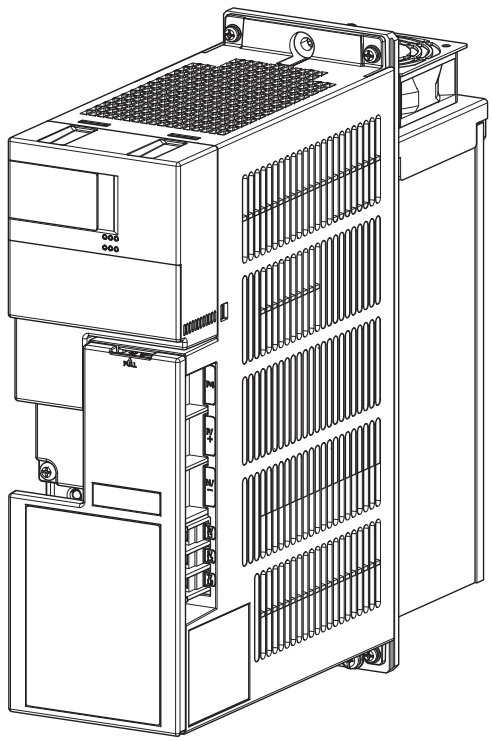
MITSUBISHI ELECTRIC

INVERTER
XC
INSTRUCTION MANUAL

Multifunction regeneration converter

FR-XC-(H)7.5K to (H)55K
FR-XC-(H)18.5K-PWM to (H)55K-PWM



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Thank you for choosing this Mitsubishi Electric multifunction regeneration converter.
This Instruction Manual provides handling information and precautions for use of the this product. Incorrect handling might cause an unexpected fault. Before using this product, always read this Instruction Manual carefully to ensure proper use of this product. Please forward this Instruction Manual to the end user.

Safety instructions

Do not attempt to install, operate, maintain or inspect the product until you have read through this Instruction Manual and supplementary documents carefully to use the equipment correctly. Do not use this product until you have a full knowledge of the equipment, safety information and instructions.
Installation, operation, maintenance and inspection must be performed by qualified personnel. Here, qualified personnel means a person who meets all the following conditions.
• A person who possesses a certification in regard with electric appliance handling, or person took a proper engineering training. Such training may be available at your local Mitsubishi Electric office. Contact your local sales office for schedules and locations.
• A person who can access operating manuals for the protective devices (for example, light curtain) connected to the safety control system, or a person who has read these manuals thoroughly and familiarized themselves with the protective devices.

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

WARNING **Incorrect handling may cause hazardous conditions, resulting in death or severe injury.**

CAUTION **Incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause only material damage.**

Note that even the CAUTION level may lead to a serious consequence depending on conditions. Be sure to follow the instructions of both levels as they are critical to personnel safety.

◆ Electric shock prevention

WARNING

- Do not remove the front cover or the wiring cover while the power of this product is ON. Do not operate this product with any cover or wiring cover removed, as accidental contact with exposed high-voltage terminals and internal components may occur, resulting in an electrical shock.
- Even if power is OFF, do not remove the front cover except for wiring or periodic inspection as you may accidentally touch the charged circuits and get an electric shock.
- Before wiring or inspection, check that the LED display of the operation panel is OFF. Any person who is involved in wiring or inspection shall wait for 10 minutes or longer after power OFF, and check that there are no residual voltage using a tester or the like. The capacitor is charged with high voltage for some time after power OFF, and it is dangerous.
- This product must be earthed (grounded). Earthing (grounding) must conform to the requirements of national and local safety regulations and electrical code (NEC section 250, IEC 61140 class 1 and other applicable standards). A neutral-point earthed (grounded) power supply must be used for 400 V class multifunction regeneration converter to be compliant with EN standard.
- Any person who is involved in wiring or inspection of this product shall be fully competent to do the work.
- The product body must be installed before wiring. Otherwise, electric shock or injury may result.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Doing so may cause an electric shock.
- Do not change the cooling fan while power is ON as it is dangerous.

◆ Fire prevention

CAUTION

- This product must be installed on a nonflammable wall without any through holes so that nobody touches the heat sink, etc. on the rear side of the product. Installing it on or near flammable material may cause a fire.
- If this product has become faulty, the product power must be switched OFF. A continuous flow of large current may cause a fire.
- Be sure to perform daily and periodic inspections as specified in the Instruction Manual. If this product is used without any inspection, a burst, breakage, or a fire may occur.

◆ Injury prevention

CAUTION

- The voltage applied to each terminal must be as specified in the Instruction Manual. Otherwise a burst, damage, etc. may occur.
- The cables must be connected to the correct terminals. Otherwise a burst, damage, etc. may occur.
- The polarity (+ and -) must be correct. Otherwise a burst, damage, etc. may occur.
- While power is ON or for some time after power-OFF, do not touch the multifunction regeneration converter as it will be extremely hot. Touching it may cause a burn.

◆ Additional instructions

The following instructions must be also followed. If the product is handled incorrectly, it may cause an unexpected fault, injury, or electric shock.

CAUTION

Transportation and installation

- This product must be transported in correct method that corresponds to the weight. Failure to do so may lead to injuries.
- Do not stand or place any heavy object on the product.
- Do not stack the boxes containing products higher than the number recommended.
- When carrying this product, do not hold it by the front cover. Doing so may cause a fall or failure of the product.
- It is not a fault if noise comes from a reactor during regenerative driving of the converter (in other words, it is a fault if noise comes despite the stop state of the converter by the Converter stop (SOF) signal). As this product is intended for installation in an enclosure, modify the enclosure in which the reactor is installed in order to reduce noise.
- The installing orientation of the product must be correct.
- Do not install or operate this product if it is damaged or has parts missing.
- Prevent conductive items such as screws and metal fragments, or flammable substances such as oil from entering this product.
- As this product is a precision instrument, do not drop or subject it to impact.
- The surrounding air temperature must be -10 to +50°C*1 (non-freezing). Otherwise the product may be damaged.
- The ambient humidity must be 95% RH or less (non-condensing). Otherwise the product may be damaged. (For the details, refer to page 27.)
- The temporary storage temperature (applicable to a short limited time such as a transportation time) must be between -20 and +65°C. Otherwise the product may be damaged.
- This product must be used indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.) Otherwise the product may be damaged.
- Do not use this product at an altitude above 2500 m. Vibration should not exceed 5.9 m/s^2 at 10 to 55 Hz in X, Y, and Z directions. Otherwise the product may be damaged. (For installation at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.)
- If halogens (including fluorine, chlorine, bromine, and iodine) contained in fumigants for wood packages enter this product, the product may be damaged. Prevent the entry of fumigant residuals or use an alternative method such as heat disinfection. Note that sterilization or disinfection of wood packages should be performed before packing the product.

*1 10 to +40°C (non-freezing) at the +40°C rating.

⚠CAUTION

Test operation

- Before starting the operation, confirm or adjust the parameter settings. Failure to do so may cause some machines to make unexpected motions.
- Before starting the operation, check the wiring of each peripheral device. Faulty wiring may cause some machines to make unexpected motions.

⚠WARNING

Usage

- Stay away from the equipment after using the retry function as the equipment will restart suddenly after output shutoff of this product.
- Be sure to turn OFF the start (STF/STR) signal input to the inverter before clearing the fault in the product as the inverter will restart a motor suddenly after a fault is cleared.
- Use only specified inverters. Connection of any other electrical equipment to the output of this product may damage the equipment.
- Do not modify this product.
- Do not remove any part which is not instructed to be removed in the Instruction Manuals. Doing so may lead to a failure or damage of this product.

⚠CAUTION

Usage

- Do not repeatedly start or stop this product with a magnetic contactor on its input side. Doing so may shorten the life of this product.
- Use a noise filter or other means to minimize the electromagnetic interference with other electronic equipment used nearby this product and the inverter.
- As all parameters return to their initial values after Parameter clear or All parameter clear is performed, the needed parameters for the product operation must be set again before the operation is started.
- Perform an inspection and test operation of this product if it has been stored for a long period of time.
- To avoid damage due to static electricity, static electricity in your body must be discharged before you touch this product.
- A safety backup such as an emergency brake must be provided for devices or equipment in a system to prevent hazardous conditions in case of failure of this product, inverter, or an external device controlling the inverter.
- If the breaker installed on the input side of this product trips, check for the wiring fault (such as short circuit) and damage to internal parts of this product, etc. Identify and remove the cause of the trip before resetting the tripped breaker and applying the power to the product again.
- When any protective function is activated, take an appropriate corrective action before resetting the product to resume the operation.
- To maintain the security (confidentiality, integrity, and availability) of the drive unit and the system against unauthorized access, DoS*1 attacks, computer viruses, and other cyberattacks from external devices via network, take appropriate measures such as firewalls, virtual private networks (VPNs), and antivirus solutions. We shall have no responsibility or liability for any problems involving drive unit trouble and system trouble by DoS attacks, unauthorized access, computer viruses, and other cyberattacks.

Maintenance, inspection and parts replacement

- Do not carry out a megger (insulation resistance) test on the control circuit of this product. Doing so will cause a failure.

Disposal

- This product must be treated as industrial waste.

*1 DoS: A denial-of-service (DoS) attack disrupts services by overloading systems or exploiting vulnerabilities, resulting in a denial-of-service (DoS) state.

General instruction

- For clarity, illustrations in this Instruction Manual may be drawn with covers or safety guards removed. Ensure all covers and safety guards are properly installed in place prior to starting operation.

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MEMO

1 OUTLINE

This chapter explains the outline of this product.
Always read the instructions before use.

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<Abbreviations>
FR-XC series converter..... Multifunction regeneration converter (FR-XC or FR-XC-PWM converter)
PU ..... Operation panel (FR-DU08) and parameter unit (FR-PU07/FR-PU07BB(-L))
FR-PU07 ..... Parameter unit (FR-PU07/FR-PU07BB(-L))
Pr. ..... Parameter number (Number assigned to function)

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<Notes on descriptions in this Instruction Manual>
- Connection diagrams in this Instruction Manual appear with the control logic of the input terminals as sink logic, unless otherwise specified. (For the control logic, refer to **page 45**.)

Harmonic Suppression Guidelines
All the models of the inverters used by specific consumers are covered by "the Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage". (For details, refer to **page 14**.)

1.1 Pre-operation instructions

Incorrect handling may cause the equipment to operate improperly or reduce its life considerably. Also, incorrect handling may damage the FR-XC series converter and the inverter. Please handle the unit properly in accordance with the information on each section as well as the precautions and instructions of the Instruction Manual.

1.1.1 Features of FR-XC series converters

NOTE

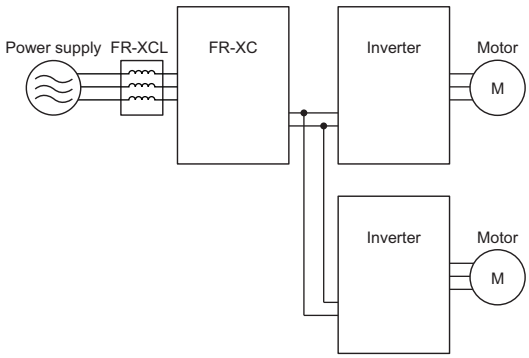
- It is not a fault if noise comes from a reactor during regenerative driving of the converter (in other words, it is a fault if noise comes despite the stop state of the converter by the Converter stop (SOF) signal).
- If needed, devise methods of reducing noise by modifying the enclosure in which the reactor is installed.

◆Three operation modes

Three modes (common bus regeneration mode, harmonic suppression mode, and power regeneration mode 2) are available for one FR-XC converter by changing options. To select the mode, use the function selection switch assembly and parameters.

◆Common bus regeneration mode

Enables continuous regenerative operation at 100% torque. This mode supports continuous regenerative operations including line operation. When the converter is connected to multiple inverters, regeneration energy from an inverter is used for the other inverters. (The FR-XC series converter can be used as a common converter.) Excessive energy is returned to the power supply, saving on the energy consumption.
Use the FR-XC series converter in combination with the FR-XCL, dedicated stand-alone reactor (option).
For the FR-XC-H[]K-PWM, the common bus regeneration mode is selected by setting **Pr.416** = "0".
For the FR-XC-H[]K, the common bus regeneration mode is initially selected.



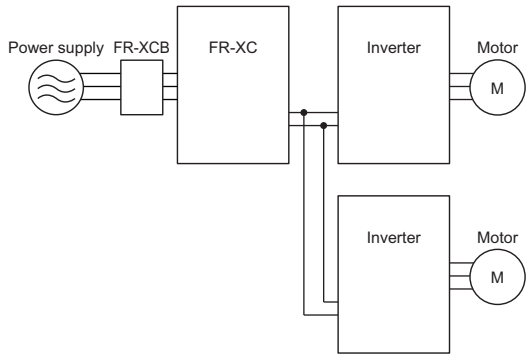
For connections, settings, and rated specifications, refer to **page 59**. When a countermeasure for harmonics is required, use the harmonic suppression mode.

NOTE

- The applicable inverter capacity and current differ when the FR-XC-(H)18.5K-PWM or FR-XC-(H)22K-PWM is used in the common bus regeneration mode. (Refer to **page 75**.)

◆Harmonic suppression mode (FR-XC-(H)22K or higher, FR-XC-(H)18.5K-PWM or higher)

The inverter unit has a converter section (rectifier circuit) and generates power supply harmonics, which may affect the power generator, power factor correction capacitor, etc. Power supply harmonics are different from noise and leakage currents in source, frequency band and transmission path. Power supply harmonics may be suppressed by using the FR-XC series converter in the harmonic suppression mode, allowing the compliance with the harmonic suppression guidelines issued by the former Japanese Ministry of International Trade and Industry (currently the Ministry of Economy, Trade and Industry). The FR-XC series converter in the harmonic suppression mode is classified as the self-excitation three-phase bridge circuit, and achieves K5 (the conversion factor) = 0. (It is assumed that the FR-XC series converter generates no harmonics.)



Use the FR-XC series converter in combination with the FR-XCB, dedicated box-type reactor (option).
For the FR-XC-(H)22K or higher, setting **Pr.416** = "1" enables the harmonic suppression mode.
The harmonic suppression mode is initially selected in the FR-XC-(H)[]K-PWM.
For connections, settings, and rated specifications, refer to **page 79**.

NOTE

- The harmonic suppression mode is not available for the FR-XC-(H)15K or lower.
- For the FR-XC-(H)22K and FR-XC-(H)30K, the applicable inverter capacity and the applicable motor current differ between the common bus regeneration mode and the harmonic suppression mode. (Refer to page 95.)

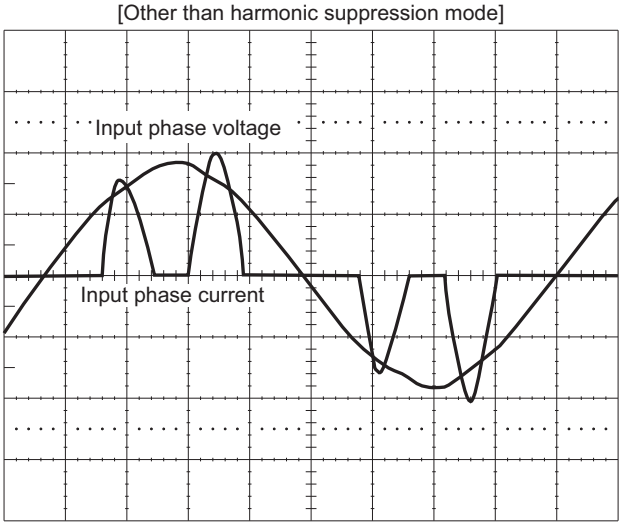
- Power supply harmonic suppression effect

  Example of the FR-XC-18.5K-PWM

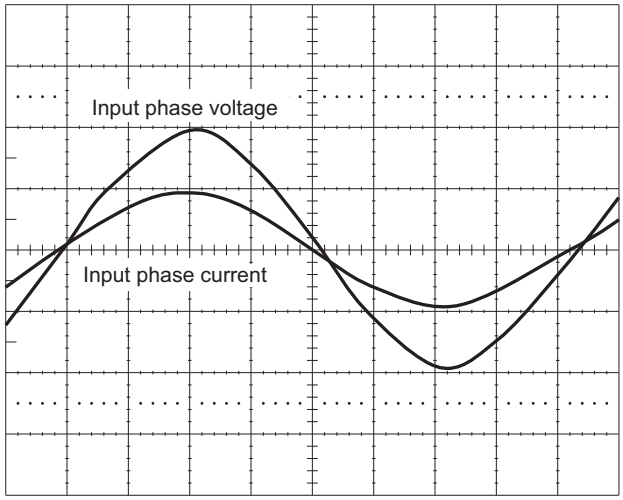
  Condition: Load = 100%

  Power factor = 0.99 or more

[Other than harmonic suppression mode]



[Harmonic suppression mode]



NOTE

- It does not mean that harmonic components completely disappear.
- When the load is light, harmonic suppression effect declines.
- When the power supply voltage is unstable, power harmonics flow in, making the harmonic current increase.

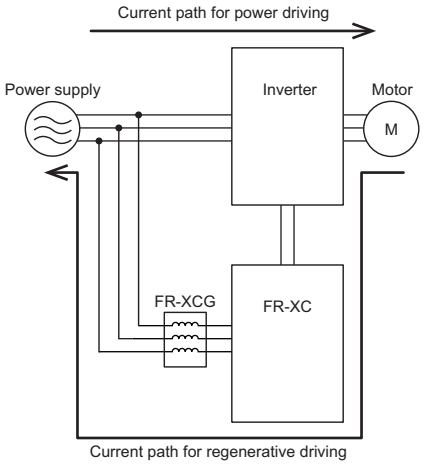
◆Power regeneration mode 2

For power driving, the converter section of inverter unit supplies power, and for regenerative driving, the FR-XC series converter returns power to the power supply. (The FR-XC series converter cannot be used as a common converter.)

Since the capacity of power regeneration converter is selectable according to the regenerative power, the compact and inexpensive power regeneration converter is applicable when the regenerative power is smaller than the inverter capacity.

This Instruction Manual basically provides the descriptions of the power regeneration mode 2. When using the power regeneration mode 1, refer to page page 224.

For connections, settings, and rated specifications, refer to page 99.



[Power regeneration mode 2]

NOTE

- When installing the converter in a common bus system, do not use the converter in the power regeneration mode 1.
- When replacing the FR-XC manufactured in October 2019 or earlier with a new FR-XC, select the power regeneration mode 1 to use the new FR-XC with the existing peripheral devices. (Refer to page 224.)

◆Temperature derating selection

By limiting the surrounding air temperature of the multifunction regeneration converter up to 40°C (the surrounding air temperature of 40°C rating), rated current and applicable current can be increased. (Refer to page 71, page 92, and page 111.)

1.1.2 Product checking and parts identification

Unpack the product and check the rating plate and the capacity plate of the multifunction regeneration converter to ensure that the model and the rated output agree with the order and the product is intact.

◆Multifunction regeneration converter model

FR-XC- H 22 K- 60 PWM

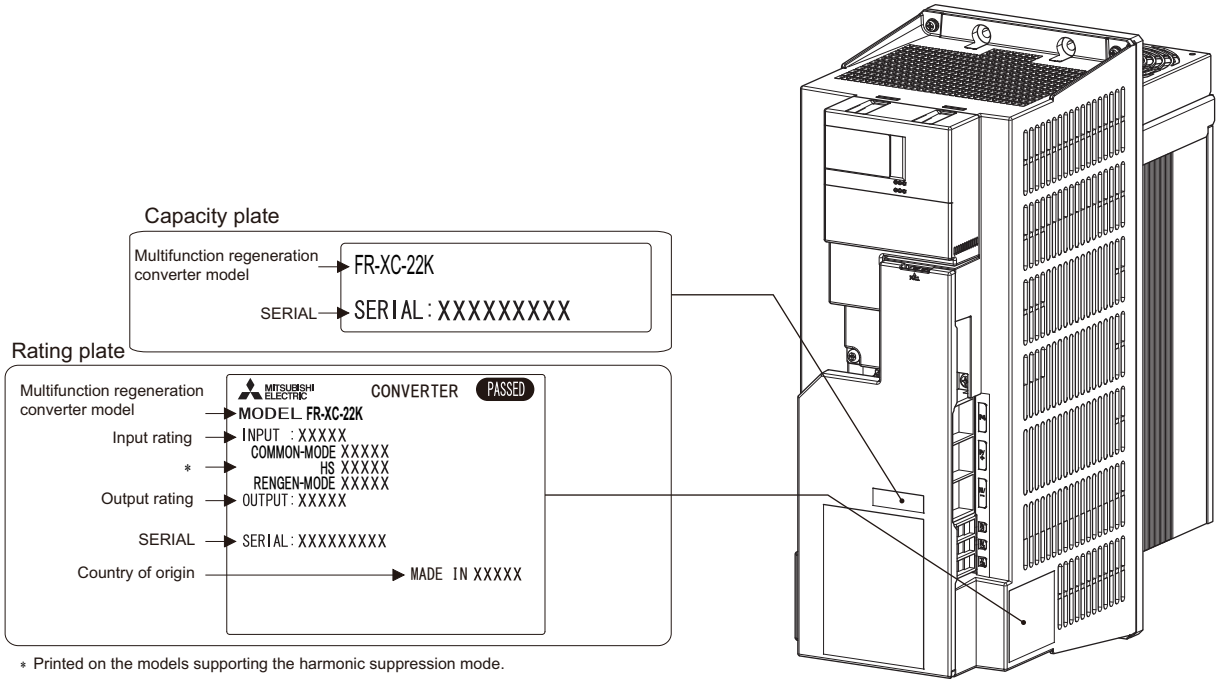
Symbol	Voltage class
None	200 V class
H	400 V class

Converter capacity
Capacity (kW)

Symbol	Circuit board coating	Plated conductor
None	Without	Without
60	With	Without
06	With	With

Symbol	Functional specification*1
None	Common bus regeneration mode
PWM	Harmonic suppression mode

*1 when **Pr.416** = "9999"



* Printed on the models supporting the harmonic suppression mode.

◆Dedicated stand-alone reactor (option) model

FR-XCL- H ☐ K

Symbol	Voltage class
None	200 V class
H	400 V class

Reactor capacity
Capacity (kW)

FR-XCG- H ☐ K

Symbol	Voltage class
None	200 V class
H	400 V class

Reactor capacity
Capacity (kW)

◆Dedicated box-type reactor (option) model

FR-XCB- H ☐ K- ☐

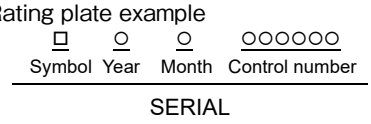
Symbol	Voltage class
None	200 V class
H	400 V class

Reactor capacity
Capacity (kW)

Symbol	Circuit board coating
None	Without
60	With

◆How to read the SERIAL number

Rating plate example



The SERIAL consists of one symbol, two characters indicating the production year and month, and six characters indicating the control number. The last digit of the production year is indicated as the Year, and the Month is indicated by 1 to 9, X (October), Y (November), or Z (December).

◆Accessory

- Earthing (grounding) cable (1)
  For connection with a communication option. (Refer to **page 55**.)
- Communication option LED label (1)
  For checking the LED indications on the communication option. (Refer to **page 55**.)

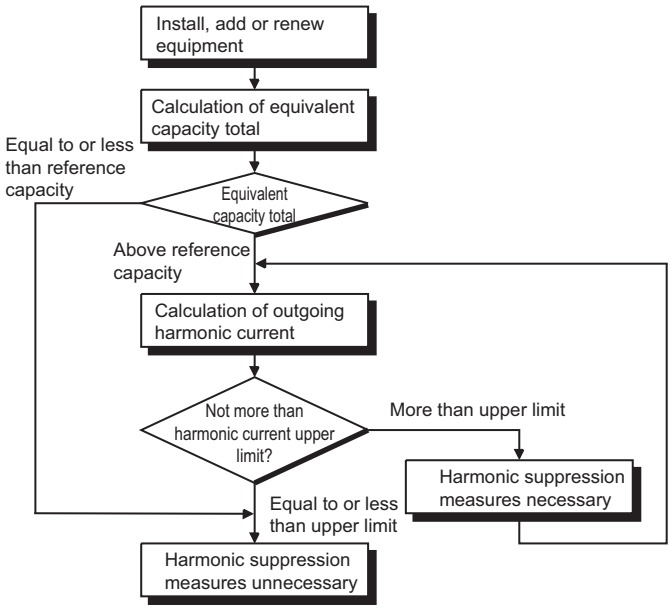
1.1.3 Harmonic suppression guidelines in Japan

Harmonic currents flow from the inverter to a power receiving point via a power transformer. The Harmonic Suppression Guidelines was established to protect other consumers from these outgoing harmonic currents.
All capacity and all models of general-purpose inverter used by specific consumers are now covered by "the Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage" (hereinafter referred to as "the Specific Consumer Guidelines").
"Specific Consumer Guidelines"
This guideline sets forth the maximum harmonic currents outgoing from a high-voltage or especially high-voltage receiving consumer who will install, add or renew harmonic generating equipment. If any of the maximum values is exceeded, this guideline requires that consumer to take certain suppression measures.

- Maximum values of outgoing harmonic currents per 1 kW contract power

Received power voltage	5th	7th	11th	13th	17th	19th	23rd	Over 23rd
6.6 kV	3.5	2.5	1.6	1.3	1.0	0.9	0.76	0.70
22 kV	1.8	1.3	0.82	0.69	0.53	0.47	0.39	0.36
33 kV	1.2	0.86	0.55	0.46	0.35	0.32	0.26	0.24

◆Application of the specific consumer guidelines



- Conversion factor

Classification	Circuit type		Conversion factor Ki
3	Three-phase bridge (capacitor smoothing)	Without reactor	K31 = 3.4
		With reactor (AC side)	K32 = 1.8
		With reactor (DC side)	K33 = 1.8
		With reactors (AC, DC sides)	K34 = 1.4
5	Self-excitation three-phase bridge	When a multifunction regeneration converter in harmonic suppression mode is used	K5 = 0

- Equivalent capacity limit

Received power voltage	Reference capacity
6.6 kV	50 kVA
22/33 kV	300 kVA
66 kV or more	2000 kVA

- Harmonic contents (values of the fundamental current is 100%)

Reactor	5th	7th	11th	13th	17th	19th	23rd	25th
Not used	65	41	8.5	7.7	4.3	3.1	2.6	1.8
Used (AC side)	38	14.5	7.4	3.4	3.2	1.9	1.7	1.3
Used (DC side)	30	13	8.4	5.0	4.7	3.2	3.0	2.2
Used (AC, DC sides)	28	9.1	7.2	4.1	3.2	2.4	1.6	1.4

- Calculation of equivalent capacity P0 of harmonic generating equipment

  "Equivalent capacity" is the capacity of a 6-pulse converter converted from the capacity of consumer's harmonic generating equipment and is calculated by the following equation. If the sum of equivalent capacities is higher than the limit (refer to page 14), harmonics must be calculated by the equation in next subheading.

P0 = Σ (Ki × Pi) [kVA]

Ki: Conversion factor (Refer to page 14.)

Pi: Rated capacity of harmonic generating equipment*1 [kVA]

i: Number indicating the conversion circuit type

*1 Rated capacity: Determined by the capacity of the applied motor and found in the following table. The rated capacity used here is used to calculate the generated harmonic amount and is different from the power supply capacity required for actual inverter drive.

- Calculation of outgoing harmonic currents

  Outgoing harmonic currents = fundamental wave current (value converted from received power voltage) × operation ratio × harmonic contents

  - Operation ratio: actual load factor × operation time ratio during 30 minutes
  - Harmonic contents: Refer to the list of the harmonic contents.

- Rated capacities and outgoing harmonic currents of inverter-driven motors

Applicable motor (kW)	Fundamental wave current (A)		Fundamental wave current converted from 6.6 kV (mA)	Rated capacity (kVA)	Outgoing harmonic current converted from 6.6 kV (mA) (No reactor, 100% operation ratio)							
	200 V	400 V			5th	7th	11th	13th	17th	19th	23rd	25th
0.4	1.61	0.81	49	0.57	31.85	20.09	4.165	3.773	2.107	1.519	1.274	0.882
0.75	2.74	1.37	83	0.97	53.95	34.03	7.055	6.391	3.569	2.573	2.158	1.494
1.5	5.50	2.75	167	1.95	108.6	68.47	14.20	12.86	7.181	5.177	4.342	3.006
2.2	7.93	3.96	240	2.81	156.0	98.40	20.40	18.48	10.32	7.440	6.240	4.320
3.7	13.0	6.50	394	4.61	257.1	161.5	33.49	30.34	16.94	12.21	10.24	7.092
5.5	19.1	9.55	579	6.77	376.1	237.4	49.22	44.58	24.90	17.95	15.05	10.42
7.5	25.6	12.8	776	9.07	504.4	318.2	65.96	59.75	33.37	24.06	20.18	13.97
11	36.9	18.5	1121	13.1	728.7	459.6	95.29	86.32	48.20	34.75	29.15	20.18
15	49.8	24.9	1509	17.6	980.9	618.7	128.3	116.2	64.89	46.78	39.24	27.16
18.5	61.4	30.7	1860	21.8	1209	762.6	158.1	143.2	79.98	57.66	48.36	33.48
22	73.1	36.6	2220	25.9	1443	910.2	188.7	170.9	95.46	68.82	57.72	39.96
30	98.0	49.0	2970	34.7	1931	1218	252.5	228.7	127.7	92.07	77.22	53.46
37	121	60.4	3660	42.8	2379	1501	311.1	281.8	157.4	113.5	95.16	65.88
45	147	73.5	4450	52.1	2893	1825	378.3	342.7	191.4	138.0	115.7	80.10
55	180	89.9	5450	63.7	3543	2235	463.3	419.7	234.4	169.0	141.7	98.10

- Determining if a countermeasure is required

  A countermeasure for harmonics is required if the following condition is satisfied: outgoing harmonic currents > maximum value per 1 kW contract power × contract power.

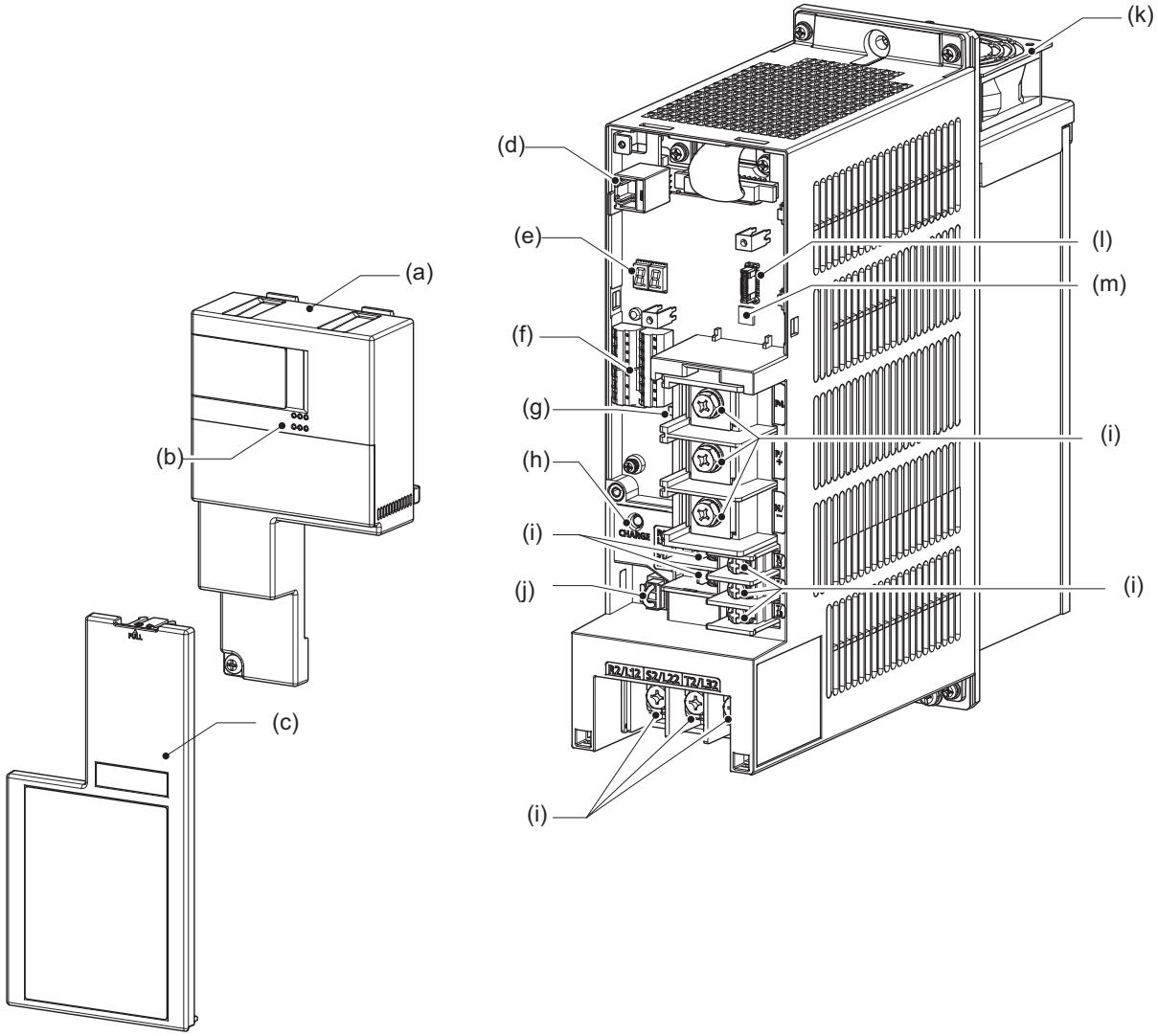
- Harmonic suppression techniques

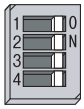
No.	Item	Description
1	Reactor (FR-HAL or FR-HEL)	Install an AC reactor (FR-HAL) on the AC side of the inverter or a DC reactor (FR-HEL) on its DC side, or install both to suppress outgoing harmonic currents.
2	Multifunction regeneration converter (FR-XC series) (Harmonic suppression mode)	The converter switches the converter section ON/OFF to reshape an input current waveform into a sine wave, greatly suppressing harmonics.
3	Power factor improving capacitor	When used with a reactor connected in series, the power factor improving correction capacitor can absorb harmonic currents.
4	Transformer multi-phase operation	Use two transformers and establish connections with a phase angle difference of 30° (the wye to delta connection or the delta to delta connection) to provide an effect corresponding to 12 pulses, reducing low-degree harmonic currents.
5	Passive filter (AC filter)	A capacitor and a reactor are used together to reduce impedances at specific frequencies. Harmonic currents are expected to be absorbed greatly by using this technique.
6	Active filter	This filter detects the current in a circuit generating a harmonic current and generates a harmonic current equivalent to a difference between that current and a fundamental wave current to suppress the harmonic current at the detection point. Harmonic currents are expected to be absorbed greatly by using this technique.

1.2 Component names

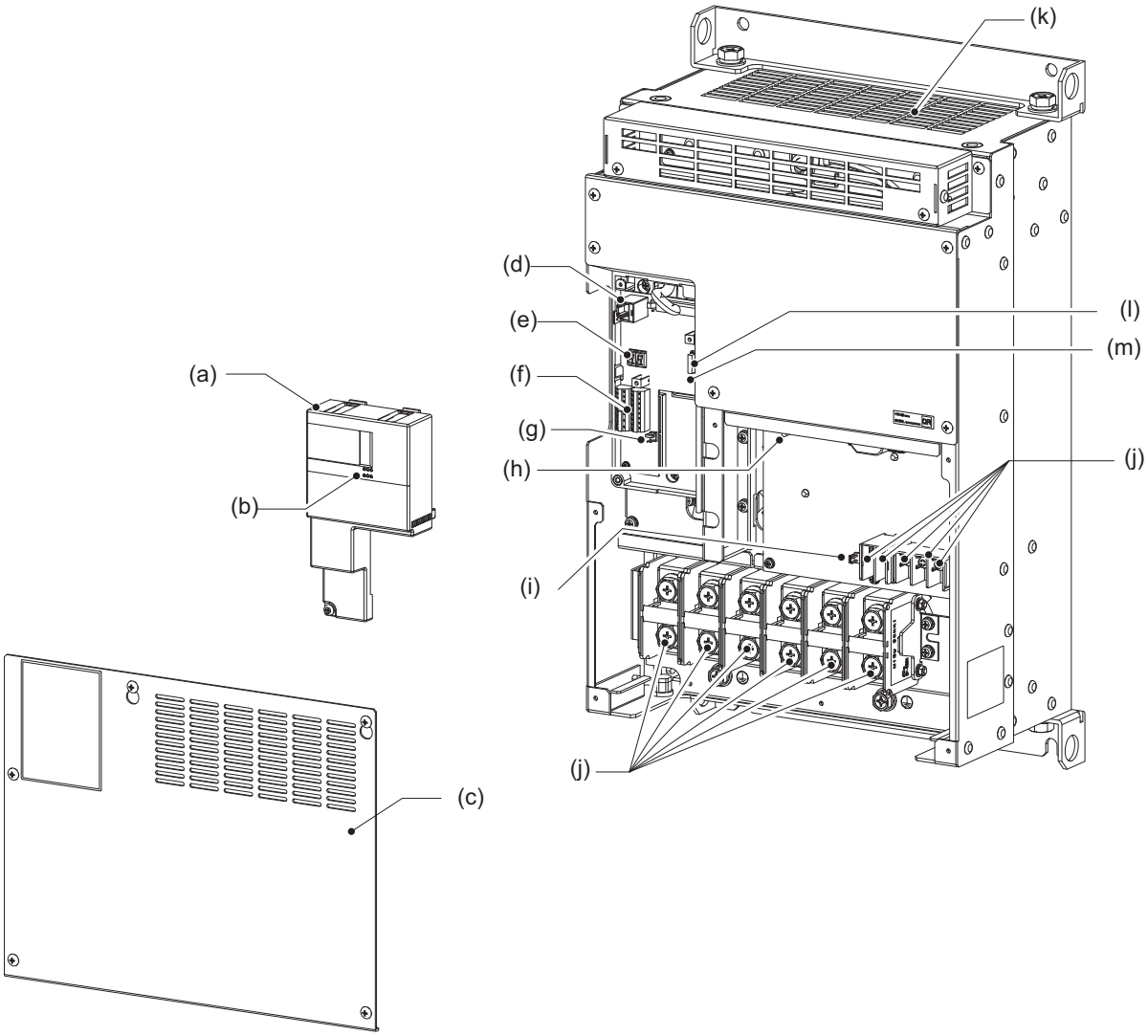
Component names are shown below.

◆(H)30K converters or lower



Symbol	Name	Description	Refer to page
(a)	Control circuit terminal block cover	Remove it for installing a communication option, wiring the control circuit terminals, or changing the SW2 switches.	24
(b)	Communication operation status inspection port (for the FR-A8NC)	Check the state (ON/blinking) of the communication operation status indicators on the communication option (FR-A8NC) when the option is installed.	—
(c)	Main control circuit terminal block cover	Remove it for wiring.	24
(d)	PU connector	Connector for parameter units. Also used for the RS-485 communication.	147
(e)	Operation status 7-segment LED display	Check the display indication or LED state (ON/blinking) for the operation status of the converter.	57
(f)	Control circuit terminal block	Connect cables for the control circuit.	44
(g)	Control logic switchover jumper connector	Change the control logic of input signals as necessary.	45
(h)	Charge lamp	Stays ON while the power is supplied to the main circuit.	57
(i)	Main circuit terminal block	Connect cables for the main circuit.	41
(j)	Connector for manufacturer setting	Do not remove the cap from the connector.	—
(k)	Cooling fan	Cools the multifunction regeneration converter.	195
(l)	Connector for communication option	Connect cables for the communication option (FR-A8NC).	55
(m)	Function selection switch assembly (SW2)	1, 2: Connection mode selection (common bus regeneration mode / harmonic suppression mode / power regeneration mode 2) 3: Temperature derating selection 4: For manufacturer setting 	71, 91, 111

◆(H)37K to (H)55K



Symbol	Name	Description	Refer to page
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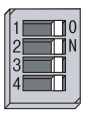
(m)	Function selection switch assembly (SW2)	1, 2: Connection mode selection (common bus regeneration mode / harmonic suppression mode / power regeneration mode 2) 3: Temperature derating selection 4: For manufacturer setting 	71, 91, 111

1.3 Precautions for selecting peripheral devices

1.3.1 Techniques and measures for electromagnetic compatibility (EMC)

In this section, electromagnetic noises refer to the 40th to 50th order harmonics of irregular waveform in a power distribution system.
Some electromagnetic noises enter the converter to cause the converter malfunction, and others are radiated by the converter to cause the peripheral devices to malfunction. (The former is called EMS problem, the latter is called EMI problem, and both is called EMC problem.) Though the FR-XC series converter is designed to be immune to noises, it requires the following basic measures and EMS measures as it handles low-level signals.
In a system including the converter, the noise created by the system increases due to additional noises generated by the converter.
If these noises cause peripheral devices to malfunction, EMI measures should be taken to suppress noises. Techniques differ slightly depending on EMI paths.

◆Basic measures

- Do not run the power cables (I/O cables) and signal cables of the converter in parallel with each other and do not bundle them.
- Use shielded twisted pair cables for the detector connecting and control signal cables and connect the sheathes of the shielded cables to terminal SD.
- Ground (earth) devices such as the reactor, converter, and inverter at one point. (Refer to page 53.)
- Do not earth (ground) the shields of the communication or control cables of the converter or inverter.

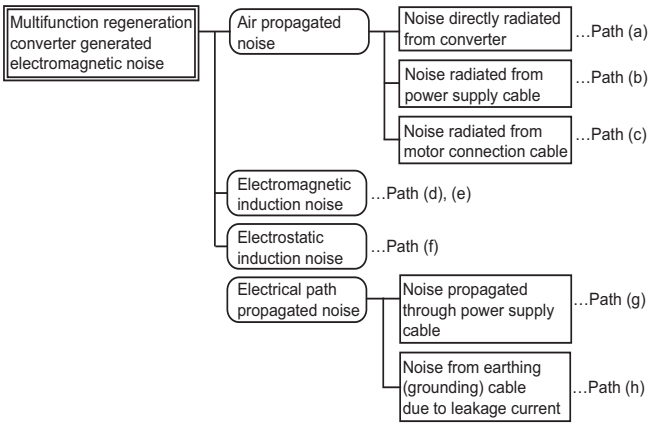
◆EMS measures to reduce electromagnetic noises that enter the converter and cause it to malfunction

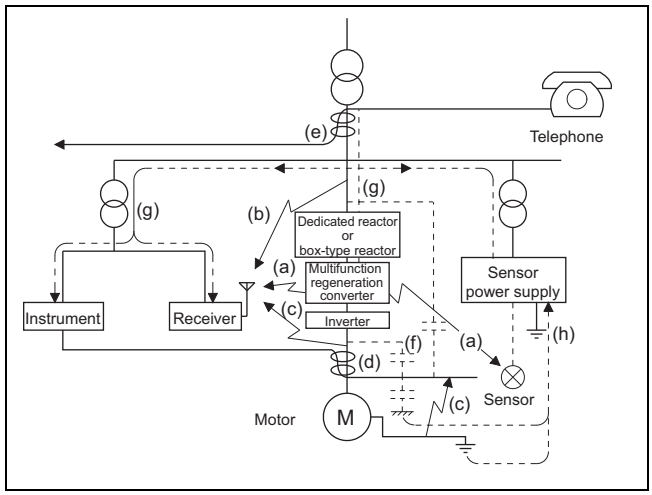
When devices that generate many electromagnetic noises (which use magnetic contactors, electromagnetic brakes, many relays, for example) are installed near the converter and the converter may malfunction due to electromagnetic noises, the following countermeasures must be taken.

- Provide surge suppressors for devices that generate many electromagnetic noises to suppress electromagnetic noises.
- Install data line filters to signal cables.
- Ground (Earth) the shields of the detector connection and control signal cables with cable clamp metal.

◆EMI measures to reduce electromagnetic noises that are radiated by the converter to cause the peripheral devices to malfunction

Converter-generated noises are largely classified into those radiated by the converter itself and by the cables (I/O) connected to its main circuit, those electromagnetically and electrostatically induced to the signal cables of the peripheral devices close to the power cable connected to the converter main circuit, and those transmitted through the power cables.

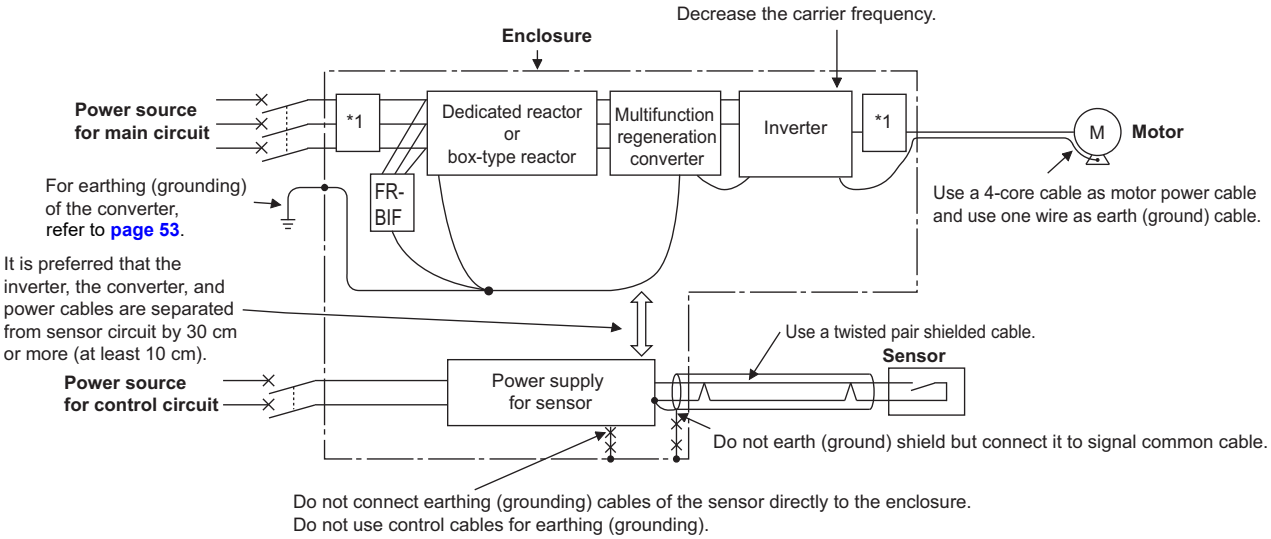




Noise propagation path	Measure
(a), (b), (c)	When devices that handle low-level signals and are liable to malfunction due to electromagnetic noises, e.g. instruments, receivers and sensors, are contained in the enclosure that contains the converter or when their signal cables are run near the converter, the devices may malfunction due to by air-propagated electromagnetic noises. The following measures must be taken: • Install the easily affected devices as far away from the converter and the inverter as possible. • Place the easily affected signal cables as far away from the converter and the inverter as possible. • Do not run signal cables and power cables (converter I/O cables) in parallel with each other and do not bundle them. • Install the line noise filter (FR-BLF, or FINEMET® FT-3KM F or FT-3KL F series ∗1) or the FR-BIF radio noise filter on the input side of the converter, and install the line noise filter on the output side of the inverter to suppress the radiated noise from the cables. • Use shielded cables as signal cables and power cables, and run them in individual metal conduits, to produce further effects.
(d), (e), (f)	When the signal cables are run in parallel with or bundled with the power cables, magnetic and static induction noises may be propagated to the signal cables to cause malfunction of the devices. The following measures must be taken: • Install the easily affected devices as far away from the converter and the inverter as possible. • Place the easily affected signal cables as far away from the converter and the inverter as possible. • Do not run signal cables and power cables (converter I/O cables) in parallel with each other and do not bundle them. • Use shielded cables as signal cables and power cables, and run them in individual metal conduits, to produce further effects.
(g)	When the peripheral devices use the power system of the converter, converter-generated noises may flow back through the power supply cables to cause malfunction of the devices. The following measures must be taken: • Install the FR-BIF radio noise filter on the input side power cable of the converter. • Install the line noise filters (FR-BLF, or FINEMET® FT-3KM F or FT-3KL F series∗1) on the input side power cable of the converter and on the output side power cable of the inverter.
(h)	When a closed loop circuit is formed by connecting the peripheral devices wiring to the converter, leakage currents may flow through the earthing (grounding) cable of the converter to cause the devices to malfunction. In that case, disconnecting the earthing (grounding) cables from the devices may stop the malfunction of the devices.

∗1 Manufactured by Hitachi Metals, Ltd.
FINEMET is a registered trademark of Hitachi Metals, Ltd.

●EMI measure example



*1 Line noise filters (FR-BLF, or FINEMET® FT-3KM F or FT-3KL F series).

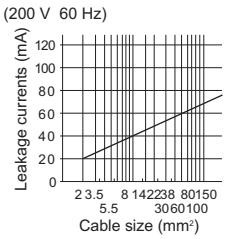
1.3.2 Selecting the rated sensitivity current for the earth leakage circuit breaker

To install the earth leakage circuit breaker on the inverter circuit, select its rated sensitivity current as follows.

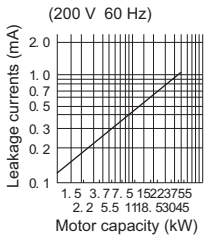
- Breaker designed for harmonic and surge suppression
  Rated sensitivity current
  IΔn ≥ 10 × (Ig1 + Ign + Ig2 + Ig3 + Igm)
- Standard breaker
  Rated sensitivity current
  IΔn ≥ 10 × {Ig1 + Ign + Ig2 + 3 × (Ig3 + Igm)}

Ig1, Ig2, Ig3: Leakage currents in wire path during commercial power supply operation
Ign: Leakage current from noise filters on the input side of the converter
Igm: Leakage current from the motor during commercial power supply operation

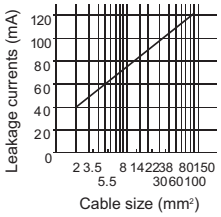
Example of leakage current of cable path per 1km during the commercial power supply operation when the CV cable is routed in metal conduit



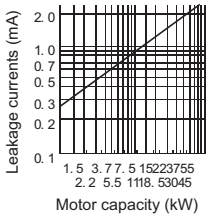
Leakage current example of three-phase induction motor during the commercial power supply operation



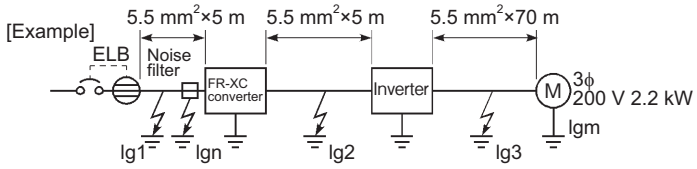
Example of leakage current per 1km during the commercial power supply operation when the CV cable is routed in metal conduit



Leakage current example of three-phase induction motor during the commercial power supply operation



For "△" connection, the amount of leakage current is approx.1/3 of the above value.



Selection example (diagram shown on the left) (mA)

	Breaker designed for harmonic and surge suppression	Standard breaker
Leakage current Ig1 (mA)	$33 \times \frac{5\text{ m}}{1000\text{ m}} = 0.17$	
Leakage current Ign (mA)	0 (without noise filter)	
Leakage current Ig2 (mA)	$33 \times \frac{5\text{ m}}{1000\text{ m}} = 0.17$	
Leakage current Ig3 (mA)	$33 \times \frac{70\text{ m}}{1000\text{ m}} = 2.31$	
Leakage current Igm (mA)	0.18	
Total leakage current (mA)	2.83	7.81
Rated sensitivity current (≥ Ig × 10) (mA)	30	100

- Multifunction regeneration converter leakage current
  Input power conditions
  : 220 V/60 Hz (200 V class) or 440 V/60 Hz (400 V class), within 3% of power supply unbalance

	Voltage (V)	Leakage current (mA)
Phase earthing (grounding) 	200	2
	400	4
Earthed-neutral system 	400	4

NOTE

- Install the earth leakage circuit breaker (ELB) on the input side of the converter.
- In the 人 connection earthed-neutral system, the sensitivity current is blunt against a ground fault in the inverter output side. Earthing (Grounding) must conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 61140 class 1 and other applicable standards)
- Do not install the breaker on the output side of the inverter. Doing so may cause unnecessarily operations by harmonics even if the effective value is within the rating, since the eddy current and hysteresis loss will increase, leading to temperature rise.
- The following models are included in the standard breakers: the BV-C1, BC-V, NVB, NV-L, NV-G2N, NV-G3NA, and NV-2F earth leakage relay (except NV-ZHA) and the NV class earth leakage circuit breaker with AA neutral wire open-phase protection.
  The following models are designed for harmonic and surge suppression: NV-C/NV-S/MN series, NV30-FA, NV50-FA, BV-C2, earth leakage alarm breaker (NF-Z), NV-ZHA, and NV-H.

2 INSTALLATION AND WIRING

This chapter explains the installation and the wiring of this product.
Always read the instructions before use.

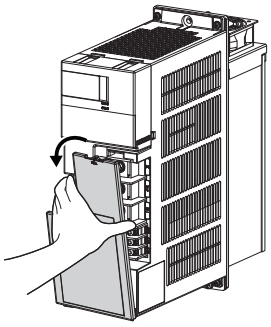
2.1 Removal and reinstallation of the converter covers 24
2.2 Removal and reinstallation of the FR-XCB reactor cover 26
2.3 Installation of the converter and enclosure design 27
2.4 Installation of peripheral devices 39
2.5 Main circuit terminal specification 41
2.6 Control circuit specification 44
2.7 Earthing (Grounding) precautions 53
2.8 Installation of communication option (FR-A8NC) 55
2.9 Before powering and starting operation 57
2.10 Digital characters and their corresponding printed equivalents 58

2.1 Removal and reinstallation of the converter covers

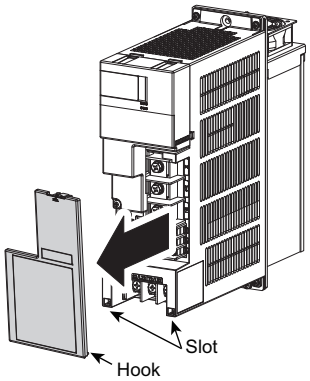
2.1.1 30K converters or lower

◆Main circuit terminal block cover

- To remove the cover, hold and pull out the upper part of the cover.



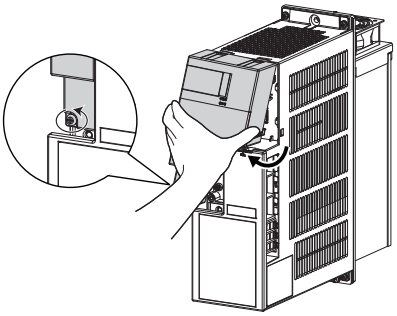
- The hooks on the lower end of the cover snap out of position. The cover is detached from the converter.



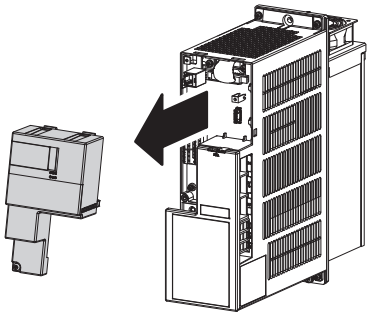
To reinstall the cover, insert the hooks into the slots on the converter and push the cover to snap it into place.

◆Control circuit terminal block cover

- To remove the cover, loosen the mounting screws of the cover, and hold and pull out the lower part of the cover.



- The hooks on the upper end of the cover snap out of position. The cover is detached from the converter.



To reinstall the cover, insert the hooks into the slots on the converter and tighten the mounting screws.

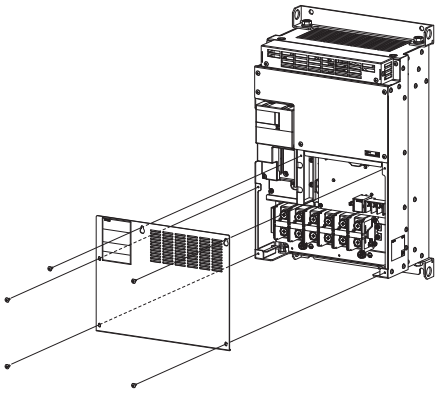
NOTE

- After installing the cover, check that it is fixed securely in place. Always tighten the mounting screws of the cover.

2.1.2 37K to 55K

◆Main circuit terminal block cover

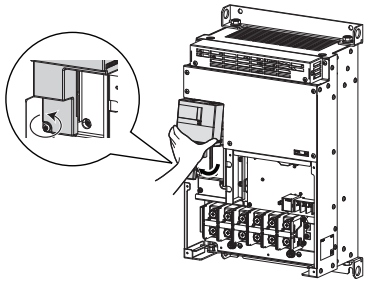
• When the mounting screws are removed, the main circuit terminal block cover can be removed.



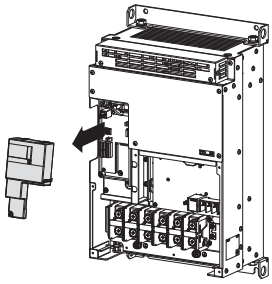
To reinstall the cover, fix the main circuit terminal block cover with the mounting screws.

◆Control circuit terminal block cover

• To remove the cover, loosen the mounting screws of the cover, and hold and pull out the lower part of the cover.



• The hooks on the upper end of the cover snap out of position. The cover is detached from the converter.



To reinstall the cover, insert the hooks into the slots on the converter and tighten the mounting screws.

NOTE

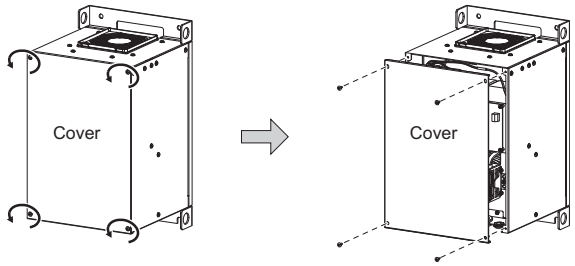
• After installing the cover, check that it is fixed securely in place. Always tighten the mounting screws of the cover.

2.2 Removal and reinstallation of the FR-XCB reactor cover

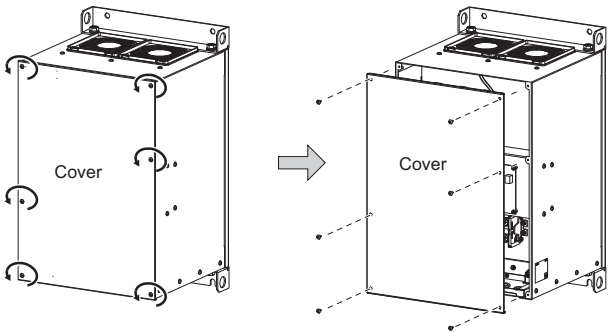
◆Removal

- Remove the mounting screws of the front cover, and pull out the cover to remove it.

●FR-XCB-(H)18.5K, (H)22K



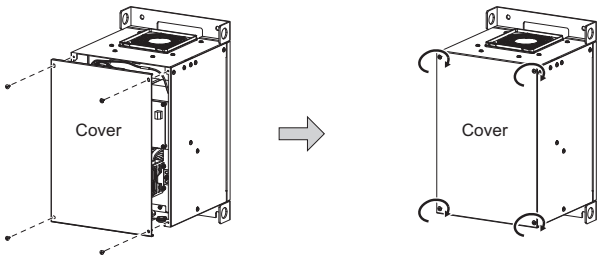
●FR-XCB-(H)37K to (H)55K



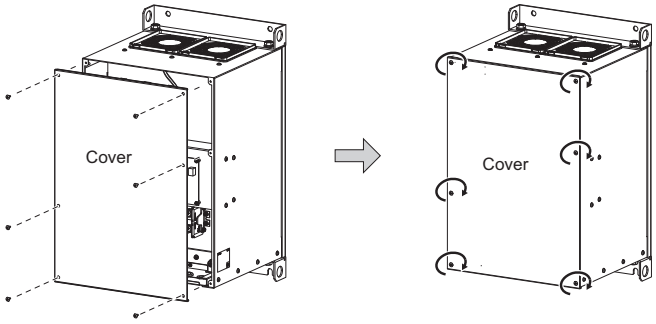
◆Reinstallation

- Fix the front cover with the mounting screws.(Tightening torque 1.7 N·m)

●FR-XCB-(H)18.5K, (H)22K



●FR-XCB-(H)37K to (H)55K



NOTE

- After installing the front cover, check that it is fixed securely in place. Always tighten the mounting screws of the cover.
- The capacity plate is placed on the cover, and the rating plate is on the remainder of the reactor box. Before reinstalling the cover, check the serial number on the capacity plate against the one on the rating plate to make sure they are identical with each other.

2.3 Installation of the converter and enclosure design

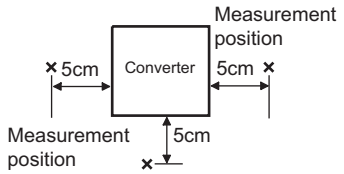
This product is intended for installation in an enclosure. When designing or manufacturing an enclosure, determine the structure, size, and device layout by fully considering the conditions such as heat generation of the contained devices and the operating environment.

The multifunction regeneration converter unit uses many semiconductor devices. To ensure higher reliability and long period of operation, operate the converter in the ambient environment that completely satisfies the equipment specifications.

2.3.1 Converter installation environment

The following table lists the standard specifications of the installation environment for the multifunction regeneration converter. Using the converter in an environment that does not satisfy the conditions deteriorates the performance, shortens the life, and causes a failure. Refer to the following points, and take adequate measures.

◆Standard environmental specifications of the converter

Item	Description	
Surrounding air temperature	-10 to +50°C*1 (non-freezing)	
Ambient humidity	With circuit board coating (conforming to class 3C2/3S2 in IEC 60721-3-3:1994 3C2/3S2): 95% RH or less (non-condensing) Without circuit board coating: 90% RH or less (non-condensing)	
Storage temperature	-20 to +65°C*2	
Atmosphere	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)	
Altitude	Maximum 2500 m*3	
Vibration	5.9 m/s^2 or less at 10 to 55 Hz (directions of X, Y, Z axes)	

*1 -10 to +40°C (non-freezing) at the 40°C rating.

*2 Temperature applicable for a short time, for example, in transit.

*3 For the installation at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.

◆Temperature

The permissible surrounding air temperature of the multifunction regeneration converter is -10 to +50°C (-10 to +40°C at the 40°C rating). Always operate the converter within this temperature range. Operation outside this range will considerably shorten the service lives of the semiconductors, parts, capacitors and others. Take the following measures to keep the surrounding air temperature of the converter within the specified range.

(a) Measures against high temperature

- Use a forced ventilation system or similar cooling system. (Refer to page 33.)
- Install the enclosure in an air-conditioned electric chamber.
- Block direct sunlight.
- Provide a shield or similar plate to avoid direct exposure to the radiated heat and wind of a heat source.
- Ventilate the area around the enclosure well.

(b) Measures against low temperature

- Provide a space heater in the enclosure.
- Do not power OFF the converter. (Keep the start signal of the inverter OFF.)

(c) Sudden temperature changes

- Select an installation place where temperature does not change suddenly.
- Avoid installing the converter near the air outlet of an air conditioner.
- If temperature changes are caused by opening/closing of a door, install the converter away from the door.

◆Humidity

Operate the multifunction regeneration converter within the ambient air humidity of usually 45 to 90% (up to 95% with circuit board coating). Too high humidity will pose problems of reduced insulation and metal corrosion. On the other hand, too low humidity may cause a spatial electrical breakdown. The insulation distance defined in JEM 1103 "Control Equipment Insulator" is humidity of 45 to 85%.

(a) Measures against high humidity

- Make the enclosure enclosed, and provide it with a hygroscopic agent.
- Provide dry air into the enclosure from outside.
- Provide a space heater in the enclosure.

(b) Measures against low humidity

Air with proper humidity can be blown into the enclosure from outside. Also when installing or inspecting the unit, discharge your body (static electricity) beforehand, and keep your body away from the parts and patterns.

(c) Measures against condensation

Condensation may occur if frequent operation stops change the in-enclosure temperature suddenly or if the outside air temperature changes suddenly.

Condensation causes such faults as reduced insulation and corrosion.

Measures

- Take the measures against high humidity in (a).
- Do not power OFF the converter. (Keep the start signal of the inverter OFF.)

◆Dust, dirt, oil mist

Dust and dirt will cause such faults as poor contacts, reduced insulation and cooling effect due to the moisture-absorbed accumulated dust and dirt, and in-enclosure temperature rise due to a clogged filter. In an atmosphere where conductive powder floats, dust and dirt will cause such faults as malfunction, deteriorated insulation and short circuit in a short time. Since oil mist will cause similar conditions, it is necessary to take adequate measures.

Measures

- Place the converter in a totally enclosed enclosure.
  Take measures if the in-enclosure temperature rises. (Refer to page 33.)
- Purge air.
  Pump clean air from outside to make the in-enclosure air pressure higher than the outside air pressure.

◆Corrosive gas, salt damage

If the converter is exposed to corrosive gas or to salt near a beach, the printed board patterns and parts will corrode or the relays and switches will result in poor contact.

In such places, take the measures given in the previous paragraph.

◆Explosive, flammable gases

As the multifunction regeneration converter is non-explosion proof, it must be contained in an explosion-proof enclosure. In places where explosion may be caused by explosive gas, dust or dirt, an enclosure cannot be used unless it structurally complies with the guidelines and has passed the specified tests. This makes the enclosure itself expensive (including the test charges). The best way is to avoid installation in such places and install the converter in a non-hazardous place.

◆High altitude

Use the multifunction regeneration converter at an altitude of within 2500 m. For use at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.

If it is used at a higher place, it is likely that thin air will reduce the cooling effect and low air pressure will deteriorate dielectric strength.

◆Vibration, impact

The vibration resistance of the multifunction regeneration converter is up to 5.9 m/s^2 at 10 to 55 Hz frequency and 1 mm amplitude for the directions of X, Y, Z axes. Applying vibration and impacts for a long time may loosen the structures and cause poor contacts of connectors, even if those vibration and impacts are within the specified values.
Especially when impacts are applied repeatedly, caution must be taken because such impacts may break the installation feet.

Measures

- Provide the enclosure with rubber vibration isolators.
- Strengthen the structure to prevent the enclosure from resonance.
- Install the enclosure away from the sources of the vibration.

2.3.2 Amount of heat generated from the converter

The following tables show the amount of heat generated from the converter, reactor, and box-type reactor.

◆Common bus regeneration mode

200 V class

Model	Amount of heat generated (W)	
	50°C rating	40°C rating
FR-XC-7.5K	220	240
FR-XC-11K	315	345
FR-XC-15K	460	505
FR-XC-22K FR-XC-18.5K-PWM	685	755
FR-XC-30K FR-XC-22K-PWM	810	890
FR-XC-37K FR-XC-37K-PWM	890	980
FR-XC-55K FR-XC-55K-PWM	1080	1190

400 V class

Model	Amount of heat generated (W)	
	50°C rating	40°C rating
FR-XC-H7.5K	130	145
FR-XC-H11K	200	220
FR-XC-H15K	280	305
FR-XC-H22K FR-XC-H18.5K-PWM	365	395
FR-XC-H30K FR-XC-H22K-PWM	435	485
FR-XC-H37K FR-XC-H37K-PWM	590	650
FR-XC-H55K FR-XC-H55K-PWM	880	965

◆FR-XCL

200 V class

Model	Amount of heat generated (W)	
	50°C rating	40°C rating
FR-XCL-7.5K	55	60
FR-XCL-11K	72	79
FR-XCL-15K	90	99
FR-XCL-22K	98	108
FR-XCL-30K	116	128
FR-XCL-37K	144	159
FR-XCL-55K	168	185

400 V class

Model	Amount of heat generated (W)	
	50°C rating	40°C rating
FR-XCL-H7.5K	62	69
FR-XCL-H11K	72	78
FR-XCL-H15K	72	79
FR-XCL-H22K	89	97
FR-XCL-H30K	109	121
FR-XCL-H37K	116	128
FR-XCL-H55K	180	197

◆Harmonic suppression mode

◆FR-XC

200 V class

Model	Amount of heat generated (W)	
	50°C rating	40°C rating
FR-XC-22K FR-XC-18.5K-PWM	745	810
FR-XC-30K FR-XC-22K-PWM	895	980
FR-XC-37K FR-XC-37K-PWM	1395	1530
FR-XC-55K FR-XC-55K-PWM	1865	2030

400 V class

Model	Amount of heat generated (W)	
	50°C rating	40°C rating
FR-XC-H22K FR-XC-H18.5K-PWM	795	855
FR-XC-H30K FR-XC-H22K-PWM	940	1025
FR-XC-H37K FR-XC-H37K-PWM	1470	1615
FR-XC-H55K FR-XC-H55K-PWM	1915	2080

◆FR-XCB

200 V class

Model	Amount of heat generated (W)	
	50°C rating	40°C rating
FR-XCB-22K	355	385
FR-XCB-30K	380	420
FR-XCB-37K	575	630
FR-XCB-55K	730	800

400 V class

Model	Amount of heat generated (W)	
	50°C rating	40°C rating
FR-XCB-H22K	495	530
FR-XCB-H30K	510	560
FR-XCB-H37K	790	870
FR-XCB-H55K	965	1050

◆Power regeneration mode 2

◆FR-XC

200 V class

Model	Amount of heat generated (W)	
	50°C rating	40°C rating
FR-XC-7.5K	220	240
FR-XC-11K	315	345
FR-XC-15K	460	505
FR-XC-22K FR-XC-18.5K-PWM	685	755
FR-XC-30K FR-XC-22K-PWM	810	890
FR-XC-37K FR-XC-37K-PWM	890	980
FR-XC-55K FR-XC-55K-PWM	1080	1190

400 V class

Model	Amount of heat generated (W)	
	50°C rating	40°C rating
FR-XC-H7.5K	130	145
FR-XC-H11K	200	220
FR-XC-H15K	280	305
FR-XC-H22K FR-XC-H18.5K-PWM	365	395
FR-XC-H30K FR-XC-H22K-PWM	435	485
FR-XC-H37K FR-XC-H37K-PWM	590	650
FR-XC-H55K FR-XC-H55K-PWM	880	965

◆FR-XCG

200 V class

Model	Amount of heat generated (W)	
	50°C rating	40°C rating
FR-XCG-7.5K	60	73
FR-XCG-11K	82	92
FR-XCG-15K	99	115
FR-XCG-22K	118	142
FR-XCG-30K	135	162
FR-XCG-37K	172	205
FR-XCG-55K	210	243

400 V class

Model	Amount of heat generated (W)	
	50°C rating	40°C rating
FR-XCG-H7.5K	68	82
FR-XCG-H11K	80	91
FR-XCG-H15K	91	105
FR-XCG-H22K	136	159
FR-XCG-H30K	156	178
FR-XCG-H37K	193	231
FR-XCG-H55K	232	275

2.3.3 Cooling system types for converter enclosure

From the enclosure that contains the multifunction regeneration converter, the heat of the converter and other equipment (inverter, transformers, reactors, lamps, resistors, etc.) and the incoming heat such as direct sunlight must be dissipated to keep the in-enclosure temperature lower than the permissible temperatures of the in-enclosure equipment including the converter.

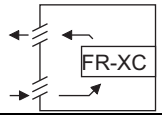
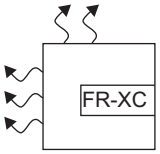
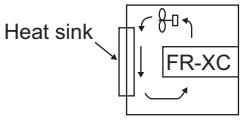
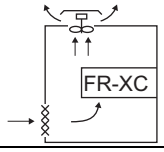
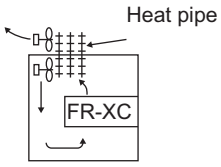
The cooling systems are classified as follows in terms of the cooling calculation method.

(a) Cooling by natural heat dissipation from the enclosure surface (totally enclosed type)

(b) Cooling by heat sink (aluminum fin, etc.)

(c) Cooling by ventilation (forced ventilation type, pipe ventilation type)

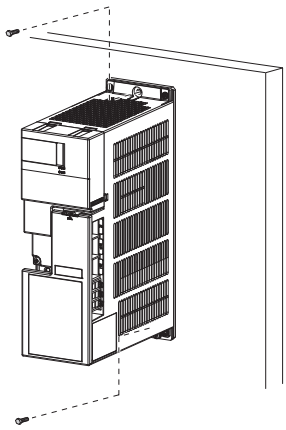
(d) Cooling by heat exchanger or cooler (heat pipe, cooler, etc.)

Cooling system		Enclosure structure	Comment
Natural	Natural ventilation (enclosed ventilated type)		This system is low in cost and generally used, but the enclosure size increases as the converter capacity increases. This system is for relatively small capacities.
	Natural ventilation (totally enclosed type)		Being a totally enclosed type, this system is the most appropriate for hostile environment having dust, dirt, oil mist, etc. The enclosure size increases depending on the converter capacity.
Forced air	Heat sink cooling		This system has restrictions on the heat sink mounting position and area. This system is for relatively small capacities.
	Forced ventilation		This system is for general indoor installation. This is appropriate for enclosure downsizing and cost reduction, and often used.
	Heat pipe		This is a totally enclosed for enclosure downsizing.

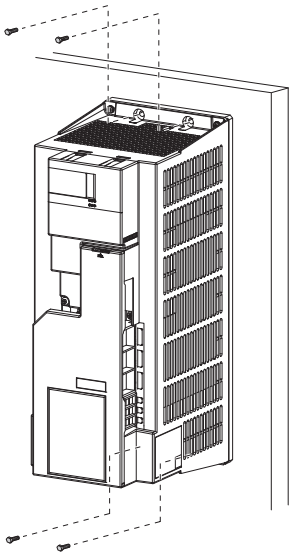
2.3.4 Converter installation

◆Converter placement

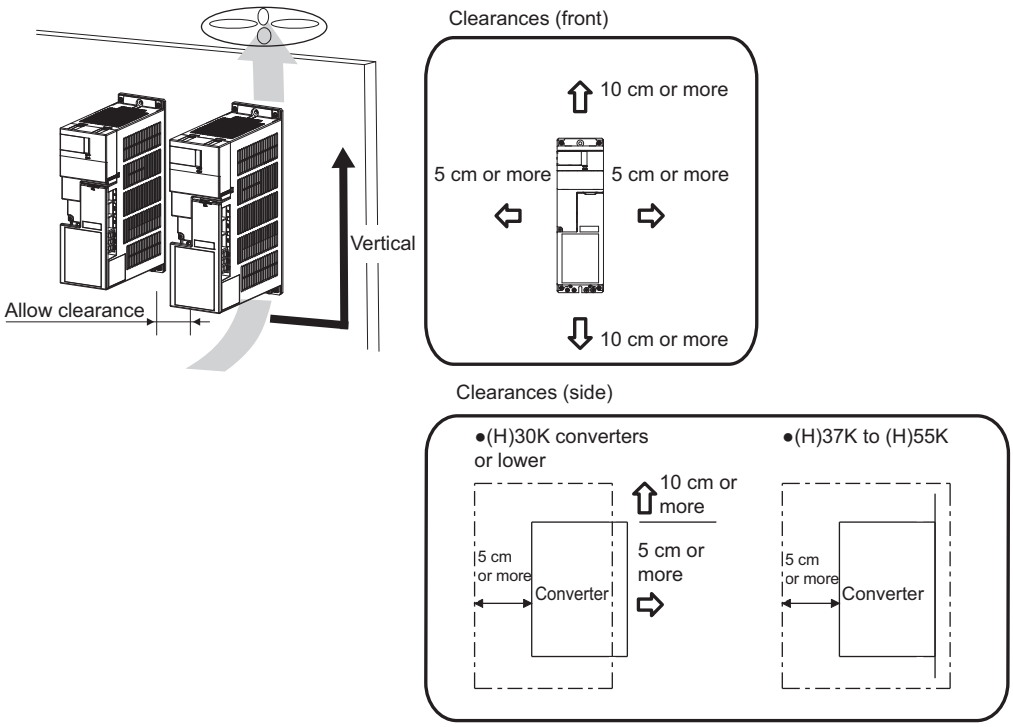
●FR-XC-(H)7.5K, (H)11K, (H)15K



●FR-XC-(H)22K, (H)30K
●FR-XC-(H)18.5K-PWM, (H)22K-PWM
●FR-XC-(H)37K, (H)55K
●FR-XC-(H)37K-PWM, (H)55K-PWM



- For the models up to 30K converters or lower, cut the enclosure according to the dimensions shown on page 37.
- Install the converter on a strong surface securely with screws.
- Leave enough clearances and take cooling measures.
- Avoid places where the converter is subjected to direct sunlight, high temperature and high humidity.
- Install the converter on a nonflammable wall surface.
- When encasing multiple converters in an enclosure, install them in parallel as a cooling measure.
- For heat dissipation and maintenance, keep clearance between the converter and the other devices or enclosure surface. The clearance below the converter is required as a wiring space, and the clearance above the converter is required as a heat dissipation space.
- When designing or building an enclosure for the converter, carefully consider influencing factors such as heat generation of the contained devices and the operating environment.



◆Installation orientation of the converter

Install the converter on a wall as specified. Do not mount it horizontally or in any other way.

