

OPERATION MANUAL

PARALLEL OPERATION CABLES

MODEL PD01M-PCR/PD01S-PCR

Model PD01M-PCR/PD01S-PCR Parallel Operation Cables are an optional cable for the PCR Series Frequency Converter. The PD01M-PCR/PD01S-PCR cannot be used for other equipment.

This manual covers primarily the method of hooking up the PD01M-PCR/PD01S-PCR to the PCR Series Frequency Converter.

When using the PD01M-PCR/PD01S-PCR, be sure to read also the operation manual for the PCR Series Frequency Converter.

First Edition

KIKUSUI ELECTRONICS CORPORATION

(KIKUSUI PART NO. Z1-986-920)

On Power Supply Source, it is requested to replace the related places in the instruction manual with the following items.

(Please apply the item of mark.)

- Power Supply Voltage: to _ _ _ _ _ V AC
- Line Fuse: to _ _ _ _ _ A
- Power Cable: to 3-core cable (See Fig. 1 for the colors.)

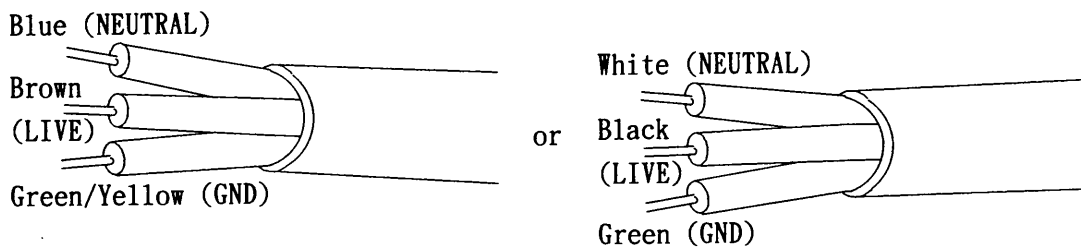


Fig. 1

Please be advised beforehand that the above matter may cause some alteration against explanation or circuit diagram in the instruction manual.

- * AC Plug: In case of Line Voltage 125V AC or more, AC Plug is in principle taken off and delivered, in view of the safety.
(AC Plug on 3-core cable is taken off in regardless of input voltages.)
TO connect the AC plug to the AC power cord, connect the respective pins of the AC plug to the respective core-wires (LIVE, NEUTRAL, and GND) of the AC power cord by referring to the color codes shown in Fig. 1.

Before using the instrument, it is requested to fix a suitable plug for the voltage used.

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TABLE OF CONTENTS

	<u>PAGE</u>
1. GENERAL INFORMATION	1
1.1 Description	1
1.2 Features	1
2. SPECIFICATIONS	2
2.1 General Specifications	2
2.2 Functional Specifications	3
2.3 Others	3
3. OPERATION	4
3.1 Description of Cables	4
3.2 Points to Be Noted before Use	5
3.3 Preparation for Use	6
3.3.1 Cautions	6
3.3.2 Input cable connection	7
3.3.3 Output cable connection	7
3.3.4 How to connect PD01M-PCR/PD01S-PCR to Frequency Converter	11
3.4 Basic Operation Method	14
4. BEFORE ORDERING REPAIR SERVICE	16

1. GENERAL INFORMATION

1.1 Description

The PD01M-PCR and PD01S-PCR Parallel Operation Cables are I/O cables with special connectors to expand the output power capacity of PCR Series Frequency Converters (PCR2000 or PCR4000) by their one-control parallel operation.

The two types of the parallel operation cables are to be used differently as follows:

- PD01M-PCR: To connect the master unit to a slave unit
- PD01S-PCR: To connect one slave unit to another slave unit

Before using the cables, read this manual and PCR Series Operation Manual thoroughly.

1.2 Features

The main features of the parallel operation cables are as follows:

- By the use of these cables, up to five units of PCR2000 or PCR4000 frequency converters can be operated in one-control parallel mode. (The frequency converters connected by the cables must be of the same type.)
- Most of the operation functions can be controlled by the master unit centrally, and any one of the frequency converters can be selected as the master unit by the way the cables are used.

- | |
|---|
| <ul style="list-style-type: none">◦ Remarks:
The master unit can be used with other optional instruments for PCR Series (IB01-PCR, RC01-PCR, 3P01-PCR and EX01-PCR).
For example, if the master unit is used with IB01-PCR and 3P01-PCR, it can control a three-phase output system of up to 60 kVA in GP-IB mode. Also, IB01-PCR can be attached to a slave unit for monitoring the output current and status of the slave unit.
For the outline of each option, refer to the PCR Series Operation Manual. |
|---|

2. SPECIFICATIONS

This chapter explains the specifications of the PCR Series Frequency Converter provided when the PD01M-PCR or PD01S-PCR Parallel Operation Cable is connected to it.

Other specifications conform to the specifications of the Frequency Converter used independently. See the PCR Series Operation Manual.

