

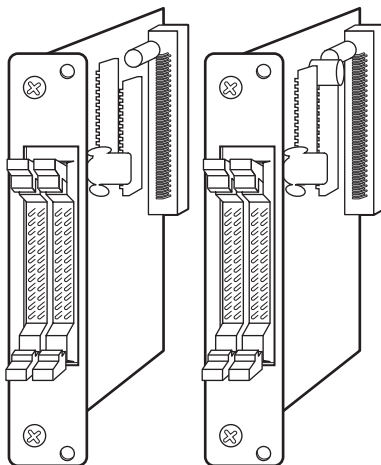
Part No. Z1-002-770, IB004111

Aug. 2003

OPERATION MANUAL

PARALLEL OPERATION DRIVER
PCR-LA Series

PD03M-PCR-LA PD03S-PCR-LA



Use of Operation Manual

Please read through and understand this Operation Manual before operating the product. After reading, always keep the manual nearby so that you may refer to it as needed. When moving the product to another location, be sure to bring the manual as well.

If you find any incorrectly arranged or missing pages in this manual, they will be replaced. If the manual it gets lost or soiled, a new copy can be provided for a fee. In either case, please contact Kikusui distributor/agent, and provide the “Kikusui Part No.” given on cover.

This manual has been prepared with the utmost care; however, if you have any questions, or note any errors or omissions, please contact Kikusui distributor/agent.

Reproduction and reprinting of this operation manual, whole or partially, without our permission is prohibited.

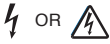
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Safety Symbols

For the safe use and safe maintenance of this product, the following symbols are used throughout this manual and on the product. Understand the meanings of the symbols and observe the instructions they indicate (the choice of symbols used depends on the products).



Indicates that a high voltage (over 1 000 V) is used here. Touching the part causes a possibly fatal electric shock. If physical contact is required by your work, start work only after you make sure that no voltage is output here.

DANGER

Indicates an imminently hazardous situation which, if ignored, will result in death or serious injury.



Indicates a potentially hazardous situation which, if ignored, could result in death or serious injury.



Indicates a potentially hazardous situation which, if ignored, may result in damage to the product and other property.



Shows that the act indicated is prohibited.



Is placed before the sign “DANGER,” “WARNING,” or “CAUTION” to emphasize these. When this symbol is marked on the product, see the relevant sections in this manual.



Indicates a protective conductor terminal.



Indicates a chassis (frame) terminal.

Contents

Safety Symbols - - - - -	I
Chapter 1 General	1-1
1.1 Outline - - - - -	1-1
1.2 Features - - - - -	1-1
1.3 Part Names and Descriptions - - - - -	1-2
Chapter 2 Precautions and Preparation for Use	2-1
2.1 Check at Unpacking - - - - -	2-1
2.2 Handling Precautions - - - - -	2-3
2.3 Combination with Other Options - - - - -	2-4
2.4 Parallel Operation Driver Installation Method- - - - -	2-4
2.4.1 Setting the Parallel Operation Addresses- - - - -	2-4
2.4.2 Installing the Master and Slave Cards in a Slot- - - - -	2-6
2.4.3 Connecting the Drive-signal Cables - - - - -	2-6
2.5 PCR-LA AC Power Supply Connection- - - - -	2-8
2.5.1 Connecting a Power-signal Cable - - - - -	2-8
2.5.2 Connecting Cables between OUTPUT Terminal Boards -	2-9
Chapter 3 Operation Method	3-1
3.1 Operation Check - - - - -	3-1
3.2 Basic Operation Required for Parallel Operations - - - - -	3-2
3.3 Limit Value Setting - - - - -	3-3
3.4 Self-test Function- - - - -	3-3
3.5 Zero Calibration Function of the Measured Current Value - - -	3-4
3.5.1 Zero Calibration Procedure When Using RC04-PCR-LA-	3-5
3.5.2 Messages Available When Using the RS-232C or GPIB Interface - - - - -	3-6
Chapter 4 Maintenance	4-1
Chapter 5 Specifications	5-1
5.1 Specifications - - - - -	5-1
5.2 Dimensions - - - - -	5-2

Provides an overview of the Parallel Operation Driver and describes its features. Also denotes parts names and describes the parts.

