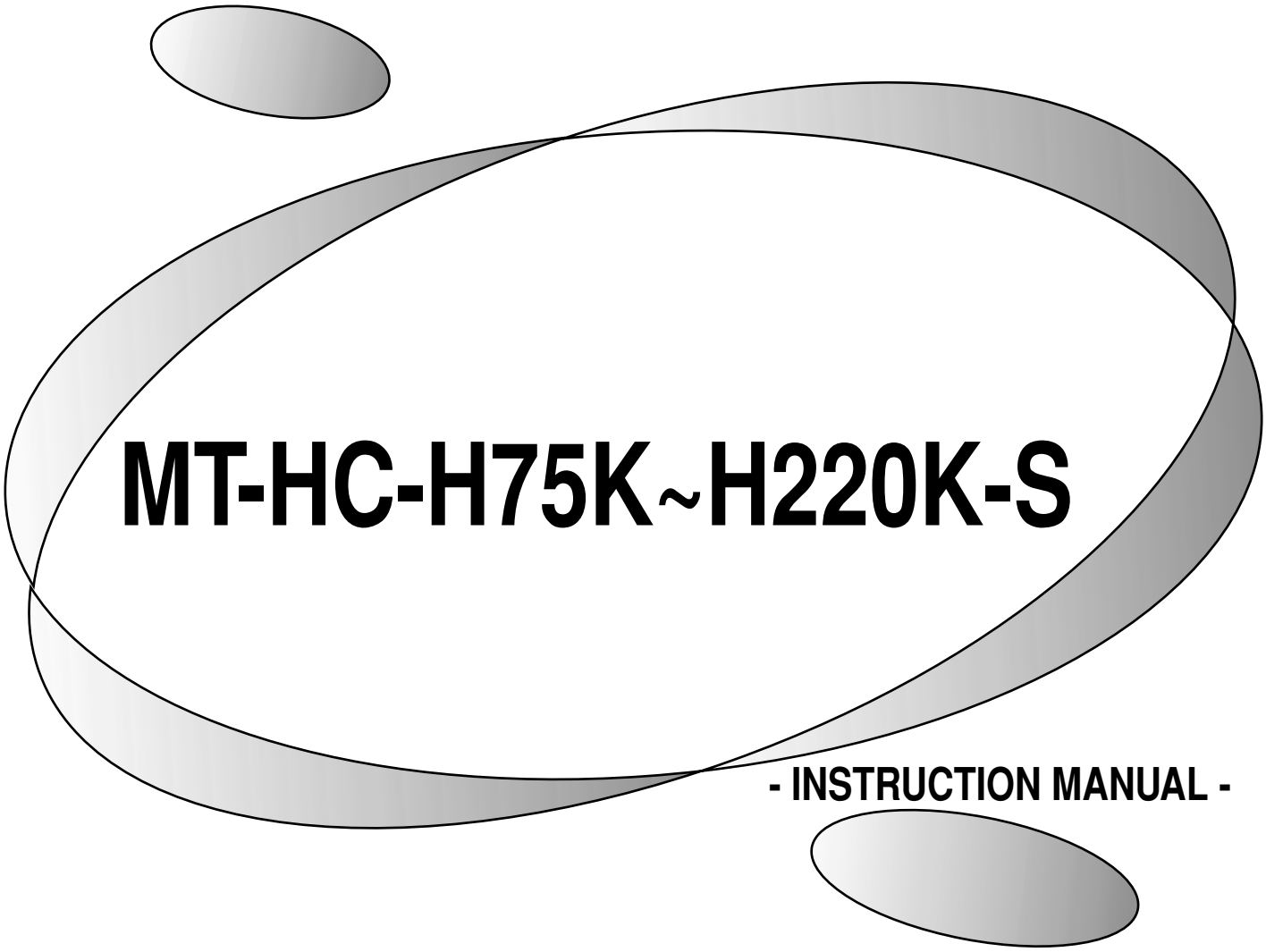
Changes for the Better

MITSUBISHI

HIGH POWER-FACTOR CONVERTER

MELTRAC-HC-S



MT-HC-H75K~H220K-S

- INSTRUCTION MANUAL -

MITSUBISHI ELECTRIC

Thank you for choosing this Mitsubishi high power-factor converter.

This instruction manual describes cautionary points to be observed during use of the inverter. Incorrect handling can lead to unforeseen results, so always read through this instruction manual before starting use so as to ensure correct usage.

Make sure that this instruction manual is delivered to the end user.

Safety Precautions

Please read this instruction manual and enclosed documents before starting installation, operation, maintenance and inspections to ensure correct usage. Thoroughly understand the device, safety information and precautions before starting operation.
The safety precautions are ranked as "DANGER" and "CAUTION" in this instruction manual.

DANGER	When a dangerous situation leading to fatal or major injuries may occur if handling is mistaken.
CAUTION	When a dangerous situation leading to medium to minor injuries, or to physical damage may occur if handling is mistaken.

Note that some items described as "CAUTION" may lead to serious results depending on the situation. In any case, important information that must be observed is described.

Operator Safety

1. Electric shock prevention

DANGER

- While power is on or when the high power-factor converter is running, do not open the front cover. You may get an electric shock.
- Do not run the high power-factor converter with the front cover removed. Otherwise, you may access the exposed high-voltage terminals or the charging part of the circuitry 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 inverter and high power-factor converter circuits and get an electric shock.
- Before starting wiring or inspection, switch power off, wait for more at least 10 minutes and check for the presence of any residual voltage with a meter etc.
- Earth the high power-factor converter (class C grouding).
- Any person who is involved in the wiring or inspection of this equipment should be fully competent to do the work.
- Always install the high power-factor converter 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 an incombustible surface. Installing the inverter directly on or near a combustible surface could lead to a fire.
- If the high power-factor converter has become faulty, switch off the inverter power. A continuous flow of large current could cause a fire.
- Do not connect a resistor directly to the DC terminals P, N. This could cause a fire.

3. Injury Prevention

CAUTION

- Apply only the voltage specified in the instruction manual to each terminal to prevent damage etc.
- Ensure that the cables are connected to the correct terminals. Otherwise, damage etc. may occur.
- Always make sure that polarity is correct to prevent damage etc.
- After the inverter has been operating for a relativly long period of time, do not touch the inverter, high power-factor converter, reactor 1, 2 and externally placed box as it may be hot and you may get burnt.

4. Additional instructions

Also note the following points to prevent an accidental failure, injury, electric shock, etc.:

(1) Transportation and installation

⚠ CAUTION

- When carrying products, use correct lifting gear to prevent injury.
- Do not stack the high power-factor converter boxes higher than the number recommended.
- Ensure that installation position and material can withstand the weight of the high power-factor converter. Install according to the information in the Instruction Manual.
- Do not operate if the high power-factor converter is damaged or has parts missing.
- Do not hold the high power-factor converter by the front cover; it may fall off.
- Do not stand or rest heavy objects on the high power-factor converter.
- Check the high power-factor converter mounting orientation is correct.
- Prevent screws, wire fragments, conductive bodies, oil or other flammable substances from entering the high power-factor converter.
- Do not drop the high power-factor converter, or subject it to impact.
- Use the high power-factor converter under the following environmental conditions:

Environment	Ambient temperature	-10°C to +50°C (without freezing) (-10°C to +40°C when the attachment of a fully-closed structure is used.)
	Ambient humidity	Less than 90% Relative Humidity without condensation.
	Storage temperature	Ensure the environment is -20°C to +65°C.*
	Atmosphere	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
	Altitude and vibration	Altitude less than 1000m above sea level, vibration is less than 5.9m/S^2 {0.6G} (based on JIS C 0911)

* Short time storage temperature

(2) Trial run

⚠ CAUTION

- Before operation, check the wiring of each peripheral device. If it is wrongly wired, an unexpected movement may occur.
- Check all parameters, and ensure that the machine will not be damaged by a sudden start-up.

(3) Operation

⚠ CAUTION

- Don't use it for any others except a 3-phase induction motor. If any other electrical device is connected to the inverter output, it may be broken.
- Don't modify the device.

(4) Emergency stop

⚠ CAUTION
• Use a circuit and mechanical brake, etc., which will protect the operator of the machine should the inverter fail.

(5) Maintenance and inspection

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

(6) Disposing of the inverter

⚠ CAUTION
• Treat as industrial waste.

(7) General

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

CONTENTS

4. PRECAUTION FOR SELECTION

5. SPECIFICATIONS

Appendix

1. OUTLINE

The chapter gives information on the "outline" of this product.
Always read the instruction in the chapter before using the equipment.

An improper operation prevents the normal operation or sometimes excessively reduce the life. In the worst case, the high power factor converter or inverter may be broken. Properly operate the product referring to the content of the items and the precautions in this manual.

1.1.1 Power harmonics guideline

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

1) Harmonic suppression guideline for specific consumers

This guideline sets forth the maximum values of harmonic currents outgoing from a high-voltage or especially high-voltage consumer who will install, add or renew harmonic generating equipment. If any of the maximum values are exceeded, this guideline requires that consumer to take certain suppression measures.

Table 1 Maximum Values of Outgoing Harmonic Currents per 1kW Contract Power (mA/kW)

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

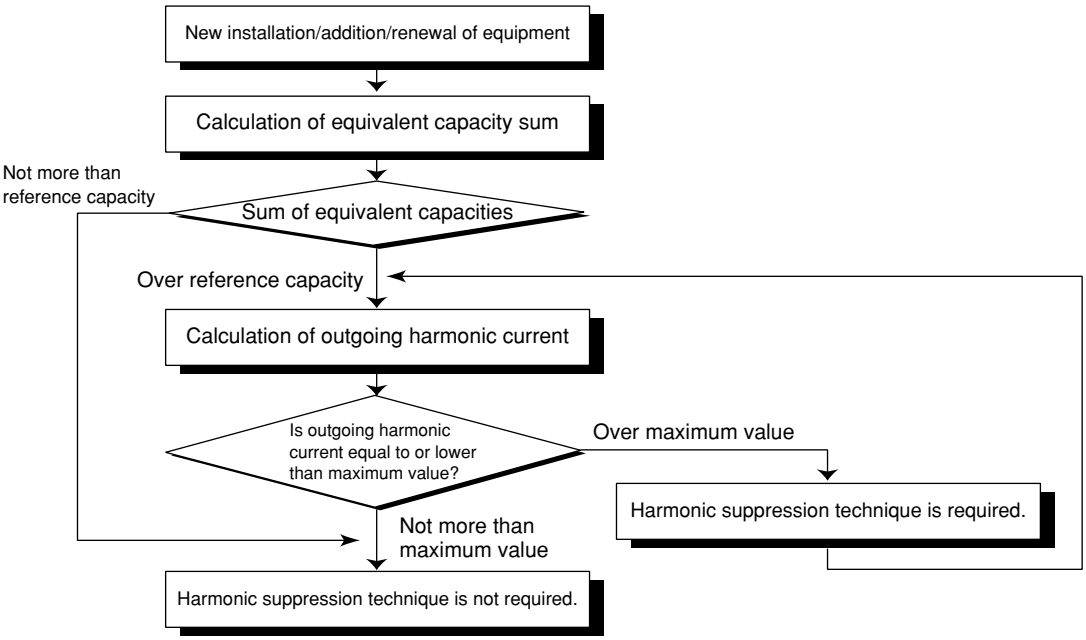


Table 2 Conversion Factors for FREQROL-A500L Series

Class	Class Circuit Type		Conversion Factor Ki
3	3-phase bridge (Capacitor-smoothed)	With reactor (DC side)	K33 = 1.8
		With reactors (AC, DC sides)	K34 = 1.4
5	Self-exciting 3-phase bridge	When high power-factor converter is used	K5 = 0

Table 3 Equivalent Capacity Limits

Received Power Voltage	Reference Capacity
6.6kV	50kVA
22/33kV	300kVA
66kV or more	2000kVA

Table 4 Harmonic Content Ratio (Values at the fundamental current of 100%)

Reactor	5th	7th	11th	13th	17th	19th	23rd	25th
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 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 with the following procedure:

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

Ki: Conversion factor (refer to Table 2)

Pi: Rated capacity of harmonic generating equipment x [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

Outgoing harmonic current = fundamental wave current (value converted from received power voltage) x operation ratio x harmonic content

• Operation ratio: Operation ratio = actual load factor x operation time 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 (400V)	Fundamental Wave Current Converted from 6.6kV (mA)	Rated Capacity (kVA)	Fundamental Wave Current Converted from 6.6kV (With DC reactor, 100% operation ratio)							
				5th	7th	11th	13th	17th	19th	23rd	25th
75	123	8,200	87	2,460	1,066	689	410	385	262	246	180
90	147	9,800	104	2,940	1,274	823	490	461	314	294	216
110	179	11,933	127	3,580	1,551	1,002	597	561	382	358	263
132	216	14,400	153	4,320	1,872	1,210	720	677	461	432	317
160	258	17,200	183	5,160	2,236	1,445	860	808	550	516	378
200	323	21,553	229	6,460	2,799	1,809	1,077	1,012	689	646	474
220	355	23,667	252	7,100	3,077	1,988	1,183	1,112	757	710	521
250	403	26,867	286	8,606	3,493	2,257	1,343	1,263	860	806	591

3) Harmonic suppression technique requirement

If the outgoing harmonic current is higher than the maximum value per 1kW (contract power) x 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 outgoing harmonic currents.
2	High power factor converter(MT-HC-S)	The converter circuit is switched on-off to convert an input current waveform into a sine wave, suppressing harmonic currents substantially. The high power factor converter (MT-HC-S) is used with the standard accessory.
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 Y-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) Feature of MT-HC-S (high power-factor converter) as an active filter

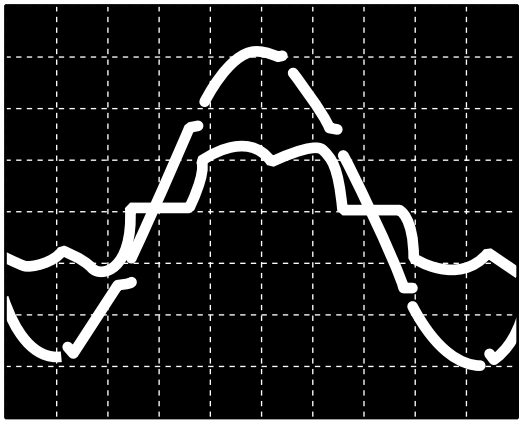
The inverter sometimes generates the higher harmonics of the power supply from the converter to influence the motor, advance capacitor, etc. The higher harmonics noise of the power supply, leakage current, generation source, frequency band and transmission method are different. Therefore, securely connect the high power-factor converter (MT-HC-S) to MELTRAC/ FREQROL.

The conversion coefficient of the high power-factor converter is K5=0 in the self-excited, 3-phase bridge circuit.

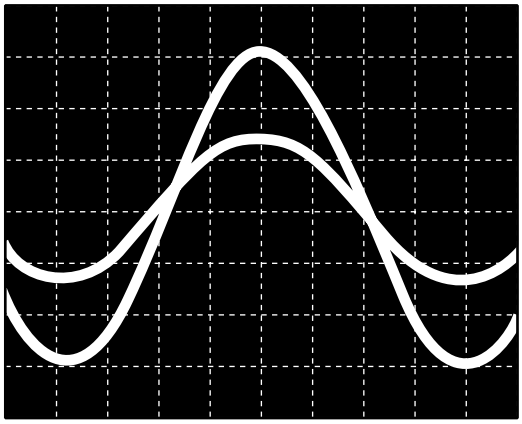
When MT-HC-S is connected, the higher harmonics of the power supply can be suppressed according to the restrictive guide line of higher harmonics issued by the Ministry of International Trade and Industry.

• Depression effect of higher harmonics of power supply

[When MT-HC-S is not connected]



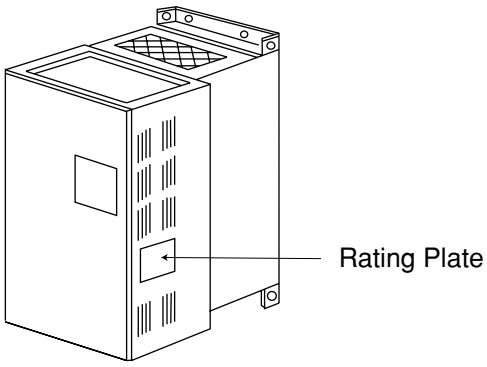
[When MT-HC-S is connected]



1.1.2 Pre-operation procedure

1. Unpacking and product check

Unpack the converter and check the capacity plate face to ensure that the type and output rating agree with your order and the inverter is intact.



- Type definition

  MT - HC - H 75 K-S

Symbol	Capacity
75	Capacity in "kW"

- Peripheral device
  a. The peripheral devices surely required are four components of MT-HCL01-S, MT-HCL02-S, MT-HCB-S and insulation transformer.
  b. MT-HCL02-S is compatible with MT-HCL02.
  c. When the existing MELTRAC inverter is combined, two insulation transformers are necessary. Separately purchase another insulation transformer.
- Accessory ..... Instruction manual

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

2. Preparations of instruments and parts required for operation

Instruments and parts to be prepared depend on how the converter is operated. For required parts, etc. refer to "Peripheral device list".

3. Installation

To operate the converter with high performance for a long time, install the converter in a proper place, in a correct direction, and with proper clearances.

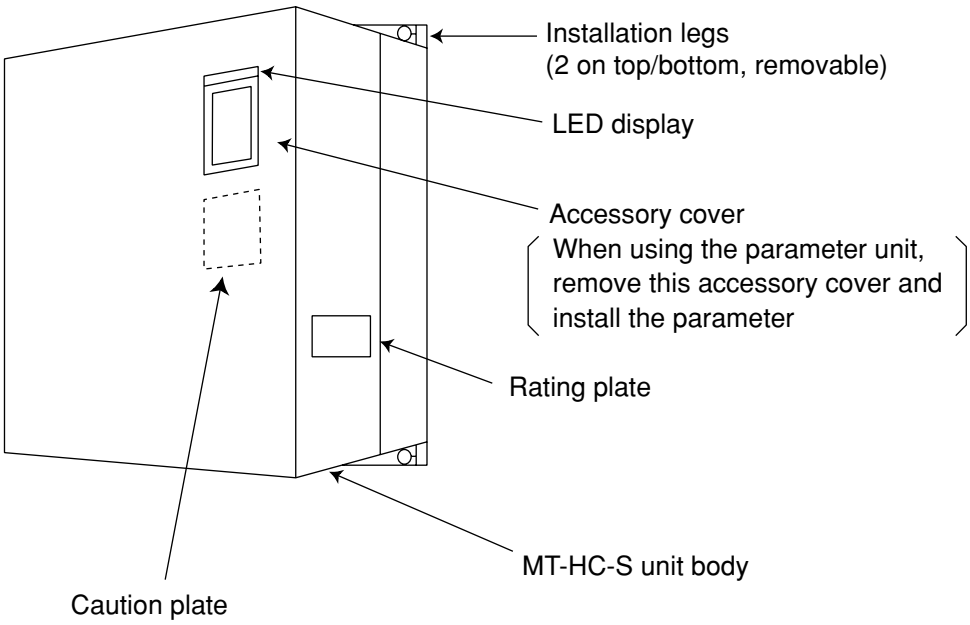
4. Wiring

Connect the power supply, motor and operation signals (control signals) to the terminal block. If they are connected improperly, the converter itself may be damaged.

