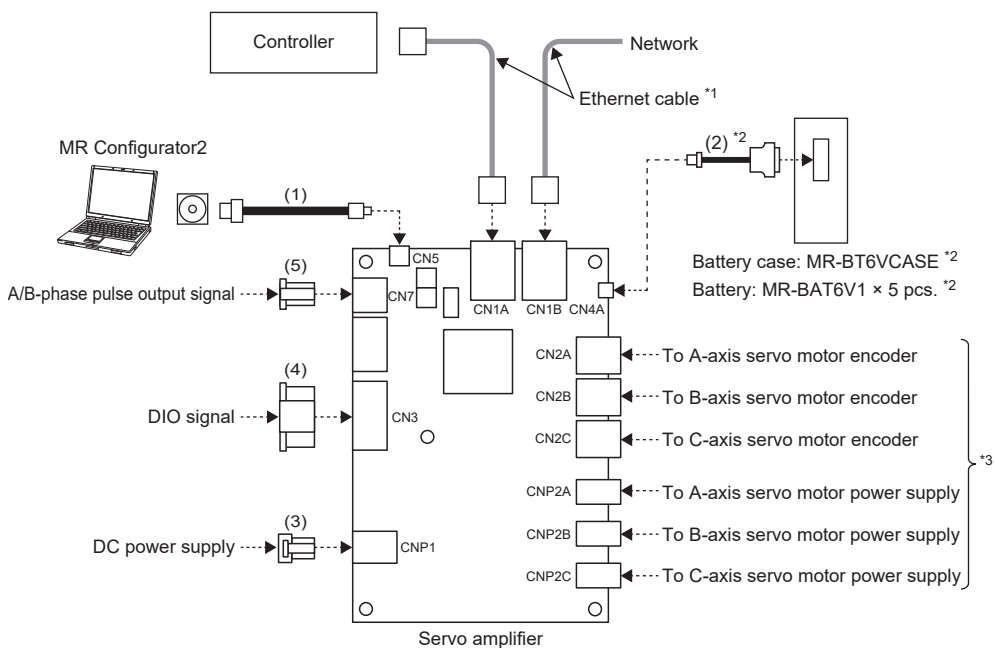
10

10.1 Cables and connectors

Purchase the optional and recommended cables and connectors indicated in this section for this servo amplifier.

Use the cables provided by Mitsubishi Electric and Mitsubishi Electric System & Service Co., Ltd. When fabricating a cable, select a wire suitable for the application. As an example for selecting a wire suitable for the application, NFPA 79 (2018 Edition) in North America demands the use of a listed and certified products that have a thermoset insulator and are compliant with the NEC standard RHH, RHW, RHW-2, XHH, XHHW, or XHHW-2.

Combinations of cables and connectors



*1 For the Ethernet cable specifications, refer to the following.

☞ Page 125 Ethernet cable

*2 This cable is required for configuring an absolute position detection system by using an HG-AK servo motor. For configuration of an absolute position detection system, refer to the following.

☞ Page 140 ABSOLUTE POSITION DETECTION SYSTEM

*3 For cables and connectors used to connect to the rotary servo motor, refer to the following.

☞ Page 63 Connecting the servo amplifier and rotary servo motor

Cable list

No.	Product name	Model	Description	Remarks
(1)	USB cable	MR-J3USBCBL3M Cable length: 3 m	(a) (b) (a) CN5 connector: mini-B connector (5 pins) (b) Personal computer connector: Connector A	For connection to PC-AT compatible personal computer
(2)	Battery cable	MR-BT6V1CBL_M Cable length: 0.3 m, 1 m	(a) (b) (a) Housing: PAP-02V-O Contact: SPHD-001G-P0.5 (JST) (b) Connector: 10114-3000PE Shell kit: 10314-52F0-008 (3M or equivalent)	For connection to battery unit ☞ Page 127 Battery

Connector list (recommended products)

No.	Connector	Applicable housing	Applicable contact	Applicable wire		Crimping tool	Manufacturer
				Size	Insulator OD		
(3)	CNP1	PSIP-03V-LE-A	SPSI-41T-M1.1	AWG 18 to 16 (0.75 mm ² to 1.25 mm ²)	1.7 mm to 3.2 mm	YC-225R	JST
(4)	CN3	PUDP-26V-S	SPUD-001T-P0.5	AWG 26 to 22	0.95 mm to 1.5 mm	YRS-1320	JST
			SPUD-002T-P0.5	AWG 28 to 24	0.76 mm to 1.5 mm	YRS-1520	
(5)	CN7	PUDP-12V-S	SPUD-001T-P0.5	AWG 26 to 22	0.95 mm to 1.5 mm	YRS-1320	JST
			SPUD-002T-P0.5	AWG 28 to 24	0.76 mm to 1.5 mm	YRS-1520	

Battery cable

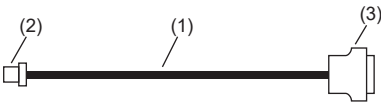
Model explanations

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 numbers are available.

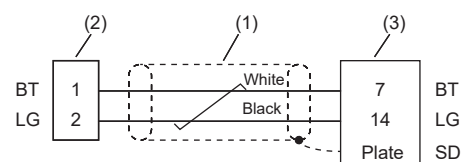
Cable model	Cable length		Bending life	Application/remarks
	0.3 m	1 m		
MR-BT6V1CBL_M	03	1	Standard	For connecting to MR-BT6VCASE

MR-BT6V1CBL_M

■Appearance

Figure	Component	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)

■Internal wiring diagram



Ethernet cable

For Ethernet cables used for network wiring, refer to "Communication specifications" in the User's Manual (Communication Function).

The following shows examples of commercially available products. For the latest product information, contact the manufacturer.

Product name		Model	Specifications	
Ethernet cable	For indoor use	SC-E5EW-S_M	"_" in the model represents the cable length (0.5 m, 1 to 100 m (in 1 m increments)).	Double shielded cable (Category 5e)
	For moving parts used indoors	SC-E5EW-S_M-MV	"_" in the model represents the cable length (0.1, 0.2, 0.3, 0.5 m, 1 to 45 m (in 1 m increments)).	
	For indoor and outdoor use	SC-E5EW-S_M-L	"_" in the model represents the cable length (1 to 100 m (in 1 m increments)).	

For commercially available cables other than the above, refer to the CC-Link Partner Association website.

<https://www.cc-link.org/ja/>

Precautions

- When branching the CC-Link IE TSN network using a switching hub, use a switching hub (Class B) that is recommended by the CC-Link Partner Association. Although a switching hub (Class A) can also be used, there are restrictions on the type of topology that can be used. For details, refer to "MELSEC iQ-R Motion Module User's Manual (Startup)".

10.2 MR Configurator2

Engineering software

MR Configurator2 (SW1DNC-MRC2-_) can be used with this servo amplifier.

For the engineering software specifications and system configuration, refer to the installation guide of the engineering software.

Precautions for using USB communication function and Ethernet communication function

Note the following to prevent an electric shock or malfunction of the servo amplifier.

Connecting the power of a personal computer

Connect the power of a personal computer with the following procedure.

■When using a personal computer with an AC power supply

- When using a personal computer with a three-core power plug or a power plug with a grounding wire, use a three-pin socket or ground the grounding wire.
- When your personal computer has a two-core power plug and has no grounding wire, connect the personal computer to the servo amplifier with the following procedure.

1. Disconnect the power plug of the personal computer from the AC power socket.
2. Check that the power plug of the personal computer has been disconnected from the AC power socket, then connect the personal computer to the servo amplifier.
3. Connect the power plug of the personal computer to the AC power socket.
 - When using a personal computer on battery power

The personal computer can be used as it is.

■Connection to other devices using servo amplifier communication function

When the servo amplifier is charged with electricity due to connection to a personal computer and the charged servo amplifier is connected to other devices, the servo amplifier or the connected devices may malfunction. Connect the servo amplifier and other devices with the following procedure.

1. Shut off the power to the device to be connected to the servo amplifier.
2. Shut off the power to the servo amplifier that was connected to the personal computer, and check that the charge light is off.
3. Connect the device to the servo amplifier.
4. Turn on the power to the servo amplifier and the connected device.