2.1 General Specifications

This section explains the general specifications of the PCR Series Frequency Converter used with the Parallel Operation Cable. All the specifications other than those listed in the following table are the same as the specifications of the Frequency Converter used independently:

Input/output power (current) capacity	[Capacity of one PCR Series Frequency Converter] ×N Note: Only the Frequency Converters of the same type (PCR2000 or PCR4000) can be connected to each other. N must not be greater than 5.
Output voltage/ current fluctuation (stability)	Measured on the OUTPUT Terminal Board of master unit
Insulation resistance	[10 MΩ]/N for 500 V DC Between input terminal and cabinet, between output terminal and cabinet, and between input and output terminals
External dimensions and total weight	[Value of one Frequency Converter] ×N

Note N = Number of Frequency Converters for parallel operation (≤ 5)

2.2 Functional Specifications

The functions of the Frequency Converter used with the Cable are the same as those of the Frequency Converter used independently, but all the items except the following ones are controlled by the master unit (this is called one-control or centralized control):

POWER switch	Turned on/off independently on each unit. A protective function, however, may turn off the POWER switches of all the Frequency Converters in parallel operation.
Ammeter	Then ammeter of each unit indicates the amount of current output from the relevant unit. The total amount of the current output by the parallel operation is the sum of the values indicated by the ammeters of all the connected units.
Protection	The overload, overvoltage, and overheat protection functions are effective on each unit independently.
Others	All the indicators on the operation/display panel of slave unit are turned off except the ammeter and SLAVE lamp.

2.3 Others

Ambient Operating Temperature and Humidity	0 to +50°C, 10 to 90% RH (Non condensing)
Accessory	Operation Manual (one copy)

3. OPERATION

3.1 Description of Cables

- PD01M-PCR

The PD01M-PCR Parallel Operation Cable connects the master unit to a slave unit.

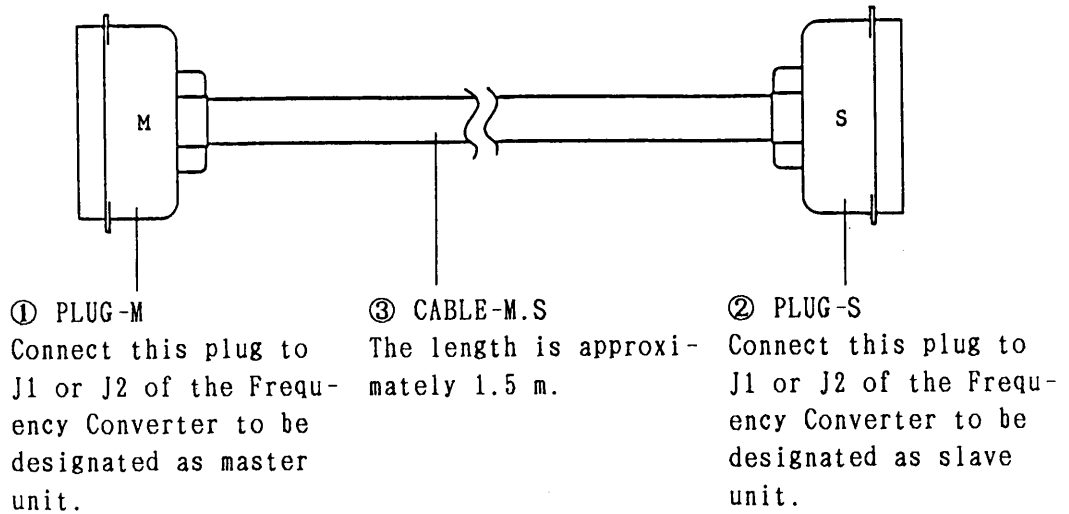


Figure 3-1

- PD01S-PCR

The PD01S-PCR Parallel Operation Cable connects one slave unit to another.

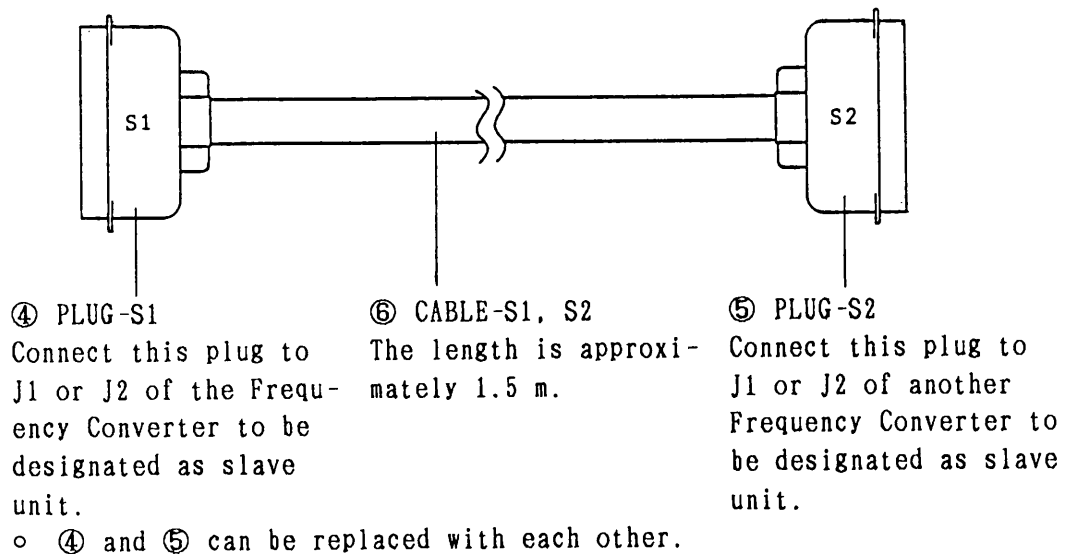


Figure 3-2

- Master unit and slave unit

Master unit: Used as the central controller of the parallel operation. All the switches and indicators on the operation/display panel of the Frequency Converter are effective.