5. Setting of inverter parameters

Set them according to procedures on Page 23.

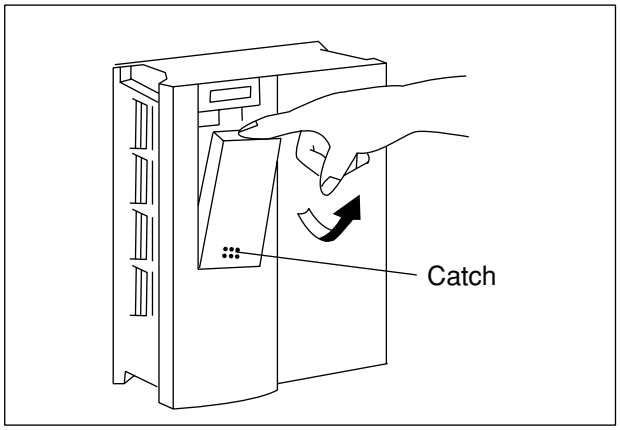
1.2.1 Appearance and structure



1.2.2 Removal and reinstallation of the accessory cover

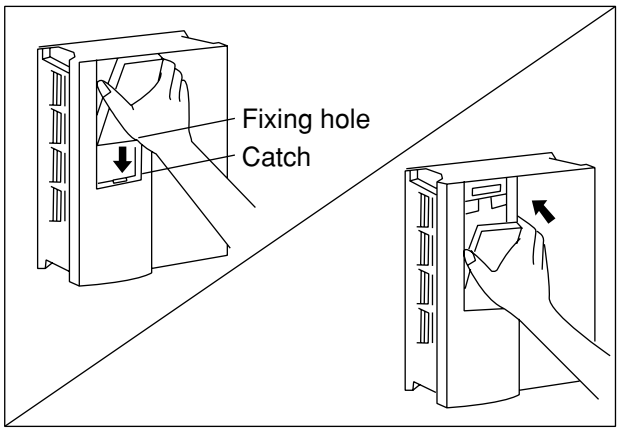
■ Removal and reinstallation

• Removal



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

• Reinstallation

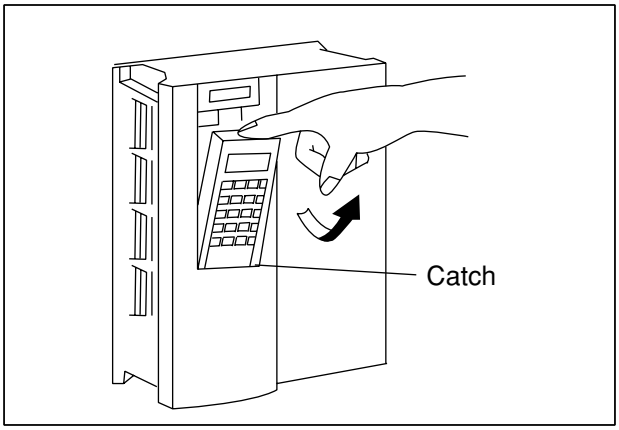


1) After fitting the fixing hole onto the catch of the cover, push it into the inverter.

1.2.3 Removal and reinstallation of the parameter unit

When using the FR-PU02 (optional parameter unit), install and remove with the following method.
To ensure safety, remove and reinstall the parameter unit after switching the power off.

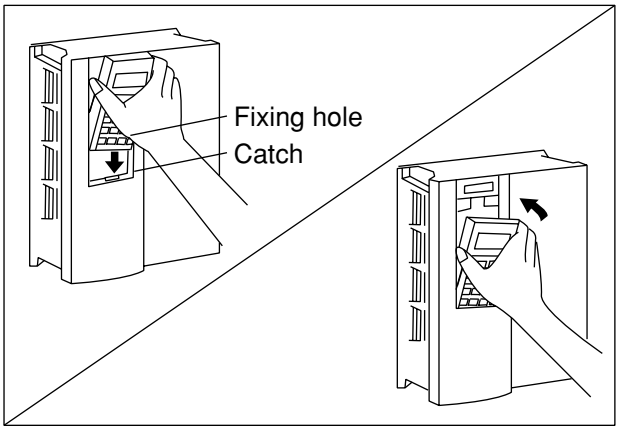
■ Removal



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

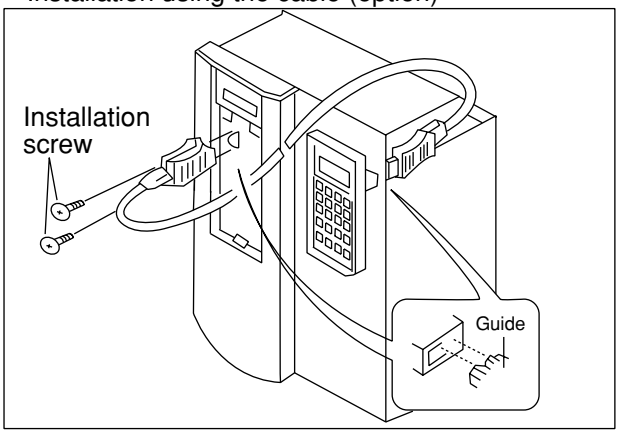
■ Reinstallation

• Direct installation onto the converter



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

• Installation using the cable (option)



1) Securely insert one connector of the cable into the connector of the inverter and the other cable connector into the PU connector.
Insert the cable connector along the guides of the inverter or PU connector.
(If the orientation is incorrect, the inverter may be damaged.)

2) After plugging the cable connector into the converter connector, fix it securely with the installation screws.

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

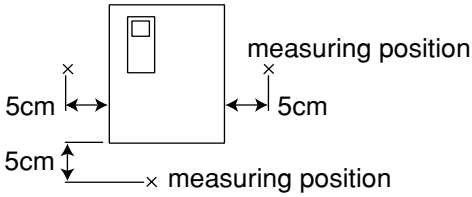
An improper installation or connection prevents the proper operation or sometimes excessively reduces the life. In the worst case, the high power factor converter or the inverter may be broken. According to the content and precautions in this manual, properly operate the product.

1.3.1 Instruction for installation

(1) Installation of high power-factor converter

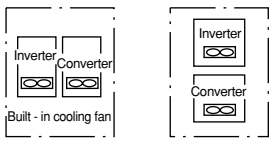
Precaution for ambient temperature

Since the service lives of the high power-factor converter and reactors 1 and 2 are largely influenced by the ambient temperature, prevent the ambient temperature from exceeding the tolerable ambient temperature (50°C). When measured at the position as shown below, confirm that it is within the tolerable ambient temperature range.



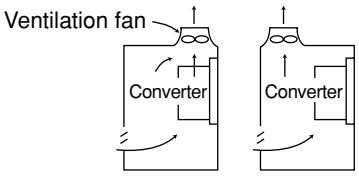
Note: 1. When the high power-factor converter is installed in a panel, determine the cooling method and panel dimensions so that the ambient temperature of the high power-factor converter is within the permissible range (as specified value is 50°C or less).

2. When the inverter and the 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 temperature of the high power-factor converter below the permissible value. If the high power-factor converter, the inverter and ventilation fan is installed in an incorrect position, the ambient temperature will rise and ventilation will be reduced.



(Correct) (Incorrect)

Installation of Two or More Inverters

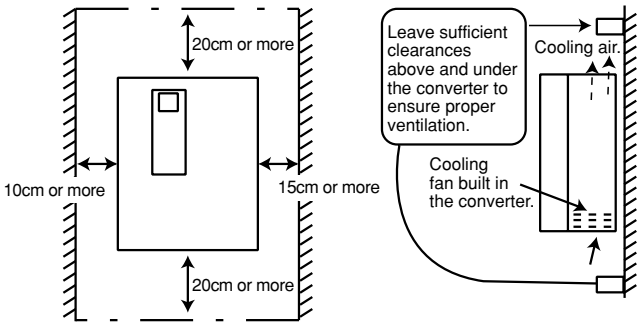


(Correct) (Incorrect)

Position of Ventilation Fan

Leave sufficient clearances around the converter.

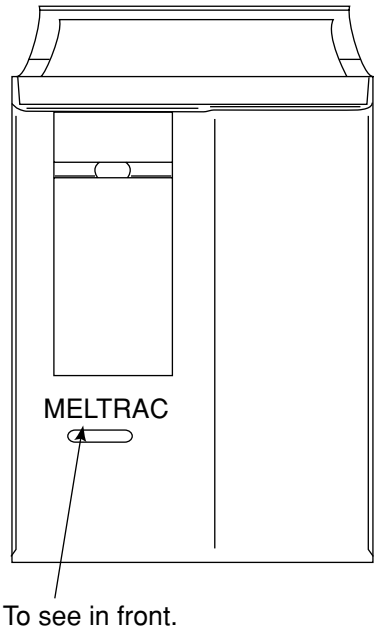
For adequate heat dissipation, leave sufficient clearances around the high power-factor converter.



Secure the high power-factor converter with bolts vertically.

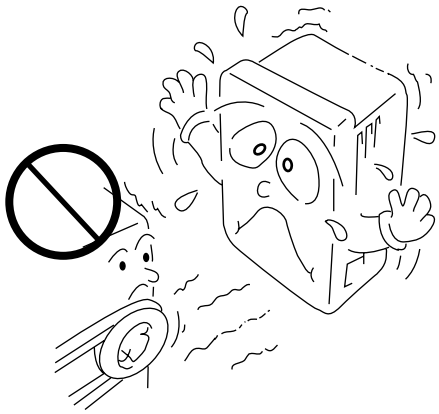
Install the high power-factor converter on an installation surface securely and vertically (so as to see "MELTRAC" in front) with screws or bolts.

Note: Since the high power-factor converter is troubled if it is horizontally or laterally installed. Be sure to install it in the vertical position.



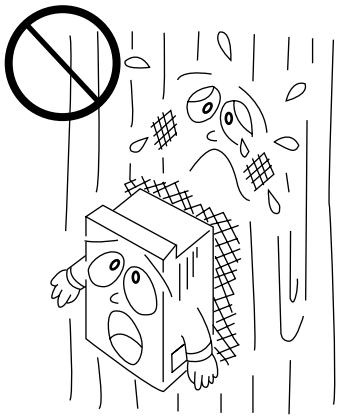
Install the high power-factor converter where it is not subjected to vibration.

Note the vibration of a cart, press, etc.



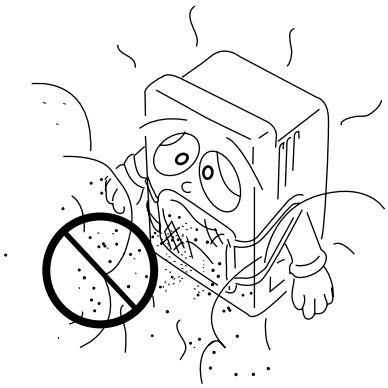
Install the high power-factor converter on a noncombustible surface.

Install the high power-factor converter on the noncombustible member. If it is directly installed on or near the combustible member, it will cause a fire.



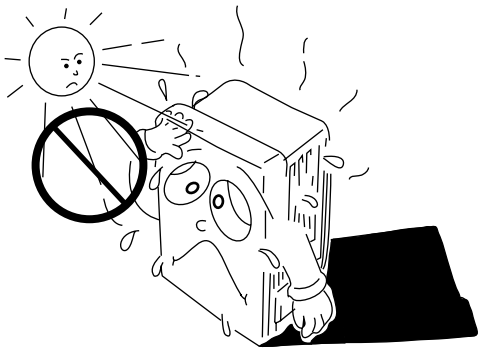
Avoid places where the high power-factor converter is exposed to oil mist, flammable gases, fluff, dust, dirt, etc.

Install the high power-factor converter is in a clean place or inside a "totally enclosed" panel which does not accept any suspended matter.



Avoid high temperature and high humidity.

Avoid places where the high power-factor converter is subjected to direct sunlight, high temperature and high humidity.



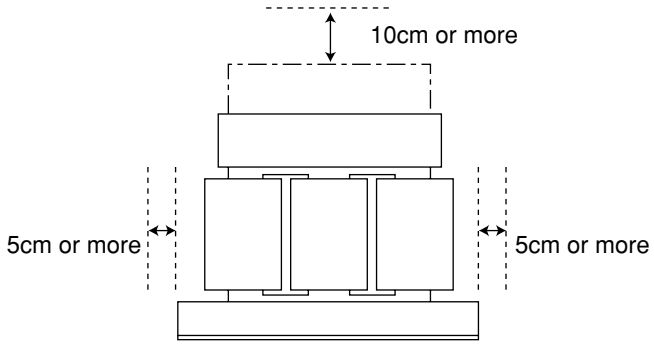
(2) Installation of reactor 1, 2 and externally placed box

Check the model name.

Since the reactor 1 (MT-HCL01-S) and reactor 2 (MT-HCL02-S) are externally similar to each other, take sufficient care for the model name.

Precaution for ambient temperature

Since the reactor 1 (MT-HCL01-S) and reactor 2 (MT-HCL02-S) generates heat, assure a space enough to radiate the heat to an open air.



Install the product at a space of nothing burned.

Install the reactor 1 (MT-HCL01-S) and reactor 2 (MT-HCL02-S) on the noncombustible member. If it is directly installed on the combustible member, it may cause a fire.

Avoid places where the high power-factor converter is exposed to oil mist, flammable gases, fluff, dust, dirt, etc.

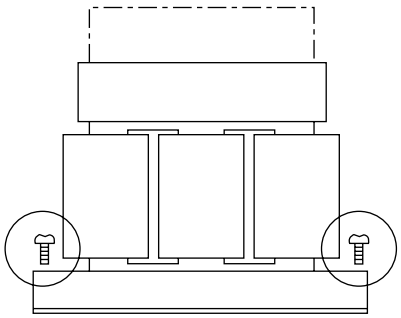
Install the high power-factor converter is in a clean place or inside a "totally enclosed" panel which does not accept any suspended matter.

Note: The externally placed box is installed in the panel.

Secure the high power-factor converter with bolts horizontally.

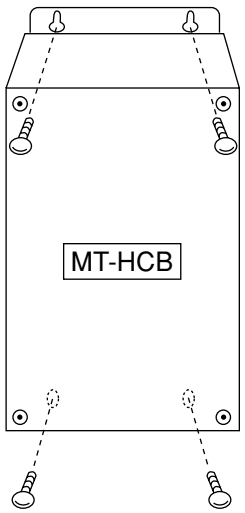
Install the reactor 1 (MT-HCL01-S) and reactor 2 (MT-HCL02-S) on an installation surface securely and horizontally with screws or bolts.

Note: Avoid vertically or laterally installed and install the reactor on the board suitable for weight.



Secure the externally placed box (MT-HCB-S) vertically.

Note: If it is horaizontally or laterally installed, it will cause the externally placed box to be troubled. Be sure to install it in the vertical position.

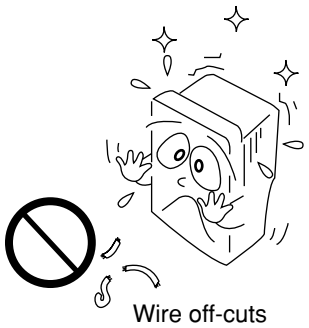


Note: Since the charged areas of the reactor 1, reactor 2 and externally placed box are exposed, take a sufficient protection against ground fault and electric shock.

1.3.2 Wiring instructions

After wiring, wire off-cuts must not be left in the high power-factor converter and the externally placed box.

Wire off-cuts can cause an alarm, failure or malfunction. Always keep the high power-factor converter clean.



When rewiring after operation, make sure that the converter LED has gone off and that the charge lamp on the printed circuit board after about 10 minutes.

After the power off for a relativly long period of time, the condenser charged high voltage is in a danger. Confirm that the charge lamp has gone off after about 10 minutes before starting the wiring.

If any power voltage is special (the rated input voltage is exceeded) in the high power-factor converter of 400V class, remove the short circuit bar of the control power supply terminal block.

(Please refer to P18.)

Wire the control circuit, using the left space of the main circuit terminal block.

The cable size for connection to the control circuit terminals should be 0.75mm² or less.

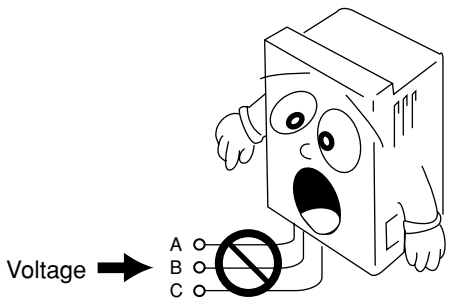
If the cable size used is 1.25mm² or more, the front cover may expand, resulting in a contact fault of the parameter unit. This fault is indicated by the following message displayed on the parameter unit and disables operation from the parameter unit. Run the cables so that they do not occupy much of the control box terminal block space.

Parameter unit display

<All set> Not communicate RES ON or communication circuit alarm

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

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



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

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

Note: Connect the housing of shielded cables with terminal SD.