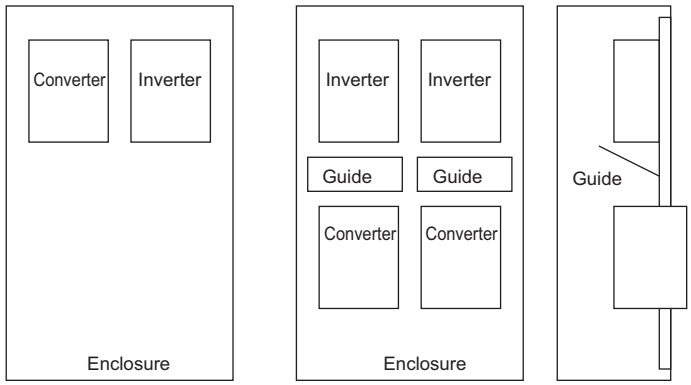
◆Above the converter

Heat is blown up from inside the converter by the small fan built in the unit. Any equipment placed above the converter should be heat resistant.

◆Arrangement of multiple converter/inverter units

When multiple converter/inverter units are placed in the same enclosure, generally arrange them horizontally as shown in the figure (a). When it is inevitable to arrange them vertically to minimize space, take such measures as to provide guides since heat generated in the units in bottom row can increase the temperatures in the units in top row, causing the failure of the units in top row.

When installing multiple units, fully take measures to prevent the surrounding air temperature of the units from being higher than the permissible value by providing ventilation or increasing the enclosure size.



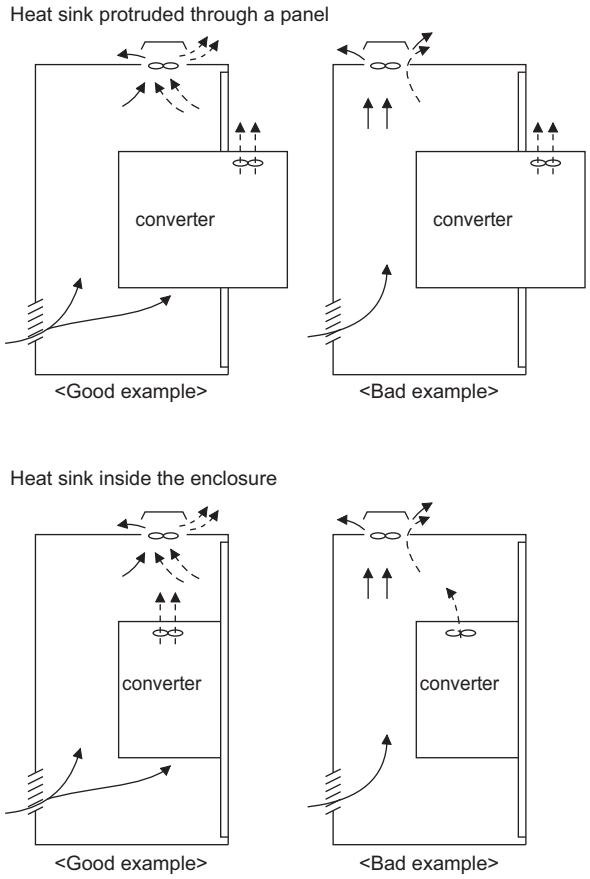
(a) Horizontal arrangement (b) Vertical arrangement

NOTE

- The FR-XCL, FR-XCG, and FR-XCB reactors also generate heat. To store the FR-XCL or FR-XCB in the enclosure that contains the converter and inverter(s), measures against temperature rises are required as is the case with the converter and inverter(s).

◆Arrangement of the ventilation fan and converter

The air warmed by the heat generated inside the converter goes up to the top of the enclosure. When installing a ventilation fan for that heat, determine the place of ventilation fan installation after fully considering an air flow. (Air passes through areas of low resistance. Make an airway and airflow plates to expose the converter to cool air.)



Arrangement of the ventilation fan and converter

2.3.5 Protruding the heat sink through a panel

When encasing the converter in an enclosure, the heat generated in the enclosure can be reduced by approximately 70% by protruding the heat sink of the converter. (The (H)30K converters or lower are designed to be installed in an enclosure with its heat sink protruded through the panel.)
When installing the multifunction regeneration converter in a compact enclosure, etc., this installation method is recommended.

◆(H)30K converters or lower

Refer to page 203 for instructions for cutting the panel of the enclosure.

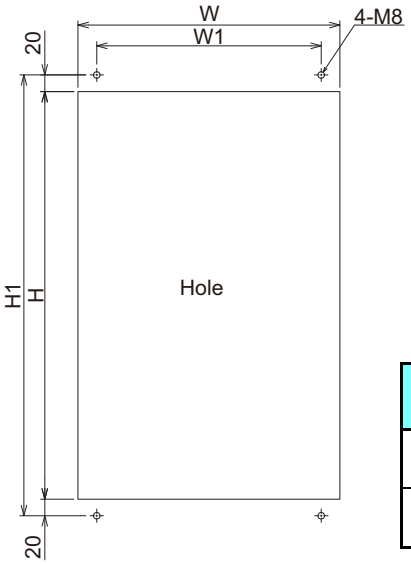
NOTE

- Use the FR-XCCP, converter installation attachment for enclosure (option), to install the multifunction regeneration converter inside the enclosure.

◆(H)37K to (H)55K

◆Panel cutting

Cut the panel of the enclosure as follows.

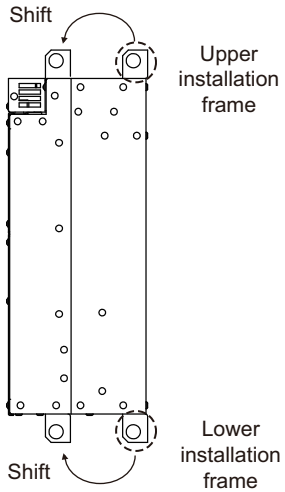


Multifunction regeneration converter	W	W1	H	H1
FR-XC-(H)37K, FR-XC-H55K FR-XC-(H)37K-PWM, FR-XC-H55K-PWM	315	270	490	530
FR-XC-55K FR-XC-55K-PWM	360	300	560	600

(Unit: mm)

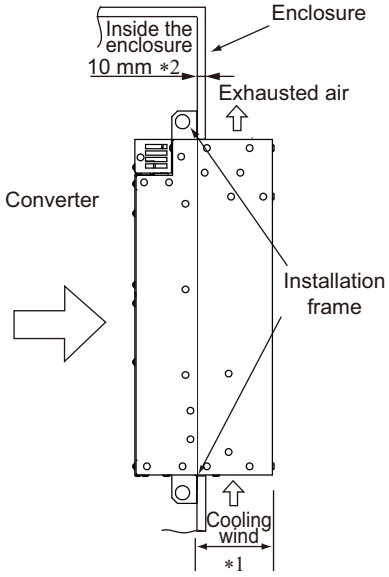
◆Mount point change of installation frame from the rear to the front

The upper and lower installation frames are attached on the multifunction regeneration converter (one for each position). Change the mount point of the upper and lower installation frames from the rear to the front as shown in the figure. When reattaching the installation frames, make sure that the installation orientation is correct.



◆Installation of the multifunction regeneration converter on the enclosure

Push the multifunction regeneration converter heat sink part outside the enclosure, and fix the multifunction regeneration converter to the panel with upper and lower installation frames.



*1 Dimension of the outside of the enclosure

Multifunction regeneration converter	Dimension of the outside of the enclosure (mm)
FR-XC-(H)37K, FR-XC-H55K FR-XC-(H)37K-PWM, FR-XC-H55K-PWM	105
FR-XC-55K FR-XC-55K-PWM	135

*2 To avoid interference with the cooling fan on top of the heat sink, the thickness of the rear panel of the enclosure should not exceed 10 mm and the space around the fan should be cleared.

NOTE

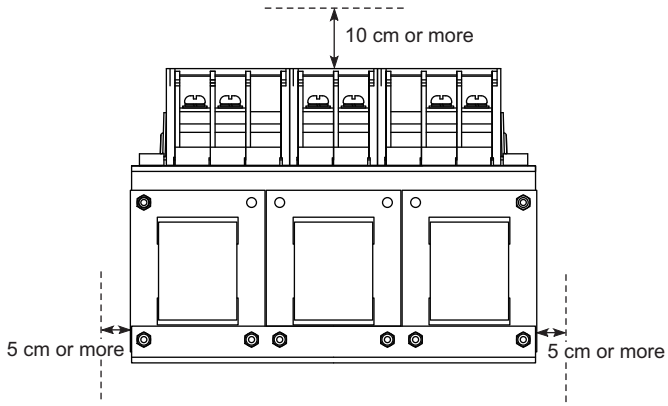
- As the heat sink part protruded through the panel includes a cooling fan, this type of installation is not suitable for the environment of water drops, oil, mist, dust, etc.
- Be careful not to drop screws, dust etc. into the multifunction regeneration converter and cooling fan section.

2.4 Installation of peripheral devices

2.4.1 Installation of reactor (FR-XCL/XCG)

◆Clearances

Because the reactor generate heat, leave sufficient space around them.



◆Installation place

Install the reactor on nonflammable material. Installing it directly on flammable material will cause a fire.

◆Surrounding environment

Avoid places where the equipment is subjected to oil mist, flammable gases, fluff, dust, dirt, etc.
Install the equipment in a clean place or protect it from suspended substances.

◆Installation orientation

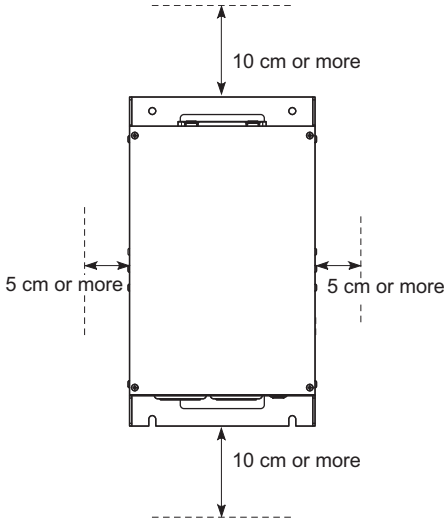
To prevent looseness, install the reactor on a horizontal or vertical surface securely with screws or bolts.
Install it on a mounting stand which can withstand its weight.

NOTE

- Since the charged section of the reactor is uncovered, fully protect it to prevent ground fault and electric shock.
- When wiring terminals, always insulate lead terminals with a heat-resistant tape or other insulating covering.
- To avoid an electric shock by touching the terminal charging section, install the reactor in the enclosure or install the terminal cover.

2.4.2 Installation of box-type reactor (FR-XCB)

◆Clearances



◆Installation place

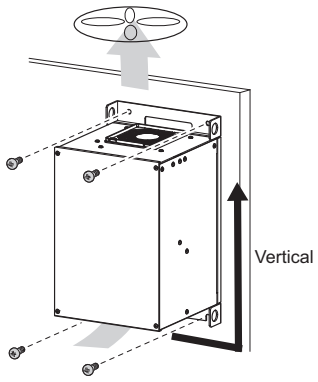
Install the reactor on nonflammable material. Installing it directly on flammable material will cause a fire.

◆Surrounding environment

Avoid places where the equipment is subjected to oil mist, flammable gases, fluff, dust, dirt, etc.
Install the equipment in a clean place or protect it from suspended substances.

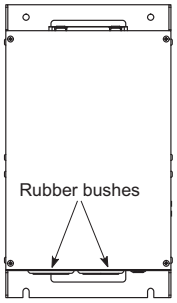
◆Installation orientation

Install the reactor on a vertical surface.



◆Wiring method

Make cuts in the rubber bushes shown in the following figures and lead the wires through the cuts.



NOTE

- To satisfy IP20 protection requirements, note the following points for wiring of the reactor.
  - Do not make cuts in rubber bushes which are not used for wiring.
  - Do not use the reactor with the rubber bushes removed.

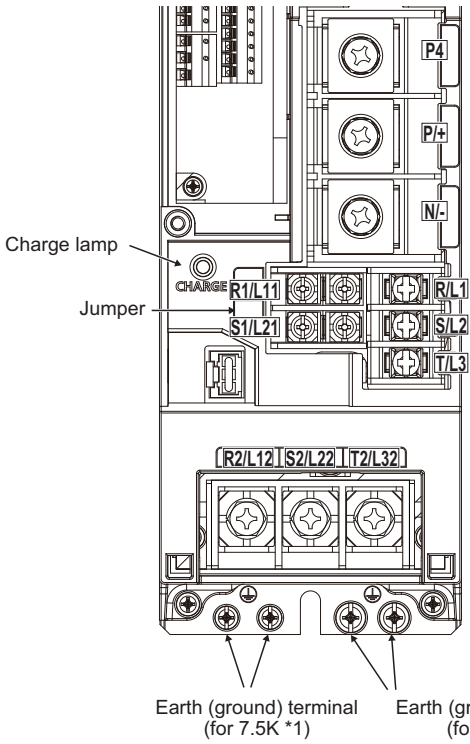
2.5 Main circuit terminal specification

2.5.1 Details on the main circuit terminals

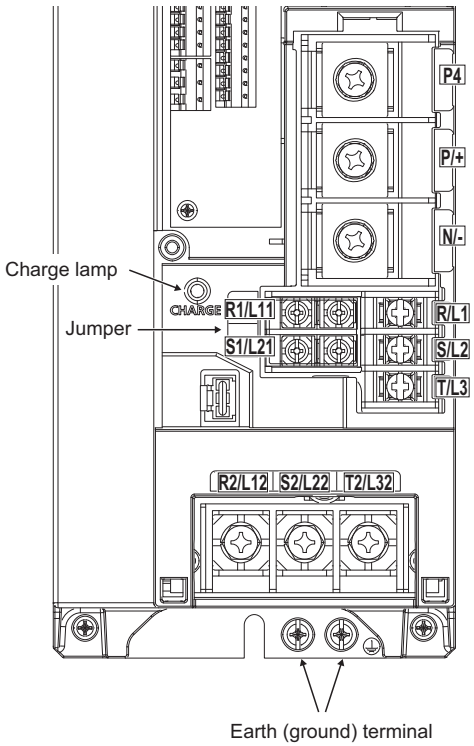
Terminal symbol	Terminal name	Description
R/L1, S/L2, T/L3	Power supply phase detection	These terminals are used to detect the phase and voltage of the power supply, and to input power to the control circuit. Connect each of them to terminals of the same name on both the power supply and the reactor. Operating the inverter without connecting them will damage the converter.
R2/L12, S2/L22, T2/L32	AC power input	Connect each of them to terminals of the same name on the reactor.
R1/L11, S1/L21	Power supply for the control circuit	These terminals are connected to the phase detection terminals R/L1 and S/L2 in the initial status. To retain the fault display and fault output, remove the jumpers (cables) and apply external power through these terminals.
P/+, N/-	DC output for the common bus regeneration mode	Connect them to the inverter terminals P/+ and N/-.
P4, N/-	DC output for the power regeneration mode 2	Connect them to the inverter terminals P/+ and N/-.
⏚	Earth (ground)	Terminals for earthing (grounding) the converter chassis. This must be earthed (grounded).

2.5.2 Main circuit terminal block layout

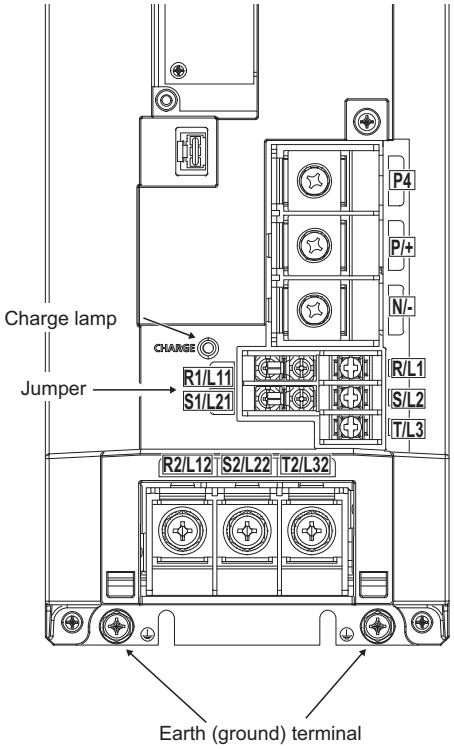
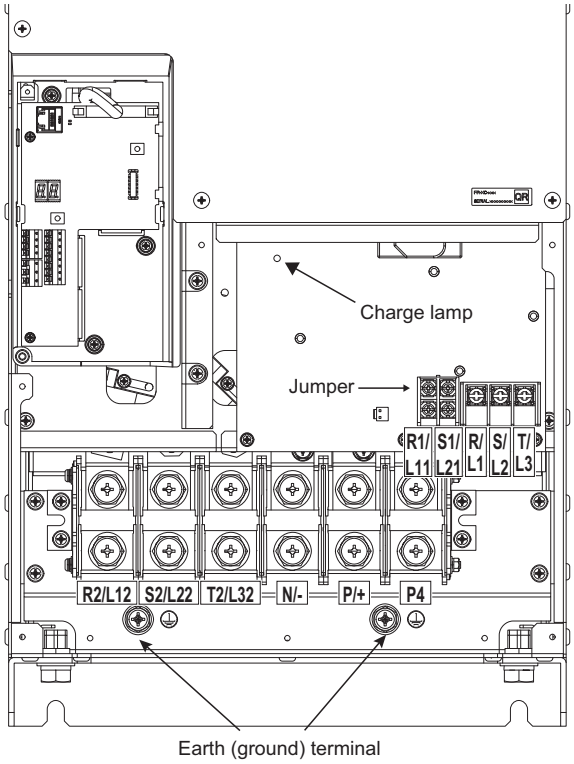
FR-XC-(H)7.5K, (H)11K



FR-XC-(H)15K



*1 Screws for earthing (grounding) for the 7.5K
*2 Screws for earthing (grounding) for the 11K

FR-XC-(H)22K-(H)30K FR-XC-(H)18.5K-PWM, (H)22K-PWM	FR-XC-(H)37K, (H)55K FR-XC-(H)37K-PWM-(H)55K-PWM
	

2.5.3 Screw size of the main circuit terminals and the earth (ground) terminal

◆Screw size

• 200 V class (220 V power reception)

Model	Terminal screw size (Tightening torque (N·m))				
	R, S, T	R2, S2, T2	P4, P, N	R1, S1	Earth (ground)
FR-XC-7.5K	M4 (1.5)	M5 (2.5)	M6 (4.4)	M4 (1.5)	M4 (1.5)
FR-XC-11K					M5 (2.5)
FR-XC-15K					
FR-XC-22K FR-XC-18.5K-PWM		M8 (7.8)			M6 (4.4)
FR-XC-30K FR-XC-22K-PWM					
FR-XC-37K FR-XC-37K-PWM		M10 (14.7)	M10 (14.7)		M8 (7.8)
FR-XC-55K FR-XC-55K-PWM		M12 (24.5)	M12 (24.5)		

Model	Terminal screw size (Tightening torque (N·m))	
	R, S, T R2, S2, T2	Earth (ground)
FR-XCB-18.5K	M8 (7.8)	M6 (4.4)
FR-XCB-22K		
FR-XCB-37K	M10 (14.7)	M8 (7.8)
FR-XCB-55K		

Model	Terminal screw size (Tightening torque (N·m))	
	R, S, T R2, S2, T2	Earth (ground)
FR-XCL-7.5K	M5 (2.5)	
FR-XCL-11K		
FR-XCL-15K	M6 (4.4)	
FR-XCL-22K		
FR-XCL-30K		
FR-XCL-37K	M10 (14.7)	
FR-XCL-55K		

Model	Terminal screw size (Tightening torque (N·m))	
	R, S, T R2, S2, T2	Earth (ground)
FR-XCG-7.5K	M5 (2.5)	M4 (1.5)
FR-XCG-11K		
FR-XCG-15K	M6 (4.4)	M5 (2.5)
FR-XCG-22K		M6 (4.4)
FR-XCG-30K		
FR-XCG-37K	M10 (14.7)	
FR-XCG-55K		

• 400 V class (440 V power reception)

Model	Terminal screw size (Tightening torque (N·m))				
	R, S, T	R2, S2, T2	P, N	R1, S1	Earth (ground)
FR-XC-H7.5K	M4 (1.5)	M5 (2.5)	M6 (4.4)	M4 (1.5)	M4 (1.5)
FR-XC-H11K					M5 (2.5)
FR-XC-H15K					
FR-XC-H22K FR-XC-H18.5K-PWM		M8 (7.8)			M6 (4.4)
FR-XC-H30K FR-XC-H22K-PWM					
FR-XC-H37K FR-XC-H37K-PWM			M8 (7.8)		M8 (7.8)
FR-XC-H55K FR-XC-H55K-PWM					

Model	Terminal screw size (Tightening torque (N·m))	
	R, S, T R2, S2, T2	Earth (ground)
FR-XCB-H18.5K	M6 (4.4)	M6 (4.4)
FR-XCB-H22K		
FR-XCB-H37K	M8 (7.8)	M8 (7.8)
FR-XCB-H55K		

Model	Terminal screw size (Tightening torque (N·m))	
	R, S, T R2, S2, T2	Earth (ground)
FR-XCL-H7.5K	M5 (2.5)	-
FR-XCL-H11K		
FR-XCL-H15K		
FR-XCL-H22K	M6 (4.4)	
FR-XCL-H30K		
FR-XCL-H37K	M8 (7.8)	
FR-XCL-H55K		

Model	Terminal screw size (Tightening torque (N·m))	
	R, S, T R2, S2, T2	Earth (ground)
FR-XCG-H7.5K	M5 (2.5)	M4 (1.5)
FR-XCG-H11K		
FR-XCG-H15K		M5 (2.5)
FR-XCG-H22K	M6 (4.4)	M6 (4.4)
FR-XCG-H30K		
FR-XCG-H37K	M8 (7.8)	
FR-XCG-H55K		

2.6 Control circuit specification

2.6.1 Details on the control circuit terminals

indicates that terminal functions can be selected using **Pr.3, Pr.4,** or **Pr.7 (Input terminal function selection)** or **Pr.11, Pr.12, or Pr.16 (Output terminal function selection)**. (Refer to page 130, page 132.)

◆Input signal

Type	Terminal symbol	Terminal name	Terminal function description	Rated specification
Contact input	RES	Reset	Use this signal to reset a fault output provided when a protective function is activated. Turn ON the RES signal for 0.1 seconds or longer, then turn it OFF.	Input resistance: 4.7 kΩ, voltage when contacts are open: 21 to 27 VDC, current when contacts are short-circuited: 4 to 6 mADC
	SOF	Converter stop	Turn ON this signal to stop the regenerative driving. The function can be changed using **Pr.4**.	
	LOH	Box-type reactor overheat protection	Used to monitor the speed of cooling fan in the FR-XCB reactor for overheat protection. When the sink logic is selected, connect this terminal to terminal LOH1 on the reactor. When the source logic is selected, connect this terminal to terminal LOH2 on the reactor.	
	SD	Contact input common (sink) (initial setting)	Common terminal for the contact input terminal (sink logic).	—
		External transistor common (source)	Connect this terminal to the power supply common terminal of a transistor output (open collector output) device, such as a programmable controller, in the source logic to avoid malfunction by undesirable current.	
		24 VDC power supply common	Common output terminal for 24 VDC 0.1A power supply (PC terminal). Isolated from terminals 5, SE, and SE2.	
	PC	External transistor common (sink) (initial setting)	Connect this terminal to the power supply common terminal of a transistor output (open collector output) device, such as a programmable controller, in the sink logic to avoid malfunction by undesirable current.	Power supply voltage range: 19.2 to 28.8 VDC, permissible load current: 100 mA
		Contact input common (source)	Common terminal for contact input terminal (source logic)	
		24 VDC power supply	Can be used as a 24 VDC 0.1 A power supply.	

◆Output signal

Type	Terminal symbol	Terminal name	Terminal function description	Rated specification
Open collector	RYA	Inverter run enable (NO contact)	Turns ON when the multifunction regeneration converter becomes ready for operation. Signal OFF: Inverter cannot run Signal ON: Inverter can run	Permissible load: 24 VDC (27 VDC at maximum) 0.1 A (The voltage drop is 2.8 V at maximum while the signal is ON.)
	RYB	Inverter run enable (NC contact)	Turns ON at alarm occurrence and reset (RES) signal input. Connect this terminal to the inverter terminal which the X10 signal is assigned to or the inverter terminal MRS. Terminal RYB is used with the normally closed (NC contact) specification. Turning ON the RYB signal stops the inverter. Signal OFF: Inverter can run Signal ON: Inverter cannot run	
	RSO	Converter reset	Turns ON during a converter reset (RES-ON). Connect this terminal to the inverter terminal which the RES signal is assigned to. Turning ON the RSO signal resets the inverter.	
	SE	Open collector output common	Common terminal for terminals RYA, RYB, and RSO. Connect it to the inverter terminal SD (sink logic).	—
Relay	A, B, C	Fault contact	1 changeover contact output that indicates that an converter's protective function has been activated and the outputs are stopped. Fault: discontinuity across B and C (continuity across A and C), Normal: continuity across B and C (discontinuity across A and C)	Contact capacity: 230 VAC 0.3 A (power factor = 0.4), Output: 30 VDC 0.3 A

◆Power supply for fan

Type	Terminal symbol	Terminal name	Terminal function description
Power supply for fan	FAN	Reactor fan power supply	Power supply terminal for the fan on the FR-XCB reactor. Connect it to terminal FAN1 on the reactor.
	SD	Reactor fan power supply common	Common terminal for terminal FAN. Connect it to terminal FAN2 on the reactor. Use it in either the sink or source logic.

◆Communication

Type	Terminal symbol	Terminal name	Terminal function description
RS-485	—	PU connector	RS-485 communication can be made through the PU connector (for connection on a 1:1 basis only). Conforming standard: EIA-485 (RS-485) Transmission format: Multidrop link Communication speed: 4800 to 38400 bps Wiring length: 500 m

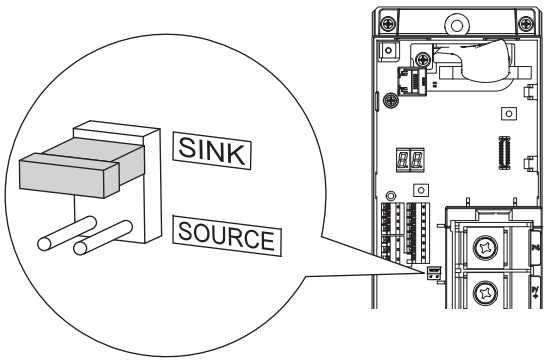
2.6.2 Control logic switchover

The control logic of input signals is initially set to the sink logic (SINK).

To change the control logic, the jumper connector next to the control circuit terminal block must be moved to the other position.

The control logic of the multifunction regeneration converter and the inverter must be consistent. The converter does not operate properly if the control logic is not consistent with each other.

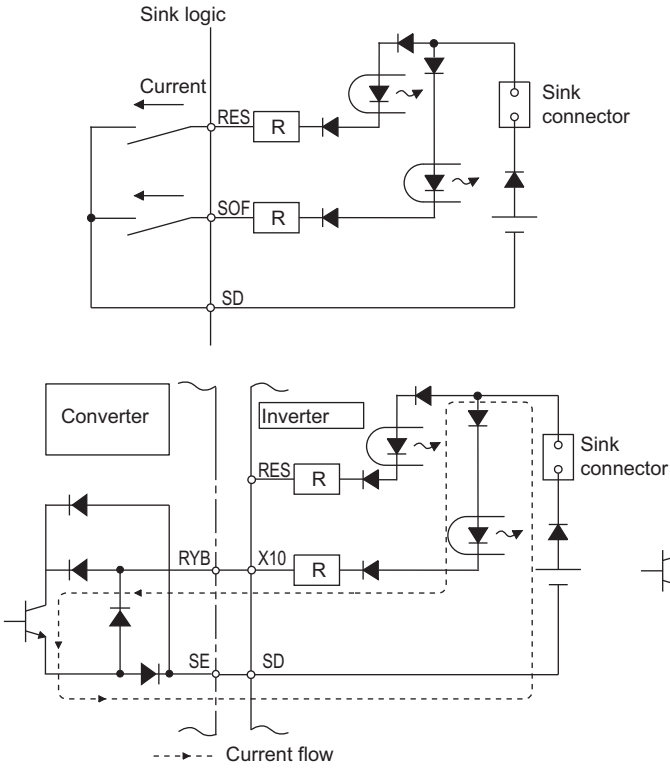
(The output signals may be used in either the sink or source logic independently of the jumper connector position.)



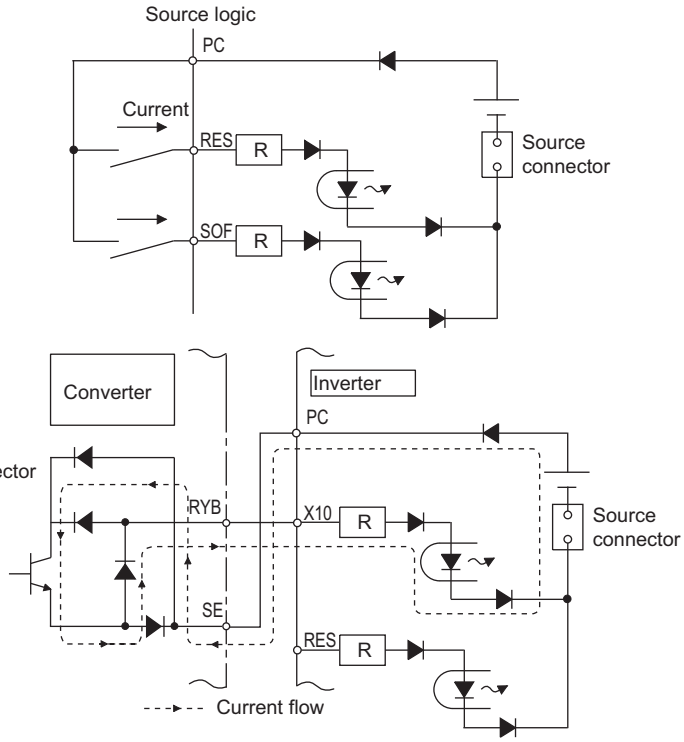
◆Sink logic and source logic

- In the sink logic, a signal switches ON when a current flows from the corresponding signal input terminal.
  Terminal SD is common to the contact input signals. Terminal SE is common to the open collector output signals.
- In the source logic, a signal turns ON when a current enters into the corresponding signal input terminal.
  Terminal PC is common to the contact input signals. Terminal SE is common to the open collector output signals.

● Current flow concerning the input/output signal when sink logic is selected



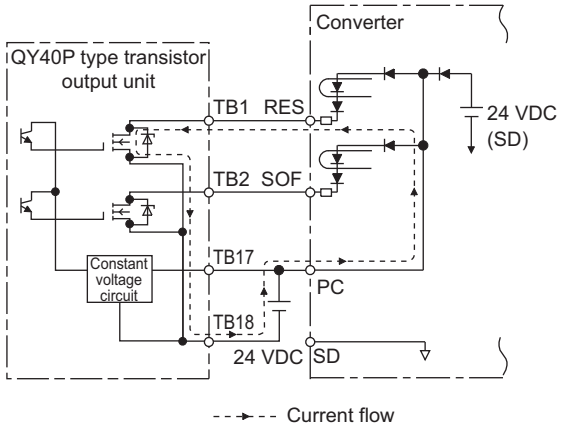
● Current flow concerning the input/output signal when source logic is selected



- When using an external power supply for transistor output

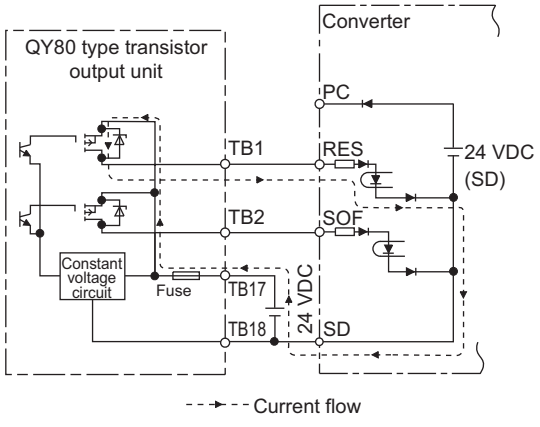
- Sink logic

  Use the terminal PC as a common terminal, and perform wiring as shown below. (Do not connect terminal SD on the converter with the terminal of 0 V for the external power supply. When using terminals PC-SD as a 24 VDC power supply, do not install an external power supply in parallel with the converter. Doing so may cause a malfunction in the converter due to undesirable currents.)

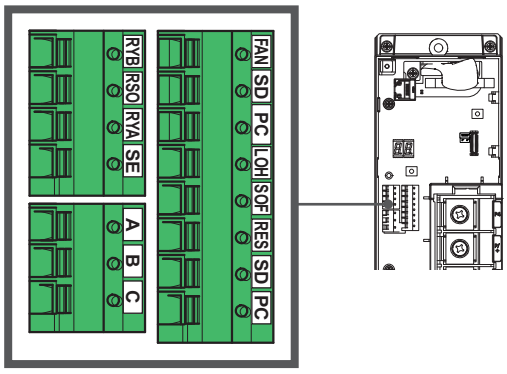


- Source logic

  Use the terminal SD as a common terminal, and perform wiring as follows. (Do not connect terminal PC on the converter with the terminal of +24 V for the external power supply. When using terminals PC-SD as a 24 VDC power supply, do not install an external power supply in parallel with the converter. Doing so may cause a malfunction in the converter due to undesirable currents.)



2.6.3 Control circuit terminal layout

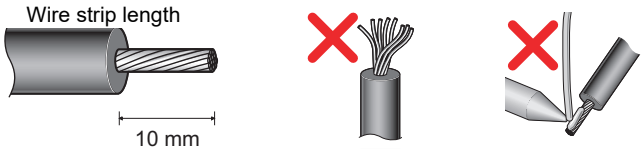


◆Wiring method

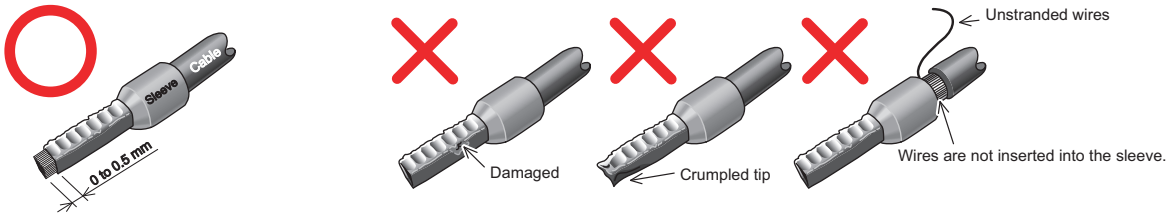
• Wire insertion

Use crimp terminals and stripped wire for the control circuit wiring. For single wire, the stripped wire can be used without crimp terminal. Connect the end of wires (crimp terminal or stranded wire) to the terminal block.

(1) Strip the signal wires as shown below. If too much of the wire is stripped, a short circuit may occur with neighboring wires. If not enough of the wire is stripped, wires may become loose and fall out. Twist the stripped end of wires to prevent them from fraying. Do not solder them.



(2) Use appropriate crimp terminals (ferrules, blade terminals, etc.).
Insert the wire into a crimp terminal, making sure that 0 to 0.5 mm of the wire protrudes from the end of the sleeve. Check the condition of the crimp terminals after crimping. Do not use the crimp terminals of which the crimping is inappropriate, or the face is damaged.



- Crimp terminals commercially available (as of October 2020)

  PHOENIX CONTACT GmbH & Co. KG

Wire gauge (mm^2)	Ferrule part No.			Crimping tool model No.
	With insulation sleeve	Without insulation sleeve	For UL wire*1	
0.3	AI 0,34-10TQ	—	—	CRIMPFOX 6
0.5	AI 0,5-10WH	—	AI 0,5-10WH-GB	
0.75	AI 0,75-10GY	A 0, 75-10	AI 0,75-10GY-GB	
1	AI 1-10RD	A 1-10	AI 1-10RD/1000GB	
1.25, 1.5	AI 1,5-10BK	A 1,5-10	AI 1,5-10BK/1000GB*2	
0.75 (two-wire product)	AI-TWIN 2×0,75-10GY	—	—	

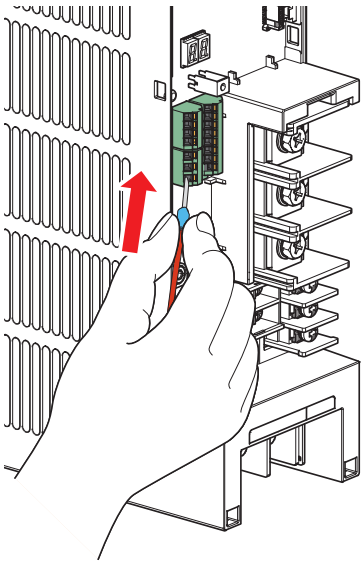
*1 A ferrule with an insulation sleeve compatible with the MTW wire which has a thick wire insulation.

*2 Applicable for terminals A, B, and C.

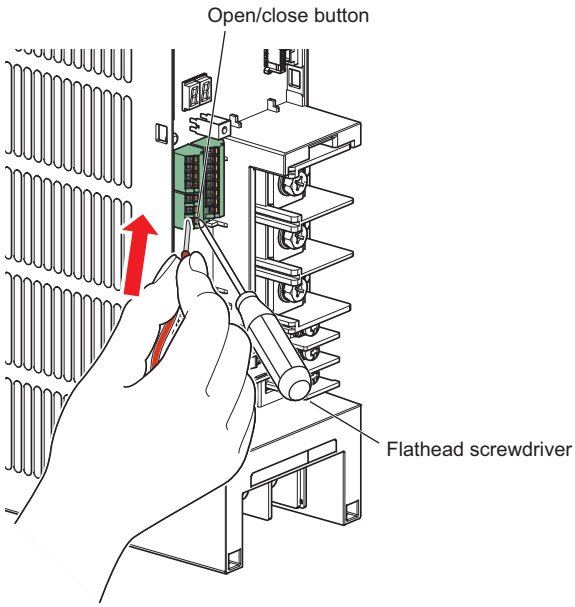
NICHIFU Co., Ltd.

Wire gauge (mm^2)	Blade terminal part No.	Insulation cap part No.	Crimping tool model No.
0.3 to 0.75	BT 0.75-11	VC 0.75	NH 69

(3) Insert each wire into the terminal.



When using single wire or stranded wires without a crimp terminal, push the open/close button all the way down with a flathead screwdriver, and insert the wire.

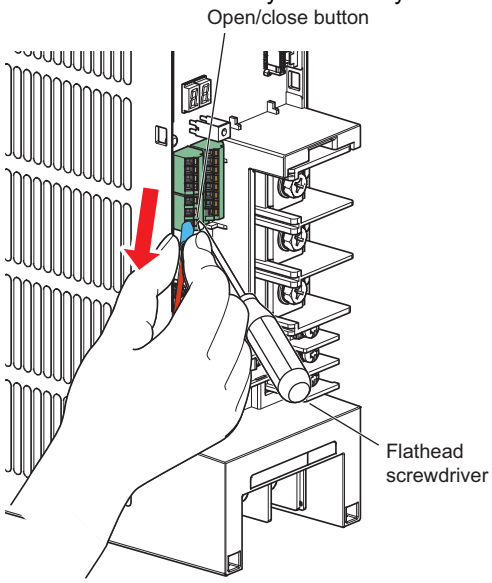


NOTE

- When using stranded wires without a crimp terminal, twist enough to avoid short circuit with neighboring terminals or wires.
- Place the flathead screwdriver vertical to the open/close button. In case the blade tip slips, it may cause the converter damage or injury.

- Wire removal

  Pull the wire while pushing the open/close button all the way down firmly with a flathead screwdriver.



NOTE

- Pulling out the wire forcefully without pushing the open/close button all the way down may damage the terminal block.
- Use a small flathead screwdriver (tip thickness: 0.4 mm / tip width: 2.5 mm).
  If a flathead screwdriver with a narrow tip is used, terminal block may be damaged.
  Commercially available product (as of October 2020).

Product name	Model	Manufacturer
Driver	SZF 0- 0,4 × 2,5	PHOENIX CONTACT GmbH & Co. KG

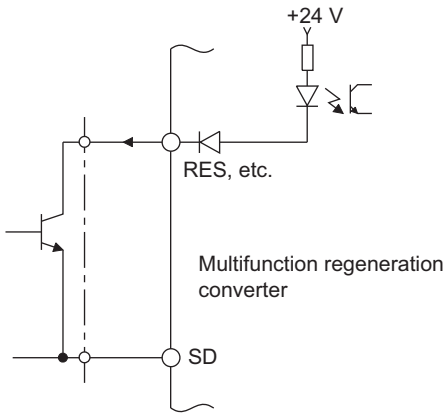
- Place the flathead screwdriver vertical to the open/close button. In case the blade tip slips, it may cause the converter damage or injury.

◆Common terminals of the control circuit (PC, SD, SE)

- Terminals PC, SD, and SE are all common terminals (0 V) for I/O signals and are isolated from each other. Do not earth (ground) these terminals.
- Terminal SD is a common terminal for the contact input terminals (RES, SOF, and LOH). Use a shielded or twisted cable to protect the terminal against malfunction caused by external noise. Connect the shielded cable to terminal SD (common terminal). To connect an external power supply to terminal PC, however, connect the shield of the power supply cable to the negative side of the external power supply. Do not directly earth (ground) the shield to the enclosure, etc. The open collector circuit is isolated from the internal control circuit by photocoupler.
- Terminal SE is a common terminal for the open collector output terminals (RYA, RYB, and RSO). The contact input circuit is isolated from the internal control circuit by photocoupler.

◆Signal inputs by contactless switches

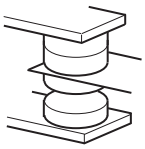
The contact input terminals of the converter (RES, SOF, and LOH) can be controlled using a transistor instead of a contact switch as follows.



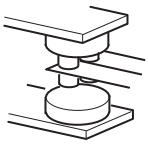
External signal input using transistor

2.6.4 Wiring precautions

- It is recommended to use a cable of 0.3 to 1.25 mm^2 for the connection to the control circuit terminals.
- The wiring length should be 30 m at the maximum.
  However, the wiring length between the control circuit and the box-type reactor should be 5 m at the maximum (refer to page 89).
- Use shielded or twisted cables for the control circuit terminals and run them away from the main and power circuits (including the 200 V relay sequence circuit).
- Use two or more parallel micro-signal contacts or twin contacts to prevent a contact faults when using contact inputs since the control circuit input signals are micro-currents.



Micro signal contacts



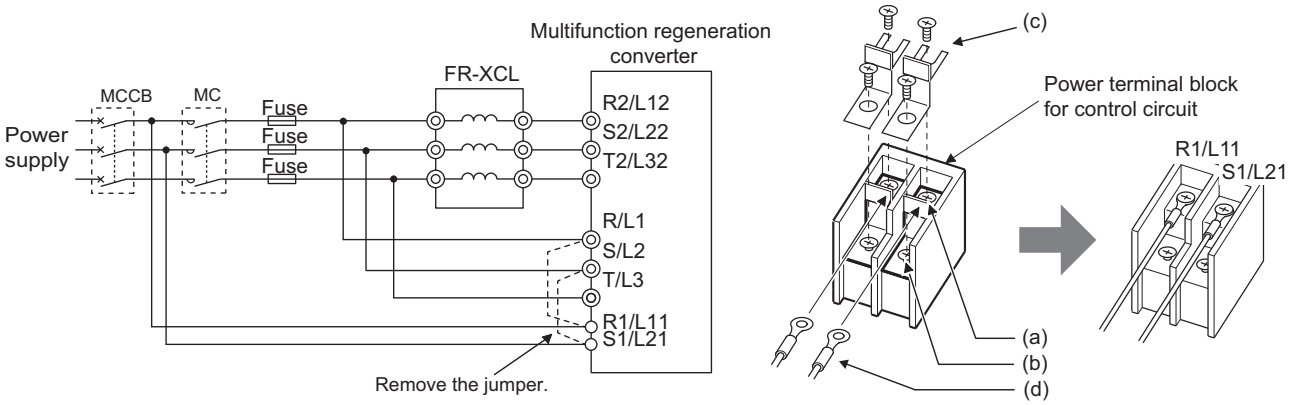
Twin contacts

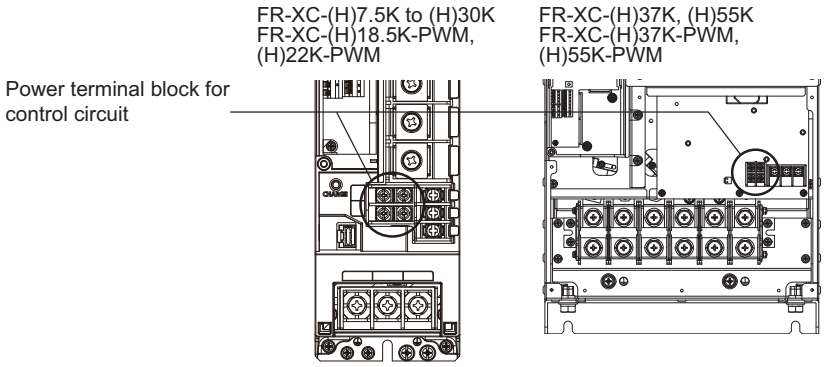
- To suppress EMI, use shielded or twisted cables for the control circuit terminals and run them away from the main and power circuits (including the 200 V relay sequence circuit). For the cables connected to the control circuit terminals, connect their shields to the common terminal of the connected control circuit terminal. When connecting an external power supply to terminal PC, however, connect the shield of the power supply cable to the negative side of the external power supply. Do not directly earth (ground) the shield to the enclosure, etc.
- Always apply a voltage to the fault output terminals (A, B, and C) via a relay coil, lamp, etc.

2.6.5 When using separate power supplies for the control circuit and the main circuit

- When the protection circuit is activated, opening of the magnetic contactor (MC) on the input side of the converter results in power loss in the control circuit of the converter, disabling the fault output signal retention. To retain the fault signal, connect the power supply terminals R1/L11, S1/L21 of the control circuit to the input side of the MC. Do not connect the power cable to incorrect terminals. Doing so may damage the converter.

Example)
Common bus regeneration mode





(a) Remove the upper screws.
(b) Remove the lower screws.
(c) Pull out the jumper to remove it.
(d) Connect the separate power supply cable for the control circuit to the upper terminals (R1/L11, S1/L21).

NOTE

- When using separate power supplies, always remove the jumpers across terminals R/L1 and R1/L11 and across S/L2 and S1/L21. Failure to do so may lead to damage of the converter.
- When the control circuit power is supplied from other than the input line of the magnetic contactor (MC), the voltage of the separate power supply must be the same as that of the main control circuit.
- When using a separate power supply connected to terminals R1/L11 and S1/L21, the necessary power capacity differs according to the converter capacity.

Converter	Power supply capacity
All capacity	80 VA

- If the main circuit power is switched OFF (for 0.1 second or more) then ON again, the converter is reset and a fault output will not be held.

2.6.6 Details on the control circuit terminals on the FR-XCB

◆Power supply for fan

Type	Terminal symbol	Terminal name	Terminal function description
Power supply for fan	FAN1	Reactor fan power input	Power input terminal for the fan on the reactor. Connect it to terminal FAN on the converter.
	FAN2*1	Fan power input common	Common terminal for terminal FAN1. Connect it to terminal SD on the converter.

*1 The terminal symbols differ depending on the manufacture year and month of the FR-XCB. (Refer to page 241)

◆Input signal

Type	Terminal symbol	Terminal name	Terminal function description
Damping resistor	DROH1, DROH2	Thermostat for built-in damping resistor	Not used.

◆Output signal

Type	Terminal symbol	Terminal name	Terminal function description	Rated specification
Open collector	LOH1	Box-type reactor overheat detection	Pulses corresponding to the speed of cooling fan on the box-type reactor is output. When the sink logic is selected, connect this terminal to terminal LOH on the converter. When the source logic is selected, connect this terminal to terminal PC on the converter.	Permissible load: 24 VDC (27 VDC at maximum) 0.1 A (The voltage drop is 2.8 V at maximum while the signal is ON.)
	LOH2	Box-type reactor overheat detection common	Common terminal for terminal LOH1. When the sink logic is selected, connect this terminal to terminal SD on the converter. When the source logic is selected, connect this terminal to terminal LOH on the converter.	

NOTE

• For the terminal layout, refer to page 219.

2.7 Earthing (Grounding) precautions

- Always earth (ground) the converter, reactor, box-type reactor, and contactor box.

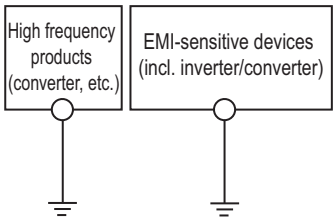
◆Purpose of earthing (grounding)

Generally, an electrical apparatus has an earth (ground) terminal, which must be connected to the ground before use.
An electrical circuit is usually insulated by an insulating material and encased. However, it is impossible to manufacture an insulating material that can shut off a leakage current completely, and actually, a slight current flows into the case. The purpose of earthing (grounding) the case of an electrical apparatus is to prevent operators from getting an electric shock from this leakage current when touching it.
To avoid the influence of external noises, the earthing (grounding) is important to EMI-sensitive equipment that handle low-level signals or operate very fast such as audio equipment, sensors, computers.

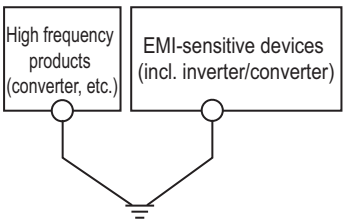
◆Earthing (grounding) system to be established

As described previously, the purpose of earthing (grounding) is roughly classified into the electrical shock prevention and the prevention of malfunction due to the influence of electromagnetic noise. These two purposes should be clearly distinguished.
Leakage currents containing many high frequency components flow into the earthing (grounding) cables of the converter. When any other devices (EMI-sensitive devices) are earthed (grounded) nearby, the appropriate earth (ground) system must be established as follows to prevent malfunction of such EMI-sensitive devices due to the leakage current from the converter, inverter, or reactor.

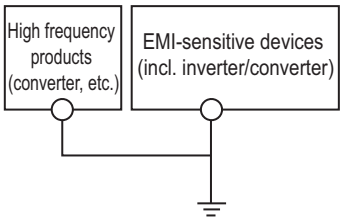
- Make the separate earth (ground) connection (I) for the converter, inverter, reactor, and contactor box away from other EMI sensitive devices wherever possible.
  Establishing adequate common (single-point) earth (ground) system (II) shown in the following figure is allowed only in cases where the separate earth (ground) system (I) is not feasible. Do not make inadequate common (single-point) earth (ground) connection (III).
  In a high building, it may be effective to use its iron structure frames as earthing (grounding) electrode for EMI prevention in order to separate from the earth (ground) system for electric shock prevention.
- Earthing (Grounding) must conform to the requirements of national and local safety regulations and electrical codes (NEC section 250, IEC 61140 class 1 and other applicable standards).
- Use the thickest possible earthing (grounding) cable. The size of the earthing (grounding) cable should be the same or larger than the one indicated in the table on page 64, page 85, and page 105.
- The earthing (grounding) point should be as close as possible to the converter, reactor, box-type reactor, and contactor box, and the earth (ground) cable length should be as short as possible.
- Run the earthing (grounding) cable as far away as possible from the I/O wiring of the EMI-sensitive devices, and run them in parallel in the minimum distance.



(I) Separate earthing (grounding): Good



(II) Common (single-point) earthing (grounding): OK

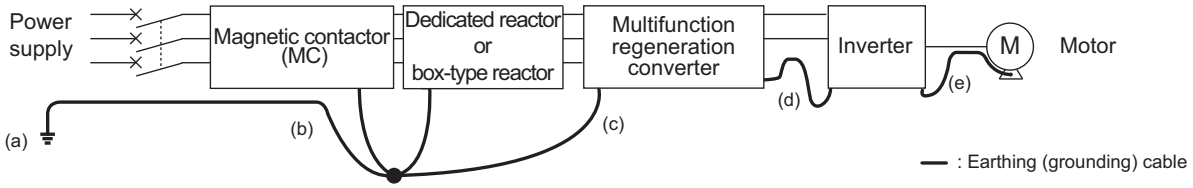


(III) Inadequate common (single-point) earthing (grounding): Bad

◆Earthing (grounding) of the FR-XCL, FR-XCG, or FR-XCB

- Use the earth (ground) terminal of the reactor (FR-XCL/FR-XCG) or box-type reactor (FR-XCB).
  (To locate the earth (ground) terminal, refer to the outline dimensions on page 212 and page 219.)
- For earthing (grounding) of the reactor (FR-XCL/FR-XCG) or box-type reactor (FR-XCB), use the same gauge earthing (grounding) cable as that for the converter (refer to page 64, page 85, and page 105).

◆Example of earthing (grounding)



Symbol	Description
a	Make the separate earth (ground) connection for the converter, inverter, reactor, and contactor box wherever possible.
b	The earthing (grounding) cable should be as close as possible to the power cables, and all these cables should be in parallel.
c	The converter, reactor, box-type reactor, and contactor box are allowed to have the common (single-point) earth (ground) system (unless the reactor is earthed (grounded) by being mounted on a panel of the enclosure).
d	If the inverter and the converter are installed far apart and the main circuit cables between them (P to P and N to N) are too long to store in an enclosure, the inverter earthing (grounding) cable is allowed to be connected to the converter and run as close as possible to the main circuit cables in parallel. When the main circuit cables are short enough to store in an enclosure, the inverter is allowed to join in the common (single-point) earth (ground) connection (c).
e	The motor earthing (grounding) cable is allowed be connected to the inverter earth (ground) terminal.

2.8 Installation of communication option (FR-A8NC)

Using the PU connector enables communication operation from a personal computer, etc. When the PU connector is used for connection between the converter and a personal, FA, or other computer with a communication cable, a user program can run to monitor the converter or read and write parameters.

Communication with the Mitsubishi inverter protocol (computer link operation) can be performed.

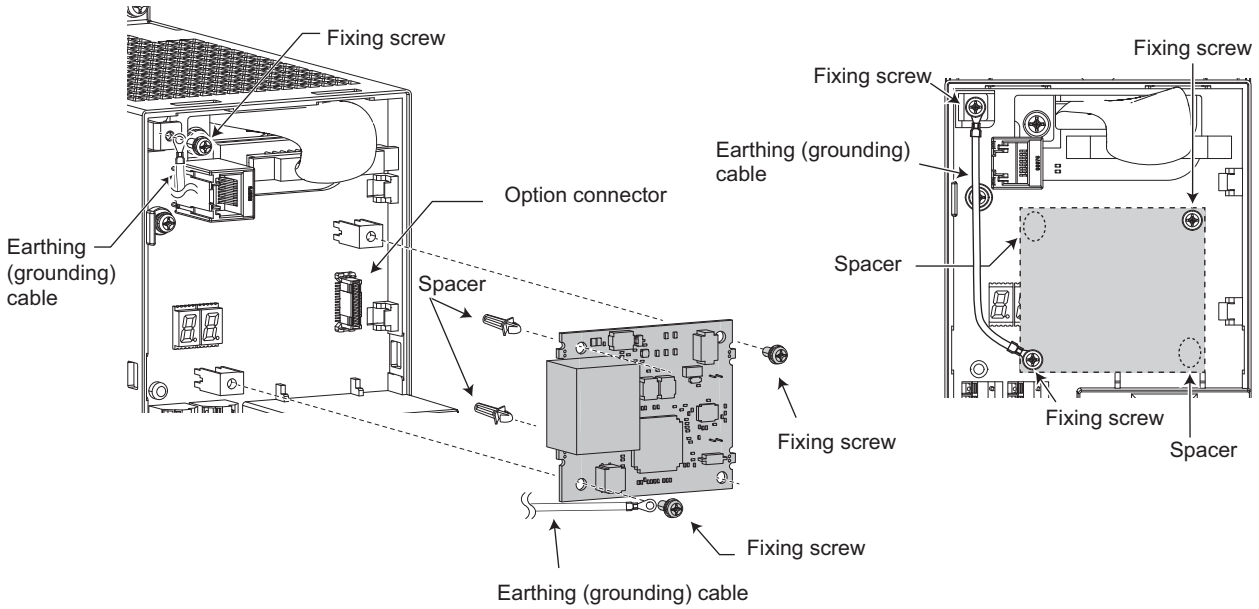
(For the details, refer to page 147.)

CC-Link communication can also be performed when a communication option (FR-A8NC) is installed on the converter.

◆Installation of the FR-A8NC

• To install the FR-A8NC, the enclosed earthing (grounding) cable is required. Follow this procedure to install the FR-A8NC.

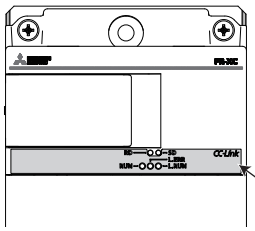
Step	Description
1	Insert spacers into the mounting holes that will not be tightened with the option mounting screws.
2	Fit the connector on the FR-A8NC to the guide of the connector on the converter, and insert it as far as it goes.
3	Secure the one terminal of earthing (grounding) cable to the left top mounting hole on the converter with the mounting screw of the FR-A8NC (tightening torque: 0.33 to 0.40 N·m).
4	Fix the right top side part of the FR-A8NC securely to the converter with the mounting screw of the FR-A8NC. Place another terminal of the earthing (grounding) cable on the left bottom mounting hole in the FR-A8NC, and secure the cable terminal and the FR-A8NC to the converter with the mounting screw of the FR-A8NC (tightening torque: 0.33 to 0.40 N·m). If the screw holes do not line up, the connector may not be inserted deep enough. Check the connector.



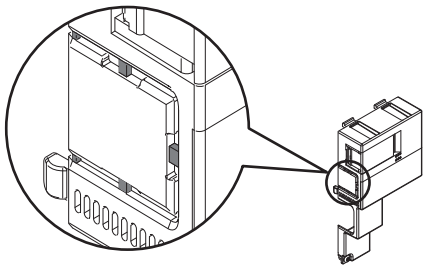
NOTE

• When the FR-A8NC is installed, it is difficult to check the operation status 7-segment LED display on the converter.

• Affix the communication option LED label on the control circuit terminal block cover so that small holes in the label can be aligned with the communication operation status inspection ports on the cover.



- Lead the CC-Link cable to the outside of the converter through the side of the control circuit terminal block cover. Use a nipper or the like to cut the side of the control circuit terminal block cover. Finish the cut surface without leaving rough edges.



2.9 Before powering and starting operation

2.9.1 Installation

Check the following points before powering and starting operation of the converter.

Make sure that the converter is installed in a proper location and manner. (Refer to page 27.)

- Confirmation of wiring

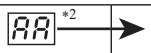
  Make sure that wiring of the main circuit and the control circuit is proper.

  Make sure that the installed option and peripheral devices are appropriate and the wiring of them is proper. (Refer to page 67, page 87, and page 108.)

2.9.2 Powering

When the charge lamp and the operation status 7-segment LED display turn ON properly after powering the converter, the converter is ready.

The operation status LED display shows the following after powering the converter.

LED display indication	 *2 →  *1	
Converter status	During initialization after power-on	Normal (ready for power driving)

*1 An example of the indications of power value.

*2 If the LED indication remains  , the power is supplied only to terminals R1 and S1.
Check that the power is supplied to terminal PN.
If the LED display does not indicate a power value although the power is supplied properly, contact your sales representative.

2.9.3 Operation

Turn ON the start signal of the inverter. The motor starts acceleration until its speed is constant. All this while, the operation status LED display keeps displaying input power value (power driving).

Turn OFF the start signal of the inverter. The motor starts deceleration to a stop. The converter operation status changes according to the amount of regenerative power. During regenerative driving, the regenerative drive indication (a decimal point LED) is ON as shown below.

LED display indication	 *1 Input power value is displayed as a percent. *2	 Input power value *2 Regenerative drive indication
Converter status	During power driving.	During regenerative driving. The regenerative drive indication (a decimal point LED) is ON during operation.

*1 An example of the indications of power value.

*2 A rate of input power compared against the rated capacity is displayed in 10% increments.
For example, the indication "12" displayed in the LED indicator corresponds to 120%.

NOTE

- It is not a fault if noise comes from the dedicated reactor during regenerative driving of the converter (in other words, it is a fault if noise comes despite the stop state of the converter by the Converter stop (SOF) signal).
- If needed, devise methods of reducing noise by modifying the enclosure in which the reactor is installed.

2.10 Digital characters and their corresponding printed equivalents

Digital characters displayed on the 7-segment LED display are as follows.

Printed	Digital
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	

Printed	Digital
A	
B	
C	
D	
E	
F	
G	
H	
I	
J	
K	
L	

Printed	Digital
M	
N	
O	
o	
P	
Q	
S	
T	
U	
V	
W	
R r	
-	

3 COMMON BUS REGENERATION MODE

This chapter explains the common bus regeneration mode of this product.
Always read the instructions before use.

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3.2 Connection of the converter and the inverter 61
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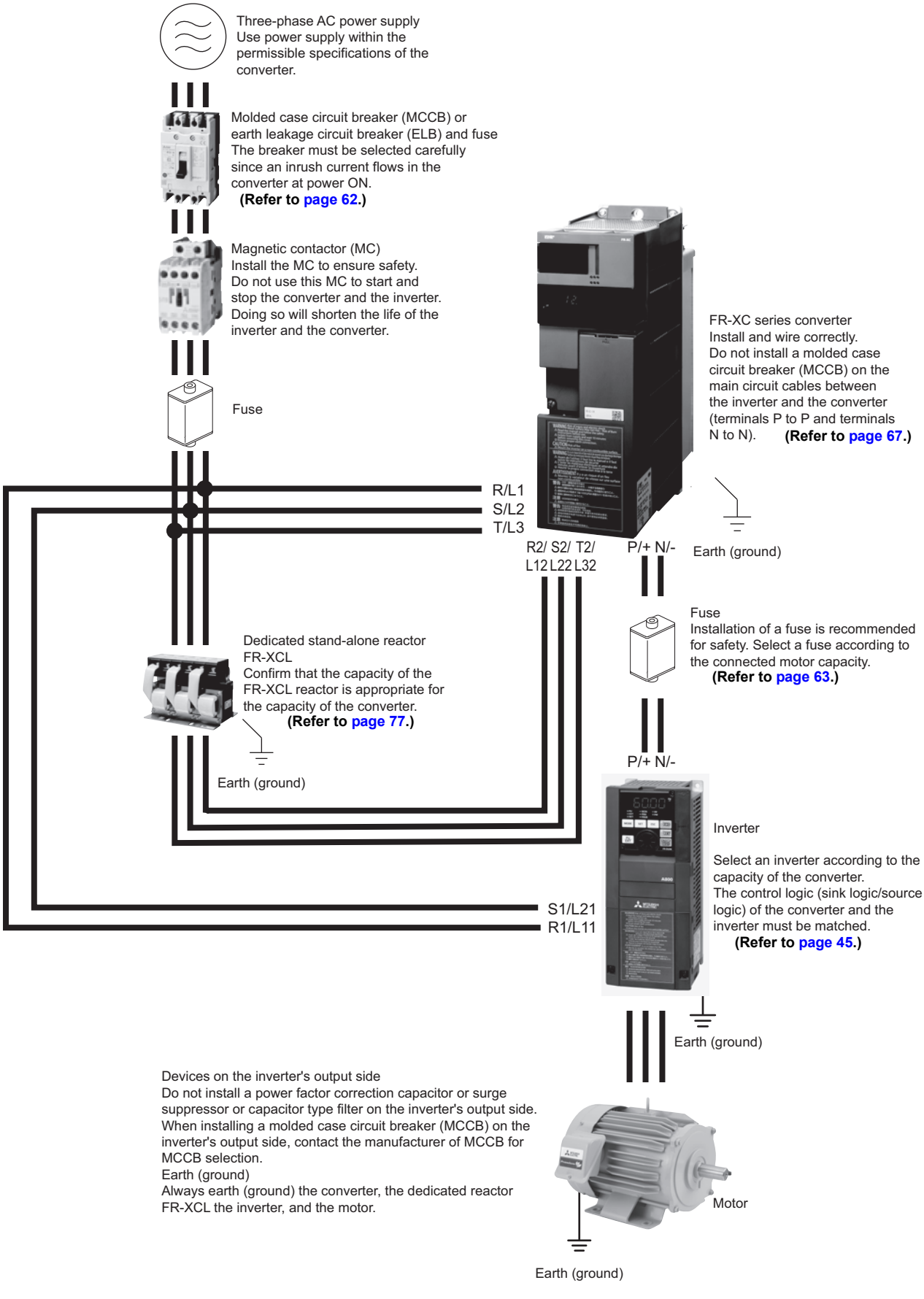
3.5 Wiring 67
3.6 Connection mode selection 71
3.7 Temperature derating selection 71
3.8 Inverter parameter settings 71
3.9 Connection of the converter and the multiple inverters 72
3.10 Rating 75
3.11 Combination matrix of FR-XCL and FR-XC(-PWM) 77

3.1 FR-XC series converter and peripheral devices



3.2 Connection of the converter and the inverter

3.2.1 Operating condition

Observe the following inverter selection conditions.

Item	Condition
Inverter capacity	The total capacity of the connected inverters (regardless of the rating or model of the inverters) must not exceed the applicable inverter capacity (kW) shown in the converter's rated specifications (refer to page 75).
Motor rated current	The total of the rated current of the connected motors (rated current for the selected rating) must not exceed the applicable motor current (A) shown in the converter's rated specifications (refer to page 75).
Number of inverters	The number of inverters actually connected must not exceed the number of connectable inverters shown in the converter's rated specifications (refer to page 75).
Inverter with the HD rating∗1	For the HD rating, 200% of the total rated current of the connected motors must not exceed 150% of the applicable motor current (A) shown in the converter's specifications (refer to page 75).

∗1 For the HD rating of the inverter, refer to the inverter Instruction Manual.

- To use the converter with the inverter, **Pr.30 Regenerative function selection** must be set in the inverter. The parameter setting differs by the inverter series. For the parameters and the inverters not listed in the table, refer to the Instruction Manual of the inverter

Inverter capacity	Pr.30 Regenerative function selection	V/F control	Other than V/F control
		Pr.19 Base frequency voltage	Pr.83 Rated motor voltage
FR-A800, FR-F800	2 or 102	Rated motor voltage	
FR-E800, FR-E700, FR-F700PJ, FR-D700	0 (initial value), 2 (automatic restart after instantaneous power failure is enabled)		

NOTE

- For details of the inverter capacity, refer to the rating specifications in the Instruction Manual of the inverter.

Example: FR-A820

Model FR-A820-[ ]	00046	00077	00105
	0.4K	0.75K	1.5K
SLD	0.75	1.5	2.2

- For the FR-V500 inverter, the capacity used for selection is as follows.

Capacity of the FR-V500 (kW)	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Capacity used for selection (kW)	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	55

- Refer to page 72 and page 75 for the details of the applicable inverter capacity, the applicable inverter current, and the number of connectable inverters.
- The power factor improving AC reactor or DC reactor cannot be used.

3.3 Peripheral device list

◆Circuit breaker and magnetic contactor

Check the model of the purchased multifunction regeneration converter. Appropriate peripheral devices must be selected according to the capacity.

For the converter in common bus regeneration mode, refer to the following table to prepare appropriate peripheral devices.

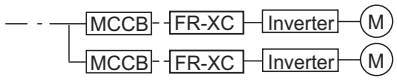
- 200 V class

FR-XC series converter model	Molded case circuit breaker (MCCB)*1/ earth leakage circuit breaker (ELB) (NF, NV type)		Magnetic contactor (MC)*2	
	50°C rating	40°C rating	50°C rating	40°C rating
FR-XC-7.5K	60 A	60 A	S-T35	S-T35
FR-XC-11K	75 A	75 A	S-T35	S-T35
FR-XC-15K	125 A	125 A	S-T50	S-T50
FR-XC-22K FR-XC-18.5K-PWM	175 A	175 A	S-T65	S-T80
FR-XC-30K FR-XC-22K-PWM	225 A	225 A	S-T100	S-T100
FR-XC-37K FR-XC-37K-PWM	250 A	250 A	S-N150	S-N150
FR-XC-55K FR-XC-55K-PWM	400 A	400 A	S-N180	S-N180

- 400 V class

FR-XC series converter model	Molded case circuit breaker (MCCB)*1/ earth leakage circuit breaker (ELB) (NF, NV type)		Magnetic contactor (MC)/ dedicated contactor box (option)*2	
	50°C rating	40°C rating	50°C rating	40°C rating
FR-XC-H7.5K	30 A	30 A	S-T21	S-T21
FR-XC-H11K	50 A	50 A	S-T21	S-T21
FR-XC-H15K	60 A	60 A	S-T35	S-T35
FR-XC-H22K FR-XC-H18.5K-PWM	100 A	100 A	S-T35	S-T35
FR-XC-H30K FR-XC-H22K-PWM	125 A	125 A	S-T50	S-T50
FR-XC-H37K FR-XC-H37K-PWM	150 A	150 A	S-T65	S-T65
FR-XC-H55K FR-XC-H55K-PWM	200 A	200 A	S-T100	S-T100

*1 Select an MCCB according to the power supply capacity.
Install one MCCB per converter.
(For the use in the United States or Canada, refer to page 236.)



*2 The magnetic contactor is selected based on the AC-1 class. The electrical durability of magnetic contactor is 100,000 times. When the magnetic contactor is used for emergency stops during motor driving, the electrical durability is 25 times. (Note that the dedicated contactor box is not intended for emergency stop.)
If using an MC for emergency stop during motor driving or using it on the motor side during commercial power supply operation, select an MC with the class AC-3 rated current for the rated motor current.

◆Fuse

Installation of a fuse between the multifunction regeneration converter and the inverter is recommended.
When using the converter in the common bus regeneration mode, select a fuse according to the capacity of the connected motor. When using a motor whose capacity is smaller than the inverter capacity by two ranks or more, select the fuse with the capacity that is one rank lower than the inverter capacity.

• 200 V class

Motor capacity (kW)	Fuse rating (A)	Model (Part number/Item number) *1	Fuse holder (2 poles)
0.1	5	6.900 CP GR 10.38 0005 (FR10GR69V5)	CUS102 (without fuse light melting indicator) or CUS102I (with fuse light melting indicator)
0.2	10	6.900 CP GR 10.38 0010 (FR10GR69V10)	
0.4	16	6.900 CP GR 10.38 0016 (FR10GR69V16)	
0.75	20	6.900 CP GR 10.38 0020 (FR10GR69V20)	
1.5	25	6.900 CP GR 10.38 0025 (FR10GR69V25)	
2.2	50	6.9 URD 30 TTF 0050	—
3.7	63	6.9 URD 30 TTF 0063	—
5.5	100	6.9 URD 30 TTF 0100	—
7.5	125	6.9 URD 30 TTF 0125	—
11	160	6.9 URD 30 TTF 0160	—
15	200	6.9 URD 30 TTF 0200	—
18.5	250	6.9 URD 30 TTF 0250	—
22	315	6.9 URD 30 TTF 0315	—
30	400	6.9 URD 30 TTF 0400	—
37	500	6.9 URD 30 TTF 0500	—
45	630	6.9 URD 31 TTF 0630	—
55	700	6.9 URD 31 TTF 0700	—

• 400 V class

Motor capacity (kW)	Fuse rating (A)	Model (Part number/Item number) *1	Fuse holder (2 poles)
0.4	12.5	6.900 CP GR 10.38 0012.5 (FR10GR69V12.5)	CUS102 (without fuse light melting indicator) or CUS102I (with fuse light melting indicator)
0.75	16	6.900 CP GR 10.38 0016 (FR10GR69V16)	
1.5	16	6.900 CP GR 10.38 0016 (FR10GR69V16)	
2.2	20	6.900 CP GR 10.38 0020 (FR10GR69V20)	
3.7	30	6.900 CP GR 10.38 0030 (FR10GR69V30)	
5.5	50	6.9 URD 30 TTF 0050	—
7.5	50	6.9 URD 30 TTF 0050	—
11	80	6.9 URD 30 TTF 0080	—
15	125	6.9 URD 30 TTF 0125	—
18.5	125	6.9 URD 30 TTF 0125	—
22	160	6.9 URD 30 TTF 0160	—
30	200	6.9 URD 30 TTF 0200	—
37	250	6.9 URD 30 TTF 0250	—
45	315	6.9 URD 30 TTF 0315	—
55	350	6.9 URD 30 TTF 0350	—

*1 Manufacturer: Mersen Japan KK
Contact: Sun-Wa Technos Corporation

NOTE

• Install fuses across terminals P/+ and P/+, and across terminals N/- and N/- of the multifunction regeneration converter and the inverter.

[Estimated lifespan of fuses]

Components	Estimated lifespan*1	Replacement method
Fuse	10 years	Replace by new one

*1 Estimated lifespan for when the yearly average surrounding air temperature is 50°C. (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)

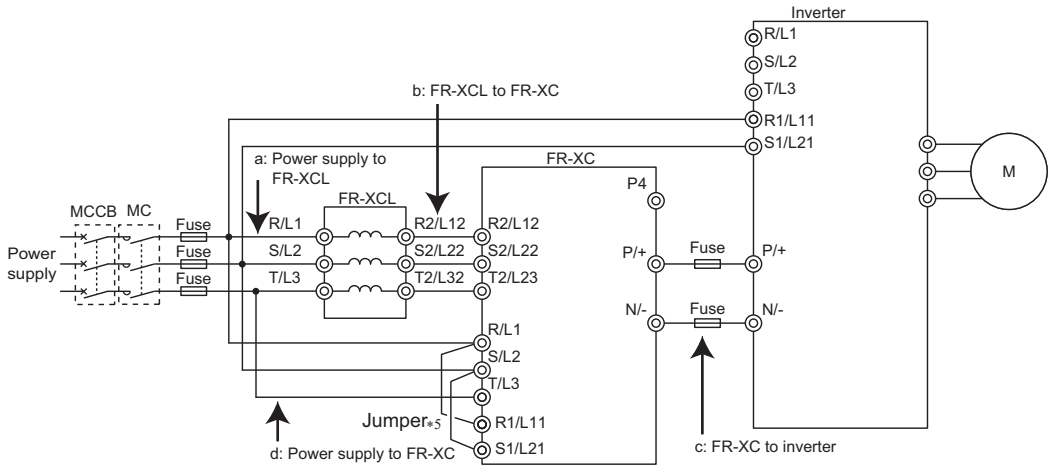
NOTE

• If the fuse melts down, wiring failure such as a short circuit may be the cause. Find out the cause and remove it before replacing the fuse.

3.4 Cable size and crimp terminal size

Select a recommended gauge size cable to ensure that the voltage drop ratio is within 2%.

The following indicates selection examples when the wiring length from the power supply to the converter is 20 m.



• 200 V class

Model	Rating	Crimp terminal (for HIV cables, etc.)				
		R, S, T	R2, S2, T2	P, N	R1, S1	Earth (ground)
FR-XC-7.5K	50°C	1.25-4	8-5	8-6	1.25-4	5.5-4
	40°C		5.5-5			5.5-4
FR-XC-11K	50°C	1.25-4	14-5	14-6	1.25-4	8-5
	40°C					8-5
FR-XC-15K	50°C	1.25-4	22-5	22-6	1.25-4	14-5
	40°C					
FR-XC-22K FR-XC-18.5K-PWM	50°C	1.25-4	38-8	38-6	1.25-4	22-6
	40°C					
FR-XC-30K FR-XC-22K-PWM	50°C	1.25-4	60-8	60-6	1.25-4	22-6
	40°C					
FR-XC-37K FR-XC-37K-PWM	50°C	1.25-4	80-10	80-10	1.25-4	22-8
	40°C					
FR-XC-55K FR-XC-55K-PWM	50°C	1.25-4	100-12	100-12	1.25-4	22-8
	40°C					

Model	Rating	Cable gauge										
		HIV cables, etc. (mm^2) *1				AWG/MCM *2			PVC cables, etc. (mm^2) *3			
		Location in the connection diagram			Earth (ground)	Location in the connection diagram			Location in the connection diagram			Earth (ground)
		a, b	c *4	d		a, b	c	d	a, b	c	d	
FR-XC-7.5K	50°C	8	8	1.25	5.5	8	8	16	10	10	1.5	10
	40°C	5.5										
FR-XC-11K	50°C	14	14	1.25	8	6	6	16	10	16	1.5	16
	40°C											
FR-XC-15K	50°C	22	22	1.25	14	4	4	16	16	25	1.5	16
	40°C											
FR-XC-22K FR-XC-18.5K-PWM	50°C	38	38	1.25	22	2	2	16	25	25	1.5	16
	40°C											
FR-XC-30K FR-XC-22K-PWM	50°C	60	60	1.25	22	1	1/0	16	35	50	1.5	25
	40°C					1/0						
FR-XC-37K FR-XC-37K-PWM	50°C	80	80	1.25	22	2/0	2/0	16	50	70	1.5	35
	40°C						3/0					
FR-XC-55K FR-XC-55K-PWM	50°C	100	100	1.25	38	4/0	4/0	16	95	95	1.5	50
	40°C											

Model	Rating	Crimp terminal (for HIV cables, etc.)
		R, S, T, R2, S2, T2
FR-XCL-7.5K	50°C	8-5
	40°C	5.5-5
FR-XCL-11K	50°C	14-5
	40°C	
FR-XCL-15K	50°C	22-6
	40°C	
FR-XCL-22K	50°C	38-6
	40°C	
FR-XCL-30K	50°C	60-6
	40°C	
FR-XCL-37K	50°C	80-10
	40°C	
FR-XCL-55K	50°C	100-10
	40°C	

∗1 It is the gauge of a cable with the continuous maximum permissible temperature of 75°C (HIV cable (600 V grade heat-resistant PVC insulated wire), etc.). It assumes a surrounding air temperature of 50°C or less (40°C or less for the 40°C rating) and the wiring distance of 20 m or less from the power supply to the converter.