Slave unit: Operates under control of the master unit in the one-control parallel operation mode. All the switches and indicators on the operation/display panel are ineffective except for the ammeter, SLAVE lamp (for slave unit indication), and POWER switch.

3.2 Points to Be Noted before Use

(1) Installation and movement

Be careful not to apply excessive force to the cable section (CABLE-M.S ③ or CABLE-S1, S2 ⑥) of the instrument.

- Set the Frequency Converters as close to each other as possible. The Frequency Converters may be piled up or set in contact with each other side by side.
- Be careful that the casters of the Frequency Converters will not pass over the cable section. If the cable is too long for the setting condition, wind it up or fix it to the handle on the rear panel of the Frequency Converter.
- Before moving the Frequency Converter, be sure to disconnect the cable from it.

(2) Grounding

Be sure to ground each PCR Series Frequency Converter independently.

Refer to the PCR Series Operation Manual for the detailed method of grounding the Frequency Converter.

3.3 Preparation for Use

3.3.1 Cautions

For the correct one-control parallel operation of PCR Series Frequency Converters, be sure to make preparation according to the steps explained in the subsequent sections.

Also, read thoroughly the notes listed below.

Since the Cable handles high electric power, its incorrect use may cause not only insufficient performance but also failure of the Frequency Converters and attached instruments.

- (1) Wiring on the OUTPUT Terminal Board of Frequency Converter and realy terminal board or load instrument (fastening of screws on the terminal board, etc.) must be done steadily.

If the wiring is unsteady and contact resistance becomes high, not only the rated output power may not be obtained but also heat may be generated at the contact point, witch is very dangerous.

If the wire comes off or disconnected, the load instrument and/or Frequency Converter may be damaged by abnormal output.

- (2) The parallel connection lines (lines to connect Frequency Converters in parallel, explained in Section 3.3.3) must be connected to proper polarities (L, N, G).

If the lines are connected to improper polarities by mistake, the load instrument and/or Frequency Converters may be damaged by abnormal output.

- (3) Connect the PD01M-PCR/PD01S-PCR Parallel Operation Cable to the Frequency Converters properly and steadily.
Improper or unsteady connection of the cable will cause failure of the Frequency Converters.

3.3.2 Input cable connection

Connect each Frequency Converter to the input power line (switch board, etc.) by the input power cable supplied with the Frequency Converter.

Refer to the PCR Series Operation Manual for details.

3.3.3 Output cable connection

The output cables must be connected as follows:

- (1) If parallel connection is allowed at the input section of load instrument:

Connect the cables from the OUTPUT Terminal Board of each Frequency Converter to the input (terminal) section of load instrument. (See Figure 3-3.)

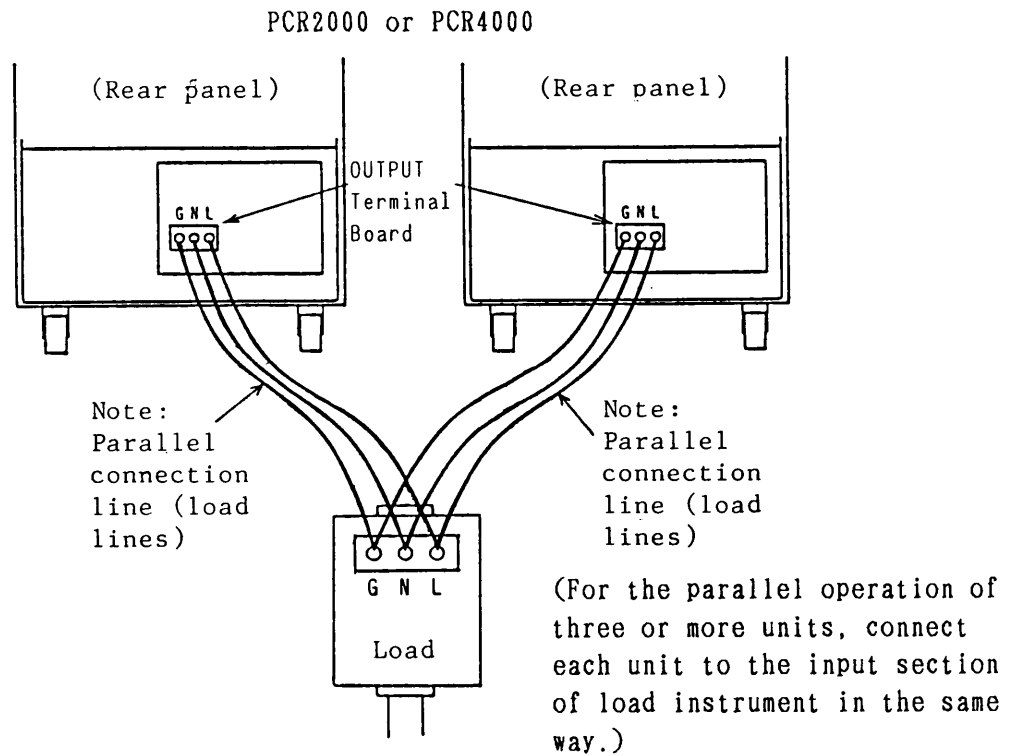


Figure 3-3

Note: The output cables (parallel connection lines) must be of the same length, and they must not exceed 1 m. Use the specified cables as the output cables. If these conditions are not satisfied, the rated output may not be obtained or the output may be unstable. Refer to the PCR Series Operation Manual for the applicable line diameter.