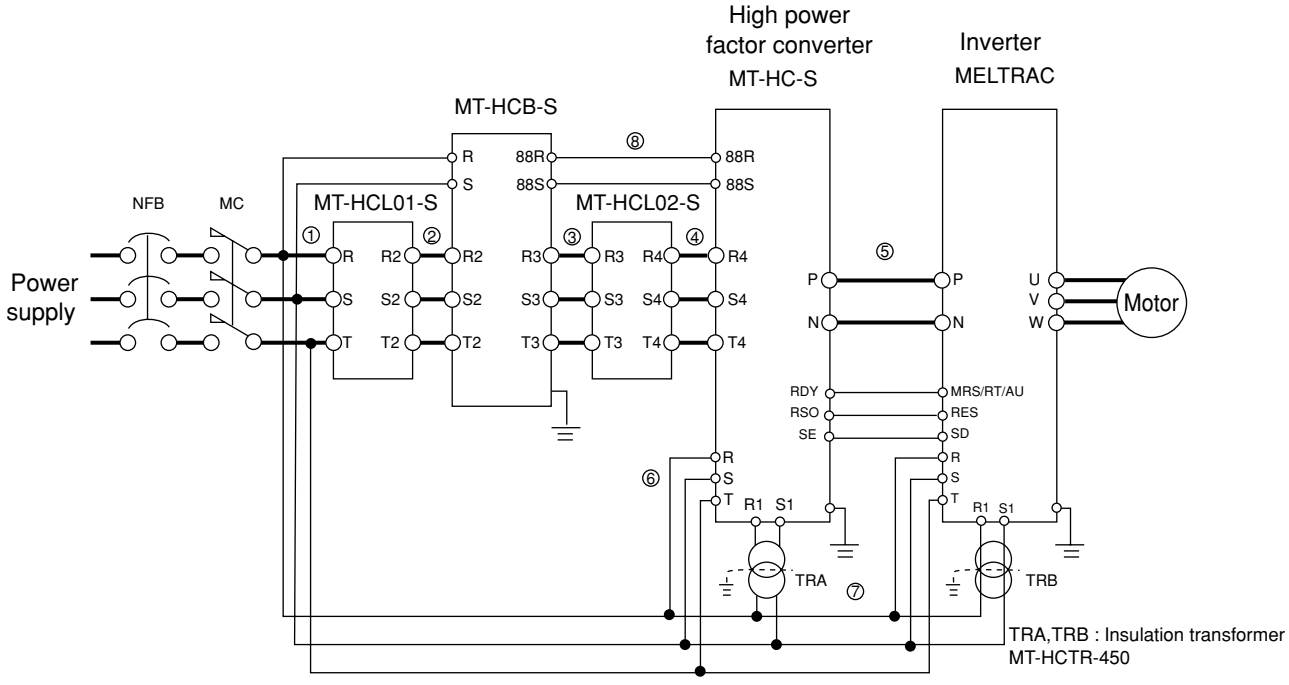
1.3.2 Wiring instructions

1.3.3 Wiring of the main circuit

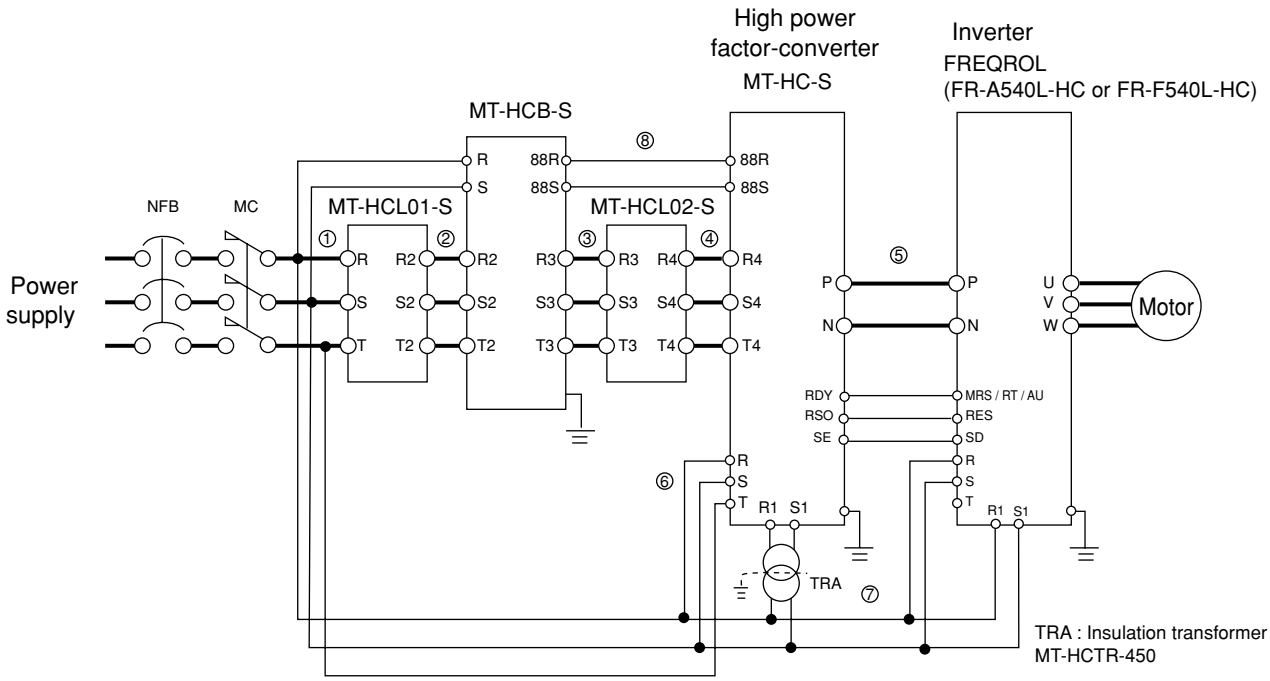
- According to the guide line of higher harmonics issued by the Ministry of International Trade and Industry, the high power-factor converter (MT-HC-S) is an inverter option unit of high power-factor and low noise which restricts the higher harmonics against the input power supply in combination with the MELTRAC Series/FREQROL Series inverter (corresponding to MT-HC-S).
- In order to comply with the guide line against the higher harmonics issued by the Ministry of International Trade and Industry, securely construct the next system and securely connect the terminals P and N to the terminals P and N of the inverter. If they are wrongly connected, the high power-factor converter will display an error or be troubled or broken.
- If they are securely wired as shown below, the higher harmonics against the input power supply can be restricted. Take special care for the wiring length and wire size.

(1) Wiring example:

If it is combined with the existing MELTRAC inverter, two insulation transformer are necessary. Separately purchase another insulation transformer.



Combination of MT-HC and MELTRAC Series

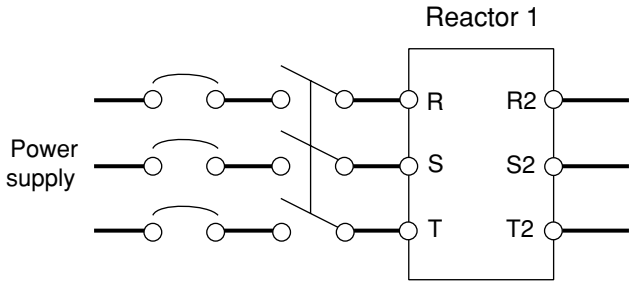


Combination of MT-HC and FREQROL

Note: 1. Take care to make each terminal-to-terminal wiring as short as possible.
2. To prevent wire chips from dropping to the inside during wiring work, cover the upper ventilation hole before the work.
3. Securely wire the device with the ground terminals.
4. To detect the voltage, the input terminals R, S and T of the inverter are used. Connect them to the same power supply as that for the high power-factor converter input. For this input, it is necessary to modify the input terminal section of the inverter connected to the high power-factor converter. If any existing inverter is used, please consult our company. The inverter delivered under the conditions of the combination is modified. (Combination with the inverter of FREQROL-A540L-HC and FREQROL-F540L-HC)
5. If any polarity of the terminal P or N is mistaken, the high power-factor converter or inverter may be broken. Properly connect them.
6. Connect the terminals R4, S4 and T4 to the terminals R, S and T according to the phases of the power supply.
7. Connect them to the terminals R1 and S1 through the insulation transformer. (High power-factor converter)
Here, the insulation transformer is supplied as the accessory.

⚠ CAUTION
Check the connection orders of the reactors 1 and 2. If they are wrongly connected, it will be abnormally heated.

① Wiring between power supply and reactor 1

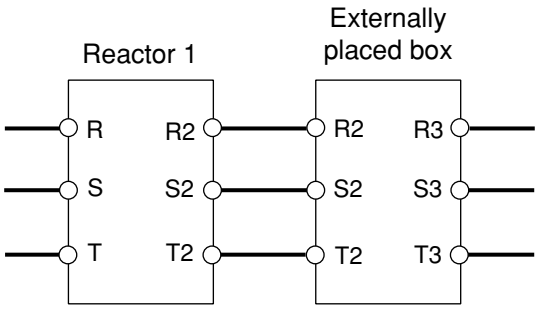


Since the wire size is different depending on the capacity of the high power-factor converter, select the wires according to the following table.

High power-factor converter	Cable (mm^2)
MT-HC-H75K-S	60
MT-HC-H110K-S	80
MT-HC-H150K-S	100
MT-HC-H220K-S	150

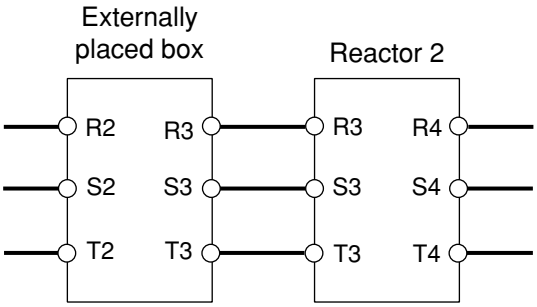
Note: Connect the electromagnetic contactor (MC) and reactor 1 which correspond to the capacity of the high power-factor converter.

② Wiring between reactor 1 and externally placed box



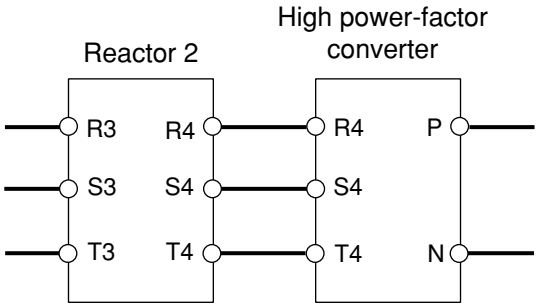
Note: 1. Since the wire size is different depending on the capacity of the externally placed box, connect it to the power supply with the wires of the same size as one connecting the power supply to the high power-factor converter.
2. Since the reactor generates heat, install it with preventing heat from being given to the externally placed box.
3. Route the wires, preventing their sheaths from interfering with the reactor.

③ Wiring between externally placed box and reactor 2



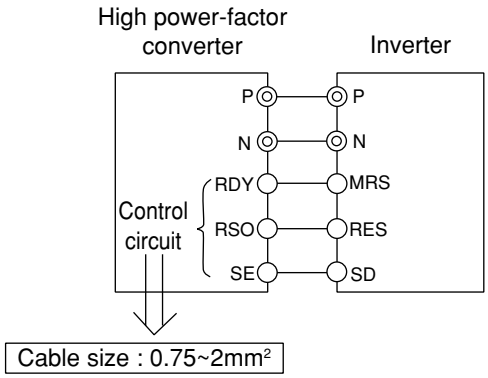
Note: Since the wire size is different depending on the reactor capacity, connect it to the power supply with the wires of the same size such as those to connect the power supply to the high power-factor converter.

④ Wiring between rector 2 and high power-factor converter



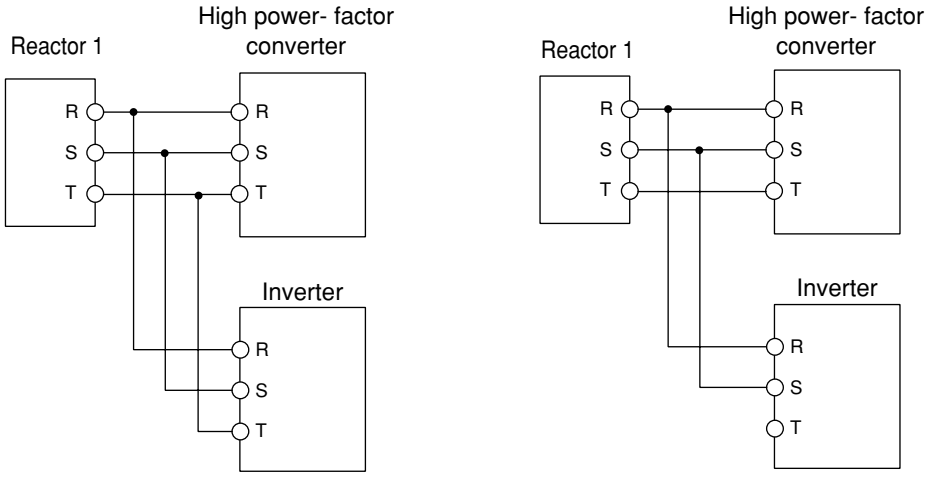
Note: Since the wire size is different depending on the reactor capacity, connect it to the power supply with the wires of the same size such as those to connect the power supply to the high power-factor converter.

⑤ Wiring between high power-factor converter and inverter
Make the command output from the high power-factor converter, surely transmitted to the converter.
For details, refer to Instruction Manual for inverter.



⑥ Wiring between reactor 1 and high power-factor converter

Separating from the wiring of the main circuit, supply power to the terminals (R, S, T) for power detection.



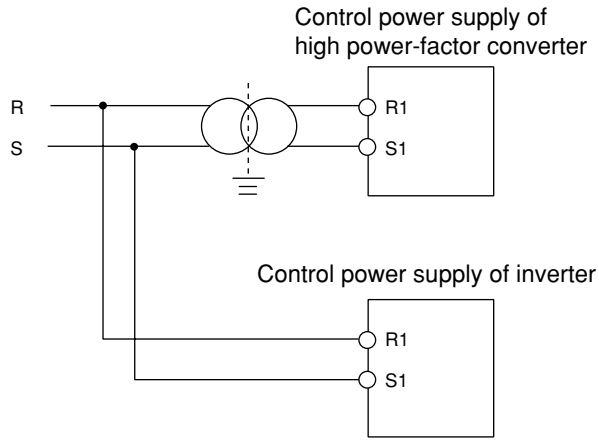
Combination with MELTRAC Series　　Combination with FREQROL Series

Note: The terminals R, S and T of the high power-factor converter are the control terminals to detect the phases of the power supply. It is necessary to wire the terminals R4, S4 and T4 to the terminals R, S and T, aligning the phases of the voltage. If they are not properly connected, the high power-factor converter (MT-HC-S) will not properly operate.

⑦ Connection to the control power supply

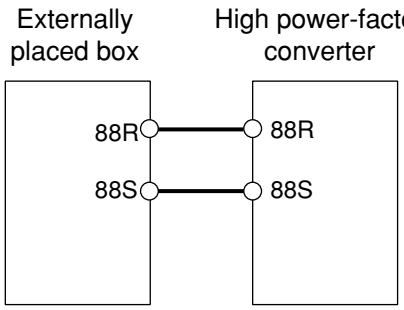
Supply power to the high power-factor converter (MT-HC-S) or inverter.

Connect the wires through the appended insulation transformer. (2mm2 or more).



Note: 1. Be sure to connect the power supply to the other power terminals R1 and S1.
2. If it is combined with the existing MELTRAC converter, two insulation transformer are necessary. Separately purchase another insulation transformer.

⑧ Wiring between externally placed box and high power-factor converter



Cable size : 0.75~2mm^2

Note: The terminals 88R and 88S of the high power-factor converter are used for the control signal for the rush current control circuit in the externally placed box. Be sure to connect them to the externally placed box. Otherwise, the circuit in the externally placed box will be broken.

Notes on Grounding

- Leakage currents flow in the high power-factor converter. To prevent an electric shock, the high power-factor converter must be grounded (class C grounding, grounding resistance 10Ω or less.).
- Use the dedicated ground terminal to ground the high power-factor converter. (Do not use the screw in the case, chassis, etc.)
- The ground cable should be thick and short as possible. The grounding should be as close to the high power-factor converter and the inverter as possible.

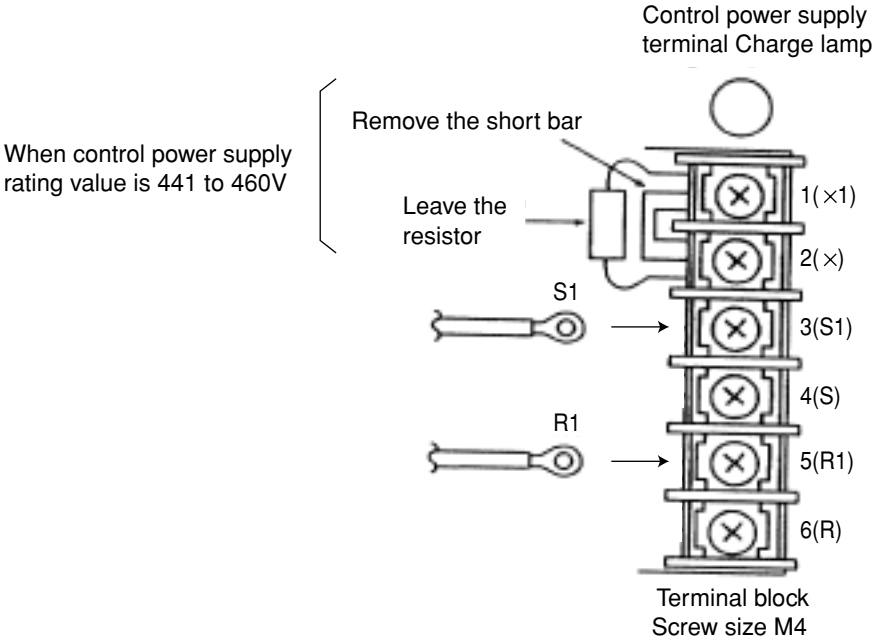
Capacity	The ground cable size (unit: mm^2)
75K	38
110K	38
150K	38
220K	38

(2) Application of high power-factor converter and inverter

Applicable inverter	High power-factor converter			
	MT-HC-H75K-S	MT-HC-H110K-S	MT-HC-H150K-S	MT-HC-H220K-S
MT-A140E-75K	○			
MT-A140E-110K		○		
MT-A140E-150K			○	
MT-A140E-220K				○
MT-A240E-75K	○			
MT-A240E-110K		○		
MT-A240E-150K			○*	
MT-A240E-220K				○
MT-V240E-55K	○			
MT-V240E-75K	○			
MT-V240E-90K		○		
MT-V240E-110K		○		
MT-V240E-132K			○	
MT-V240E-160K			○*	
MT-V240E-200K				○
FR-A540L-75K-HC	○			
FR-A540L-90K-HC		○		
FR-A540L-110K-HC		○		
FR-A540L-132K-HC			○	
FR-A540L-160K-HC			○*	
FR-A540L-220K-HC				○
FR-F540L-75K-HC	○			
FR-F540L-90K-HC		○		
FR-F540L-110K-HC		○		
FR-F540L-132K-HC			○	
FR-F540L-160K-HC			○*	
FR-F540L-185K-HC				○
FR-F540L-220K-HC				○

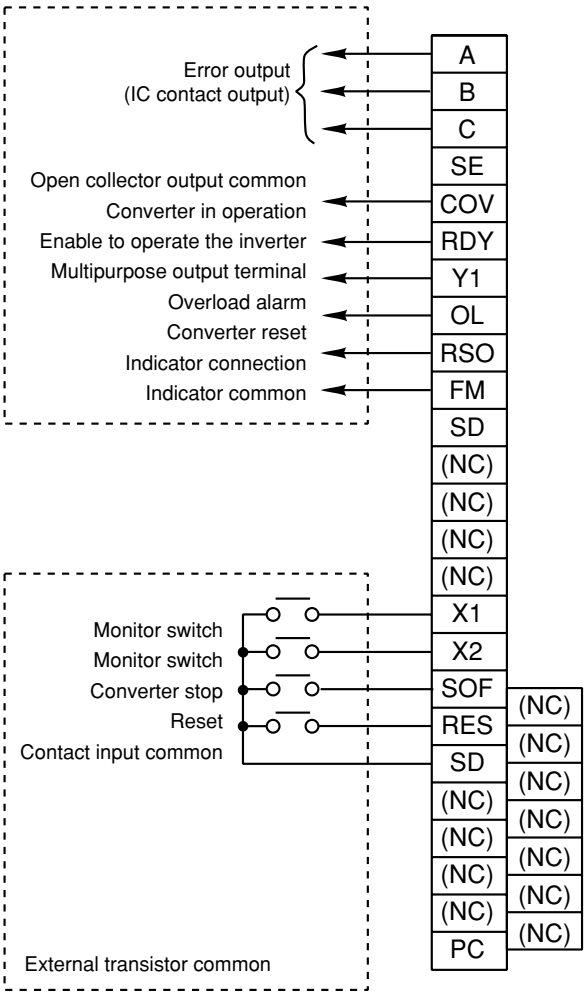
* If the motor capacity exceeds 150kW, select MT-HC-H220K-S.