10.3 Battery

10

Point

- Unlock and then pull out the option such as a battery connected to the CN4A connector.
- For battery transportation and the new EU Battery Directive, refer to the following.
 ↳ Page 147 Handling of AC servo amplifier batteries for the United Nations Recommendations on the Transport of Dangerous Goods

MR-BT6VCASE battery case

Point

The battery unit consists of an MR-BT6VCASE battery case and five MR-BAT6V1 batteries.
 For the specifications and the date of manufacture of the MR-BAT6V1 battery, refer to the following.
 ↳ Page 132 MR-BAT6V1 battery

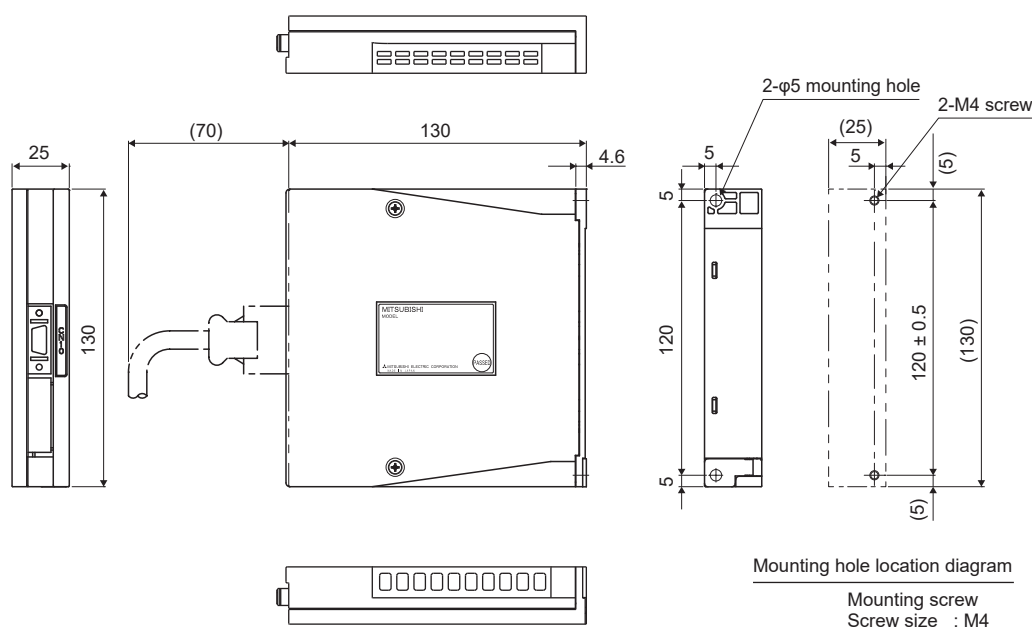
MR-BT6VCASE is a case used for connecting and mounting five MR-BAT6V1 batteries. No batteries are included in the battery case. Prepare MR-BAT6V1 batteries separately.

Number of connectable servo motors

One MR-BT6VCASE can hold the absolute position data of up to 3-axis rotary servo motors.

Dimensions

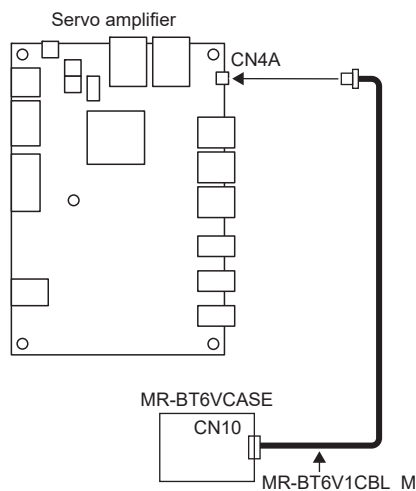
[Unit: mm]



Mass: 0.18 [kg]

Battery connection

Connect one MR-MD333G_ servo amplifier per MR-BT6VCASE.
It is not possible to connect multiple MR-MD333G_ servo amplifiers to a single MR-BT6VCASE1.



Battery replacement procedure

Replace the battery while only the control circuit power supply is on. Replacing the battery with the control circuit power supply on triggers [AL. 09F.1 Low battery]. However, the absolute position data will not be erased.

Precautions

- Before replacing batteries, turn off the main circuit power supply and wait for 15 minutes or more until the charge light turns off.
- The servo amplifier may be damaged by static electricity. Observe following instructions.
- Ensure that the work bench and your body are grounded.
 - Do not directly touch conductive areas such as the connector pins and electrical parts.

Point

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

■Assembly of the battery unit

Point

- Replace all the batteries with new ones at the same time at battery replacement.
- Mount five MR-BAT6V1 batteries in the MR-BT6VCASE battery case.

- Things to be prepared

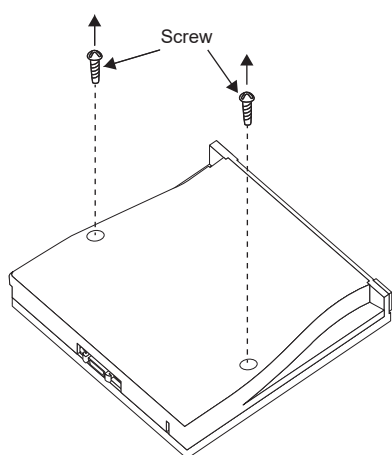
Product name	Model	Quantity	Remarks
Battery case	MR-BT6VCASE	1	MR-BT6VCASE is a case used for connecting and mounting five MR-BAT6V1 batteries.
Battery	MR-BAT6V1	5	Lithium battery (primary battery, nominal + 6 V)

- Disassembly and assembly of the battery case MR-BT6VCASE

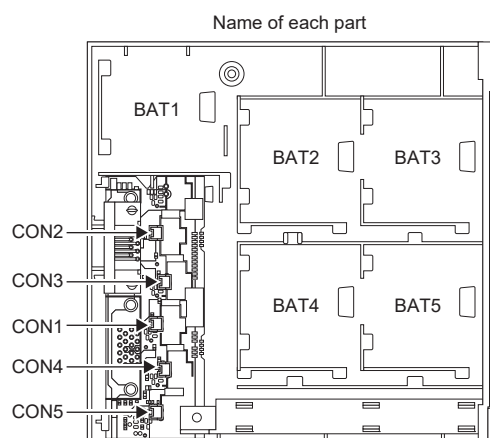
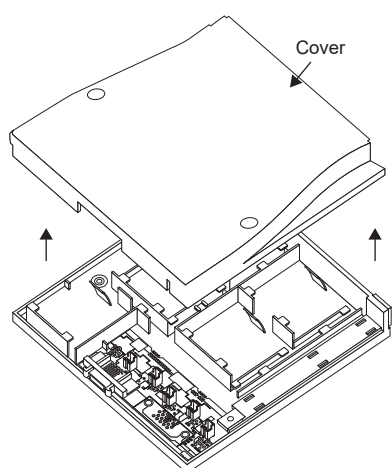
Disassembly of the case

MR-BT6VCASE is shipped assembled. To mount MR-BAT6V1 batteries, the case needs to be disassembled.

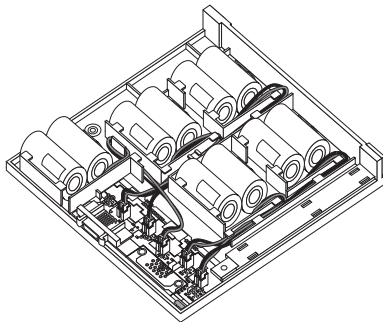
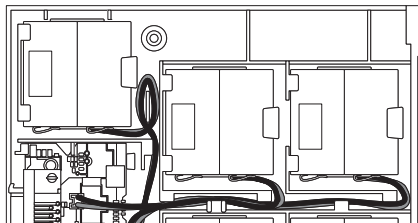
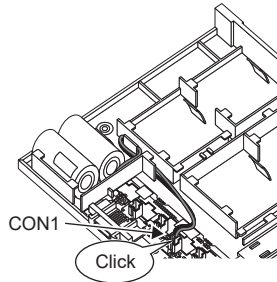
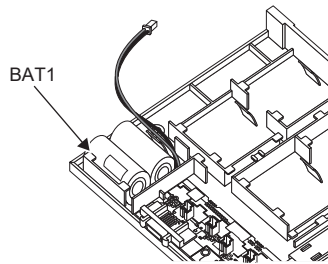
- 1.** Remove the two screws using a Phillips head screwdriver.



