OPERATION MANUAL

AC POWER SUPPLY/
FREQUENCY CONVERTER

PCR SERIES

APLICABLE MODELS

PCR 500
PCR 1000
PCR 2000
PCR 4000

KIKUSUI ELECTRONICS CORPORATION

(KIKUSUI PART NO. Z1-728-020)

Power Requirements of this Product

Power requirements of this product have been changed and the relevant sections of the Operation Manual should be revised accordingly.
(Revision should be applied to items indicated by a check mark ☑.)

☐ Input voltage

The input voltage of this product is _____ VAC,
and the voltage range is _____ to _____ VAC. Use the product within this range only.

☐ Input fuse

The rating of this product's input fuse is _____A, _____VAC, and _____.

WARNING

- To avoid electrical shock, always disconnect the AC power cable or turn off the switch on the switchboard before attempting to check or replace the fuse.
- Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that short circuits the fuse holder may result in fire, electric shock, or irreparable damage.

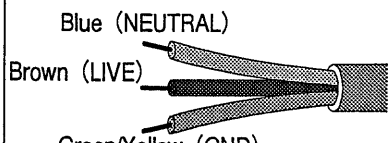
☐ AC power cable

The product is porvided with AC power cables described below. If the cable has no power plug, attach a power plug or crimp-style terminals to the cable in accordance with the wire colors specified in the drawing.

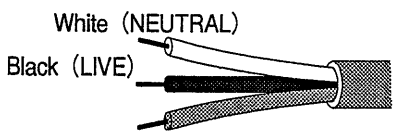
WARNING

- The attachment of a power plug or crimp-style terminals must be carried out by qualified personnel.

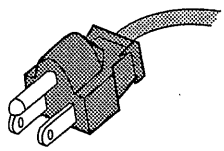
☐ Without a power plug



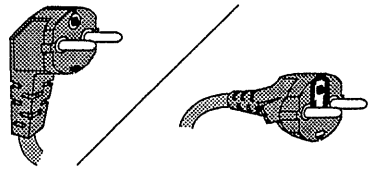
☐ Without a power plug



☐ Plugs for USA



☐ Plugs for Europe



☐ Provided by Kikusui agents

Kikusui agents can provide you with suitable AC power cable.
For further information, contact your Kikusui agent.

☐ Another Cable _____

 Kikusui Part No. Z9-000-027 IB001681

KIKUSUI

TABLE OF CONTENTS

1. GENERAL

1.1 Description

The PCR Series AC Power Supply/Frequency Converters are industrial power equipments which convert a commercial AC line power into an AC supply power of regulated voltage and controlled frequency. By employing a linear amplifier system, the equipment delivers an AC output power of a clean sinusoidal voltage waveform with high stability.
The equipment employs a microprocessor-based control system to provide various convenient control functions and enhanced operability.

The equipment can incorporate various options for GP-IB control, 3-phase operation, remote control, simulation of line abnormalities including power failure, and master-slave mode for parallel operation.
Thus, the equipment is highly flexible and expandable, and can be used for various purposes ranging from experimental laboratory installation or manufacturing factory installation to FA (factory automation) or ATE (automatic test equipment).

1.2 Features

The major features of the PCR Series Frequency Converters can be summarized as follows:

(1) Wide output frequency range

The output frequency range is as wide as 5 - 500 Hz

(2) Wide output voltage ranges

The output voltage ranges (two ranges) are as wide as 1 - 140 V and 2 - 280 V

(3) Large allowable maximum peak output current

When the load is a capacitor input type of rectifier, the PCR allows repetitive peak current of up to 3 times of the rated maximum output current (in rms value).

(4) Wide input voltage ranges

The input voltage ranges (two ranges) are as wide as 85 - 115 V and 170 - 230 V. They can be modified to ranges 98 - 132 V and 196 - 264 V.

(5) Standard rack mount casing

The equipment is housed in a casing for standard 19-inch rack mount. Two or more units of PCR equipment or in combination with other power supply devices or measuring devices can be readily installed on a standard 19-inch rack. (The equipment employs a front air intake system allowing the units to be densely installed on a rack.)

A system for an output of 6 kVA or more or for a 3-phase output with PCR units can be structured as one system on a rack. For this type of system, please consult your Kikusui agent.

(6) Stable output frequency

The equipment employs a crystal-controlled oscillator and a synthesizer-type frequency divider, thereby ensuring good frequency stability.

☐ Output frequency stability: $\pm 5 \times 10^{-5}$ or better

(7) Stable output voltage

The equipment employs a high-stability digital-processing reference generator and a high-stability wide-band OTL (output transformerless) power amplifier, thereby ensuring a good voltage stability.

☐ Regulation against input voltage change: ±0.1% or better

Regulation against load change: ±0.1 V/0.2 V or better (for 100V/200V output ranges, respectively)

Regulation against frequency change: ±1% or better (with reference to output voltage at 200 Hz)

Regulation against temperature change: 100 ppm/℃ typical

(8) Large digital readouts

Large 7-segment LED digital readouts are used as standard provisions to display the voltage, current and frequency.

(9) Enhanced operability and reliability

To control the output voltage and frequency, seesaw switches of variable speed type are used, thereby allowing to set them rapidly and accurately. For selector switches, key switches with digital processing are used and the current statuses are indicated with characters by LEDs, thereby attaining an enhanced operability and reliability. The equipment has a memory function to store output voltage and frequency programs (up to 9 programs separately between voltage and frequency), allowing, for examples, to reduce the number of test procedures and to eliminate the chances of human errors in measurement.

(10) Full protection systems

The equipment incorporates a full protection systems including protectors against overload, overvoltage and overtemperature, making the equipment safely applicable to ageing test and other automatic test systems.

(11) Recessed Terminals

For the sake of safety, the input and output terminals are located at recessed positions and protected with transparent covers.

2. SPECIFICATIONS AND FUNCTIONS

2.1 Specifications

Model	PCR500	PCR1000	PCR2000	PCR4000
Input Rating (AC rms)				
Voltage, frequency and phase	85 - 115 V / 170 - 230 V (for 100 V / 200 V input ranges, respectively) (*1), 47 - 63 Hz, single-phase			
Apparent power	Approx. 1.5 kVA	Approx. 3 kVA	Approx. 6 kVA	Approx. 12 kVA
Current (100V/200V input ranges)	16A/8A	32A/16A	65A/32A	130A/65A
Output Rating (AC rms)				
Voltage	1 - 140 V / 2 - 280 V (for 100 V / 200 V output ranges, respectively) (*2)			
Maximum current (*3)	5A/2.5A	10A/5A	20A/10A	40A/20A
Phase	Single-phase			
Volt Amperes total	500 VA	1 kVA	2 kVA	4 kVA
Maximum peak current (*4)	3 times of maximum output current (rms)			
Load power factor	0 - 1 (lead or lag phase) (*3)			
Frequency	5 - 500 Hz (*3, *5)			
Output Voltage Stability				
Line effect: Input voltage change within rating range	±0.1%			
Load effect: Output current change of 0 - 100% of value rating	±0.1V/±0.2V (for 100V/200V output ranges, respectively) (*6)			
Output frequency change within rating range	±1% (*7)			
Temperature coefficient (change within rating range)	100 ppm/℃ typical (*8)			
Output Frequency Stability	±5 × 10^{-5}			
Output Frequency Setting accuracy	±1 × 10^{-4}			
Output voltage harmonic distortion (*9)	Less then 0.5%			
Output voltage recovery time (*10)	50 µsec typical			
Efficiency (*11)	More than 50%			
Meters (LED type digital displays)				
Voltmeter (*12)				
Full scale	285.0 V (4 digits)			
Accuracy	±1% ±1 digit. (At 10 to 285 V, for 20 - 50 Hz: ±3% ±1 digit) at normal operating temperature			
Ammeter (*13)				
Full scale	5.50 A (3 digits)	11.00 A (3-1/2 digits)	22.0A (3 digits)	44.0 A (3 digits)
Accuracy	±1% ±1 digit. (At current of 5% to 100% scale, for 20 - 50 Hz: ±3% ±1 digit) at normal operating temperature			
Frequency meter (*14)				
Full scale	99.99 Hz, 500.0 Hz. (4 digits, auto ranging)			

Model	PCR500	PCR1000	PCR2000	PCR4000
Insulation Resistance				
Input to chassis, output to chassis, or input to output	more than 30 MΩ (500 V DC)		more than 10 MΩ (500 V DC)	
Withstanding Voltage				
Input to chassis, output to chassis, or input to output	1.5 kV AC (1 minute)			
Ambient Operating Temperature and Humidity	0 to +50 ℃, 10 - 90% RH (noncondensing)			
Dimensions	See Section 2.4 Dimensions of Converters			
Weight	Approx. 110 lbs (50 kg)	Approx. 198 lbs (90 kg)	Approx. 308 lbs (110 kg)	Approx. 551 lbs (250 kg)
Input/Output Terminal Screws				
Input terminal screws	M4	M4	M6	M8
Output terminal screws	M4	M4	M4	M6
Accessories				
Input power cable (core cross section/ length) (*15)	3.5 mm²/3 m	8 mm²/3 m	14 mm²/3 m	38 mm²/3 m
Instruction manual	1 copy			

(*1): Either the input voltage ranges (nominal 100V or 200V) can be selected by changing terminal connections (for Models PCR2000 and PCR4000) or by changing switch setting (for Models PCR500 or PCR1000). To modify the input voltages to nominal 115V/230V (98 - 132V/196 - 264V), modification by Kikusui's factory is needed.

(*2): The output voltage ranges (nominal 100 V and 200 V) are selectable with a switch on the front panel. The voltage setting resolution is 0.1 V.

(*3): When the output voltage is 1 - 100 V or 2 - 200 V and the load power factor is 0.8 - 1. (When the output voltage is 100 - 140 V or 200 - 280 V, the output current is reduced depending on the output voltage as shown in Figure 2-1-1. When the load power factor is 0 - 0.8, the output current is reduced depending on the load power factor as shown in Figure 2-1-2. When the output frequency is 5 - 40 Hz, the output current is reduced depending on the output frequency as shown in Figure 2-1-3.)

(*4): For capacitor input type of rectifier load. (Limitation imposed by the rated output current rms value)

(*5): Resolution (1) 0.01 Hz for 5.00 - 100.0 Hz range or (2) 0.1 Hz for 100.0 - 500.0 Hz range.

(*6): Regulation at output terminals when output voltage is 20 - 140V/40 - 280V and load power factor is 1.

(*7): Regulation of output voltage with reference to that at 200 Hz, when output voltage is 20 - 140V/40 - 280V and output currnet is zero.

(*8): Typical value when output voltage is 100V/200V and output current is zero.

(*9): When output voltage is 40 - 140V/80 - 280V and the load power factor is 1.

(*10): Response to output current change from zero to the rated, when output voltage is 100V/200V and load power factor is 1.

(*11): When output voltage is 100V/200V, output current is at the rated value, load power factor is 1, and output frequency is 40 - 500 Hz.

(*12): Average value calculated from rms value.

(*13): Rms value. (For current of crest factor not greater than 3)

(*14): Set output frequency (frequency of internal reference voltage signal)

(*15): Cable with GND wire. (With solderless terminals provided on the equipment input side)
Model PCR500, PCR1000: One 3-core cabtire cable (insulated cable)
Model PCR2000, PCR4000: Three single-core cables

Notes: Output voltage stability, output total harmonic distortion, Voltmeter and Ammeter specifications are theoretical value when otuput frequency is between 5 Hz and 20 Hz.

This product is not to be applied for the user accessible reprogramming capability and an alterable programme.

The reading speed of Voltmeter and Ammeter is approximately once per second.

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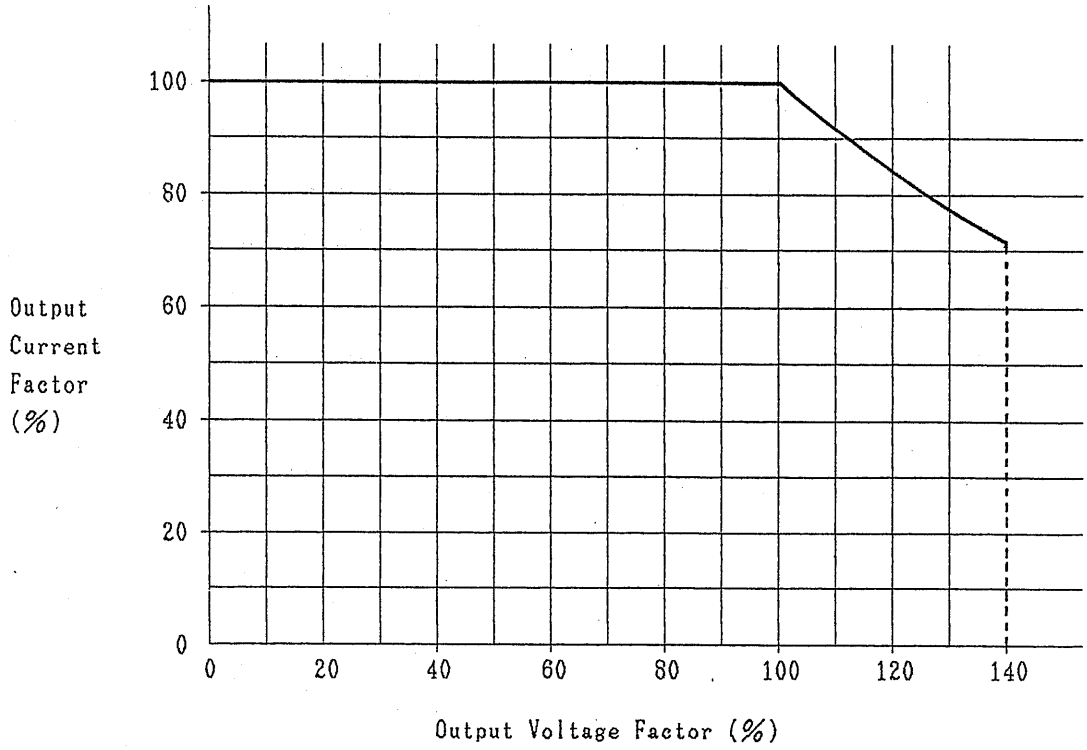


Figure 2-1-1. Output Voltage Factor vs. Output Current Factor

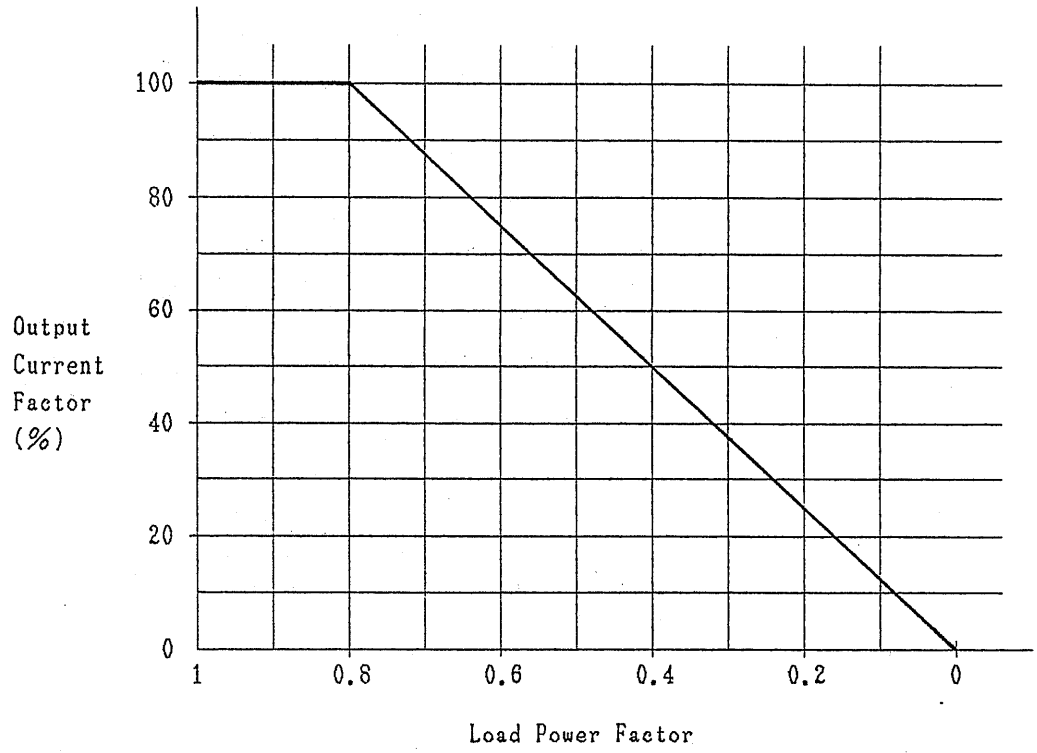


Figure 2-1-2. Load Power Factor vs. Output Current Factor

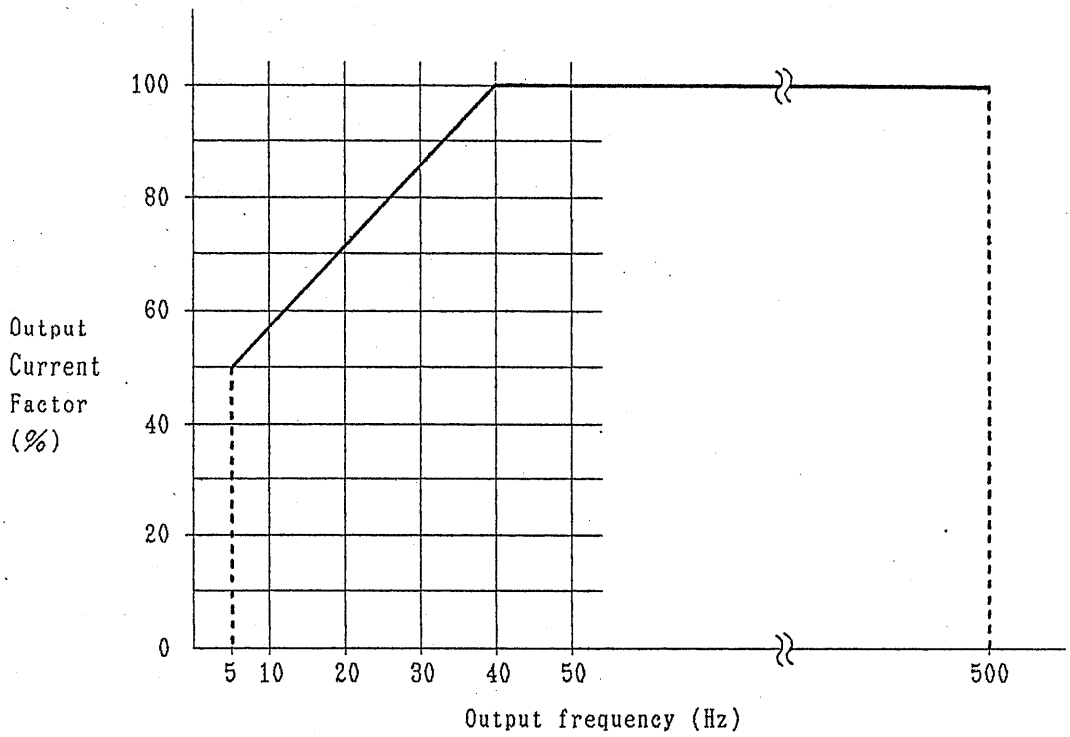


Figure 2-1-3. Output Frequency vs. Output Current factor

Notes: 1. The output voltage factor is in percent with 100 or 200 volts as 100% for the 100V or 200V ranges, respectively.

2. The output current factor in percent is with the maximum rated output current as 100%.

3. The maximum allowable output current can be calculated by multiplying the rated output current by the output current percentages found in Figures 2-1-1 and 2-1-2. The maximum allowable current calculated employing the percentage found in Figure 2-1-3 has a priority over the above-calculated rating when this calculated value is smaller than the above-calculated value. For details, see Section 3.3.

2.2 Description of Functions

(1) Memory Function

This function allows storage of preset values of output voltages and frequencies. The memory capacity is for three voltages and three frequencies, or nine combinations in total. For details, see Section 3-2-5.

(2) Synchronized Operation Function

This function allows synchronization of the output frequency (Phase) with the input line frequency (phase). The accuracy of synchronization is within ±1.9 Hz from 50 or 60 Hz. For details, see Section 3.2.7.

(3) Voltage Limit Function

This function is to limit the output voltage to a preset value (adjustable within a range of 30 to 285 V) to protect the load against overvoltage when setting the output voltage with the voltage adjustment switch or by means of the memory function, GP-IB control function (with optional interface IB01-PCR) or remote control function (with optional controller RC01-PCR). For details, see Section 3.2.6.

(4) Output ON/OFF Function

This function allows turn on or turn off of the output power delivered to the output terminal or to the output receptacle. Since an electronic switch is employed, the output power can be turned on or off without chatter.

(5) Preset Function

This function is to preset the output voltage or the limit voltage and to display the voltage when the output ON/OFF function of (4) is in the OFF state.

(6) Key Lock Function

This function is to lock the functions of the operation/display panel switches, except the output ON/OFF function and set-value monitoring function which are not locked.

(7) Clear Function

This function is to clear all operation/display panel switch settings to the initial settings or default vaues as shown in the following table.