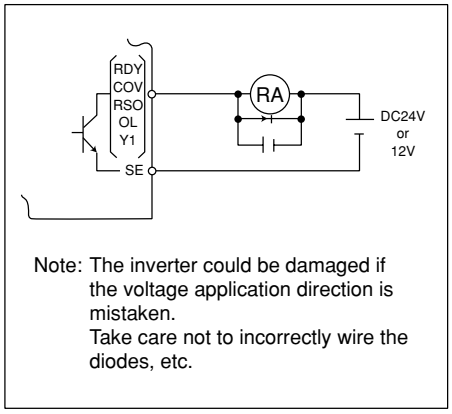
(3) When the power supply voltage is special (441V or more, 460V or less) for the 400V series inverter, remove the short bar on the control power supply terminal block as shown below.
If not removed, the inverter could be damaged.



1.3.4 Wiring of the control circuit

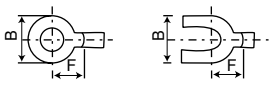
(For the function of the terminal block, refer to "Common specifications" in Page 50.)





Note: The inverter could be damaged if the voltage application direction is mistaken.
Take care not to incorrectly wire the diodes, etc.

Note: 1. Terminals SD is the common terminals for the input/output signals and are isolated from each others. These common terminals must not be connected to each other or grounded.
2. Use shielded or twisted cables for connection to the control circuit terminals and wire them away from the main and power supply circuits (including the 200V relay sequence circuit).
3. As the control circuit input signals are micro currents, when inserting a contact, use two parallel micro signal contacts or a twin contact to prevent contact faults.
4. Don't connect anything to the open terminal (NC).
Otherwise, it will cause the high power-factor converter will malfunction.
5. When connecting two crimp terminals to one terminal of the control circuit terminal, use the round or U shaped terminals shown on the right, keeping their flat sides in contact with each other.



Call	B(mm)	F(mm)
1.25-3	6.4 or less	5.3 or more

Example: Round crimp terminal V1.25-MS3

⚠ CAUTION

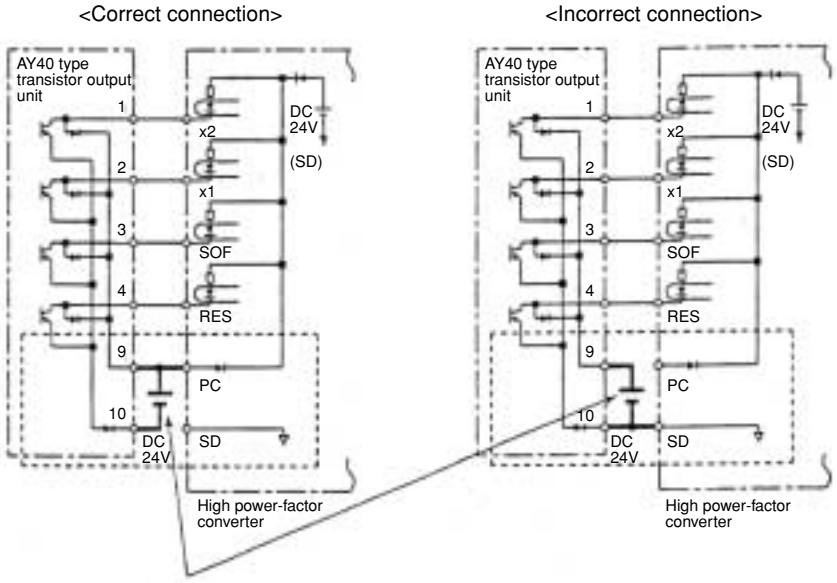
- Don't use any open terminal (NC) of the control circuit.
Otherwise, the high power factor converter or inverter will be troubled.
- If any steep distortion or recess occurs in the power supply, abnormal noise may be heard from the reactor. This phenomenon results from the power supply error but not from the breakage of the high power factor converter (MT-HC-S).
- If the load becomes light, the effect to suppress the higher harmonics will drop.

(1) Using the PC terminal

This terminal is used to connect transistor outputs (open collector outputs) such as programmable logic controllers (PLC's).

Connecting the external power supply common for transistor output to the PC terminal prevents a faulty operation caused by a sneak current.

(Set 24VDC for the power voltage of the PC terminals connected.)



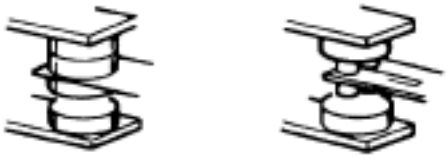
The AY40 module requires a 24VDS power supply.

Note: If the output unit and input unit are connected to the input terminal and output terminal of the high power-factor converter when the terminal PC is used, any following countermeasure shall be taken to prevent the current from flowing around as taken when the terminal PC is not used.

1) The diode is inserted to prevent the current from flowing around.
2) Use the output unit of an all-point independent type.
3) Use another power supply for the output unit and input unit of the PLC.

(2) Instruction for contact input

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



Micro signal contact Twin contact

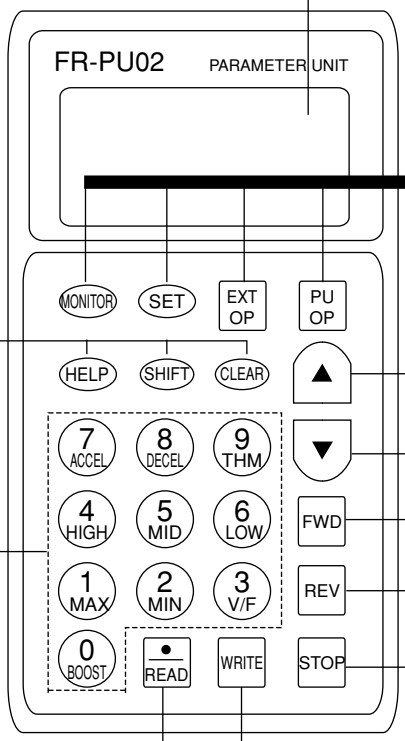
MEMO

2. PARAMETERS

The chapter gives information on the "parameter" of this product.
Always read the instruction in the chapter before using the equipment.

The parameter unit (FR-PU02) is directly installed on the main body of the high power factor converter or can be made to set the parameters and display the monitor by connecting the cable (FR-CBL). However, keep in mind that the function is restricted in comparison with the inverter. In this manual, the parameter unit is sometimes abbreviated PU.

2.1.1 Structure of the parameter unit



Help key
- The Help Selection screen is displayed.
- Take care for the restrictions.

Clear key
- The setting values input are cleared.
- To select the other items except the function with the help items, they are returned to initial.

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

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

Read key
- Used also as a decimal point key.
- Acts as a select read key in the function.

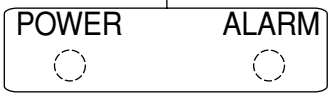
Display
- The Monitor screen is displayed.

Mode select keys
- Used to select the setting mode or monitoring mode. It does not function the PU operation key and external operation key.

Frequency keys
- On the monitoring, parameter or help menu 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.

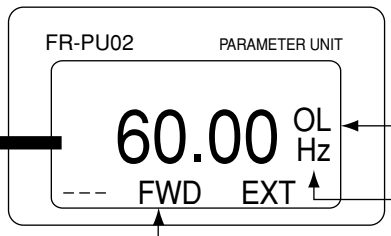
Operation command keys
- It does not function.

Write keys
- In the setting mode, etc., writing is executed.



Inverter LED display

It indicates whether the power is supplied or not/POWER (Yellow) and whether the alarm is output or not/ALARM (Red).



PU main monitor

3 types of data can be selected in sequence by the [shift] key.

Overload signal detection level display

Display unit

Forward running (FWD) or regeneration (REV) is displayed.

(1) Setting of inverter parameters

For the main circuit configuration, refer to Pages 11 and 12.

The high power factor converter outputs higher voltage to the DC circuit than the diode converter. To prevent an excessive voltage from being applied to the motor, it is necessary to set the base frequency voltage of the inverter. According to the model of the inverter to be connected, be sure to set the following parameters. For the operation of the parameter unit, refer to the Instruction Manual appended to the inverter.

High power-factor converter	Inverter	Items necessary to set at the inverter parameters.
MT-HC-H_ _K-S (Equipment concerned with this Instruction Manual.)	FR-A540L FR-F540L	Set the rated voltage of the motor at Pr.19 "Base frequency voltage".
	MT-A140E MT-A240E	Set the rated voltage of the motor at Pr.19 "Base frequency voltage".
	MT-V240E	Set the rated voltage of the motor at Pr.49 "Base frequency voltage".

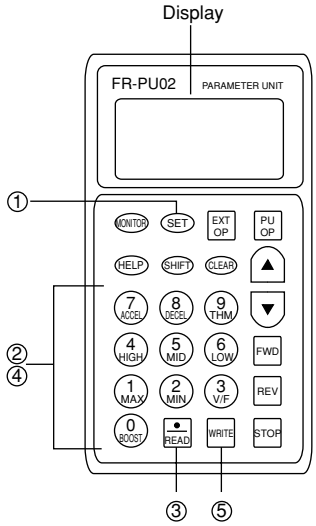
2.1.2 Setting and Changing the Values in the parameters

The high power factor inverter has many parameters. Using the PU, the required parameters can be selected and their values set and/or changed as appropriated according to the load and running conditions. For more information, see the "Prameter List" (Page 25). Set "1" "in Pr.77" parameter write disable" to disable write.(See Page 31)

• Operation procedure (reading and writing the value of Pr. 22 "overload signal detection level".)

① Press the [SET] key . ... The converter is placed in the parameter setting mode.	SETTING MODE Set Pr.NO. FOR PR.List <HELP>
② Enter the required parameter number ②② ... 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 to 180 seconds] (Note 1)	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 paramter(Pr.40) and call the current set value. Then, press the [SHIFT] key to advance to the next parameter.



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

2.2.1 Parameter list

Function	Parameter number	Name	Setting range	Minimum setting increments	Factory setting	Customer setting
———	1	Power frequency 1 (Note 1)	-	-	70.00Hz	-
	2	Power frequency 2 (Note 2)	-	-	45.00Hz	-
Standard function	22	Overload signal detection	0 to 150%	0.1	150.0%	
Multi-function output terminal function	40	Output terminal assignment	0 to 3 (Note 6)	1	1	
Display function	51	Input power monitor reference	0 to 400kW	0.1	Rated current (Note 2)	
	52	PU main display data selection	0 to 3333 (Note 7)	1	123	
	53	Input voltage monitor reference	0 to 100.0V	0.1	460V	
	54	FM terminal function selection	0 to 3333 (Note 7)	1	123	
	55	Bus voltage monitor reference	0 to 1000.0V	0.1	680V	
	56	Current monitor reference	0 to 1000A	0.01	Rated current (Note 5)	
Automatic restart functions	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	1	0	
	68	Retry waiting time	0.1-360 sec.	0.1 sec.	1.0 sec.	
	69	Retry count display erasure	0	-	0	
	77	Parameter write disable selection	1, 2	1	2	
Calibration functions	145	Parameter unit language changeover	0, 1, 2, 3	1	0	
	900	FM terminal calibration	-	-	-	

(Note) 1. Pr.1 "Power supply frequency 1" and Pr.2 "Power supply frequency 2" can be neither set nor changed.
2. Since the setting values are different depending on the capacity of the high power factor converter, the rated power of each capacity is set.
3. The set value can be changed in the ▭ parameter even if "1" (inhibit to write) is set at Pr.77 "Parameter write inhibition selection".
4. Since the setting values are different depending on the capacity of the high power factor converter, the rated current of each capacity is set.
5. Set a combination of 2 digits of 0 to 3 at Pr.40 "Output terminal assignment".
6. Set a combination of 4 digits of 0 to 3 at Pr.52 "PU main display data selection" and Pr.54 "FM terminal selection function".

2.2.2 Setting of parameters to improve the corresponding operational hunctions

The input frequency to the converter is set.

⇨ Pr.1 [Power frequency 1], Pr.2 [Power frequency 2]

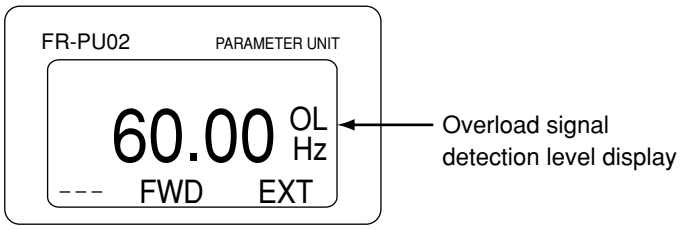
- It displays that the power frequency of 45 to 70Hz can be used. It can not be written.

Number	Factory setting
1	70Hz
2	45Hz

The overload signal is detected.

⇨ Pr.22 [Overload signal detection level]

- If the rush current of the high power-factor converter exceeds the value set at Pr.22 "Overload signal detection level", the error detection signal "OL" will be displayed, and be output at the output terminal "OL". Set the rated current at the reference.
  Normally, set 150% (default value).



(Note) The set value (%) is the ratio of the high power-factor converter against the rated current.

To change the fuctions of output terminal

⇨ Pr.40 [Output terminal assignment]

- The function of the output terminal Y1 can be changed and assigned. For setting, assign an integer at Pr.40 "Output terminal assignment". The value of each digit indicates the function of each terminal.

Pr.40 = Y1

Pr.40 set value	Function name	Operation explanation
0 (Factory setting)	Power supply phase detection signal	If the phase of the input power supply matches the phase which CPU calculates, the power supply phase detection signal will be locked. If the phase is deviated, the power supply phase detection signal will be deviated and be output with the open collector output.
1	Output voltage match	If the bus voltage matches the value commanded from CPU, the signal will be output with the open collector output.
2	Instantaneous power failure detection	Signal when the instantaneous failure occurs
3	Forward running/regeneration discrimination	The forward running mode or regeneration mode is discriminated, and the open collector is not continuous in the forward running mode. ON: Forward running OFF: Regeneration

(Note) "Output" means that the integrated transistor for open collector output is ON (continuous).

The reference of the terminal FM is set.

⇨ Pr.51 [Input power monitoring refrence], Pr.53 [Input voltage monitoring reference] Pr.55 [Bus voltage monitor reference], Pr.56 [Current monitoring reference]

- The reference values of the power, voltage, bus voltage and current input from the power supply to the high power-factor converter can be set. Set the values which match the rated values of the power supply and high power-factor converter.
- It becomes the reference output to the terminal FM.
- Parameters

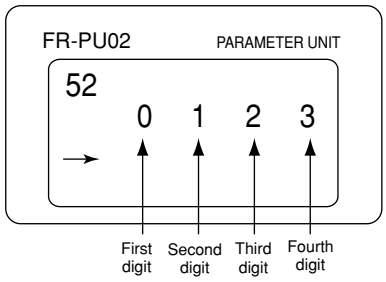
Number	Name	Factory setting	Setting range
51	Input power monitor reference	Rated power	0 to 400kW
53	Input voltage monitor reference	460V	0 to 1000V
55	Bus voltage monitor reference	680V	0 to 1000.0V
56	Current monitor reference	Rated current	0 to 1000A

The data displayed by the parameter unit (terminal FM) can be set and changed.

⇨ Pr.52 [PU main display data selection], Pr.54 [FM terminal function selection]

- The data displayed by the parameter unit can be set and changed. However, the monitor does not display only if the parameter is set. It can be switched with the switch.
- The current monitor varies as Pr.52 "PU main display data selection" is set or changed.

(1) The digits set at Pr.52 (Pr.54) are concerned with the switches of the terminals X1 and X2.



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 value set at Pr.52 (Pr.54) is as follows.

Pr.52 (Pr.54) set value	Display
0	Input current monitor
1	Bus voltage monitor
2	Input voltage monitor
3	Input power monitor

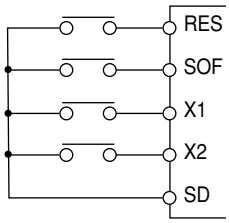
(3) The following are set as the default value.

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

Since the terminals (switches) were factory-set at X1 (OFF) and X2 (OFF), "input current monitor" is displayed by the monitor of the parameter unit.

(Note) As basic, 4 digits are input, and "0" is not displayed if it is set at the 1st digit of the 4-digit input. If "0" is set at the 1st digit only, it will be displayed. Default value "123" is regarded as "0123".

<Factory setting of terminals (switches)>



(4) Shift operation of PU main monitor

Three types of monitor can be sequentially called up merely by pressing (shift) key at the monitor set at Pr.52 "PU main display data selection".

(5) Method to select the monitor display with (monitor) key

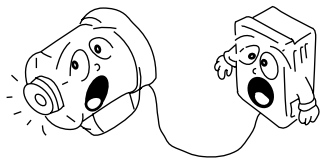
1) Press (monitor) key --> (help) key, and the monitor list will be displayed.
2) Select with the arrow key.
3) Press the reading key, and the monitor will be displayed.
Here, keep in mind that the monitors which can be read are limited.