1.1 Outline

These devices (PD03M-PCR-LA and PD03S-PCR-LA) are options for use of the PCR-LA Series AC power supplies in master-slave control parallel operations.

Connecting the outputs of up to five PCR-LA power supplies in parallel and installing the Parallel Operation Driver in these power supplies allows them to be used as single-phase, large-capacity power supplies.

The number of these devices to be used and their models are as shown in Table 1-1, based on the number of PCR-LA power supplies operated in parallel.

Table 1-1 Number of PD03M-PCR-LAs and PD03S-PCR-LAs

Number of PCR-LA power supplies operated in parallel	Number of PD03M-PCR-LAs	Number of PD03S-PCR-LAs
2	1	1
3	1	2
4	1	3
5	1	4

The PD03M-PCR-LA is used in the master unit of the PCR-LA AC power supplies, while the PD03S-PCR-LA is used in their slave units.

1.2 Features

Enabling PCR-LA AC Power Supplies to Generate Large-capacity, Multifunctional High-quality Output

Through the use of the Parallel Operation Driver, the PCR-LA power supplies are capable of generating single-phase output of up to 30 kVA. The output power can be calculated as follows:

Total output capacity = output capacity per PCR-LA power supply x number of power supplies

The Parallel Operation Driver allows up to five units of identical models, or PCR2000LA, PCR4000LA, or PCR6000LA, to be operated in parallel.

Combining the PD03M-PCR-LA and PD03S-PCR-LA with the optional Single-phase Three-wire Driver (2P03-PCR-LA) or 3-phase Output Driver (3P03-PCR-LA) enables the PCR-AC power supplies to generate large-capacity, multiphase output.

- For a combination of these devices and 2P03-PCR-LA (single-phase three-wire output)
Output capacity = output capacity of the power supplies operated in parallel* x 2 (maximum capacity: 36 kVA)
- For a combination of these devices and 3P03-PCR-LA (three-phase output)
Output capacity = output capacity of the power supplies operated in parallel* x 3 (maximum capacity: 54 kVA)

* In this case, the number of power supplies operated in parallel is up to three of identical models, PCR2000LA, PCR4000LA, or PCR6000LA.

Expansion of Output Capacity in the Future or Temporarily

Use of the Parallel Operation Driver allows expansion of the output capacity if a PCR-LA power supply is small capacity and the capacity is to be increased later. Alternatively, PCR-LA power supplies installed singly can be integrated for use if they are generally used at small capacity, but a large capacity is required due to provisional testing or the like. Thus, investment in equipment can be reduced.

1.3 Part Names and Descriptions

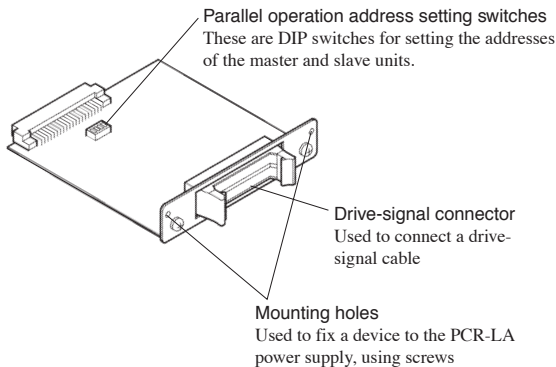


Fig.1-1 PD03M-PCR-LA/PD03S-PCR-LA

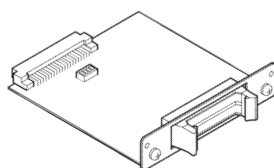
Chapter 2 Precautions and Preparation for Use

Describes the precautions and preparation information that must be understood for use of the Parallel Operation Driver.

2.1 Check at Unpacking

Upon reception of the product, confirm that the package contains the necessary accessories and that the device and accessories have not been damaged during transportation.