Item	Initial Setting (Default Value)
Output Voltage Setting	0 V (zero volts)
Limit Voltage	285 V
Nominal Output Voltage Range	100 V
Output Frequency	50 Hz
Voltage Memory Values	A = 0 V, B = 0 V, C = 0 V
Frequency Memory Values	A = 50Hz, B = 60Hz, C = 400Hz
Memory Mode	Voltage mode
Others	The SYNC, STORE, LIMIT, PRESET, and OUTPUT switches are set to the OFF state.

As the equipment comes from the factory, it is set to the initial settings.

(8) Master-slave Parallel Operation Function (for Models PCR2000 and PCR4000 only) (Optional)

This function allows operation of up to three units of the same model of converter connected in parallel, by controlling only one master unit and operating the others as slave units. By employing this type of setup, the output power rating can be increased by the amount of the slave units. For details, see Section 4.1 (4).

(9) Display Function

This function is to display the operating status of the equipment on the operation/display panel. For details, see Section 3.1.2.

(10) Optional Functions

For functional expansion of the equipment, optional items are available as follows:

1) IB01-PCR: GP-IB Interface
2) 3P01-PCR: 3-phase Driver
3) RC01-PCR: Remote Controller
4) EX01-PCR: External Signal Interface
5) PD01M-PCR/PD01S-PCR: Parallel Operation Cable

For details, see Section 4.

2.3 Protection systems

The PCR Series Frequency Converters have protection systems incorporated as follows:

(1) Overload Protector

When the output current has exceeded the rated value, the overload protector trips to limit or cut out the output current (voltage).
For the rated value, see Section 3.3.1.

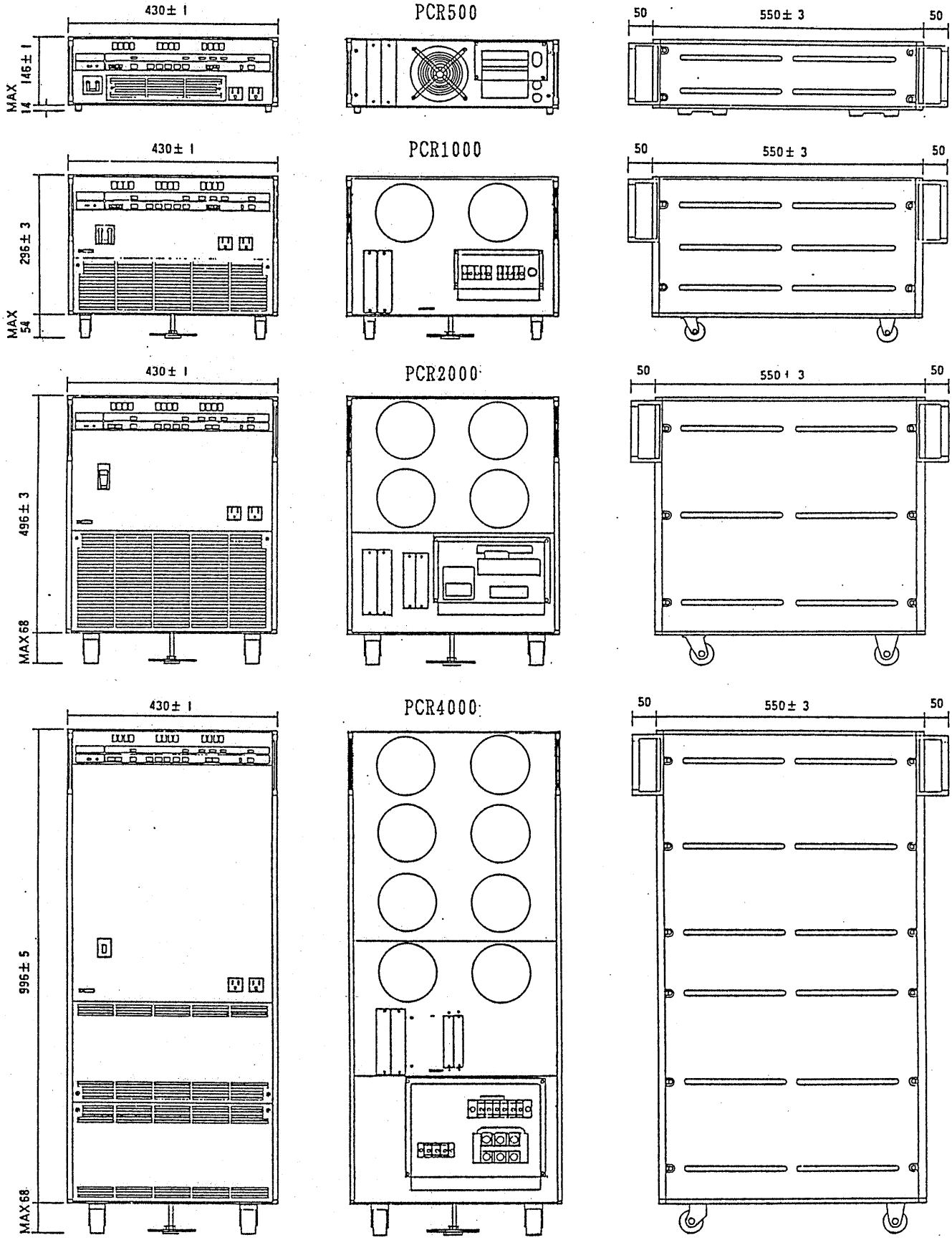
(2) Overvoltage Protector

When the converter is operating with an external control signal (employing optional Interface EX01-PCR) and the output voltage of the converter has exceeded the limit voltage mentioned in Section 2.2 (3), the overvoltage protector trips to cut out the output.

(3) Overtemperature Protector

When the heat sink temperature of the converter has exceeded its limit, the overtemperature protector trips to cut out the output.

