MITSUBISHI ELECTRIC

TRANSISTORIZED INVERTER

FREQROL-HC

HIGH POWER FACTOR CONVERTER

FR-HC-7.5K to 55K

FR-HC-H7.5K to H55K

FREQROL

— INSTRUCTION MANUAL —

Thank you for choosing the Mitsubishi High Power Factor Converter.
This instruction manual gives handling information and precautions for use of this equipment. Incorrect handling might cause an unexpected fault. Before using the inverter, please read this manual carefully to use the equipment to its optimum.
Please forward this manual to the end user.

Safety Instructions

Do not attempt to install, operate, maintain or inspect the unit until you have read through this instruction manual and appended documents carefully and can use the equipment correctly. Do not use the unit until you have a full knowledge of the equipment, safety information and instructions.
In this instruction manual, the safety instruction levels are classified into “WARNING” and “CAUTION”.

⚠ **WARNING**	Assumes that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠ **CAUTION**	Assumes that incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause physical damage only.

Note that the ⚠ **CAUTION** level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.

SAFETY INSTRUCTIONS

1. Electric Shock Prevention

⚠ WARNING

- While power is on or when the equipment is running, do not open the front cover. You may get an electric shock.
- Do not run the equipment with the front cover removed. Otherwise, you may access the exposed high-voltage terminals and charging part and get an electric shock.
- If power is off, do not remove the front cover except for wiring or periodic inspection. You may access the charged circuits of the inverter and high power factor converter and get an electric shock.
- Before starting wiring or inspection, check for residual voltages with a meter etc. more than 10 minutes after power-off.
- This converter must be earthed (grounded). Earthing (grounding) must be conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 536 class 1 and other applicable standards)
- Any person who is involved in the wiring or inspection of this equipment should be fully competent to do the work.
- Always install the equipment before wiring. Otherwise, you may get an electric shock or be injured.
- Operate the switches with dry hands to prevent an electric shock.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise, you may get an electric shock.

2. Fire Prevention

⚠ CAUTION

- Mount the high power factor converter on a non-combustible surface. Installing the equipment directly on or near a combustible surface could lead to a fire.
- Power off the high power factor converter if it has failed. A continuous flow of a large current can cause a fire.
- Do not connect a resistor directly to the DC terminals P, N. This could cause a fire.
- When a brake resistor is used, switch power off if an alarm signal appears on the PU. Otherwise, the brake resistor may excessively overheat due to damage of the brake transistor, etc., causing a fire.

3. Injury Prevention

⚠ CAUTION

- Apply only the voltage specified in the instruction manual to each terminal to prevent burst, damage, etc.
- Ensure that the cables are connected to the correct terminals. Otherwise, burst, damage, etc. may occur.
- Always make sure that polarity is correct to prevent burst, damage, etc.
- While power is on or for some time after power-off, do not touch the inverter, high power factor converter, reactors 1 and 2, or the external box as they are hot and you may get burnt.

4. Additional instructions

To prevent injury, damage or product failure, please note the following points.

(1) Transportation and mounting

⚠ CAUTION

- Please use common sense when carrying the product. Not doing so can cause injury.
- Do not stack the equipment higher than the number recommended.
- Install the product in a load-bearing place in accordance with the instruction manual.
- Do not operate if the high power factor converter is damaged or has parts missing.
- Do not lift the equipment with the front cover attached; it may fall off.
- Do not stand or rest heavy objects on the product.
- Check the equipment mounting orientation is correct.
- Prevent any dust, wire fragments or other foreign bodies from dropping into the high power factor converter.
- Do not drop the high power factor converter, or subject it to impact.
- Use the equipment under the following environmental conditions:

Environment	Ambient temperature	-10°C to +50°C (non-freezing) (-10°C to +40°C when the dust-protection structure attachment is used)
	Ambient humidity	90%RH or less (non-condensing)
	Storage temperature	-20°C to +65°C*
	Ambience	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
	Altitude, vibration	Maximum 1000m above sea level for standard operation. After that derate by 3% for every extra 500m up to 2500m (91%). 5.9m/s^2 or less

*Temperatures applicable for a short time, e.g. in transit.

(2) Trail run

⚠ CAUTION

- Check all parameters, and ensure that the machine will not be damaged by sudden start-up.
- Before starting operation, ensure that each peripheral device is wired properly. Incorrect connection may lead to unexpected operation.

(3) Operation

⚠ CAUTION

- The load used must be a three-phase induction motor. If any other electrical equipment is connected to the inverter output, the equipment may be damaged.
- Do not modify the equipment.

(4) Emergency stop

⚠ CAUTION

- Provide a safety backup such as an emergecy brake which will prevent the machine and equipment from hazardous conditions if the high power factor converter fails.
- When any protective function is activated, take the corresponding corrective action, then reset the inverter, and resume operation.

(5) Maintenance, inspection and parts replacement

⚠ CAUTION

- Do not carry out a megger (insulation resistance) test on the control circuit of the high power factor converter.

(6) Disposal

⚠ CAUTION

- Treat the equipment as industrial waste.

(7) General instructions

Many of the diagrams and drawing in this instruction manual show the equipment without a cover, or partially open. Never run the inverter like this. Always replace the cover and ensure adequate cooling, etc. before using the product.

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2. PARAMETERS

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4. PRECAUTIONS FOR SELECTION

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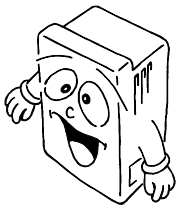
APPENDIX

1. OVERVIEW

This chapter provides an “overview” of this product.
Always read the precautions, etc. before starting use.

1.1 PRECAUTIONS FOR OPERATION

Incorrect handling might cause the equipment to operate improperly, its life to be reduced considerably, and in the worst case, the high power factor converter and inverter to be damaged. Please handle the unit properly in accordance with the information on each section as well as the precautions and instructions of this manual.



FR-HC Function

The FR-HC high power factor converter provides three functions

1) Inverter generated mains harmonics reduction
   See the Power harmonic guideline section below.
2) Near unity power factor at 100% load
   Gives better efficiency and lower stress on power line components.
3) Regeneration of load to the mains power supply
   The FR-HC can continuously regenerate converter rated current to the power supply, for example from a 'back-driving' load such as a down escalator. This gives very efficient full 4-quadrant control of the AC motor from the inverter without the need for brake resistors or braking units etc.

1.1.1 Japanese harmonic suppression guideline

Harmonic currents flow from the inverter to a power receiving point via a power transformer. The harmonic suppression guideline was established to protect other consumers from these outgoing harmonics.

1) "Harmonic suppression guideline for household appliances and general-purpose products"
   200V class inverters of 3.7kW and less are covered by this guideline. Install a power factor improving reactor to comply with this guideline.
2) "Harmonic suppression guideline for specific consumers"
   This guideline sets forth the maximum values of harmonic currents outgoing from a high-voltage or specially high-voltage 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.

Table 1 Maximum Values of Outgoing Harmonic Currents per 1kW Contract Power

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

(1) Application of the harmonic suppression guideline for specific consumers

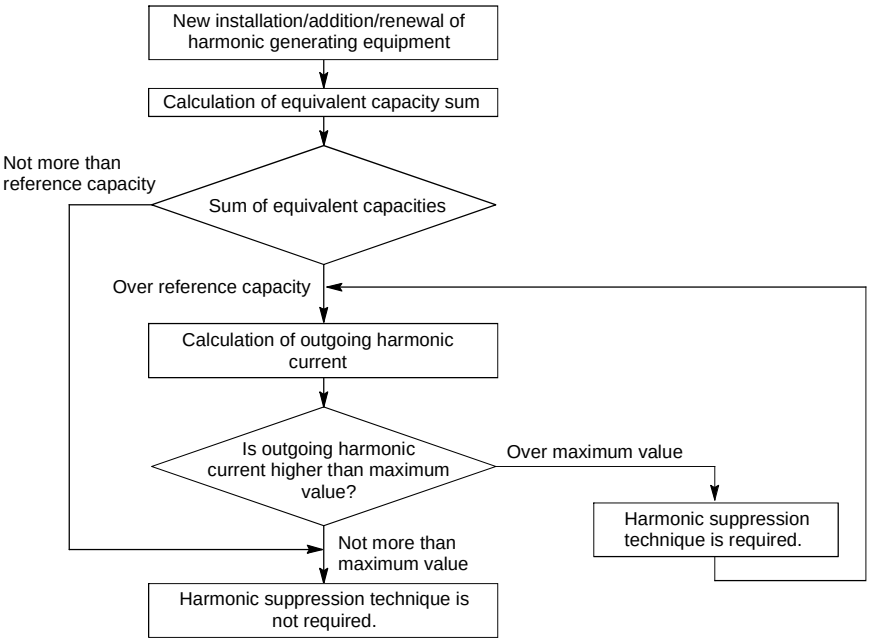


Table 2 Conversion Factors for FR-A500 Series

Classification	Circuit Type		Conversion Factor
3	Three-phase bridge (Capacitor smoothed)	Without reactor	K31=3.4
		With reactor (on AC side)	K32=1.8
		With reactor (on DC side)	K33=1.8
		Without reactor (on AC/DC side)	K34=1.4
5	Self-excited three-phase bridge	When high power factor converter is used	K5=0

Table 3 Equivalent Capacity Limits

Received Power Voltage	Reference Capacity
6.6kV	50kVA
22/23kV	300kVA
66kV or more	2000kVA

Table 4 Harmonic Content (Values at the fundamental current of 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

1) Calculation of equivalent capacity P0 of harmonic generating equipment
The “equivalent capacity” is the capacity of a 6-pulse converter converted from the capacity of a consumer’s harmonic generating equipment and is calculated with the following equation. If the sum of equivalent capacities is higher than the limit in Table 3, harmonics must be calculated in the following procedure:

$P0 = \Sigma(Ki \times Pi)$ [kVA]

Ki: Conversion factor (refer to Table 2)
Pi: Rated capacity of harmonic generating equipment* [kVA]
i: Number indicating the conversion circuit type

* Rated capacity: Determined by the capacity of the applied motor and found in Table 5. It should be noted that the rated capacity used here is used to calculate generated harmonic amount and is different from the power supply capacity required for actual inverter drive.

2) Calculation of outgoing harmonic current

$$\text{Outgoing harmonic current} = \text{fundamental wave current (value converted from received power voltage)} \times \text{operation ratio} \times \text{harmonic content}$$

- Operation ratio: Operation ratio = actual load factor × operation tim ratio during 30 minutes
- Harmonic content: Found in Table 4.

Table 5 Rated Capacities and Outgoing Harmonic Currents for Inverter Drive

Applied Motor (kW)	Rated Current [A]		Fundamental Wave Current Converted from 6.6kV (mA)	Rated Capacity (kVA)	Fundamental Wave Current Converted from 6.6kV(mA) (No reactor, 100% operation ratio)							
	200V	400V			5th	7th	11th	13th	17th	19th	23rd	25th
0.4	1.61 (Note)	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 (Note)	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 (Note)	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 (Note)	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 (Note)	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

Note:When a motor of 3.7kW or less capacity is driven by a transistorized inverter of more than 3.7kW. For example, when a 3.7kW or less motor is driven by a 5.5kW transistorized inverter, the transistorized inverter is not the target of the household appliances/general-purpose products guideline, but because they must be included in the calculation of the harmonic current of the guideline, the fundamental wave input currents are indicated.

3) Harmonic suppression technique requirement
If the outgoing harmonic current is higher than the maximum value per 1kW contract power × contract power, a harmonic suppression technique is required.

4) Harmonic suppression techniques

No.	Item	Description
1	Reactor installation (ACL, DCL)	Install a reactor (ACL) in the AC side of the inverter or a reactor (DCL) in its DC side or both to suppress harmonic currents.
2	High power factor converter (FR-HC)	Designed to switch the converter circuit on-off to convert an input current waveform into a sine wave, the high power factor converter (FR-HC) suppresses harmonic current considerably. The FR-HC is used with the standard accessories.
3	Installation of power factor improving capacitor	When used with a series reactor, the power factor improving capacitor has an effect of absorbing harmonic currents.
4	Transformer multi-phase operation	Use two transformers with a phase angle difference of 30° as in ⅄-Δ, Δ-Δ combination to provide an effect corresponding to 12 pulses, reducing low-degree harmonic currents.
5	AC filter	A capacitor and a reactor are used together to reduce impedance at specific frequencies, producing a great effect of absorbing harmonic currents.
6	Active filter	This filter detects the current of 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 a harmonic current at a detection point, providing a great effect of absorbing harmonic currents.

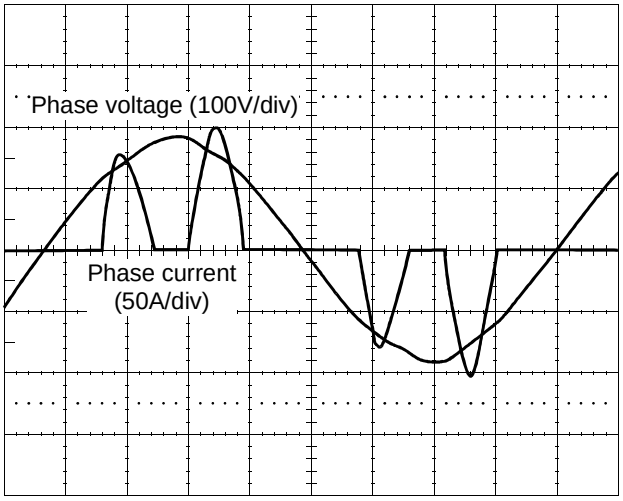
(2) Features of the FR-HC (high power factor converter)

The converter circuit of an inverter generates power harmonics, which may affect a generator, power capacitor, etc. Power harmonics are different from noises and leakage currents in their sources, frequency bands and transmission routes. Therefore, securely connect the high power factor converter (FR-HC) with the FR series inverter, and refer to the inverter instruction manual on how to set the parameters. The conversion factor of the high power factor converter is K5=0 for a self-excited, three-phase bridge circuit:

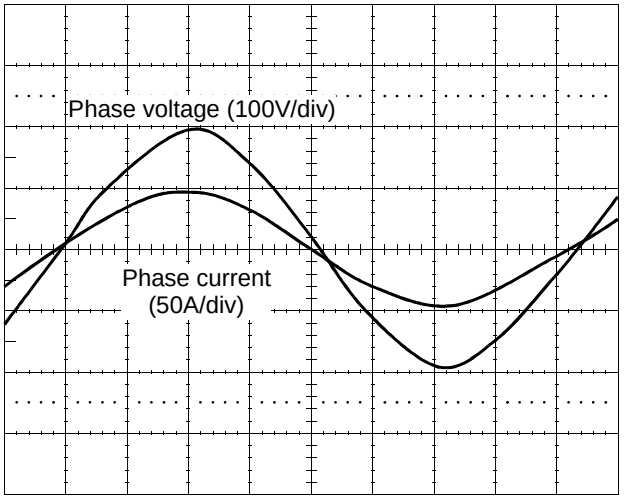
Making the above settings suppresses power harmonics to conform to the harmonic suppression guidelines published by the Ministry of International Trade and Industry.

- Power harmonic suppression effect
  (Example) FR-HC-7.5K
  (Environment) Load: 100%
  Power factor: 1

[FR-HC not connected]



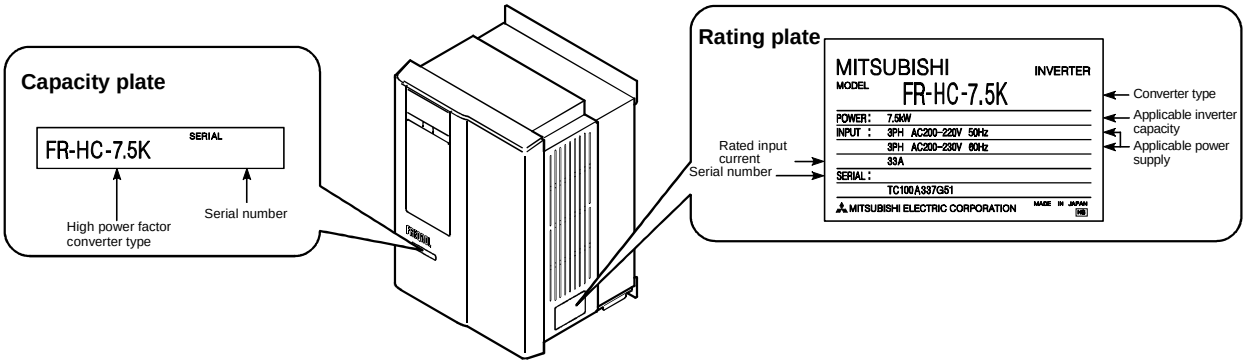
[FR-HC connected]



1.1.2 Pre-operation procedure

1. Unpacking and product check

Unpack the product and check the capacity plate on the front cover and the rating plate on the equipment side face to ensure that the type and output rating agree with your order and the product is intact.
When using reactors 1, 2 and the external box, especially when they are used with the Mitsubishi transistorized inverter be sure to use them as a set and make sure they are securely connected. This high power factor converter suppresses harmonics according to the harmonic suppression guidelines published by Ministry of Economy Trade and Industry (formerly Ministry of International, Trade and Industry). Pay attention to the applicable capacity, etc.



- **Definition of the high power factor converter type**

FR-HC- □ □ K

Symbol	Voltage class
None	200V class
H	400V class

Symbol	Applicable inverter capacity
7.5 to 55	Capacity in "kW"

- **Confirmation of the peripheral device types**

The following three peripheral devices, FR-HCL01, FR-HCL02 and FR-HCB, must be installed. Confirm their types:

High Power Factor Converter	Reactor 1	Reactor 2	External Box
FR-HC-7.5K	FR-HCL01-7.5K	FR-HCL02-7.5K	FR-HCB-7.5K
FR-HC-15K	FR-HCL01-15K	FR-HCL02-15K	FR-HCB-15K
FR-HC-30K	FR-HCL01-30K	FR-HCL02-30K	FR-HCB-30K
FR-HC-55K	FR-HCL01-55K	FR-HCL02-55K	FR-HCB-55K

Note: 400V class devices have capacity numbers preceded by H in their type codes.

- **Accessory . . . . . Instruction manual**

If you have found any discrepancy, damage, etc., please contact your sales representative.

2. Installation

To operate the product with high performance for a long time, install it in a proper place, in a correct direction, and with proper clearances. (See page 13.)

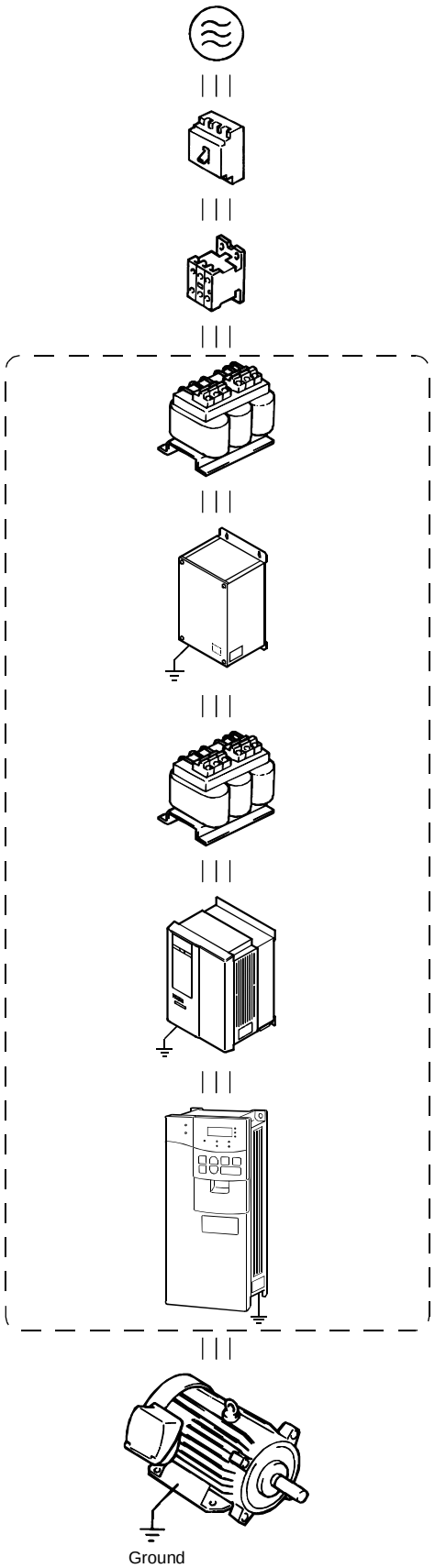
3. Wiring

Securely connect the power supply, reactors 1, 2, external box, high power factor converter and inverter to the terminal blocks.
If they are connected improperly, the peripheral devices and the high power factor converter itself may be damaged. (See page 16.)
After making sure that the wiring is secured, refer to the inverter instruction manual on how to set the parameters.

Note: If the inverter is provided with a jumper connector for sink and source logic change, fit the jumper connector to the sink logic (factory setting) when connecting a high power factor converter (FR-HC). If the jumper connector is fitted to the source logic, the converter cannot be connected.

1.1.3 Handling precautions

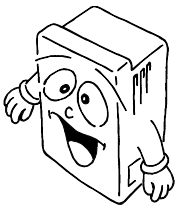
The following system is required to operate the inverter. Install the high power factor converter in a proper position. For the selection and specifications of each peripheral device, refer to “Precautions for Selecting Peripheral Devices” on page 52:



Name	Description	Refer to Page:
Power supply	Use the power supply within the permissible power supply specifications of the high power factor converter.	56
Earth leakage circuit breaker or no-fuse breaker	The breaker should be selected with care since a large inrush current flows in the high power factor converter at power on.	55
Magnetic contactor	Install the magnetic contactor to ensure safety. When installed, do not use it to start or stop the inverter. It might reduce the high power factor converter life.	55
Reactor 1 FR-HCL01	Make sure that the reactor has a proper capacity which matches the high power factor converter capacity.	62
External box FR-HCB	Make sure that the external box has a proper capacity which matches the high power factor converter capacity.	64
Reactor 2 FR-HCL02	Make sure that the reactor has a proper capacity which matches the high power factor converter capacity.	62
High power factor converter	Install and wire the equipment correctly. Note: Do not install a no-fuse breaker (NFB) across terminals P-P and N-N of the high power factor converter and the inverter.	13
Inverter	Make sure that the inverter is compatible with the FR-HC. Connect the inverter suitable for the capacity of the high power factor converter.	56
Devices connected to the output	Do not connect a power capacitor, surge suppressor or radio noise filter to the output side. Note: When installing a no-fuse breaker (NFB) on the output side, contact the NFB manufacturer for selection of no-fuse breaker.	Instruction manuals of the devices connected on the output side
Motor	Connect the motor suitable for the capacity.	Inverter instruction manual
Ground	To prevent an accidental electric shock, always ground the high power factor converter, external box, inverter and motor.	Inverter instruction manual

1.2 STRUCTURE

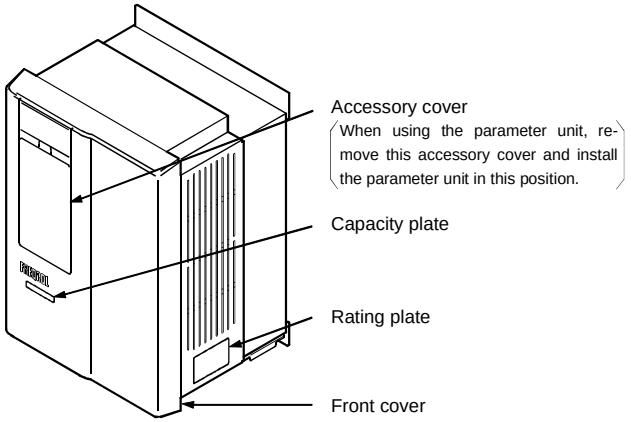
This section covers the structure, installation and removal of the equipment.
In this manual, equipment parts are described with the following names.

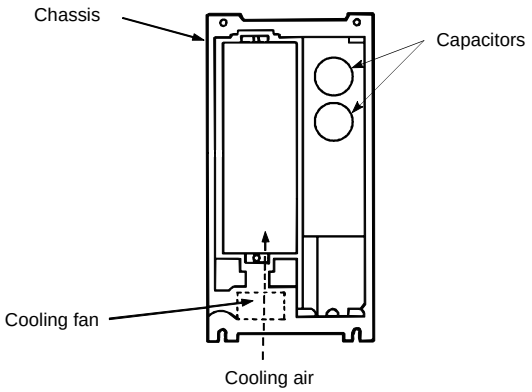


1.2.1 Structure

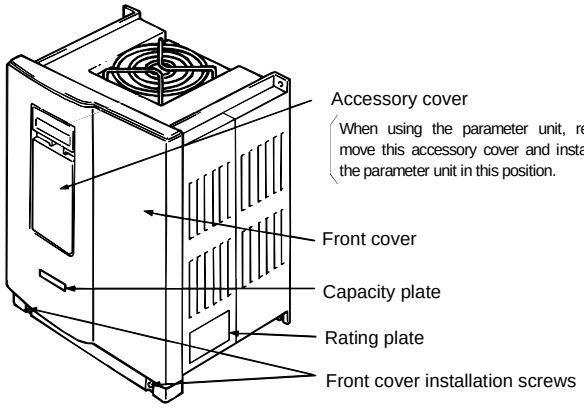
The high power factor converter models have the following parts as shown below.
For the location of the charge lamp, refer to “Terminal block arrangement” on page 60.

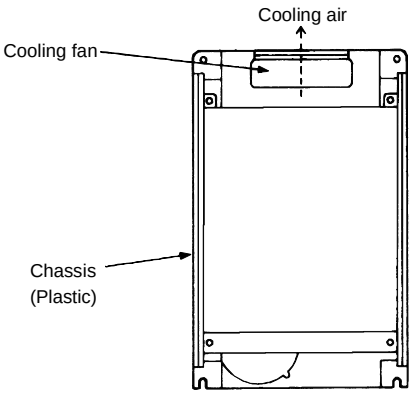
■ FR-HC-7.5K/H7.5K



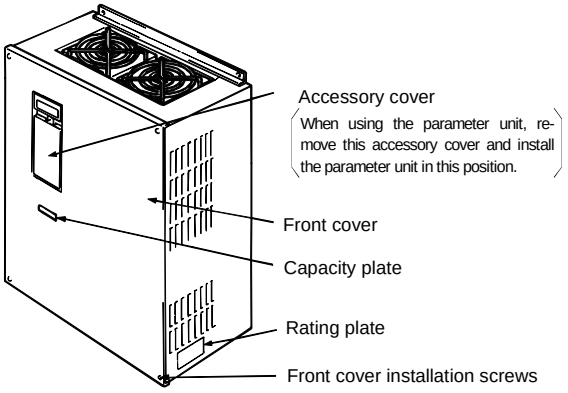


■ FR-HC-15K/H15K





■ FR-HC-30K, 55K/H30K, H55K

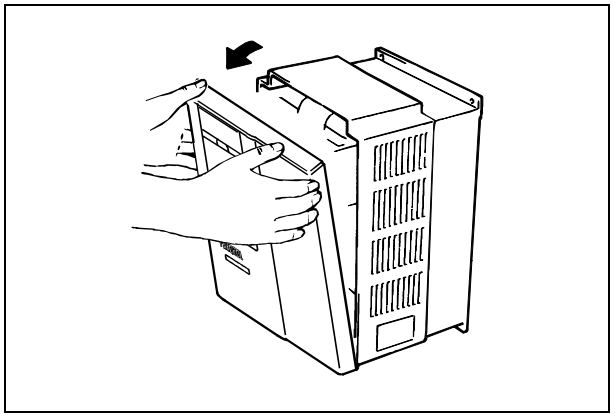


Note:Dimensions vary with the capacity. For full information, refer to “Outline Dimension Drawings” on page 61.

1.2.2 Removal and reinstallation of the front cover

■ FR-HC-7.5K/H7.5K

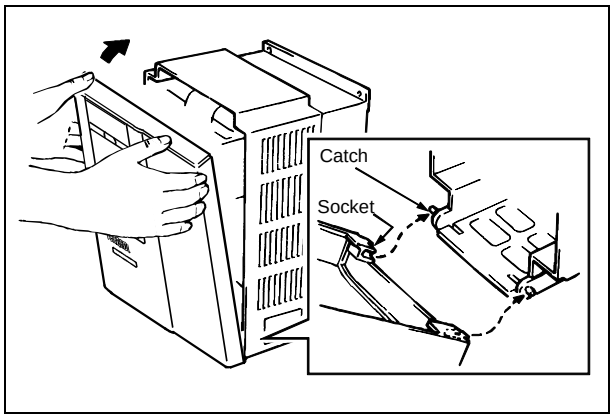
- **Removal**



1) Hold both sides of the front cover top.
2) Pull the cover toward you.