∗2 The cable size is that of the THHW cable with continuous maximum permissible temperature of 75°C. It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
(For the use in the United States or Canada, refer to page 236.)

∗3 For the FR-XC-15K or lower, it is the gauge of a cable with the continuous maximum permissible temperature of 70°C (PVC cable). It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
For the FR-XC-22K / FR-XC-18.5K-PWM or higher, it is the gauge of a cable with the continuous maximum permissible temperature of 90°C (PVC cable). It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
(Selection example mainly for use in Europe.)

∗4 If a cable thinner than the recommended cable size is used, it may not be protected by the DC fuse. (Refer to page 63 for the fuse selection.)

∗5 When using a separate power supply for the control circuit, remove the jumpers connected to terminals R1/L11 and S1/L21.

• 400 V class

Model	Rating	Crimp terminal (for HIV cables, etc.)				
		R, S, T	R2, S2, T2	P, N	R1, S1	Earth (ground)
FR-XC-H7.5K	50°C	1.25-4	3.5-5	3.5-6	1.25-4	3.5-4
	40°C					
FR-XC-H11K	50°C	1.25-4	5.5-5	5.5-6	1.25-4	5.5-5
	40°C					
FR-XC-H15K	50°C	1.25-4	8-5	8-6	1.25-4	5.5-5
	40°C					
FR-XC-H22K FR-XC-H18.5K-PWM	50°C	1.25-4	14-8	22-6	1.25-4	14-6
	40°C					
FR-XC-H30K FR-XC-H22K-PWM	50°C	1.25-4	22-8	22-6	1.25-4	14-6
	40°C					
FR-XC-H37K FR-XC-H37K-PWM	50°C	1.25-4	38-8	38-8	1.25-4	14-8
	40°C					
FR-XC-H55K FR-XC-H55K-PWM	50°C	1.25-4	60-8	60-8	1.25-4	22-8
	40°C					

Model	Rating	Cable gauge										
		HIV cables, etc. (mm^2) ∗1				AWG/MCM ∗2			PVC cables, etc. (mm^2) ∗3			
		Location in the connection diagram			Earth (ground)	Location in the connection diagram			Location in the connection diagram			Earth (ground)
		a, b	c ∗4	d		a, b	c	d	a, b	c	d	
FR-XC-H7.5K	50°C	3.5	3.5	1.25	3.5	12	12	16	4	4	1.5	4
	40°C											
FR-XC-H11K	50°C	5.5	5.5	1.25	5.5	10	10	16	6	6	1.5	6
	40°C											
FR-XC-H15K	50°C	8	8	1.25	5.5	8	8	16	10	10	1.5	10
	40°C											
FR-XC-H22K FR-XC-H18.5K-PWM	50°C	14	22	1.25	14	6	6	16	10	16	1.5	16
	40°C											
FR-XC-H30K FR-XC-H22K-PWM	50°C	22	22	1.25	14	4	4	16	16	25	1.5	16
	40°C								25			
FR-XC-H37K FR-XC-H37K-PWM	50°C	38	38	1.25	14	4	2	16	25	35	1.5	16
	40°C					2			35			
FR-XC-H55K FR-XC-H55K-PWM	50°C	60	60	1.25	22	2	2	16	35	35	1.5	16
	40°C						1			50		25

Cable size and crimp terminal size

Model	Rating	Crimp terminal (for HIV cables, etc.)
		R, S, T, R2, S2, T2
FR-XCL-H7.5K	50°C	3.5-5
	40°C	
FR-XCL-H11K	50°C	5.5-5
	40°C	
FR-XCL-H15K	50°C	8-5
	40°C	
FR-XCL-H22K	50°C	14-6
	40°C	
FR-XCL-H30K	50°C	22-6
	40°C	
FR-XCL-H37K	50°C	38-8
	40°C	
FR-XCL-H55K	50°C	60-8
	40°C	

∗1 It is the gauge of a cable with the continuous maximum permissible temperature of 75°C (HIV cable (600 V grade heat-resistant PVC insulated wire), etc.). It assumes a surrounding air temperature of 50°C or less (40°C or less for the 40°C rating) and the wiring distance of 20 m or less from the power supply to the converter.

∗2 For the FR-XC-H37K or lower, it is the gauge of the cable with the continuous maximum permissible temperature of 75°C (THHW cable). It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
For FR-XC-H55K, the cable gauge is with the continuous maximum permissible temperature of 90°C (THHN cable).
It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
(For the use in the United States or Canada, refer to **page 236**.)

∗3 For the FR-XC-H37K or lower, it is the gauge of the cable with the continuous maximum permissible temperature of 70°C (PVC cable).
For FR-XC-H55K, the cable gauge is with the continuous maximum permissible temperature of 90°C (XLPE cable).
It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
(Selection example mainly for use in Europe.)

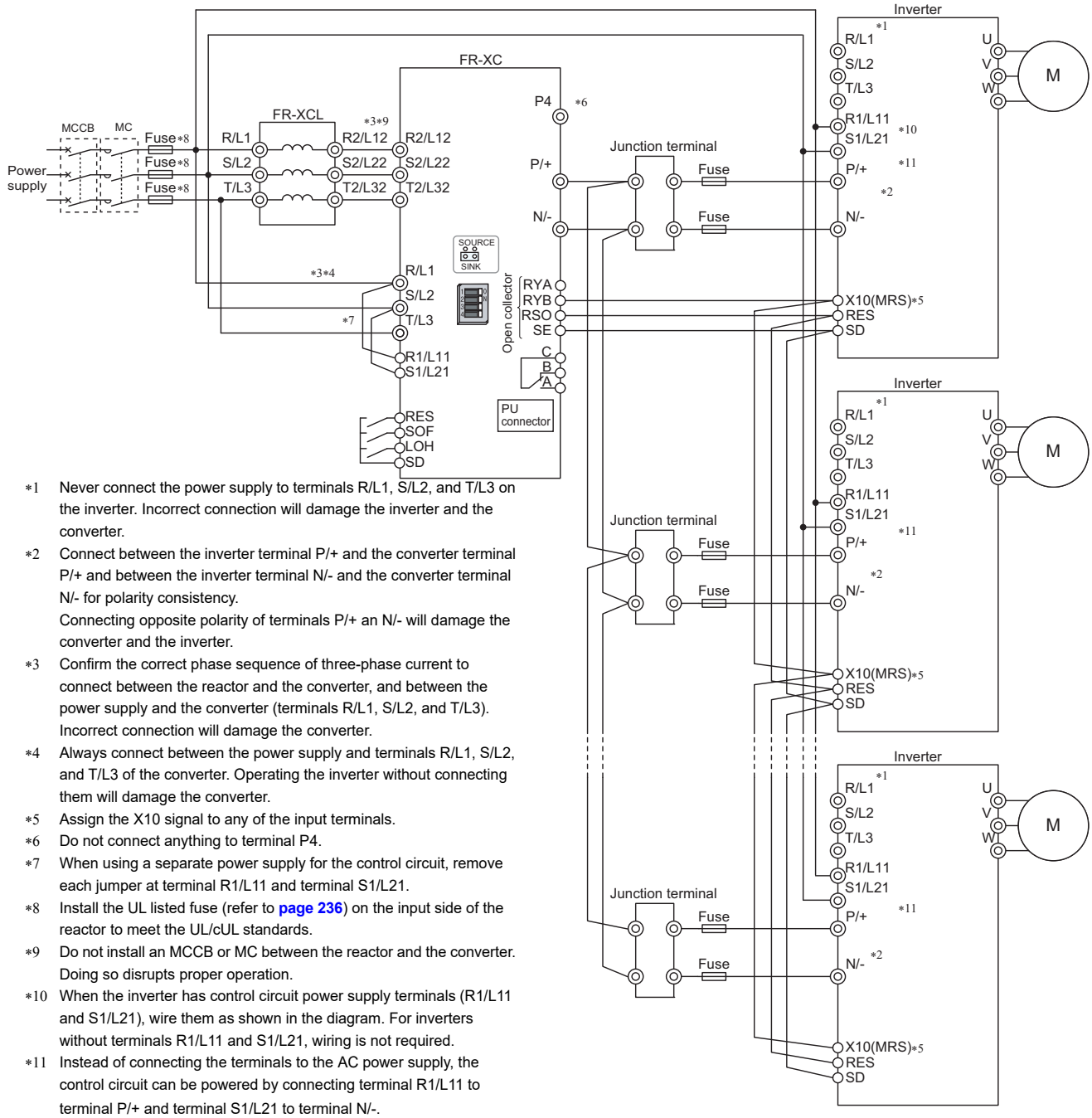
∗4 If a cable thinner than the recommended cable size is used, it may not be protected by the DC fuse. (Refer to **page 63** for the fuse selection.)

∗5 When using a separate power supply for the control circuit, remove the jumpers connected to terminals R1/L11 and S1/L21.

3.5 Wiring

Incorrect wiring will cause a fault indication, failure, or damage of the multifunction regeneration converter.
Refer to the Instruction Manual of each inverter for the wiring of the inverter. Special attention must be paid to the wiring length and cable size.

3.5.1 Terminal connection diagram



*1 Never connect the power supply to terminals R/L1, S/L2, and T/L3 on the inverter. Incorrect connection will damage the inverter and the converter.

*2 Connect between the inverter terminal P/+ and the converter terminal P/+ and between the inverter terminal N/- and the converter terminal N/- for polarity consistency.
Connecting opposite polarity of terminals P/+ an N/- will damage the converter and the inverter.

*3 Confirm the correct phase sequence of three-phase current to connect between the reactor and the converter, and between the power supply and the converter (terminals R/L1, S/L2, and T/L3). Incorrect connection will damage the converter.

*4 Always connect between the power supply and terminals R/L1, S/L2, and T/L3 of the converter. Operating the inverter without connecting them will damage the converter.

*5 Assign the X10 signal to any of the input terminals.

*6 Do not connect anything to terminal P4.

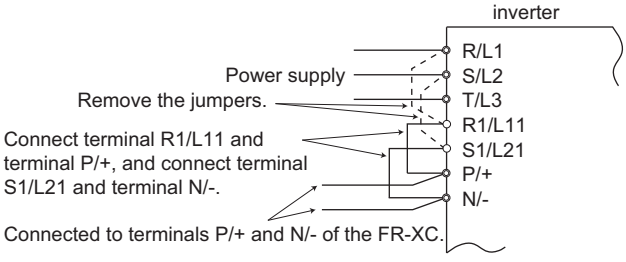
*7 When using a separate power supply for the control circuit, remove each jumper at terminal R1/L11 and terminal S1/L21.

*8 Install the UL listed fuse (refer to page 236) on the input side of the reactor to meet the UL/cUL standards.

*9 Do not install an MCCB or MC between the reactor and the converter. Doing so disrupts proper operation.

*10 When the inverter has control circuit power supply terminals (R1/L11 and S1/L21), wire them as shown in the diagram. For inverters without terminals R1/L11 and S1/L21, wiring is not required.

*11 Instead of connecting the terminals to the AC power supply, the control circuit can be powered by connecting terminal R1/L11 to terminal P/+ and terminal S1/L21 to terminal N/-.



⚠CAUTION

- In the common bus regeneration mode, always connect between the converter terminal RYB and the inverter terminal to which the X10 (MRS) signal is assigned, and also connect between the converter terminal SE and the inverter terminal SD. If the terminals are not connected, the converter may be damaged.

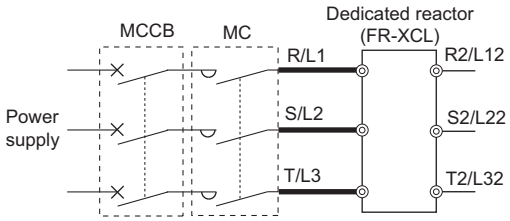
NOTE

- Do not connect a DC reactor to the inverter when using the converter in the common bus regeneration mode.
- Configure a system so that the magnetic contactor at the converter input side shuts off the power supply at a failure of the converter or the connected inverter. (The converter does not shut off the power supply by itself.) Failure to do so may overheat and burn the resistors in the converter and the connected inverter.
- Do not connect an external brake resistor such as the FR-ABR when using the converter.

3.5.2 Wiring

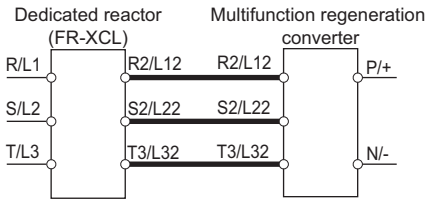
◆Wiring the power supply to the reactor

- Cable gauge differs by the capacity. Select an appropriate cable by referring to page 64 to perform wiring.



◆Wiring the reactor to the converter

- Cable gauge differs by the capacity. Select an appropriate cable by referring to page 64 to perform wiring.



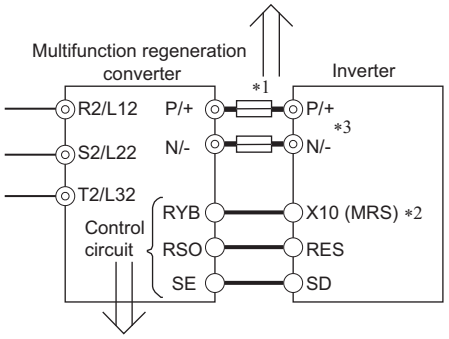
Total wiring length	10 m or shorter

◆Wiring the converter to the inverter

- Connect the wiring for the control circuit correctly so that the commands sent from the converter are transmitted to the inverter without fail.

  For the cable gauge of the cable for the main circuit terminals P/+ and N/- (P to P and N to N), refer to page 64.

Main circuit wiring length	5 m or shorter



Control circuit cable gauge	0.3 to 1.25 mm^2
Control circuit wiring length	30 m or shorter

*1 Installation of a fuse on each cable is recommended to prevent the damage from spreading in case of an inverter failure. Select the fuse according to the motor capacity. To use a motor whose capacity is smaller than the inverter capacity by two ranks or more, select the fuse with the capacity that is one rank lower than the inverter capacity. Refer to the fuse selection table on page 63.
For connection of multiple inverters, use the same gauge cable as the inverter's power cable for wiring between the inverter main circuit terminal (P/+ or N/-) and a junction terminal. (Refer to the Instruction Manual of the inverter.)

*2 The function needs to be assigned to an inverter terminal to be connected to the converter terminal RYB.
Refer to the Instruction Manual of the Inverter.

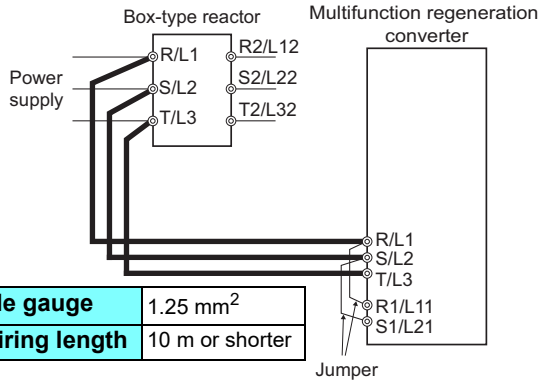
*3 Do not install any MCCB between the inverter and the converter (P to P and N to N).
For the gauge of the cable used for connection of multiple inverters, refer to page 72.

NOTE

- Terminals P/+ and N/- are used for connection with the inverter. Do not connect anything to power input terminals (R/L1, S/L2, and T/L3) of the inverter. Incorrect power input connection will damage the inverter. Connecting opposite polarity of terminals P/+ and N/- will damage the inverter and the converter.
- Do not connect a DC reactor to the inverter when using the converter in the common bus regeneration mode.

◆Wiring the power supply to the converter

Supply power to the power detecting terminals (R/L1, S/L2, and T/L3) separately from the main circuit wiring.



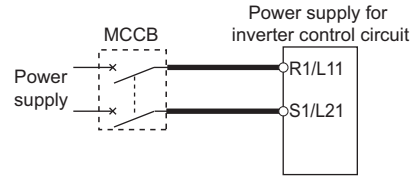
Cable gauge	1.25 mm^2
Total wiring length	10 m or shorter

NOTE

- The terminals R/L1, S/L2, and T/L3 on the converter are control terminals to detect power phases of the power supply. For wiring, the voltage phase must be consistent between terminals R2/L12, S2/L22, and T2/L32 and terminals R/L1, S/L2, and T/L3. If these terminals are not connected correctly, the converter does not operate properly.
- If the inverter is operated while the converter terminals R/L1, S/L2, and T/L3 are not connected to the power supply, the converter will be damaged.

◆Wiring of the power supply and the inverter (equipped with terminals R1/L11 and S1/L21)

For the power input to the control circuit in the inverter which has the control circuit power supply terminals (R1/L11 and S1/L21), bypass the converter and perform the direct wiring between the inverter (these terminals) and the power supply.



Cable gauge	0.75 to 2 mm^2

NOTE

- Remove jumpers across main circuit terminals R/L1 and R1/L11 and across S/L2 and S1/L21 on the inverter (refer to the Instruction Manual of the inverter).
- Always connect the power supply to terminals R1/L11 and S1/L21 of the inverter directly to supply power to the control circuit. If they are not connected, the inverter may shut off its output by a fault occurrence or be damaged.

3.6 Connection mode selection

Use the function selection switch assembly (SW2) and **Pr.416 Control method selection** to select the connection mode.

- Select the common bus regeneration mode / harmonic suppression mode by setting the position of switch 1 (connection mode setting switch) in the function selection switch assembly (SW2).

Switch		Function
1	2	
ON	ON or OFF*1	Common bus regeneration mode/ harmonic suppression mode
OFF	ON	Not used.
	OFF	Power regeneration mode 2 (Refer to page 99.)

*1 The common bus regeneration mode / harmonic suppression mode is enabled regardless of the position of switch 2.

- Select the function status by setting **Pr.416**. For the FR-XC-[]K-PWM, set **Pr.416** = "0" to select the common bus regeneration mode.

Pr.416 setting	Function
0	Common bus regeneration mode
1	Harmonic suppression mode (Refer to page 79.)
9999 (initial value)	FR-XC-[ ]K: Common bus regeneration mode FR-XC-[ ]K-PWM: Harmonic suppression mode Check the model of the multifunction regeneration converter described on the rating plate (refer to page 12).

NOTE

- The new setting of the switch is applied at the next power-ON or converter reset.
- If the connection mode setting does not match the actual wiring of the main circuit terminals, the connection mode fault "E.T" occurs.
- The change of the **Pr.416** setting is applied at the next power-ON or converter reset.

3.7 Temperature derating selection

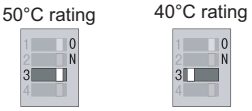
The temperature rating changes according to the setting position of the switch 3 in the function selection switch assembly (SW2).

When the 40°C rating is selected, the rated current and the applied current can be increased.

When the 40°C rating is selected, the surrounding air temperature must be between -10 and +40°C (non-freezing).

NOTE

- The new setting of the switch is applied at the next power-ON or converter reset.



3.8 Inverter parameter settings

To use the converter with the inverter, **Pr.30 Regenerative function selection** in the inverter parameters must be set. The parameter setting differ by the inverter series.

Refer to the Instruction Manual of the Inverter.

- To use the converter in the common bus regeneration mode, select the setting for a multifunction regeneration converter, high power factor converter, or power regeneration common converter. (Example: **Pr.30** in the FR-A800 = "2 or 102").

NOTE

- Set **Pr.30** in the inverter used with the converter. Incorrect setting may disrupt normal operation.

3.9 Connection of the converter and the multiple inverters

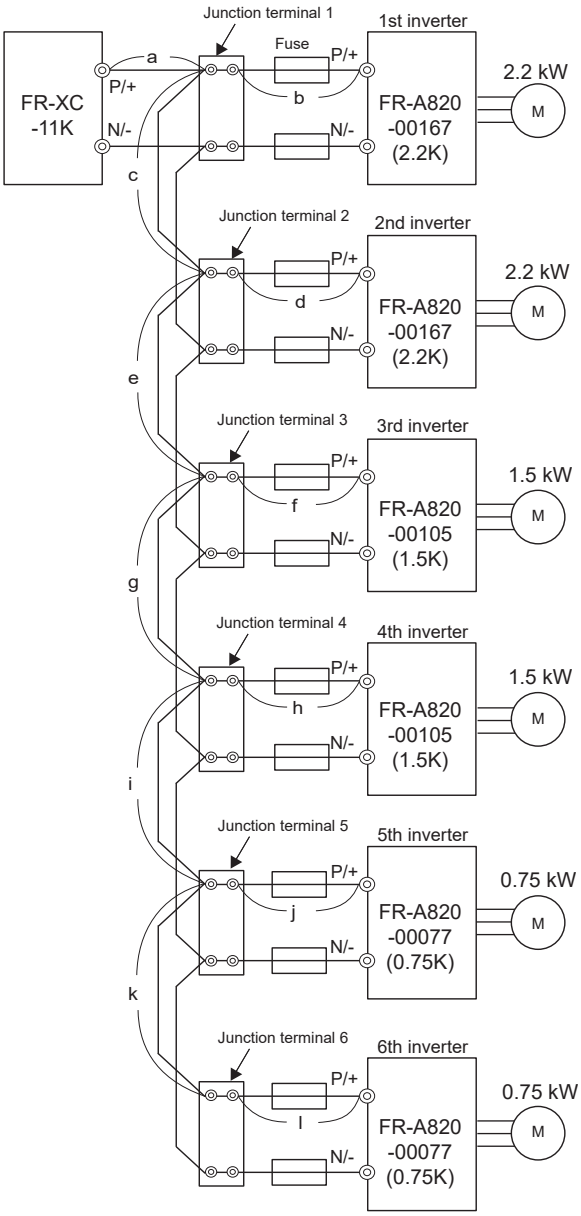
When the multifunction regeneration converter is used in common bus regeneration mode, multiple inverters can be connected to the converter. (The allowable number of inverters to be connected and their total capacity differs depending on the converter capacity. Refer to **page 75**.) Select the converter so that the total capacity of the connected inverters must not exceed the applicable inverter capacity.

- For the multiple inverter connection, place the higher capacity inverter in the lower number axis.
- Junction terminals and cross wiring may be required for the wiring of the multiple inverters. For the gauge of cable used between the two junction terminals, refer to the descriptions in the following figure. Total capacity of higher-number axis inverters must be considered for the cable selection.
- It is recommended to install a fuse on each inverter power cable used between the inverter and the junction terminal, as shown in the following figure. Select a fuse according to the motor capacity. (Refer to **page 63**.)
  When using a motor whose capacity is smaller than the inverter capacity by two ranks or more, select the fuse with the capacity that is one rank lower than the inverter capacity.
- The total wiring length between terminals P/+ or terminals N/- on the converter and connected inverters should not exceed 5 m.

◆Wiring examples

In the following examples, six inverters (two FR-A820-00167(2.2K) inverters, two FR-A820-00105(1.5K) inverters, and two FR-A820-00077(0.75K) inverters) are connected to the FR-XC-11K converter.

- Main circuit wiring example



1st inverter

a: The gauge of cable between the FR-XC and the junction terminal 1 is 14 mm^2 because the FR-XC capacity is 11 kW.

b: The gauge of cable between the junction terminal 1 and the 1st axis inverter is 2 mm^2 because the inverter capacity is 2.2 kW.

2nd inverter

c: The gauge of cable between the junction terminal 1 and the junction terminal 2 is 14 mm^2 because the total capacity of lower axis inverters is regarded as 7.5 kW (an approximate inverter capacity of "6.7 kW" determined by the expression: 2.2 + 1.5 + 1.5 + 0.75 + 0.75).

d: The gauge of cable between the junction terminal 2 and the 2nd axis inverter is 2 mm^2 because the inverter capacity is 2.2 kW.

3rd inverter

e: The gauge of cable between the junction terminal 2 and the junction terminal 3 is 5.5 mm^2 because the total capacity of lower axis inverters is regarded as 5.5 kW (an approximate inverter capacity of "4.5 kW" determined by the expression: 1.5 + 1.5 + 0.75 + 0.75).

f: The gauge of cable between the junction terminal 3 and the 3rd axis inverter is 2 mm^2 because the inverter capacity is 1.5 kW.

4th inverter

g: The gauge of cable between the junction terminal 3 and the junction terminal 4 is 3.5 mm^2 because the total capacity of lower axis inverters is regarded as 3.7 kW (an approximate inverter capacity of "3.0 kW" determined by the expression: 1.5 + 0.75 + 0.75).

h: The gauge of cable between the junction terminal 4 and the 4th axis inverter is 2 mm^2 because the inverter capacity is 1.5 kW.

5th inverter

i: The gauge of cable between the junction terminal 4 and the junction terminal 5 is 2 mm^2 because the total capacity of lower axis inverters is 1.5 kW determined by the expression: 0.75 + 0.75.

j: The gauge of cable between the junction terminal 5 and the 5th axis inverter is 2 mm^2 because the inverter capacity is 0.75K.

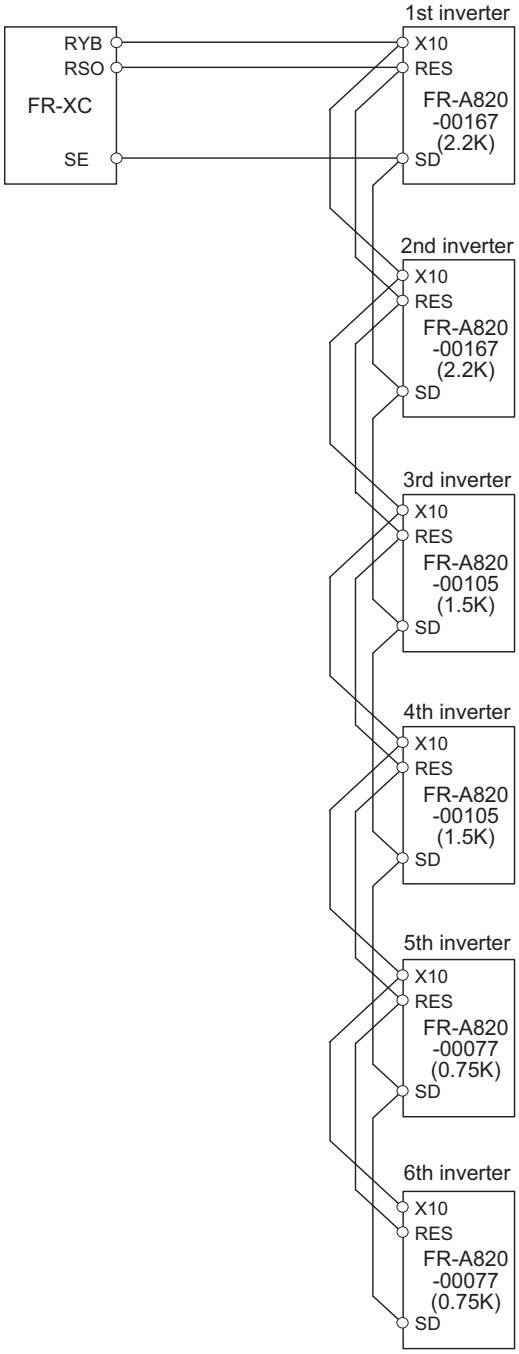
6th inverter

k: The gauge of cable between the junction terminal 5 and the junction terminal 6 is 2 mm^2 because the inverter capacity is 0.75K.

l: The gauge of cable between the junction terminal 6 and the 6th axis inverter is 2 mm^2 because the inverter capacity is 0.75K.

Connection of the converter and the multiple inverters

• Control circuit wiring example



• For the control circuit wiring, use shielded or twisted wires, and separate the wire from the main circuit and high-voltage circuits.
• The total wiring length should be 30 m or shorter.

3.10 Rating

3.10.1 FR-XC-[ ]K

200 V class

Model FR-XC-[ ]K*1			7.5	11	15	22	30	37	55
50°C rating	Applicable inverter capacity (kW)		7.5	11	15	22	30	37	55
	Applicable motor current (A)		33	46	61	90	115	145	215
	Rated input current (A)	Power driving	33	47	63	92	124	151	223
		Regenerative driving	26	37	51	74	102	125	186
	Continuous rating / overload current rating		100% continuous / 150% 60 s						
	Power supply capacity (kVA)*2		17	20	28	41	52	66	100
40°C rating	Applicable inverter capacity (kW)		7.5	11	15	22	30	37	55
	Applicable motor current (A)		36	50	67	99	127	160	236
	Rated input current (A)	Power driving	36	51	69	101	136	166	245
		Regenerative driving	28	40	56	81	112	138	204
	Continuous rating / overload current rating		100% continuous / 150% 60 s						
	Power supply capacity (kVA)*2		19	22	31	45	57	73	110
Power source	Rated input AC voltage/frequency		Three-phase 200 to 240 V, 50/60 Hz*7						
	Permissible AC voltage fluctuation		Three-phase 170 to 264 V, 50/60 Hz						
	Permissible frequency fluctuation		±5%						
Protection rating of structure (IEC 60529)			IP00*4						
Cooling system			Forced air						
Number of connectable inverters			10*5						
Approx. mass (kg)*6			5	5	6	10.5	10.5	28	38

400 V class

Model FR-XC-H[ ]K*1			7.5	11	15	22	30	37	55
50°C rating	Applicable inverter capacity (kW)		7.5	11	15	22	30	37	55
	Applicable motor current (A)		17	23	31	44	57	71	110
	Rated input current (A)	Power driving	18	25	34	49	65	80	118
		Regenerative driving	14	20	27	39	54	66	98
	Continuous rating / overload current rating		100% continuous / 150% 60 s						
	Power supply capacity (kVA)*3		17	20	28	41	52	66	100
40°C rating	Applicable inverter capacity (kW)		7.5	11	15	22	30	37	55
	Applicable motor current (A)		18	25	34	48	63	78	120
	Rated input current (A)	Power driving	20	27	37	53	72	88	129
		Regenerative driving	15	21	29	42	59	72	107
	Continuous rating / overload current rating		100% continuous / 150% 60 s						
	Power supply capacity (kVA)*3		19	22	30	44	58	73	110
Power source	Rated input AC voltage/frequency		Three-phase 380 to 500 V, 50/60 Hz*7						
	Permissible AC voltage fluctuation		Three-phase 323 to 550 V, 50/60 Hz						
	Permissible frequency fluctuation		±5%						
Protection rating of structure (IEC 60529)			IP00*4						
Cooling system			Forced air						
Number of connectable inverters			10*5						
Approx. mass (kg)*6			5	5	6	10.5	10.5	28	28

*1 The common bus regeneration mode is selected initially.
*2 Selection example for 220 V power supply voltage.
*3 Selection example for 440 V power supply voltage.
*4 IP00 for the FR-XCL.
*5 If you want to connect 11 or more inverters, contact your sales representative.
*6 Mass of the FR-XC alone.
*7 The permissible voltage imbalance ratio is 3% or less. (Unbalance factor = Max | Line voltage - Mean of three line voltages | / Mean of three line voltages × 100)

3.10.2 FR-XC-[ ]K-PWM

200 V class

Model FR-XC-[ ]K-PWM*1			18.5	22	37	55
50°C rating	Applicable inverter capacity (kW)		22	30	37	55
	Applicable motor current (A)		90	115	145	215
	Rated input current (A)	Power driving	92	124	151	223
		Regenerative driving	74	102	125	186
	Continuous rating / overload current rating		100% continuous / 150% 60 s			
	Power supply capacity (kVA)*2		41	52	66	100
40°C rating	Applicable inverter capacity (kW)		22	30	37	55
	Applicable motor current (A)		99	127	160	236
	Rated input current (A)	Power driving	101	136	166	245
		Regenerative driving	81	112	138	204
	Continuous rating / overload current rating		100% continuous / 150% 60 s			
	Power supply capacity (kVA)*2		45	57	73	110
Power source	Rated input AC voltage/frequency		Three-phase 200 to 240 V, 50/60 Hz*7			
	Permissible AC voltage fluctuation		Three-phase 170 to 264 V, 50/60 Hz			
	Permissible frequency fluctuation		±5%			
Protection rating of structure (IEC 60529)			IP00*4			
Cooling system			Forced air			
Number of connectable inverters			10*5			
Approx. mass (kg)*6			10.5	10.5	28	38

400 V class

Model FR-XC-H[ ]K-PWM*1			18.5	22	37	55
50°C rating	Applicable inverter capacity (kW)		22	30	37	55
	Applicable motor current (A)		44	57	71	110
	Rated input current (A)	Power driving	49	65	80	118
		Regenerative driving	39	54	66	98
	Continuous rating / overload current rating		100% continuous / 150% 60 s			
	Power supply capacity (kVA)*3		41	52	66	100
40°C rating	Applicable inverter capacity (kW)		22	30	37	55
	Applicable motor current (A)		48	63	78	120
	Rated input current (A)	Power driving	53	72	88	129
		Regenerative driving	42	59	72	107
	Continuous rating / overload current rating		100% continuous / 150% 60 s			
	Power supply capacity (kVA)*3		44	58	73	110
Power source	Rated input AC voltage/frequency		Three-phase 380 to 500 V, 50/60 Hz*7			
	Permissible AC voltage fluctuation		Three-phase 323 to 550 V, 50/60 Hz			
	Permissible frequency fluctuation		±5%			
Protection rating of structure (IEC 60529)			IP00*4			
Cooling system			Forced air			
Number of connectable inverters			10*5			
Approx. mass (kg)*6			10.5	10.5	28	28

*1 The harmonic suppression mode is selected initially. Set **Pr.416** = "0" to select the common bus regeneration mode. (Refer to page 71.)
*2 Selection example for 220 V power supply voltage.
*3 Selection example for 440 V power supply voltage.
*4 IP20 for the FR-XCB.
*5 If you want to connect 11 or more inverters, contact your sales representative.
*6 Mass of the FR-XC alone.
*7 The permissible voltage imbalance ratio is 3% or less. (Unbalance factor = Max | Line voltage - Mean of three line voltages | / Mean of three line voltages × 100)

3.11 Combination matrix of FR-XCL and FR-XC(-PWM)

• 200 V class

Multifunction regeneration converter		Dedicated stand-alone reactor
Model	Rated surrounding temperature	FR-XCL-[ ]K
FR-XC-7.5K	50°C/40°C rating	7.5K
FR-XC-11K		11K
FR-XC-15K		15K
FR-XC-18.5K-PWM		22K
FR-XC-22K		
FR-XC-22K-PWM		30K
FR-XC-30K		
FR-XC-37K FR-XC-37K-PWM		37K
FR-XC-55K FR-XC-55K-PWM		55K

• 400 V class

Multifunction regeneration converter		Dedicated stand-alone reactor
Model	Rated surrounding temperature	FR-XCL-H[ ]K
FR-XC-H7.5K	50°C/40°C rating	H7.5K
FR-XC-H11K		H11K
FR-XC-H15K		H15K
FR-XC-H18.5K-PWM		H22K
FR-XC-H22K		
FR-XC-H22K-PWM		H30K
FR-XC-H30K		
FR-XC-H37K FR-XC-H37K-PWM		H37K
FR-XC-H55K FR-XC-H55K-PWM		H55K

MEMO

4 HARMONIC SUPPRESSION MODE

This chapter explains the harmonic suppression mode of this product.
Always read the instructions before use.

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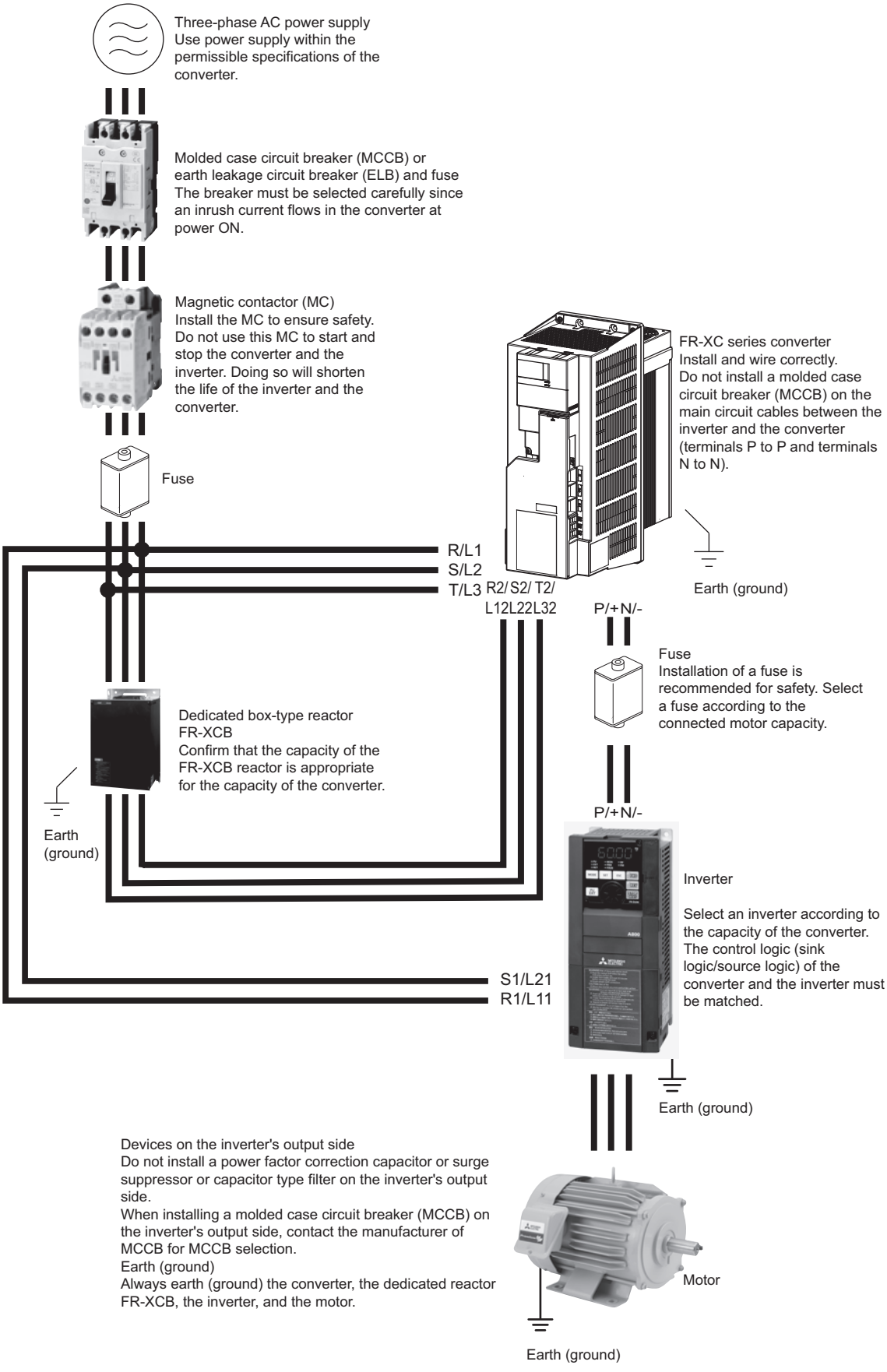
4.1 FR-XC series converter and peripheral devices



4.2 Connection of the converter and the inverter

4.2.1 Operating condition

Observe the following inverter selection conditions.

Item	Condition
Inverter capacity	The total capacity of the connected inverters (regardless of the rating or model of the inverters) must not exceed the applicable inverter capacity (kW) shown in the converter's rated specifications (refer to **page 95**).
Motor rated current	The total of the rated current of the connected motors (rated current for the selected rating) must not exceed the applicable motor current (A) shown in the converter's rated specifications (refer to **page 95**).
Number of inverters	The number of inverters actually connected must not exceed the number of connectable inverters shown in the converter's rated specifications (refer to **page 95**).
Inverter with the HD rating∗1	For the HD rating, 200% of the total rated current of the connected motors must not exceed 150% of the applicable motor current (A) shown in the converter's specifications (refer to **page 95**).

∗1 For the HD rating of the inverter, refer to the inverter Instruction Manual.

To use the converter with the inverter, **Pr.30 Regenerative function selection** must be set in the inverter. The parameter setting differs by the inverter series. For the parameters and the inverters not listed in the table, refer to the Instruction Manual of the inverter

Inverter capacity	Pr.30 Regenerative function selection	V/F control	Other than V/F control
		Pr.19 Base frequency voltage	Pr.83 Rated motor voltage
FR-A800, FR-F800	2 or 102	Rated motor voltage	
FR-E800, FR-E700, FR-F700PJ, FR-D700	0 (initial value), 2 (automatic restart after instantaneous power failure is enabled)		

NOTE

- For details of the inverter capacity, refer to the rating specifications in the Instruction Manual of the inverter.

Example: FR-A820

Model FR-A820-[ ]	00046	00077	00105
	0.4K	0.75K	1.5K
SLD	0.75	1.5	2.2

- For the FR-V500 inverter, the capacity used for selection is as follows.

Capacity of the FR-V500 (kW)	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Capacity used for selection (kW)	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	55

- Refer to **page 92** and **page 95** for the details of the applicable inverter capacity, the applicable inverter current, and the number of connectable inverters.
- The power factor improving AC reactor or DC reactor cannot be used.

◆Precautions for selection (load factor condition)

When the load is light for the rated current of the FR-XC in harmonic suppression mode, a fundamental wave current is reduced and harmonic contents increase. Make sure that the load is approximately 50% or higher. The following table shows the applicable combinations for connection of one motor. (Other combinations are not applicable.)

○: Applicable.

-: Usable as a common converter or regenerative converter, but the harmonic suppression effect decreases.

×: Not applicable.

200 V class

Model	Rating	Motor capacity								
		7.5K or lower	11K	15K	18.5K	22K	30K	37K	45K	55K
FR-XC-18.5K-PWM	50°C/40°C rating	-	○	○	○	○	×	×	×	×
FR-XC-22K		-	○	○	○	○	×	×	×	×
FR-XC-22K-PWM		-	-	○	○	○	○	×	×	×
FR-XC-30K		-	-	○	○	○	○	×	×	×
FR-XC-37K		-	-	-	○	○	○	○	×	×
FR-XC-37K-PWM		-	-	-	○	○	○	○	×	×
FR-XC-55K		-	-	-	-	-	○	○	○	○
FR-XC-55K-PWM		-	-	-	-	-	○	○	○	○

400 V class

Model	Rating	Motor capacity								
		7.5K or lower	11K	15K	18.5K	22K	30K	37K	45K	55K
FR-XC-H18.5K-PWM	50°C/40°C rating	-	○	○	○	○	×	×	×	×
FR-XC-H22K		-	○	○	○	○	×	×	×	×
FR-XC-H22K-PWM		-	-	○	○	○	○	×	×	×
FR-XC-H30K		-	-	○	○	○	○	×	×	×
FR-XC-H37K		-	-	-	○	○	○	○	×	×
FR-XC-H37K-PWM		-	-	-	○	○	○	○	×	×
FR-XC-H55K		-	-	-	-	-	○	○	○	○
FR-XC-H55K-PWM		-	-	-	-	-	○	○	○	○

4.3 Peripheral device list

◆Circuit breaker and magnetic contactor

Check the model of the purchased multifunction regeneration converter. Appropriate peripheral devices must be selected according to the capacity.

Refer to the following tables to prepare appropriate peripheral devices.

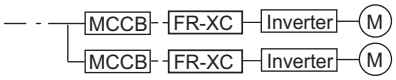
- 200 V class

FR-XC series converter model	Molded case circuit breaker (MCCB)*1/ earth leakage circuit breaker (ELB) (NF, NV type)		Magnetic contactor (MC)*2	
	50°C rating	40°C rating	50°C rating	40°C rating
FR-XC-22K FR-XC-18.5K-PWM	125 A	125 A	S-T50	S-T50
FR-XC-30K FR-XC-22K-PWM	125 A	125 A	S-T65	S-T65
FR-XC-37K FR-XC-37K-PWM	200 A	200 A	S-T100	S-N150
FR-XC-55K FR-XC-55K-PWM	300 A	300 A	S-N180	S-N180

- 400 V class

FR-XC series converter model	Molded case circuit breaker (MCCB)*1/ earth leakage circuit breaker (ELB) (NF, NV type)		Magnetic contactor (MC)/ dedicated contactor box (option)*2	
	50°C rating	40°C rating	50°C rating	40°C rating
FR-XC-H22K FR-XC-H18.5K-PWM	60 A	60 A	S-T35	S-T35
FR-XC-H30K FR-XC-H22K-PWM	75 A	75 A	S-T35	S-T35
FR-XC-H37K FR-XC-H37K-PWM	100 A	100 A	S-T50	S-T65
FR-XC-H55K FR-XC-H55K-PWM	150 A	150 A	S-T80	S-T80

*1 Select an MCCB according to the power supply capacity.
Install one MCCB per converter.
(For the use in the United States or Canada, refer to page 236.)



*2 The magnetic contactor is selected based on the AC-1 class. The electrical durability of magnetic contactor is 100,000 times. When the magnetic contactor is used for emergency stops during motor driving, the electrical durability is 25 times. (Note that the dedicated contactor box is not intended for emergency stop.)
If using an MC for emergency stop during motor driving or using it on the motor side during commercial power supply operation, select an MC with the class AC-3 rated current for the rated motor current.

◆Fuse

Installation of a fuse between the multifunction regeneration converter and the inverter is recommended.
When using the converter in the common bus regeneration mode, select a fuse according to the capacity of the connected motor. When using a motor whose capacity is smaller than the inverter capacity by two ranks or more, select the fuse with the capacity that is one rank lower than the inverter capacity.

• 200 V class

Motor capacity (kW)	Fuse rating (A)	Model (Part number/Item number) *1	Fuse holder (2 poles)
0.1	5	6.900 CP GR 10.38 0005 (FR10GR69V5)	CUS102 (without fuse light melting indicator) or CUS102I (with fuse light melting indicator)
0.2	10	6.900 CP GR 10.38 0010 (FR10GR69V10)	
0.4	16	6.900 CP GR 10.38 0016 (FR10GR69V16)	
0.75	20	6.900 CP GR 10.38 0020 (FR10GR69V20)	
1.5	25	6.900 CP GR 10.38 0025 (FR10GR69V25)	
2.2	50	6.9 URD 30 TTF 0050	—
3.7	63	6.9 URD 30 TTF 0063	—
5.5	100	6.9 URD 30 TTF 0100	—
7.5	125	6.9 URD 30 TTF 0125	—
11	160	6.9 URD 30 TTF 0160	—
15	200	6.9 URD 30 TTF 0200	—
18.5	250	6.9 URD 30 TTF 0250	—
22	315	6.9 URD 30 TTF 0315	—
30	400	6.9 URD 30 TTF 0400	—
37	500	6.9 URD 30 TTF 0500	—
45	630	6.9 URD 31 TTF 0630	—
55	700	6.9 URD 31 TTF 0700	—

• 400 V class

Motor capacity (kW)	Fuse rating (A)	Model (Part number/Item number) *1	Fuse holder (2 poles)
0.4	12.5	6.900 CP GR 10.38 0012.5 (FR10GR69V12.5)	CUS102 (without fuse light melting indicator) or CUS102I (with fuse light melting indicator)
0.75	16	6.900 CP GR 10.38 0016 (FR10GR69V16)	
1.5	16	6.900 CP GR 10.38 0016 (FR10GR69V16)	
2.2	20	6.900 CP GR 10.38 0020 (FR10GR69V20)	
3.7	30	6.900 CP GR 10.38 0030 (FR10GR69V30)	
5.5	50	6.9 URD 30 TTF 0050	—
7.5	50	6.9 URD 30 TTF 0050	—
11	80	6.9 URD 30 TTF 0080	—
15	125	6.9 URD 30 TTF 0125	—
18.5	125	6.9 URD 30 TTF 0125	—
22	160	6.9 URD 30 TTF 0160	—
30	200	6.9 URD 30 TTF 0200	—
37	250	6.9 URD 30 TTF 0250	—
45	315	6.9 URD 30 TTF 0315	—
55	350	6.9 URD 30 TTF 0350	—

*1 Manufacturer: Mersen Japan KK
Contact: Sun-Wa Technos Corporation

NOTE

• Install fuses across terminals P/+ and P/+, and across terminals N/- and N/- of the multifunction regeneration converter and the inverter.

[Estimated lifespan of fuses]

Components	Estimated lifespan*1	Replacement method
Fuse	10 years	Replace by new one

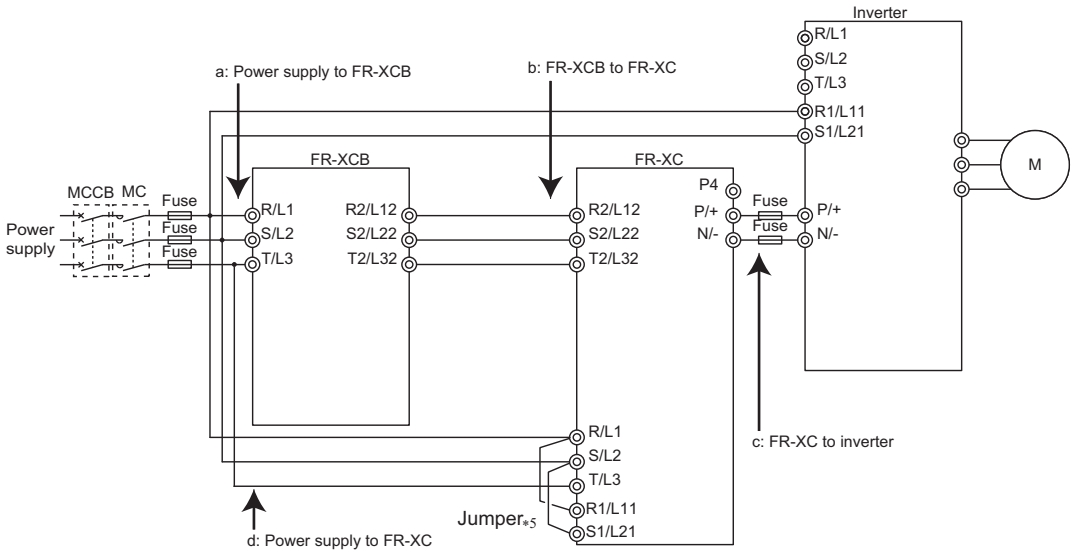
*1 Estimated lifespan for when the yearly average surrounding air temperature is 50°C. (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)

NOTE

• If the fuse melts down, wiring failure such as a short circuit may be the cause. Find out the cause and remove it before replacing the fuse.

4.4 Cable size and crimp terminal size

Select a recommended gauge size cable to ensure that the voltage drop ratio is within 2%.
The following indicates selection examples when the wiring length from the power supply to the converter is 20 m.



• 200 V class

Model	Rating	Crimp terminal (for HIV cables, etc.)				
		R, S, T	R2, S2, T2	P, N	R1, S1	Earth (ground)
FR-XC-22K FR-XC-18.5K-PWM	50°C 40°C	1.25-4	22-8	38-6	1.25-4	22-6
FR-XC-30K FR-XC-22K-PWM	50°C 40°C	1.25-4	38-8	38-6	1.25-4	22-6
FR-XC-37K FR-XC-37K-PWM	50°C 40°C	1.25-4	60-10	80-10	1.25-4	22-8
FR-XC-55K FR-XC-55K-PWM	50°C 40°C	1.25-4	100-12	100-12	1.25-4	38-8

Model	Rating	Cable gauge									
		HIV cables, etc. (mm^2) *1				AWG/MCM *2			PVC cables, etc. (mm^2) *3			
		Location in the connection diagram			Earth (ground)	Location in the connection diagram			Location in the connection diagram			Earth (ground)
		a, b	c *4	d		a, b	c	d	a, b	c	d	
FR-XC-22K FR-XC-18.5K-PWM	50°C 40°C	22	38	1.25	22	4	4 2	16	16	16 25	1.5	16
FR-XC-30K FR-XC-22K-PWM	50°C 40°C	38	38	1.25	22	4 2	2	16	16 25	25	1.5	25
FR-XC-37K FR-XC-37K-PWM	50°C 40°C	60	80	1.25	22	1/0 2/0	2/0 3/0	16	50	70	1.5	35
FR-XC-55K FR-XC-55K-PWM	50°C 40°C	100	100	1.25	38	3/0 4/0	4/0	16	70	95	1.5	50

Model	Rating	Crimp terminal (for HIV cables, etc.)	
		R, S, T R2, S2, T2	Earth (ground)
FR-XCB-18.5K	50°C 40°C	22-8	22-6
FR-XCB-22K	50°C 40°C	38-8	22-6
FR-XCB-37K	50°C 40°C	60-10	22-8
FR-XCB-55K	50°C 40°C	100-10	38-8

*1 It is the gauge of a cable with the continuous maximum permissible temperature of 75°C (HIV cable (600 V grade heat-resistant PVC insulated wire), etc.). It assumes a surrounding air temperature of 50°C or less (40°C or less for the 40°C rating) and the wiring distance of 20 m or less from the power supply to the converter.

*2 It is the gauge of the cable with continuous maximum permissible temperature of 75°C (THHW cable). It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
(For the use in the United States or Canada, refer to page 236.)

*3 It is the gauge of a cable with the continuous maximum permissible temperature of 90°C (PVC cable). It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
(Selection example mainly for use in Europe.)

*4 If a cable thinner than the recommended cable size is used, it may not be protected by the DC fuse. (Refer to page 84 for the fuse selection.)

*5 When using a separate power supply for the control circuit, remove the jumpers connected to terminals R1/L11 and S1/L21.

- 400 V class

Model	Rating	Crimp terminal (for HIV cables, etc.)				
		R, S, T	R2, S2, T2	P, N	R1, S1	Earth (ground)
FR-XC-H22K	50°C	1.25-4	8-8	14-6	1.25-4	8-6
FR-XC-H18.5K-PWM	40°C					
FR-XC-H30K	50°C	1.25-4	14-8	22-6	1.25-4	14-6
FR-XC-H22K-PWM	40°C			14-6		
FR-XC-H37K	50°C	1.25-4	22-8	38-8	1.25-4	14-8
FR-XC-H37K-PWM	40°C					
FR-XC-H55K	50°C	1.25-4	60-8	60-8	1.25-4	22-8
FR-XC-H55K-PWM	40°C		38-8			

Model	Rating	Cable gauge										
		HIV cables, etc. (mm^2) *1				AWG/MCM *2			PVC cables, etc. (mm^2) *3			
		Location in the connection diagram			Earth (ground)	Location in the connection diagram			Location in the connection diagram			Earth (ground)
		a, b	c *4	d		a, b	c	d	a, b	c	d	
FR-XC-H22K	50°C	8	14	1.25	8	8	6	16	10	10	1.5	10
FR-XC-H18.5K-PWM	40°C											
FR-XC-H30K	50°C	14	22	1.25	14	6	6	16	10	16	1.5	10
FR-XC-H22K-PWM	40°C		14				4					
FR-XC-H37K	50°C	22	38	1.25	14	4	2	16	25	35	1.5	16
FR-XC-H37K-PWM	40°C											
FR-XC-H55K	50°C	60	60	1.25	22	2	2	16	25	35	1.25	25
FR-XC-H55K-PWM	40°C	38					1					

Model	Rating	Crimp terminal (for HIV cables, etc.)	
		R, S, T R2, S2, T2	Earth (ground)
FR-XCB-H18.5K	50°C	8-6	8-6
	40°C		
FR-XCB-H22K	50°C	14-6	14-6
	40°C		
FR-XCB-H37K	50°C	22-8	14-8
	40°C		
FR-XCB-H55K	50°C	60-8	22-8
	40°C	38-8	

*1 It is the gauge of a cable with the continuous maximum permissible temperature of 75°C (HIV cable (600 V grade heat-resistant PVC insulated wire), etc.). It assumes a surrounding air temperature of 50°C or less (40°C or less for the 40°C rating) and the wiring distance of 20 m or less from the power supply to the converter.

*2 For the FR-XC-H37K or lower, it is the gauge of the cable with the continuous maximum permissible temperature of 75°C (THHW cable). It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
For FR-XC-H55K, the cable gauge is with the continuous maximum permissible temperature of 90°C (THHN cable).
(For the use in the United States or Canada, refer to page 236.)

*3 For the FR-XC-H37K or lower, it is the gauge of the cable with the continuous maximum permissible temperature of 70°C (PVC cable). For the FR-XC-H55K or higher, it is the gauge of the cable with the continuous maximum permissible temperature of 90°C (XLPE cable).
For FR-XC-H55K, the cable gauge is with the continuous maximum permissible temperature of 90°C (XLPE cable).
(Selection example mainly for use in Europe.)

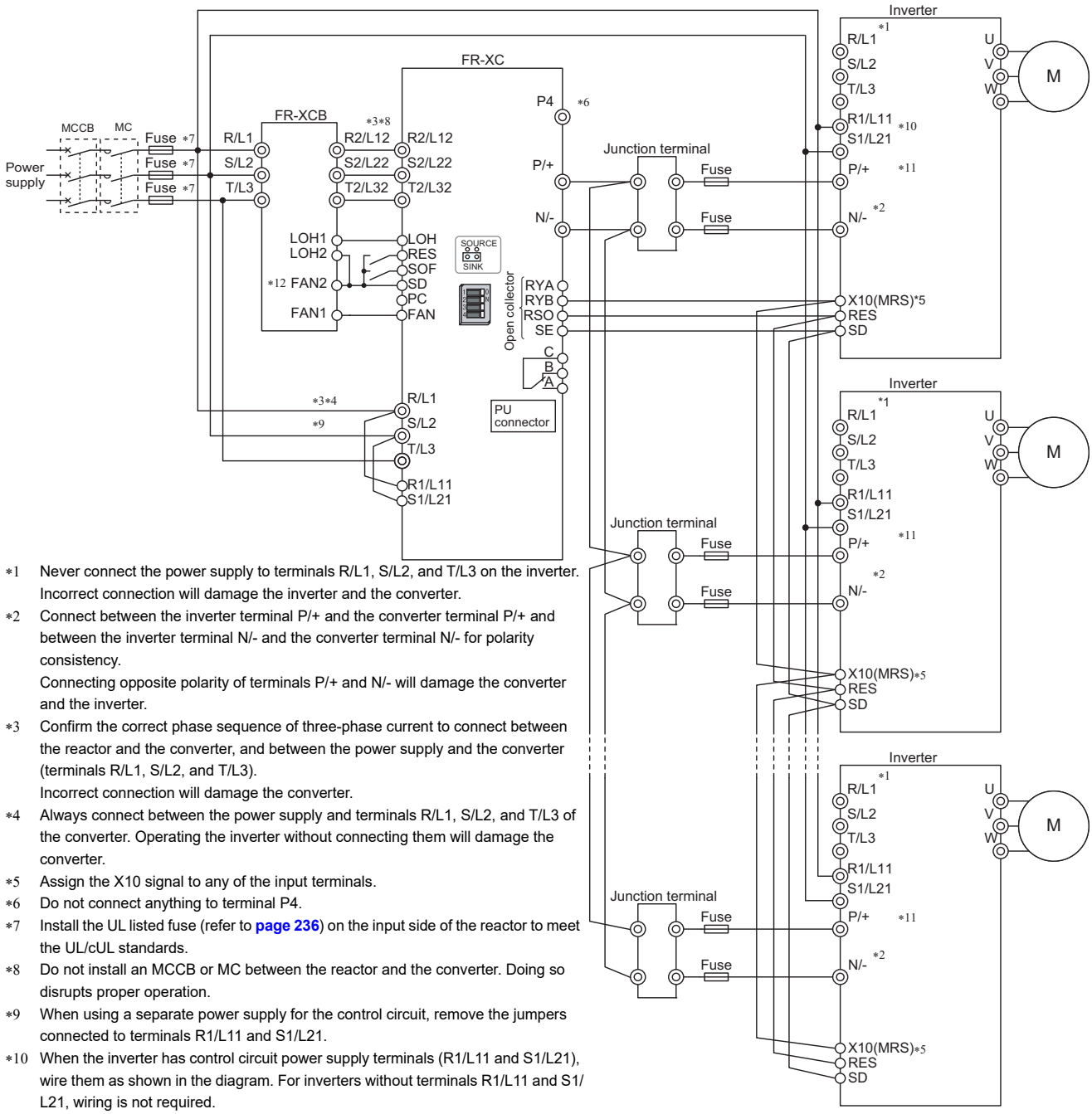
*4 If a cable thinner than the recommended cable size is used, it may not be protected by the DC fuse. (Refer to page 84 for the fuse selection.)

*5 When using a separate power supply for the control circuit, remove the jumpers connected to terminals R1/L11 and S1/L21.

4.5 Wiring

- Incorrect wiring will cause a fault indication, failure, or damage of the multifunction regeneration converter.
- Refer to the Instruction Manual of each inverter for the wiring of the inverter. Special attention must be paid to the wiring length and cable size.

4.5.1 Terminal connection diagram



*1 Never connect the power supply to terminals R/L1, S/L2, and T/L3 on the inverter. Incorrect connection will damage the inverter and the converter.

*2 Connect between the inverter terminal P/+ and the converter terminal P/+ and between the inverter terminal N/- and the converter terminal N/- for polarity consistency.
Connecting opposite polarity of terminals P/+ and N/- will damage the converter and the inverter.

*3 Confirm the correct phase sequence of three-phase current to connect between the reactor and the converter, and between the power supply and the converter (terminals R/L1, S/L2, and T/L3).
Incorrect connection will damage the converter.

*4 Always connect between the power supply and terminals R/L1, S/L2, and T/L3 of the converter. Operating the inverter without connecting them will damage the converter.

*5 Assign the X10 signal to any of the input terminals.

*6 Do not connect anything to terminal P4.

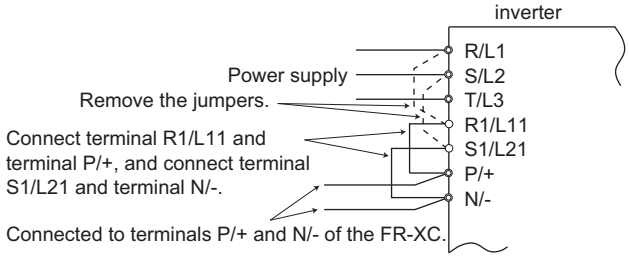
*7 Install the UL listed fuse (refer to page 236) on the input side of the reactor to meet the UL/cUL standards.

*8 Do not install an MCCB or MC between the reactor and the converter. Doing so disrupts proper operation.

*9 When using a separate power supply for the control circuit, remove the jumpers connected to terminals R1/L11 and S1/L21.

*10 When the inverter has control circuit power supply terminals (R1/L11 and S1/L21), wire them as shown in the diagram. For inverters without terminals R1/L11 and S1/L21, wiring is not required.

*11 Instead of connecting the terminals to the AC power supply, the control circuit can be powered by connecting terminal R1/L11 to terminal P/+ and terminal S1/L21 to terminal N/-. In this case, do not connect the terminals to the AC power supply.
Doing so will damage the inverter.



*12 The terminal symbols differ depending on the manufacture year and month of the FR-XCB. (Refer to page 241.)

CAUTION

- Always connect the converter terminal RYB and the inverter terminal to which the X10 (MRS) signal is assigned, and connect the converter terminal SE and the inverter terminal SD. If the terminals are not connected, the converter may be damaged.

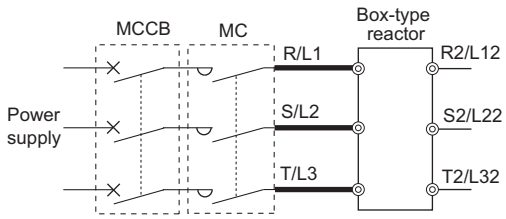
NOTE

- Do not connect the DC reactor to the inverter when using the converter in harmonic suppression mode.
- Configure a system so that the magnetic contactor at the converter input side shuts off the power supply at a failure of the converter or the connected inverter. (The converter does not shut off the power supply by itself.) Failure to do so may overheat and burn the resistors in the converter and the connected inverter.
- The control logic (sink logic/source logic) of the converter and the inverter must be matched. The converter does not operate properly if the control logic is not consistent with each other.
  (Refer to page 45 for the switching of the control logic. Refer to the Instruction Manual of the inverter for the switching of the control logic of the inverter.)
- Keep the wiring length between terminals as short as possible.
- When the power is distorted or falls off sharply, the reactors may generate abnormal acoustic noise. This acoustic noise is caused by the power supply fault and not by the damage of the converter.
- Do not connect an external brake resistor such as the FR-ABR when using the converter.

4.5.2 Wiring

◆Wiring the power supply to the reactor

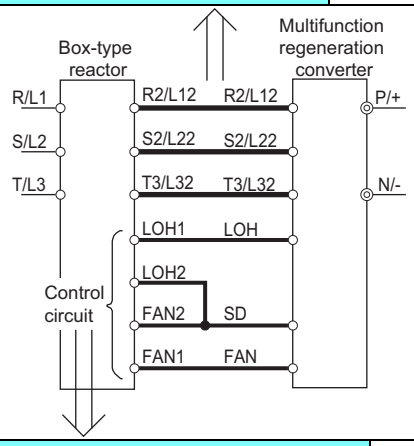
- Cable gauge differs by the capacity. Select an appropriate cable by referring to page 85 to perform wiring.



◆Wiring the reactor to the converter

- Cable gauge differs by the capacity. Select an appropriate cable by referring to page 85 to perform wiring.

Main circuit wiring length	10 m or shorter

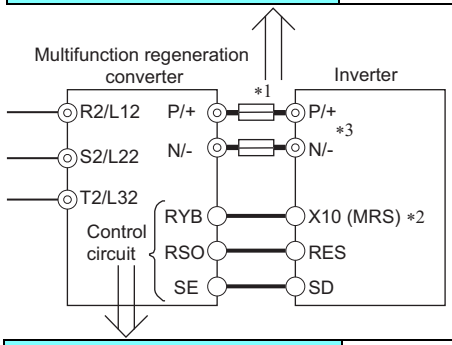


Control circuit cable gauge	0.3 to 1.25 mm^2
Control circuit wiring length	5 m or shorter

◆Wiring the converter to the inverter

- Connect the wiring for the control circuit correctly so that the commands sent from the converter are transmitted to the inverter without fail.
  For the cable gauge of the cable for the main circuit terminals P/+ and N/- (P to P and N to N), refer to page 85.

Main circuit wiring length	50 m or shorter



Control circuit cable gauge	0.3 to 1.25 mm^2
Control circuit wiring length	30 m or shorter

*1 Installation of a fuse on each cable is recommended to prevent the damage from spreading in case of an inverter failure. Select the fuse according to the motor capacity. To use a motor whose capacity is smaller than the inverter capacity by two ranks or more, select the fuse with the capacity that is one rank lower than the inverter capacity. Refer to the fuse selection table on page 84.
For connection of multiple inverters, use the same gauge cable as the inverter's power cable for wiring between the inverter main circuit terminal (P/+ or N/-) and a junction terminal. (Refer to the Instruction Manual of the inverter.)

*2 The function needs to be assigned to an inverter terminal to be connected to the converter terminal RYB.
Refer to the Instruction Manual of the Inverter.

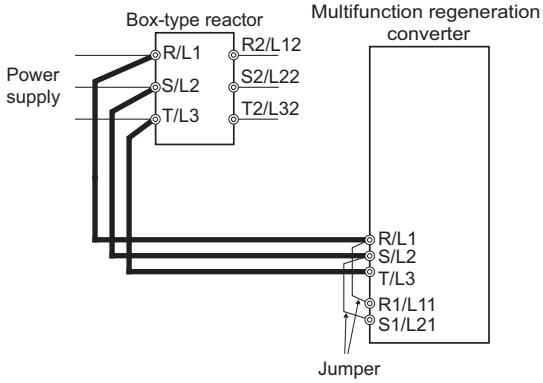
*3 Do not install any MCCB between the inverter and the converter (P to P and N to N). For the gauge of the cable used for connection of multiple inverters, refer to page 92.

NOTE

- Terminals P/+ and N/- are used for connection with the inverter. Do not connect anything to power input terminals (R/L1, S/L2, and T/L3) of the inverter. Incorrect power input connection will damage the inverter. Connecting opposite polarity of terminals P/+ and N/- will damage the inverter and the converter.
- Do not connect an AC or DC reactor to the inverter when using the converter in harmonic suppression mode.

◆Wiring the power supply to the converter

Supply power to the power detecting terminals (R/L1, S/L2, and T/L3) separately from the main circuit wiring.



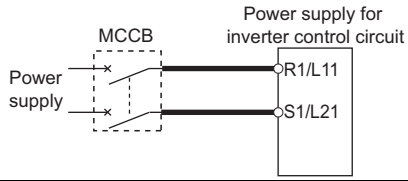
Cable gauge	1.25 mm^2
Total wiring length	10 m or shorter

NOTE

- The terminals R/L1, S/L2, and T/L3 on the converter are control terminals to detect power phases of the power supply. For wiring, the voltage phase must be consistent between terminals R2/L12, S2/L22, and T2/L32 and terminals R/L1, S/L2, and T/L3. If these terminals are not connected correctly, the converter does not operate properly.
- If the inverter is operated while the converter terminals R/L1, S/L2, and T/L3 are not connected to the power supply, the converter will be damaged.

◆Wiring of the power supply and the inverter (equipped with terminals R1/L11 and S1/L21)

For the power input to the control circuit in the inverter which has the control circuit power supply terminals (R1/L11 and S1/L21), bypass the converter and perform the direct wiring between the inverter (these terminals) and the power supply.



Cable gauge	0.75 to 2 mm^2

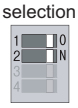
NOTE

- Remove jumpers across main circuit terminals R/L1 and R1/L11 and across S/L2 and S1/L21 on the inverter (refer to the Instruction Manual of the inverter).
- Always connect the power supply to terminals R1/L11 and S1/L21 of the inverter directly to supply power to the control circuit. If they are not connected, the inverter may shut off its output by a fault occurrence or be damaged.

4.6 Connection mode selection

Use the function selection switch assembly (SW2) and **Pr.416 Control method selection** to select the connection mode.

- Select the common bus regeneration mode / harmonic suppression mode by setting the position of switch 1 (connection mode setting switch) in the function selection switch assembly (SW2).



Switch		Function
1	2	
ON	ON or OFF*1	Common bus regeneration mode/ harmonic suppression mode
OFF	ON	Not used.
	OFF	Power regeneration mode 2 (Refer to page 99.)

*1 The common bus regeneration mode / harmonic suppression mode is enabled regardless of the position of switch 2.

- Select the function status by setting **Pr.416**. For the FR-XC-[]K, set **Pr.416** = "1" to select the harmonic suppression mode.

Pr.416 setting	Function
0	Common bus regeneration mode
1	Harmonic suppression mode
9999 (initial value)	FR-XC-[ ]K: Common bus regeneration mode FR-XC-[ ]K-PWM: Harmonic suppression mode Check the model of the multifunction regeneration converter described on the rating plate (refer to page 12).

NOTE

- The new setting of the switch is applied at the next power-ON or converter reset.
- If the connection mode setting does not match the actual wiring of the main circuit terminals, the connection mode fault "E.T" occurs.
- The change of the **Pr.416** setting is applied at the next power-ON or converter reset.
- If the harmonic suppression mode is selected in the FR-XC-15K or lower, the fault "E.U" (Unsupported function selected) occurs.

4.7 Temperature derating selection

The temperature rating changes according to the setting position of the switch 3 in the function selection switch assembly (SW2).
When the 40°C rating is selected, the rated current and the applied current can be increased.
When the 40°C rating is selected, the surrounding air temperature must be between -10 and +40°C (non-freezing).

NOTE

- The new setting of the switch is applied at the next power-ON or converter reset.

50°C rating

40°C rating

4.8 Inverter parameter settings

To use the converter with the inverter, **Pr.30 Regenerative function selection** in the inverter parameters must be set. The parameter setting differ by the inverter series.
Refer to the Instruction Manual of the Inverter.

- To use the converter in the common bus regeneration mode, select the setting for a multifunction regeneration converter, high power factor converter, or power regeneration common converter. (Example: **Pr.30** in the FR-A800 = "2 or 102").
  When **Pr.416** = "1", set the rated motor voltage in **Pr.19 Base frequency voltage** (under V/F control) or **Pr.83 Rated motor voltage** (under control other than V/F control).

NOTE

- Set **Pr.30** in the inverter used with the converter in harmonic suppression mode. Incorrect setting may disrupt normal operation.

4.9 Connection of the converter and the multiple inverters

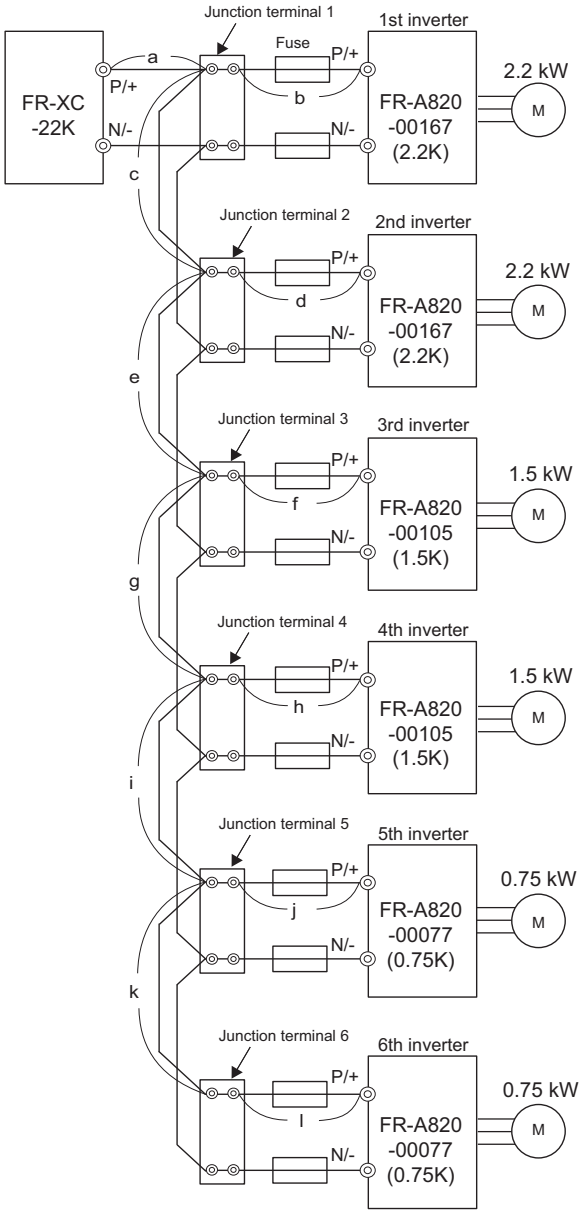
When the multifunction regeneration converter is used in harmonic suppression mode, multiple inverters can be connected to the converter. (The allowable number of inverters to be connected and their total capacity differs depending on the converter capacity. Refer to **page 95**.) Select the converter so that the total capacity of the connected inverters must not exceed the applicable inverter capacity.

- For the multiple inverter connection, place the higher capacity inverter in the lower number axis.
- Junction terminals and cross wiring may be required for the wiring of the multiple inverters. For the gauge of cable used between the two junction terminals, refer to the descriptions in the following figure. Total capacity of higher-number axis inverters must be considered for the cable selection.
- It is recommended to install a fuse on each inverter power cable used between the inverter and the junction terminal, as shown in the following figure. Select a fuse according to the motor capacity. (Refer to **page 84**.)
  When using a motor whose capacity is smaller than the inverter capacity by two ranks or more, select the fuse with the capacity that is one rank lower than the inverter capacity.
- The total wiring length between terminals P/+ or terminals N/- on the converter and connected inverters should not exceed 50 m.

◆Wiring examples

In the following examples, six inverters (two FR-A820-00167(2.2K) inverters, two FR-A820-00105(1.5K) inverters, and two FR-A820-00077(0.75K) inverters) are connected to the FR-XC-22K converter.

- Main circuit wiring example



1st inverter

a: The gauge of cable between the FR-XC and the junction terminal 1 is 14 mm^2 because the FR-XC capacity is 11 kW.

b: The gauge of cable between the junction terminal 1 and the 1st axis inverter is 2 mm^2 because the inverter capacity is 2.2 kW.

2nd inverter

c: The gauge of cable between the junction terminal 1 and the junction terminal 2 is 14 mm^2 because the total capacity of lower axis inverters is regarded as 7.5 kW (an approximate inverter capacity of "6.7 kW" determined by the expression: 2.2 + 1.5 + 1.5 + 0.75 + 0.75).

d: The gauge of cable between the junction terminal 2 and the 2nd axis inverter is 2 mm^2 because the inverter capacity is 2.2 kW.