<Monitor list>

1. Frequency	Input frequency [Hz]
2. Current	Input current [A]
3. Voltage	Input voltage [V]
4. Alarm Hist	8 alarms error definitions
5. F command	The specified No. monitor is not found. ▶Clear
6. rpm	
7. Shaft Trq	
8. Vdc	Converter output voltage [V]
9. Brake%ED	The specified No. monitor is not found. ▶Clear
10. Thermal	
11. I Peak	
12. Vdc peak	
13. kw IN	Converter input power [kW]
14. kw OUT	The specified No. monitor is not found. ▶Clear
15. I/P signal	
16. O/P signal	

(Note) In each monitor display, press (write) key, and the first priority screen will be determined. If the first priority screen is determined, it will be first displayed soon after the power supply is turned "ON" or when the setting mode , etc. is changed to the monitor mode.

In case of instantaneous stop, restart is selected.



⇨ Pr.57 [Restart selection]

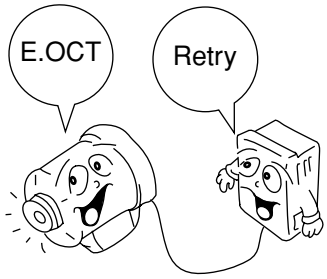
- If the instantaneous stop restart is selected in the "restart free run time" with the parameter on the inverter side, set Pr.57 "restart selection" ≠ "0". In case of Pr.57 "0", the inverter will stop the inverter output according to the error signal "E.IPF" even if the instantaneous stop restart is selected.

Pr.57 set value	Restart operation
0	Enable
9999 (Factory setting)	Disable

⚠ CAUTION

When automatic restart after instantaneous power failure has been selected, the motor and machine will start suddenly (after the reset time has elapsed) after occurrence of an instantaneous power failure. Stay away from the motor and machine.
When you have selected automatic restart after instantaneous power failure, apply the supplied CAUTION seals in easily visible places.

The retried error content is limited.



⇨ Pr.65 [Retry selection], Pr.67 [Number of retries at alarm occurrence]
Pr.68 [Retry wating time], Pr.69[Retry count display erasure]

- If any error occurs in the high power factor converter, the high power factor converter will automatically reset the alarm with the retry function to allow the operation to be continued.

(1) Pr.65 "Retry selection" can limit the high power factor converter error which will be retried. The retried error content is limited.

Pr.65	"Retry selection" can limit the high power factor converter error which will be retried.
0	Not retried.
1	Overcurrent shutdown (OCT)
2	Power supply error (IPF) (Note 4)
3	Overcurrent shutdown (OCT) and power supply error (IPF)

(2) Use Pr. 67 to set the number of retries at alarm occurrence.

Pr.67 set value	Number of retries	Alarm signal output
0 (Factory setting)	Retry is not made.	-
1 to 10	1 to 10 times	Not output

(3) Use Pr. 68 to set the waiting time from when an high power-factor converter alarm occurs until a restart in the range 0 to 360 seconds.

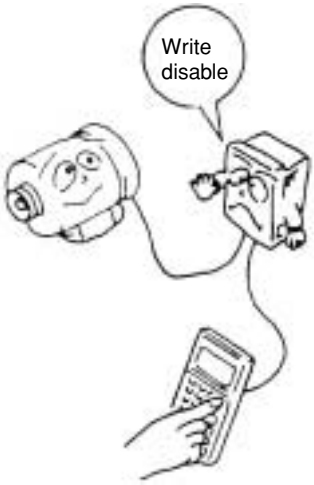
(4) Reading the Pr. 69 value provides the cumulative number of successful restart times made by retry. The setting of "0" erases the cumulative number of times.

(Note) 1. After Pr.68 "retry execution waiting time", the high power factor converter will automatically restart the operation. Taken care to prevent giving any danger to the worker.
2. The cumulative number in Pr. 69 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 more than four times longer than the time set in Pr. 68.
3. If alarms occur consecutively within a period four times longer than the above waiting time, the operation panel may show data different from the most recent data or the parameter unit may show data different from the first retry data. The data stored as the error reset for retry is only that of the alarm which occurred the first time.
4. Keep in mind that the error at the time of retry is not memorized.
5. IPF signal of Pr.65 "Retry selection" = 2 (power supply error) is detected at the time of the power supply error.

⚠ CAUTION

When you have selected the retry function, stay away from the motor and machine unless required. They will start suddenly (after the reset time has elapsed) after occurrence of an alarm.
When you have selected the retry function, apply the supplied CAUTION seals in easily visible places.

To set parameter write disable



⇨ Pr.77 [Parameter write disable selection]

- Writing of the various parameters with the parameter unit can be prevented.

Pr.77 set value	Write disable function
1	Parameter write disable
2 (Factory setting)	Parameter write enable

(Note) 1. Monitor-related parameters Pr.51, 53, 55, 56 can be set at any time.
2. Pr.77 can be set at any time.

⚠ CAUTION

If the setting is changed during operation, an alarm may occur in the high power-factor converter causing the motor to enter the free run state.

To change the language displayed on the parameter unit

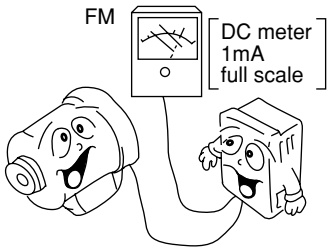
⇨ Pr.145 [Parameter write disable selection]

- The language displayed by the unit FR-PU02ER (optional) can be selected.

Set value	Language displayed
0	English (Factory setting)
1	German
2	French
3	Spanish

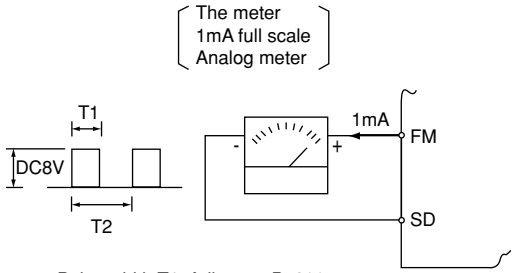
(Note) This will not function even when set if using the FR-PU02 or FR-PU02E parameter units.

Terminal FM calibration and output



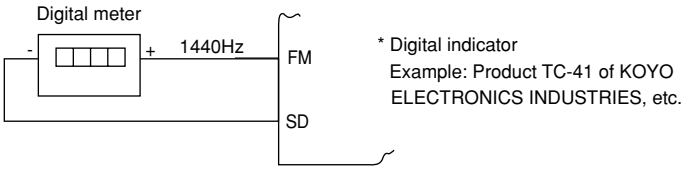
⇨ Pr.900 [FM terminal calibration]

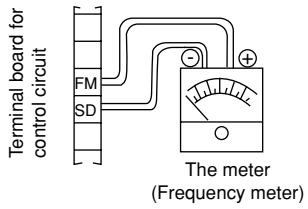
- By using the parameter unit, you can calibrate a meter.
  This calibration function is common to all monitors selected by Pr.54 [FM terminal function selection].
- Terminal FM provides the pulse output. By setting Pr. 900, you can calibrate the meter connected to the inverter from the parameter unit without providing a calibration resistor.



Pulse width T1: Adjust on Pr.900

- Monitor with the digital indicator
  The digital display with the digital counter is possible when the pulse train output of the terminal FM is used. The selection monitor of the monitor can set the ratio of the terminal FM monitor with Pr.51 "Input power monitor reference", Pr.53 "input voltage monitor reference", Pr. 55 "Base line voltage monitor reference" and Pr.56 "Current monitor reference".



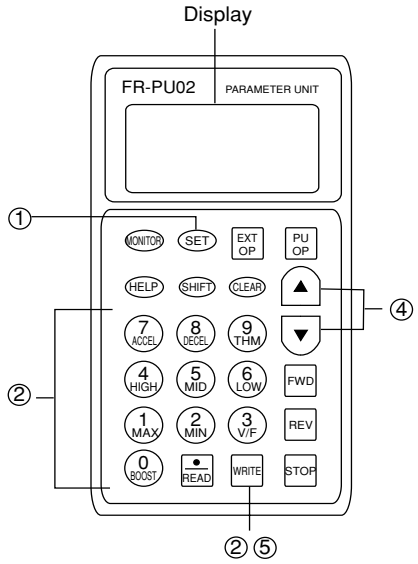


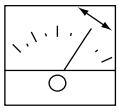
• Calibration procedure

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

(2) When a calibration resistor has already been connected, adjust the resistance to "0" or remove the resistor.

(3) Set Pr.54 "FM terminal selection function". According to the necessity of the output signal, previously set the parameter.



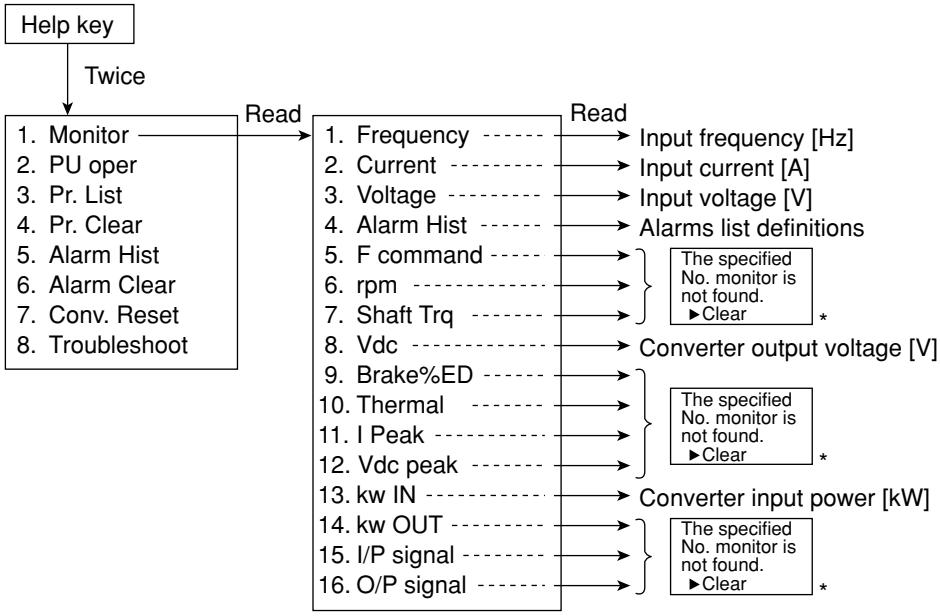
① Press the [SET] key . ... The converter is placed in the parameter setting mode.	SETTING MODE Set Pr.NO. FOR PR.List <HELP>
②Type ⑨ ⓪ ⓪ and the [READ] key . ... The screen on the right is displayed.	SETTING MODE Pr.NO. 900 <READ>
③The input current is displayed.	900 MONITOR 2.31A ▶▽△<WRITE> EXT
④Using the △ or ▽ key, adjust the meter reading to a predetermined position. ... The meter reading moves. (It takes a long time until the meter reading moves.)	
⑤ Press the [WRITE] key . ... Calibration is complete.	900 Complated <MONITOR>

Press any of the [MONITOR], [SET] keys to switch to the respective mode.

The monitor selection, parameter setting and parameter clear can be done with the help key.
On each monitor, press the help key 2 times, and the help function menu will be called up. From this menu, each mode can be set or selected. Here, take care for the restrictions.

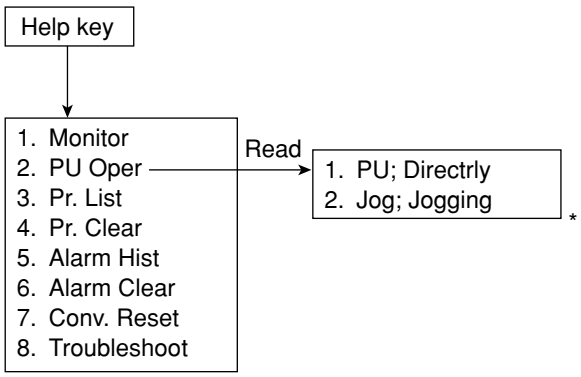
2.3.1 Help function menu

(1) Monitoring function



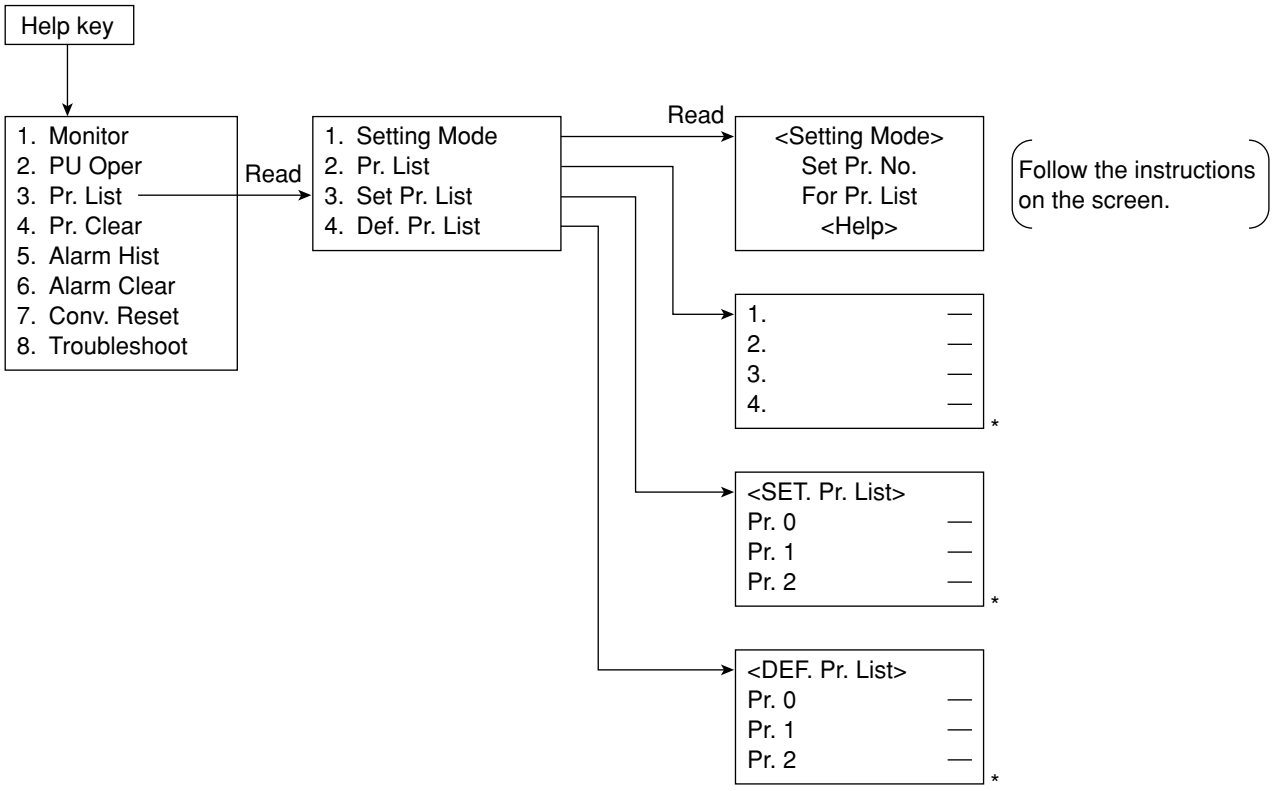
* This function can not be used. It will be returned to the help selection screen with the clear key.

(2) PU operation function



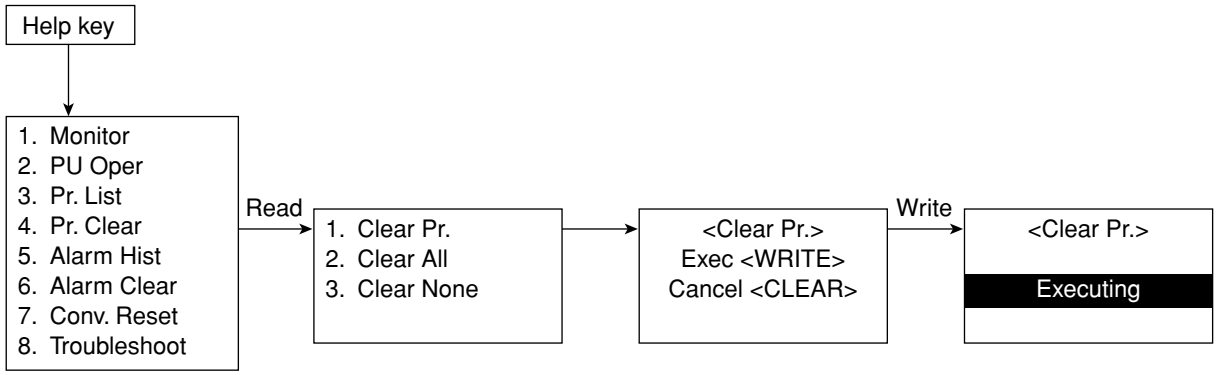
* This function can not be used. It will be returned to the help selection screen with the clear key.

(3) Parameter setting function (Keep in mind that any other functions except "1 Setting" do not function.)

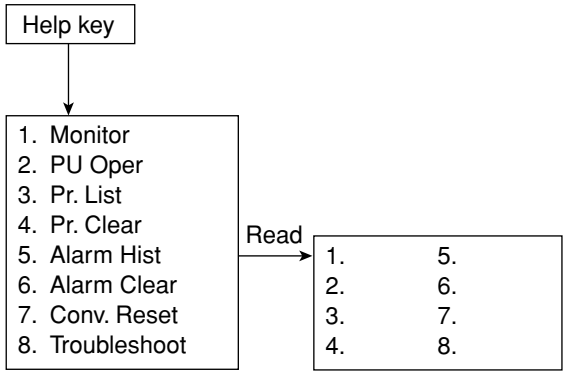


* This function can not be used. It will be returned to the help selection screen with the clear key.

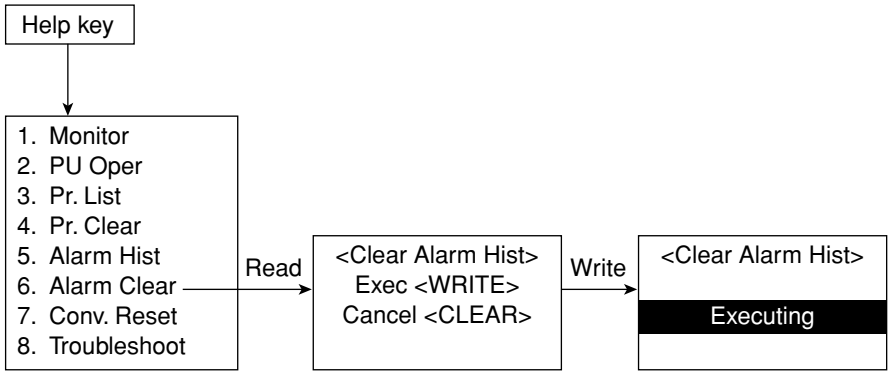
(4) Parameter initializing function ..... The value set for the parameter is returned to the default value.