2.4 Dimensions of Converters



3. OPERATING INSTRUCTIONS

3.1 Layout and Description

3.1.1 Layout and Description of Panel Items (Except Operation/Display Panel) of Main Unit

[1] Front Panels

1) Model PCR500

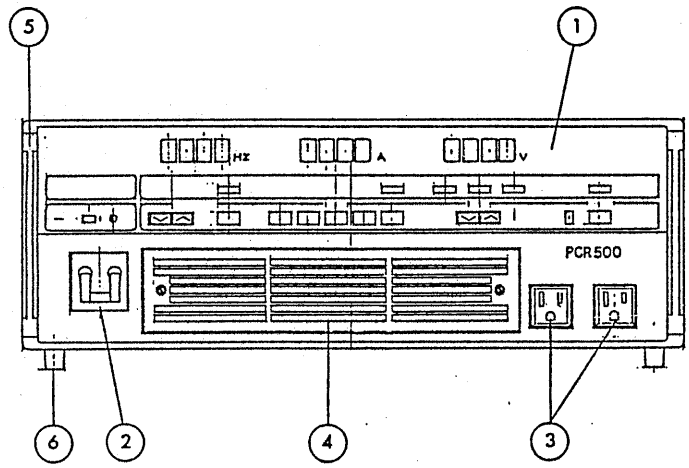


Figure 3-1-1

2) Model PCR1000

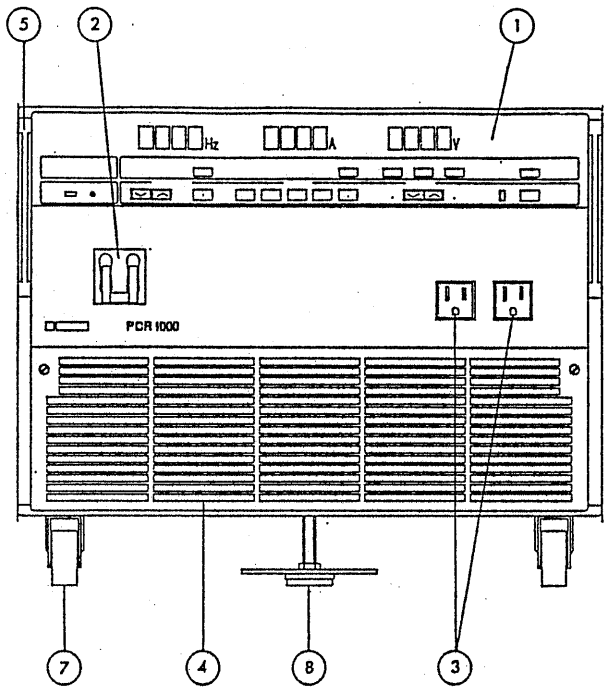


Figure 3-1-2

3) Model PCR2000

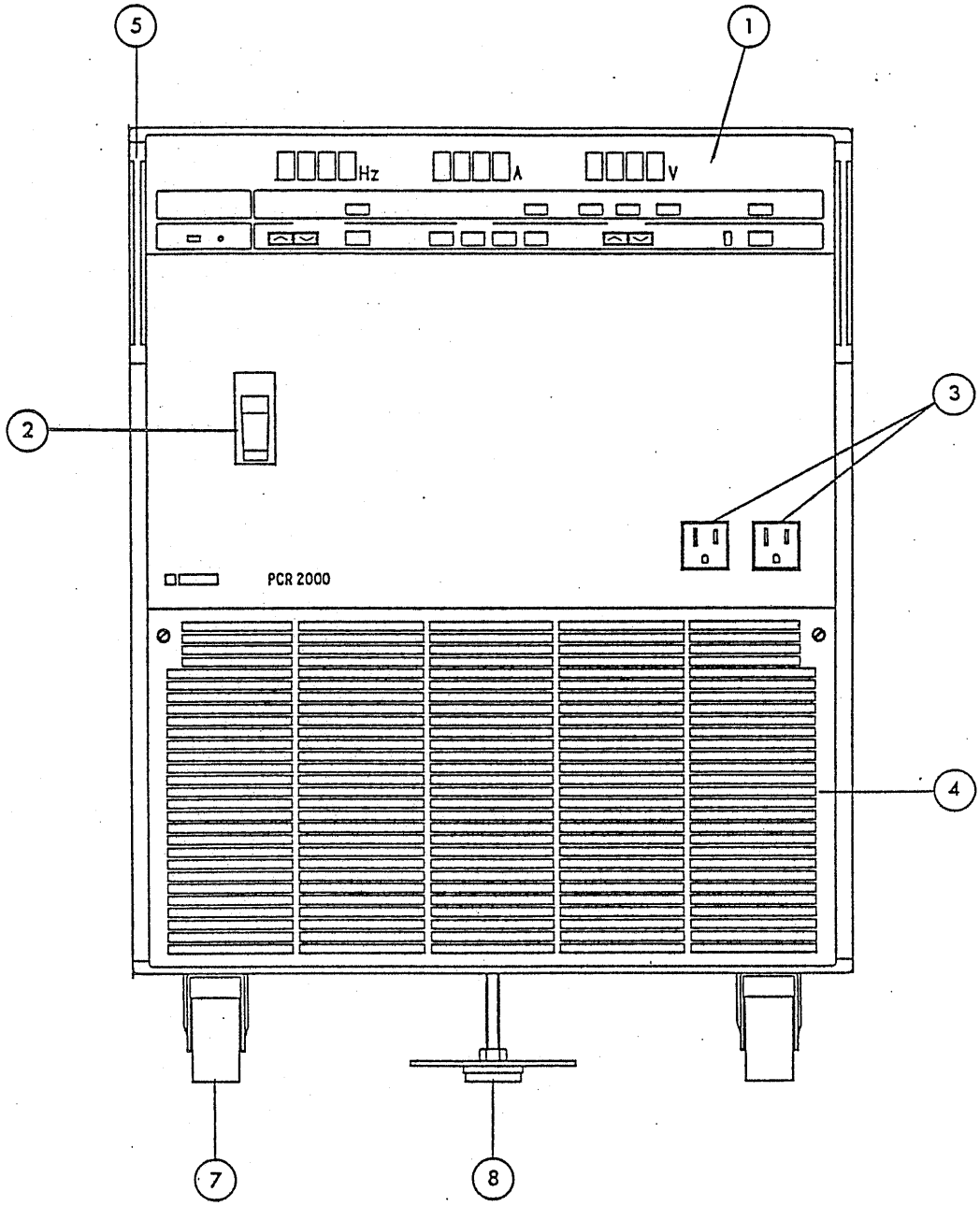


Figure 3-1-3

4) Model PCR4000

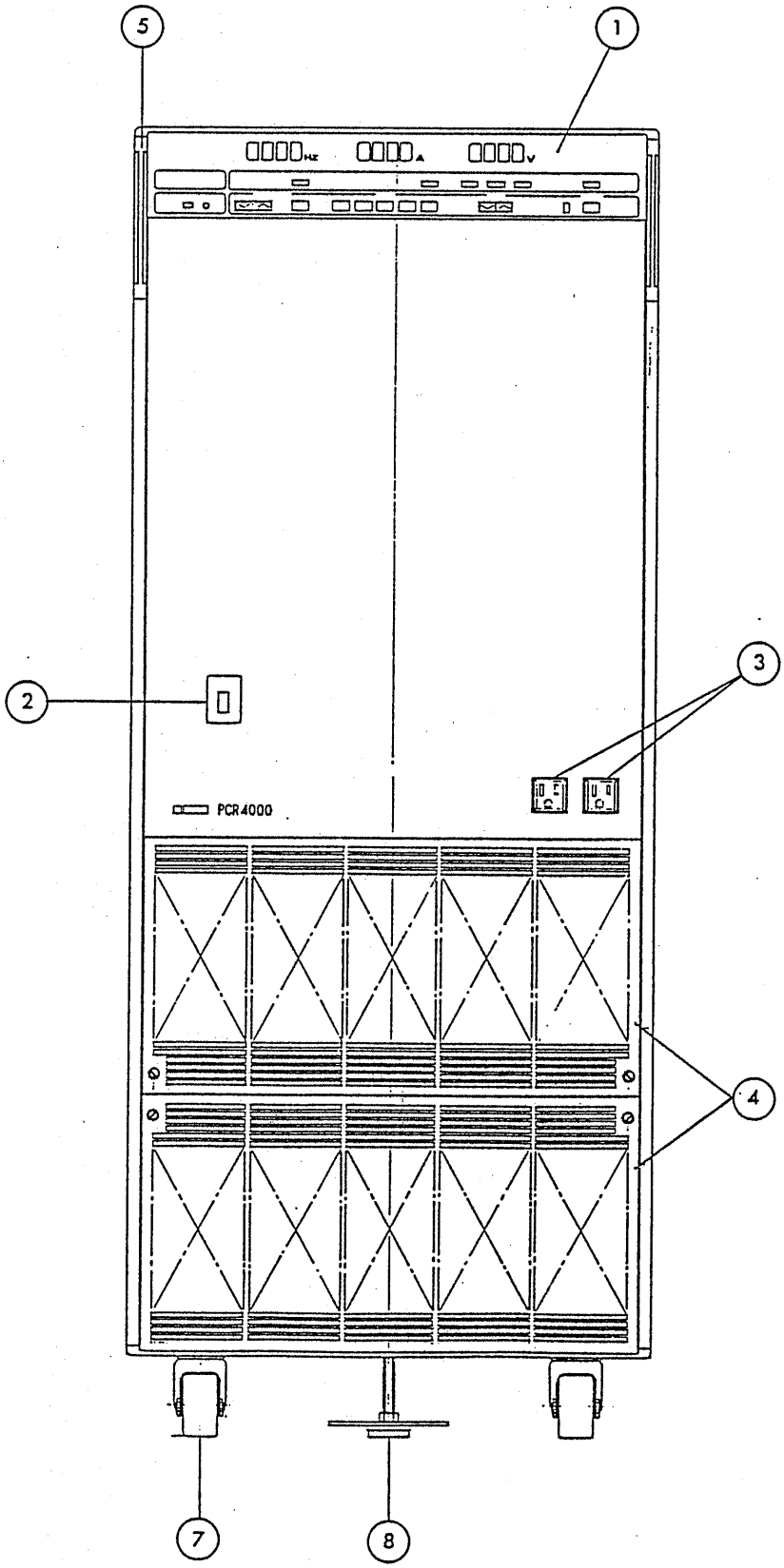


Figure 3-1-4

[2] Rear Panels

1) Model PCR500

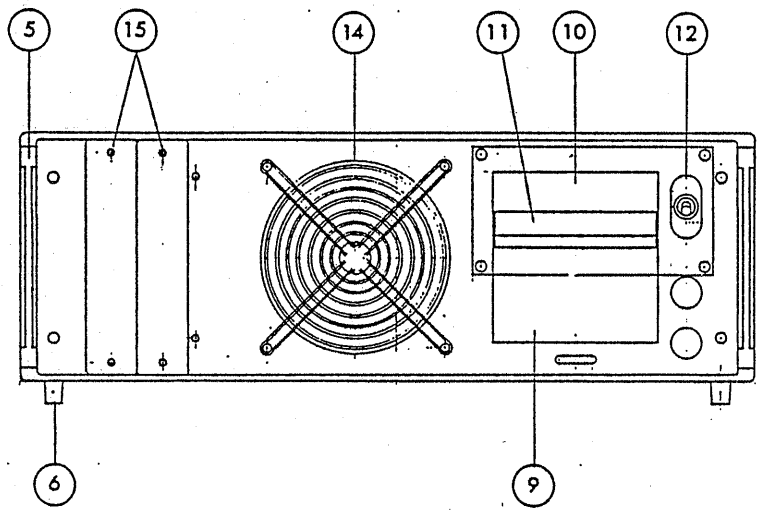


Figure 3-1-5

2) Model PCR1000

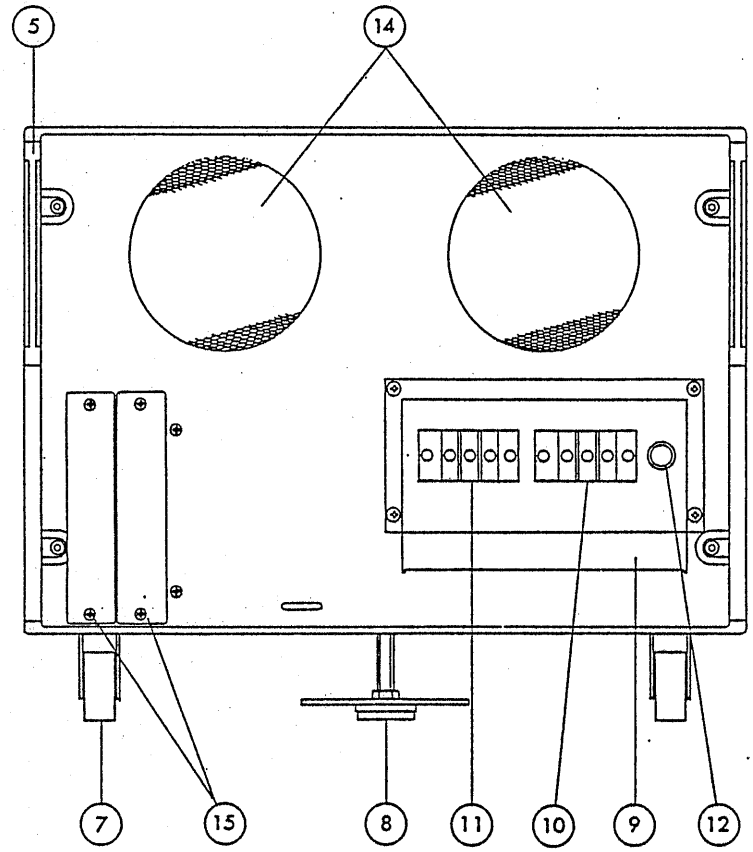


Figure 3-1-6

3) Model PCR2000

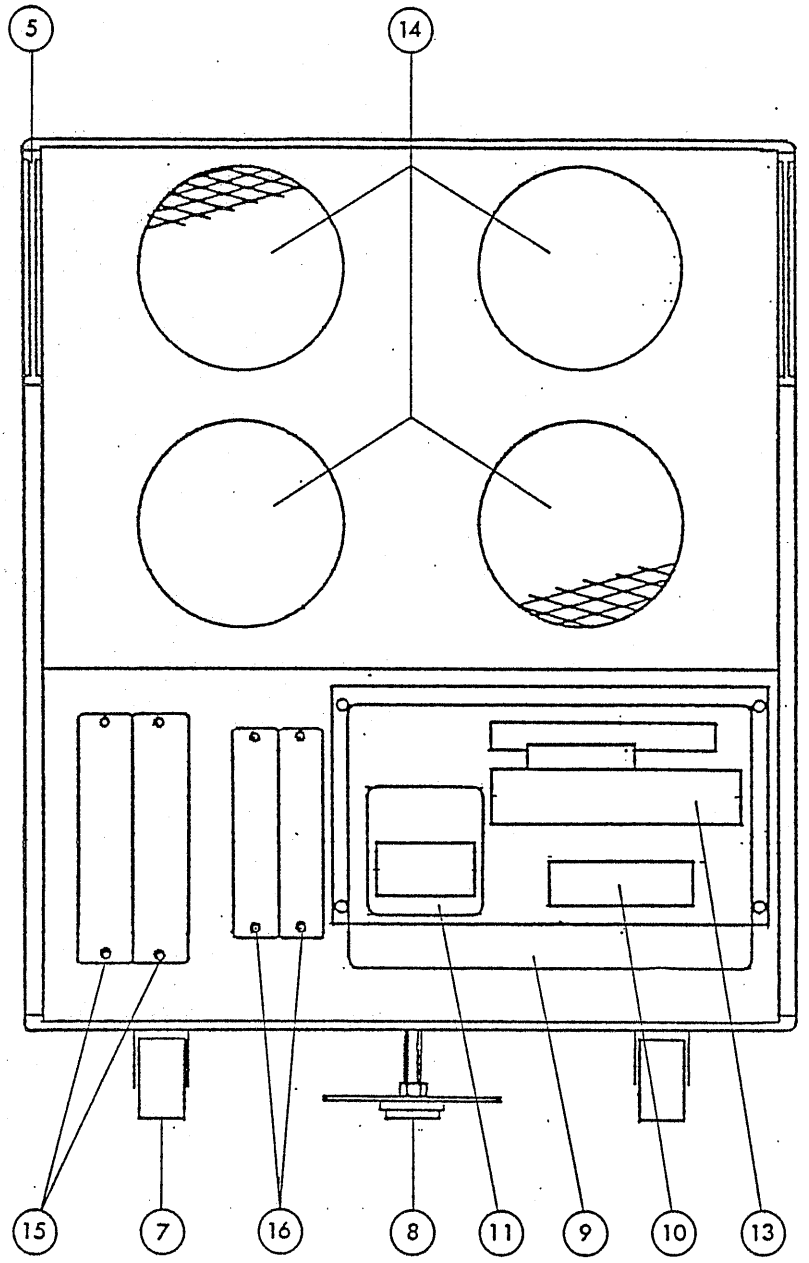


Figure 3-1-7

4) Model PCR4000

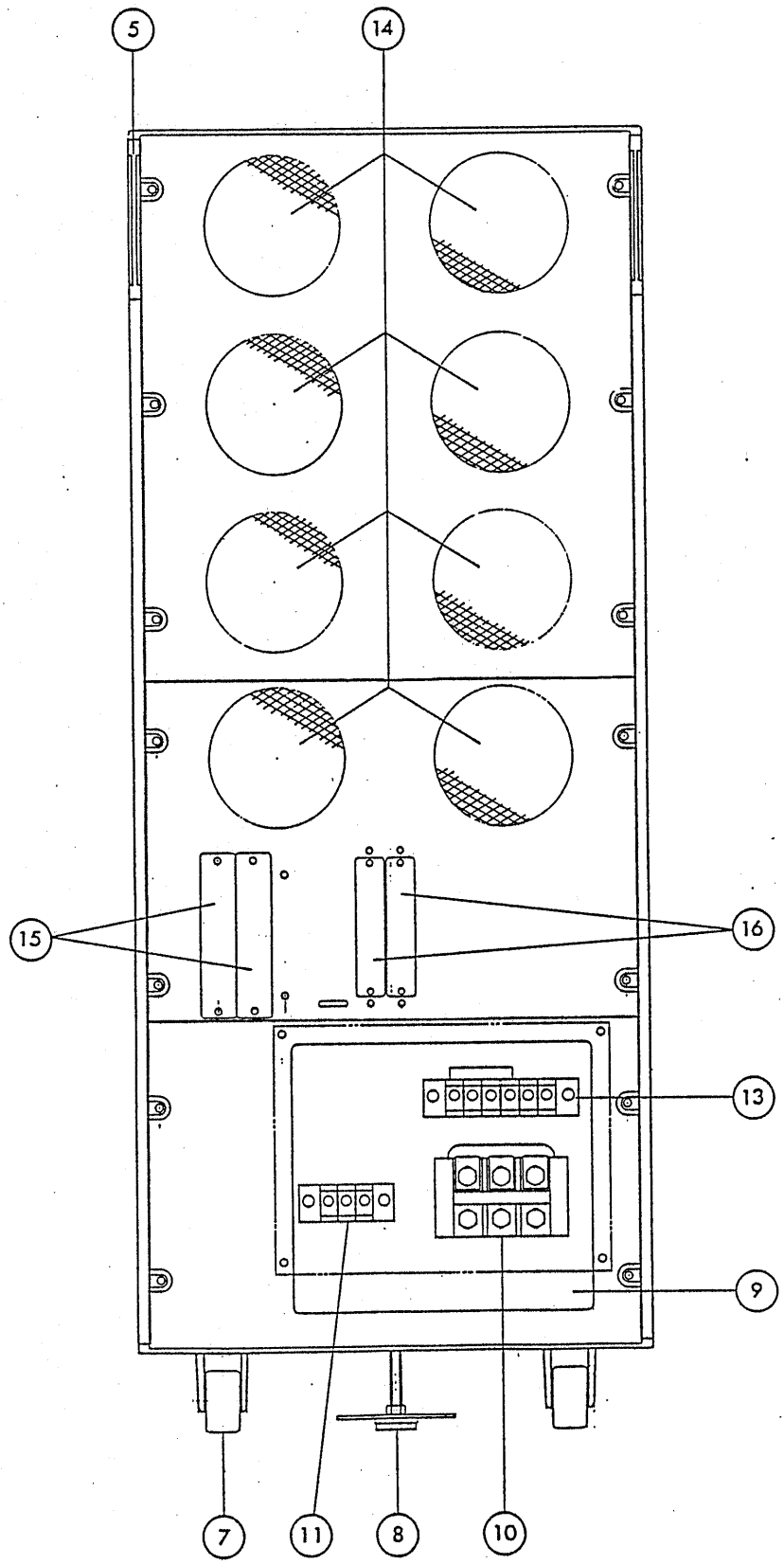


Figure 3-1-8

[3] Description of Panel Items

NO.	Item	Description	Remarks
①	Operation/Display Panel	The panel is for control and display of the converter output. For details, see Section 3.1.2.	
②	Power Switch	The switch is for ON/OFF control of LINE. This switch may be automatically turned OFF when one of the protectors has tripped.	For instructions and precautions for turning on the POWER switch, see Section 3.2.2.
③	OUTPUT ⚠ Receptacles (Outlets)	The outlets deliver the converter output. Note: The current rating of each outlet is 10 amperes.	Note that, for Models PCR2000 and PCR4000, the overload protector may trip if an overload is caused to these outlets. For details, see Section 3.3.2. The converter output can be delivered also via OUTPUT terminal block ⑩.
④	Air Intakes	The intakes (louvers) are for intake of air for forced air cooling of the converter. The intakes have filters.	For cleaning of the filters, see Section 3.3.4 [1].

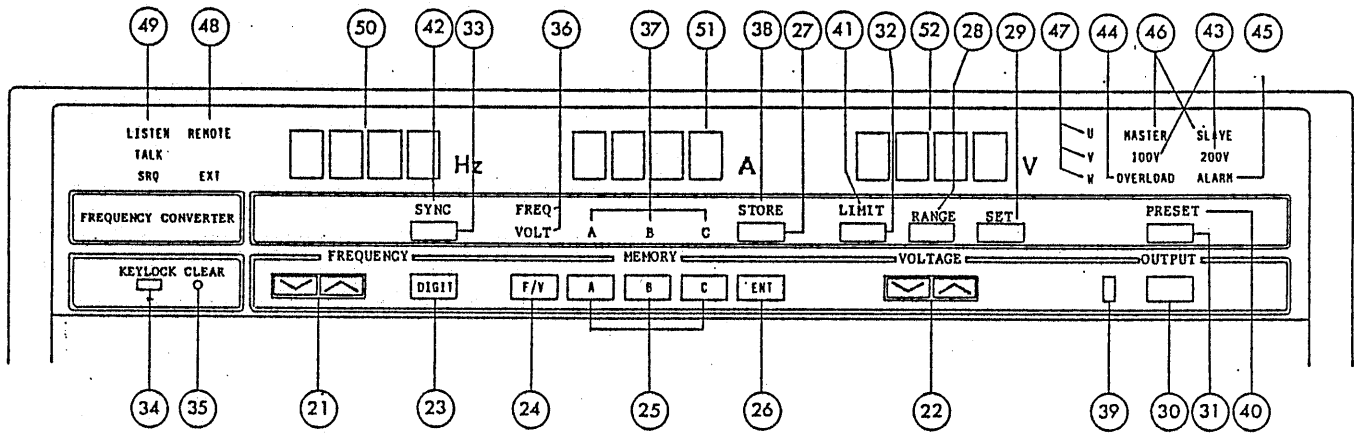
No.	Item	Description	Remarks
⑤	Handles	The handles are for moving Model PCR500 Converter only. CAUTION: Never use these handles to carry the Converters, except those of Model PCR500. The handles are only for moving the Converters on their castors. Note that the handles are not sturdy enough to carry the Converters (except Model PCR500).	For notes and precautions for installing or moving the converter, see Section 3.2.1 [2] and [3].
⑥	Rubber Studs (Model PCR500 only)		
⑦	Castors (Models PCR1000, PCR2000 and PCR4000)	The front two wheels swivel and the rear two wheels are unidirectional. On Models PCR2000 and PCR4000, the front two wheels can be locked with stoppers.	For details, see Section 3.2.1 [2].
⑧	Stopper Bolts (Models PCR1000, PCR2000 and PCR4000)	The bolts are to stabilise the converter on the floor. To stabilise the converter turn (as viewed from the top) the handles of the stopper bolts clockwise until the castors are slightly raised off the floor.	For details, see Section 3.2.1. [2].

No.	Item	Description	Remarks
⑨	Terminal Box	The terminal box accommodates the INPUT terminal block ⑩, OUTPUT terminal block ⑪, INPUT VOLTAGE SELECTOR switch ⑫ (for Model PCR1000 only), and INPUT VOLTAGE SELECTOR terminal block ⑬ (for Models PCR2000 and PCR4000 only).	
⑩	INPUT ⚠ Terminal Block	The terminal block feeds the AC line power to the converter input circuit. The terminal block is protected in the terminal box ⑨.	For details, see Section 3.2.2 [1].
⑪	OUTPUT Terminal Block	The terminal block feeds the converter output to the load. The terminal block is protected in the terminal box ⑨. Note: On Model PCR500, the INPUT terminal block ⑩ and OUTPUT terminal block ⑪ are structured as a single terminal block.	For details, see Section 3.2.2 [1]. The converter output for the load is delivered also via the OUTPUT receptacles (outlets).
⑫	INPUT VOLTAGE SELECTOR ⚠ Switch (for Models PCR500 and PCR1000 only)	The switch is to select a nominal input voltage range: Either the 100V range or the 200V range.	The converter comes from the factory with the switch set to the 200V range. For details, see Section 3.2.2 [2].
⑬	INPUT VOLTAGE SELECTOR ⚠ terminal Block (for Models PCR2000 and PCR4000 only)	The terminal block is to select a nominal input voltage range: either the 100V range (by connecting the shorting strip to the 100V terminal) or the 200V range (by connecting the shorting strip to the 200V terminal).	The converter comes from the factory with the terminal block set for the 200V range. For details, see Section 3.2.2 [2].

No.	Item	Description	Remarks
⑭	Air Exhaust Ports	The ports are to ventilate the exhaust air of the forced air cooling system. Note: Provide a clearance of 20 cm or more from the ports so that the exhaust air is freely ventilated.	For details, see Section 3.2.1 [2].
⑮	SLOT 1, SLOT 2	The slots are to accommodate cards for optional functions. On the standard converter, the slots are covered with blank panels.	For details of the optional functions, see Section 4.
⑯	Connectors J1 and J2 (for Models PCR2000 and PCR4000 only)	The connectors are for connections of the signal cables for optional master-slave parallel operation of two or more converters. On the standard converters, the connector sections are covered with blank panels. Note: The above optional function is not available for Models PCR500 and PCR1000 converters.	

3.1.2 Layout and Description of the Operation/Display Panel

[1] Layout of Panel Items



[2] Description of Panel Items

No.	Item	Description	Remarks
㉑	FREQUENCY Switch	The switch is to change the output frequency. As you press the right hand side of the switch (seesaw type), the frequency increases; as you press the left hand side, the frequency decreases. Each time as you press the switch, the frequency is incremented or decremented by the minimum resolution*. If you keep the switch pressed, the frequency changes continuously and the change rate increases in steps with 2 change rates.	*: 0.01 Hz (for 5.00 - 100.0 Hz range) or 0.1 Hz (for 100.0 - 500.0 Hz) Variable resolution can be attained by using the FREQUENCY DIGIT switch ㉓ in conjunction. For details, see Section 3.2.4 [1].
㉒	VOLTAGE Switch	The switch is to change the output voltage or the limit voltage (see ㉜ LIMIT switch). As you press the right hand side of the switch (seesaw type), the voltage increases; as you press the left hand side of the switch, the voltage decreases. Each time as you press the switch, the voltage is incremented or decremented by the minimum resolution*. If you keep the switch pressed, the voltage changes continuously and the change rate increases in steps with 2 change rates.	*: 0.1 V (within all rated voltage ranges) Note: When in the OUTPUT OFF state (see ㉚ OUTPUT switch), the output voltage cannot be changed unless in the PRESET mode (see ㉛ PRESET switch). For details, see Section 3.2.3 [2].

No.	Item	Description	Remarks
㉓	FREQUENCY DIGIT Switch	The switch is to select the DIGIT mode which allows to selection of the variable digits (variable resolution) for output frequency setting. As you press the switch, the frequency setting circuit is set to the DIGIT mode. Thereafter, each time as you press the switch, the digits which are subject to change move upward and these digits on the frequency meter ㊿ become dim. These digits can be varied with the FREQUENCY switch ㉒.	For details, see Section 3.2.4 [2].
㉔	MEMORY F/V Switch	The switch selects either the F (frequency) memory function or the V (voltage) memory function. Each time as you press the switch, the selected function changes between F and V. The selected function is indicated by the FREQ lamp ㊱ or the VOLT lamp ㊲.	For details, see Section 3.2.5.
㉕	MEMORY A, B, C Switches	The switches select memory (A, B or C) to read data (RECALL mode) or to write data (STORE mode). When in the RECALL mode, as you press one of the A, B and C switches, data of the corresponding memory is called out onto the frequency meter ㊿ or voltmeter ㊿, and the corresponding A, B or C lamps and the meter readout blink for several seconds. When in the STORE mode (see the STORE switch ㉗), as you press one of the A, B and C switches, data is stored in the corresponding memory, and the corresponding A, B or C lamp and the STORE lamp ㊳ blink for several seconds.	Note: When in the RECALL mode and the F/V switch is set for F, the FREQUENCY switch ㉑ and FREQUENCY DIGIT switch ㉓ remain disabled; when the F/V switch is set for V, the VOLTAGE switch ㉒ remain disabled. For details, see Section 3.2.5.

No.	Item	Description	Remarks
㉖	MEMORY ENT Switch	The switch is for delivery of data stored in memory. If you press the switch when in the RECALL mode, data being indicated on the meter is delivered.	For details, see Section 3.2.5 [2].
㉗	STORE Switch	The switch is to select the STORE mode to write data in memory. As you press the STORE switch and one of the MEMORY A, B or C switches, data being indicated on the meter is written into the correcponding memory. When in the STORE mode, the STORE lamp blinks. As you press the STORE switch again, the STORE mode is released.	Note: The STORE mode is selectable only when in the PRESET mode (see the PRESET switch ㉛). For details, see Section 3.2.5 [1].
㉘	RANGE Switch	The switch is to select the RANGE STANDBY mode which allows selection of the nominal output voltage (100V range or 200V range). As you press the switch, the RANGE STANDBY mode is selected and the selected range is indicated by blinking of the 100V or 200V lamp ㊸ on the operation/display panel ① while the lamp of the existing range is illuminated steadily. As you press the SET switch ㉙, the range indicated by the blinking lamp is selected. As you press the RANGE switch again, the RANGE STANDBY mode is released.	Note: The RANGE switch is enabled and the RANGE STANDBY mode is selectable only when in the OUTPUT OFF mode (see the OUTPUT switch ㉚). For details, see Section 3.2.3 [1].

No.	Item	Description	Remarks
㉙	Set Switch	The switch is to set the output to the nominal 100V or 200V range. As you press the switch when in the RANGE STANDBY mode (see the RANGE switch ㉘), either the nominal 100V or 200V range is selected and the indicator lamp of the selected range (the 100V lamp ㊸ or 200V lamp ㊸) ceases blinking and illuminates continuously, and the other lamp goes off.	
㉚	OUTPUT Switch	The switch is to turn on or off the converter output delivered to the OUTPUT terminal block ⑪ or to the OUTPUT receptacles (outlets). Each time as you press the switch, the output is turned on (the OUTPUT ON state) or off (the OUTPUT OFF state). When in the OUTPUT ON state, the OUTPUT lamp ㊴ illuminates.	The switch operates even when in the KEY LOCK mode. (see the KEY LOCK switch ㉞).

No.	Item	Description	Remarks
㉛	PRESET Switch	The switch is to select the PRESET mode which allows the output voltage to be preset. As you press the switch, the PRESET mode is selected and the voltmeter ㊷ indicates the preset voltage and the PRESET lamp ㊵ illuminates. As you press the switch again, the PRESET mode is released.	Notes: o The PRESET mode is released also when the VOLTAGE LIMIT SETTING mode (see the LIMIT switch ㉜) is selected.
㉜	LIMIT Switch	The switch is to select the LIMIT VOLTAGE SETTING mode which allows on output limit voltage to be set. As you press the switch, the LIMIT VOLTAGE SETTING mode is selected and the voltmeter ㊷ indicates the limit voltage which is now adjustable with the VOLTAGE switch ㉑. When in the LIMIT VOLTAGE SETTING mode, the LIMIT lamp ㊶ illuminates. As you press the switch again, the LIMIT VOLTAGE SETTING mode is released.	For details, see Section 3.2.6.

No.	Item	Description	Remarks
㉝	SYNC Switch	The switch is to select the SYNC STANDBY mode which allows to synchronization of the output frequency (phase) with the input line frequency (phase). As you press the switch, the SYNC STANDBY mode is selected. When the output frequency is synchronized with the input line frequency, the SYNC lamp ㊷ illuminates. As you press the switch again, the SYNC or STANDBY mode is released.	Notes: ○ Synchronizable frequency range: Within ±1.9 Hz from 50 or 60 Hz ○ The SYNC lamp ㊷ blinks when synchronization is unsuccessful due to any reason or up to the time when synchronization is completed. For details, see Section 3.2.7.
㉞	KEY LOCK Switch	The switch is to set the switches (keys) of the operation/display panel ① to the locked state (the KEY LOCK mode). As you throw the switch knob to the right (▷ direction), the KEY LOCK mode is selected. As you throw the switch knob to the left, the KEY LOCK mode is released.	Even when in the KEY LOCK mode, the ON/OFF function of the OUTPUT switch ㉚ and the monitoring functions of the set values, etc. remain enabled.
㉟	CLEAR Switch	The switch is to clear (set to the initial states) all switches of the operation/display panel ①. The switch is located at a recessed position in a panel hole and can be turned on by pressing it with a sharp nose tool (such as a propelling pencil).	Note: The CLEAR switch is disabled when in the KEY LOCK mode or REMOTE mode.
㊱	FREQ/VOLT Lamps	The lamps indicate whether memory is for frequency or voltage. When the MEMORY F/V switch ㉔ is set for F, the FREQ lamp ㊱ illuminates; when it is set for V, the VOLT lamp ㊱ illuminates.	

No.	Item	Description	Remarks
㊲	A, B, C Lamps	The lamps denote the memory addresses being recalled. Lamps A, B, or C blinks to indicate that address A, B, or C, respectively, are selected by the MEMORY A, B, C switch ㉕.	
㊳	STORE Lamp	The lamp indicates the STORE mode. It illuminates when the STORE mode is selected with the STORE switch ㉗. The lamp blinks for several seconds after frequency or voltage setting data is stored.	
㊴	OUTPUT Lamp	The lamp indicates the OUTPUT ON state. It illuminates when the OUTPUT switch ㉚ is turned on.	
㊵	PRESET Lamp	The lamp indicates the PRESET mode. It illuminates when the PRESET mode is selected with the PRESET switch ㉛.	
㊶	LIMIT Lamp	The lamp indicates the LIMIT VOLTAGE SETTING mode or the voltage limited state. The lamp illuminates when the LIMIT VOLTAGE SETTING mode is selected with the LIMIT switch ㉜. It blinks when in the voltage limited state.	

No.	Item	Description	Remarks
㊷	SYNC Lamp	The lamp indicates the SYNC STANDBY mode or the SYNC mode. The lamp blinks when the SYNC STANDBY mode is selected with the SYNC switch ㉝. The lamp steadily illuminates when in the synchronized state (when the output frequency is synchronized with the input line frequency).	
㊸	100V/200V Lamps	The lamps indicate the selected nominal output voltage range (100V or 200V). When the RANGE STANDBY mode is selected with the RANGE switch ㉘, the lamp of the range which is ready to be selected blinks while that of the current range illuminates steadily. As you select the new range with the SET switch ㉙, the lamp of the newly selected range illuminates steadily and that of the old range goes off.	
㊹	OVERLOAD Lamp	The lamp illuminates when the overload protector has tripped.	For details, see Section 3.3.1.
㊺	ALARM Lamp	The lamp illuminates when the overtemperature protector or the output overvoltage protector has tripped.	
㊻	MASTER/SLAVE Lamps	The lamps indicate whether the equipment is operating as a master (the MASTER lamp ㊻ illuminates) or as a slave (the SLAVE lamp ㊻ illuminates) when in master/slave parallel operation.	Note: Effective only when the MASTER/SLAVE operation is incorporated.