3rd inverter

e: The gauge of cable between the junction terminal 2 and the junction terminal 3 is 5.5 mm^2 because the total capacity of lower axis inverters is regarded as 5.5 kW (an approximate inverter capacity of "4.5 kW" determined by the expression: 1.5 + 1.5 + 0.75 + 0.75).

f: The gauge of cable between the junction terminal 3 and the 3rd axis inverter is 2 mm^2 because the inverter capacity is 1.5 kW.

4th inverter

g: The gauge of cable between the junction terminal 3 and the junction terminal 4 is 3.5 mm^2 because the total capacity of lower axis inverters is regarded as 3.7 kW (an approximate inverter capacity of "3.0 kW" determined by the expression: 1.5 + 0.75 + 0.75).

h: The gauge of cable between the junction terminal 4 and the 4th axis inverter is 2 mm^2 because the inverter capacity is 1.5 kW.

5th inverter

i: The gauge of cable between the junction terminal 4 and the junction terminal 5 is 2 mm^2 because the total capacity of lower axis inverters is 1.5 kW determined by the expression: 0.75 + 0.75.

j: The gauge of cable between the junction terminal 5 and the 5th axis inverter is 2 mm^2 because the inverter capacity is 0.75K.

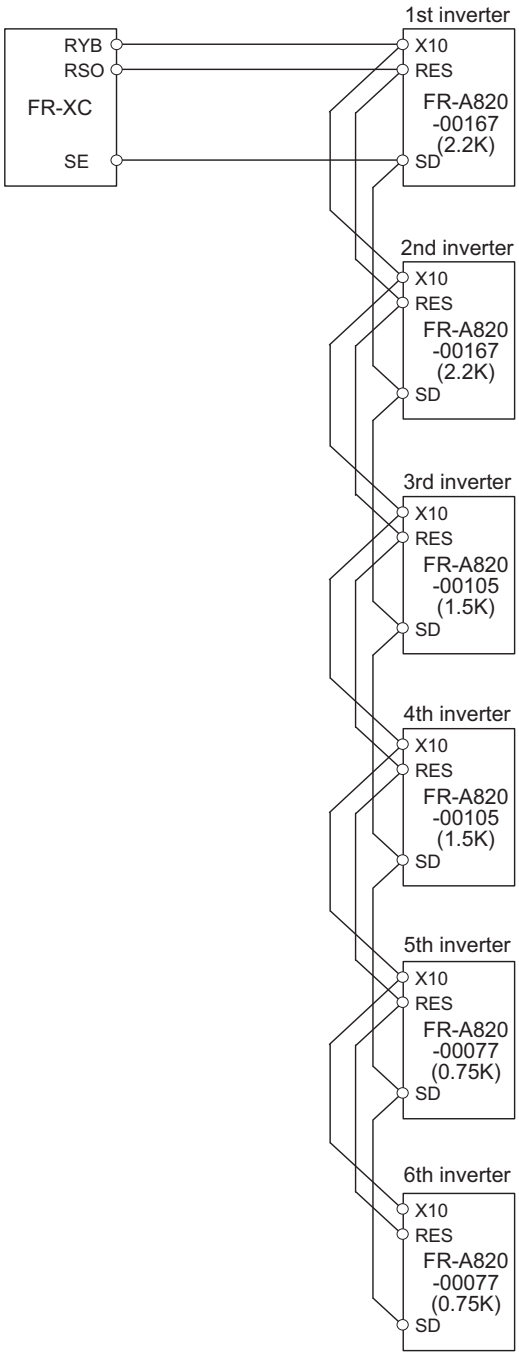
6th inverter

k: The gauge of cable between the junction terminal 5 and the junction terminal 6 is 2 mm^2 because the inverter capacity is 0.75K.

l: The gauge of cable between the junction terminal 6 and the 6th axis inverter is 2 mm^2 because the inverter capacity is 0.75K.

Connection of the converter and the multiple inverters

• Control circuit wiring example



• For the control circuit wiring, use shielded or twisted wires, and separate the wire from the main circuit and high-voltage circuits.
• The total wiring length should be 30 m or shorter.

4.10 Rating

4.10.1 FR-XC-[ ]K

200 V class

Model FR-XC-[ ]K*1		22	30	37	55
50°C rating	Applicable inverter capacity (kW)	18.5	22	37	55
	Applicable motor current (A)	76	90	145	215
	Rated input current (A) | Power/regenerative driving	69	82	134	198
	Continuous rating / overload current rating	100% continuous / 150% 60 s			
	Power supply capacity (kVA)*2	30	35	57	84
40°C rating	Applicable inverter capacity (kW)	18.5	22	37	55
	Applicable motor current (A)	83	99	160	236
	Rated input current (A) | Power/regenerative driving	75	90	147	217
	Continuous rating / overload current rating	100% continuous / 150% 60 s			
	Power supply capacity (kVA)*2	32	38	62	92
Power source	Rated input AC voltage/frequency	Three-phase 200 to 230 V, 50/60 Hz*5*9			
	Permissible AC voltage fluctuation	Three-phase 170 to 253 V, 50/60 Hz			
	Permissible frequency fluctuation	±5%			
Input power factor		0.99 or more (when load ratio is 100%)			
Protection rating of structure (IEC 60529)		IP00*4			
Cooling system		Forced air			
Number of connectable inverters		10*7			
Approx. mass (kg)*8		10.5	10.5	28	38

400 V class

Model FR-XC-H[ ]K*1		22	30	37	55
50°C rating	Applicable inverter capacity (kW)	18.5	22	37	55
	Applicable motor current (A)	38	44	71	110
	Rated input current (A) | Power/regenerative driving	37	43	71	104
	Continuous rating / overload current rating	100% continuous / 150% 60 s			
	Power supply capacity (kVA)*3	32	37	60	88
40°C rating	Applicable inverter capacity (kW)	18.5	22	37	55
	Applicable motor current (A)	42	48	78	120
	Rated input current (A) | Power/regenerative driving	40	47	78	113
	Continuous rating / overload current rating	100% continuous / 150% 60 s			
	Power supply capacity (kVA)*3	34	40	66	96
Power source	Rated input AC voltage/frequency	Three-phase 380 to 480 V, 50/60 Hz*6*9			
	Permissible AC voltage fluctuation	Three-phase 323 to 506 V, 50/60 Hz			
	Permissible frequency fluctuation	±5%			
Input power factor		0.99 or more (when load ratio is 100%)			
Protection rating of structure (IEC 60529)		IP00*4			
Cooling system		Forced air			
Number of connectable inverters		10*7			
Approx. mass (kg)*8		10.5	10.5	28	28

*1 The common bus regeneration mode is selected initially. Set **Pr.416** = "1" to select the harmonic suppression mode. (page 91)
*2 Selection example for 220 V power supply voltage.
*3 Selection example for 440 V power supply voltage.
*4 IP00 for the FR-XCL.
*5 The DC bus voltage is approx. 297 VDC at an input voltage of 200 VAC, approx. 327 VDC at 220 VAC, and approx. 342 VDC at 230 VAC.
*6 The DC bus voltage is approx. 594 VDC at an input voltage of 400 VAC, approx. 653 VDC at 440 VAC, and approx. 713 VDC at 480 VAC.
*7 If you want to connect 11 or more inverters, contact your sales representative.
*8 Mass of the FR-XC alone.
*9 The permissible voltage imbalance ratio is 3% or less. (Unbalance factor = Max | Line voltage - Mean of three line voltages | / Mean of three line voltages × 100)

4.10.2 FR-XC-[ ]K-PWM

200 V class

Model FR-XC-[ ]K-PWM*1			18.5	22	37	55
50°C rating	Applicable inverter capacity (kW)		18.5	22	37	55
	Applicable motor current (A)		76	90	145	215
	Rated input current (A)	Power/regenerative driving	69	82	134	198
	Continuous rating / overload current rating		100% continuous / 150% 60 s			
	Power supply capacity (kVA)*2		30	35	57	84
40°C rating	Applicable inverter capacity (kW)		18.5	22	37	55
	Applicable motor current (A)		83	99	160	236
	Rated input current (A)	Power/regenerative driving	75	90	147	217
	Continuous rating / overload current rating		100% continuous / 150% 60 s			
	Power supply capacity (kVA)*2		32	38	62	92
Power source	Rated input AC voltage/frequency		Three-phase 200 to 230 V, 50/60 Hz*5*9			
	Permissible AC voltage fluctuation		Three-phase 170 to 253 V, 50/60 Hz			
	Permissible frequency fluctuation		±5%			
Input power factor			0.99 or more (when load ratio is 100%)			
Protection rating of structure (IEC 60529)			IP00*4			
Cooling system			Forced air			
Number of connectable inverters			10*7			
Approx. mass (kg)*8			10.5	10.5	28	38

400 V class

Model FR-XC-H[ ]K-PWM*1			18.5	22	37	55
50°C rating	Applicable inverter capacity (kW)		18.5	22	37	55
	Applicable motor current (A)		38	44	71	110
	Rated input current (A)	Power/regenerative driving	37	43	71	104
	Continuous rating / overload current rating		100% continuous / 150% 60 s			
	Power supply capacity (kVA)*3		32	37	60	88
40°C rating	Applicable inverter capacity (kW)		18.5	22	37	55
	Applicable motor current (A)		42	48	78	120
	Rated input current (A)	Power/regenerative driving	40	47	78	113
	Continuous rating / overload current rating		100% continuous / 150% 60 s			
	Power supply capacity (kVA)*3		34	40	66	96
Power source	Rated input AC voltage/frequency		Three-phase 380 to 480 V, 50/60 Hz*6*9			
	Permissible AC voltage fluctuation		Three-phase 323 to 506 V, 50/60 Hz			
	Permissible frequency fluctuation		±5%			
Input power factor			0.99 or more (when load ratio is 100%)			
Protection rating of structure (IEC 60529)			IP00*4			
Cooling system			Forced air			
Number of connectable inverters			10*7			
Approx. mass (kg)*8			10.5	10.5	28	28

*1 The harmonic suppression mode is selected initially.
*2 Selection example for 220 V power supply voltage.
*3 Selection example for 440 V power supply voltage.
*4 IP20 for the FR-XCB.
*5 The DC bus voltage is approx. 297 VDC at an input voltage of 200 VAC, approx. 327 VDC at 220 VAC, and approx. 342 VDC at 230 VAC.
*6 The DC bus voltage is approx. 594 VDC at an input voltage of 400 VAC, approx. 653 VDC at 440 VAC, and approx. 713 VDC at 480 VAC.
*7 If you want to connect 11 or more inverters, contact your sales representative.
*8 Mass of the FR-XC alone.
*9 The permissible voltage imbalance ratio is 3% or less. (Unbalance factor = Max | Line voltage - Mean of three line voltages | / Mean of three line voltages × 100)

4.11 Combination matrix of FR-XCB and FR-XC(-PWM)

• 200 V class

Multifunction regeneration converter		Dedicated box-type reactor
Model	Rated surrounding temperature	FR-XCB-[ ]K
FR-XC-18.5K-PWM	50°C/40°C rating	18.5
FR-XC-22K		
FR-XC-22K-PWM		22
FR-XC-30K		
FR-XC-37K FR-XC-37K-PWM		37
FR-XC-55K FR-XC-55K-PWM		55

• 400 V class

Multifunction regeneration converter		Dedicated box-type reactor
Model	Rated surrounding temperature	FR-XCB-H[ ]K
FR-XC-H18.5K-PWM	50°C/40°C rating	18.5
FR-XC-H22K		
FR-XC-H22K-PWM		22
FR-XC-H30K		
FR-XC-H37K FR-XC-H37K-PWM		37
FR-XC-H55K FR-XC-H55K-PWM		55

MEMO

5 POWER REGENERATION MODE 2

This chapter explains the power regeneration mode 2 of this product.
Always read the instructions before use.

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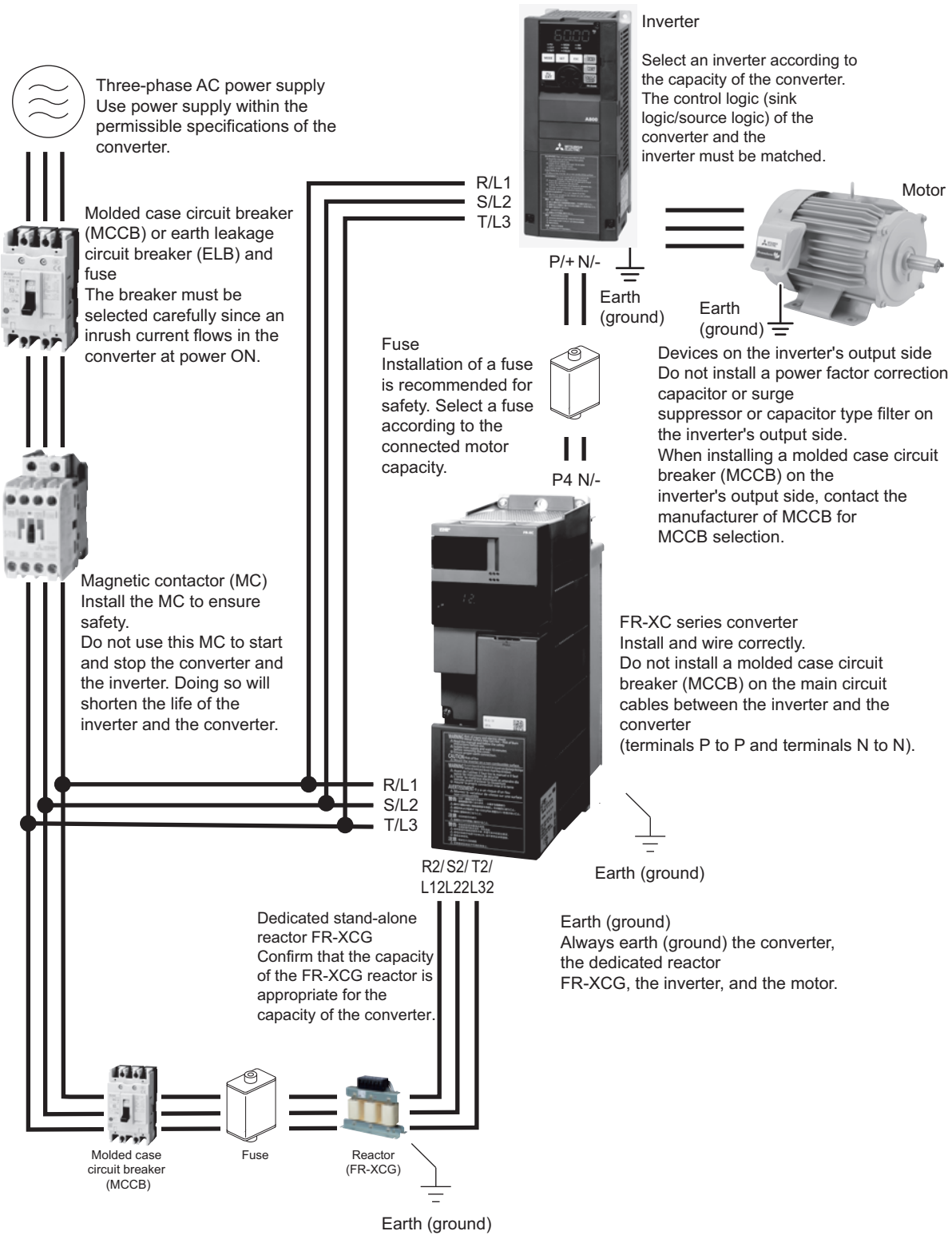
5.8 Inverter parameter settings 112
5.9 Rating 113
5.10 Combination matrix of FR-XCG and FR-XC(-PWM) 115

5.1 FR-XC series converter and peripheral devices



5.2 Connection of the converter and the inverter

5.2.1 Operating condition

- To select the converter, refer to page 113 for the potential regenerative capacity and overload current rating of the converter. Ensure that the selected converter is one with a larger regenerative power than that of the motor that will be used.
- Confirm that the converter is correctly selected, and select a dedicated stand-alone reactor (FR-XCG) by referring to "Combination matrix of FR-XCG and FR-XC(-PWM)" on page 115.

  Selection example:

  For the 50°C rating

  For a motor which can supply 10 kW regenerative power with an overload capacity of 120% (12 kW) for 60 seconds, the FR-XC-15K (15 kW converter) should be selected.

Model FR-XC-[ ]K *1		7.5	11	15	22	30	37	55
	Applicable inverter capacity (kW)	7.5	11	15	22	30	37	55
		—	—	—	18.5	22	37	55
50°C rating	Potential regenerative capacity (kW) *7	5.5	7.5	11	18.5	22	30	45
	Rated current (A) (regenerative driving)	19	26	37	62	74	102	152
	Continuous rating / overload current rating	100% continuous / 150% 60 s						
40°C rating	Potential regenerative capacity (kW)	5.5	7.5	11	18.5	22	30	45
	Rated current (A) (regenerative driving)	21	28	40	68	81	112	167
	Continuous rating / overload current rating	100% continuous / 150% 60 s						

The following table shows applicable combinations of the converter and the inverter.

200 V class

Model	Rating	Inverter capacity											
		3.7K or lower	5.5K	7.5K	11K	15K	18.5K	22K	30K	37K	45K	55K	75K or higher
FR-XC-7.5K	50°C/40°C rating	×	Δ	Δ	○	○	○	○	○	○	○	○	○
FR-XC-11K		×	×	Δ	Δ	○	○	○	○	○	○	○	○
FR-XC-15K		×	×	×	Δ	Δ	○	○	○	○	○	○	○
FR-XC-22K		×	×	×	×	×	Δ	Δ	○	○	○	○	○
FR-XC-30K		×	×	×	×	×	×	Δ	Δ	○	○	○	○
FR-XC-37K		×	×	×	×	×	×	×	Δ	Δ	○	○	○
FR-XC-55K		×	×	×	×	×	×	×	×	×	Δ	Δ	○

○: Compatible, Δ: Compatible (common bus regeneration mode or harmonic suppression mode is recommended),
×: Not compatible

400 V class

Model	Rating	Inverter capacity											
		3.7K or lower	5.5K	7.5K	11K	15K	18.5K	22K	30K	37K	45K	55K	75K or higher
FR-XC-H7.5K	50°C/40°C rating	×	Δ	Δ	○	○	○	○	○	○	○	○	○
FR-XC-H11K		×	×	Δ	Δ	○	○	○	○	○	○	○	○
FR-XC-H15K		×	×	×	Δ	Δ	○	○	○	○	○	○	○
FR-XC-H22K		×	×	×	×	×	Δ	Δ	○	○	○	○	○
FR-XC-H30K		×	×	×	×	×	×	Δ	Δ	○	○	○	○
FR-XC-H37K		×	×	×	×	×	×	×	Δ	Δ	○	○	○
FR-XC-H55K		×	×	×	×	×	×	×	×	×	Δ	Δ	○

○: Compatible, Δ: Compatible (common bus regeneration mode or harmonic suppression mode is recommended),
×: Not compatible

NOTE

- Select an appropriate magnetic contactor (MC) according to the inverter capacity referring to the Instruction Manual of the inverter.
  For wiring, refer to page 110.
- For details on the power regeneration mode 1, refer to page 224.

5.3 Peripheral device list

◆Circuit breaker and magnetic contactor

Check the model of the purchased multifunction regeneration converter. Appropriate peripheral devices must be selected according to the capacity.
To use the converter in power regeneration mode 2, select a circuit breaker and a magnetic contactor (MC) for the inverter according to the inverter capacity. For details, refer to the Instruction Manual of each inverter.
Additionally, install a molded case circuit breaker (MCCB) or earth leakage circuit breaker (ELB) with the rating shown in the following table on the input side of the FR-XCG reactor. For the information of the installation location, refer to page 108.

• 200 V class

FR-XC series converter model	Molded case circuit breaker (MCCB)/ earth leakage circuit breaker (ELB) (NF, NV type)
FR-XC-7.5K	50 A
FR-XC-11K	60 A
FR-XC-15K	75 A
FR-XC-22K FR-XC-18.5K-PWM	125 A
FR-XC-30K FR-XC-22K-PWM	175 A
FR-XC-37K FR-XC-37K-PWM	200 A
FR-XC-55K FR-XC-55K-PWM	250 A

• 400 V class

FR-XC series converter model	Molded case circuit breaker (MCCB)/ earth leakage circuit breaker (ELB) (NF, NV type)
FR-XC-H7.5K	30 A
FR-XC-H11K	30 A
FR-XC-H15K	40 A
FR-XC-H22K FR-XC-H18.5K-PWM	75 A
FR-XC-H30K FR-XC-H22K-PWM	100 A
FR-XC-H37K FR-XC-H37K-PWM	125 A
FR-XC-H55K FR-XC-H55K-PWM	150 A

NOTE

- If any breaker trips, check for the wiring fault (such as short circuit), damage to internal parts of the multifunction regeneration converter, etc. The cause of the trip must be identified and removed before turning ON the power of the breaker.
- For details on the power regeneration mode 1, refer to page 224.

◆Fuse

Installation of a fuse between the multifunction regeneration converter and the inverter is recommended.
Select a fuse according to the capacity of the converter. (Refer to page 110 for wiring between the converter and the inverter.)

• 200 V class

FR-XC series converter capacity (kW)	Fuse rating (A)	Model (Part number/Item number) *1
FR-XC-7.5K	125	6.9 URD 30 TTF 0125
FR-XC-11K	160	6.9 URD 30 TTF 0160
FR-XC-15K	200	6.9 URD 30 TTF 0200
FR-XC-22K FR-XC-18.5K-PWM	315	6.9 URD 30 TTF 0315
FR-XC-30K FR-XC-22K-PWM	400	6.9 URD 30 TTF 0400
FR-XC-37K FR-XC-37K-PWM	500	6.9 URD 30 TTF 0500
FR-XC-55K FR-XC-55K-PWM	700	6.9 URD 31 TTF 0700

• 400 V class

FR-XC series converter capacity (kW)	Fuse rating (A)	Model (Part number/Item number) *1
FR-XC-H7.5K	50	6.9 URD 30 TTF 0050
FR-XC-H11K	80	6.9 URD 30 TTF 0080
FR-XC-H15K	125	6.9 URD 30 TTF 0125
FR-XC-H22K FR-XC-H18.5K-PWM	160	6.9 URD 30 TTF 0160
FR-XC-H30K FR-XC-H22K-PWM	200	6.9 URD 30 TTF 0200
FR-XC-H37K FR-XC-H37K-PWM	250	6.9 URD 30 TTF 0250
FR-XC-H55K FR-XC-H55K-PWM	350	6.9 URD 30 TTF 0350

*1 Manufacturer: Mersen Japan KK
Contact: Sun-Wa Technos Corporation

NOTE

• Install fuses across terminals P/+ and P/+, and across terminals N/- and N/- of the multifunction regeneration converter and the inverter.

[Estimated lifespan of fuses]

Components	Estimated lifespan*1	Replacement method
Fuse	10 years	Replace by new one

*1 Estimated lifespan for when the yearly average surrounding air temperature is 50°C. (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)

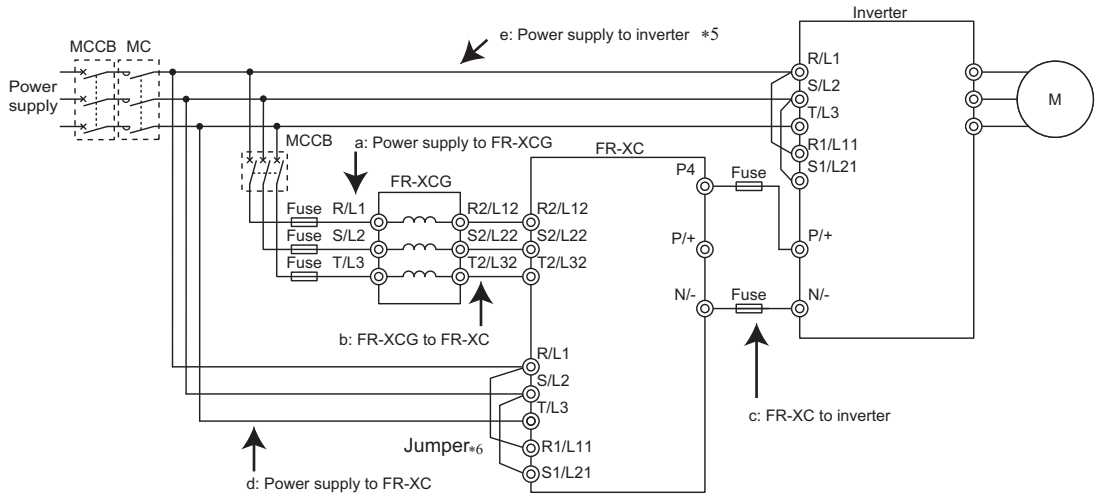
NOTE

• If the fuse melts down, wiring failure such as a short circuit may be the cause. Find out the cause and remove it before replacing the fuse.

5.4 Cable size and crimp terminal size

Select a recommended gauge size cable to ensure that the voltage drop ratio is within 2%.

The following indicates selection examples when the wiring length from the power supply to the converter is 20 m.



• 200 V class

Model	Rating	Crimp terminal (for HIV cables, etc.)				
		R, S, T	R2, S2, T2	P4, N	R1, S1	Earth (ground)
FR-XC-7.5K	50°C	1.25-4	3.5-5	5.5-6	1.25-4	5.5-4
	40°C					
FR-XC-11K	50°C	1.25-4	5.5-5	8-6	1.25-4	8-5
	40°C			5.5-6		
FR-XC-15K	50°C	1.25-4	8-5	14-6	1.25-4	14-5
	40°C					
FR-XC-22K FR-XC-18.5K-PWM	50°C	1.25-4	22-8	22-6	1.25-4	22-6
	40°C					
FR-XC-30K FR-XC-22K-PWM	50°C	1.25-4	38-8	38-6	1.25-4	22-6
	40°C					
FR-XC-37K FR-XC-37K-PWM	50°C	1.25-4	60-10	60-10	1.25-4	22-8
	40°C		38-10			
FR-XC-55K FR-XC-55K-PWM	50°C	1.25-4	80-12	100-12	1.25-4	38-8
	40°C					

Model	Rating	Cable gauge										
		HIV cables, etc. (mm^2) *1				AWG/MCM *2			PVC cables, etc. (mm^2) *3			
		Location in the connection diagram			Earth (ground)	Location in the connection diagram			Location in the connection diagram			Earth (ground)
		a, b	c *4	d		a, b	c	d	a, b	c	d	
FR-XC-7.5K	50°C	3.5	5.5	1.25	5.5	14	12	16	4	4	1.5	10
	40°C		3.5			12						
FR-XC-11K	50°C	5.5	8		8	10	10	16	6	6	1.5	16
	40°C		5.5									
FR-XC-15K	50°C	8	14	1.25	14	8	8	16	10	10	1.5	16
	40°C											
FR-XC-22K FR-XC-18.5K-PWM	50°C	22	22	1.25	22	6	4	16	10	16	1.5	16
	40°C					4			16			
FR-XC-30K FR-XC-22K-PWM	50°C	38	38	1.25	22	4	2	16	16	16	1.5	25
	40°C	22								25		
FR-XC-37K FR-XC-37K-PWM	50°C	60	60	1.25	22	1	1	16	35	35	1.5	25
	40°C	38					1/0			50		
FR-XC-55K FR-XC-55K-PWM	50°C	80	100	1.25	38	2/0	3/0	16	50	70	1.5	35
	40°C											

Model	Rating	Crimp terminal (for HIV cables, etc.)	
		R, S, T R2, S2, T2	Earth (ground)
FR-XCG-7.5K	50°C	3.5-5	5.5-4
	40°C		
FR-XCG-11K	50°C	5.5-5	8-4
	40°C		
FR-XCG-15K	50°C	8-6	14-5
	40°C		
FR-XCG-22K	50°C	22-6	22-6
	40°C		
FR-XCG-30K	50°C	22-6	22-6
	40°C		
FR-XCG-37K	50°C	60-10	22-6
	40°C	38-10	
FR-XCG-55K	50°C	80-10	38-6
	40°C		

∗1 It is the gauge of a cable with the continuous maximum permissible temperature of 75°C (HIV cable (600 V grade heat-resistant PVC insulated wire), etc.). It assumes a surrounding air temperature of 50°C or less (40°C or less for the 40°C rating) and the wiring distance of 20 m or less from the power supply to the converter.

∗2 The cable size is that of the THHW cable with continuous maximum permissible temperature of 75°C. It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
(For the use in the United States or Canada, refer to page 236.)

∗3 For the FR-XC-15K or lower, it is the gauge of a cable with the continuous maximum permissible temperature of 70°C (PVC cable). It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
For the FR-XC-22K / FR-XC-18.5K-PWM or higher, it is the gauge of a cable with the continuous maximum permissible temperature of 90°C (PVC cable). It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
(Selection example mainly for use in Europe.)

∗4 If a cable thinner than the recommended cable size is used, it may not be protected by the DC fuse. (Refer to page 104 for the fuse selection.)

∗5 Refer to the Inverter Instruction Manual.

∗6 When using a separate power supply for the control circuit, remove the jumpers connected to terminals R1/L11 and S1/L21.

- 400 V class

Model	Rating	Crimp terminal (for HIV cables, etc.)				
		R, S, T	R2, S2, T2	P4, N	R1, S1	Earth (ground)
FR-XC-H7.5K	50°C	1.25-4	3.5-5	3.5-6	1.25-4	3.5-4
	40°C					
FR-XC-H11K	50°C	1.25-4	3.5-5	3.5-6	1.25-4	3.5-5
	40°C					
FR-XC-H15K	50°C	1.25-4	3.5-5	5.5-6	1.25-4	5.5-5
	40°C					
FR-XC-H22K FR-XC-H18.5K-PWM	50°C	1.25-4	8-8	14-6	1.25-4	8-6
	40°C			8-6		
FR-XC-H30K FR-XC-H22K-PWM	50°C	1.25-4	14-8	14-6	1.25-4	14-6
	40°C		8-8			
FR-XC-H37K FR-XC-H37K-PWM	50°C	1.25-4	22-8	22-8	1.25-4	14-8
	40°C		14-8			
FR-XC-H55K FR-XC-H55K-PWM	50°C	1.25-4	38-8	38-8	1.25-4	22-8
	40°C					

Model	Rating	Cable gauge										
		HIV cables, etc. (mm^2) ∗1				AWG/MCM ∗2			PVC cables, etc. (mm^2) ∗3			
		Location in the connection diagram			Earth (ground)	Location in the connection diagram			Location in the connection diagram			Earth (ground)
		a, b	c ∗4	d		a, b	c	d	a, b	c	d	
FR-XC-H7.5K	50°C	3.5	3.5	1.25	3.5	12	12	16	4	4	1.5	4
	40°C											
FR-XC-H11K	50°C	3.5	3.5		3.5	12	12	16	4	4	1.5	4
	40°C											
FR-XC-H15K	50°C	3.5	5.5	1.25	5.5	12	12	16	4	4	1.5	4
	40°C						10					
FR-XC-H22K FR-XC-H18.5K-PWM	50°C	8	14	1.25	8	10	8	16	6	10	1.5	10
	40°C		8			8						

Model	Rating	Cable gauge										
		HIV cables, etc. (mm^2) *1				AWG/MCM *2			PVC cables, etc. (mm^2) *3			
		Location in the connection diagram			Earth (ground)	Location in the connection diagram			Location in the connection diagram			Earth (ground)
		a, b	c *4	d		a, b	c	d	a, b	c	d	
FR-XC-H30K FR-XC-H22K-PWM	50°C	14	14	1.25	14	8	6	16	10	10	1.5	10
	40°C	8										
FR-XC-H37K FR-XC-H37K-PWM	50°C	22	22	1.25	14	6	4	16	16	16	1.5	16
	40°C	14										
FR-XC-H55K FR-XC-H55K-PWM	50°C	38	38	1.25	22	4	2	16	25	25	1.5	16
	40°C					2						

Model	Rating	Crimp terminal (for HIV cables, etc.)	
		R, S, T R2, S2, T2	Earth (ground)
FR-XCG-H7.5K	50°C	3.5-5	3.5-4
	40°C		
FR-XCG-H11K	50°C	3.5-5	3.5-4
	40°C		
FR-XCG-H15K	50°C	3.5-5	5.5-5
	40°C		
FR-XCG-H22K	50°C	8-6	8-6
	40°C		
FR-XCG-H30K	50°C	14-6	14-6
	40°C	8-6	
FR-XCG-H37K	50°C	22-8	14-6
	40°C	14-8	
FR-XCG-H55K	50°C	38-8	22-6
	40°C		

*1 It is the gauge of a cable with the continuous maximum permissible temperature of 75°C (HIV cable (600 V grade heat-resistant PVC insulated wire), etc.). It assumes a surrounding air temperature of 50°C or less (40°C or less for the 40°C rating) and the wiring distance of 20 m or less from the power supply to the converter.

*2 For the FR-XC-H37K or lower, it is the gauge of the cable with the continuous maximum permissible temperature of 75°C (THHW cable). It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
For FR-XC-H55K, the cable gauge is with the continuous maximum permissible temperature of 90°C (THHN cable). It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
(For the use in the United States or Canada, refer to page 236.)

*3 For the FR-XC-H37K or lower, it is the gauge of the cable with the continuous maximum permissible temperature of 70°C (PVC cable). It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
For FR-XC-H55K, the cable gauge is with the continuous maximum permissible temperature of 90°C (XLPE cable). It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
(Selection example mainly for use in Europe.)

*4 If a cable thinner than the recommended cable size is used, it may not be protected by the DC fuse. (Refer to page 104 for the fuse selection.)

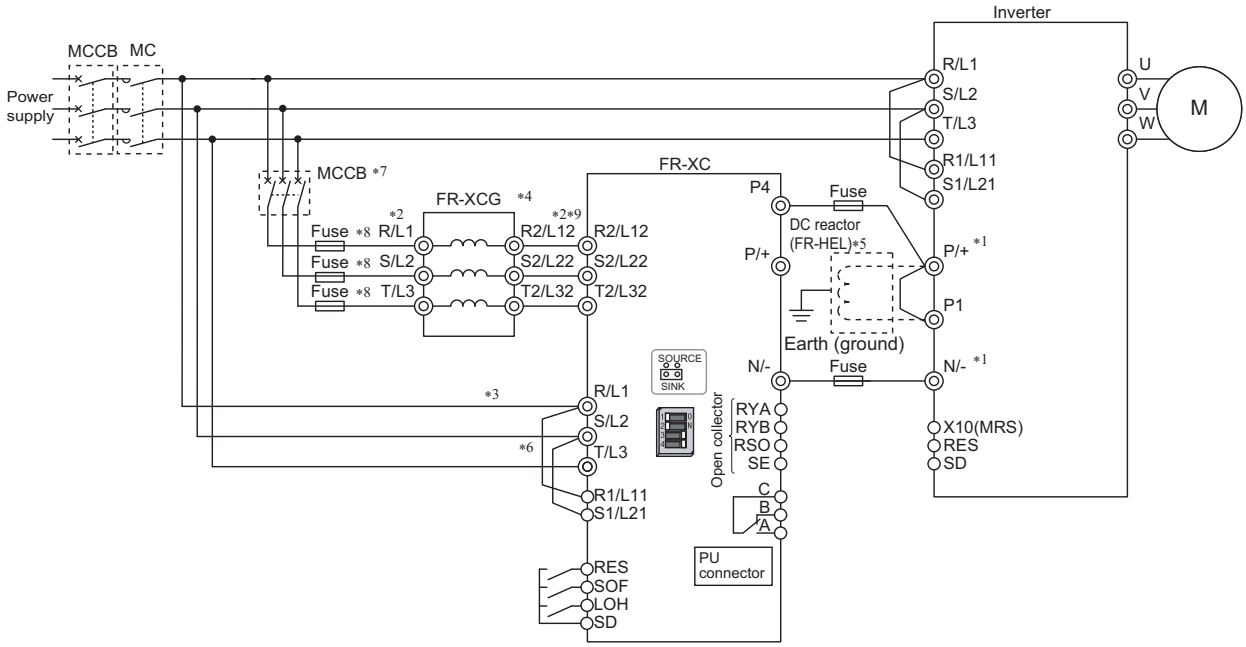
*5 Refer to the Inverter Instruction Manual.

*6 When using a separate power supply for the control circuit, remove the jumpers connected to terminals R1/L11 and S1/L21.

5.5 Wiring

5.5.1 Terminal connection diagram

Incorrect wiring will cause a fault indication, failure, or damage of the multifunction regeneration converter.
Refer to the Instruction Manual of each inverter for the wiring of the inverter. Special attention must be paid to the wiring length and cable size.



*1 Connect between the inverter terminal P/+ and the converter terminal P4 and between the inverter terminal N/- and the converter terminal N/- for polarity consistency.
Connecting the opposite polarity of terminals P/+ and N/- will damage the converter and the inverter.

*2 Confirm the correct phase sequence of three-phase current to connect between the reactor and the converter, and between the power supply and the reactor.
Incorrect connection will damage the converter.

*3 Always connect between the power supply and terminals R/L1, S/L2, and T/L3 of the converter. Operating the inverter without connecting them will damage the converter. A branch point to each of these terminals must be placed between the power supply and the FR-HAL reactor.

*4 Install the FR-XCG reactor between the power supply and the converter as shown in the figure. For information to select an appropriate model, refer to page 115.

*5 To connect a DC reactor, remove a jumper installed across terminals P1 and P/+ before installing the DC reactor.

*6 When using a separate power supply for the control circuit, remove the jumpers connected to terminals R1/L11 and S1/L21.

*7 For selection of an MCCB for the converter, refer to page 103.

*8 Install the UL listed fuse (refer to page 236) on the input side of the FR-XCG reactor to meet the UL/cUL standards.

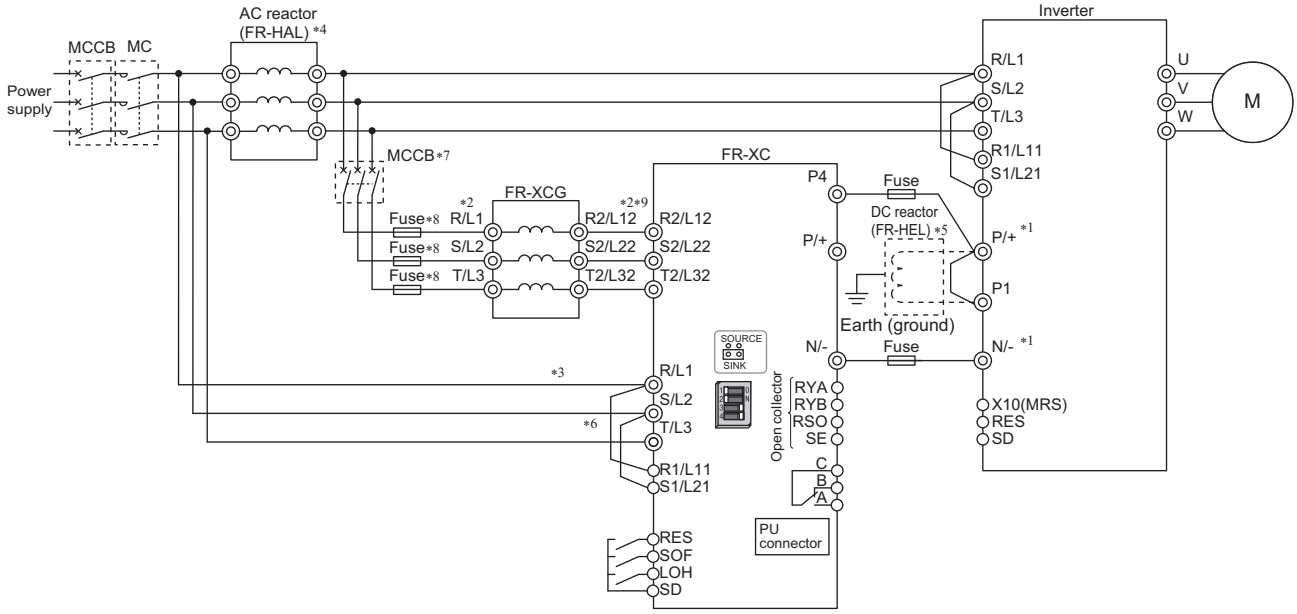
*9 Do not install an MCCB or MC between the reactors and the converter. Doing so disrupts proper operation.

⚠CAUTION

- Configure a system so that the magnetic contactor (MC) at the converter input side shuts off the power supply at a failure of the converter or the connected inverter. (The converter does not shut off the power supply by itself.)
  Failure to do so may overheat and burn the resistors in the converter and the connected inverter.

◆When using an AC reactor

• When using the AC reactor (FR-HAL) with the inverter and converter, wire them as follows.



*1 Connect between the inverter terminal P/+ and the converter terminal P4 and between the inverter terminal N/- and the converter terminal N/- for polarity consistency.
Connecting the opposite polarity of terminals P/+ and N/- will damage the converter and the inverter.

*2 Confirm the correct phase sequence of three-phase current to connect between the reactor and the converter, and between the power supply and the reactor.
Incorrect connection will damage the converter.

*3 Always connect between the power supply and terminals R/L1, S/L2, and T/L3 of the converter. Operating the inverter without connecting them will damage the converter. A branch point to each of these terminals must be placed between the power supply and the FR-HAL reactor.

*4 Install the FR-HAL reactor between the node points joined to the converter terminals R/L1, S/L2, and T/L3 and the node points joined to the FR-XCG reactor. To select an appropriate reactor, refer to the table below.

*5 To connect a DC reactor, remove a jumper installed across terminals P1 and P/+ before installing the DC reactor.

*6 To use separate power supply for the control circuit, remove each jumper at terminal R1/L11 and terminal S1/L21.

*7 For selection of an MCCB for the converter, refer to page 103.

*8 Install the UL listed fuse (refer to page 236) on the input side of the FR-XCG reactor to meet the UL/cUL standards.

*9 Do not install an MCCB or MC between the reactors and the converter. Doing so disrupts proper operation.

⚠CAUTION

● Configure a system so that the magnetic contactor (MC) at the converter input side shuts off the power supply at a failure of the converter or the connected inverter. (The converter does not shut off the power supply by itself.)
Failure to do so may overheat and burn the inverter connected to the FR-XC-H75K, or the resistors in the converter (FR-XC-(H)55K or lower) and the connected inverter.

NOTE

• For details on the power regeneration mode 1, refer to page 224.

• The following table shows applicable combinations of the converter and AC reactor.

Model		FR-HAL-(H)[]									
		7.5K or lower	11K	15K	18.5K	22K	30K	37K	45K	55K	75K or higher
FR-XC-(H)[]	7.5K	×	○	○	○	○	○	○	○	○	○
	11K	×	×	○	○	○	○	○	○	○	○
	15K	×	×	×	○	○	○	○	○	○	○
	22K	×	×	×	×	×	○	○	○	○	○
	30K	×	×	×	×	×	×	○	○	○	○
	37K	×	×	×	×	×	×	×	○	○	○
	55K	×	×	×	×	×	×	×	×	×	○

○: Possible, ×: Not possible

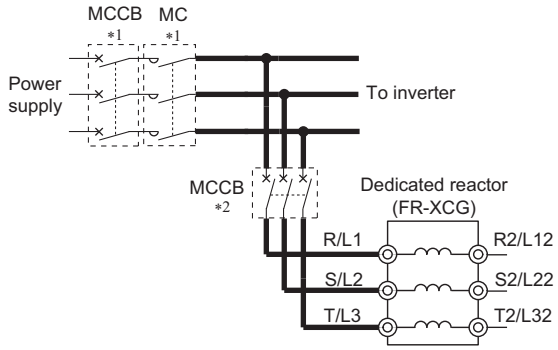
• Ensure that the combination is possible. The AC reactor may overheat if the combination is not applicable.

• Do not connect an external brake resistor such as the FR-ABR when using the converter.

5.5.2 Wiring

◆Wiring the power supply to the reactor

• Cable gauge differs by the capacity. Select an appropriate cable by referring to **page 105** to perform wiring.

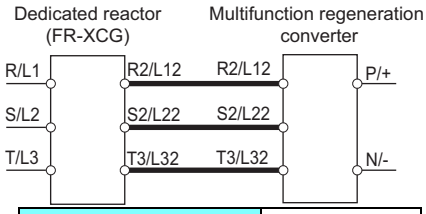


*1 Select a MCCB and a MC according to the inverter capacity.

*2 For selection of MCCB for the converter, refer to **page 103**.

◆Wiring the reactor to the converter

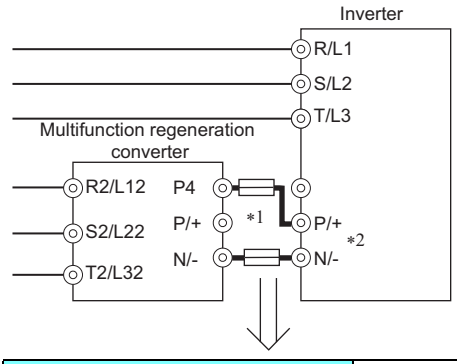
• Cable gauge differs by the capacity. Select an appropriate cable by referring to **page 105** to perform wiring.



Total wiring length	10 m or shorter

◆Wiring the converter to the inverter

• For the cable gauge of the cable for the main circuit terminals P/+ and N/- (P to P and N to N), refer to **page 105**.



Main circuit wiring length	5 m or shorter

*1 Installation of a fuse on each cable is recommended to prevent the damage from spreading in case of an inverter failure. Select the fuse according to the motor capacity. To use a motor whose capacity is smaller than the inverter capacity by two ranks or more, select the fuse with the capacity that is one rank lower than the inverter capacity. Refer to the fuse selection table on **page 104**.

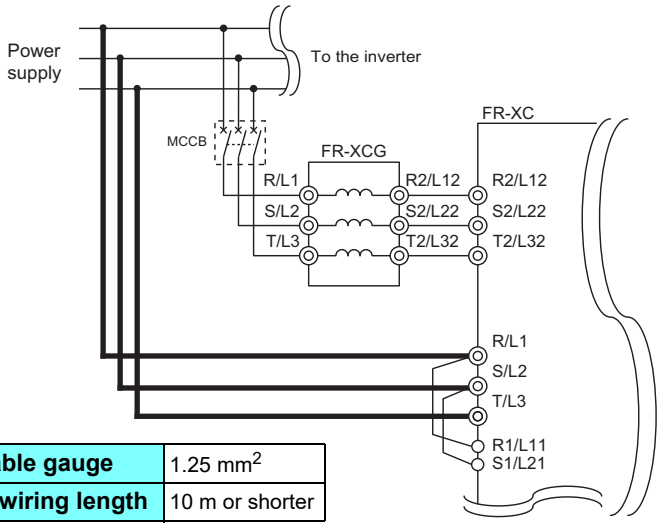
*2 Do not install any MCCB between the inverter and the converter (P to P and N to N).

NOTE

• Connecting opposite polarity of terminals P4 and N/- will damage the converter.

◆Wiring the power supply to the converter

Supply power to the power detecting terminals (R/L1, S/L2, and T/L3) separately from the main circuit wiring.



Cable gauge	1.25 mm^2
Total wiring length	10 m or shorter

NOTE

- The terminals R/L1, S/L2, and T/L3 on the converter are control terminals to detect power phases of the power supply. For wiring, the voltage phase must be consistent between terminals R2/L12, S2/L22, and T2/L32 and terminals R/L1, S/L2, and T/L3. If these terminals are not connected correctly, the converter does not operate properly.
- If the inverter is operated while the converter terminals R/L1, S/L2, and T/L3 are not connected to the power supply, the converter will be damaged.

5.6 Connection mode selection

- Select the power regeneration mode 2 by setting the positions of switches 1 and 2 (connection mode setting switches) in the function selection switch assembly (SW2).

Connection mode selection

Switch		Function
1	2	
ON	ON or OFF	Common bus regeneration mode (page 59) / harmonic suppression mode (page 79)
OFF	ON	Power regeneration mode 1
	OFF	Power regeneration mode 2

NOTE

- The new setting of the switch is applied at the next power-ON or converter reset.
- If the connection mode setting does not match the actual wiring of the main circuit terminals, the connection mode fault "E.T" occurs.

5.7 Temperature derating selection

The temperature rating changes according to the setting position of the switch 3 in the function selection switch assembly (SW2).

When the 40°C rating is selected, the rated current and the applied current can be increased.

When the 40°C rating is selected, the surrounding air temperature must be between -10 and +40°C (non-freezing).

NOTE

- The new setting of the switch is applied at the next power-ON or converter reset.

50°C rating

40°C rating

5.8 Inverter parameter settings

To use the converter with the inverter, **Pr.30 Regenerative function selection** in the inverter parameters must be set.

- To use the converter in power regeneration mode 2, set "0" in **Pr.30** in any inverter regardless of the model and capacity. If a jumper is installed across terminals PR and PX, remove the jumper.

NOTE

- Set **Pr.30** in the inverter used with the converter in power regeneration mode 2. Incorrect setting may disrupt normal operation.

5.9 Rating

5.9.1 FR-XC-[ ]K

200 V class

Model FR-XC-[ ]K		7.5	11	15	22	30	37	55
50°C rating	Potential continuous regenerative capacity (kW)*2	5.5	7.5	11	18.5	22	30	45
	Rated current (A) (regenerative driving)	19	26	37	62	74	102	152
	Continuous rating / overload current rating	100% continuous / 150% 60 s						
40°C rating	Potential continuous regenerative capacity (kW)*2	5.5	7.5	11	18.5	22	30	45
	Rated current (A) (regenerative driving)	21	28	40	68	81	112	167
	Continuous rating / overload current rating	100% continuous / 150% 60 s						
Power source	Rated input AC voltage/ frequency	Three-phase 200 to 240 V, 50/60 Hz*3						
	Permissible AC voltage fluctuation	Three-phase 170 to 264 V, 50/60 Hz						
	Permissible frequency fluctuation	±5%						
Protection rating of structure (IEC 60529)		IP00						
Cooling system		Forced air						
Number of connectable inverters		1						
Approx. mass (kg)*1		5	5	6	10.5	10.5	28	38

400 V class

Model FR-XC-H[ ]K		7.5	11	15	22	30	37	55
50°C rating	Potential continuous regenerative capacity (kW)*2	5.5	7.5	11	18.5	22	30	45
	Rated current (A) (regenerative driving)	10	14	20	33	39	54	80
	Continuous rating / overload current rating	100% continuous / 150% 60 s						
40°C rating	Potential continuous regenerative capacity (kW)*2	5.5	7.5	11	18.5	22	30	45
	Rated current (A) (regenerative driving)	11	15	21	36	42	59	88
	Continuous rating / overload current rating	100% continuous / 150% 60 s						
Power source	Rated input AC voltage/ frequency	Three-phase 380 to 500 V, 50/60 Hz*3						
	Permissible AC voltage fluctuation	Three-phase 323 to 550 V, 50/60 Hz						
	Permissible frequency fluctuation	±5%						
Protection rating of structure (IEC 60529)		IP00						
Cooling system		Forced air						
Number of connectable inverters		1						
Approx. mass (kg)*1		5	5	6	10.5	10.5	28	28

*1 Mass of the FR-XC alone.

*2 Maximum capacity of regenerative power generated from the Mitsubishi Electric standard 4-pole motor in each axis.

*3 The permissible voltage imbalance ratio is 3% or less. (Unbalance factor = Max | Line voltage - Mean of three line voltages | / Mean of three line voltages × 100)

5.9.2 FR-XC-[ ]K-PWM

200 V class

Model FR-XC-[ ]K-PWM		18.5	22	37	55
50°C rating	Potential continuous regenerative capacity (kW)*2	18.5	22	30	45
	Rated current (A) (regenerative driving)	62	74	102	152
	Continuous rating / overload current rating	100% continuous / 150% 60 s			
40°C rating	Potential continuous regenerative capacity (kW)*2	18.5	22	30	45
	Rated current (A) (regenerative driving)	68	81	112	167
	Continuous rating / overload current rating	100% continuous / 150% 60 s			
Power source	Rated input AC voltage/ frequency	Three-phase 200 to 240 V, 50/60 Hz*3			
	Permissible AC voltage fluctuation	Three-phase 170 to 264 V, 50/60 Hz			
	Permissible frequency fluctuation	±5%			
Protection rating of structure (IEC 60529)		IP00			
Cooling system		Forced air			
Number of connectable inverters		1			
Approx. mass (kg)*1		10.5	10.5	28	38

400 V class

Model FR-XC-H[ ]K-PWM		18.5	22	37	55
50°C rating	Potential continuous regenerative capacity (kW)*2	18.5	22	30	45
	Rated current (A) (regenerative driving)	33	39	54	80
	Continuous rating / overload current rating	100% continuous / 150% 60 s			
40°C rating	Potential continuous regenerative capacity (kW)*2	18.5	22	30	45
	Rated current (A) (regenerative driving)	36	42	59	88
	Continuous rating / overload current rating	100% continuous / 150% 60 s			
Power source	Rated input AC voltage/ frequency	Three-phase 380 to 500 V, 50/60 Hz*3			
	Permissible AC voltage fluctuation	Three-phase 323 to 550 V, 50/60 Hz			
	Permissible frequency fluctuation	±5%			
Protection rating of structure (IEC 60529)		IP00			
Cooling system		Forced air			
Number of connectable inverters		1			
Approx. mass (kg)*1		10.5	10.5	28	28

*1 Mass of the FR-XC alone.

*2 Maximum capacity of regenerative power generated from the Mitsubishi Electric standard 4-pole motor in each axis.

*3 The permissible voltage imbalance ratio is 3% or less. (Unbalance factor = Max | Line voltage - Mean of three line voltages | / Mean of three line voltages × 100)

5.10 Combination matrix of FR-XCG and FR-XC(-PWM)

• 200 V class

Multifunction regeneration converter		Dedicated stand-alone reactor
Model	Rated surrounding temperature	FR-XCG-[ ]K
FR-XC-7.5K	50°C/40°C rating	7.5
FR-XC-11K		11
FR-XC-15K		15
FR-XC-18.5K-PWM		22
FR-XC-22K		
FR-XC-22K-PWM		30
FR-XC-30K		
FR-XC-37K FR-XC-37K-PWM		37
FR-XC-55K FR-XC-55K-PWM		55

• 400 V class

Multifunction regeneration converter		Dedicated stand-alone reactor
Model	Rated surrounding temperature	FR-XCG-H[ ]K
FR-XC-H7.5K	50°C/40°C rating	7.5
FR-XC-H11K		11
FR-XC-H15K		15
FR-XC-H18.5K-PWM		22
FR-XC-H22K		
FR-XC-H22K-PWM		30
FR-XC-H30K		
FR-XC-H37K FR-XC-H37K-PWM		37
FR-XC-H55K FR-XC-H55K-PWM		55

MEMO

6 PARAMETERS

This chapter explains the parameters in this product.
Always read the instructions before use.

6.1 PU installation on converter 118
6.2 Operation panel (FR-DU08) 119
6.3 Monitoring the converter status 122
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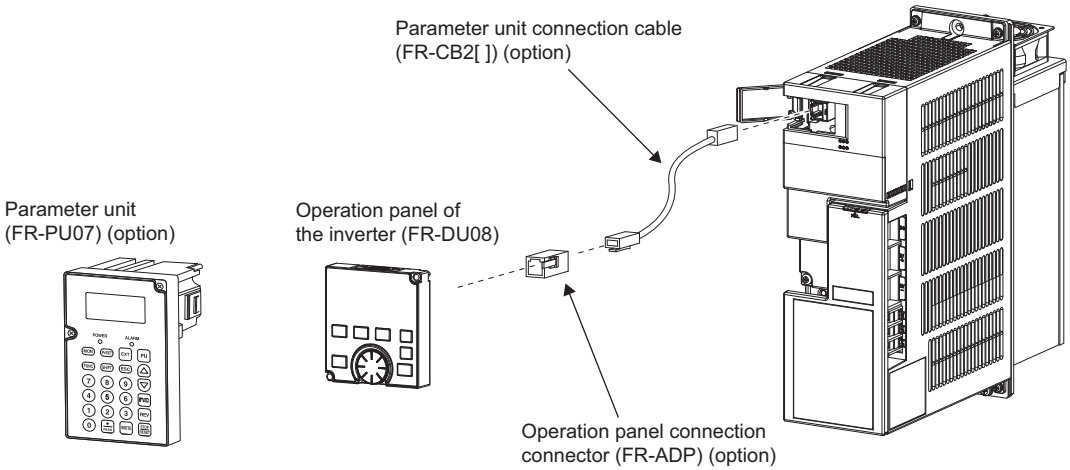
6.1 PU installation on converter

- When the PU (inverter operation panel or optional parameter unit) is installed on the multifunction regeneration converter, the setting of converter parameters is possible by using the PU.
  Use the option FR-CB2[ ] or the following connector and cable available on the market.
  (To install the operation panel, the optional connector (FR-ADP) is also required.)
  Securely insert one end of connection cable into the PU connector on the converter and the other end into the connection connector on the parameter unit or the FR-ADP attached on the operation panel along the guides until the stoppers are fixed.



NOTE

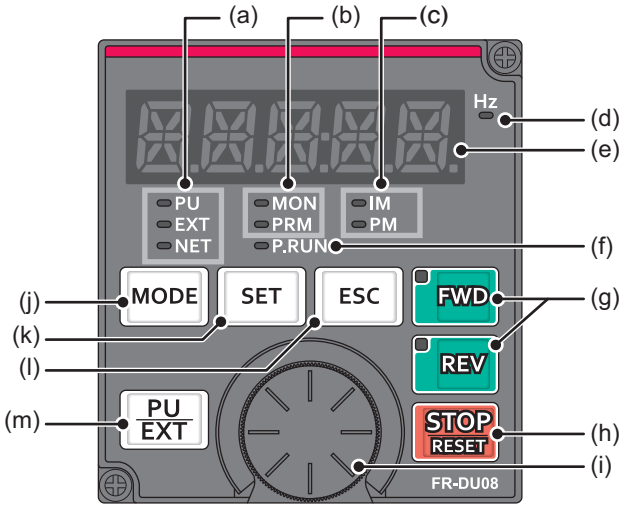
- Refer to the following table when fabricating the cable on the user side. Keep the total cable length within 20 m.

Name	Remarks
Communication cable	Cable compliant with EIA-568 (such as 10BASE-T cable)

6.2 Operation panel (FR-DU08)

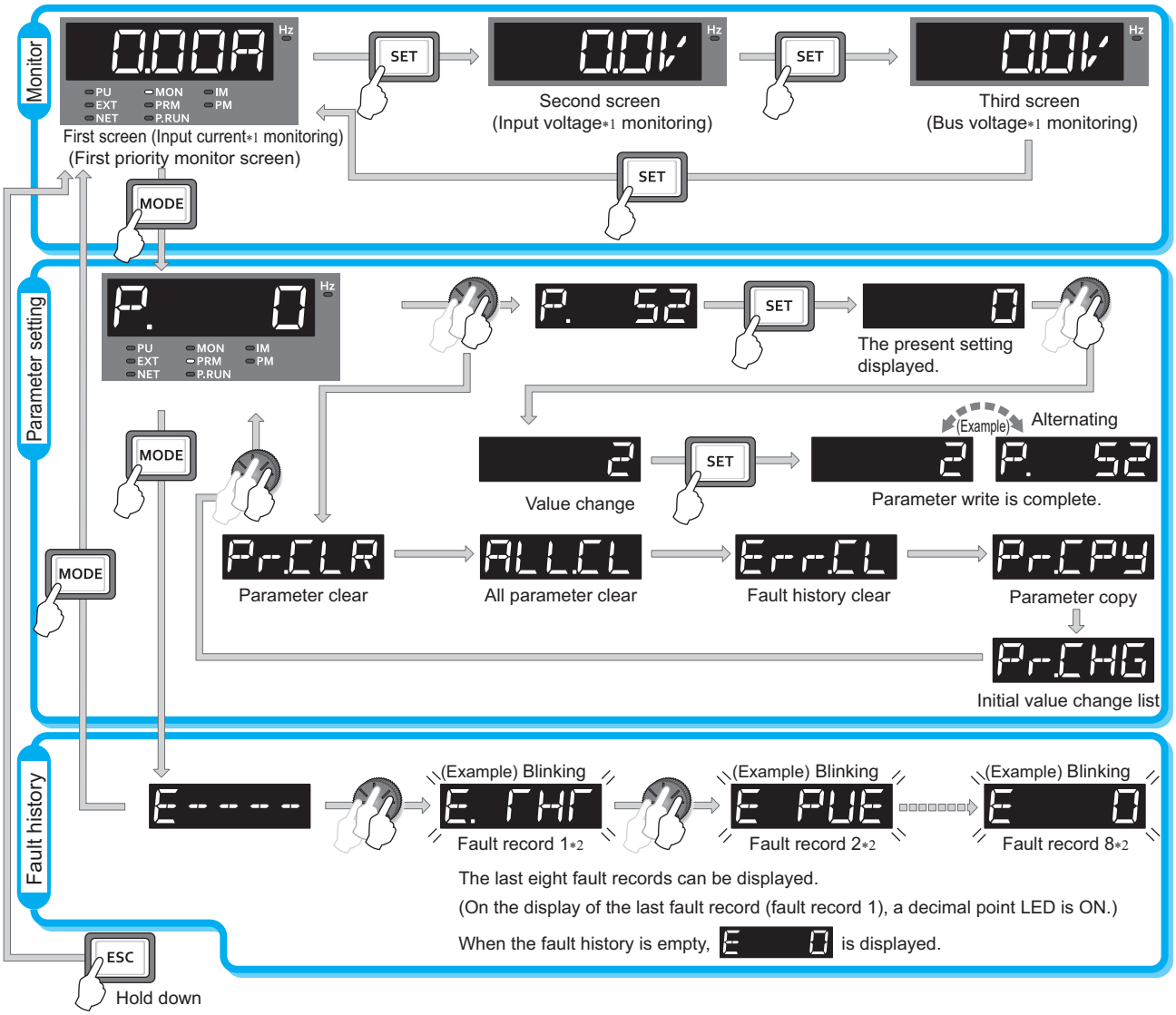
6.2.1 Components of the operation panel

Installing the inverter operation panel (FR-DU08) on the multifunction regeneration converter allows to set the converter parameters and monitor the converter status.



No.	Component	Name	Description
(a)	PU EXT NET	Not available for the FR-XC(-PWM) converter.	
(b)	MON PRM	Operation panel mode LED indicator	MON: ON when the operation panel is in the monitor mode. Quickly blinks twice intermittently while the converter protective function is activated. PRM: ON when the operation panel is in the parameter setting mode.
(c)	IM PM	Not available for the FR-XC(-PWM) converter.	
(d)	Hz	Not available for the FR-XC(-PWM) converter.	
(e)		Monitor (5-digit LED)	Shows a numeric value, a parameter number, etc. (The monitor item can be changed according to the **Pr.52** setting.)
(f)	P.RUN	Not available for the FR-XC(-PWM) converter.	
(g)	FWD REV	FWD key, REV key	FWD key: Its LED is ON during power driving. REV key: Its LED is ON during regenerative driving. The LEDs are OFF when the converter stops its operation due to power supply failure or when a fault occurs. The LEDs blink when the converter stops its operation due to a cause except the above-mentioned cause.
(h)	STOP RESET	STOP/RESET key	Used to stop operation commands. Used to reset the converter when the protective function is activated.
(i)		Setting dial	Turn the setting dial to select a parameter or change the parameter setting. Press the setting dial to display a fault history number in the fault history mode.
(j)	MODE	MODE key	Switches the operation panel to a different mode. Holding this key for 2 seconds locks the operation of the operation panel.
(k)	SET	SET key	Used to confirm each selection. Pressing this key during the converter operation changes the monitor item to be displayed. Initial setting in the monitor mode Input current → Input voltage → Bus voltage (The monitor item can be changed according to the **Pr.52** setting.)
(l)	ESC	ESC key	Goes back to the previous display. Holding down this key changes the mode of operation panel back to the monitor mode.
(m)	PU EXT	PU/EXT key	Cancels the PU stop warning.

6.2.2 Basic operation of the operation panel (factory setting)



*1 The monitor item can be changed. (Refer to page 138.)
*2 For the details of fault history, refer to page 188.

◆Parameter setting mode

In the parameter setting mode, converter functions (parameters) can be set.

The following table explains the indications in the parameter setting mode.

Operation panel indication	Function name	Description	Refer to page
P.	Parameter setting mode	The set value of the displayed parameter number is read or changed.	121
Pr.CLR	Parameter clear	Clears and resets parameter settings to the initial values. However, terminal function selection parameters are not cleared. For the details of the uncleared parameters, refer to page 232.	170
ALL.CL	All parameter clear	Clears and resets parameter settings to the initial values. Terminal function selection parameters are also cleared. For the details of the uncleared parameters, refer to page 232.	170
Er.CL	Fault history clear	Deletes the fault history.	188
Pr.CPY	Parameter copy	Copies the parameter settings saved in the converter to the operation panel. The parameters copied to the operation panel can be also copied to other converter.	171
Pr.CHG	Initial value change list	Identifies the parameters that have been changed from their initial settings.	174

6.2.3 Digital characters and their corresponding printed equivalents

Digital characters displayed on the operation panel display are as follows.

0	1	2	3	4	5	6	7	8	9	A	B(b)	C	c	D(d)
														
E(e)	F(f)	G(g)	H	h	I(i)	J(j)	K(k)	L(l)	M(m)	N	n	O	o	P(p)
														
Q(q)	R	r	S(s)	T(t)	U	u	V	v	W	w	X(x)	Y(y)	Z(z)	
														

6.2.4 Changing the parameter setting value

Changing example | Change the setting of **Pr.52 PU main monitor selection**.

Operating procedure

1. Turning ON the power of the converter

The operation panel is in the monitor mode.

2. Selecting the parameter setting mode

Press MODE to choose the parameter setting mode. (The parameter number read previously appears.)

3. Selecting the parameter

Turn the dial until "P. 52" **(Pr.52)** appears. Press SET to read the present set value. "0" (initial value) appears.

4. Changing the setting value

Turn the dial to change the set value to "9". Press SET to confirm the selection. "9" and "P. 52" are displayed alternately.

- Turn the dial to read another parameter.
- Press SET to show the setting again.
- Press SET twice to show the next parameter.
- Press MODE twice to return to the monitor mode.

NOTE

- If a parameter write condition is not satisfied, a parameter write error appears on the LCD display. (Refer to page 178.)

Error indication	Description
Er 1	Write disable error

POINT

- When **Pr.77 Parameter write selection** = "2 (initial value)", the parameter setting change is always enabled. The parameter setting change can be disabled by changing the **Pr.77** setting. (Refer to page 145.)

6.3 Monitoring the converter status

6.3.1 Monitoring of input voltage or bus voltage

POINT

- Press SET on the operation panel in the monitor mode to switch the monitor item between input current, input voltage, and bus voltage (factory setting).

Operating procedure

1.	Press MODE during converter operation to monitor the input current. The unit of current "A" appears.
2.	Press SET to monitor the input voltage. This operation is valid under any operation mode of the converter and whether the converter is running or at a stop. The unit of voltage "V" appears.
3.	Press SET to monitor the bus voltage. The unit of voltage "V" appears.

NOTE

- Use **Pr.52 PU main monitor selection** to change the monitor item. (Refer to page 138.)

6.3.2 First priority monitor screen

The first priority monitor screen, which is displayed first when the operation panel becomes in the monitor mode, is selectable. To set it, hold down SET when the desired monitor item is displayed on a monitor screen.

Changing example | Set the monitor screen displaying the input voltage as the first priority monitor screen.

Operating procedure

1.	Change the mode of the operation panel to the monitor mode, and switch the monitor screen to the one on which the input voltage can be monitored.
2.	Hold down SET for 1 second. The input voltage monitor screen is set as the first priority monitor screen.
3.	When the operation panel is in the monitor mode next time, the input voltage monitored value is displayed first.

NOTE

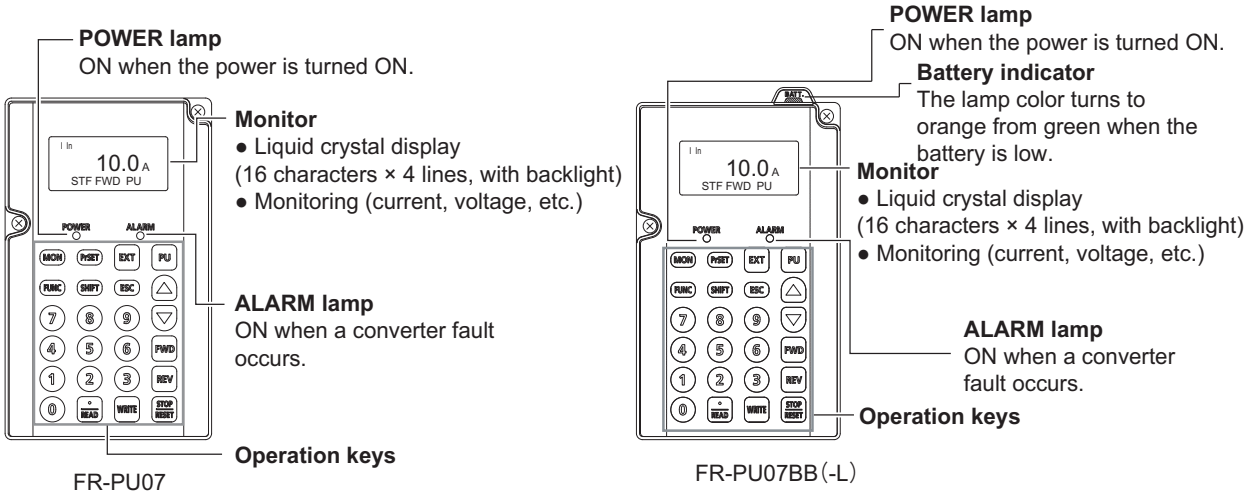
- Use **Pr.52 PU main monitor selection** to change the monitor item. (Refer to page 138.)

6.4 Parameter unit (FR-PU07) / Parameter unit with battery pack (FR-PU07BB(-L))

Installing the optional parameter unit (FR-PU07) / parameter unit with battery pack (FR-PU07BB(-L)*1) on the multifunction regeneration converter allows to set the converter parameters and monitor the converter status. However, the available functions in the parameter unit installed on the converter are limited compared to those in the parameter unit installed on the inverter.

*1 Batteries are not included in FR-PU07BB-L.

6.4.1 Components of the parameter unit



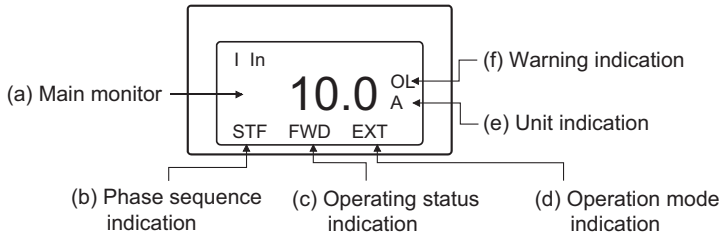
Key	Description
PrSET	Used for parameter setting. Press this key to select the parameter setting mode.
MON	Used to display the first priority monitoring screen. The first priority monitoring screen is initially set to the input current monitoring screen.
ESC	Used to cancel the operation.
FUNC	Used to display the function menu. A variety of functions can be used from the function menu.
SHIFT	Used to shift to the next item in the setting or monitoring mode.
0 to 9	Used to enter a parameter number or set value.
EXT	Used to clear the PU stop warning (" Ld " indication on the converter) when the converter is stopped by pressing STOP RESET (by the PU stop function).
PU	Not available for the FR-XC(-PWM) converter.
▲ / ▼	• Press either of these keys on the parameter setting mode screen to change the parameter setting value sequentially. • On the selecting screen, these keys are used to move the cursor. • Hold down SHIFT and press either of these keys to advance or return the display screen one page.
FWD	Not available for the FR-XC(-PWM) converter.
REV	Not available for the FR-XC(-PWM) converter.
STOP RESET	• Stop command key. • Used to reset the converter when a fault occurs.
WRITE	• Used to write a set value in the setting mode. • Used as a clear command key for All parameter clear or the alarm clear (resetting the fault history).
. READ	• Used to enter a decimal point when entering numerical value. • Used as a parameter number read key in the parameter setting mode. • Used as an item select key on the menu screen such as parameter list or monitoring list. • Used to show the details of each fault in the alarm (fault) history mode.

NOTE

- Do not operate the keys with sharp tools.
- Do not press the LCD part.

6.4.2 Monitoring function

◆Indications displayed on the monitoring screen



(a) Main monitor

The input current, input voltage, bus voltage, alarm history, or other monitor data is displayed.

Press [READ] to display the monitoring list.

Select an item from the monitoring list and press [READ] to monitor the selected item.

The following items can be monitored.

I In	: Input current (A)
V In	: Input voltage (V)
Dc Bus	: Bus voltage (V)
Alarm His	: Fault history (the last 8 faults)
Hz In	: Power supply frequency (Hz)
THT %	: Electronic thermal O/L relay load factor (%)
Pwr In	: Input power (kW)
Cum Pwr	: Cumulative power (kWh)
Cum Opr	: Cumulative energization time (h)
I/P Signal	: Input signal
O/P Signal	: Output signal

(b) Connection phase sequence indication

The following phase sequence is displayed.

STF	: Positive
STR	: Negative
---	: Power supply not detected

(c) Operating status indication

The operating status of the multifunction regeneration converter is displayed.

STOP	: Stop state
FWD	: Power driving
REV	: Regenerative driving
ALAR	: Fault state

(d) Operation mode indication

"EXT" (External operation mode) is always indicated.

(e) Unit indication

The unit of the main monitor item is indicated.

(f) Warning indication

The following is indicated when the multifunction regeneration converter outputs a warning.

Nothing is indicated when there is no warning output.

(For the details, refer to **page 180**.)

OL	: Overload signal detection
TH	: Electronic thermal relay function pre-alarm
PS	: PU stop
MT	: Maintenance signal output
SL	: Power supply not detected
CP	: Parameter copy

6.4.3 Function menu

Press FUNC in any operation mode to call the function menu, on which you can perform various functions.

NOTE

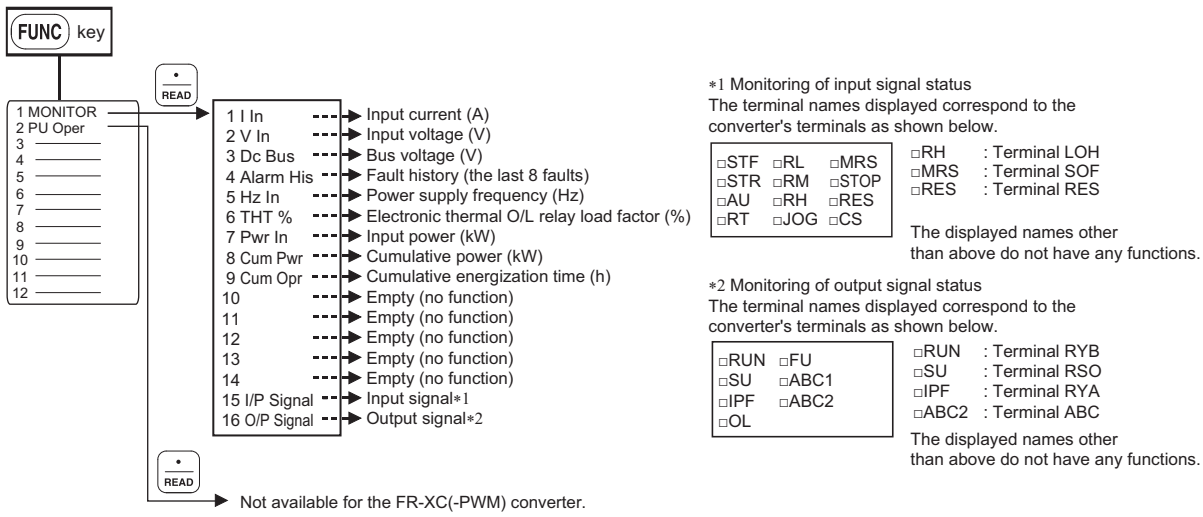
- There are menus in which some functions are not available.