(5) Alarm history display function

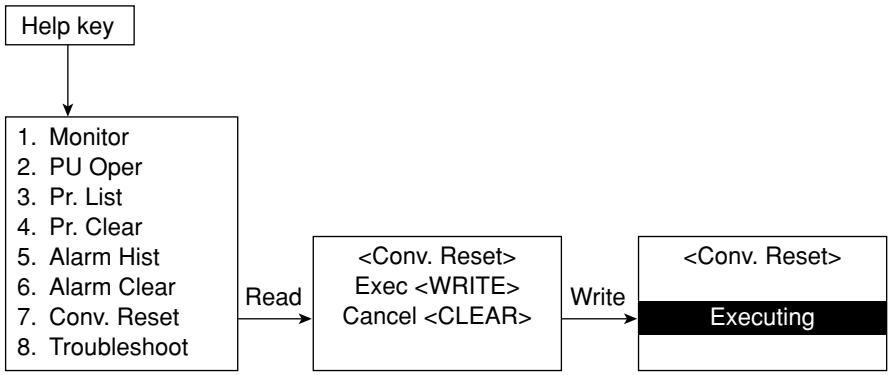


(6) Alarm history clear function (The alarm history is deleted.)

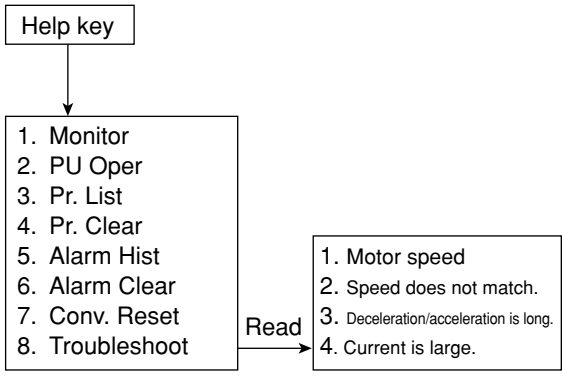


(7) Converter reset (The high power factor converter is reset.)

Note: Keep in mind that the display is applied to the inverter resetting but the inverter is not reset. (In order to make the inverter reset at the same time when the converter is reset, it is necessary to make the wiring between the terminals RSO and RES and between the terminals SE and SD.)



(8) Troubleshoot (Keep in mind that it does not function.)



Note 1. The help function of the high power factor converter have more restrictions than that of the inverter.
2. If any item which does not function is selected, return the screen to the help selection screen with the clear key.

3. PROTECTIVE FUNCTIONS

The chapter gives information on the "protective functions" of this product.
Always read the instruction in the chapter before using the equipment.

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 PU display. When the protective function is activated, reset the converter .

3.1.1 Error (alarm) definitions

Parameter unit display (LED display)	Description	Cause	Check point	Remedy
Low speed overcurrent (E.OC2)	Overcurrent protection	If the input current exceeds the specified level during operation of the high power factor converter, the high power factor converter and inverter stop operating.	Does the load rapidly vary?	Eliminate the rapid load variation.
Low speed overcurrent (E.ATT)	Arm short-circuit	Display that an arm short-circuit occurs between P and N of the transistor. The converter and inverter stop operating.		
Transistor protective thermal relay (E.UVT)	Electronic thermal relay	For IGBT protection, the electronic thermal relay is activated due to the reverse time characteristics against converter input, and the converter and inverter stop operating.	Does the motor run under overload?	Reduce the load.
Instantaneous power failure (E.IPF)	Power supply trouble	If the power failure continues 15msec and is recovered within approx. 100msec, the converter and inverter stop operating. If DC voltage exceeds 857V during operation of the inverter, the inverter and converter stop operating.	Inspect the cause of instantaneous power failure.	
Undervoltage (E.UVT)	Undervoltage protection	If DC voltage drops beyond 400V, the converter and inverter stop operating.		
Undervoltage (E.UVT)	Control power supply voltage drop	If the control power supply drops beyond 50% of +15V, the converter and inverter stop operating.		
Ground leak current (E.GF)	Ground leak overcurrent protection on the power side	If any overcurrent leaks due to the ground short-circuit on the input side (power side) of the converter, the converter and inverter stop operating.		
Retry overtime (E.RET)	Excessive times of retrial	If it can not be properly operated with the specified times of retrial, the converter and inverter stop operating.	Inspect the occurrence cause of the trouble.	
CPU error (E.CPU)	CPU error	If CPU calculation is not ended within the specified time, the converter and inverter stop operating.		
Fin overheat (E.FIN)	Cooling fin overheat protection	If the cooling fan stops due to any trouble or the cooling fin is overheated due to the clogged fin, the converter and inverter stop operating.	Check the cooling fan and fin for abnormality.	
Fan stop (E.FAN)	Cooling fan stop	The cooling fan stops due to an abnormality. The converter and inverter stop operating.		
Fan stop (E.FAN)	Gate power voltage drop	If gate power voltage drops beyond 75%, the converter and inverter stop operating.		
Low speed overcurrent (E.FUT)	DC fuse is blown.	DC fuse is blown. The converter and inverter stop operating.		

3.1.2 Faults and check points

Phenomenon	Check point
It does not properly operate.	Check the connection. • Is it properly wired? • Is any proper power voltage applied? • Is the phase sequence proper? • Is the inverter modified to match the high power factor converter? (FR-A540L-HC or FR-F540L-HC)
Power lamp is not lit.	Check the connection • Is it properly connected? • Is it properly wired at the control circuit terminals R, S and T? • Is any resistor broken in the externally placed box?
Charge lamp is not lit.	Check the connection • Is it properly connected? • Is it properly wired at the main circuit terminals R4, S4 and T4?
The reactor is excessively heated?	Check the connection. • Is the sequence of the reactors 1 and 2 mistaken?
The motor is excessively heated?	Is the rated voltage of the motor set at the parameter 19 "base frequency voltage" of the inverter?
Abnormal noise is heard from the reactor.	Is the phase sequence proper?

The transistorized inverter is a static unit mainly consisting of semiconductor devices.
Daily inspection must be performed to prevent any fault from occurring due to adverse influence by the operating 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, a high voltage remains in the smoothing capacitor. When accessing the inverter for inspection, switch power off. When more than 10 minutes have elapsed, make sure that the voltage across the main circuit terminals P-N <+ - -> of the inverter is 30VDC or less using a meter, etc.

⚠ DANGER

Reactor 1 and 2 as it may be hot and you may get burnt.

3.2.2 Check items

(1) Daily inspection

- Check the following:
  1) Improper installation environment
  2) Cooling system fault
  3) Unusual vibration and noise
  4) Unusual overheating and discoloration

- During operation, check the inverter input voltages using a meter.

(2) Periodic inspection

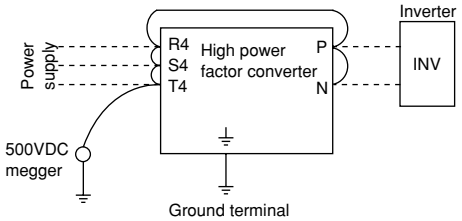
- Check the areas inaccessible during operation and requiring periodic inspection. For periodic inspection, consult us.
  1) Cooling system: Clean the air filter, etc.
  2) Screws and bolts: These parts may become loose due to vibration, temperature changes, etc. Check that they are tightened securely 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: Since the high power factor converter has the unit which displays the power during operation and an error (abnormality) during a trouble, the content is understood. Moreover, the content is checked with the parameter unit, and the value set at the normal time is recorded.

For the daily/periodic inspection items and the judgment criteria, refer to the next page.

(3) Megger test

1) Before performing the insulation resistance test using a megger on the external circuit, disconnect the cables from all terminals of the inverter so that the test voltage is not applied to the inverter.
2) For the continuity test of the control circuit, use a meter (high resistance range) and do not use the megger or buzzer.
3) For the inverter, conduct the insulation resistance test on the main circuit only as shown below 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
			Daily	Periodic				
				1 year	2 years			
General	Surrounding environment	Check ambient temperature, humidity, dust, dirt, etc.	○			Refer to page 7.	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 hgih power-factor converter terminals R, S, T, R4, S4, T4.	323 to 506V 50Hz 323 to 506V 60Hz	Meter, 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-ing of 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) Re-tighten. (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) Is it discolored?		○ ○		(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 range of 100Ω.	(See the following pages)	Analog meter
	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, wire-wound resistor. (2) Disconnect one end and measure with tester.	(1) No fault. (2) Error should be within ±10% of indicated resistance value.	Meter, 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) Visual check.	(1) Must rotate smoothly. (2) No fault.	
Display	Display	(1) Check if POWER lamp is blown. (2) Clean.	○	 ○		(1) Light 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.

• Checking the inverter and converter modules

<Preparation>

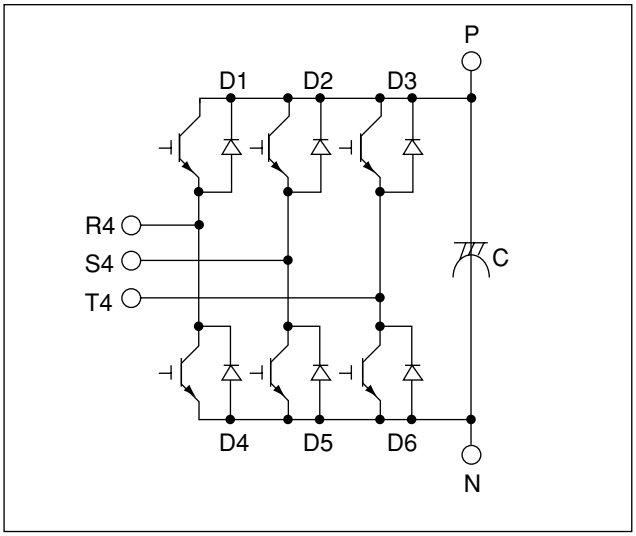
1) Disconnect the external power supply cables (R4, S4, T4, N, P) .
2) Prepare an analog meter. (Use 1Ω range.)

<Checking method>

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

Note: 1. Before measurement, check that the smoothing capacitor is discharged.
2. At the time of continuity, the measured value is several to several ten's-of ohms depending on the module type, circuit tester type, etc. If all measured values are almost the same, the modules are without fault.

		Tester polarity		Measured value
		⊕	⊖	
Converter module	D1	R4	P	No continuity
		P	R4	Continuity
	D2	S4	P	No continuity
		P	S4	Continuity
	D3	T4	P	No continuity
		P	T4	Continuity
	D4	R4	N	Continuity
		N	R4	No continuity
	D5	S4	N	Continuity
		N	S4	No continuity
	D6	T4	N	Continuity
		N	T4	No continuity



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.

(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 2~3 years if the inverter 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 inverter is operated in an 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 their life will be expired soon).

Check the following:

1) Case (side faces and bottom face for expansion)
2) Sealing plate (for remarkable warping and extreme cracks)
3) Explosion-proof valve (for excessive valve expansion and operation)
4) Appearance, external cracks, discoloration, leakage. When the measured capacitance of the capacitor has reduced below 85% of the rating, change the capacitor.

(3) Relays

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

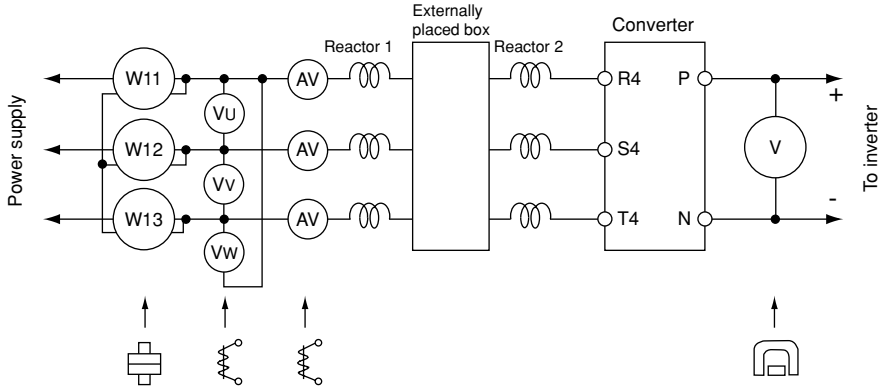
See the following table for the inverter parts replacement guide. Lamps and other short-life parts must also be changed during periodic inspection.

Replacement parts of the high power-factor converter

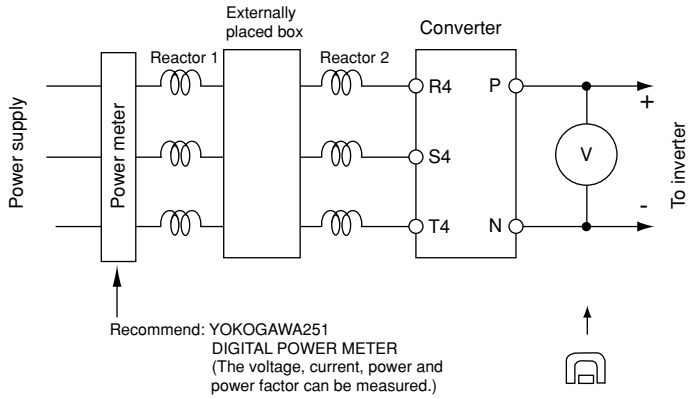
Part name	Standard replacement interval	Description
Cooling fan	2 to 3 years	Change (as required)
Smoothing capacitor in main circuit	5 years	Change (as required)
Smoothing capacitor on control board	5 years	Change the board (as required)
Relays	-	As required

3.2.4 Measurement of main circuit voltages, currents and powers

- Measurement of voltages and currents
  When instruments for commercial speed are used for measurement, measure the following circuits using the instruments given on the drawing below.
- When the instruments and others are installed on the output side of the high power factor,
  If the wiring between the high power factor converter and the inverter is long, the instrument may generate heat particularly due to the influence of the leak current between the lines on the 400V Class. Therefore, select the instrument which has an excess for the current rating.
- The output voltage is generated between the terminals P and N of the high power factor inverter, and can be measured with the moving coil type meter (tester). Though it varies depending on the voltage of the power supply, the voltage will drop if any load is applied.



<Typical measuring points and instruments>

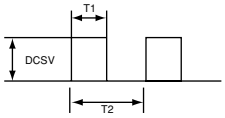


<Typical measuring points and instruments>

- Classification and application depending on the operational principle of the electrical indicators

Type	Symbol	Principle	Indication	Applicable meter	Feature
Moving coil type		It uses the force generated by the current which flows in the moving coil under the magnetic field.	DC (average)	Voltmeter, ammeter, resistance meter, thermometer, magnetic flux meter, tachometer	It is frequently used due to the high sensitivity. The influence of the consumed power and external magnetic field is small.
Moving-iron type		It uses the force generated between the moving iron and the current which flows in the fixed coil.	AC (effective value)	Voltmeter, ammeter	Strong structure and low price. It is largely influenced by the external magnetic field, frequency and waveform.
Electrodynamometer type		It uses the force generated between the currents in two coils.	DC and AC (effective)	Wattmeter, voltmeter, ammeter	In case of the power meter, the scale is graduated at the equal intervals. It is largely influenced by the external magnetic field with a large consumed power. It is used as the standard for AC and DC.
Air-core					

Measuring points and instruments

Item	Measuring point	Measuring instrument	Remarks (Note 1) (Reference measured value)
Power supply voltage V_1	Across R-S, S-T and T-R	Moving-iron type AC voltage	Commercial power supply 342 to 506V 50Hz 342 to 506V 60Hz
Power supply side current I_1	R, S and T line currents	Moving-on type AC ammeter	
Power supply side power P_1	At R, S and T, and across R-S, S-T and T-R	Electrodynamic type single-phase wattmeter	$P_1 = W_{11} + W_{12} + W_{13}$ (3-Wattmeter method)
Power supply side power factor Pf_1	Calculate after measuring power supply voltage, power supply side current and power supply side power. $Pf_1 = \frac{P_1}{\sqrt{3}V_1 \cdot I_1} \times 100\%$		
Converter output	Across P-N	Moving-coil type (such as tester)	Converter LED display is lit. 1.35 x V_1 Max. 760V during regenerative operation.
Meter signal	Across FM (+) -SD	Moving-coil type (such as tester) (Internal resistance: 50kΩ or larger)	Approx. DC 5V at maximum frequency (When the meter is not provided,)  Pulse width T1: Adjustment with Pr.900 Pulse frequency T2: Setting with Pr.55 (Effective only at the frequency monitor)
			Approx. DC 10V at maximum frequency (When the frequency meter is not provided,)
			20 to 30DC when open. ON voltage: 1V or less.
			"SD" is common.
Analog 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: Accurate data will not be obtained by a tester.

MEMO

4. PRECAUTION FOR SELECTION

The chapter gives information on the "precaution for selection" of this product.
Always read the instruction in the chapter before using the equipment.

4.1.1 Noise

The noise described in this item generally shows an irregular state under the high frequency of 40 to 50 orders or more in the power distribution system.

There are two kinds of noises: the noise enters from the outside to malfunction the high power-factor converter, and the other noise is radiated from the high power-factor converter to malfunction the peripheral equipment. Though the high power-factor converter is designed to be hardly influenced by the noise, the following basic countermeasure is necessary since the electronic equipment uses a week signal. Since the high power-factor converter moreover chops the output at the high carrier frequency, it becomes a noise generating source. If this noise is generated to malfunction the peripheral equipment, the countermeasure must be taken to suppress the noise. The countermeasure is slightly different depending on the noise transmission path.

(1) Basic countermeasure

- Prevent routing the power cables (input/output cables) of the high power-factor converter in parallel but route them in dispersion.
- Use the twist pair shield cables to connect the detector and the control signals, and connect the outer sheaths of the shield cables to the terminal SD.
- Ground the reactors 1 and 2, externally installed box, high power-factor converter, inverter and motor at one place.