(The cover may be removed with the parameter unit on.)

- **Reinstallation**

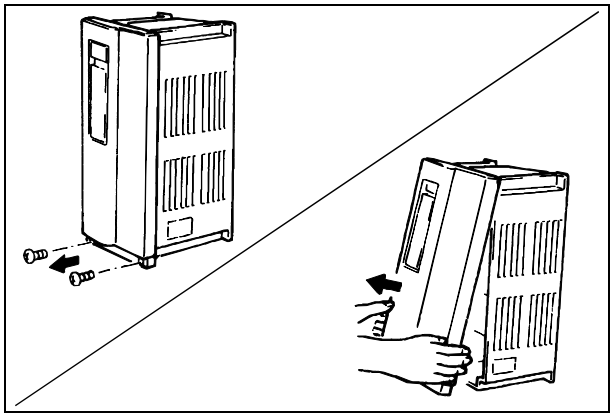


1) Fit the sockets at the cover bottom onto the catches of the inverter.
2) Using the catches as supports, securely press the cover against the inverter.

(The cover may be reinstalled with the parameter unit on.)

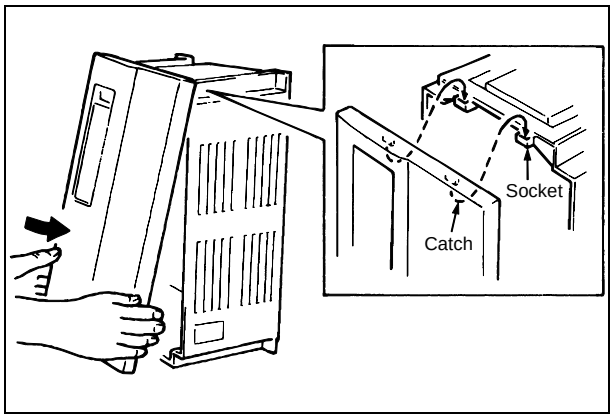
■ FR-HC-15K/H15K

• **Removal**

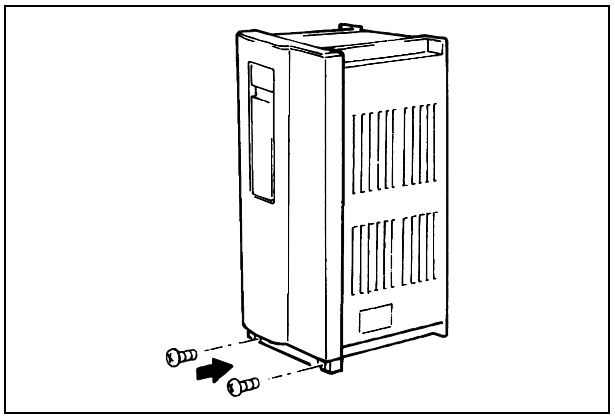


1) Remove the two installation screws at the bottom of the front cover.
2) Hold both ends of the front cover bottom and pull the cover toward you

• **Reinstallation**



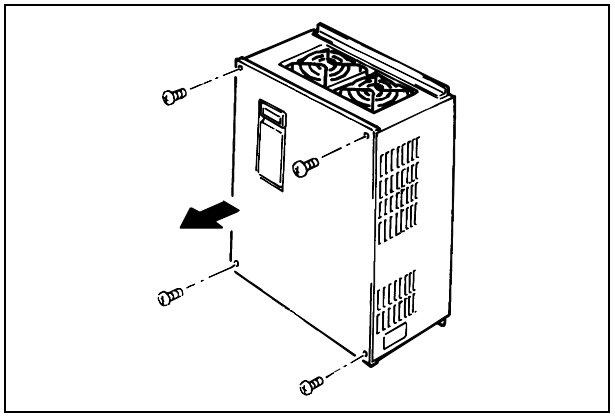
1) Fit the catches on the inside of the front cover top into the sockets of the inverter.
2) Securely press the cover against the inverter.



3) Fix the cover with the bottom installation screws.

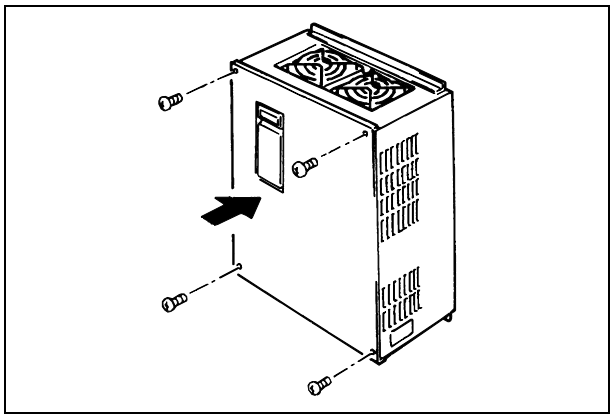
■ FR-HC-30K, 55K/H30K, H55K

• **Removal**



1) Remove the front cover installation screws.

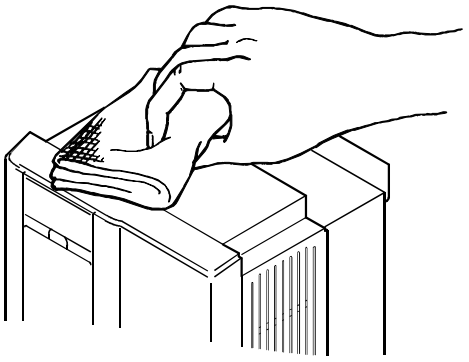
• **Reinstallation**



1) Attach the front cover with the installation screws.

Note: 1.Fully check that the front cover has been reinstalled securely.
2.The serial number is printed on both the capacity plate on the front cover and the rating plate on the high power factor converter side face. Before reinstalling the front cover, check the serial numbers are the same.
Example:
Capacity plate A46152
Rating plate A46152 001
3-digit serial number

If the high power factor converter surface is stained with fingermarks, oil, etc. during removal and/or reinstallation work, gently clean it with a cloth soaked with a neutral detergent or ethanol.

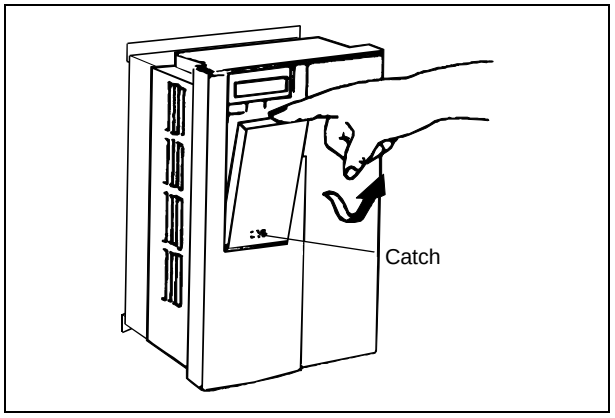


Note: 1.Do not use any solvent, such as acetone, benzene, toluene and alcohol, that will cause the high power factor converter surface to dissolve and the paint to peel.
2. Do not clean the lens of the high power factor converter's power lamp with a detergent or alcohol.

1.2.3 Removal and reinstallation of the accessory cover

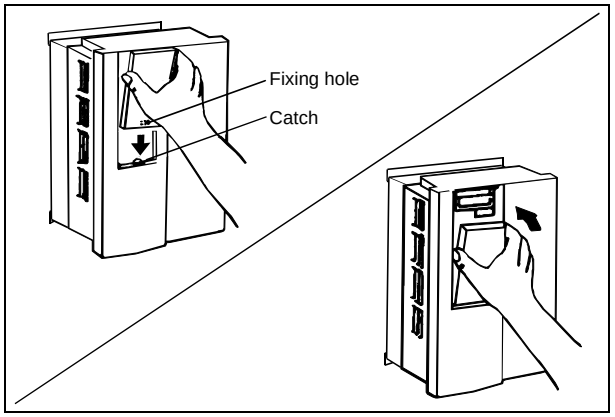
To ensure safety, remove and reinstall the accessory cover after switching the power off.

- **Removal**



1) As in the removal of the parameter unit, hold down the top and pull the accessory cover toward you, using the catch as a support.

- **Reinstallation**

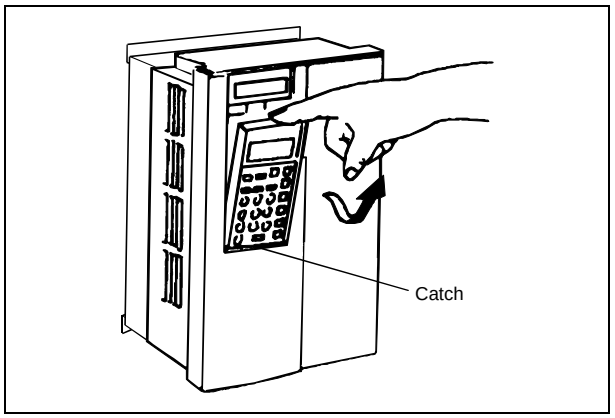


1) After fitting the fixing hole onto the catch of the cover, push it into the inverter.

1.2.4 Removal and reinstallation of the parameter unit (FR-PU02)

To ensure safety, remove and reinstall the parameter unit after switching the power off.

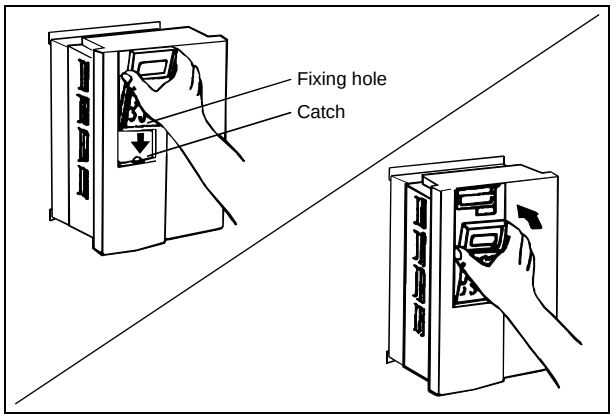
■ Removal



1) Hold down the top button of the parameter unit and pull the parameter unit toward you, using the catch as a support.

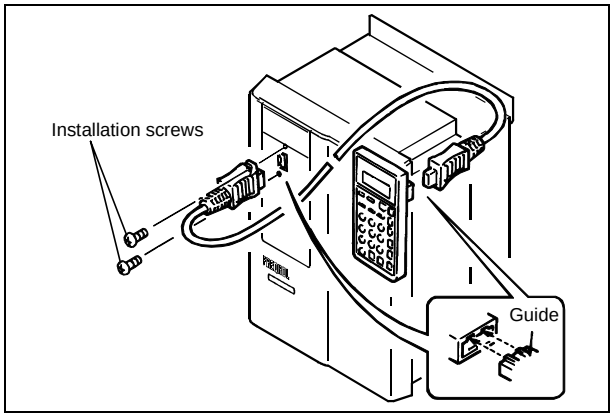
■ Reinstallation

- **Direct installation onto the high power factor converter**



1) After fitting the fixing hole of the parameter unit (PU) on the catch of the cover, confirm the connector position and push the parameter unit into the inverter, using the catch as a support.

- **Installation using the cable (FR-CBL□□)**

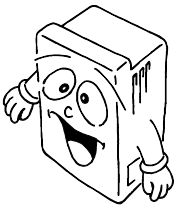


1) Securely insert one connector of the cable into the connector of the high power factor converter and the other cable connector into the PU connector. Insert the cable connector along the guides. (If the orientation is incorrect, the high power factor converter may be damaged.)
2) After plugging the cable connector into the high power factor converter connector, fix it securely with the installation screws.

Note: 1. The parameter unit must only be installed on the high power factor converter when the front cover is fitted.
2. During installation, do not apply force to the display (liquid crystal).

1.3 INSTALLATION AND WIRING

Incorrect handling might cause the equipment to operate improperly, its life to be reduced considerably, and in the worst case, the high power factor converter and inverter to be damaged. Please handle the unit properly in accordance with the information on each section as well as the precautions and instructions of this manual.

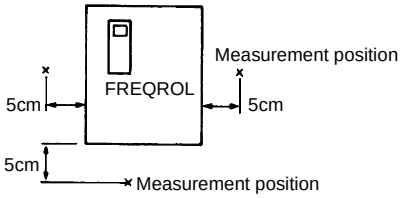


1.3.1 Precautions for installation

(1) Installation of the high power factor converter

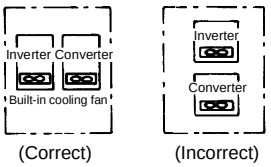
Instructions for ambient temperatures

The lives of the high power factor converter and reactors 1, 2 are affected considerably by ambient temperatures. Keep their ambient temperatures below the permissible value (50°C). Measure the ambient temperatures in the following positions to make sure that they are within the permissible range.:

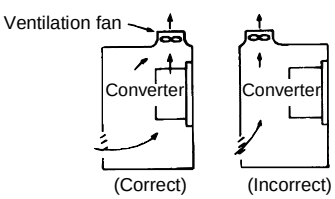


Note: 1. When the high power factor converter is installed in a panel, determine the cooling method and panel dimensions so that the ambient temperature of the high power factor converter is within the permissible range (specified value is given on page 56).

2. When the inverter and high power factor converter are installed in the same panel or a ventilation fan is mounted in the panel, extreme care must be taken to keep the ambient temperatures of the high power factor converter and inverter below the permissible value. If the high power factor converter, inverter and/or ventilation fan is installed in an improper position, the ambient temperature of the high power factor converter will rise and ventilation effects will reduce.



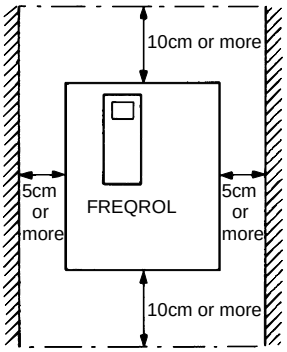
Installation of Converter and Inverter

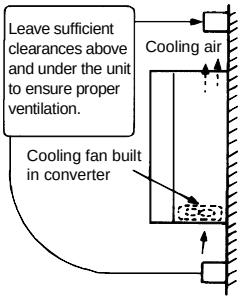


Position of Ventilation Fan

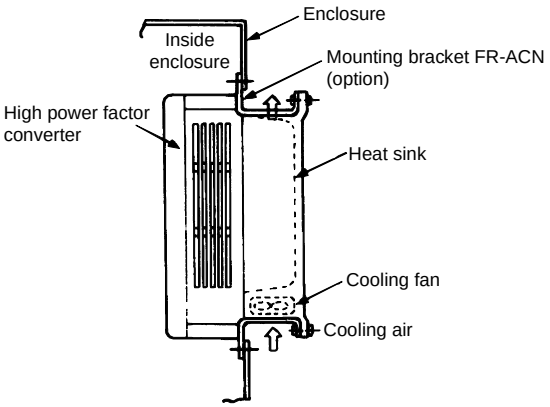
Leave sufficient space around the equipment.

For adequate heat dissipation, leave sufficient space around the high power factor converter.





It is possible to place the heat sink outside the enclosure to greatly reduce heat generated.



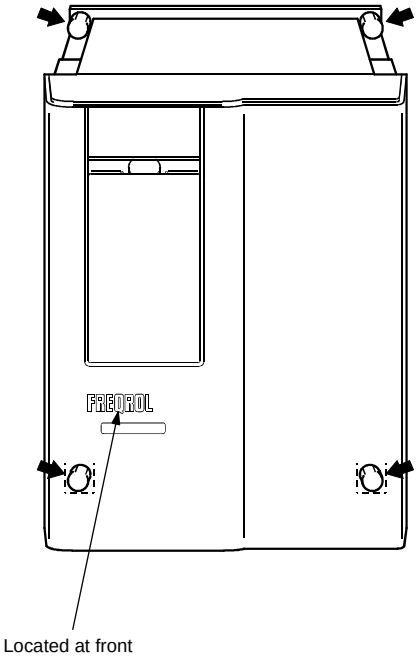
Note: 1. Use the optional mounting bracket (FR-ACN) (see page 70). The mounting area should be machined to the panel cutting dimensions on page 66.

2. The cooling section outside the panel has a cooling fan. Do not use the inverter in damp, oil mist or dust environments.

Bolt the unit securely and vertically.

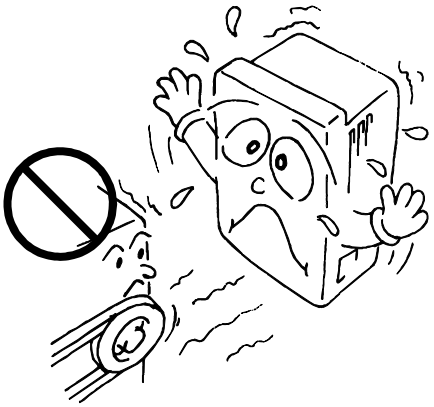
Install the high power factor converter on a surface securely and vertically (so that the letters FREQROL are located at the front) with screws or bolts.

Note: Horizontal or side installation may cause the high power factor converter to fail. Always install the unit vertically.



Install the inverter where it is not subjected to vibration.

Also take the vibration of a trolley, press, etc. into consideration.

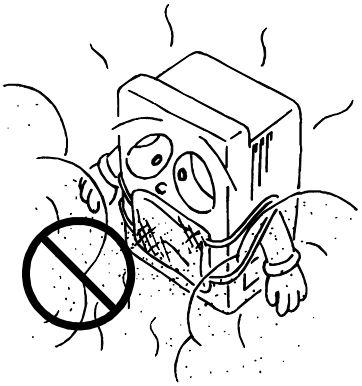


Install the unit on a non-combustible surface.

Install the high power factor converter on a non-combustible. If it is installed directly on or near a combustible, a fire may take place.

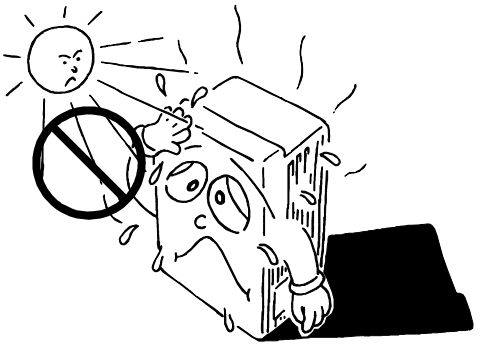
Avoid places where the equipment is subjected to oil mist, flammable gases, fluff, dust, dirt, etc.

Install the unit in a clean place or inside an “enclosure” which does not accept any suspended matter.



Avoid high temperature and high humidity.

Avoid direct sunlight, heat and humidity.

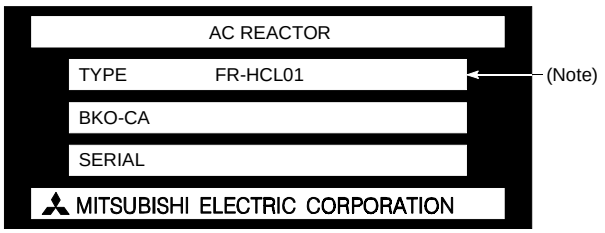


(2) Installation of the reactors 1, 2 and external box

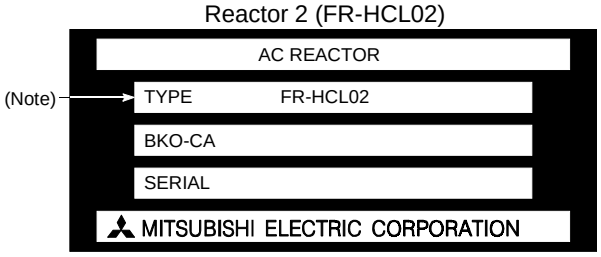
Confirm the types.

Note the types of the reactor 1 (FR-HCL01) and reactor 2 (FR-HCL02) look alike in outline.

Reactor 1 (FR-HCL01)



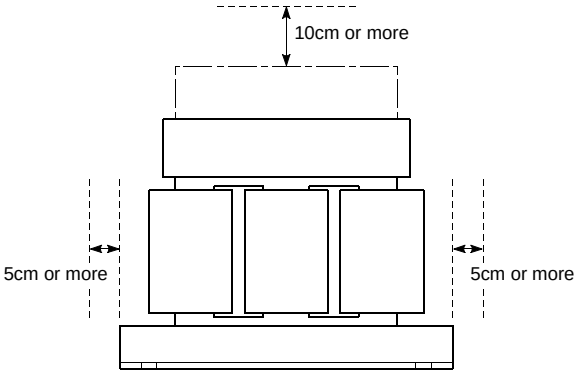
Reactor 2 (FR-HCL02)



Note: For the reactor 1 (FR-HCL01) and reactor 2 (FR-HCL02), check the "TYPE" in the above rating plates.

Instructions for ambient temperatures

For adequate heat dissipation, leave sufficient space around the reactor 1 (FR-HCL01) and reactor 2 (FR-HCL02).



Install the equipment on a non-combustible surface.

Install the reactor 1 (FR-HCL01) and reactor 2 (FR-HCL02) on a non-combustible. Direct installation on a combustible may cause a fire.

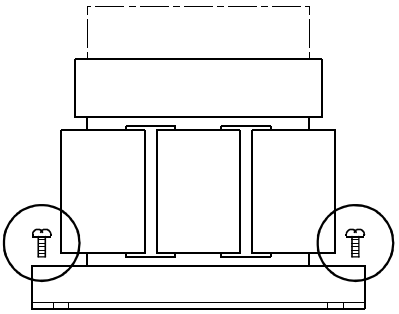
Avoid places where the equipment is subjected to oil mist, flammable gases, fluff, dust, dirt, etc.

Install the equipment in a clean place or protect them from suspended matter.

Bolt the reactors securely and horizontally.

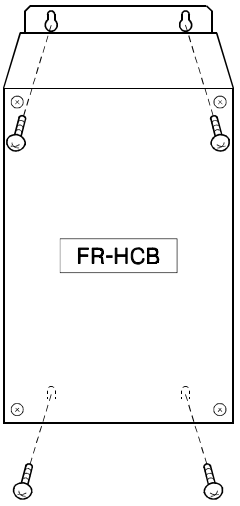
To prevent looseness, install the reactor 1 (FR-HCL01) and reactor 2 (FR-HCL02) on a surface securely and horizontally with screws or bolts.

Note: Avoid vertical or side installation and install them on a mounting stand which can withstand their weights.



Install the external box (FR-HCB) vertically.

Note: Install it vertically. Horizontal or side installation may lead the external box to a failure.



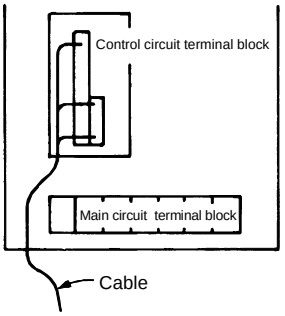
Note: Since the charged sections of the reactor 1, reactor 2 and external box are uncovered, fully protect them to prevent ground fault and electric shock.

1.3.2 Wiring instructions

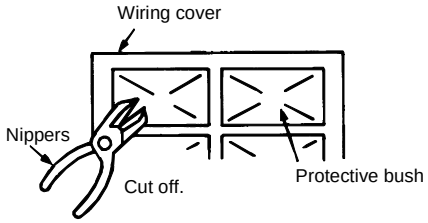
During wiring, do not leave wire off-cuts in the high power factor converter and external box.

Wire offcuts will cause a malfunction, failure or fault. The high power factor converter should always be kept clean.

Use the space on the left-hand side of the main circuit terminal block to run the control circuit cable.

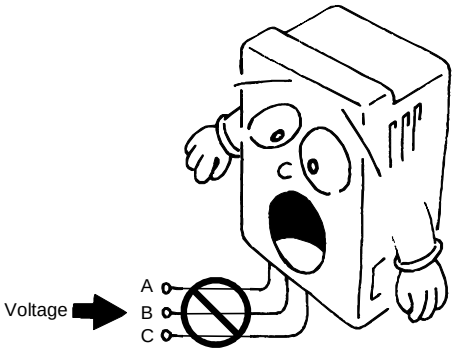


Cut off the wiring cover (protective bush) windows using nippers or a cutter when running the cables. (FR-HC-7.5K/H7.5K)



Do not apply a voltage directly to the alarm output signal terminals (A, B, C).

Always apply a voltage via a relay coil, lamp, etc. to these terminals.

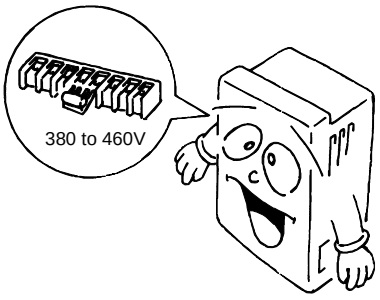


Before starting wiring or inspection, switch power off, make sure that the converter LED indicator has gone off, wait for at least 10 minutes after the charge lamp on the printed circuit board has gone off.

For some short time after power-off, there is a dangerous voltage in the capacitor. Start work about 10 minutes after ensuring that the charge lamp is off.

When the power supply voltage is special for the high power factor converter (the rated input voltage is exceeded), change the connection of the jumper in the internal transformer. (FR-HC-H7.5K H15K, H30K, H55K)

If the connection is not changed, the 400V class high power factor converter may be heated, resulting in fault or burnout.
For the FR-HC-H7.5K, change the connection of the jumper in the internal transformer in the external box.



The cable size for connection to the control circuit terminals should be 0.75mm^2 or less.

If the cable size used is 1.25mm^2 or more, the front cover may expand, resulting in a contact fault of the parameter unit. This fault is indicated by the following message displayed on the parameter unit and disables operation from the parameter unit. Run the cables so that they do not occupy much of the control box terminal block space.

Parameter unit display

PU to Inverter comms. Error Inv. Reset ON

Use shielded or twisted cables for connection to the control circuit terminals.

Run them away from the main and power circuits (such as the 200V relay sequence circuit).

Note: Connect the sheath of the shielded cable to terminal SD.

1.3.3 Wiring of the main circuit

- The high power factor converter (FR-HC) is a high-power factor, low-noise inverter option unit designed for use with the transistorized inverters (FR-HC compatible models) in accordance with the harmonic suppression guidelines published by Ministry of Economy Trade and Industry (formerly Ministry of International, Trade and Industry). This high power factor converter is used for the suppression of harmonics to an input power supply.
- To comply with the harmonic suppression guidelines published by the MITI, the system needs to be configured as indicated and make sure that terminals P and N are sacurely connected to terminals P and N of the inverter. An incorrect connection will cause the high power factor converter to display an alarm or to be faulty or damaged.
- Refer to the inverter instruction manual on how to wire the system to suppress harmonics to the input power supply. Especially note the wiring distance and cable size.

(1) Cable, Crimping terminals etc.