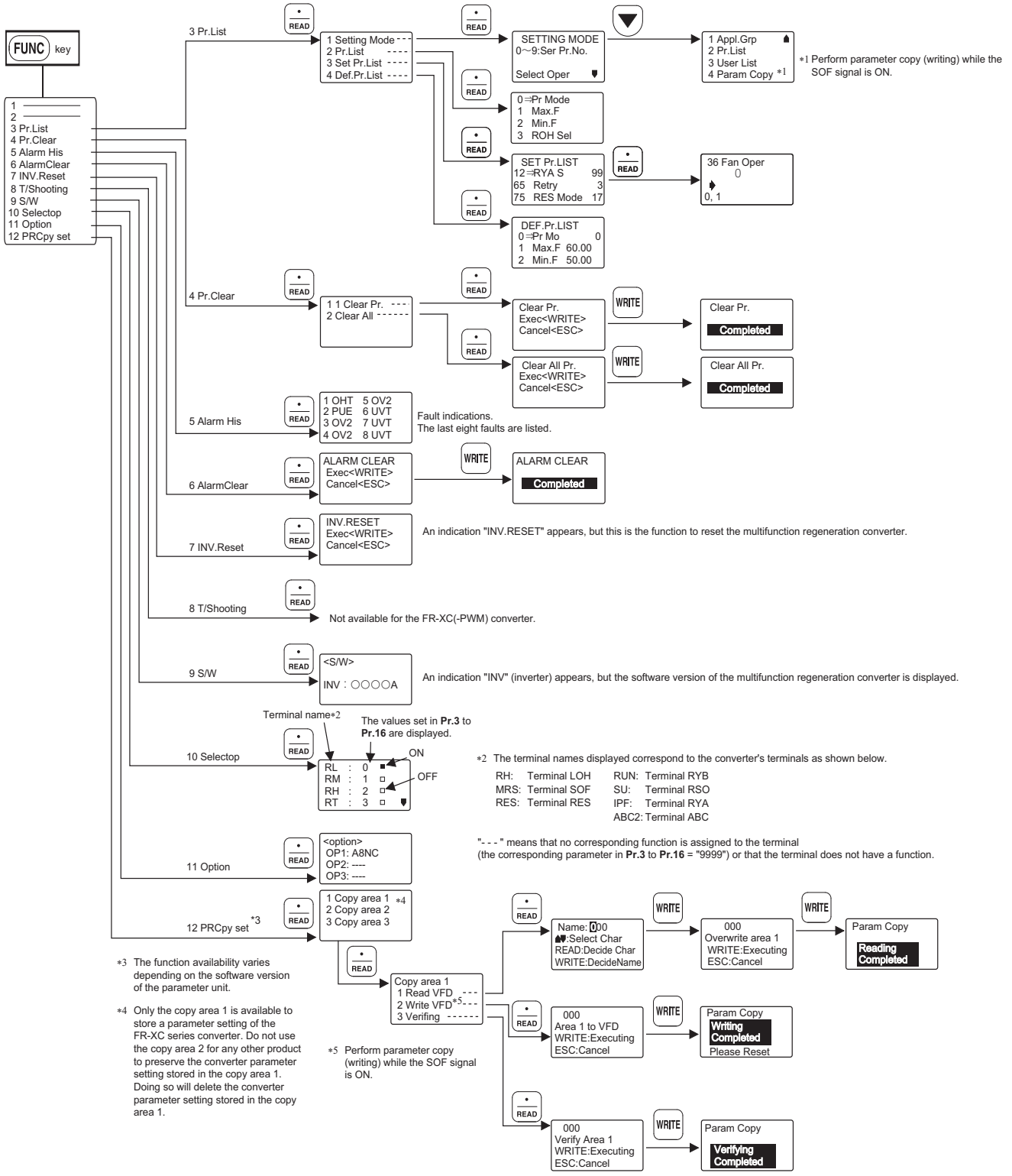
◆Function menu list

Function menu	Description
1. MONITOR	The monitoring list appears, and the functions on monitoring such as the monitor item selection to be displayed, the first priority monitoring screen selection.
2. PU Oper	The menu appears, but every function in the menu is disabled.
3. Pr.List	The parameter menu appears, and the parameter setting and the displaying of the initial value change list are available.
4. Pr.Clear	The menu to clear parameters appears. Parameter clear and All parameter clear can be executed.
5. Alarm Hist	The last 8 faults are displayed.
6. AlarmClear	The fault history (all fault records) can be cleared.
7. Inv.Reset	The multifunction regeneration converter can be reset. (The inverter can also be reset simultaneously.)
8. T/Shooting	The menu appears, but every function in the menu is disabled.
9. S/W	The software control number of the converter is displayed.
10. Selectop	The signals assigned to the I/O control terminals and the ON/OFF status of the signals can be checked.
11. Option	The option connector occupancy condition is displayed.
12. FRCpy set	Parameter copy (reading, writing, and verifying of parameters) can be performed.*1

*1 Parameter copy using the FR-PU07(BB) is available when the product manufactured in September 2015 or later is used.

◆Function menu transition




FUNC key
1
2
3 Pr.List
4 Pr.Clear
5 Alarm His
6 AlarmClear
7 INV.Reset
8 T/Shooting
9 S/W
10 Selectop
11 Option
12 PRCpy set
READ
WRITE
3 Pr.List
1 Setting Mode
2 Pr.List
3 Set Pr.List
4 Def.Pr.List
SETTING MODE
0～9:Ser Pr.No.
Select Oper
1 Appl.Grp
2 Pr.List
3 User List
4 Param Copy *1
*1 Perform parameter copy (writing) while the SOF signal is ON.
0⇒Pr Mode
1 Max.F
2 Min.F
3 ROH Sel
SET Pr.LIST
12⇒RYA S 99
65 Retry 3
75 RES Mode 17
36 Fan Oper
0
0, 1
DEF.Pr.LIST
0⇒Pr Mo 0
1 Max.F 60.00
2 Min.F 50.00
4 Pr.Clear
1 1 Clear Pr.
2 Clear All
Clear Pr.
Exec<WRITE>
Cancel<ESC>
Completed
Clear All Pr.
Exec<WRITE>
Cancel<ESC>
Completed
5 Alarm His
1 OHT 5 OV2
2 PUE 6 UVT
3 OV2 7 UVT
4 OV2 8 UVT
Fault indications.
The last eight faults are listed.
6 AlarmClear
ALARM CLEAR
Exec<WRITE>
Cancel<ESC>
ALARM CLEAR
Completed
7 INV.Reset
INV.RESET
Exec<WRITE>
Cancel<ESC>
An indication "INV.RESET" appears, but this is the function to reset the multifunction regeneration converter.
8 T/Shooting
Not available for the FR-XC(-PWM) converter.
9 S/W
<S/W>
INV : ○○○○A
An indication "INV" (inverter) appears, but the software version of the multifunction regeneration converter is displayed.
Terminal name*2
The values set in Pr.3 to Pr.16 are displayed.
10 Selectop
ON
OFF
RL : 0
RM : 1
RH : 2
RT : 3
*2 The terminal names displayed correspond to the converter's terminals as shown below.
RH: Terminal LOH
MRS: Terminal SOF
RES: Terminal RES
RUN: Terminal RYB
SU: Terminal RSO
IPF: Terminal RYA
ABC2: Terminal ABC
"- - - " means that no corresponding function is assigned to the terminal
(the corresponding parameter in Pr.3 to Pr.16 = "9999") or that the terminal does not have a function.
11 Option
<option>
OP1: A8NC
OP2: ----
OP3: ----
12 PRCpy set *3
1 Copy area 1 *4
2 Copy area 2
3 Copy area 3
Copy area 1
1 Read VFD
2 Write VFD*5
3 Verifing
Name: 000
:Select Char
READ:Decide Char
WRITE:DecideName
000
Overwrite area 1
WRITE:Executing
ESC:Cancel
Param Copy
Reading Completed
000
Area 1 to VFD
WRITE:Executing
ESC:Cancel
Param Copy
Writing Completed
Please Reset
000
Verify Area 1
WRITE:Executing
ESC:Cancel
Param Copy
Verifying Completed
*3 The function availability varies depending on the software version of the parameter unit.
*4 Only the copy area 1 is available to store a parameter setting of the FR-XC series converter. Do not use the copy area 2 for any other product to preserve the converter parameter setting stored in the copy area 1. Doing so will delete the converter parameter setting stored in the copy area 1.
*5 Perform parameter copy (writing) while the SOF signal is ON.

6.5 Parameter list

Parameter read/write requires the operation panel (FR-DU08) or the optional parameter unit (FR-PU07 or FR-PU07BB(-L)).

NOTE

- ◎ indicates simple mode parameters.
- The setting of parameters in highly colored cell ( ) is changeable during operation even if "1" (write disabled) is set to **Pr.77 Parameter write selection**.

Pr.	Name	Setting range	Minimum setting increment	Initial value	Refer to page	Customer setting
◎0	Simple mode selection	0, 9999	0	0	129	
◎1	Maximum power supply frequency	60 Hz (Read only)	—	(60 Hz)	129	
◎2	Minimum power supply frequency	50 Hz (Read only)	—	(50 Hz)	129	
3	LOH terminal function selection	0, 3 to 5, 9999	1	5	130	
4	SOF terminal function selection		1	0	130	
7	RES terminal function selection		1	3	130	
8	SOF input selection	0 to 2	1	0	131	
9	OH input selection	0, 1	1	0	131	
11	RSO terminal function selection	0 to 4, 6 to 11, 14 to 18, 98, 99, 101 to 104,106 to 111, 114 to 118, 198, 199, 9999	1	1	132	
12	RYA terminal function selection		1	0	132	
16	ABC terminal function selection		1	99	132	
◎22*4	Current limit level	0 to 190%	0.1%	150	133	
23*4	Current limit level (regenerative)	0 to 190%, 9999	0.1%	9999	133	
31	Life alarm status display	0, 1, 4, 5, 8, 9, 12, 13 (Read only)	1	0	134	
32	Inrush current limit circuit life display	0 to 100% (Read only)	1%	100%	134	
33	Control circuit capacitor life display	0 to 100% (Read only)	1%	100%	134	
34	Maintenance timer	0 (1 to 9998)	1	0	135	
35	Maintenance timer warning output set time	0 to 9998, 9999	1	9999	135	
44	Instantaneous power failure detection signal clear	0, 9999	1	9999	136	
46	Watt-hour meter clear	0 to 2, 10, 9999	1	9999	138	
47	Energization time carrying-over times	Read only	1	0	138	
48	Cumulative power monitor digit shifted times	0 to 4, 9999	1	9999	138	
◎52	PU main monitor selection	0, 5 to 10, 25 to 28	1	0	138	
◎57	Restart selection	0, 9999	1	9999	141	
58	Free parameter 1	0 to 9999	1	9999	141	
59	Free parameter 2	0 to 9999	1	9999	141	
61	Key lock operation selection	0, 10	1	0	141	
◎65	Retry selection	0 to 4	1	0	142	
◎67	Number of retries at fault occurrence	0 to 10, 101 to 110, 1001 to 1010, 1101 to 1110	1	0	142	
◎68	Retry waiting time	0.1 to 600 s	0.1 s	1 s	142	
◎69	Retry count display erase	0	1	0	142	

Parameter list

Pr.	Name	Setting range	Minimum setting increment	Initial value	Refer to page	Customer setting
75	Reset selection / disconnected PU detection / PU stop selection	0 to 3, 14 to 17	1	14	144	
◎77	Parameter write selection	1, 2	1	2	145	
80*4	Voltage control proportional gain	0 to 1000%	1%	100	133	
81*4	Voltage control integral gain	0 to 1000%	1%	100	133	
82*4	Current control proportional gain	0 to 200%	1%	100	146	
83*4	Current control integral gain	0 to 200%	1%	100	146	
117	PU communication station number	0 to 31	1	0	148	
118	PU communication speed	48, 96, 192, 384	1	192	148	
119	PU communication stop bit length	0, 1, 10, 11	1	1	148	
120	PU communication parity check	0 to 2	1	2	148	
121	PU communication retry count	0 to 10, 9999	1	1	148	
123	PU communication waiting time setting	0 to 150 ms, 9999	1 ms	9999	148	
124	PU communication CR/LF selection	0 to 2	1	1	148	
◎145	PU display language selection	0 to 7	1	0	169	
168	Parameter for manufacturer setting. Do not set.					
169						
269						
342	Communication EEPROM write selection	0, 1	1	0	168	
415	SW2 setting status	0 to 15 (Read only)	1	15	137	
416	Control method selection	0, 1, 9999	1	9999	71, 91, 111	
◎500*1	Communication error execution waiting time	0 to 999.8 s	0.1 s	0 s	167	
◎501*1	Communication error occurrence count display	0	1	0	167	
◎502*1	Stop mode selection at communication error	0, 3	1	0	167	
520	Parameter for manufacturer setting. Do not set.					
◎542*1, *2,*3	Station number (CC-Link)	1 to 64	1	1	161	
◎543*1, *2,*3	Transmission speed selection (CC-Link)	0 to 4	1	0	161	
◎544*1,*2	CC-Link extended setting	0, 1, 12	1	0	161	
896	Power unit cost	0 to 500	0.01	0	140	
989	Parameter copy alarm release	10, 100	1	10	171	
990	PU buzzer control	0, 1	1	1	169	
991	PU contrast adjustment	0 to 63	1	58	169	
Pr.CLR	Parameter clear	(0), 1	1	0	170	
ALL.C	All parameter clear	(0), 1	1	0	170	
Err.CL	Fault history clear	(0), 1	1	0	188	
Pr.CPY	Parameter copy	(0), 1 to 3	1	0	171	

*1 The setting is available only when a communication option (FR-A8NC) is installed.
*2 The setting is applied after the converter reset or next power-ON.
*3 [L.ERR] LED indicator on the FR-A8NC blinks when a setting is changed. The setting is applied after the converter reset, and the [L.ERR] turns OFF.
*4 The setting is available only when the harmonic suppression mode is selected.

6.6 Parameter details

6.6.1 Showing/hiding extended parameters (Pr.0)

This function restricts the parameters that are read on the PU (operation panel or parameter unit).

Pr.	Name	Initial value	Setting range	Description
0	Simple mode selection	0	9999	Displays only the simple mode parameters.
			0	Displays simple mode and extended parameters.

- When **Pr.0** = "9999", only the simple mode parameters are displayed on the PU. (For the simple mode parameters, refer to the parameter list on page 127.)
- In the initial setting (**Pr.0** = "0"), simple mode parameters and extended parameters are displayed.

NOTE

- Every parameter can be read through communication regardless of the **Pr.0** setting when a communication option is installed.
- **Pr.991 PU contrast adjustment** is regarded as a simple mode parameter on the FR-PU07.

6.6.2 Power frequency input to the converter (Pr.1 and Pr.2)

The following parameters show that the allowable power frequency for the converter is between 50 and 60 Hz.

Pr.	Name	Initial value	Setting range	Description
1	Maximum power supply frequency	60 Hz	(60 Hz)	The parameter shows that the upper limit of allowable range of the power frequency is 60 Hz. (Read only)
2	Minimum power supply frequency	50 Hz	(50 Hz)	The parameter shows that the lower limit of allowable range of the power frequency is 50 Hz. (Read only)

6.6.3 Input terminal function selection (Pr.3, Pr.4, and Pr.7)

Use the following parameters to select or change the input terminal functions.

Pr.	Name	Initial value (signal name)		Setting range
3	**LOH terminal function selection**	5	LOH (Box-type reactor overheat protection)	0, 3 to 5, 9999
4	**SOF terminal function selection**	0	SOF (Converter stop)	
7	**RES terminal function selection**	3	RES (Converter reset)	

◆Input terminal function assignment

• Use **Pr.3, Pr.4, and Pr.7** to assign the functions of the input terminals. Refer to the following table to set the parameters.

Setting	Signal name	Function		Related parameter
0	SOF	Converter stop	When this signal turns ON, the converter operation stops. The converter operation for this signal can be changed by using **Pr.8**.	Pr.8
3	RES	Converter reset	When this signal turns ON, the converter reset is performed.	—
4	OH	External thermal relay input	The signal is input from the external thermal relay. When this signal turns ON, the fault E.H occurs and the converter output is shut off. *1 The converter operation for this signal can be changed by using **Pr.9**.	Pr.9
5	LOH	Box-type reactor overheat protection	The signal is input from the box-type reactor. If the converter in harmonic suppression mode starts operation while the LOH signal is not assigned to any of the input terminals or if the cooling fan in the box-type reactor connected the converter stops due to a failure or reduces speed, the fault E.FT1 occurs and the converter output is shut off. If the LOH signal is input to the converter in common bus regeneration mode, the fault E.FT1 occurs and the converter output is shut off.	—
9999	—	No function		—

*1 When "E.H" is indicated, terminals PC and SD may be shorted. If terminals PC and SD are shorted intermittently, "E.FT1" may be indicated.

NOTE

• One function can be assigned to the different terminals. In this case, the logic of terminal input is OR.

• When the terminal assignment is changed by changing the initial setting of **Pr.3, Pr.4, and Pr.7 (Input terminal function selection)**, it may cause improper wiring due to a mismatch between the terminal name and the signal name or affect other functions. Set parameters after confirming the function of each terminal.

6.6.4 Operation selection for the SOF signal and the OH signal (Pr.8 and Pr.9)

The converter operations can be changed by using **Pr.8** for the SOF signal and **Pr.9** for the OH signal.

Pr.	Name	Initial value	Setting range	Description
8	SOF input selection	0	0	NO contact: Turning ON of the SOF signal stops the converter operation.
			1	NC contact: Turning OFF of the SOF signal stops the converter operation.
			2	External signal: NC contact CC-Link communication: NO contact
9	OH input selection	0	0	NO contact: Turning ON of the OH signal stops the converter operation after a fault occurs.
			1	NC contact: Turning OFF of the OH signal stops the converter operation after a fault occurs.

<Converter operation determined by the SOF signal input status and the Pr.8 setting>

SOF signal input status		Converter operation		
External terminal	Virtual terminal of CC-Link communication	Pr.8 = "0" (NO contact)	Pr.8 = "1" (NC contact)*1	Pr.8 = "2" (External terminal: NC contact, virtual terminal on CC-Link communication: NO contact)
OFF	OFF	Operation continues.	Operation stops.	Operation stops.
OFF	ON	Operation stops.	Operation stops.	Operation stops.
ON	OFF	Operation stops.	Operation stops.	Operation continues.
ON	ON	Operation stops.	Operation continues.	Operation stops.

*1 The converter with the FR-A8NC not installed does not operate when **Pr.8** = "1" (NC contact). To use the external terminal with NC contact specification without using CC-Link communication, set **Pr.8** = "2" (External signal: NC contact, CC-Link communication: NO contact).

<Converter operation determined by the OH signal input status and the Pr.9 setting>

OH signal input status (external terminal)	Converter operation	
	Pr.9 = "0"	Pr.9 = "1"
ON	Operation stops due to the fault.	Operation continues.
OFF	Operation continues.	Operation stops due to the fault.

6.6.5 Output terminal function selection (Pr.11, Pr.12, and Pr.16)

Use the following parameters to change the functions of the open collector output terminals and relay output terminals.

Pr.	Name	Terminal type	Initial value (signal name)		Setting range
11	RSO terminal function selection	Open collector output terminal	1	RSO (During converter reset)	0 to 4, 6 to 11, 14 to 18, 98, 99, 101 to 104, 106 to 111, 114 to 118, 198, 199, 9999
12	RYA terminal function selection		0	RDY (Inverter run enable)	
16	ABC terminal function selection	Relay output terminal	99	ALM (Fault output)	

◆Output signal list

- Functions listed below can be assigned to any of the output terminal.
- Refer to the following table to set the parameters. (0 to 99: Positive logic, 101 to 199: Negative logic)

Setting		Signal name	Function		Related parameter	Refer to page
Positive logic	Negative logic					
0	—	RDY	Inverter run enable	Output when the inverter is ready.	—	—
1	101	RSO	During converter reset	Output during a converter reset.	—	—
2	102	CVO	Converter running	Output when the converter is regenerative driving, or when the converter in harmonic suppression mode is running.	—	—
3	103	OL	Overload warning	Output when the current limit function is active.	Pr.22, Pr.23	133
4	104	PHS	Power supply phase detection	Output when a phase is confirmed after a completion of the power supply phase detection.	—	—
6	106	IPF	Instantaneous power failure detection	Output when an instantaneous power failure is detected.	Pr.57	141
7	107	Y7	Regenerative drive recognition	Output during regenerative driving.	—	—
8	108	THP	Electronic thermal O/L relay pre-alarm	Output when the electronic thermal relay cumulative value reaches 85% of the transistor protection thermal activation level. (The Converter overload trip (electronic thermal relay function) fault (E.C) occurs when the value reaches 100%.)	—	—
9	109	FAN	Fan fault output	Output when a fan fault occurs.	—	—
10	110	FIN	Heat sink overheat pre-alarm	Output when the heat sink temperature reaches about 85% of the heat sink overheat protection operation temperature.	—	—
11	111	RTY	During retry	Output during retry processing.	Pr.65, Pr.67 to Pr.69	142
14	114	Y14	Life alarm	Output when any of the control circuit capacitor, the inrush current limit circuit, or the cooling fan approaches the end of its life.	Pr.31 to Pr.33	134
15	115	Y15	Maintenance timer alarm	Output when the cumulative operation time reaches the set time period.	Pr.34, Pr.35	135
16	116	Y16	Instantaneous power failure detection hold	Output when the IPF signal turns ON. This signal keeps being output until a converter reset is performed or **Pr.44** is set to "0."	Pr.44	136
17	117	PS	PU stopped	Output while the PU is stopped.	—	—
18	118	FTP	Box-type reactor overheat pre-alarm	Outputs when the speed of cooling fan in the box-type reactor decreases.	—	—
98	198	LF	Alarm	Output when an alarm (fan fault or communication error warning) occurs.	Pr.36, Pr.121	149
99	199	ALM	Fault	Output when the converter's protective function activates to stop the output (at fault occurrence).	—	—
9999		—	No function	—	—	—

6.6.6 DC voltage control (Pr.22, Pr.23, Pr.80, and Pr.81)

Use the following parameters to control DC voltage output from the converter in harmonic suppression mode as commanded.
Operation can be stable enough with these parameters in the initial setting, however, some adjustments may be required if voltage vibration occurs depending on the power supply condition.

Pr.	Name	Initial value	Setting range	Description
22	**Current limit level**	150%	0 to 190%	Set the current limit where the current limit operation starts (during power driving).
23	**Current limit level (regenerative)**	9999	0 to 190%	Set the current limit where the current limit operation starts (during regenerative driving).
			9999	The same setting in **Pr.22** is applied.
80	**Voltage control proportional gain**	100%	0 to 1000%	Set the proportional gain for the voltage control. Increasing the setting value reduces the DC voltage fluctuation caused by external disturbance.
81	**Voltage control integral gain**	100%	0 to 1000%	Set the integral gain for the voltage control. Increasing the setting value shortens the recovery time from the DC voltage fluctuation caused by external disturbance.

◆Adjusting DC voltage fluctuation (Pr.80 and Pr.81)

- Adjust the fluctuation range of the DC voltage by setting **Pr.80**.
  Increasing the setting value reduces the DC voltage fluctuation caused by external disturbance.
- Adjust the recovery time to the commanded value at a fluctuation of DC voltage by setting **Pr.81**.
  Increasing the setting value shortens the recovery time from the DC voltage fluctuation caused by external disturbance.

NOTE

- Setting **Pr.80** too large makes the operation unstable.
- Setting only **Pr.81** makes the operation unstable.
- The setting is available only when the harmonic suppression mode is selected.

◆Setting the current limit level (Pr.22 and Pr.23)

- Limit the output current not to exceed the specified value.
  Set the current limit level by using **Pr.22**.
  Current limit level at the regenerative operation can be individually set by setting a value other than "9999" to **Pr.23**
  Set the current limits as a percentage (set current limit ratios) with 100 being equal to the converter rated current in **Pr.22** and **Pr.23**.
- The OL signal is output when output currents are limited by the current limit level (when the current limit function is active).

NOTE

- When the output current reaches the current limit level, DC voltage decreases during power driving or increases during regeneration.
- The setting is available only when the harmonic suppression mode is selected.

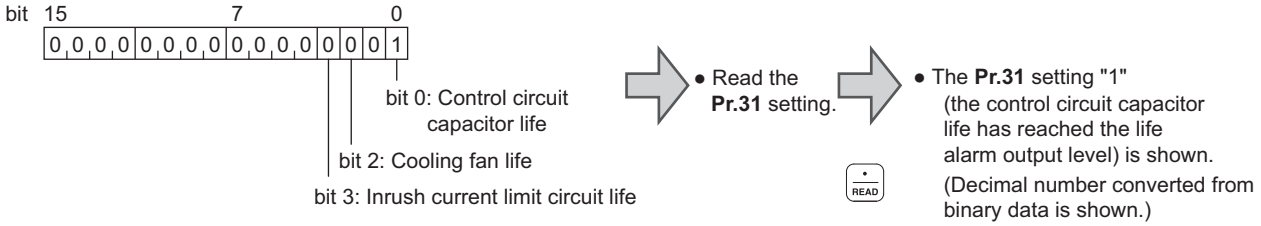
6.6.7 Converter parts life display (Pr.31 to Pr.33)

The degrees of deterioration of main circuit capacitor, cooling fan and inrush current limit circuit can be diagnosed on the monitor.
When a part approaches the end of its life, an alarm can be output by self diagnosis to prevent a fault.
(Note that the life diagnosis of this function should be used as a guideline only, because with the exception of the main circuit capacitor, the life values are theoretical calculations.)

Pr.	Name	Initial value	Setting range	Description
31	**Life alarm status display**	0	(0, 1, 4, 5, 8, 9, 12, 13)	Displays whether or not the parts of the control circuit capacitor, cooling fan, and inrush current limit circuit have reached the life alarm output level. Read-only.
32	**Inrush current limit circuit life display**	100%	(0 to 100%)	Displays the deterioration degree of the inrush current limit circuit. Read-only.
33	**Control circuit capacitor life display**	100%	(0 to 100%)	Displays the deterioration degree of the control circuit capacitor. Read-only.

◆Life alarm display and signal output (Y14 signal, Pr.31)

- Whether or not the parts of the control circuit capacitor, cooling fan or inrush current limit circuit have reached the life alarm output level can be checked with **Pr.31 Life alarm status display** and the life alarm (Y14) signal.



Pr.31 (decimal)	Bit (binary)	Inrush current limit circuit life	Cooling fan life	Control circuit capacitor life
13	1101	○	○	○
12	1100	○	○	×
9	1001	○	×	○
8	1000	○	×	×
5	0101	×	○	○
4	0100	×	○	×
1	0001	×	×	○
0	0000	×	×	×

○: Alarm output, ×: Alarm not output

- The Life alarm (Y14) signal turns ON when any of the control circuit capacitor, cooling fan and inrush current limit circuit reaches the life alarm output level.
- For the terminal used for the Y14 signal, set "14 (positive logic) or 114 (negative logic)" in any of **Pr.11, Pr.12, and Pr.16 (Output terminal function selection)**.

NOTE

- Changing the terminal assignment using **Pr.11, Pr.12, and Pr.16 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆Life display of the inrush current limit circuit (Pr.32)

- The life of the inrush current limit circuit (relay, contactor, and inrush resistor) is displayed in **Pr.32**.
- The number of times the contacts of relay, contactor, and thyristor turn ON is counted down from 100% (0 time) by 1% every 1000 times.
  When the counter reaches 10% (90000 times), bit 3 of **Pr.31** turns ON and the life alarm is output by the Y14 signal turned ON.

◆Life display of the control circuit capacitor (Pr.33)

- The deterioration degree (life) of the control circuit capacitor is displayed on **Pr.33**.
- The control circuit capacitor life calculated from the operating conditions (energization time and temperature) is counted down from 100%.
  When the counter reaches 10%, bit 0 of **Pr.31** turns ON and the life alarm is output by the Y14 signal turned ON.

◆Life display of the cooling fan

- When the cooling fan speed of 50% or less is detected, the alarm indication "LA" is displayed on the operation status 7-segment LED display of the multifunction regeneration converter. When the alarm indication is displayed, bit 2 of **Pr.31** turns ON and the life alarm is output by the Y14 signal turned ON.

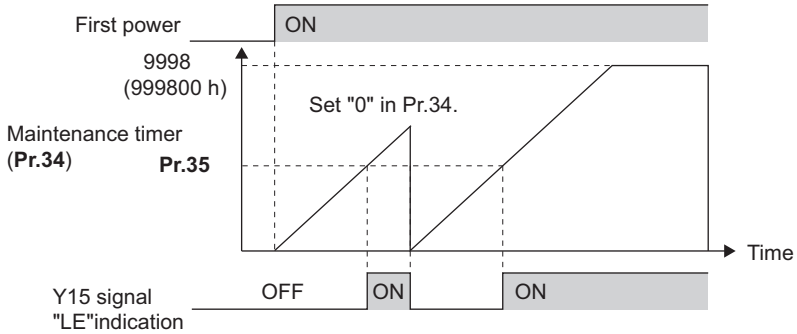
NOTE

- When the converter is mounted with two or more cooling fans, "LA" is displayed even only one of the fans is detected.
- For parts replacement, consult the nearest Mitsubishi FA Center.

6.6.8 Maintenance timer alarm (Pr.34 and Pr.35)

When the cumulative energization time of the multifunction regeneration converter reaches the parameter set time, the Maintenance timer (Y15) signal is output. The warning indication "LE" is displayed on the operation status 7-segment LED display of the multifunction regeneration converter.
This can be used as a guideline for the maintenance time of peripheral devices.

Pr.	Name	Initial value	Setting range	Description
34	**Maintenance timer**	0	0 (1 to 9998)	Displays the cumulative energization time of the converter in 100 hours. Read-only. Writing the setting of "0" clears the cumulative energization time.
35	**Maintenance timer warning output set time**	9999	0 to 9998	Set the cumulative energization time in 100 hours which triggers the Maintenance timer (Y15) signal output.
			9999	Function disabled.



- The cumulative energization time of the converter is recorded into the EEPROM every hour and indicated in 100 hours on **Pr.34 Maintenance timer**. The number indication on **Pr.34** stopped at 9998 (999,800 hours).
- When the **Pr.34** value (the cumulative energization time in 100 hours) becomes equal to the setting value of **Pr.35 Maintenance timer warning output set time**, the Maintenance timer (Y15) signal is output.
- For the terminal used for Y15 signal, set "15 (positive logic)" or "115 (negative logic)" to any of **Pr.11, Pr.12, and Pr.16 (Output terminal function selection)**.

NOTE

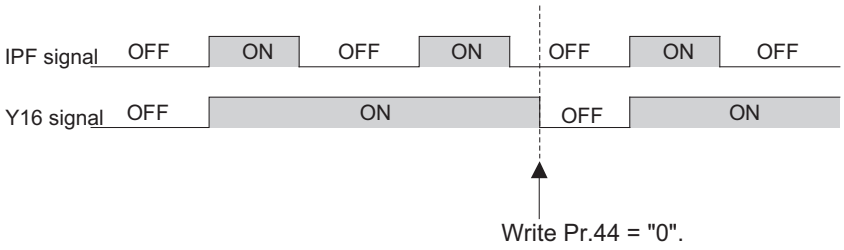
- The cumulative energization time is counted every hour. Energization time of less than 1 hour is not considered.
- Changing the terminal assignment using **Pr.11, Pr.12, and Pr.16 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

6.6.9 Instantaneous power failure detection hold signal (Pr.44)

Use this function to check the history of instantaneous power failures.

Pr.	Name	Initial value	Setting range	Description
44	**Instantaneous power failure detection signal clear**	9999	0	Turns OFF the Instantaneous power failure detection hold (Y16) signal.
			9999	Function disabled.

- The Instantaneous power failure detection hold (Y16) signal turns ON when the Instantaneous power failure (IPF) signal turns ON during the converter operation. The Y16 signal turns OFF when a converter reset is performed or **Pr.44** is set to "0".
- For the terminal used for the Y16 signal, set "16 (positive logic)" or "116 (negative logic)" to any of **Pr.11, Pr.12, and Pr.16 (Output terminal function selection)**.



NOTE

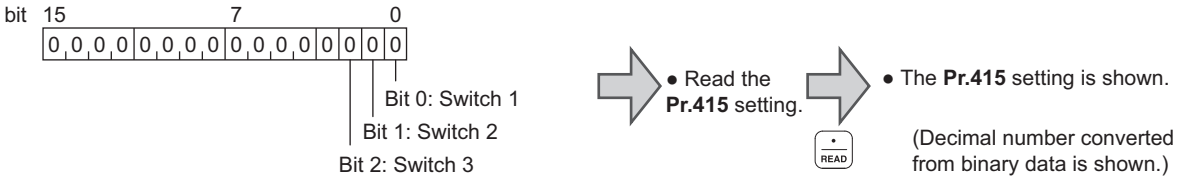
- **Pr.44** always reads "9999." The Y16 signal does not turn OFF even if "9999" is set in **Pr.44**.
- Changing the terminal assignment using **Pr.11, Pr.12, and Pr.16 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

6.6.10 Setting status display of function selection switch assembly (SW2)

The SW2 setting status can be checked with a parameter setting

Pr.	Name	Initial value	Setting range	Description
415	**SW2 setting status**	15	0 to 15 (Read-only)	SW2 setting status shown in decimal number

Use **Pr.415** to check the setting status of the switches 1 to 4 in the function selection switch assembly (SW2): temperature derating selection and connection mode selection.



Pr.415		SW2-4: For manufacturer setting	SW2-3: Temperature derating selection	SW2-2: Connection mode selection	SW2-1: Connection mode selection
Decimal	Binary				
15	**1111**	○	○	○	○
14	**1110**	○	○	○	×
13	**1101**	○	○	×	○
12	**1100**	○	○	×	×
11	**1011**	○	×	○	○
10	**1010**	○	×	○	×
9	**1001**	○	×	×	○
8	**1000**	○	×	×	×
7	**0111**	×	○	○	○
6	**0110**	×	○	○	×
5	**0101**	×	○	×	○
4	**0100**	×	○	×	×
3	**0011**	×	×	○	○
2	**0010**	×	×	○	×
1	**0001**	×	×	×	○
0	**0000**	×	×	×	×

○: ON, ×: OFF

NOTE

- Refer to page 71, page 91, and page 111 for information of the function selection switches.

6.6.11 Function selection for monitor item indication (Pr.46 to Pr.48, Pr.52, and Pr.896)

The monitor item to be displayed on the operation panel or the main monitor of the parameter unit can be selected.

Pr.	Name	Initial value	Setting range	Description
46	**Watt-hour meter clear**	9999	0	Set "0" to clear the watt-hour meter.
			1	Set "1" to clear the cumulative power-driving power monitor.
			2	Set "2" to clear the cumulative regenerative power monitor.
			10	Set "10" to monitor the cumulative power in the range of 0 to 9999 kWh via communication.
			9999	Set "9999" to monitor the cumulative power in the range of 0 to 65535 kWh via communication.
47	**Energization time carrying-over times**	0	0 to 65535 (Read-only)	The number of times that the cumulative energization time exceeded 65535 hours is displayed Read-only.
48	**Cumulative power monitor digit shifted times**	9999	0 to 4	Set the number of times to shift the decimal point position on the values of the cumulative power monitor, the cumulative power-driving power monitor, and the cumulative regenerative power monitor. The meter stops at the maximum number.
			9999	Shifting disabled. The meter is reset to 0 when it reaches the maximum number.
52	**PU main monitor selection**	0	0, 5 to 10, 25, 28	Select the item monitored on the operation panel or parameter unit. Refer to the following table for the monitor item selection.
896	**Power unit cost**	0	0 to 500	Set the electricity rate (cost per kWh).

◆Monitor items list (Pr.52)

- Use **Pr.52 PU main monitor selection** to select the item to monitor on the operation panel or the parameter unit.
- Refer to the following table and select the item to be monitored.

Monitor item	Increment and unit	Pr.52 setting	Description
Input current	0.01 A	0	The input current to the converter is monitored.*2
Input voltage	0.1 V	0	The effective value of input voltage to the converter is monitored.
Bus voltage	0.1 V	0	The output current from the converter is monitored.
Fault indication	—	—	Each of the last 8 faults is displayed individually.
Power supply frequency	0.01 Hz	5	The power supply frequency is monitored.
Electronic thermal O/L relay load factor	0.1%	6	The motor thermal cumulative value displayed as a percentage with 100 being the thermal O/L relay operating level is monitored.
Input power	0.01 kW	7	The input power to the converter is monitored.
Cumulative power	0.01 kWh	8	The counter of cumulative power calculated from the input power monitor value is displayed. When using the converter in the regenerative status at all times or in power regeneration mode 2, monitor the cumulative regenerative power.) Setting "0" in Pr.46 clears the counter.
Cumulative energization time *1	1 h	9	The counter of cumulative energization time since the converter shipment is displayed. The number of times a cumulative value has reached the maximum value of 65535 hours can be checked with **Pr.47**.
Input power with regenerative driving indication	0.1 kW	10	The values of input power during regenerative driving is displayed with signed numbers on the operation panel. The monitoring on the parameter unit or via communication does not support the display of the values with signed numbers (the absolute values are displayed).
I/O terminal status	—	25	The ON/OFF status of I/O terminals on the multifunction regeneration converter is displayed. The parameter unit does not support this display.

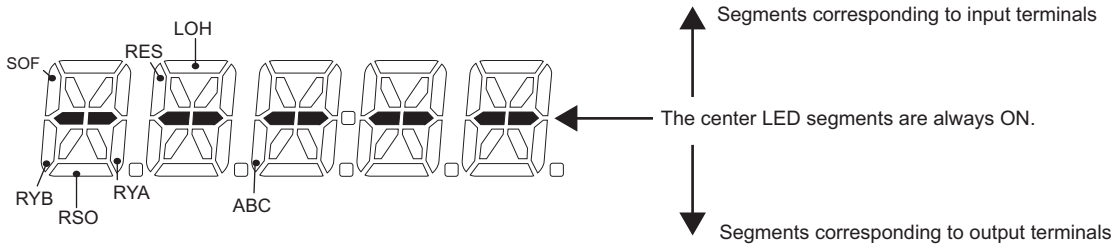
Monitor item	Increment and unit	Pr.52 setting	Description
Cumulative power-driving power	0.01 kW	26	The counter of cumulative power-driving power calculated from the input power monitor value is displayed. Setting "1" in Pr.46 clears the counter.
Cumulative regenerative power	0.01 kW	27	The counter of cumulative regenerative power calculated from the input power monitor value is displayed. Setting "2" in Pr.46 clears the counter.
Electricity cost	—	28	The electricity cost calculated from the electricity rate (cost per kWh) set in **Pr.896** and the cumulative energy is displayed.

*1 The cumulative energization time is accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0.

*2 The currents value may be displayed due to undesirable current while the converter in the power regeneration mode (1 or 2) is during power driving. This is not a fault.

◆Monitoring I/O terminals on the operation panel (FR-DU08) (Pr.52)

- When **Pr.52** = "25", the I/O terminal states can be monitored on the operation panel (FR-DU08).
- When a terminal is ON, the corresponding LED segment is ON . The center LED segments are always ON.



◆Monitoring and resetting cumulative power / cumulative power-driving power / cumulative regenerative power (Pr.46 and Pr.48)

- When the cumulative power is monitored (**Pr.52** = "8"), the input power monitor value is added up and is updated in 100 ms increments. (The values are registered in EEPROM every hour.)
- When the cumulative power-driving power is monitored (**Pr.52** = "26"), the input power monitor value for the power-driving power is added up and is updated in 100 ms increments. (The values are registered in EEPROM every hour.)
- When the cumulative regenerative power is monitored (**Pr.52** = "27"), the input power monitor value for the regenerative power is added up and is updated in 100 ms increments. (The values are registered in EEPROM every hour.)
- Increments and ranges of monitoring on the operation panel or parameter unit or via communication (RS-485 communication) are as follows.
  - When Pr.48 = "0 or 9999"

On operation panel / parameter unit *1		Via communication		
Range	Increment	Range		Increment
		Pr.46 = 10	Pr.46 = 9999	
0 to 999.99 kWh	0.01 kWh	0 to 9999 kWh	0 to 65535 kWh (initial value)	1 kWh
1000.0 to 9999.9 kWh	0.1 kWh			
10000 to 99999 kWh	1 kWh			

*1 The value is measured in 0.01 kWh and the upper five digits are displayed.
After the watt-hour meter (cumulative power counter) reaches "999.99" (999.99 kWh), the meter displays values in 0.1 increments such as "1000.0" (1000.0 kWh).

- The decimal point position on the watt-hour meter can be shifted to left. The number of digits to be shifted is equal to the setting of **Pr.48**.
  For example, when **Pr.48** = "2", the cumulative power value 1278.56 kWh is displayed as 12.78 (in 100 kWh increments) on the PU or displayed as 12 on a display used for monitoring via communication.
- When **Pr.48** = "0 to 4", the meter stops at the maximum number. When **Pr.48** = "9999", the meter returns to 0 and the counting starts again.
- After the setting of **Pr.48** is changed, the watt-hour meter holds the cumulative value.
- Writing "0" in **Pr.46** clears the cumulative power monitor.
- Writing "1" in **Pr.46** clears the cumulative power-driving power monitor.
- Writing "2" in **Pr.46** clears the cumulative regenerative power monitor.

NOTE

• When Pr.46 is read just after "0 to 2" has been written in Pr.46, the setting "9999" or "10" is displayed.

◆Displaying electricity cost (Pr.896)

• When the electricity cost is selected as a monitor item (**Pr.52** = "28"), the electricity cost calculated from the electricity rate (cost per kWh) set in **Pr.896** and the cumulative energy is displayed.

◆Monitoring cumulative energization time (Pr.47)

• When the cumulative energization time is selected as a monitor item (**Pr.52** = "9"), the counter of cumulative energization time since the converter shipment accumulated every hour is displayed.

• When the cumulative energization time counter reaches 65535, it starts from 0 again. The number of times the cumulative energization time counter reaches 65535 can be checked with **Pr.47**.

6.6.12 Operation selection at instantaneous power failure (Pr.57)

Use this parameter to set whether the multifunction regeneration converter restarts the operation at the power restoration after an instantaneous power failure occurs.

Pr.	Name	Initial value	Setting range	Description
57	Restart selection	9999	0	The converter restarts operation at the power restoration from instantaneous power failure.
			9999	The converter does not restart operation automatically at the power restoration from instantaneous power failure.

- When the automatic restart after instantaneous power failure is selected on the inverter, set "0" in **Pr.57 Restart selection** of the converter.
  If **Pr.57** = "9999" even though the automatic restart after instantaneous power failure is activated in the inverter, the converter shows the fault indication "E.E" and stops the inverter operation at the instantaneous power failure.

⚠ CAUTION

- The motor and machine will start suddenly after occurrence of an instantaneous power failure (after the reset time has elapsed). Stay away from the motor and machine when automatic restart after instantaneous power failure has been selected.

6.6.13 Free parameter (Pr.58 and Pr.59)

Any number within the setting range of 0 to 9999 can be input.
For example, these numbers can be used:

- As a unit number when multiple units are used.
- As a pattern number for each operation application when multiple units are used.
- As the year and month of introduction or inspection.

Pr.	Name	Initial value	Setting range	Description
58	Free parameter 1	9999	0 to 9999	Any value can be input. The settings are retained even if the converter power is turned OFF.
59	Free parameter 2	9999	0 to 9999	

NOTE

- **Pr.58 and Pr.59** do not influence the operation of the converter.

6.6.14 Disabling keys on the operation panel (Pr.61)

The keys on the operation panel can be disabled.

Pr.	Name	Initial value	Setting range	Description
61	Key lock operation selection	0	0	The keys are operable.
			10	The keys are inoperable.

- The setting dial and keys on the operation panel can be disabled to prevent unexpected parameter changes.
- Set **Pr.61** to "10" and then press MODE for 2 seconds to disable setting dial and keys.
- When the setting dial and keys are disabled, "HOLd" appears on the operation panel. If the setting dial or any key is used while keys are inoperable, "HOLd" appears on the operation panel. (When the setting dial or any key is not used for 2 seconds, the operation panel switches to the monitor mode.)
- To enable the setting dial and keys again, press MODE for 2 seconds.

NOTE

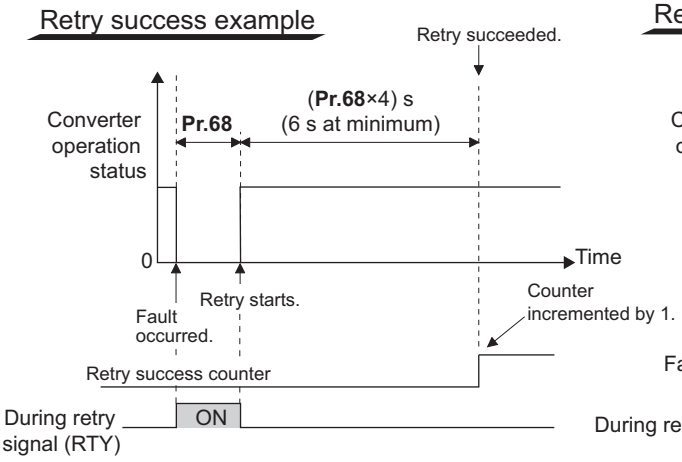
- Even if the setting dial and keys are disabled, the converter reset by using STOP RESET are enabled.
- Switching of the monitor item is disabled.
- The PU stop warning cannot be reset by using keys while the key locks are enabled.

6.6.15 Retry function (Pr.65, Pr.67 to Pr.69)

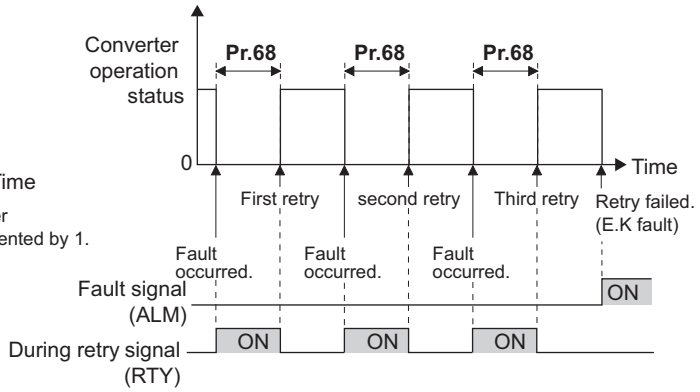
This function allows the converter the retry operation (automatic reset and restart) after a fault occurred. Faults which trigger the retry operation can be selected.

Pr.	Name	Initial value	Setting range	Description
65	**Retry selection**	0	0 to 4	Faults which trigger the retry operation can be selected. (Refer to the table in the next page.)
67	**Number of retries at fault occurrence**	0	0	The retry function disabled.
			1 to 10	Set the number of retries at a fault occurrence. A fault output is not provided during the retry operation.
			101 to 110	Set the number of retries at a fault occurrence. (The setting value minus 100 is the number of retries.) A fault output is provided during the retry operation.
			1001 to 1010	Set the number of retries at a fault occurrence. (The setting value minus 1000 is the number of retries.) A fault output is not provided during the retry operation. The RDY signal is ON during retry.
			1101 to 1110	Set the number of retries at a fault occurrence. (The setting value minus 1100 is the number of retries.) A fault output is provided during the retry operation. The RDY signal is ON during retry.
68	**Retry waiting time**	1 s	0.1 to 600 s	Set the time delay from when a converter fault occurs until the retry operation starts.
69	**Retry count display erase**	0	0	Setting "0" clears the retry success counter ("retry success" means that the converter successfully restarts).

Retry success example



Retry failure example



- When a fault occurs and a protective function is activated while the retry function is enabled, the retry function automatically deactivates (resets) the protective function and restarts the operation after a lapse of the time set in **Pr.68**.
- The retry function is enabled when the **Pr.67** setting is other than "0." Set the number of retries at activation of the protective function in **Pr.67**.

Pr.67 setting	Retry times	Fault output	RDY signal ON state during retry
0	The retry function disabled.	—	—
1 to 10	Number of times equal to **Pr.67** setting	No	Not held
101 to 110	Number of times calculated by subtracting 100 from **Pr.67** setting	Yes	Not held
1001 to 1010	Number of times calculated by subtracting 1000 from **Pr.67** setting	No	Held*1
1101 to 1110	Number of times calculated by subtracting 1100 from **Pr.67** setting	Yes	Held*1

*1 The RDY signal state during retries by fault is as follows.

Retry-inducing fault	RDY signal ON state
E.A (Overcurrent trip)	Held
E.B (Overvoltage trip)	Held
E.G (Input phase loss)	Held
E.Q (Communication option fault)	Held
E.8 (Input power supply fault 1)	Held

Retry-inducing fault	RDY signal ON state
E.C (Converter overload trip (electronic thermal relay function))	Not held
E.E (Instantaneous power failure)	Not held
E.F (Undervoltage)	Not held
E.H (External thermal relay operation)	Not held

- When the protective function is activated after retries are attempted consecutively more than the number of times set in **Pr.67**, the Retry count excess fault (E.K) occurs and the converter output is shut off. (Refer to the figure of retry failure example.)
- Use **Pr.68** to set the waiting time from when the converter output has been shut off until a retry is made in the range of 0 to 600 seconds.
- The cumulative count in **Pr.69** increases by 1 when a retry is successful. Retry is regarded as successful when normal operation continues without a fault for the **Pr.68** setting multiplied by four or longer (6 seconds at the shortest). (When retry is successful, the cumulative number of retry failures is cleared.)
- Writing "0" in **Pr.69** clears the retry counter.

During a retry, the RTY signal is ON. For the RTY signal, set "11 (positive logic)" or "111 (negative logic)" in any of **Pr.11, Pr.12, and Pr.16 (Output terminal function selection)** to assign the function.

NOTE

- Changing the terminal assignment using **Pr.11, Pr.12, or Pr.16** (Output terminal function selection) may affect the other functions. Set parameters after confirming the function of each terminal.

- Faults which trigger the retry operation can be selected with **Pr.65**. The faults not described in the following table do not enable the retry function. (For the fault details, refer to page 178.)
  "●" indicates the fault selected.

Retry-inducing fault	Pr.65 setting				
	0	1	2	3	4
E.A (Overcurrent trip)	●	●		●	●
E.B (Overvoltage trip)	●		●	●	●
E.C (Converter overload trip (electronic thermal relay function))	●				
E.E (Instantaneous power failure)	●				●
E.F (Undervoltage)	●				●
E.G (Input phase loss)	●				●
E.H (External thermal relay operation)	●				
E.Q (Communication option fault)	●				●
E.8 (Input power supply fault 1)	●				●

NOTE

- Only the first fault is recorded in the fault history during retries.
- If a fault that does not trigger the retry operation occurs during retries, the converter output is shut off with the fault indication after the retries finish.
- The fault reset by the retry function does not reset the accumulated data such as the electronic thermal relay function data. (The reset result is different from the power-ON reset.)

⚠ CAUTION

- When setting the retry function enabled, stay away from the motor and machine. The motor and machine will start suddenly (after the reset time has elapsed) after the shutoff.

6.6.16 Reset selection / disconnected PU detection / PU stop selection (Pr.75)

The reset input acceptance, disconnected PU connector detection function, and PU stop function can be selected.

Pr.	Name	Initial value	Setting range	Description
75	**Reset selection / disconnected PU detection / PU stop selection**	14	0 to 3, 14 to 17	For the initial setting, reset is always enabled, without disconnected PU detection, and with the PU stop function.

• **Pr.75** can be set any time. The setting does not return to its initial values even if Parameter clear/All parameter clear is executed.

Pr.75 setting	Reset selection	Disconnected PU detection	PU stop selection
0	Reset command input always enabled.	Operation continues even when PU is disconnected.	Operation cannot be stopped by using STOP RESET.
1	Reset command input enabled only when the protective function activated.		
2	Reset command input always enabled.	Converter output shut off when PU is disconnected.	
3	Reset command input enabled only when the protective function activated.		
14 (initial value)	Reset command input always enabled.	Operation continues even when PU is disconnected.	Operation can be stopped by using STOP RESET.
15	Reset command input enabled only when the protective function activated.		
16	Reset command input always enabled.	Converter output shut off when PU is disconnected.	
17	Reset command input enabled only when the protective function activated.		

◆Reset selection

- The conditions where the reset command is enabled (using the RES signal or through communication) can be selected.
- When **Pr.75** is set to any of "1, 3, 15, and 17", the reset input is enabled only when the protective function is activated.

NOTE

- When the RES signal is input during operation, the inverter is also reset. The motor coasts since the inverter being reset shuts off the output. Also, the cumulative value of the electronic thermal relay is cleared.
- The reset input by using the reset key on the PU on the converter is enabled only when the protective function is activated, regardless of the **Pr.75** setting.

◆Disconnected PU detection

- If the converter detects that the operation panel has been disconnected for 1 second or longer, the protective function (E.J) is activated and the converter output is shut off.
- When **Pr.75** is set to any of "0, 1, 14, and 15", operation continues even if the PU is disconnected.

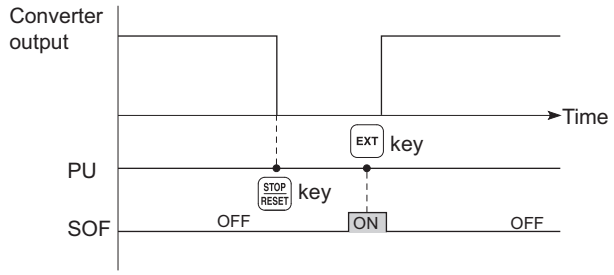
NOTE

- When the PU has been disconnected before power-ON, the fault is not activated.
- To restart operation, make sure that the PU is connected before reset.
- When RS-485 communication operation is performed through the PU connector, the reset selection/PU stop selection function is enabled but the disconnected PU detection function is disabled.

◆PU stop selection

- The converter operation can be stopped by pressing STOP RESET on the PU when **Pr.75** = "14 to 17".
- When the operation is stopped by the PU stop, the "LD" is displayed on the operation status 7-segment LED display of the converter (and "PS" is displayed on the PU). A fault output is not provided.

◆How to restart operation stopped by using STOP RESET on the PU ("PS" (PU stop) warning reset method)



Stop/restart example for External operation

- For the operation panel (FR-DU08)
  1. Turn ON the SOF signal to stop the converter operation.
  2. Press PU EXT.
     The indication "LD (PS)" on the converter is cleared (the PS warning is reset).
  3. Turn OFF the SOF signal to restart the converter operation.
- For the parameter unit (FR-PU07/FR-PU07BB(-L))
  1. Turn ON the SOF signal to stop the converter operation.
  2. Press EXT.
     The indication "LD (PS)" on the converter is cleared (the PS warning is reset).
  3. Turn OFF the SOF signal to restart the converter operation.

- The converter is also restarted after performing the reset by turning OFF and ON the power or inputting the RES signal.

⚠ CAUTION

- Do not reset the converter while the inverter start signal is being input. Otherwise, the motor will start suddenly after resetting, leading to potentially hazardous conditions.

6.6.17 Parameter write disable selection (Pr.77)

Whether to enable the parameter write or not can be selected. Use this function to prevent parameter values from being rewritten by misoperation.

Pr.	Name	Initial value	Setting range	Description
77	Parameter write selection	2	1	Parameter write is disabled.
			2	Parameter write is enabled regardless of operation status.

Pr.77 can be set at any time regardless of the operation status.

◆Parameter write disabled (Pr.77 = "1")

- Parameter write is disabled.
  (Parameter read is enabled.)
- Parameter clear and All parameter clear are also disabled.
- The parameters listed in the table at right can be written even if **Pr.77** = "1".

Pr.	Name
0	Simple mode selection
75	Reset selection / disconnected PU detection / PU stop selection
77	Parameter write selection

◆Parameter write enabled during operation (Pr.77 = "2")

- The parameters can always be written.

6.6.18 Current control (Pr.82 and Pr.83)

Use this function to control current output from the converter in harmonic suppression mode as commanded.
Operation can be stable enough with these parameters in the initial setting, however, some adjustments may be required if current vibration occurs depending on the power supply condition.

Pr.	Name	Initial value	Setting range	Description
82	**Current control proportional gain**	100%	0 to 200%	Set the proportional gain for the current control. Increasing the setting value reduces the current fluctuation caused by external disturbance.
83	**Current control integral gain**	100%	0 to 200%	Set the integral gain for the current control. Increasing the setting value shortens the recovery time from the current fluctuation caused by external disturbance.

- Adjust the fluctuation range of current by setting **Pr.82**.
  Increasing the setting value reduces the current fluctuation caused by external disturbance.
- Adjust the recovery time to the commanded current after a current fluctuation by setting **Pr.83**.
  Increasing the setting value shortens the recovery time from the current fluctuation caused by external disturbance.

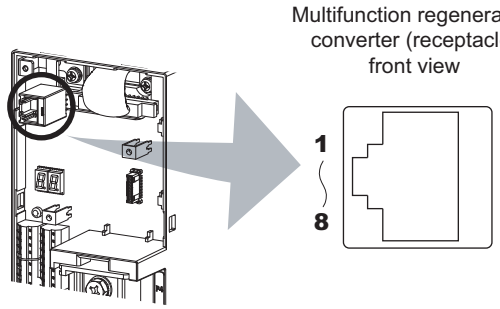
NOTE

- Setting **Pr.82** too large makes the operation unstable.
- Setting only **Pr.83** makes the operation unstable.
- The setting is available only when the harmonic suppression mode is selected.

6.6.19 Wiring and configuration of PU connector

Using the PU connector enables communication operation from a personal computer, etc.
When the PU connector is connected to a personal, FA, or other computer with a communication cable, a user program can run and monitor the converter or read and write to parameters.

◆PU connector pin-outs



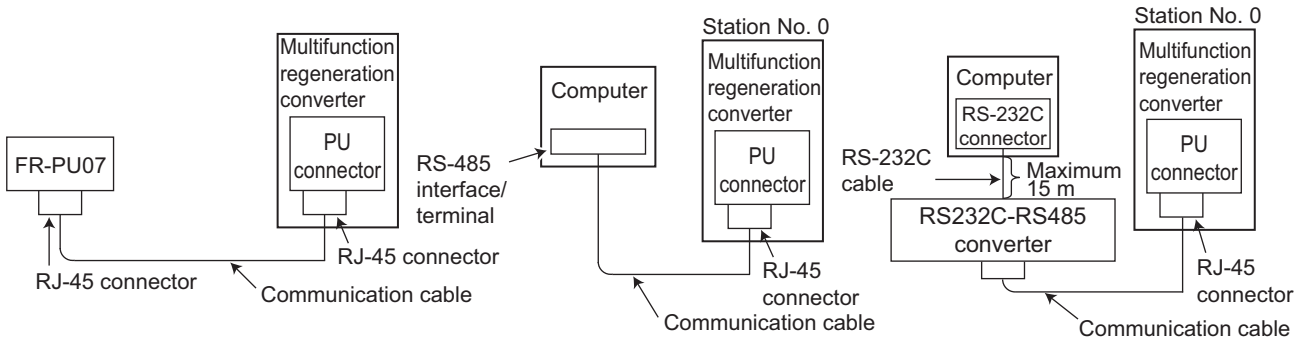
Pin number	Name	Description
1	SG	Earthing (grounding)
2	—	Operation panel / parameter unit power supply
3	RDA	Converter receive +
4	SDB	Converter send -
5	SDA	Converter send +
6	RDB	Converter receive -
7	SG	Earthing (grounding)
8	—	Operation panel / parameter unit power supply

NOTE

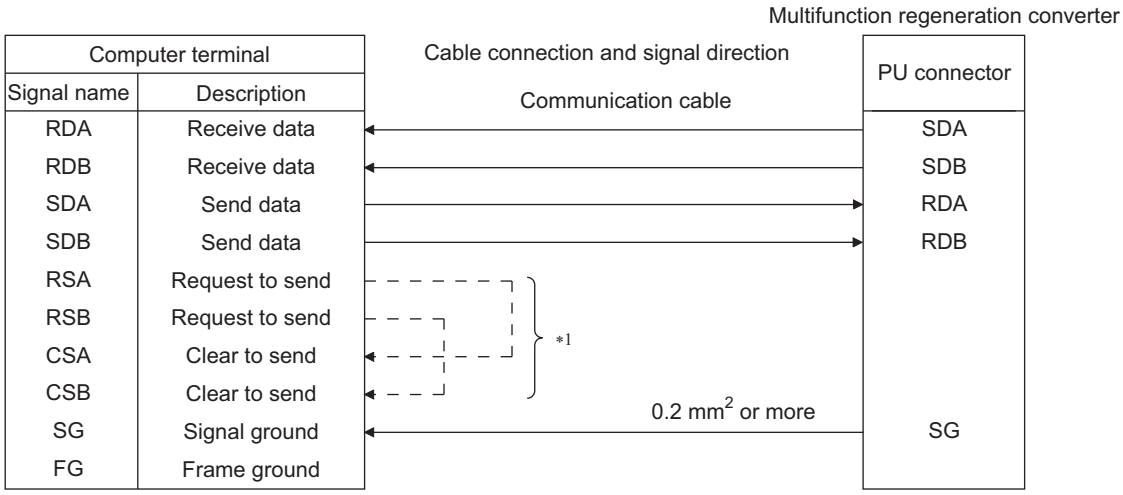
- Pins No. 2 and 8 provide power to the operation panel or parameter unit. Do not use these pins for RS-485 communication.
- Do not connect the PU connector to the computer's LAN board, FAX modem socket, or telephone modular connector. The product could be damaged due to differences in electrical specifications.

◆Wiring and configuration of PU connector communication system

◆System configuration



◆Wiring a computer to a converter for RS-485 communication



*1 Make connection in accordance with the Instruction Manual of the computer to be used with. Fully check the terminal numbers of the computer since they vary with the model.

NOTE

- Connection cable between converters and computer
  Refer to the following for the connection cable (RS-232C to RS-485 converter) between the computer with an RS-232C interface and a converter. Commercially available products (as of February 2015)

Model	Manufacturer
Interface embedded cable DAFXIH-CAB (D-SUB25P for personal computer) / DAFXIH-CABV (D-SUB9P for personal computer) + Connector conversion cable DINV-485CAB (for converter) *1	Diatrend Corp.
Interface embedded cable dedicated for inverter DINV-CABV *1	

*1 The conversion cable cannot be used for connection of multiple converters. (The computer and the converter are connected in a 1:1 pair.) This is an RS232C-to-RS485 converter-embedded conversion cable. No additional cable or connector is required. For the product details, contact the manufacturer.

- Refer to the following table when fabricating the cable on the user side.

Ethernet cable	Connector	Standard
Category 5e or higher straight cable (double shielded / STP)*2	RJ-45 connector	The cables compliant with the following standards: • IEEE 802.3 (1000BASE-T) • ANSI/TIA/EIA-568-B (Category 5e)

*2 Do not use pins No. 2 and 8 of the communication cable.

6.6.20 Initial settings and specifications of RS-485 communication (Pr.117 to Pr.124)

Use the following parameters to perform required settings for RS-485 communication between the converter and a personal computer.

- Use the PU connector on the converter as communication interface.
- The Mitsubishi inverter protocol is used. Parameter setting, monitoring, etc. can be performed through communication.
- To make communication between the personal computer and the converter, setting of the communication specifications must be made to the converter in advance.
  Data communication cannot be made if the settings are not made or if there is any setting error.

[Parameters related to PU connector communication]

Pr.	Name	Initial value	Setting range	Description	
117	**PU communication station number**	0	0 to 31	Use this parameter to specify the converter station number. Set the station number for each converter when two or more converters are connected to one personal computer.	
118	**PU communication speed**	192	48, 96, 192, 384	Set the communication speed. The setting value × 100 equals the communication speed. For example, enter 192 to set the communication speed of 19200 bps.	
119	**PU communication stop bit length**	1		**Stop bit length**	**Data length**
			0	1 bit	8 bits
			1	2 bits	
			10	1 bit	7 bits
			11	2 bits	
120	**PU communication parity check**	2	0	Parity check disabled.	
			1	Parity check (odd parity) enabled.	
			2	Parity check (even parity) enabled.	
121	**PU communication retry count**	1	0 to 10	Set the permissible number of retries for unsuccessful data reception. When the number of consecutive errors exceeds the permissible value, the converter stops retrying for communication.	
			9999	The converter does not retry for communication when the communication is unsuccessful.	

Pr.	Name	Initial value	Setting range	Description
123	PU communication waiting time setting	9999	0 to 150 ms	Set the time delay between data transmission to the converter and the response.
			9999	The time delay is not set in this parameter but in communication data. Delay time: Number set in the data × 10 ms
124	PU communication CR/LF selection	1	0	Without CR+LF
			1	With CR
			2	With CR+LF

NOTE

- Always reset the converter after making the settings of the parameters. After changing the communication-related parameters, communication cannot be made until the converter is reset.

6.6.21 Mitsubishi inverter protocol (computer link communication)

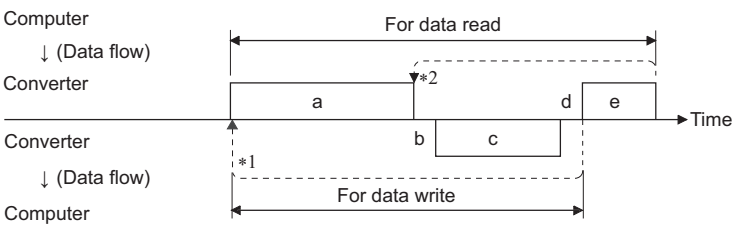
Parameter setting and monitoring, etc. are possible through communication using the Mitsubishi inverter protocol (computer link communication) via the PU connector on the converter.

◆Communication specifications

- The communication specifications are given below.

Item		Description	Related parameter
Communication protocol		Mitsubishi inverter protocol (computer link)	—
Conforming standard		EIA-485 (RS-485)	—
Number of connectable units		1:N (maximum 32 units), for stations No. 0 to 31	Pr.117
Communication speed		Selected among 4800/9600/19200/38400 bps	Pr.118
Control procedure		Asynchronous method	—
Communication method		Half-duplex system	—
Communication specifications	Character system	ASCII (selectable between 7 bits and 8 bits)	Pr.119
	Start bit	1 bit	—
	Stop bit length	Selectable between 1 bit and 2 bits	Pr.119
	Parity check	Selectable between enabled (even or odd) or disabled	Pr.120
	Error check	Sum code check	—
	Terminator	CR/LF (Selectable between enabled (either or both) or disabled)	Pr.124
Time delay setting		Selectable between enabled or disabled	Pr.123

◆Communication procedure



- In communication between the computer and the converter, the following data is exchanged in the order from a to e.

a	Request data: sent from the computer to the converter (The converter will not send data unless requested.)
b	Communication delay time
c	Reply data: sent from the converter to the computer in response to the computer request (data a)
d	Converter data processing time
e	Answer data: sent from the computer in response to the reply data sent from the converter (data c) (Subsequent communication is made properly even without data e.)

*1 If a data error is detected and a retry must be made, perform retry operation with the user program. The converter stops retrying and outputs the LF signal when the number of consecutive retries exceeds the parameter setting.

*2 On receipt of a data error occurrence, the converter returns reply data (data c) to the computer again. The converter stops retrying and outputs the LF signal when the number of consecutive data errors exceeds the parameter setting.

◆Communication operation presence/absence and data format types

- Data communication between the computer and converter uses ASCII codes (hexadecimal codes).
- Communication operation presence/absence (with/without) and data format type (A to F) are as follows.

Data	Operation		Parameter/ monitor write	Converter reset	Monitoring	Parameter read
a	Communication request: sent to the converter from the computer in accordance with the user program		A/ A1	A	B	B
b	Converter data processing time		With	Without	With	With
c	Reply data from the converter (Data a is checked for an error.)	No data error detected *1 (Request accepted)	C	C *2	E / E1	E
		Data error detected (Request rejected)	D	D *2	D	D
d	Computer processing delay time		With (10 ms or more)			
e	Answer from computer in response to reply data (data c) (Data c is checked for an error.)	No data error detected *1 (No converter processing)	Without	Without	Without (C)	Without (C)
		Data error detected (Converter outputs data c again.)	Without	Without	F	F

*1 In the communication request data from the computer to the converter, the time of 10 ms or more is also required after an acknowledgement (ACK) signal showing "No data error detected" is sent. **(Refer to page 153.)**

*2 Reply from the converter to the converter reset request can be selected. **(Refer to page 158.)**

- Data writing format

Data a: Communication request data from the computer to the converter

Format	Number of characters												
	1	2	3	4	5	6	7	8	9	10	11	12	13
A	ENQ *1	Converter station No. *2		Instruction code		*3	Data				Sum check		*4
A1	ENQ *1	Converter station No. *2		Instruction code		*3	Data		Sum check		*4		

Data c: Reply data from the converter to the computer (No data error detected)

Format	Number of characters			
	1	2	3	4
C	ACK *1	Converter station No. *2		*4

Data c: Reply data from the converter to the computer (Data error detected)

Format	Number of characters				
	1	2	3	4	5
D	NAK *1	Converter station No. *2		Error code	*4

*1 A control code.

*2 The converter station number is specified in hexadecimal in the range of H00 to H1F (stations No. 0 to 31).

*3 Set the delay time. When **Pr.123 PU communication waiting time setting** is set to other than "9999", create the communication request data without "delay time" in the data format. (The number of characters decreases by 1.)

*4 CR+LF code

When a computer transmits data to the converter, some computers automatically provide either one or both of the codes CR (carriage return) and LF (line feed) at the end of a data group. In this case, the same setting is required for data sent from the converter to the computer. Use **Pr.124 PU communication CR/LF selection** for the CR+LF code setting.

- Data reading format

Data a: Communication request data from the computer to the converter

Format	Number of characters								
	1	2	3	4	5	6	7	8	9
B	ENQ *1	Converter station No. *2		Instruction code		*3	Sum check		*4

Data c: Reply data from the converter to the computer (No data error detected)

Format	Number of characters										
	1	2	3	4	5	6	7	8	9	10	11
E	STX *1	Converter station No. *2		Read data				ETX *1	Sum check		*4
E1	STX *1	Converter station No. *2		Read data		ETX *1	Sum check		*4		

Data c: Reply data from the converter to the computer (Data error detected)

Format	Number of characters				
	1	2	3	4	5
D	NAK *1	Converter station No. *2		Error code	*4

Data e: Transmission data from the computer to the converter

Format	Number of characters			
	1	2	3	4
C (No data error detected)	ACK *1	Converter station No. *2		*4
F (Data error detected)	NAK *1	Converter station No. *2		*4

*1 A control code.

*2 The converter station number is specified in hexadecimal in the range of H00 to H1F (stations No. 0 to 31).

*3 Set the delay time.
When **Pr.123 PU communication waiting time setting** is set to other than "9999", create the communication request data without "delay time" in the data format. (The number of characters decreases by 1.)

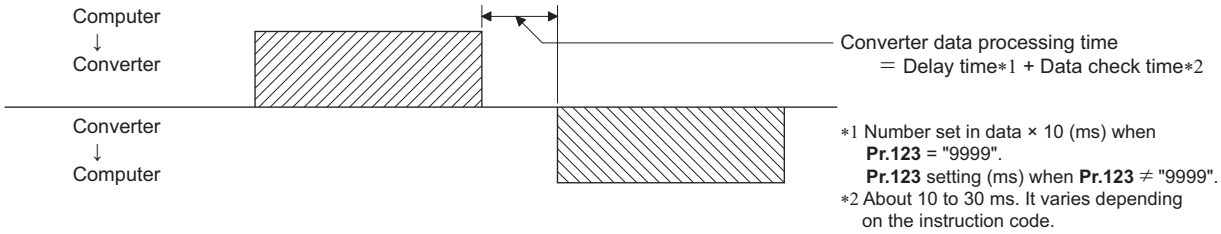
*4 CR+LF code
When a computer transmits data to the converter, some computers automatically provide either one or both of the codes CR (carriage return) and LF (line feed) at the end of a data group. In this case, the same setting is required for data sent from the converter to the computer. Use **Pr.124 PU communication CR/LF selection** for the CR+LF code setting.

◆Data definitions

- Control code

Signal name	ASCII code	Description
STX	H02	Start of text (Start of data)
ETX	H03	End of text (End of data)
ENQ	H05	Enquiry (Communication request)
ACK	H06	Acknowledge (No data error detected)
LF	H0A	Line feed
CR	H0D	Carriage return
NAK	H15	Negative acknowledge (Data error detected)

- Converter station No.
  Specify the station number of the converter which communicates with the computer.
- Instruction code
  Specify the processing request, for example, operation or monitoring, given by the computer to the converter. Therefore, the operation or monitoring an item is enabled by specifying the corresponding instruction code. (Refer to page 158.)
- Data
  Read/write data such as parameters transmitted from/to the converter. The definition and range of set data are determined in accordance with the instruction code. (Refer to page 158.)
- Time delay
  Specify the delay time (time period between the time when the converter receives data from the computer and the time when the converter starts transmission of reply data). Set the delay time in accordance with the response time of the computer in the range of 0 to 150 ms in 10 ms increments. (For example, "1" for 10 ms or "2" for 20 ms.)
  When **Pr.123 PU communication waiting time setting** is set to other than "9999", the **Pr.123** setting is effective as the delay time.
  Create the communication request data without "delay time" in the data format. (The number of characters decreases by 1.)



NOTE

- The data check time varies depending on the instruction code. (Refer to page 154.)

• Sum check code

The sum check code is 2-digit ASCII (hexadecimal) representing the lower 1 byte (8 bits) of the sum of the target data converted in ASCII character code.

(Example 1)

Computer → Converter

	ENQ	Station No.		Instruction code		Delay time*	Data				Sum check code		
		0	1	E	1	1	0	7	A	D	F	4	← Binary code
ASCII code →	H05	H30	H31	H45	H31	H31	H30	H37	H41	H44	H46	H34	

H30+H31+H45+H31+H31+H30+H37+H41+H44

=H1F4

Sum

* When the **Pr.123 PU communication waiting time setting** is other than "9999", create the communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)

(Example 2)

Converter → Computer

	STX	Station No.		Read data				ETX	Sum check code		
		0	1	1	7	7	0		3	0	← Binary code
ASCII code →	H02	H30	H31	H31	H37	H37	H30	H03	H33	H30	

H30+H31+H31+H37+H37+H30

=H130

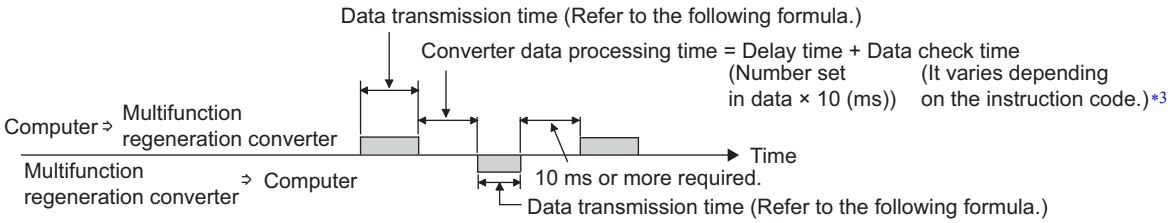
Sum

• Error code

If any error is found in the data the converter received, its error definition is sent back to the computer together with the NAK code.

Error code	Error item	Error description	Converter operation
H0	Computer NAK error	The number of errors consecutively detected in communication request data from the computer is greater than the permissible number of retries.	If errors occur consecutively and exceed the number of the permissible number of retries, the converter outputs the Alarm (LF) signal.
H1	Parity error	The parity check result does not match the specified parity.	
H2	Sum check error	The sum check code in the computer does not match that of the data received by the converter.	
H3	Protocol error	The data the converter received has a grammatical mistake. Or, data receive is not completed within the predetermined time. CR or LF code specification is not the same as the setting of the parameter.	
H4	Framing error	The stop bit length differs from the parameter setting.	
H5	Overrun	New data has been sent by the computer before the converter completes receiving the preceding data.	
H6	—	—	—
H7	Character error	The converter received an unusable character (other than 0 to 9, A to F, and control codes).	The converter does not accept the data sent to the converter.
H8	—	—	—
H9	—	—	—
HA	Mode error	Parameter write was attempted when the converter does not perform computer link communication, when the operation commands are not given through communication, or when parameter write is set to be disabled.	The converter does not accept the data sent to the converter.
HB	Instruction code error	The specified instruction code does not exist.	
HC	Data range error	Invalid data has been specified for parameter write, etc.	
HD	—	—	—
HE	—	—	—
HF	—	—	—

◆Response time



[Formula for data transmission time]

$$\frac{1}{\text{Communication speed (bps)}} \times \text{Number of data characters}^{*1} \times \text{Communication specifications (Total number of bits)}^{*2} = \text{Data transmission time (s)}$$

*1 Refer to **page 150**.

*2 Communication specifications

Name		Number of bits
Stop bit length		1 bit/ 2 bits
Data length		7 bits/ 8 bits
Parity check	Enabled	1 bit
	Disabled	0

In addition to the above, 1 start bit is necessary.
Minimum number of total bits: 9 bits
Maximum number of total bits: 12 bits

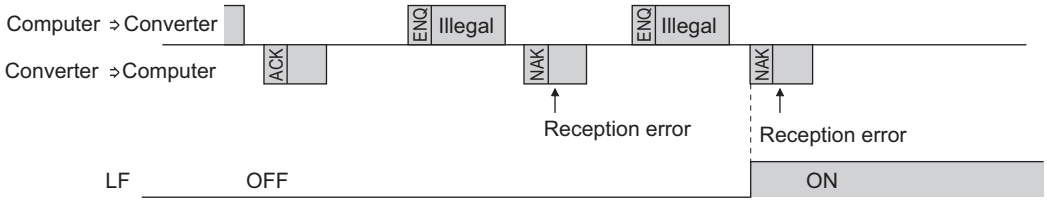
*3 Data check time

Item	Check time
Monitoring	Less than 12 ms
Parameter read/write	Less than Approx. 30 ms
Parameter clear / All parameter clear	Less than 5 s
Reset command	No reply

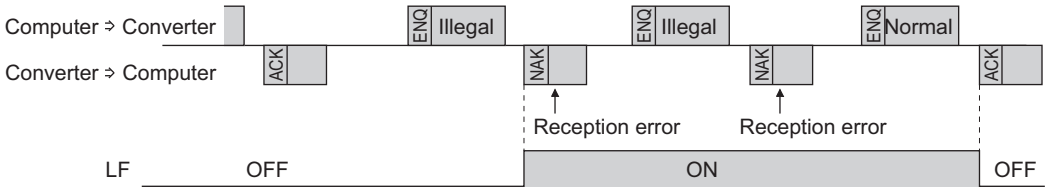
◆Retry count setting (Pr.121)

- Set the permissible number of retries at data receive error occurrence. (Refer to page 153 for data receive error which enables retry.)
- When the data receive errors occur consecutively and exceed the permissible number of retries set, the converter outputs the Alarm (LF) signal. (The converter does not shot off its output.)
- When a data transmission error occurs while "9999" is set, the converter outputs the Alarm (LF) signal. (The converter does not shot off its output.)
  To use the LF signal, set "98 (positive logic) or 198 (negative logic)" in any of **Pr.11, Pr.12,** and **Pr.16 (Output terminal function selection)** to assign the function to an output terminal.