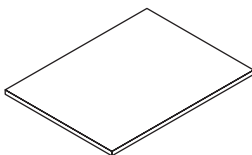
If the device is damaged or any accessory is missing, notify Kikusui distributor/agent.



☐ Master card (1 pc.)

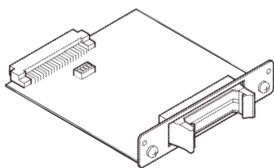
 M3 x 6 mm

☐ Card-mounting screws (2 pcs.)
[M3-003-011]



☐ Operation Manual (1 copy)
[Z1-002-770]

Fig.2-1 Items Contained in the PD03M-PCR-LA Package



☐ Slave card (1 pc.)

 M3 x 6 mm

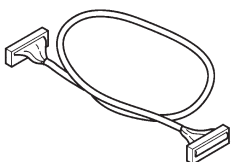
☐ Card-mounting screws (2 pcs.)
[M3-003-011]



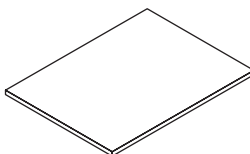
☐ Power-signal cable for
PCR2000LA (1 pc.)
[91-87-8159]



☐ Power-signal cable for
PCR4000LA/6000LA (1 pc.)
[91-87-8158]



☐ Drive-signal cable (1 pc.)
[91-87-6330]



☐ Operation Manual (1 copy)
[Z1-002-772]

Fig.2-2 Items Contained in the PD03S-PCR-LA Package

2.2 Handling Precautions

Handling of the Master and Slave Cards

Always observe the following precautions when handling each card, as its PCB is not protected. Otherwise, a problem may occur.

- **Never touch any of the electronic parts installed in the PCB.**
- **Never handle the card under conditions in which static electricity may accumulate.**
- **After unpacking the Parallel Operation Driver carton, promptly install each card in a PCR-LA power supply.**
- **When storing the cards, always take anti-electrostatic measures such as storing them in the bag in which they were packaged.**
- **Do not drop a card or subject it to other impact.**
- **Do not place a card where it could be exposed to water or other liquid.**

Handling of the Drive-signal Cables and Power-signal Cables

- **Never damage the cables.**
- **Do not pull, bend, or apply any other stress to the cables.**

2.3 Combination with Other Options

The PCR-LA Series AC power supplies have various options in addition to the Parallel Operation Driver. However, the following options can be used only in the PCR-LA power supply (master) in which the master card has been installed. These options do not function in a slave unit.

The functions and operation methods of the PCR-LA power supplies (when these devices are installed together with the following options in the power supplies) are the same as those in a PCR-LA power supply operated singly.

Table 2-1 Options Available in the Master Unit

Option name	Model name
Remote Controller	RC04-PCR-LA
GPIB Interface	IB03-PCR-LA
3-phase Output Driver	3P03-PCR-LA*
Single-phase Three-wire Output Driver	2P03-PCR-LA

* The number of PCR-LA AC power supplies to be operated in parallel is up to three for each phase when the Parallel Operation Driver is used in combination with the 3-phase Output Driver or Single-phase Three-wire Output Driver to perform parallel operation in a three-phase system or single-phase three-wire system.

2.4 Parallel Operation Driver Installation Method

The Parallel Operation Driver can be installed by inserting one of the master and slave cards into SLOT3 or SLOT4 of up to five PCR-LA power supplies.

2.4.1 Setting the Parallel Operation Addresses

The Parallel Operation Driver cards have DIP switches (on the PCB) for setting a parallel operation address. Set the addresses as shown in Table 2-2 according to the number of PCR-LA power supplies to be operated in parallel.