The following table lists the cables and crimping terminals used for each of the devices of the High power factor converter system and the torques for tightening the screws:

Type	Terminal screw size	Tightening torque N·m *3	Crimping terminal *2		Cables				PVC insulated Cables	
					mm^2		AWG *1		mm^2 *4	
			R4, S4, T4	P, N	R4, S4, T4	P, N	R4, S4, T4	P, N	R4, S4, T4	P, N
FR-HC-7.5K	M4	1	8-4	8-4	8	8	8	8	6	6
FR-HC-15K	M6	4	22-6	22-6	22	22	4	4	16	16
FR-HC-30K	M8	7	60-8	60-8	60	60	1/0	1/0	50	50
FR-HC-55K	M12	24	150-12	150-12	150	150	MCM 300	MCM 300	–	–
FR-HC-H7.5K	M4	1	3.5-4	3.5-4	3.5	3.5	12	12	4	4
FR-HC-H15K	M6	4	8-6	8-6	8	8	8	8	10	10
FR-HC-H30K	M6	4	22-6	22-6	22	22	4	4	25	25
FR-HC-H55K	M8	7	60-8	60-8	60	60	1/0	1/0	50	50

Type	Terminal screw size	Tightening torque N·m *3	Crimping terminal *2		Cables				PVC insulated Cables	
					mm^2		AWG *1		mm^2 *4	
			R2, S2, T2	R3, S3, T3	R2, S2, T2	R3, S3, T3	R2, S2, T2	R3, S3, T3	R2, S2, T2	R3, S3, T3
FR-HCB-7.5K	M5	2	8-5	8-5	8	8	8	8	6	6
FR-HCB-15K	M5	2	22-5	22-5	22	22	4	4	16	16
FR-HCB-30K	M6	4	60-6	60-6	60	60	1/0	1/0	50	50
FR-HCB-55K	M8	7	150-8	150-8	150	150	MCM 300	MCM 300	–	–
FR-HCB-H7.5K	M5	2	3.5-5	3.5-5	3.5	3.5	12	12	4	4
FR-HCB-H15K	M5	2	8-5	8-5	8	8	8	8	10	10
FR-HCB-H30K	M5	2	22-5	22-5	22	22	4	4	25	25
FR-HCB-H55K	M8	7	60-8	60-8	60	60	1/0	1/0	50	50

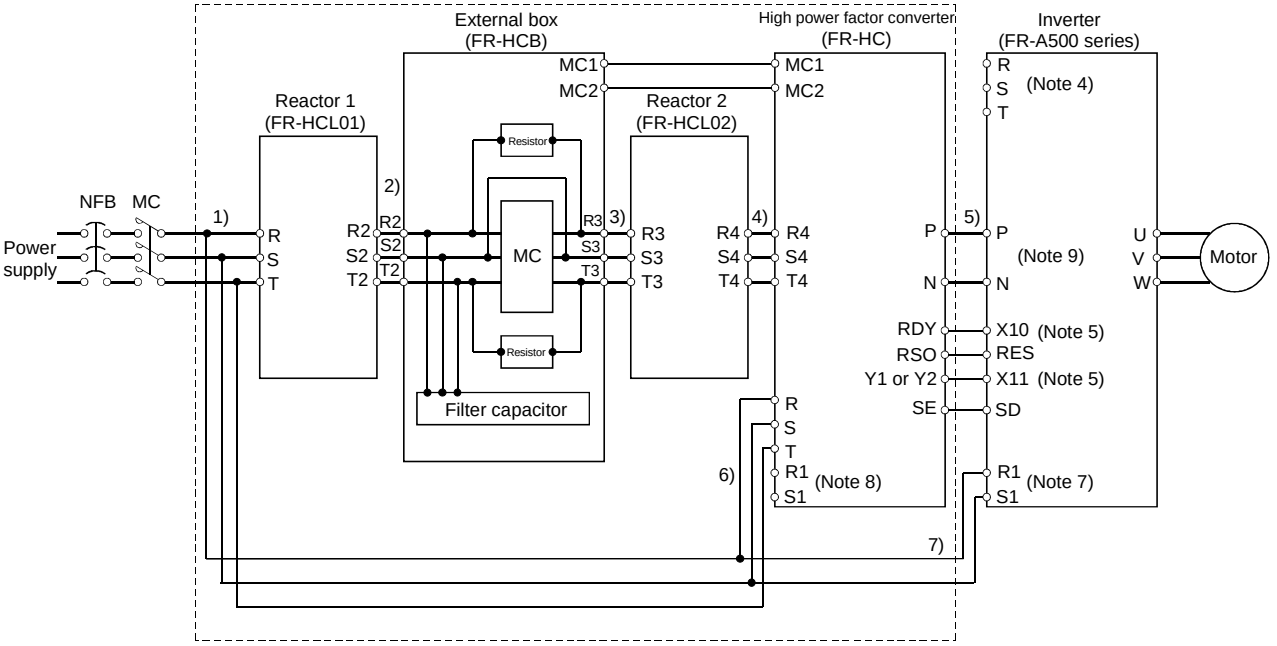
Type	Terminal screw size	Tightening torque N·m *3	Crimping terminal *2		Cables				PVC insulated Cables	
					mm^2		AWG *1		mm^2 *4	
			R, S, T	R2, S2, T2	R, S, T	R2, S2, T2	R, S, T	R2, S2, T2	R, S, T	R2, S2, T2
FR-HCL01-7.5K	M5	2	8-5	8-5	8	8	8	8	6	6
FR-HCL01-15K	M6	4	22-6	22-6	22	22	4	4	16	16
FR-HCL01-30K	M8	7	60-8	60-8	60	60	1/0	1/0	50	50
FR-HCL01-55K	M12	24	150-12	150-12	150	150	MCM 300	MCM 300	–	–
FR-HCL01-H7.5K	M4	1	3.5-4	3.5-4	3.5	3.5	12	12	4	4
FR-HCL01-H15K	M5	2	8-5	8-5	8	8	8	8	10	10
FR-HCL01-H30K	M6	4	22-6	22-6	22	22	4	4	25	25
FR-HCL01-H55K	M8	7	60-8	60-8	60	60	1/0	1/0	50	50

Type	Terminal screw size	Tightening torque N·m *3	Crimping terminal *2		Cables				PVC insulated Cables	
					mm²		AWG *1		mm² *4	
			R3, S3, T3	R4, S4, T4	R3, S3, T3	R4, S4, T4	R3, S3, T3	R4, S4, T4	R3, S3, T3	R4, S4, T4
FR-HCL02-7.5K	M5	2	8-5	8-5	8	8	8	8	6	6
FR-HCL02-15K	M6	4	22-6	22-6	22	22	4	4	16	16
FR-HCL02-30K	M8	7	60-8	60-8	60	60	1/0	1/0	50	50
FR-HCL02-55K	M12	24	150-12	150-12	150	150	MCM 300	MCM 300	–	–
FR-HCL02-H7.5K	M4	1	3.5-4	3.5-4	3.5	3.5	12	12	4	4
FR-HCL02-H15K	M5	2	8-5	8-5	8	8	8	8	10	10
FR-HCL02-H30K	M6	4	22-6	22-6	22	22	4	4	25	25
FR-HCL02-H55K	M8	7	60-8	60-8	60	60	1/0	1/0	50	50

Note: *1.The cable used should be 75°C copper cables.
*2.Use the UL approved round crimping terminals. Crimp the terminals with the crimping tool recommended by the terminal manufacturer.
*3.Tighten the terminal screws to the specified torques. Undertigtening can cause a short or misoperation. Overtigtening can cause the screws and unit to be damaged, resulting in a short or misoperation.
*4.This column is for Low Voltage Directive.

(2) Wiring example (FR-A500 series)

The wiring method varies with the inverter series.

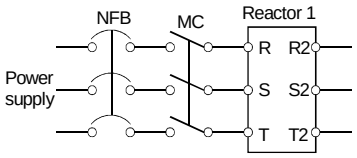


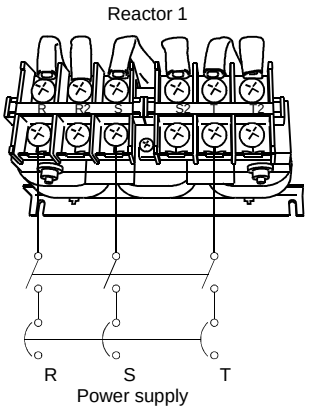
Note: 1.Use care to minimize the wiring distance between respective terminals.
2.Before starting wiring, cover the top ventilation hole to prevent wire offcuts from entering.
3.Use the ground terminal to ground the equipment securely.
4.Keep the inverter's power input terminals R, S, T open. The inverter will be damaged if they are connected accidentally. Also, opposite polarity of terminals P, N will damage the high power factor converter and inverter.
5.The terminals used with the X10, X11 signals require their functions to be set. (Refer to the inverter instruction manual for details.)
6.Match the power supply phases before connecting terminals R4, S4, T4 and terminals R, S, T.
7.A different power supply may be supplied to terminals R1 and S1.
8.Keep the high power factor converter's terminals R1, S1 unconnected.
9.Do not insert the NFB between terminals P-N (P-P, N-N).
10.The R, S, T terminals of the high power factor converter (FR-HC) must be connected to the power supply. Running the inverter without connecting the terminals to the power supply will damage the high power factor converter (FR-HC).

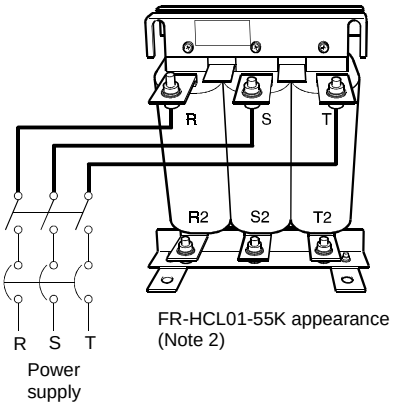
⚠ CAUTION

⚠ Confirm the connection sequence of the reactors 1 and 2. Incorrect connection will make them abnormally hot.

1) Wiring the power supply and reactor 1



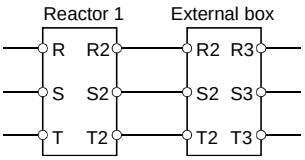


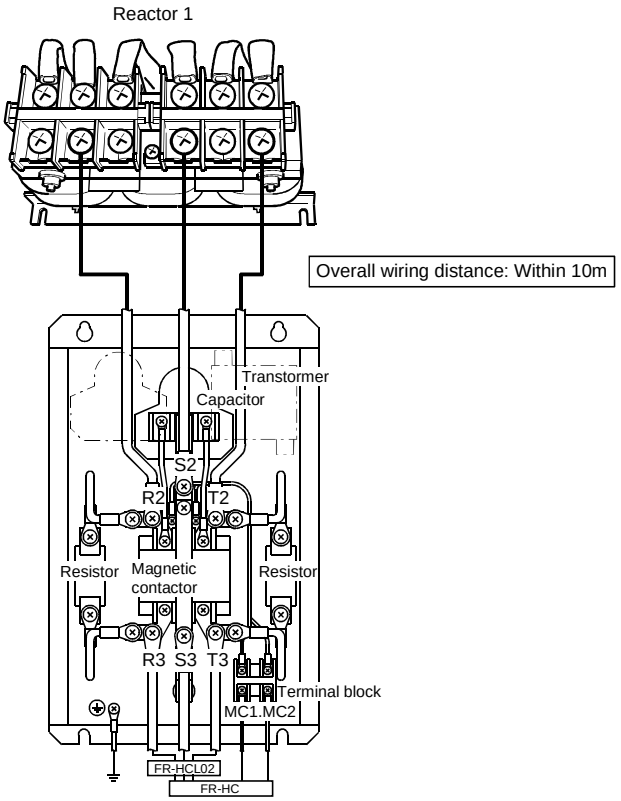


The cable size is dependent on the capacity of the high power factor converter. (Refer to page 17.)

Note: 1.Use the magnetic contactor (MC) and reactor 1 which match the high power factor converter capacity. (Refer to page 62.)
2.Note that the FR-HCL01-55K is different in outline and terminal positions.

2) Wiring the reactor 1 and external box

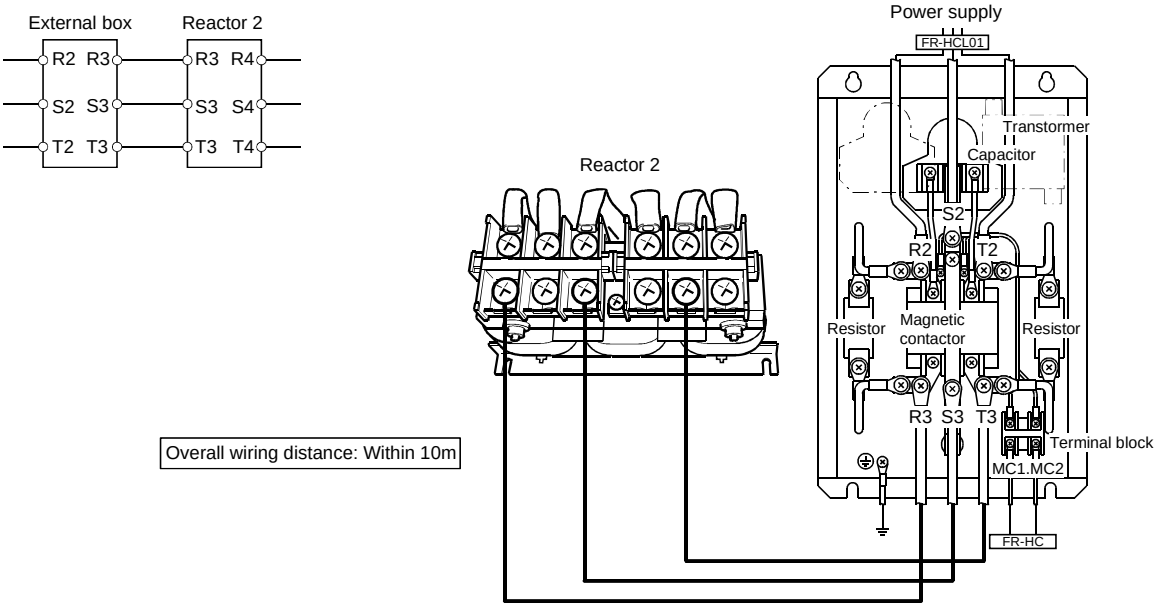




Note: 1.The cable size is dependent on the capacity of the external box. (Refer to page 17.)
2.The reactor generates heat. When installing the reactor, exercise care not to heat the external box.
3.Run the cables to keep the reactor untouched by the sheaths of the cables.

3) Wiring the external box and reactor 2

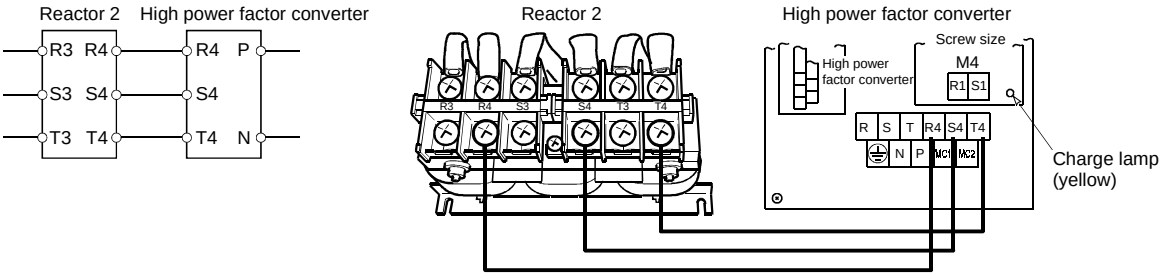
(Overall wiring distance should be not more than 10m.)



Note: The cable size is dependent on the capacity of the reactor. (Refer to page 17.)

4) Wiring the reactor 2 and high power factor converter

(Overall wiring distance should be not more than 10m.)



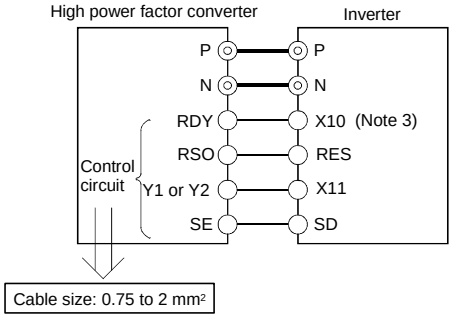
Note: The cable size is dependent on the capacity of the reactor. (Refer to page 17.)

5) Example of how to wire the high power factor converter and inverter (FR-A500 series)

These units should be connected to transmit commands from the high power factor converter to the inverter securely.

The cable size varies with the inverter series. Refer to the inverter instruction manual for wiring instructions.

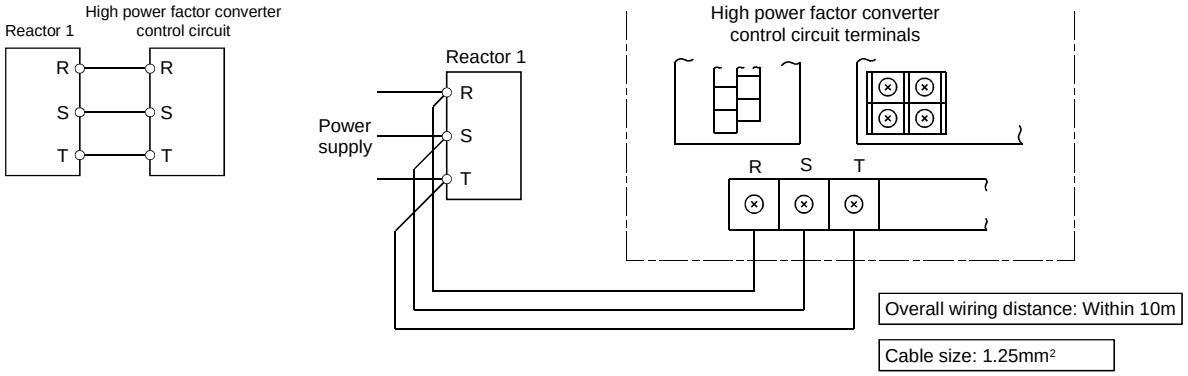
(Overall wiring distance should be not more than 50m.)



Note: 1.The high power factor converter (FR-HC) operates as a common converter. Use terminals P, N to connect it with the inverter. Always keep the inverter's power input terminals R, S, T open. If they are connected accidentally, the inverter will be damaged. Opposite polarity of terminals P, N will damage the inverter and high power factor converter.
2.The size of the cables for connection of terminals P, N should be the same as that used in the power supply side of the inverter. (Refer to the inverter instruction manual.)
3.Refer to the inverter instruction manual for the inverter terminal to be connected to terminal RDY of the high power factor converter.
4.Do not insert the NFB between terminals P-N (P-P, N-N).

6) Wiring the reactor 1 and high power factor converter

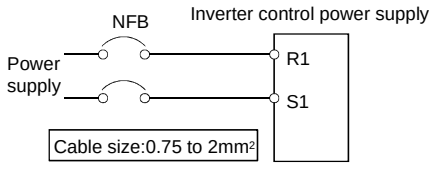
Supply power to the power detecting terminals (R, S, T) independently of the main circuit wiring.

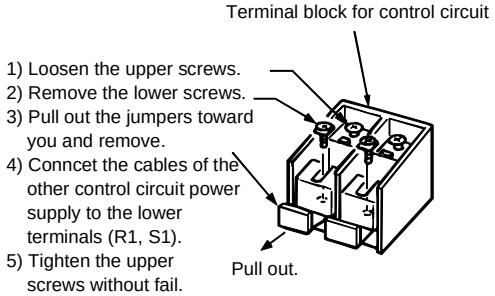


Note: 1.Terminals R, S, T of the high power factor converter (FR-HC) are control terminals designed to detect power supply phases. Before wiring, it is necessary to match the phases of terminals R4, S4, T4 with those of terminals R, S, T. If wiring is incorrect, the high power factor converter (FR-HC) will not operate properly.
2.The R, S, T terminals of the high power factor converter (FR-HC) must be connected to the power supply.
Running the inverter without connecting the terminals to the power supply will damage the high power factor converter (FR-HC).

7) Wiring the power supply and inverter

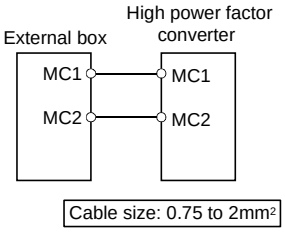
Supply power to the inverter independently of the high power factor converter (FR-HC).

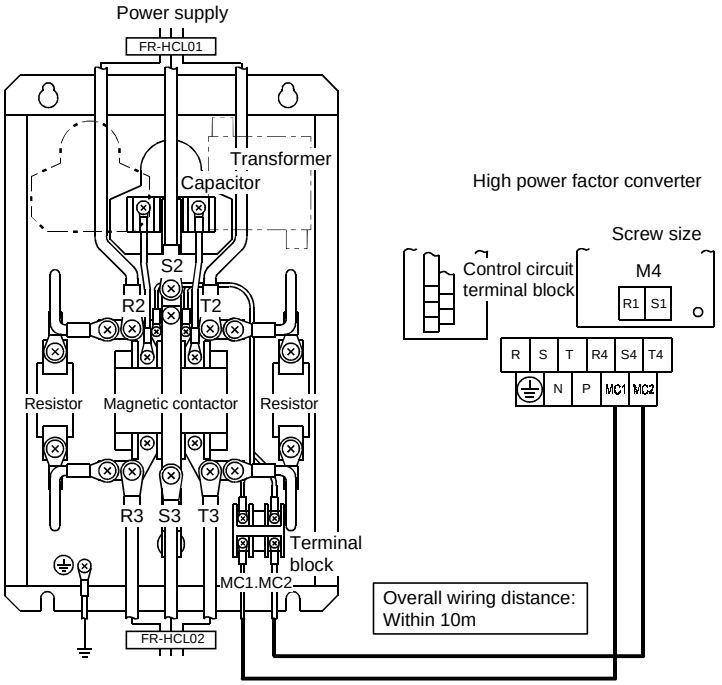




Note: 1.Remove the jumpers across terminals R-R1 and S-S1 of the inverter control circuit.
2.Always connect the power supply to the inverter which has the alternate power supply input terminals R1, S1. Power for the inverter's control power and large-capacity cooling fan (200V 15K or more/ 400V 11K or more) will be supplied. Otherwise the inverter may come to an alarm stop or be damaged. Refer to the inverter instruction manual to check whether the inverter has the alternate power supply input terminals or not.

8) Wiring the external box and high power factor converter





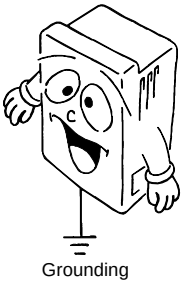
Note: Terminals MC1, MC2 of the high power factor converter provide control signals for the inrush current control circuit within the external box. Always connect these terminals with the external box. Otherwise, the external box's internal circuit will be damaged.

Notes for grounding

- The high power factor converter leaks current. To prevent an electric shock, always ground the converter before starting operation (200V class: class D grounding, grounding resistance 100Ω maximum, 400V class: class C grounding, grounding resistance 10Ω maximum).
- To ground the high power factor converter, use the exclusive ground terminal. (Do not use the screws in the casing, chassis, etc.)
- Use the thickest and shortest possible ground cable that is equal to, or larger than the size indicated in the right table. Ground the high power factor converter at a point nearest to itself and the inverter.

(Unit:mm^2)

High power factor converter capacity	Ground cable size	
	200V class	400V class
7.5kW	5.5	3.5
15kW	14	8
30kW	22	14
55kW	38	22



(3) Application of the high power factor converter and inverter

1) When one inverter is connected to the high power factor converter, the capacities of the inverters that may be connected are as listed in the following selection table. [ ] : indicates that the high power factor converter and inverter may be used together. –: indicates that they cannot be used together. (Note)

Motor capacity (kW)		2.2 or less	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Inverter capacity (K)		2.2 or less	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
200V	FR-HC-7.5K	–				Outside application range							
	FR-HC-15K	–	–	–				Outside application range					
	FR-HC-30K	–	–	–	–	–					Outside application range		
	FR-HC-55K	–	–	–	–	–	–	–	–				
400V	FR-HC-H7.5K	–				Outside application range							
	FR-HC-H15K	–	–	–				Outside application range					
	FR-HC-H30K	–	–	–	–	–					Outside application range		
	FR-HC-H55K	–	–	–	–	–	–	–	–				

Note: When the inverter connected has a capacity less than in the application range, the high power factor converter may be used as a common converter or regenerative converter, but its capability to suppress power harmonics will reduce.

(4) Connection of more than one inverter to the high power factor converter

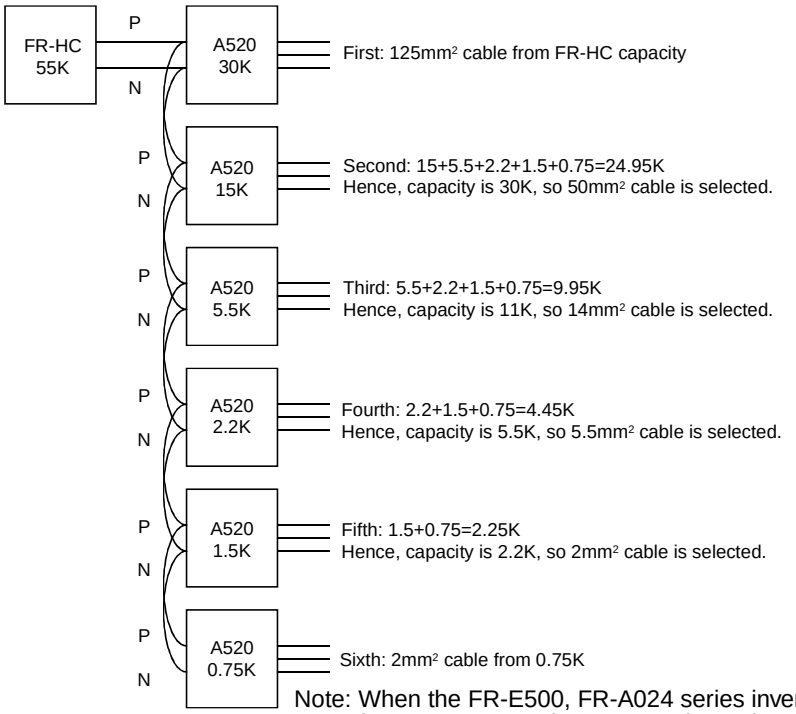
Up to six inverters may be connected to one high power factor converter. (Do not connect seven or more inverters.) The capacity of the high power factor converter should always be higher than the sum of those of the inverters connected. Also, one inverter connected should have a capacity more than half of the high power factor converter capacity.

Note: Note that if the sum of the inverter capacities is less than half of the high power factor converter capacity, the high power factor converter may be used as a common converter or regenerative converter, but its capability to suppress power harmonics will decrease.

1)For connection of more than one inverter, select the cable size carefully because the inverter terminals P, N will be wired using junction terminals or jumpers. Select the cable size so that inverter capacities are added in order, beginning with the farthest inverter.

2)For connection of more than one inverter, connect them in sequence of larger capacities.

3)Specific example



Note: When the FR-E500, FR-A024 series inverters are connected to the high power factor converter (FR-HC-7.5K), at least one of the inverter connected is required to be at least half the rating of the high power factor rating. In this case, at least one of the inverter connected is 3.7K or greater.

(5) Where the power supply is special (rated input voltage is exceeded) for the 400V class high power factor converters (FR-HC-H15K, H30K, H55K, FR-HCB-H7.5K)

Change the connection of the jumper to the internal transformer according to the operating power supply voltage. For the FR-HC-H7.5K, change the connection of the internal transformer inside the external box.

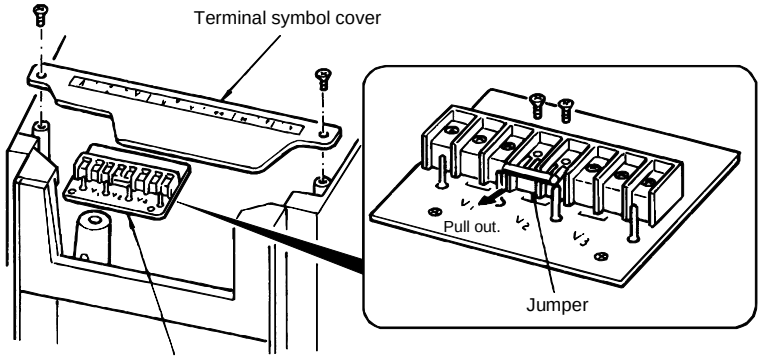
■ Operating power supply voltage range vs. jumper position

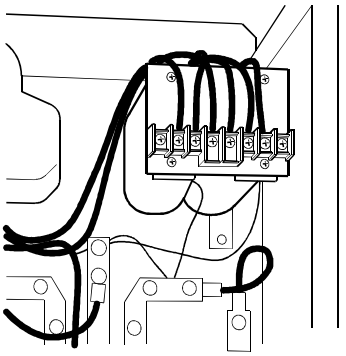
Jumper Position	Operating Power Supply Voltage		Remarks
	50Hz	60Hz	
V1	323V(380V-15%) to 456V(415V+10%)	As on the left	
V2	342V(380V-15%) to 484V(440V+10%)	342V(380V-10%) to 506V(460V+10%)	Factory setting
V3	391V(460V-15%) to 506V(460V+10%)	As on the left	

Note: Change the jumper position according to the operating power supply. Otherwise the high power factor converter will be heated and may become faulty or burn out.

■ Changing the jumper position

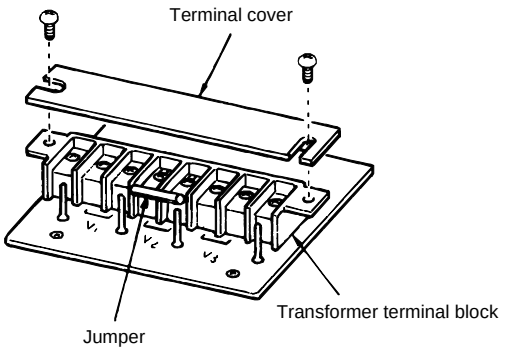
- Model: FR-HC-H15K, FR-HCB-H7.5K




Appearance of FR-HCB-H7.5K

1) Remove the mounting screws of the terminal symbol cover and remove the cover.
2) This reveals the terminal block of the internal transformer. After removing the screws from the jumper in the terminal block, reconnect the jumper in accordance with the operating voltage in the above table.