Example: PU connector communication when **Pr.121** = "1 (initial value)"



Example: PU connector communication when **Pr.121** = "9999"



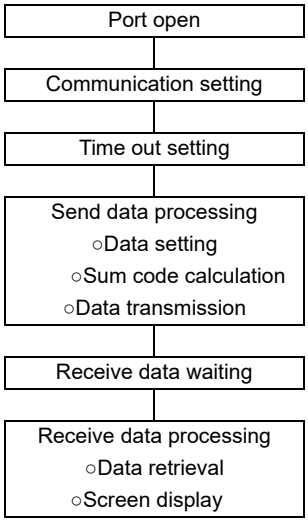
◆Programming instructions

- When data from the computer has any error, the converter does not accept that data. Hence, in the user program, always insert a retry program for data error.
- Data communication starts when the computer gives a communication request to the converter. The converter does not send any data without the computer's request. Hence, design the program so that the computer gives a data read request for monitoring, etc. as required.
- Program example: Performing Parameter clear of the converter

Microsoft® Visual C++® (Ver.6.0) programming example

```
#include <stdio.h>
#include <windows.h>

void main(void){
	HANDLE		hCom;		// Communication handle
	DCB		hDcb;		// Structure for setting communication
	COMMTIMEOUTS		hTim;	// Structure for setting timeouts

	char		szTx[0x10];		// Send buffer
	char		szRx[0x10];		// Receive buffer
	char		szCommand[0x10];// Command
	int		nTx,nRx;		// For storing buffer size
	int		nSum;			// For calculating sum code
	BOOL		bRet;
	int		nRet;
	int		i;

	//**** Open COM1 port ****
	hCom = CreateFile("COM1", (GENERIC_READ | GENERIC_WRITE), 0, NULL, OPEN_EXISTING, FILE_ATTRIBUTE_NORMAL, NULL);
	if(hCom != NULL) {
		//****Set COM1 port communication ****
		GetCommState(hCom,&hDcb);				// Get current communication information
		hDcb.DCBlength = sizeof(DCB);				// Set structure size
		hDcb.BaudRate  = 19200;				// Communication speed = 19200 bps
		hDcb.ByteSize  = 8;					// Data length = 8 bits
		hDcb.Parity    = 2;					// Even parity
		hDcb.StopBits  = 2;					// Stop bit = 2 bits
		bRet = SetCommState(hCom,&hDcb);			// Set the changed communication information
		if(bRet == TRUE) {
			//**** Set COM1 port timeout ****
			GetCommTimeouts(hCom,&hTim);			// Get current timeout values
			hTim.WriteTotalTimeoutConstant = 1000;		// Writing timeout = 1 second
			hTim.ReadTotalTimeoutConstant = 1000;		// Reading timeout = 1 second
			SetCommTimeouts(hCom,&hTim);			// Set the changed timeout values
			//**** Set command to perform Parameter clear of the station 1 converter ****
			sprintf(szCommand,"01FC15A5A");			// Transmission data ( Parameter clear)
			nTx = strlen(szCommand);			// Transmission data size
			//**** Generate sum code ****
			nSum = 0;					// Initialize sum data
			for(i = 0;i < nTx;i++) {
				nSum += szCommand[i];			// Calculate sum code
				nSum &= (0xff);				// Mask data
			}

			//**** Generate transmission data ****
			memset(szTx,0,sizeof(szTx));			// Initialize send buffer
			memset(szRx,0,sizeof(szRx));			// Initialize receive buffer
			sprintf(szTx,"\5%s%02X",szCommand,nSum);// ENQ code, transmission data, sum code
			nTx = 1 + nTx + 2;				// Number of ENQ code,  send data, sum code

			nRet = WriteFile(hCom,szTx,nTx,&nTx,NULL);
			//**** Send ****
			if(nRet != 0) {
				nRet = ReadFile(hCom,szRx,sizeof(szRx),&nRx,NULL);
			//**** Receive ****
				if(nRet != 0) {
					//**** Display received data ****
					for(i = 0;i < nRx;i++) {
						printf("%02X ",(BYTE)szRx[i]);// Output received data to console
						// ASCII character code is displayed in hexadecimal. Character "0" is represented as hexadecimal "30".
					}
					printf("\n\r");
				}
			}
		}
		CloseHandle(hCom);					// Close communication port
	}
}
```

General flowchart

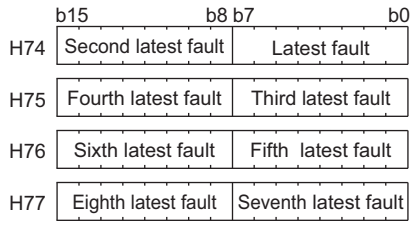


⚠ CAUTION

- Always set the communication check time interval before starting operation to prevent hazardous conditions.
- Note that the converter does not detect a fault if communication is broken due to signal cable breakage, computer fault etc.

◆Setting items and set data

After completion of parameter settings, set the instruction codes and data, then start communication from the computer to allow various types of operation control and monitoring.

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Read/ write</th><th>Instruction code</th><th>Data description</th><th>Number of data digits (format)</th></tr>
<tr><td rowspan="8">1</td><td rowspan="8">Monitoring</td><td>Input current</td><td>Read</td><td>H6F</td><td>H0000 to HFFFF: Input current (hexadecimal) in 0.01 A increments</td><td>4 digits (B.E/D)</td></tr>
<tr><td>Input voltage</td><td>Read</td><td>H70</td><td>H0000 to HFFFF: Input voltage (hexadecimal) in 0.1 V increments.</td><td>4 digits (B.E/D)</td></tr>
<tr><td>Bus voltage</td><td>Read</td><td>H71</td><td>H0000 to HFFFF: Bus voltage (hexadecimal) in 0.1 V increments.</td><td>4 digits (B.E/D)</td></tr>
<tr><td>Special monitor</td><td>Read</td><td>H72</td><td>H0000 to HFFFF: Data of the monitor item selected with the instruction code HF3.</td><td>4 digits (B and E/D)</td></tr>
<tr><td rowspan="2">Special monitor selection No.</td><td>Read</td><td>H73</td><td rowspan="2">H01 to H1C: Monitor selection data.
Refer to the special monitor number list (on page 159).</td><td>2 digits (B and E1/D)</td></tr>
<tr><td>Write</td><td>HF3</td><td>2 digits (A1 and C/D)</td></tr>
<tr><td>Fault record</td><td>Read</td><td>H74 to H77</td><td>H0000 to HFFFF: Two fault records per code.
 

Refer to the fault data list (on page 159).</td><td>4 digits (B and E/D)</td></tr>
<tr><td rowspan="2">2</td><td colspan="2">Monitoring of converter status (extended)</td><td>Read</td><td>H79</td><td rowspan="2">The status of output signals during power/regenerative driving can be monitored. (For the details, refer to page 160.)</td><td>4 digits (B and E/D)</td></tr>
<tr><td colspan="2">Monitoring of converter status</td><td>Read</td><td>H7A</td><td>2 digits (B and E1/D)</td></tr>
<tr><td rowspan="2">3</td><td colspan="2" rowspan="2">Converter reset</td><td rowspan="2">Write</td><td rowspan="2">HFD</td><td>H9696: The multifunction regeneration converter is reset.
• As the converter is reset after the computer starts communication, the converter cannot send reply data back to the computer.</td><td>4 digits (A and C/D)</td></tr>
<tr><td>H9966: The multifunction regeneration converter is reset.
• After the computer correctly starts communication and send data to the converter, the converter returns the ACK signal to the computer before being reset.</td><td>4 digits (A and D)</td></tr>
<tr><td>4</td><td colspan="2">Fault history clear</td><td>Write</td><td>HF4</td><td>H9696: Fault history is cleared.</td><td>4 digits (A,C/D)</td></tr>
<tr><td>5</td><td colspan="2">Parameter clear/
All parameter clear</td><td>Write</td><td>HFC</td><td>Parameters return to initial values.
Whether to clear communication parameters or not can be selected according to the data. (○: Cleared, ×: Not cleared)
Refer to page 232 for Parameter clear, All parameter clear, and communication parameters.
<table>
<tr><th>Clear type</th><th>Data</th><th>Communication parameters</th></tr>
<tr><td rowspan="2">Parameter clear</td><td>H9696</td><td>○</td></tr>
<tr><td>H5A5A</td><td>×*1</td></tr>
<tr><td rowspan="2">All parameter clear</td><td>H9966</td><td>○</td></tr>
<tr><td>H55AA</td><td>×*1</td></tr>
</table>
When a clear is performed with H9696 or H9966, the setting of communication parameters also returns to the initial setting. So, set the parameters again when resuming the operation.
Performing clear will clear the setting of the instruction codes HF3 and HFF.
*1 Turning OFF the converter power during clearing parameters with H5A5A or H55AA returns the setting of communication parameters to the initial setting.</td><td>4 digits (A and C/D)</td></tr>
</table>

Refer to **page 150** for data formats (A, A1, B, B1, C, D, E, E1, and F).

No.	Item		Read/ write	Instruction code	Data description	Number of data digits (format)
6	Parameter setting		Read	H00 to H63	Refer to the instruction code list (on page 232) to read/write parameter settings as required. For the setting of **Pr.100** or later, the link parameter extended setting is required.	4 digits (B and E/D)
7			Write	H80 to HE3		4 digits (A and C/D)
8	Link parameter extended setting		Read	H7F	Parameter settings are switched (extended) according to a setting from H00 to H09. For details of the settings, refer to the extended code in the instruction code list (on page 232).	2 digits (B and E1/D)
			Write	HFF		2 digits (A1 and C/D)
9	Product profile	Model	Read	H7C	The model name can be read in ASCII code. "H20" (blank code) is set for blank area. Example) "FR-XC": H46, H52, H2D, H58, H43, H20, ..., H20	20 digits (B and E3/D)
		Capacity	Read	H7D	The converter capacity can be read in ASCII code. Data read is displayed in increments of 0.1 kW (rounded down to one decimal place). "H20" (blank code) is set for blank area. Example) 7.5K: H20, H20, H20, H20, H37,H35)	6 digits (B and E2/D)

Refer to page 150 for data formats (A, A1, B, B1, C, D, E, E1, and F).

NOTE

- Set 65535 (HFFFF) as a parameter value "9999".
- For the instruction codes HFF and HF3, their values are held once written but cleared to zero when the converter reset or All parameter clear is performed.

[Special monitor selection No.]

Refer to page 138 for details of the monitor items.

Data	Description	Increment
H01	Input current	0.01 A
H02	Input voltage	0.1 V
H03	Bus voltage	0.1 V
H05	Power supply frequency	0.01 Hz
H06	Electronic thermal O/L relay load factor	0.1%

Data	Description	Increment
H07	Input power	0.01 kW
H08	Cumulative power	1 kWh
H09	Cumulative energization time	1 h
H0A	Input power with regenerative driving indication *3	0.1 kW

Data	Description	Increment
H0F	Input terminal status	— *1
H10	Output terminal status	— *2
H1A	Cumulative power-driving power	1 kWh
H1B	Cumulative regenerative power	1 kWh
H1C	Electricity cost	1

*1 Input terminal monitor details ("1" denotes terminal ON and "2" denotes terminal OFF.)

b15															b0
0	0	0	0	0	RES	0	SOF	0	LOH	0	0	0	0	0	0

*2 Output terminal monitor details ("1" denotes terminal ON and "2" denotes terminal OFF.)

b15															b0
0	0	0	0	0	0	0	0	0	ABC	0	0	0	RYA	RSO	RYB

*3 Absolute (unsigned) values are displayed.

[Fault data]

Refer to page 178 for details of faults.

Data	Description
H00	No fault
H13	E.A
H23	E.B
H30	E.C
H40	E.D
H50	E.E
H51	E.F
H52	E.G
H90	E.H
HA1	E.Q

Data	Description
HA4	E.6
HB0	E.P
HB1	E.J
HB2	E.K
HB3	E.P
HC0	E.L
HC2	E.M
HC5	E.N
HF1	E.1
HFD	E.L

Data	Description
HB8	E.T
HB9	E.U
HBA	E.V
HBB	E.W
HF8	E.8

Fault monitor details (example of the instruction code H74)

When data read is H30B1
(The second latest fault: E.T)
(The latest fault: E.J)

b15							b8 b7							b0
0	0	1	1	0	0	0	0	1	0	1	1	0	0	1

The second latest fault (H30) | The latest fault (HB1)

[Monitoring of converter status]

Item	Instruction code	Bit length	Description	Example
Converter status monitor	H7A	8 bits	b0: RYB (Inverter run enable) b1: Power driving b2: Regenerative driving b3: RSO (During converter reset)*1 b4: — b5: — b6: RYA (Inverter run enable)*1 b7: —	[Example 1] H43: Converter is power driving. b7 b0 0 1 0 0 0 0 1 1 [Example 2] H45: Converter is regenerative driving. b7 b0 0 1 0 0 0 1 0 1
Converter status monitor (extended)	H79	16 bits	b0: RYB (Inverter run enable) b1: Power driving b2: Regenerative driving b3: RSO (During converter reset)*1 b4: — b5: — b6: RYA (Inverter run enable)*1 b7: — b8: ABC (Fault)*1 b9: — b10: — b11: — b12: — b13: — b14: — b15: Fault occurred.	[Example 1] H0043: Converter is power driving. b15 b0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 1 1 [Example 2] H8100: Stop at fault occurrence b15 b0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0

*1 A function described in parentheses ( ) is initially assigned to the signal. The function can be change by using **Pr.11, Pr.12, or Pr.16 (Output terminal function selection)**.

6.6.22 Initial setting and specification of the CC-Link communication function (Pr.542 to Pr.544)

Set the CC-Link communication details such as station number and transmission speed.

Pr.	Name	Initial value	Setting range	Description
542*1	Station number (CC-Link)	1	1 to 64	Enter the station number of the converter.
543*1	Transmission speed selection (CC-Link)	0	0 to 4	Set the data transmission speed.
544*1	CC-Link extended setting	0	0, 1, 12	Extends the remote register function.

*1 The setting is available only when a communication option (FR-A8NC) is installed.

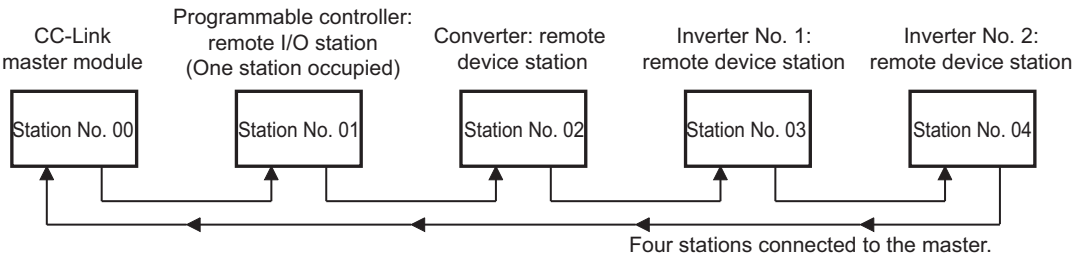
◆Station number setting (Pr.542)

Enter the station number of the converter in **Pr.542 Station number (CC-Link)**. The setting range is 1 to 64.

NOTE

- Assign a unique station number to each station. (Overlapping in station number interferes with proper communication.)

◆Connection example



NOTE

- Set consecutive numbers for the station numbers. (Do not skip any numbers like 1, 2, then 4.)
  The station number does not have to match with the physical connection sequence. (There is no problem with having the physical connection sequence like "station number 1 - station number 3 - station number 4 - station number 2".
- One converter occupies one station (one remote device station).
- [L.ERR] LED blinks when the parameter setting is changed. The LED turns OFF when the setting becomes effective by turning the power OFF and ON or performing the converter reset.

◆Transmission speed setting (Pr.543)

Set the data transmission speed. (Refer to the manual of the CC-Link master module for the details of the transmission speed.)

Pr.543 setting	Transmission speed
0 (initial value)	156 kbps
1	625 kbps
2	2.5 Mbps
3	5 Mbps
4	10 Mbps

NOTE

- [L.ERR] LED blinks when the parameter setting is changed. The LED turns OFF when the setting becomes effective by turning the power OFF and ON or performing the converter reset.

◆CC-Link extended setting (Pr.544)

The functions of the remote register can be extended. Refer to "I/O signal list" for details of the remote I/O signals and the remote registers.

Pr.544 setting	CC-Link version	Description
0 (initial value)	1	One station occupied (FR-A5NC compatible)*1
1		One station occupied
12 *2	2	One station occupied, double setting

*1 The program created for the earlier series inverter (with the FR-A5NC option) can be used.
The upper 8 bits of RWw2 are not used for the link parameter extended setting.

*2 When the double setting of the CC-Link Ver. 2 is used, station data of the master station must be set to double.
(If the master station uses CC-Link Ver. 1, this setting is not available.)

NOTE

- The setting becomes effective after the converter reset. (Refer to page 176 for the converter reset.)

◆I/O signal list

Remote I/O (32 fixed points) (Refer to page 164.)

Device number	Signal name
RYn0	Unused
RYn1	Unused
RYn2	Converter stop (Function of terminal SOF)*1
RYn3	Unused
RYn4	Unused
RYn5	Converter reset (Function of terminal RES)*1
RYn6	Box-type reactor overheat protection (Function of terminal LOH)*1
RYn7	Unused
RYn8	Unused
RYn9	Unused
RYnA	Unused
RYnB	Unused
RYnC	Monitor command
RYnD	Unused
RYnE	Unused
RYnF	Instruction code execution request
RY(n+1)0 to RY(n+1)7	Reserved
RY(n+1)8	Unused (initial data process completion flag)
RY(n+1)9	Unused (initial data process request flag)
RY(n+1)A	Error reset request flag
RY(n+1)B to RY(n+1)F	Reserved

Device number	Signal name
RXn0	Unused
RXn1	Unused
RXn2	Converter ready (Inverter run enable signal)
RXn3	During converter reset (Function of terminal RSO)*2
RXn4	Inverter run enable (Function of terminal RYA)*2
RXn5	Unused
RXn6	Unused
RXn7	Unused
RXn8	Fault (ABC signal)*2
RXn9	Unused
RXnA	Unused
RXnB	Unused
RXnC	Monitoring
RXnD	Unused
RXnE	Unused
RXnF	Instruction code execution completed
RX(n+1)0 to RX(n+1)7	Reserved
RX(n+1)8	Unused (initial data process request flag)
RX(n+1)9	Unused (initial data process completion flag)
RX(n+1)A	Error status flag*3
RX(n+1)B	Remote station ready
RX(n+1)C to RX(n+1)F	Reserved

("n" indicates a value determined by the station number setting.)

*1 A signal shown is initially assigned to the terminal. Use **Pr.3, Pr.4, or Pr.7** to assign a different input signal to the terminal.
For the available signals, refer to page 130.

*2 A signal shown is initially assigned to the terminal. Use **Pr.11, Pr.12, or Pr.16** to assign a different output signal to the terminal.
For the available signals, refer to page 132.

*3 Output of the error status flag signal depends on the retry function setting.

Remote register (Refer to page 165.)

● When "One station occupied (FR-A5NC compatible)" for the CC-Link Ver. 1 is selected (**Pr.544** = "0")

Address	Description	
	Upper 8 bits	Lower 8 bits
RWwn	Monitor code 2	Monitor code 1
RWwn+1	Unused	
RWwn+2	H00 (arbitrary)*1	Instruction code
RWwn+3	Data to be written	

Address	Description	
	Upper 8 bits	Lower 8 bits
RWrn	First monitor value	
RWrn+1	Second monitor value	
RWrn+2	Reply code	
RWrn+3	Data read	

("n" indicates a value determined by the station number setting.)

*1 The upper 8 bits always contains H00 even a different value is set.

● When "One station occupied" for the CC-Link Ver. 1 is selected (**Pr.544** = "1")

Address	Description	
	Upper 8 bits	Lower 8 bits
RWwn	Monitor code 2	Monitor code 1
RWwn+1	Unused	
RWwn+2	Link parameter extended setting	Instruction code
RWwn+3	Data to be written	

Address	Description	
	Upper 8 bits	Lower 8 bits
RWrn	First monitor value	
RWrn+1	Second monitor value	
RWrn+2	Reply code	H00
RWrn+3	Data read	

("n" indicates a value determined by the station number setting.)

● When "One station occupied, double setting" for the CC-Link Ver. 2 is selected (**Pr.544** = "12")

Address	Description	
	Upper 8 bits	Lower 8 bits
RWwn	Monitor code 2	Monitor code 1
RWwn+1	Unused	
RWwn+2	Link parameter extended setting	Instruction code
RWwn+3	Data to be written	
RWwn+4	Monitor code 3	
RWwn+5	Monitor code 4	
RWwn+6	Monitor code 5	
RWwn+7	Monitor code 6	

Address	Description	
	Upper 8 bits	Lower 8 bits
RWrn	First monitor value	
RWrn+1	Second monitor value	
RWrn+2	Reply code	H00
RWrn+3	Data read	
RWrn+4	Third monitor value	
RWrn+5	Fourth monitor value	
RWrn+6	Fifth monitor value	
RWrn+7	Sixth monitor value	

("n" indicates a value determined by the station number setting.)

◆Details of the remote I/O signals

The device numbers described in this section are for the station number 1.
For the station number 2 and later, the device numbers are different. (Refer to the manual of the CC-Link master module for the correspondence between device numbers and station numbers.)

● Output signals (Master module to converter (with the FR-A8NC))

Signals output from the master module (input to the converter) are as follows.

Device number	Signal name	Description
RY2	Converter stop (Function of terminal SOF)*1	The function of a signal assigned to terminal SOF, RES, or LOH works.
RY5	Converter reset (Function of terminal RES)*1	
RY6	Box-type reactor overheat protection (Function of terminal LOH)*1	
RYC	Monitor command	When the Monitor command (RYC) signal turns ON, monitor values are set to the remote register RWr0, 1, and 4 to 7, and the Monitoring (RXC) signal turns ON. While the Monitor command (RYC) signal is ON, the monitor values keep being updated.
RYF	Instruction code execution request	When the Instruction code execution request (RYF) signal turns ON, an action corresponding to the instruction code set in RWw2 is executed. The instruction code execution completion (RXF) signal turns ON after the instruction code execution is completed. When an instruction code execution error occurs, a value other than "0" is set in the reply code (RWr2).
RY1A	Error reset request flag	When the Error reset request flag (RY1A) signal turns ON at a converter fault occurrence, the converter is reset and the Error status flag (RX1A) signal turns OFF.

*1 A signal shown is initially assigned to the terminal. Use **Pr.3, Pr.4, or Pr.7** to assign a different input signal to the terminal. For the available signals, refer to **page 130**.
Note that the RES, OH, and LOH signals cannot be controlled through the network.

● Input signals (Converter (with the FR-A8NC) to master module)

Signals input to the master module (output from the converter) are as follows.

Device number	Signal name	Description
RX2	Inverter run enable	OFF: The converter is not ready. ON: The converter is ready.
RX3	During converter reset (Function of terminal RSO)*1	The function of a signal assigned to terminal RSO, RYA, or ABC works.
RX4	Inverter run enable (Function of terminal RYA)*1	
RX8	Fault (ABC signal)*1	
RXC	Monitoring	Turning ON the Monitor command (RYC) signal sets monitor values to the remote registers RWr0, 1, and 4 to 7, and turns ON this signal. The Monitoring signal turns OFF when the monitor command (RYC) signal turns OFF.
RXF	Instruction code execution completed	Turning ON the Instruction code execution request (RYF) signal executes the instruction code set in RWw2, and after the completion, this signal turns ON. This signal turns OFF when the Instruction code execution request (RYF) signal turns OFF.
RX1A	Error status flag	The signal turns ON at a converter fault occurrence (when the protective function is activated). Output of the Error status flag signal depends on the retry function setting.
RX1B	Remote station ready	This signal turns ON when the converter becomes ready after initial setting is completed following a power-ON or a hardware reset. The signal turns OFF at a converter fault occurrence (when the protective function is activated). The signal is used as an interlock during the write to/read from the master module.

*1 A signal shown is initially assigned to the terminal. Use **Pr.11, Pr.12, or Pr.16** to assign a different output signal to the terminal. For the available signals, refer to **page 132**.

◆Details of the remote register

The device numbers described in this section are for the station number 1.

For the station number 2 and later, the device numbers are different. (Refer to the manual of the CC-Link master module for the correspondence between device numbers and station numbers.)

● Remote register (Master module to converter (with the FR-A8NC))

Remote register definition

Device number	Signal name	Description
RWw0	Monitor code 1/ Monitor code 2	Set the monitor code (refer to page 159) of the item to be monitored. Turning ON the RYC signal after setting this register sets the data of monitor value to RWr0/RWr1.
RWw2	Link parameter extended setting/ Instruction code	Set an instruction code (refer to page 166) for an operation such as parameter read/write, fault check, and fault clear. Turning ON the RYF signal after setting this register executes the instruction code. The RXF signal turns ON after the instruction code execution is completed. When a value other than "0" is set to **Pr.544 CC-Link extended setting**, upper 8 bits are used for the link parameter extended setting. Example) Instruction code to read **Pr.300**: 0300H
RWw3	Data to be written	Set data for the instruction code set in RWw2 (when required). Turn ON the RYF signal after setting RWw2 and this register. Set "0" when the write data is not required.
RWw4	Monitor code 3	Set the monitor code (refer to page 159) of the item to be monitored. Turning ON the RYC signal after setting this register sets the monitor data to RW[]. ([] denotes a register number (RWr4 to 7).)
RWw5	Monitor code 4	
RWw6	Monitor code 5	
RWw7	Monitor code 6	

● Remote register (Converter (with the FR-A8NC) to master module)

Remote register definition

Device number	Signal name	Description
RWr0	First monitor value	Turning ON the RYC signal sets the monitor value to the lower 8 bits of the specified monitor code (RWw0).
RWr1	Second monitor value	Turning ON the RYC signal sets the monitor value to the upper 8 bits of the monitor code (RWw0) except when "0" is set to the upper 8 bits.
RWr2	Reply code	Turning ON the RYF signal sets the reply code which corresponds to the instruction code of RWw2. The value "0" is set for a normal reply, and a value other than "0" is set for errors in data, mode, etc.
RWr3	Data to be read	In a normal reply, a replay code for the instruction code is set.
RWr4	Third monitor value	Turning ON the RYC signal sets the monitor values to the specified monitor code (RWw[]). ([] denotes a register number (RWw4 to 7).)
RWr5	Fourth monitor value	
RWr6	Fifth monitor value	
RWr7	Sixth monitor value	

RWr2 Reply code

Reply code		Description	Fault description
When Pr.554 = "0"	When Pr.554 ≠ "0"		
H0000	H00	Normal	No fault (Instruction codes are executed without any fault.)
H0001	H01	Write mode fault	Parameter write is attempted when the converter is running.
H0002	H02	Parameter selection fault	Unregistered code is set.
H0003	H03	Setting range fault	Set data exceeds the permissible range.

◆Details of instruction code

Operation control and monitoring can be performed through CC-Link communication by setting the following instruction codes and corresponding data after setting parameters.

Set instruction codes using the remote register (RWw) (refer to page 165).

Definitions read by instruction codes are stored in the remote register (RWr) (refer to page 165).

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Read/ Write</th><th>Instruction code</th><th>Data description</th></tr>
<tr><td rowspan="6">1</td><td rowspan="6">Monitor</td><td>Input current</td><td>Read</td><td>H6F</td><td>H0000 to HFFFF: Input current (hexadecimal) in 0.01 A increments.</td></tr>
<tr><td>Input voltage</td><td>Read</td><td>H70</td><td>H0000 to HFFFF: Input voltage (hexadecimal) in 0.1 V increments.</td></tr>
<tr><td>Bus voltage</td><td>Read</td><td>H71</td><td>H0000 to HFFFF: Bus voltage (hexadecimal) in 0.1 V increments.</td></tr>
<tr><td>Special monitor</td><td>Read</td><td>H72</td><td>H0000 to HFFFF: Monitor data selected in the instruction code HF3.</td></tr>
<tr><td rowspan="2">Special monitor selection No.</td><td>Read</td><td>H73</td><td rowspan="2">H01 to H1C: Monitor selection data.
Refer to the special monitor number list (on page 159).
*1 Data to be written is in hexadecimal, and only the last two digits are valid. (The upper two digits are ignored.)</td></tr>
<tr><td>Write</td><td>HF3*1</td></tr>
<tr><td>Fault description</td><td>Read</td><td>H74 to H77</td><td>H0000 to HFFFF: Two fault records per code.
b15 b8 b7 b0
H74 Second latest fault | Latest fault
H75 Fourth latest fault | Third latest fault
H76 Sixth latest fault | Fifth latest fault
H77 Eighth latest fault | Seventh latest fault
Refer to the fault data list (on page 159).</td></tr>
<tr><td>2</td><td colspan="2">Multifunction regeneration converter reset</td><td>Write</td><td>HFD</td><td>H9696: The multifunction regeneration converter is reset.</td></tr>
<tr><td>3</td><td colspan="2">Fault history clear</td><td>Write</td><td>HF4</td><td>H9696: Fault history is cleared.</td></tr>
<tr><td>4</td><td colspan="2">Parameter clear/ All parameter clear</td><td>Write</td><td>HFC</td><td>Parameters return to initial values.
Whether to clear communication parameters or not can be selected according to the data.
(○: Cleared, ×: Not cleared)
Refer to page 232 for Parameter clear, All parameter clear, and communication parameters.
<table><tr><th>Clear type</th><th>Data</th><th>Communication parameters</th></tr><tr><td rowspan="2">Parameter clear</td><td>H9696</td><td>○</td></tr><tr><td>H5A5A</td><td>×*2</td></tr><tr><td rowspan="2">All parameter clear</td><td>H9966</td><td>○</td></tr><tr><td>H55AA</td><td>×*2</td></tr></table>When a clear is performed with H9696 or H9966, communication related parameter settings also return to the initial values. When resuming the operation, set the parameters again.
Performing clear will clear the instruction code HF3 and HFF settings.
*2 Turning OFF the power supply while clearing parameters with H5A5A or H55AA returns the communication parameter settings to the initial settings.</td></tr>
<tr><td>5</td><td rowspan="2" colspan="2">Parameter</td><td>Read</td><td>H00 to H63</td><td rowspan="2">Refer to the instruction code list (on page 232) to read/write parameter settings as required.
For the setting of Pr.100 or later, the link parameter extended setting is required.</td></tr>
<tr><td>6</td><td>Write</td><td>H80 to HE3</td></tr>
<tr><td>7</td><td colspan="2">Link parameter extended setting</td><td>Read</td><td>H7F</td><td rowspan="2">Parameter settings are switched (extended) according to a setting from H00 to H09.
For details of the settings, refer to the extended code in the instruction code list (on page 232).</td></tr>
<tr><td colspan="2"></td><td>Write</td><td>HFF</td></tr>
</table>

NOTE

- Set 65535 (HFFFF) as a parameter value "9999".
- For the instruction codes HFF and HF3, their values are held once written but cleared to zero when the converter reset or All parameter clear is performed.

6.6.23 Operation at a communication error (Pr.500 to Pr.502)

The converter operation at an error occurrence in the CC-Link communication can be selected.

Pr.	Name	Initial value	Setting range	Description
500∗1	**Communication error execution waiting time**	0 s	0 to 999.8 s	Set the waiting time from the communication error occurrence to the communication error activation.
501∗1	**Communication error occurrence count display**	0	0	The communication error occurrence count is displayed. Write "0" to clear the cumulative count.
502∗1	**Stop mode selection at communication error**	0	0, 3	Set the converter's operation at a communication line error or an option fault.

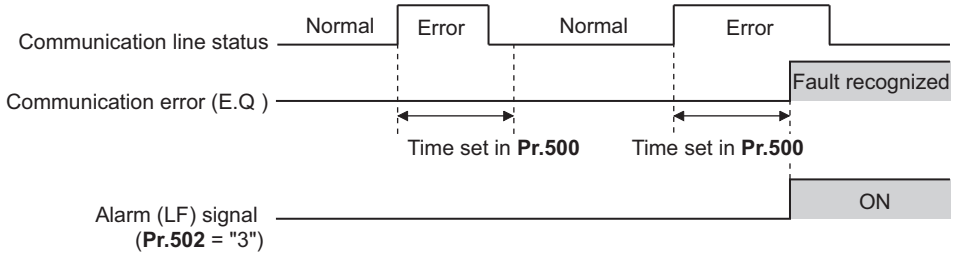
∗1 The setting is available only when a communication option (FR-A8NC) is installed.

◆Waiting time setting from the communication line error occurrence to the communication error activation (Pr.500)

The waiting time from the communication error occurrence to the communication error activation can be set.

When a communication line error occurs and lasts longer than the time set in **Pr.500**, the converter recognizes a communication error.

If the communication returns to normal state within the time, the converter does not recognize a communication error, and the operation continues.

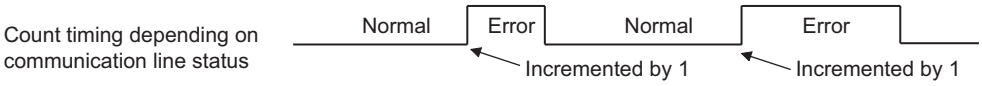


◆Displaying and clearing the communication error count (Pr.501)

The cumulative count of communication error occurrences can be displayed. Write "0" to clear this cumulative count.

When a communication line error occurs, the setting of **Pr.501 Communication error occurrence count display** increases by one.

The cumulative count of communication error occurrences is counted from 0 to 65535. When the count exceeds 65535, the displayed value is cleared and the counting starts over from 0 again.



NOTE

- Communication error count is temporarily stored in the RAM memory. The error count is stored in EEPROM only once per hour. If power reset or converter reset is performed, **Pr.501** setting will be the one that is last stored to EEPROM depending on the reset timing.

◆Operation selection at a communication error (Pr.502)

The converter operation at a communication line error occurrence or at an option fault occurrence can be selected.

◆Parameter setting

• Converter operation at fault occurrence

Fault type	Pr.502 setting	Converter operation	Indication	Fault signal
Communication line	0 (initial value), 3	Continued*1	Normal*1	OFF
Communication option	0 (initial value), 3	Stopped	"E.1"	ON

*1 When the communication returns to normal state within the time period set in **Pr.500**, the communication option error (E.Q) does not occur.

• Converter operation at fault recognition after the elapse of a time period set in **Pr.500**

Fault type	Pr.502 setting	Converter operation	Indication	Fault signal
Communication line	0 (initial value)	Stopped	"E.Q"	ON
	3	Continued	Normal	OFF
Communication option	0 (initial value), 3	Stopped	"E.1"	ON

• Converter operation at fault removal

Fault type	Pr.502 setting	Converter operation	Indication	Fault signal
Communication line	0 (initial value)	Remains stopped	Remains at "E.Q"	Remains ON
	3	Continued	Normal	OFF
Communication option	0 (initial value), 3	Remains stopped	Remains at "E.1"	Remains ON

NOTE

- Communication line error E.Q (fault data: HA1) is an error that occurs on the communication line. Communication option fault E.1 (fault data: HF1) is an error that occurs in the communication circuit inside the option.
- The "fault signal" in the tables above refers to the Fault output (ABC) signal or fault bit.
- When the fault signal is set to output, each fault is stored in the fault history. (A fault record is written to the fault history at a fault signal output.)
  When the fault signal is not set to output, fault record is temporarily overwritten to the fault history but not stored.
  After the fault is removed, the fault indication is reset, changing the display back to normal, and the latest in the stored fault records is displayed in the fault history.

6.6.24 Communication EEPROM write selection (Pr.342)

Storage device of the parameter settings can be changed to RAM only from EEPROM + RAM for the parameter writing through the RS-485 communication or the CC-Link communication. Use this function if parameter settings are changed frequently.

Pr.	Name	Initial value	Setting range	Description
342	**Communication EEPROM write selection**	0	0	When parameter write is performed through communication, the parameter settings are written to the EEPROM and RAM.
			1	When parameter write is performed through communication, the parameter settings are written to the RAM only.

• When changing the parameter settings frequently, set "1" in **Pr.342** to write them to the RAM only.
The life of the EEPROM will be shorter if parameter write is performed frequently with the initial setting "0" (written to the EEPROM and RAM).

NOTE

- Turning OFF the converter's power clears the modified parameter settings when **Pr.342** = "1" (written to the RAM only)". Therefore, the parameter settings last stored to EEPROM applies at next power-ON.

6.6.25 Setting of parameter unit / operation panel (Pr.145, Pr.990, and Pr.991)

Setting of the PU (parameter unit / operation panel) can be changed.

Pr.	Name	Initial value	Setting range	Description
145	**PU display language selection**	0	0	Japanese
			1	English
			2	German
			3	French
			4	Spanish
			5	Italian
			6	Swedish
			7	Finnish
990	**PU buzzer control**	1	0	Beep (buzzer) is OFF.
			1	Beep (buzzer) is ON.
991	**PU contrast adjustment**	58	0 to 63	0: Lowest ↓ 63: Highest

◆PU display language selection (Pr.145)

- The display language of the PU can be switched by using **Pr.145**.

NOTE

- Parameter names and monitor item names are always displayed in English regardless of the **Pr.145** setting.

◆Beep control (Pr.990)

- The key operation beep (buzzer) of the PU sounds when **Pr.990** = "1 (initial value)".

◆PU contrast adjustment (Pr.991)

- Contrast of the LCD on the parameter unit can be adjusted.
  Decreasing the **Pr.991** setting makes the contrast low.
- **Pr.991** is available as a simple mode parameter only when the parameter unit is installed.

6.7 Parameter clear / All parameter clear on the operation panel

POINT

- Set "1" to **Pr.CLR Parameter clear** or **ALL.CL All parameter clear** to initialize parameters. (Parameters cannot be cleared when **Pr.77 Parameter write selection** = "1".)
- **Pr.CLR** does not clear the terminal function selection parameters.
- Refer to the parameter list on page 232 for parameters cleared by Parameter clear or All parameter clear.

Operating procedure

1. Turning ON the power of the converter

The operation panel is in the monitor mode.

2. Selecting the parameter setting mode

Press MODE to choose the parameter setting mode. (The parameter number read previously appears.)

3. Selecting a parameter number

Turn  to "Pr.CLR" for Parameter clear or turn it to "ALLCL" for All parameter clear, and press SET.

"0 (initial value)" appears.

4. Parameter clear

Turn  to change the set value to "1". Press SET to enter the setting. "1" and "Pr.CLR or ALLCL" are displayed alternately after parameters are cleared.

- •Turn  to read another parameter.
- •Press SET to show the setting again.
- •Press SET twice to show the next parameter.

Setting	Description	
	Pr.CL Parameter clear	ALL.CL All parameter clear
0	Initial display (Parameters are not cleared.)	
1	The settings of parameters except for terminal function selection parameters are initialized.	The settings of all the parameters, including terminal function selection parameters, are initialized.

6.8 Copying and verifying parameters on the operation panel

Pr.CPY setting	Description
0.---	Initial display
1.RD	Read the parameters from the source converter and store them to the operation panel.
2.WR	Write the parameters stored in the operation panel to the target converter.
3.VFY	Verify parameters in the converter and those in the operation panel. (Refer to page 173.)

NOTE

- When the copy destination is other than the FR-XC(-PWM) converter or when Parameter copy is attempted after the parameter copy reading was stopped, the product series error indication "rE4" appears.
- Refer to the parameter list on page 232 for the availability of parameter copy.
- When the power is turned OFF or an operation panel is disconnected, etc. during parameter copy writing, perform parameter copy writing again or check the setting values by using parameter verification.
- If parameters are copied from a not-upgraded converter to an upgraded converter that has additional parameters due to upgrade, out-of-range setting values may be written in some parameters. In that case, those parameters operate as if they were set to initial values.
- Parameter copy using the FR-PU07(BB) is available when the product manufactured in September 2015 or later is used.

6.8.1 Parameter copy

- Parameter settings in a FR-XC series converter can be copied to another FR-XC series converter.

◆Reading the parameter settings in the converter and storing them in the operation panel

Operating procedure

1.	Connect the operation panel to the source converter.
2.	Selecting the parameter setting mode Press MODE to choose the parameter setting mode. (The parameter number read previously appears.)
3.	Selecting the parameter number Turn to "PrCPY" (parameter copy), and press SET. "0.---" appears.
4.	Reading to and storing in the operation panel Turn to change the set value to " rEd". Press SET to start reading the parameter settings from the converter and storing them in the operation panel. (It takes about 30 seconds to read and store all the settings. During reading, " rEd" blinks.)
5.	End of reading and storing " rEd" and "PrCPY" are displayed alternately after the reading and storing are completed.

NOTE

- "rE1" appears... Why?
  -Parameter read error. Perform operation from Step 3 again.
- CP ⇄ 000 are displayed alternately.
  Parameters copy was performed between the FR-XC-(H)55K or lower and the FR-XC-H75K.
  1.Set "0" in **Pr.0 Simple mode selection**.
  2.Set either of the following values (initial values) in **Pr.989 Parameter copy alarm release.**

	FR-XC-(H)55K or lower	FR-XC-H75K
Pr.989 setting	10	100

  3.Set **Pr.52 PU main monitor selection** and **Pr.57 Restart selection**.

◆Writing parameter settings stored in the operation panel to the converter

Operating procedure

1. Connect the operation panel to the target converter.

2. Turning ON the SOF (Converter stop) signal

Turn ON the SOF signal to stop the converter operation.

3. Selecting the parameter setting mode

Press MODE to choose the parameter setting mode. (The parameter number read previously appears.)

4. Selecting a parameter

Turn  to "Pr.CPY" (Parameter copy), and press SET.

"0.---" appears.

5. Selecting parameter write

Turn  to change the set value to "2.WR", then press SET.

2. ALL appears.

6. Writing to the converter

Press SET to start writing the parameter settings stored in the operation panel to the converter. (It takes about 60 seconds to write all the settings. During writing, "2. ALL" blinks.)

7. End of copying

"2.WR" and "Pr.CPY" are displayed alternately after copying ends.

8. When parameters are written to the target converter, reset the converter before operation by, for example, turning the power OFF.

NOTE

- "rE2" appears... Why?
  - Parameter write error. Perform operation from Step 3 again.

6.8.2 Parameter verification

- Whether the parameter settings of converters are the same or not can be checked.

Operating procedure

1.	Copy the parameter settings in the verification source converter to the operation panel according to the procedure on page 171.
2.	Detach the operation panel from the source converter and attach it to the verification target converter.
3.	Turning ON the power of the converter The operation panel is in the monitor mode.
4.	Selecting the parameter setting mode Press MODE to choose the parameter setting mode. (The parameter number read previously appears.)
5.	Selecting a parameter Turn  to "PrCPY" (Parameter copy), and press SET. "0.-- -- -- " appears.
6.	Parameter verification Turn  to change the setting value to "3rFY" (Parameter copy verification). Press SET. Verification of the parameter settings copied to the operation panel and the parameter settings in the verification target converter is started. (It takes about 60 seconds to verify all the settings. During verification, "3rFY" blinks.) ● If there are different parameters, the different parameter number and "rE3" are displayed alternately. ● To continue verification, press SET.
7.	"PrCPY" and "3rFY" are displayed alternately after verification ends.

NOTE

- "rE3" blinks... Why?
  - Check the parameter setting of the source converter against the setting of the target converter. To continue verification, press SET.

6.9 Checking parameters changed from their initial values (initial value change list)

Parameters changed from their initial values can be displayed.

Operating procedure

1. Turning ON the power of the converter

The operation panel is in the monitor mode.

2. Selecting the parameter setting mode

Press MODE to choose the parameter setting mode. (The parameter number read previously appears.)

3. Selecting a parameter

Turn  to "Pr.CHG" (Initial value change list), and press SET.

"P.-- -- -- -- " appears.

4. Checking the Initial value change list

Turn  . The parameter numbers that have been changed from their initial value appear in order.

● When SET is pressed with a changed parameter displayed, the setting change process of the parameter starts. (Parameter numbers are no longer displayed in the list when they are returned to their initial values.)

Other changed parameters appear by turning  .

● The indication returns to "P.-- -- -- -- " when the last changed parameter is displayed.

NOTE

Parameter setting using the initial value change list is also possible.

7 PROTECTIVE FUNCTIONS

This chapter explains the protective functions in this product.
Always read the instructions before use.

7.1 Converter fault and indication 176
7.2 Reset method for the protective functions.....176
7.3 List of indications 177
7.4 Causes and corrective actions 178
7.5 Check and clear of the fault history 188
7.6 Check first when you have a trouble 189

7.1 Converter fault and indication

When a fault occurs in the converter, a protective function is automatically activated to shut off the converter output and show an indication on the PU and on the operation status 7-segment LED display of the converter.
If any indication which is not shown in the list of indications (provided in a subsequent section) appears or if you have any other problem, please contact your sales representative.

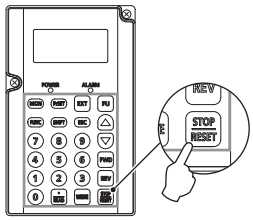
- Indication: When a protective function is activated, the display on the PU and on the converter automatically shows an indication.
- Reset: While a protective function is activated, the converter output is kept shutoff. Reset the converter to restart the operation.
- When any protective function is activated, take an appropriate corrective action before resetting the product to resume the operation. Failure to do so may break or damage the converter.

- The converter indications are roughly categorized as below.
  - Error message
    A message regarding operational fault or setting fault on the operation panel is displayed. The converter output is not shut off.
  - Warning
    The converter output is not shut off even when a warning is displayed. However, failure to take appropriate measures will lead to a fault.
  - Alarm
    The converter output is not shut off. The Alarm (LF) signal can be output depending on the parameter setting.
  - Fault
    When a protective function is activated, the converter output is shut off and the Fault (ALM) signal is output.

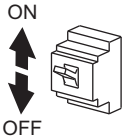
7.2 Reset method for the protective functions

Reset the converter by performing any of the following methods. Note that the internal accumulated heat value of the electronic thermal relay function and the number of retries are cleared (erased) by resetting the converter.
The converter recovers about 1 second after the reset is released.

Method 1: Press STOP RESET on the PU.
(This method is available only when a fault occurs. Refer to page 180 for details of faults.)

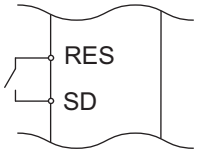


Method 2: Switch the converter power OFF once, then switch it ON again.



Method 3: Turn ON the Reset (RES) signal and keep it ON for more than 0.1 seconds. (If the RES signal is kept ON, "AA" appears (blinks) on the converter display to indicate that the converter is in a reset state.)

Multifunction regeneration converter



7.3 List of indications

Indication on the operation status 7-segment LED display of the converter			Name	Refer to page
Error message	—	—	Operation panel lock (HOLD)	178
	—	—	Write disable error (Er1)	178
	—	—	Copy operation fault (rE1 to rE4)	178
Warning	LB	LB	Overload signal detection	179
	LC	LC	Electronic thermal relay function pre-alarm	179
	Ld	LD	PU stop	179
	LE	LE	Maintenance signal output	179
	CP	CP	Parameter copy	179
	LG	LG	Power supply not detected	179
	LH	LH	Converter operation disabled	180
	LJ	LJ	Box-type reactor overheat pre-alarm	180
Alarm	LA	LA	Fan alarm	180
Fault	E.A	E.A	Overcurrent trip	180
	E.b	E.B	Overvoltage trip	181
	E.C	E.C	Converter overload trip (electronic thermal relay function)	181
	E.d	E.D	Heat sink overheat	181
	E.E	E.E	Instantaneous power failure	182
	E.F	E.F	Undervoltage	182
	E.G	E.G	Input phase loss	182
	E.H	E.H	External thermal relay operation	182
	E.J	E.J	PU disconnection	183
	E.K	E.K	Retry count excess	183
	E.L	E.L	CPU fault	183
			Internal circuit fault	183
	E.M	E.M	24 VDC power output short circuit	184
	E.n	E.N	Inrush current limit circuit fault	184
	E.P	E.P	Parameter storage device fault	184
	E.Q	E.Q	Communication option fault	185
	E.T	E.T	Connection mode fault	185
	E.U	E.U	Unsupported control selection	185
	E.v	E.V	Box-type reactor overheat protection	186
	E.W	E.W	Box-type reactor power supply short circuit protection	186
	E.1	E.1	Option fault	186
	E.6	E.6	Main circuit power supply detection fault	187
	E.8	E.8	Input power supply fault 1	187

7.4 Causes and corrective actions

◆Error message

A message regarding operational troubles on the operation panel is displayed. Output is not shut off.

Operation panel indication	HOLD	HOLd
Name	Operation panel lock	
Description	Operation lock is set. Operation other than STOP RESET is invalid. (Refer to page 141.)	
Check point	—	
Corrective action	Press MODE for 2 seconds to release the lock.	

Operation panel indication	Er1	Er 1
Name	Write disable error	
Description	Parameter setting was attempted while **Pr.77 Parameter write selection** is set to disable parameter write.	
Check point	Check the **Pr.77** setting. (Refer to page 145.)	

Operation panel indication	rE1	rE 1
Name	Parameter read error	
Description	• A failure has occurred at EEPROM in the operation panel during reading of the parameter settings for Parameter copy.	
Check point	—	
Corrective action	• Perform Parameter copy again. (Refer to page 171.) • The operation panel (FR-DU08) may be faulty. Contact your sales representative.	

Operation panel indication	rE2	rE2
Name	Parameter write error	
Description	• Parameter write from the operation panel to the multifunction regeneration converter was attempted for Parameter copy during operation. • A failure has occurred at EEPROM in the operation panel during writing of the parameter settings for Parameter copy.	
Check point	Check that the converter is stopped.	
Corrective action	• After turning ON the SOF signal, perform Parameter copy again. (Refer to page 171.) • The operation panel (FR-DU08) may be faulty. Contact your sales representative.	

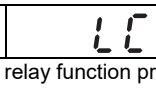
Operation panel indication	rE3	rE3
Name	Parameter verification error	
Description	• The data in the converter are different from the data in the operation panel. • A failure has occurred at EEPROM in the operation panel during parameter verification.	
Check point	Check the parameter setting of the source converter against the setting of the target converter.	
Corrective action	• Continue the verification by pressing SET. • Perform the parameter verification again. (Refer to page 173.) • The operation panel (FR-DU08) may be faulty. Contact your sales representative.	

Operation panel indication	rE4	rE4
Name	Product series error	
Description	• The series of the source converter used to copy or verify parameters is not the same as the target converter. • The operation panel data was incorrect when attempting to verify parameters or copy parameters from the operation panel to the converter.	
Check point	• Check that the source converter being used to verify or copy parameters is the same series as the target converter. • Check that the copying of parameters was not interrupted due to a loss of power to the converter or the operation panel being disconnected.	
Corrective action	• Try to copy or verify parameters • Try to copy the parameters to the operation panel from the converter unit again.	

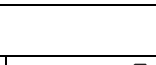
◆Warning

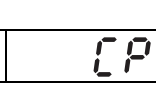
Output is not shut off when a protective function is activated.

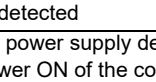
Converter indication	LB		PU indication	OL
Name	Overload signal detection			
Description	Appears when the current limit function of the converter is activated.			
Check point	• Check that the acceleration/deceleration time set in the inverter is not too short. • Check that the load is not too heavy. • Check for any failures in peripheral devices.			
Corrective action	• Set the acceleration/deceleration time longer in the inverter. • Reduce the load. • Check that the peripheral devices are operating properly.			

Converter indication	LC		PU indication	TH
Name	Electronic thermal relay function pre-alarm			
Description	Appears if the cumulative value of the electronic thermal relay reaches or exceeds 85% of the preset level. If the cumulative value reaches or exceeds the specified value, the protection circuit is activated to stop the outputs of the multifunction regeneration converter. The THP signal can be simultaneously output with the indication "TH" displayed. For the terminal used for the THP signal output, set "8 (positive logic)" or "108 (negative logic)" in any of **Pr.11, Pr.12, and Pr.16 (Output terminal function selection)** to assign the function. (Refer to page 132.)			
Check point	Check for large load or sudden acceleration.			
Corrective action	Reduce the load and frequency of operation.			

Converter indication	LD		PU indication	PS
Name	PU stop			
Description	The PU stop (stop of the converter operation by pressing STOP RESET on the PU) is enabled by the setting of **Pr.75 Reset selection / disconnected PU detection / PU stop selection**. (For the details of **Pr.75**, refer to page 144.)			
Check point	Check for a stop made by pressing STOP RESET on the PU.			
Corrective action	To reset the indication, turn ON the Converter stop (SOF) signal to stop the converter output, and press EXT.			

Converter indication	LE		PU indication	MT
Name	Maintenance signal output			
Description	Appears when the converter's cumulative energization time reaches or exceeds the parameter set value. This warning is not activated when **Pr.35 Maintenance timer warning output set time** is in the initial setting (**Pr.35** = "9999").			
Check point	Check that the value of **Pr.34 Maintenance timer** is larger than that of **Pr.35 Maintenance timer warning output set time**. (Refer to page 135.)			
Corrective action	Write "0" in **Pr.34 Maintenance timer**.			

Converter indication	CP		PU indication	CP
Name	Parameter copy			
Description	Appears when parameter copy is performed between the FR-XC-(H)55K or lower and the FR-XC-H75K.			
Check point	**Pr.52 PU main monitor selection** and **Pr.57 Restart selection** must be set again.			
Corrective action	Set the initial value in **Pr.989 Parameter copy alarm release**.			

Converter indication	LG		PU indication	SL
Name	Power supply not detected			
Description	Appears when the power supply detection ends incompletely at a power failure. Appears at the power ON of the control circuit when using separate power supply sources for the control circuit power supply and for the main circuit power supply. It is not a fault.			
Check point	Check that the wiring from proper power source is performed correctly. Check that the wiring is performed correctly so that the power source can be detected.			
Corrective action	Correct the wiring.			

Converter indication	LH	LH	PU indication	—
Name	Converter operation disabled			
Description	Appears when the regenerative operation is not possible due to data processing in the converter such as during operation triggered by the SOF signal.			
Check point	• Check that the SOF signal is not ON. • Check that the multifunction regeneration converter was reset after Parameter copy (parameter is written to the converter). • Check if the converter is attempted to be run with power supplied not to the main circuit but to the control circuit. • Check that the power supply condition is stable.			
Corrective action	• Turn OFF the SOF signal. • Check the power supply condition.			

Converter indication	LJ	LJ	PU indication	—
Name	Box-type reactor overheat pre-alarm			
Description	Appears when the speed of cooling fan on the box-type reactor decreases.			
Check point	Check the cooling fan for a failure.			
Corrective action	The fan may be faulty. Contact your sales representative.			

◆Alarm

Output is not shut off when a protective function is activated. The Alarm (LF) signal can be output depending on the parameter setting.

(Set "98" in any of **Pr.11, Pr.12, and Pr.16 (Output terminal function selection)**. Refer to page 132.)

Converter indication	LA	LA	PU indication	FN
Name	Fan alarm			
Description	Appears when the cooling fan in the converter stops due to a fault or slows down.			
Check point	Check the cooling fan for a failure.			
Corrective action	The fan may be faulty. Contact your sales representative.			

◆Fault

When a protective function is activated, the converter output is shut off and the Fault (ALM) signal is output. Output of the connected inverters are also shut off.

Converter indication	E.A	E.A	FR-PU07 indication	Stedy Spd OC
			FR-PU07 indication (Alarm Hist)	OCT
			FR-DU08 indication	E.OCT
Name	Overcurrent trip			
Description	The converter output is shut off if the input current exceeds the specified level during operation.			
Check point	• Check for sudden load change. • Check for a short-circuit in the output circuit. • Check that the wiring is performed correctly. • Check that any power supply failure did not occur.			
Corrective action	• Keep the load stable. • Check the wiring to make sure that output short circuit does not occur. • Check the wiring. • Check the power supply.			

Converter indication	E.B	E.b	FR-PU07 indication	Stedy Spd OV
			FR-PU07 indication (Alarm Hist)	OVT
			FR-DU08 indication	E.OVT
Name	Overvoltage trip			
Description	• If the converter's internal main circuit DC voltage reaches or exceeds the specified value, the protective circuit is activated to stop the outputs of the converter. The circuit may also be activated by a surge voltage produced in the power supply system.			
Check point	• Check for sudden load change and excessive regeneration. • Check that any power supply failure did not occur.			
Corrective action	• Keep the load stable. • Check the power supply.			

Converter indication	E.C	E.C	FR-PU07 indication	Inv. Overload
			FR-PU07 indication (Alarm Hist)	THT
			FR-DU08 indication	E.THT
Name	Overload trip (electronic thermal relay function)*1			
Description	For the protection of transistor, electronic thermal relay activates in inverse-time characteristics against the converter input to stop the output of the converter.			
Check point	• Check the motor for the use under overload. • Check that the total capacity of the inverters used is not larger than the capacity of the converter. • Check that the permissible voltage imbalance ratio is within 3%.			
Corrective action	• Reduce the load. • Reconsider the configuration of the inverters for the converter. • Make the permissible voltage imbalance ratio within 3%.			

*1 Resetting the converter initializes the internal cumulative heat value of the electronic thermal relay function.

Converter indication	E.D	E.d	FR-PU07 indication	H/Sink O/Temp
			FR-PU07 indication (Alarm Hist)	FIN
			FR-DU08 indication	E.FIN
Name	Heat sink overheat			
Description	When the heat sink overheats, the temperature sensor activates, and the converter output is stopped. The FIN signal can be output when the temperature becomes approximately 85% of the heat sink overheat protection operation temperature. For the terminal used for the FIN signal output, assign the function by setting "10 (positive logic) or 110 (negative logic)" in **Pr.11, Pr.12, and Pr.16 (Output terminal function selection)**. (Refer to page 132).			
Check point	• Check for too high surrounding air temperature. • Check for heat sink clogging. • Check that the cooling fan is not stopped. (Check that "LA" is not displayed on the operation status 7-segment LED display of the converter.)			
Corrective action	• Set the surrounding air temperature to within the specifications. • Clean the heat sink. • Replace the cooling fan.			

Converter indication	E.E		FR-PU07 indication	Inst. Pwr. Loss
			FR-PU07 indication (Alarm Hist)	IPF
			FR-DU08 indication	E.IPF
Name	Instantaneous power failure			
Description	When a power failure occurs (or when power input to the converter is shut off), the instantaneous power failure protection function activates to stop the output of the converter and prevent the control circuit from malfunctioning. If a power failure persists for 100 ms or longer, the fault output is not provided, and the converter and the inverter restart if the start signal is ON upon power restoration. (The converter and the inverter continues operating if an instantaneous power failure is within 10 ms.) In some operating status (load magnitude, acceleration/deceleration time setting of the inverter, etc.), overcurrent or other protection may be activated upon power restoration. The IPF signal is output when a power failure is detected. (Refer to page 132.)			
Check point	Find the cause of the instantaneous power failure occurrence.			
Corrective action	• Remedy the instantaneous power failure. • Prepare a backup power supply for instantaneous power failure. • Set the function of automatic restart after instantaneous power failure **(Pr.57)**. (Refer to page 141).			

Converter indication	E.F		FR-PU07 indication	Under Voltage
			FR-PU07 indication (Alarm Hist)	UVT
			FR-DU08 indication	E.UVT
Name	Undervoltage			
Description	If the power supply voltage of the converter decreases, the control circuit will not perform normal functions. To prevent this, the output of the converter is stopped when the power supply voltage drops to about 150 VAC or lower.			
Check point	• Check if a high-capacity motor is driven. • Check that the wiring is performed correctly.			
Corrective action	Investigate the devices on the power system such as the power supply itself. If the situation does not improve after taking the above measure, please contact your sales representative.			

Converter indication	E.G		FR-PU07 indication	Input phase loss
			FR-PU07 indication (Alarm Hist)	ILF
			FR-DU08 indication	E.ILF
Name	Input phase loss			
Description	This protective function is activated when any of the three phases of power input is lost.			
Check point	Check for a break in the cables for the three-phase power supply input.			
Corrective action	• Correct the wiring. • Repair a broken wire.			

Converter indication	E.H		FR-PU07 indication	OH Fault
			FR-PU07 indication (Alarm Hist)	OHT
			FR-DU08 indication	E.OHT
Name	External thermal relay operation			
Description	• If an overheat protection device such as a thermostat activates, the output of the converter is stopped. This function is available when "4" (OH signal) is set in any of **Pr.3, Pr.4, and Pr.7 (Input terminal function selection)**. This protective function is not available in the initial status (OH signal is not assigned). • The converter output is shut off if terminals PC and SD are shorted when the OH signal is assigned to a terminal.			
Check point	• Check for the overheat of a thermostat or other similar peripheral devices. • Check that the value "4" (OH signal) is set to any of **Pr.3, Pr.4, and Pr.7 (Input terminal function selection)**. • Check for a short circuit between terminals PC and SD.			
Corrective action	• Check the wiring. • Reset the thermostat (even if the thermostat restarts automatically, the converter does not restart unless it is reset).			

Converter indication	**E.J**		**FR-PU07 indication**	**PU Leave Out**
			FR-PU07 indication (Alarm Hist)	**PUE**
			FR-DU08 indication	**E.PUE**
Name	PU disconnection			
Description	• This function stops the converter output if communication between the converter and the PU is suspended (for example, by disconnecting the parameter unit) while "2, 3, 16 or 17" is set in **Pr.75 Reset selection / disconnected PU detection / PU stop selection**. This protective function is not enabled in the initial setting (**Pr.75** = "14").			
Check point	• Check that the PU is connected properly. • Check that the **Pr.75** setting is correct.			
Corrective action	• Set the **Pr.75** appropriately. • Fit the PU securely.			

Converter indication	**E.K**		**FR-PU07 indication**	**Retry No Over**
			FR-PU07 indication (Alarm Hist)	**RET**
			FR-DU08 indication	**E.RET**
Name	Retry count excess			
Description	If operation cannot be resumed properly within the number of retries set, this function stops the outputs of the converter. This function is enabled when **Pr.67 Number of retries at fault occurrence** is set. This protective function is disabled in the initial setting (**Pr.67** = "0").			
Check point	Find the cause of the fault occurrence.			
Corrective action	Eliminate the cause of the error preceding this error indication.			

Converter indication	**E.L**		**FR-PU07 indication**	**CPU Fault**
			FR-PU07 indication (Alarm Hist)	**CPU**
			FR-DU08 indication	**E.CPU**
Name	CPU fault			
Description	The converter output is shut off if the communication fault in the built-in CPU occurs.			
Check point	Check for devices producing excess electrical noises around the converter.			
Corrective action	• Take measures against noises if there are devices producing excess electrical noises around the converter. • Contact your sales representative.			

Converter indication	**E.L**		**FR-PU07 indication**	**Fault 13**
			FR-PU07 indication (Alarm Hist)	**E13**
			FR-DU08 indication	**E.13**
Name	Internal circuit fault			
Description	• The converter output is shut off when an internal circuit fault occurs.			
Corrective action	• Contact your sales representative.			

Converter indication	E.M		FR-PU07 indication	E.P24
			FR-PU07 indication (Alarm Hist)	P24
			FR-DU08 indication	E.P24
Name	24 VDC power output short circuit			
Description	When the 24 VDC power output from terminal PC is shorted, this function is activated to shut off the power output. At this time, all external contact inputs turn OFF. The converter cannot be reset by inputting the RES signal via an external terminal. To reset the converter, use the PU, or turn the converter power OFF and ON again.			
Check point	Check for a short circuit in terminal PC.			
Corrective action	Repair the short-circuited portion.			

Converter indication	E.N		FR-PU07 indication	Inrush overheat
			FR-PU07 indication (Alarm Hist)	IOH
			FR-DU08 indication	E.IOH
Name	Inrush current limit circuit fault			
Description	• Stops the converter operation when the inrush current limit contactor does not turn ON, or a thermostat of the limit resistor activates. • The converter output is shut off when the inrush current limit circuit is damaged.			
Check point	• Check that frequent power ON/OFF is not repeated.			
Corrective action	• Configure a circuit where frequent power ON/OFF is not repeated. • If the situation does not improve after taking the above measure, please contact your sales representative.			

Converter indication	E.P		FR-PU07 indication	Corrupt Memry
			FR-PU07 indication (Alarm Hist)	PE
			FR-DU08 indication	E.PE
Name	Parameter storage device fault (control circuit board)			
Description	The converter output is shut off if a fault occurs in the parameters stored. (EEPROM failure)			
Check point	Check for too many number of parameter write times.			
Corrective action	• Set "1" in **Pr.342** (write to RAM) for the operation which requires frequent parameter writing via communication, etc. Note that writing to RAM goes back to the initial status at power OFF. • If the situation does not improve after taking the above measure, please contact your sales representative.			

Converter indication	E.P		FR-PU07 indication	PR storage alarm
			FR-PU07 indication (Alarm Hist)	PE2
			FR-DU08 indication	E.PE2
Name	Parameter storage device fault (main circuit board)			
Description	The converter output is shut off if a fault occurs in the parameters stored. (EEPROM failure)			
Corrective action	Contact your sales representative.			

Converter indication	E. Q	E.9	FR-PU07 indication	Option1 Fault
			FR-PU07 indication (Alarm Hist)	OP1
			FR-DU08 indication	E.OP1
Name	Communication option fault			
Description	The converter output is shut off if a communication line error occurs in the communication option.			
Check point	• Check for a wrong option function setting and operation. • Check that the communication option is plugged into the connector securely. • Check for a break in the communication cables. • Check that the terminating resistor is fitted properly.			
Corrective action	• Check the option function setting, etc. • Connect the communication option securely. • Check the connection of communication cables.			

Converter indication	E.T	E.1	FR-PU07 indication	Fault
			FR-PU07 indication (Alarm Hist)	ERR
			FR-DU08 indication	E.MF1
Name	Connection mode fault			
Description	If the setting of connection mode selection switch (common bus regeneration mode or power regeneration mode (1 or 2)) does not match the actual wiring of the main circuit terminals, the protective function is activated to stop the operation of the multifunction regeneration converter.			
Check point	Check that the setting of **Pr.415 SW2 setting status** is correct. (Refer page 71, page 91, and page 111.)			
Corrective action	• Check the wiring. • Set the **Pr.415** appropriately.			

Converter indication	E.U	E.U	FR-PU07 indication	Fault
			FR-PU07 indication (Alarm Hist)	ERR
			FR-DU08 indication	E.MF2
Name	Unsupported control selection			
Description	Appears to stop the outputs of the multifunction regeneration converter if unsupported function is set to be enabled by using **Pr.416 Control method selection**.			
Check point	Check the setting of **Pr.416**. (Refer page 71, page 91, and page 111.)			
Corrective action	Set **Pr.416** correctly. (Refer page 71, page 91, and page 111.)			

Converter indication	**E.V**		**FR-PU07 indication**	**Fault**
			FR-PU07 indication (Alarm Hist)	**ERR**
			FR-DU08 indication	**E.FT1**
Name	Box-type reactor overheat protection			
Description	• The multifunction regeneration converter stops its output if the box-type reactor overheat protection (LOH) signal is detected during operation in harmonic suppression mode. • The multifunction regeneration converter stops its output if the **Pr.416 Control method selection** setting does not match the actual installation of reactor (FR-XCL/FR-XCB). • The converter output is shut off if the LOH signal turns ON (because the box-type reactor has been installed by mistake or terminals PC and SD are shorted) even though the common bus regeneration mode is selected. • The converter output is shut off if the cooling fan in the box-type reactor connected to the converter stops due to a failure or reduces speed while the harmonic suppression mode is selected.			
Check point	• Check if any foreign matter is stuck in the cooling fan on the box-type reactor. • Check the setting of **Pr.416**. (Refer to **page 71**, **page 91**, and **page 111**.) When the setting is "9999 (initial value)", check that the setting matches the installation situation of reactor. • Check that the cooling fan on the box-type reactor has no failure. • Check that the wiring is performed correctly.			
Corrective action	• Remove foreign matter. • Set **Pr.416** correctly. (Refer to **page 71**, **page 91**, and **page 111**.) Check the rating plate of the multifunction regeneration converter in use to find the model name for appropriate selection of reactor (FR-XCL/FR-XCB) when the setting is "9999 (initial value)". • Check the wiring. • If the situation does not improve after taking the above measure, please contact your sales representative.			

Converter indication	**E.W**		**FR-PU07 indication**	**Fault**
			FR-PU07 indication (Alarm Hist)	**ERR**
			FR-DU08 indication	**E.FT2**
Name	Box-type reactor cooling fan power supply short circuit protection			
Description	The multifunction regeneration converter stops its output if the power supply for the cooling fan on the box-type reactor is shorted.			
Check point	Check for a short circuit in power supply for the box-type reactor cooling fan.			
Corrective action	Correct the wiring.			

Converter indication	**E. 1**		**FR-PU07 indication**	**Fault 1**
			FR-PU07 indication (Alarm Hist)	**E.1**
			FR-DU08 indication	**E.1**
Name	Option fault			
Description	The converter output is shut off when a contact failure occurs between the converter and the communication option. Appears when the switch for manufacturer setting on the communication option is changed.			
Check point	• Check that the communication option is plugged into the connector securely. • Check for excess electrical noises generated around the converter. • Check that the initial position of the switch for manufacturer setting was not changed.			
Corrective action	• Connect the communication option securely. • Take measures against noises if there are devices producing excess electrical noises around the converter. • Set the switch for manufacturer setting on the communication option back to the initial position. (Refer to the Instruction Manual of each option.) • If the situation does not improve after taking the above measure, please contact your sales representative.			

Converter indication	**E.6**		**FR-PU07 indication**	**Fault 16**
			FR-PU07 indication (Alarm Hist)	**E.16**
			FR-DU08 indication	**E.16**
Name	Main circuit power supply detection fault			
Description	Appears if power supply to the main circuit is not detected.			
Check point	—			
Corrective action	Contact your sales representative.			

Converter indication	**E.8**		**FR-PU07 indication**	**Fault 8**
			FR-PU07 indication (Alarm Hist)	**E.8**
			FR-DU08 indication	**E.8**
Name	Input power supply fault 1			
Description	• When a fault is detected in the power supply frequency, • When the phase detection cannot be performed for the normal power supply, • When an overvoltage occurs during power failure or at an input phase loss, • When the power supply amplitude changes suddenly, • When the load changes suddenly, • When the wiring in the phase detection terminals (terminals R, S, and T) is not correct, or • When the converter in harmonic suppression mode detects overcurrent during power failure, it is regarded as a power supply fault, and the outputs of the converter and the inverter are stopped.			
Check point	Check that the wiring from proper power source is performed correctly.			
Corrective action	Correct the wiring.			

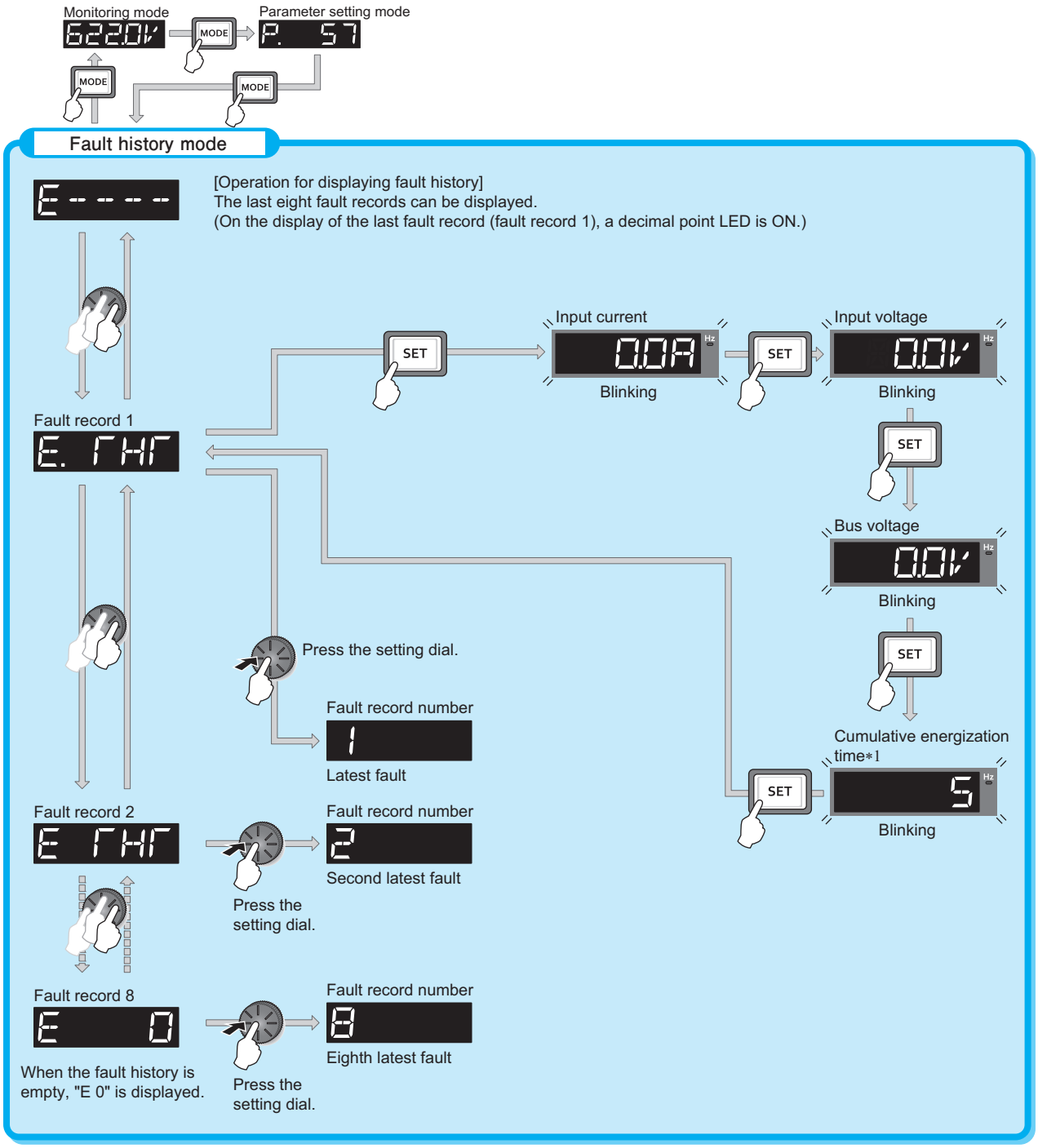
NOTE

• If faults other than the above appear, contact your sales representative.

7.5 Check and clear of the fault history

The operation panel stores the last eight fault records which appeared when a protective function was activated (fault history).

◆Checking the fault history



*1 The cumulative energization time is accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0.

◆Clearing the fault history

POINT

- Set **Err.CL Fault history clear** = "1" to clear the fault history.

Operating procedure

1. Turning ON the power of the converter
The operation panel is in the monitor mode.

2. Selecting the parameter setting mode
Press MODE to choose the parameter setting mode. (The parameter number read previously appears.)

3. Selecting the parameter number
Turn the dial until "Err.CL" (Fault history clear) appears. Press SET to read the present set value. "0 (initial value)" appears.

4. Fault history clear
Turn the dial to change the set value to "1". Press SET to start clear.
"1" and "Err.CL" are displayed alternately after the fault history is cleared.
- •Turn the dial to read another parameter.
- •Press SET to show the setting again.
- •Press SET twice to show the next parameter.

7.6 Check first when you have a trouble

Condition	Point to be checked
The converter does not operate properly.	Check the following about connection: ● Wiring is performed correctly. ● Appropriate power supply voltage is applied. ● The phase sequence is correct. ↳When the phase sequence is correct, check for the short circuit across terminals SOF and SD and across terminals RES and SD.
The operation status 7-segment LED display does not come on.	Check the following about connection: ● Connection is performed correctly. ● Wiring for the main circuit terminals R/L1, S/L2, and T/L3 on the inverter is performed correctly. ● The inrush current limit resistor is not damaged.
The charge lamp on the converter does not come on.	Check the following about connection: ● Connection is performed correctly. ● Wiring for the main circuit terminals R2/L12, S2/L22, and T2/L32 on the converter is performed correctly.
The inverter does not run.	Check the following about the setting: ● The parameter settings in the inverter are appropriate. (Setting method differs by the inverter series.)
A breaker trips.	Check the following about connection: ● Wiring is performed correctly. ● Appropriate power supply voltage is applied. ● The phase sequence is correct. Identify the cause of the trip and remove it before turning ON the power of the breaker.
Unusual noises are generated from the reactor.	Unusual noises may be generated from the reactor when the converter is in the following state (except during a stop of the converter by the Converter stop (SOF) signal), but it is not a fault. ● Common bus regeneration mode / power regeneration mode 2: during regenerative driving ● Harmonic suppression mode: during power-on (power/regenerative driving) If needed, modify the enclosure in which the reactor is installed in order to reduce noise.

