

Mitsubishi Electric AC Servo System

MITSUBISHI ELECTRIC SERVO SYSTEM
MELSERVO

MR-CV Power Regeneration Converter Unit User's Manual

-MR-CV_

SAFETY INSTRUCTIONS

Please read the instructions carefully before using the equipment.

To use the equipment correctly, do not attempt to install, operate, maintain, or inspect the equipment until you have read through this manual, installation guide, and appended documents carefully. Do not use the equipment until you have a full knowledge of the equipment, safety information and instructions.

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



WARNING

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



CAUTION

Indicates that incorrect handling may cause hazardous conditions, resulting in medium or slight injury.

Note that 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, instructions for other functions, and other information are shown separately in the "POINT" area.

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

[Transportation]

CAUTION

- To prevent injury, transport the products correctly according to their mass.
-

[Installation/wiring]

Warning

- To prevent an electric shock, turn off the power and wait for 20 minutes or more before starting wiring and/or inspection.
 - To prevent an electric shock, ground the converter unit.
 - To prevent an electric shock, any person who is involved in wiring should be fully competent to do the work.
 - To prevent an electric shock, mount the converter unit before wiring.
 - To prevent an electric shock, connect the protective earth (PE) terminal of the converter unit to the protective earth (PE) 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, any person who is involved in inspection should be fully competent to do the work.
 - To prevent an electric shock, do not operate the switches with wet hands.
-

DISPOSAL OF WASTE

Please dispose of this product and other options according to your local laws and regulations.

ABOUT THE MANUAL

Point

e-Manuals are Mitsubishi Electric FA electronic book manuals that can be browsed with a dedicated tool.

e-Manuals enable the following:

- Searching for desired information in multiple manuals at the same time (manual cross searching)
- Jumping from a link in a manual to another manual for reference
- Browsing for hardware specifications by scrolling over the components shown in product illustrations
- Bookmarking frequently referenced information
- Copying sample programs to engineering tools

U.S. CUSTOMARY UNITS

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

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

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1 FUNCTIONS AND CONFIGURATION

1.1 Outline

The MR-CV_ power regeneration converter unit can return the regenerative energy generated at servo motor deceleration to the power supply. The MR-CV_ power regeneration converter unit supports connections that share the bus voltage with multiple drive units and servo amplifiers, enabling energy conservation, less wiring, and space saving.

1.2 Model designation

Rating plate

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

AC SERVO
SER. A33001001

MITSUBISHI ELECTRIC
MODEL MR-CV55K

CAPACITY: 55kW

INPUT : 3AC200-240V 200.0A 50Hz/60Hz

OUTPUT : DC270-324V 238.0A

STD.: IEC/EN61800-5-1 MAN.: IB(NA)0300228

Max. Surrounding Air Temp.: 55°C

IP20 (Terminal block IP00)

MSIP-REI-MEK- TC300A911G51

MITSUBISHI ELECTRIC CORPORATION DATE: 2016-3
TOKYO 100-8310, JAPAN MADE IN JAPAN (PASSED)

- Serial number
- Model
- Capacity
- Applicable power supply
- Rated output
- Standard, Manual number
- Ambient temperature
- IP rating
- KC certification number
- The year and month of manufacture
- Country of origin

Model

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

MR - CV 7 5 K 4

Series

Capacity

Symbol	Capacity [kW]
11K	11
18K	18
30K	30
37K	37
45K	45
55K	55
75K	75

Power supply

Symbol	Power supply
None	3-phase 200 V AC to 240 V AC
4	3-phase 380 V AC to 480 V AC

1.3 Standard specifications

200 V class

Model MR-CV_			11K	18K	30K	37K	45K	55K
Output	Rated voltage		270 V DC to 324 V DC					
	Rated current [A]		41	76	144	164	198	238
Main circuit power supply input	Voltage/Frequency		3-phase 200 V AC to 240 V AC, 50 Hz/60 Hz					
	Rated current [A]		35	65	107	121	148	200
	Permissible voltage fluctuation		3-phase 170 V AC to 264 V AC					
	Permissible frequency fluctuation		Within ± 3 %					
	Power supply capacity [kVA]		☞ Page 67 Power supply capacity and generated loss					
	Inrush current [A]		☞ Page 69 Inrush currents at power-on of main circuit and control circuit					
Control circuit power supply input	Voltage/Frequency		1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz					
	Rated current [A]		0.2					
	Permissible voltage fluctuation		1-phase 170 V AC to 264 V AC					
	Permissible frequency fluctuation		Within ± 3 %					
	Power consumption [W]		30					
	Inrush current [A]		☞ Page 69 Inrush currents at power-on of main circuit and control circuit					
Interface power supply	Voltage		24 V DC ± 10 %					
	Current capacity [A]		0.35 *1					
Capacity [kW]			11	18	30	37	45	55
Protective functions			Undervoltage protection, regenerative error protection, regenerative overvoltage shut-off, MC drive circuit error protection, open-phase detection, inrush current suppression circuit error protection, main circuit device overheat error protection, cooling fan error protection, overload shut-off (electronic thermal)					
Main circuit method			Converter with power regeneration function					
Continuous rating [kW]			7.5	11	20	22	22	37
Instantaneous maximum rating [kW]			39	60	92	101	125	175
Satisfied standards	CE marking		LVD: EN 61800-5-1 EMC: EN 61800-3 MD: EN ISO 13849-1, EN 61800-5-2, EN 62061					
	UL standard		UL 508C					
Structure (IP rating)			Force cooling, open (IP20) *2					
Environment	Ambient temperature	Operation	0 °C to 55 °C (non-freezing)					
		Storage	-20 °C to 65 °C (non-freezing)					
	Ambient humidity	Operation	5 %RH to 90 %RH (non-condensing)					
		Storage						
	Ambience		Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist or dust					
	Altitude		Altitude 2000 m or less *3					
Vibration resistance		5.9 m/s ² , 10 Hz to 55 Hz (in each of the X, Y, and Z directions)						
Mass [kg]			6.1		12.1		25.0	

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

*2 This does not apply to the terminal block.

*3 Refer to the following for restrictions on using this product at an altitude exceeding 1000 m and up to 2000 m.

☞ Page 15 Restrictions when using this product at an altitude exceeding 1000 m and up to 2000 m

400 V class

Model MR-CV_			11K4	18K4	30K4	37K4	45K4	55K4	75K4
Output	Rated voltage		513 V DC to 648 V DC						
	Rated current [A]		21	38	72	82	99	119	150
Main circuit power supply input	Voltage/Frequency		3-phase 380 V AC to 480 V AC, 50 Hz/60 Hz						
	Rated current [A]		18	35	61	70	85	106	130
	Permissible voltage fluctuation		3-phase 323 V AC to 528 V AC						
	Permissible frequency fluctuation		Within ± 3 %						
	Power supply capacity [kVA]		☞ Page 67 Power supply capacity and generated loss						
	Inrush current [A]		☞ Page 69 Inrush currents at power-on of main circuit and control circuit						
Control circuit power supply input	Voltage/Frequency		1-phase 380 V AC to 480 V AC, 50 Hz/60 Hz						
	Rated current [A]		0.1						
	Permissible voltage fluctuation		1-phase 323 V AC to 528 V AC						
	Permissible frequency fluctuation		Within ± 3 %						
	Power consumption [W]		30						
	Inrush current [A]		☞ Page 69 Inrush currents at power-on of main circuit and control circuit						
Interface power supply	Voltage		24 V DC ± 10 %						
	Current capacity [A]		0.35 *1						
Capacity [kW]			11	18	30	37	45	55	75
Protective functions			Undervoltage protection, regenerative error protection, regenerative overvoltage shut-off, MC drive circuit error protection, open-phase detection, inrush current suppression circuit error protection, main circuit device overheat error protection, cooling fan error protection, overload shut-off (electronic thermal)						
Main circuit method			Converter with power regeneration function						
Continuous rating [kW]			7.5	11	20	25	25	55	55
Instantaneous maximum rating [kW]			39	60	92	101	125	175	180
Satisfied standards	CE marking		LVD: EN 61800-5-1 EMC: EN 61800-3 MD: EN ISO 13849-1, EN 61800-5-2, EN 62061						
	UL standard		UL 508C						
Structure (IP rating)			Force cooling, open (IP20) *2						
Environment	Ambient temperature	Operation	0 °C to 55 °C (non-freezing)						
		Storage	-20 °C to 65 °C (non-freezing)						
	Ambient humidity	Operation	5 %RH to 90 %RH (non-condensing)						
		Storage							
	Ambience		Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist or dust						
	Altitude		Altitude 2000 m or less *3						
Vibration resistance		5.9 m/s ² , 10 Hz to 55 Hz (in each of the X, Y, and Z directions)							
Mass [kg]			6.1		12.1			25.0	

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

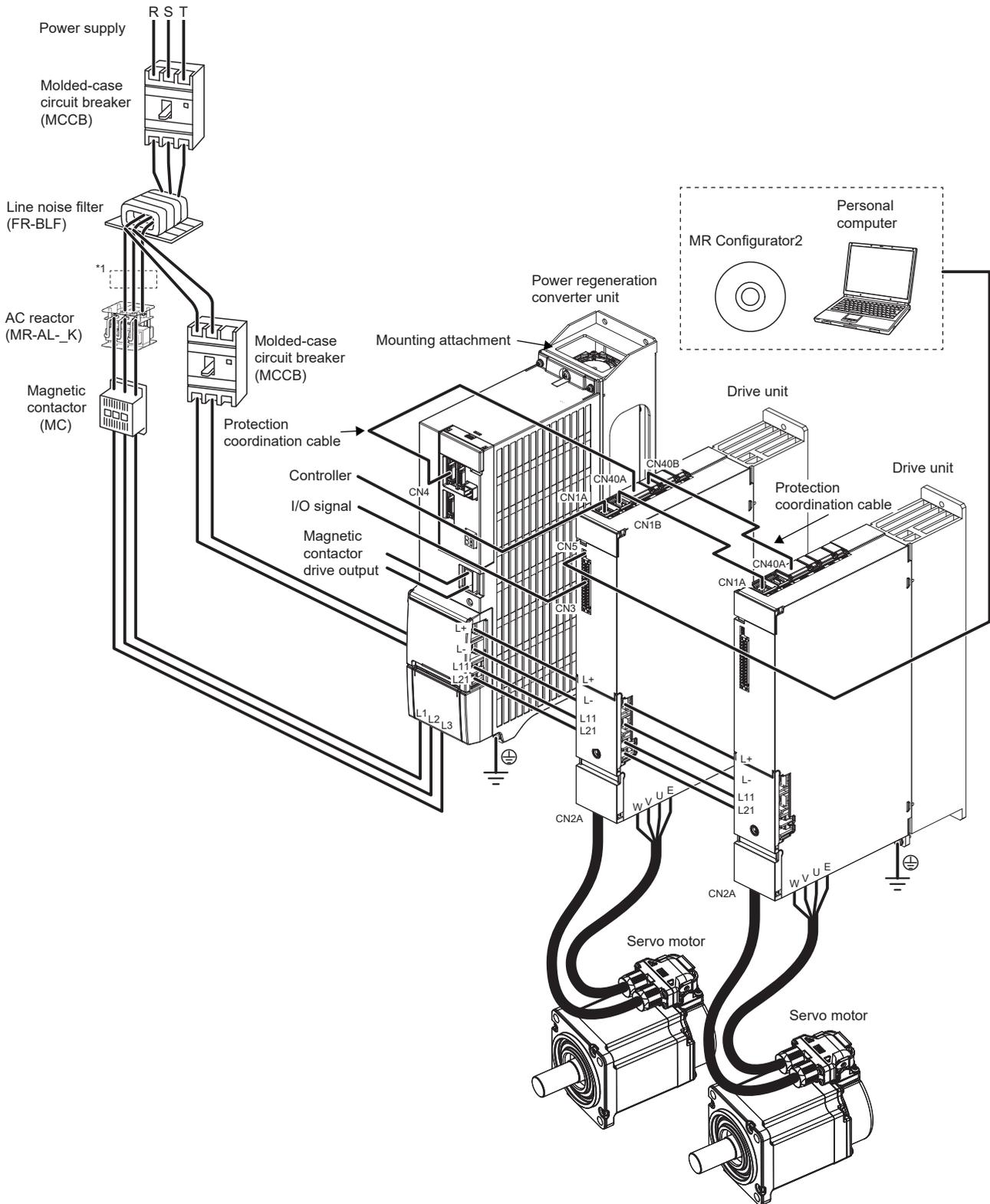
*2 This does not apply to the terminal block.

*3 Refer to the following for restrictions on using this product at an altitude exceeding 1000 m and up to 2000 m.

☞ Page 15 Restrictions when using this product at an altitude exceeding 1000 m and up to 2000 m

1.4 Configuration including peripheral equipment

- Equipment other than the converter unit, drive unit and servo motor is optional or a recommended product.
- The following is an example using the MR-J5D1-100G4 and MR-CV11K4.
 The actual converter unit and drive unit are mounted closely together.



*1 When sharing the power supply of an inductive load such as a cooling fan with the main circuit of the MR-CV_, do not supply the power from between the MR-CV_ and AC reactor or from the secondary side of the magnetic contactor to the inductive load. Connect the inductive load on the power supply side beyond the area in the dotted line.

2 INSTALLATION

Precautions

- Install the converter unit on incombustible material. Installing them either directly on or near combustibles may lead to smoke or a fire. In addition, the converter unit must be installed in a metal cabinet.
- Provide an adequate protection to prevent the following matter from entering the converter unit: conductive matter such as screws and metal fragments, and combustible matter such as oil.
- The converter unit may become hot. Take safety measures such as providing covers.
- Do not stack in excess of the specified number of product packages.
- Do not hold the front cover, cables, or connectors when carrying the converter unit. Doing so may cause the converter unit to drop.
- Use the eyebolts of the converter unit for transportation only. Do not use them to transport the converter unit when it is mounted on a machine.
- Do not overtighten the eyebolts of the converter unit. Tightening too hard may damage the tap.
- To prevent a malfunction, do not drop the converter unit or subject it to impact.
- When installing the converter unit, follow the user's manual and install the unit in a place that can support its weight.
- Do not get on the equipment or put a heavy load on it.
- Do not install or operate a converter unit that is missing parts or is damaged.
- To prevent a malfunction, do not block the intake and exhaust areas of the converter unit.
- 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 8 Standard specifications

- To prevent a fire or injury from occurring in the event of an earthquake or other natural disaster, securely install, mount, and wire the servo amplifier as stated in the user's manual.
- When the product has been stored for an extended period of time, contact your local sales office.
- When handling the converter unit, be careful with the edges of the converter unit.
- 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 materials 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 operation failure or malfunction.

2.1 Mounting direction and clearances

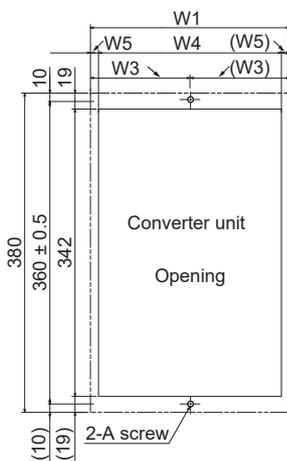
Precautions

- The converter unit must be installed in the specified direction.
- To prevent a malfunction, maintain the specified clearances between the converter unit and cabinet walls or other equipment.
- Circulate air so that the air at the top and bottom of the converter unit does not stagnate.
- When using heat generating equipment, install it with full consideration of heat generation so that the converter unit is not affected.
- Mount the converter unit on a perpendicular wall in the correct vertical direction.

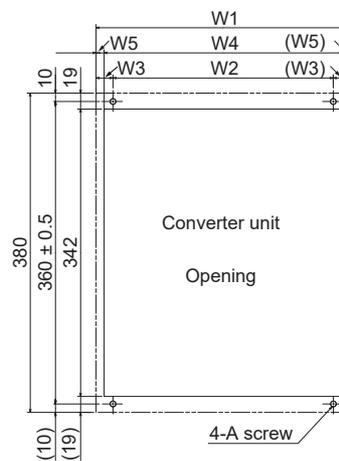
Installation

For details on installation, refer to the drive unit/servo amplifier user's manual and instruction manual.

Mounting hole location diagram



For the MR-CV_ with 18 kW or less



For the MR-CV_ with 30 kW or more

Converter unit	Variable dimensions [mm]					Screw size
	W1	W2	W3	W4	W5	A
MR-CV11K MR-CV18K MR-CV11K4 MR-CV18K4	90	—	45	82	4	M5
MR-CV30K MR-CV37K MR-CV45K MR-CV30K4 MR-CV37K4 MR-CV45K4	150	60 ± 0.5		142		
MR-CV55K MR-CV55K4 MR-CV75K4	300	180 ± 0.5	60	282	9	

2.2 Keeping out foreign materials

When drilling the cabinet for assembly, prevent drill chips and wire fragments from entering the converter unit.

Prevent foreign matter such as oil, water, and metallic dust from entering the converter unit 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.

2.3 Inspection items

Precautions

- Do not disassemble, repair, or modify the product.
- For repair and parts replacement, contact your local sales office.
- To prevent a malfunction, do not perform an insulation resistance test (megger test) on the converter unit.

Periodic inspection

Perform the following inspections.

- Check for loose terminal block screws. Retighten any loose screws.
- Check the cables and the like for scratches or cracks. Inspect them periodically according to operating conditions especially when the servo motor is movable.
- Check that the connector is securely connected to the converter unit.
- Check that the wires are not coming out from the connector.
- Check for dust accumulation on the converter unit.
- Check for unusual noise generated from the converter unit.
- Make sure that the emergency stop circuit operates properly such that an operation can be stopped immediately and a power is shut off by the emergency stop switch.

2.4 Parts with a service life

The service life of the following parts is listed below. In addition, 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. For parts replacement, please contact your local sales office.

Part name	Recommended service life
Smoothing capacitor	10 years
Cooling fan	10000 hours to 30000 hours (2 to 3 years)

Smoothing capacitor

The service life of the capacitor is 10 years (with a three-phase power supply input) under continuous operation in air-conditioned environments (ambient temperatures of 40 °C or less at altitudes of up to 1000 m and 30 °C or less at altitudes of over 1000 m and up to 2000 m). Ripple currents or other factors will deteriorate the characteristic of the smoothing capacitor. The service life of the capacitor greatly varies depending on ambient temperature and operating conditions.

Converter unit cooling fan

The cooling fan bearings will reach the end of their service life in 10000 hours to 30000 hours. Therefore, the cooling fan must be replaced after two to three years of continuous operation as a guideline. If unusual noise or vibration is found during inspection, the cooling fan must also be replaced.

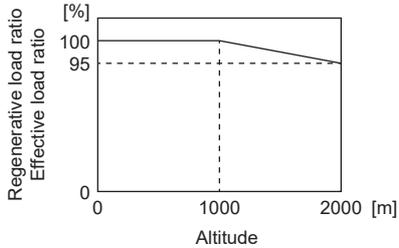
The service life has been calculated in an environment which contains no corrosive gas, flammable gas, oil mist, or dust. The average annual ambient temperature was 40 °C.

2.5 Restrictions when using this product at an altitude exceeding 1000 m and up to 2000 m

For restrictions on the drive unit/servo amplifier, refer to the drive unit/servo amplifier user's manual and instruction manual.

Effective load ratio and regenerative load ratio

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



Input voltage

Generally, withstand voltage decreases as altitude increases; however, there is no restriction on the withstand voltage.

Parts with a service life

■Smoothing capacitor

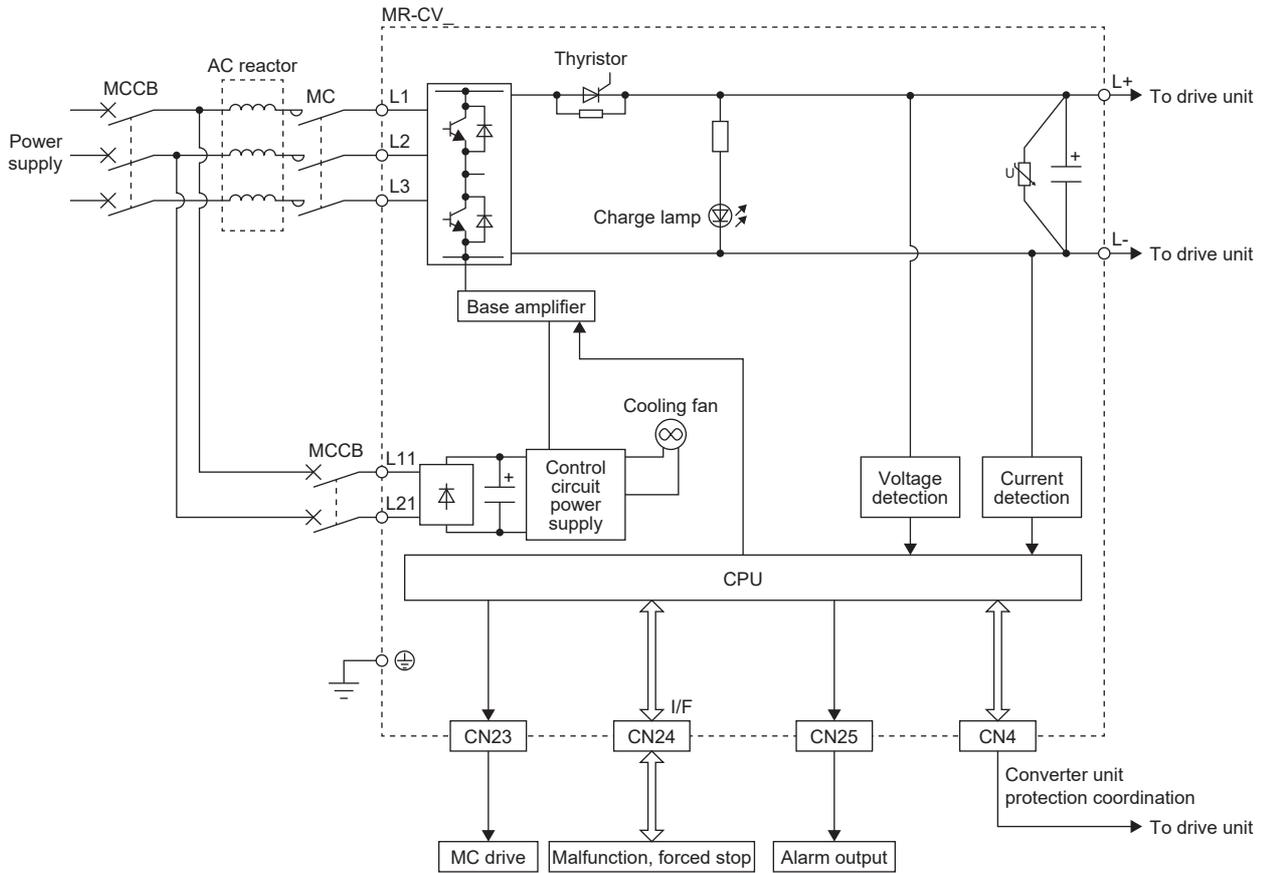
The capacitor will reach the end of its service life in 10 years of continuous operation in an air-conditioned environment (with an ambient temperature of 30 °C or less).

■Converter unit cooling fan

There is no restriction.

3 FUNCTION BLOCK DIAGRAM

This chapter shows the function block diagram of this servo.



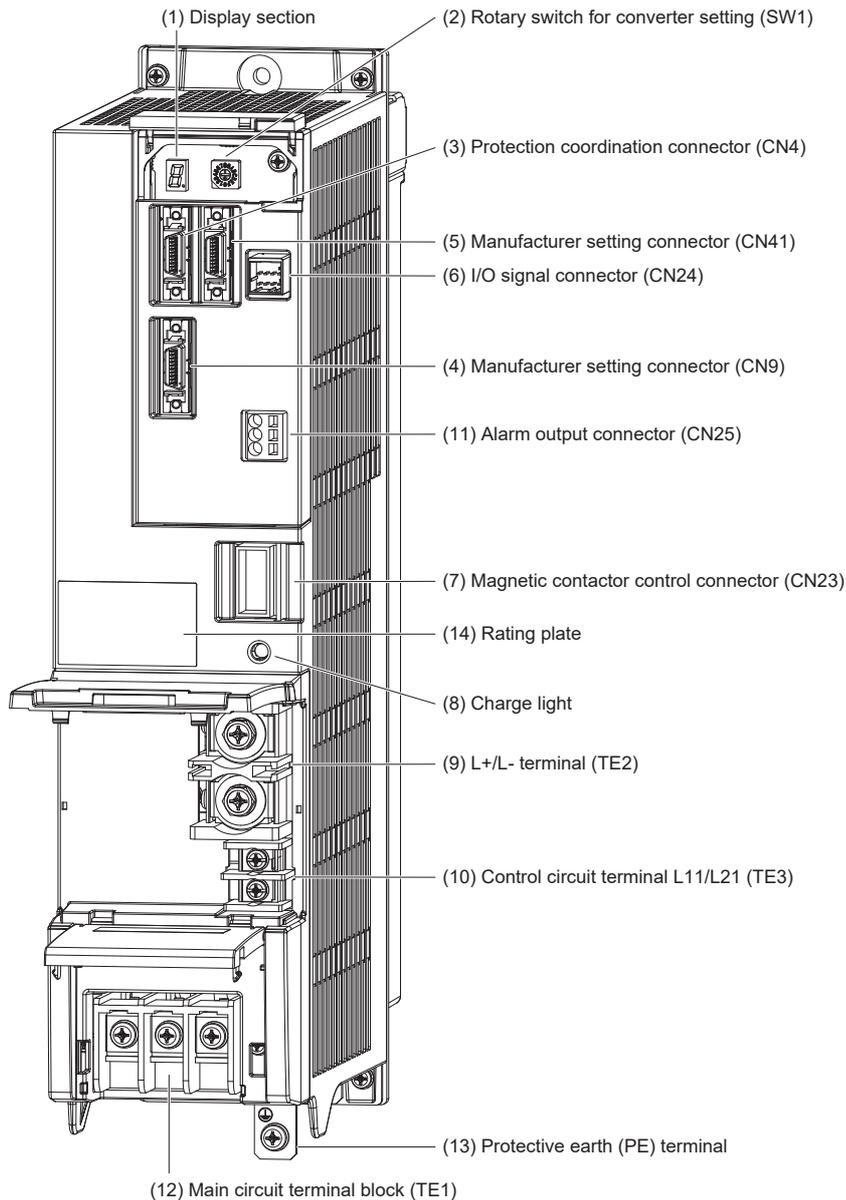
4 STRUCTURE (PARTS IDENTIFICATION)

4.1 Parts identification

MR-CV18K(4) or lower

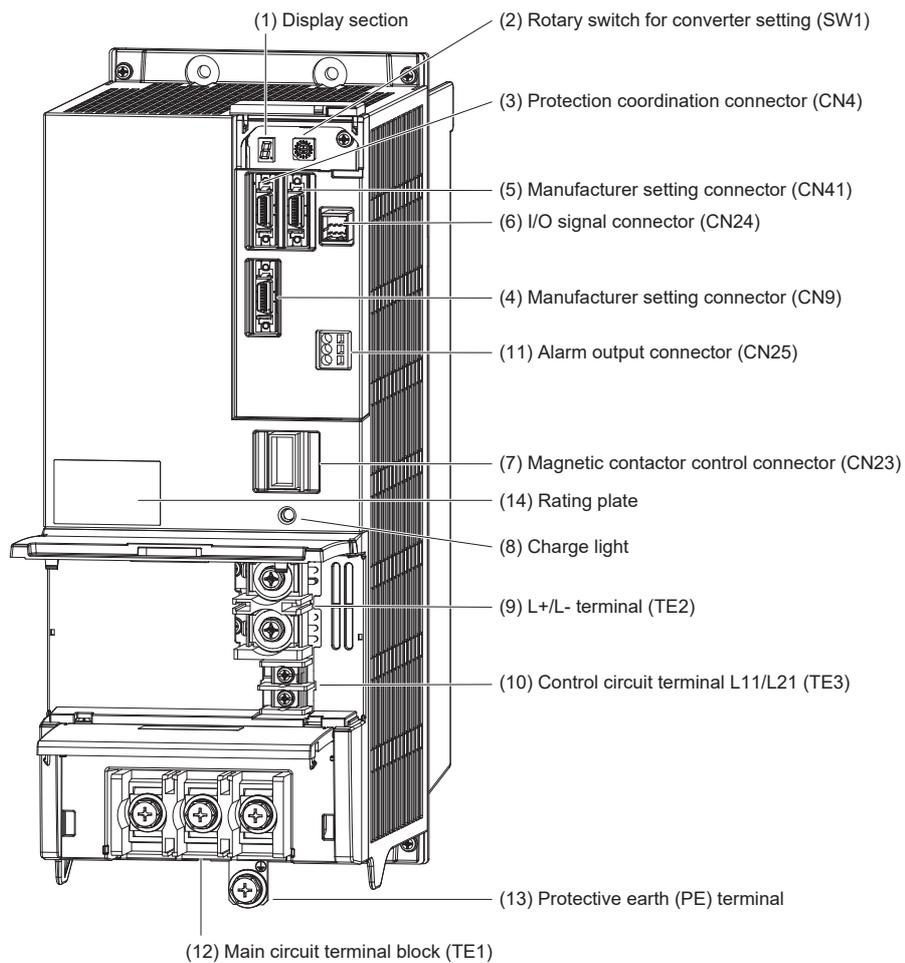
This diagram shows the terminal cover in the open position. For how to open and close the terminal cover, refer to the following.

☞ Page 24 Opening and closing the terminal cover



No.	Name	Application	Detailed explanation
(1)	Display section	The 1-digit, 7-segment LED indicator shows the converter unit status and alarm number.	☞ Page 28 Converter unit switch settings and operation panel
(2)	Rotary switch for converter setting (SW1)	Set the function of the converter unit.	
(3)	Protection coordination connector (CN4)	Connect it with CN40A of the drive unit.	☞ Page 28 Converter unit switch settings and operation panel ☞ Page 45 Connectors and pin assignments
(4)	Manufacturer setting connector (CN9)	This is for manufacturer setting. Although this connector has the same shape as the protection coordination connector (CN4), do not connect anything to it, including the protection coordination cable.	—
(5)	Manufacturer setting connector (CN41)	This is for manufacturer setting. Although this connector has the same shape as the protection coordination connector (CN4), do not connect anything to it, including the protection coordination cable.	
(6)	I/O signal connector (CN24)	Connect the digital I/O signals.	☞ Page 49 Signal (device) explanation
(7)	Magnetic contactor control connector (CN23)	Connect it to the coil of the magnetic contactor.	☞ Page 32 Example power circuit connections ☞ Page 45 Connectors and pin assignments
(8)	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.	—
(9)	L+/L- terminal (TE2)	Connect it with the drive unit by using the bus bar.	☞ Page 32 Example power circuit connections
(10)	Control circuit terminal L11/L21 (TE3)	Connect it with the control circuit power supply.	
(11)	Alarm output connector (CN25)	This is a changeover contact output which indicates that the protective functions of the converter unit have been activated and that the output to the drive unit has stopped.	☞ Page 49 Signal (device) explanation
(12)	Main circuit terminal block (TE1)	Connect the input power supply.	☞ Page 32 Example power circuit connections
(13)	Protective earth (PE) terminal	Connect this terminal to the protective earth (PE) of the cabinet.	☞ Page 63 Grounding
(14)	Rating plate	Indicates model, capacity, and other information.	☞ Page 7 Model designation

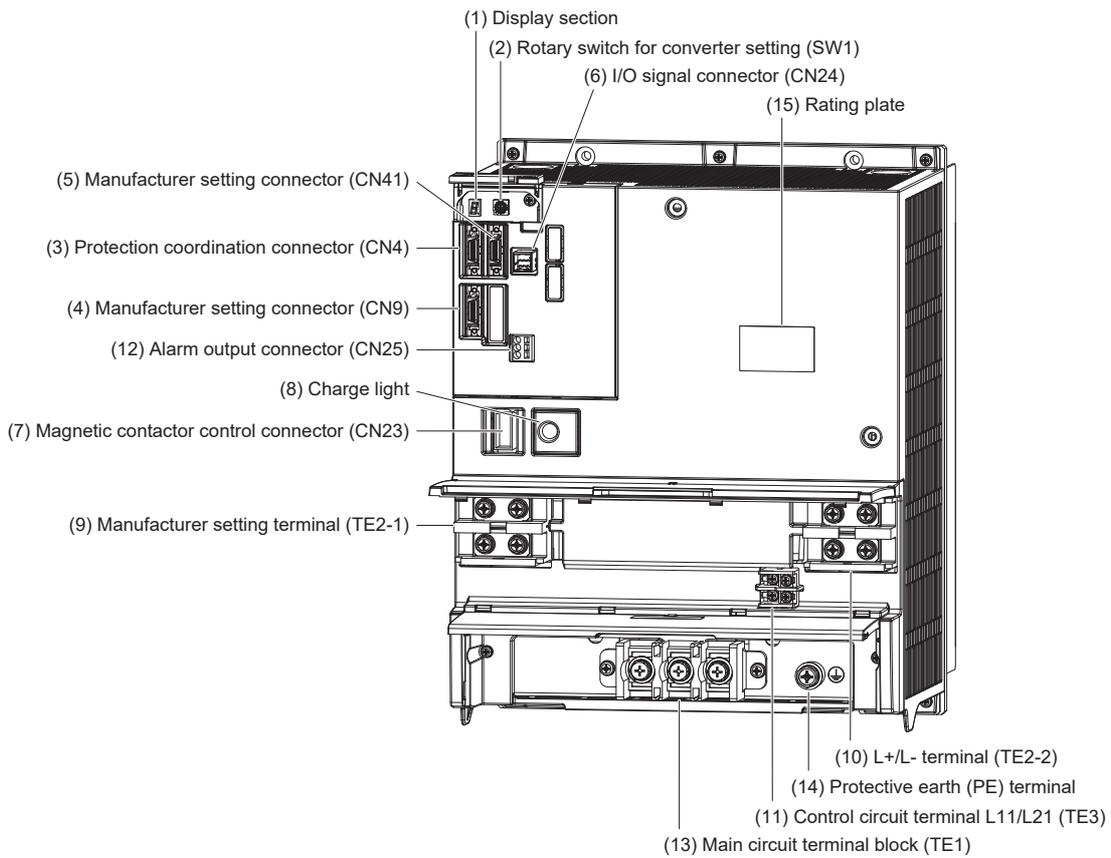
MR-CV30K(4)/MR-CV37K(4)/MR-CV45K(4)



No.	Name	Application	Detailed explanation
(1)	Display section	The 1-digit, 7-segment LED indicator shows the converter unit status and alarm number.	☞ Page 28 Converter unit switch settings and operation panel
(2)	Rotary switch for converter setting (SW1)	Set the function of the converter unit.	
(3)	Protection coordination connector (CN4)	Connect it with CN40A of the drive unit.	☞ Page 28 Converter unit switch settings and operation panel ☞ Page 45 Connectors and pin assignments
(4)	Manufacturer setting connector (CN9)	This is for manufacturer setting. Although this connector has the same shape as the protection coordination connector (CN4), do not connect anything to it, including the protection coordination cable.	—
(5)	Manufacturer setting connector (CN41)	This is for manufacturer setting. Although this connector has the same shape as the protection coordination connector (CN4), do not connect anything to it, including the protection coordination cable.	
(6)	I/O signal connector (CN24)	Connect the digital I/O signals.	☞ Page 49 Signal (device) explanation
(7)	Magnetic contactor control connector (CN23)	Connect it to the coil of the magnetic contactor.	☞ Page 32 Example power circuit connections ☞ Page 45 Connectors and pin assignments
(8)	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.	—
(9)	L+/L- terminal (TE2)	Connect it with the drive unit by using the bus bar.	☞ Page 32 Example power circuit connections
(10)	Control circuit terminal L11/L21 (TE3)	Connect it with the control circuit power supply.	
(11)	Alarm output connector (CN25)	This is a changeover contact output which indicates that the protective functions of the converter unit have been activated and that the output to the drive unit has stopped.	☞ Page 49 Signal (device) explanation
(12)	Main circuit terminal block (TE1)	Connect the input power supply.	☞ Page 32 Example power circuit connections
(13)	Protective earth (PE) terminal	Connect this terminal to the protective earth (PE) of the cabinet.	☞ Page 63 Grounding
(14)	Rating plate	Indicates model, capacity, and other information.	☞ Page 7 Model designation

MR-CV55K(4)/MR-CV75K4/MR-CV55K

The diagram shows the MR-CV55K4.