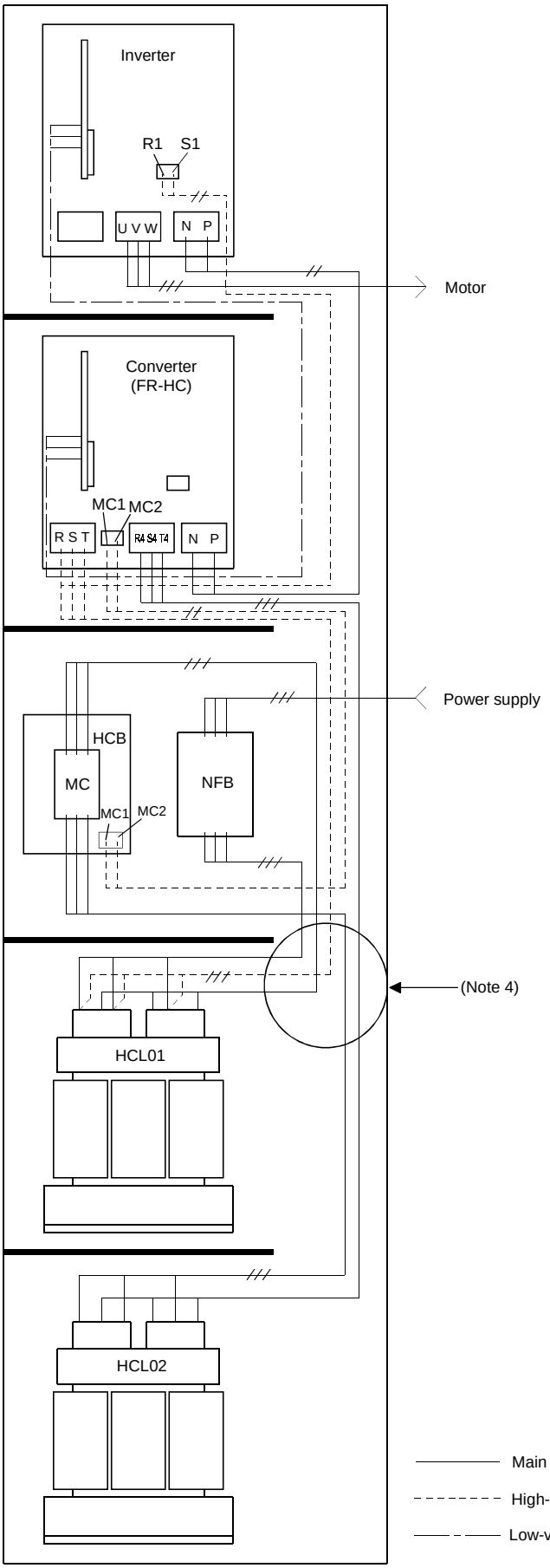
- Model: FR-HC-H30K, H55K



1) Remove the terminal cover of the internal transformer located under the main circuit terminal block (R, S, T).
2) Remove the screws from the jumper in the terminal block, and reconnect the jumper.

(6) Installation and wiring example

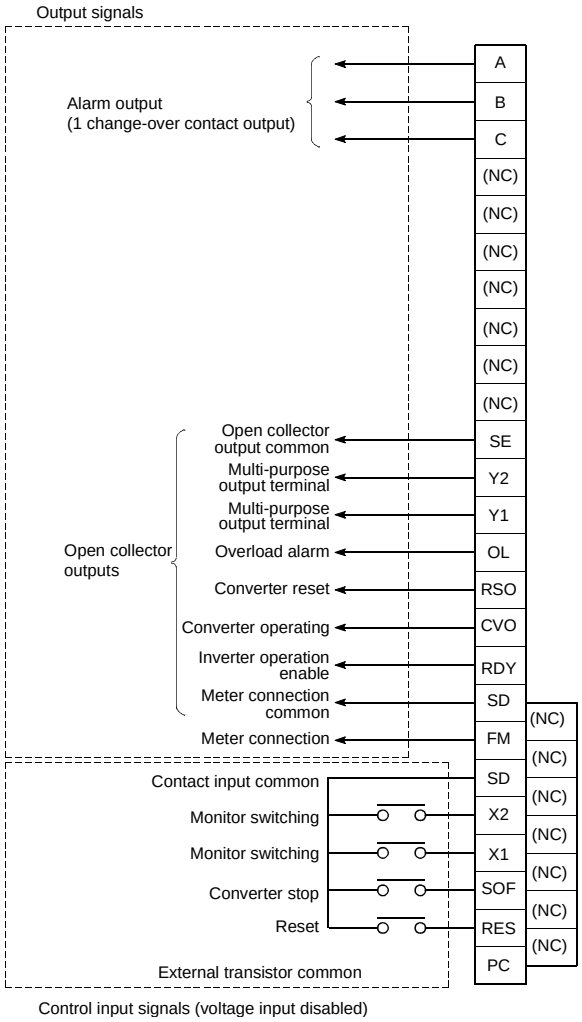
<Vertical mounting>

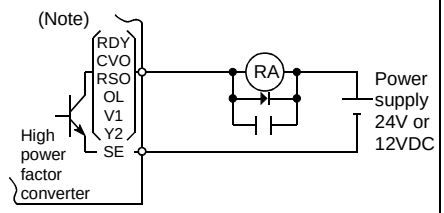


<Instructions>

1) Leave clearances of at least 10cm above and below and 5cm on the left and right side of each unit.
2) Up to six cables may be bundled.
3) Install partitions to shut off heat given to the upper units.
4) The reactors generate heat. Run cables away from them.
5) When the installation place has enough space, it is recommended to install the units side by side.

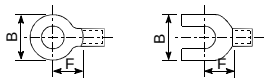
1.3.4 Wiring of the control circuit
(For terminal block functions, refer to "Terminals" on page 58.)





Note: A voltage applied in the wrong direction will damage the high power factor converter. Beware of miswiring such as the direction of diode connection.

Note: 1.Terminals SD and SE are common to the I/O signals and are isolated from each other. Do not earth (ground).
2.Use shielded or twisted cables for connection to the control circuit terminals and run them away from the main and power circuits (including the 200V relay sequence circuit).
3.Since the control circuit input signals are micro currents, use two parallel micro signal contacts or a twin contact to prevent a contact fault.
4.Keep the free terminals (NC) unconnected. Otherwise, the high power factor converter may become faulty.
5.When connecting two crimping terminals to one of the control circuit terminals, round or square open-ended crimping terminals of the size as shown on the rightshould be used back to back.



Nominal	B(mm)	F(mm)
1.25-3	6.4 or less	53 or more

Note: Round crimping terminal V1.25-MS3 (Japan Solderless Terminal)

⚠ CAUTION

⚠ Do not use the free terminals (NC) of the control circuit. Using them will lead to the failure of the high power factor converter and inverter.

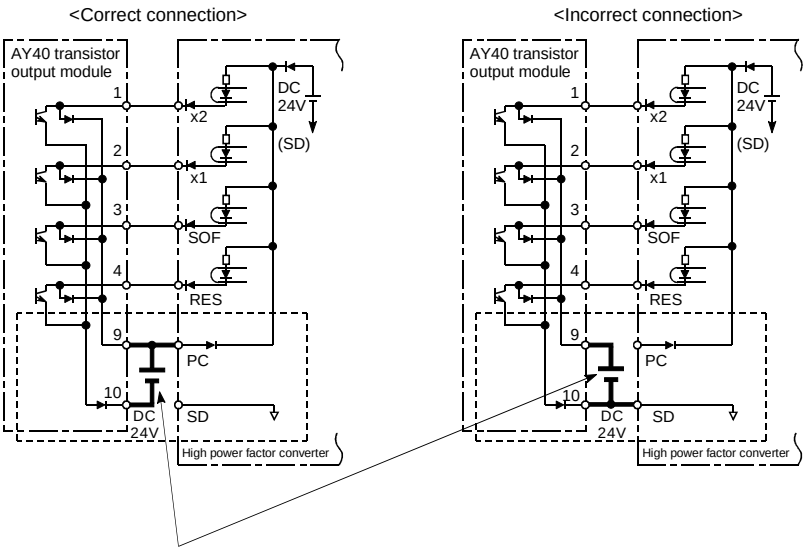
⚠ Steep distortion or sinking in power may cause the reactor 2 (FR-HCL02) to generate unusual noise. This phenomenon occurs due to a power fault and is not attributable to a damaged high power factor converter (FR-HC).

⚠ When the load is light, harmonic suppression effects will decrease.

⚠ Be sure to connect terminal RDY of the FR-HC to the X10 or MRS signal assigned terminal of the inverter, and connect terminal SE of the FR-HC to terminal SD of the inverter. Without proper connecting, FR-HC will be damaged.

Using the PC terminal

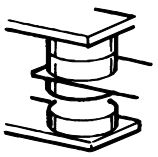
This terminal is used to connect transistor output (open collector output) such as a programmable controller (PC). Connecting the external power supply common for transistor output to the PC terminal prevents a faulty operation caused by a sneak current.
(The power supply voltage of the PC terminal should be 24VDC.)



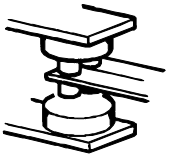
The AY40 module requires a 24VDC power supply.

Instruction for contact inputs

Since input signals to the control circuit are at a low level, use two parallel micro signal contacts or twin contact for contact inputs to prevent a contact fault.



Micro signal contacts

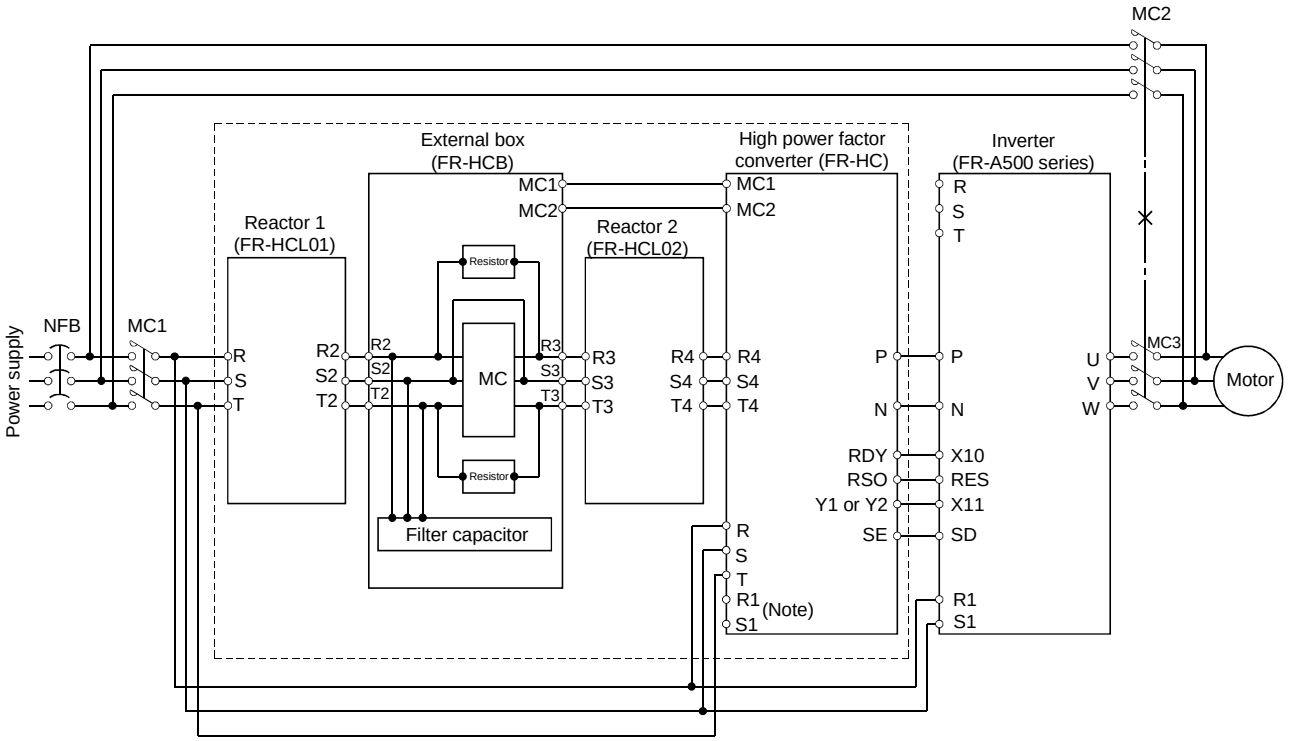


Twin contact

Wiring example for commercial power supply-inverter switch-over

- Complicated sequence circuit for commercial power supply-inverter switch-over

  The following example shows wiring for connection of a commercial power supply. (FR-A500 series) When making connection, always provide interlocks between magnetic contactors MC2 and MC3:



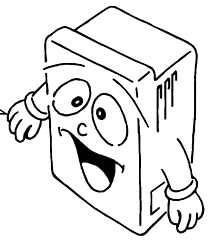
Note: Keep the high power factor converter's terminals R1, S1 unconnected.

2. PARAMETERS

This chapter presents details on the “parameters” of this product.
Always read the precautions, etc. before starting use.

2.1 PARAMETER UNIT

The parameter unit (FR-PU02E-1) is installed directly to the high power factor converter or connected to it by the cable (FR-CBL) to allow parameters to be set and data to be monitored. Note that as compared to the inverter, there are restrictions on functions. In this manual, the parameter unit may be referred to as the PU.



2.1.1 Structure of the parameter unit

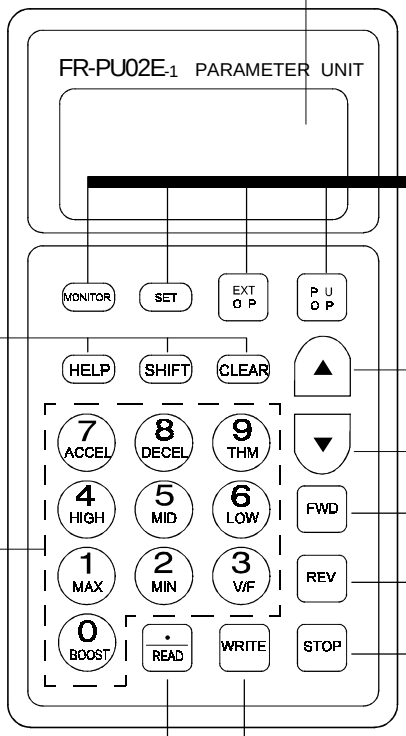
Help key
- Used to call the help selection screen.
- Note that there are restrictions.

Clear key
- Used to clear a set value entered.
- Used to return to the help selection screen when you have selected an invalid help item.

Shift key
- Used to shift to the next item in the setting or monitoring mode.

Numeral keys
- Used to enter the parameter number and set value.

Read key
- Used also as a decimal point key.
- Acts as a key to select or read any of various functions.



Display
- Shows the monitor screen, etc.

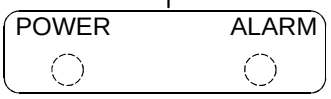
Mode selecton keys
- Used to select the setting mode and monitoring mode. The “EXT OP” and “PU OP” keys are invalid.

Frequency change keys
- On the monitoring, parameter or help item selection screen, these keys are used to move the cursor. Hold down the SHIFT key and press either of these keys to advance or return the display screen one page.

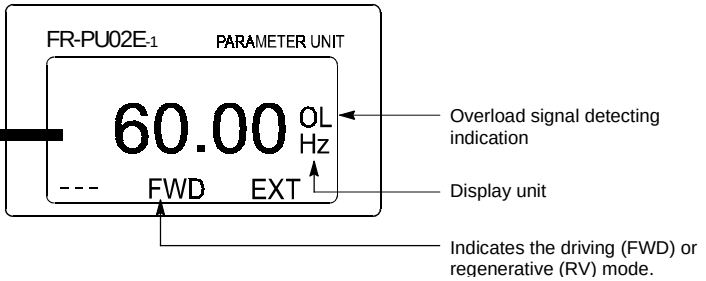
Operation command keys
- Invalid.

Write key
- Used to write a set value in the setting mode, etc.

Converter LED display
- POWER (yellow) indicates whether power is supplied or not and ALARM (red) indicates whether alarm output is provided or not.

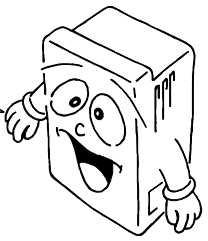


PU main monitor
- Three different monitors can be selected in sequence with the [SHIFT] key.



2.1.2 Setting and changing the parameter values

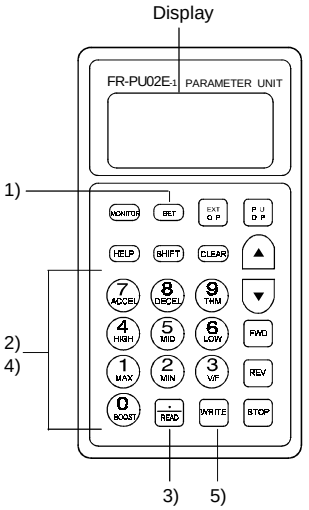
The high power factor converter has many parameters. Using the PU, the required parameters can be selected and their values set and/or changed as appropriate according to the running conditions. For more information, see the “Parameter List” (page 31). Set “1” in Pr. 77 “parameter write disable” to disable write. (See page 37.)



- **Operation procedure (Reading and writing the value of Pr. 22 “overload signal detection level”)**

1) Press the [SET] key.	. . . . . The parameter setting mode is entered.	SETTING MODE Set Pr. NO. FOR PR. List <HELP>
2) Enter the intended parameter number [2][2].	. . . . . The screen on the right is displayed.	SETTING MODE Pr. NO. 22 <READ>
3) Press the [READ] key.	. . . . . The current set value is shown on the display.	22 150.0%
4) Enter the required value. (Example: To set 180 %) (Note 1)	. . . . . A new set value is shown on the display.	22 150.0% 180.0%
5) Press the [WRITE] key.	. . . . . The set value is stored into memory.	22 180.0% Completed

6) Press the [SHIFT] key to move to the next parameter (Pr. 40) and call the current set value. Then, press the [SHIFT] key to advance to the next parameter.



Note 1:If a setting error has occurred during the entry of a set value, press the [CLEAR] key to return to the status before that set value was entered.

2.2 PARAMETER FUNCTION DETAILS

2.2.1 Parameter list

Function	Parameter No.	Name	Setting Range	Minimum setting Increment	Factory Setting	Customer Setting
–	1	Power supply frequency 1 (Note1)	–	–	60.00Hz	–
	2	Power supply frequency 2 (Note1)	–	–	50.00Hz	–
Standard operation function	22	Overload signal detection level	0 to 200%	0.1	150.0%	
Multi-function output terminal function	40	Output terminal assignment	0 to 33 (Note 6)	1	1	
Display functions	51	Input power monitoring reference	0 to 100kW	0.1	Rated power (Note 2)	
	52	PU main display data selection	0 to 3333 (Note 7)	1	123	
	53	Input voltage monitoring reference	0 to 500.0V	0.1	220V/400V (Note 3)	
	54	FM terminal function selection	0 to 3333 (Note 7)	1	123	
	55	Bus voltage monitoring reference	0 to 1000.0V	0.1	340V/680V (Note 3)	
	56	Current monitoring reference	0 to 500.00A	0.01	Rated current (Note 5)	
Automatic restart function	57	Restart selection	0, 9999	1	9999	
Operation selection functions	65	Retry selection	0, 1, 2, 3	1	0	
	67	Number of retries at alarm occurrence	0 to 10, 101 to 110	1	0	
	68	Retry waiting time	0.1 to 360.0 s	0.1 s	1.0 s	
	69	Retry count display erasure	0	–	0	
	77	Parameter write disable selection	1, 2	1	2	
Calibra-tion func-tions	145	Parameter unit language switching	0, 1, 2, 3	1	0	
	900	FM terminal calibration	–	–	–	

Note: 1. You cannot set or change the values of Pr.1 “power supply frequency 1” and Pr. 2 “power supply frequency 2”.
2. This set value varies with the capacity of the high power factor converter and is factory-set to the rated power of the corresponding capacity.
3. These set values vary with the rated voltage of the high power factor converter and is factory-set according to the 200V/400V class.
4. The set values of the half-tone screened parameters can be changed if “1” (write disable) is set in Pr. 77 “parameter write disable selection”.
5. This set value varies with the capacity of the high power factor converter and is factory-set to the rated current of the corresponding capacity.
6. Use numerals 0 to 3 to set a two-digit value in Pr. 40 “output terminal assignment”.
7. Use numerals 0 to 3 to set a four-digit value in Pr. 52 “PU main display data selection” and Pr. 54 “FM terminal function selection”.

2.2.2 Setting of parameters to improve the corresponding operational functions

Preset input frequency to the converter

⇨ **Pr.1 "power supply frequency 1", Pr.2 "power supply frequency 2"**

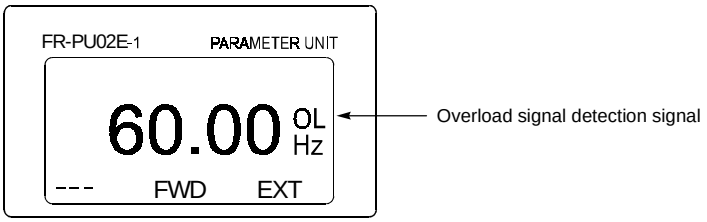
- Indicates that the converter is operable in the district where the power supply frequency is 50Hz or 60Hz.

Parameter Number	Factory Setting
1	60.00Hz
2	50.00Hz

To detect the overload signal

⇨ **Pr.22 "overload signal detection level"**

- If the inrush current of the high power factor converter exceeds the set value of Pr. 22 "overload signal detection level", the alarm detection signal "OL" is displayed and output from the output terminal "OL". Set a value with reference to the rated current.

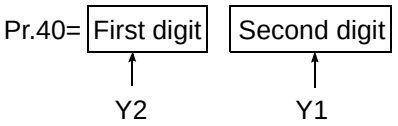


Note: The set value (%) indicates the ratio of the inrush current to the rated current of the high power factor converter.

To change the functions of the output terminals Y1, Y2

⇨ **Pr.40 "output terminal assignment"**

- Functions can be reassigned to output terminals Y1, Y2.
  Set a 2-digit integer in Pr. 40 "output terminal assignment". The value of each digit indicates the function of the corresponding terminal.



Pr.40 Setting	Function Name	Operation
0 (Factory setting)	Power supply phase detection signal	When the input power supply is in phase with the arithmetic result, the power supply phase detection signal is locked. When they are out of phase, the power supply phase detection signal is unlocked and output from the open collector output terminal.
1	Output voltage match	When the bus voltage matches the command value from the CPU, the corresponding signal is output from the open collector output terminal.
2	Instantaneous power failure detection	This signal indicates that an instantaneous power failure occurred.
3	Driving/regenerative mode judgment	Whether the mode is driving or regenerative is judged. In the driving mode, the open collector terminal does not conduct.

Note: 1.“Output” means that the open collector outputting built-in transistor switches on (conducts).
2.When a one-digit value is entered, the unit recognizes that “0” is in the first digit and terminal Y2 serves to output the power supply phase detection signal.

To set the reference values of terminal FM

⇨Pr. 51 “input power monitoring reference”, Pr. 53 “input voltage monitoring reference”, Pr. 55 “bus voltage monitoring reference”, Pr. 56 “current monitoring reference”

- With these parameters, you can set the reference values of the power, voltage, bus voltage and current input from the power supply to the high power factor converter. Set values which are suitable for the rated values of the power supply and high power factor converter.
- These values are used as reference outputs to terminal FM.
- Parameters

Parameter Number	Name	Factory Setting	Setting Range
51	Input power monitoring reference	Rated power	0 to 100KW
53	Input voltage monitoring reference	220V/440V (Note)	0 to 500.0V
55	Bus voltage monitoring reference	340V/680V (Note)	0 to 1000.0V
56	Current monitoring reference	Rated current	0 to 500.00A

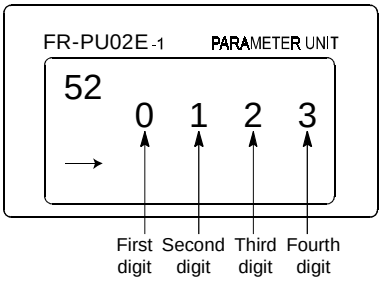
Note: These set values vary with the voltage class of the high power factor converter and are factory-set according to the 200V/400V class.

To set/change the display data on the parameter unit (terminal FM)

⇨Pr. 52 “PU main display data selection”, Pr. 54 “FM terminal function selection”

- The display data of the parameter unit can be set or changed. Note that the monitor display is not provided by merely setting the parameter. Use the switches X1, X2 to change to the monitor display.
- By setting or changing the value in Pr. 52 “PU main display data selection”, current monitoring will vary.

(1) Each digit where the Pr. 52 (Pr. 54) value is set has relationships with the positions of terminal X1, X2 switches.



Parameter: Pr.52 (Pr.54) = First digit | Second digit | Third digit | Fourth digit

Terminal (switch);				
X1	OFF	ON	OFF	ON
X2	OFF	OFF	ON	ON

(2) The following values may be set in Pr. 52 (Pr. 54):

Pr. 52 (Pr. 54) Setting	Display
0	Input current monitoring
1	Bus voltage monitoring
2	Input voltage monitoring
3	Input power monitoring

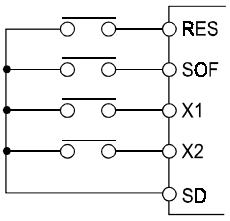
(3) Pr. 52 (Pr. 54) is factory-set as follows:

Parameter; Pr.52 (Pr.54) = | 0(Note) | 1 | 2 | 3 |

Since the terminals (switches) are factory-set to X1=OFF and X2=OFF, the monitor screen on the parameter unit shows “input current monitoring”.

Note: Basically, a four-digit value is entered in Pr. 52 (Pr. 54). “0” set in the first of the four digits is not displayed. The factory setting of “123” is recognized as “0123”.

<Factory setting of terminals (switches)>

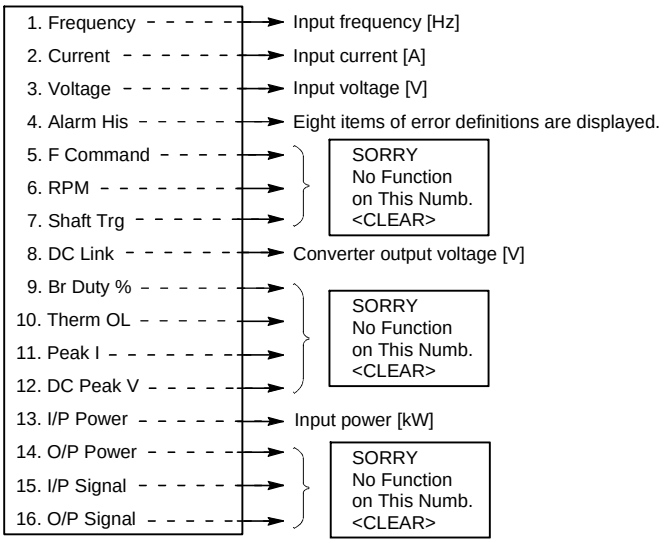


(4) Shift operation for PU main monitoring

Three different monitors set in Pr. 52 “PU main display data” can be called in sequence by pressing the [SHIFT] key.

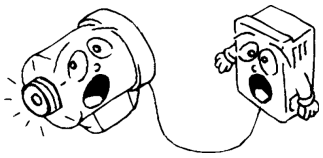
(5) Using the [MONITOR] key to select the monitor display
   1) Press the [MONITOR] key, then the [HELP] key to call the monitor list.
   2) Make selection with the arrow keys.
   3) Press the READ key to display the monitor.
      Note that the monitors that may be read are limited.

<Monitor list>



Note: 1.Note that any value less than 5% of the high power factor converter's rated current cannot be detected or displayed.
2.By pressing the [WRITE] key on any monitor display, the first priority screen can be determined. This operation allows the first priority screen to be displayed immediately after power-on or when the setting mode is switched to the monitoring mode.

To select automatic restart after instantaneous power failure



⇨ **Pr.57 "restart selection"**

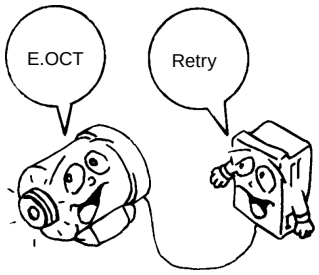
- When automatic restart after instantaneous power failure has been selected in the inverter parameter "restart coasting time", set "0" in Pr. 57 "restart selection".
- When "9999" is set in Pr. 57, the converter (FR-HC) will stop the inverter output due to the alarm signal "E.IPF" even if automatic restart after instantaneous power failure has been selected in the inverter parameter.

Pr.57 Setting	Restart Operation
0	Yes
9999 (factory setting)	No

⚠ CAUTION

⚠ The motor will start suddenly (after reset time has elapsed) when an instantaneous power failure has occurred.
When the restart after instantaneous power failure function is selected, stay away from the motor and machine.
Apply the supplied CAUTION labels to easily identifiable positions when the restart after instantaneous power failure function is selected.

To limit the errors reset for retry



⇨ **Pr. 65 “retry selection”, Pr. 67 “number of retries at alarm occurrence”, Pr. 68 “retry waiting time”, Pr. 69 “retry count display erasure”**

- When an error occurs in the high power factor converter, the retry function allows it to reset the alarm automatically and continue operation.