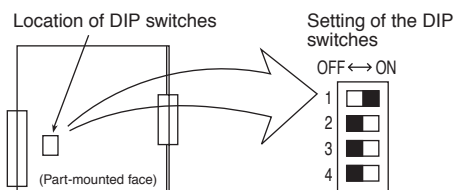


































Fig.2-3 DIP Switches on the PCB

Table 2-2 DIP-Switch Settings

Number of PCR-LA power supplies oper- ated in parallel	PD03M- PCR-LA	PD03S-PCR-LA			
	Master	Slave 1	Slave 2	Slave 3	Slave 4
2	OFF ↔ ON 1  2  3  4 	OFF ↔ ON 1  2  3  4 	—	—	—
3	OFF ↔ ON 1  2  3  4 	↓	OFF ↔ ON 1  2  3  4 	—	—
4	OFF ↔ ON 1  2  3  4 		↓	OFF ↔ ON 1  2  3  4 	—
5	OFF ↔ ON 1  2  3  4 	↓	↓	↓	OFF ↔ ON 1  2  3  4 

- The DIP switches used for setting are switches 1 and 2. Leave switches 3 and 4 in the OFF position.
- The slave-unit numbers have no bearing on the placement of the power supplies. Set the address of each slave unit (PD03S-PCR-LA) to a different value.

2.4.2 Installing the Master and Slave Cards in a Slot

⚠ CAUTION • Before installing a card in a slot, be sure to turn the PCR-LA AC power supply POWER switch OFF.

1. Unscrew the screws that fasten the SLOT3 or SLOT4 cover to remove it.

The slots are located at the upper rear part of the PCR-LA power supplies.

Keep the removed cover and screws to ensure that they are not lost.

2. Hold each card by the panel.
3. Orient the card so that the parts-mounted side of the PCB is at the right, and place the PCB in the slot grooves.
4. Carefully insert the card into the slot so that the PCB does not come out of the grooves.
5. Fully insert the card, and confirm that it cannot be pulled out easily.
6. Fix the card to the PCR-LA power supply using the screws provided.

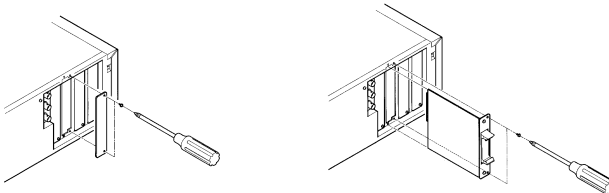


Fig.2-4 Installing a Card

This completes installation of the card.

2.4.3 Connecting the Drive-signal Cables

⚠ CAUTION • Before connecting a drive-signal cable, always turn the PCR-LA power supply POWER switches OFF.

1. Place the three PCR-LA power supplies as close to each other as possible.

Place the power supplies so that no stress is applied to the power-signal cables or drive-signal cables.

-
- NOTE**
- For parallel operation of two or three power supplies, the master and slave units can be positioned freely.
 - For parallel operation of four or five power supplies, place the master and slave units so that three or more slaves are not located next to each other as shown in Fig. 2-5. Otherwise, operation may become unstable.

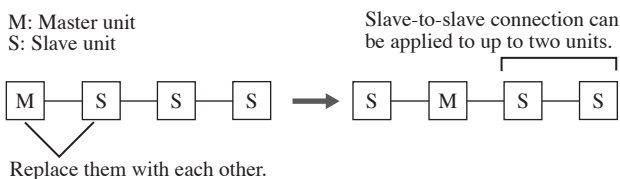


Fig.2-5 Example of the Placement of Four Power Supplies Operated in Parallel

2. Using the drive-signal cables, connect the master and slave cards.

Open the tabs of the J1 connectors of all cards, orient the connector of a drive-signal cable to a J1 connector, and insert it into the J1 connector.

In such a case, insert the cable connector into the J1 connector so that the tabs are closed to lock the cable securely. The J1 connector has two connection ports, each of which operates the same.

The J1 connectors of the AC power supplies located at the right and left sides have only one cable connected to the slot. Do not connect anything to the other empty slot.

This completes connection of the drive-signal cables.