- 2.** Remove the cover.



Mounting MR-BAT6V1



- 1.** Securely mount an MR-BAT6V1 to the BAT1 holder.

- 2.** Insert the MR-BAT6V1 connector mounted on the BAT1 holder into CON1.

Confirm that you hear a click sound at this point.

The connector has to be connected in the right orientation.

If the connector is pushed forcefully in the incorrect orientation, it will be damaged.

Place the MR-BAT6V1 lead wire in the duct designed to store lead wires.

Insert MR-BAT6V1 into the holders in the same procedure in the order from BAT2 to BAT5.

- 3.** Bring out the lead wires from the space between the ribs, and bend the wires as shown in the figure to store them in the ducts. Connect the lead wires to the connectors.

Be careful not to get the lead wires caught in the case or other parts.

When the lead wire is damaged, external short circuit may occur, and the battery can become hot.

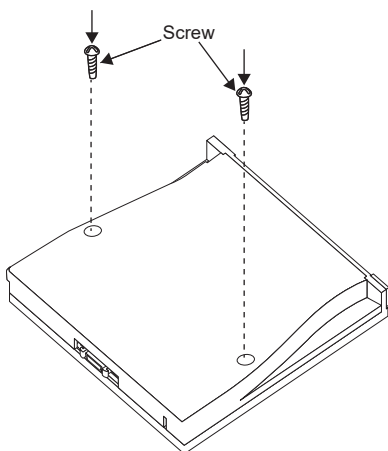
Assembly of the case

After all MR-BAT6V1 batteries are mounted, attach the cover, insert screws into the two holes, and tighten them. Tightening torque is 0.71 N·m.

Point

Be careful not to trap the lead wires when installing the screws and re-installing the cover.

10



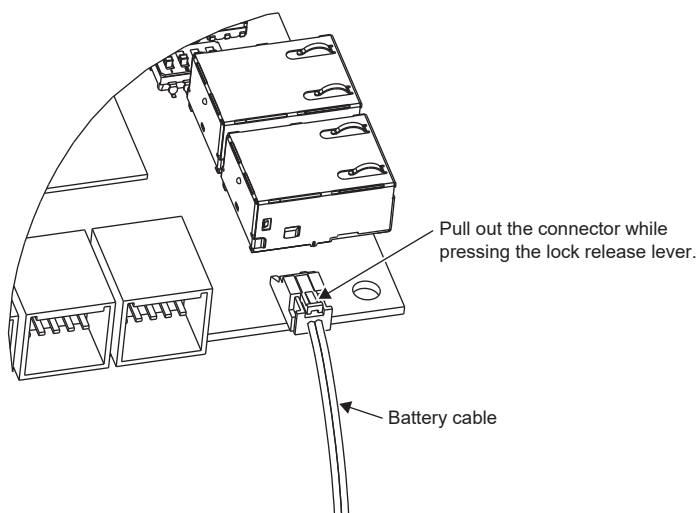
Precautions for removal of battery

The connector attached to the MR-BAT6V1 battery has a lock release lever. When removing the connector, pull out the connector while pressing the lock release lever.

- Battery cable removal

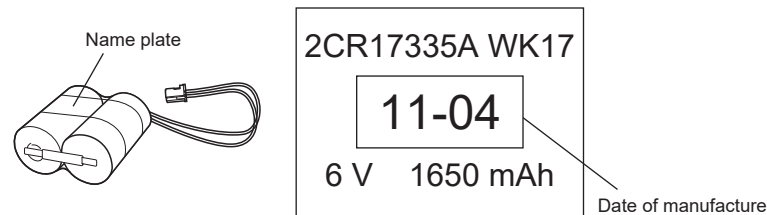
Precautions

- Pulling out the connector of MR-BT6V1CBL without the lock release lever pressed may damage the CN4A connector of the servo amplifier or the connector of MR-BT6V1CBL.



MR-BAT6V1 battery

MR-BAT6V1 is a lithium primary battery intended for use built into MR-BT6VCASE. Store MR-BAT6V1 in the case to use. The date of manufacture of the MR-BAT6V1 battery is indicated on the battery label.



Item	Description
Battery pack	2CR17335A (CR17335A × 2 pcs. connected 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 classified as the dangerous goods (Class 9) ☞ Page 147 Handling of AC servo amplifier batteries for the United Nations Recommendations on the Transport of Dangerous Goods
Operating humidity and storage humidity	5%RH to 90%RH (non-condensing)
Battery life *1	Five years after the date of manufacture
Mass [g]	34

*1 Characteristics of a battery degrade while it is stored. The battery life is 5 years from the date of manufacture, even if it is not connected to the servo amplifier.

10.4 Selection example of wires



The voltage drops due to the cable conductor resistance. Wire so that the desired input voltage is ensured at the servo amplifier input section. It is recommended to make the cable length as short as possible.

Servo amplifier	Wire
	PM/PC/0
MR-MD333G_	0.75 mm ² to 1.25 mm ² ; Sheath OD 1.7 mm to 3.2 mm

10.5 Relay (recommended)

When using a relay for each interface, use the following relays.

Interface name	Selection example
Digital input signal (interface DI-1) Relay used for switching signals	To prevent loose connections, use a relay for small signals (twin contacts). (Example) Omron: Type G2A, type MY
Digital output signal (interface DO-1) Relay used for signals	Small relay with 12 V DC or 24 V DC of rated current 40 mA or less (Example) Omron: Type MY

10.6 Noise reduction techniques

Noise is classified into external noise, which enters the servo amplifier and causes it to malfunction, and noise radiated by the servo amplifier that causes peripheral equipment to malfunction. Because the servo amplifier is an electronic device that handles small signals, the following general noise reduction techniques are required.

The servo amplifier can also be a source of noise as its outputs are chopped by high carrier frequencies. If peripheral equipment malfunctions due to noise produced by the servo amplifier, take measures to reduce the noise. The reduction techniques will vary slightly with the routes of noise transmission.

Noise reduction techniques

General reduction techniques

- Avoid bundling power cables (input/output cables) and signal cables together or running them in parallel to each other. Separate the power cables from the signal cables.
- Use a shielded twisted pair cable for connection to the encoder and for control signal transmission, and connect the external conductor of the shielded wire to the SHD terminal.
- For grounding, refer to the following.