(1) With Pr. 65 “retry selection”, you can limit the high power factor converter errors reset for retry.

Pr.65	Alarms Reset for Retry
0	No retry
1	Overcurrent shut-off (OCT)
2	Power supply fault (IPF) (Note 4)
3	Overcurrent shut-off (OCT), power supply fault (IPF)

(2) With Pr. 67 “number of retries at alarm occurrence”, you can set the number of retries to be made when a high power factor converter error occurs.

Pr.67 Setting	Number of Retres	Alarm Signal Output
0 (factory setting)	Retry is not made.	–
1 to 10	1 to 10 times	Not output
101 to 110	1 to 10 times	Output.

(3) With Pr. 68 “retry waiting time”, waiting time from when a high power factor converter error occurs until a restart is made can be set in the range 0.1 to 360s.

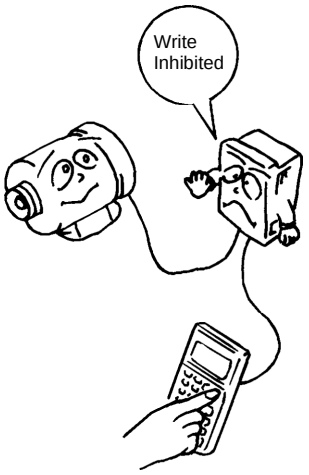
(4) By reading the value of Pr. 69 “retry count display”, the cumulative number of restart times successfully made by retry is provided. The set value of “0” erases this cumulative number of times.

Note: 1.The high power factor converter automatically starts operation after the time set in Pr. 68 “retry waiting time” has elapsed. Exercise care not to jeopardize the operator.
2.The cumulative number in Pr. 69 “retry count display erasure” is incremented by “1” when retry operation is regarded as successful, i.e. when normal operation is continued without any alarm occurring during a period four times longer than the time set in Pr. 68 “retry waiting time”.
3.If alarms occur successively during a period four times longer than the above waiting time set in Pr. 68, the screen display of the parameter unit will be different from the display provided when the first retry is made. (Option fault “E.OPT”) Note that the error reset for retry is not stored.
4.With 2 set in Pr. 65 “retry selection” (power supply fault), the IPF signal is detected when a power supply fault occurs.

⚠ CAUTION

⚠ When you have selected the retry function, stay away from the motor and machine. They will start suddenly (after a given time has elapsed) when an alarm occurs. When you have selected the retry function, apply the supplied CAUTION labels to easily identifiable positions.

To set parameter write disable



⇨ **Pr.77 "parameter write disable selection"**

• Prevents parameter values from being written from the parameter unit.

Pr.77 Setting	Write Disable Function
1	Parameter write disable
2 (factory setting)	Parameter write enable

Note: 1.Monitor-related parameters Pr. 51, Pr. 53, Pr. 55 and Pr. 56 may be set at any time.
2.The Pr. 77 value may be written at any time.

⚠ CAUTION

⚠ If the setting is changed during operation, the high power factor converter may stop operating due to alarm occurrence.

To change the language displayed on the parameter unit

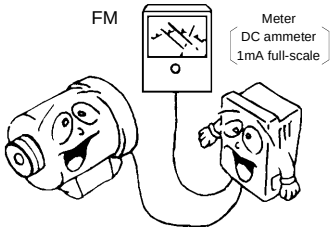
⇨ **Pr.145 "parameter unit language switching"**

• You can select the language displayed on the four-language parameter unit FR-PU02ER-1 and copy unit FR-ARWER-1 (option).

Set Value	Language Displayed
0	English (factory setting)
1	German
2	French
3	Spanish

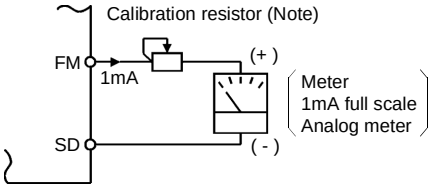
Note: This function is invalid for the FR-PU02-1, FR-PU02E-1 or FR-ARW-1 parameter (copy) unit is used.

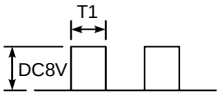
To make the output calibration of terminal FM



⇨ **Pr.900 “FM terminal calibration”**

- The meter connected to terminal FM can be calibrated from the parameter unit. This calibration function is common to all monitored data selected in Pr. 54 “FM terminal function selection”.
- Terminal FM provides the pulse output as shown below. The setting of Pr. 900 “FM terminal calibration” allows the meter connected to the converter to be calibrated from the parameter unit without providing a calibration resistor.

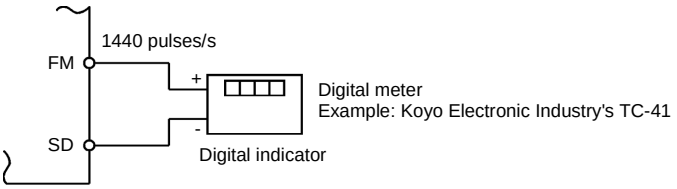


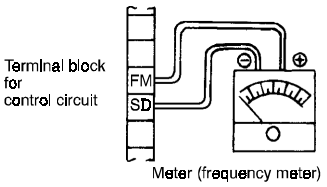


Pulse width T1: Adjusted with Pr. 900

Note: Calibration need not be made using Pr. 900 “FM terminal calibration”. This resistor is used when calibration must be made near the frequency meter for such a reason as a remote frequency meter. Note that the needle of the frequency meter may not deflect to full-scale when the calibration resistor is connected. In this case, use both the resistor and Pr. 900 “FM terminal calibration” to make calibration.

- Monitoring using a digital meter
  A digital value can be displayed on a digital counter using the pulse train signal from the FM terminal. By making monitoring selection, the ratios of the FM terminal monitoring can be set in Pr. 51 “input power monitoring reference”, Pr. 53 “input voltage monitoring reference”, Pr. 55 “bus voltage monitoring reference” and Pr. 56 “current monitoring reference”.



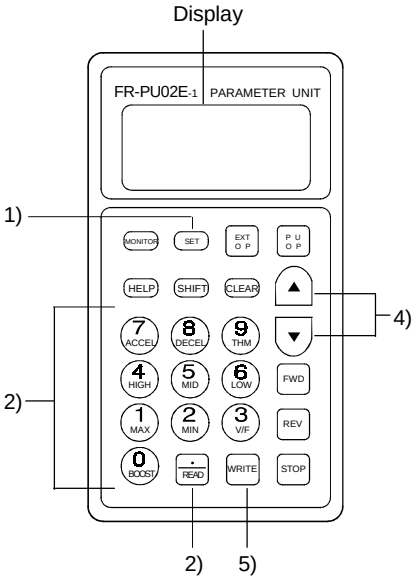


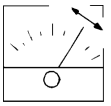
• Calibration procedure

(1) Connect a meter across converter terminals FM and SD. (Note the polarity. FM is the positive terminal.)

(2) When a calibration resistor has already been connected, adjust the resistance value to zero or remove the resistor.

(3) Set the required value in Pr. 54 “FM terminal function selection”. Preset the parameter value as required by the output signal.

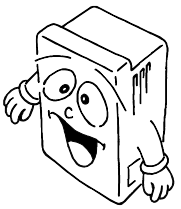


1) Press the [SET] key. . . . . The parameter setting mode is entered.	SETTING MODE Set Pr. NO. FOR PR. List <HELP>
2) Type [9][0][0] and press the [READ] key. . . . . The data as shown on the right is displayed.	900 FM Tune Run Inverter set 60.00Hz PU
3) Input current is displayed.	901 AM Tune Mntrl 2.31A <WRITE>PU
4) Using the [▲] or [▼] key, adjust the meter indicator to a predetermined position . . . . . The meter indicator moves. (It takes a long time until the indicator moves.)	
5) Press the [WRITE] key. . . . . Calibration is complete.	900 FM Tune Completed <MONITOR>

Press the [MONITOR] or [SET] key to switch to the corresponding mode.

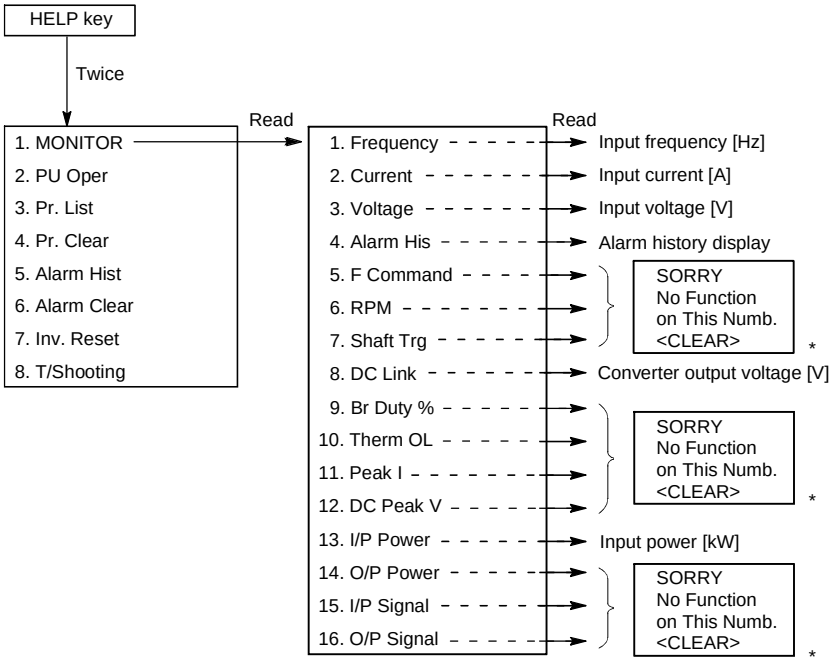
2.3 HELP FUNCTIONS

Use the HELP key to select monitoring, set parameter values, or clear parameters. On any monitor screen, press the HELP key twice to call the help menu, with which various functions can be set or selected. Note that there are restrictions.



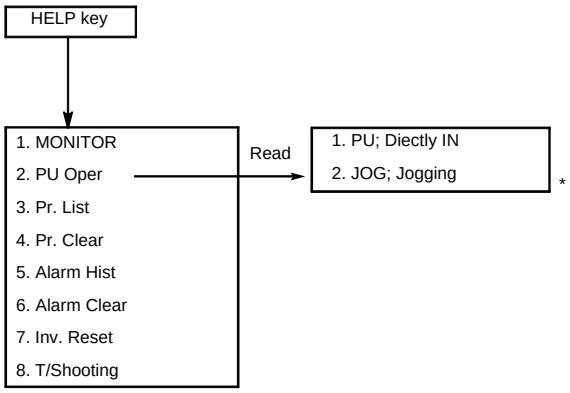
2.3.1 Definitions of the help function displays

(1) Monitoring function



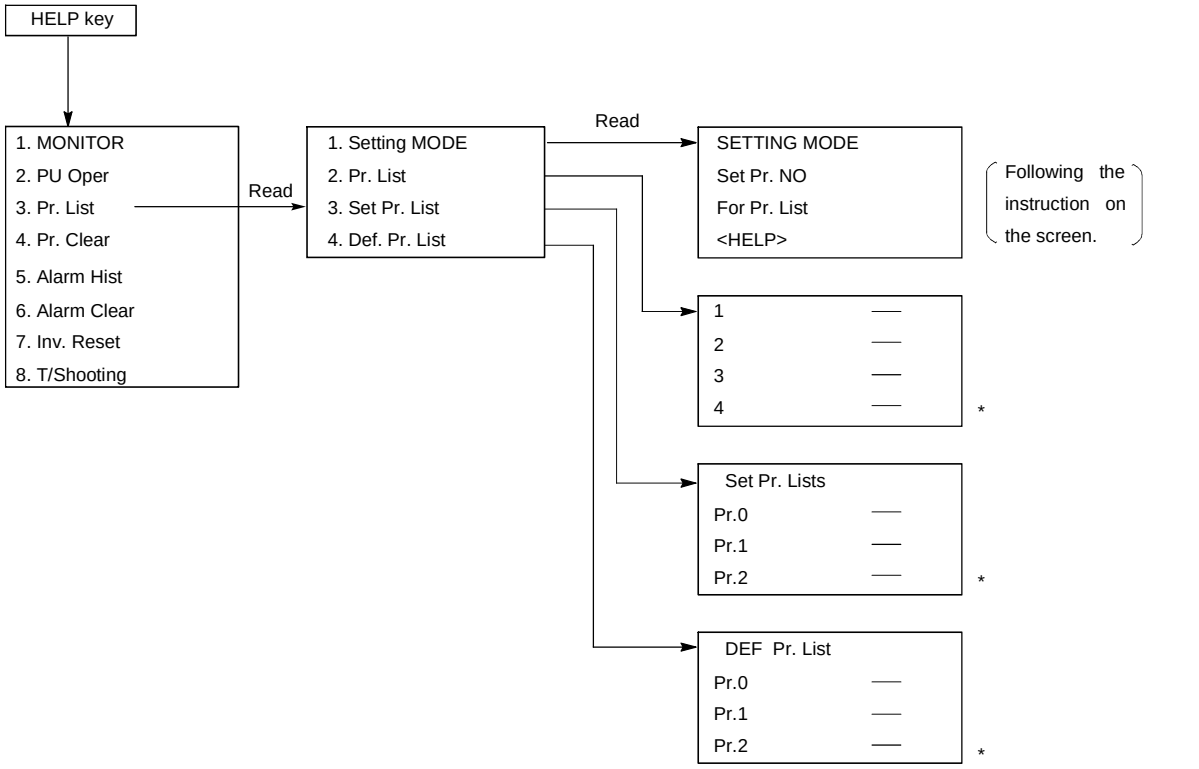
* This function cannot be used. Press the CLEAR key to return to the help selection screen.

(2) PU operation function



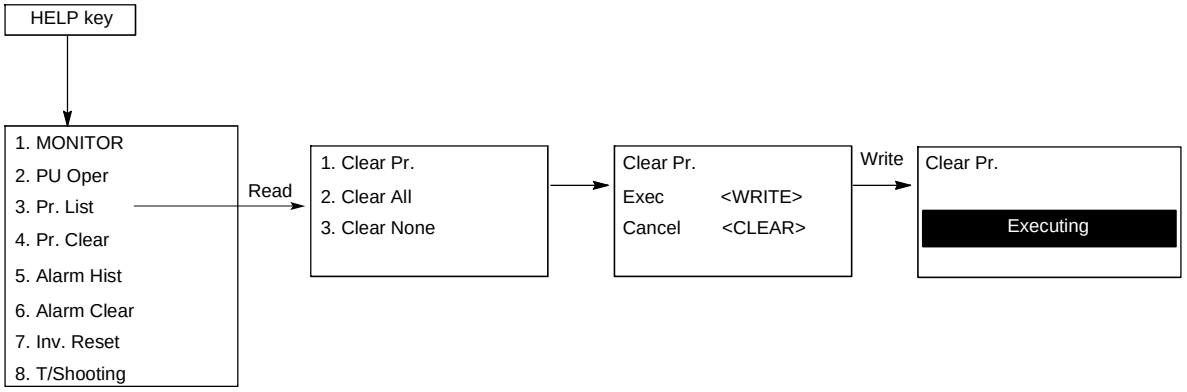
* This function cannot be used. Press the CLEAR key to return to the help selection screen.

(3) Parameter setting function (Note that only “1 Setting” is valid)

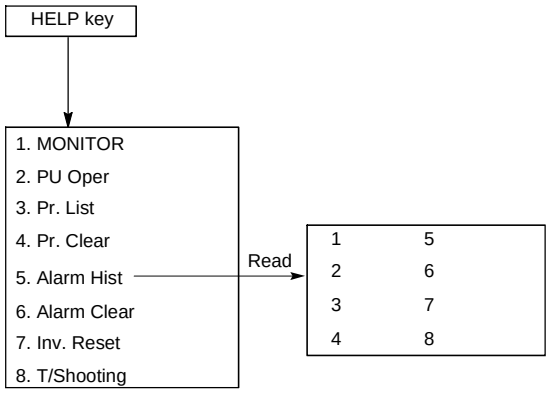


* This function cannot be used. Press the CLEAR key to return to the help selection screen.

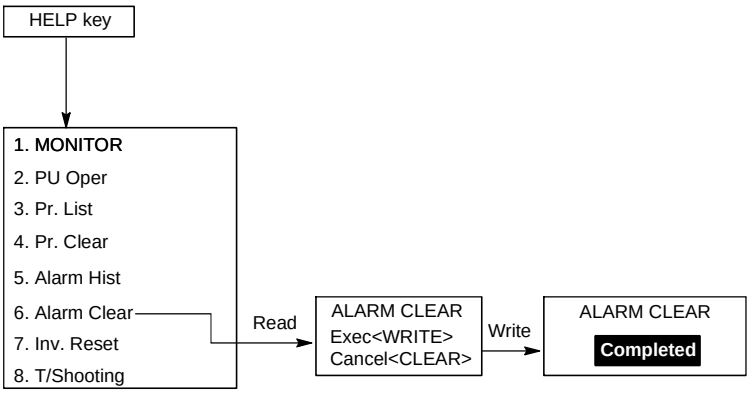
(4) Parameter initialization function... Returns parameter values to the factory setting.



(5) Alarm history display function

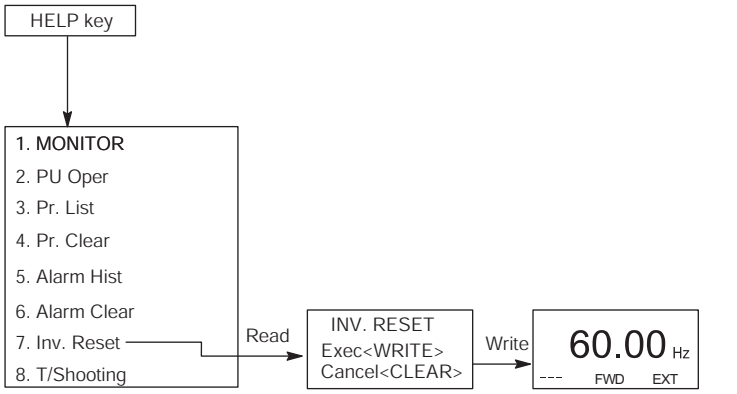


(6) Alarm history clear function (Erases alarm history)



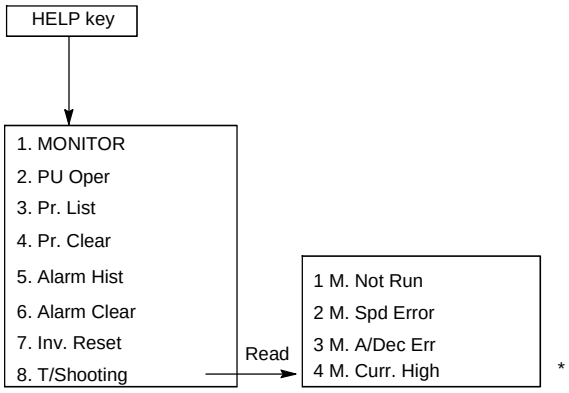
(7) Converter reset (Resets the high power factor converter)

Note: Though the display shows inverter reset, note that the inverter is not reset. (To reset the inverter together with the converter, terminals RSO-RES and terminals SE-SD must have been connected.)



Note: Returns to the screen at the power on (first priority screen (refer to page 35))

(8) Troubleshooting (Note that this function is invalid)

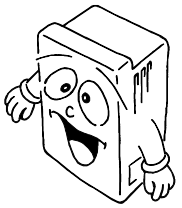


* This function cannot be used. Press the HELP key to return to the previous screen or press the MONITOR or SET key to return to the help selection screen.

Note: 1.There are restrictions on the help functions of the high power factor converter compared to those of the inverter.
2.When you have selected an invalid item, press the CLEAR key to return to the help selection screen.

2.4 CONVERTER RESET

The high power factor converter can be reset by any of the following three operations. Note that resetting clears (erases) the cumulative internal heat value of the electronic overcurrent protector and the number of retries.



Operation 1

Using the help function, reset the inverter. For details, see “7 CONVERTER RESET” on page 42.

Operation 2

Switch the power off once. After more than 0.1s, switch it on again.

Note: When the Pr. 57 (Coasting time for automatic restart after instantaneous power failure/commercial power supply-inverter switch-over) setting is other than “9999”, this operation is mistaken for an automatic restart after instantaneous power failure and the inverter cannot be reset. Hence, the power should be switched on again about 5s after the control power has been lost.

Operation 3

Connect the reset terminal RES-SD for more than 0.1s, then disconnect.

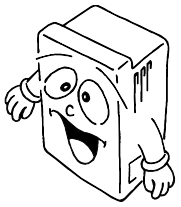
Note: Avoid resetting the converter as part of its operation cycle.

3. PROTECTIVE FUNCTIONS

This chapter offers details on the “protective functions” of this product.
Always read the precautions, etc. before starting use.

3.1 ERRORS

If any fault has occurred with the high power factor converter, the corresponding protective function is activated to bring the high power factor converter to an alarm stop and automatically give the corresponding error (alarm) indication on the parameter unit display. When the protective function is activated, refer to page 42 on how to reset the converter.



3.1.1 Error (alarm) definitions and remedies

Parameter Unit Display (Note 4)		Definition	Cause	Check Point	Remedy
Stedy Spd Oc	E.OC2	Overcurrent protection	If the input current exceeds a given level during operation of the high power factor converter, the operations of the high power factor converter and inverter are stopped.	Check for sudden load variation.	Eliminate sudden variation. Change the fan, remove a fan obstacle. (Note 1)
Inv. Overload	E.THT	Electronic overload protection	To protect the IPM, the electronic overload protection is activated in response to the high power factor converter input according to the inverse-time characteristics to stop the operations of the high power factor converter and inverter.	Check for overload on motor. Check for low carrier frequency on inverter side. (Note 3)	Reduce load weight. Increase the high power factor converter capacity.
Stedy Spd Oc	E.OC3	Main circuit device heat	If the main circuit devices are heated due to cooling fan stop, overload, etc., the high power factor converter is stopped.	Check for overload.	Reduce load weight. Change the fan.
Corrupt Memory	E. PE	Parameter error	If any stored parameter error occurs, the operations of the high power factor converter and inverter are stopped.	Check if parameters are written too many times.	Change the high power factor converter.
Retry No. Over	E.rET	Retry count excess	If proper operation cannot be resumed within the given number of retries, the outputs of the high power factor converter and inverter are stopped.	Find the fault cause.	
Inst. Pwr. Loss	E. IPF	Instantaneous power failure protection	If power is restored within about 100ms after a power failure of longer than 15ms, the operations of the high power factor converter and inverter are stopped.	Find the instantaneous power failure cause.	
		Power supply fault	If cable disconnection or other power supply fault has occurred, the outputs of the high power factor converter and inverter are stopped.	Check for power cable disconnection.	
CPU Fault	E.CPU	CPU error	If the CPU arithmetic does not end within a given period, the operations of the high power factor converter and inverter are stopped.		
Under Voltage	E.UVT	Undervoltage protection	If the DC bus voltage falls below 150VAC (300VAC for 400V class), the operations of the high power factor converter and inverter are stopped.	Check for a start of large-capacity motor.	Check power supply system equipment, e.g. power capacity.
Option Fault	E.OPT	Option fault	Displayed during error retry.		

Note: 1.This alarm does not occur if the cooling fan stops, but it will occur to prevent the main circuit devices from overheating due to the cooling fan stopping.

2.If the alarm is still displayed on the parameter unit after remedy, the internal circuit may be faulty. Consult your sales representative.

3.For the E.THT error, the electronic overcurrent protection of the inverter should activate earlier than that of the high power factor converter. However, the inverter's electronic overcurrent protection "E.THT" has the property that it is activated earlier at a higher carrier frequency and later at a lower carrier frequency. Therefore, when the carrier frequency of the inverter is low, the electronic overcurrent protection of the high power factor converter may be activated earlier.

4.Displayed on the FR-PU02E-1 (option) and is not displayed on the FR-PU03E (option).

3.1.2 Faults and check points

Fault	Check Point
Unit does not operate properly.	Checking the connections • Check that wiring is correct. • Check that proper power supply voltage is applied. • Check that phase sequence is correct. ↳When phase sequence is correct, check that terminals SOF-SD or terminals RES-SD are connected.
POWER lamp is not lit.	Checking the connections • Check that connections are correct. • Check that control circuit terminals R, S, T are wired correctly. • Check for damaged resistor in the external box.
Charge lamp is not lit.	Checking the connections • Check that connections are correct. • Check that main circuit terminals R4, S4, T4 are wired correctly.
Reactors become unusually hot.	Checking the connections • Check that the reactors 1 and 2 are connected in correct sequence.
Inverter is inoperative.	Checking the settings • Check that the parameter setting of the inverter is correct. (Since the parameter setting method varies with the inverter series, refer to the inverter instruction manual.)
Reactors generate unusual noise.	Check that phase sequence is correct.

3.2 MAINTENANCE AND INSPECTION

The high power factor converter is a static unit consisting mainly of semiconductor devices. Daily inspection must be performed to prevent any fault from occurring due to adverse influence by the installation environment, such as temperature, humidity, dust, dirt and vibration, changes in the parts with time, service life, and other factors.

3.2.1 Precautions for maintenance and inspection

For some short time after the power is switched off, the smoothing capacitor remains at a high voltage. Before accessing the high power factor converter for inspection, make sure that the charge lamp is off and check that the voltage across the main circuit terminals P-N of the high power factor converter is 30VDC or less using a tester, etc. (For the location of the charge lamp, see the terminal block arrangement on page 60.)

⚠ CAUTION

⚠ The reactors 1 and 2 are hot. Take care not to get burnt.

3.2.2 Check items

(1) Daily inspection

- Check the following during operation:
  (1) Improper installation environment
  (2) Cooling system fault
  (3) Unusual vibration and noise
  (4) Unusual overheat and discoloration
- During operation, check the input voltage of the high power factor converter using a tester.

(2) Periodic maintenance and inspection

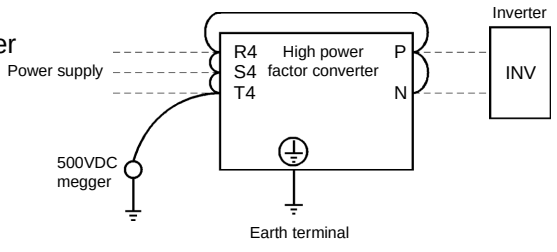
- Check the areas inaccessible during operation and requiring period inspection.
  (1) Cooling system: Clean the air filter, etc.
  (2) Screws and bolts: Check that they are securely tightened and retighten as necessary.
  (3) Conductors and insulating materials: Check for corrosion and damage.
  (4) Insulation resistance: Measure.
  (5) Cooling fan, smoothing capacitor, relay: Check and change if necessary.

Note: Have a proper understanding of the definitions of power and error (alarm) indications provided for the high power factor converter. Also, have a proper understanding of the settings with the parameter unit and record proper set values. (Enter the values into the Customer Setting section of the “Parameter List” on page 31.)

See the next page for the Inspection List.

(3) Insulation resistance test using megger

(1) Before performing the insulation resistance test using a megger on the external circuit, disconnect the cables from all terminals of the high power factor converter so that the test voltage is not applied to the high power factor converter.
(2) For the continuity test of the control circuit, use a tester (high resistance range) and do not use the megger or buzzer.
(3) For the high power factor converter, conduct the insulation resistance test on the main circuit only as shown on the right and do not perform the test on the control circuit. (Use a 500VDC megger.)