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- (2) If parallel connection is not allowed at the input section of load instrument:

Connect the cables from the OUTPUT Terminal Board of each Frequency Converter to the load instrument via a relay terminal board. (See Figure 3-4.)

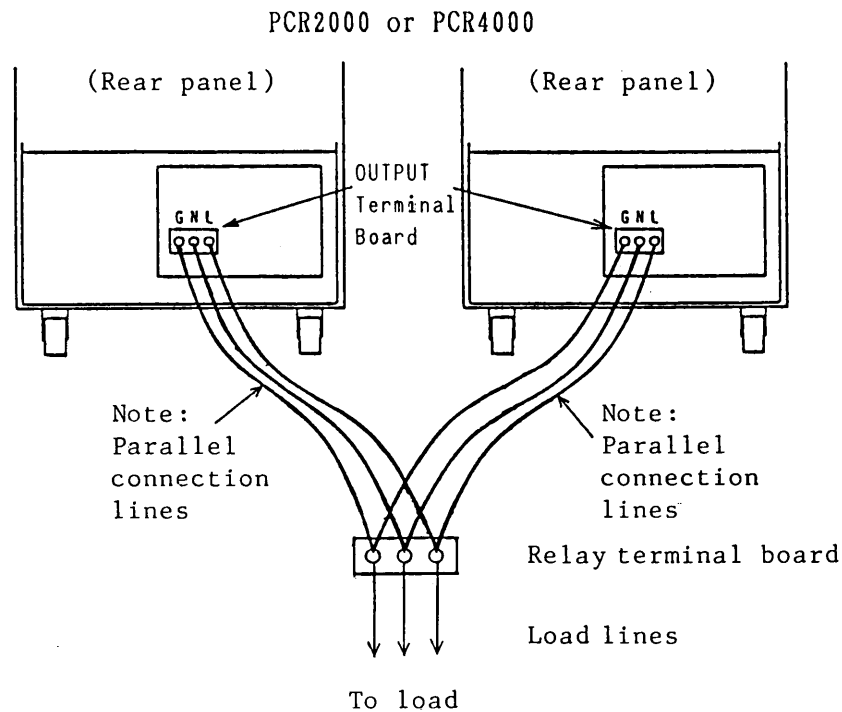


Figure 3-4

Note: ◦ The restrictions on the cables (parallel connection lines) to connect each Frequency Converter to relay terminal board are the same as those of the parallel connection lines explained in the above section 1.

- Regarding the cables from the relay terminal board to the load instrument, check the allowable current carefully. Refer to the PCR Series Operation Manual for details.

(3) Special connection method

The special connection method can be taken only when the following conditions are satisfied:

- 1) The output voltage range is 100V, and two units of PCR2000 or PCR4000 Frequency Converters are to be used for parallel operation. (See Figure 3-5).