Page 86 Grounding

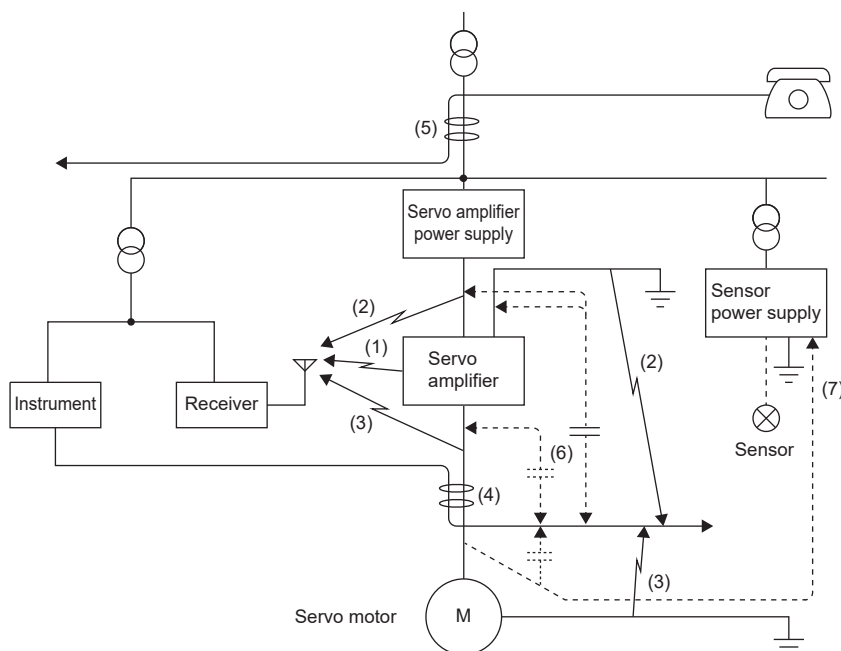
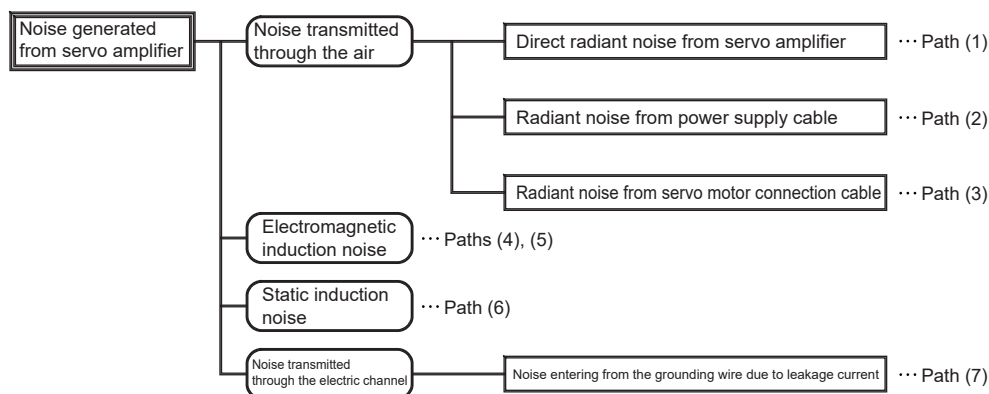
External noise that causes the servo amplifier to malfunction

If there are noise sources (such as a magnetic contactor, an electromagnetic brake, and many relays) that make a large amount of noise near the servo amplifier and the servo amplifier may malfunction, the following countermeasures are required.

- Provide surge killers on the noise sources to suppress noise.
- 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.
- To protect the servo amplifier and other equipment against large external noise and lightning surge, attaching a varistor to the power input section of the equipment is recommended.

Noise radiated by the servo amplifier that causes peripheral equipment to malfunction

Noise produced by the servo amplifier is classified into noise radiated from the cables connected to the servo amplifier and its main circuits (input/output), noise induced electromagnetically or statically by the signal cables of the peripheral equipment located near the main circuit cables, and noise transmitted through the power supply cables.



Noise transmission route	Suppression techniques
(1), (2), (3)	A malfunction due to noise transmitted through the air may occur in devices which handle weak signals and are susceptible to noise, such as measuring instruments, receivers, and sensors. In addition, a malfunction may also occur when their signal cables are stored in a cabinet together with the servo amplifier or when the signal cables run near the servo amplifier. Take the following measures to prevent a malfunction: • Install susceptible devices as far away from the servo amplifier as possible. • Route susceptible signal cables as far away from the I/O cables of the servo amplifier as possible. • Avoid bundling power cables (input/output cables of the servo amplifier) and signal cables together or running them in parallel to each other. • Attach a line noise filter to the input/output cables or a radio noise filter to the input cable to reduce radiated noise from the cables. • Use shielded wires for the signal and power cables, or put the cables in separate metal conduits.
(4), (5), (6)	When power cables and signal cables are laid side by side or bundled together, electromagnetic and static induction noise is transmitted to the signal cables, causing malfunctions. Take the following precautions to protect the signal cables against noise. • Install susceptible devices as far away from the servo amplifier as possible. • Route susceptible signal cables as far away from the I/O cables of the servo amplifier as possible. • Avoid bundling power cables (input/output cables of the servo amplifier) and signal cables together or running them in parallel to each other. • Use shielded wires for the signal and power cables, or put the cables in separate metal conduits.
(7)	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 disconnecting the grounding wires from the equipment.

Noise reduction techniques for the network cable



Take measures against noise for both ends of the network cable.

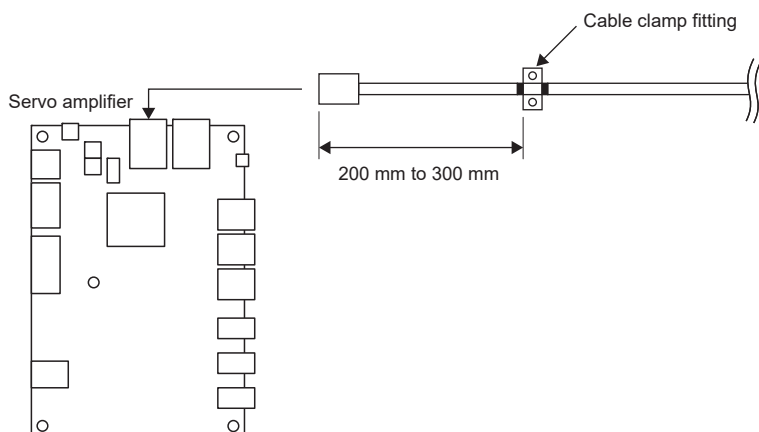
When using the network cable in an environment with excessive noise, directly connect the shield of the cable to the ground plate with a cable clamp fitting at a place 200 mm to 300 mm from the servo amplifier.

When connecting the network cable from outside the cabinet, connect it to the ground plate at a place 5 mm to 10 mm away from the cabinet entrance.

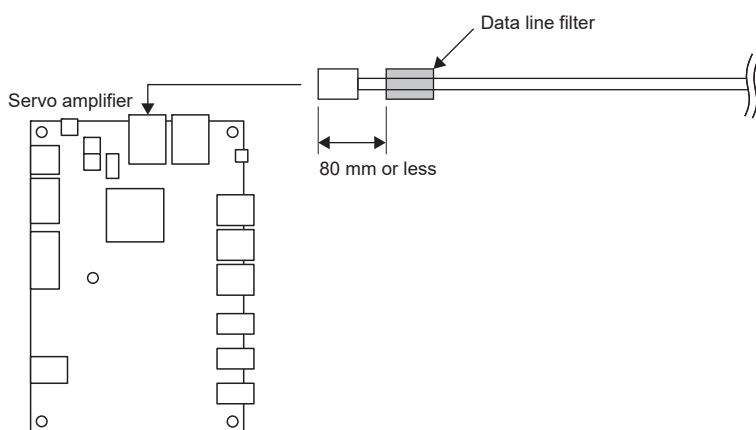
To reinforce noise reduction techniques, installing a data line filter (TDK ZCAT1730-0730) to the network cable is recommended. Install the data line filter to a place 80 mm or less from the servo amplifier.