No.	Name	Application	Detailed explanation
(1)	Display section	The 1-digit, 7-segment LED indicator shows the converter unit status and alarm number.	☞ Page 28 Converter unit switch settings and operation panel
(2)	Rotary switch for converter setting (SW1)	Set the function of the converter unit.	
(3)	Protection coordination connector (CN4)	Connect it with CN40A of the drive unit.	☞ Page 28 Converter unit switch settings and operation panel ☞ Page 45 Connectors and pin assignments
(4)	Manufacturer setting connector (CN9)	This is for manufacturer setting. Although this connector has the same shape as the protection coordination connector (CN4), do not connect anything to it, including the protection coordination cable.	—
(5)	Manufacturer setting connector (CN41)	This is for manufacturer setting. Although this connector has the same shape as the protection coordination connector (CN4), do not connect anything to it, including the protection coordination cable.	
(6)	I/O signal connector (CN24)	Connect the digital I/O signals.	☞ Page 49 Signal (device) explanation
(7)	Magnetic contactor control connector (CN23)	Connect it to the coil of the magnetic contactor.	☞ Page 32 Example power circuit connections ☞ Page 45 Connectors and pin assignments
(8)	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.	—
(9)	Manufacturer setting terminal (TE2-1)	This is for manufacturer setting. Do not connect anything.	
(10)	L+/L- terminal (TE2-2)	Connect it with the drive unit by using the bus bar.	☞ Page 32 Example power circuit connections
(11)	Control circuit terminal L11/L21 (TE3)	Connect it with the control circuit power supply.	
(12)	Alarm output connector (CN25)	This is a changeover contact output which indicates that the protective functions of the converter unit have been activated and that the output to the drive unit has stopped.	☞ Page 49 Signal (device) explanation
(13)	Main circuit terminal block (TE1)	Connect the input power supply.	☞ Page 32 Example power circuit connections
(14)	Protective earth (PE) terminal	Connect this terminal to the protective earth (PE) of the cabinet.	☞ Page 63 Grounding
(15)	Rating plate	Indicates model, capacity, and other information.	☞ Page 7 Model designation

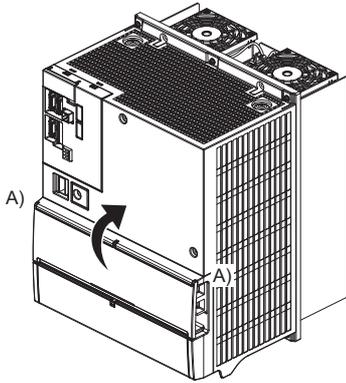
4.2 Opening and closing the terminal cover

This section describes how to open and close the terminal cover.

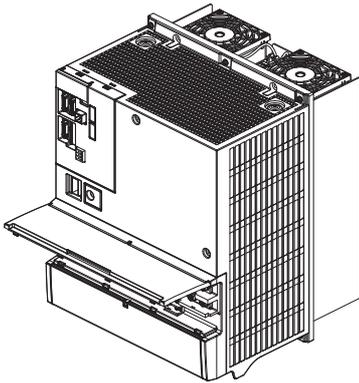
Top terminal cover

■How to open

1. Support point A) and pull up the cover.

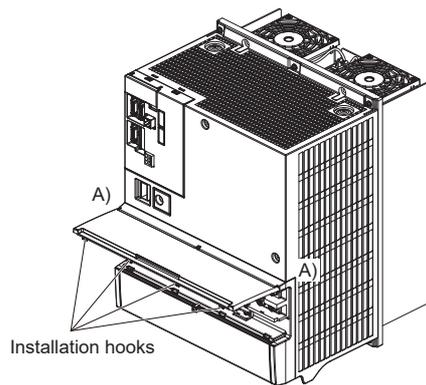


2. The cover is fixed when it is raised to the position shown in the figure.

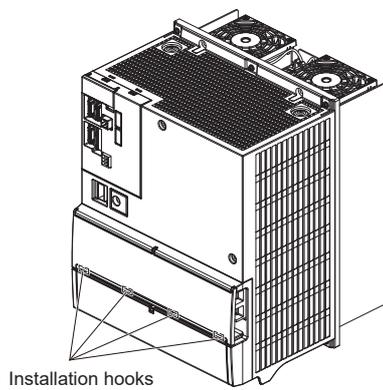


■How to close

1. Support point A) and close the cover.



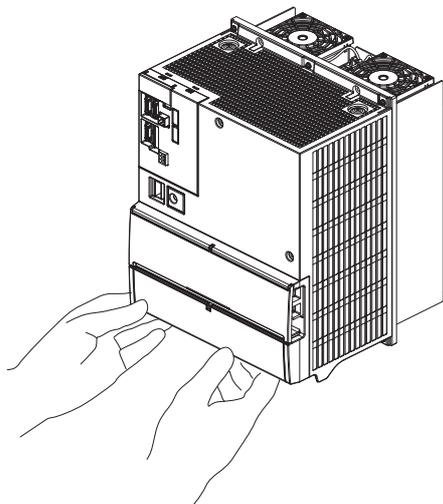
2. Press the cover until the installation hooks click.



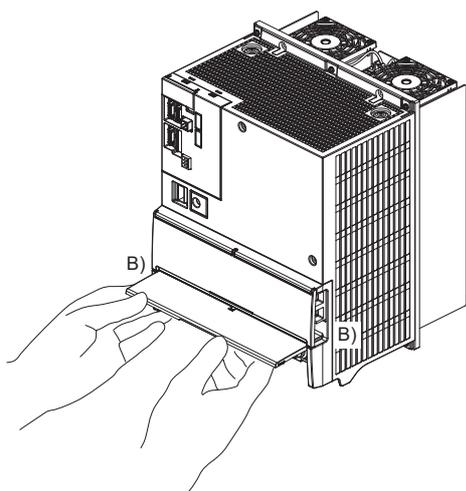
Bottom terminal cover

■How to open

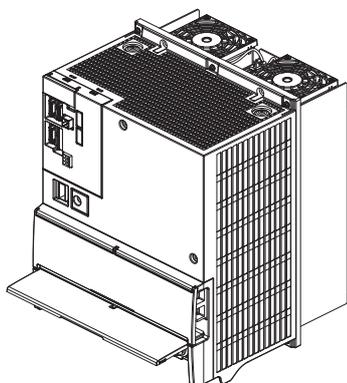
1. Hold the left and right sides of the bottom of the terminal cover with both hands.



2. Support point B) and close the cover.

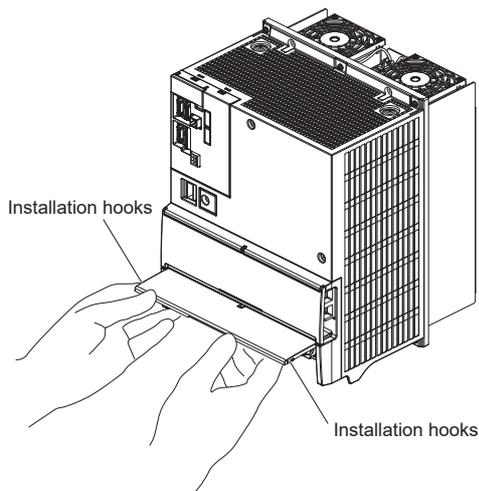


3. The cover is fixed when it is raised to the top.

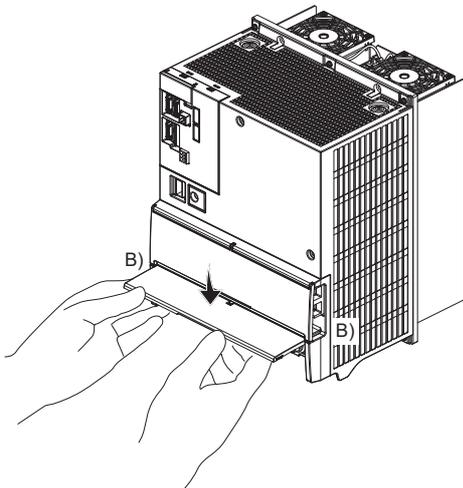


■ How to close

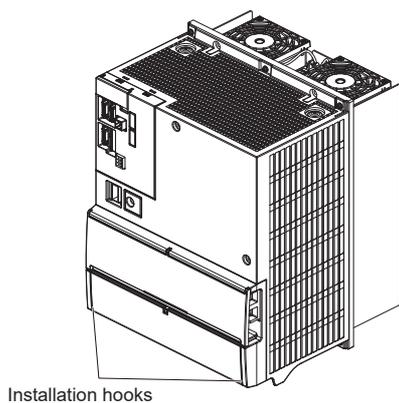
1. Hold the left and right sides of the bottom of the terminal cover with both hands.



2. Support point B) and close the cover.



3. Press the cover until the installation hooks click.



4.3 Converter unit switch settings and operation panel

Forced stop, protection coordination, and magnetic contactor drive output can be configured by setting the converter unit switch.

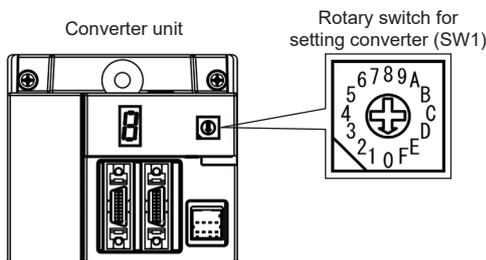
The converter unit status and alarm number can be displayed on the converter unit display (1-digit, 7-segment LED).

Switches

If a metal screw driver contacts with the conductive areas, the switches may malfunction. Therefore, use an insulated screw driver instead of a metal screw driver to operate the rotary switch (SW1).

Do not set a value other than the listed setting values on the rotary switch for converter setting (SW1).

The setting of each switch becomes effective by cycling the main circuit power supply and the control circuit power supply. To enable/disable forced stop, protection coordination, and magnetic contactor drive output, set the rotary switch for converter setting. The following table shows the settings of the rotary switch for converter setting and the combinations for enabling/disabling each function.

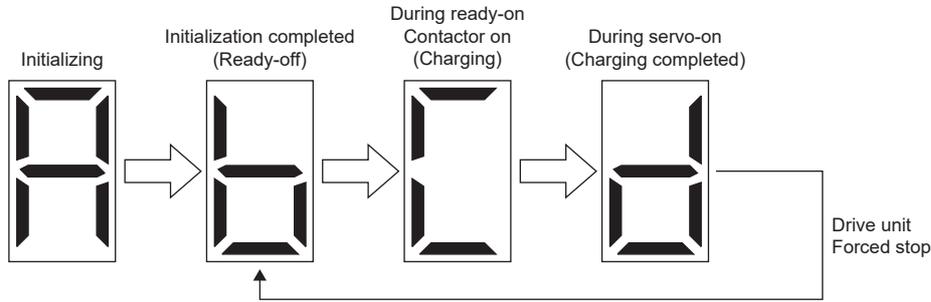


No.	Forced stop	Protection coordination		Magnetic contactor drive output
		Protection coordination	Standalone drive	
0 (initial value)	Disabled	Enabled	Disabled	Enabled
1	Disabled	Enabled	Disabled	Disabled
4	Enabled	Enabled	Disabled	Enabled
8	Disabled	Disabled	Enabled	Disabled
Other than the above	Do not use them.			

Scrolling display

Normal display

When the power supply to the control section of the converter unit is turned on, the progress of the initial setting is displayed on the 1-digit, 7-segment LED. Normally, the 1-digit, 7-segment LED is always lit.

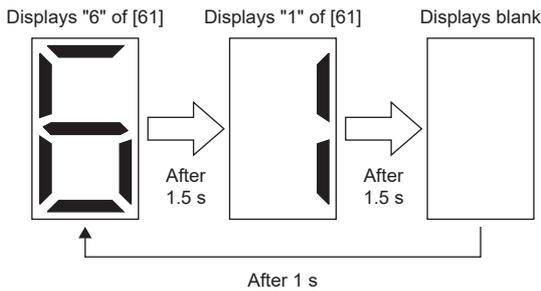


Alarm display

If an alarm or warning has occurred, the alarm number or warning number is displayed by flashing one digit at a time.

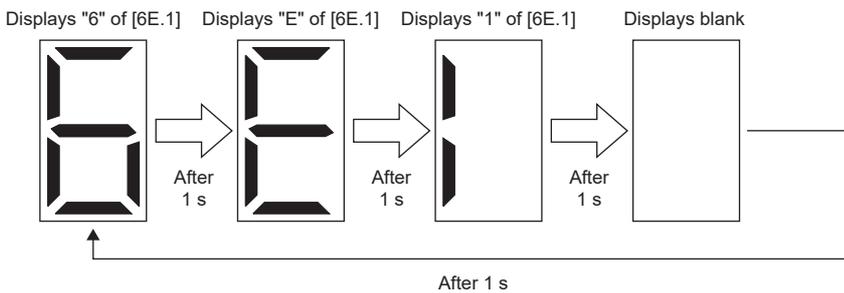
■For 2-digit display

The sequence of displaying the 2-digit alarm/warning number and a blank display is repeated. This is an example of the alarm display for when [61] is occurring.

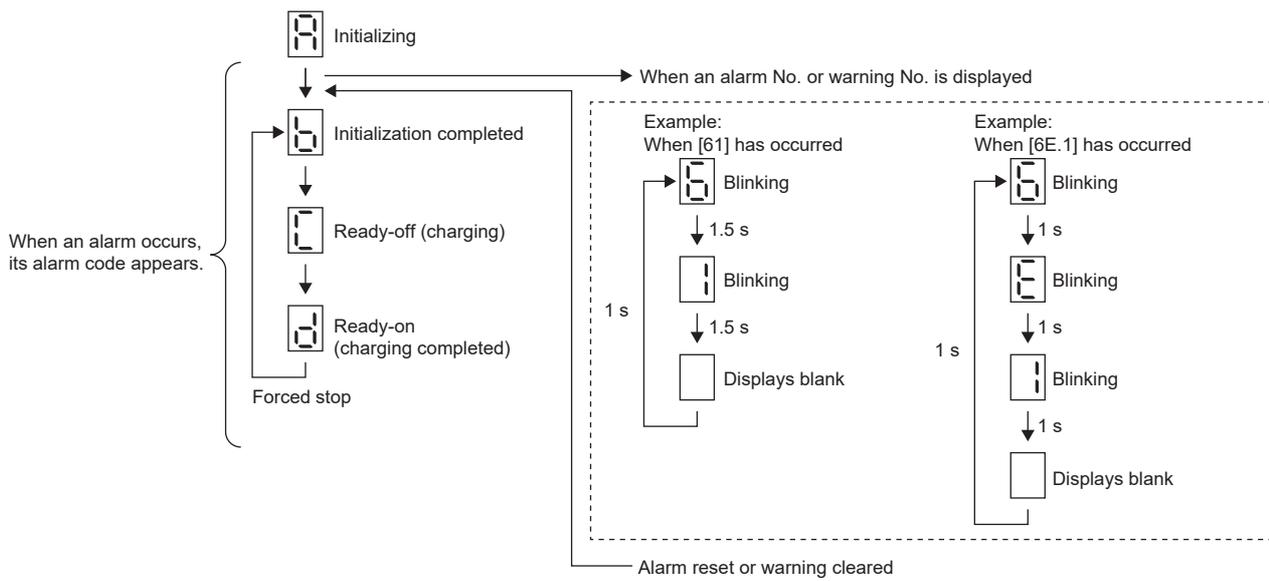


■For 3-digit display

The sequence of displaying the 3-digit alarm/warning number and a blank display is repeated. This is an example of the alarm display for when [6E.1] is occurring.



Display sequence



Status display list

The following table shows the status of the converter unit.

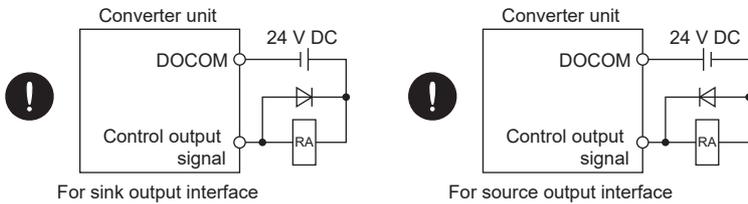
Display	Status	Description
	Initializing	Displayed during initialization.
	Initialization complete	Displayed when the status is initialization complete, ready-off, and servo-off.
	Ready-off (charging)	Displayed in the servo-off status.
	Ready-on (charging complete)	Displayed in the servo-on status.
 ^{*1}	Alarms and warnings	The alarm number or warning number that occurred is displayed.

1 "" represents the alarm numbers and warning numbers.

5 SIGNALS AND WIRING

Precautions

- Insulate the conductive parts of the terminals.
- Turn off the power and wait for 20 minutes or more until the charge light of the unit turns off. Checking the voltage between L+ and L- using the tester, etc. is recommended.
- To prevent failure and malfunction, only the power supply/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. Failing to do so may cause the cables and connectors to disconnect during operation.
- Unless stated otherwise, all connection diagrams in this user's manual are sink interface diagrams.
- Install a surge absorbing diode in the correct direction. Failing to do so may cause the amplifier to malfunction and not to output signals, disabling protective circuits such as the emergency stop.



- If the wires are not properly secured to the terminal block, the poor contact may cause the wires and terminal block to generate heat. Be sure to secure the wires with the specified torque.
- Check that no operation signal is being input to the drive unit and servo amplifier before resetting an alarm or releasing the emergency stop. Failing to do so may cause an unexpected operation.
- If the power supply is shut off by a molded-case circuit breaker or a fuse, remove the cause and secure safety before switching the power on.
- Install the converter unit according to the EMC guidelines because electromagnetic interference may affect the electronic equipment used near the converter unit.
- 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

- Connect a magnetic contactor between a power supply and the main circuit power supply (L1/L2/L3) of a converter unit to configure a circuit that shuts off the power supply on the converter unit side because failure of the converter unit may cause smoke and fire if a magnetic contactor is not connected.
- Use a configuration that shuts off the main circuit power supply with ALM (Malfunction).
- Check the converter unit model and use the correct power supply voltage.
- Exogenous noise or lightning surges may degrade the characteristics of the surge absorber (varistor) built into the converter unit and damage it.
- To prevent malfunction, avoid bundling the converter unit's power line (input cable) 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. Use a molded-case circuit breaker (MCCB) with the input cables of the main circuit power supply.

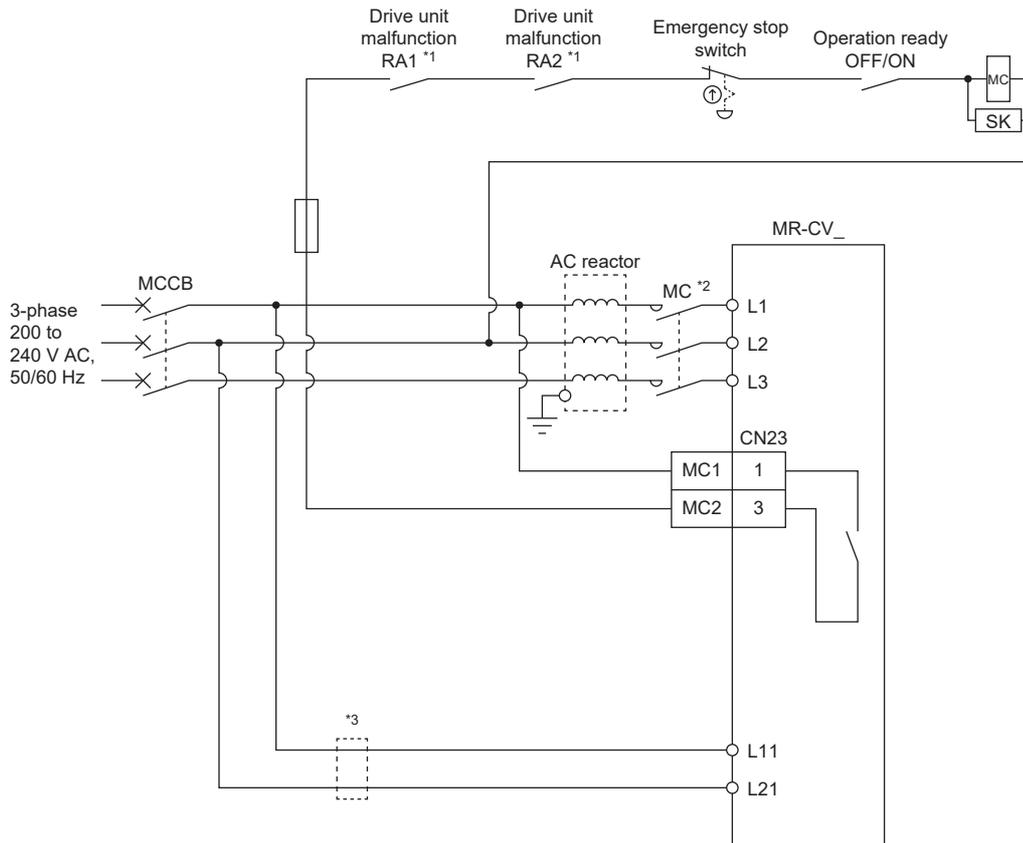
Magnetic contactor control connector (CN23)

By enabling the magnetic contactor drive output, the main circuit power supply can be automatically shut off when an alarm occurs in the converter unit and drive unit.

The magnetic contactor drive output can be enabled by setting the rotary switch for converter setting (SW1) of the converter unit to "0" or "4".

When the magnetic contactor drive output is enabled

The magnetic contactor can be controlled by connecting the magnetic contactor control connector (CN23) to the coil of the magnetic contactor.



*1 When connecting multiple drive units to one converter unit, configure the system to input the emergency stop input of the controller by the alarm signal of each drive unit, and configure the sequence so that if an alarm occurs in any of the drive units, all the drive units turn to ready-off. Because the drive units and servo amplifiers coast when in ready-off (emergency stop status from the controller), install a dynamic brake when stopping the servo motor.

*2 Use the magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. If forced stop deceleration is enabled when connecting one unit, the bus voltage may drop depending on the main circuit power supply voltage and operation pattern, causing a dynamic brake deceleration during forced stop deceleration. If dynamic brake deceleration is not required, delay the time to turn off the magnetic contactor.

*3 Install an overcurrent protection device (molded-case circuit breaker, fuse, etc.).

☞ Page 93 Molded-case circuit breakers, fuses, magnetic contactors

When the converter unit receives a start command from the drive unit, a short circuit occurs between the CN23-1 pin (MC1) and CN23-3 pin (MC2) connected to the AC power supply, and power is supplied to the control circuit of the magnetic contactor. When power is supplied to the control circuit of the magnetic contactor, the magnetic contactor is turned on and the main circuit power supply is turned on to the converter unit.

In the following cases, the converter unit opens the connection between CN23-1 pin (MC1) and CN23-3 pin (MC2) to automatically turn off the main circuit power supply.

- When an alarm occurs on the converter unit
- When an alarm occurs on the drive unit
- When EM1 (Forced stop) of the converter unit is turned off
- When an STO warning occurs on the drive unit

When the magnetic contactor drive output is disabled

Even if an alarm occurs on the converter unit and drive unit, the main circuit power supply is not automatically turned off, so configure a circuit that detects the alarms externally and turns off the main circuit power supply.

Wiring diagram

When the magnetic contactor drive output is enabled

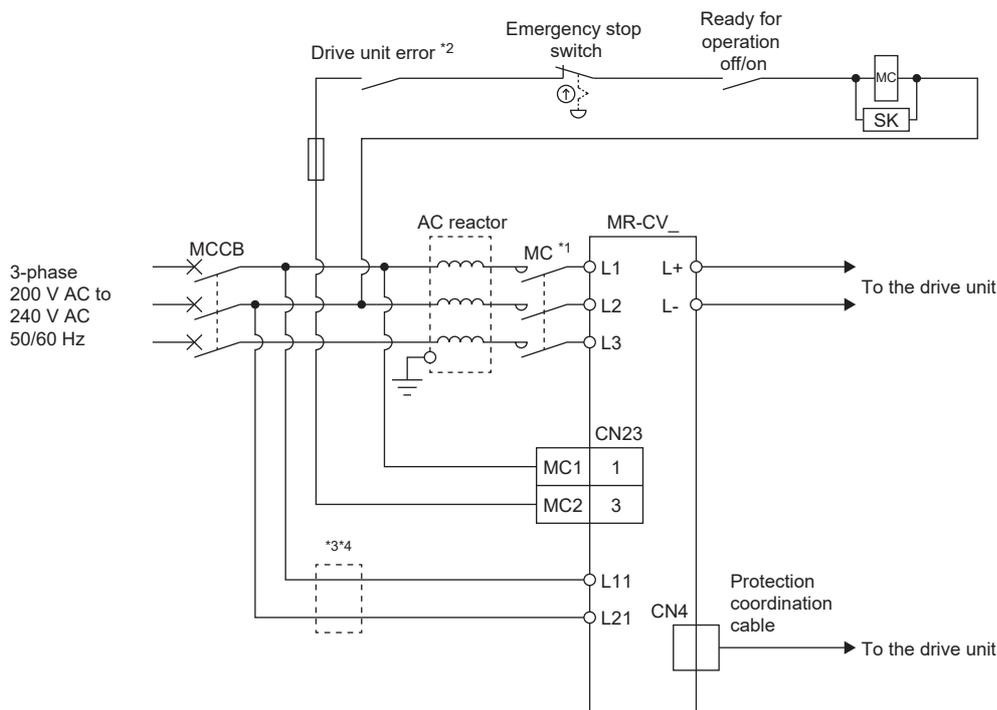
Set the rotary switch for converter setting to "0" (factory setting).

The converter unit controls the magnetic contactor.

Connect the converter unit and the drive unit adjacent to it with a protection coordination cable.

Turn on/off the control circuit power supplies of the converter unit and drive unit at the same time.

■200 V class



*1 Use the magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. The bus voltage may drop depending on the main circuit power supply voltage and operation pattern, causing a dynamic brake deceleration during a forced stop deceleration.

*2 Configure a sequence that shuts off the main circuit power supply when an alarm occurs on a drive unit.

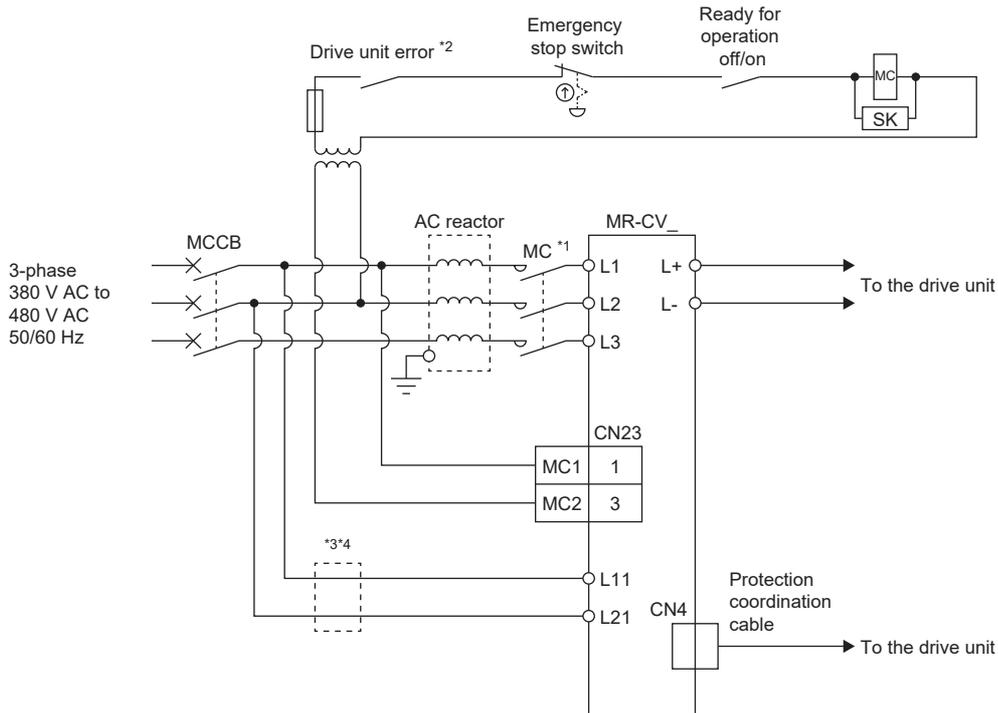
*3 Install an overcurrent protection device (molded-case circuit breaker, fuse, etc.) to protect the branch circuit.

☞ Page 93 Molded-case circuit breakers, fuses, magnetic contactors

*4 For wire size and overcurrent protection device selection, refer to the following.

☞ Page 89 Selection example of wires

■400 V class



- *1 Use the magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. The bus voltage may drop depending on the main circuit power supply voltage and operation pattern, causing a dynamic brake deceleration during a forced stop deceleration.
- *2 Configure a sequence that shuts off the main circuit power supply when an alarm occurs on a drive unit.
- *3 Install an overcurrent protection device (molded-case circuit breaker, fuse, etc.) to protect the branch circuit.
☞ Page 93 Molded-case circuit breakers, fuses, magnetic contactors
- *4 For wire size and overcurrent protection device selection, refer to the following.
☞ Page 89 Selection example of wires

When the magnetic contactor drive output is disabled

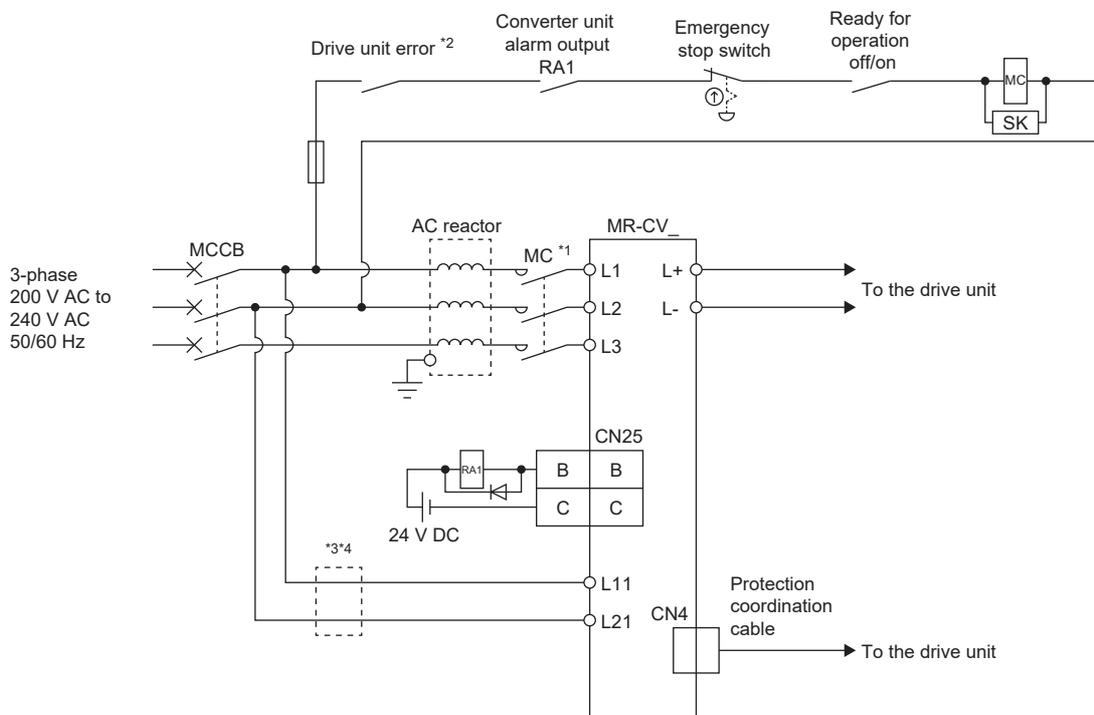
Set the rotary switch for converter setting to "1".

The converter unit controls the magnetic contactor.

Connect the converter unit and the drive unit adjacent to it with a protection coordination cable.

Turn on/off the control circuit power supplies of the converter unit and drive unit at the same time.

■200 V class



*1 Use the magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. The bus voltage may drop depending on the main circuit power supply voltage and operation pattern, causing a dynamic brake deceleration during a forced stop deceleration.

*2 Configure a sequence that shuts off the main circuit power supply when an alarm occurs on a drive unit.