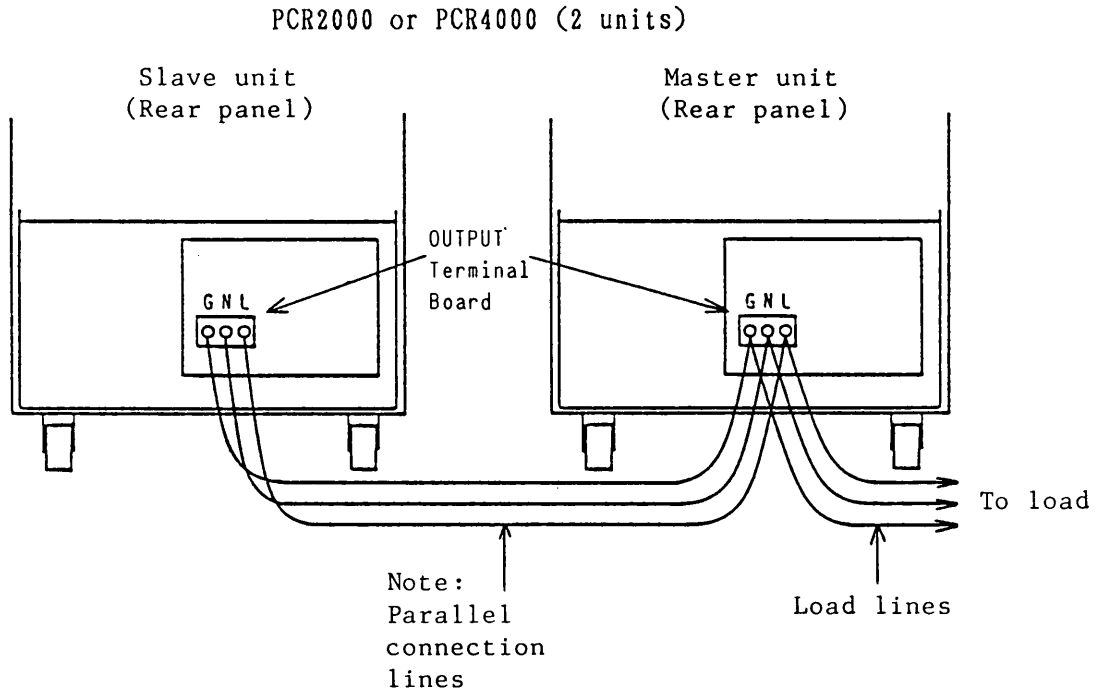


Figure 3-5

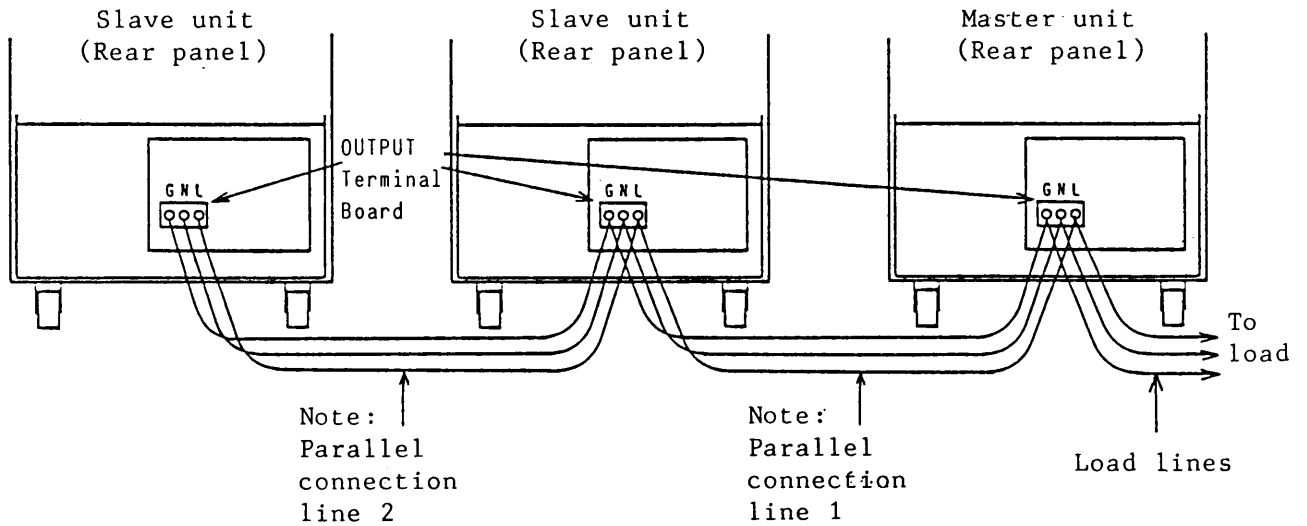
Note: Table 3-1 lists the regulations on the conductor cross section area and length of the parallel connection lines. If these regulations are not kept, the rated output may not be obtained or the output may be unstable.

Table 3-1

Frequency Converter type name	Cable conductor cross section area	Length of each parallel connection line
PCR2000	5.5 mm ² or more	0.8 m or less
PCR4000	14 mm ² or more	1 m or less

- 2) The output voltage range is 200V, and two or three units of PCR2000 or PCR4000 Frequency Converters are to be used for parallel operation.
(See Figure 3-6.)

PCR2000 or PCR4000 (3 units)



For the parallel operation of two PCR2000 or PCR4000 Frequency Converters, use parallel connection lines 1 only. In this case, however, the cross section area of parallel connection line 1 may be the same as that of parallel connection line 2.

Figure 3-6

Note: Table 3-2 lists the regulations on the conductor cross section area and length of each parallel connection line.

Table 3-2

Frequency Converter type name	Cable conductor cross section area		Length of each parallel connection line
	Parallel connection line 1	Parallel connection line 2	
PCR2000	5.5 mm ² or more	2 mm ² or more	1 m or less
PCR4000	14 mm ² or more	5.5 mm ² or more	1 m or less

3.3.4 How to connect PD01M-PCR/PD01S-PCR to Frequency Converter

(1) Attaching PD01M-PCR/PD01S-PCR to Frequency Converter

- 1) Take off the blind plate from the J1 or J2 section of the Frequency Converter rear panel. (The blind plate can be taken off by removing the two screws.)
- 2) Insert the plug of PD01M-PCR or PD01S-PCR Cable (PLUG-M①, PLUG-S②, PLUG-S1④, or PLUG-S2⑤) into the internal receptacle (connector) firmly, and lock the spring band (see Figure 3-7).

Note: ○ If the Cable (plug) is not connected to the Frequency Converter (receptacle) steadily, not only the rated output may not be obtained but also the Frequency Converter may be damaged or give a danger of electric shock.

○ Do not take off the blind plate from the J1 or J2 section which is not to be used. The unnecessary removal of the blind plate is dangerous because the terminal in the receptacle has a high voltage. The blind plate that has been taken off must be kept separately.