■ Inside the cabinet

- When using a cable clamp fitting

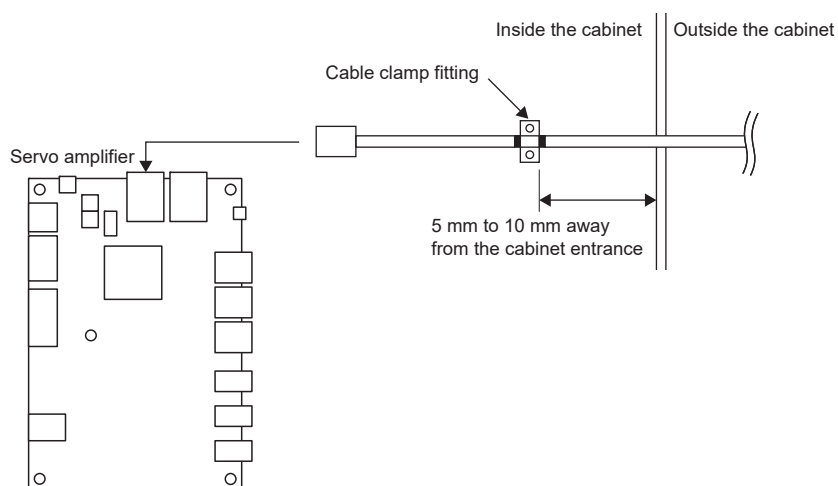


- When using a data line filter

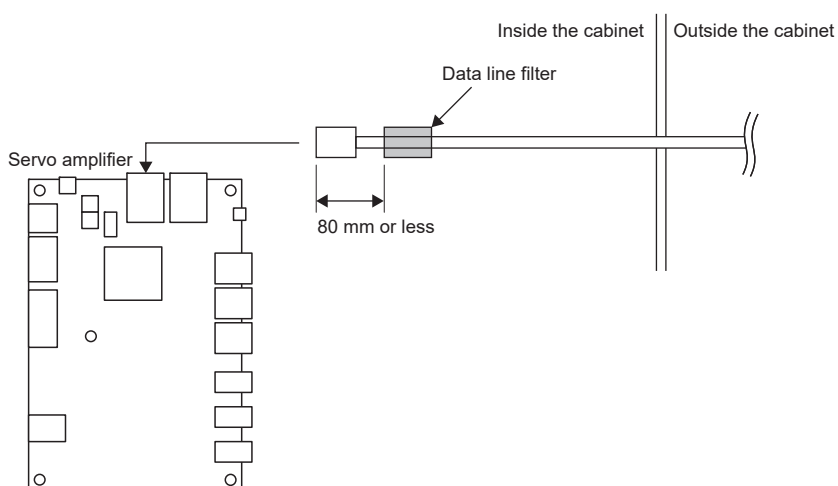


■ Outside the cabinet

- When using a cable clamp fitting



- When using a data line filter



Noise reduction products

Data line filter (recommended)

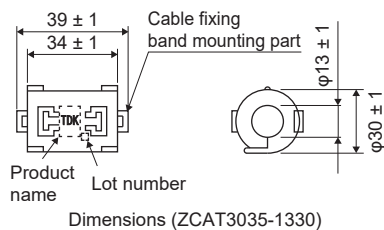
Noise can be prevented by installing a data line filter onto cables such as the encoder cable.

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]

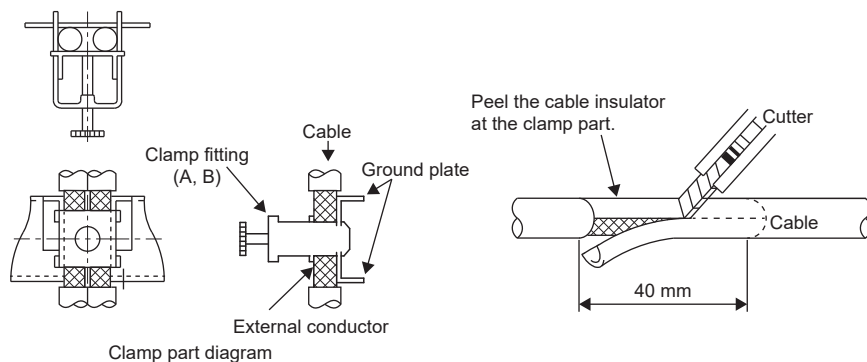


Cable clamp fitting AERSBAN-_SET

Generally, connecting the grounding wire of the shielded wire to the SHD terminal of the connector provides a sufficient effect. However, the effect can be increased when the shielded wire is connected directly to the ground plate as shown below.

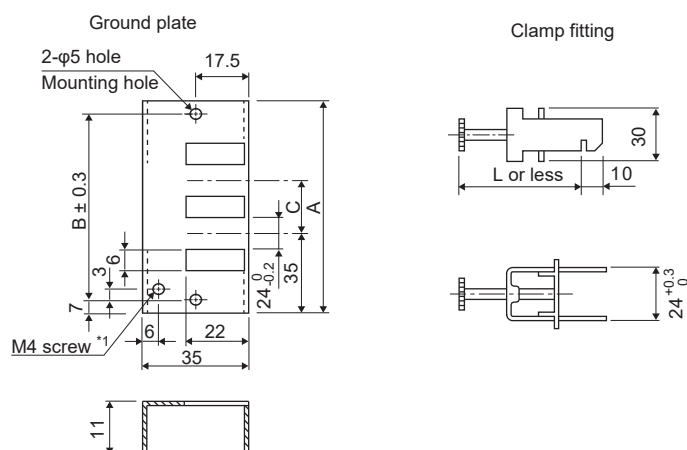
Install the ground plate near the servo amplifier for the encoder cable. Peel part of the cable insulator to expose the external conductor, and press that part against the ground plate with the cable clamp fitting. If the cable is thin, clamp several cables together.

The cable clamp fitting comes as a set with the grounding plate.



• Dimensions

[Unit: mm]



*1 Screw hole for grounding. Connect it to the ground plate of the cabinet.

Model	A	B	C	Accessory fittings
AERSBAN-DSET	100	86	30	Clamp fitting A: 2 pcs.
AERSBAN-ESET	70	56	—	Clamp fitting B: 1 pc.
Clamp fitting		L		
A		70		
B		45		

Precautions

- The motor cable (single cable type) has no shield on the outermost circumference. Therefore, to ground the motor cable with a cable clamp, use a motor cable (dual cable type).

10.7 Circuit protector (CP)

Power supply specification *1	Circuit protector *2
Control circuit power supply (48 V DC)	CP30-BA 1P 1-M 1A/10A/15A
Control circuit power supply (24 V DC)	CP30-BA 1P 1-M 5A/15A
Main circuit power supply (48 V DC)	CP30-BA 1P 1-M 10A/15A *3
Main circuit power supply (24 V DC)	CP30-BA 1P 1-M 15A

- *1 The circuit protector is provided to protect cables when an excessive current flows through the power supply line. When using this circuit protector, limit the output current of the power supply to 500 A or less. Using a power supply with an output current greater than 500 A can cause the cable to overheat when the power supply lines are short-circuited, leading to smoke or a fire.
- *2 For the operation characteristics, use the medium-speed type or inertial delay type.
- *3 For connection to an HK-KT servo motor, "CP30-BA 1P 1-M 15A" is recommended.

11 ABSOLUTE POSITION DETECTION SYSTEM

Precautions

- If [AL. 025 Absolute position erased] or [AL. 0E3 Absolute position counter warning] occurs, configure home position setting again.
- For the battery replacement procedure, refer to the following.

 Page 127 Battery

- When a servo motor that requires a battery for absolute position detection system is used, disconnecting the encoder cable or replacing the battery while the control circuit power supply is off may cause the encoder to erase its absolute position data. If the absolute position data is erased, configure home position setting before operation.
- Using batteries outside the specified range may erase absolute position data.

11.1 Overview

Characteristics

The encoder consists of a circuit that detects the position within one revolution and a circuit that detects the rotary speed. The absolute position detection system always detects and memorizes the absolute position of the machine regardless of whether the controller power is on/off. Therefore, once the home position is set during machine installation, it is not necessary to perform homing each time the machine is powered on thereafter. Even if a power failure or a malfunction occurs, the system can be easily restored.

Restrictions

When configuring the system as an absolute position detection system, it cannot be configured under the following conditions.

- When an incremental type encoder is used
- Stroke-less coordinate system (except for degree unit setting) for infinite positioning and other applications when used with a controller other than a Mitsubishi Electric controller

Precautions

Even when a servo motor with a batteryless absolute position encoder is used, the absolute position data is erased (ABSV turns on) under the following conditions. If the absolute position data is erased, perform homing again.

- The servo motor or servo amplifier is replaced.
- The incremental system is enabled.
- [Pr. PA01 Operation mode selection] is changed.
- [AL. 025 Absolute position erased] occurs.
- [AL. 0E3 Absolute position counter warning] occurs.
- [AL. 069 Command error] occurs while [Pr. PD61.2 [AL. 069 Command error] output selection with absolute position erased] is "1" (enabled).

Connecting a servo motor other than the one with a batteryless absolute position encoder that was connected at the startup of the absolute position detection system triggers [AL. 01A Servo motor combination error]. In such cases, reconnect the servo motor with a batteryless absolute position encoder that was connected at the startup of the absolute position detection system to operate without erasing the absolute position data. When replacing a servo motor, refer to the following.