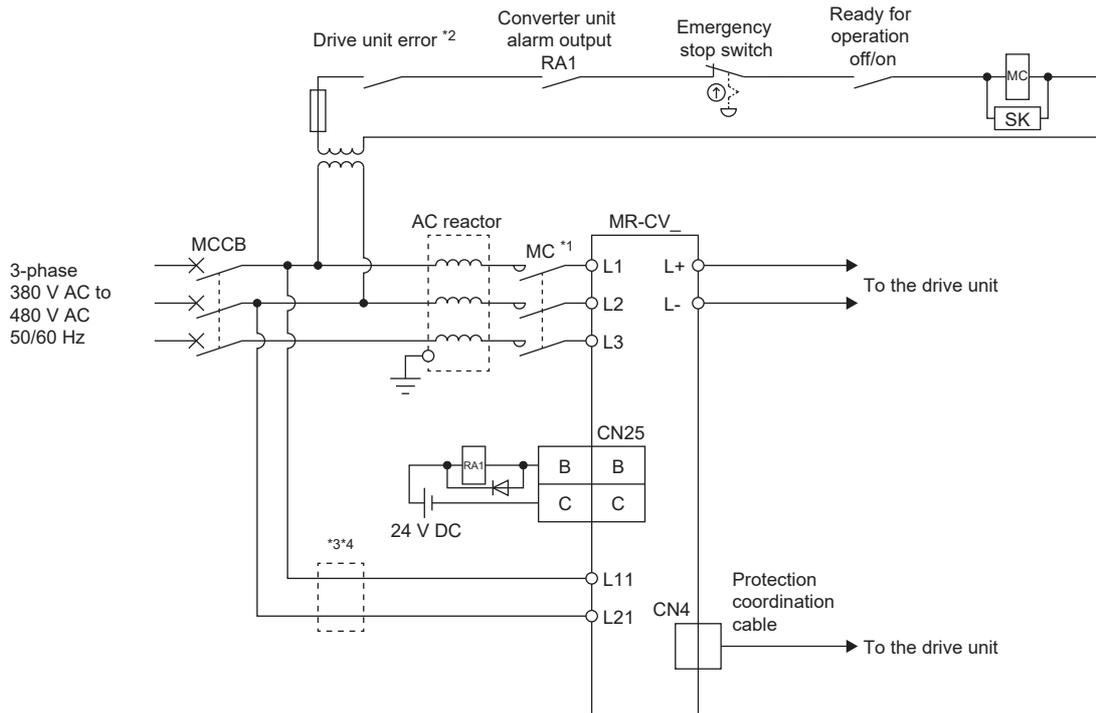
*3 Install an overcurrent protection device (molded-case circuit breaker, fuse, etc.) to protect the branch circuit.

☞ Page 93 Molded-case circuit breakers, fuses, magnetic contactors

*4 For wire size and overcurrent protection device selection, refer to the following.

☞ Page 89 Selection example of wires

■400 V class



- *1 Use the magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. The bus voltage may drop depending on the main circuit power supply voltage and operation pattern, causing a dynamic brake deceleration during a forced stop deceleration.
- *2 Configure a sequence that shuts off the main circuit power supply when an alarm occurs on a drive unit.
- *3 Install an overcurrent protection device (molded-case circuit breaker, fuse, etc.) to protect the branch circuit.
 - ☞ Page 93 Molded-case circuit breakers, fuses, magnetic contactors
- *4 For wire size and overcurrent protection device selection, refer to the following.
 - ☞ Page 89 Selection example of wires

5.2 Explanation of power supply system

Explanation of signals

For the layout of terminal blocks, refer to the following.

☞ Page 84 DIMENSIONS

Connection destination (application)	Symbol	Terminal block	Description	
			MR-CV11K to MR-CV55K	MR-CV11K4 to MR-CV75K4
Main circuit power supply	L1/L2/L3	TE1	Supply 3-phase 200 V AC to 240 V AC, 50 Hz/60 Hz power to L1, L2, and L3.	Supply 3-phase 380 V AC to 480 V AC, 50 Hz/60 Hz power to L1, L2, and L3.
Control circuit power supply	L11/L21	TE3	Supply 1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz power to L11 and L21.	Supply 1-phase 380 V AC to 480 V AC, 50 Hz/60 Hz power to L11 and L21.
Drive unit	L+/L-	TE2	Connect them with L+ and L- of the drive unit. Use the bus bar.	
Protective earth (PE)		PE	Connect this terminal to the protective earth (PE) of the cabinet.	

Power-on sequence

Power-on procedure

1. Wire the power supply using a magnetic contactor between the power supply and the main circuit power supply (L1/L2/L3) of a servo amplifier by referring to the following section. Configure the circuit to switch off the magnetic contactor as soon as an alarm occurs using an external sequence.

☞ Page 32 Example power circuit connections

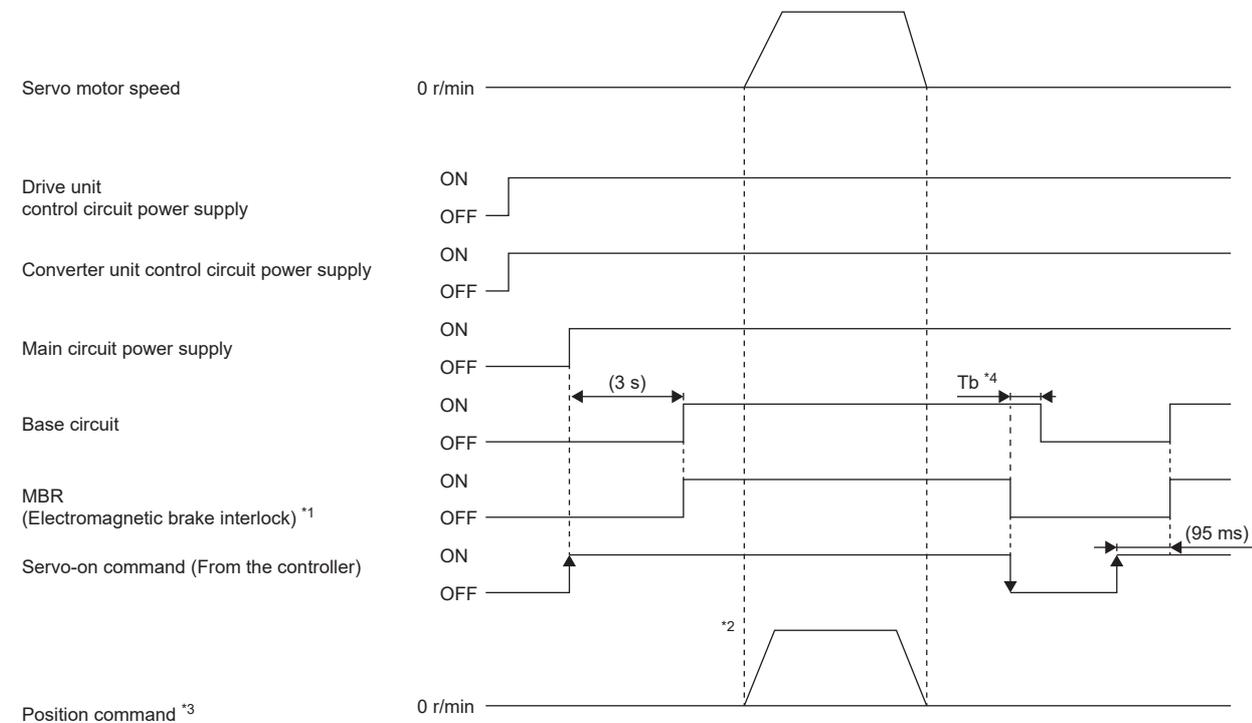
2. Switch on the control circuit power supply (L11 and L21) of the converter unit and drive unit simultaneously with or before switching on the main circuit power supply. If the main circuit power supply is not on, the drive unit display shows the corresponding warning. However, the warning will disappear and the equipment will operate properly if the main circuit is powered on.

Timing chart

■When combining one converter unit and one drive unit

- When the magnetic contactor drive output is enabled and remains ready-on

The main circuit power supply is not shut off even in the servo-off status.



*1 If an electromagnetic brake is installed externally, configure the circuit so that the electromagnetic brake operates with MBR as described below.

ON: Electromagnetic brake is not activated

OFF: Electromagnetic brake is activated

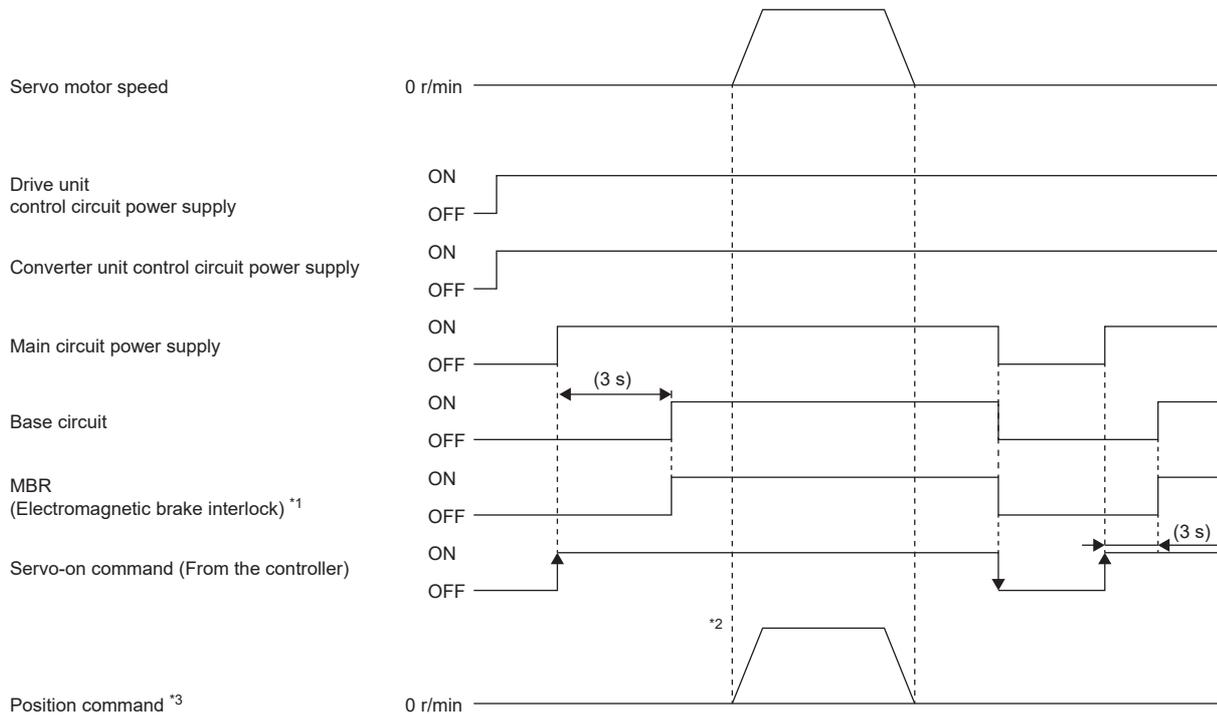
*2 Give a position command after the externally-installed electromagnetic brake is released.

*3 When in the position control mode.

*4 In the drive unit parameters, set the delay time (T_b) from when the MBR shuts off at servo-off until base circuit shut-off.

- When the magnetic contactor drive output is enabled and returns to ready-off

When in ready-off, the magnetic contactor of the converter unit is turned off and the main circuit power supply is shut off.



*1 If an electromagnetic brake is installed externally, configure the circuit so that the electromagnetic brake operates with MBR as described below.

ON: Electromagnetic brake is not activated

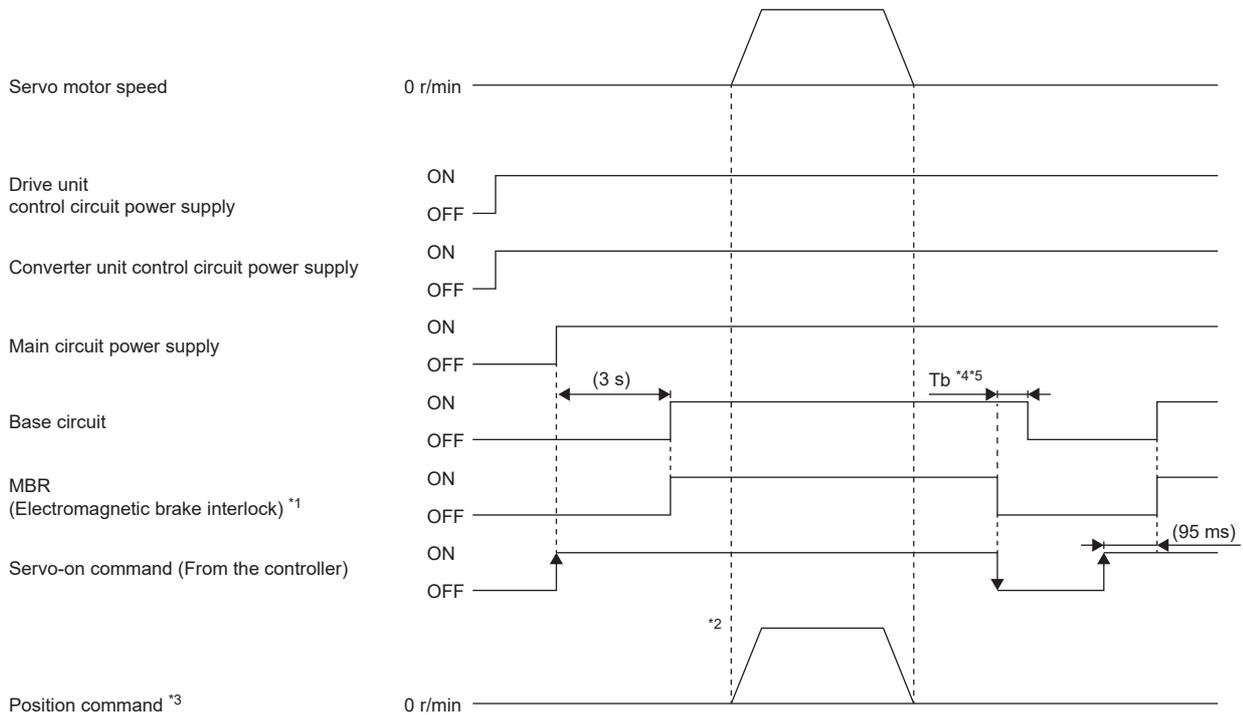
OFF: Electromagnetic brake is activated

*2 Give a position command after the externally-installed electromagnetic brake is released.

*3 When in the position control mode.

- When the magnetic contactor drive output is disabled

When an alarm occurs, turn off the magnetic contactor using an external sequence and shut off the main circuit power supply.



*1 If an electromagnetic brake is installed externally, configure the circuit so that the electromagnetic brake operates with MBR as described below.

ON: Electromagnetic brake is not activated

OFF: Electromagnetic brake is activated

*2 Give a position command after the externally-installed electromagnetic brake is released.

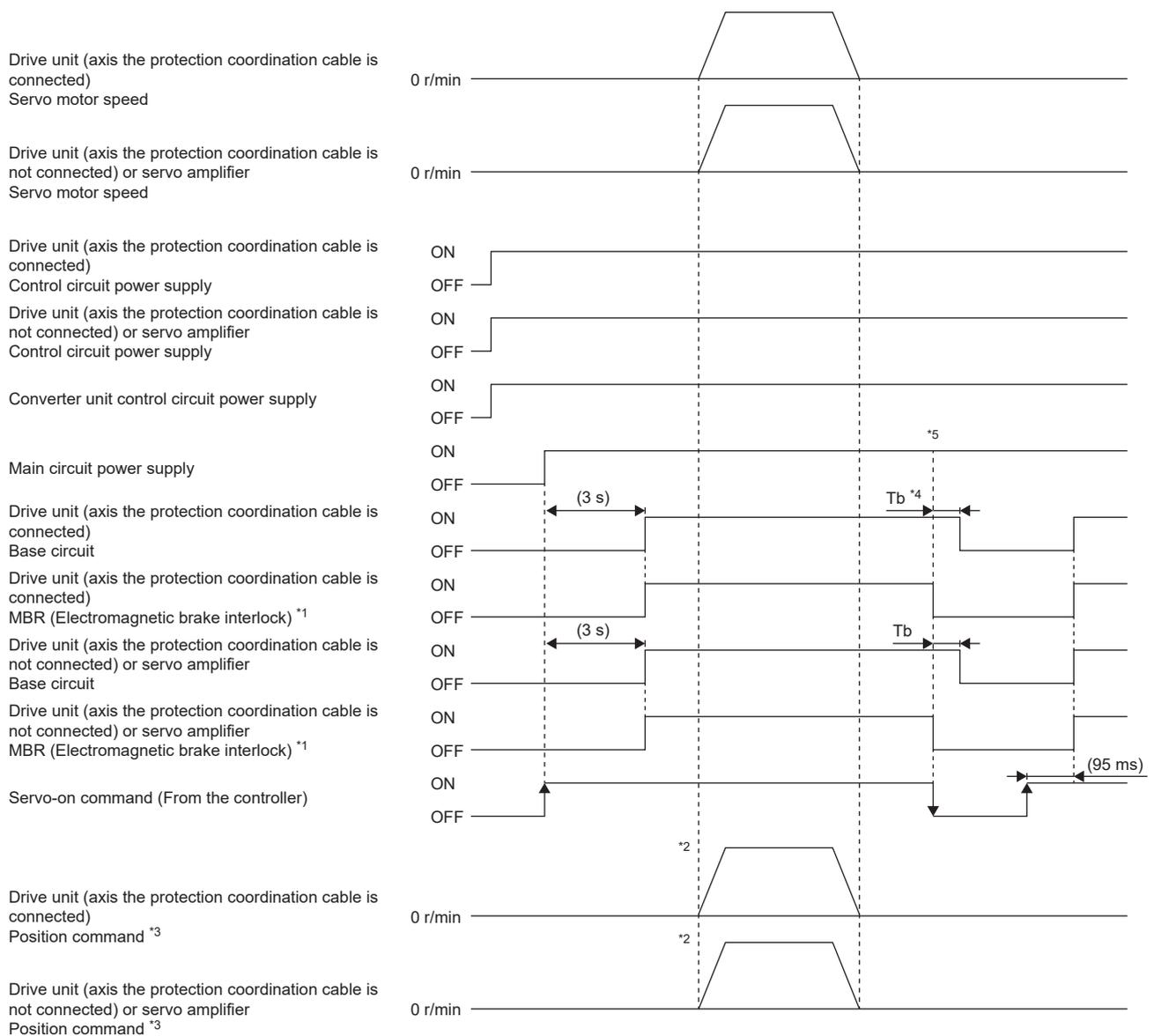
*3 When in the position control mode.

*4 In the drive unit parameters, set the delay time (T_b) from when the MBR shuts off at servo-off until base circuit shut-off.

*5 This is the case when in the ready-on status during servo-off. In the ready-off status, the base circuit is turned off at the same time as the servo-on command is turned off. ($T_b = 0$)

■ When connecting multiple drive units and servo amplifiers to the converter unit

- When the magnetic contactor drive output is enabled and remains ready-on



*1 If an electromagnetic brake is installed externally, configure the circuit so that the electromagnetic brake operates with MBR as described below.

ON: Electromagnetic brake is not activated

OFF: Electromagnetic brake is activated

*2 Give a position command after the externally-installed electromagnetic brake is released.

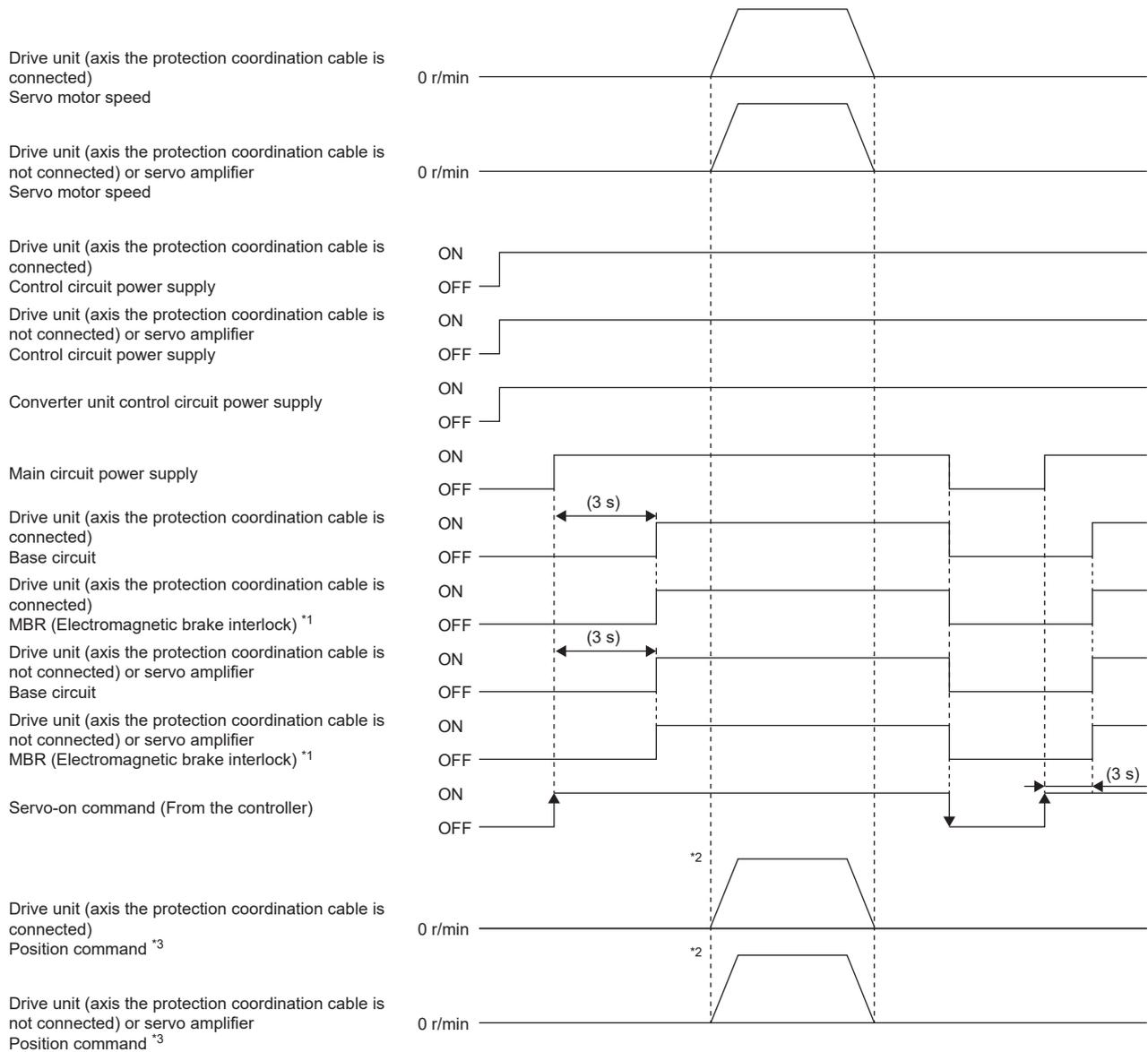
*3 When in the position control mode.

*4 In the drive unit parameters, set the delay time (Tb) from when the MBR shuts off at servo-off until base circuit shut-off.

*5 The main circuit power supply is not shut off even in the servo-off status.

- When the magnetic contactor drive output is enabled and returns to ready-off

When the axis connected by the protection coordination cable is in the servo-off status, the magnetic contactor of the converter unit is turned off and the main circuit power supply is shut off. The main circuit power supply is not shut off even if the axes that are not connected by protection coordination cables are in the servo-off status.



*1 If an electromagnetic brake is installed externally, configure the circuit so that the electromagnetic brake operates with MBR as described below.

ON: Electromagnetic brake is not activated

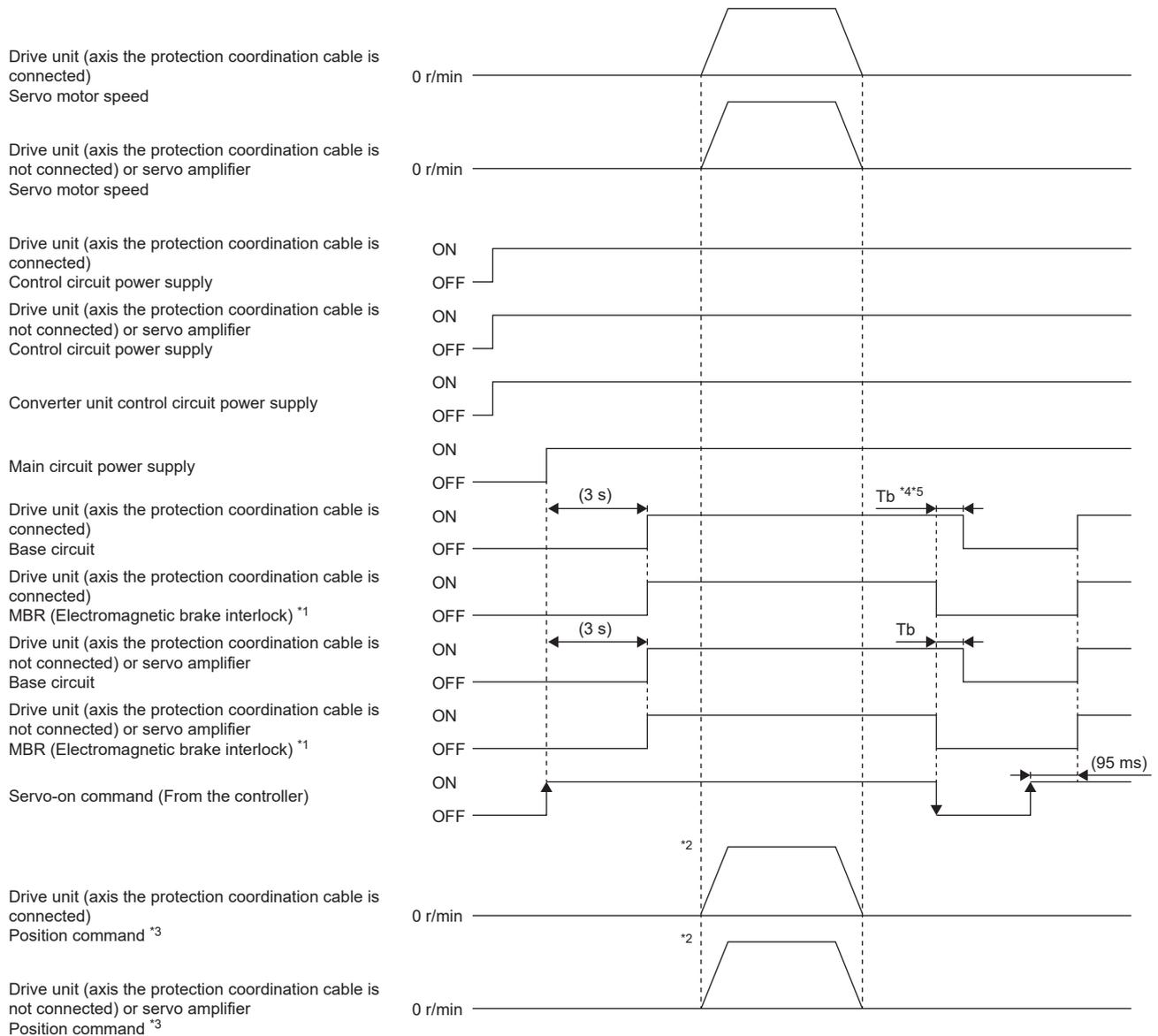
OFF: Electromagnetic brake is activated

*2 Give a position command after the externally-installed electromagnetic brake is released.

*3 When in the position control mode.

- When the magnetic contactor drive output is disabled

When an alarm occurs, turn off the magnetic contactor using an external sequence and shut off the main circuit power supply.



*1 If an electromagnetic brake is installed externally, configure the circuit so that the electromagnetic brake operates with MBR as described below.

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

*2 Give a position command after the externally-installed electromagnetic brake is released.

*3 When in the position control mode.

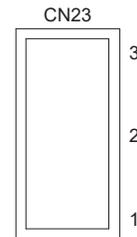
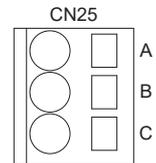
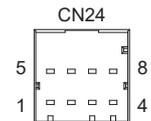
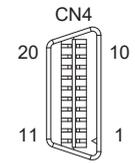
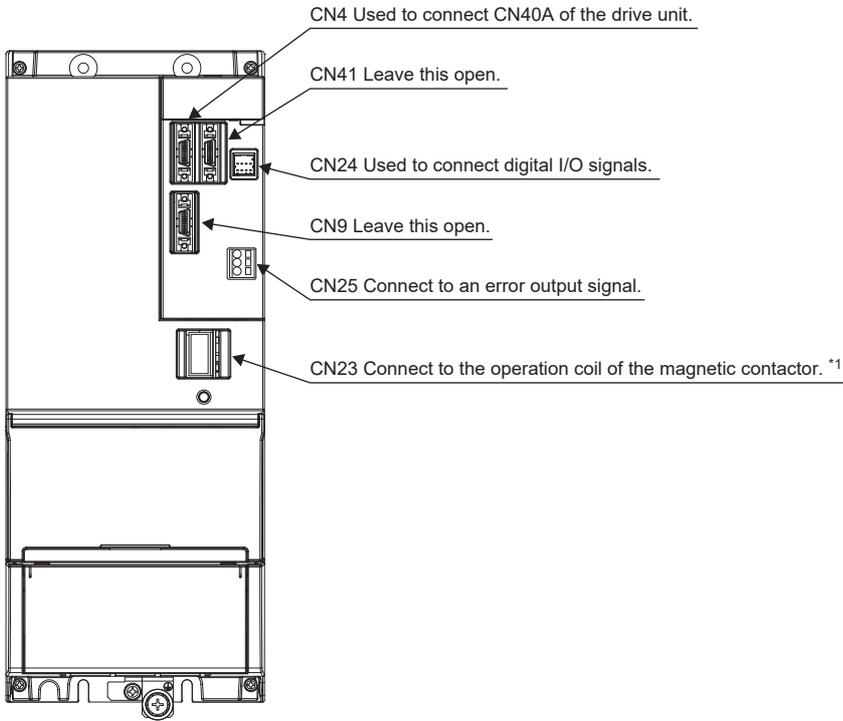
*4 In the drive unit parameters, set the delay time (Tb) from when the MBR shuts off at servo-off until base circuit shut-off.

*5 This is the case when in the ready-on status during servo-off. In the ready-off status, the base circuit is turned off at the same time as the servo-on command is turned off. (Tb = 0)

5.3 Connectors and pin assignments

The pin assignments of the connectors are as viewed from the cable connector wiring section.
 When using the CN24 connector, the MR-CVCN24S connector set and crimping tool are required.

Converter unit connectors and pin assignments



*1 The connector for CN23 and open tool are supplied with the converter unit.

Connecting the CN25

Use care not to damage the conductor when stripping wires. Using a damaged conductor may cause poor insulation, loose connection, and missing wires.

After completing the connection, pull the wires lightly one by one to ensure that they cannot be easily pulled out. Not satisfying this requirement may lead to loose connection and missing wires.

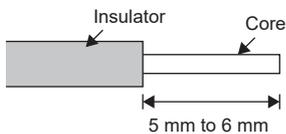
After the connection is completed, be careful not to apply wire tension (twisting force) directly to the point of contact between the conductive part of the terminal block and the wire. Applying such wire tension may lead to loose connection and power loss.

When opening the spring, do not apply excessive force. Doing so may cause damage to the housing.

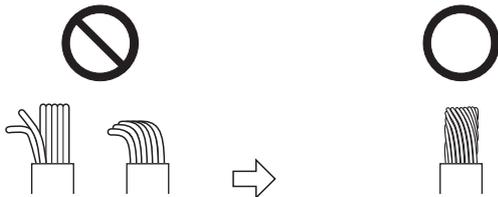
Fabricating the wire insulator

The stripped length of the wire insulator should be 5 mm to 6 mm. Set the appropriate length based on the wire type and fabrication condition.

AWG 28 to 14 stranded or solid wire can be connected to CN25. Wire that has a thick insulator and does not fit into the CN25 wire insertion hole cannot be used.



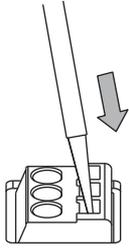
Twist the core wires lightly and straighten them as follows.



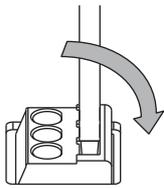
Inserting wire

Insert one wire per wire insertion hole (round hole) of CN25.

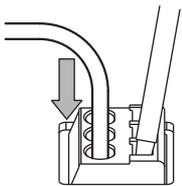
1. Insert a screwdriver diagonally into the operation slot (square hole).



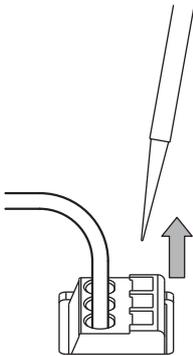
2. Insert the screwdriver fully while adjusting the angle to the upright position. If performed correctly, the screwdriver will hold this position even when released.



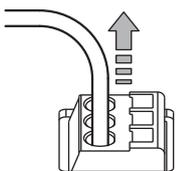
3. Insert the properly exposed wire into the wire insertion hole. When doing so, run the wire along the edge of the round hole to insert it smoothly.



4. Insert the wire until it touches the back of the hole, and remove the screwdriver while holding the wire.



5. To confirm, pull the wire lightly. Do not pull harder than necessary. In addition, confirm that the core wires do not fray and stick out. The wire can be removed by inserting a screwdriver into the operation slot.

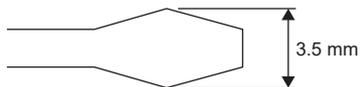


Usable screwdrivers

The following dedicated screwdrivers are recommended for installing the wires.

Model number	Type	Brand
210-720	Standard type (made in Europe)	WAGO
210-120J	Standard type (made in Japan)	
210-657J	Mini type (made in Japan)	

When using a general-purpose screwdriver, use one with a blade width of 3.5 mm. Do not use a screwdriver that does not fit into the operation slot or that cannot properly release the spring.



5.4 Signal (device) explanation

This section describes the signals (devices) of the converter unit.