-
- ⚠ CAUTION**
- Do not turn ON the POWER switch of a PCR-LA power supply with only a drive-signal cable connected. Otherwise, a problem may occur.
To conduct an operation check, follow the procedure specified in “3.1 Operation Check”.
 - Moving a PCR-LA power supply with a drive-signal cable connected to the card may result in breakage of the cable or connector.
Before moving the PCR-LA power supply, be sure to disconnect the drive-signal cable(s).
-

2.5 PCR-LA AC Power Supply Connection

This section describes the procedure for connection of the outputs between the PCR-LA AC power supplies.

For the input and output connections of a single PCR-LA power supply, always read through “Chapter 2 Installation and Preparation for Use” in the PCR-LA AC Power Supply Operation Manual.

Operating the PCR-LA power supplies in master-slave control and in parallel requires connection of the power-signal cables and OUTPUT terminal board, in addition to connection of the drive-signal cables described in “2.4 Parallel Operation-Driver Installation Method”. The following describes the procedure for connecting a power-signal cable and the OUTPUT terminal board.



WARNING • Before carrying out connection work, be sure to cut off the power supply from the switchboard.

2.5.1 Connecting a Power-signal Cable

Using a power-signal cable provided for the product, connect terminal J1 at the lower part of a PCR-LA power supply and terminal J2 at the lower part of another PCR-LA power supply.

To connect PCR2000LAs in parallel:

Use the power-signal cable with a 4-pin connector on one end and a 2-pin connector on the other end. Connect the 4-pin connector to terminal J1 of a PCR-LA power supply and the 2-pin connector to terminal J2 of another PCR-LA power supply.

For connection of PCR4000LA or PCR6000LA in parallel (identical models):


Use the power-signal cable with a 6-pin connector on one end and a 4-pin connector on the other end. Connect the 6-pin connector to terminal J1 of a PCR-LA power supply and the 4-pin connector to terminal J2 of another PCR-LA power supply. (The identical power-signal cable is used for PCR4000LA or PCR6000LA.)




CAUTION • Never attempt to use any cable other than those provided for the product. Otherwise, a problem may occur. Improper cable connection may result in abnormal output, which could damage a load or cause a problem in a PCR-LA AC power supply.

2.5.2 Connecting Cables between OUTPUT Terminal Boards

Taking the polarity into consideration, connect output cables between the L terminals of the OUTPUT terminal boards of all PCR-LA power supplies, and between their N terminals.

-  **CAUTION**
- Incorrect connection of terminals L and N (such as connection of terminal L to terminal N or vice versa) will cause a problem.
 - The thickness (cross-sectional area) of the output cables to be used for this connection should be the same as that of the output cables for one PCR-LA power supply. For cable selection, see the PCR-LA AC Power Supply Operation Manual.

-  **NOTE**
- Use of a relay terminal board
Parallel operations can be performed only when the outputs of all PCR-LA power supplies have been connected in parallel using cables.
The operation check described in Chapter 3 “Operation Method” is conducted under no-load conditions. To facilitate the connection of a load, we recommend that a relay terminal board be used to connect the load.

This completes the parallel connection of the PCR-LA power supplies.

To turn the POWER switches of the PCR-LA power supplies ON, follow the procedure described in “3.1 Operation Check”.

The diagram below shows the output connection status, which differs from the actual terminal configuration.

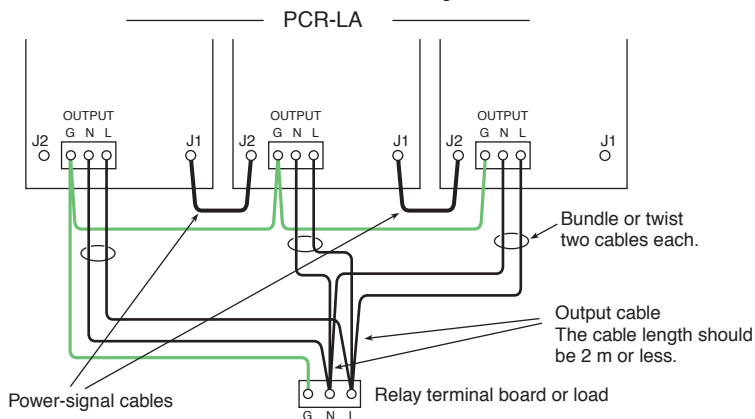


Fig.2-6 Example of the Parallel Connection of PCR-LA Power Supplies

This Operation Manual describes the procedures for use of the functions available in parallel operation that differ from those available when a PCR-LA power supply is used in single operation.