No.	Item	Description	Remarks
㊼	U, V, W Lamps	The lamps indicate the phases when in 3-phase operation (optional). On the equipment operating for the U phase, the U lamp illuminates; on that operating for the V phase, the V lamp illuminates; on that operating for the W phase, the W lamp illuminates.	Note: The lamps are enabled only when the option is incorporated.
㊽	REMOTE EXT Lamps	The lamps indicate the operating status when in GP-IB control operation (optional) or external signal control operation (optional). The REMOTE lamp illuminates when in the remote control state with the GP-IB option. The EXT lamp illuminates when in the external control state with an EXT mode.	Note: The lamps are enabled only when the option is incorporated.
㊾	LISTEN, TALK, SRQ Lamps	The lamps indicate the operating status when in GP-IB control operation (optional). The LISTEN lamp illuminates for the listener mode, the TALK lamp for the talker mode, and the SRQ lamp for the SRQ (service request) mode.	Note: The lamps are enabled only when the option is incorporated.

No.	Item	Description	Remarks
⑩	Frequency Meter	The frequency meter indicates the preset output frequency. The meter has 4 digits with auto-ranging (for two ranges). The lowest digit is for 0.01 Hz (5.00 - 99.99 Hz) or 0.1 Hz (100.0 - 500.0 Hz).	○ The meter blinks when in the MEMORY RECALL mode (see MEMORY A, B, C switches ㉕). ○ The digit which can be changed becomes dim when in the DIGIT mode (see Frequency Digit switch ㉓).
⑪	Ammeter	The ammeter indicates the actual output current. The ammeter has 3 digits (Models PCR500, PCR2000 and PCR4000) or 3-1/2 digits (Model PCR1000), with a fixed range. The lowest digit is 0.01 A (Models PCR500 and PCR1000) or 0.1 A (Models PCR2000 and PCR4000).	
⑫	VOLTMETER	The voltmeter indicates the preset output voltage, actual output voltage, or limit output voltage. The meter has 4 digits. The lowest digit is 0.1 V.	○ The meter blinks when in the MEMORY RECALL mode (see MEMORY A, B, C switches ㉕).

3.2 Operation Method and Precautions

3.2.1 General Precautions

Before operating the converter, be sure to pay attention to the matters mentioned in this section.

[1] Input AC Line Power

(1) AC Line Voltage and Frequency

Make sure that the input AC line voltage and frequency are within the following tolerances.

(a) The input AC line voltage must be 85 - 115 V (nominal 100 V range) or 170 - 230 V (nominal 200 V range). For the input voltage range selection method, see Section 3.2.2 [2].

(b) The input AC line frequency must be 47 - 63 Hz.

Note that the converter may not operate normally or may be damaged if the input AC power is not within the above tolelances. Note also that the input AC power must not be a badly deformed waveform and must not excessively noisy.

(2) Input Power Cables

(a) Be sure to use the input power cables which are supplied as accessories accompanying the counter, or equivalent cables.
When using equivalent cables, make sure that the cables are of sufficiently large gauges (of sufficiently large conductor cross-sectional area), terminals are property provided at the ends of the conductors, and the cable insulators are made of proper types of materials.
For the cable gauges, see Table 3-2-1.

Table 3-2-1. Cable Gauges and Allowable Currents
At ambient temperture 50°C (122°F)
(As per Japan Electrical Association Code JEAC 8001-1982)

Cable Gauge (Cross Sectional Area of Conductor) [mm²]	Allowable Current [A] Allowable Temperature of Insulator	
	60°C (140°F)	75°C (167°F)
0.75	8	13
1.25	11	17
2.0	15	23
3.5	21	34
5.5	28	45
8	36	56
14	51	80
22	67	105
38	96	150

The above examples are for single-conductor cables. The values may differ depending on materials (allowable temperatures) of insulators, the number of conductors per cable, and other conditions of the cables.

(b) Make sure that the AC source line has a sufficient wattage for the converter. Use of a power distribution panel is recommended. (See Section 2.1 "Specifications" for the voltage and current requirements.) Pay attention also to the rush current which the converter draws for a short period when it is turned on.

(c) Make sure that the input and output cables are correctly and securely connected. (See Section 3.2.2 [1].) Note that fire hazards can be caused unless the cables are correctly and securely connected.

(3) To Prevent Electric Shock Hazards

(a) Be sure to turn off the input AC power (with the switch of the power distribution panel, for example) before connecting the input cables to the converter.

(b) Be sure to turn off the input AC power before changing the nominal input voltage ranges. (This is especially true for Models PCR2000 and PCR4000.)

[2] Environmental Conditions

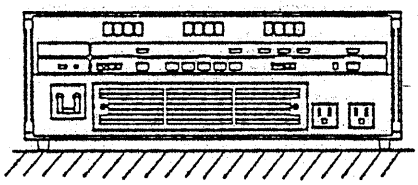
(1) Install the converter in a safe and stable place. The installation site must be sufficiently sturdy to support the converter which is a heavy equipment. The place must be level and must not be inclined.

(a) Regarding Model PCR500, be sure to install it in the position that its bottom rubber studs ⑥ face the floor.

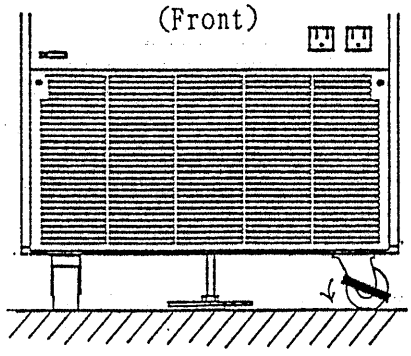
Precaution: Never install the converter in such a position that its handles ⑤ are facing the floor because the converter in this position is very unstable and can fall down. (The converter may be placed temporarily in this position when moving it.)

(b) Regarding Model PCR1000, PCR2000 or PCR4000, be sure to let the castors ⑦ facing the floor, lock the stoppers of the castors ⑦ (Model PCR1000 has no stoppers) and let the converter stably settle on the floor with the stopper bolts ⑧. (See Figure 3-2-1.)

Model PCR500



Models PCR1000, PCR2000, PCR4000



Lock the stoppers of the castors ⑦.

Raise slightly (by several milli meters) the converter by turning the handles of the stopper bolts ⑧ clockwise.

Figure 3-2-1

(2) Be sure to provide a space of 20 cm or more from the front air intake ports ④ and the rear air exhaust ports to the wall or other objects which may impede the cooling air flow.

Do not any loose material at an upstream position of the air intake ports lest it should be sucked to the ports and choke them.

Hot air (whose temperature is higher than approximately 30°C) comes out of the air exhaust ports ⑭. Do not place near the exhaust ports any objects which are not heat resistant.

(3) The installation site of the converter should not have a high ambient temperature or humidity, should not be dusty or have a corrosive atmosphere, and be free from mechanical vibration. These adverse conditions will deteriorate the reliability of the converter, reduce its life and cause failures.

(4) Note that highly sensitive measuring instruments and radio equipment should not be placed near the converter since their operation may be disturbed by the converter. (When it is unavoidable to install such instruments or equipment near the converter, consult your Kikusui agent for shielding against disturbances.)

(5) Do not put any heavy objects on the converter.

[3] Notes for Moving the Converter

Be extremely careful when moving the converter which is quite heavy, especially when moving it on slopes or stairs.

(a) Never attempt to move Model PCR500 Converter by a single person--move it by two or more persons. When lowering the converter onto the floor, be careful not to have your hands or feets caught under the converter.

(b) Never attempt to raise Model PCR1000, PCR2000 or PCR4000 Converter by holding it by its handles ⑤. The handles are to move the converter on their castors and are not sturdy enough to lift the converter.

When moving the converter using a forklift, make sure before raising the converter that it is stable on the forks.

When moving the converter on its castors ⑦, retract the stopper bolts ⑧ by turning them fully counterclockwise (as viewed from the top) so that sufficient clearances are obtained between them and the floor.

[4] Grounding the Chassis

Be sure to ground the converter chassis. To do this, connect the ground line of the input AC line power to that (the GND terminal) of the converter by using the input power cable which is supplied with the converter, or connect the GND terminal of the INPUT terminal block ⑩ to an earth ground line.

If the load equipment of the converter has a chassis ground terminal, connect it to the G terminal of the OUTPUT terminal block of the converter or to an earth ground-line.

Note that the gauge (cross sectional area of the conductor) of the grounding cable must be larger than that of the input AC power cables (live lines and neutral line). (The gauge of the grounding cable of the load side must be larger than that of the input power cables of the load side.)

Note that, unless the converter is properly grounded, it may become susceptible to external noise, may generate noise, and the chances of electric shock hazards when the converter has failed may increase.

Since the converter has a noise filter at its input section and a small current flows into the chassis, you may feel slight electric shocks when you touch the converter unless it is grounded.

[5] Ambient Temperature

The ambient temperature range to enabel the performance and other specifications of the converter to be met is 0 to 50°C (32 to 122°F). If the ambient temperature is outside of this range, the converter may not operate stably to its full performance and its components may be damaged in an extreme case. Note that certain types of components rapidly deteriorate at high temperatures (typical ones are semiconductors and electrolytic capacitors). Avoid, whenever possible, operation of the converter at high ambient temperature.

3.2.2 Preparation for Operation

[1] Connecting the Input/Output Cables

Note: Note that the connection of cables to an AC power source (typically, a power distribution panel) must be made after the connections of cables to the converter as mentioned in the following are completed.

1) Remove the transparent cover of the converter rear terminal box ⑨.

2) Connect the black, white, and green input power cables (supplied as accessories of Models PCR500 and PCR1000 Converters) or the black, white, and green sheathed solderless terminals of the input power cables (supplied as asccessories of Models PCR2000 and PCR4000 Converters) to the L (live), N (neutral), and GND (ground) terminals of the INPUT terminal block ⑩.

3) Connect the other ends of the above input power cables to respective terminals (live, neutral, and ground terminals) of the input power source (power distribution panel).

4) Connect the output cables (which run from the load) to respective terminals of the OUTPUT terminal block ⑪ of the converter.

5) Replace in the original position the transparent cover (which was removed in Step 1)), of the converter rear terminal box.
The input/output cables may run through the slit at the bottom of the transparent cover.

[2] Selecting a Nominal Input Voltage Range

Select either the nominal 100 V or 200 V range of the converter.
The nominal input voltage ranges can cover the actual input voltage tolerances as follows:

Nominal 100 V range: Actual 85 - 115 V
Nominal 200 V range: Actual 170 - 230 V

(1) Models PCR500 and PCR1000

1) Remove the transparent cover of the INPUT VOLTAGE SELECTOR switch ⑫ (or of the terminal box ⑨ for Model PCR1000).

2) Select a nominal input voltage range you may require, by throwing the selector switch to the top position for the 100 V range or to the bottom position for the 200 V range.
(The converter is shipped from its manufacturer with the selector switch set at the 200 V range.)

3) Replace in the original position the transparent cover which was removed in Step 1).

(2) Models PCR2000 and PCR4000

1) Remove the transparent cover of the terminal box ⑨ and the black cover of the INPUT VOLTAGE SELECTOR terminal block ⑬.

2) Select either the nominal 100 V or 200 V input voltage range as you may require by changing the positions of the shorting bars of the INPUT VOLTAGE SELECTOR terminal block ⑬ as shown in Figure 3-2-2. (The converter is shipped from its manufacturer with the selector switch set at the 200 V range.)

The shorting bars can be removed by loosening the four screws of the terminal block. Be sure to securely tighten the screws when installing the shorting bars.

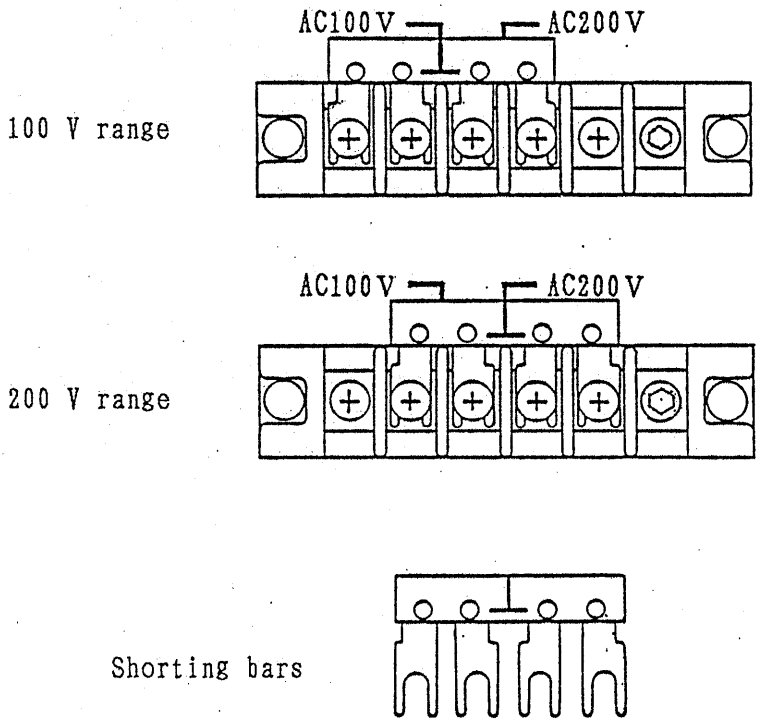


Figure 3-2-2

3) Replace in the original positions the transparent cover and black cover which were removed in Step 1).

Caution:	Be sure to turn off the input power source (with the power distribution panel switch, for example) before changing the nominal input voltage ranges. Note that the input power is delivered to the INPUT VOLTAGE SELECTOR terminal block ⑬ even when the POWER switch ② on the converter front panel is turned off.

[3] Turning on the POWER Switch

(1) After making sure that the procedures of Items [1] and [2] are complete and that the POWER switch ② of the converter is off, turn on the input power source.

(2) Turn on the POWER switch ② and the converter will start running. Check that the indications on the operating/display panel ① are as follows:

(a) SYNC, A, B, C, STORE, LIMIT, RESET, OUTPUT, OVERLOAD, and ALARM lamps: off
(The switch functions are disabled.)

(b) Voltmeter ⑫ and ammeter ⑪ ; Zero (The readout may indicate certain values.)

(c) Preset voltage, output voltage range (100 V or 200 V), limit voltage, preset frequency, memory data, and memory mode (F or V); as existed when the POWER switch ② was turned off, since these data items are stored in memory backed up with a battery.
When the converter is shipped from its manufacturer, the data items are set as follows:

Preset voltage:	0 V
Limit voltage:	285.0 V
Nominal output voltage range:	100 V
Preset frequency:	50.00 Hz
Memory mode:	V
Memory data:	F A = 50.00 Hz, B = 60.00 Hz, C = 400.0 Hz
	V A = 0 V, B = 0 V, C = 0 V
	(A, B, C are memory addresses.)

Note: If the input power is turnd off once when the memory backup battery has been discharged, the data items are set to the initial values (default values) as mentioned in the above. For details, see Section 3.3.3. The data items can be reset to the initial values also by pressing the CLEAR switch ⑮ on the front panel of the converter.

(d) When the converter has optional functions, other indications than those mentioned in the above may appear on the operation/display panel depending on the types of optional functions.

3.2.3 Setting the Output Voltage Range

[1] Selecting a Nominal Output Voltage Range

Select either the nominal 100 V or 200 V output voltage range as described below. (When the converter is shipped from its manufacturer, it is set at the nominal 100 V ramge.) The nominal output voltage ranges can cover the actual output voltages as follows:

Nominal 100 V range: Actual 1 - 140 V
Nominal 200 V range: Actual 140 - 280 V

> Note: The actual output voltage may be set at 0 - 1 V (with nominal 100 V range) or 0 - 2 V (with nominal 200 V range), although the output voltage waveform and stabilty may be badly degraded at these very low voltages.
> Note that, when the output voltage is set at 2 - 140 V with the nominal 200 V range, the maximum available output current is limited to 50 - 70% of that available with the nominal 100 V range. For details, see Section 3.3.1.

To select a nominal output voltage range, proceed follows:

(1) Turn off the output (the OUTPUT lamp ㉙ is off) with the OUTPUT switch ㉚.

(2) Press the RANGE switch ㉘. The lamp of the selectable range will blink (if the 100 V range is currently used, the 200 V lamp ㊸ will blink; if the 200 V range is currently used, the 100 V lamp ㊸ will blink). This mode is called "RANGE STANDBY mode." The lamp of the currently used range illuminate steadily.

(3) Press the SET switch ㉙ when in the RANGE STANDBY mode. Within several seconds, the ranges will be changed and the lamp which has been blinking will illuminate steadily and the lamp which has been illuminating steadily will go off.

Notes: The preset voltage (output voltage setting) remains unaltered even when the output voltage ranges are changed. However, in the case that the preset voltage has been higher than 142.5 V with the 200 V range, the new preset voltage is clamped at 142.5 V when the output range is changed to 100 V.

When the output is on (the OUTPUT lamp ㊴ is illuminating), the RANGE switch ㉘ is disabled and the output voltage ranges cannot be changed.

Resetting from the RANGE STANDBY mode the regular output mode can be accessed by pressing the OUTPUT switch ㉚, pressing the RANGE switch ㉘ again, or by turning off the input power.

The preset voltage data is maintained as the memory is backed up with the internal battery.

[2] Setting the Output Voltage

(1) Set the equipment to the PRESET mode (the PRESET lamp ㊵ is illuminating) with the PRESET switch ㉛. This mode is called "PRESET mode".

(2) Adjust the output voltage (the reading of the voltmeter ㊷) to the required voltage (preset voltage) with the VOLTAGE switch ㉒. (When the equipment is shipped from its manufacturer's factory, the preset voltage is adjusted to zero volts.)

The VOLTAGE switch is of a seesaw type. As you press its right hand side (marked ^), the voltage increases: as you press its left hand side (marked v), the voltage decreases. Each time as you press the switch, the voltage changes by 0.1 V (the minimum resolution of the equipment).
If you keep pressed the switch, the voltage changing speed varies (becomes faster) in two steps. As you release the switch which has been kept pressed, the original state (that the voltage changes each time as you press the switch) is restored.

Note: When the output is on (the OUTPUT lamp ㊴ is illuminating), the output voltage can be changed even when the equipment is not in the PRESET mode. It should be noted, however, that the output voltmeter indication may change with a certain time lag (reflecting the response time of the voltmeter) from the actual output voltage change. This is especially true when the voltage is raised, and the actual voltage can be higher than the value indicated by the voltmeter. Therefore, it is recommended to preset the output voltage by employing the PRESET mode.

When the output is off (the OUTPUT lamp ㊴ is not illuminating), the output voltage cannot be changed unless the equipment is in the PRESET mode. Be sure to set it to the PRESET mode.

The output voltage cannot be changed when the output frequency is being changed with the FREQUENCY switch ㉑.

The preset output voltage data is maintained even when the input power is turned off, as the memory is backed up by the internal battery.

3.2.4 Setting the Output Frequency

[1] Continuously Variable Mode

Adjust the reading of the frequency meter ㊿ to the required frequency (the preset frequency) with the FREQUENCY switch ㉑. (When the equipment is shipped from its manufacturer's factory, the preset frequency is at 50.00 Hz.)

The FREQUENCY switch is of a seesaw type. As you press its right hand side (marked [∧]), the frequency increases; as you press its left hand side (marked [∨]), the frequency decreases. Each time as you press the switch, the frequency changes by 0.01 Hz (the minimum resolution for a range of 5.00 to 100.0 Hz) or 0.1 Hz (the minimum resolution for a range of 100.0 to 500.0 Hz). If you keep the switch pressed, the frequency changing speed varies (becomes faster) in two steps. As you release the switch, the original state (that the frequency changes each time as you press the switch) is restored.

[2] DIGIT Mode

The DIGIT mode allows you to rapidly set the required frequency by selecting the resolution of frequency change. As you press the FREQUENCY DIGIT switch ㉓ once, the readout of the frequency meter ㊿ becomes dim. As youpress the switch once more, the highest three digits alone become dim (the lowest digit alone becomes bright). When in this mode, the highest three digits (dim digits) alone can be changed. The mode that the readoutof the frequency meter ㊿ is dim is called "DIGIT mode."

If you leave the FREQUENCY switch ㉑ untouched for several seconds when in the DIGIT mode, the frequency meter automatically resets to the regular mode (the readout becomes bright) and the frequency can be changed with the minimum resolution as mention in [1] above for the continuously variable mode.

If you press the FREQUENCY DIGIT switch ㉓ once when in the continuously variable mode, the DIGIT mode (the highest three digits alone of the readout are dim and variable) is attained.

Thereafter, each time as you press the FREQUENCY DIGIT switch ㉓ once, the dim digits move to higher digits by one digit and the dim digits alone can be varied by pressing the FREQUENCY switch ㉑.

Notes: The frequency can be changed regardless of whether the output is on or off (whether the OUTPUT lamp ㊴ is illuminating or not). However, the frequency cannot be changed when the voltage is being changed with the VOLTAGE switch ㉒.

If you leave the FREQUENCY switch ㉑ for several seconds when in the DIGIT mode, the equipment is reset to the regular mode.

The preset output frequency data is maintained even when the input power is turned off, so far as memory is backed up by the internal battery.

3.2.5 Memory Functions

The memory allows write and read of output voltage and frequency data, with three addresses (A, B, and C) for each voltage and frequency, therby allowing nine different combinations of voltages and frequencies.

[1] To Store (Write) Data in Memory

The data (voltage or frequency) which is writen in memory is the value (preset voltage or preset frequency) currently displayed on the meter (voltmeter ㊷ or frequency meter ㊵).

> Note: The voltage data cannot be written unless the equipment is in the PRESET mode (the PRESET lamp ㊵ is illuminated).

(1) With the MEMORY F/V switch ㉔, select the V memory to write voltage data (the VOLT lamp ㉟ will illuminate) or the F memory to write frequency data (the FREQUENCY lamp ㉟ will illuminate).