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

☞ Page 61 Interface

I/O signal connector (CN24)

Signal (device) name	Symbol	Connector pin No.	Function and application	I/O signal interface type
Forced stop	EM1	CN24-1	When using EM1, set the rotary switch for converter setting (SW1) of the converter unit to "4". When EM1 is turned off, the converter is forcibly stopped, the magnetic contactor is turned off as the drive unit generates a main circuit off warning, and the status becomes servo-off. The forced stop state of the converter will be deactivated if EM1 is turned on while the converter is in the forced stop state.	DI
Reset	RES	CN24-2	Used to deactivate the alarm. Turn off RES after at least 100 ms from when it turns on. Some alarms cannot be deactivated by RES. Refer to the following for the alarms that cannot be deactivated. ☞ Page 75 CONVERTER UNIT TROUBLESHOOTING If RES is turned on in an alarm-free state, the state becomes ready-off. This device is not for stopping and should not be turned on during operation.	DI
Alarm	ALM	CN24-3	When an alarm occurs, ALM turns off.	DO
Digital I/F power supply input	DICOM	CN24-4	Input 24 V DC (24 V DC \pm 10 % 500 mA) for I/O interfaces. 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.	—
Ready	RDYA	CN24-5	When the converter unit is ready for operation, RDYA turns on. This signal has the opposite logic of RDYB. RDYA is off from when the power is turned on until the unit starts up.	DO
Operation permission	RDYB	CN24-6	When a converter unit error occurs or when a reset is input, RDYB turns on. This signal has the opposite logic of RDYA. RDYB is off from when the power is turned on until the unit starts up.	DO
Converter reset	RSO	CN24-7	When RES is input to the converter unit, RSO turns on.	DO
Digital I/F power supply output	DOCOM	CN24-8	Input 24 V DC (24 V DC \pm 10 % 500 mA) for I/O interfaces. 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.	—

Alarm output connector (CN25)

Signal (device) name	Symbol	Connector pin No.	Function and application	I/O signal interface type
Alarm output	A B C	CN25-1 CN25-2 CN25-3	This is a changeover contact output which indicates that the protective functions of the converter unit have been activated and that the output to the drive unit has stopped. Error state: Open between B-C (closed between A-C) Normal state: Closed between B-C (open between A-C)	DO

Magnetic contactor control connector (CN23)

Signal (device) name	Symbol	Connector pin No.	Function and application	I/O signal interface type
Magnetic contactor drive output	MC1	CN23-1	Connect to the coil of the magnetic contactor and the power supply for magnetic contactor control. When the converter unit receives a start command from the drive unit, a short circuit occurs between MC1 (CN23-1 pin) and MC2 (CN23-3 pin). If the magnetic contactor control connector (CN23) is not used for control, set the rotary switch for converter setting (SW1) of the converter unit to "1". (☞ Page 28 Converter unit switch settings and operation panel)	—
	MC2	CN23-3		

5.5 Timing chart at alarm occurrence

Precautions

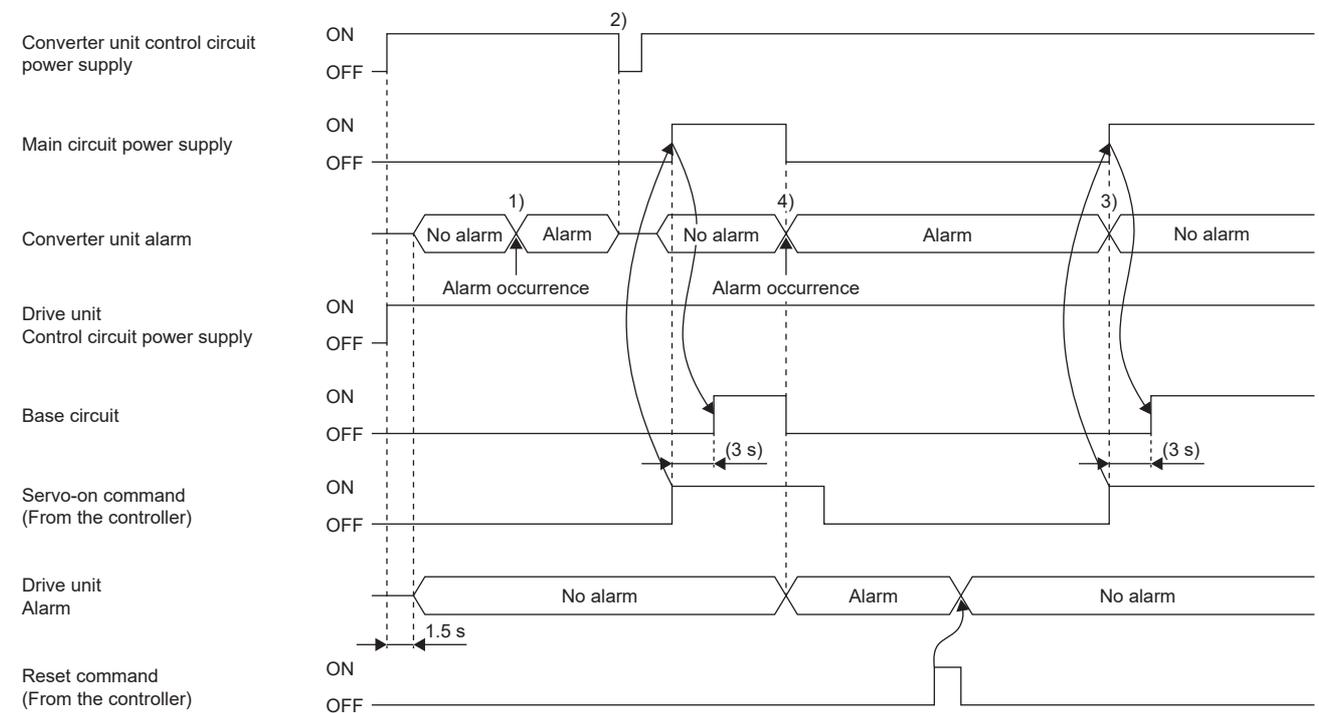
When an alarm occurs, remove its cause, check that the operation signal is not being inputted, ensure safety, and reset the alarm before restarting the operation.

When combining one converter unit and one drive unit

When the magnetic contactor drive output is enabled

■ Converter unit

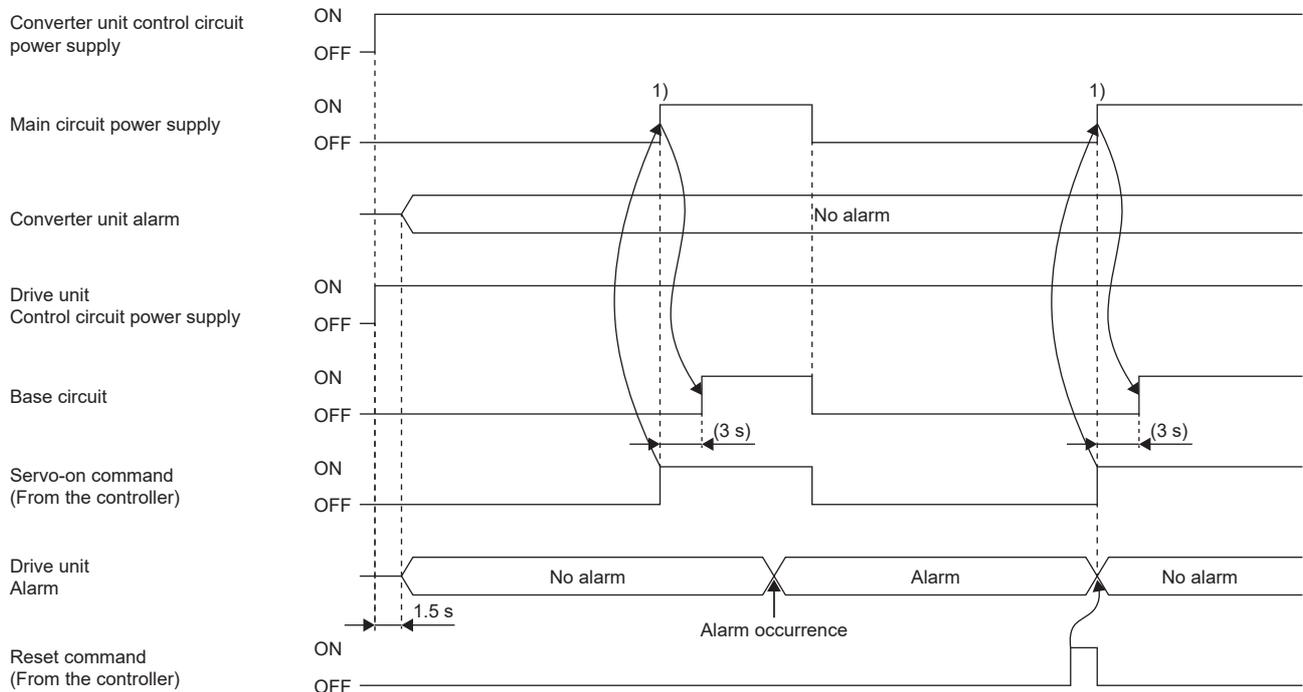
When an alarm occurs on the converter unit, the magnetic contactor turns off and the main circuit power supply is shut off. The drive units in operation stop. The alarm can be canceled by cycling the control circuit power supply or by requesting operation from a drive unit, but it cannot be canceled unless the cause of the alarm is eliminated.



Transition No.	Description
1) in the figure	When the drive unit is servo-off, the drive unit does not detect alarms that occur on the converter unit.
2) and 3) in the figure	To cancel the alarm of the converter unit, cycle the power of the converter unit (2)) or turn on the servo-on command (3)). For details on which alarms can be reset by turning on the servo-on command, refer to the following. ☞ Page 75 CONVERTER UNIT TROUBLESHOOTING
4) in the figure	If an alarm occurs on the converter unit while the drive unit is servo-on, an alarm also occurs on the drive unit, and the status becomes servo-off.

■ Drive unit

When an alarm occurs on the drive unit, the base circuit is shut off, and the servo motor begins to coast. Once the servo motor begins to coast, the dynamic brake is activated and the servo motor stops. The alarm can be canceled by cycling the control circuit power supply, turning on the error reset command from the controller, or using the CPU reset command, but it cannot be canceled unless the cause of the alarm is eliminated.

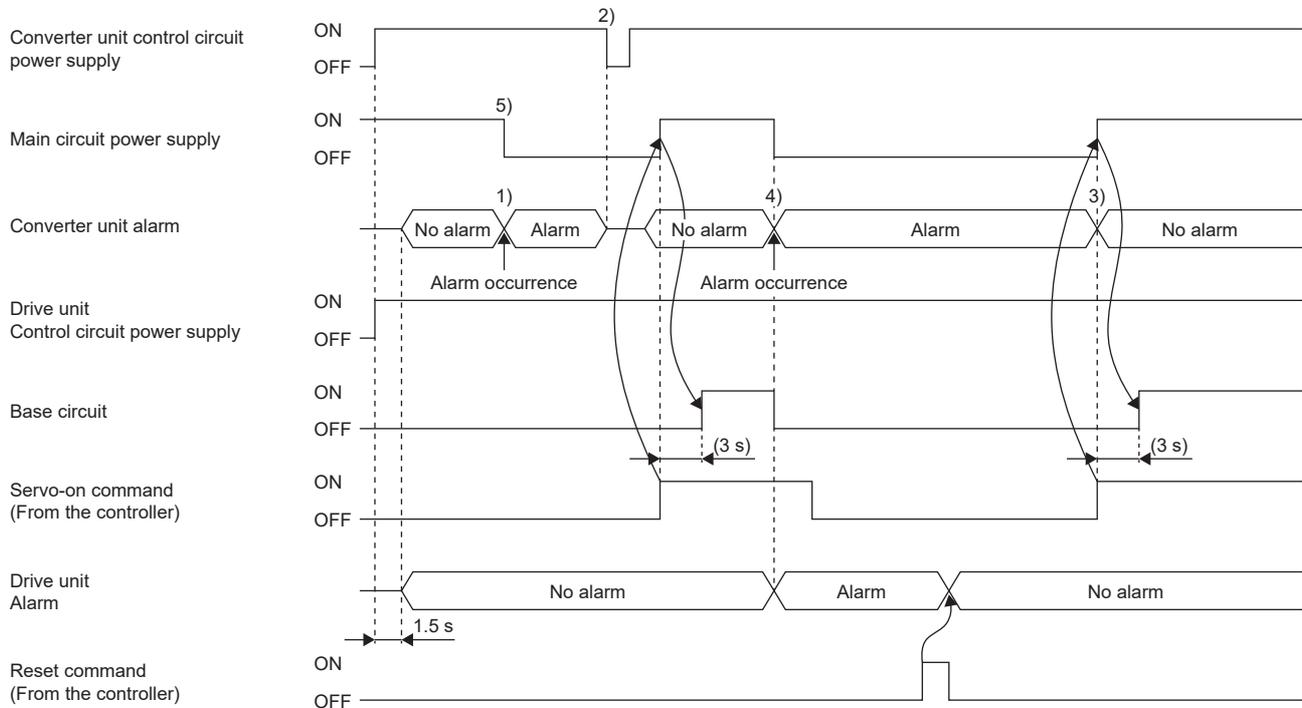


Transition No.	Description
1) in the figure	After the drive unit has started up, the main circuit power supply is turned on without alarms for the drive unit and converter unit.

When the magnetic contactor drive output is disabled

■ Converter unit

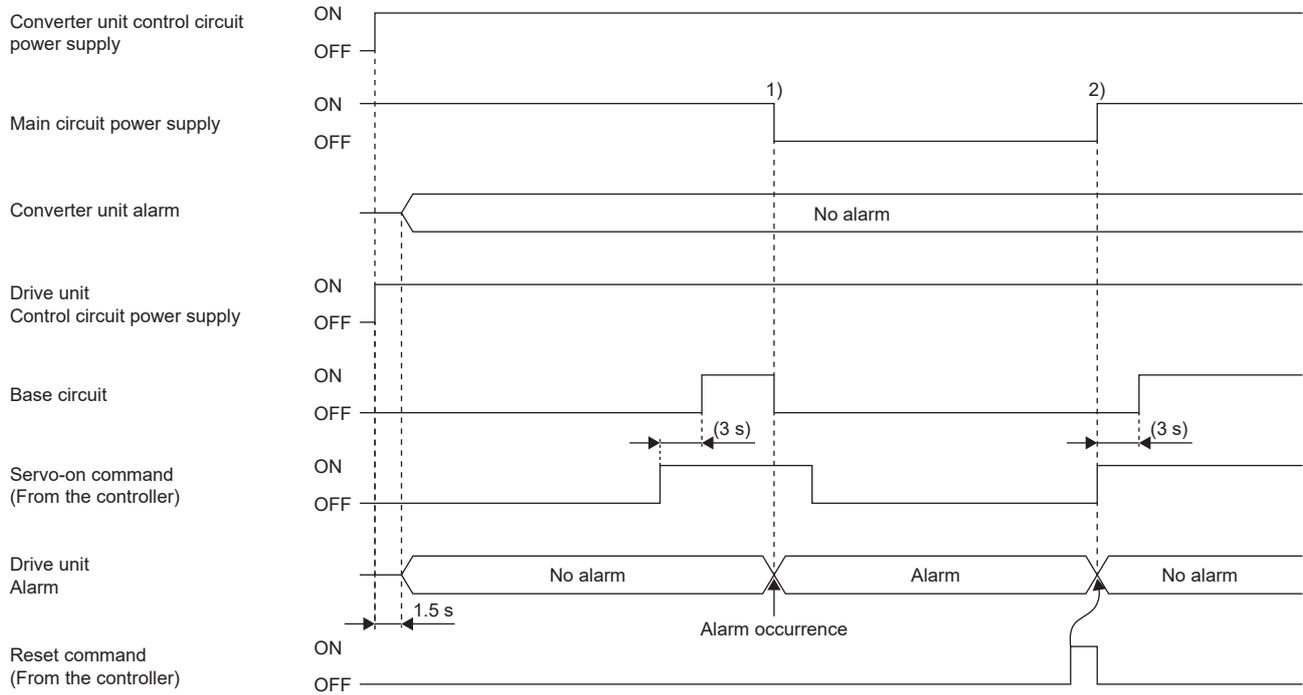
When an alarm occurs on the converter unit, the status becomes servo-off, but the main circuit power supply is not shut off, so shut off the main circuit power supply using an external sequence. After canceling the alarm on the converter unit (if the alarm is also on the drive unit, then after canceling the alarm on the drive unit), the operation is enabled again by turning on the error reset command from the controller.



Transition No.	Description
1) in the figure	When the drive unit is servo-off, the drive unit does not detect alarms that occur on the converter unit.
2) and 3) in the figure	To cancel the alarm of the converter unit, cycle the power of the converter unit (2)) or turn on the servo-on command (3)). For details on which alarms can be reset by turning on the servo-on command, refer to the following. 📖 Page 75 CONVERTER UNIT TROUBLESHOOTING
4) in the figure	If an alarm occurs in the converter unit in the servo-on status, an alarm also occurs on the drive unit, and the status becomes servo-off.
5) in the figure	Use an external sequence to shut off the main circuit power supply the same time that an alarm occurs.

■ Drive unit

When an alarm occurs on the drive unit, the status becomes servo-off, but the main circuit power supply is not shut off, so shut off the main circuit power supply using an external sequence. After canceling the alarm on the drive unit, the operation is enabled again by turning on the error reset command from the controller.



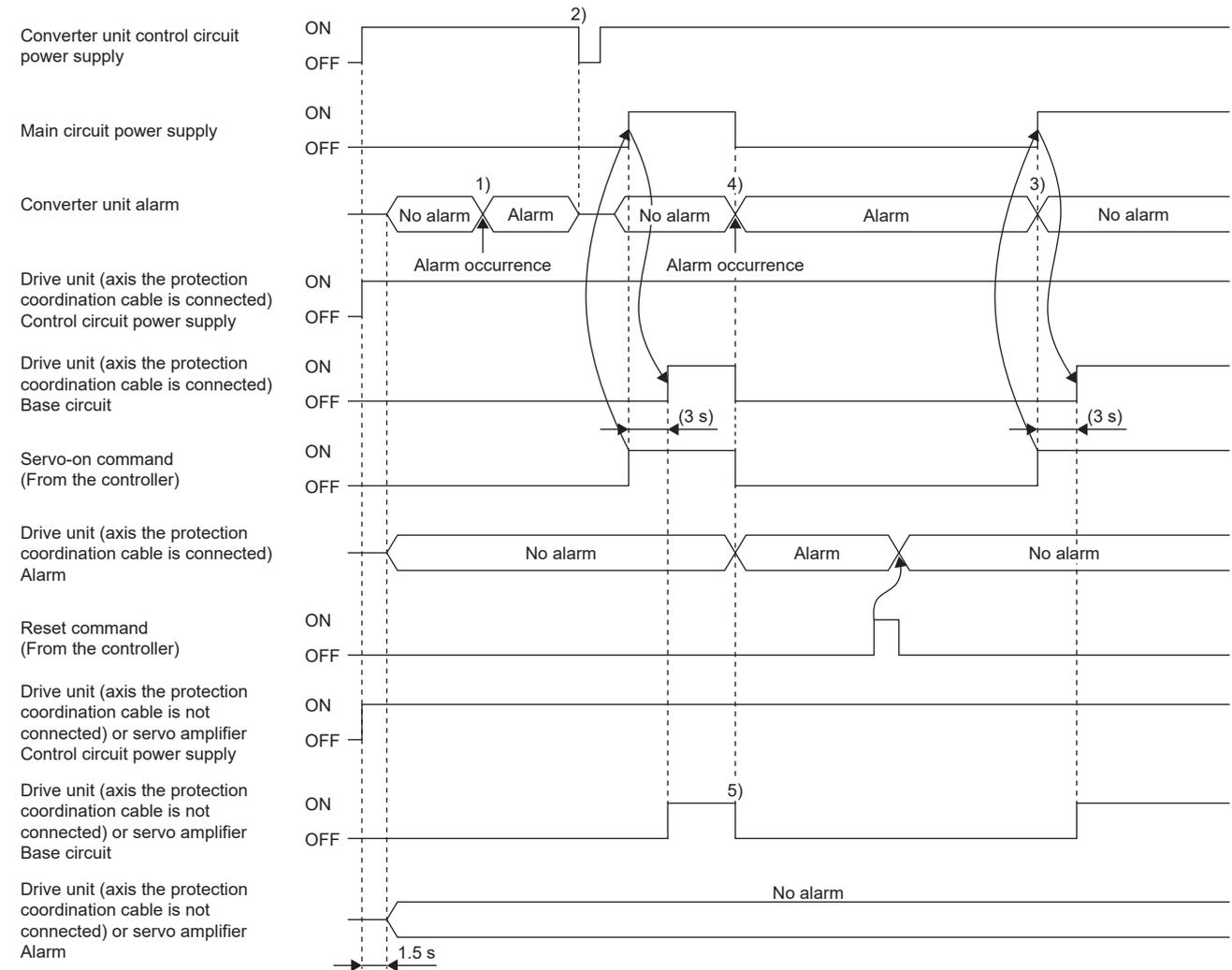
Transition No.	Description
1) in the figure	If an alarm occurs on the drive unit, shut off the main circuit power supply by using an external sequence.
2) in the figure	Turn on the main circuit power supply while the alarm on the drive unit is deactivated.

When connecting multiple drive units and servo amplifiers to the converter unit

When the magnetic contactor drive output is enabled

■ Converter unit

When an alarm occurs on the converter unit, the magnetic contactor turns off and the main circuit power supply is shut off. Input the emergency stop signal of the controller to the operating drive units or servo amplifiers to change all axes to servo-off. The alarm can be canceled by cycling the control circuit power supply or by requesting operation from the axis connected by the protection coordination cable, but it cannot be canceled unless the cause of the alarm is eliminated.

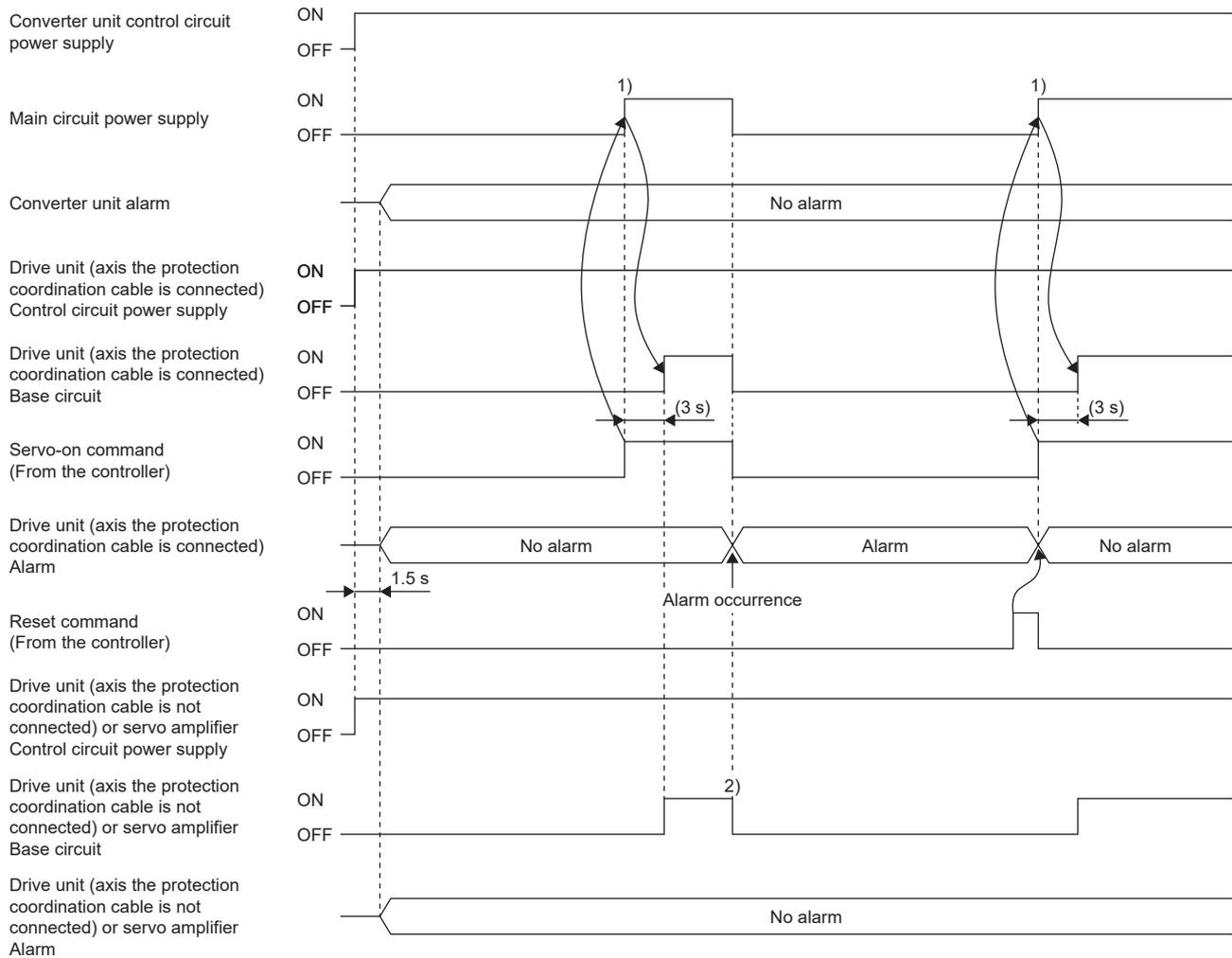


Transition No.	Description
1) in the figure	When the drive unit is servo-off, the drive unit does not detect alarms that occur on the converter unit.
2) and 3) in the figure	To cancel the alarm of the converter unit, cycle the power of the converter unit (2)) or turn on the servo-on command (3)). . For details on which alarms can be reset by turning on the servo-on command, refer to the following. ☞ Page 75 CONVERTER UNIT TROUBLESHOOTING
4) in the figure	If an alarm occurs on the converter unit while the drive unit is servo-on, an alarm also occurs on the axis connected by the protection coordination cable, and the status becomes servo-off.
5) in the figure	If an alarm occurs on the converter unit, input the emergency stop signal of the controller to change all axes to servo-off.

■ Drive unit

If an alarm occurs on the drive unit of the axis connected by the protection coordination cable, the base circuit is shut off, and the servo motor begins to coast. If an alarm occurs on a drive unit or servo amplifier other than the axis connected by the protection coordination cable, turn off the magnetic contactor using an external sequence and shut off the main circuit power supply. Once the power supply is shut off, the dynamic brake is activated and the servo motor stops. If an alarm occurs on any of the axes, input the emergency stop signal of the controller to change all axes to servo-off.

The alarm can be canceled by cycling the control circuit power supply, turning on the error reset command from the controller, or using the CPU reset command, but it cannot be canceled unless the cause of the alarm is eliminated.

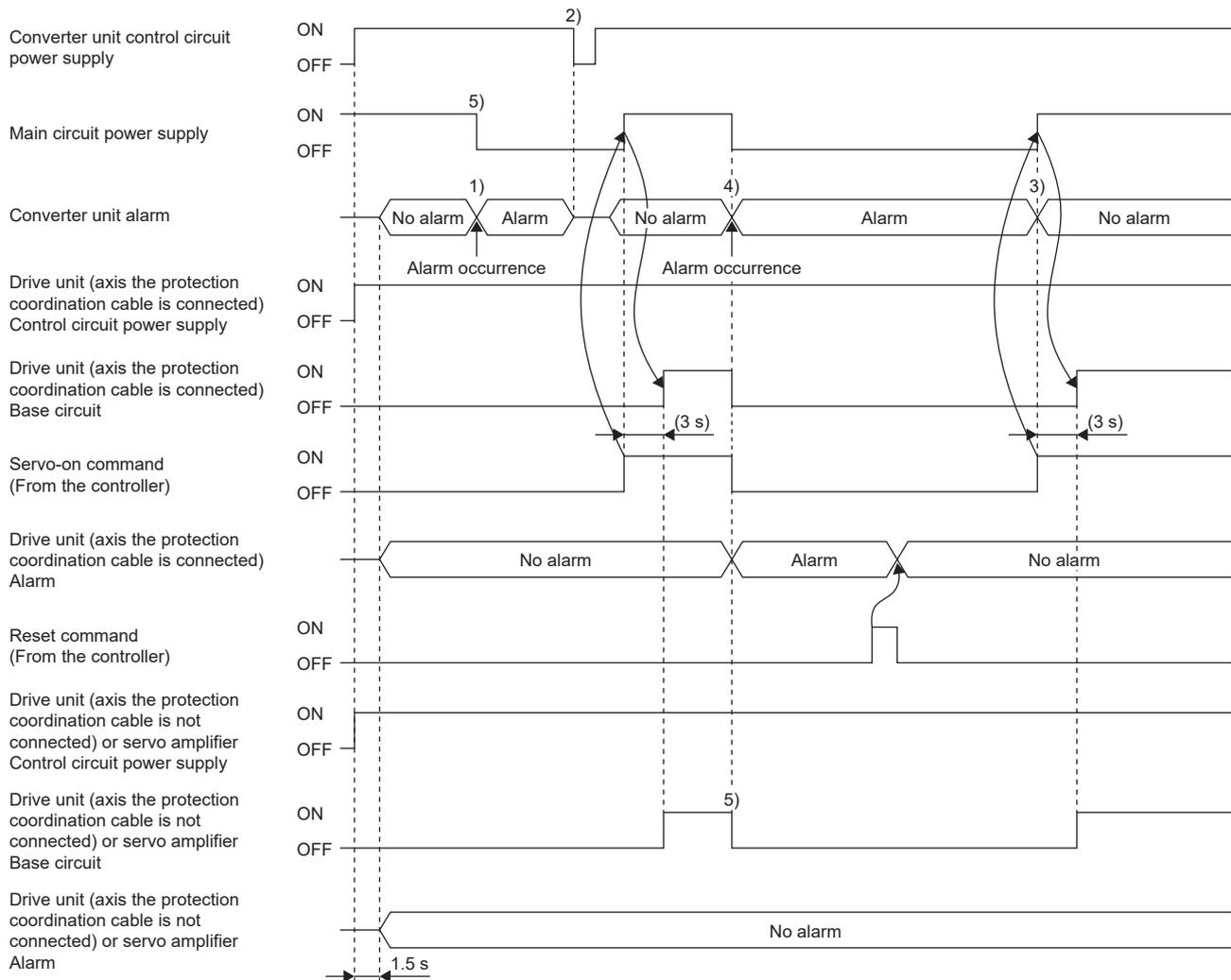


Transition No.	Description
1) in the figure	After the drive unit has started up, the main circuit power supply is turned on without alarms for the drive unit and converter unit.
2) in the figure	If an alarm occurs on any of the axes, input the emergency stop signal of the controller to change all axes to servo-off.

When the magnetic contactor drive output is disabled

■ Converter unit

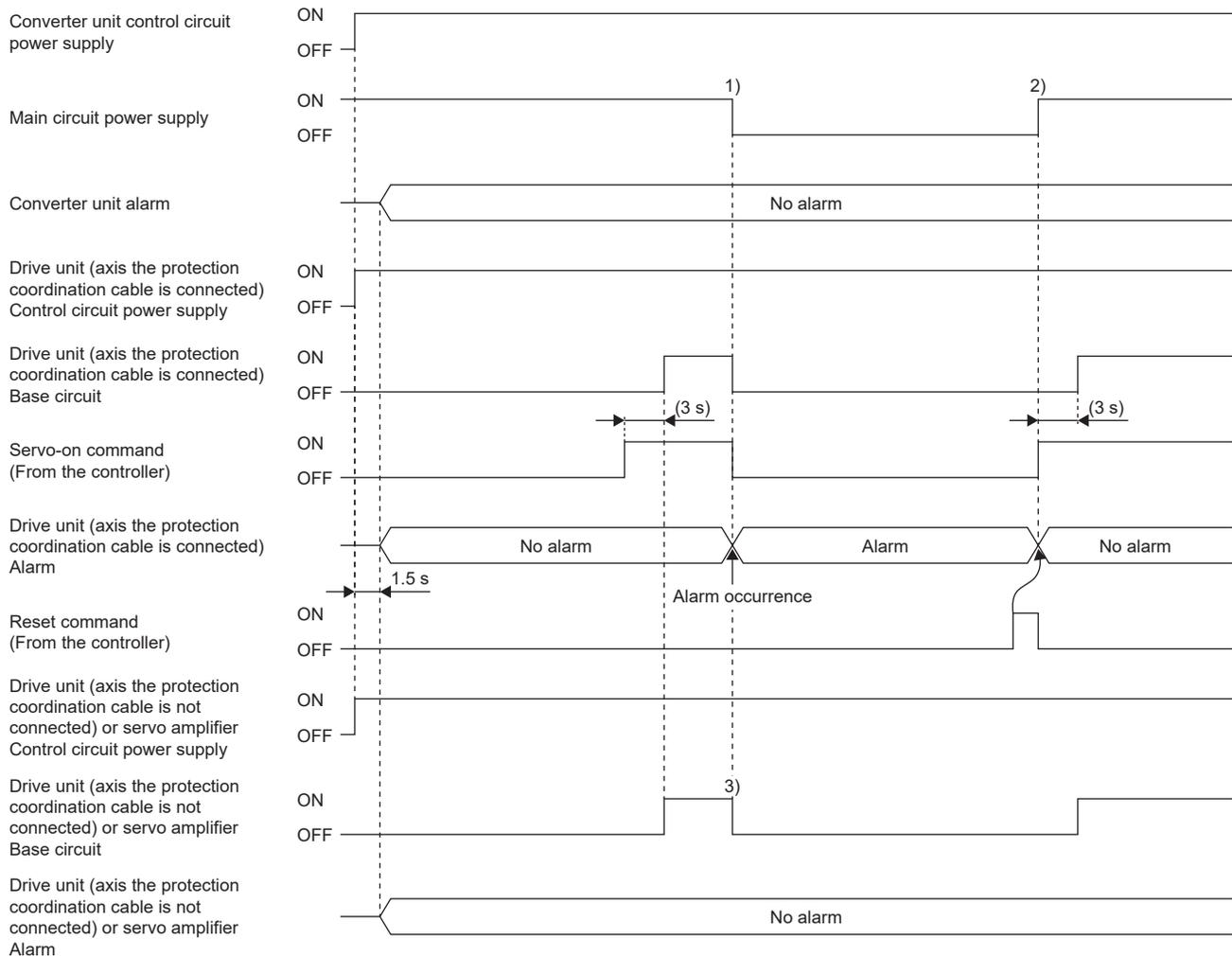
When an alarm occurs on the converter unit, the status becomes servo-off, but the main circuit power supply is not shut off, so shut off the main circuit power supply using an external sequence. Input the emergency stop signal of the controller to the operating drive units or servo amplifiers to change all axes to servo-off. After canceling the alarm on the converter unit (if the alarm is also generated in the drive units or servo amplifiers, then after canceling the alarm on the drive units or servo amplifiers), the operation is enabled again by turning on the error reset command from the controller.



Transition No.	Description
1) in the figure	When the drive unit is servo-off, the drive unit does not detect alarms that occur on the converter unit.
2) and 3) in the figure	To cancel the alarm of the converter unit, cycle the power of the converter unit (2)) or turn on the servo-on command (3)). . For details on which alarms can be reset by turning on the servo-on command, refer to the following. 📖 Page 75 CONVERTER UNIT TROUBLESHOOTING
4) in the figure	If an alarm occurs in the converter unit in the servo-on status, an alarm also occurs on the drive unit, and the status becomes servo-off.
5) in the figure	If an alarm occurs on the converter unit, input the emergency stop signal of the controller to change all axes to servo-off.