For information not provided in this manual, see the PCR-LA AC Power Supply Operation Manual. Moreover, before reading the PD03M-PCR-LA and PD03S-PCR-LA Operation Manual, always read through the PCR-LA AC Power Supply Operation Manual.

NOTE

- Unless otherwise specified, the operation method described in this chapter applies to the master unit.
-

3.1 Operation Check

Before conducting an operation check of parallel operation, confirm the connections of each PCR-LA power supply by referring to Chapter 2 “Precautions and Preparation for Use”.

**CAUTION**

- To protect a load, carry out an operation check without connecting a load.

Note that parallel operation requires that the outputs of all PCR-LA power supplies be connected in parallel using cables.

If a load has been connected to the OUTPUT terminal boards, disconnect the load only.

Operation Check Procedure

Principally, check the following items in the same way as in “2.7 Operation Check” in the PCR-LA AC Power Supply Operation Manual.

- POWER switch ON
- Voltage setting
- OUTPUT ON/OFF
- Voltage-range switching

For operations specific to parallel operation, see “3.2 Basic Operation Required for Parallel Operation” onward.

3.2 Basic Operation Required for Parallel Operations

The basic operation for master-slave control parallel operations is as follows:

POWER Switch Operation

- When turning the POWER switches of the PCR-LA power supplies ON, first turn the slave-unit POWER switches ON. Alternatively, turn the POWER switches of the master and slave units (all PCR-LA power supplies) ON simultaneously (see the description below).
- When turning the POWER switches of all PCR-LA power supplies connected in parallel ON (or OFF), complete all turn-ONs (or turn-OFFs) within three seconds.

NOTE • If the turn-ON procedure for the POWER switches is improper, the AC power supplies may not start up. In such a case, turn all POWER switches OFF and then turn them ON again in accordance with the correct procedure.

DESCRIPTION • Turning the POWER switches ON simultaneously
Note that if the number of PCR-LA power supplies to be operated in parallel becomes too large, it may be difficult to turn ON all POWER switches for the slaves to the master within 3 seconds.
In such a case, turn all PCR-LA power supply POWER switches ON, with the switch on the switchboard turned OFF. Then, turn ON the switch on the switchboard to allow all power supplies to turn ON simultaneously.

Control Panel Operation and Displays

- All slave units are controlled from the master unit; use the master-unit control panel to make or change a setting.
- The master-unit control panel can be operated in the same way as the control panel of a PCR-LA power supply operated singly. For the output-current value, the total current value of the master and slave units will be displayed on the master-unit control panel. The frequency display area of a slave unit indicates the parallel operation address (1-digit figure) of that power supply.

-
- | | |
|-------------|---|
| NOTE | • Performing master-slave control parallel operation starts up all power supplies in the status that has been established in the master power supply (voltage, frequency, and other factors). |
|-------------|---|
-

Action in the Event of an Alarm

- If an alarm occurs in one of the PCR-LA power supplies during master-slave control parallel operation, the outputs of all remaining power supplies will be turned OFF.

3.3 Limit Value Setting

- When master-slave control parallel operation is first carried out, the current limit value that has been set for the master unit applies. To set a new current limit value, see “4.2 Limit Value Setting” of the PCR-LA AC Power Supply Operation Manual.
- Also for the voltage and frequency limit values, those that have been set for the master unit apply.
- If the Parallel Operation Driver has been removed from the PCR-LA power supplies to cancel master-slave parallel operation, the current limit values of all power supplies will return to the initial setup status (maximum set value).

3.4 Self-test Function

For master-slave control parallel operation, the self-test is also conducted from the master unit. It will be performed on all PCR-LA power supplies.