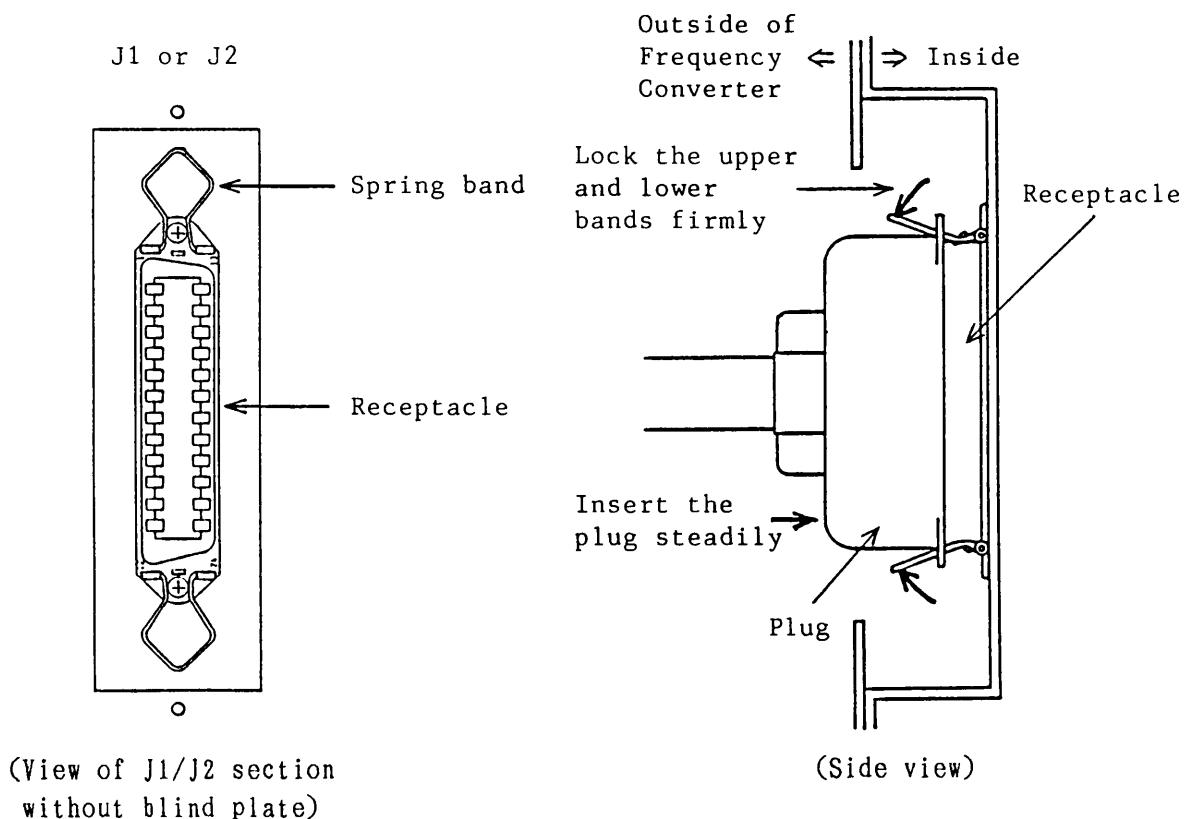
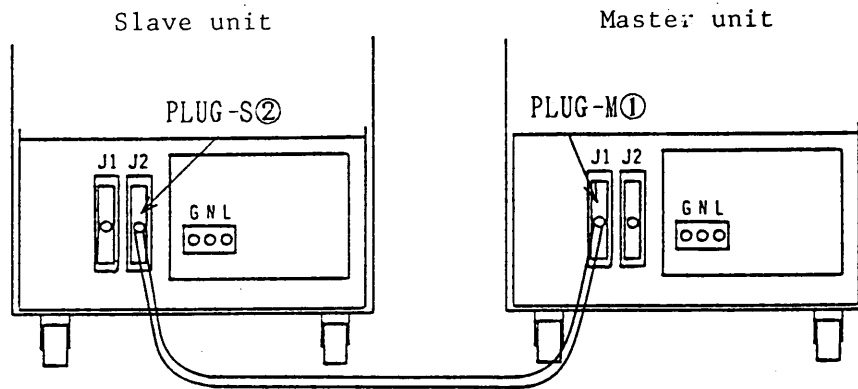


Figure 3-7

(2) Connecting Frequency Converters by PD01M-PCR/PD01S-PCR

1) For two units of Frequency Converters

Insert PLUG-M① of the PD01M-PCR Cable into J1 or J2 of the Frequency Converter to be used as master unit, and insert PLUG-S② of the PD01M-PCR Cable into J1 or J2 of the Frequency Converter to be used as slave unit. Either J1 or J2 of each unit may be used. (See Figure 3-8.)