■ Drive unit or servo amplifier

When an alarm occurs on the drive unit or servo amplifier, the status becomes servo-off, but the main circuit power supply is not shut off, so shut off the main circuit power supply using an external sequence. Input the emergency stop signal of the controller to the operating drive units or servo amplifiers to change all axes to servo-off. After canceling the alarm on the drive units or servo amplifiers, the operation is enabled again by turning on the error reset command from the controller.



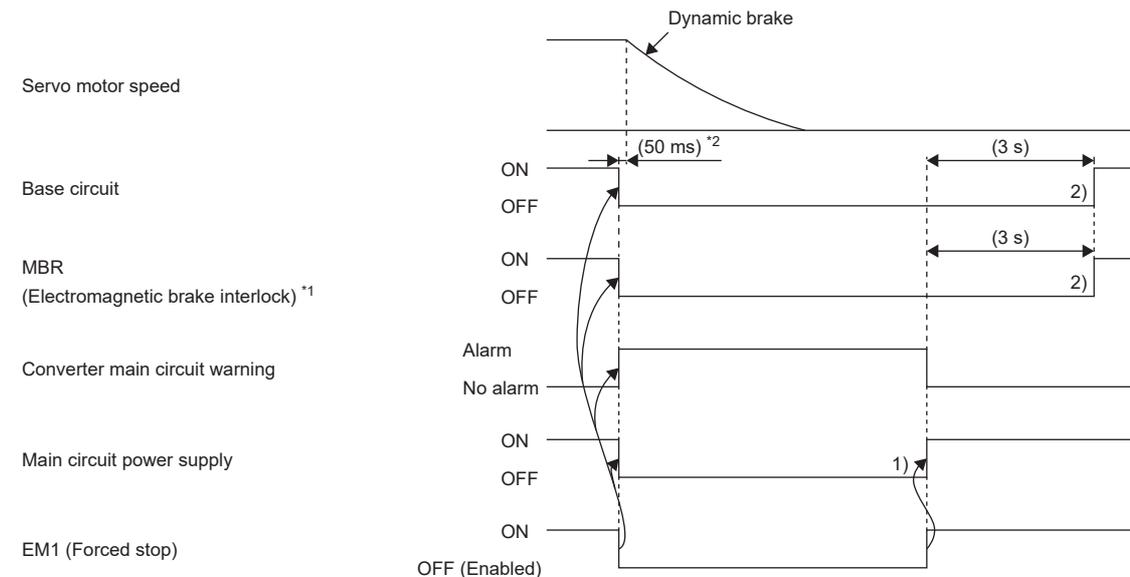
Transition No.	Description
1) in the figure	If an alarm occurs on the drive unit, shut off the main circuit power supply by using an external sequence.
2) in the figure	Turn on the main circuit power supply while the alarm on the drive unit is deactivated.
3) in the figure	If an alarm occurs on any of the axes, input the emergency stop signal of the controller to change all axes to servo-off.

5.6 Forced stop of the converter unit

When combining one converter unit and one drive unit

When the magnetic contactor drive output is enabled

When EM1 (Forced stop) of the converter unit is turned off, the magnetic contactor is turned off, and the main circuit power supply is shut off. The operating drive unit shuts off the base circuit, and a main circuit off warning is displayed on the drive unit. When EM1 of the converter unit is turned on, the magnetic contactor is turned on and the main circuit power supply is turned on, then the drive unit automatically resumes operation.



*1 If an electromagnetic brake is installed externally, configure the circuit so that the electromagnetic brake operates with MBR as described below.

ON: Electromagnetic brake is not activated

OFF: Electromagnetic brake is activated

*2 Magnetic contactors with a built-in external dynamic brake have a delay (about 50 ms), as do external relays.

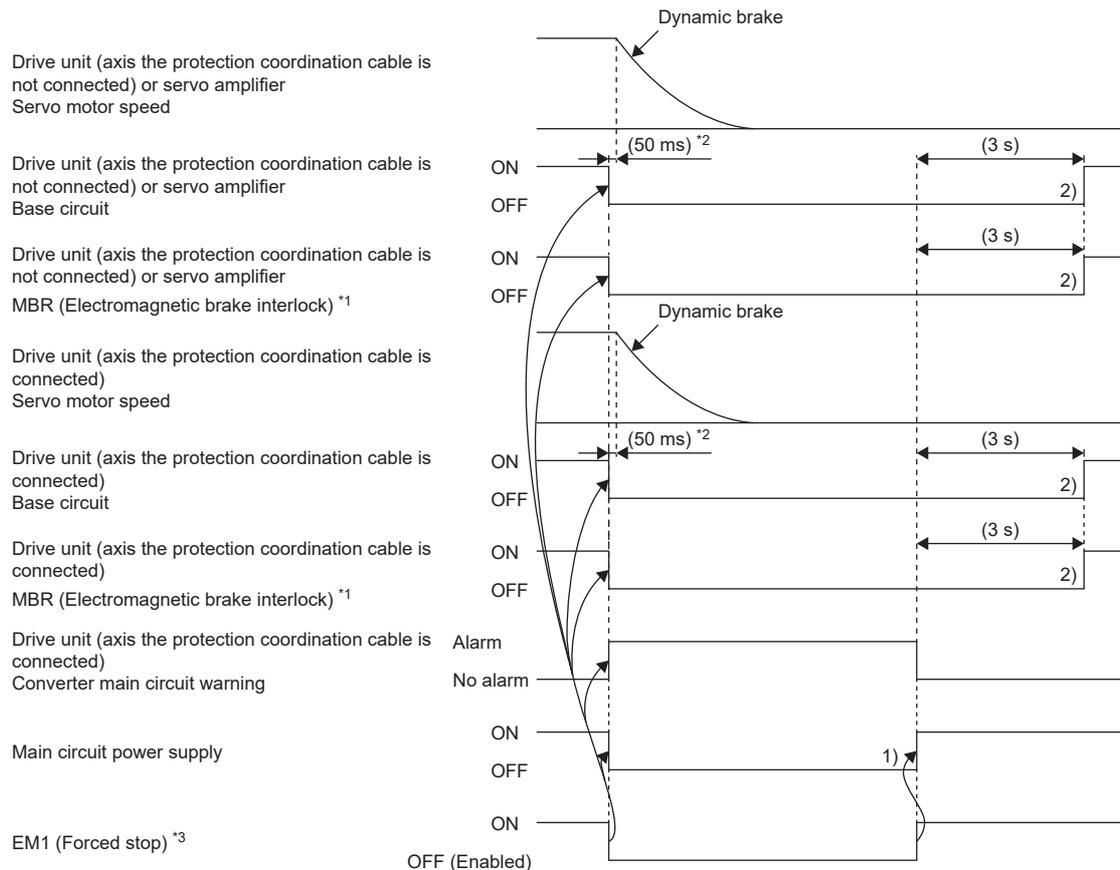
Transition No.	Description
1) in the figure	When EM1 of the converter unit is turned on, the main circuit power supply is turned on.
2) in the figure	After the main circuit capacitor is completely charged, the base circuit and MBR are turned on.

When connecting multiple drive units and servo amplifiers to the converter unit

To stop the converter unit and drive units at the same time, wire the converter unit and drive units so that EM1 (Forced stop) of both are turned off at the same time.

When the magnetic contactor drive output is enabled

When EM1 (Forced stop) of the converter unit and drive units are turned off, the magnetic contactor is turned off and the main circuit power supply is shut off. The operating drive units shut off the base circuit, and a servo forced stop warning is displayed on the drive units. When EM1 is turned on by the converter unit and drive units, the magnetic contactor is turned on and the main circuit power supply is turned on, then the drive units automatically resume operation.



*1 If an electromagnetic brake is installed externally, configure the circuit so that the electromagnetic brake operates with MBR as described below.

ON: Electromagnetic brake is not activated

OFF: Electromagnetic brake is activated

*2 Magnetic contactors with a built-in external dynamic brake have a delay (about 50 ms), as do external relays.

*3 Wire the converter unit and drive units so that EM1 (Forced stop) of both are turned off at the same time.

Transition No.	Description
1) in the figure	When EM1 of the converter unit is turned on, the main circuit power supply is turned on.
2) in the figure	After the main circuit capacitor is completely charged, the base circuit and MBR are turned on.

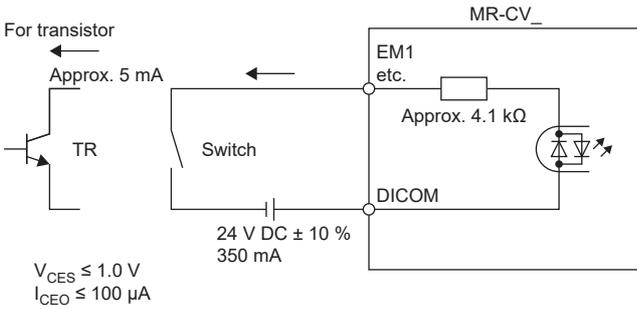
5.7 Interface

Sink I/O interface

Digital input interface DI

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. Refer to the following for source input.

☞ Page 62 Source I/O interface



Digital output interface DO

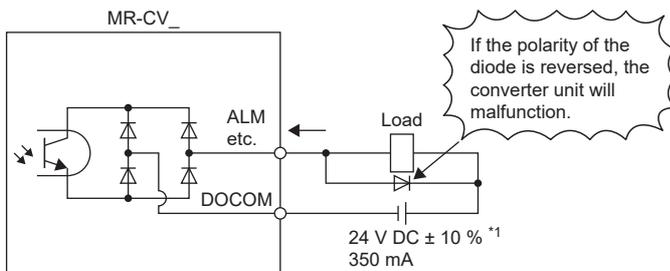
This is a circuit in which the collector of the output transistor is the output terminal. When the output transistor is turned on, the current flows to the collector terminal.

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, maximum current: 50 mA or less, inrush current: 100 mA or less) A maximum of 2.6 V voltage drop occurs in the converter unit.

The following connection diagram is for the sink output. Refer to the following for the source output.

☞ Page 62 Source I/O interface



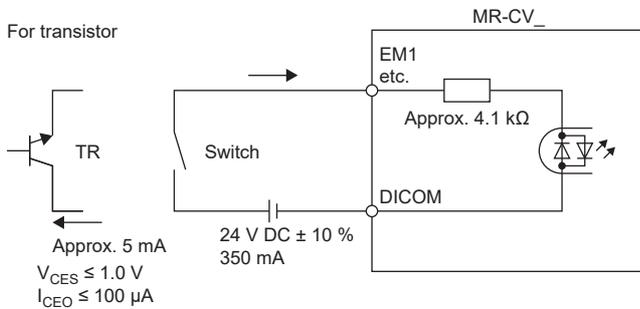
*1 If the voltage drop (a maximum of 2.6 V) interferes with the relay operation, apply high voltage (a maximum of 26.4 V) from an external source.

Source I/O interface

For the MR-CV_ power regeneration converter unit, source type I/O interfaces can be used.

Digital input interface DI

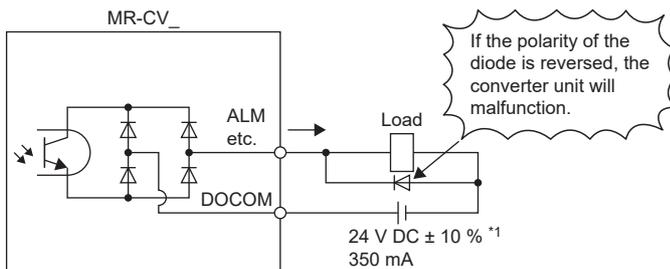
This is an input circuit in which the anode of the photocoupler is the input terminal. Transmit signals from a source (open-collector) type transistor output, relay switch, etc.



Digital output interface DO

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.

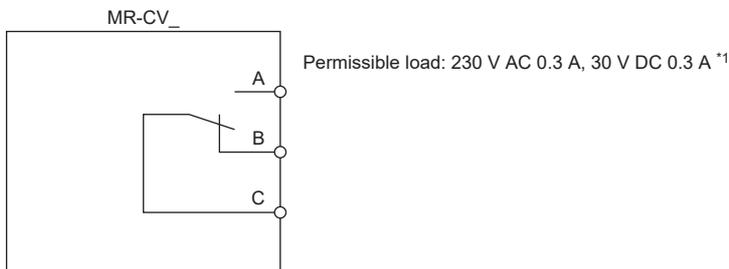
A maximum of 2.6 V voltage drop occurs in the converter unit.



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

Alarm output

When the converter unit is operating normally, the line between B and C is closed. When an alarm occurs, the line between A and C becomes closed. Connect the converter unit to the alarm output (A/B/C) via a relay coil or by other means.



*1 For compliance with the IEC/EN/UL/CSA standards, operate at 30 V DC or less.

5.8 Grounding

The drive unit/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 problem, refer to the drive unit/servo amplifier user's manual and instruction manual and install grounding.

For information on how to comply with the EMC Directive, refer to "EMC Installation Guidelines".

6 CHARACTERISTICS

6.1 Overload protection characteristics

An electronic thermal is built into the converter unit to protect the converter unit from overloads.

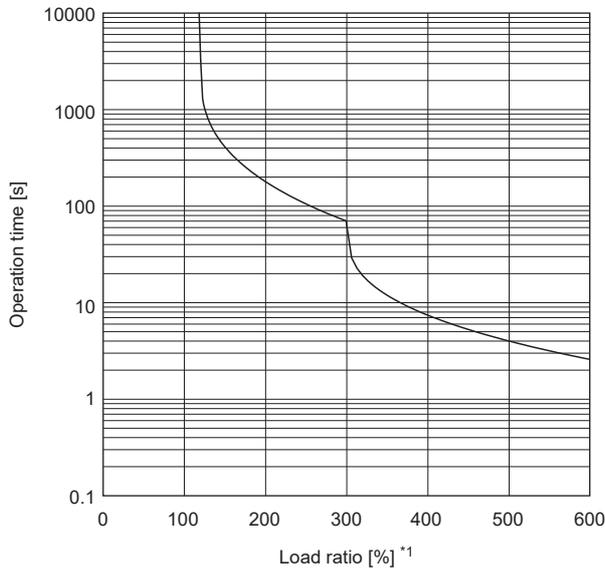
[7E Overload 1] occurs when overload operation exceeds the electronic thermal protection curve shown in this section. [7F Overload 2] occurs when operation continues above the rated speed and rated torque. Use the equipment within the area on the left side of the graph.

Graph of overload protection characteristics

The table lists the converter units and corresponding graphs of overload protection characteristics.

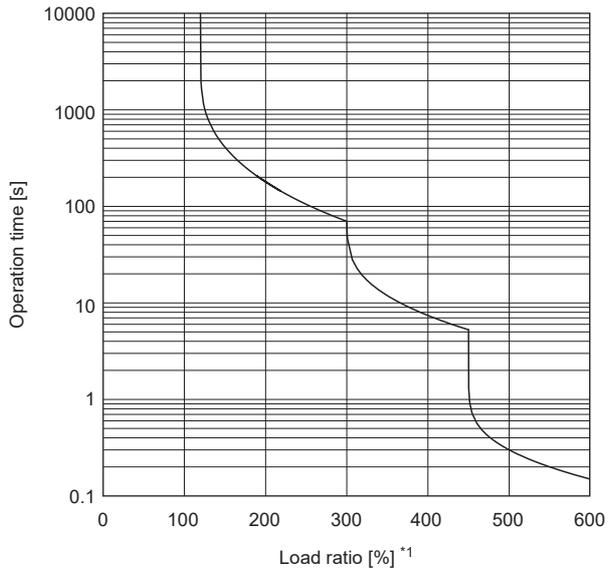
Converter unit	Graph of overload protection characteristics
MR-CV11K MR-CV30K MR-CV37K MR-CV45K MR-CV11K4 MR-CV30K4 MR-CV37K4 MR-CV45K4	Characteristic A
MR-CV18K MR-CV18K4	Characteristic B
MR-CV55K	Characteristic C
MR-CV55K4 MR-CV75K4	Characteristic D

■ Characteristic A



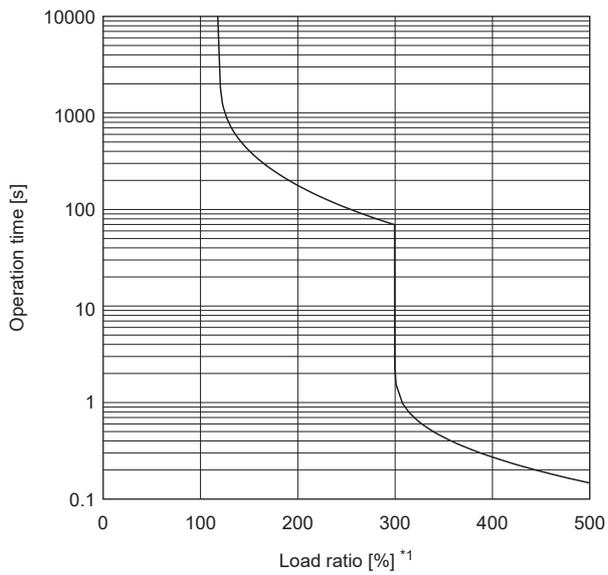
*1 A resistive force of 100 % indicates the continuous rating of the converter unit.

Characteristic B



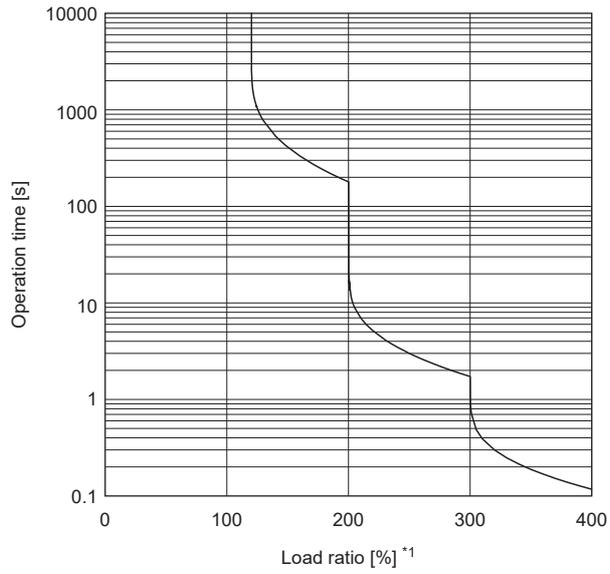
*1 A resistive force of 100 % indicates the continuous rating of the converter unit.

Characteristic C



*1 A resistive force of 100 % indicates the continuous rating of the converter unit.

■Characteristic D



*1 A resistive force of 100 % indicates the continuous rating of the converter unit.

6.2 Power supply capacity and generated loss

Amount of heat generated by converter unit

The following table indicates the generated loss and the power supply capacity of the converter unit under rated load.

Converter unit	Power supply capacity [kVA]	Converter unit generated heat [W]			Area required for heat dissipation [m ²]
		At rated output	At rated output (internal heat generation when cooling externally)	At servo-off	
MR-CV11K	16	124	25	25	2.5
MR-CV18K	27	193	32	25	3.9
MR-CV30K	43	317	45	25	6.4
MR-CV37K	53	396	53	25	8.0
MR-CV45K	64	496	104	25	10.0
MR-CV55K	78	595	164	30	12.0
MR-CV11K4	16	124	25	25	2.5
MR-CV18K4	27	193	32	25	3.9
MR-CV30K4	43	317	45	25	6.4
MR-CV37K4	53	402	53	25	8.1
MR-CV45K4	64	496	104	25	10.0
MR-CV55K4	78	596	164	30	12.0
MR-CV75K4	107	842	228	30	16.9

Even if multiple drive units and servo amplifiers are connected to one converter unit, calculate the power supply capacity from the capacity of the converter unit. If the total value of the output wattage of the servo motors driven by the drive units and servo amplifiers connected to the converter unit is smaller than the converter capacity, the power supply capacity will be smaller than the values in the table.

Because 2 to 2.5 times the instantaneous power is required during servo motor acceleration, use a power supply that can secure a voltage within the permissible voltage fluctuation of the main circuit power supply terminals (L1/L2/L3) of the converter unit. The power supply capacity will vary according to the power impedance.

The actual amount of generated heat depends on the frequency of use during operation and will be within the range of "At rated output" and "At servo-off". For the design of an enclosed type cabinet, use the values in the tables in consideration for the harshest conditions with regard to the environment and operation pattern.

Heat dissipation area for enclosed type cabinet

For the heat dissipation area of the drive unit/servo amplifier, refer to the drive unit/servo amplifier user's manual and instruction manual.

The enclosed type cabinet (hereafter called the cabinet) that stores the converter unit should be designed to ensure that its internal temperature rise is within +10 °C at an ambient temperature of 40 °C. Calculate the necessary heat dissipation area of the cabinet with the equation below (10.1) while allowing a margin of approximately 5 °C for a maximum ambient temperature of 55 °C.

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

A: Heat dissipation area [m²]

P: Loss generated in the cabinet [W]

ΔT : Difference between internal and ambient temperatures [°C]

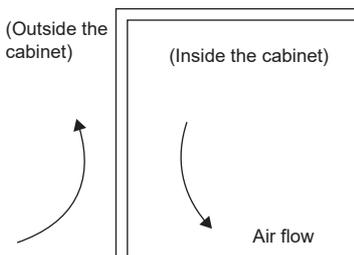
K: Heat dissipation coefficient [5 to 6]

When calculating the heat dissipation area with the equation (10.1), assume that P is the sum of all losses generated in the cabinet. Refer to the following for details about the heat generated by the converter unit.

☞ Page 67 Amount of heat generated by converter unit

"A" indicates the effective area for heat dissipation, but if the cabinet is directly installed on an insulated wall, that extra amount must be added to the cabinet's surface area. The required heat dissipation area will vary with the conditions in the cabinet. If convection in the cabinet is poor and heat builds up, effective heat dissipation will not be possible. Therefore, arrangement of the equipment in the cabinet and the use of a cooling fan should be considered. The following page contains information on the required heat dissipation area (estimated) of converter unit cabinets when operating the converter unit at a rated load in ambient temperatures of 40 °C.

☞ Page 67 Amount of heat generated by converter unit



When air flows along the outer wall of the cabinet, effective heat exchange is possible, because the temperature slope inside and outside the cabinet is steeper.

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

A molded-case circuit breaker and magnetic contactor may fail or malfunction due to an inrush current flowing through the converter units power lines (input lines) at power-on. Therefore, use products with the specifications described on the following page.

☞ Page 93 Molded-case circuit breakers, fuses, magnetic contactors

When circuit protectors are used, it is recommended that the inertia delay type, which is not tripped by an inrush current, be used.

200 V class

The following shows the inrush currents (reference data) that will flow when 240 V AC is applied with a wiring length of 1 m.

Converter unit	Inrush currents (A_{0-p})	
	Main circuit power supply (L1/L2/L3)	Control circuit power supply (L11/L21)
MR-CV11K	38 A (attenuated to approx. 10 A in 45 ms)	23 A (attenuated to approx. 2 A in 5 ms)
MR-CV18K	38 A (attenuated to approx. 10 A in 70 ms)	
MR-CV30K	81 A (attenuated to approx. 20 A in 65 ms)	
MR-CV37K	81 A (attenuated to approx. 20 A in 86 ms)	
MR-CV45K		
MR-CV55K	57 A (attenuated to approx. 20 A in 137 ms)	

400 V class

The following shows the inrush current (reference data) that will flow when 480 V AC is applied with a wiring length of 1 m.

Converter unit	Inrush currents (A_{0-p})	
	Main circuit power supply (L1/L2/L3)	Control circuit power supply (L11/L21)
MR-CV11K4	24 A (attenuated to approx. 10 A in 22 ms)	15 A (attenuated to approx. 2 A in 5 ms)
MR-CV18K4	24 A (attenuated to approx. 10 A in 35 ms)	
MR-CV30K4	48 A (attenuated to approx. 20 A in 35 ms)	
MR-CV37K4	48 A (attenuated to approx. 20 A in 45 ms)	
MR-CV45K4		
MR-CV55K4	42 A (attenuated to approx. 20 A in 66 ms)	15 A (attenuated to approx. 2 A in 7 ms)
MR-CV75K4		

7 PROTECTION COORDINATION MODE DISABLED (STANDALONE DRIVE)

Precautions

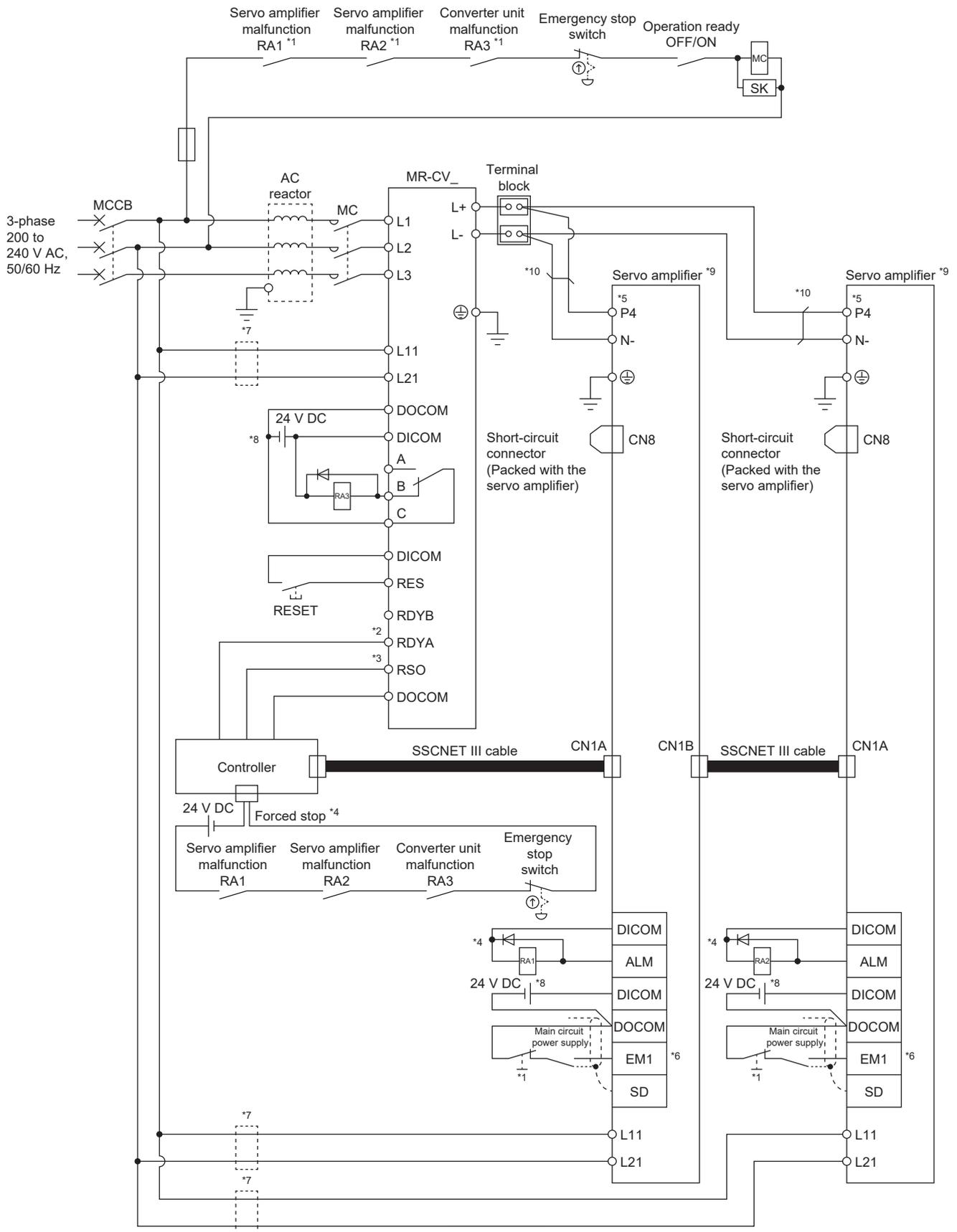
- Do not apply power to the main circuit power supply terminals (L1/L2/L3) of the servo amplifier. Doing so will cause the servo amplifier and converter unit to malfunction.
- Connect the polarities of the DC power supply between the converter unit and the servo amplifier correctly. Connecting them incorrectly will cause the converter unit and servo amplifier to malfunction.
- Only the MR-J4 series can be used with the protection coordination mode disabled (standalone drive).

Point

- When using a servo amplifier other than a drive unit in combination with the converter unit, set the rotary switch for converter setting (SW1) of the converter unit to "8" to disable protection coordination mode.
- The regenerative capacity cannot be improved by connecting two or more converter units in a row. Two or more converter units cannot be connected to the same DC power supply line.
- When using a servo amplifier and converter unit in combination, set the parameters of the servo amplifier to enable EM1 (Forced stop 1).
- In this configuration, only the STO function is supported. The forced stop deceleration function cannot be used.
- When using the converter unit, set the parameters of the servo amplifier.

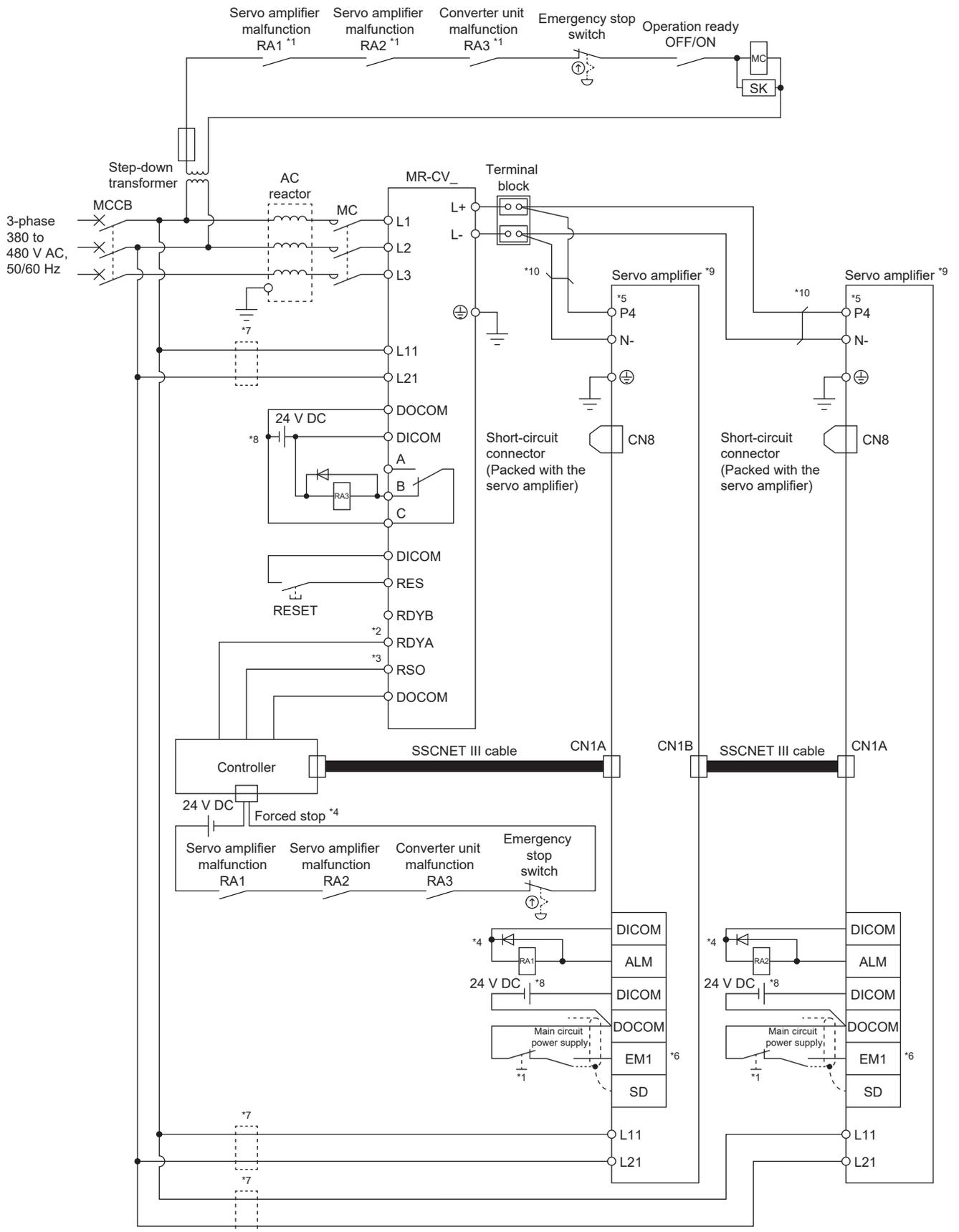
In this chapter, the connection between the MR-CV_ power regeneration converter unit and the servo amplifier is explained using the MR-J4-_B_ servo amplifier as an example.

7.1 200 V class



- *1 Configure a sequence that shuts off the main circuit power supply in the following situations:
 When an alarm has occurred on the converter unit or servo amplifier.
 When EM1 (Forced stop 1) of the servo amplifier is enabled.
 When the main circuit of the converter unit is shut off after the converter unit became ready-on, causing an alarm that monitors the power supply of the converter unit ([62 Frequency error], [67 Open phase], or [71 Undervoltage]) to occur. Eliminate the issue that caused the main circuit of the converter unit to shut off, shut off the power supply, then cycle the power to recover.
- *2 Configure a sequence that shifts the status to servo-on once the converter unit is ready.
- *3 When the reset signal is input and the converter unit is ready for operation, the RSO signal is turned off. Configure a sequence in which the servo amplifier does not operate when the RSO signal is on.
- *4 If an alarm has occurred on the converter unit, configure a sequence for stopping with the emergency stop input of the controller. If the controller does not have an emergency stop input, use the forced stop input of the servo amplifier to stop the servo motor.
- *5 When using the converter unit, remove the wire between P3 and P4.
- *6 Enable EM1 (Forced stop 1) of the servo amplifier.
- *7 Use a molded-case circuit breaker for L11 and L21.
- *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.
- *9 Wire the built-in regenerative resistor when using servo amplifiers with a capacity of 7 kW or less. (factory-wired). (5 kW or less: Between P+ and D, 7 kW: Between P+ and C)
- *10 For the wires between L+/L- of the converter unit and P4/N- of the servo amplifier, twist or bundle them with cable ties to keep the two wires close to each other. The wiring length from L+/L- of the converter unit to P4/N- of the servo amplifier should be 1.5 m or more, and the total wiring length should be 5 m or less.