(2) Press the STORE switch ㉗ to set the equipment to the STORE mode (the STORE lamp ㊳ will illuminate). (The equipment can be reset from the STORE mode by pressing the STORE switch ㉗ again.)
This mode is called "STORE mode".

(3) Press the MEMORY A, B, or C switch ㉕. The MEMORY ADDRESS lamp A, B, or C ㊲ and the STORE lamp ㊳ will blink for several seconds indicating that the data is written in the selected address of the memory.

> Notes: Data cannot be written unless the equipment is in the STORE mode (the STORE lamp ㊳ is illuminating). The old data is automatically erased as a new data is written over it.
> The written data is maintained even when the input power is turned off (as the memory is backed up by the internal battery), although the STORE mode is released.

[2] To Recall (Read) Data from Memory

(1) With the MEMORY F/V switch ㉔, select the V memory to read voltage data (the VOLT lamp ㉟ will illuminate) or the F memory to read frequency data (the FREQUENCY lamp ㉟ will illuminate).

(2) Press the MEMORY A, B, or C switch ㉕ to read data. As the data is read, the voltmeter ㊷ or frequency meter ㊵ indicates the data by blinking for several seconds. The MEMORY A, B, or C lamp ㊲ also blinks. This mode is called "MEMORY RECALL mode".

> Notes: When in the MEMORY RECALL mode and F mode is selected, the FREQUENCY switch ㉑ and the FREQUENCY DIGIT switch ㉓ are disabled; when in the MEMORY RECALL mode and V mode is selected, the VOLTAGE switch ㉒ is diabled.

(3) Press the MEMORY ENTER switch ㉖ when in the MEMORY RECALL mode, and the data read from the memory will be delivered.

> Notes: Note that, when the output is on (the OUTPUT lamp ㊴ is illuminating), the output may change at the instant you press the MEMORY ENTER switch ㉖. Also note that the MEMORY RECALL mode lasts only for a few seconds.

3.2.6 Usage of Voltage Limit Function

The voltage limit function is to prevent the output voltage from exceeding the output limit voltage when setting the output voltage.

[1] Setting the Limit Voltage

(1) Press the LIMIT switch ㉜ to set the equipment to the LIMIT VOLTAGE SETTING mode (the LIMIT lamp ㊶ illuminates). This mode is called "LIMIT VOLTAGE SETTING mode".

(2) Set the limit voltage with the VOLTAGE switch ㉒. (When the equipment is shipped from its manufacturer's factory, the limit voltage is set at default 285 V.) The limit voltage is indicated on the voltmeter ㊷. The limit voltage adjusting procedure is identical with the output voltage adjusting procedure (see Section 3.2.8 [2]).

(3) To release from the LIMIT VOLTAGE SETTING mode, press the LIMIT switch ㉜ again.

When in the LIMIT VOLTAGE SETTING mode and the LIMIT lamp ㊶ is illuminating, the voltmeter ㊷ on the operation/display panel ① indicates the limit voltage.

[2] Voltage Limit Function

When adjusting preset output voltage with the VOLTAGE switch ㉒, if the output voltage exceeds the limit voltage, the voltage limit function is brought into effect and the output voltage does not become higher than the limit voltage (the output voltage cannot be raised beyond this limit by pressing the right hand side (marked ⋀) of the VOLTAGE switch ㉒. As you press the left hand side (marked ⋁)of the switch once or more, the voltage limit function is released and the preset output voltage becomes lower.

When adjusting the preset output voltage with the memory function, if the preset output voltage (the data value stored in the memory) is higher than the limit voltage, and the MEMORY ENT switch ㉖ is pressed, the preset output voltage is clamped at the limit voltage.

When the voltage limit function is brought into effect, the LIMIT lamp ㊶ blinks.

Notes: The limit voltage remains unaltered even when the nominal output ranges are changed. When the equipment is shipped from its manufacturer's factory, the limit voltage is set at default 285.0 V. The limit voltage data is maintained even when the input power is turned off, as the memory is backed up by the internal battery.

Also when operating with the remote control function (optional) or the GP-IB control function (optional), the voltage limit function is brought into effect (the LIMIT lamp ㊶ blinks) as the preset output voltage exceeds the limit voltage.

When operating with the external signal control function (optional), however, the voltage limit function remains disabled. If the output voltage becomes higher than the limit voltage by as small amount the overvoltage protector (OVP) trip to cuts off the output. In this case the ALARM lamp ㊶ illuminates.

When this has occurred, check the external control signal voltage level and the limit voltage, turn off the POWER switch ② at once, allow a period of several seconds or more, and then turn on the POWER switch ②. If the overvoltage protector trips in spite of the fact that the external control signal voltage level and the limit voltage are normal, it is possible that the equipment is malfunctioning. If this is the case, please refer to your Kikusui agent for repair.

3.2.7 Usage of Synchronization Function

The synchronization function is to synchonize the output frequency and phase of the converter with the input line frequency and phase.

(1) Set the output frequency (preset frequency) of the converter at 50 Hz (48.10 - 51.90 Hz) or 60 Hz (58.10 - 61.90 Hz). For the setting method, see Section 3.2.4 "Setting the Output Frequency."

Note: Select the nominal 50 or 60 Hz range depending on the input line frequency. Synchronization can be successfully attained when the input line frequency is within the following tolerance ranges:

50 Hz ±1.9 Hz, or 60 Hz ±1.9 Hz or better

(2) Press the SYNC switch ㉝. The equipment will be set to the SYNC STANDBY mode and the SYNC lamp ㊷ will blink, but only for a very short period and is hardly discernible.

(3) As the output frequency and phase are synchronized with the input line frequency and phase (that is, as the SYNC state is attained), the SYNC lamp ㊷ illuminates. When in the SYNC STANDBY mode or in the SYNC mode, the frequency meter ㊿ indicates "50.--" or "60.--".

Note: Note that, when in any of the following conditions, the output frequency and phase cannot be successfully synchronized with the input frequency and phase.

- When the input line frequency and output frequency setting are not within the afore-mentioned tolerance ranges.

○ When the input line voltage waveform is badly degraded with noise components or similar.

(4) As you press the SYNC switch ㉝ again, the equipment reset from the SYNC state and the output frequency and phase are not synchronized with the input frequency and phase. (When they are not synchronized, the SYNC lamp ㊷ goes off and the frequency meter ㊿ indicates the preset frequency.) The equipment is reset from the SYNC state also when the input power is turned off once.

Note: When in the SYNC state (the SYNC lamp ㊷ is illuminating), the FREQUENCY switch ㉑ and the FREQUENCY DIGIT switch ㉓ are disabled. Writing of data in MEMORY (A, B, or C) also is disabled.

3.3 General Precautions

3.3.1 Output and Load

Pay particular attention when the output conditions of the converter and the features of the load are as mentioned in the following.

[1] Linear Load

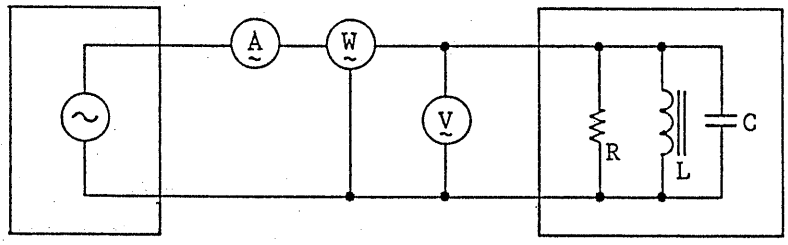
The allowable maximum output current (rms value) of the converter is limited as shown in Figue 2-1-1, 2-1-2 or 2-1-3 in Section 2.1, depending on the output voltage, load power factor, and output frequency.
While the output voltage and load power factor are correlated, they are not correlated with the output frequency. Therefore, the allowable maximum output current is limited by whichever is the smaller of these factors. See Examples 1 and 2 on subsequent pages.

The term "linear load" as used here means a load which is comprised of pure resistive elements or linear reactive elements (inductive or capacitive elements whose impedances do not change depending on the voltages applied to them) connected in series or parallel.

Note: The load power factor is expressed as follows:

$$\text{Load power factor} = \frac{\text{Effective power [W]}}{\text{Apparent power [VA]}}$$

Where, "effective power" means the energy consumed by the load and "apparent power" is the product of multiplication of the voltage (rms value) applied to the load by the current (rms value) fed to the load. An example of load power factor measurement is shown in Figure 3-3-1.



AC Power Equipment (PCR Series, for example)

Load (Linear Load)

Effective power: Wattmeter (W) reading

Apparent power: Product of multiplication of Voltmeter (V) reading by Ammeter (A) reading

Figure 3-3-1

To elucidate the matter, two examples of calculations of the rated (maximum allowable) output currents of Model PCR1000 Converter under different conditions are given below.

Example 1

Assume that the output voltage is 115 V (with the nominal 100 V range), the load power factor is 0.7, and the output frequency is 25 Hz. In the figures in Section 2 "Specifications," the factors are found as follows:

(1) The output current factor at output voltage 115 V is 87% as found in Figure 2-1-1.

(2) The output current factor at power factor 0.7 is 87.5% as found in Figure 2-1-2.

8769888

(3) The output current factor at output frequency 25 Hz is 78% as found in Figure 2-1-3.

The output current factor for the conditions of (1) and (2) is 87% × 87.5%≒76.1%, which is smaller than that (78%) for the conditions of (3). Therefore the condition of (3) is ignored and the maximum allowable output current factor is judged to be 76.1%.

For Model PCR1000 Converter example, since its output current rating at output current factor 100% is 10 A (with the nominal 100 V range), the maximum allowable output current when in the above conditons is calculated to be 7.61 A.

Example 2

Assume that the output voltage is 240 V (with the nominal 200 V range), the load power factor is 0.65, and the output frequency is 15 Hz. In the figures in Section 2 "Specifications," the factors are found as follows:

(1) The output current factor at output voltage 240 V is 83% as found in Figure 2-1-1.

(2) The output current factor at load power factor 0.65 is 81% as found in Figure 2-1-2.

(3) The output current factor at output frequency 15 Hz is 64% as found in Figure 2-1-3.

The output current factor for the conditions of (1) and (2) is 83% × 81%≒67.2%, which is larger than that (64%) for the condition of (3). Therfore, the conditions of (1) and (2) are ignored and the maximum allowable output current factor is judged to be 64%.

For the Model PCR1000 Converter for example, since its output current rating at output current factor 100% is 5A (with the nominal 200 V range), the maximum allowable output current when in the above conditions is calculated to be 3.2 A.

Note: Note that, if a current larger than the rated (maximum allowable) output current is drawn from the equipment, it's overload protector may trip, its output voltage may drop, or its output may be turned off (the OUTPUT switch ㉚ or POWER switch ② is turned off).

The protective actions of overload protector are as described in the following.

When the load is of a pure resistance type (the load factor is 1), the protective actions are as follows:
When the output current has gradually increased exceeding the rated output current (maximum allowable output current), the overload protector trips causing the OUTPUT switch to trip to cut out the output within several hundreds milliseconds. When the output current has sharply increased exceeding the rated output current, peaks of the sinusoidal output waveform are clipped (see Figure 3-3-3) and, in an extreme case (a case of heavy overloading), the POWER switch ② trips to shut down the equipment.

When the load is of a linear reactance type (the load power factor is 0 to less than 1), the protective actions are as follows:
When the output current has exceeded the rated output current shown in Figure 2-1-2 of Section 2.1, some portions of the output waveform are clipped (see Figure 3-3-4) and the OUTPUT switch trips to cut out the output within several hundreds milliseconds.

When the overload protector is brought into effect as above, the OVERLOAD lamp ㊹ on the operation/display panel ① illuminates.

When the output is turned off as above, the OUTPUT lamp ㊴ goes off. When this has occurred, adjust the load so that the output current becomes not greater than the maximum allowable output current. Then turn on the output with the OUTPUT switch ㉚.

When the output is not turned off (the OUTPUT lamp ㊴ is illuminated) although in an overload state (the OVERLOAD lamp ㊹ is illuminated), reduce the output current so that the normal operation is restored (the OVERLOAD lamp ㊹ will go off).

When the POWER switch ② is turned off due to overload, reduce the output current to less than the maximum allowable output current and then turn on the POWER switch ②.

Note: The equipment must not be operated in an overloaded state. Note that the equipment may be damaged or its life may be reduced if it is operated in an overloaded state.

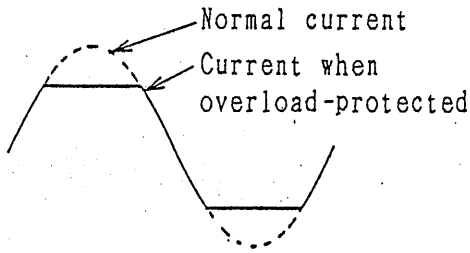


Figure 3-3-3

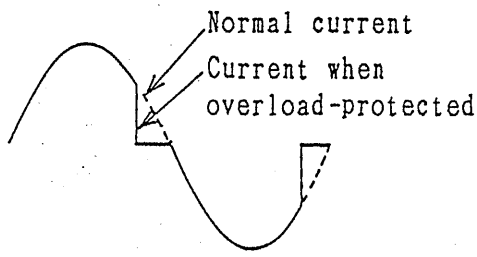


Figure 3-3-4

[2] Capacitor-input Rectifier Load

A capacitor-input type of rectifier load may draw a peak input current (a peak output current of the converter) which is several times larger than the rms output current of the converter, at output voltage peaks of the converter. (See Figure 3-3-5.) The allowable maximum peak output current is up to 3 times of the values calculated with the following formulas.

At nominal 100V range: $\frac{\text{Rated output power [VA]}}{100\ [\text{V}]}$

At nominal 200V range: $\frac{\text{Rated output power [VA]}}{200\ [\text{V}]}$

In the above case, the rms value of allowable maximum output current is nearly the same with that calculated in Item [1] "Linear Load." For the calculation, the load power factor should be assumed to be 1.

When the output current has become larger than the allowable maximum current (peak value or rms value), the overload protector will trip and the output voltage may drop and the output may be turned off (the OUTPUT switch ㉚ or POWER switch ② may be turned off).

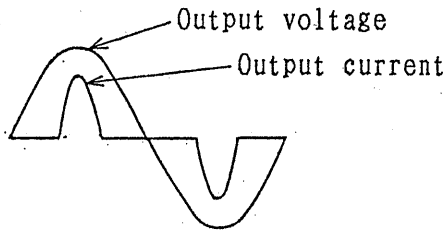


Figure 3-3-5

[3] Load which Draws Input Rush Current

Each of the below-mentioned types of loads draws an input rush current when starting up or when the voltage applied to it is rapidly changed. The rush current is as large as several times to several hundred times the steady-state current and lasts for several cycles to several hundred cycles.

(1) Transformers (Including Autotransformers)

This type of loads tend to draw a rush current of several times to several hundred times the steady-state current for several cycles, and may differ depending on voltage application timing and residual magnetism.

(2) Motors and Lamps

These types of loads tend to draw a rush current of several times to several tens of the steady-state current for several tens of seconds to several hundred seconds.

(3) Capacitor-input Rectifiers

Electronic devices which have a capacitor-input rectifier (without

any protector or limiter against the rush current) tend to draw a rush current of several tens to several hundreds of times of the steady-state current for several cycles.

When a rush current is drawn by the load, the overload protector of the converter may be brought into effect and the output voltage may drop. (See Figure 3-3-6.) As the rush current ceases, the output voltage will become steady.

Notes: Note that, when the load is a motor or other similar type of load, its start up characteristics when operated on the converter power may differ from those when operated on an AC line power.

Also note that, when the rush current is very large or lasts for a long period, the output may be turned off (the OUTPUT switch ㉚ or POWER switch ② may be turned off).

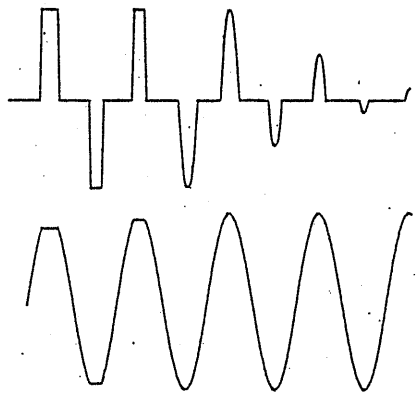


Figure 3-3-6

(4) Special Load Connection

If the capacitor connects directly to the OUTPUT terminal block ⑪ or the OUTPUT receptacles ③, the waveform of output voltage might be occured incorrectly. When it happened like this case, the capacitor should be connected with final end of output cables.

3.3.2 OUTPUT Receptacles (Outlets)

The converter output is delivered to the OUTPUT receptacles ③ on the front panel of the converter as well as to the OUTPUT terminal block ⑪ on the rear panel.

The maximum rated output current which can be delivered via each of the

OUTPUT receptacles is 10 A. The available current depends also on the allowable maximum current as explained below.

Example: For the Model PCR1000 Converter
When the output voltage is 115 V (nominal 100 V range), load power factor is 0.7 and the output frequency is 35 Hz, the allowable maximum current is 7.61 A. (See Section 3.3.1 [1], Example 1.)

Note that, if a current larger than 10 A per receptacle is drawn, the internal circuit protector may trip. (This is applicable only to Models PCR2000 and PCR4000 Converters, and is not applicable to Models PCR5000 and PCR1000 Converters whose rated output currents are less than 10 A.) To restart the converter which has been turned off by its internal circuit protector tripping, turn off the POWER switch ② at once, proceed as mentioned below in Items (1) - (4) and then turn on the POWER switch ②.

(1) Remove the air filter of the air intake ④. For the removal procedure, see Section 3.3.4 [1].

(2) The circuit protector is located at the bottom of the chassis (marked S2 and S3 near the protector). As the circuit trips, the red knob comes out. The circuit can be reset by pressing the red knob. (See Figure 3-3-7.)

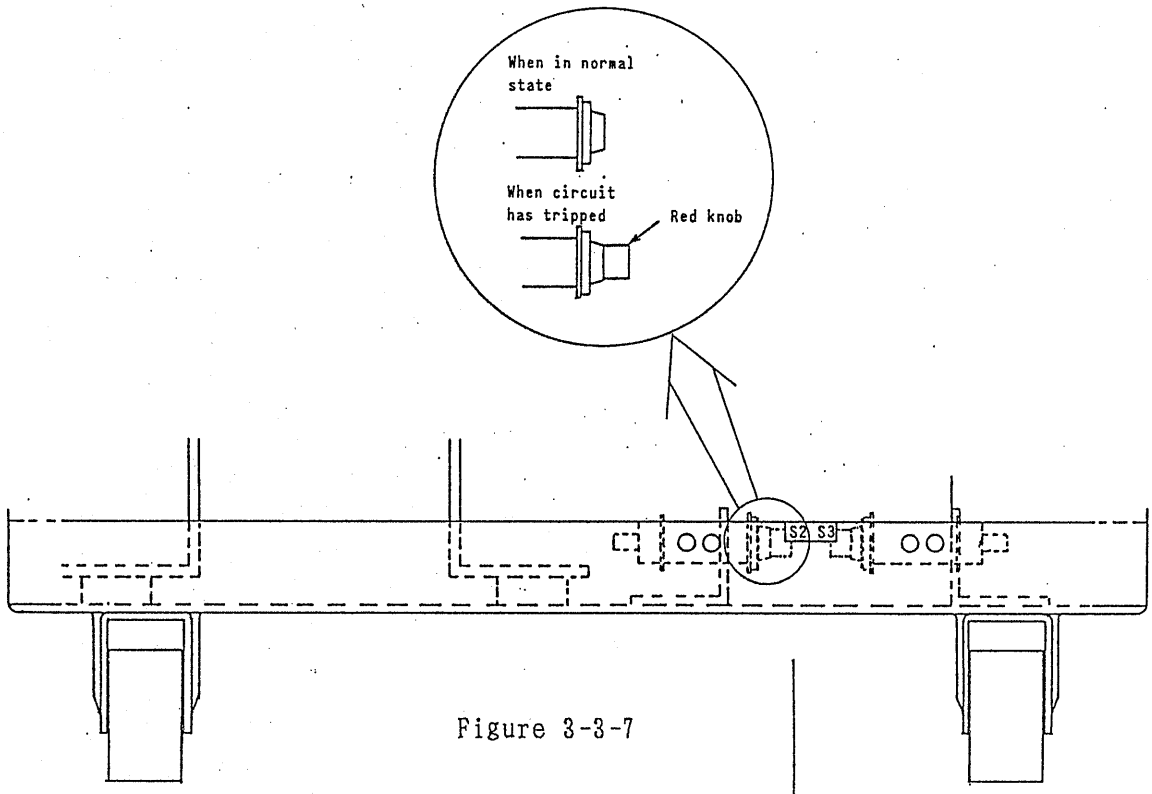


Figure 3-3-7

(3) Install the air filter in the original position.

(4) Adjust the load so that it does not draw a current larger than 10 A. Then, turn on the POWER switch ② of the converter.

Notes: (a) The sum of the output currents drawn via the two OUTPUT receptacles ③ and the OUTPUT terminal block ⑪ must not be larger than the rated output current of the converter. Note that, if the former becomes larger than the latter, the overload protector may be brought into effect. (See Section 3.3.1 [1].)