MEMO

8 PRECAUTIONS FOR MAINTENANCE AND INSPECTION

This chapter explains the precautions for maintenance and inspection of this product.
Always read the instructions before use.

8.1 Inspection item.....192
8.2 Measurement of main circuit voltages, currents, and powers 198

The converter is a static unit mainly consisting of semiconductor devices. Daily inspection must be performed to prevent any fault from occurring due to the adverse effects of the operating environment, such as temperature, humidity, dust, dirt and vibration, changes in the parts with time, service life, and other factors.

- Precautions for maintenance and inspection

When accessing the converter for inspection, wait for at least 10 minutes after the power supply has been switched OFF. Then, make sure that the voltage across the main circuit terminals P/+ and N/- on the converter is not more than 30 VDC using a tester, etc.

⚠CAUTION

- Reactors are extremely hot. Take caution not to get burned.

8.1 Inspection item

8.1.1 Daily inspection

Basically, check for the following faults during operation.

- Improper installation environment
- Cooling system fault
- Abnormal vibration, abnormal noise
- Abnormal overheat, discoloration

8.1.2 Periodic inspection

Check the areas inaccessible during operation and requiring periodic inspection. Consult us for periodic inspection.

- Check for cooling system fault: Clean the air filter, etc.
- Check the tightening and retighten: The screws and bolts may become loose due to vibration, temperature changes, etc. Check and tighten them.
  Tighten them according to the specified tightening torque. **(Refer to page 43.)**
- Check the conductors and insulating materials for corrosion and damage.
- Measure the insulation resistance.
- Check and change the cooling fan and the relay.

8.1.3 Daily and periodic inspection list

Area of inspection	Inspection item	Description	Inspection interval		Corrective action at fault occurrence	Check by user
			Daily	Periodic *2		
General	Surrounding environment	Check the surrounding air temperature, humidity, dirt, corrosive gas, oil mist, etc.	○		Improve the environment.	
	Overall unit	Check for unusual vibration and noise.	○		Check fault location and retighten.	
		Check for dirt, oil, and other foreign material.*3	○		Clean.	
	Power supply voltage	Check that the main circuit voltage and control circuit voltage are normal.*1	○		Inspect the power supply.	
Main circuit	General	(1) Check with megger (between main circuit terminals and earth (ground) terminal).		○	Contact the manufacturer.	
		(2) Check for loose screws and bolts.		○	Retighten.	
		(3) Check for overheat traces on the parts.		○	Contact the manufacturer.	
		(4) Check for stains.		○	Clean.	
	Conductors and cables	(1) Check conductors for distortion.		○	Contact the manufacturer.	
		(2) Check cable sheaths for breakage and deterioration (crack, discoloration, etc.).		○	Contact the manufacturer.	
	Transformer/ Reactor	Check for unusual odor and abnormal increase of whining sound.	○		Stop the equipment and contact the manufacturer.	
	Terminal block	Check for a damage.		○	Stop the equipment and contact the manufacturer.	
	Smoothing aluminum electrolytic capacitor	(1) Check for liquid leakage.		○	Contact the manufacturer.	
		(2) Check for safety valve projection and bulge.		○	Contact the manufacturer.	
		(3) Visual check		○		
	Relay/contactor	Check that the operation is normal and no chattering sound is heard.		○	Contact the manufacturer.	
Control circuit, protective circuit	Operation check	Check that no fault is found in protective and display circuits in a sequence protective operation test.		○	Contact the manufacturer.	
	Components check: Overall	(1) Check for unusual odor and discoloration.		○	Stop the equipment and contact the manufacturer.	
		(2) Check for serious rust development.		○	Contact the manufacturer.	
	Components check: Aluminum electrolytic capacitor	(1) Check for liquid leakage in a capacitor and deformation trace.		○	Contact the manufacturer.	
		(2) Visual check		○		
Cooling system	Cooling fan	(1) Check for unusual vibration and noise.	○		Replace the fan.	
		(2) Check for loose screws and bolts.		○	Retighten.	
		(3) Check for stains.		○	Clean.	
	Heat sink	(1) Check for clogging.		○	Clean.	
		(2) Check for stains.		○	Clean.	
Display	Indication	(1) Check that indications are correct.	○		Contact the manufacturer.	
		(2) Check for stains.		○	Clean.	
	Meter/counter	Check that readouts are correct.	○		Stop the equipment and contact the manufacturer.	

*1 It is recommended to install a voltage monitoring device for checking the voltage of the power supplied to the converter.

*2 One to two years of periodic inspection cycle is recommended. However, it differs according to the installation environment. Consult us for periodic inspection.

*3 Oil component of the heat dissipation grease used inside the converter may leak out. The oil component, however, is not flammable, corrosive, nor conductive and is not harmful to humans. Wipe off such oil component.

NOTE

- Continuous use of a leaked, deformed, or degraded smoothing aluminum electrolytic capacitor (as shown in the table above) may lead to a burst, breakage, or fire. Replace such capacitor without delay.

8.1.4 Continuity test

◆Preparation

- Disconnect the external power cables from terminals R2/L12, S2/L22, T2/L32, P/+, and N/-.
- Prepare a continuity tester. (For the resistance measurement, use the 100 Ω range.)

◆Checking method

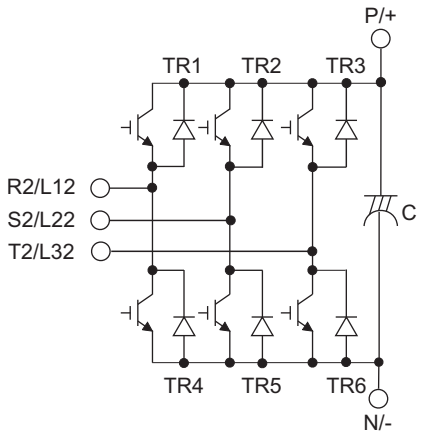
Change the polarity of the tester alternately at a semiconductor device (transistor) on an electrical path between two terminals among the converter main circuit terminals R2/L12, S2/L22, T2/L32, P/+, and N/- to check the electric continuity.

NOTE

- Before measurement, check that the smoothing capacitor is discharged.
- At the time of electric discontinuity, the measured value is almost ∞. When there is an instantaneous electric continuity, due to the smoothing capacitor, the tester may not indicate ∞. At the time of electric continuity, the measured value is several Ω to several tens of Ω. When all measured values are almost the same (although values may not be constant depending on the tester type), it shows that there are no electrical paths with problems.

◆Device number and target terminal

Device No.	Tester polarity		Continuity
	⊕	⊖	
TR1	R2/L12	P/+	No
	P/+	R2/L12	Yes
TR2	S2/L22	P/+	No
	P/+	S2/L22	Yes
TR3	T2/L32	P/+	No
	P/+	T2/L32	Yes
TR4	R2/L12	N/-	Yes
	N/-	R2/L12	No
TR5	S2/L22	N/-	Yes
	N/-	S2/L22	No
TR6	T2/L32	N/-	Yes
	N/-	T2/L32	No



(Assuming that an analog meter is used.)

8.1.5 Cleaning

Always run the converter in a clean state.

When cleaning the converter, gently wipe dirty areas with a soft cloth immersed in neutral detergent.

NOTE

- Do not use solvent, such as acetone, benzene, toluene and alcohol, as these will cause the converter surface paint to peel off.
  As the display on the converter or the parameter unit, etc. are vulnerable to detergent and alcohol, avoid using them for cleaning.

8.1.6 Replacement of parts

The converter consists of many electronic parts such as semiconductor devices.
The following parts may deteriorate with age because of their structures or physical characteristics, leading to reduced performance or fault of the converter. For preventive maintenance, the parts must be replaced periodically.

The standard replacement interval of the converter parts is as follows.

Part name	Estimated lifespan*1	Description
Cooling fan	10 years	Replace (as required)
Main circuit smoothing capacitor	10 years*2	Replace (as required)
On-board smoothing capacitor	10 years*2	Replace the board (as required)
Relays	—	As required

*1 Estimated lifespan for when the yearly average surrounding air temperature is 40°C (without corrosive gas, flammable gas, oil mist, dust and dirt etc.).
*2 Input current: 80% of the converter rating

NOTE

- When the cooling fan stops due to a fault, the alarm indication "LA" is displayed on the operation status 7-segment LED display of the converter. (Refer to page 180.)
- For replacement of each part, contact the nearest Mitsubishi FA center.

◆Cooling fan

The replacement interval of the cooling fan used for cooling the parts generating heat such as the main circuit semiconductor is greatly affected by the surrounding air temperature. When unusual noise and/or vibration are noticed during inspection, the cooling fan must be replaced immediately.

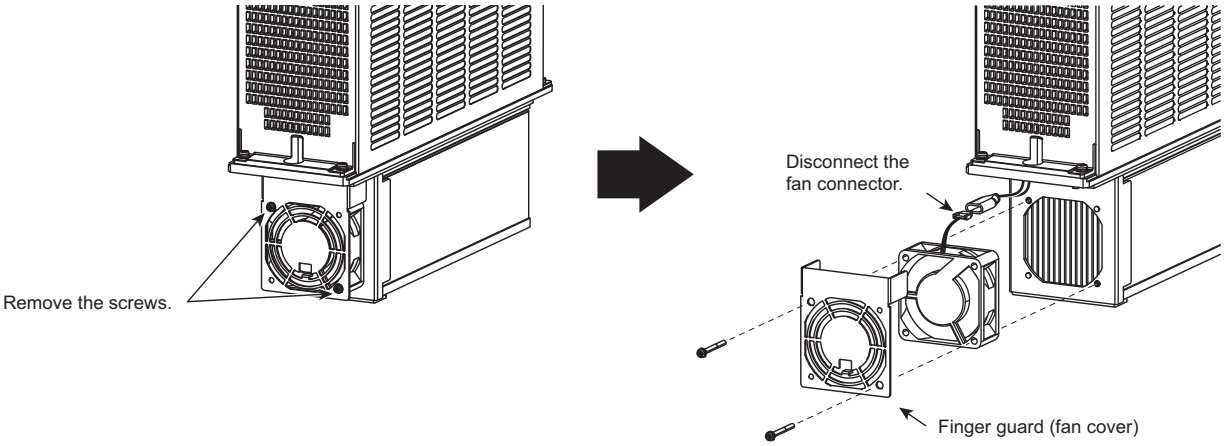
NOTE

- For replacement of each part, contact the nearest Mitsubishi FA center.

◆Replacement procedure of the converter cooling fan

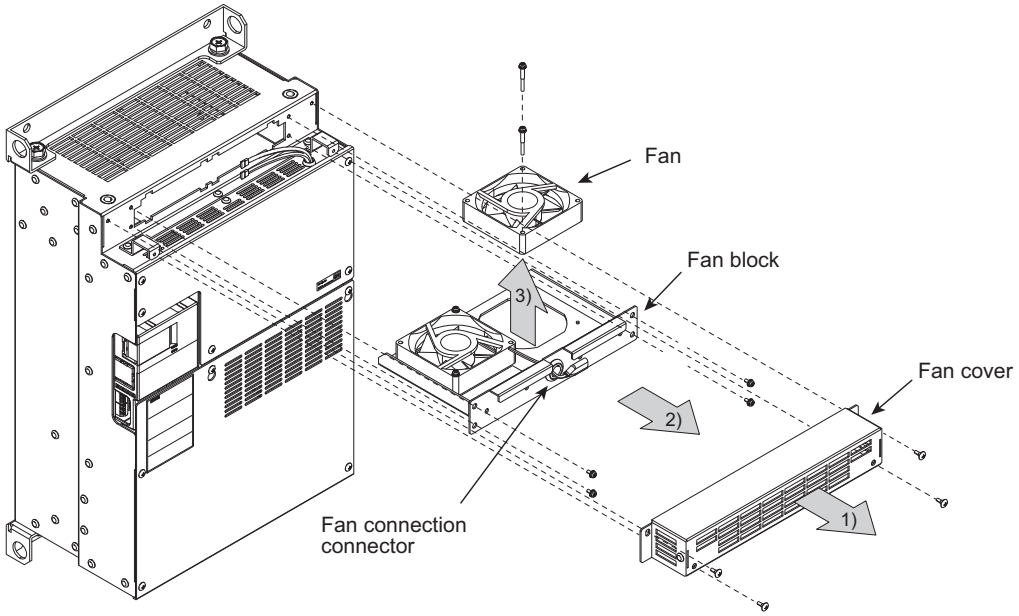
- FR-XC-(H)30K converters or lower

1) Remove all cables from the converter, and dismount the converter from an enclosure.
2) Remove the fan fixing screws.



3) Disconnect the fan connector. The fan can be detached from the converter.
4) Replace the fan with a new one. Before installing the new fan, check the orientation of the fan to be sure that the "AIR FLOW" arrow printed on the side of the fan points upward.
5) Follow the removal procedure in reverse order to install the fan on the converter. Be sure to keep fan cables inside the finger guard (fan cover).

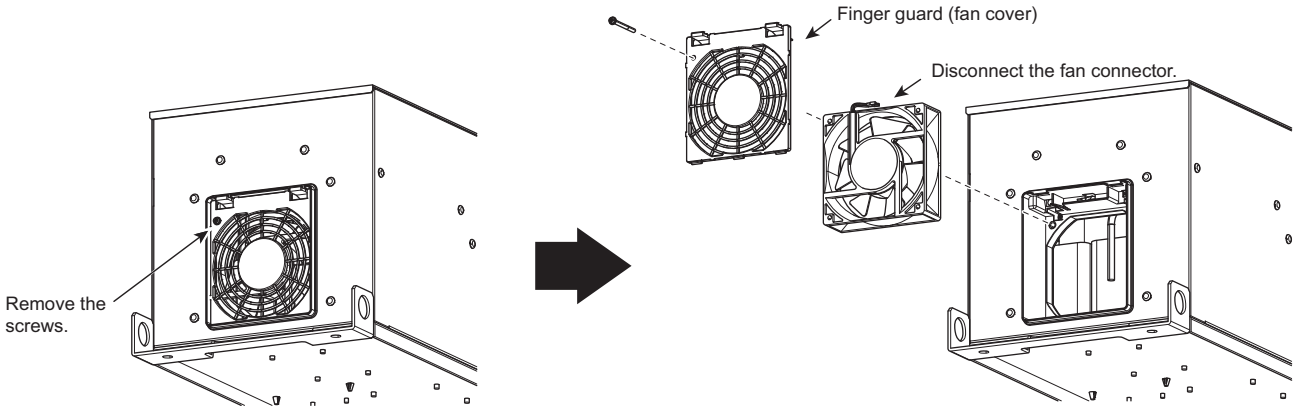
- FR-XC-(H)37K to (H)55K
  1) Remove the fan cover fixing screws, and remove the fan cover.
  2) Disconnect the fan connector and remove the fan block.
  3) Remove the fan fixing screws, and remove the fan.



  4) Replace the fan with a new one. Before installing the new fan, check the orientation of the fan to be sure that the "AIR FLOW" arrow printed on the side of the fan points upward.
  5) Follow the removal procedure in reverse order to install the fan on the converter. Be sure to keep fan cables inside the finger guard (fan cover).

◆Replacement procedure of the box-type reactor cooling fan

  1) Remove all cables from the reactor, and dismount the reactor from an enclosure.
  2) Remove the fan fixing screws.



  3) Disconnect the fan connector. The fan can be detached from the reactor.
  4) Replace the fan with a new one. Before installing the new fan, check the orientation of the fan to be sure that the "AIR FLOW" arrow printed on the side of the fan points upward.
  5) Follow the removal procedure in reverse order to install the fan on the reactor. Be sure to keep fan cables inside the finger guard (fan cover).

NOTE

- If the fan is installed in a wrong orientation, wrong direction of air flow may shorten the converter life.
- Prevent the cable from being caught when installing a fan.
- Switch the power OFF before replacing a fan. To prevent an electric shock accident, keep the converter or the reactor with its cover on during fan replacement since the circuits inside the converter or the reactor are charged with voltage even after power OFF.

◆Smoothing capacitors

A large-capacity aluminum electrolytic capacitor is used for smoothing in the main circuit DC section, and an aluminum electrolytic capacitor is used for stabilizing the control power in the control circuit. Their characteristics are deteriorated by the adverse effects of ripple currents, etc. The replacement intervals greatly vary with the surrounding air temperature and operating conditions. When the converter is operated in air-conditioned, normal environment conditions, replace the capacitors about every 10 years.

When a certain period of time has elapsed, the capacitors will deteriorate more rapidly. Check the capacitors at least every year (less than six months if the life will be expired soon).

End of life appearance criteria are as follows:

- Case: Check the side and bottom faces for expansion.
- Sealing plate: Check for remarkable warp and extreme crack.
- Top (vent): Check for swollen, open, or exploded vent.
- Others: Check for external crack, discoloration, liquid leakage, etc.

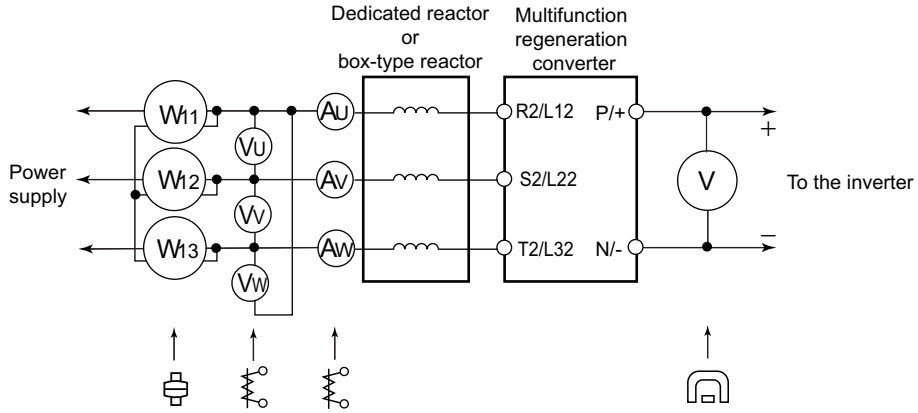
End of life performance criterion is the measured capacitance of the capacitor reduced below 85% of the rating.

◆Relays

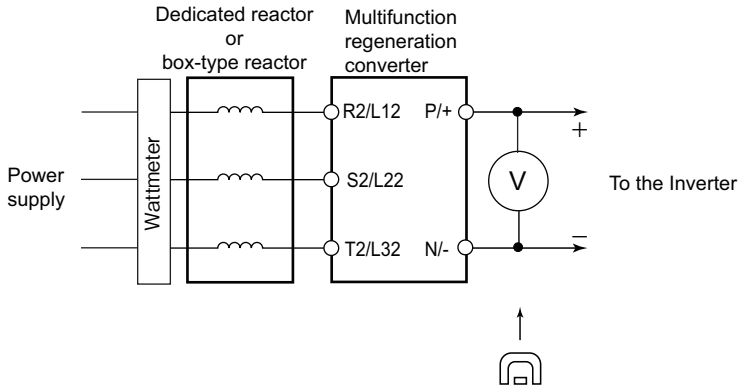
To prevent a contact fault, etc., relays must be replaced according to the cumulative number of switching times (switching life).

8.2 Measurement of main circuit voltages, currents, and powers

- Measurement method of voltage and current at each section:
  When instruments for commercial frequency are used for measurement, measure the following circuits with the instruments given below.
- When installing meters etc. on the converter output side:
  When the converter-to-inverter wiring length is long, especially in the 400 V class, the meters may generate heat due to line-to-line leakage current. Therefore, choose the equipment which has enough allowance for the current rating.
- The output voltage across terminals P/+ and N/- on the converter can be measured with a moving-coil type meter (tester). The voltage varies according to the power supply voltage. The voltage decreases when a load is applied.



[Measuring points and instruments example 1]



[Measuring points and instruments example 2]

◆Operation principle and application to electric meters

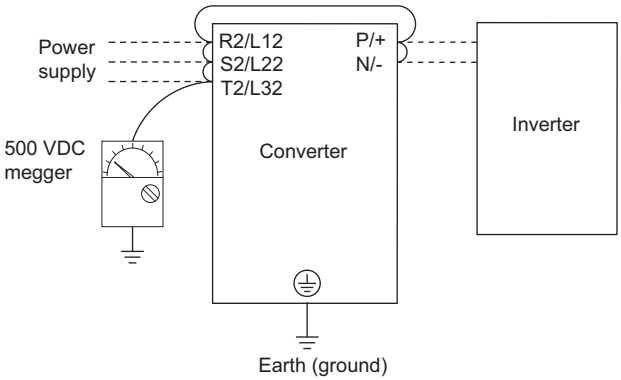
Type		Symbol	Operation principle	Measurement	Applicable meter	Characteristic
Moving-coil			Uses kinetic energy generated between the magnetic field of a permanent magnet and the current that flows through the moving-coil.	DC (Average)	Voltmeter/ammeter/ resistance meter/ thermometer/flux meter/speed meter	High sensitivity and commonly used. Energy saving, small influence of magnetic field.
Moving-iron			Uses kinetic energy generated between the moving-iron and the magnetic field of the current that flows though the fixed coil.	AC (RMS)	Voltmeter/ammeter	Strong structure and inexpensive. Large influence from external magnetic field, frequency, and waveform.
Electrodynamic	Air-core coil		Uses kinetic energy generated between the currents that flow through two different coils.	AC/DC (RMS)	Wattmeter/ voltmeter/ammeter	Scale is divided equally when using a wattmeter. Large influence from external magnetic field, high energy consumption. This can be used as a standard meter for AC and DC.

◆Measuring points and instruments

Item	Measuring point	Measuring instrument	Remarks (reference measured value)
Input voltage V_1	Across terminals R2 and S2, S2 and T2, and T2 and R2	Moving-iron AC voltmeter	Commercial power, within permissible AC voltage fluctuation (Refer to page 75, page 95, and page 113.)
Input current I_1	Line current at terminal R2, S2, and T2	Moving-iron AC ammeter	
Input power P_1	At terminals R2, S2, and T2, and across terminals R2 and S2, S2 and T2, and T2 and R2	Electrodynamic single-phase wattmeter	$P_1 = W_{11} + W_{12} + W_{13}$ (3-wattmeter method)
Input power factor Pf_1	Calculate after measuring input voltage, input current, and input power. $Pf_1 = \frac{P_1}{\sqrt{3}V_1 \times I_1} \times 100\%$		
Converter output voltage	Across P/+ and N/-	Moving-coil type instrument (such as tester)	A measured value can be monitored on the PU. Reference value: 1.35 × V_1 Maximum 380 V (200 V class) and 750 V or less (400 V class) during the regenerative driving
Input signal	Across terminals RES, SOF, or LOH (+) and SD (for sink logic)	Moving-coil type instrument (Tester and such may be used, with internal resistance 50 kΩ or more.)	Voltage when terminal is open: 20 to 30 VDC Voltage when signal is ON: 1 V or less
Fault signal	Across terminals A and C Across terminals B and C	Moving-coil type instrument (such as tester)	Continuity test Across A and C / Across B and C [Normal] Discontinuity / Continuity [Fault] Continuity / Discontinuity

8.2.1 Insulation resistance test using megger

- For the converter, conduct the insulation resistance test on the main circuit only as follows (use a 500 VDC megger), and do not perform the test on the control circuit.



NOTE

- Before performing the insulation resistance test on the external circuit, disconnect the cables from all terminals of the converter so that the test voltage is not applied to the converter.
- For the continuity test of the control circuit, use a tester (high resistance range), and do not use the megger or buzzer.

8.2.2 Pressure test

Do not conduct a pressure test. Deterioration may occur.

MEMO

9 SPECIFICATIONS

This chapter explains the specifications of this product.
Always read the instructions before use.
For the rated specifications of the converter, refer to the following pages.

- Common bus regeneration mode (page 75)
- Harmonic suppression mode (page 95)
- Power regeneration mode 2 (page 113)

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9.1 Common specifications

Control	Input frequency range		50 to 60 Hz
Operation	Input signal (3)		The following signals can be assigned to **Pr.3, Pr.4, or Pr.7 (Input terminal function selection)**: Converter stop (SOF), Converter reset (RES), External thermal relay input (OH), and Box-type reactor overheat protection (LOH).
	Output signal Open collector output (3)*6 Relay output (1)		The following signals can be assigned to **Pr.11, Pr.12, or Pr.16 (Output terminal function selection)**: Inverter run enable (RDY), During converter reset (RSO), Converter running (CVO), Overload warning (OL), Power supply phase detection (PHS), Instantaneous power failure detection (IPF), Regenerative drive recognition (Y7), Electronic thermal O/L relay pre-alarm (THP), Fan fault output (FAN), Heat sink overheat pre-alarm (FIN), During retry (RTY), Life alarm (Y14), Maintenance timer alarm (Y15), Instantaneous power failure detection hold (Y16), PU stopped (PS), Box-type reactor overheat pre-alarm (FTP), Alarm (LF), and Fault (ALM).
Indication	Status monitoring	Converter	Input power value (with regenerative driving indication)
		FR-DU08/ FR-PU07	Power supply frequency, input current, input voltage, fault indication, bus voltage (output voltage), electronic thermal relay load factor, cumulative energization time, cumulative power, input power (with regenerative driving indication), I/O terminal status, electricity cost, option connector status
	Fault monitoring	Converter	When a protective function is activated, a fault indication is displayed.
		FR-DU08/ FR-PU07	When a protective function is activated, a fault indication is displayed, and the latest monitored value of input voltage, input current, bus voltage, cumulative energization time are recorded. The last eight fault records are stored.
Protective function		Fault	Overcurrent trip, Overvoltage trip, Converter overload trip (electronic thermal relay function), Heat sink overheat, Instantaneous power failure, Undervoltage, Input phase loss, External thermal relay operation*3, Communication option fault*4, Parameter storage device fault, PU disconnection*3, Retry count excess*3, CPU fault, Internal circuit fault, 24 VDC power output short circuit, Inrush current limit circuit fault, Connection mode fault, Unsupported control selection, Box-type reactor overheat protection, Box-type reactor power supply short circuit protection, Option fault*4, Main circuit power supply detection fault, Input power supply fault 1
		Alarm, Warning, Error message	Overload signal detection, Electronic thermal relay function pre-alarm, PU stop, Maintenance signal output*3, Power supply not detected, Converter operation disabled, Box-type reactor overheat pre-alarm, Fan alarm, Operation panel lock*5, Write disable error*5, Copy operation fault*5
Environment	Surrounding air temperature		-10 to +50°C (non-freezing)*1
	Surrounding air humidity		90% RH or less (non-condensing)
	Storage temperature*2		-20 to +65°C
	Atmosphere		Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt)
	Altitude/vibration		2500 m or less (For the installation at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.) 5.9 m/s^2 or less at 10 to 55 Hz (directions of X, Y, Z axes)

*1 -10 to +40°C (non-freezing) at the 40°C rating.
*2 Applicable to conditions for a short time, for example, in transit.
*3 Not enabled in the initial state.
*4 Available when the FR-A8NC is installed.
*5 Displayed on the operation panel (FR-DU08) only.
*6 Signal assignment is not available for one of the three terminals (terminal RYB).

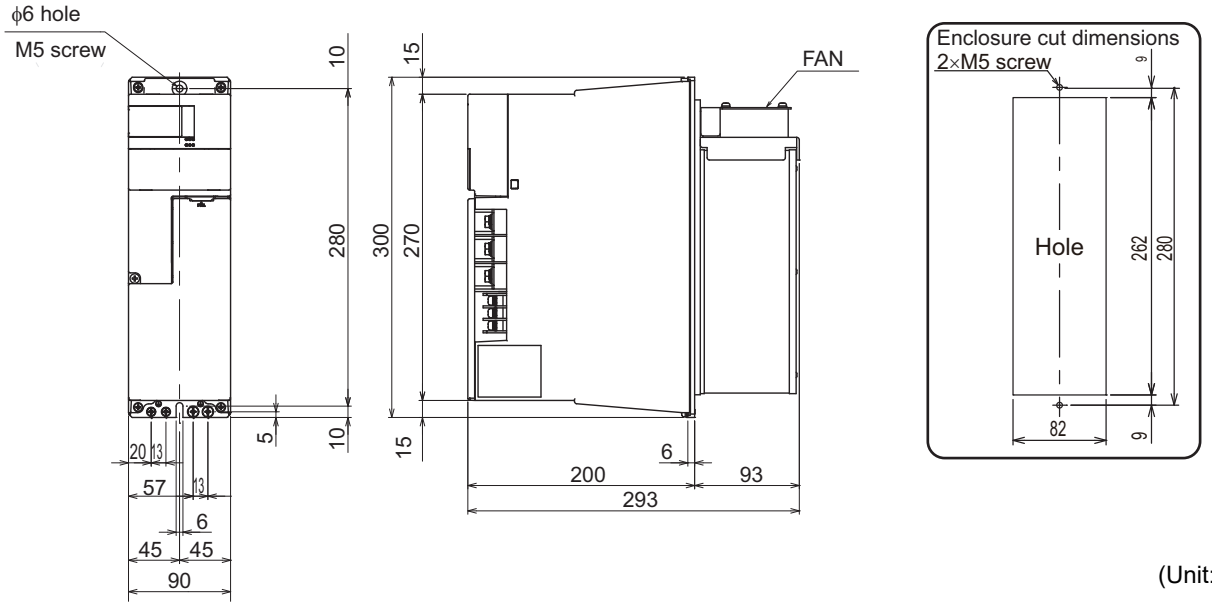
NOTE

- For the rated specifications of the FR-XC-[]K(-PWM) and combinations with stand-alone options (FR-XCL/FR-XCG/FR-XCB), refer to the chapters describing each control mode (**page 77**, **page 97**, and **page 115**).

9.2 Outline dimension drawings

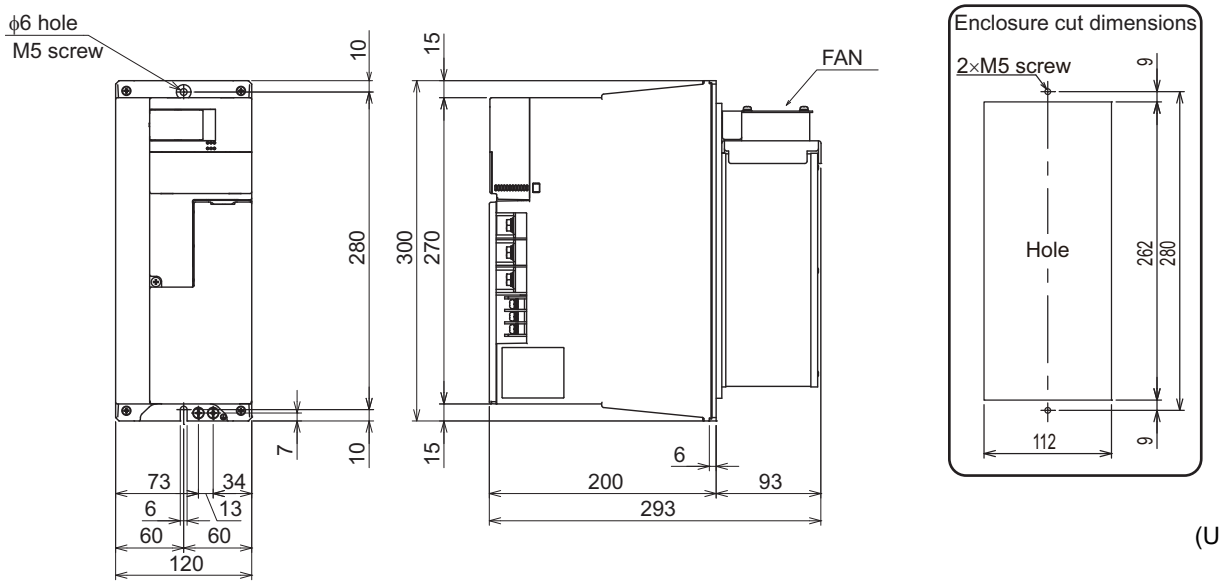
9.2.1 Multifunction regeneration converter (FR-XC (-PWM))

● **FR-XC-(H)7.5K, (H)11K**



(Unit: mm)

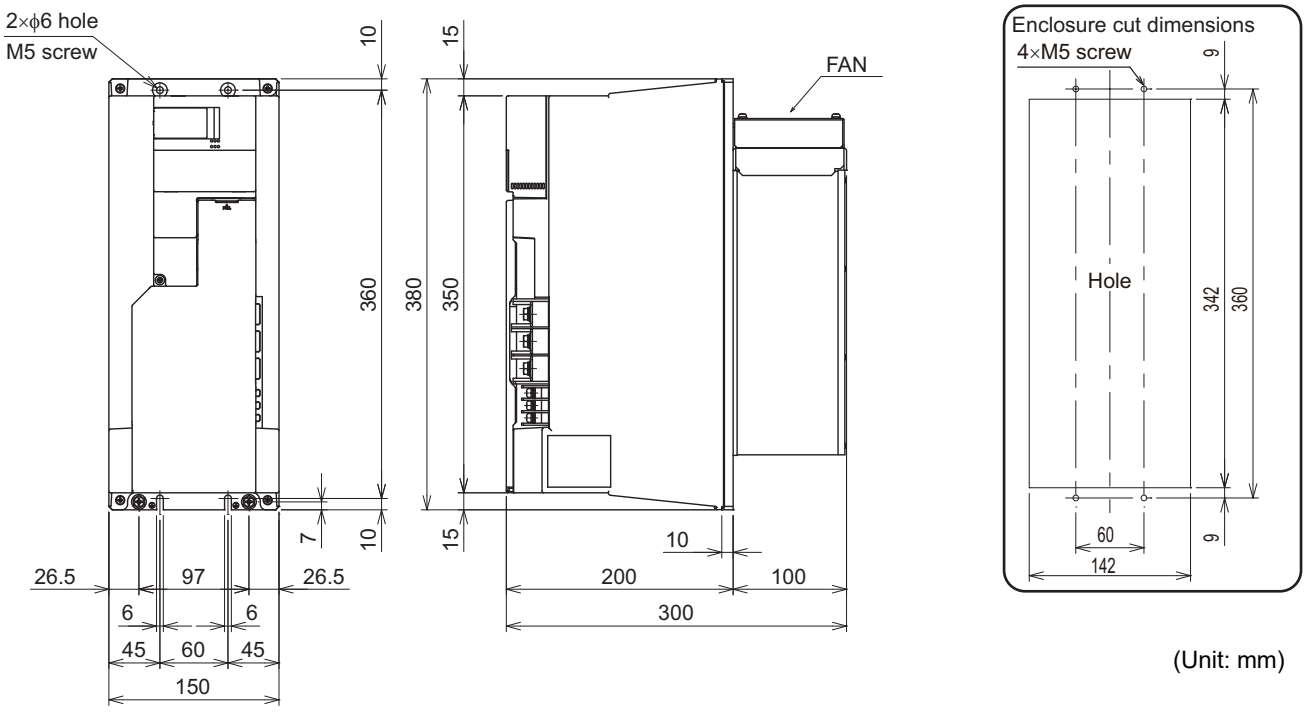
● **FR-XC-(H)15K**



(Unit: mm)

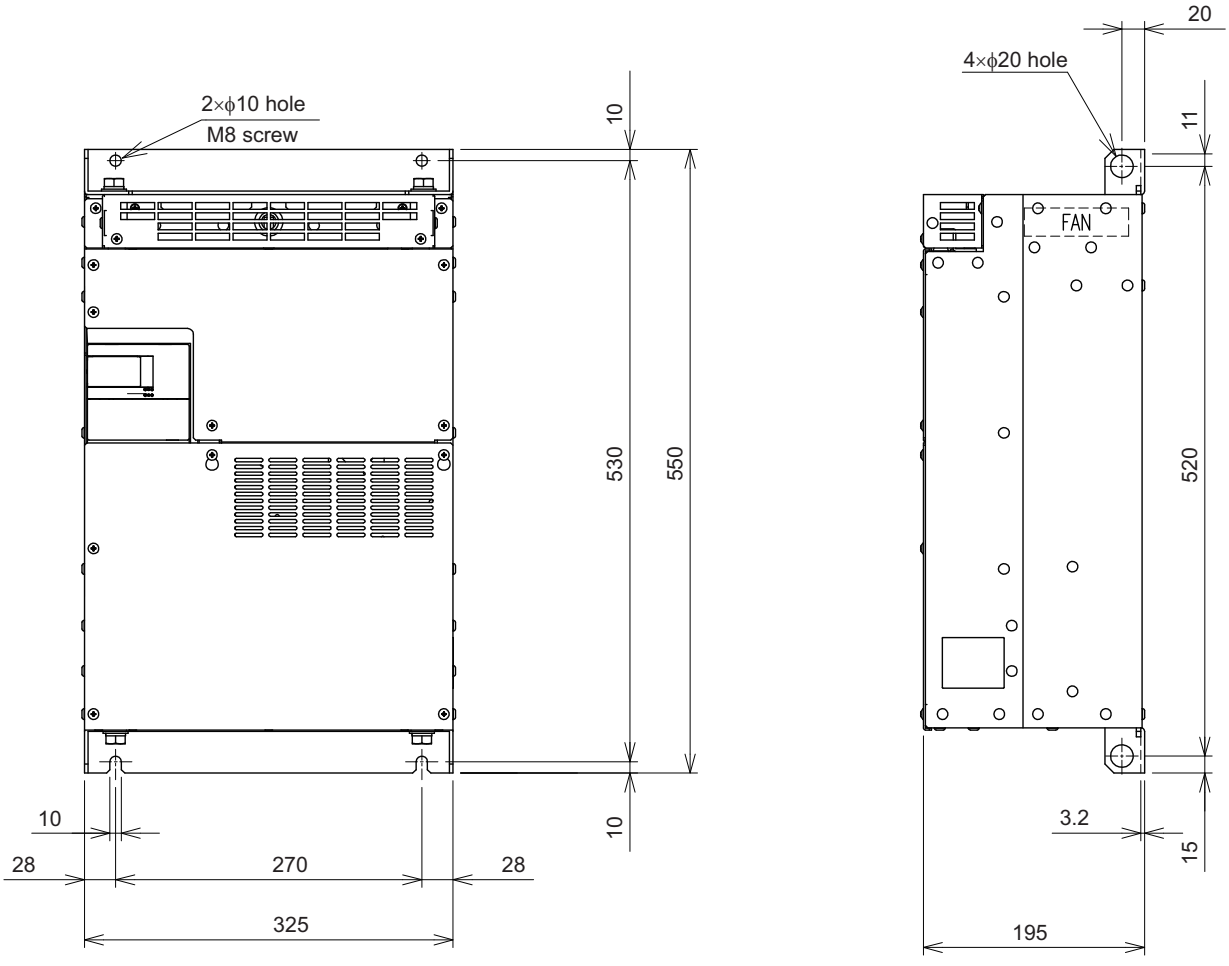
Outline dimension drawings

- **FR-XC-(H)22K, (H)30K**
- **FR-XC-(H)18.5K-PWM, (H)22K-PWM**



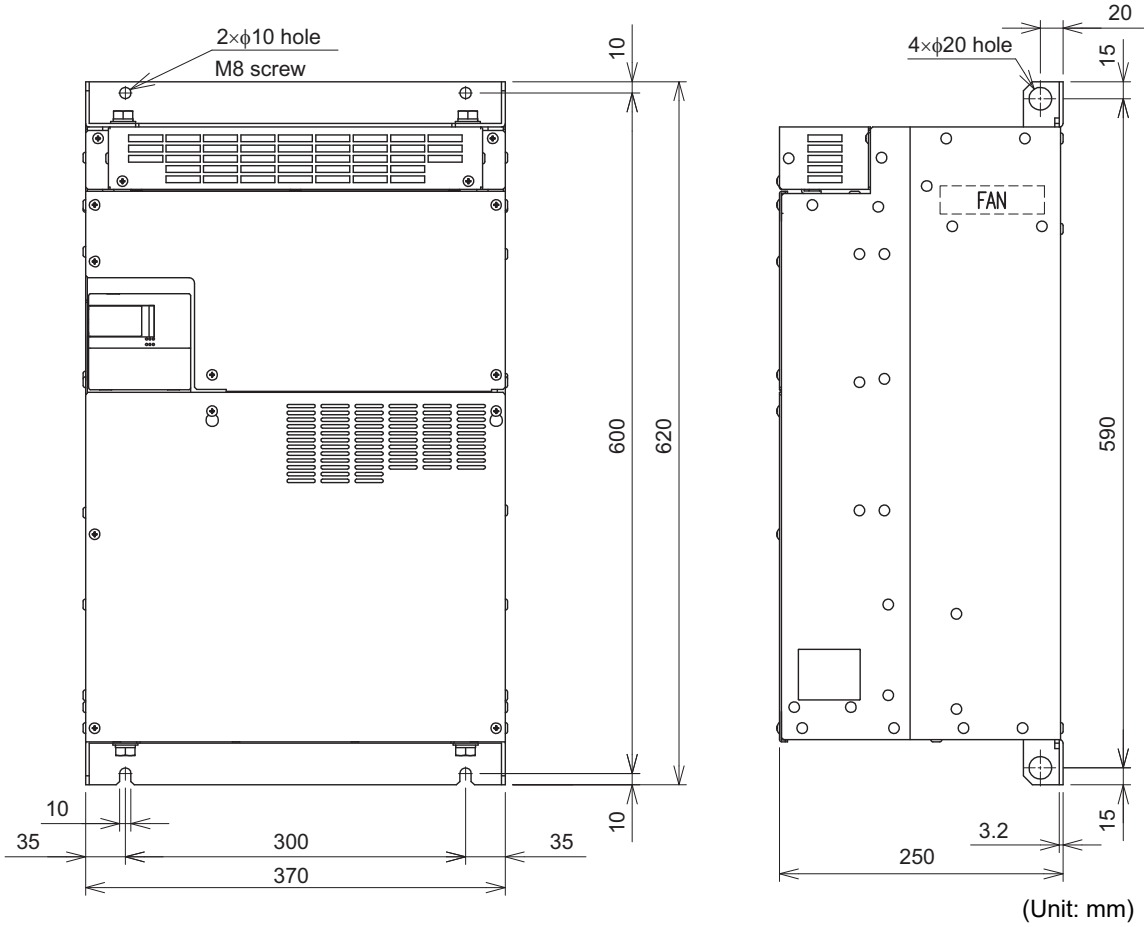
(Unit: mm)

- **FR-XC-(H)37K, H55K**
- **FR-XC-(H)37K-PWM, H55K-PWM**



(Unit: mm)

- **FR-XC-55K**
- **FR-XC-55K-PWM**



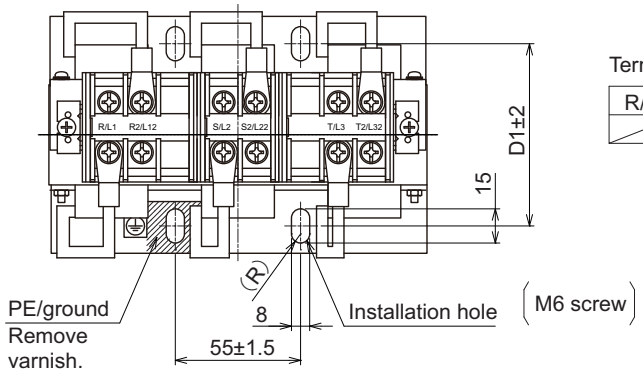
(Unit: mm)

9.2.2 Dedicated stand-alone reactor (FR-XCL)

Check that the FR-XCL reactor that matches the converter is selected.

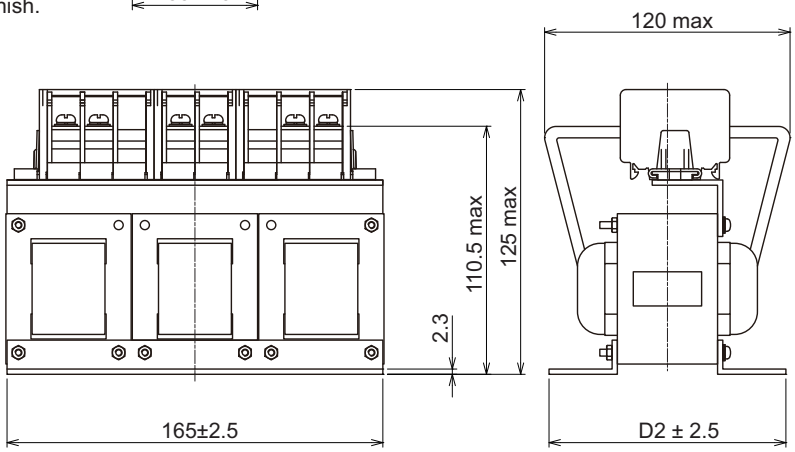
200 V class

- **FR-XCL-7.5K, 11K**



Terminal layout

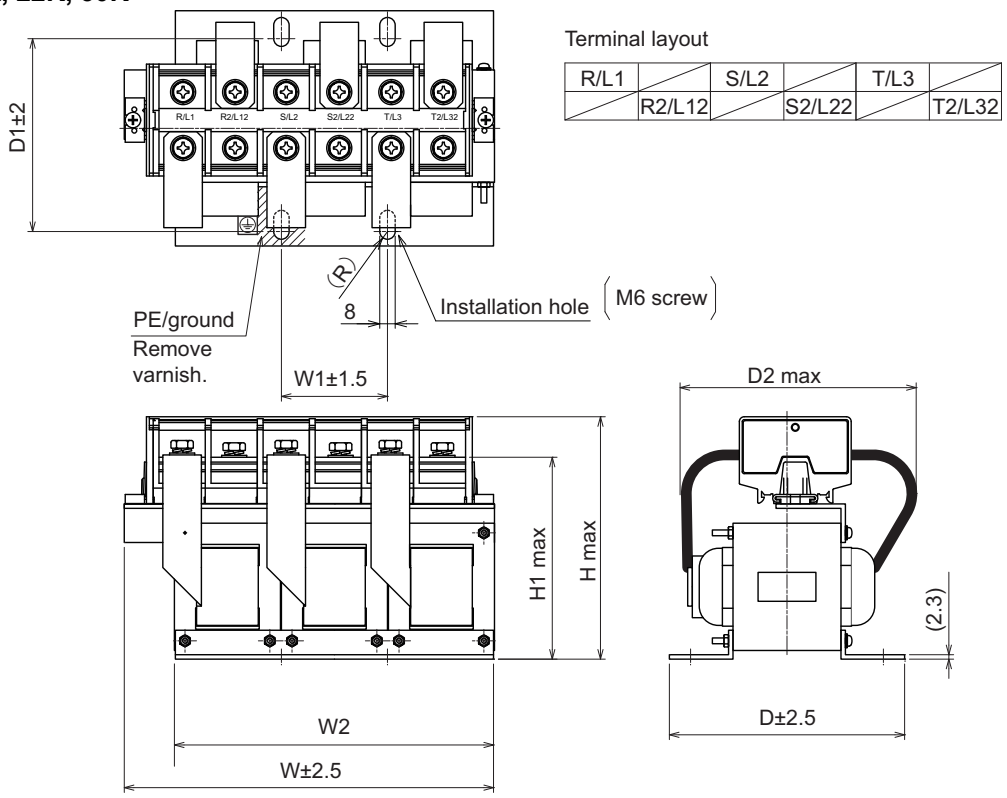
R/L1		S/L2		T/L3	
	R2/L12		S2/L22		T2/L32



Model	D1	D2	Terminal screw size	Mass
FR-XCL-7.5K	80	104	M5	3.9 kg
FR-XCL-11K	73	97		3.6 kg

(Unit: mm)

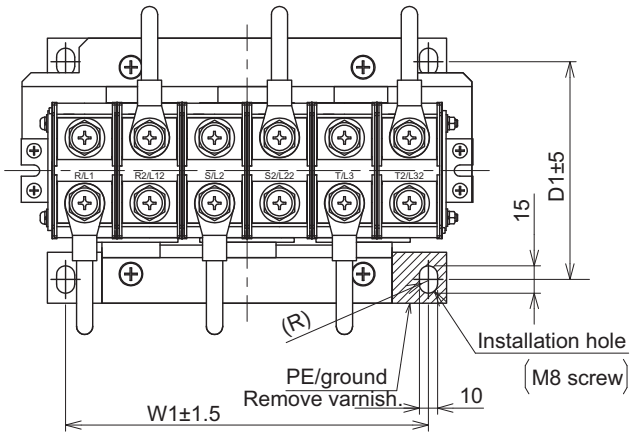
● **FR-XCL-15K, 22K, 30K**



Model	W	W1	W2	H	H1	D	D1	D2	Terminal screw size	Mass
FR-XCL-15K	192	55	165	130	110.5	122	100	130	M6	5.5 kg
FR-XCL-22K	192	55	165	130	110.5	132	110	140		6.3 kg
FR-XCL-30K	240	70	215	150	125.5	145	119	160		10 kg

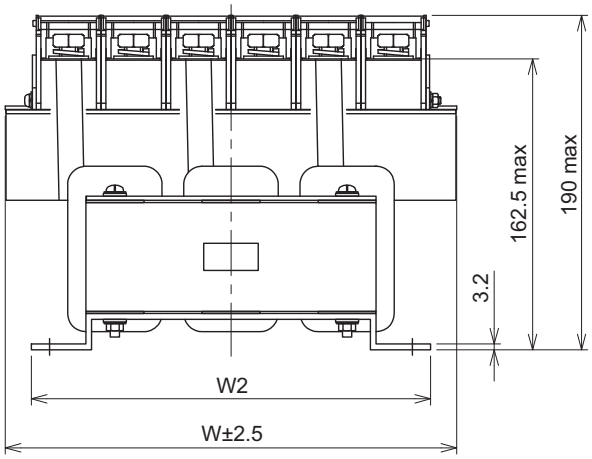
(Unit: mm)

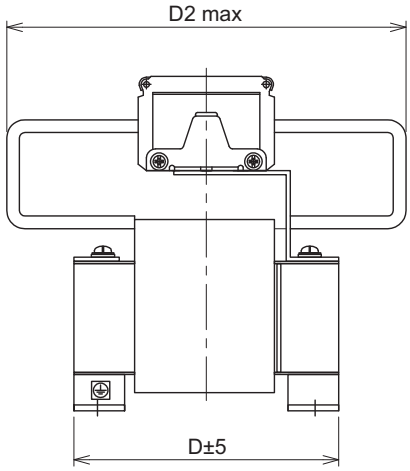
● **FR-XCL-37K, 55K**



Terminal layout

R/L1		S/L2		T/L3	
	R2/L12		S2/L22		T2/L32



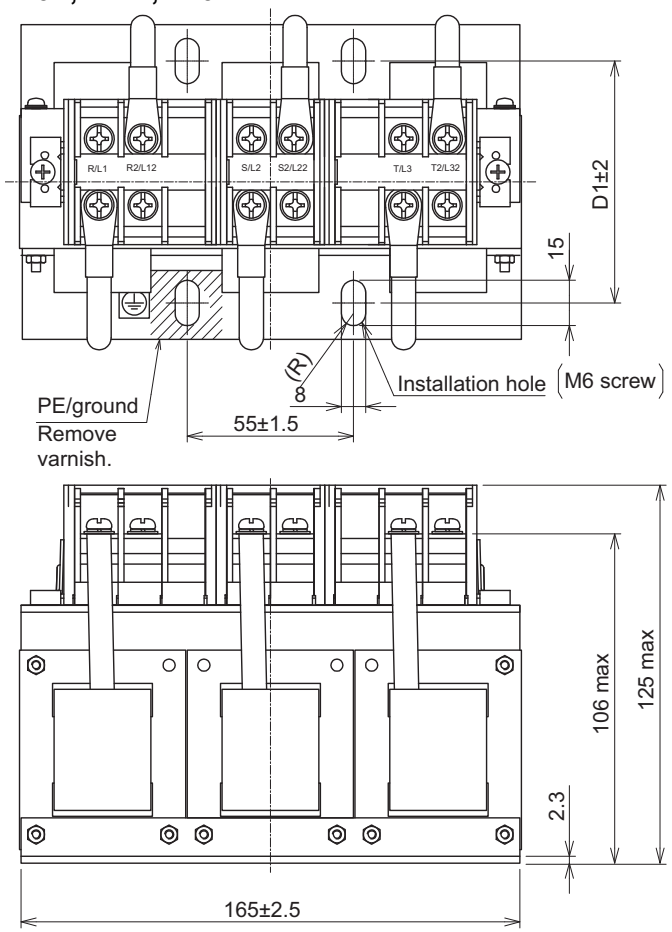


Model	W	W1	W2	D	D1	D2	Terminal screw size	Mass
FR-XCL-37K	248	200	220	146	120	240	M10	12.0 kg
FR-XCL-55K	250	225	250	173	135	260		15.5 kg

(Unit: mm)

400 V class

● FR-XCL-H7.5K, H11K, H15K



Terminal layout

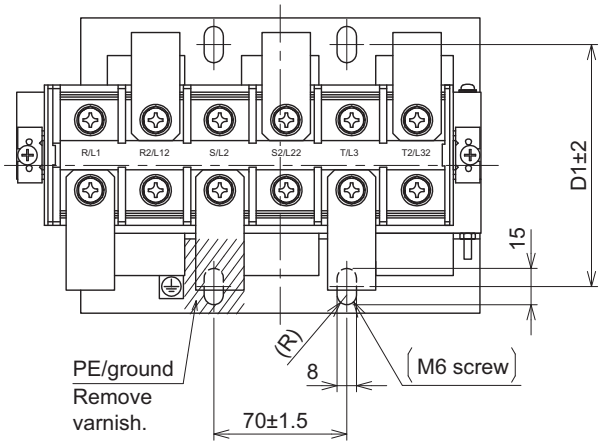
R/L1		S/L2		T/L3	
	R2/L12		S2/L22		T2/L32

Model	D	D1	D2	Terminal screw size	Mass
FR-XCL-H7.5K	97	73	120	M5	3.7 kg
FR-XCL-H11K	104	80	120		4.2 kg
FR-XCL-H15K	132	110	135		6.0 kg

(Unit: mm)

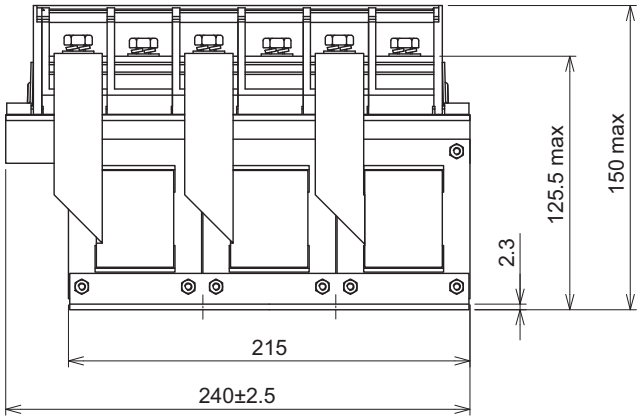
Outline dimension drawings

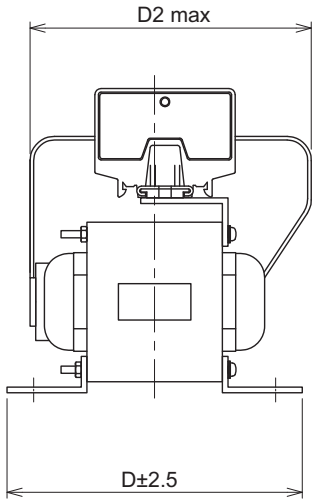
● **FR-XCL-H22K, H30K**



Terminal layout

R/L1		S/L2		T/L3	
	R2/L12		S2/L22		T2/L32

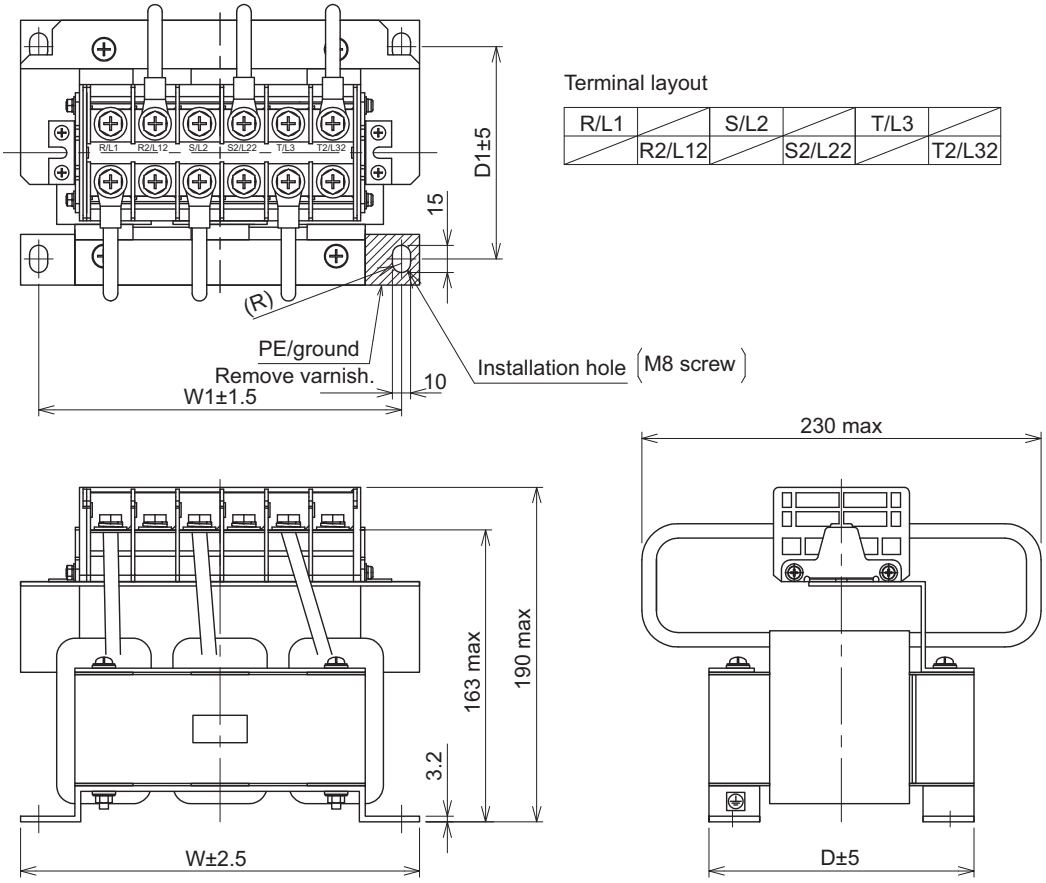




Model	D	D1	D2	Terminal screw size	Mass
FR-XCL-H22K	135	109	150	M6	9.0 kg
FR-XCL-H30K	155	129	170		12.0 kg

(Unit: mm)

● **FR-XCL-H37K, H55K**



Model	W	W1	D	D1	Terminal screw size	Mass
FR-XCL-H37K	220	200	146	120	M8	12.0 kg
FR-XCL-H55K	250	225	173	135		16.0 kg

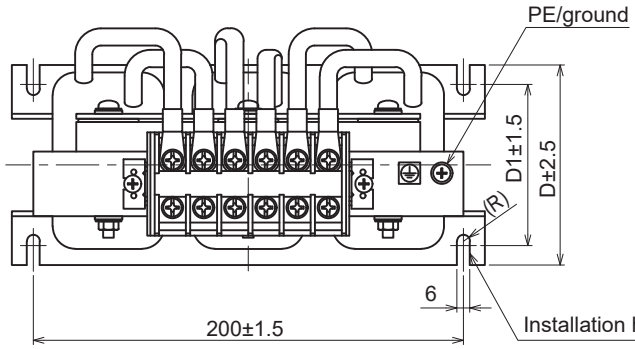
(Unit: mm)

9.2.3 Dedicated stand-alone reactor (FR-XCG)

Check that the FR-XCG reactor that matches the converter is selected.

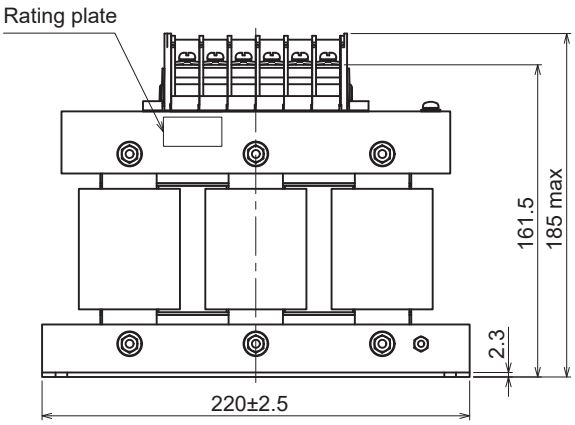
200 V class

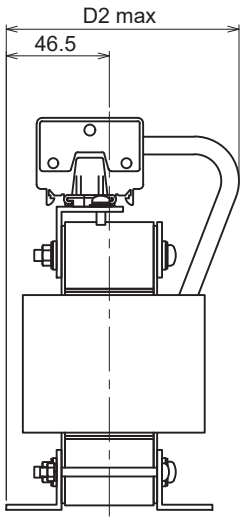
- **FR-XCG-7.5K, 11K**



Terminal layout

R/L1	R2/L12	S/L2	S2/L22	T/L3	T2/L32

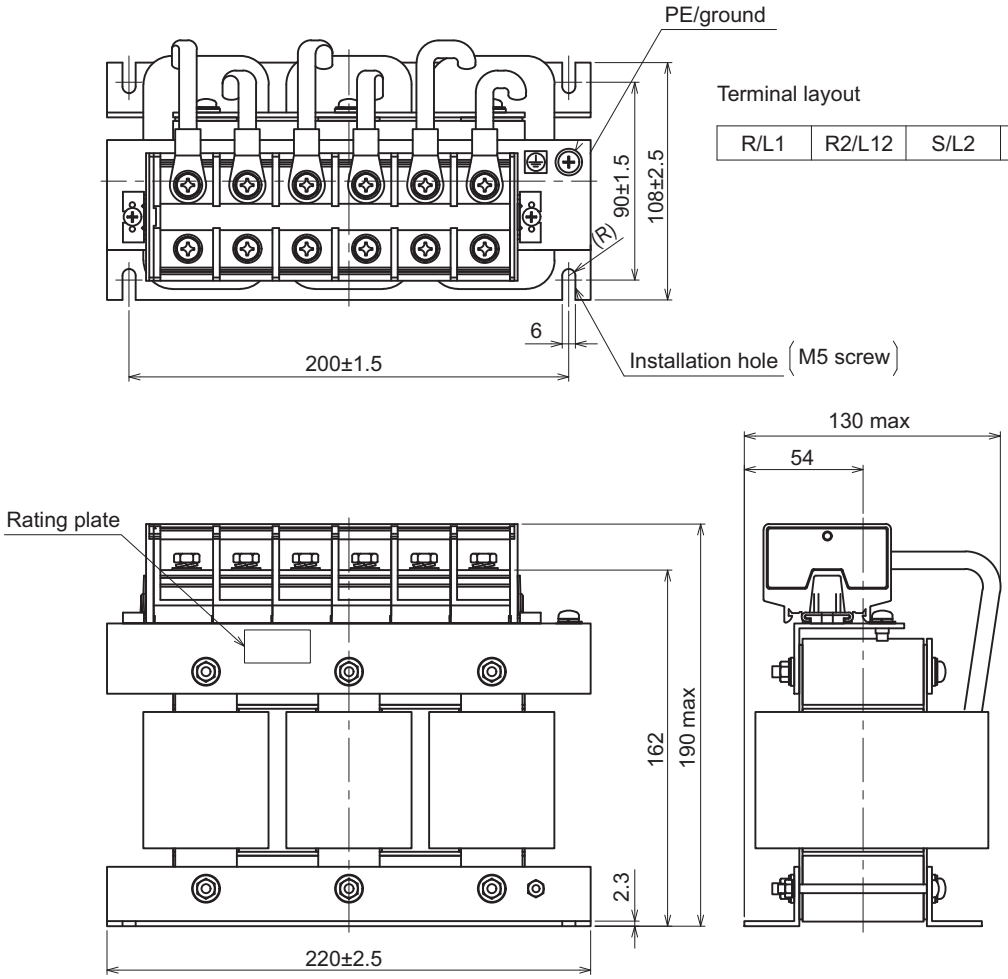




Model	D	D1	D2	Terminal screw size	Mass
FR-XCG-7.5K	78	60	115	M5	5 kg
FR-XCG-11K	93	75	120		8 kg

(Unit: mm)

● **FR-XCG-15K**

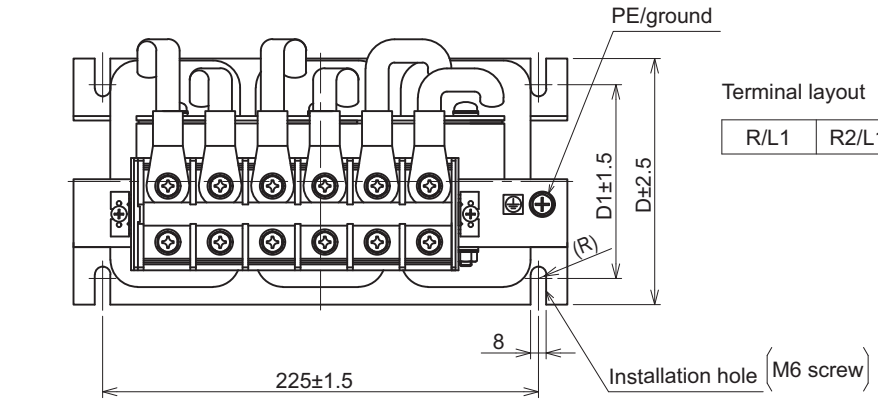


Model	Terminal screw size	Mass
FR-XCG-15K	M6	11 kg

(Unit: mm)

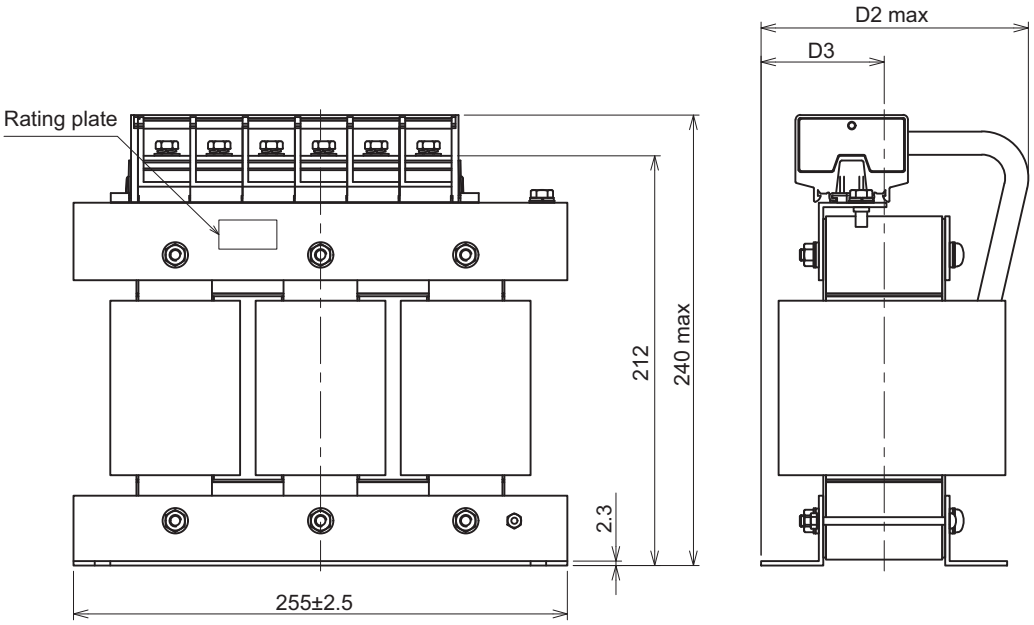
Outline dimension drawings

● **FR-XCG-22K, 30K**



Terminal layout

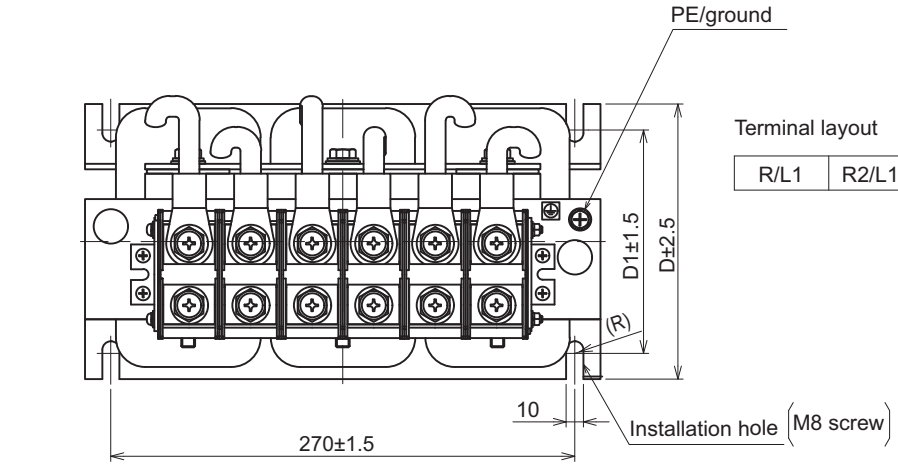
R/L1	R2/L12	S/L2	S2/L22	T/L3	T2/L32



Model	D	D1	D2	D3	Terminal screw size	Mass
FR-XCG-22K	112	85	140	60	M6	16 kg
FR-XCG-30K	127	100	155	70		20 kg

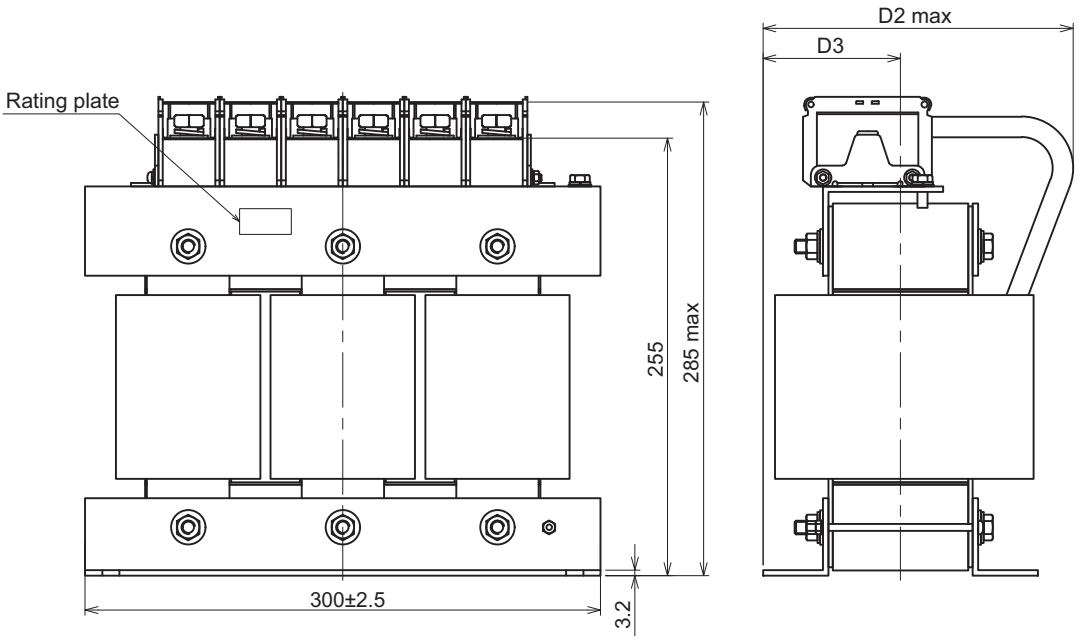
(Unit: mm)

● **FR-XCG-37K, 55K**



Terminal layout

R/L1	R2/L12	S/L2	S2/L22	T/L3	T2/L32



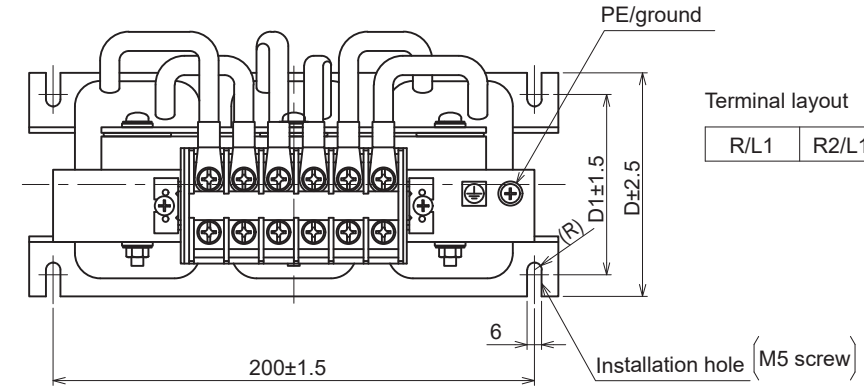
Model	D	D1	D2	D3	Terminal screw size	Mass
FR-XCG-37K	130	100	180	75	M10	25 kg
FR-XCG-55K	160	130	190	85		40 kg

(Unit: mm)

Outline dimension drawings

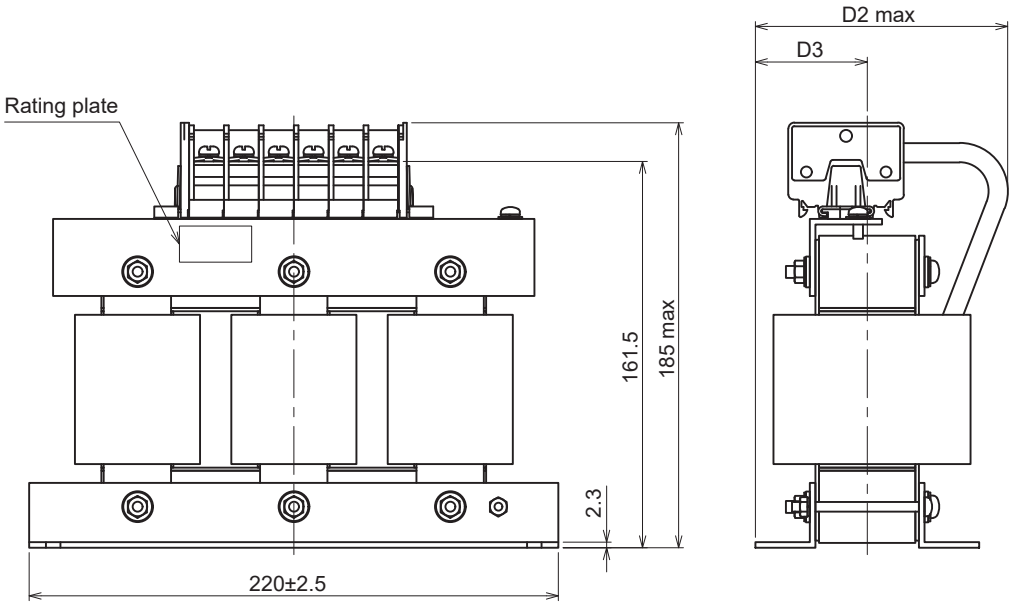
400 V class

● **FR-XCG-H7.5K, H11K, H15K**



Terminal layout

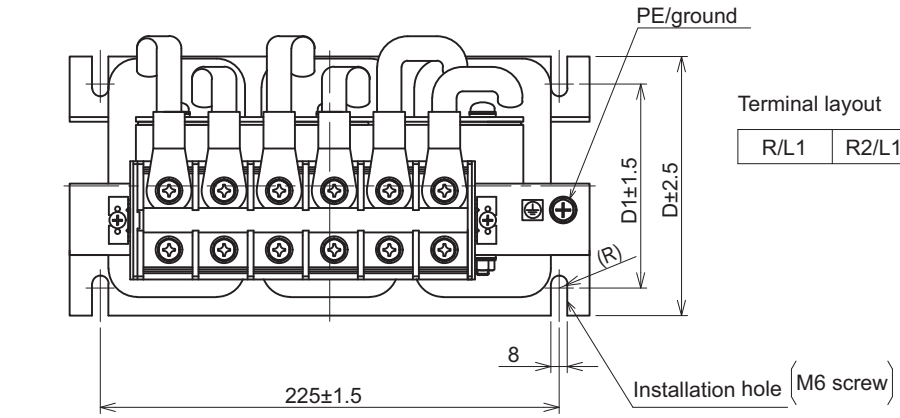
R/L1	R2/L12	S/L2	S2/L22	T/L3	T2/L32



Model	D	D1	D2	D3	Terminal screw size	Mass
FR-XCG-H7.5K	78	60	115	55	M5	5 kg
FR-XCG-H11K	93	75	120			8 kg
FR-XCG-H15K	108	90	130	60		11 kg

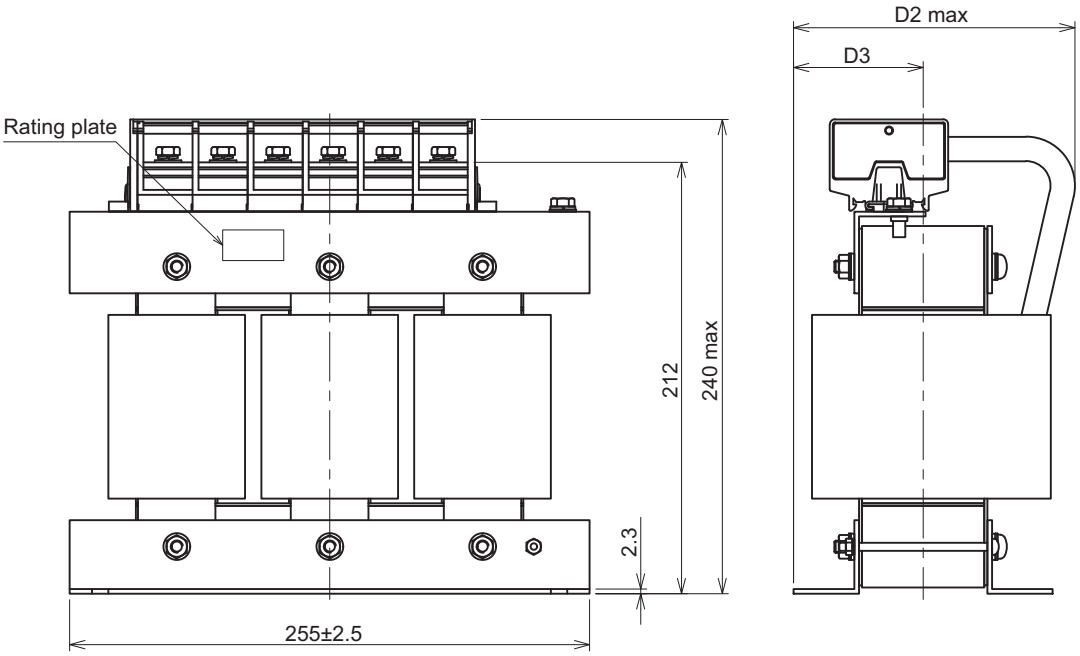
(Unit: mm)

● **FR-XCG-H22K, H30K**



Terminal layout

R/L1	R2/L12	S/L2	S2/L22	T/L3	T2/L32

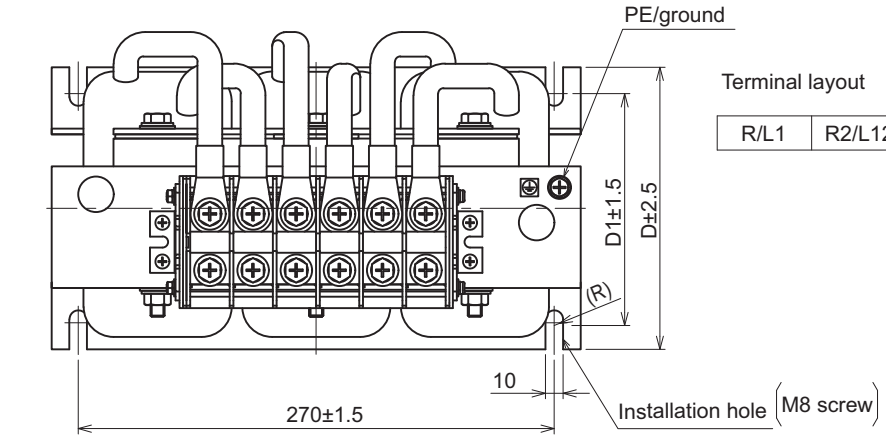


Model	D	D1	D2	D3	Terminal screw size	Mass
FR-XCG-H22K	112	85	130	60	M6	16 kg
FR-XCG-H30K	127	100	140	70		20 kg

(Unit: mm)

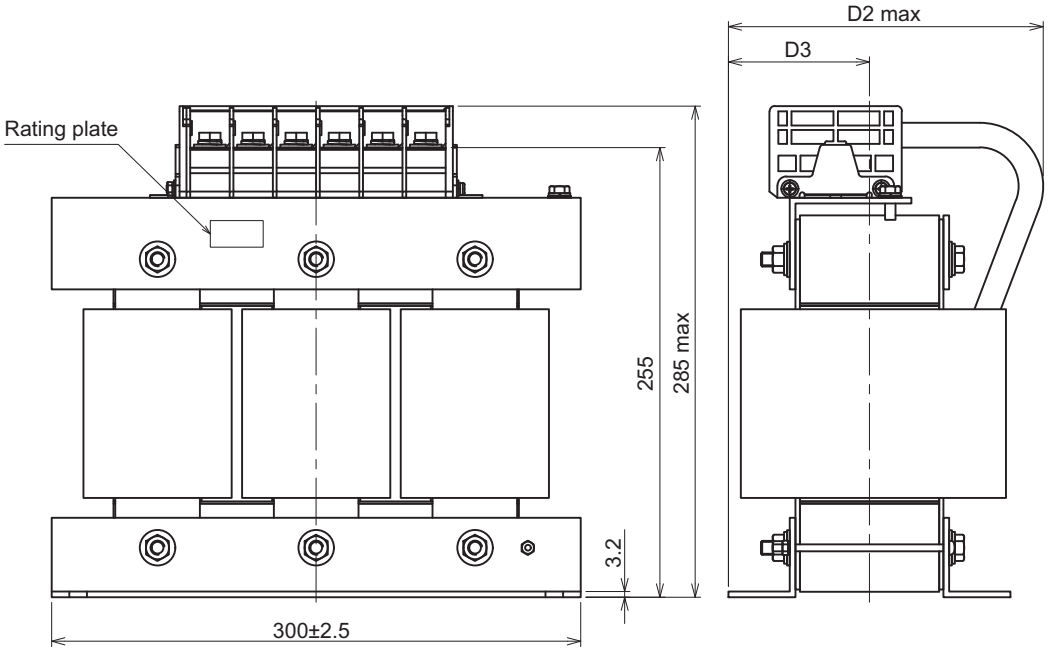
Outline dimension drawings

● **FR-XCG-H37K, H55K**



Terminal layout

R/L1	R2/L12	S/L2	S2/L22	T/L3	T2/L32



Model	D	D1	D2	D3	Terminal screw size	Mass
FR-XCG-H37K	130	100	180	75	M8	25 kg
FR-XCG-H55K	160	130	190	85		40 kg

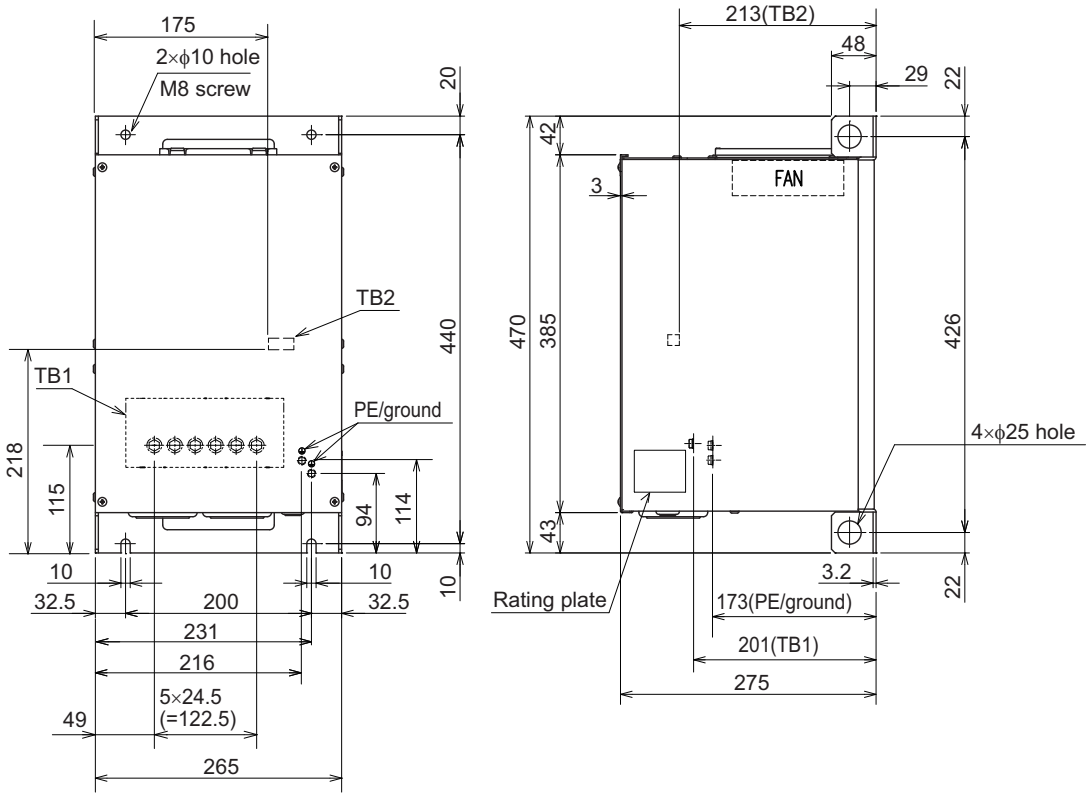
(Unit: mm)

9.2.4 Dedicated box-type reactor (FR-XCB)

Check that the FR-XCB reactor that matches the converter is selected.