7.2 400 V class



- *1 Configure a sequence that shuts off the main circuit power supply in the following situations:
 When an alarm has occurred on the converter unit or servo amplifier.
 When EM1 (Forced stop 1) of the servo amplifier is enabled.
 When the main circuit of the converter unit is shut off after the converter unit became ready-on, causing an alarm that monitors the power supply of the converter unit ([62 Frequency error], [67 Open phase], or [71 Undervoltage]) to occur. Eliminate the issue that caused the main circuit of the converter unit to shut off, shut off the power supply, then cycle the power to recover.
- *2 Configure a sequence that shifts the status to servo-on once the converter unit is ready.
- *3 When the reset signal is input and the converter unit is ready for operation, the RSO signal is turned off. Configure a sequence in which the servo amplifier does not operate when the RSO signal is on.
- *4 If an alarm has occurred on the converter unit, configure a sequence for stopping with the emergency stop input of the controller. If the controller does not have an emergency stop input, use the forced stop input of the servo amplifier to stop the servo motor.
- *5 When using the converter unit, remove the wire between P3 and P4.
- *6 Enable EM1 (Forced stop 1) of the servo amplifier.
- *7 Use a molded-case circuit breaker for L11 and L21.
- *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.
- *9 Wire the built-in regenerative resistor when using servo amplifiers with a capacity of 7 kW or less. (factory-wired). (3.5 kW or less:
 Between P+ and D, 7 kW: Between P+ and C)
- *10 For the wires between L+/L- of the converter unit and P4/N- of the servo amplifier, twist or bundle them with cable ties to keep the two wires close to each other. The wiring length from L+/L- of the converter unit to P4/N- of the servo amplifier should be 1.5 m or more, and the total wiring length should be 5 m or less.

8 CONVERTER UNIT TROUBLESHOOTING

8.1 Outline

If an error occurs in the servo system, the corresponding alarm or warning is displayed on the converter unit. When an alarm occurs, ALM (Malfunction) turns off.

If an alarm or warning is displayed, take appropriate measures according to the following:

☞ Page 77 Handling methods for alarms/warnings

8.2 List of alarm No./warning No.

Alarm deactivation/warning deactivation

After the cause of the alarm has been removed, the alarm can be deactivated by using the methods marked with "○" in the "Alarm deactivation" column of "List". Warnings are automatically canceled when the cause is eliminated. Alarms can be deactivated by alarm reset, CPU reset, or power cycling.

Explanation of the list

Alarm deactivation

Alarm deactivation	Explanation
Alarm reset	1. Turn on RES (Reset). *1 2. For a drive unit connected with a protection coordination cable, enter the servo-on command.
CPU reset	Reset the controller.*2
Power cycling	Cycle the power.

*1 When deactivating the alarm, do so in the servo-off status. If the alarm is deactivated in the servo-on status, an alarm will occur on the drive unit.

*2 If a protection coordination cable is not connected, the alarm cannot be deactivated by CPU reset.

List

No.	Alarm/Warning	Alarm deactivation		
		Alarm reset	CPU reset	Power cycling
61	Alarm	—	○	○
62	Alarm	—	○	○
66	Alarm	—	○	○
67	Alarm	—	○	○
68	Alarm	—	—	○
69	Alarm	○	○	○
6A	Alarm	—	○	○
6B	Alarm	—	○	○
6C	Alarm	—	○	○
6E_* ¹	Alarm	—	—	○
70	Alarm	—	○	○
71	Alarm	○	○	○
72	Alarm	—	○	○
73	Alarm	○* ²	○* ²	○* ²
75	Alarm	○	○	○
76	Alarm	—	—	○
77	Alarm	—	○* ²	○* ²
7E	Alarm	○* ²	○* ²	○* ²
7F	Alarm	○* ²	○* ²	○* ²
E9	Warning	—	—	—
EA	Warning	—	—	—
EB	Warning	—	—	—
EC	Warning	—	—	—
EE	Warning	—	—	—

*1 The "_" digit may be displayed. The alarm handling method is the same as for [6E].

*2 Remove the cause of the alarm and allow a cooling time of approximately 30 minutes.

8.3 Handling methods for alarms/warnings

Remove the cause of the alarm and warning in accordance with this section.

[61_Overcurrent]

- A current higher than the permissible current flowed in the converter unit.

Cause	Check/action method
1. The combination of AC reactor and converter unit is incorrect.	Check that the connected AC reactor is the correct combination. Refer to the following for AC reactors.  Page 95 AC reactor
2. The instantaneous maximum rating of the converter unit has been exceeded.	Check that the sum total of the instantaneous values of the servo motor outputs of the drive units and servo amplifiers connected to the converter unit does not exceed the instantaneous maximum rating of the converter unit.
3. The power supply capacity is insufficient.	Check if the specified power supply capacity is satisfied.
4. The phase balance of the input power supply voltage is poor.	Check that the potential difference in the input power supply voltage is less than the specified value. 200 V class: 10 V 400 V class: 20 V
5. There is a problem with the surrounding environment.	Check the power supply for noise. If there is noise, take countermeasures to reduce the noise. For noise reduction techniques, refer to the following.  Page 96 Noise reduction techniques
6. The converter unit has malfunctioned.	Replace the converter unit, then check the repeatability.

[62_Frequency error]

- The input power supply frequency has exceeded the permissible range.

Cause	Check/action method
1. The main circuit power supply is not turned on.	Turn on the main circuit power supply.
2. The input power supply frequency has exceeded the specification range.	Check that the normal power supply voltage waveform does not deviate beyond 50 Hz $\pm 3\%$ or 60 Hz $\pm 3\%$.
3. The power supply voltage during operation is unstable.	Measure the power supply voltage during acceleration/deceleration of the servo motor.
4. There is a problem with the surrounding environment.	Check the power supply for noise. If there is noise, take countermeasures to reduce the noise. For noise reduction techniques, refer to the following.  Page 96 Noise reduction techniques
5. The converter unit has malfunctioned.	Replace the converter unit, then check the repeatability.

[66_Process error]

- The process did not complete within the specified time.

Cause	Check/action method
1. There is a problem with the surrounding environment.	Check the power supply for noise. If there is noise, take countermeasures to reduce the noise. For noise reduction techniques, refer to the following.  Page 96 Noise reduction techniques
2. The converter unit has malfunctioned.	Replace the converter unit, then check the repeatability.

[67_Open phase]

- An open phase occurred in the main circuit power supply of the converter unit.

Cause	Check/action method
1. An open phase occurred in the main circuit power supply of the converter unit.	Check that the main circuit power line is connected with the converter unit. Check if the main circuit power line of the converter unit is closed. If the main circuit power line of the converter unit is open, replace the main circuit power line.
2. The converter unit has malfunctioned.	Replace the converter unit, then check the repeatability.

[68_Watchdog]

- The CPU or other component parts have malfunctioned.

Cause	Check/action method
1. The converter unit has malfunctioned.	Replace the converter unit, then check the repeatability.

[69_Ground fault]

- The servo motor has a ground fault.

Cause	Check/action method
1. The servo motor power cable has a ground fault or has shorted.	Check if the servo motor power cable has a ground fault. If the servo motor power cable has a ground fault, correct the wiring. Check if the servo motor power cable has shorted. If the servo motor power cable has shorted, replace the servo motor power cable.
2. The servo motor has a ground fault.	After disconnecting the connector on the servo motor side of the servo motor power cable, check the insulation between phases (U/V/W/E). If the servo motor has a ground fault or has shorted, replace the servo motor.
3. The drive unit and servo amplifier have malfunctioned.	Check if this alarm occurs while the connector on the drive unit and servo amplifier side of the servo motor power cable is disconnected. If the alarm occurs, replace the drive unit and servo amplifier.
4. The converter unit has malfunctioned.	Replace the converter unit, then check the repeatability.

[6A_MC drive circuit error]

- With an error in the magnetic contactor drive circuit, the main circuit power supply is turned on even though the magnetic contactor output is turned off.

Cause	Check/action method
1. The setting value of the magnetic contactor drive output of the rotary switch for converter setting (SW1) is inconsistent with the wiring configuration.	Check the SW1 setting and wiring configuration. For details on the SW1 setting and wiring configuration, refer to the following. ☞ Page 28 Converter unit switch settings and operation panel
2. The magnetic contactor has malfunctioned.	Replace the magnetic contactor, then check the repeatability.
3. The converter unit has malfunctioned.	Replace the converter unit, then check the repeatability.

[6B_Inrush current suppression circuit error]

- The inrush current suppression circuit error was detected.

Cause	Check/action method
1. The inrush current suppression circuit of the converter unit has malfunctioned.	Replace the converter unit, then check the repeatability.

[6C_Main circuit error]

- An abnormality was detected while charging the main circuit capacitor.

Cause	Check/action method
1. The drive units and servo amplifiers connected to the converter unit do not meet the combination selection conditions.	Check that the drive units and servo amplifiers connected to the converter unit meet the combination selection conditions. For the combination selection conditions, refer to the drive unit/servo amplifier user's manual and instruction manual.
2. The converter unit has malfunctioned.	Replace the converter unit, then check the repeatability.
3. The servo amplifier has malfunctioned.	Replace the servo amplifier, then check the repeatability.

[6E_Board error]

- There is a problem with an internal part of the converter unit.

Cause	Check/action method
1. The converter unit has malfunctioned.	Check the repeatability when only the control circuit power supply is connected.
2. There is a problem with the surrounding environment.	Check the power supply for noise. If there is noise, take countermeasures to reduce the noise. For noise reduction techniques, refer to the following. ☞ Page 96 Noise reduction techniques

[70_Converter forced stop error]

- EM1 (Forced stop) of the converter unit was turned off.

Cause	Check/action method
1. EM1 of the converter unit was turned off.	Check the status of EM1 of the converter unit. After ensuring safety, turn EM1 on.
2. An external 24 V DC power supply has not been inputted.	Input the external 24 V DC power supply.
3. The converter unit has malfunctioned.	Replace the converter unit, then check the repeatability.

[71_Undervoltage]

- The power supply voltage has dropped.

Cause	Check/action method
1. The power supply connection is incorrect.	Check the connection of the power supply. Refer to the following for connection of the power supply.  Page 32 Example power circuit connections
2. The bus voltage (between L+ and L-) is low.	Check that the bus voltage (between L+ and L-) is not equal to or lower than the specified value. 200 V class: 190 V DC 400 V class: 380 V DC
3. An instantaneous power failure lasted for 60 ms or more.	Check that the power supply has no problems. After checking, cycle the power of the converter unit.
4. The converter unit has malfunctioned.	Replace the converter unit, then check the repeatability.

[72_Cooling fan error]

- The speed of the converter unit cooling fan decreased.

Cause	Check/action method
1. A foreign object was caught in the cooling fan.	Check if a foreign object is caught in the cooling fan. If a foreign object is found, remove it.
2. The cooling fan has reached the end of its service life.	The cooling fan requires to be replaced. For replacement of cooling fans, contact your local sales office.

[73_Regenerative error]

- The excessive regeneration protection characteristics of the converter unit were exceeded.

Cause	Check/action method
1. The regenerative load ratio exceeds 100 %.	Take corrective actions as follows: <ul style="list-style-type: none">• Reduce the frequency of positioning.• Increase the deceleration time constant.• Reduce the load.

[75_Overvoltage]

- The value of the bus voltage exceeded the specified value.

200 V class: 420 V DC

400 V class: 840 V DC

Cause	Check/action method
1. The regeneration capacity is insufficient.	Set a longer deceleration time constant, then check the repeatability. If the error does not repeat, take corrective actions as follows: <ul style="list-style-type: none"> • Check the operation pattern. • Use a converter unit with a larger capacity.
2. The power supply voltage is too high.	Check if the voltage of the input power supply exceeds the upper limit of the permissible voltage. If the power supply voltage exceeds the upper limit, reduce the power supply voltage. 200 V class: 297 V AC 400 V class: 594 V AC
3. The servo motor power cable has a ground fault or has shorted.	Check if the servo motor power cable has a ground fault. If the servo motor power cable has a ground fault, correct the wiring. Check if the servo motor power cable has shorted. If the servo motor power cable has shorted, replace the servo motor power cable.
4. The servo motor has a ground fault.	After disconnecting the servo motor power cables on the servo motor side, check the insulation between phases (U/V/W/E). If the servo motor has a ground fault or has shorted, replace the servo motor.
5. There is a problem with the surrounding environment.	Check the noise, ambient temperature, and other conditions, and implement appropriate countermeasures for the cause. If there is noise, take countermeasures to reduce the noise. For noise reduction techniques, refer to the following. ☞ Page 96 Noise reduction techniques

[76_Switch setting error]

- The setting of the rotary switch is incorrect.

Cause	Check/action method
1. The value set with the rotary switch (SW1) is set out of the settable range.	Check the settings of the rotary switches. For details on the rotary switch settings, refer to the following. ☞ Page 28 Converter unit switch settings and operation panel
2. Forced stop has been input when the rotary switch is set to disable forced stop.	Check the forced stop wiring and rotary switch setting. For details on the forced stop wiring and the rotary switch settings, refer to the following. ☞ Page 28 Converter unit switch settings and operation panel ☞ Page 32 Example power circuit connections
3. The converter unit has malfunctioned.	Replace the converter unit, then check the repeatability.

[77_Main circuit device overheat]

- The inside of the converter unit overheated.

Cause	Check/action method
1. The ambient temperature exceeded the specified value (55 °C).	Check the ambient temperature, and if the temperature exceeds the specified value, lower the ambient temperature.
2. The power was turned on and off repeatedly under the overload status.	Check if the overload status occurred frequently. If the overload status occurred frequently, review the operation pattern.
3. A cooling fan, heat sink, or opening is clogged.	Clean the cooling fan, heat sink, or openings.
4. The converter unit has malfunctioned.	Replace the converter unit, then check the repeatability.

[7E_Overload 1]

- The load exceeded the overload protection characteristics of the converter unit.

Cause	Check/action method
1. A current larger than the continuous output current of the converter unit flowed.	Check the effective load ratio of the converter unit. If the effective load ratio of the converter unit is too high, take corrective actions as follows: <ul style="list-style-type: none">• Reduce the load.• Check the operation pattern.

[7F_Overload 2]

- The load exceeded the overload protection characteristics of the converter unit.

Cause	Check/action method
1. A current larger than the short-time output current of the converter unit flowed.	Check the effective load ratio of the converter unit. If the effective load ratio of the converter unit is too high, review the operation pattern.

[E9_ Instantaneous power failure warning]

- [71 Undervoltage] may occur.

Cause	Check/action method
1. An instantaneous power failure lasted for 30 ms or more.	Check if the power supply has a problem. After checking, cycle the power of the converter unit.

[EA_ External forced stop warning]

- EM1 (Forced stop) of the converter unit was turned off.

Cause	Check/action method
1. EM1 was turned off.	After ensuring safety, turn EM1 on.
2. An external 24 V DC power supply has not been inputted.	Input the external 24 V DC power supply.
3. The converter unit has malfunctioned.	Replace the converter unit, then check the repeatability.

[EB_ Excessive regeneration Warning]

- [73 Regenerative error] may occur.

Cause	Check/action method
1. The converter regenerative load ratio exceeded 80 %.	Perform the check method for [73 Regenerative error].  Page 80 [73_Regenerative error]

[EC_ Overload warning]

- [7E Overload 1] or [7E Overload 2] may occur.

Cause	Check/action method
1. Perform the check methods for [7E Overload 1] and [7F Overload 2].  Page 82 [7E_Overload 1]	

[EE_ Decreased cooling fan speed warning]

- The cooling fan speed decreased to a warning level or lower.

Cause	Check/action method
1. Perform the check method for [72 Cooling fan error].  Page 80 [72_Cooling fan error]	

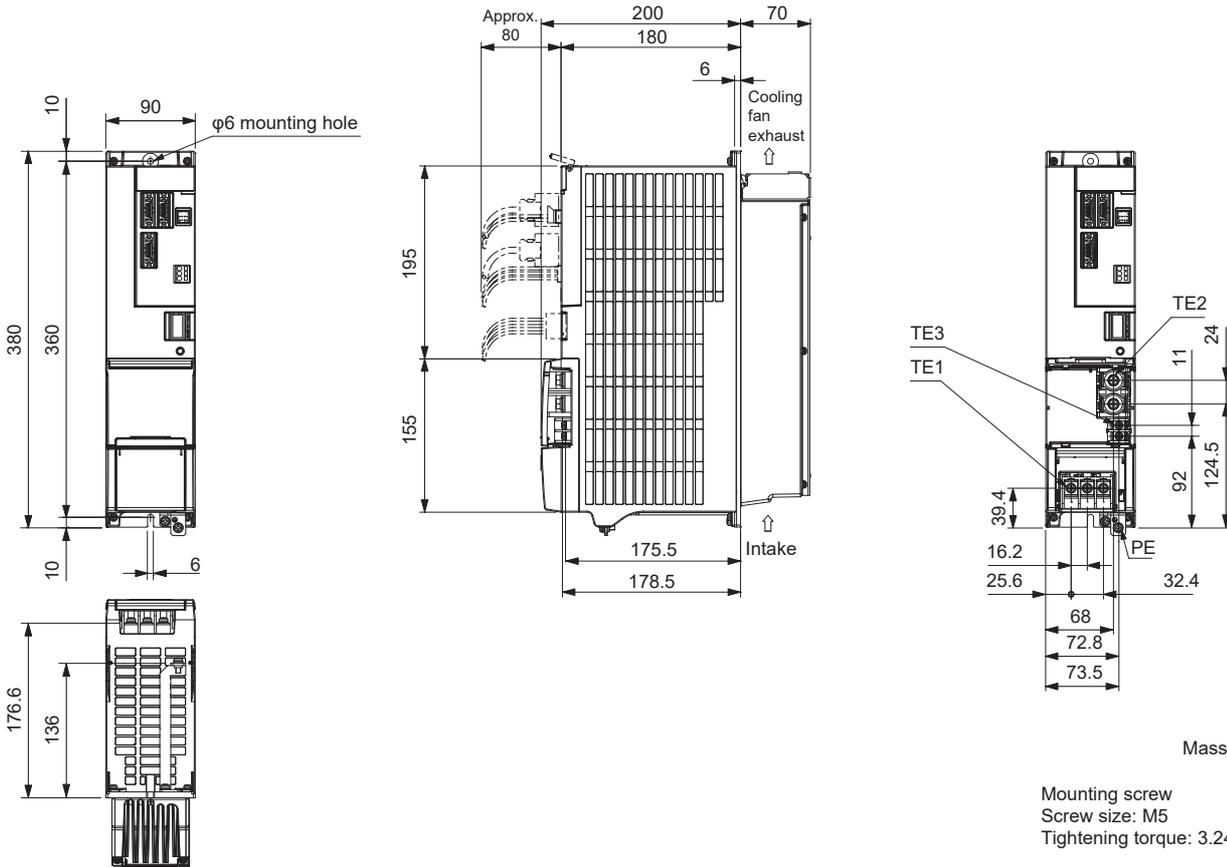
9 DIMENSIONS

Point

- Refer to the following for the mounting hole location diagram.
- ☞ Page 12 Mounting direction and clearances

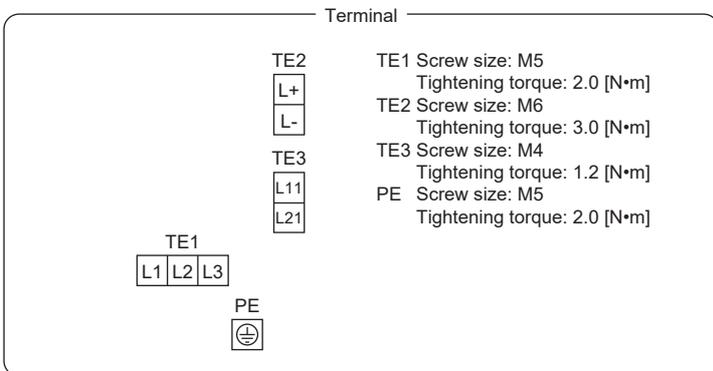
9.1 MR-CV11K(4)/MR-CV18K(4)

[Unit: mm]



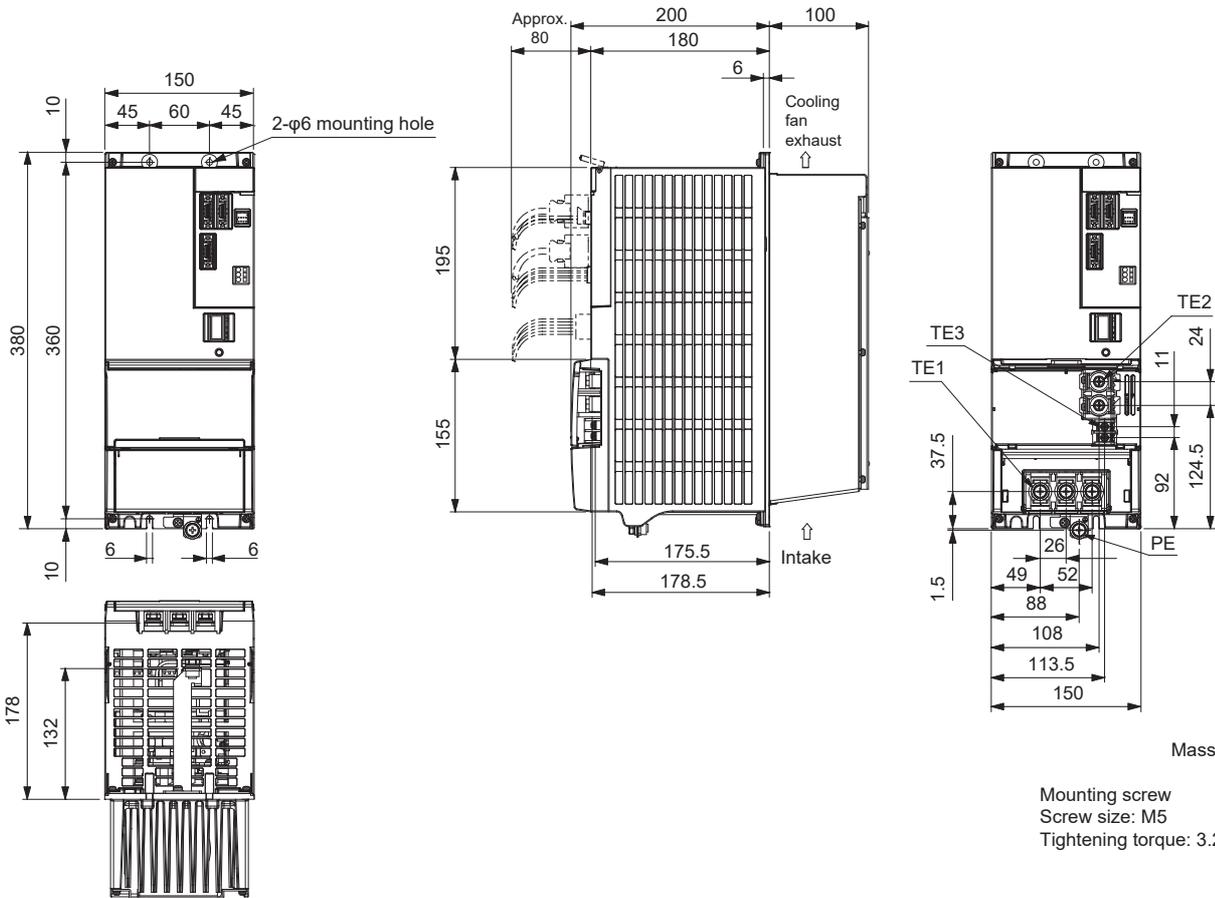
Mass: 6.1 [kg]

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



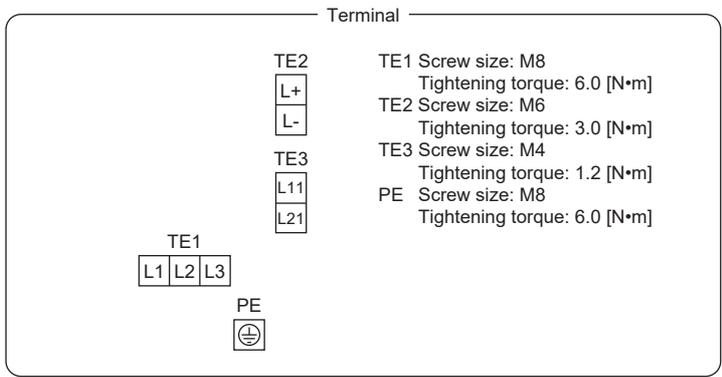
9.2 MR-CV30K(4)/MR-CV37K(4)/MR-CV45K(4)

[Unit: mm]



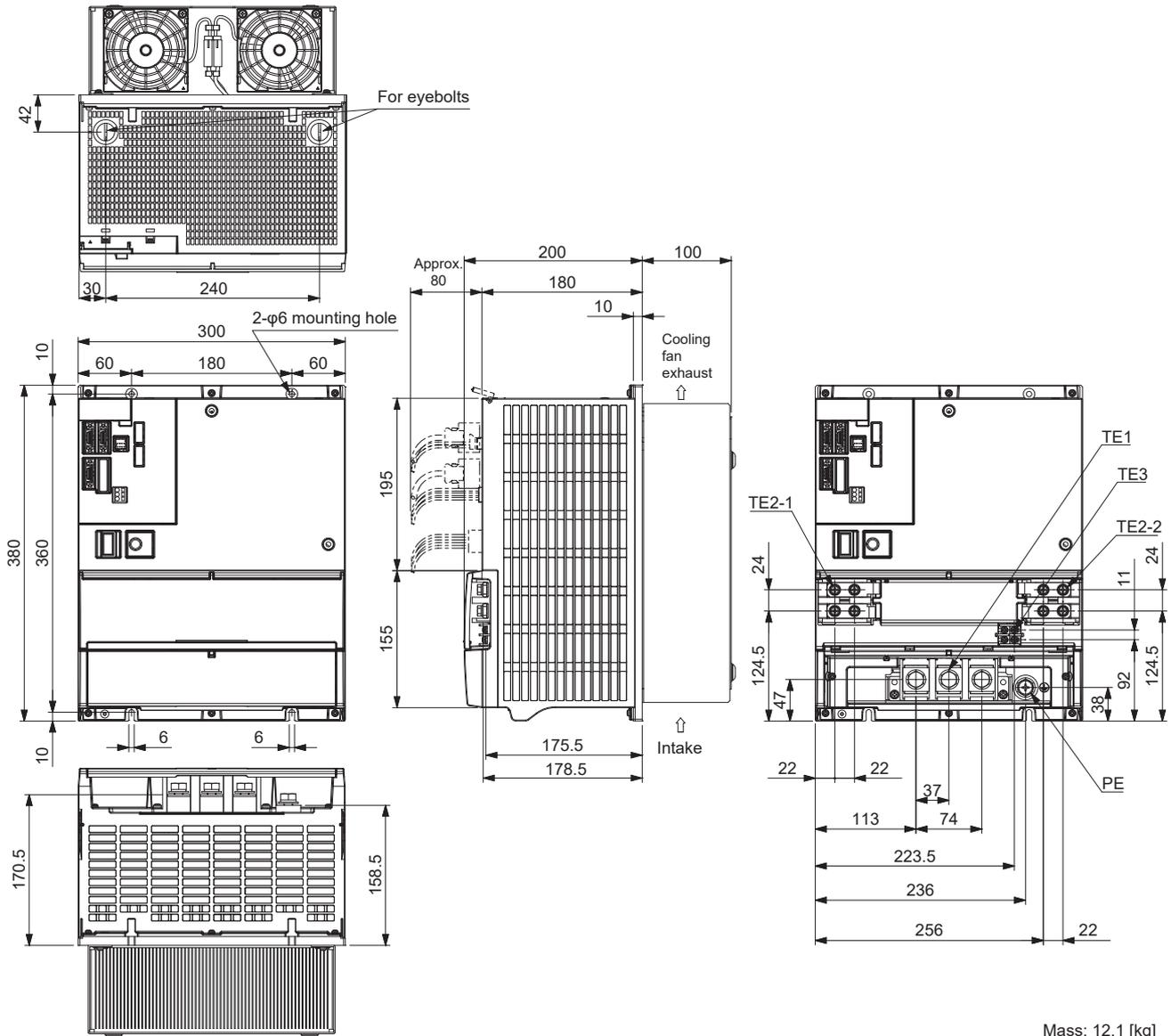
Mass: 12.1 [kg]

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



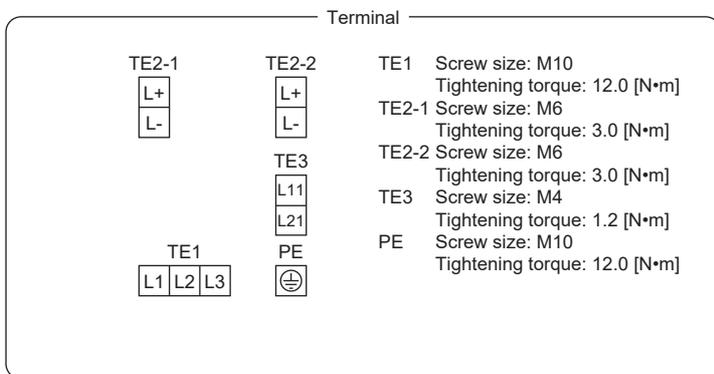
9.3 MR-CV55K

[Unit: mm]



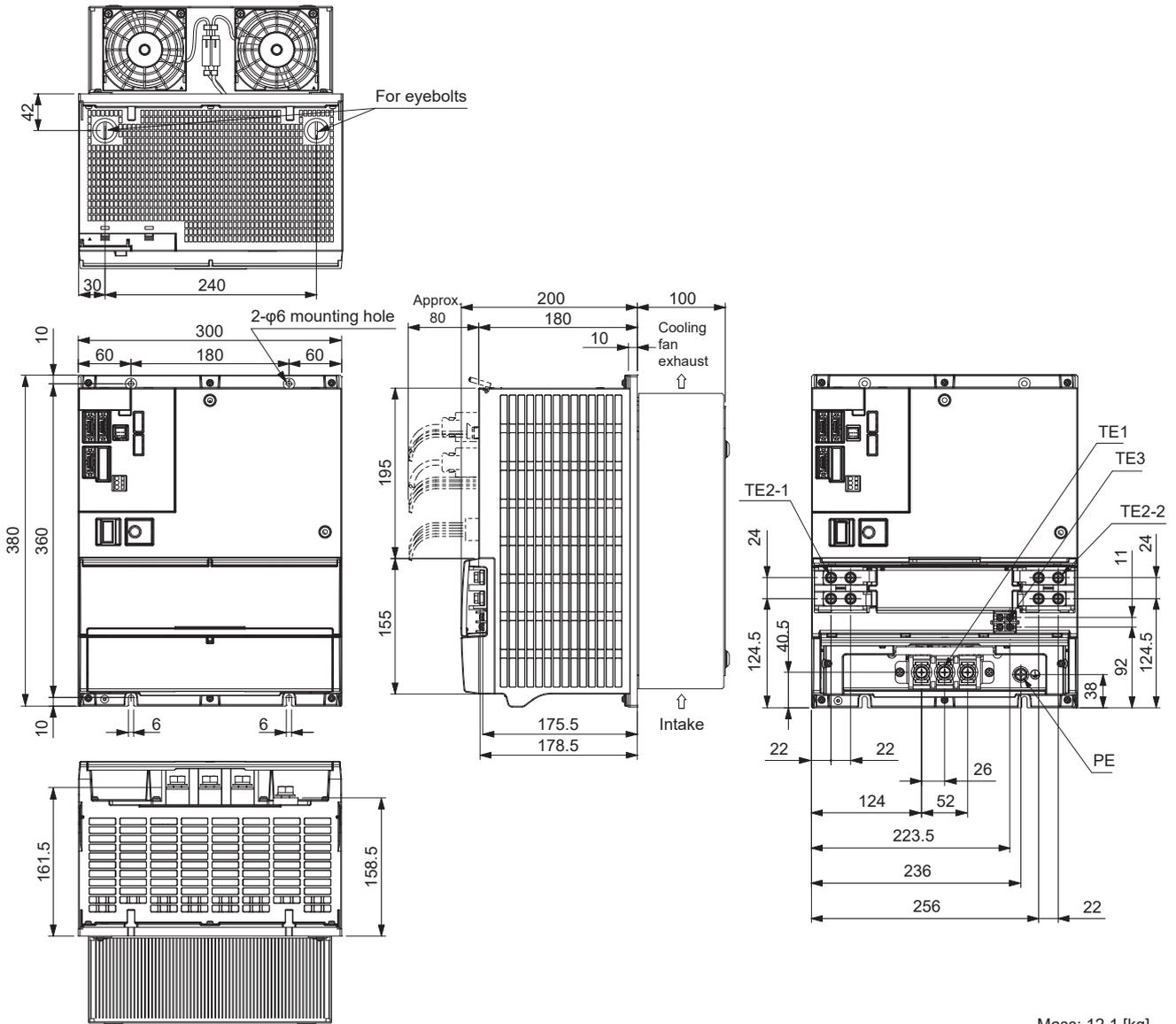
Mass: 12.1 [kg]

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



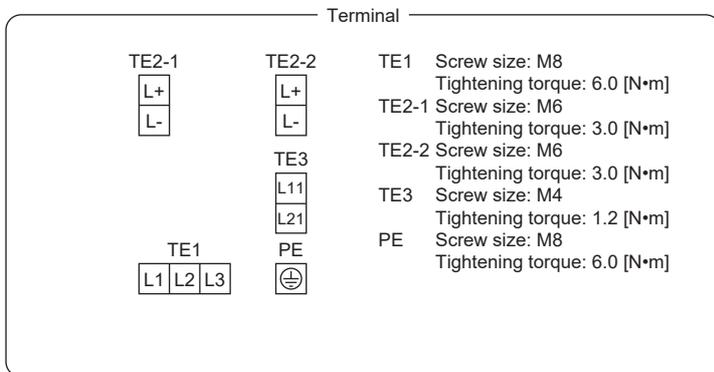
9.4 MR-CV55K4/MR-CV75K4

[Unit: mm]



Mass: 12.1 [kg]

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



10 OPTIONS AND PERIPHERAL EQUIPMENT

Precautions

- HIV wires are recommended to wire the converter unit, options, and peripheral equipment. Therefore, the recommended wire sizes may differ from those used for the previous generation converter units.
- To prevent an electric shock or a fire, correctly wire options and peripheral equipment, etc. in the correct combination.