 Page 144 Procedure for replacing a servo motor with a batteryless absolute position encoder

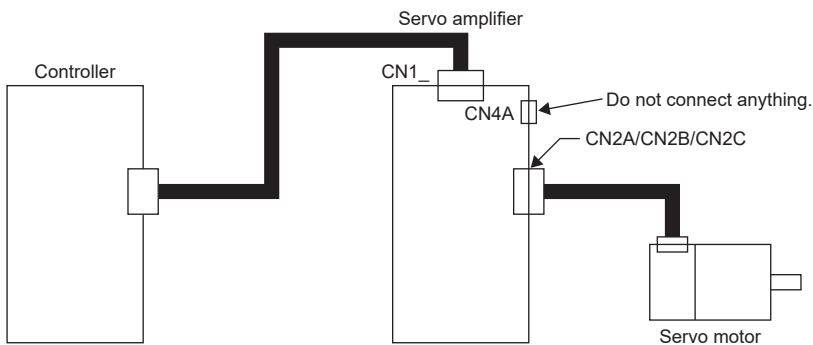
When [Pr. PF63.0 [AL. 01A.5 Servo motor combination error 3] selection] is set to "1" (disabled), connecting a servo motor with a batteryless absolute position encoder that had not been connected at the startup of the absolute position detection system will cause [AL. 025 Absolute position erased], erasing absolute position data.

Therefore, check if a correct servo motor is connected.

Configuration

The following shows the configuration of the absolute position detection system.

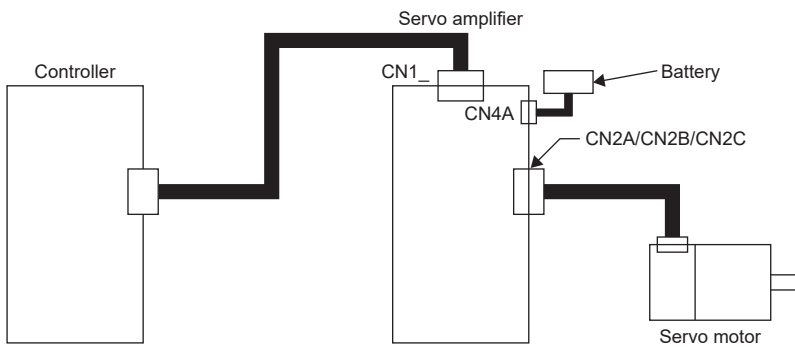
When connecting a batteryless absolute position encoder



When connecting a battery backup type absolute position encoder

For each battery connection, refer to the following.

📖 Page 127 Battery



Servo parameter setting

Set [Pr. PA03.0 Absolute position detection system selection] to "1" (enabled (absolute position detection system)).

When an absolute position detection system is configured in the cyclic synchronous mode with a Motion module manufactured by Mitsubishi Electric, set [Pr. PC29.5 [AL. 0E3 Absolute position counter warning] selection] to "0" (disabled).

Home position return

After the absolute position detection system is enabled, [AL. 025 Absolute position erased] occurs at the initial startup. Then, ABSV (Absolute position erased) turns on. Refer to "CONTROL MODE" in the following manual and perform homing.

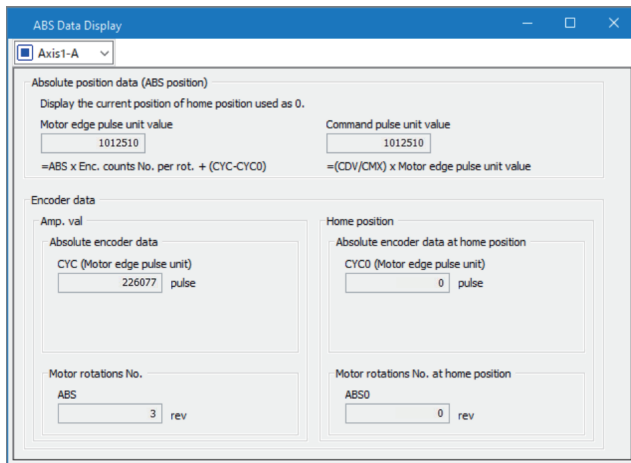
MR-J5 User's Manual (Function)

Checking the detected absolute position data

Absolute position data can be checked with MR Configurator2.

Select "Monitor" and "ABS Data Display" to open the "ABS Data Display" window.

ABS data display



No.	Item		Screen operation
	MR Configurator2	Configuration diagram *1	
(1)	Motor (machine) side pulse unit value	—	The value in the unit of the servo motor (machine) side pulses is acquired from the servo amplifier of the specified axis and displayed.
(2)	Command pulse unit value	Current position	The command pulse unit value is acquired from the servo amplifier for the specified axis and displayed.
(3)	CYC	1X	The position within one revolution in the unit of the servo motor (machine) side pulses is acquired from the servo amplifier of the specified axis and displayed.
(4)	ABS	LS	The multi-revolution counter travel distance from the absolute home position is acquired from the servo amplifier of the specified axis and displayed.
(5)	CYC0	1XO	The home position within one revolution in the unit of the servo motor (machine) side pulses is acquired from the servo amplifier of the specified axis and displayed.
(6)	ABS0	LSO	The multi-revolution counter value of the absolute home position is acquired from the servo amplifier of the specified axis and displayed.

*1 For the configuration diagrams, refer to the following.

☞ Page 145 When connecting a battery-less encoder

☞ Page 146 When connecting a battery backup type absolute position encoder

Procedure for replacing a servo motor with a batteryless absolute position encoder

To replace a servo motor with a battery-less absolute position encoder, follow the procedure described in this section.

Precautions

When [Pr. PF63.0 [AL. 01A.5 Servo motor combination error 3] selection] is set to "1" (disabled), connecting a servo motor with a batteryless absolute position encoder that had not been connected at the startup of the absolute position detection system will cause [AL. 025.1 Servo motor absolute position erased], erasing absolute position data. Therefore, check if a correct servo motor is connected.

Servo motor replacement procedure

Point

- For servo amplifiers with firmware version A4 or later, step 3 is not required.
- When the power of the servo amplifier is cycled or a software reset is performed after [Pr. PA03.1 Servo motor replacement preparation] is set to "1" (enabled), [Pr. PA03.1] automatically changes to "0" (disabled) and absolute position data is erased. Therefore, check if a correct servo parameter is set.

1. Replacing the servo motor

Turn off the power supply to the servo amplifier and replace the servo motor.

2. Deactivating [AL. 01A Servo motor combination error]

When the power supply to the servo amplifier is turned on, [AL. 01A.5 Servo motor combination error 3] occurs.

After setting [Pr. PA03.1 Servo motor replacement preparation] to "1" (enabled), cycle the power of the servo amplifier or perform a software reset to then deactivate [AL. 01A.5].

3. Cycling the power

After checking that [AL. 01A.5] does not occur, cycle the power of the servo amplifier or perform a software reset.

4. Home position return

When the servo motor is replaced, the servo amplifier will erase absolute position data. Before starting operation, perform homing.

Procedure for replacing the servo motor without changing the servo parameter setting

By setting [Pr. PF63.0 [AL. 01A.5 Servo motor combination error 3] selection] to "1" (disabled) while the absolute position detection system is enabled, an in-use servo motor with a batteryless absolute position encoder can be replaced without changing the setting value of [Pr. PA03.1 Servo motor replacement preparation].

To replace the servo motor without changing the servo parameter setting, refer to the following procedure. Set [Pr. PF63.0] to "1" (disabled) in advance, and reset the controller or cycle the power.

1. Replacing the servo motor

Turn off the power supply to the servo amplifier and replace the servo motor.

2. Deactivating [AL. 025 Absolute position erased]

When the power supply to the servo amplifier is turned on, [AL. 025.1 Servo motor encoder absolute position erased] occurs.

Cycle the power of the servo amplifier to deactivate [AL. 025.1].