- The self-test procedure is as described in “Alarm-type checking procedure (SELF TEST)” in “4.6.1 Steps to be Taken in the Event of an Alarm” in the PCR-LA AC Power Supply Operation Manual.
- Turning JOG causes the numbers in “Ad.” and “No.” to change. The “Ad.” numbers will be indicated as shown in Table 3-1.

Table 3-1 Ad. Numbers

PCR-LA power supply model	Master	Slave 1	Slave 2	Slave 3	Slave 4
PCR2000LA	1 – 2	11 – 12	21 – 22	31 – 32	41 – 42
PCR4000LA	1 – 4	11 – 14	21 – 24	31 – 34	41 – 44
PCR6000LA	1 – 6	11 – 16	21 – 26	31 – 36	41 – 46

3.5 Zero Calibration Function of the Measured Current Value

When the PD03M-PCR-LA and PD03S-PCR-LA are used to perform master-slave operations for the first time, there may be an offset (indication of a slight value under no-load conditions) in the current, power, power-factor, and apparent-power displays and the analyzed harmonic current value for the current measurements. In this case, the RS-232C Interface or either of the following options can be used to perform zero calibration.

- Remote Controller (RC04-PCR-LA)
- GPIB Interface (IB03-PCR-LA)

To enable more accurate measurement, turn the POWER switches of the PCR-LA power supplies ON, and wait for more than 30 minutes.

Then, conduct zero calibration immediately before starting measurements. To conduct zero calibration, first set the following items (different settings disable the zero calibration function).

- Output voltage mode: DC mode
- Current display mode: AVE
- Output voltage setting: 0 V
- OUTPUT switch: ON

Moreover, preset the output voltage range (100 V or 200 V) to be used. Perform zero calibration in the output voltage range to be used, or conduct it in both output voltage ranges at the beginning of zero calibration. Upon completion of zero calibration, the PCR-LA power supply retains the calibrated values in its internal memory even when the POWER switch is turned OFF, as long as master-slave control parallel operation is active (connection of the master and slave units is not modified).

NOTE

- The zero calibration function can be activated with a load connected to the PCR-LA power supplies. However, performing zero calibration under no-load conditions allows more accurate zero calibration.
-

3.5.1 Zero Calibration Procedure When Using RC04-PCR-LA

Before performing the following procedure, be sure to also read through the RC04-PCR-LA Operation Manual.

1. Press the ESC key to select the Home Position.
2. Press the SHIFT key, followed by the MODE key.

I O C A L

F1

F2

F3

F4

F5

3. Press the F1 key. This starts zero calibration and the following appears on the display unit:

U n d e r A d j u s t m e n t
I O C A L

F1

F2

F3

F4

F5

When zero calibration ends several 10's of seconds later, the following appears:

F i n i s h e d
I O C A L

F1

F2

F3

F4

F5

4. Press the ESC key to exit the zero calibration mode.

The calibrated values will be stored in the PCR-LA power supply memory; however, conduct re-calibration in accordance with changes in ambient temperature.

3.5.2 Messages Available When Using the RS-232C or GPIB Interface

Be sure to also read through the PCR-LA AC Power Supply Operation Manual and the IB03-PCR-LA Operation Manual (when the GPIB Interface is used).

Use the CALPARA message to conduct zero calibration.

No other messages will be accepted until completion of zero calibration, i.e., for several 10's of seconds. The calibrated values will be stored in the PCR-LA power supply memory. However, conduct recalibration in accordance with changes in ambient temperature.

Describes the maintenance required for the Parallel Operation Driver.

Before Requesting a Repair

If a problem occurs in the PD03M-PCR-LA or PD03S-PCR-LA, check the problem in accordance with Table 4-1. In addition, remove the Parallel Operation Driver from the PCR-LA power supply concerned, and check whether the power supply alone operates normally. If the power supply does not recover to normal status, contact Kikusui distributor/agent to request repairs.