Example: For Model PCR4000 Converter
Assume that the output voltage is 100 V (with the nominal 100 V range), the load power factor is 1 and the output frequency is 50 Hz. The rated output current of the converter when in these conditions is 40 A. Assume that a current of 10 A is drawn via each of the two OUTPUT receptacles ②. The output current which can be drawn via the OUTPUT terminal block ⑪ is 20 A [40 A - (10 A × 2)].

(b) Note that, when an output current is drawn via the OUTPUT receptacle ③, the output voltage regulation against load change (against output current change) may be poorer than that of the specification which is for the OUTPUT terminal block ⑪ .

(c) The OUTPUT receptacles ③ comply only with JIS (Japanese Industrial Standards) and mate only with the power plugs that are used for the commercial power lines in Japan. Note that the rated voltage of the receptacles is 125 V and damage to the equipment may result if you attempt to deliver voltages higher than 125 V.

3.3.3 Backup Battery

The data items set with the operation/display panel ① and stored in the internal memory is maintained even when the input power of the converter is turned off, as the memory is backed up by the internal battery.
When the input power is turned on, the converter is ready to operate with the data values stored in the memory. The data items which are backed up by the

internal battery are as follows:

- Preset voltage
- Nominal output voltage range
- Limit voltage
- Preset frequency
- Memory data of voltage and frequency
- Values set for simulation of abnormalities of power source line (only when option RC01-PCR or IB01-PCR is incorporated)

The backup battery is automatically charged when the converter power is on. When the converter is in regular use, the backup battery rarely requires replacement. For the backup battery, note the following:

Notes: (1) The period the memory is backed up by the battery is approximately 1 month after the input power of the converter is turned off. (The backup period may change slightly due to ambient temperature and the level of charge of the battery when the converter input power is turned off.) When the battery is discharged and the memory data is lost, the default values as mentioned in Section 3.2.2 [3]are used for the data values.

(2) The fully discharged battery takes approximately 15 hours of charging period (period during which the converter input power is kept on) before it is fully charged up. The backup period will be shorter if the battery is not fully charged up.. The battery should be charged when using the converter for the first time after it is delivered to you.

(3) If the backup period with the battery after turning off the converter input power is abnormally short, the battery should be replaced. For battery replacement, please order from your Kikusui agent. (The longevity of the battery is approximately 5 years on average although it differs depending on the conditions of use).

3.3.4 Other Precautions

[1] Cleaning the Air Filter

Clean the air filter of the air intake ④ of the converter at appropriate time intervals. Note that, if the air filter is clogged with dust, air flow will be impeded and the overheat protector may trip to cut off the output or other adverse effects on the converter may result. To remove the air filter, proceed as follows referring to Figures 3-3-8 and 3-3-9.

(1) Be sure to turn off the input power source (with a power distribution panel, for example) before servicing the converter.

(2) Loosen the two clamping screws of the filter by 180 degrees with a screwdriver or a coin, and the filter section will lean out to the front. Take out the air filter upward.

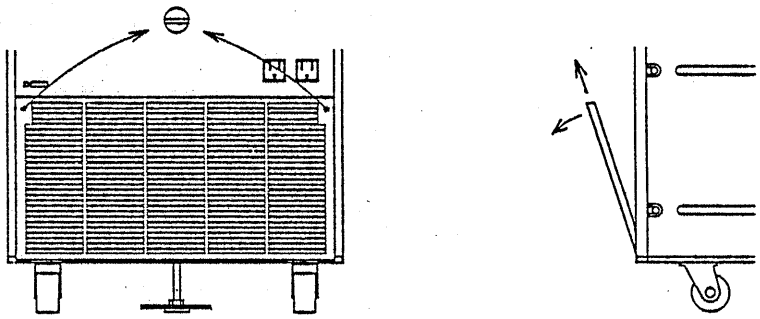


Figure 3-3-8

(3) Remove the filter element retainer (steel wire) and take out the filter element. Clean the filter element by blowing it with a compressed air (a vacuum cleaner may be used) or by washing it with water (if it is heavily stained).

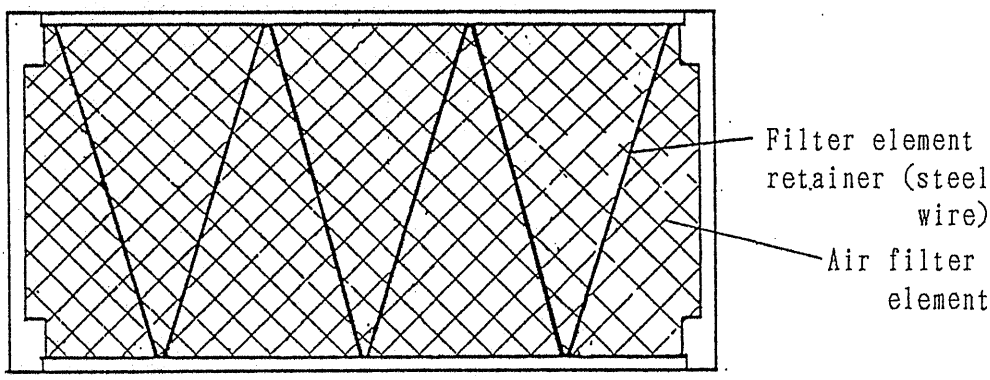


Figure 3-3-9

(4) Replace the air filter into the original position by following the removing procedures in the reverse order.
The illustrations in Figures 3-3-8 and 3-3-9 are for Model PCR2000 Converter. The same are applicable to other models also. Note, however, that Model PCR4000 Converter has two air filters as shown in Figure 3-3-10.

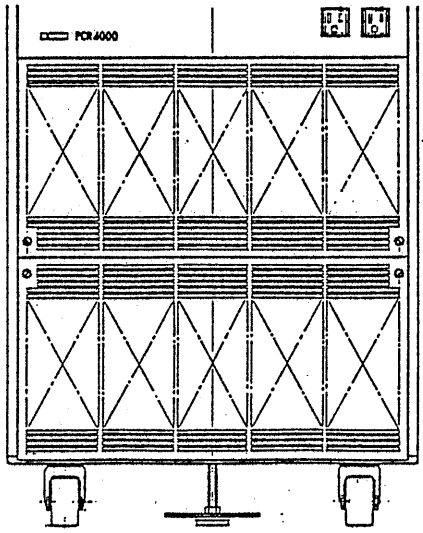


Figure 3-3-10

[2] Inhibition of Removal of Panels

Never attempt to remove the panels (side, top, and rear panels), except the air intake ④ (air filtar).

Caution: Note that, even after the input power of the converter is turned off, some of the internal components may remain charged up to hazardously high voltages or heated up to high temperatures. Beware of electric shocks and burns.

Note that, if you loosen the clamping screws of the converter panels, the resistances of the converter against noise and static electricity may be degraded and noise radiated by the converter may increase.

[3] Note for Installing/Removing the Optional Provisions

Be sure to turn off the POWER switch ② before installing or removing any of the optional provisions mentioned in Section 4. Note that both converter and optional provision may be damaged if they are connected or disconnected when the converter power is on.

4. OPTIONS

4.1 Introduction

This section introduces the optional provisions available for the PCR Series Frequency Converters.

[1] IB01-PCR (GP-IB Interface)

The interface is used to control the converter via GP-IB (IEEE 488-1978) bus.

The interface is fabricated on cards which can be installed in SLOTS 1 and 2 ⑮ of the optional I/O slot section of the converter.

The interface allows you to control via GP-IB the functions of the operation/display panel ① of the converter and the line power abnormality simulation functions.

The major functions of the interface are as follows:

(1) Listener Functions

To set an output voltage (and nominal output range) and output frequency

To set a limit voltage

To write data in memory, or to clear the memory

To turn on/off the various switches

To set power line abnormality simulation conditions

Power down (POWER switch ② off)

Others

(2) Talker Functions

Output voltage (and nominal output range), preset output voltage, and output current

Output frequency and preset limit voltage

Memory data

On/off states of the various switches

Power line abnormality simulation conditions

Statues

Others

(3) Service Request

Power on

Overload

Alarm (abnormality or failure)

Error

Synchronization abnormality or failure

Others

[2] 3P01-PCR (3-phase Driver)

The driver is used to deliver a 3-phase output.

A frequency converter system which delivers a 3-phase output can be made up by employing one set of the 3-phase driver and three units of PCR converters.

One set of 3-phase driver is comprise of three drive cards (for three respective converters) and two signal cables which connect the cards.

One of the three converters is used as a master unit. The master unit and phase rotation are selectable with the switches of the 3-phase driver. It also is possible to adjust the voltages of the U, V and W phases mutually independently.

The 3-phase driver (3P01-PCR) can be used together with the GP-IB interface (IB01-PCR) or the remote controller (RC01-PCR).

By employing parallel operation cables (PD01M-PCR/PD01S-PCR) in conjunction, the 3-phase converter set up is able to cope with a large output (up to 36 kVA).

By employing the 3-phase driver, PCR systems with output ratings as mentioned below can be realized.

Output voltage: 1 - 140 V or 2 - 280 V (star voltage)
1.7 - 242 V or 3.5 - 485 V (delta voltage)
Note: As a general rule, star connections should be used for the load.

Output power: (Rated output power [VA] of one unit of converter) ×3
When two or more units of converters are operated in parallel for each of the phases, the total output power is as the above output power is multiplied by the

number of units operated in parallel for each of the phases. For example, when two Model PCR4000 Converters are used for each of the phases, the total output power is calculated as 4 kVA × 2 × 3 = 24 kVA.

Rack-mounted master-slave type of converter systems with centralized control of input/output terminals and power switches also are available from Kikusui. For details, please consult your Kikusui agent.
Use of the IB01-PCR Driver allows you to monitor the current of each of the phases and to set the phase differences between phases.

[3] RC01-PCR (Remote Controller)

The remote controller is used to remotely control the converter and to expand its functions.
The remote controller comprises of a remote control box (which has an operation/display section) and an interface card (which can be installed in the converter).
The remote controller allows control of the functions which basically are similar to those of the operation/display panel Ⓘ of the converter and of the optional functions (such as the power line abnormality simulation functions), at output frequency 50 Hz or 60 Hz. The major functions of the remote controller are as follows:

(1) Voltage and Frequency Setting Functions

Voltage and frequency can be set digitally and continuously with switches (identical with those of the converter)

(2) Memory Function

To read and write data in memory (99 addresses) and to execute data items

(3) Power Line Abnormality Simulation Function

The following items can be set or executed:
Line voltage change start phase (time), T1: 0 - 9.9 ms* (Resolution 0.1 ms), Accuracy ····+0.2ms/-0ms

Slope time, T2, T4:	0 - 9999 ms (Resolution 1 ms), Accuracy ····±1 ms
Pop/dip time, T3:	0 - 9999 ms (Resolution 1 ms), Accuracy ····±1 ms
Power restoration cycles, N:	0 to infinity cycles
Pop/dip voltage, V (T3):	Within rated output voltage range (1 - 280 V, resolution 0.1 V)
Polarity of change start:	"+" or "-"

*: When the preset output frequency is 50 Hz. When the preset output frequency is 60 Hz, the value is 0 - 8.3 ms.

An example of power line abnormality simulation waveform is shown in Figure 4-1.

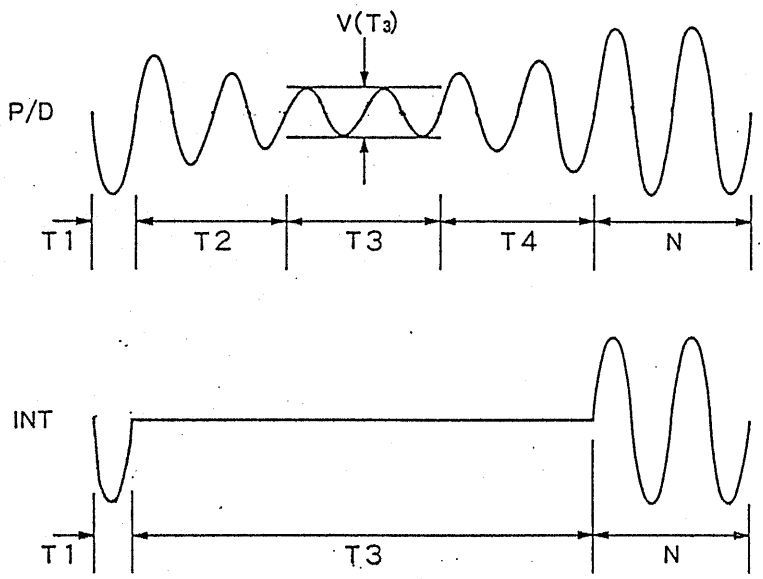


Figure 4-1

(4) Display and Other Functions

Output voltage, current and frequency display

Output on/off

Preset

Key lock

Power failure signal output

Other status indication function

[4] PD01M-PCR/PD01S-PCR (Parallel Operation Cable)

The cables allows coneection of up to 3 units of Model PCR2000 or PCR4000 Converters in parallel for master-slave operation.
When converters are used in this mode, the total output power of the system is calculated as follows:

Total output power = (No. of PCR2000 Converters) × 2 kVA
(≦ 6 kVA)
or
(No. of PCR4000 Converters) × 4 kVA
(≦12 kVA)

Note: When ordering cables, please indicate the number of converters to be operated in parallel. The number of cables required differs by the number of converters to be operated in parallel.

No. of Cables Required	No. of Converters Operated in Parallel	
	2	3
PD01M-PCR	1	1
PD01S-PCR	0	1

Rack-mounted master-slave type of converter systems with centralized control of input/output terminals and power switches also are available from Kikusui. For details, please consult your Kikusui agent.

[5] EX01-PCR (External Signal Interface)

The interface is used to control the PCR Converter with an external AC signal.
The interface is fabricated on cards, which can be installed in SLOTS 1 and 2 ⑮ of the optional I/O slot section of the converter.
By employing the interface, the converter can be operated as a power amplifier.
The performance specifications of the PCR Converter when the interface is employed are as follows:

External signal input

Voltage:	0 to approximately 1.4 V rms (sinusoidal wave) The voltage gain of the converter at the nominal 100 V range is approximately 100 and that at the nominal 200 V ramge is approximately 200.
Output frequency:	5 - 500 Hz (= input frequency)
Others:	The frequency meter, and the panel control functions for voltage and frequency (adjusting functions, memory function, synchronization function, etc.) are disabled. Other performance specifications are identical with those of the PCR Converter.

4.2 Others

Up to two items of the previously mentioned optional provisions can be incorporated per in each converter, with limitations as shown in the following table.

	Available Combination of Optional Provisions		Remarks
①	IB01-PCR	3P01-PCR	GP-IB control of 3-phase output
②	RC01-PCR	3P01-PCR	Remote control of 3-phase output
③	(IB01-PCR)	(RC01-PCR)	Either two can be used at one time by switching between them. (They cannot be used at the same time.)
④	(IB01-PCR)	(EX01-PCR)	
⑤	(RC01-PCR)	(EX01-PCR)	

The PD01M-PCR/PD01S-PCR can be incorporated in addition to the abovementioned optional provisions. (These are connected via their dedicated connectors which are independent from the I/O slots for the abovementioned optional provisions.)

For example, a GP-IB controlled large power 3-phase frequency converter can be realized by employing a combination of IB01-PCR, 3P01-PCR and PD01M-PCR/PD01S-PCR.

Other various applications are possible. Please consult your Kikusui agent.

5. RACK MOUNT

The PCR converter can be installed on a standard rack by employing brackets.

5.1 Types of Brackets

The types of brackets differ by the model of the converter and by the type of the rack as shown in the following table.

Model of Converter	JIS Rack	EIA Rack
PCR500	BH3AM (Figure 5-1)	BH4C (Figure 5-2)
PCR1000	BH6BM (Figure 5-3)	BH7 (Figure 5-4)
PCR2000	BH10M (Figure 5-5)	BH12A(Figure 5-6)
PCR4000	BH20M (Figure 5-7)	BH23 (Figure 5-8)

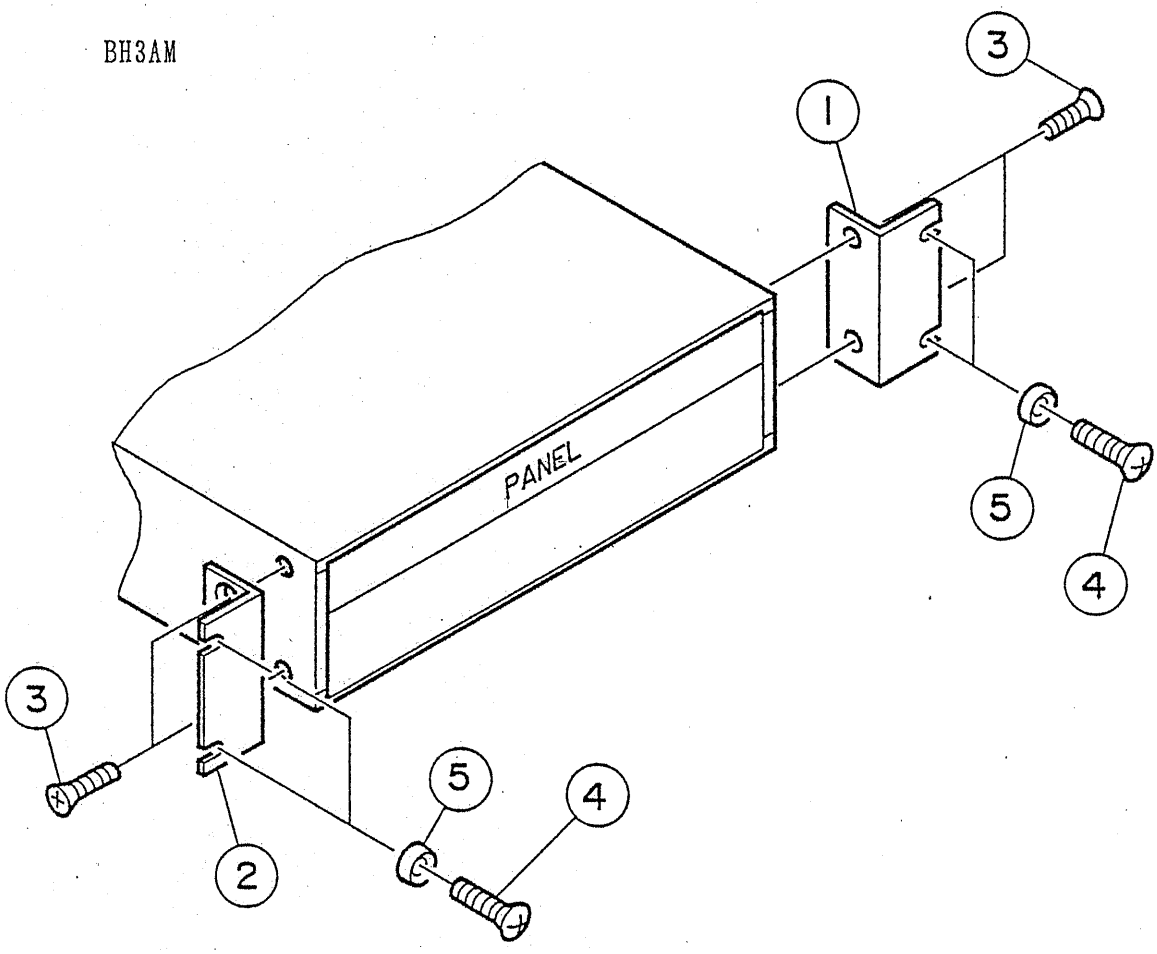
The brackets and accessory parts for rack mount as shown in each of Figures 5-1 through 5-8 are included in the shipping package of the converter.

5.2 Fixing the Brackets

Fix the brackets to both sides of the converter as illustrated below.