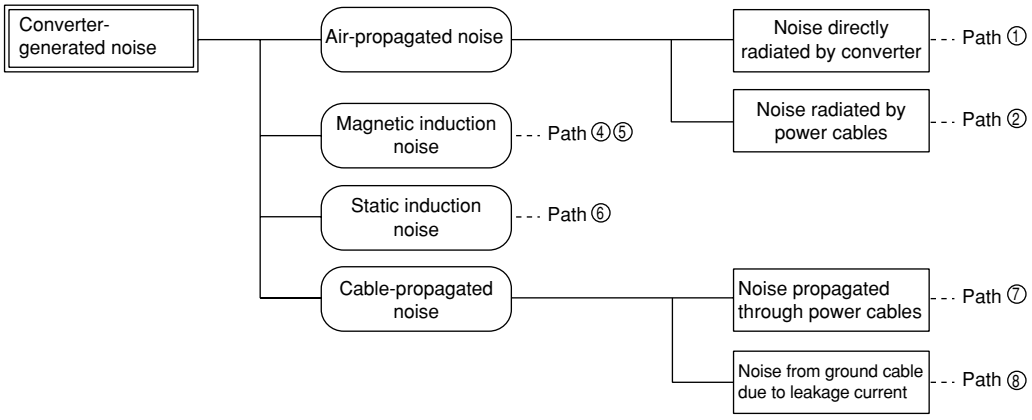
(2) Countermeasure against the noise which enters from the external and malfunction the high power-factor converter.

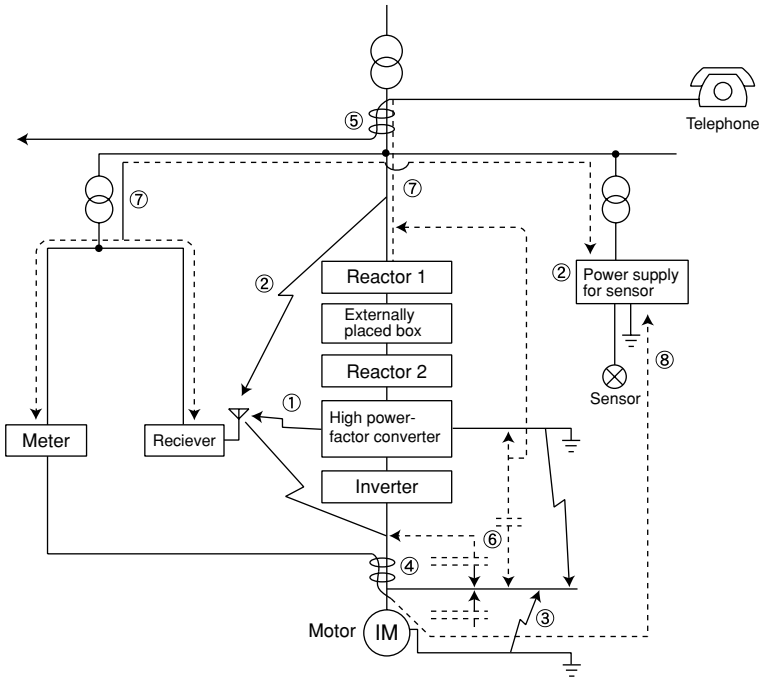
The equipment (electromagnetic contactor, electromagnetic brake, many relays and others) which generates much noise are installed near the high power-factor converter. If the high power-factor converter may malfunction, it is necessary to take the following countermeasures.

- On the equipment which generates much noise, install the surge killer to suppress the generated noise.
- Install the data line filters on the signal cables.
- Ground the detectors and the shields of the connection cables and control signal cables with the cable clamp metal.

(3) Countermeasure against the noise which is radiated from the high power-factor converter and malfunctions the peripheral equipment

The noise generated by the high power-factor converter is mainly classified as the noise radiated by the cables which are connected to the main body of the high power-factor converter and the main circuit (input/output) of the high power-factor converter, the noise electromagnetically or electrostatically induced in the signal cables of the peripheral equipment near the power supply of the main circuit, and the noise transmitted through the power supply cable.





Noise transmission path	Countermeasure
① ②	The measuring instrument, receiver, sensor and other equipment which process slight signals and are easily influenced to easily malfunction. If they and their signal cables are stored in the same panel together with the high power factor converter and are routed near it, it is necessary to take the following countermeasure since the equipment may malfunction due to the aerial transmission of the noise. (1) Place the easily influenced equipment to be as far as possible away from the high power factor converter. (2) Place the easily influenced equipment to be as far as possible away from the high power factor converter and their input/output cables. (3) Prevent routing the signal cables and power cables (input/output cables of the high power factor converter) in parallel or bundled state. (4) If the line noise filter is inserted to the input/output or the radio noise filter is inserted to the input, the noise radiated from the cable can be suppressed. (5) It is more effective if any shield cable is used for the signal cable or power cable or is respectively passed through the metallic duct.
④ ⑤ ⑥	If any signal cable is routed in parallel with the power cable or is bundled together with the power cable, the noise may be transmitted and malfunctioned to the signal cable by the electromagnetically induced noise or electrostatically induced noise. Therefore, it is necessary to take the following countermeasure. (1) Place the easily influenced equipment to be as far as possible away from the high power factor converter. (2) Place the easily influenced equipment to be as far as possible away from the high power factor converter and their input/output cables. (3) Prevent routing the signal cables and power cables (input/output cables of the high power factor converter) in parallel or bundled state. (4) It is more effective if any shield cable is used for the signal cable or power cable or is respectively passed through the metallic duct.
⑦	If the power supply of the peripheral equipment is connected to the power supply in the same system of the high power factor converter, the noise generated by the high power factor converter may cause a malfunction due to the noise which reversely flows against the power cable. Therefore, it is necessary to take the following countermeasure. (1) Install the radio noise filter (FR-BIF) on the power cable (input/output cable) of the high power factor converter. (2) Install the line noise filter (FR-BLF) on the power cable of the high power factor converter.
⑧	If any closed loop is produced by wiring the peripheral equipment to the high power factor converter, the current may leak from the ground cable of the high power factor converter and flow into the equipment, thus resulting in the malfunction. In this case, disconnect the ground cable of the equipment, and the malfunction will be possibly eliminated.

4.12. Peripheral device list

High power-factor converter	No fuse braker(NF) or leakage braker(NV)	Electro-magnetic conector(MC)
MT-HC-H75K-S	Type NF225, type NV225 225A	S-N95
MT-HC-H110K-S	Type NF225, type NV225 225A	S-N180
MT-HC-H150K-S	Type NF400, type NV400 400A	S-N300
MT-HC-H220K-S	Type NF600, type NV600 500A	S-N600

5. SPECIFICATIONS

The chapter gives information on the "specifications" of this product.
Always read the instruction in the chapter before using the equipment.

5.1.1 Standard specifications

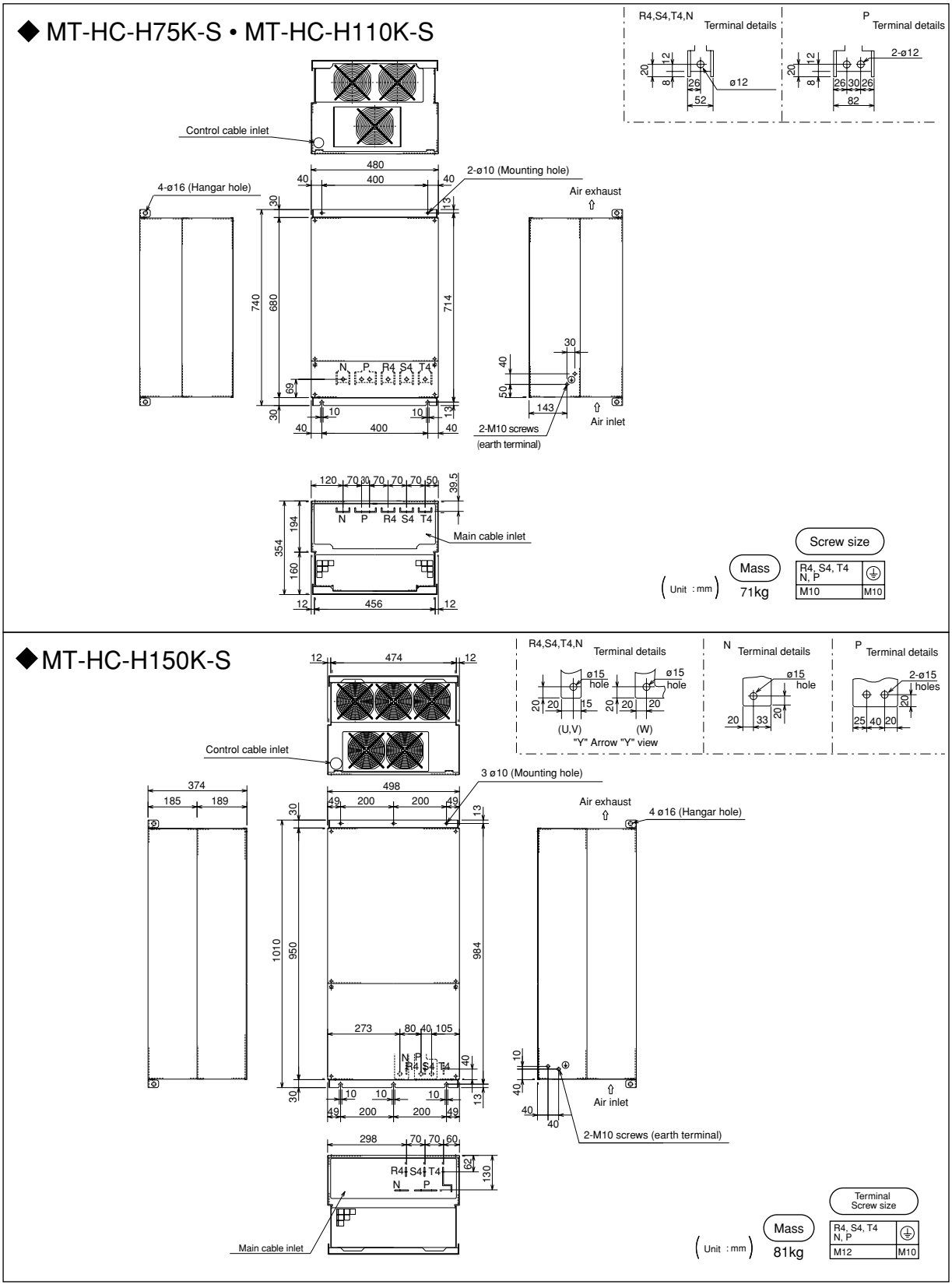
Input voltage		400V class			
Model MT-HC-□□□□□		H75K-S	H110K-S	H150K-S	H220K-S
Applicable inverter capacity (W)		75K	110K	150K	220K
Rated input voltage (V)		3 phase 380~460V 50/60Hz			
Rated input current (A)		144	216	288	432
Overload current rating		150% for one minute			
Input power factor		0.99 or more (Load ratio: 100%)			
Circuit type and circuit No.		Self-excited type 3-phase bridge K5=0			
Protective structure		Open type (IP00)			
Cooling system		Forced wind-cooling			
Approx. mass (kg)	Unit	67	71	81	133
	Total (with option)	246	423	605	755
Input signal		Reset, converter stop, monitor switch			
Output signal		Abnormal signal, inverter operation allowance, converter operating, overload alarm, one kind selection among (instantaneous stop, phase match, voltage match, forward running/regeneration discrimination), inverter resetting, input voltage/current/power/DC voltage			
Control system		Sine wave PWM control			
Indication	Parameter unit	・Power frequency, input voltage, input current, input power, DC voltage ・The content of 8 errors is memorized.			
Protective function		Overcurrent shutdown, arm short-circuit, electronic thermal relay, power failure, undervoltage protection, control power voltage drop, ground short-circuit overcurrent protection on the power side, excessive retrial times, CPU error, cooling fin overheat protection, cooling fan stop, gate power voltage drop, DC fuse blow, current limit trouble			
Environments	Ambient temperature	—10¡C to +50¡C (without freezing)			
	Ambient humidity	90%RH or less (without dewing)			
	Atmosphere	Indoor without corrosive gas, flammable gas, oil mist, dust, etc.			
Altitude		1,000m or less from sea level			
Vibration		0.6G or less			

5.1.2 Common specifications

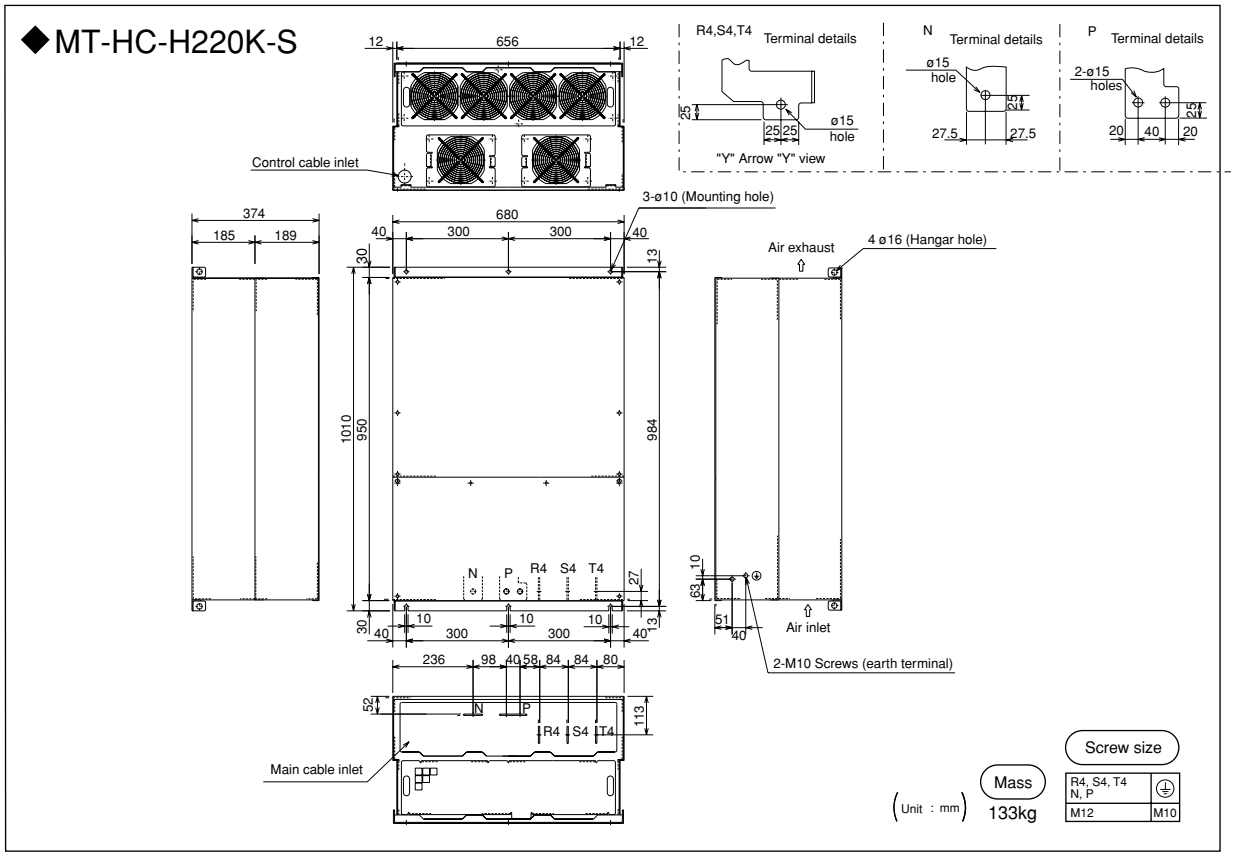
	Type		Symbol	Name	Content		
High power-factor converter	Main circuit		R, S, T	Control power input	Connect to the commercial power supply.		
			R4,R4,T4	Power supply input	Connect to the reactor 2.		
			R1, S1	Control power supply	Connect to the commercial power supply.		
			P, N	DC output	Connect to P and N terminals of inverter.		
			⏚	Ground terminal	Connect to the ground. (C Class ground)		
	Control circuit	Input signal	88R, 88S	MC connection terminal	Connect to 88R and 88S of the externally installed box.		
					Function	Circuit	Remarks
			RES	Reset	Converter stops operating. (Reset from the error.)	24VDC sink circuit	The converter and connected inverter are stopped.
			SOF	Converter stop	Converter gate shutdown		RDY signal is not output. The rush MC is closed.
			X1	Monitor switch	FM output and PU monitor display Contents selection		Input current monitor Bus voltage monitor Input voltage monitor Input power monitor
			X2				
			SD	Common terminal	Common terminal (Input, FM)	—	
		Output signal	RDY	Inverter operation allowance signal	Output during operation of rush MC Shutdown for the alarm	Open collector	Inverter is stopped.
			CVO	Converter operating	Output during IGBT switching		
			OL	Overload alarm	Overcurrent (150% or more) Overvoltage (Output during overvoltage tripless operation)		
			Y1	Multipurpose output terminal	Multipurpose output External error		Power supply phase detection signal Output voltage match signal detection Instantaneous power failure detection Forward running/regeneration discrimination
			RSO	Converter reset	Output with converter reset		Inverter is reset.
			FM	Indicator output terminal	Pulse array signal is output proportionally to the input current.	PWM pulse output	Depending on the setting of X1 and X2 terminals
			SE	Open collector output common	Open collector common	—	
			SD	Contact input common	Common terminal (input/output, FM)	—	
			A, B, C	Abnormal contact	Abnormal output	C contact	
Reactor 1	Main circuit		R, S, T	Power supply input	Connect to the commercial power supply.		
			R2,S2,T2	Power supply output	Connect to R2, S2 and T2 of externally installed box.		
Externally placed box	Main circuit		R2,S2,T2	Power supply input	Connect to R2, S2 and T2 of the reactor 1.		
			R3,S3,T3	Power supply output	Connect to R3, S3 and T3 of the reactor 2.		
	Control circuit	Output signal	88R, 88S	Terminal for MC connection	Connect to 88R and 88S of the high power factor converter.		
			R1, S1	Power supply terminal	Connect to commercial power supply.		
Reactor 2	Main circuit		R3,S3,T3	Power supply input	Connect to R3, S3 and T3 of externally installed box.		
			R4,S4,T4	Power supply output	Connect to R4, S4 and T4 of high power factor converter.		