Daily and Periodic Inspection

Area of Inspection	Inspection Item	Description	Interval			Method	Criterion	Instrument	Customer setting
			Daily	Periodic					
				1 year	2 years				
General	Surrounding environment	Check ambient temperature, humidity, dust, dirt, etc.	○			See note on page 13.	Ambient temperature: -10°C to +50°C, non-freezing. Ambient humidity: 90% or less, non-condensing.	Thermometer, hygrometer, recorder	
	Overall unit	Check for unusual vibration and noise.	○			Visual and auditory checks.	No fault.		
	Power supply voltage	Check that main circuit voltage is normal.	○			Measure voltage across high power factor converter terminals R, S, T-P4, S4, T4.	170 to 242V (323 to 506V) 50Hz 170 to 253V (323 to 506V) 60Hz	Tester, digital multimeter	
Main circuit	General	(1) Check with megger (across main circuit terminals and ground terminal). (2) Check for loose screws and bolts. (3) Check for overheat on each part. (4) Clean.		○ ○ ○	○	(1) Disconnect all cables from high power factor converter and measure across terminals R4, S4, T4, P, N and ground terminal with megger. (2) Retighten. (3) Visual check.	(1) 5MΩ or more. (2), (3) No fault.	500VDC class megger	
	Conductors, cables	(1) Check conductors for distortion. (2) Check cable sheaths for breakage. (3) Check for discoloration.		○ ○		(1), (2) Visual check.	(1), (2) No fault.		
	Terminal block	Check for damage.		○		Visual check	No fault		
	Converter module	Check resistance across terminals.			○	Disconnect cables from converter and measure across terminals R4, S4, T4⇔P, N with tester ×1Ω range.	(See the next page.)	Analog tester	
	Smoothing capacitor	(1) Check for liquid leakage. (2) Check for safety valve projection and bulge. (3) Measure electrostatic capacity.	○ ○	○		(1), (2) Visual check. (3) Measure with capacity meter.	(1), (2) No fault. (3) 85% or more of rated capacity.	Capacity meter	
	Relay	(1) Check for chatter during operation. (2) Check for rough surface on contacts.		○ ○		(1) Auditory check. (2) Visual check.	(1) No fault. (2) No fault.		
	Resistor	(1) Check for crack in resistor insulation. (2) Check for open cable.		○ ○		(1) Visual check. Cement resistor, wirewound resistor. (2) Disconnect one end and measure with tester.	(1) No fault. (2) Error should be within ±10% of indicated resistance value.	Tester, digital multimeter	
Cooling system	Cooling fan	(1) Check for unusual vibration and noise. (2) Check for loose connection.	○	○		(1) Turn by hand with power off. (2) Retighten.	(1) Smooth rotation. (2) No fault.		
Display	Display	(1) Check for power lamp blown. (2) Clean.	○	○		(1) Lamps indicate indicator lamps on panel. (2) Clean with rag.	(1) Check that lamps are lit.		
	Meter	Check that reading is normal.	○			Check reading of meters on panel.	Must satisfy specified and management values.	Voltmeter, ammeter, etc.	

Note:Values for the 400V class are indicated in parentheses.

- **Checking the converter module**

<Preparation>

(1) Disconnect the external power supply cables (R4, S4, T4, N, P).

(2) Prepare a tester. (Use 1 Ω range.)

<Checking method>

Change the polarity of the tester alternately at the main circuit terminals R4, S4, T4, P and N of the converter, and check for continuity.

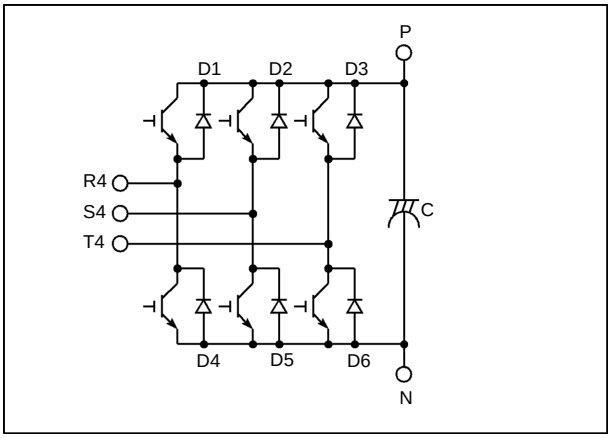
Note: 1.Before measurement, check that the smoothing capacitor is discharged.

2.At the time of discontinuity, the measured value indicated is a nearly infinite value. Due to the influence of the smoothing capacitor, continuity may be instantaneously established and infinite not indicated. At the time of continuity, the measured value is several to several ten ohms depending on the module type, tester type, etc. If all measured values are almost the same, the modules are without fault.

<Module device numbers and terminals to be checked>

		Tester Polarity		Measured Value
		⊕	⊖	
Converter module	D1	R4	P	Discontinuity
		P	R4	Continuity
	D2	S4	P	Discontinuity
		P	S4	Continuity
	D3	T4	P	Discontinuity
		P	T4	Continuity
	D4	R4	N	Continuity
		N	R4	Discontinuity
	D5	S4	N	Continuity
		N	S4	Discontinuity
	D6	T4	N	Continuity
		N	T4	Discontinuity

(Assumes the use of an analog meter.)



3.2.3 Replacement of parts

The high power factor 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 failure of the high power factor converter. For preventive maintenance, the parts must be changed periodically.
See the following table for the high power factor converter parts replacement guide. Lamps and other short-life parts must also be changed during periodic inspection.

Replacement Parts of the High Power Factor Converter

Part Name	Standard Replacement Interval	Description
Cooling fan	2 to 3 years	Change (as required)
Smoothing capacitor in main circuit	5 years	Change (as required)
Smoothing capacitor on control board	5 years	Change the board (as required).
Relays	–	Change as required.

Note:For part replacement, contact the nearest Mitsubishi FA center.

(1) Cooling fan

The cooling fan cools heat-generating parts such as the main circuit semiconductor devices. The life of the cooling fan bearing is usually 10,000 to 35,000 hours. Hence, the cooling fan must be changed every 2 to 3 years if the high power factor converter is run continuously. When unusual noise and/or vibration is noticed during inspection, the cooling fan must be changed immediately.

(2) Smoothing capacitors

A large-capacity aluminum electrolytic capacitor is used for smoothing the DC in the main circuit, and an aluminum electrolytic capacitor is also used for stabilizing the control power in the control circuit. Their characteristics are adversely affected by ripple current, etc. When the high power factor converter is operated in ordinary, air-conditioned environment, change the capacitors about every 5 years.
When 5 years have 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).
Check the following:

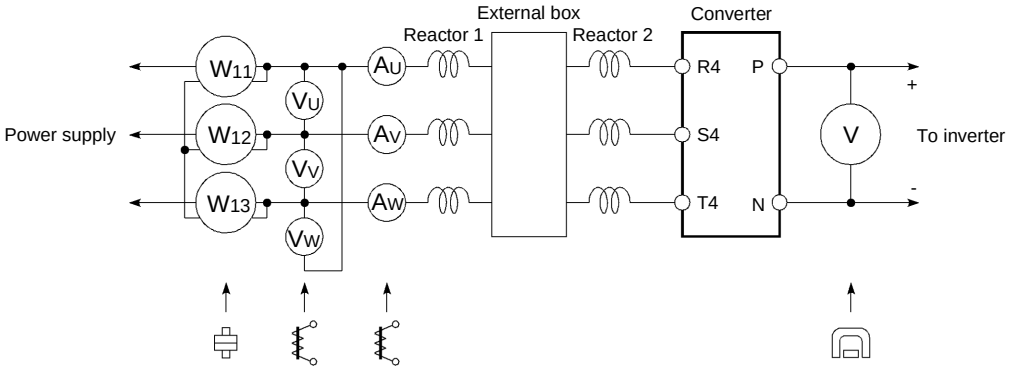
1) Case (side faces and bottom face for expansion)
2) Sealing plate (for remarkable warp and extreme crack)
3) Explosion-proof valve (for excessive valve expansion and operation)
4) Appearance, external crack, discoloration, leakage.
   When the measured capacitance of the capacitor has reduced below 85% of the rating, change the capacitor. For capacitance measurement, it is recommended to use a handy device available on the market.

(3) Relays

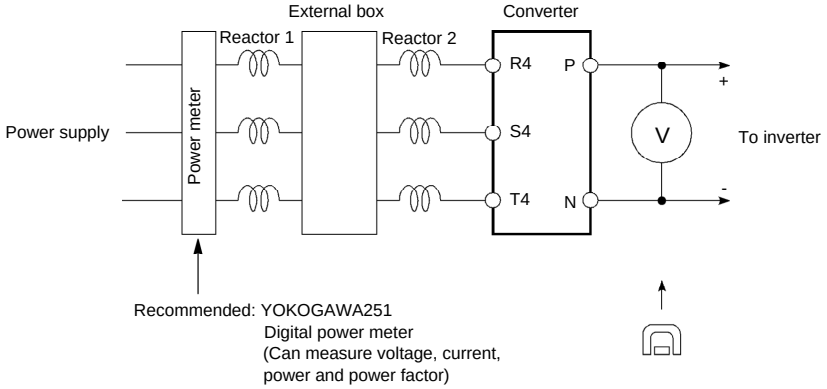
To prevent a contact fault, etc., relays must be changed according to the number of accumulative switching times (switching life).

3.2.4 Measurement of main circuit voltages, currents and powers

- Measurement of voltages and currents
  When instruments for commercial frequency are used for measurement, measure the following circuits using the following instruments.
- When installing instruments, etc. on the high power factor converter output side
  When the wiring distance is long between the high power factor converter and inverter, the instruments may generate heat due to line leakage currents in especially 400V class. Select the devices which have large enough current rating.
- There is an output voltage across terminals P-N of the high power factor converter and this voltage can be measured by a moving-coil instrument (tester). This voltage varies with the power supply voltage and reduces when load is applied.



<Typical Measuring Points and Instruments>

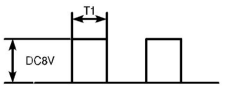


<Typical Measuring Points and Instruments>

- Classification and Application of Indicating Electric Instruments by Operation Principle

Type		Symbol	Principle	Indication	Applied Instrument	Features
Moving-coil type			Uses force working between the magnetic field of a permanent magnet and a current flowing in the moving coil.	DC (Mean value)	Voltmeter, ammeter, resistance meter, thermometer, flux meter, speed meter	High in sensitivity and most often used. Power consumption small, rarely affected by external magnetic field.
Moving-iron type			Uses force working between the magnetic field of a current flowing in the fixed coil and the moving iron.	AC (Effective value)	Voltmeter, ammeter	Rigid in structure and low in price. Greatly affected by external magnetic field, frequency and waveform.
Electrodynamic type	Air core		Uses force working between currents flowing in two coils.	AC/DC (Effective value)	Wattmeter, voltmeter, ammeter	Wattmeter is graduated equally. Affected by external magnetic field and consumes large power. May be used as a standard AC/DC instrument.

Measuring Points and Instruments

Item	Measuring Point	Measuring Instrument	Remarks (Reference Measured Value)*	
Power supply voltage V1	Across R-S, S-T and T-R	Moving-iron type AC voltmeter	Commercial power supply 170 to 242V (342 to 506V) 50Hz 170 to 253V (342 to 506V) 60Hz	
Power supply side current I1	R, S and T line currents	Moving-iron type AC ammeter		
Power supply side power P1	At R, S and T, and across R-S, S-T and T-R	Electrodynamic type single-phase wattmeter	P_1=W11+W12+W13 (3-wattmeter method)	
Power supply side power factor Pf1	Calculate after measuring power supply voltage, power supply side current and power supply side power. $Pf_1=\frac{P_1}{\sqrt{3}V_1 \times I_1} \times 100\%$			
Converter output	Across P-N	Moving-coil type (such as tester)	Inverter LED display is lit. 1.35 × V1 Max. 380V (760V) during regenerative operation	
Meter signal	Across FM(+)-SD	Moving-coil type (Tester, etc. may be used) (Internal resistance: 50kΩ or larger)	Approx. 5VDC at max. frequency (without meter)  Pulse width T1: Adjusted with Pr. 900	SD is common.
			Approx. 10VDC at maximum frequency (without frequency meter)	
			20 to 30VDC when open. ON voltage: 1V or less	
Alarm signal	Across A-C Across B-C	Moving-coil type (such as tester)	Continuity check <Normal> <Fault> Across A-C: Discontinuity Continuity Across B-C: Continuity Discontinuity	

Note 1: Do not use a tester because accurate data will not be obtained.
* Values in parentheses indicate those for 400V class.

4. PRECAUTIONS FOR SELECTION

This chapter provides details on “precautions for selection” in using this product.
Always read the precautions, etc. before starting use.

4.1 PRECAUTIONS FOR SELECTING PERIPHERAL DEVICES

4.1.1 Measures against noises

In this section, noises indicate those of more than 40th to 50th high frequencies in a power distribution system, which assume generally irregular conditions.
Some noises enter the high power factor converter to adversely affect it and others are radiated by the high power factor converter to adversely affect peripheral devices. Though the high power factor converter is designed to be immune to noises, it handles low-level signals, so it requires the following basic measures to be taken. Also, since the high power factor converter chops output voltage at high carrier frequency, it could generate noises. If these noises affect peripheral devices, measures should be taken to suppress noises. The measures differ slightly depending on noise propagation paths.

1) Basic measures

- Do not run the power cables (I/O cables) and signal cables of the high power factor converter in parallel with each other and do not bundle them.
- Use twisted shield cables for the detector connecting and control signal cables and connect the screen of the shield cables to terminal SD.
- Ground the reactors 1, 2, external box, high power factor converter, inverter, motor, etc. at one point.

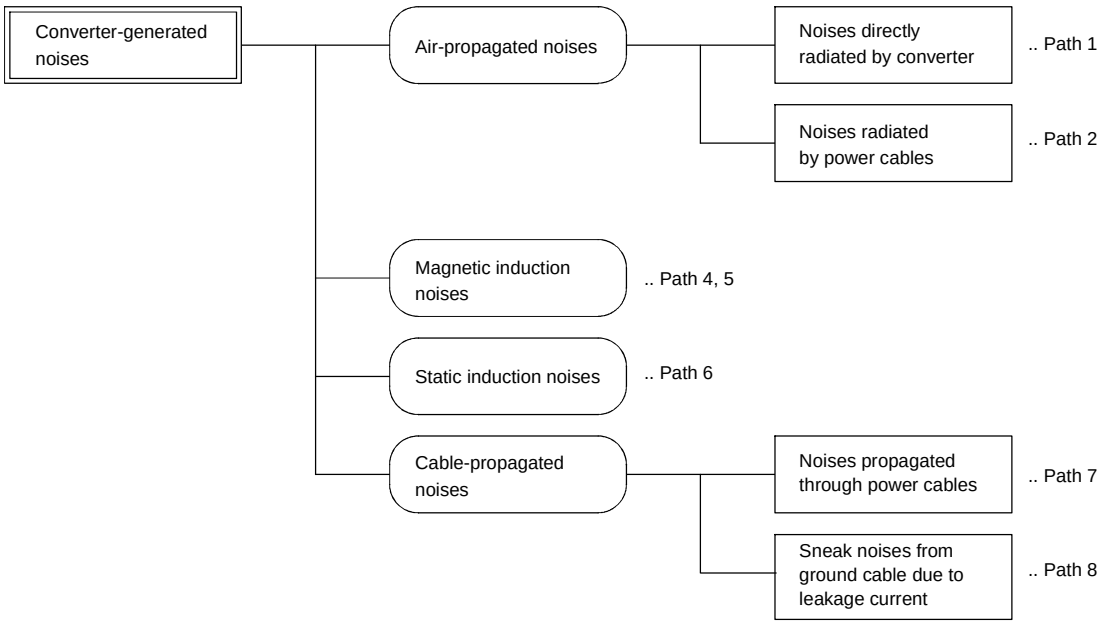
2) Measures against noises which enter and affect the high power factor converter

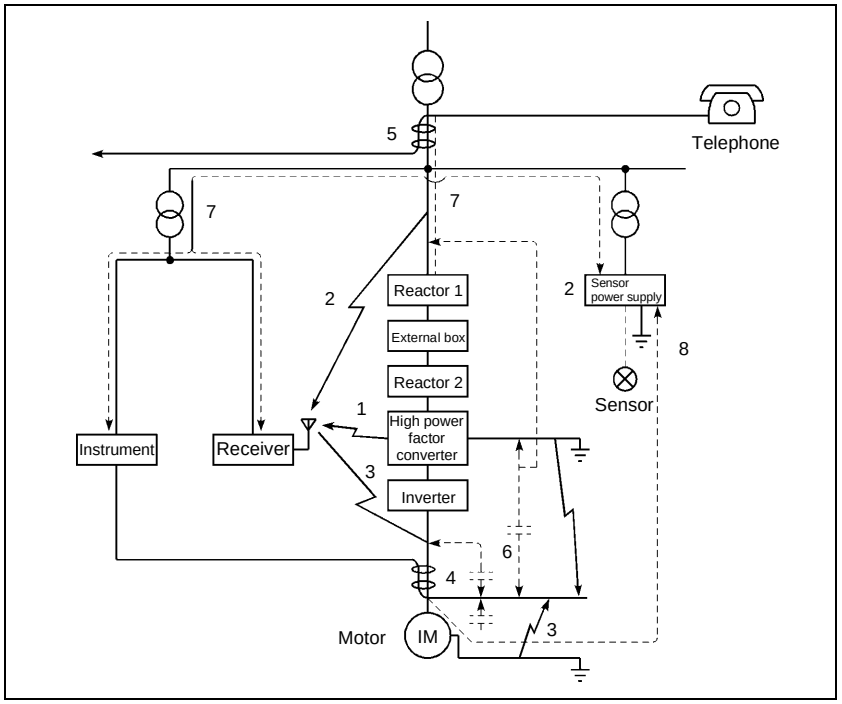
When devices which generate many noises (which use magnetic contactors, magnetic brakes, many relays, for example) are installed near the high power factor converter and the high power factor converter may be affected by noises, the following measures must be taken:

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

3) Measures against noises which are radiated by the high power factor converter to affect peripheral devices

Noises generated by the high power factor converter are largely classified into those radiated by the cables connected to the high power factor converter and high power factor converter's main circuit (I/O), those electromagnetically and electrostatically inducted to the signal cables of the peripheral devices close to the main circuit power supply, and those transmitted through the power supply cables.



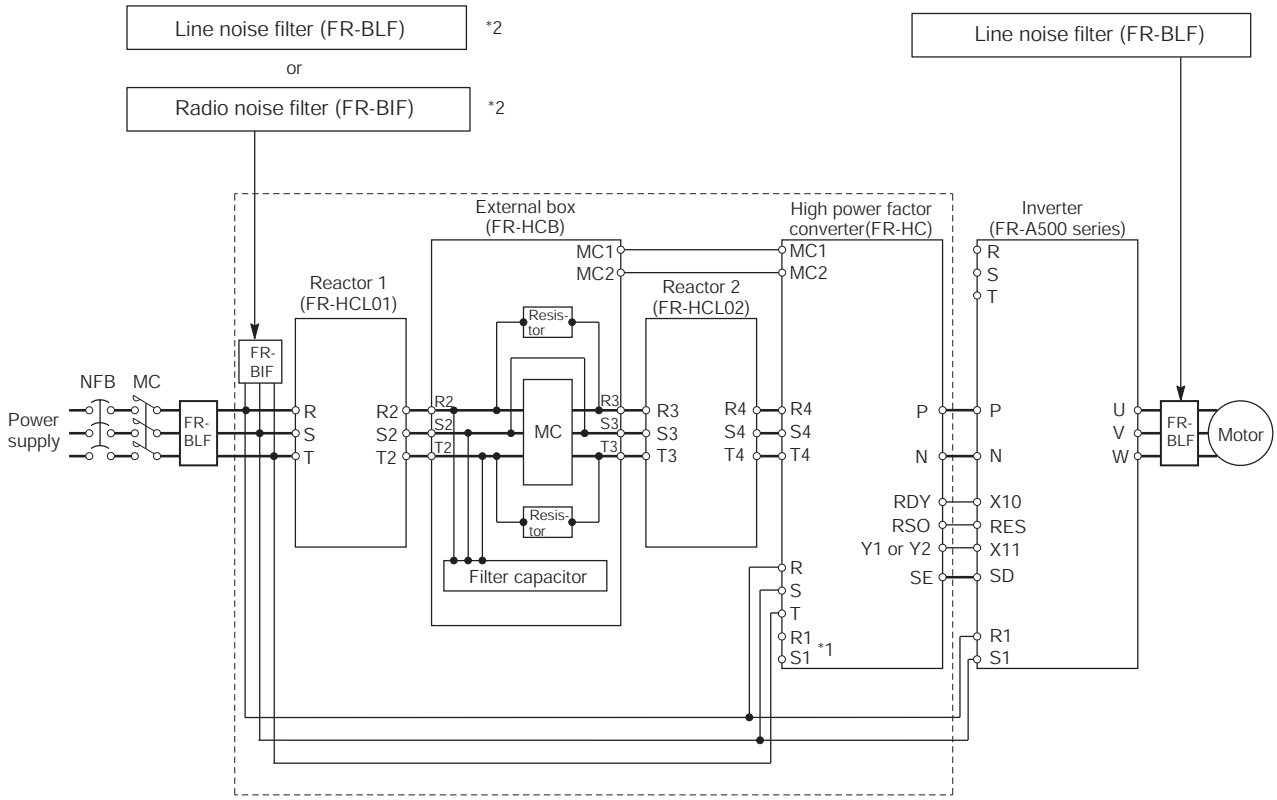


Noise Path	Measures
1, 2, 3	When devices which handle low-level signals and are susceptible to noises (such as instruments, receivers and sensors) are installed near the high power factor converter and their signal cables are contained in the same panel as the high power factor converter or are run near the high power factor converter, the devices may be affected by air-propagated noises and the following measures must be taken: (1) Install easily affected devices as far away from the high power factor converter and inverter as possible. (2) Run easily affected signal cables as far away from the high power factor converter and inverter as possible. (3) Do not run the signal cables and power cables (high power factor converter I/O cables) in parallel with each other and do not bundle them. (4) Insert line noise filters into I/O and radio noise filters into cables input to suppress cable-radiated noises. (5) Use shield cables for signal cables and power cables and run them in individual metal conduits to produce further effects.
4, 5, 6	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 affect the devices and the following measures must be taken: (1) Install easily affected devices as far away from the high power factor converter and inverter as possible. (2) Run easily affected signal cables as far away from the high power factor converter and inverter as possible. (3) Do not run the signal cables and power cables (high power factor converter and inverter I/O cables) in parallel with each other and do not bundle them. (4) Use shield cables for signal cables and power cables and run them in individual metal conduits to produce further effects.
7	When the power supplies of the peripheral devices are connected to the power supply of the high power factor converter in the same line, high power factor converter-generated noises may flow back through the power supply cables to the devices and the following measures must be taken: (1) Install the radio noise filter (FR-BIF) to the power cables (Input cables) of the high power factor converter. (2) Install the line noise filter (FR-BLF) to the power cables (I/O cables) of the high power factor converter.
8	When a closed loop circuit is formed by connecting the peripheral device wiring to the high power factor converter, leakage current may flow through the ground cable of the high power factor converter to affect the device. In such a case, disconnection of the ground cable of the device may cause the device to operate properly.

4) Using options to suppress noises

To suppress noises radiated by cables, the radio noise filter (FR-BIF) and line noise filter (FR-BLF) are available. (Refer to page 68.) For more information, refer to the corresponding manual.

- Example (FR-A500)



*1 Keep terminals R1, S1 of the high power factor converter unconnected.

*2 Inserting a filter in front of terminal R, S, T of the high power factor converter will produce more effective noise reduction. Refer to the noise filter manual for installation procedure of the noise filter.

4.1.2 Peripheral device list

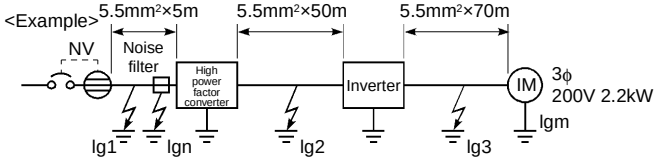
Voltage	High Power Factor Converter Type	No-fuse breaker (NFB note 1) or leakage breaker (NV) (note 2)	Magnetic Contactor (MC)
200V class	FR-HC-7.5K	50AF 50A	S-N35
	FR-HC-15K	100AF 75A	S-N65
	FR-HC-30K	225AF 125A	S-N125
	FR-HC-55K	225AF 225A	S-N220
400V class	FR-HC-H7.5K	30AF 30A	S-N20
	FR-HC-H15K	50AF 50A	S-N25
	FR-HC-H30K	100AF 75A	S-N65
	FR-HC-H55K	225AF 125A	S-N125

Note: 1. Select the NFB according to the capacity of the high power factor converter and install one NFB per high power factor converter.
2. For installations in the United States or Canada, the circuit breaker must be inverse time or instantaneous trip type.
3. When the breaker on the primary side of the high power factor converter tripped, check for wiring fault (e.g.short circuit), damage to internal parts of the inverter (high power factor converter), etc. Identify the cause of the breaker trip, then power on the breaker after removing the cause of the trip.

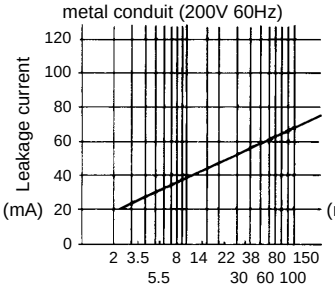
4.1.3 Selecting the rated sensitivity current for the earth leakage circuit breaker

When using the earth leakage circuit breaker with the inverter circuit, select its rated sensitivity current as follows:

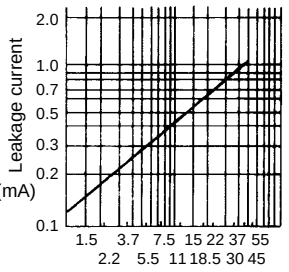
- Breaker for harmonic and surge
  Rated sensitivity current: $I\Delta n > 10\times(Ig1+Ig2+Ig3+Igm)$
- Standard breaker
  Rated sensitivity current:
  $I\Delta n > 10\times\{Ig1+Ign+Ig2+3\times(Ig3+Igm)\}$
  where, Ig1, Ig2, Ig3:leakage currents of cable path during commercial power supply operation
  Ign* :leakage current of noise filter on converter input side
  Igm :leakage current of motor during commercial power supply operation



Example of leakage current per 1km in cable path during commercial power supply operation when the CV cable is routed in metal conduit (200V 60Hz)



Leakage Current Example of 3-Phase Induction Motor during Commercial Power Supply Operation (200V 60Hz)



Note: 1. Install the NV on the primary (power supply) side of the power return common converter.
2. Ground fault on the output side of the inverter can be detected at the running frequency of 120Hz or lower.
3. In the ⅄ connection neutral point grounded system, the sensitivity current becomes worse for ground faults in the inverter secondary side. Hence, the protective grounding of the load equipment should be class C grounding (10 Ω or less).
4. When the breaker is installed in the secondary side of the inverter, it may be unnecessarily operated by harmonics if the effective value is less than the rating. In this case, do not install the breaker since the eddy current and hysteresis loss increase and the temperature rises.
5. The following models are standard breakers Type BV-C1, BC-V, NVB, NV-L, NV-G2N, NV-G3NA, NV-2F type leakage current relay (except for NV-ZHA), NV with AA neutral wire open-phase protection
The following models are for harmonic surge
NV-C/NV-S/MN series, NV30-FA, NV50-FA, BV-C2, leakage current alarm breaker (NF-Z), NV-ZHA, NV-H

* Note the leakage current value of the noise filter installed on the high power factor converter input side. (For Mitsubishi's dedicated filters, see page 71.)

Selection Example
(for the diagram shown on the left) (mA)

	Breaker for harmonic and surge	Standard Breaker
Leakage current lg1 (mA)	$33\times\frac{5\,m}{1000\,m}=0.17$	
Leakage current lgn (mA)	0 (without noise filter)	
Leakage current lg2 (mA)	$33\times\frac{50\,m}{1000\,m}=1.65$	
Leakage current lg3 (mA)	$33\times\frac{70\,m}{1000\,m}=2.31$	
Motor leakage current lgm (mA)	0.18	
Total leakage current (mA)	4.31	7.97
Rated sensitivity current (≧lg×10) (mA)	30	100

5. SPECIFICATIONS

This chapter offers details on the “specifications” of this product.
Always read the precautions, etc. before starting use.