(1) To install the PCR500 on a JIS rack

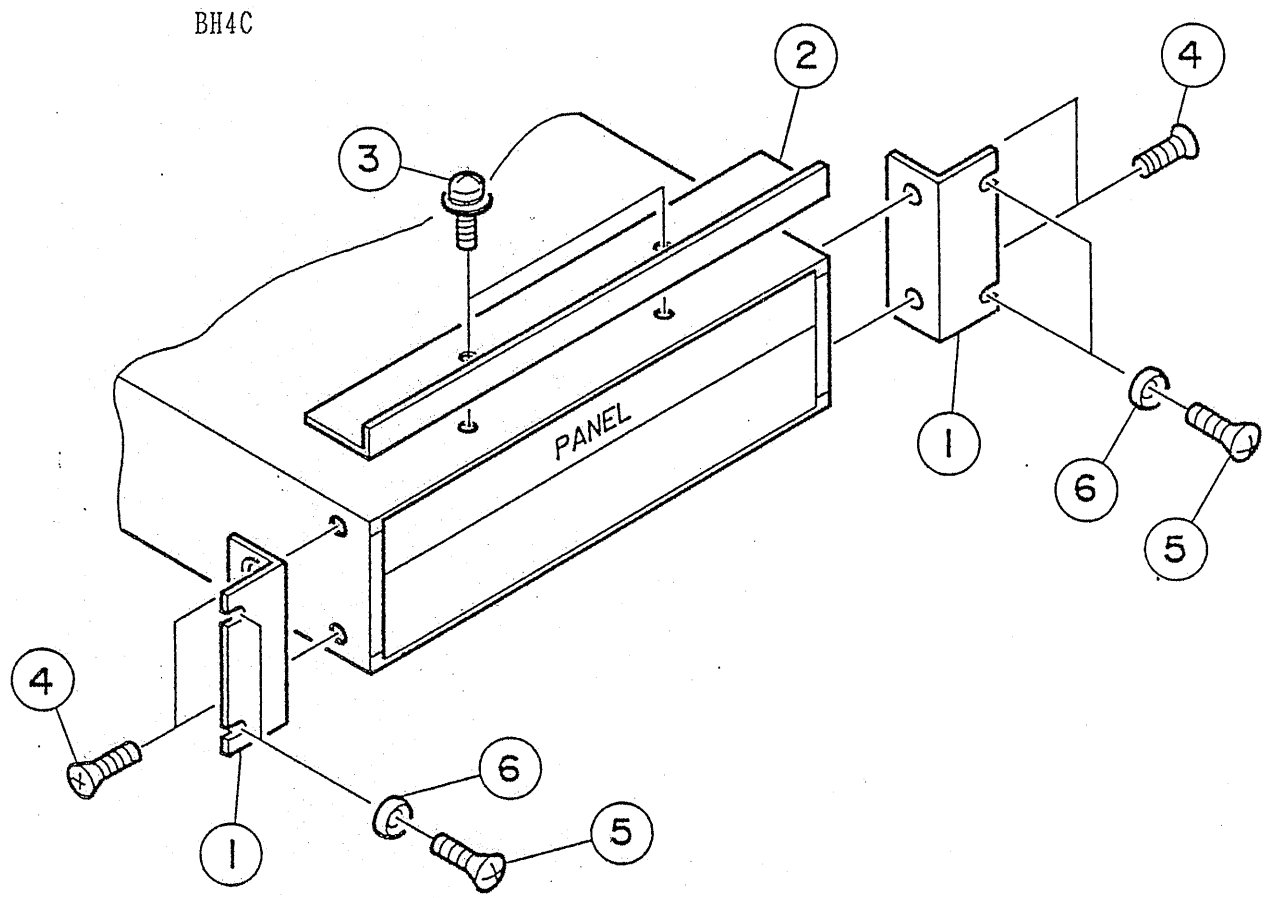
BH3AM



NO.	DESCRIPTION	QTY
1	BRACKET BH3AM RIGHT	1
2	BRACKET BH3AM LEFT	1
3	SCREW,FLAT HEAD M4x0.7x16 S-ZN	4
4	SCREW,OVAL HEAD M5x0.8x14 B-NI	4
5	FINISHING WASHER 5CW	4

Figure 5-1

(2) To install the PCR500 on an EIA rack

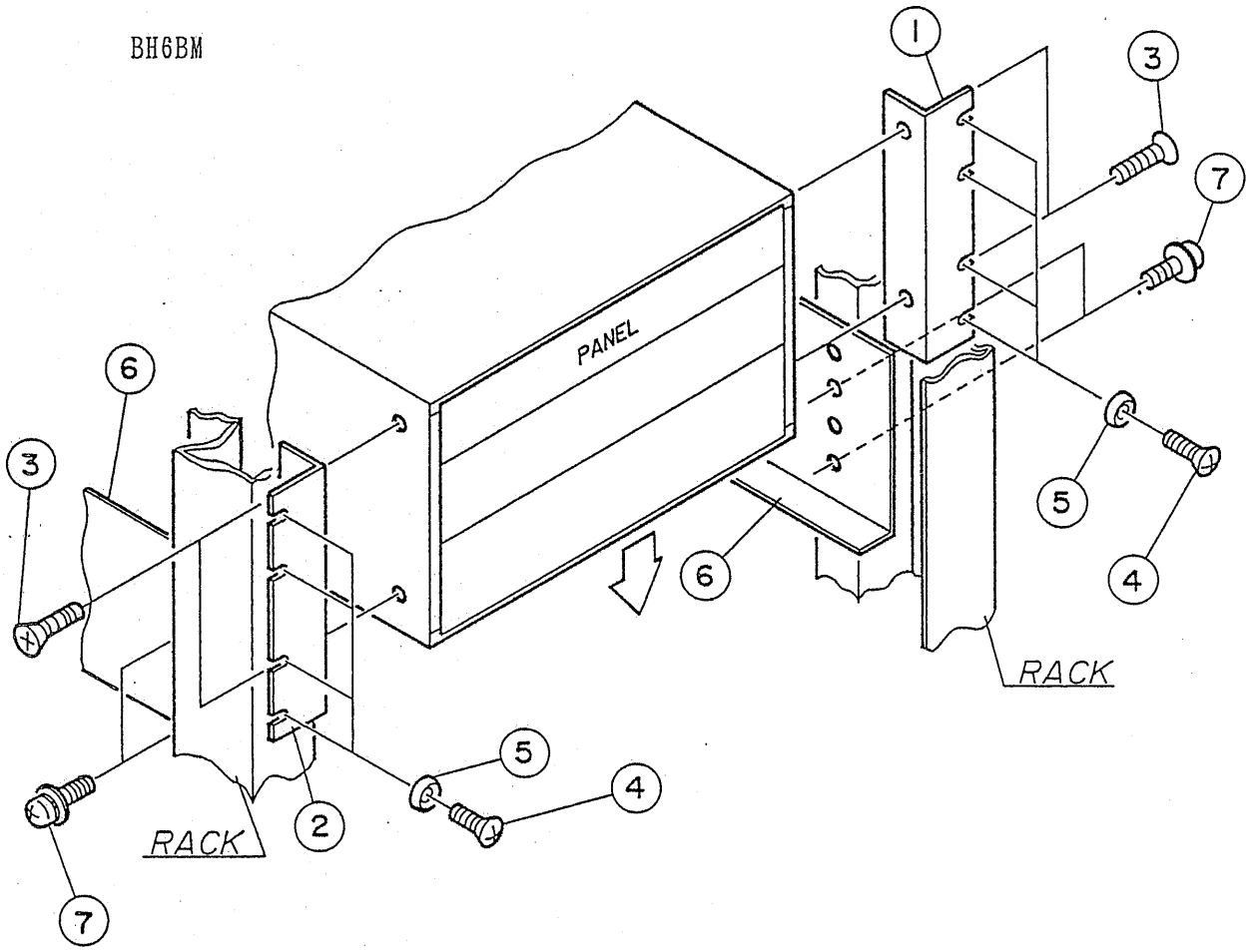


NO.	DESCRIPTION	QTY
1	BRACKET BH4C	2
2	BRANK PANEL BH4C	1
3	SCREW WITH SW,PW M3x0.5x12 S-ZN	2
4	SCREW,FLAT HEAD M4x0.7x16 S-ZN	4
5	SCREW,OVAL HEAD M5x0.8x14 B-NI	4
6	FINISHING WASHER 5CW	4

Figure 5-2

(3) To install the PCR1000 on a JIS rack

BH6BM

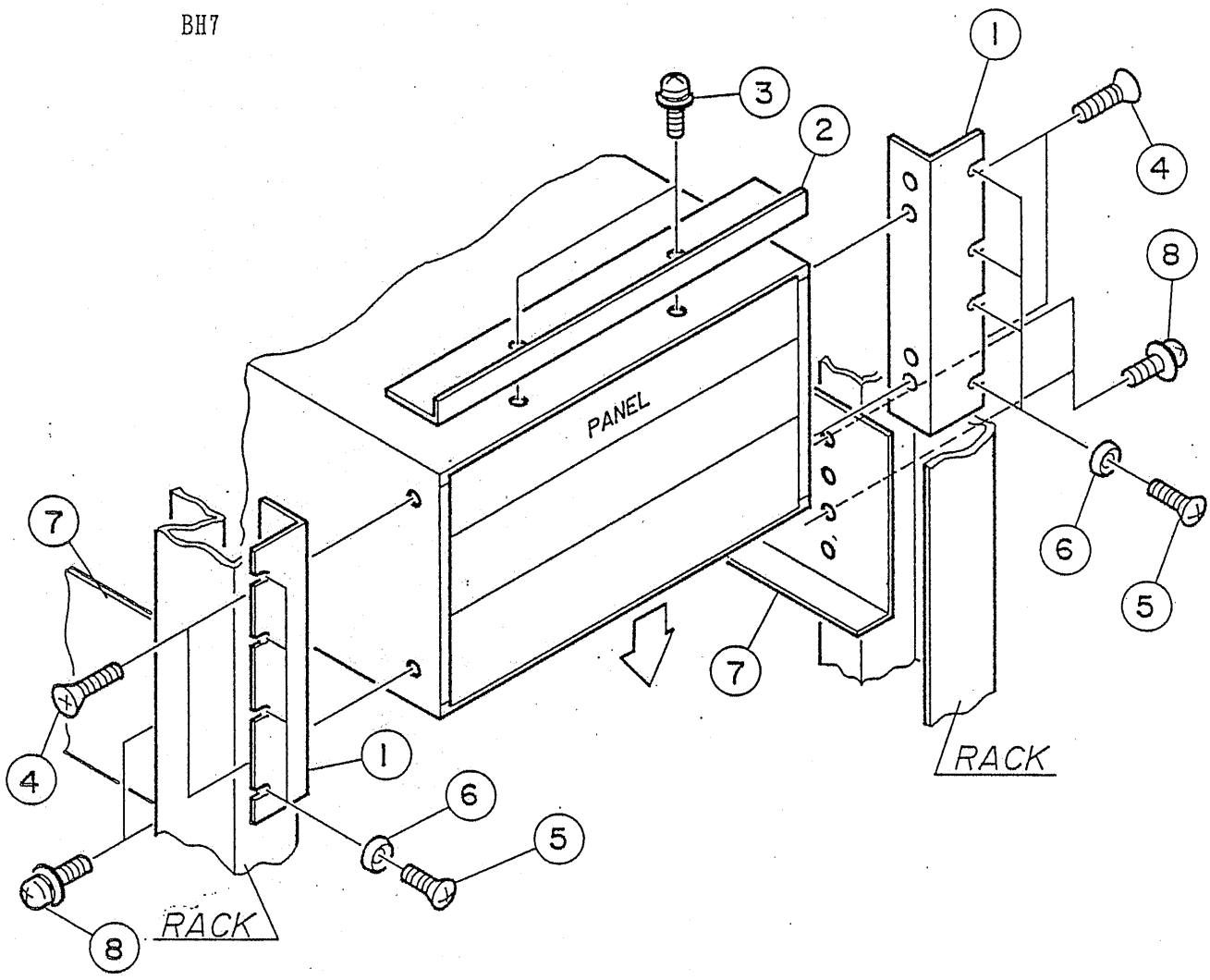


NO.	DESCRIPTION	QTY
1	BRACKET BH6BM RIGHT	1
2	BRACKET BH6BM LEFT	1
3	SCREW,FLAT HEAD M5x0.8x20 S-ZN	4
4	SCREW,OVAL HEAD M5x0.8x14 B-NI	8
5	FINISHING WASHER 5CW	8
6	RAIL FOR EXTRA WEIGHT	2
7	SCREW WITH SW,PW M5x0.8x10 S-ZN	8

Figure 5-3

(4) To install the PCR1000 on an EIA rack

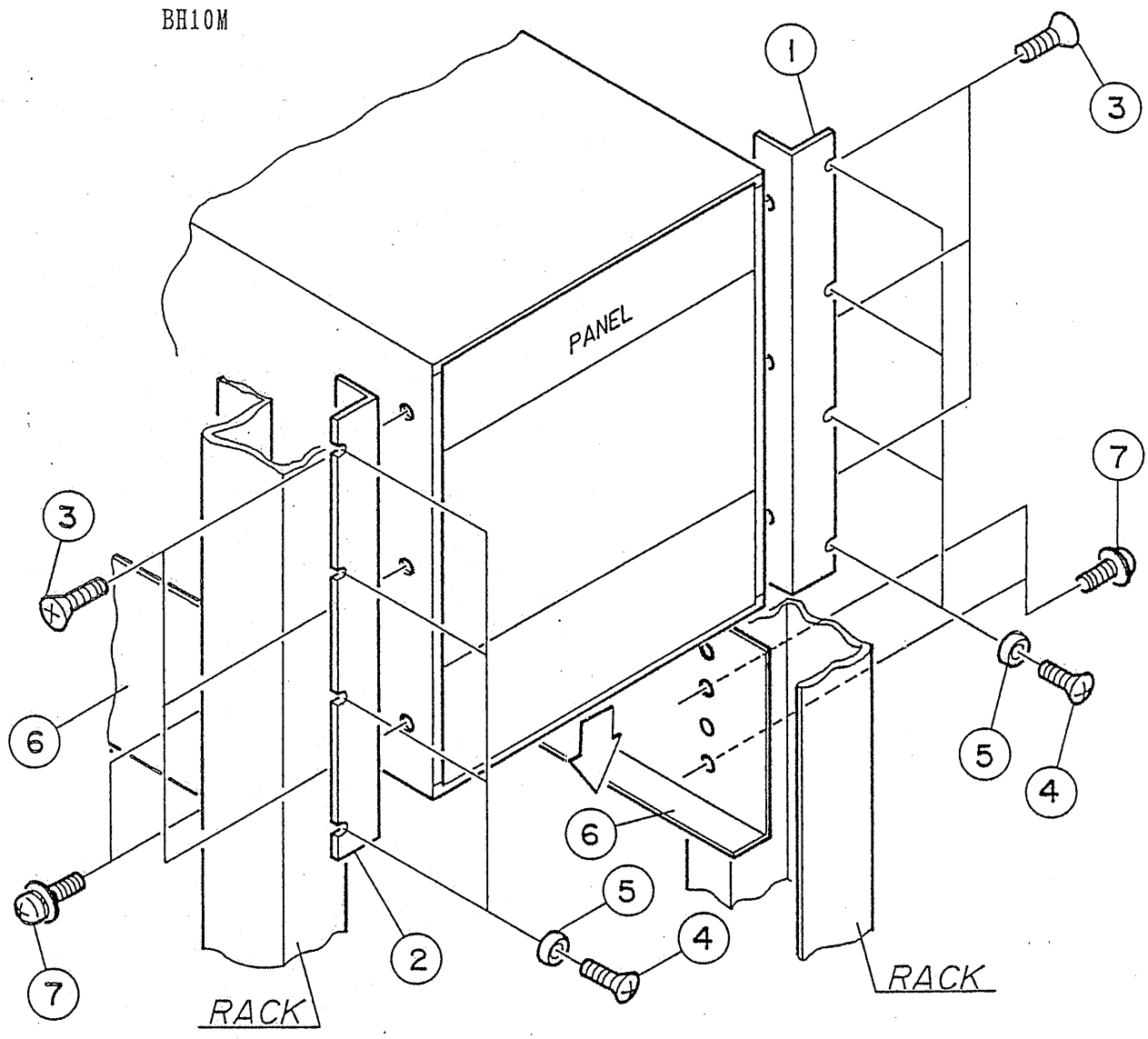
BH7



NO.	DESCRIPTION	QTY
1	BRACKET BH7	2
2	BLANK PANEL BH7	1
3	SCREW WITH SW,PW M3X0.5X12 S-ZN	2
4	SCREW,FLAT HEAD M5X0.8X20 S-ZMC2	4
5	SCREW,OVAL HEAD M5X0.8X14 B-NI	8
6	FINISHING WASHER 5CW	8
7	RAIL FOR EXTR WEIGHT	2
8	SCREW WITH SW,PW M5X0.8X10 S-ZN	8

Figure 5-4

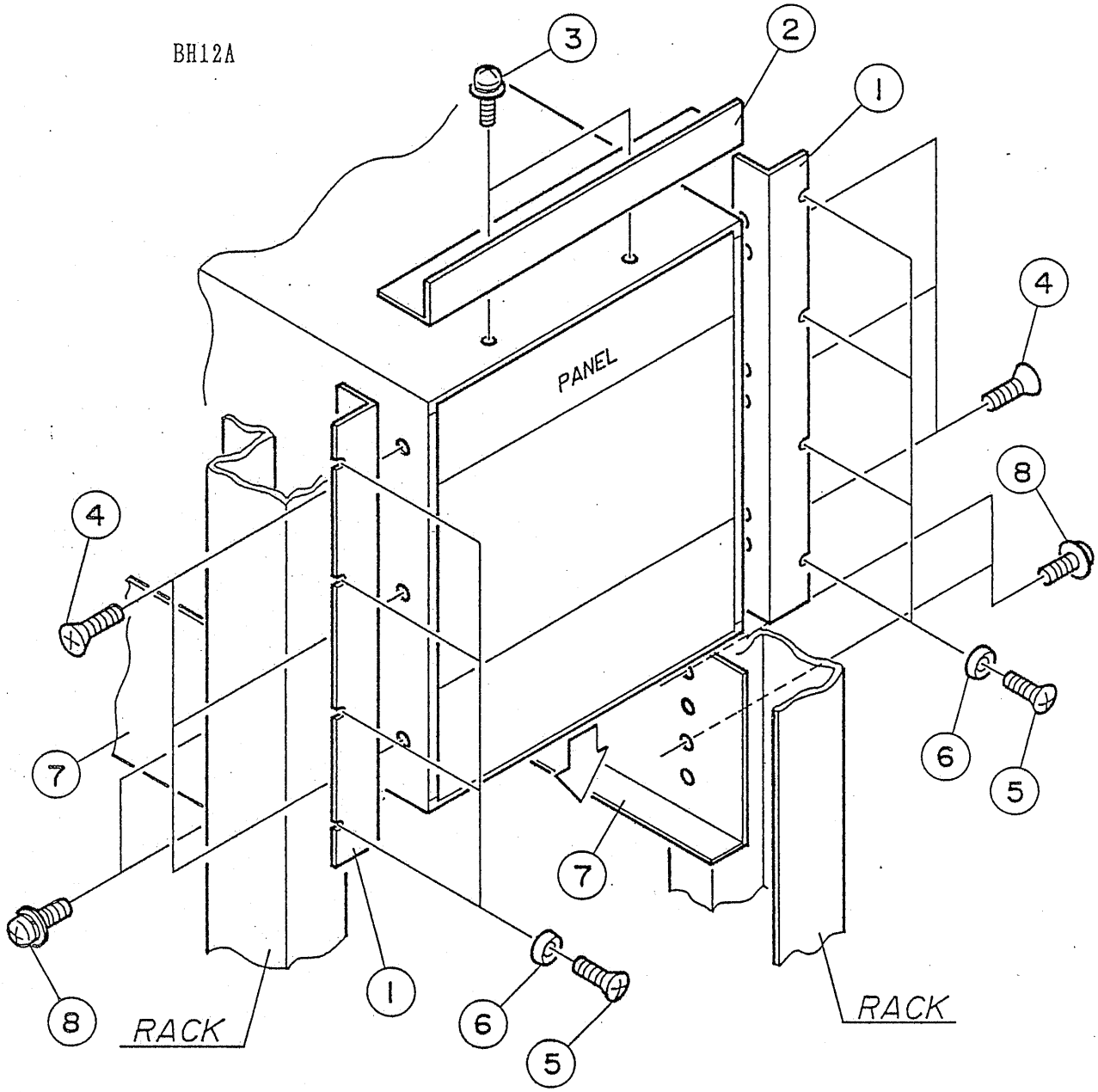
(5) To install the PCR2000 on a JIS rack



NO.	DESCRIPTION	QTY
1	BRACKET BH10M RIGHT	1
2	BRACKET BH10M LEFT	1
3	SCREW,FLAT HEAD M5×0.8×20 S-ZMC2	6
4	SCREW,OVAL HEAD M5×0.8×14 B-NI	8
5	FINISHING WASHER 5CW	8
6	RAIL FOR EXTRA WEIGHT	2
7	SCREW WITH SW,PW M5×0.8×10 S-ZN	8

Figure 5-5

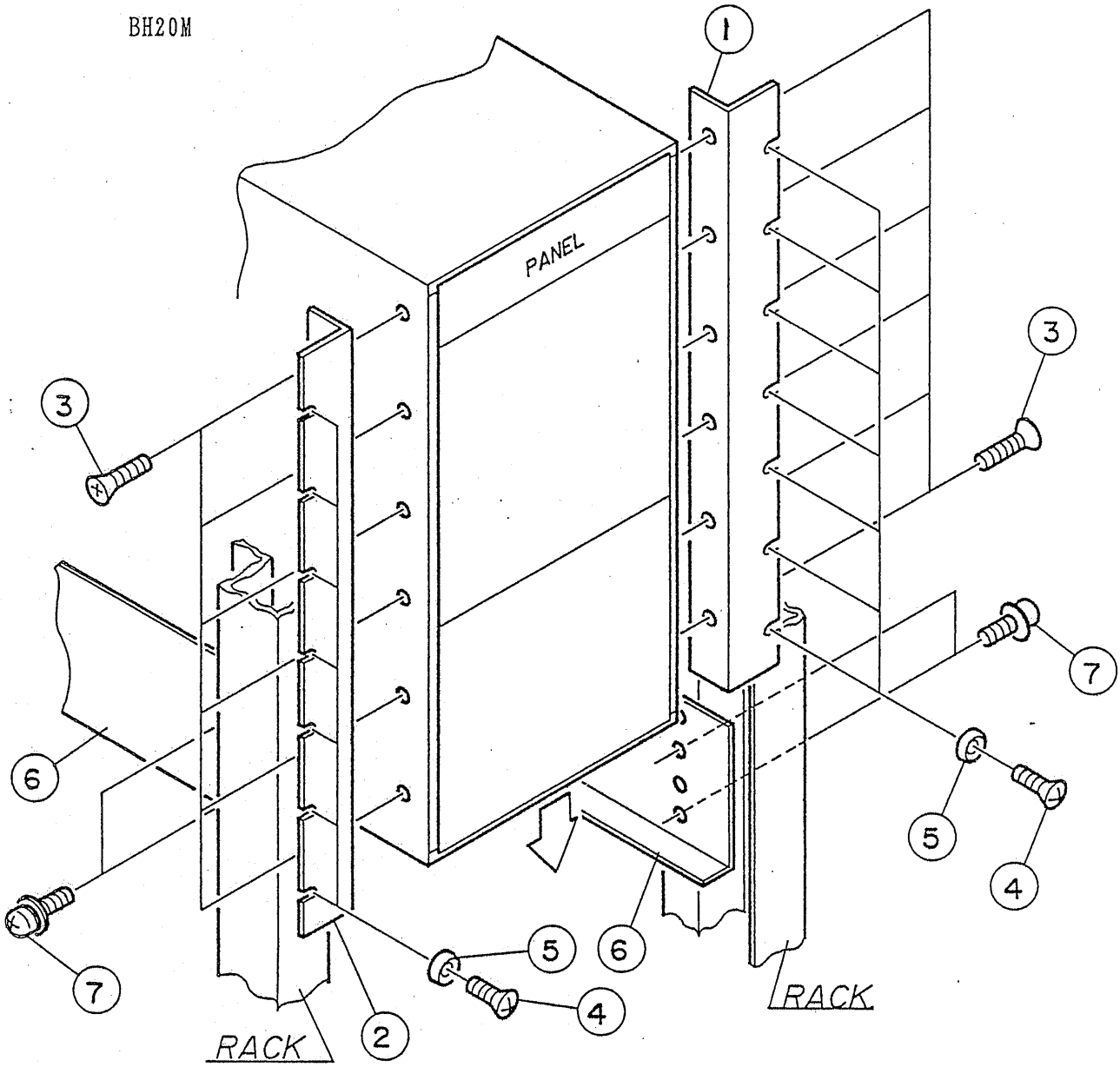
(6) To install the PCR2000 on an EIA rack