5.1.3 Outline drawings

(1) High power-factor converter

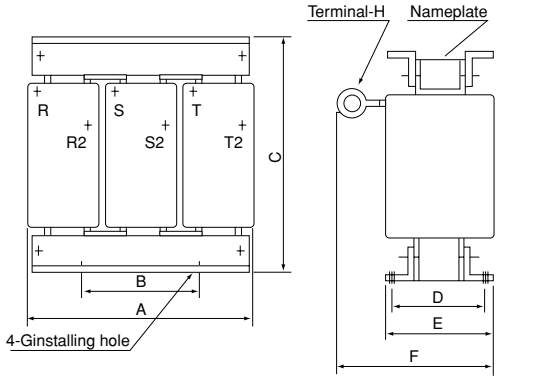


◆MT-HC-H220K-S


R4,S4,T4 Terminal details
N Terminal details
P Terminal details
ø15 hole
2-ø15 holes
"Y" Arrow "Y" view
Control cable inlet
3-ø10 (Mounting hole)
4 ø16 (Hangar hole)
Air exhaust
Air inlet
2-M10 Screws (earth terminal)
Main cable inlet
N P R4 S4 T4
656
680
374
185
189
300
1010
950
984
236
98
58
84
80
52
113
Unit : mm
Mass
133kg
Screw size
R4, S4, T4
N, P
M12
M10

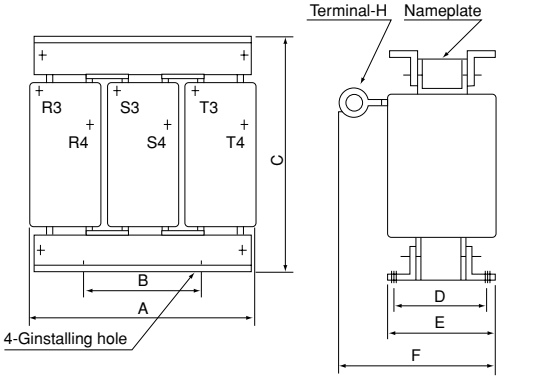
◆ REACTOR1 MT-HCL01-H__K-S

Model	A	B	C	D	E	F	G	H	Mass (kg)
MT-HCL01-H75K-S	240	150	215	120	136	223	M8	M10	29
MT-HCL01-H110K-S	270	150	255	130	162	246	M8	M10	33
MT-HCL01-H150K-S	330	150	275	130	162	266	M10	M12	55
MT-HCL01-H220K-S	330	150	292	185	216	318	M10	M12	85



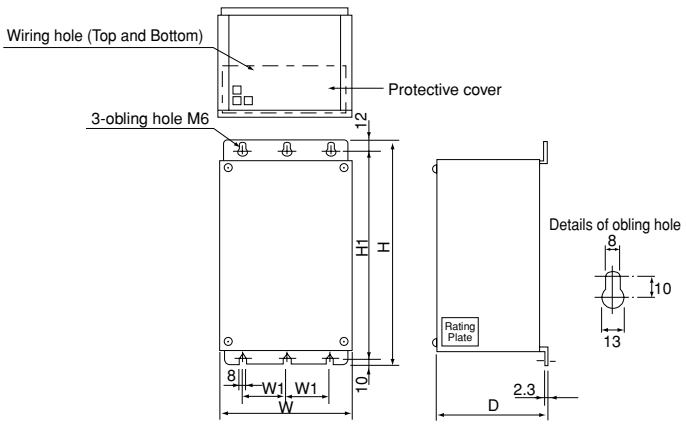
◆ REACTOR2 MT-HCL02-H__K-S

Model	A	B	C	D	E	F	G	H	Mass (kg)
MT-HCL02-H75K-S	455	200	435	200	240	340	M12	M10	150
MT-HCL02-H110K-S	510	350	580	335	395	455	M12	M12	260
MT-HCL02-H150K-S	570	400	600	390	450	510	M12	M12	380
MT-HCL02-H220K-S	630	400	665	445	505	565	M12	M12	460

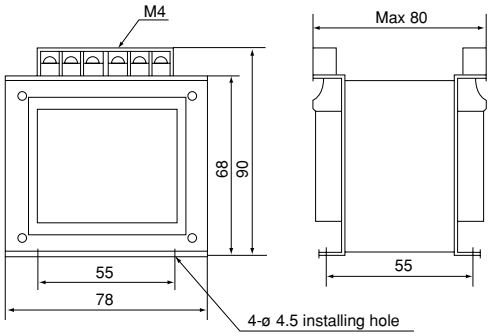


◆ EXTERNALLY PLACED BOX MT-HCB-H__K-S

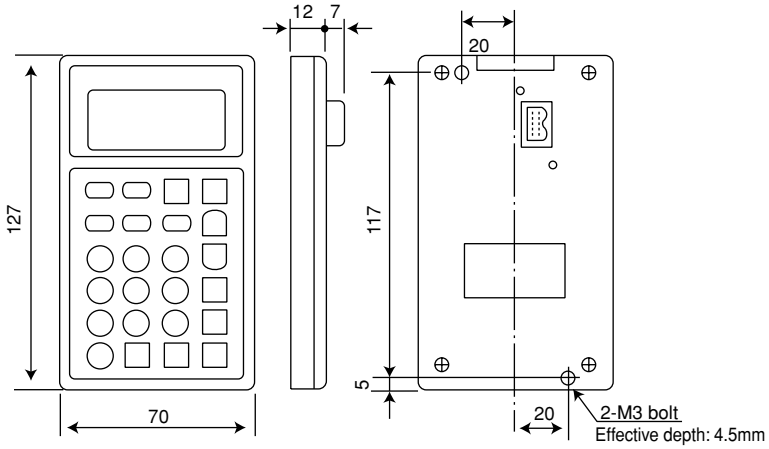
Model	W	H	D	W1	H1	Mass (kg)
MT-HCB-H75K-S	300	350	320	125	328	16
MT-HCB-H110K-S	350	450	480	125	428	30
MT-HCB-H150K-S	400	450	480	175	428	40
MT-HCB-H220K-S	550	500	500	250	478	67



◆ INSULATION TRANSFORMER MT-HCTR-450

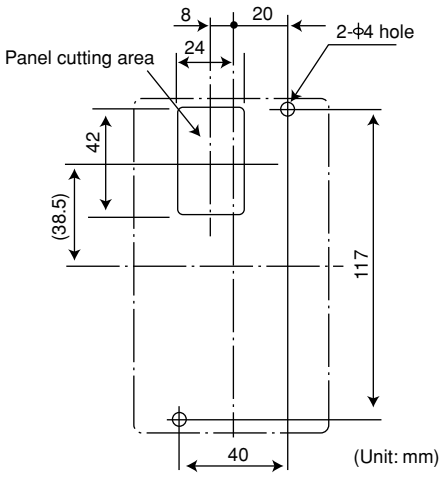


5.1.4 Parameter unit(FR-PU02) dimension drawing



(Note) Select the length of the installing bolt, taking care to prevent it from exceeding the effective depth of the installing bolt of the parameter unit.

Panel cutting dimensions to install the parameter unit on the panel,



(Drawing viewed from the front surface of the parameter unit)

■ FR-PU02 specifications

Item	Specifications		
Ambient temperature	Operation	-10~+50°C Note 1	
	Storage	-20~+65°C	
Ambient humidity	90%RH or less		With no dew condensation
Operational atmosphere	Reduced dust without oil mist and corrosive gas		
Connected target	Main body of FR-A Series inverter, or exclusive cable (FR-CBL)		
Power supply	Received from the inverter		
Connection system	Connect to the main body of the inverter or to the main body with exclusive cable		
Indication method	LCD liquid crystal display system (13 characters x 4 lines) Note 2		
Operation method	24 operation keys (covered with polyurethane film)		
Outside dimensions	127 (height) x 70 (width) x 12 (depth)		

(Note) 1. The liquid crystal display may slowly operated at the low temperature of approx. 0°C or less.
2. Don't expose the liquid crystal screen to the direct sunlight.

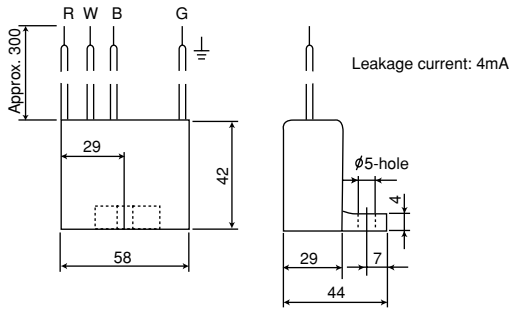
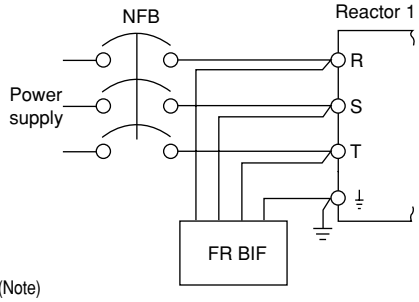
If the following options are used, the high power factor converter can be provided with more complete functions. Take care to prevent mistaking the selection method.
Here, the following options are all applicable for the exclusive separate-installation type optional unit.

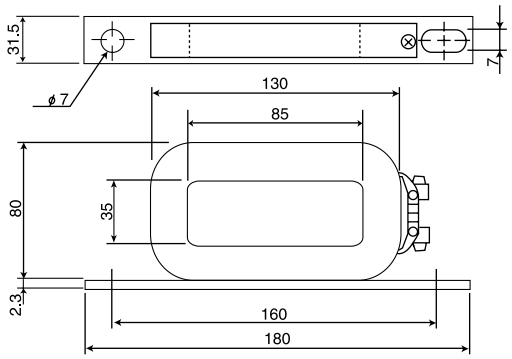
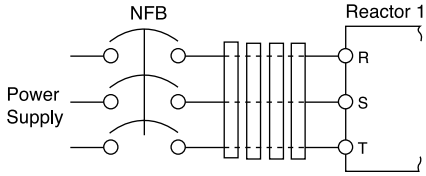
5.2.1 Option list

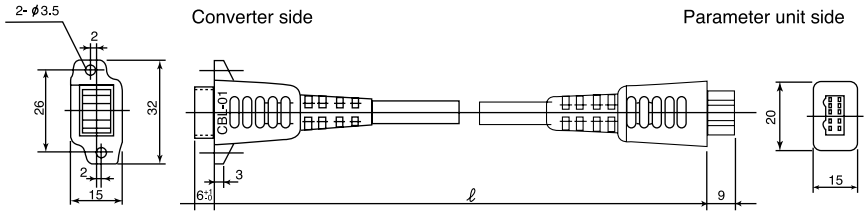
Name	Type	lication, Specifications, etc.
Parameter unit (Japanese)	FR-PU02-1	Interactive parameter unit using LCD display.
Parameter unit (English)	FR-PU02E	LCD display and ten keys of FR-PU02 are expressed in English.
Parameter unit (4 languages)	FR-PU02ER	Applicable to English, German, French and Spanish languages
Parameter unit connection cable	FR-CBL□□	Connection cable to the parameter unit Two types of straight type and L type
Radio noise filter	FR-BIF	For radio noise reduction
Line noise filter	FR-BLF	For line noise reduction

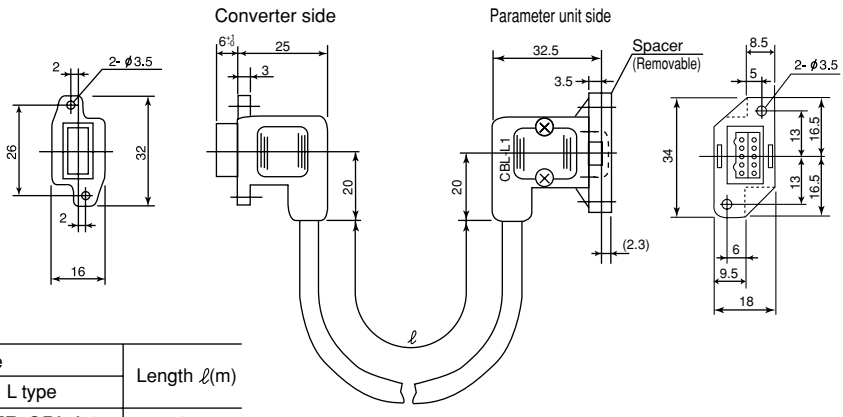
* FR-PU02 can be used in parameter unit (Japanese).

5.2.2 Option outline

<table>
<tr><th>Outline</th><th>Specifications and structures, etc.</th><th>Remarks</th></tr>
<tr><td>Radio noise filter
FR-BIF: 200V Series
FR-BIF-H:400V Series</td><td> 
</td><td> 

(Note)
1. It cannot be connected to the output side of the inverter.
2. Cut the cable to as short as possible, and connect it to the terminal block of the inverter.</td></tr>
<tr><td>Line noise filter
(FR-BLF)</td><td> 
</td><td> 

(Note)
1. Pass it through four or more filters.
2. On some models, it cannot be used depending on the cable size.</td></tr>
<tr><td>For Parameter unit Cable(FR-CBL⬚)</td><td>STRAIGHT TYPE
 

L TYPE
 

<table>
<tr><th colspan="2">Type</th><th rowspan="2">Length ℓ(m)</th></tr>
<tr><th>Straight type</th><th>L type</th></tr>
<tr><td>FR-CBL01</td><td>FR-CBL-L1</td><td>1</td></tr>
<tr><td>FR-CBL03</td><td>FR-CBL-L3</td><td>3</td></tr>
<tr><td>FR-CBL05</td><td>FR-CBL-L5</td><td>5</td></tr>
</table>
On L type cable, the connector on the parameter unit side can be also fastened with the appended bolts. parameter unit side can be also fastened with the appended bolts.</td><td></td></tr>
</table>

Replacement of parts

The inverter 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 inverter. For preventive maintenance, the parts must be changed periodically.

(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 40,000 to 50,000 hours. Hence, the cooling fan must be changed every 5years if the inverter is run continuously. When unusual noise and/or vibration is noticed during inspection, the cooling fan must be changed immediately.

• Removal

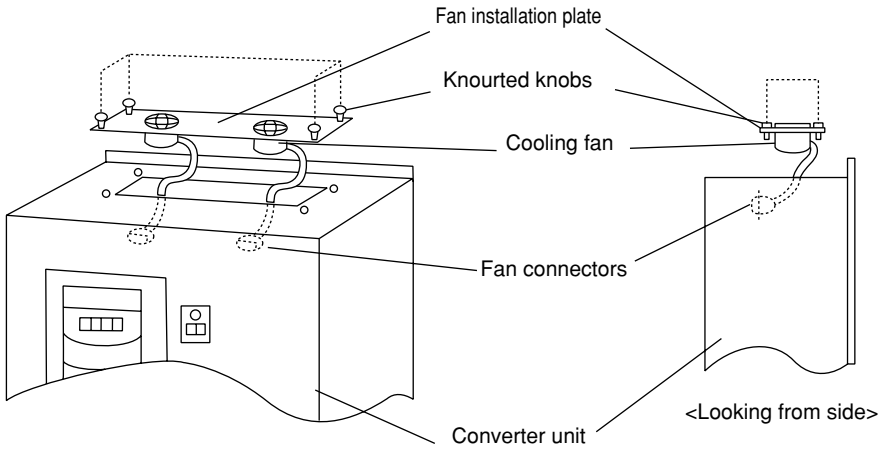
1) Turn the four knurled knobs fixing the cooling fan installation plate counterclockwise. (The knobs can be turned easily using a coin, etc.)
2) Lift the installation plate and cooling fan slightly, and disconnect the fan connectors.
3) Remove the fan with the installation plate.
4) Remove the four screws fixing the cooling fan to the installation plate.

• Reinstallation

1) After confirming the orientation of the fan, reinstall the fan so that the arrow on the left of "AIR FLOW" faces up.

<Fan side>

2) Connect the fan connectors
When wiring, use care to avoid catching the wires in the fan and sandwiching in the metal sections of the cooling fan and inverter unit.
3) Insert the cooling fan installation plate into the inverter unit, and securely fix with screws.



Caution: The number of cooling fans used differs according to the converter capacity. Depending on the number of cooling fans used, they may be installed on two installation plates.

(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 converter is operated in an 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 their life will be expired soon).

Check the following:

1) Case (side faces and bottom face for expansion)
2) Sealing plate (for remarkable warping and extreme cracks)
3) Explosion-proof valve (for excessive valve expansion and operation)
4) Appearance, external cracks, discoloration, leakage. When the measured capacitance of the capacitor has reduced below 70% of the rating, change the capacitor.

(3) Relays

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

See the following table for the inverter parts replacement guide. Lamps and other short-life parts must also be changed during periodic inspection.

Replacement parts of the Inverter

Part name	Standard replacement interval	Description
Cooling fan	5 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)
Cooling fan smoothing capacitor on control power	5 years	Change the power (as required)
Relays	-	As required

"Guarantee"

1. Gratuitous guaranteed term and range of guarantee

[Gratuitous guaranteed term]

Less than 1 year after installing in your company or the customer of your company or 18 months (reckoning on manufacturing day) after shipping from our company , ether is made short one.

[Guaranteed term]

(1) Failure diagnosis

As a rule, please execute the failure diagnosis temporarily in your company.
However, our company or our company service net onerously executes these activities as a proxy.
In this case, it will be assumed gratuitousness when as a result of the conference with your company, the failure cause is on our company side.

(2) Failure repair

For the repair, replacement exchange and make a local business trip when failure occurs, the following cases 1), 2), 3) and 4) will assumed onerousness, another will assume gratuitousness.

1) For the improper storage, handling on side of your company such as your company and your customers, careless faults and the failure by the reason for the content etc. of software or the hardware design on the side of your company.
2) For the failure which originates the fact that the hand such as remodeling was added to the our company product on the side of your company without the consent of our company.
3) For the failure which originates in use outside the specifications range of the our company product.
4) For the failure admitted that your company besides is outside the our company responsibility.

Please assume the above-mentioned service to be correspondence in domestic, and pardon the failure diagnosis in overseas etc.
However, it is necessary to register to our company when hoping for after-sales service in overseas.
Please inquire of our company about details beforehand.

2. Exclusion of guarantee obligation such as losses of chance

Regardless of the inside and outside of a gratuitous guaranteed term, a loss of chance on the side of your company such as your company and your customer which originates in the failure of the our company product, damage excluding our company product and other amends to activities are made outside the guarantee of our company.

3. Repair period after production is discontinued

For the model (product) of the production discontinuance, the repair is executed within the range of seven years after production was discontinued.

4. Handing over condition

As for standard parts which do not contain setting and the adjustment on the application, carrying into your company is assumed handing over, the local adjustment and the trial run will be made outside the obligation of our company.

⚠ About the application of this product

- This product is not an equipment used in the situation which affects the life or the one designed and produced purpose to be used for the system.
- Please inquire of our sales window when you examine the application of this product to a special usage such as the equipment for passenger mobile object, medical application, airlines space, nuclear power, electric power and bottom of the sea relay or system.
- The product is manufactured under strict quality management, when applying to equipment to which occurrences of a serious accident or loss are forecast by the failure of the product, please set up the safeguard.
- Please do not use for loads other than the three-phase induction motor.

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