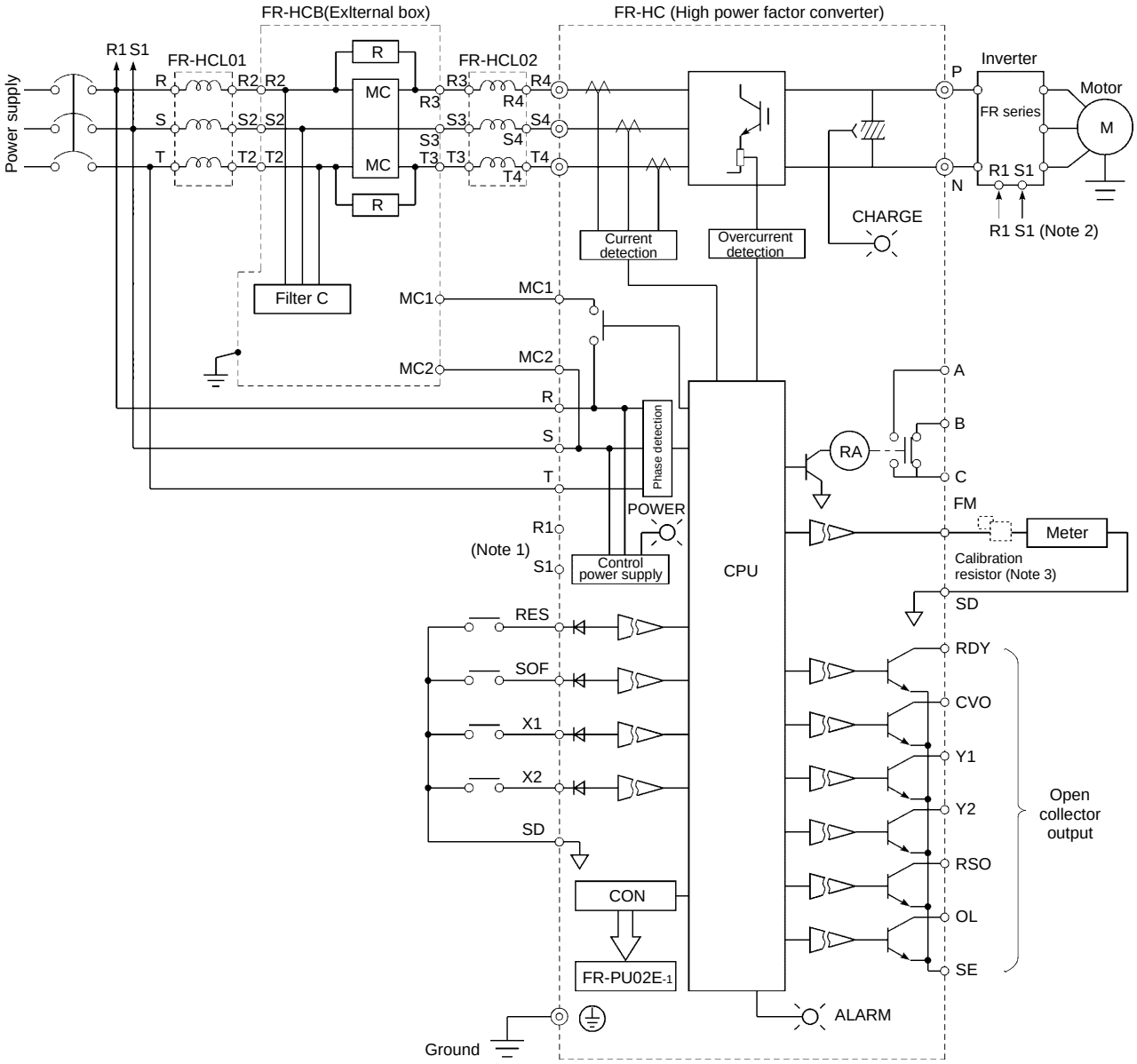
5.1 SPECIFICATIONS

5.1.1 Standard specifications

Input Voltage		200V Class				400V Class			
Type FR-HC-		7.5K	15K	30K	55K	H7.5K	H15K	H30K	H55K
Applicable inverter capacity (W)		7.5K	15K	30K	55K	7.5K	15K	30K	55K
Rated input voltage (V)		Three-phase 200V to 220V 50Hz /200V to 230V 60Hz				Three-phase 380V to 460V 50/60Hz			
Rated input current (A)		33	61	115	215	17	31	57	110
Overload current rating		150% for 1 minute							
Permissible power supply voltage fluctuation		170 to 242V 50Hz, 170 to 253V 60Hz				323 to 506V 50/60Hz			
Permissible power supply frequency fluctuation		±5%							
Input power factor		0.99 or more (for load factor of 100%)							
Protective structure		Enclosed type IP20	Open type IP00			Enclosed type IP20	Open type IP00		
Cooling system		Forced air cooling							
Approx. weight	Unit (kg)	8	15	29	70	9	16	35	72
	Accessory (kg)*	20.3	30.8	66.6	96.3	22.7	31.9	51.3	93.3
Input signal		Reset, converter stop, monitor switching							
Output signal		Inverter run enable signal, converter operating, overload alarm, meter, alarm signal, reset, multi-purpose (two signals selected from among power supply phase detection signal, voltage match, instantaneous power failure detection, and driving/regenerative mode judgment) output							
Control system		High carrier frequency sine-wave PWM control							
Display	Parameter unit	• Power supply frequency, input current, power supply voltage, input power, converter output voltage • Eight alarm definitions are stored.							
Protective function		Power supply fault, overcurrent, device fault, undervoltage, transistor thermal relay (inverter protection)							
Environment	Ambient temperature	-10°C to +50°C (non-freezing)							
	Ambient humidity	90%RH or less (non-condensing)							
	Ambience	Indoors. (No corrosive gases, flammable gases, oil mist, dust and dirt)							
Altitude		1000m or less below sea level							
Vibration		5.9m/s^2 or less							

Note: 1.Select the model carefully.
When using inverters with the high power factor converter, the sum of all inverter capacities should be within the applicable capacity:
Example: Inverter capacities applicable to FR-HC-15K→①FR-A520-15K
②FR-A520-11K+FR-A520-3.5K
2.The 400V class high power factor converters are provided with H in their type codes.
3.The overload current rating % value indicates the ratio of the overload current to the converter's rated input current. For repeated use, it is necessary to wait until the high power factor converter and inverter return to less than the temperature under 100% load.
4.Storage temperature is applicable during a short period, e.g. in transit.
5.When the 400V class converter is used and the power supply voltage fluctuation is outside the range 342V to 484V, the internal transformer setting must be changed. (Refer to page 24.)

5.1.2 Block diagram



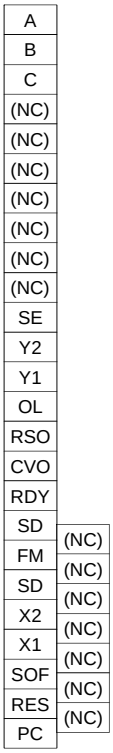
Note: 1.Keep terminals R1, S1 of the high power factor converter unconnected.
2.Except the FR-E500 and A024 series.
3.The parameter unit need not be used for calibration.
This resistor is used for calibration of a remotely located frequency meter. Note that the needle of the frequency meter may not deflect to fullscale when the calibration resistor is connected. In this case, use both the resistor and parameter unit to make calibration.
4.The R, S, T terminals of the high power factor converter (FR-HC) must be connected to the power supply.
Running the inverter without connecting the terminals to the power supply will damage the high power factor converter (FR-HC).

5.1.3 Terminals

Type		Terminal Symbol	Terminal Name	Description		
Main circuit		R, S, T	Power input	Terminals for power supply phase, power voltage detection and control power input. Connect to commercial power supply. Running the inverter without connecting these terminals will damage the high power factor converter (FR-HC).		
		R4, S4, T4	Power input	Connect to reactor 2.		
		P, N	Inverter connection	Connect to P and N terminals of inverter.		
Control ciruit		MC1,CMC2	MC connection	Connect to MC1, MC2 in external box.		
	Input signals	RES	Reset	Function: Converter operation stop (used to return from error)	Circuit: 24VDC sink circuit	Remarks: Operations of converter and all inverters connected are stopped.
		SDF	Converter stop	Converter gate shut-off		RDY signal is open. Inrush MC is closed.
		X1	Monitoring switch-over	Selection of FM output and PU monitor display		• Input current monitor • Bus voltage monitor • Input voltage monitor • Input power monitor
		X2				
		SD	Common terminal	Common terminal (input, FM)	–	
	Output signals	RDY	Inverter run enable signal	Closed only when alarm occurs or reset (RES) signal is input.	Open collector	Inverter is stopped. (RDY signal open: Inverter operative RDY signal closed: Inverter inoperative)
		CVO	Converter operating	Output during IGBT switching		
		OL	Overload alarm	Overcurrent (150% load or more) Overvoltage (output at overvoltage trip-less operation)		
		Y1	Multi-Purpose output terminal	Multi-purpose output External fault		• Power supply phase detection signal • Output voltage match signal detection • Instantaneous power failure detection • Driving/regenerative mode judgment
		Y2				
		RSO	Converter reset	Output when converter is reset.		Inverter is reset.
		FM	Meter connection terminal	Pulse train signal is output in proportion to input current.	PWM pulse output	Depends on setting of X1, X2 terminals.
		SE	Open collector output common	Open collector common	–	
		SD	Contact input common	Common terminal (I/O, FM)	–	
		A, B, C	Alarm conntact	Alarm output	Change-over contact	

Terminal Block for Control Circuit

Common to all models
Structure:2-stage molded terminals
Screw size: M3

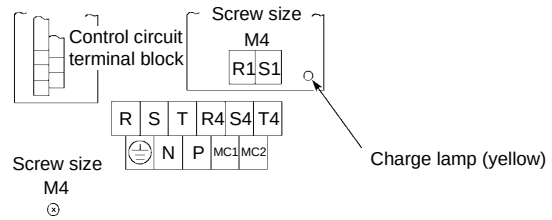


Note: Terminals (NC) are free terminals. Keep them open. Actually, no terminals symbols are printed on these terminals.

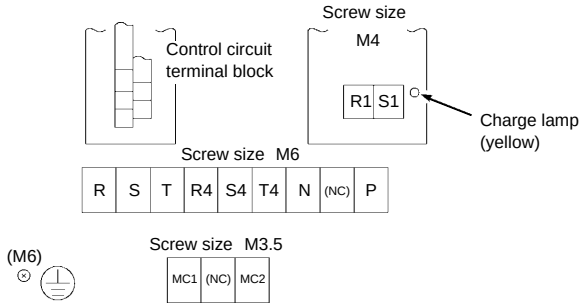
5.1.4 Terminal block arrangement

(1) 200V class

FR-HC-7.5K

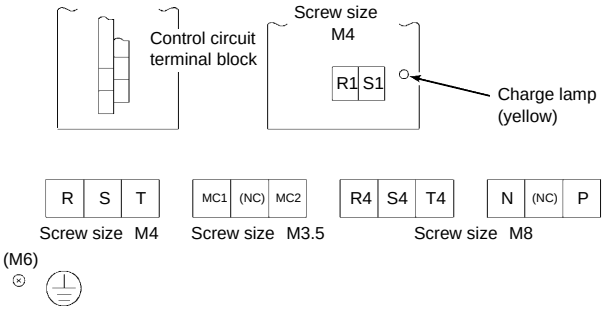


FR-HC-15K

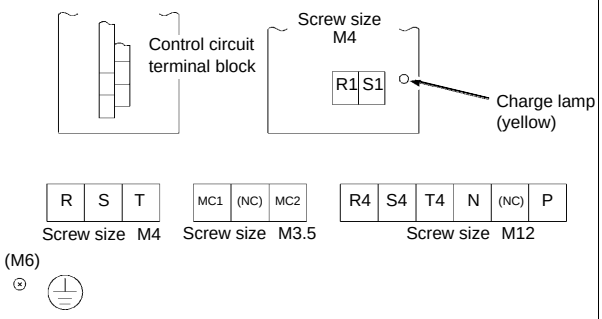


•Terminals MC1, MC2 are located under the terminal symbol cover. Connect terminals MC1, MC2 after removing the terminal symbol cover.

FR-HC-30K

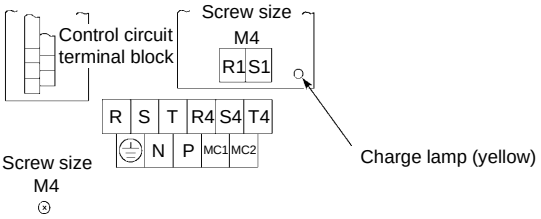


FR-HC-55K

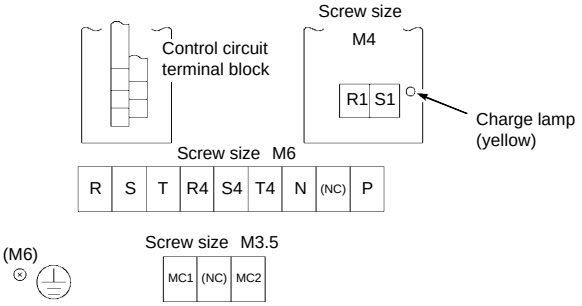


(2) 400V class

FR-HC-H7.5K

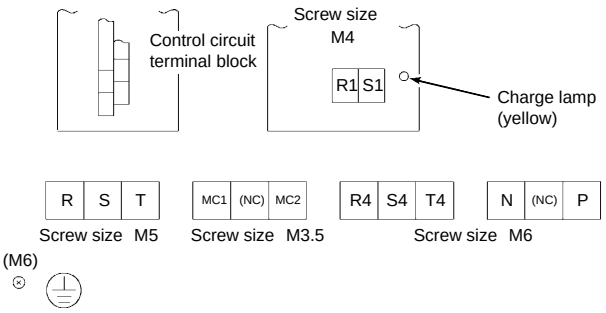


FR-HC-H15K

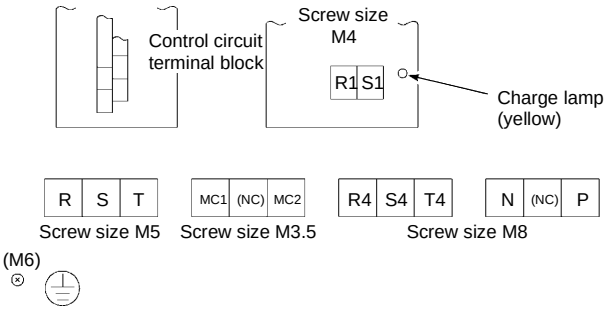


•Terminals MC1, MC2 are located under the terminal symbol cover. Connect terminals MC1, MC2 after removing the terminal symbol cover.

FR-HC-H30K



FR-HC-H55K



Note: Keep the control circuit terminals R1, S1 of the high power factor converter unconnected.

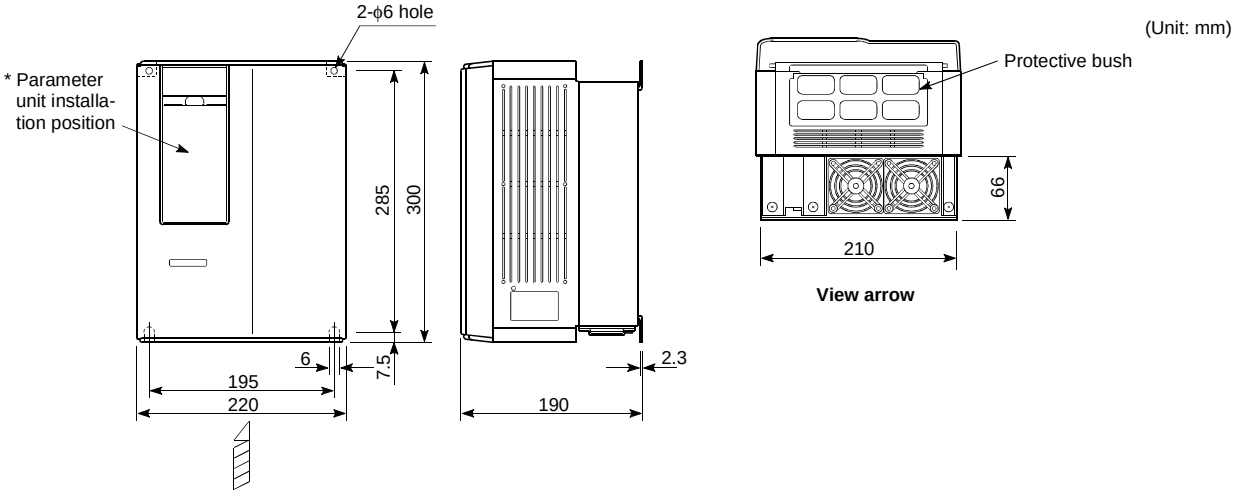
Note: Terminals (NC) are free terminals. Keep them open. Actually, no terminal symbols are printed on these terminals.

5.1.5 Outline drawings (400V class models have H in their type codes)

(1) High power factor converter (FR-HC)

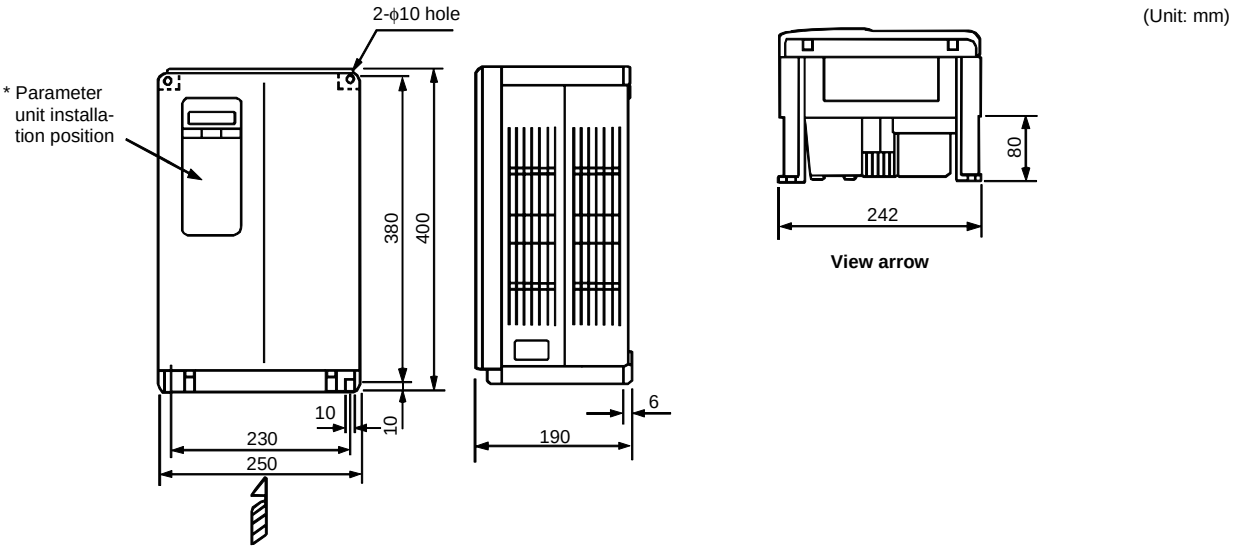
- **FR-HC-7.5K, H7.5K**

(Unit: mm)



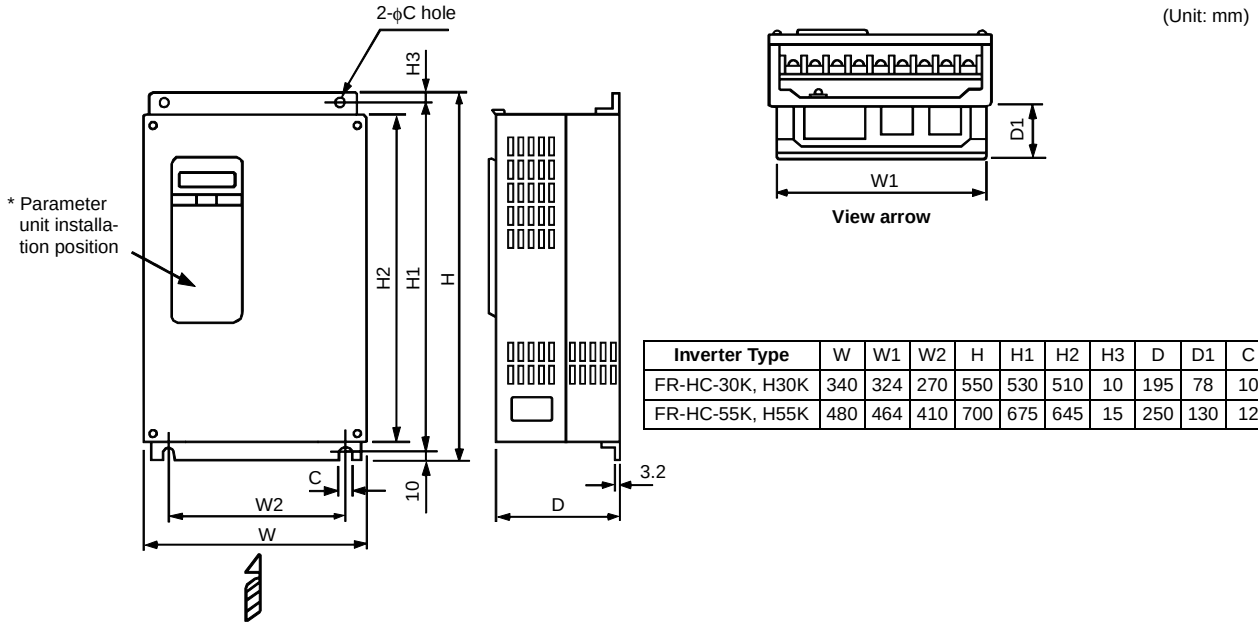
- **FR-HC-15K, H15K**

(Unit: mm)



- **FR-HC-30K, 55K, H30K, H55K**

(Unit: mm)



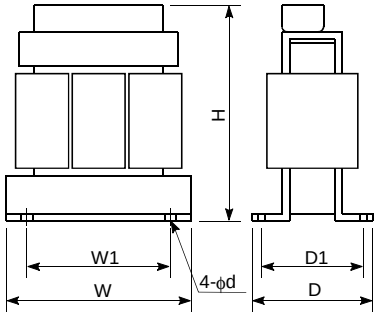
Inverter Type	W	W1	W2	H	H1	H2	H3	D	D1	C
FR-HC-30K, H30K	340	324	270	550	530	510	10	195	78	10
FR-HC-55K, H55K	480	464	410	700	675	645	15	250	130	12

(2) Reactor 1 (FR-HCL01), reactor 2 (FR-HCL02)

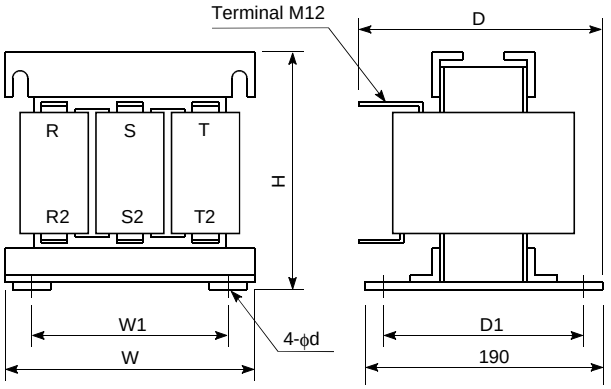
Make sure that the reactors 1 and 2 have the same capacity as the high power factor converter.

1) Reactor 1 (FR-HCL01)

- **FR-HCL01-7.5K to 30K, H7.5K to H55K**



- **FR-HCL01-55K**

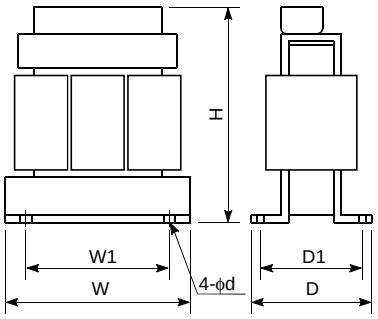


(Unit:mm)

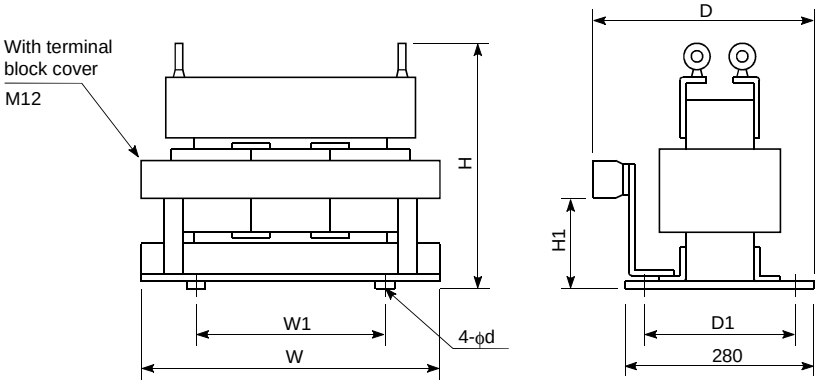
Type		H	W	W1	D	D1	d	Approx. weight (kg)
2	FR-HCL01-7.5K	155	160	145	100	58	5	3.3
0	FR-HCL01-15K	205	190	170	130	73	6	6.0
0	FR-HCL01-30K	230	220	200	170	88	6	10.8
V	FR-HCL01-55K	260	210	165	225	160	8	21.0
4	FR-HCL01-H7.5K	150	160	145	100	65	5	4.2
0	FR-HCL01-H15K	195	190	170	130	80	6	7.2
0	FR-HCL01-H30K	215	220	200	140	90	6	12.0
V	FR-HCL01-H55K	255	280	255	190	112	8	22.5

2) Reactor 2 (FR-HCL02)

- **FR-HCL02-7.5K to 30K, H7.5K to H55K**



- **FR-HCL02-55K**

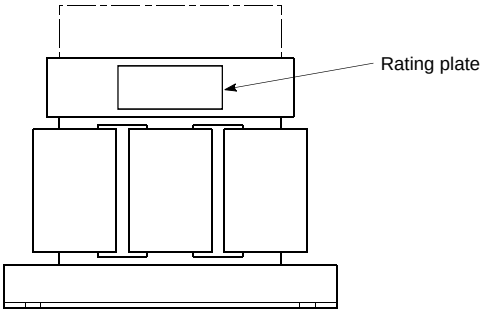


(Unit:mm)

Type		H	H1	W	W1	D	D1	d	Approx. weight (kg)
2	FR-HCL02-7.5K	230	–	240	210	160	110	7	12.8
0	FR-HCL02-15K	270	–	260	230	170	120	7	20.5
0	FR-HCL02-30K	320	–	340	310	180	130	10	37.0
V	FR-HCL02-55K	470	240	430	270	360	240	10	63.0
4	FR-HCL02-H7.5K	220	–	240	210	160	110	7	13.8
0	FR-HCL02-H15K	260	–	260	230	170	120	7	20.5
0	FR-HCL02-H30K	310	–	340	310	180	130	10	35.0
V	FR-HCL02-H55K	380	–	400	270	285	240	10	60.0

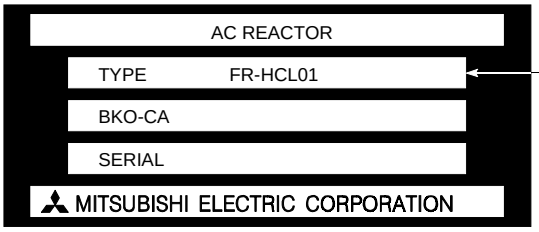
3) Identification of the reactor 1 (FR-HCL01) and reactor 2 (FR-HCL02)

Each reactor has a rating plate. Connect the reactors 1 and 2 carefully. If they are connected in a wrong sequence, they will be hot and it will be hazardous.



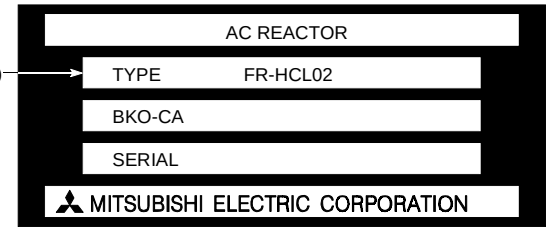
<Data on Rating Plates>

Reactor 1 (FR-HCL01)



(Note)

Reactor 2 (FR-HCL02)



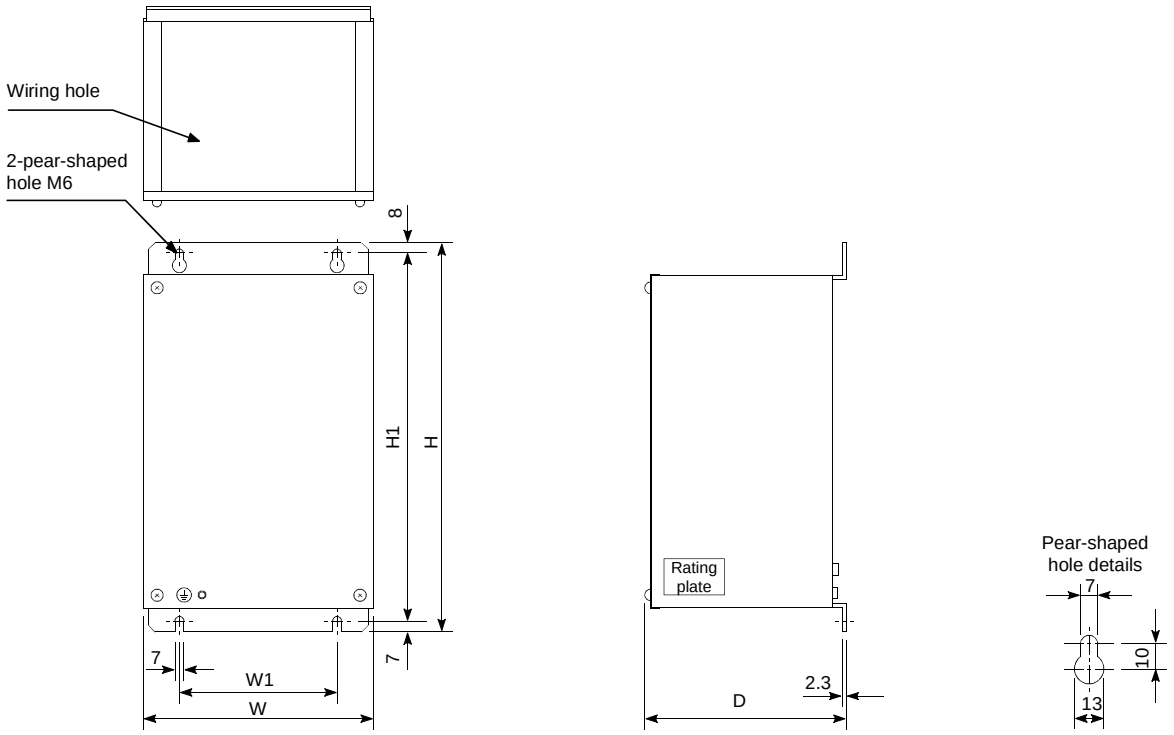
Note: Check this “TYPE” to discriminate between reactors 1 and 2.