10.1 Cables/connector sets

Point

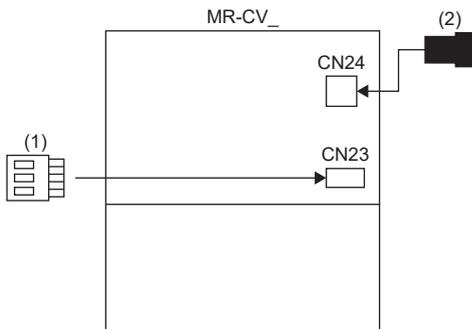
The indicated IP rating is the cable and connector's protection against ingress of dust and water when the cable and connector are connected to a converter unit. If the IP ratings of the cables, connectors, and converter units differ, the overall IP rating is determined by the lowest IP rating of all the components.

Purchase the cable and connector options indicated in this section for the MR-CV_ power regeneration converter unit. If using cables other than the cables described in this manual, comply with the standards and directives applicable to each country. For example, NFPA 79 in North America demands the use of a listed, certified product that has a thermoset insulator and is compliant with the NEC standard RHH, RHW, RHW-2, XHH, XHHW, or XHHW-2.

For details on the bus bar, refer to the drive unit/servo amplifier user's manual and instruction manual.

Combinations of connector sets

For the options used to connect to the drive unit, refer to the drive unit manual.



No.	Product name	Model	Description	Remark
(1)	Magnetic contactor wiring connector	—	MR-CV_ side connector Connector: 03JFAT-SAXGSA-L (JST) Open tool J-FAT-OT-EXL (JST)	Supplied with the converter unit.
(2)	Connector set	MR-CVCN24S	MR-CV_ side connector Connector: DK-2100D-08R Contact: DK-2RECSLP1-100 (DDK) *1	—

*1 Crimping tool: 357J-22733 (DDK) is required.

10.2 Selection example of wires

Point

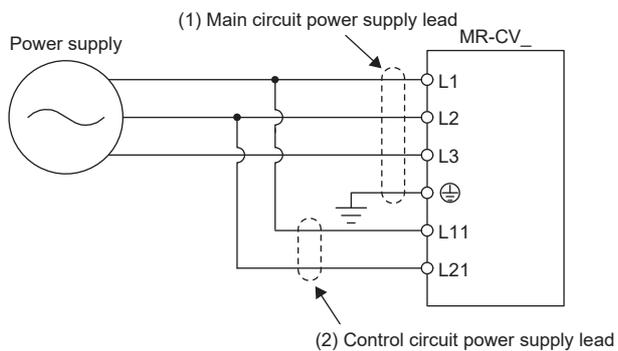
- To comply with the IEC/EN/UL/CSA standard for wiring, use the wires described in "MR-CV_ Instructions and Cautions for Safe Use of AC Servos (IB(NA)-0300228)". To comply with other standards, use wires that comply with each standard.
- Selection requirements for the wire size are as follows.

Construction requirements: Single wire set in midair

Wiring length: 50 m or less

Selection example of wires for converter unit

The following shows the wires used for wiring. Use the wires given in this section or equivalent wires. The following figure is a schematic diagram that shows the wires used for wiring.



Wire size selection examples

The following table lists selection examples for 600 V Grade heat-resistant polyvinyl chloride insulated wire (HIV wire).

Converter unit ^{*2}	Wire [mm ²] ^{*1*3}	
	L1/L2/L3 	L11/L21
MR-CV11K	8 (AWG 8): c	1.25 to 2 (AWG 16 to 14): b ^{*4}
MR-CV18K	22 (AWG 4): i	
MR-CV30K	38 (AWG 2): h	
MR-CV37K	60 (AWG 2/0): d	
MR-CV45K		
MR-CV55K	80 (AWG 3/0): e	
MR-CV11K4	5.5 (AWG 10): f	
MR-CV18K4	8 (AWG 8): c	
MR-CV30K4	14 (AWG 6): g	
MR-CV37K4	22 (AWG 4): a	
MR-CV45K4		
MR-CV55K4	38 (AWG 2): h	
MR-CV75K4	60 (AWG 2/0): d	

*1 The alphabetical letters in the table indicate the symbols of the selection example of crimp terminals.

 Page 90 Selection example of crimp terminals

*2 When connecting to the terminal block, use the screws included with the terminal block.

*3 The wires are selected based on the largest rated current among the servo motors to be combined.

*4 Use the size of 2 mm² for compliance with the IEC/EN/UL/CSA standard.

Selection example of crimp terminals

Symbol	Crimp terminal on the converter unit side				Manufacturer
	Crimp terminal ^{*2}	Applicable tool			
		Body	Head	Die	
a	FVD22-8	YF-1 E-4	YNE-38	DH-123 DH-113	JST
b	FVD2-4	YNT-1614	—	—	
c	FVD8-5	YF-1 E-4	YNE-38	DH-121 DH-111	
d ^{*1}	60-S8	YPT-60N	—	TD-125 TD-113	
		YF-1 E-4	YET-60-1		
e ^{*1}	80-10	YPT-150-1	—	TD-227 TD-214	
		YF-1 E-4	YET-150-1		
f	FVD5.5-5	YNT-1210S	—	—	
g	FVD14-8	YF-1 E-4	YNE-38	DH-122 DH-112	
h	FVD38-8	YF-1 E-4	YNE-38	DH-124 DH-114	
i ^{*1}	22-S5	YPT-60N	—	DH-123 DH-112	
		YF-1 E-4	YET-60-1		

*1 Cover the crimped part with an insulating tube.

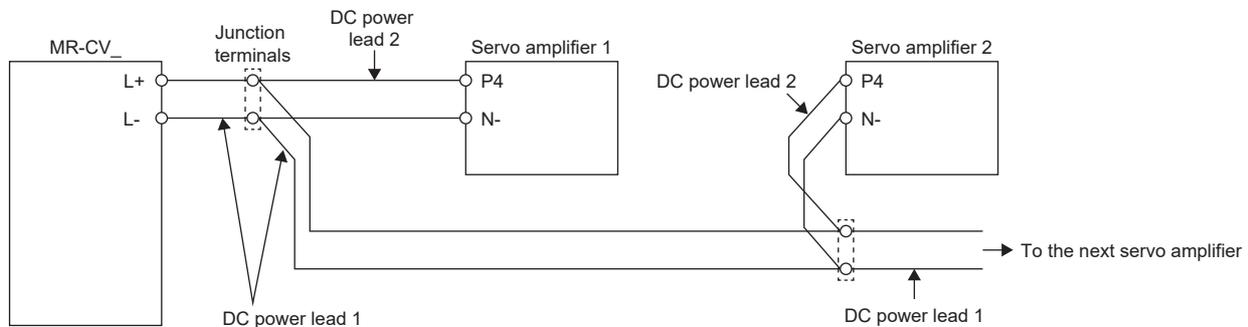
*2 Mounting may not be possible depending on the size of the crimp terminal, so use the recommended product or an equivalent.

Connection of converter unit and servo amplifier (MR-J4 series)

Point

When introducing a fuse to the DC power supply wiring between the converter unit and the servo amplifier, use a wire size that takes the protection coordination between the wires and the fuse into consideration.

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



Wire size

The following table lists selection examples for when 600 V Grade heat-resistant polyvinyl chloride insulated wire (HIV wire) is used for the DC power supply (L+ and P4, L- and N-) between the converter unit and the servo amplifier.

200 V class

DC power supply lead 1 Total capacity of servo amplifiers [kW]	DC power supply lead 2 Servo amplifier capacity	Wire [mm ²]
1.9 or less	100 W/200 W/400 W/600 W/750 W/1 kW	2 (AWG 14)
More than 1.9 and up to 3.1	2 kW	3.5 (AWG 12)
More than 3.1 and up to 5.2	3.5 kW/5 kW	5.5 (AWG 10)
More than 5.2 and up to 8.0	7 kW	8 (AWG 8)
More than 8.0 and up to 11.3	11 kW	14 (AWG 6)
More than 11.3 and up to 15.4	15 kW	22 (AWG 4)
More than 15.4 and up to 20.1	—	38 (AWG 2)
More than 20.1 and up to 26.2	22 kW	50 (AWG 1/0) *1
More than 26.2 and up to 27.5	—	60 (AWG 2/0) *1

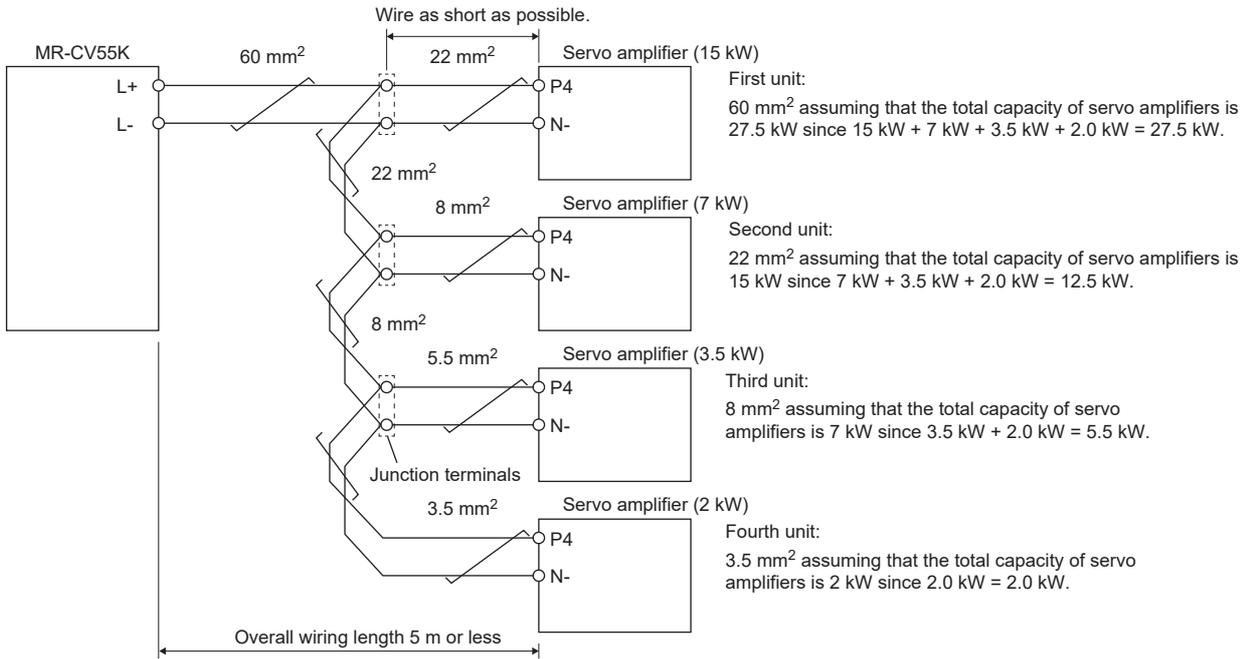
*1 The mounting of 50 mm² and 60 mm² wires to L+/L- of the converter unit is not possible. Connect two wires whose total cross-sectional area of the conductive parts is equal to or greater than the cross-sectional area shown in this table, or connect one wire each from TE2-1 or TE2-2.

400 V class

DC power supply lead 1 Total capacity of servo amplifiers [kW]	DC power supply lead 2 Servo amplifier capacity	Wire [mm ²]
4.4 or less	600 W/1 kW/2 kW/3.5 kW	2 (AWG 14)
More than 4.4 and up to 6.6	5 kW	3.5 (AWG 12)
More than 6.6 and up to 9.9	7 kW	5.5 (AWG 10)
More than 9.9 and up to 15.2	11 kW/15 kW	8 (AWG 8)
More than 15.2 and up to 22.1	22 kW	14 (AWG 6)
More than 22.1 and up to 27.5	—	22 (AWG 4)

■ Wire size selection examples

When connecting multiple servo amplifiers to the FR-XC, use junction terminal blocks for the wiring to terminals P4 and N- on the servo amplifiers. Also, connect the servo amplifiers in order with the largest capacity first.



10.3 Molded-case circuit breakers, fuses, magnetic contactors

When using a fuse instead of the molded-case circuit breaker, use the one having the specifications given in this section.

Precautions

- Select the molded-case circuit breakers specified in this section.
- Wire the molded-case circuit breaker and magnetic contactor as recommended.

For main circuit power supply

Converter unit	Molded-case circuit breaker *1		Fuse			Magnetic contactor *2
	Frame, rated current	Voltage AC [V]	Class	Current [A]	Voltage AC [V]	
MR-CV11K	50 A frame 50 A	240	T	100	300	S-T35
MR-CV18K	100 A frame 100 A			175		S-T65
MR-CV30K	225 A frame 150 A			300		S-N125
MR-CV37K	225 A frame 175 A			350		S-N125
MR-CV45K	225 A frame 225 A			400		S-N150
MR-CV55K	400 A frame 300 A			600		S-N220
MR-CV11K4	30 A frame 30 A	480		50	600	S-T21
MR-CV18K4	50 A frame 50 A			100		S-T35
MR-CV30K4	100 A frame 80 A			175		S-T65
MR-CV37K4	100 A frame 100 A			200		S-T80
MR-CV45K4	125 A frame 125 A			250		S-T100
MR-CV55K4	225 A frame 150 A			300		S-N125
MR-CV75K4	225 A frame 200 A			350		S-N150

*1 To comply with the IEC/EN/UL/CSA standards, refer to "MR-CV_ Instructions and Cautions for Safe Use of AC Servos (IB(NA)-0300228)".

*2 Use the magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less.

For control circuit power supply

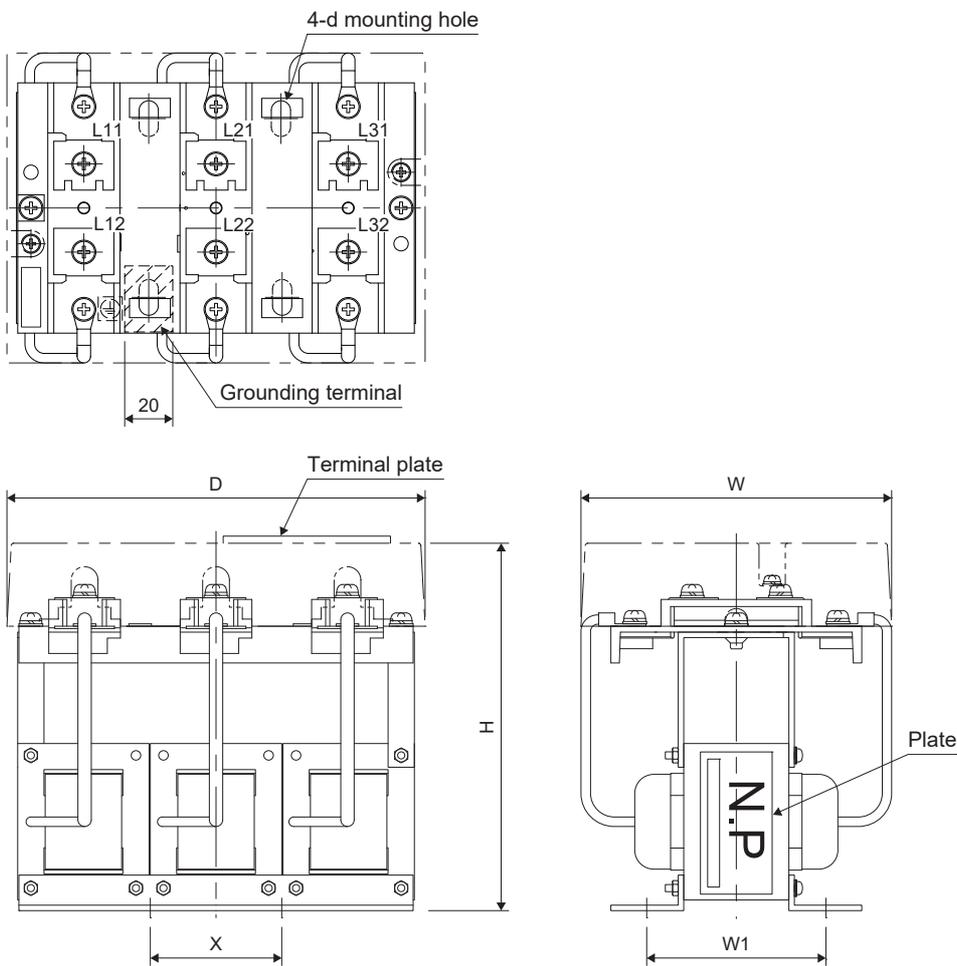
When the wiring for the control circuit power supply (L11/L21) is thinner than that for the main circuit power supply (L1/L2/L3), install an overcurrent protection device (molded-case circuit breaker, fuse, etc.) to protect the branch circuit. The following table lists the selection of overcurrent protection devices (molded-case circuit breaker, fuse, etc.) that are connected only to the converter unit. When crossing over the wiring of the control circuit power supply, refer to the drive unit/servo amplifier user's manual and instruction manual.

Converter unit	Molded-case circuit breaker *1		Fuse (Class T)		Fuse (Class K5)	
	Frame, rated current	Voltage AC [V]	Current [A]	Voltage AC [V]	Current [A]	Voltage AC [V]
MR-CV11K MR-CV18K MR-CV30K MR-CV37K MR-CV45K MR-CV55K	30 A frame 5 A	240	1	300	1	250
MR-CV11K4 MR-CV18K4 MR-CV30K4 MR-CV37K4 MR-CV45K4 MR-CV55K4 MR-CV75K4	30 A frame 5 A	480	1	600	1	600

*1 To comply with the IEC/EN/UL/CSA standards, refer to "MR-CV_ Instructions and Cautions for Safe Use of AC Servos (IB(NA)-0300228)".

10.4 AC reactor

Converter unit	AC reactor	Variable dimensions [mm]						Terminal screw	Mass [kg]
		W	D	H	W1	X	d		
MR-CV11K	MR-AL-11K	145	175	155	75	55	M6	M5	3.7
MR-CV18K	MR-AL-18K	145	175	155	105	55	M6	M6	5.3
MR-CV30K	MR-AL-30K	145	175	155	110	55	M6	M6	6.1
MR-CV37K	MR-AL-37K	150	215	175	110	70	M6	M6	8.6
MR-CV45K	MR-AL-45K	160	215	175	120	70	M6	M6	9.7
MR-CV55K	MR-AL-55K	230	220	192	120	200	M8	M10	11.5
MR-CV11K4	MR-AL-11K4	145	175	155	75	55	M6	M5	3.7
MR-CV18K4	MR-AL-18K4	145	175	155	105	55	M6	M6	5.3
MR-CV30K4	MR-AL-30K4	145	175	155	110	55	M6	M6	6.0
MR-CV37K4	MR-AL-37K4	150	215	175	110	70	M6	M6	8.5
MR-CV45K4	MR-AL-45K4	160	215	175	120	70	M6	M6	9.8
MR-CV55K4	MR-AL-55K4	230	220	210	120	200	M8	M6	10.5
MR-CV75K4	MR-AL-75K4	230	250	215	143	230	M8	M6	13.0



10.5 Noise reduction techniques

Noises are classified into external noises, which enter the converter unit/drive unit to cause it to malfunction, and those radiated by the converter unit/drive unit to cause peripheral equipment to malfunction. Because the converter unit/drive unit is an electronic device that handles small signals, the following general noise reduction techniques are required.

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

 Page 63 Grounding

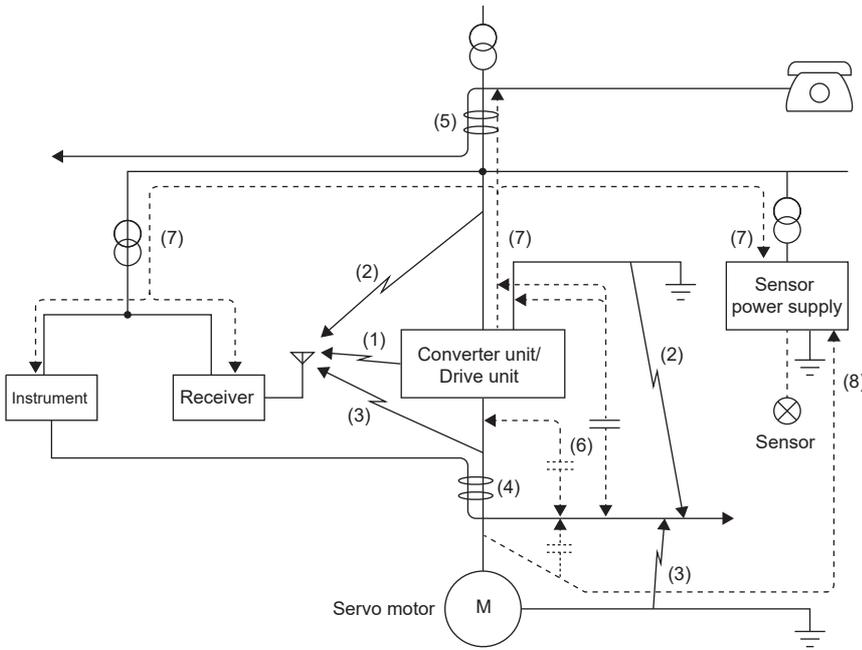
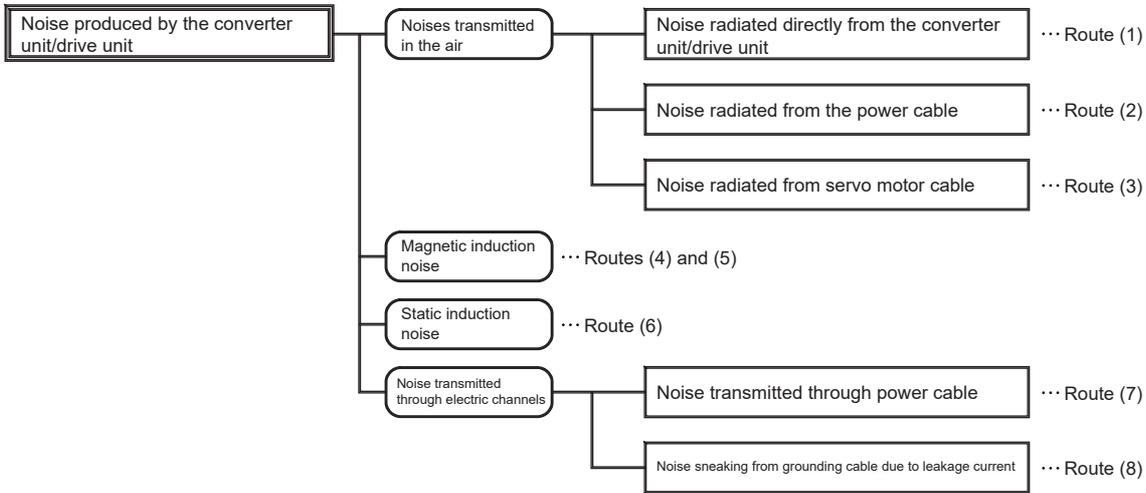
■Reduction techniques for external noises that cause the converter unit/drive unit to malfunction

If noise sources (such as a magnetic contactor, an electromagnetic brake, and many relays) are generating a large amount of noise near the converter unit/drive unit and the converter unit/drive unit 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.
- Although a surge absorber is built into the converter unit, to protect the converter unit/drive unit and other equipment against large exogenous noise and lightning surge, attaching a varistor to the power input section of the equipment is recommended.

Techniques for noises radiated by the converter unit/drive unit that cause peripheral equipment to malfunction

Noises produced by the converter unit/drive unit are classified into those radiated from the cables connected to the converter unit/drive unit and its main circuits (input/output), those induced electromagnetically or statically by the signal cables of the peripheral equipment located near the main circuit cables, and those transmitted through the power supply cables.



Noise transmission route	Suppression techniques
(1), (2), (3)	<p>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 a converter unit/drive unit or when the signal cables run near it. Take the following measures to prevent a malfunction:</p> <ul style="list-style-type: none"> • Provide maximum clearance between easily affected devices and the converter unit/drive unit. • Provide maximum clearance between easily affected signal cables and the I/O cables of the converter unit/drive unit. • Avoid bundling power lines (input/output lines of the converter unit/drive unit) and signal cables together or running them in parallel to each other. • Insert a line noise filter to the I/O cables or a radio noise filter on the input line to reduce radiated noise from the cables. • Use shielded wires for the signal and power lines, or put the lines in separate metal conduits.
(4), (5), (6)	<p>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.</p> <ul style="list-style-type: none"> • Provide maximum clearance between easily affected devices and the converter unit/drive unit. • Provide maximum clearance between easily affected signal cables and the I/O cables of the converter unit/drive unit. • Avoid bundling power lines (input/output lines of the converter unit/drive unit) and signal cables together or running them in parallel to each other. • Use shielded wires for the signal and power lines, or put the lines in separate metal conduits.
(7)	<p>When the power supply of peripheral equipment is connected to the power supply of the converter unit/drive unit, noise produced by the converter unit/drive unit may be transmitted back through the power supply cable, and the equipment may malfunction. The following techniques are required.</p> <ul style="list-style-type: none"> • Install the radio noise filter (FR-BIF(-H)) on the power lines (input lines) of the converter unit/drive unit. • Install the line noise filter (FR-BSF01/FR-BLF) on the power lines of the converter unit/drive unit.
(8)	<p>If the grounding wires of the peripheral equipment and the converter unit/drive unit 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.</p>

Noise reduction products

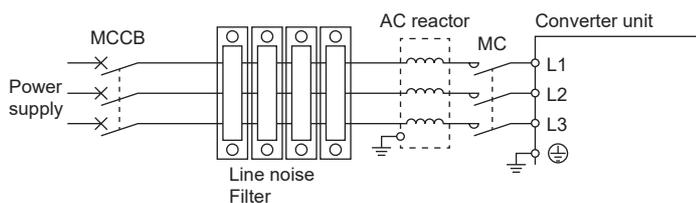
For the noise reduction products to connect to a drive unit, refer to the manual and instruction manual of each drive unit.

■Line noise filter (FR-BLF)

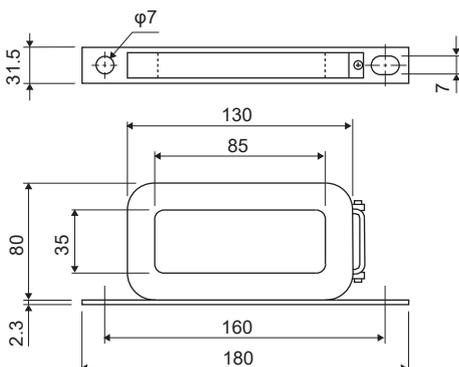
This filter is effective in suppressing noise radiated from the power supply of the converter unit and output side of the drive unit and also in suppressing high-frequency leakage current (0-phase current). It is especially effective for noise between 0.5 MHz and 5 MHz band.

- Connection diagram

Pass the three-phase wires through four line noise filters. When using a line noise filter for the power supply line, passing it through together with the grounding wire reduces the filter effect. Wire the grounding wire separately from the power supply wire.



- Dimensions [Unit: mm]

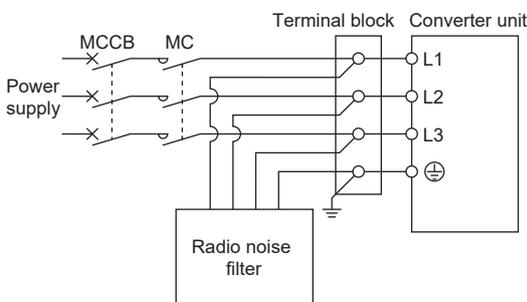
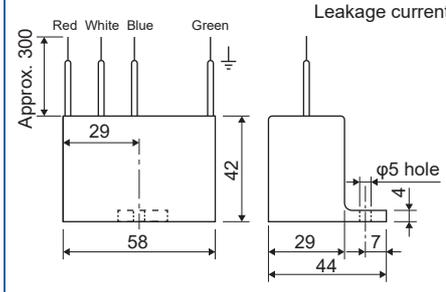


Radio noise filter (FR-BIF(-H))

This filter is effective in suppressing noise radiated from the power supply side of the converter unit, especially in 10 MHz and lower radio frequency bands. The FR-BIF(-H) is designed for the input only.

200 V class: FR-BIF

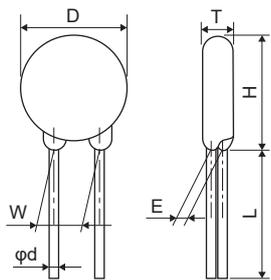
400 V class: FR-BIF-H

Connection diagram	Dimensions [Unit: mm]
<p>Make the connection cables as short as possible. Grounding is required. When using the FR-BIF(-H) with a single-phase power supply, insulate unconnected lead wires.</p> 	<p>Leakage current: 4 mA</p> 

Varistor for input power supply (recommended)

Varistors are effective to prevent exogenous noise and lightning surges from entering the converter unit. When using a varistor, connect it between each phase of the input power supply of the equipment. For varistors, the TND20V-431K, TND20V-471K, and TND20V-102K manufactured by Nippon Chemi-Con are recommended. For detailed specification and usage of the varistors, refer to the manufacturer catalog.

Power supply voltage	Varistor	Maximum rating					Maximum limit voltage		Static capacity (reference value)	Varistor voltage rating (range) V1 mA
		Permissible circuit voltage		Surge current immunity	Energy immunity	Rated pulse power	[A]	[V]		
		AC [Vrms]	DC [V]	8/20 μs [A]	2 ms [J]	[W]			[pF]	[V]
200 V	TND20V-431K	275	350	10000/1 time 7000/2 times	195	1.0	100	710	1300	430 (387 to 473)
	TND20V-471K	300	385		215				775	1200
400 V	TND20V-102K	625	825	7500/1 time 6500/2 times	400	1.0	100	1650	560	1000 (900 to 1100)



[Unit: mm]

Model	D Max.	H Max.	T Max.	E ±1.0	L Min.*1	φd ±0.05	W ±1.0
TND20V-431K	21.5	24.5	6.4	3.3	20	0.8	10.0
TND20V-471K			6.6	3.5			
TND20V-102K	22.5	25.5	9.5	6.4	20	0.8	10.0

*1 For special purpose items for lead length (L), contact the manufacturer.

10.6 Earth-leakage current breaker

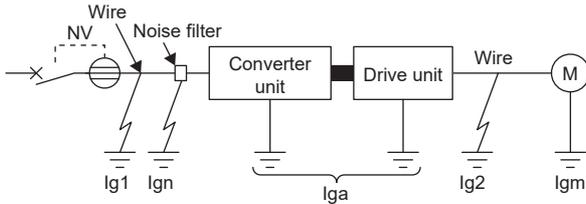
Selection method

High-frequency chopper currents controlled by pulse width modulation flow in the AC servo circuits. Leakage currents containing harmonic contents are larger than those of the motor, which runs on AC power.

Select an earth-leakage current breaker according to the following formula, and ground the converter unit, drive unit, servo amplifier, servo motor, etc. securely.

To minimize leakage currents, make the input and output wires as short as possible, and keep a distance of 30 cm or longer between the wires and ground.

$$\text{Rated sensitivity current} \geq 10 \cdot \{I_{g1} + I_{gn} + I_{ga} + K \cdot (I_{g2} + I_{gm})\} \text{ [mA]} \dots (10.1)$$



Earth-leakage current breaker		K
Type	Mitsubishi Electric products	
Models provided with harmonic and surge reduction techniques	NV-SV NV-SVF NV-SW NV-CV NV-CVF NV-CW NV-HV	1
General models	BV-C1	3

I_{g1}: Leakage current on the electric channel from the earth-leakage current breaker to the input terminals of the converter unit

☞ Page 101 Example of leakage current (I_{g1}, I_{g2}) per km of CV cable run in metal conduit

I_{g2}: Leakage current on the electric channel from the output terminals of the drive unit to the servo motor

☞ Page 101 Example of leakage current (I_{g1}, I_{g2}) per km of CV cable run in metal conduit

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

I_{ga}: Leakage current of the converter unit and drive unit

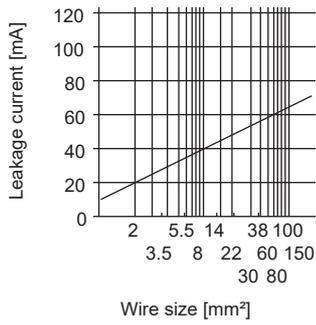
The leakage current of the MR-CV_ power regeneration converter unit is 5 mA for all series. For the leakage current of the drive units, refer to the manual and instruction manual of each drive unit.

I_{gm}: Servo motor leakage current

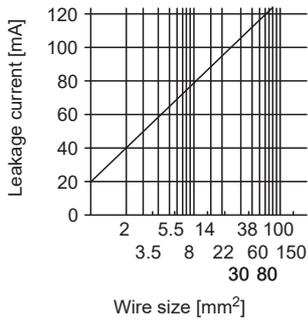
Refer to the manual and instruction manual for each drive unit.

Example of leakage current (I_{g1}, I_{g2}) per km of CV cable run in metal conduit

- 200 V class

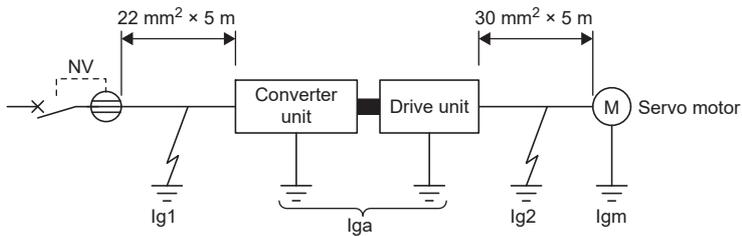


- 400 V class



Selection example

This section shows examples of selecting an earth-leakage current breaker under the following conditions.



Use an earth-leakage current breaker designed for suppressing harmonics/surges.

Find each term of formula (10.1) from the diagram.

$$I_{g1} = 95 \cdot \frac{5}{1000} = 0.475 \text{ [mA]}$$

$$I_{g2} = 105 \cdot \frac{5}{1000} = 0.525 \text{ [mA]}$$

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

$$I_{ga} = 5 \text{ [mA]}$$

$$I_{gm} = 2.5 \text{ [mA]}$$

Insert these values in formula (10.1).

$$I_g \geq 10 \cdot \{0.475 + 0 + 5 + 1 \cdot (0.525 + 2.5)\}$$

$$I_g \geq 85 \text{ [mA]}$$

According to the result of calculation, use an earth-leakage current breaker with a rated sensitivity current (I_g) of 85 mA or more.

Use 200 mA for the NV-SV/NV-SVF/NV-SW/NV-CV/NV-CVF/NV-CW/NV-HV series.