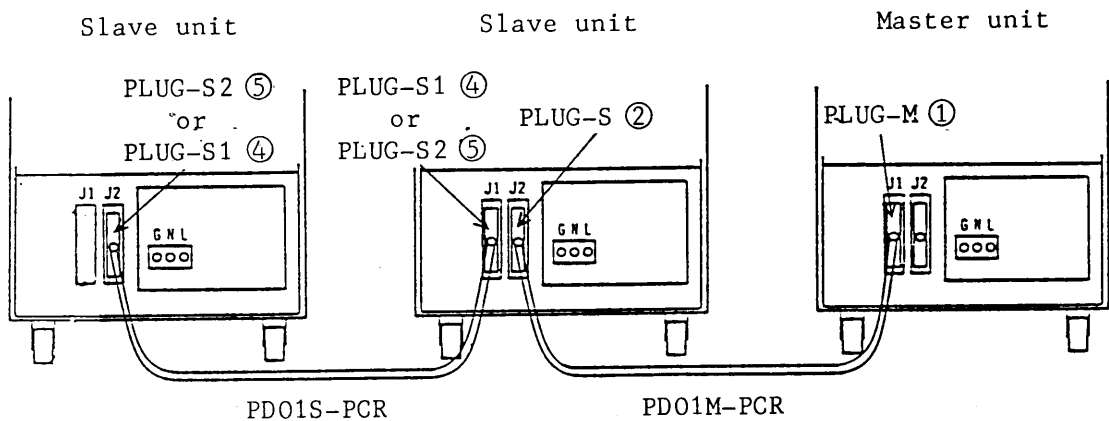


PD01M-PCR

Figure 3-8

2) For three units of Frequency Converters

Determines the master unit, and connect it to a slave unit by the PD01M-PCR Cable in the same way as 1). Then, connect that slave unit to another slave unit by the PD01S-PCR Cable. Either PLUG-S1④ or PLUG-S2⑤ may be inserted into J1/J2 of either one of the slave units. Connect all the slave units in this way. (See Figure 3-9.)



PD01S-PCR

PD01M-PCR

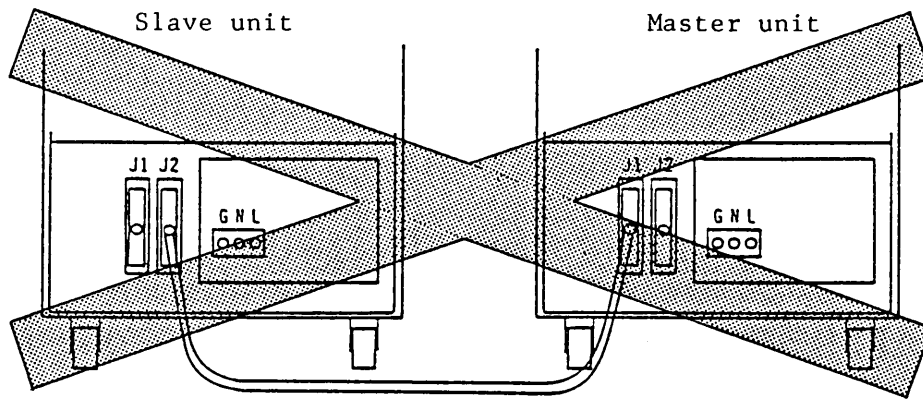
Figure 3-9

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(3) Caution

Be sure to connect the Frequency Converters in the way explained in the above section 2. If the connection method is incorrent, no output may be obtained or the Frequency Converters may be damaged. (Figures 3-10 and 3-11 show examples of the incorrect connection.)

Example 1. The PD01S-PCR Cable is used for the parallel operation of two Frequency Converters (Figure 3-10).



*PD01S-PCR

Figure 3-10

Example 2. For the parallel operation of three or more Frequency Converters, PLUG-M① and PLUG-S② of the PD01M-PCR Cable are connected to improper units (Figure 3-11).

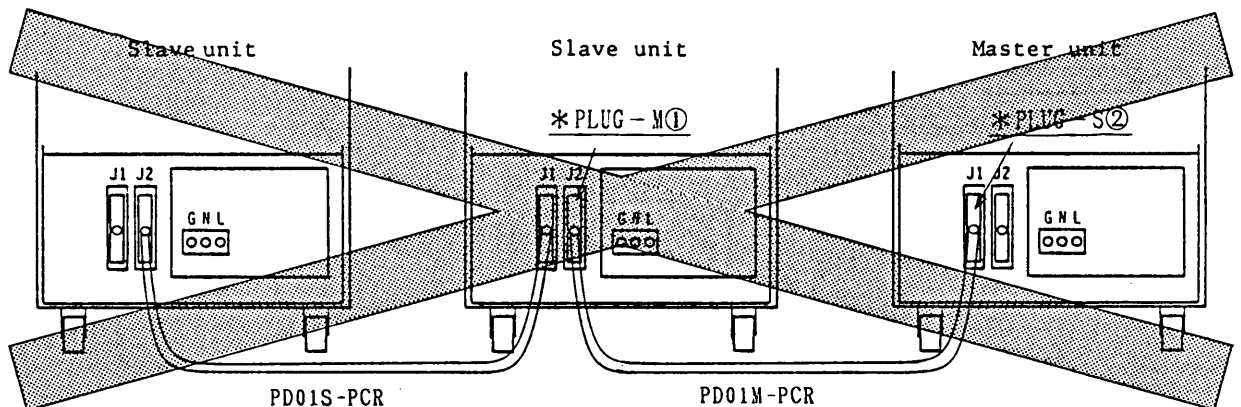


Figure 3-11

3.4 Basic Operation Method

(1) Turning on POWER switch and confirming operation

Turn on the POWER switches of the PCR Series Frequency Converters as follows:

Note: Memories of the PCR series have to be cleared prior to initiate the parallel operation mode, in case this is the first parallel operation mode on the PCR series. Turn on the PCR series then press a CLEAR switch on the operation/display panels of the PCR series before connecting PD01M-PCR/PD01S-PCR Cables.