3. Home position return

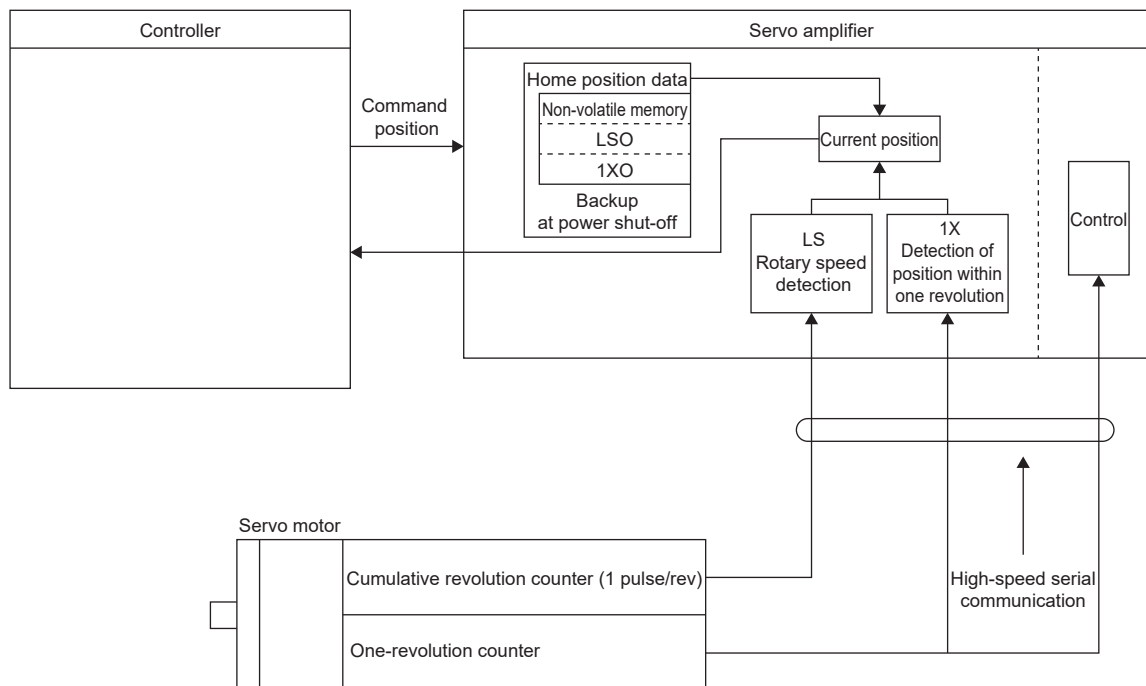
When [AL.025] occurs, the servo amplifier will erase absolute position data. Before starting operation, perform homing.

11.2 Configuration and specifications

When connecting a battery-less encoder

The following shows an example of battery-less encoder connection.

Configuration diagram



Specification list

Item		Description
Type		Electronic, battery backup type
Maximum rotation range		Home position ± 32767 rev
Maximum speed at power failure [r/min] *1	Rotary servo motor manufactured by Mitsubishi Electric	8000 (only when the acceleration/deceleration time until 8000 r/min is 0.2 s or longer)

*1 Maximum speed available when the shaft is rotated by external force at the time of a power failure. Note that if the power is turned on while the servo motor is being rotated by an external force at a speed of 3000 r/min or higher, a position mismatch may occur.

When connecting a battery backup type absolute position encoder

The following shows an example of battery backup type absolute position encoder connection.

Using the MR-BT6VCASE battery case

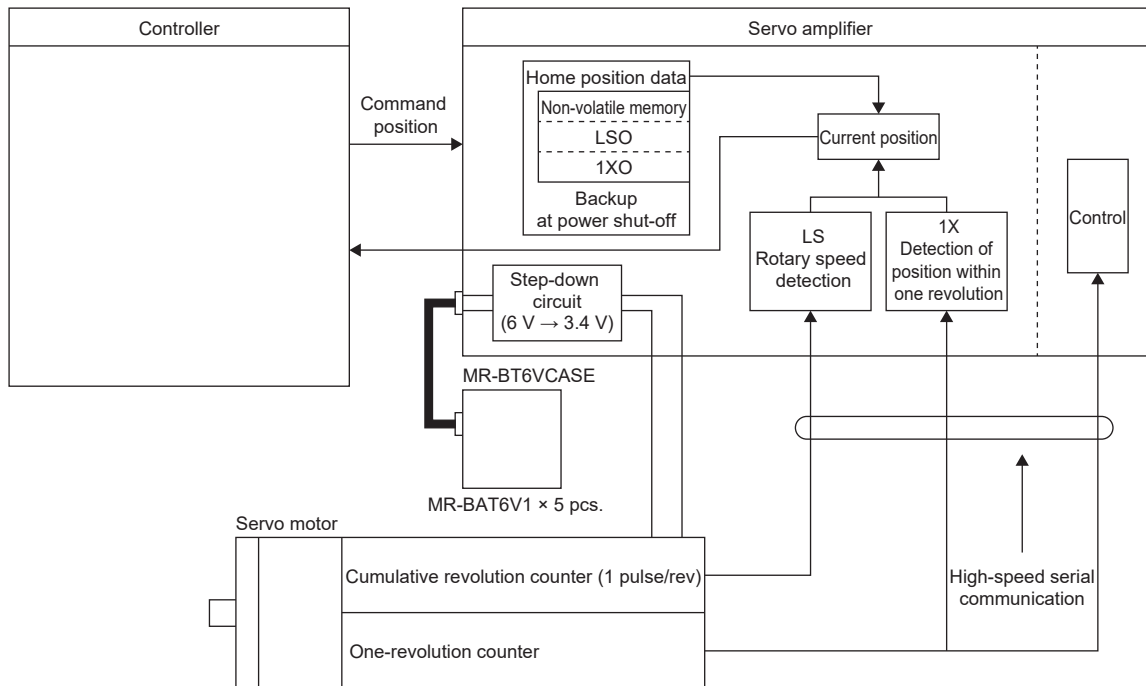
One MR-BT6VCASE can hold the absolute position data of up to 3-axis servo motors.

Connect one MR-MD333G_ servo amplifier per MR-BT6VCASE.

It is not possible to connect multiple MR-MD333G_ servo amplifiers to a single MR-BT6VCASE1.

Mount five MR-BAT6V1 batteries in MR-BT6VCASE.

■Configuration diagram



■Specification list

Item		Description
Type		Electronic, battery backup type
Maximum rotation range		Home position ± 32767 rev
Maximum speed at power failure [r/min] *1	Rotary servo motor manufactured by Mitsubishi Electric	500
Battery backup time *2	Rotary servo motor manufactured by Mitsubishi Electric	Approx. 30000 hours/3 axes (when the equipment power is off and ambient temperature is 20°C) Approx. 38000 hours/3 axes (When the power-on ratio is 25% and ambient temperature is 20°C) *3

*1 Maximum speed available when the shaft is rotated by external force at the time of a power failure.

*2 The data-hold time with five MR-BAT6V1. The battery life varies depending on the number of target axes (including axes used in an incremental system). Replace the batteries within three years from the operation start regardless of whether the power supply to the servo amplifier is on/off. If the batteries are used outside of specification range, [AL. 025 Absolute position erased] may occur.

*3 Power-on ratio of 25% is the equivalent to power-on for 8 hours on weekdays and power-off on weekends.

12 COMPLIANCE WITH GLOBAL STANDARDS AND REGULATIONS

This chapter provides information common among AC servo amplifiers.

12.1 Compliance with global standards

For compliance with the standards of Europe/UK and South Korea, refer to the following manual.

Safety Instructions and Precautions for AC Servos (IB(NA)0300570)

12.2 Handling of AC servo amplifier batteries for the United Nations Recommendations on the Transport of Dangerous Goods

The transportation of lithium metal batteries is regulated under 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), which are based on the United Nations Recommendations on the Transport of Dangerous Goods (hereinafter Recommendations of the United Nations).

This section describes the handling of lithium metal batteries in air transportation that has been changed in response to the IATA (International Air Transport Association) Dangerous Goods Regulations 63rd Edition issued on January 1, 2022, and the handling of lithium metal batteries in maritime transportation that has also been changed.