(3) External box (FR-HCB)

(Unit: mm)

Type		H	H1	W	W1	D	Approx. weight (kg)
200V	FR-HCB-7.5K	320	305	190	130	165	4.7
	FR-HCB-15K						4.7
	FR-HCB-30K	450	435	270	200	203	9.7
	FR-HCB-55K						12.6
400V	FR-HCB-H7.5K	320	305	190	130	165	5.7
	FR-HCB-H15K						4.7
	FR-HCB-H30K						4.8
	FR-HCB-H55K	450	435	270	200	203	9.9

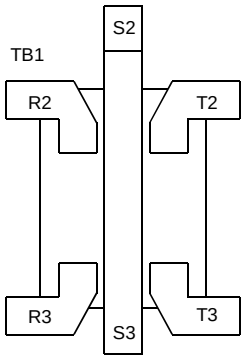
1) Outline

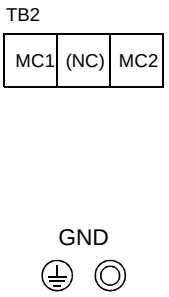


2) Terminal block

(a) FR-HCB-7.5K/15K/H7.5K/H15K/H30K

<Terminal layout>



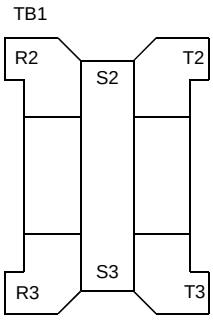


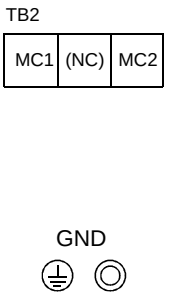
<Terminal screw size>

Type	TB1	TB2	GND
FR-HCB-7.5K/H7.5K	M5	M3.5	M5
FR-HCB-15K/H15K/H30K			

(b) FR-HCB-30K/55K/H55K

<Terminal layout>





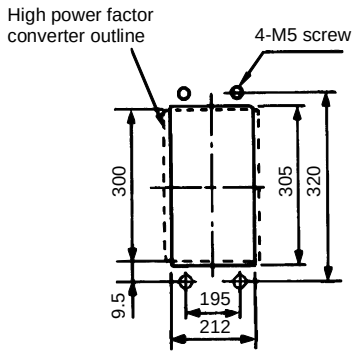
<Terminal screw size>

Type	TB1	TB2	GND
FR-HCB-30K	M6	M3.5	M6
FR-HCB-55K/H55K	M8	M3.5	M6

Note: Terminals (NC) are free terminals. Keep them open. Actually, no terminal symbols are printed on these terminals.

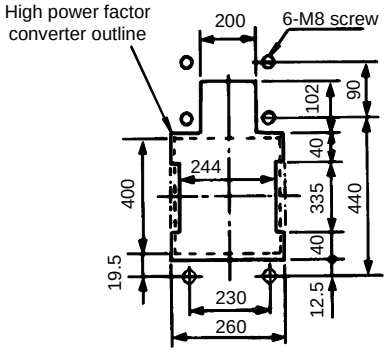
5.1.6 Panel cutting dimension diagrams (For use of the heat sink outside mounting attachment)

•FR-HC-7.5K/H7.5K



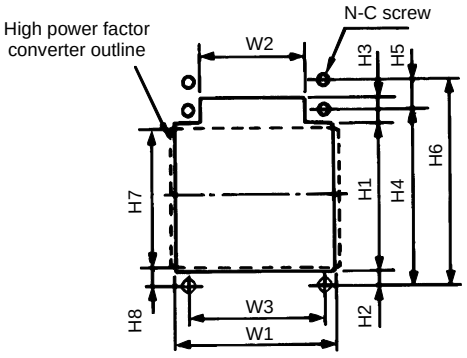
(Unit: mm)

•FR-HC-15K/H15K



(Unit: mm)

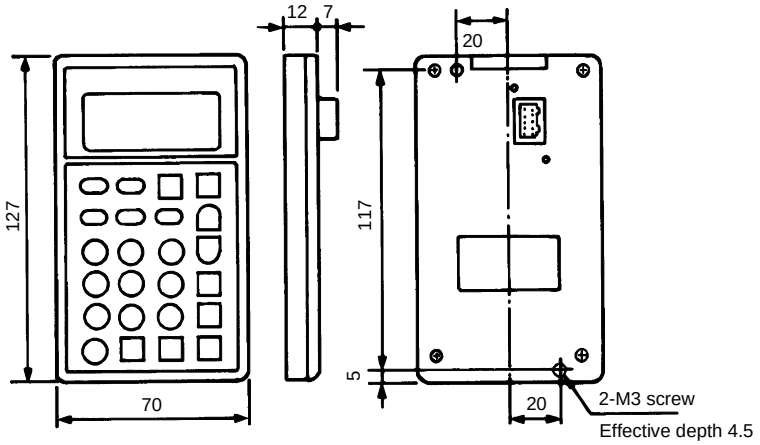
•FR-HC-30K, 55K/H30K, H55K



(Unit: mm)

Inverter Type	W1	W2	W3	H1	H2	H3	H4	H5	H6	H7	H8	N	C
FR-HC-30K, H30K	330	265	290	516	12	95	540	85	–	510	15	6	M8
FR-HC-55K, H55K	470	390	430	650	15	70	–	–	730	645	24.5	4	M10

5.1.7 Parameter unit (FR-PU02-1/FR-PU02E-1/FR-PU02ER-1) dimension diagram



(Unit: mm)

Note: The length of the installation screw should be selected so that it does not exceed the effective installation screw depth of the parameter unit.

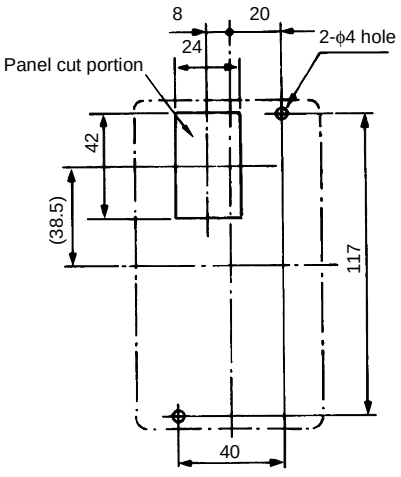
■ FR-PU02E-1 Specifications

Item	Specifications		
Ambient temperature	Operating	-10 to +50°C (Note 1)	
	Storage	-20 to +65°C	
Ambient humidity	90%RH		Non-condensing
Operating ambience	No oil mist and corrosive gases. Minimal dust and dirt.		
Power supply	Power is supplied from the inverter.		
Connection	Loaded to the inverter directly or connected by the cable.		
Display	LCD (liquid crystal display, 13 characters × 4 lines)		
Keyboard	24 keys (covered with polyurethane film)		
Size	127 (H) × 70 (W) × 12 (D)		

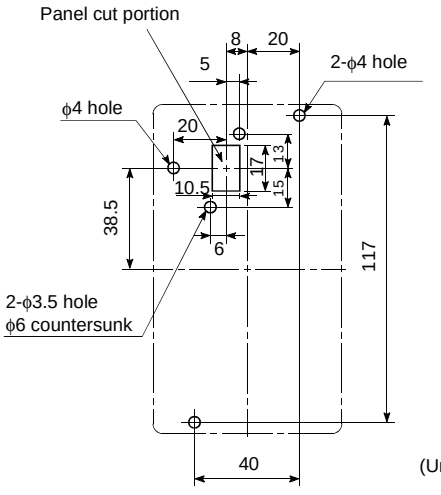
Note: 1. When the temperature is less than about 0°C, the liquid crystal display (LCD) may be slower in operation. And high temperature may reduce the LCD life.
2. Do not expose the liquid crystal display directly to the sun.

■ Panel cutting dimensions for installation of the parameter unit to a panel or the like

- **Parameter unit cable (straight type) is used and is not fixed to the panel**



- **Parameter unit cable (L type) is used and fixed to the panel**



(Unit: mm)

(View as seen from the parameter unit)

5.2 OPTIONS

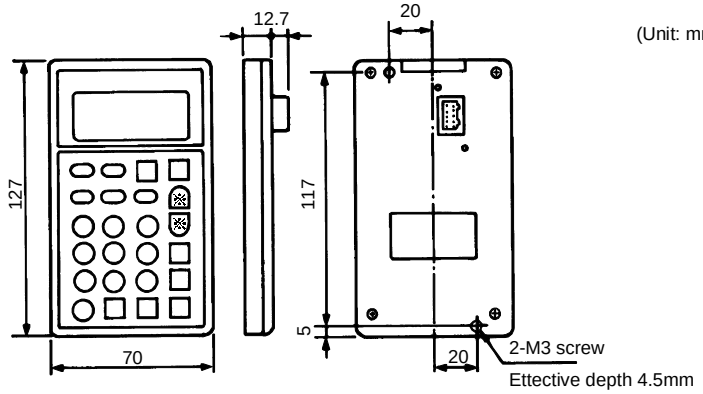
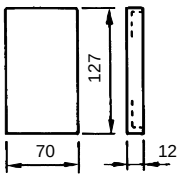
By using the following options, the functions of the high power factor converter can be increased. Make a correct selection.
The following options are all external dedicated option units.

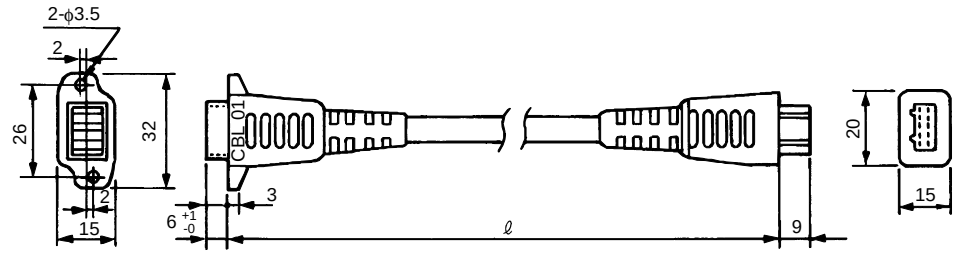
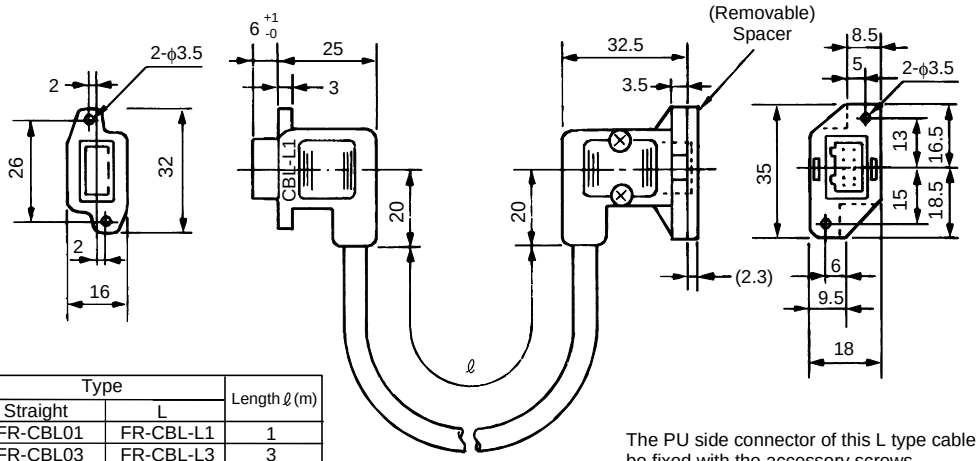
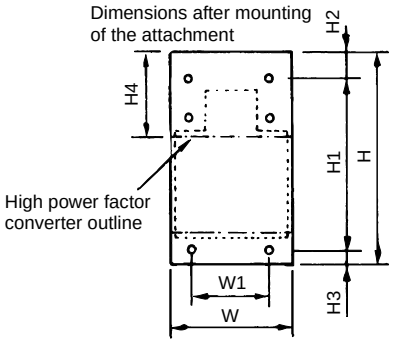
5.2.1 Option list

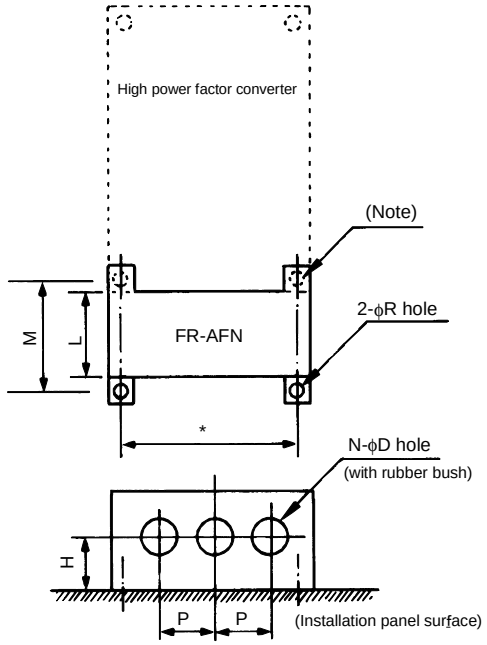
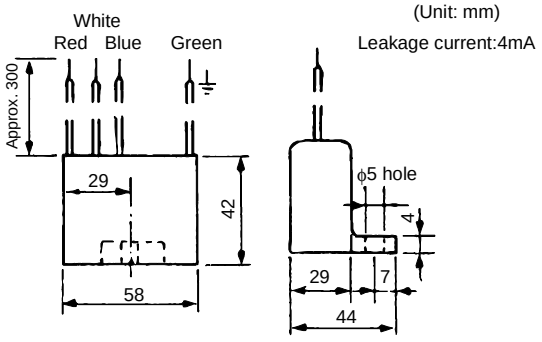
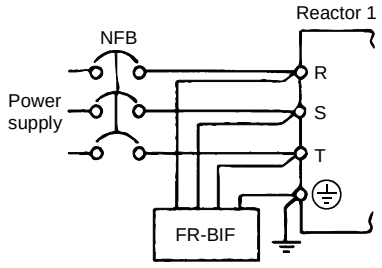
Name	Type	Application, Specifications, Etc.
Parameter unit (Japanese)	FR-PU02-1	Interactive parameter unit using LCD display
Parameter unit (English)	FR-PU02E-1	The LCD display and ten-key pad of the FR-PU02-1 are indicated in English.
Parameter unit (4 languages)	FR-PU02ER-1	For use in English, German, French and Spanish.
Parameter copy unit (Japanese)	FR-ARW-1	Allows parameter settings to be read in batch and copied to the other converter.
Parameter copy unit (English)	FR-ARWE-1	The LCD display and ten-key pad of the FR-ARW-1 are indicated in English.
Parameter copy unit (4 languages)	FR-ARWER-1	For use in English, German, French and Spanish.
Accessory cover	-	Blind cover fitted after the parameter unit is removed from the converter.
Parameter unit cable	FR-CBL□	Cable for connection of the parameter unit or parameter copy unit. Straight or L types are available.
Heat sink outside mounting attachment	FR-ACN□□	Used to place only the heat generating section of the high power factor converter in the back of the control box.
Dirt-protection structure attachment	FR-ACV□□	By installing this option, the high power factor converter meets the totally enclosed structure specifications (IP40).
Conduit connection attachment	FR-AFN□□	Used to connect a conduit pipe directly to the high power factor converter. (IP20)
Radio noise filter	FR-BIF-(H)*	For radio noise reduction
Line noise filter	FR-BLF	For line noise reduction

* 400V class models have H in their type codes.
Note: Not all options are available in all countries, please refer to your Mitsubishi distributor.

5.2.2 External dedicated options

Name (Type)	Specifications, Structure, Etc.	Remarks
Parameter copy unit FR-ARW-1 (Japanese) FR-ARWE-1 (English) FR-ARWER-1 (4 languages)	• Allows parameters set to application to be read in batch and easily written to another high power factor converter. • LCD and ten-key pad representations are available in three ways: Japanese, English and four languages (English, German, French, Spanish). • Outline dimensions are the same as those of the FR-PU02-1 parameter unit. • Can also be used as the parameter unit. (Unit: mm)  * The keys marked have different functions from those for the FR-PU02(E)-1.	
Accessory cover	• When the parameter unit is removed from the high power factor converter, this cover is fitted to that position. ποσιΑτιον • This cover can be fitted and removed by a single action. (Unit: mm)  	This cover is supplied to the model which is not equipped with the parameter unit.

Name (Type)	Specifications, Structure, Etc.
Parameter unit cable FR-CBL☐	Straight type (Unit: mm) High power factor converter side Parameter unit side  L shape type High power factor converter side Parameter unit side  The PU side connector of this L type cable can be fixed with the accessory screws. Type / Straight / L / Length ℓ (m) FR-CBL01 / FR-CBL-L1 / 1 FR-CBL03 / FR-CBL-L3 / 3 FR-CBL05 / FR-CBL-L5 / 5
Heat sink outside mounting attachment FR-ACN☐☐	• By using this attachment, the heat sink acting as the heat generator of the high power factor converter can be placed at the back of the control box. Since the converter-generated heat can be dissipated to the outside of the control box, the control box can be made compact. • For the mounting state and panel cut dimensions, see the outline drawing (page 66). Note: Since the cooling fan exists in the cooling section placed out of the box, do not use this attachment in environments subjected to water drops, oil mist, dust, etc. Type / Applicable High Power Factor Converter (200V class / 400V class) FR-ACN01 / – / – FR-ACN02 / – / – FR-ACN03 / FR-HC-7.5K / FR-HC-H7.5K FR-ACN04 / FR-HC-15K / FR-HC-H15K FR-ACN05 / – / – FR-ACN06 / FR-HC-30K / FR-HC-H30K FR-ACN07 / – / – FR-ACN08 / FR-HC-55K / FR-HC-H55K Dimensions after mounting of the attachment  (Unit: mm) Type / W / W1 / H / H1 / H2 / H3 / H4 FR-ACN01 / 150 / 125 / 336 / 320 / 8 / 8 / 17 FR-ACN02 / 150 / 125 / 336 / 320 / 8 / 8 / 17 FR-ACN03 / 220 / 195 / 336 / 320 / 8 / 8 / 17 FR-ACN04 / 280 / 230 / 554 / 530 / 12 / 12 / 122 FR-ACN05 / 330 / 280 / 604 / 580 / 12 / 12 / 122 FR-ACN06 / 340 / 290 / 682 / 625 / 19 / 38 / 122 FR-ACN07 / 460 / 410 / 625 / 590 / 15 / 20 / 80 FR-ACN08 / 490 / 430 / 775 / 730 / 17 / 28 / 80

Name (Type)	Specifications, Structure, Etc.
Dirt-protection structure attachment FR-ACV□□	• By installing this option in the slits at the top, bottom, right and left of the high power factor converter, the high power factor converter can be changed to be an enclosed structure model (IP40). (The box-shaped attachment is added to the wiring section of 11K to 22K.) • Adequate for wall mounting application, etc.IP40 (JEM1030): Structure which prevents a wire, copper band or the like in excess of 1mm in diameter or thickness from entering into the high power factor converter. Note 1: This structure is not protected from water and fluid entry and is therefore not appropriate for environments often exposed to water drops or oily smoke. Note 2: When this attachment is used, the permissible ambient temperature of the high power factor converter is -10°C to +40°C.
Conduit connection attachment FR-AFN□□	• Used to connect a conduit pipe directly to the bottom of the high power factor converter. • By installing this attachment, 11K to 55K (200V, 400V) are changed in structure specification to IP20. (IP00 is standard.)  Note: Secured by a total of four places, the two installation screws at the bottom of the high power factor converter and the two places at the bottom of the FR-AFN.
Radio noise filter FR-BIF 200V class FR-BIF-H 400V class	  Note: 1. This filter must not be connected to the output circuit of the high power factor converter. 2.The cables should be as short as possible and connected to the terminal block of the high power factor converter.

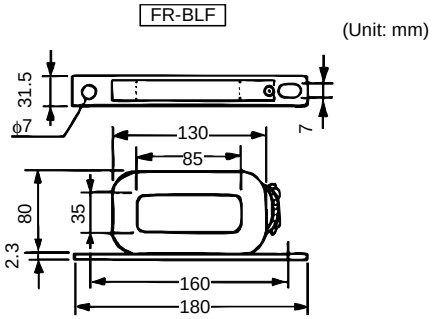
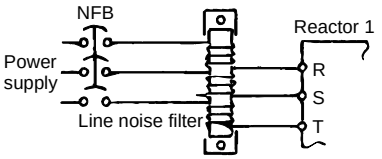
Type	Applicable High Power Factor Converter	
	200V class	400V class
FR-ACV01	–	–
FR-ACV02	–	–
FR-ACV03	FR-HC-7.5K	FR-HC-H7.5K
FR-ACV04	FR-HC-15K	FR-HC-H15K
FR-ACV05	–	–

Type	Applicable High Power Factor Converter	
	200V class	400V class
FR-AFN01	–	–
FR-AFN02	–	–
FR-AFN03	–	–
FR-AFN04	–	–
FR-AFN05	FR-HC-7.5K	FR-HC-H7.5K
FR-AFN06	FR-HC-15K	FR-HC-H15K
FR-AFN07	–	–
FR-AFN08	FR-HC-30K	FR-HC-H30K
FR-AFN09	–	–
FR-AFN10	FR-HC-55K	FR-HC-H55K

Attachment Outline Drawing (Unit: mm)

Type	L	H	P	N	D	M	R
FR-AFN01	45	56	48	2	35	60	6
FR-AFN02	45	71	48	2	35	60	6
FR-AFN03	45	75	48	3	35	60	6
FR-AFN04	45	115	48	3	35	60	6
FR-AFN05	55	115	60	3	44	70	6
FR-AFN06	70	115	68	3	50	90	10
FR-AFN07	145	115	68	4	50	185	10
FR-AFN08	145	95	68	4	50	102.5	10
FR-AFN09	285	120	113	3	91	227.5	12
FR-AFN10	285	120	113	4	91	227.5	12

* Same dimensions as those of the high power factor converter.

Name (Type)	Specifications, Structure, Etc.	
Line noise filter FR-BLF		 Note:1.Wind the cable 4 or more times in the same direction in each phase. (A greater effect is produced as the winding times increase.) 2.If the cable size is too large to wind, use four or more filters in series and wind the cable in the same direction in each phase. 3.This filter can also be used on the output side as on the input side. The winding on the output side should be within 3 turns.

* (H) in a type code indicates that the unit is for 400V.

APPENDIX

This chapter provides an “supplementary information” of this product.
Always read the precautions, etc. before starting use.

APPENDIX 1 INSTRUCTIONS FOR COMPLIANCE WITH THE EUROPEAN STANDARDS

(The products conforming to the Low Voltage Directive carry the CE mark.)

Low Voltage Directive for FR-HC series (High power factor converters)

(1) Our view of the FR-HC series for the Low Voltage Directive.
The FR-HC series is covered by the Low Voltage Directive (DIN VDE0160).

(2) Compliance
* We have self-confirmed the FR-HC series as products compliant to the Low Voltage Directive.
* Since the FR-HCB box, FR-HCL01 reactor and FR-HCL02 reactor are considered parts of the FR-HC unit and we place the CE mark on the FR-HC unit.

(3) Outline of instruction
* In the FR-HC-H series (400V class), the rated input voltage range is three-phase, 380V to 415V, 50Hz/60Hz.
* Connect the equipment to the earth securely. Do not use an earth leakage circuit breaker as an electric shock protector without connecting the equipment to the earth.
* Wire the earth terminal independently. (Do not connect two or more cables to one terminal.)
* The wire size for PVC cables are shown for the following conditions;
  Ambient Temperature: 40°C maximum
  Wire installation: On wall without ducts or conduits
  If conditions are different from above, select appropriate wire according to EN60204 ANNEX C, TABLE 5.
* On the input side, use the recommended no-fuse breaker and magnetic contactor which conform to the EN or IEC standard.
* Use the FR-HC unit, including the FR-HCB box and the reactors, under the conditions of overvoltage category II and contamination level 2 or less set forth in IEC664.
  (a) To meet the overvoltage category II, insert an EN or IEC standard-compliant isolation transformer or surge suppressor in the input of the FR-HC (FR-HCL01 reactor).
  (b) To meet the contamination level 2, install the FR-HC unit, the FR-HCB box and the reactors in a control box protected against ingress of water, oil, carbon, dust, etc. (IP54 or higher).

* The operating capacity of the relay outputs (terminal symbol A, B, C) should be 30VDC, 0.3A. (The relay outputs are basically isolated from the terminal circuitry of the FR-HC unit.)

APPENDIX 2 Instructions for UL and cUL

(Standard to comply with: UL 508C, CSA C22.2 No. 14)

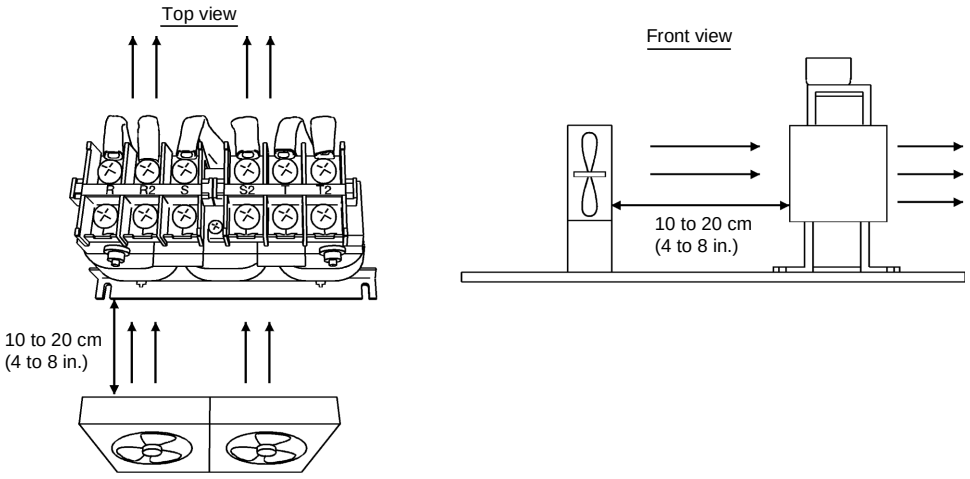
1. General Precaution

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 P and N with a meter etc., to avoid a hazard of electrical shock.

2. Installation

(1) The FR-HC units have been approved as products for use in an enclosure. Please refer to the following UL's requirement for the enclosure.
   * The minimum enclosure size is 150 percent of each converter and inverter combination, which must be provided with ventilation openings on each side near the top.
   * The minimum area for the ventilation openings must be 55 percent of the overall surface area of each side and be located in the top quarter of the side. The maximum width of each individual vent must be 3.17mm (1 / 8 in.).

(2) The FR-HC-H55K have been approved on the following condition.
   * A 2.8 m^3/min {100 cfm } fan must be used spaced 10cm (4 in.) above the FR-HC-H55K and FR-HCB-H55K.
   * Two 2.8 m^3/min {100 cfm } fans for air circulation for the FR-HCL02-H55K must be used as shown in the following illustrations.



3. Branch circuit protection

For installation in 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.

4. Short circuit ratings

Suitable For Use in A Circuit Capable Of Delivering Not More Than 5 kA rms Symmetrical Amperes, 500 Volts Maximum.

5. Wiring

When wiring the I/O terminals and control circuit, use UL-approved, 75°C or higher rated copper wires and round crimping terminals and screw them to the specified tightening torque . Crimp the crimping terminals with the crimping tool recommended by the terminal maker.

REVISIONS

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

Print Date	*Manual Number	Revision
Dec., 1996	IB(NA)66718-A	First edition
Mar., 2001	IB(NA)66718-B	Additions • Applicable inverters • Instructions for Compliance with the European Standards (Appendix 1) • Instructions for Compliance with U.S. and Canadian Electrical Codes (Appendix 2)
Apr., 2003	IB(NA)66718-C	Partial additions • Wiring
Sep., 2008	IB(NA)66718-D	Partial additions • Note for terminal connection diagram Partial changes • Converter reset