- 1) After turning on the POWER switches of all the slave units, turn on the POWER switch of the master unit.

Do not turn on the OUTPUT switch before turning on all the POWER switches.

- 2) When electric power is supplied to all the units, the MASTER lamp (for master unit) and SLAVE lamps (for slave units) on the operation/display panels of the respective units are turned on. The frequency indicators, voltmeters, and other indicator lamps on the slave units are not effective.

Note: If the MASTER and SLAVE lamps are not turned on correctly, check the connection of the PD01M-PCR/PD01S-PCR Cables. (One of the Frequency Converters must be the master unit and the remaining Frequency Converters must be the slave units.)

- 3) Set the output level by the master unit according to the explanation in and after Section 3.2.3 of the PCR Series Operation Manual, and then turn on the OUTPUT switch of the master unit.

Note: If the output cannot be obtained properly or the output is cut (the POWER or OUTPUT switch is turned off) by the protective function after the OUTPUT switch is turned on, check if the current required by the load instrument is within the rated current output by the parallel operation of the Frequency Converters.

(2) Turning off POWER switch

Turn off the POWER switches of the PCR Series Frequency Converters as follows:

- 1) Turn off the OUTPUT switch of the master unit.
- 2) Turn off the POWER switch of each unit.

Note: If the POWER switch is turned off before the OUTPUT switch, the output voltage may be lowered gradually or the output voltage waveform may be distorted.

(3) Other points to be noted

- 1) Before taking off the PD01M-PCR/PD01S-PCR Parallel Operation Cable from any one of the PCR Series Frequency Converters connected for parallel operation, be sure to turn off the POWER switches of all the connected Frequency Converters or disconnect the Frequency Converters from the input power line. If the Cable is taken off during operation of the Frequency Converters, abnormal output may occur or the Frequency Converters may be damaged.
- 2) During the parallel operation, the operation panels of the slave units are ineffective.
- 3) The ammeter of each unit indicates the current output from the relevant unit. To obtain the total amount of the current output to the load instrument, sum up the values indicated by the ammeters of all the connected units.
- 4) In case of overload, the protective function of the Frequency Converter operates but the POWER switch may be turned off without the constant current characteristics. (In this point, the operation of the Frequency Converter used for parallel operation differs from that of the Frequency Converter used independently.)

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4. BEFORE ORDERING REPAIR SERVICE

If the Frequency Converters (PCR2000 or PCR4000) connected by the PD01M-PCR/PD01S-PCR Parallel Operation Cable do not function properly for the one-control parallel operation, check the items listed in Table 4-1 before ordering the repair service.

Table 4-1. Trouble Check Items

Sympton	Check Item	Probable Cause
<ul style="list-style-type: none"> ○ POWER switch cannot be turned on (or goes off abnormally). 	1. Is the PD01M-PCR/PD01S-PCR Cable connected to J1 or J2 of the Frequency Converter correctly?	<ul style="list-style-type: none"> ○ Incorrect connection of the PD01M-PCR/PD01S-PCR Cable ○ Snapping of the PD01M-PCR/PD01S-PCR Cable
	2. Are the output cable correctly connected?	<ul style="list-style-type: none"> ○ Incorrect connection of the output cable ○ Open the output cable
	3. Are OVER LOAD lamps on?	<ul style="list-style-type: none"> ○ The output capacity is insufficient ○ All the POWER switches are not turned on
	4. Other than above	<ul style="list-style-type: none"> ○ Circuit failure (PCR series)
<ul style="list-style-type: none"> ○ OUTPUT switch cannot be turned on (or goes off abnormally). 	1. Is the PD01M-PCR/PD01S-PCR Cable connected to J1 or J2 of the Frequency Converter correctly?	<ul style="list-style-type: none"> ○ Incorrect connection of the PD01M-PCR/PD01S-PCR Cable ○ Snapping of the PD01M-PCR/PD01S-PCR Cable
	2. Are the output cable correctly connected?	<ul style="list-style-type: none"> ○ Incorrect connection of the output cable ○ Open the output cable
	3. Are OVER LOAD lamps on?	<ul style="list-style-type: none"> ○ The output capacity is insufficient ○ All the POWER switches are not turned on
	4. Other than above	<ul style="list-style-type: none"> ○ Circuit failure (PCR series)

Sympton	Check Item	Probable Cause
◦ OUTPUT waveform is distorted.	1. Is the PD01M-PCR/PD01S-PCR Cable connected to J1 or J2 of the Frequency Converter correctly?	<ul style="list-style-type: none"> ◦ Incorrect connection of the PD01M-PCR/PD01S-PCR Cable ◦ Snapping of the PD01M-PCR/PD01S-PCR Cable
	2. Are the output cable correctly connected?	<ul style="list-style-type: none"> ◦ Incorrect connection of the output cable ◦ Open the output cable
	3. Are OVER LOAD lamps on?	<ul style="list-style-type: none"> ◦ The output capacity is insufficient ◦ All the POWER switches are not turned on
	4. Other than above	◦ Circuit failure (PCR series)

If the instrument is judged be defective as result of checking the above items, contact our Service Office; if not, eliminate the error cause and use the instrument.

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