NO.	DESCRIPTION	QTY
1	BRACKET BH12A	2
2	BLANK PANEL BH12A	1
3	SCREW WITH SW,PW M3 0.5 12 S-ZN	2
4	SCREW,FLAT HEAD M5 0.8 20 S-ZMC2	6
5	SCREW,OVAL HEAD M5 0.8 14 B-NI	8
6	FINISHING WASHER 5CW	8
7	RAIL FOR EXTRA WEIGHT	2
8	SCREW WITH SW,PW M5 0.8 10 S-ZN	8

Figure 5-6

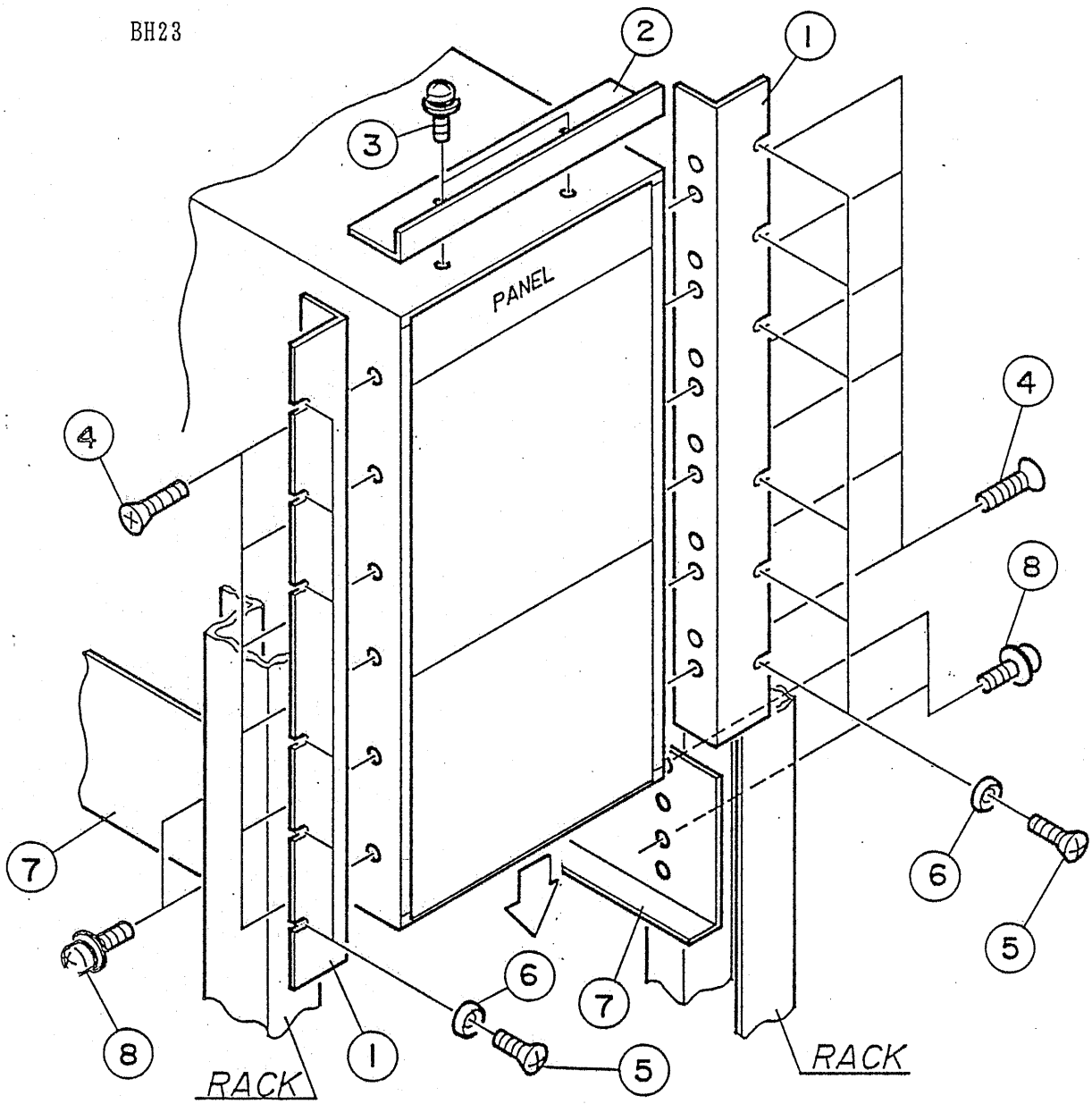
(7) To install the PCR4000 on a JIS rack



NO.	DESCRIPTION	QTY
1	BRACKET BH20M RIGHT	1
2	BRACKET BH20M LEFT	1
3	SCREW,FLAT HEAD M5X0.8X20 S-ZMC2	12
4	SCREW,OVAL HEAD M5X0.8X14 B-NI	14
5	FINISHING WASHER 5CW	14
6	RAIL FOR EXTRA WEIGHT	2
7	SCREW WITH SW,PW M5X0.8X10 S-ZN	8

Figure 5-7

(8) To install the PCR4000 on an EIA rack



NO.	DESCRIPTION	QTY
1	BRACKET BH23	2
2	BLANK PANEL BH23	1
3	SCREW WITH SW,PW M3X0.5X12 S-ZN	2
4	SCREW,FLAT HEAD M5X0.8X20 S-ZMC2	12
5	SCREW,OVAL HEAD M5X0.8X14 B-NI	12
6	FINISHING WASHER 5CW	12
7	RAIL FOR EXTRA WEIGHT	2
8	SCREW WITH SW,PW M5X0.8X10 S-ZN	8

Figure 5-8

5.3 To Install the Converter onto a Rack

Fix the support angles* (rails for extra weight) to the rack.
Put the converter onto the angles.

*: The support angles accompany the bracket, except for BH3AM and BH4C in which case the support angles which accompany the rack should be used.

6. CHARACTERISTIC CHARTS

The output current factor in percent is with the maximum rated output current as 100%.

Figure 6-1 Characteristics of Output Current VS. Input Current, Efficiency

[Typical curve]

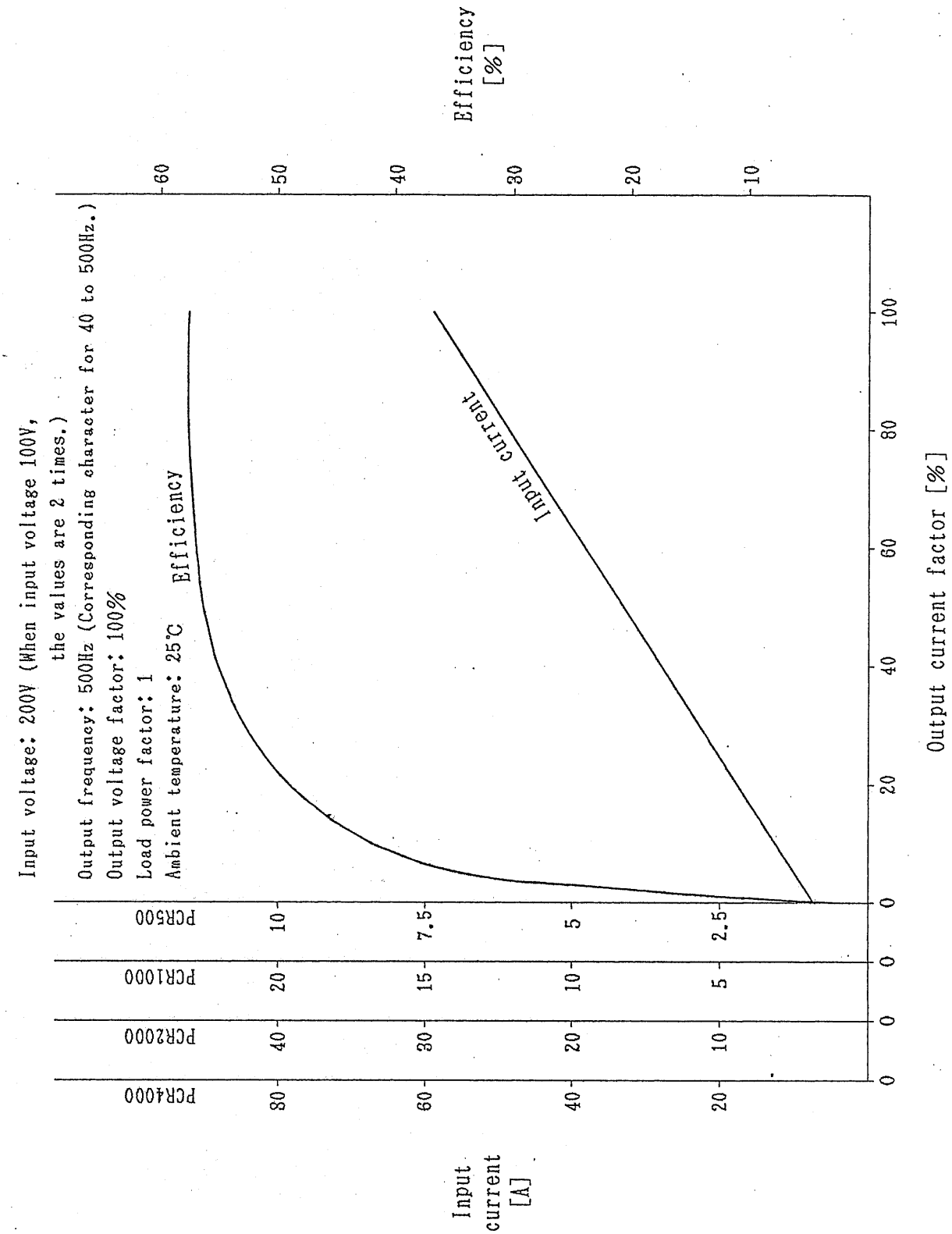
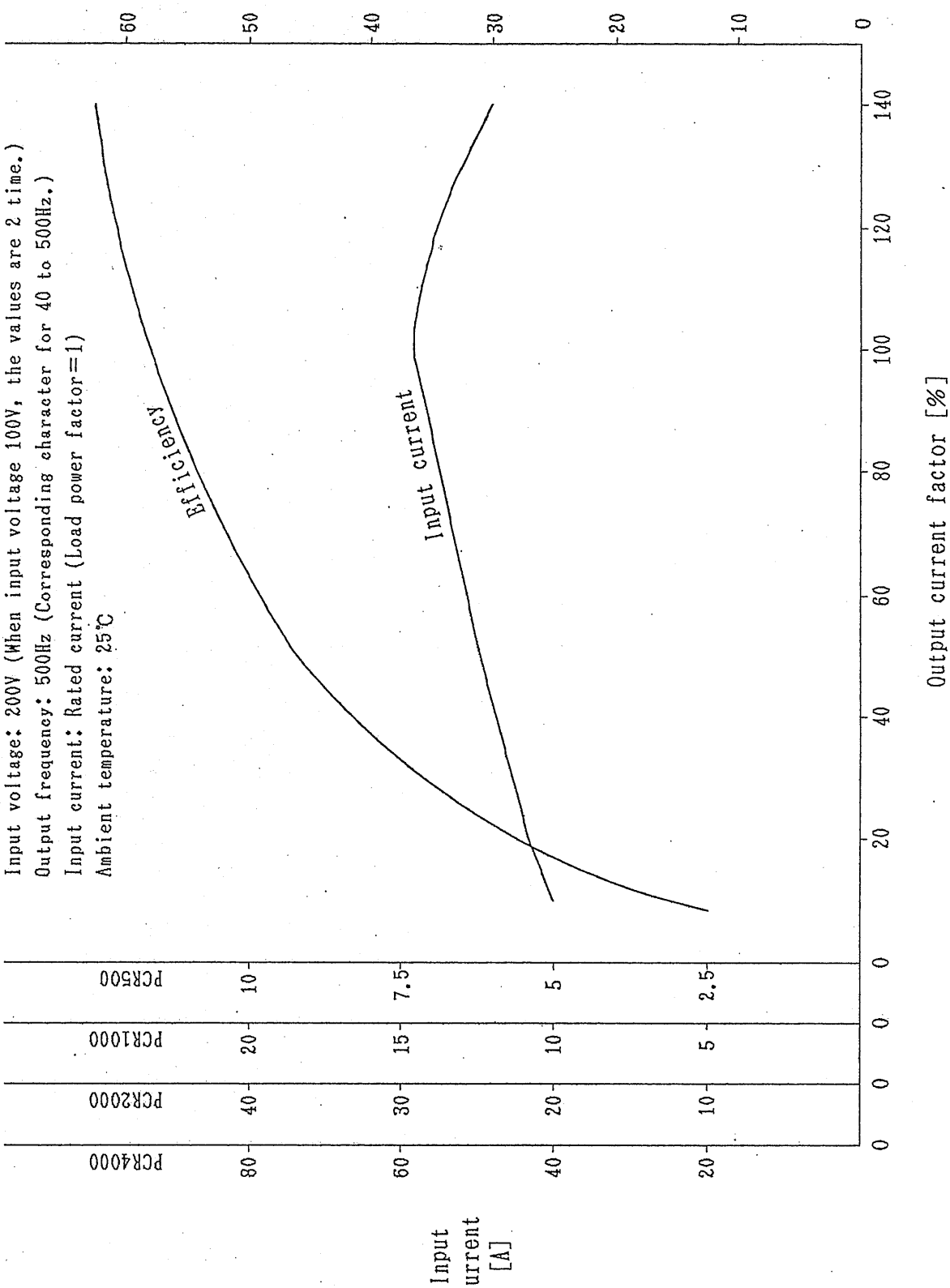


Figure 6-2 Characteristics of Output Voltage VS. Input Current, Efficiency

[Typical curve]



7. BEFORE ORDERING REPAIR SERVICE

The PCR equipment must be serviced only by qualified agents authorized by Kikusui. If your PCR equipment appears to have developed a fault, check the items shown in Table 7-1 before asking your Kikusui agent for repair service. If the cause of the problem lies in the equipment set up, correct it as per the following table and then use the equipment; if it is a circuit failure, then refer to your Kikusui agent forrepair.

Table 7-1. Trouble Check Items

Symptom	Check Item	Probable Cause
Equipment does not operate at all even when POWER switch ① is turned on.	1. Is input power applied to input terminal?	○ Open circuit input power cable ○ Incorrect connection of input power cable
	2. Is the input voltage selector correctly set for the actual input voltage?	○ Incorrect setting of INPUT VOLTAGE SELECTOR switch ⑫ (for PCR500 and PCR1000) or incorrect connection of INPUT VOLTAGE SELECTOR terminals ⑬ (for PCR2000 and PCR4000)
	3. Other than the above	○ Circuit failure
POWER switch ① cannot be turned on (or it turns off automatically).	1. Is the input voltage selector correctly set for the actual input voltage?	○ Incorrect setting of INPUT VOLTAGE SELECTOR switch ⑫ (for PCR500 and PCR1000) or incorrect connection of INPUT VOLTAGE SELECTOR terminals ⑬ (for PCR2000 and PCR4000)
	2. Is the OVERLOAD lamp illuminated?	○ Overload protector tripped
	3. Is a signal applied via card inserted in SLOT1 or SLOT2 ⑮?	○ POWER OFF command is received through GP-IB when IB01-PCR is used. ○ A signal of lower than 5 Hz is applied when EX01-PCR is used. ○ A signal of higher than 1.4 Vrms is applied when EX01-PCR is used.
	4. Other than the above	○ Circuit failure
Panel switches are partially (or entirely disabled.)	1. Is the KEY LOCK switch ㉞ set to the KEY LOCK mode?	○ Incorrect setting of KEY LOCK switch ㉞.
	2. Is the REMOTE lamp ㊽ illuminated?	○ Equipment is set to the REMOTE mode by GP-IB.
	3. Is the EXT lamp ㊽ illuminated?	○ The selector switch of EX01-PCR is set to the EXT mode.

Symptom	Check Item	Probable Cause
Panel switches are partially (or entirely disabled.) (cont'd)	4. Is the U, V, W lamp ㊼ illuminated?	○ 3P01-PCR is inserted in SLOT1 or SLOT2 ⑮.
	5. Is the SLAVE lamp ㊻ illuminated? (for PCR2000 and PCR4000 only)	○ PD01M-PCR or PD01S-PCR is connected to J1 or J2 ⑯.
	6. Is the input voltage within the specified range?	○ The input voltage is incorrect.
	7. Is the ALARM lamp ㊺ illuminated?	○ Overheat protector tripped
	8. Is there a nearby source of large noise?	○ Erroneous operation caused by noise.
	9. Other than the above	○ Circuit failure
Panel lamp indication is abnormal.	1. Is the input voltage within the specified range?	○ The input voltage is incorrect
	2. Is the SYNC lamp ㊷ not illuminated?	○ Equipment is in the synchronized mode of operation.
	3. Is the SLAVE lamp ㊻ not illuminated? (for PCR2000 and PCR4000 only)	○ PD01M-PCR, PD01S-PCR is connected to J1 or J2 ⑯.
	4. Is there a nearby source of large noise?	○ Erroneous operation caused by noise
	5. Other than the above	○ Circuit failure
OUTPUT switch ㉚ is automatically turned off (or cannot be turned on).	1. Is the ALARM lamp ㊺ not illuminated?	○ Overheat protector tripped ○ Output overvoltage protector tripped
	2. Is the OVERLOAD lamp ㊹ not illuminated?	○ Overload
	3. Is the input voltage within the specified range?	○ The input voltage is incorrect
	4. Is the IB01-PCR or RC01-PCR inserted in SLOT1 or SLOT2 ⑮.	○ An output off signal is being received from GP-IB or remote controller.
	5. Is there a nearby source of large noise?	○ Erroneous operation caused by noise
	6. Other than the above	○ Circuit failure
Output waveform is distorted.	1. Is the OVERLOAD lamp ㊹ not illuminated?	○ Overload
	2. Is the EX01-PCR being used?	○ The input signal waveform is distorted.

Symptom	Check Item	Probable Cause
Output waveform is distorted. (cont'd)	3. Is the IB01-PCR or RC01-PCR inserted in SLOT1 or SLOT2 ⑮?	○ In power interruption mode of operation
	4. Other than the above	○ Circuit failure
OVERLOAD lamp ㊹ illuminates.	1. Is the reading of ammeter ㊶ within the specified range?	○ Overload
	2. Is the load power factor within the specified range?	○ The load is a non-linear type (capacitor input type of rectifier circuit or phase-controlled circuit) and the protector has tripped.
	3. Does the lamp turn on when the output voltage is changed or when the output is turned on?	○ Overcurrent is caused by rush current of load (lamp, capacitor-input rectifier, or transformer).
	4. Other than the above	○ Circuit failure
ALARM lamp ㊺ turns on.	1. Is the fan running?	○ Fan failure. Trip of overheat protector
	2. Is the air intake port ④ or exhause port ⑭ clogged?	○ Overheat protector tripped ○ Clogged air filter
	3. Is the ambient temperature higher than 50℃?	○ Overheat protector tripped
	4. Is the load power factor within the specified range?	○ Overheat protector tripped
	5. Is EX01-PCR being used?	○ An output voltage exceeding the limit voltage is delivered.
	6. Other than the above	○ Circuit failure

Note: When the ALARM lamp ㊺ is turned on, proceed as follows:

(a) Run the equipment with its output turned off. If the ALARM lamp ㊺ goes off within 10 to 30 minutes, eliminate the cause of trip of the overvoltage protector and then use the equipment.

(b) In other cases than the above, turn off the POWER switch ① once and then turn it on again. If the ALARM lamp ㊺ turns on each time as you turn on the POWER switch ①, the equipment has failed and needs repair.