200 V class

● **FR-XCB-18.5K, 22K**



Terminal layout

TB1

R/L1	S/L2	T/L3	R2/L12	S2/L22	T2/L32

TB2

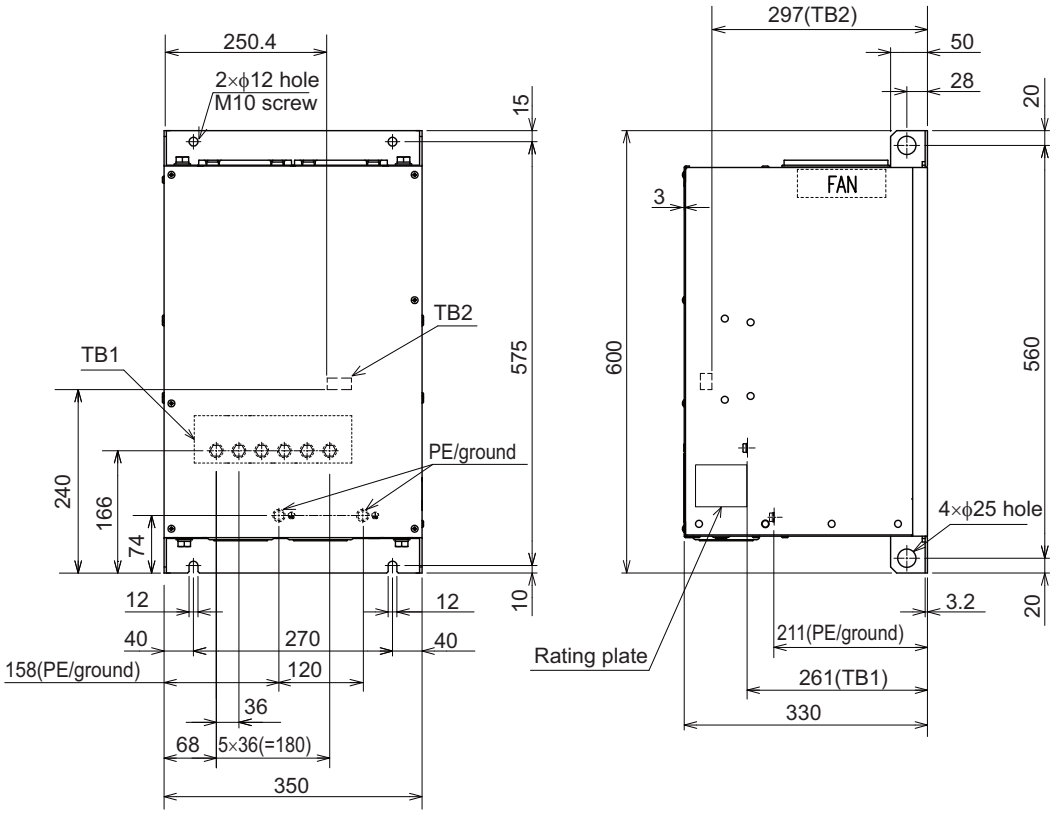
LOH1	LOH2	T/L3	FAN1	FAN2	DROH1	DROH2

Model	Mass
FR-XCB-18.5K, 22K	26.0 kg

(Unit: mm)

Outline dimension drawings

● **FR-XCB-37K, 55K**



Terminal layout

TB1

R/L1	S/L2	T/L3	R2/L12	S2/L22	T2/L32

TB2

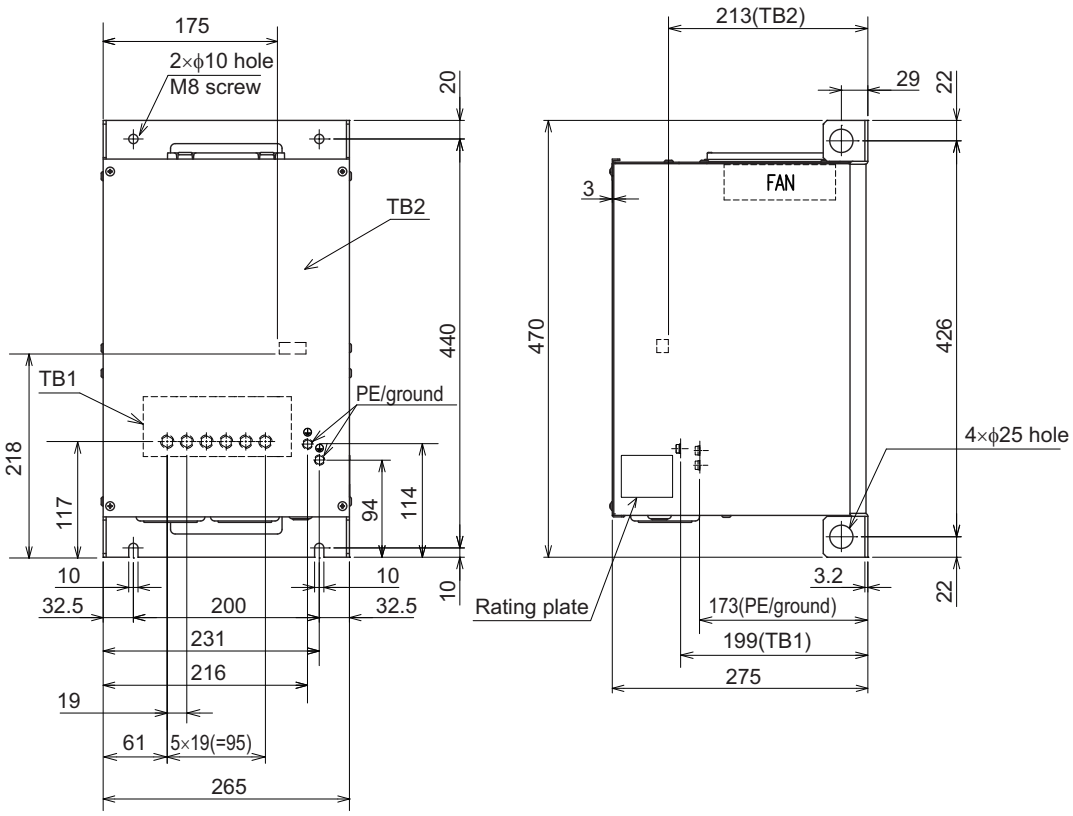
LOH1	LOH2	T/L3	FAN1	FAN2	DROH1	DROH2

Model	Mass
FR-XCB-37K	56.9 kg
FR-XCB-55K	68.5 kg

(Unit: mm)

400 V class

- **FR-XCB-H18.5K, H22K**



Terminal layout

TB1

R/L1	S/L2	T/L3	R2/L12	S2/L22	T2/L32

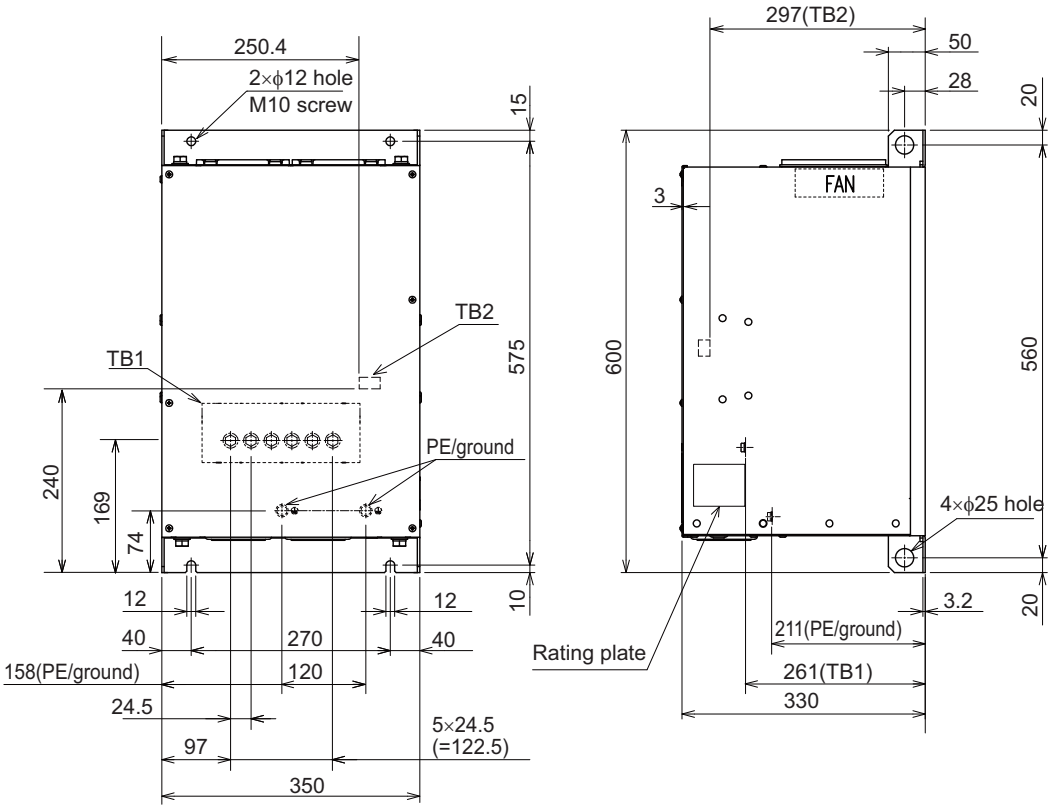
TB2

LOH1	LOH2	T/L3	FAN1	FAN2	DROH1	DROH2

Model	Mass
FR-XCB-H18.5K, H22K	26.9 kg

(Unit: mm)

● FR-XCB-H37K, H55K



Terminal layout

TB1

R/L1	S/L2	T/L3	R2/L12	S2/L22	T2/L32

TB2

LOH1	LOH2	T/L3	FAN1	FAN2	DROH1	DROH2

Model	Mass
FR-XCB-H37K	63.0 kg
FR-XCB-H55K	73.0 kg

(Unit: mm)

APPENDIX

APPENDIX provides the reference information for use of this product.
Refer to APPENDIX as required.

Appendix 1 Major differences between FR-XC and FR-XC-PWM ..224
Appendix 2 Replacing the FR-XC manufactured in October 2019 or earlier (using power regeneration mode 1) 224
Appendix 3 Instruction code list 232
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Appendix 6 Instructions for EAC 239
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Appendix 8 Referenced Standard (Requirement of Chinese standardized law) 240
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Appendix 1 Major differences between FR-XC and FR-XC-PWM

Item	FR-XC	FR-XC-PWM
Capacity indication in model name	FR-XC-[ ]K []: Rating of the converter with common bus regeneration mode	FR-XC-[ ]K-PWM []: Rating of the converter with harmonic suppression mode
Capacity range (kW)	7.5, 11, 15, 22, 30, 37, 55, 75*1, 160*1, 220*1	18.5, 22, 37, 55, 75*1, 160*1, 220*1
Functional status at "9999 (initial value)" in Pr.416 Control method selection	Common bus regeneration mode (Same status as established by setting "0".)	Harmonic suppression mode (Same status as established by setting "1".)
Capacity of applicable FR-XCL reactor	Same as the converter capacity	Not same as the converter capacity (22K or lower) (Refer to page 77.)
Capacity of applicable FR-XCB reactor	Not same as the converter capacity (22K or lower) (Refer to page 97.)	Same as the converter capacity
Capacity of applicable FR-MCB contactor box	Same as the converter capacity	Not same as the converter capacity (22K or lower)

*1 400 V class only

Appendix 2 Replacing the FR-XC manufactured in October 2019 or earlier (using power regeneration mode 1)

When replacing the FR-XC manufactured in October 2019 or earlier, the power regeneration mode 1 is available with the FR-XCL (dedicated stand-alone reactor).

Turn OFF (initial status) switch 2 in the function selection switch assembly (SW2).

Appendix2.1 Operating condition

- Follow the following steps to confirm your converter selection and select the FR-HAL AC reactor.
  1) To select the converter, refer to page 113 for the potential regenerative capacity and overload current rating of the converter. Ensure that the selected converter is one with a larger regenerative power than that of the motor that will be used.
  Selection example:
  For a motor which can supply 10 kW regenerative power with an overload capacity of 120% (12 kW) for 60 seconds, the FR-XC-15K (15 kW converter) should be selected.

Model FR-XC-[ ]K *1		7.5	11	15	22	30	37	55
	Applicable inverter capacity (kW)	7.5	11	15	22	30	37	55
		—	—	—	18.5	22	37	55
50°C rating	Potential regenerative capacity (kW) *7	5.5	7.5	11	18.5	22	30	45
	Rated current (A) (regenerative driving)	19	26	37	62	74	102	152
	Continuous rating / overload current rating	100% continuous / 150% 60 s						
40°C rating	Potential regenerative capacity (kW)	5.5	7.5	11	18.5	22	30	45
	Rated current (A) (regenerative driving)	21	28	40	68	81	112	167
	Continuous rating / overload current rating	100% continuous / 150% 60 s						
Rated input AC voltage/	Disabled	Three-phase 200 to 240 V, 50/60 Hz						

2) Select the FR-HAL with appropriate capacity according to the capacity (model) of the motor and the converter.

200 V class

Multifunction regeneration converter	AC reactor	Motor capacity											
		7.5K	11K	15K	18.5K	22K	30K	37K	45K	55K	75K	90K	110K
FR-XC-7.5K	FR-HAL-[]K	—	11	15	18.5	22	30	×	×	×	×	×	×
	Quantity		1	2	2	3	3						
FR-XC-11K	FR-HAL-[]K	—	—	15	18.5	22	30	37	×	×	×	×	×
	Quantity			1	2	2	3	3					
FR-XC-15K	FR-HAL-[]K	—	—	—	18.5	22	30	37	45	×	×	×	×
	Quantity				1	2	2	3	3				
FR-XC-22K FR-XC-18.5K-PWM	FR-HAL-[]K	—	—	—	—	—	30	37	45	55	75	×	×
	Quantity						1	2	2	3	3		
FR-XC-30K FR-XC-22K-PWM	FR-HAL-[]K	—	—	—	—	—	—	37	45	55	75	110	×
	Quantity							1	2	2	3	3	
FR-XC-37K FR-XC-37K-PWM	FR-HAL-[]K	—	—	—	—	—	—	—	45	55	75	110	110
	Quantity								1	2	2	3	3
FR-XC-55K FR-XC-55K-PWM	FR-HAL-[]K	—	—	—	—	—	—	—	—	—	75	110	110
	Quantity										1	2	2

× : Invalid combination regardless of the converter operation mode.

— : Invalid combination in the power regeneration mode. (Check the inverter models applicable to the converter in the common bus regeneration mode.)

400 V class

Multifunction regeneration converter	AC reactor	Motor capacity														
		7.5K	11K	15K	18.5 K	22K	30K	37K	45K	55K	75K	90K	110 K	132 K	160 K	185K or higher
FR-XC-H7.5K	FR-HAL-H[]K	—	11	15	18.5	22	30	×	×	×	×	×	×	×	×	×
	Quantity		1	2	2	3	3									
FR-XC-H11K	FR-HAL-H[]K	—	—	15	18.5	22	30	37	×	×	×	×	×	×	×	×
	Quantity			1	2	2	3	3								
FR-XC-H15K	FR-HAL-H[]K	—	—	—	18.5	22	30	37	45	×	×	×	×	×	×	×
	Quantity				1	2	2	3	3							
FR-XC-H22K FR-XC-H18.5K-PWM	FR-HAL-H[]K	—	—	—	—	—	30	37	45	55	75	×	×	×	×	×
	Quantity						1	2	2	3	3					
FR-XC-H30K FR-XC-H22K-PWM	FR-HAL-H[]K	—	—	—	—	—	—	37	45	55	75	110	×	×	×	×
	Quantity							1	2	2	3	3				
FR-XC-H37K FR-XC-H37K-PWM	FR-HAL-H[]K	—	—	—	—	—	—	—	45	55	75	110	110	×	×	×
	Quantity								1	2	2	3	3			
FR-XC-H55K FR-XC-H55K-PWM	FR-HAL-H[]K	—	—	—	—	—	—	—	—	—	75	110	110	185	185	×
	Quantity										1	2	2	3	3	

× : Invalid combination regardless of the converter operation mode.

— : Invalid combination in the power regeneration mode. (Check the inverter models applicable to the converter in the common bus regeneration mode.)

NOTE

- For information of the installation location of the AC reactor, refer to page 230.
  To install multiple AC reactors in a system, connect them in series.
- When using a 75 kW inverter/motor or higher, also install the FR-HEL DC reactor (refer to the inverter instruction manuals).

Appendix2.2 Peripheral devices

◆Circuit breaker and magnetic contactor

To use the converter in power regeneration mode 1, select a circuit breaker and a magnetic contactor (MC) for the inverter according to the inverter capacity. For details, refer to the Instruction Manual of each inverter.
Additionally, install a molded case circuit breaker (MCCB) or earth leakage circuit breaker (ELB) with the rating shown in the following table on the input side of the FR-XCL reactor. For the information of the installation location, refer to page 230.

• 200 V class

FR-XC series converter model	Molded case circuit breaker (MCCB)/ earth leakage circuit breaker (ELB) (NF, NV type)
FR-XC-7.5K	50 A
FR-XC-11K	60 A
FR-XC-15K	75 A
FR-XC-22K FR-XC-18.5K-PWM	125 A
FR-XC-30K FR-XC-22K-PWM	175 A
FR-XC-37K FR-XC-37K-PWM	200 A
FR-XC-55K FR-XC-55K-PWM	250 A

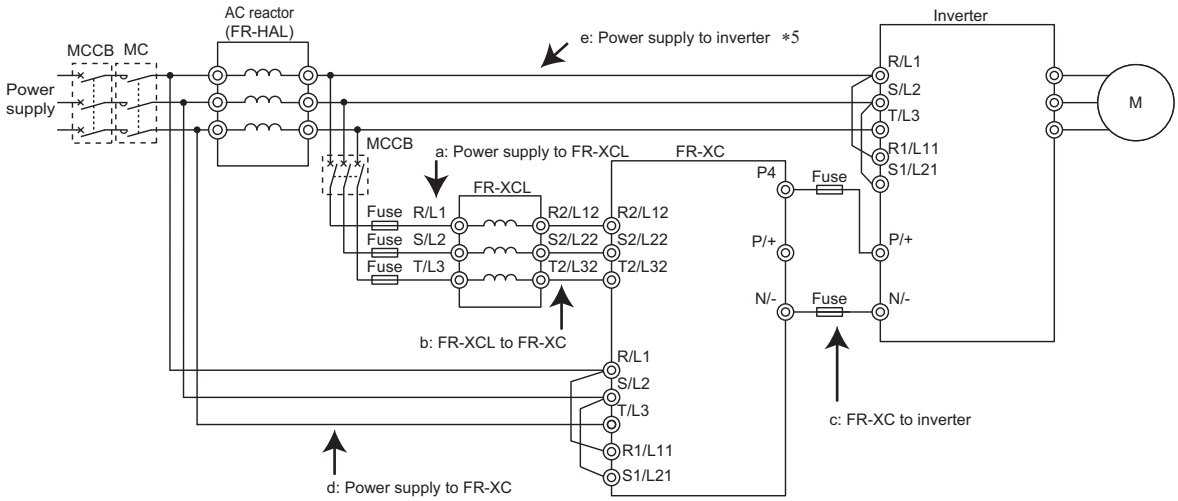
• 400 V class

FR-XC series converter model	Molded case circuit breaker (MCCB)/ earth leakage circuit breaker (ELB) (NF, NV type)
FR-XC-H7.5K	30 A
FR-XC-H11K	30 A
FR-XC-H15K	40 A
FR-XC-H22K FR-XC-H18.5K-PWM	75 A
FR-XC-H30K FR-XC-H22K-PWM	100 A
FR-XC-H37K FR-XC-H37K-PWM	125 A
FR-XC-H55K FR-XC-H55K-PWM	150 A

NOTE

• If any breaker trips, check for the wiring fault (such as short circuit), damage to internal parts of the multifunction regeneration converter, etc. The cause of the trip must be identified and removed before turning ON the power of the breaker.

Appendix2.3 Cable size of the main circuit terminals and the earth (ground) terminal



- 200 V class

Model	Rating	Crimp terminal (for HIV cables, etc.)				
		R, S, T	R2, S2, T2	P4, N	R1, S1	Earth (ground)
FR-XC-7.5K	50°C	1.25-4	3.5-5	5.5-6	1.25-4	5.5-4
	40°C					
FR-XC-11K	50°C	1.25-4	5.5-5	8-6	1.25-4	8-5
	40°C			5.5-6		
FR-XC-15K	50°C	1.25-4	8-5	14-6	1.25-4	14-5
	40°C					
FR-XC-22K FR-XC-18.5K-PWM	50°C	1.25-4	22-8	22-6	1.25-4	22-6
	40°C					
FR-XC-30K FR-XC-22K-PWM	50°C	1.25-4	38-8	38-6	1.25-4	22-6
	40°C					
FR-XC-37K FR-XC-37K-PWM	50°C	1.25-4	60-10	60-10	1.25-4	22-8
	40°C		38-10			
FR-XC-55K FR-XC-55K-PWM	50°C	1.25-4	80-12	100-12	1.25-4	38-8
	40°C					

Model	Rating	Cable gauge				Cable gauge						
		HIV cables, etc. (mm^2) *1				AWG/MCM *2			PVC cables, etc. (mm^2) *3			
		Location in the connection diagram			Earth (ground)	Location in the connection diagram			Location in the connection diagram			Earth (ground)
		a, b	c *4	d		a, b	c	d	a, b	c	d	
FR-XC-7.5K	50°C	3.5	5.5	1.25	5.5	14	12	16	4	4	1.5	10
	40°C		3.5			12						
FR-XC-11K	50°C	5.5	8		8	10	10	16	6	6	1.5	16
	40°C		5.5									
FR-XC-15K	50°C	8	14	1.25	14	8	8	16	10	10	1.5	16
	40°C											
FR-XC-22K FR-XC-18.5K-PWM	50°C	22	22	1.25	22	6	4	16	10	16	1.5	16
	40°C					4			16			
FR-XC-30K FR-XC-22K-PWM	50°C	38	38	1.25	22	4	2	16	16	16	1.5	25
	40°C	22								25		
FR-XC-37K FR-XC-37K-PWM	50°C	60	60	1.25	22	1	1	16	35	35	1.5	25
	40°C	38					1/0			50		
FR-XC-55K FR-XC-55K-PWM	50°C	80	100	1.25	38	2/0	3/0	16	70	70	1.5	35
	40°C											

Model	Rating	Crimp terminal (for HIV cables, etc.)
		R, S, T R2, S2, T2
FR-XCL-7.5K	50°C	3.5-5
	40°C	
FR-XCL-11K	50°C	5.5-5
	40°C	
FR-XCL-15K	50°C	8-6
	40°C	
FR-XCL-22K	50°C	22-6
	40°C	
FR-XCL-30K	50°C	22-6
	40°C	
FR-XCL-37K	50°C	60-10
	40°C	38-10
FR-XCL-55K	50°C	80-10
	40°C	

*1 It is the gauge of a cable with the continuous maximum permissible temperature of 75°C (HIV cable (600 V grade heat-resistant PVC insulated wire), etc.). It assumes a surrounding air temperature of 50°C or less (40°C or less for the 40°C rating) and the wiring distance of 20 m or less from the power supply to the converter.

*2 The cable size is that of the THHW cable with continuous maximum permissible temperature of 75°C. It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
(For the use in the United States or Canada, refer to page 236.)

*3 For the FR-XC-15K or lower, it is the gauge of a cable with the continuous maximum permissible temperature of 70°C (PVC cable). It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
For the FR-XC-22K / FR-XC-18.5K-PWM or higher, it is the gauge of a cable with the continuous maximum permissible temperature of 90°C (PVC cable). It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
(Selection example mainly for use in Europe.)

*4 If a cable thinner than the recommended cable size is used, it may not be protected by the DC fuse. (Refer to page 101 for the fuse selection.)

*5 Refer to the Inverter Instruction Manual.

• 400 V class

Model	Rating	Crimp terminal (for HIV cables, etc.)				
		R, S, T	R2, S2, T2	P4, N	R1, S1	Earth (ground)
FR-XC-H7.5K	50°C	1.25-4	3.5-5	3.5-6	1.25-4	3.5-4
	40°C					
FR-XC-H11K	50°C	1.25-4	3.5-5	3.5-6	1.25-4	3.5-5
	40°C					
FR-XC-H15K	50°C	1.25-4	3.5-5	5.5-6	1.25-4	5.5-5
	40°C					
FR-XC-H22K FR-XC-H18.5K-PWM	50°C	1.25-4	8-8	14-6	1.25-4	8-6
	40°C			8-6		
FR-XC-H30K FR-XC-H22K-PWM	50°C	1.25-4	14-8	14-6	1.25-4	14-6
	40°C		8-8			
FR-XC-H37K FR-XC-H37K-PWM	50°C	1.25-4	22-8	22-8	1.25-4	14-8
	40°C		14-8			
FR-XC-H55K FR-XC-H55K-PWM	50°C	1.25-4	38-8	38-8	1.25-4	22-8
	40°C					

Model	Rating	Cable gauge				Cable gauge						
		HIV cables, etc. (mm^2) *1				AWG/MCM *2			PVC cables, etc. (mm^2) *3			
		Location in the connection diagram			Earth (ground)	Location in the connection diagram			Location in the connection diagram			Earth (ground)
		a, b	c *4	d		a, b	c	d	a, b	c	d	
FR-XC-H7.5K	50°C	3.5	3.5	1.25	3.5	12	12	16	4	4	1.5	4
	40°C											
FR-XC-H11K	50°C	3.5	3.5		3.5	12	12	16	4	4	1.5	4
	40°C											
FR-XC-H15K	50°C	3.5	5.5	1.25	5.5	12	12	16	4	4	1.5	4
	40°C						10					
FR-XC-H22K FR-XC-H18.5K-PWM	50°C	8	14	1.25	8	10	8	16	6	10	1.5	10
	40°C		8			8						
FR-XC-H30K FR-XC-H22K-PWM	50°C	14	14	1.25	14	8	6	16	10	10	1.5	10
	40°C	8										
FR-XC-H37K FR-XC-H37K-PWM	50°C	22	22	1.25	14	6	4	16	16	16	1.5	16
	40°C	14										
FR-XC-H55K FR-XC-H55K-PWM	50°C	38	38	1.25	22	4	2	16	25	25	1.5	16
	40°C					2						

Model	Rating	Crimp terminal (for HIV cables, etc.)
		R, S, T, R2, S2, T2
FR-XCL-H7.5K	50°C	3.5-5
	40°C	
FR-XCL-H11K	50°C	3.5-5
	40°C	
FR-XCL-H15K	50°C	3.5-5
	40°C	
FR-XCL-H22K	50°C	8-6
	40°C	
FR-XCL-H30K	50°C	14-6
	40°C	8-6
FR-XCL-H37K	50°C	22-8
	40°C	14-8
FR-XCL-H55K	50°C	38-8
	40°C	

*1 It is the gauge of a cable with the continuous maximum permissible temperature of 75°C (HIV cable (600 V grade heat-resistant PVC insulated wire), etc.). It assumes a surrounding air temperature of 50°C or less (40°C or less for the 40°C rating) and the wiring distance of 20 m or less from the power supply to the converter.

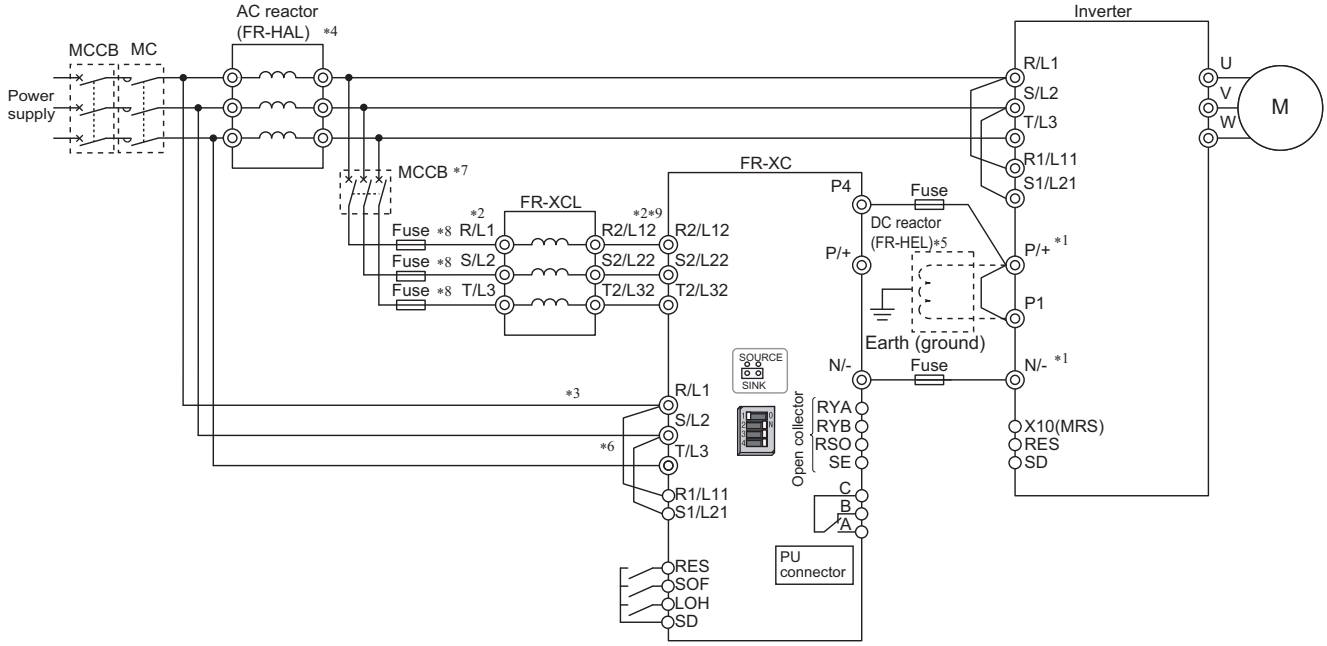
*2 The cable size is that of the THHW cable with continuous maximum permissible temperature of 75°C. It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
(For the use in the United States or Canada, refer to page 236.)

*3 For the FR-XC-15K or lower, it is the gauge of a cable with the continuous maximum permissible temperature of 70°C (PVC cable). It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
For the FR-XC-22K / FR-XC-18.5K-PWM or higher, it is the gauge of a cable with the continuous maximum permissible temperature of 90°C (PVC cable). It assumes a surrounding air temperature of 40°C or less and the wiring distance of 20 m or less from the power supply to the converter.
(Selection example mainly for use in Europe.)

*4 If a cable thinner than the recommended cable size is used, it may not be protected by the DC fuse. (Refer to page 101 for the fuse selection.)

*5 Refer to the Inverter Instruction Manual.

Appendix2.4 Terminal connection diagram



*1 Connect between the inverter terminal P/+ and the converter terminal P4 and between the inverter terminal N/- and the converter terminal N/- for polarity consistency.
Connecting the opposite polarity of terminals P/+ and N/- will damage the converter and the inverter.

*2 Confirm the correct phase sequence of three-phase current to connect between the reactor and the converter, and between the power supply and the reactor.
Incorrect connection will damage the converter.

*3 Always connect between the power supply and terminals R/L1, S/L2, and T/L3 of the converter. Operating the inverter without connecting them will damage the converter. A branch point to each of these terminals must be placed between the power supply and the FR-HAL reactor.

*4 Install the FR-HAL reactor between the node points joined to the converter terminals R/L1, S/L2, and T/L3 and the node points joined to the FR-XCL reactor. For information to select an appropriate model, refer to page 224.

*5 To connect a DC reactor, remove a jumper installed across terminals P1 and P/+ before installing the DC reactor.

*6 To use separate power supply for the control circuit, remove each jumper at terminal R1/L11 and terminal S1/L21.

*7 For selection of an MCCB for the converter, refer to page 226.

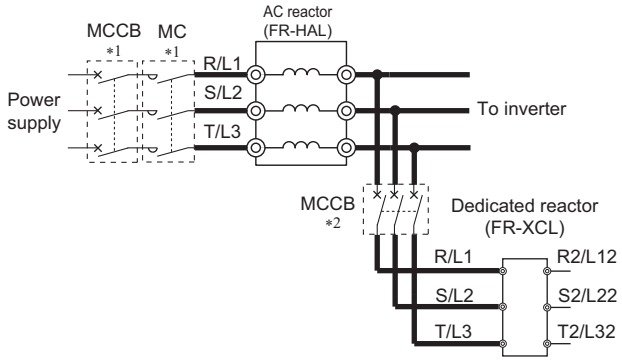
*8 Install the UL listed fuse (refer to page 236) on the input side of the FR-XCL reactor to meet the UL/cUL standards.

*9 Do not install an MCCB or MC between the reactors and the converter. Doing so disrupts proper operation.

Appendix2.5 Wiring

◆Wiring the power supply to the reactor

• Cable gauge differs by the capacity. Select an appropriate cable by referring to page 227 to perform wiring.

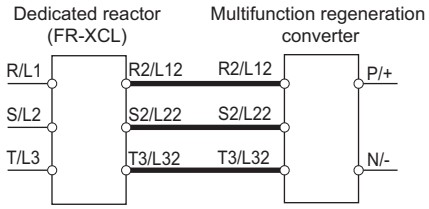


*1 Select a MCCB and a MC according to the inverter capacity.

*2 For selection of MCCB for the converter, refer to page 226.

◆Wiring the reactor to the converter

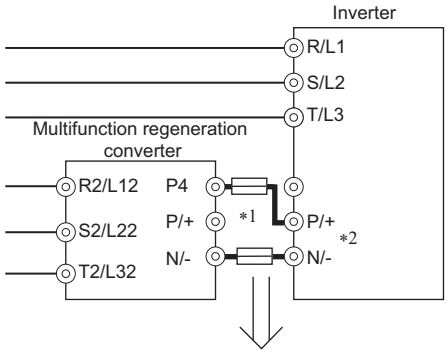
• Cable gauge differs by the capacity. Select an appropriate cable by referring to page 227 to perform wiring.



Total wiring length	10 m or shorter

◆Wiring the converter to the inverter

• For the cable gauge of the cable for the main circuit terminals P/+ and N/- (P to P and N to N), refer to page 227.



Main circuit wiring length	5 m or shorter

*1 Installation of a fuse on each cable is recommended to prevent the damage from spreading in case of an inverter failure. Select the fuse according to the motor capacity. To use a motor whose capacity is smaller than the inverter capacity by two ranks or more, select the fuse with the capacity that is one rank lower than the inverter capacity. Refer to the fuse selection table on page 101.

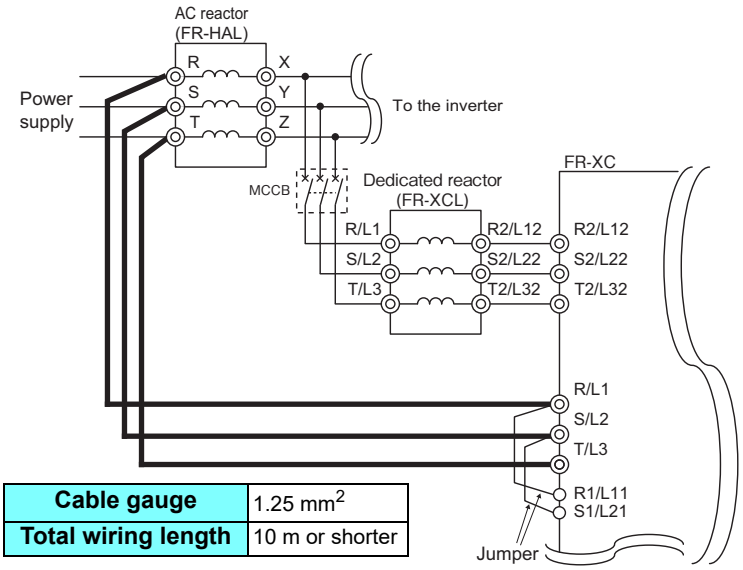
*2 Do not install any MCCB between the inverter and the converter (P to P and N to N).

NOTE

• Connecting opposite polarity of terminals P4 and N/- will damage the converter.

◆Wiring the power supply to the converter

Supply power to the power detecting terminals (R/L1, S/L2, and T/L3) separately from the main circuit wiring.



Cable gauge	1.25 mm^2
Total wiring length	10 m or shorter

NOTE

• The terminals R/L1, S/L2, and T/L3 on the converter are control terminals to detect power phases of the power supply. For wiring, the voltage phase must be consistent between terminals R2/L12, S2/L22, and T2/L32 and terminals R/L1, S/L2, and T/L3. If these terminals are not connected correctly, the converter does not operate properly.

• If the inverter is operated while the converter terminals R/L1, S/L2, and T/L3 are not connected to the power supply, the converter will be damaged.

Appendix 3 Instruction code list

*1 The instruction code is used to write or read parameters through RS-485 communication or CC-Link communication. (For RS-485 communication, refer to page 149. For CC-Link communication, refer to page 161.)
*2 For Parameter copy, Parameter clear, and All parameter clear, ○ indicates the function is available, and × indicates the function is not available.
*3 These parameters are not cleared by Parameter clear command or All parameter clear command sent through RS-485 communication or CC-Link communication. (For RS-485 communication, refer to page 149.) For CC-Link communication, refer to page 161.)
*4 Reading and writing are enabled when commands are sent through communication via the PU connector.

The parameter marked with the following option icon is available when the corresponding option is installed.

NC : FR-A8NC

Pr.	Name	Instruction code*1			Parameter		
		Read	Write	Extended	Copy *2	Clear *2	All clear *2
0	Simple mode selection	00	80	0	○	○	○
1	Maximum power supply frequency	01	81	0	○	×	×
2	Minimum power supply frequency	02	82	0	○	×	×
3	LOH terminal function selection	03	83	0	○	×	○
4	SOF terminal function selection	04	84	0	○	×	○
7	RES terminal function selection	07	87	0	○	×	○
8	SOF input selection	08	88	0	○	×	○
9	OH input selection	09	89	0	○	×	○
11	RSO terminal function selection	0B	8B	0	○	×	○
12	RYA terminal function selection	0C	8C	0	○	×	○
16	ABC terminal function selection	10	90	0	○	×	○
22	Current limit level	16	96	0	○	○	○
23	Current limit level (regenerative)	17	97	0	○	○	○
31	Life alarm status display	1F	9F	0	○	×	×
32	Inrush current limit circuit life display	20	A0	0	○	×	×
33	Control circuit capacitor life display	21	A1	0	○	×	×
34	Maintenance timer	22	A2	0	×	×	×
35	Maintenance timer warning output set time	23	A3	0	○	×	○
44	Instantaneous power failure detection signal clear	2C	AC	0	×	×	×
46	Watt-hour meter clear	2E	AE	0	○	×	○
47	Energization time carrying-over times	2F	AF	0	×	×	×
48	Cumulative power monitor digit shifted times	30	B0	0	○	○	○
52	PU main monitor selection	34	B4	0	○	○	○
57	Restart selection	39	B9	0	○	○	○
58	Free parameter 1	3A	BA	0	○	×	×
59	Free parameter 2	3B	BB	0	○	×	×
61	Key lock operation selection	3D	BD	0	○	×	○
65	Retry selection	41	C1	0	○	○	○
67	Number of retries at fault occurrence	43	C3	0	○	○	○
68	Retry waiting time	44	C4	0	○	○	○
69	Retry count display erase	45	C5	0	○	○	○
75	Reset selection / disconnected PU detection / PU stop selection	4B	CB	0	○	×	×
77*4	Parameter write selection	4D	CD	0	○	○	○
80	Voltage control proportional gain	50	D0	0	○	○	○
81	Voltage control integral gain	51	D1	0	○	○	○
82	Current control proportional gain	52	D2	0	○	○	○
83	Current control integral gain	53	D3	0	○	○	○
117	PU communication station number	11	91	1	○	○*3	○*3
118	PU communication speed	12	92	1	○	○*3	○*3
119	PU communication stop bit length	13	93	1	○	○*3	○*3
120	PU communication parity check	14	94	1	○	○*3	○*3
121	PU communication retry count	15	95	1	○	○*3	○*3
123	PU communication waiting time setting	17	97	1	○	○*3	○*3
124	PU communication CR/LF selection	18	98	1	○	○*3	○*3
145	PU display language selection	2D	AD	1	○	×	×
168, 169, 269	Parameter for manufacturer setting. Do not set.						
342	Communication EEPROM write selection	2A	AA	3	○	○	○
415	SW2 setting status	0F	8F	4	×	×	×
416	Control method selection	10	90	4	○	×	×
500	Communication error execution waiting time NC	00	80	5	○	○	○
501	Communication error occurrence count display NC	01	81	5	×	○	○
502	Stop mode selection at communication error NC	02	82	5	○	○	○
520	Parameter for manufacturer setting. Do not set.						
542	Station number (CC-Link) NC	2A	AA	5	○	○*3	○*3
543	Transmission speed selection (CC-Link) NC	2B	AB	5	○	○*3	○*3
544	CC-Link extended setting NC	2C	AC	5	○	○*3	○*3
896	Power unit cost	60	E0	8	○	○	○
989	Parameter copy alarm release	59	D9	9	○	×	○
990	PU buzzer control	5 A	DA	9	○	○	○
991	PU contrast adjustment	5B	DB	9	○	×	○

Appendix 4 Instructions for compliance with the EU Directives

The EU Directives are issued to standardize different national regulations of the EU Member States and to facilitate free movement of the equipment, whose safety is ensured, in the EU territory.
Since 1996, compliance with the EMC Directive that is one of the EU Directives has been legally required. Since 1997, compliance with the Low Voltage Directive, another EU Directive, has been also legally required. When a manufacturer confirms its equipment to be compliant with the EMC Directive and the Low Voltage Directive, the manufacturer must declare the conformity and affix the CE marking.

- The authorized representative in the EU
  The authorized representative in the EU is shown below.
  Name: Mitsubishi Electric Europe B.V.
  Address: Mitsubishi-Electric-Platz 1, 40882 Ratingen, Germany
- Note
  We declare that this multifunction regeneration converter, when equipped with the dedicated EMC filter, conforms with the EMC Directive in industrial environments and affix the CE marking on the converter. When using the converter in a residential area, take appropriate measures and ensure the conformity of the converter used in the residential area.

◆EMC Directive

We declare that this converter, when equipped with the EMC Directive compliant EMC filter, conforms with the EMC Directive and affix the CE marking on the converter.

- EMC Directive: 2014/30/EU
- Standard(s): EN 61800-3:2004+A1:2012 (Second environment / PDS Category "C3")

Note: First environment
Environment including buildings/facilities which are directly connected to a low voltage main supply which also supplies residential buildings.
Directly connected means that there is no intermediate transformer between these buildings.
Second environment
Environment including all buildings/facilities which are not directly connected to a low voltage main supply which also supplies residential buildings.

◆Note

- Set the EMC Directive compliant EMC filter to the converter. Use a recommended EMC compliant EMC filter shown in the table below. Insert line noise filters and ferrite cores to the power and control cables as required.
  - EMC Directive compliant noise filter
    200 V class
    (Manufacture by: SOSHIN ELECTRIC CO., LTD.)

Multifunction regeneration converter	FR-XC-7.5K	FR-XC-11K
EMC Directive compliant noise filter	HF3040C-UQC	HF3060C-UQC

(Manufacture by: COSEL CO., LTD.)

Multifunction regeneration converter	FR-XC-15K	FR-XC-22K FR-XC-30K FR-XC-18.5K-PWM FR-XC-22K-PWM		FR-XC-37K FR-XC-55K FR-XC-37K-PWM FR-XC-55K-PWM	
		Common bus regeneration mode	Harmonic suppression mode	Common bus regeneration mode	Harmonic suppression mode
EMC Directive compliant noise filter	FTB-80-663-L	FTB-150-663-L		TBC-300-104	

400 V class

(Manufacture by: COSEL CO., LTD.)

Multifunction regeneration converter	FR-XC-H7.5K FR-XC-H11K	FR-XC-H15K	FR-XC-H22K FR-XC-H30K FR-XC-H18.5K-PWM FR-XC-H22K-PWM		FR-XC-H37K FR-XC-H55K FR-XC-H37K-PWM FR-XC-H55K-PWM	
			Common bus regeneration mode	Harmonic suppression mode	Common bus regeneration mode	Harmonic suppression mode
EMC Directive compliant noise filter	FSB-30-324	FTB-80-663-L	FTB-80-663-L	FTB-80-355-L	FTB-150-355-L	FTB-150-355-L

- Connect the converter to an earthed (grounded) power supply.
- Install a motor and a control cable written in the Technical News (MF-S-135) according to the instruction.
- Confirm that the final integrated system with the converter conforms with the EMC Directive.

◆Low Voltage Directive

We declare that this converter conforms with the Low Voltage Directive and affix the CE marking on the converter.

- Low Voltage Directive: 2014/35/EU
- Standard(s): EN 61800-5-1:2007

◆Outline of instructions

- Do not use an earth leakage circuit breaker as an electric shock protector without connecting the equipment to the earth. Connect the equipment to the earth (ground) securely.
- Wire the earth terminal independently. (Do not connect two or more cables to one terminal.)
- Use the cable sizes on **page 64**, **page 85**, and **page 105** under the following conditions.
  - Surrounding air temperature: 40°C maximum

    If conditions are different from above, select appropriate wire according to EN 60204-1, IEC 60364-5-52.
- Use a tinned (plating should not include zinc) crimping terminal to connect the earth (ground) cable. When tightening the screw, be careful not to damage the threads.

  For use as a product compliant with the Low Voltage Directive, use PVC cable whose size is indicated on **page 64**, **page 85**, and **page 105**.
- Use the molded case circuit breaker and magnetic contactor which conform to the EN or IEC Standard.
- DC current may flow from the converter to a protective earth (ground) conductor. When using a residual current device (RCD) or residual current monitor (RCM), connect a type B RCD or RCM to the power supply side.
- Use the converter under the conditions of overvoltage category III (usable regardless of the earth (ground) condition of the power supply), overvoltage category III (usable with the earth-neutral system power supply, 400 V class only) and pollution degree 2 or lower specified in IEC 60664.
  - To use the converter under the conditions of pollution degree 2, install it in the enclosure of IP2X or higher.
  - To use the converter under the conditions of pollution degree 3, install it in the enclosure of IP54 or higher.
- On the input and output of the converter, use cables of the type and size set forth in EN 60204-1, IEC 60364-5-52.
- The operating capacity of the relay outputs (terminal symbols A, B, and C) should be 30 VDC, 0.3 A. (Relay output has basic isolation from the converter internal circuit.)
- Control circuit terminals on **page 67**, **page 87**, and **page 108** are safely isolated from the main circuit.

- Environment

	During operation	In storage	During transportation
Surrounding air temperature	-10 to +50°C*1	-20 to +65°C	-20 to +65°C
Ambient humidity	95% RH or less	95% RH or less	95% RH or less
Maximum altitude	2500 m*2	2500 m	10000 m

*1 -10 to +40°C (non-freezing) at the +40°C rating.

*2 For the installation at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.

For the details, refer to the Technical News (MF-S-135).

- Use the fuse listed in the following table.

For the information of the installation location, refer to page 236. (The location is the same as that for UL or cUL certification.)

Multifunction regeneration converter model	Fuse model	Manufacturer	Rating
FR-XC-7.5K	A070URD30TTI0125/ 6.9URD30TTF0125	Mersen	700 V, 125 A
FR-XC-11K	A070URD30TTI0160/ 6.9URD30TTF0160	Mersen	700 V, 160 A
FR-XC-15K	A070URD30TTI0160/ 6.9URD30TTF0160	Mersen	700 V, 160 A
FR-XC-22K FR-XC-18.5K-PWM	A070URD30TTI0250/ 6.9URD30TTF0250	Mersen	700 V, 250 A
FR-XC-30K FR-XC-22K-PWM	A070URD30TTI0315/ 6.9URD30TTF0315	Mersen	700 V, 315 A
FR-XC-37K FR-XC-37K-PWM	A070URD30TTI0350/ 6.9URD30TTF0350	Mersen	700 V, 350 A
FR-XC-55K FR-XC-55K-PWM	A070URD30TTI0500/ 6.9URD30TTF0500	Mersen	700 V, 500 A
FR-XC-H7.5K	A070URD30TTI0050/ 6.9URD30TTF0050	Mersen	700 V, 50 A
FR-XC-H11K	A070URD30TTI0063/ 6.9URD30TTF0063	Mersen	700 V, 63 A
FR-XC-H15K	A070URD30TTI0080/ 6.9URD30TTF0080	Mersen	700 V, 80 A
FR-XC-H22K FR-XC-H18.5K-PWM	A070URD30TTI0125/ 6.9URD30TTF0125	Mersen	700 V, 125 A
FR-XC-H30K FR-XC-H22K-PWM	A070URD30TTI0160/ 6.9URD30TTF0160	Mersen	700 V, 160 A
FR-XC-H37K FR-XC-H37K-PWM	A070URD30TTI0200/ 6.9URD30TTF0200	Mersen	700 V, 200 A
FR-XC-H55K FR-XC-H55K-PWM	A070URD30TTI0315/ 6.9URD30TTF0315	Mersen	700 V, 315 A

◆Short circuit ratings

- 200 V class (FR-XC-[]K)

  Suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 240 V maximum.
- 200 V class (FR-XC-[]K-PWM)

  Suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 230 V maximum.
- 400 V class (FR-XC-H[]K)

  Suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 500Y/290 V maximum.
- 400 V class (FR-XC-H[]K-PWM)

  Suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 480Y/277 V maximum.

◆EU RoHS Directive

We declare that our converters are compliant to the EU RoHS Directive (2011/65/EU) and affix the CE marking on the converters.

Appendix 5 Instructions for UL and cUL

(Standard to comply with: UL 61800-5-1, CSA C22.2 No.274-13)

◆General precaution

The bus capacitor discharge time is 10 minutes. Before starting wiring or inspection, switch power off, wait for more than 10 minutes, and check for residual voltage between terminal P/+ and N/- with a meter etc., to avoid a hazard of electrical shock.

ATTENTION - Risque de choc électrique -

La durée de décharge du condensateur de bus est de 10 minutes. Avant de commencer le câblage ou l'inspection, mettez l'appareil hors tension et attendez plus de 10 minutes.

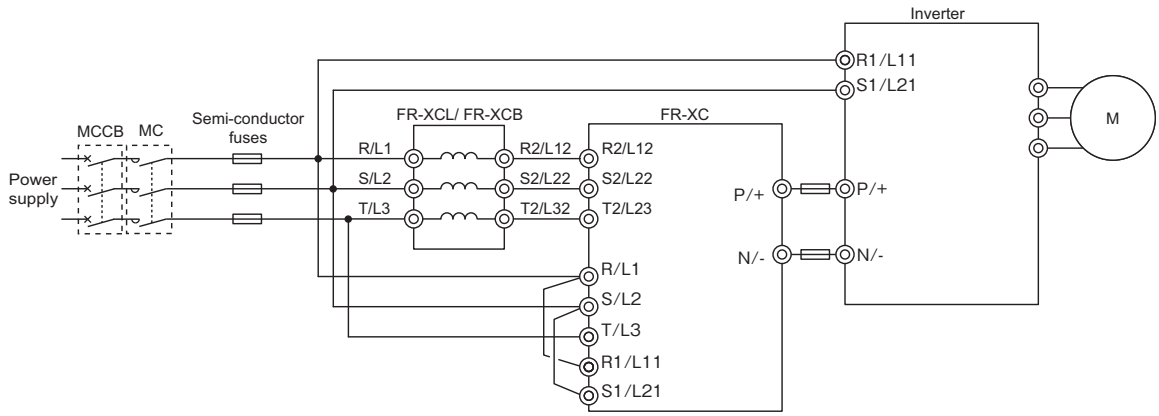
◆Installation

- Multifunction regeneration converter (FR-XC) and its accessories are open type devices which must be installed inside a separate and suitable Type 1 enclosure along with the external components (Input reactors).
- Make the necessary wiring connections in accordance with the NEC for installations in North America, CEC for Canada and any applicable local codes.
- For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code and any applicable local codes.
- For installation in Canada, branch circuit protection must be provided in accordance with the Canada Electrical Code and any applicable provincial codes.
- Always install the following semiconductor fuses for branch circuit protection.
- The semiconductor fuses must be installed in an enclosure (panel) and the panel have to be evaluated to UL 508A.

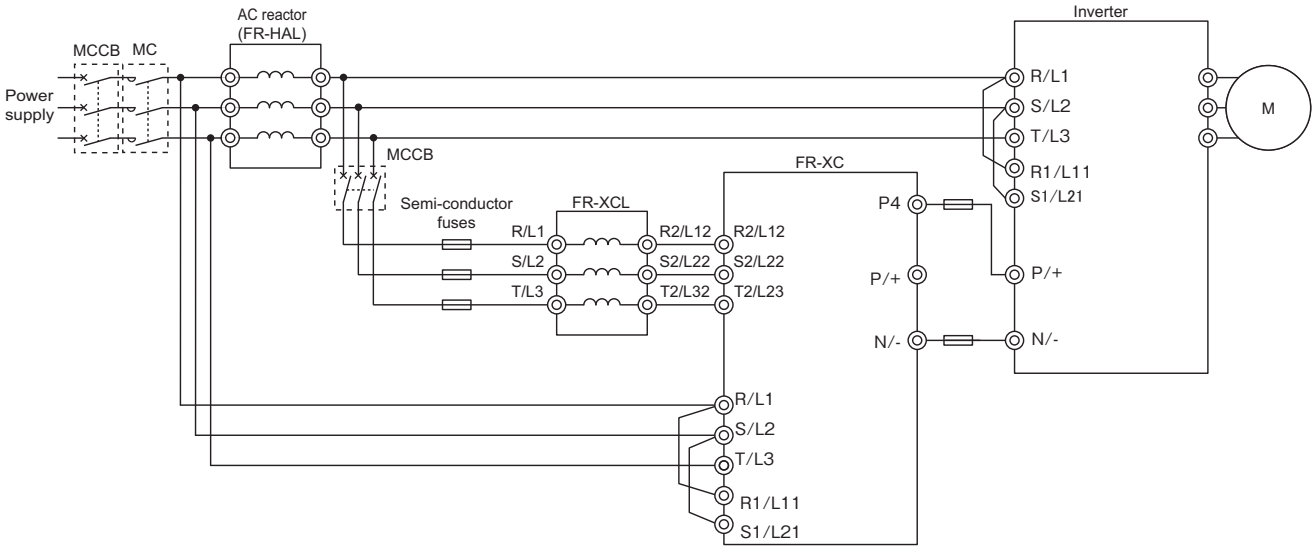
Converter model	Fuse type (Semi-conductor fuse)	Manufacturer	Rating
FR-XC-7.5K	A070URD30TTI0125/ 6.9URD30TTF0125	Mersen	700 V, 125 A
FR-XC-11K	A070URD30TTI0160/ 6.9URD30TTF0160	Mersen	700 V, 160 A
FR-XC-15K	A070URD30TTI0160/ 6.9URD30TTF0160	Mersen	700 V, 160 A
FR-XC-22K FR-XC-18.5K-PWM	A070URD30TTI0250/ 6.9URD30TTF0250	Mersen	700 V, 250 A
FR-XC-30K FR-XC-22K-PWM	A070URD30TTI0315/ 6.9URD30TTF0315	Mersen	700 V, 315 A
FR-XC-37K FR-XC-37K-PWM	A070URD30TTI0350/ 6.9URD30TTF0350	Mersen	700 V, 350 A
FR-XC-55K FR-XC-55K-PWM	A070URD30TTI0500/ 6.9URD30TTF0500	Mersen	700 V, 500 A
FR-XC-H7.5K	A070URD30TTI0050/ 6.9URD30TTF0050	Mersen	700 V, 50 A
FR-XC-H11K	A070URD30TTI0063/ 6.9URD30TTF0063	Mersen	700 V, 63 A
FR-XC-H15K	A070URD30TTI0080/ 6.9URD30TTF0080	Mersen	700 V, 80 A
FR-XC-H22K FR-XC-H18.5K-PWM	A070URD30TTI0125/ 6.9URD30TTF0125	Mersen	700 V, 125 A
FR-XC-H30K FR-XC-H22K-PWM	A070URD30TTI0160/ 6.9URD30TTF0160	Mersen	700 V, 160 A
FR-XC-H37K FR-XC-H37K-PWM	A070URD30TTI0200/ 6.9URD30TTF0200	Mersen	700 V, 200 A
FR-XC-H55K FR-XC-H55K-PWM	A070URD30TTI0315/ 6.9URD30TTF0315	Mersen	700 V, 315 A

[Fuse installation example]

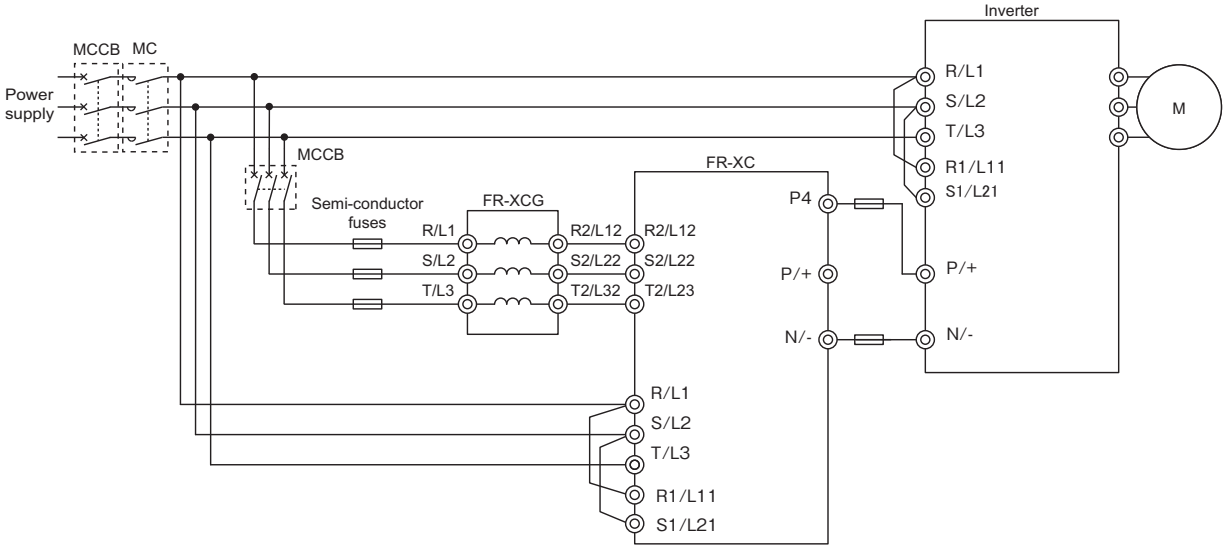
- Common bus regeneration mode / harmonic suppression mode



- Power regeneration mode 1

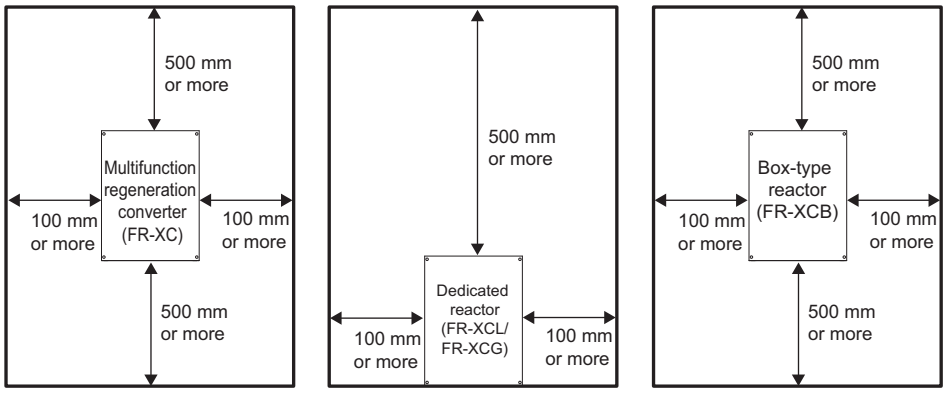


- Power regeneration mode 2



- When designing a Type 1 enclosure for encasing the multifunction regeneration converter, consider its size, cooling fans, ventilation, and installation location, and be sure to monitor the surrounding air temperature of the converter to check that the temperatures are kept under 50°C. Use additional cooling means as necessary.
- Install all appended accessories inside the enclosure.

- Minimum spacing distances inside the enclosure are as follows.



◆Wiring

- Wiring the multifunction regeneration converter to an inverter
  Refer to the National Electrical Code (Article 310) regarding the allowable current of the cable. Select the cable size for 125% of the rated current according to the National Electrical Code (Article 430).
  Use the UL listed copper stranded wire (rated at 75°C) for wiring between an inverter and the multifunction regeneration converter (terminals P/+ and N/-) and between the multifunction regeneration converter and a reactor installed on the input side of the converter (terminals R2/L12, S2/L22, and T2/L32). To wire the terminals, use the UL listed crimp ring terminal employing insulation tubing.
- The FR-XCB reactor is a UL listed option for use only with the following converter. (Refer to page 97.)

FR-XCB model	Applicable converter model
FR-XCB-18.5K	FR-XC-22K FR-XC-18.5K-PWM
FR-XCB-22K	FR-XC-30K FR-XC-22K-PWM
FR-XCB-37K	FR-XC-37K FR-XC-37K-PWM
FR-XCB-55K	FR-XC-55K FR-XC-55K-PWM

FR-XCB model	Applicable converter model
FR-XCB-H18.5K	FR-XC-H22K FR-XC-H18.5K-PWM
FR-XCB-H22K	FR-XC-H30K FR-XC-H22K-PWM
FR-XCB-H37K	FR-XC-H37K FR-XC-H37K-PWM
FR-XCB-H55K	FR-XC-H55K FR-XC-H55K-PWM

◆Short circuit ratings for FR-XC

- 200 V class(FR-XC-[]K)
  Suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 240 V maximum.
- 200 V class(FR-XC-[]K-PWM)
  Suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 230 V maximum.
- 400 V class(FR-XC-H[]K)
  Suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 500Y/290 V maximum.
- 400 V class(FR-XC-H[]K-PWM)
  Suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 480Y/277 V maximum.

Appendix 6 Instructions for EAC

The product certified in compliance with the Eurasian Conformity has the EAC marking.

Note: EAC marking

In 2010, three countries (Russia, Belarus, and Kazakhstan) established a Customs Union for the purposes of revitalizing the economy by forming a large economic bloc by abolishing or reducing tariffs and unifying regulatory procedures for the handling of articles.

Products to be distributed over these three countries of the Customs Union must comply with the Customs Union Technical Regulations (CU-TR), and the EAC marking must be affixed to the products.

For information on the country of origin, manufacture year and month, and authorized sales representative (importer) in the CU area of this product, refer to the following:

- Country of origin indication
  Check the rating plate of the product. (Refer to **page 12**.)
  Example: MADE IN JAPAN
- Manufactured year and month
  Check the SERIAL number indicated on the rating plate of the product. (Refer to **page 12**.)
- Authorized sales representative (importer) in the CU area
  The authorized sales representative (importer) in the CU area is shown below.
  Name: Mitsubishi Electric (Russia) LLC
  Address: 52, bld 1 Kosmodamianskaya Nab 115054, Moscow, Russia
  Phone: +7 (495) 721-2070
  Fax: +7 (495) 721-2071

Appendix 7 Restricted Use of Hazardous Substances in Electronic and Electrical Products

The mark of restricted use of hazardous substances in electronic and electrical products is applied to the product as follows based on the "Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products" of the People's Republic of China.

电器电子产品有害物质限制使用标识要求

环境保护使用期限标识

本产品中所含有的有害物质的名称、含量、含有部件如下表所示。

• 产品中所含有害物质的名称及含量

部品名称*2	有害物质*1					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr (VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
电路板组件 （包括印刷电路板及其构成的零部件，如电阻、电容、集成电路、连接器等）、电子部件	×	○	×	○	○	○
金属壳体、金属部件	×	○	○	○	○	○
树脂壳体、树脂部件	○	○	○	○	○	○
螺丝、电线	○	○	○	○	○	○

上表依据SJ/T11364的规定编制。
○：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。
*1 即使表中记载为×，根据产品型号，也可能会有有害物质的含量为限制值以下的情况。
*2 根据产品型号，一部分部件可能不包含在产品中。

Appendix 8 Referenced Standard (Requirement of Chinese standardized law)

This Product is designed and manufactured accordance with following Chinese standards.

Electrical safety: GB/T 12668.501
EMC: GB/T 12668.3

Appendix 9 Compliance with the UK certification scheme

We declare that this product conforms with the related technical requirements under UK legislation, and affix the UKCA (UK Conformity Assessed) marking on the product. Approval conditions are the same as those for the EU Directives. (Refer to page 233)

UKCA marking:

The UKCA marking is used for products sold in the markets of Great Britain (England, Wales, and Scotland) from January 1, 2021 after the departure of the UK from the EU on January 31, 2020.

Appendix 10 How to check specification changes

Check the SERIAL number indicated on the rating plate or packaging of the converter, the FR-XCB reactor, or other products. For how to read the SERIAL number, refer to page 13.

Appendix10.1 Details of specification changes

◆Connection with the FR-XCB reactor manufactured in October 2020 or later

When the FR-XC is used in harmonic suppression mode, the terminal of the FR-XCB to be connected to terminal SD of the FR-XC depends on the SERIAL number of the FR-XCB.

Connected terminal		SERIAL number of the FR-XCB
FR-XC	FR-XCB	
SD	SD	□ 09 ○○○○○○ or earlier
	FAN2	□ 0X ○○○○○○ or later

MEMO

WARRANTY

When using this product, make sure to understand the warranty described below.

1. Warranty period and coverage

We will repair any failure or defect (hereinafter referred to as "failure") in our FA equipment (hereinafter referred to as the "Product") arisen during warranty period at no charge due to causes for which we are responsible through the distributor from which you purchased the Product or our service provider. However, we will charge the actual cost of dispatching our engineer for an on-site repair work on request by customer in Japan or overseas countries. We are not responsible for any on-site readjustment and/or trial run that may be required after a defective unit are repaired or replaced.

[Term]

The term of warranty for Product is twelve months after your purchase or delivery of the Product to a place designated by you or eighteen months from the date of manufacture whichever comes first ("Warranty Period"). Warranty period for repaired Product cannot exceed beyond the original warranty period before any repair work.

[Limitations]

(1) You are requested to conduct an initial failure diagnosis by yourself, as a general rule. It can also be carried out by us or our service company upon your request and the actual cost will be charged.
However, it will not be charged if we are responsible for the cause of the failure.

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

(3) Even during the term of warranty, the repair cost will be charged on you in the following cases;
- a failure caused by your improper storing or handling, carelessness or negligence, etc., and a failure caused by your hardware or software problem
- a failure caused by any alteration, etc. to the Product made on your side without our approval
- 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
- a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
- any replacement of consumable parts (condenser, cooling fan, etc.)
- 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
- 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
- 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

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 product, its applications should be those that may not result in a serious damage even if any failure or malfunction occurs in product, and a backup or fail-safe function should operate on an external system to product when any failure or malfunction occurs.

(2) Our product 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.

REVISIONS

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

Revision Date	*Manual Number	Revision
Nov. 2017	IB(NA)-0600668ENG-A	First edition
Jan. 2018	IB(NA)-0600668ENG-B	Added • FR-XC-37K, 55K • FR-XC-37K, 55K-PWM • FR-XC-H7.5K to H55K • FR-XC-H18.5K to H55K-PWM • Appendix7 Referenced Standard (Requirement of Chinese standardized law)
Apr. 2018	IB(NA)-0600668ENG-C	Edited • 2.5.1 Inverter selection
Nov. 2019	IB(NA)-0600668ENG-D	Added • Power regeneration mode 2
May 2020	IB(NA)-0600668ENG-E	Added • FR-XC-H75K(-PWM) • Monitor: Cumulative power-driving power, cumulative regenerative power • Pr.455, Pr.456
Sep. 2020	IB(NA)-0600668ENG-F	Edited • Contactor box (FR-MCB) certified as complying with UL Added • Connection diagram (when the MC is used alone)
Nov. 2021	IB(NA)-0600668ENG-G	Edited • Installation orientation of the FR-XCL/FR-XCG reactor Added • Applicable inverter capacity • Connecting terminals P and N to the control circuit power supply in common bus regeneration mode • How to check specification changes
Nov. 2022	IB(NA)-0600668ENG-H	Edited • Chapter structure • Separation by capacity (Deleting the descriptions for the FR-XC-H75K(-PWM))

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Specifications subject to change without notice.