10.7 EMC filter (recommended)

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

When connecting one or more converter units to one EMC filter, satisfy the following conditions:

- Rated input of EMC filter [V] \geq Rated input voltage of the converter units [V]
- Rated current of EMC filter [A] \geq Rated input current of the converter units [A]

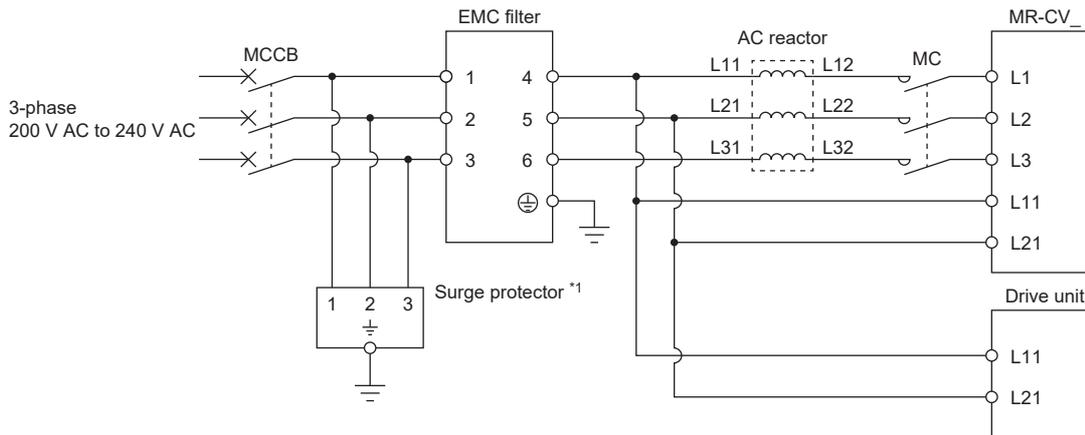
Application environment	EMC filter					Manufacturer
	Model	Rated current [A]	Rated voltage [VAC]	Operating temperature [°C]	Mass [kg]	
IEC/EN 61800-3 Category C2, C3 *1	FSB-20-355	20	500	-40 to 85	1.8	COSEL Co., Ltd.
	FSB-30-355	30			3.3	
	FSB-40-355	40			6.3	
	FSB-80-355	80			8.8	
	FSB-100-355	100				
	FSB-150-355	150				
IEC/EN 61800-3 Category C3 *1	HF3030C-SZL	30	500	-20 to 50	1.3	Soshin Electric Co., Ltd.
	HF3060C-SZL	60			2.1	
	HF3100C-SZL	100			5.8	
	HF3150C-SZL	150			9.0	

*1 Category C2: intended for use in the first environment (residential environment) only when installed by professional personnel or for use in the second environment (commercial, light industry and industrial environments)

Category C3: intended for use in the second environment (commercial, light industry and industrial environments)

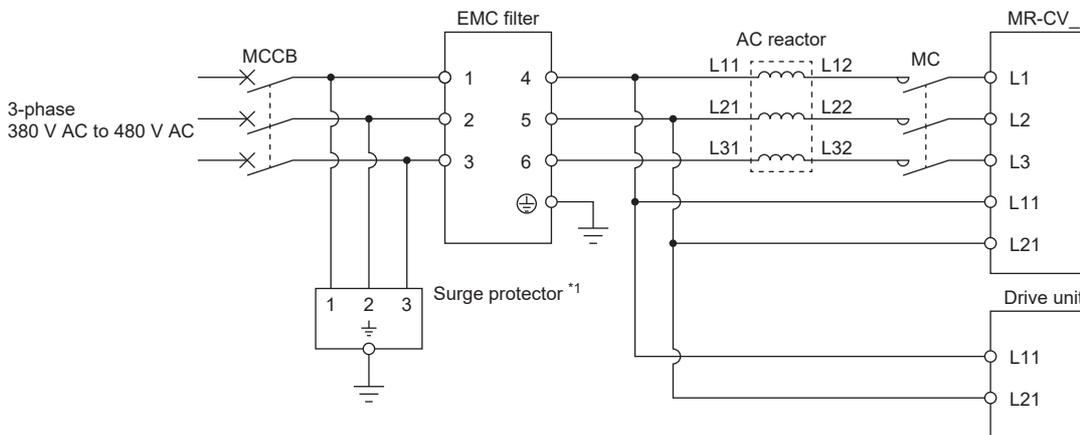
Connection example

■ For 3-phase 200 V AC to 240 V AC power supply



*1 When a surge protector is used.

■ For 3-phase 380 V AC to 480 V AC power supply



*1 When a surge protector is used.

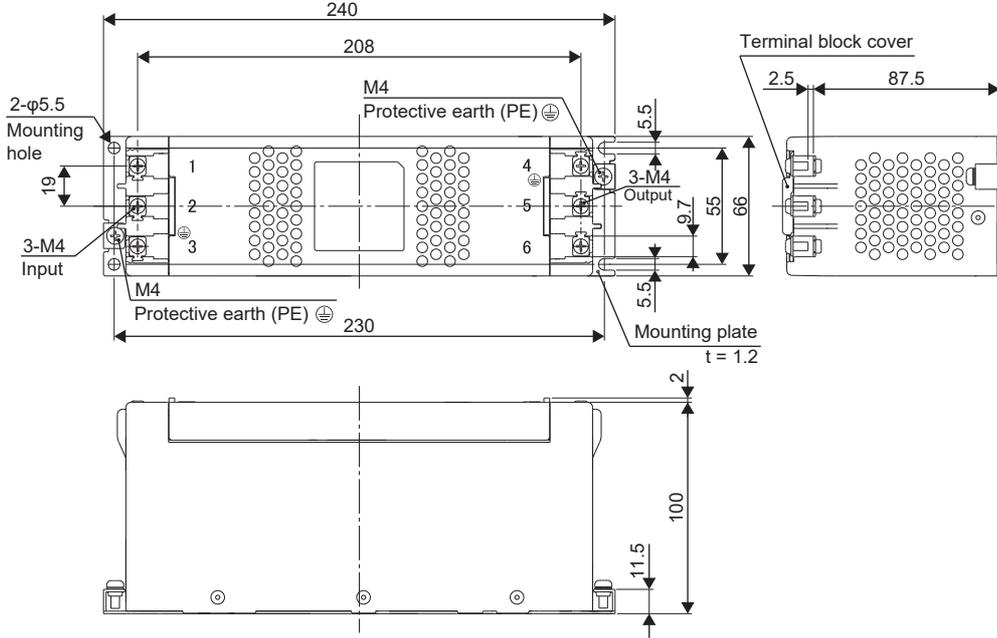
Dimensions

■ EMC filter

For dimensions including dimensional tolerances, contact the manufacturer of the EMC filter being used.

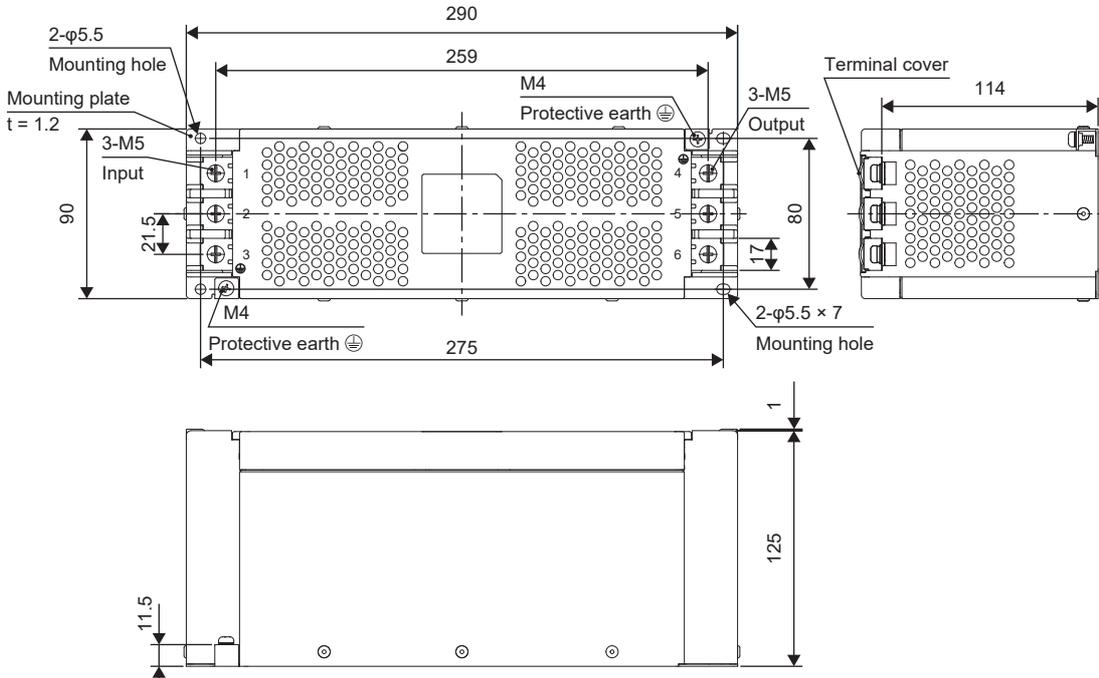
- FSB-20-355/FSB-30-355

[Unit: mm]



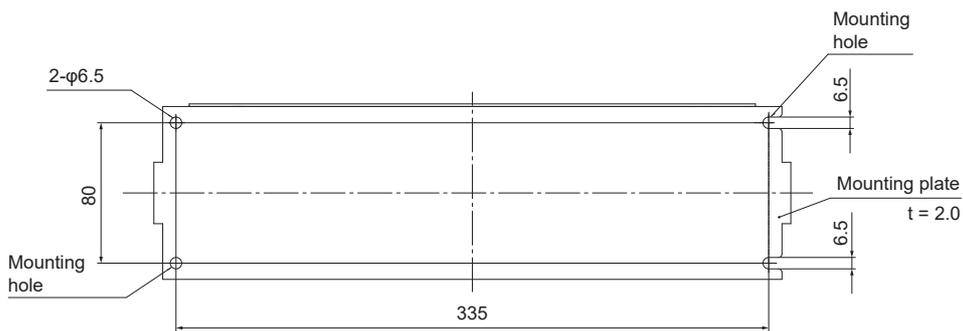
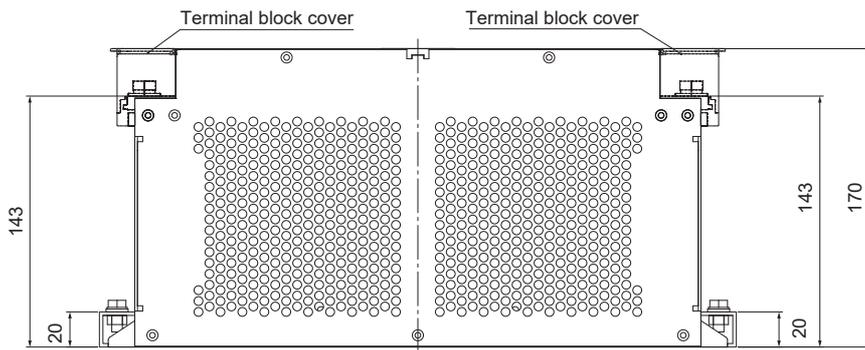
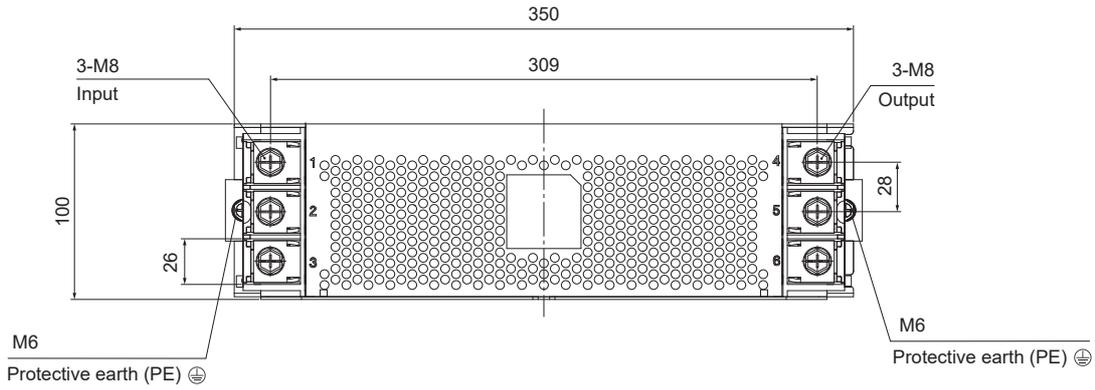
- FSB-40-355

[Unit: mm]



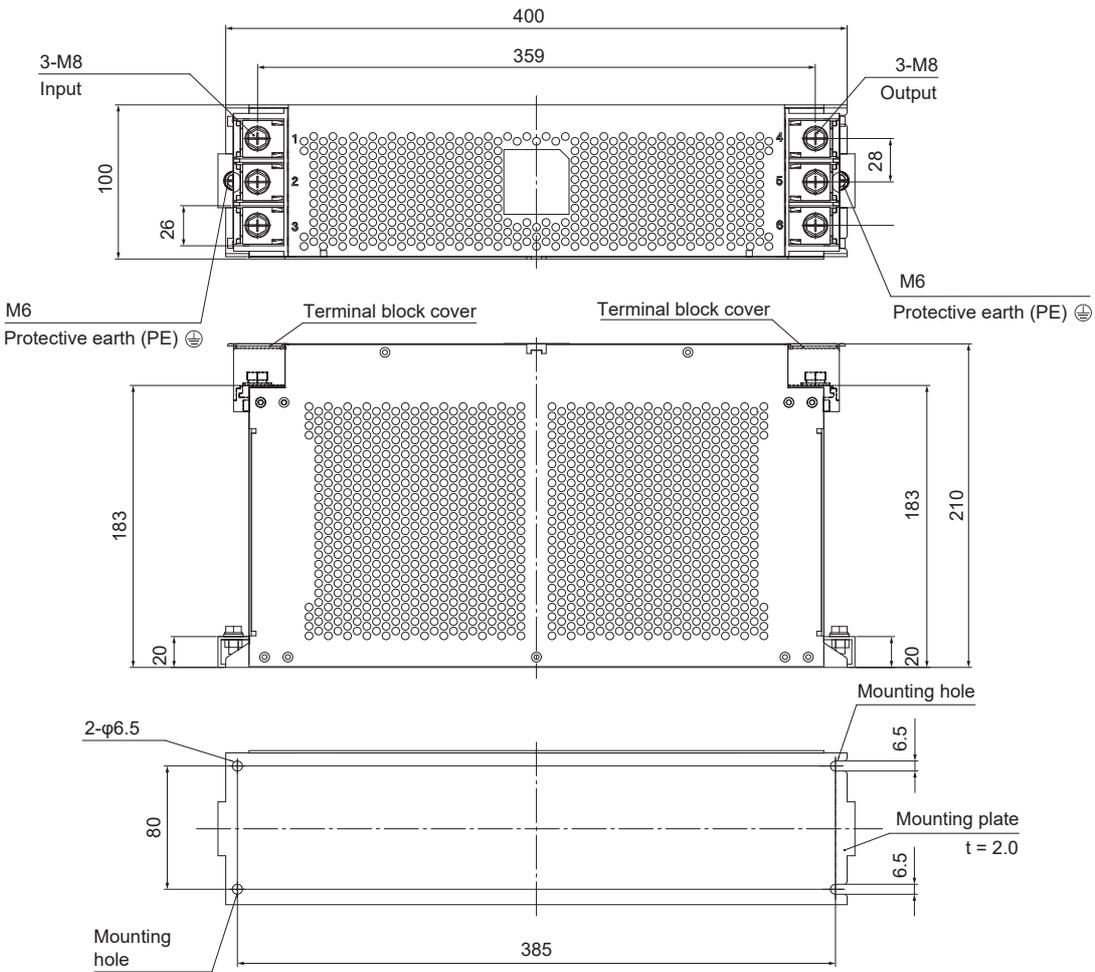
• FSB-80-355/FSB-100-355

[Unit: mm]



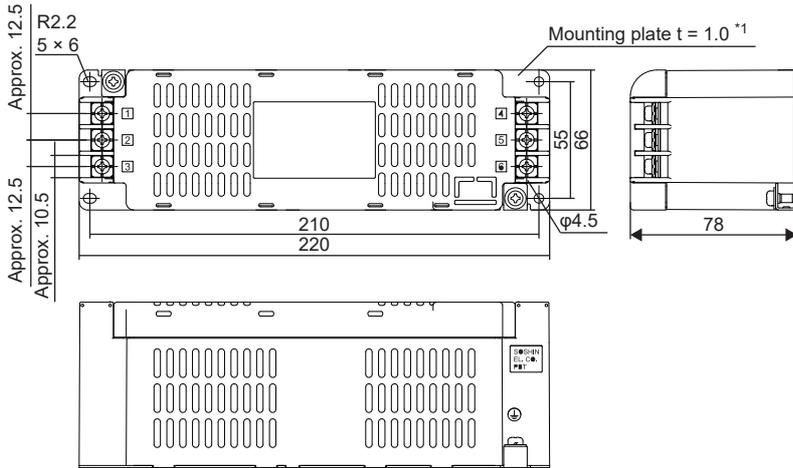
• FSB-150-355

[Unit: mm]



• HF3030C-SZL/HF3060C-SZL

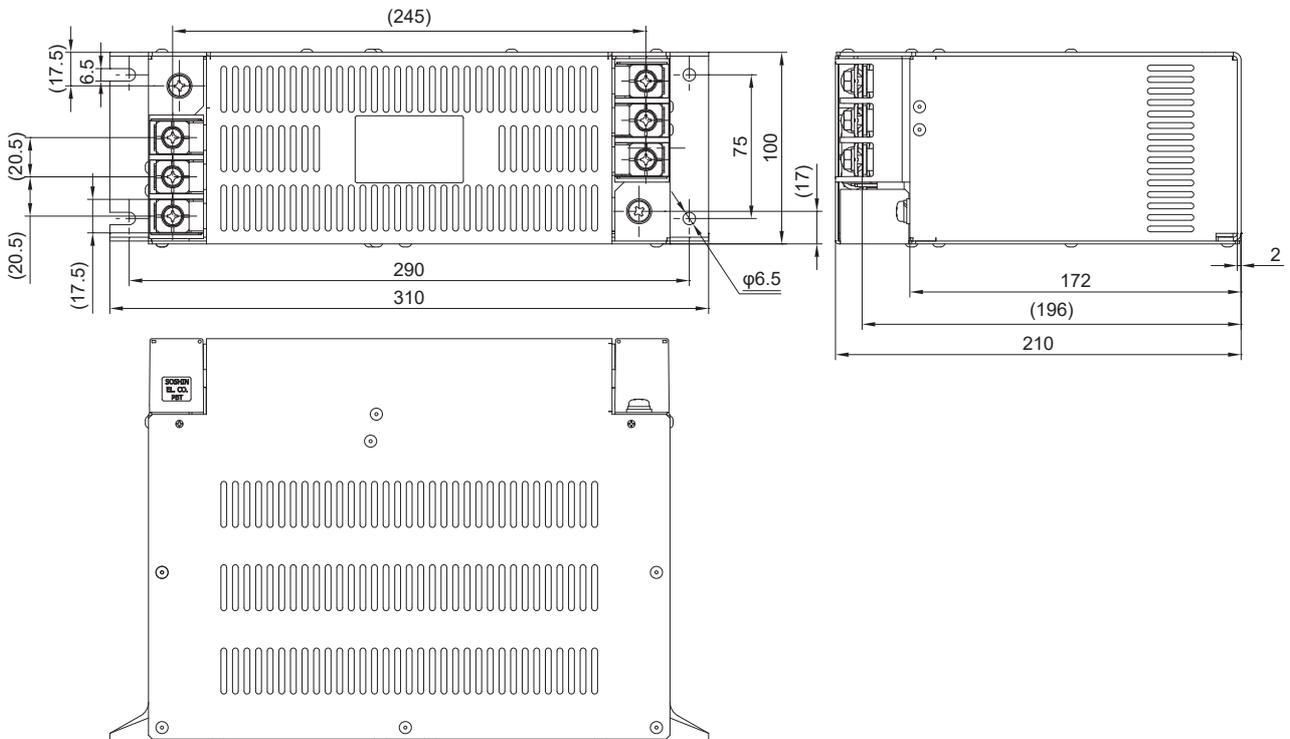
[Unit: mm]



*1 This applies to HF3030C-SZL. The mounting plate thickness of HF3060C-SZL is 1.2 mm.

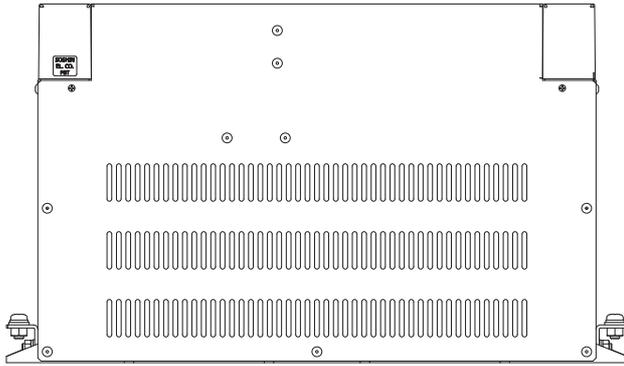
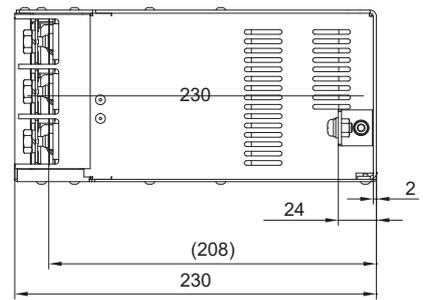
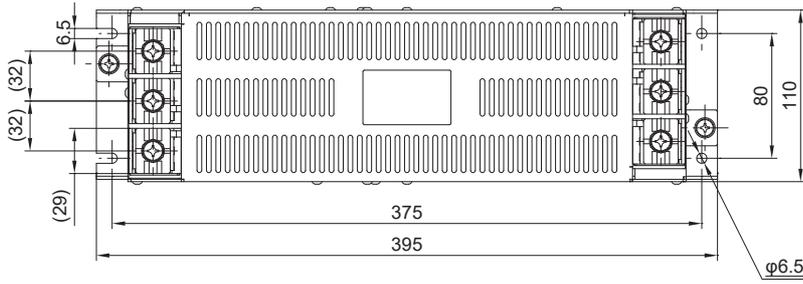
• HF3100C-SZL

[Unit: mm]



• HF3150C-SZL

[Unit: mm]



■ Surge protector (recommended)

Point

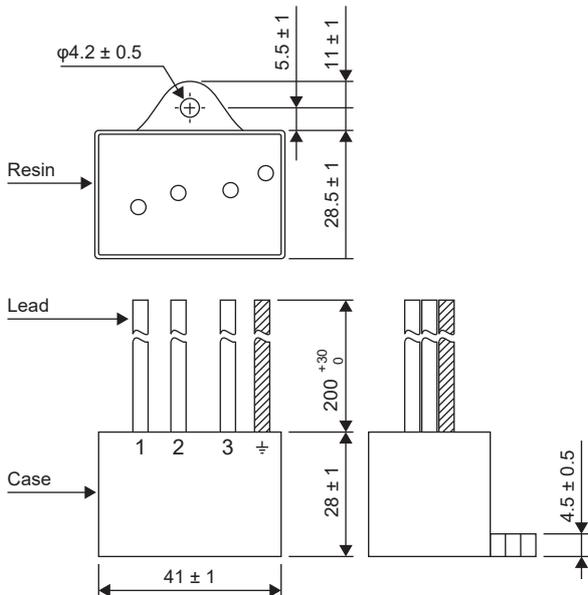
- To use an EMC filter with the converter unit, a surge protector is required.

To prevent damage due to surges (such as lightning and sparks) applied to the AC power supply lines, connect the following surge protectors to the main circuit power supply (L1/L2/L3).

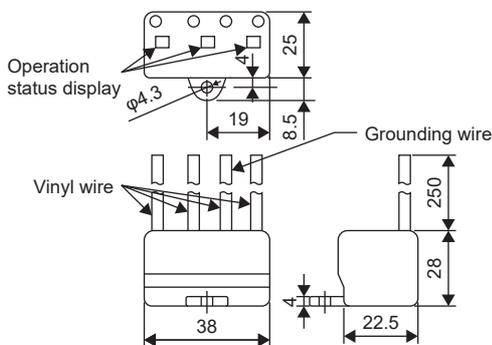
Surge protector model	Maximum continuous operating voltage 50/60 Hz	DC operating start voltage	Voltage protection level	Nominal discharge current 8/20 μ s	Maximum discharge current 8/20 μ s	Impulse current life 8/20 μ s - 1000 A	Manufacturer
RSPD-250-U4	3-phase 250 V AC	700 V \pm 25 %	1300 V	2500 A	5000 A	About 300 times	Okaya Electric Industries Co., Ltd.
RSPD-500-U4	3-phase 500 V AC	1300 V \pm 25 %	2000 V	2500 A	5000 A	About 300 times	Okaya Electric Industries Co., Ltd.
LT-CS32G801WS	3-phase 275 V AC	660 V \pm 10 %	1400 V	5000 A	8000 A	About 1000 times	Soshin Electric Co., Ltd.

- RSPD series (Okaya Electric Industries)

[Unit: mm]



- LT-CS-WS series (Soshin Electric)



11 COMPLIANCE WITH GLOBAL STANDARDS

This chapter describes the converter unit and drive units as servo amplifiers.

11.1 Compliance with global standards

Refer to the following manual for information about compliance with global standards.

MR-CV_ Instructions and Cautions for Safe Use of AC Servos (IB(NA)-0300228)

11.2 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 certification: 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).

Judgment

20 product groups divided into 158 categories are specified as the subject products (announcement No. 45, 2014). The following table shows whether the servo products are required to comply with CCC.

Product	Judgment
AC servo amplifier	Not subject
AC servo motor *1	Not subject
Options *2	Not subject

*1 Small capacity motors with a capacity of 750 W or lower are included in the catalog of products subject to CCC, but the requirements do not apply to our products for the following reasons:

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 is not classified into the cable category in the catalog.

11.3 Compliance with the China RoHS directive

Outline

The China RoHS directive: 电子信息产品污染控制管理办法 (Management Methods for Controlling Pollution by Electronic Information Products) came into effect on March 1, 2007. The China RoHS directive was replaced by the following China RoHS directive: 电器电子产品有害物质限制使用管理办法 (Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products). The succeeding China RoHS directive has been in effect since July 1, 2016.

The China RoHS directive restricts the following hazardous substances: six hazardous substances (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE)) which are also restricted by EU RoHS 2 (directive 2011/65/EU), and other hazardous substances specified by the State (currently no applicable substances).

Status of our products for compliance with the China RoHS directive

The following table shows the logo types for the environmental protection use period, and whether the six hazardous substances are contained in our products or not. This table was created based on the standard SJ/T11364.

Part name		Hazardous substance (substance/threshold/standard) *1						Logo for environmental protection on use period *2	Remark
		Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent chromium (Cr(VI))	PBB	PBDE		
		Threshold: cadmium: 0.01 wt% (100 ppm), other than cadmium: 0.1 wt% (1000 ppm)							
Servo amplifier Servo system controller Converter unit Drive unit	Mounting board	×	○	○	○	○	○		—
	Heat sink	×	○	○	○	○	○		
	Resin cabinet	○	○	○	○	○	○		
	Plate and screw	○	○	○	○	○	○		
Servo motor	Bracket	×	○	○	○	○	○		—
	Mounting board	×	○	○	○	○	○		
	Resin cabinet	○	○	○	○	○	○		
	Core and cable	○	○	○	○	○	○		
Cable product	Wire	○	○	○	○	○	○		Including connector set
	Connector	○	○	○	○	○	○		
Optional unit	Mounting board	×	○	○	○	○	○		—
	Resin cabinet	○	○	○	○	○	○		
	Plate and screw	○	○	○	○	○	○		

*1 ○: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T26572.

×: Indicates that said hazardous substance contained in at least one of the homogeneous materials for this part is above the limit requirement of GB/T26572.

*2 Indications based on "Marking for the restriction of the use of hazardous substances in electrical and electronic products" [SJ/T11364-2014]



Indicates that a certain hazardous substance is contained in the product manufactured or sold in China.

Follow safety and usage precautions for the product, and use the product within a limited number of years from the production date. Doing so prevents any hazardous substances in the product from causing environmental pollution or seriously affecting human health or property.



Indicates that no certain hazardous substance is contained in the product.

Difference between the China RoHS directive and the EU RoHS directive

The China RoHS directive allows no restriction exemption unlike the EU RoHS directive. Although a product complies with the EU RoHS directive, a hazardous substance in the product may be considered to be above the limit requirement (marked "×") in the China RoHS directive.

The following shows some restriction exemptions and their examples according to the EU RoHS directive.

- Lead as an alloying element in steel for machining purposes and in galvanized steel containing up to 0.35 % lead by weight, lead as an alloying element in aluminum containing up to 0.4 % lead by weight, and copper alloy containing up to 4 % lead by weight, e.g. brass-made insert nuts
- Lead in high melting temperature type solders (i.e. lead-based alloys containing 85 % by weight or more lead)
- Electrical and electronic components (such as piezoelectric sensors) containing lead in glass or ceramic materials, but not including the dielectric ceramics used in capacitors
- Electrical and electronic components containing lead in a glass or ceramic matrix compound, e.g. chip resistors

Status of our products for compliance with the China RoHS directive (Chinese)

The following table is given in Chinese according with a request by "Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products".

☞ Page 112 Status of our products for compliance with the China RoHS directive

部件名称		有害物质 (物质名称/限值/基准)*1						环境保护 使用期限 标识*2	备注
		铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	PBB	PBDE		
		限值: 镉: 0.01wt% (100ppm)、镉以外: 0.1wt% (1000ppm)							
伺服放大器 伺服系统控制 器 转换器模块 驱动模块	电路板组件	×	○	○	○	○	○		—
	散热片	×	○	○	○	○	○		
	树脂壳体	○	○	○	○	○	○		
	金属板、螺丝	○	○	○	○	○	○		
伺服电机	托架	×	○	○	○	○	○		—
	电路板组件	×	○	○	○	○	○		
	树脂壳体	○	○	○	○	○	○		
	铁心、电线	○	○	○	○	○	○		
电缆加工品	电线	○	○	○	○	○	○		包括连接器 组件
	连接器	○	○	○	○	○	○		
选件模块	电路板组件	×	○	○	○	○	○		—
	树脂壳体	○	○	○	○	○	○		
	金属板、螺丝	○	○	○	○	○	○		

*1 ○: 表示该有害物质在该部件所有均质材料中的含量均在GB/T26572规定的限量要求以下。

×: 表示该有害物质在该部件的至少一种均质材料中的含量超出GB/T26572规定的限量要求。

*2 根据“电子电气产品有害物质限制使用标识要求”、[SJ/T11364-2014] 的表示

 该标志表示在中国制造/销售的产品中含有特定有害物质。

只要遵守本产品的安全及使用方面的注意事项, 从生产日算起的环保使用期限内不会造成环境污染或对人体、财产产生深刻的影响。

 该标志表示制造的产品中不含有特定有害物质。

REVISIONS

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

Revision date	*Manual number	Description
June 2021	IB(NA)-0300553ENG-A	First edition

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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 are repaired or replaced.

[Term]

For terms of warranty, please contact your original place of purchase.

[Limitations]

(1) You are requested to conduct an initial failure diagnosis by yourself, as a general rule.

It can also be carried out by us or our service company upon your request and the actual cost will be charged. However, it will not be charged if we are responsible for the cause of the failure.

(2) This limited warranty applies only when the condition, method, environment, etc. of use are in compliance with the terms and conditions and instructions that are set forth in the instruction manual and user manual for the Product and the caution label affixed to the Product.

(3) Even during the term of warranty, the repair cost will be charged on you in the following cases;

1. a failure caused by your improper storing or handling, carelessness or negligence, etc., and a failure caused by your hardware or software problem
2. a failure caused by any alteration, etc. to the Product made on your side without our approval
3. a failure which may be regarded as avoidable, if your equipment in which the Product is incorporated is equipped with a safety device required by applicable laws and has any function or structure considered to be indispensable according to a common sense in the industry
4. a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
5. any replacement of consumable parts (battery, fan, smoothing capacitor, etc.)
6. a failure caused by external factors such as inevitable accidents, including without limitation fire and abnormal fluctuation of voltage, and acts of God, including without limitation earthquake, lightning and natural disasters
7. a failure generated by an unforeseeable cause with a scientific technology that was not available at the time of the shipment of the Product from our company
8. any other failures which we are not responsible for or which you acknowledge we are not responsible for

2. Term of warranty after the stop of production

(1) We may accept the repair at charge for another seven (7) years after the production of the product is discontinued. The announcement of the stop of production for each model can be seen in our Sales and Service, etc.

(2) Please note that the Product (including its spare parts) cannot be ordered after its stop of production.

3. Service in overseas countries

Our regional FA Center in overseas countries will accept the repair work of the Product. However, the terms and conditions of the repair work may differ depending on each FA Center. Please ask your local FA center for details.

4. Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to:

- (1) Damages caused by any cause found not to be the responsibility of Mitsubishi.
- (2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products.
- (3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products.
- (4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

5. Change of Product specifications

Specifications listed in our catalogs, manuals or technical documents may be changed without notice.

6. Application and use of the Product

- (1) For the use of our AC Servo, its applications should be those that may not result in a serious damage even if any failure or malfunction occurs in AC Servo, and a backup or fail-safe function should operate on an external system to AC Servo when any failure or malfunction occurs.
- (2) Our AC Servo is designed and manufactured as a general purpose product for use at general industries. Therefore, applications substantially influential on the public interest for such as atomic power plants and other power plants of electric power companies, and also which require a special quality assurance system, including applications for railway companies and government or public offices are not recommended, and we assume no responsibility for any failure caused by these applications when used. In addition, applications which may be substantially influential to human lives or properties for such as airlines, medical treatments, railway service, incineration and fuel systems, man-operated material handling equipment, entertainment machines, safety machines, etc. are not recommended, and we assume no responsibility for any failure caused by these applications when used. We will review the acceptability of the abovementioned applications, if you agree not to require a specific quality for a specific application. Please contact us for consultation.

TRADEMARKS

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IB(NA)-0300553ENG-A(2106)MEE

MODEL:

MODEL CODE:

mitsubishi electric corporation

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NAGOYA WORKS : 1-14, YADA-MINAMI 5-CHOME, HIGASHI-KU, NAGOYA, JAPAN

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