Table 4-1 Troubleshooting Check Sheet

Problem	Check item	Results	Possible causes
The PCR-LA power supply display panel indicates “Err2” or nothing, or retains the version-number indication.	Check whether the master and slave cards are properly inserted into a slot.	NO	Improper card installation (See 2.4.2 .)
	Check whether the drive-signal cables are properly connected.	NO	Improper drive-signal cable connection (See 2.4.3 .)
	Check whether all of the PCR-LA power supply POWER switches are ON.	NO	Turn-ON of the POWER switches for the PCR-LA power supplies was not performed correctly.
	Check whether the DIP switches (parallel operation addresses) on all cards are correctly set.	NO	A parallel operation address has not been correctly set (see 2.4.1).
The “ALARM” indication appears, or output voltage is not generated as specified.	Check whether the power-signal cables and the cables connecting the OUTPUT terminal boards are correctly installed.	NO	Any of the power-signal cables and output cables is not correctly connected (see 2.5).

Lists the specifications.

5.1 Specifications

The specifications given below cover the comprehensive performance of master-slave parallel operations in which the Parallel Operation Driver is installed in the PCR-LA AC power supplies. Other specifications comply with those of the PCR-LA Series AC power supplies.

Input/output power (current) capacity		[Capacity of one PCR-LA power supply] x N N: Number of PCR-LA power supplies operated in parallel (Up to five units of the identical PCR-LA model)
Output voltage stability		
Output current variation	Changes in the 0 % to 100 % rating range	$\pm 0.5 \text{ V}^{*1, *2}$
Output frequency variation	Changes in the rated range	Within $\pm 1.2 \text{ \%}^{*1, *2}$
Output voltage waveform distortion factor		0.5 \% or less $^{*1, *2}$
Output voltage response time		$60 \mu\text{s}$, typical value *4
Ammeter and power meter		A total value for parallel operation is displayed. *5
Insulation resistance	Input to enclosure Output to enclosure Input to output	500 V DC [Insulation resistance of one PCR-LA power supply] / N N: Number of PCR-LA power supplies operated in parallel

*1 Value obtained at the OUTPUT terminal board of the master power supply

*2 For output voltage of 80 V to 150 V/160 V to 300 V and a load power factor of 1

*3 For output voltage of 80 V to 150 V/160 V to 300 V and a load power factor of 1.
The value specified is for the output voltage variations obtained using 200 Hz as a reference.

*4 To change from output current of 0 A to the rated value and vice versa when the output voltage is 100 V/200 V and the load power factor is 1

*5 The resolution changes in accordance with the output capacity achieved during parallel operations. The accuracy is the same as that of the PCR-LA power supply when the zero calibration function has been activated.

5.2 Dimensions

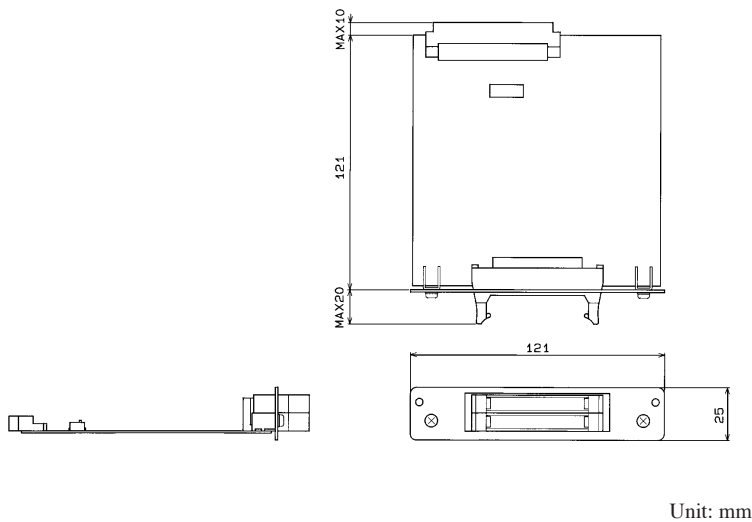


Fig.5-1 PD03M/S-PCR-LA Outer Dimensions

PARALLEL OPERATION DRIVER PD03M/S-PCR-LA

OPERATION MANUAL