Applicable models

Battery (cell)

Model	Option model	Type	Lithium content	Mass of battery	Remarks
ER6	MR-J3BAT	Cell	0.65 g	16 g	Each battery (cell) contains more than 0.3 grams of lithium content and must be handled as dangerous goods (Class 9) for certain packaging requirements.
	MR-J3W03BATSET	Cell	0.65 g	16 g	
ER17330	MR-BAT	Cell	0.48 g	13 g	
	A6BAT	Cell	0.48 g	13 g	

Battery unit (assembled)

Model	Option model	Type	Lithium content	Mass of battery	Remarks
ER6	MR-J2M-BT_	Assembled battery (7 cells)	4.55 g	112 g	The assembled battery contains more than two grams of lithium content and must be handled as dangerous goods (Class 9) regardless of packaging requirements.
CR17335A	MR-BAT6V1	Assembled battery (2 cells)	1.20 g	34 g	Each battery (cell) contains more than 0.3 grams of lithium content and must be handled as dangerous goods (Class 9) for certain packaging requirements.
	MR-BAT6V1SET_	Assembled battery (2 cells)	1.20 g	34 g	
	MR-BAT6V1BJ	Assembled battery (2 cells)	1.20 g	34 g	

Purpose

To enable safer transportation of lithium metal batteries.

Handling during transportation

This section describes how to handle lithium metal batteries in transportation. The batteries alone transported by air are classified as UN3090, and the batteries packed with or contained in equipment transported by air are classified as UN3091. Lithium metal batteries are classified as SP188 when transported by sea as non-dangerous goods.

Air transportation of lithium metal batteries alone

Packaging requirements	Classification	Main requirements
Lithium content per cell ≤ 1 g Lithium content per assembled battery ≤ 2 g	UN3090 PI968 Section IB	The total battery weight per package must be 10 kg or less. The package must pass a 1.2 m drop test, and a lithium battery mark (size: 100 × 100 mm) must be attached to the package. The batteries must be handled conforming to Class 9 Dangerous Goods Regulations (such as displaying lithium battery hazard labels).
Lithium content per cell > 1 g Lithium content per assembled battery > 2 g	UN3090 PI968 Section IA	The total battery weight per package must be 35 kg or less. The package must comply with UN specification packing requirements and be handled complying with Class 9 Dangerous Goods Regulations (such as displaying lithium battery hazard labels).

Transportation of lithium metal batteries alone as cargo on passenger aircraft has been prohibited since January 1, 2015. Lithium metal batteries can be transported by sea or cargo aircraft.

Air transportation of lithium metal batteries packed with or contained in equipment

Lithium metal batteries packed with or contained in equipment can be transported as cargo on passenger aircraft.

■For batteries packed with equipment, follow the requirements of UN3091 PI969.

Batteries are classified into either Section II or Section I depending on the lithium content/packaging requirements.

■For batteries contained in equipment, follow the requirements of UN3091 PI970.

Batteries are classified into either Section II or 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.

Maritime transportation of lithium metal batteries

Packaging requirements	Classification	Main requirements
Lithium content per cell ≤ 1 g Lithium content per assembled battery ≤ 2 g	SP188	For transportation of batteries alone, the total weight of the package must be 30 kg or less. The package must pass a 1.2 m drop test, and a lithium battery mark (size: 100 × 100 mm) must be attached to the package. For transportation of batteries packed with or contained in equipment, the special handling may be unnecessary depending on the number of batteries per package.
Lithium content per cell > 1 g Lithium content per assembled battery > 2 g	—	The package must comply with UN specification packaging requirements and be handled complying with Class 9 Dangerous Goods Regulations (such as displaying lithium battery hazard labels).

Package at our shipment

When the packages containing the target batteries are shipped overseas directly from us, a lithium battery mark (Figure 1) is displayed on the packages.

If the packages are shipped domestically, the mark (Figure 1) is not displayed.

Thus, when customers transport the domestic-bound packages overseas, the lithium battery mark (Figure 1) must be displayed on the packages by customers. The responsibility for the cargo lies with the customers. Please contact the transportation company for details on the lithium battery mark (Figure 1).

For both domestic and overseas shipments, the target battery units which must be handled as Class 9 Dangerous Goods are packaged according to UN specification packaging requirements, and the lithium battery hazard label (Figure 2) is displayed on the packages.

Figure 1: Lithium battery mark example



* UN number(s)

** Telephone number for additional information

Figure 2: Lithium battery hazard label example



Precaution for transportation by customers

For maritime or air transportation, the lithium battery mark (Figure 1) is also required for the outer package containing several packages of Mitsubishi Electric cells or batteries. When the content of a package must be handled as dangerous goods (Class 9), the package must comply with UN specification packaging requirements. Please issue Shipper's Declaration for Dangerous Goods and an Air Waybill (AWB) and attach the lithium battery hazard label (Figure 2) to the packages for transportation.

This section outlines the IATA Dangerous Goods Regulations 63rd Edition and the conditions of SP188 for non-dangerous goods transported by sea. 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 and International Maritime Dangerous Goods Code (IMDG Code).

12.3 Symbol for EU

The contents of the regulations described in this section apply in countries within the European Union.

EU battery regulation

To comply with the requirements of the EU battery regulation (Regulation (EU) 2023/1542) newly enacted by the European Commission, which took effect on August 18, 2024, the batteries incorporated in the AC servo amplifier products are marked with the CE mark.



The symbol that is affixed to the battery inside the product is explained here.



Point

- This symbol is valid only in countries within the European Union.

This symbol is specified in Article 13 "Labelling and marking of batteries" and Annex IV of the EU battery regulation (Regulation (EU) 2023/1542).

Mitsubishi Electric products are designed and manufactured with high-quality materials and components which can be recycled and/or reused.

This symbol means that batteries and accumulators should be disposed of separately from household waste.

If a chemical symbol is shown beneath the above symbol, a heavy metal of the corresponding chemical symbol is contained in the battery or the accumulator with the following standard concentration or more.

The concentration standards are 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. Batteries and accumulators must be disposed of properly.

We appreciate your cooperation in conserving the global environment.

12.4 Compliance with China Compulsory Certification (CCC)

Introduction

Some products are required to comply with China Compulsory Certification (hereinafter referred to as CCC) if exported, distributed, or sold to China. An outline of CCC is explained in this section. Mitsubishi Electric servo products are not subject to CCC.



Outline of CCC

CCC is a system for product certification that has been in effect in China since August 2003, the purpose of which is to protect consumers and ensure safety domestically in China. The certification system currently has five types of certifications: safety, electromagnetic compatibility (EMC), safety + EMC, fire-fighting equipment, and wireless LAN. Products subject to the certification are allowed to be exported, distributed, or sold to China only if they are certified by this system.

Products that have received certification proving compliance with the relevant technical standards (or products declared by the manufacturer as being compliant) must carry the specified mark (CCC mark). Many of the technical standards to be applied are GB standards (Chinese national standards), which comply with global standards such as those set forth by the IEC (International Electrotechnical Commission) and CISPR (International Special Committee on Radio Interference).

As part of the State Administration for Market Supervision and Administration Announcement No. 36 of 2023 ("Administration for Market Supervision and Administration Announcement on the Description of the Catalogue of Compulsory Product Certification and Issue of the List of Products" (Thursday, August 10, 2023)), a revised list of products subject to CCC certification (2023 version) has been published. Simultaneously, the description of the catalogue of compulsory product certification and the list of products in Announcement No. 18 of 2020 (revised 2020) was repealed.

Judgment

16 product groups divided into 96 categories are specified as the subject products (announcement No. 36 of 2023). The following table shows the judgment rendered regarding the CCC compliance requirement for servo products.

Model	Judgment
AC servo amplifier	Not subject
AC servo motor ^{*1}	Not subject
Options ^{*2}	Not subject

^{*1} AC servo motors are included in the list of low-power motors (small motors 750 W or less) in the list of products subject to compulsory certification, but are not subject to certification requirements for the following reason.

Explosion proof motors and controlled motors (servo motors, stepping motors, etc.) are excluded from the subject small capacity motors.

^{*2} Mitsubishi Electric option cables use the wires that are not classified into the cable category in the catalog.

REVISIONS

*The manual number is given on the bottom left of the back cover.

Revision date	*Manual number	Description
September 2026	IB(NA)0300641ENG-A	First edition

This manual confers no industrial property rights or any rights of any other kind, nor does it confer any patent licenses. Mitsubishi Electric Corporation cannot be held responsible for any problems involving industrial property rights which may occur as a result of using the contents noted in this manual.

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WARRANTY

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 is 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.

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TRANSLATION OF THE ORIGINAL INSTRUCTIONS

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MODEL:

MODEL CODE:

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