# OPERATION MANUAL

THREE-PHASE OUTPUT DRIVER
PCR-LA Series

# 3P03-PCR-LA

**KIKUSUI**
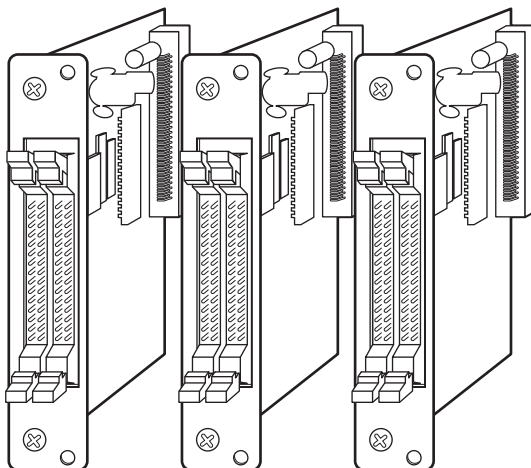
**Use of Operation Manual**

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.

# ⚠ **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).
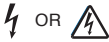
| | |
|---|---|
| ⚡ OR ⚡ | Indicates that a high voltage (over 1 000 V) is used here. Touching the part causes a possibly fatal electric shock. If physical contact is required by your work, start work only after you make sure that no voltage is output here. |
| DANGER | Indicates an imminently hazardous situation which, if ignored, will result in death or serious injury. |
| ⚠WARNING | Indicates a potentially hazardous situation which, if ignored, could result in death or serious injury. |
| ⚠ CAUTION | 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. |

# Arrangement of this manual

This Operation Manual is made up of the following sections.

### Chapter 1 General

Provides an overview of the Three-phase Output Driver and describes its features. Also denotes parts names and descriptions.

### Chapter 2 Precautions and Preparation for Use

Describes the precautions and preparation information that must be understood for use of the Three-phase Output Driver.

### Chapter 3 Operation Method

Describes the operations and functions of the 3P03-PCR-LA Three-phase Output Driver.

### Chapter 4 Using the Remote Controller

Describes the functions and operation methods for three-phase operation of the PCR-LA power supplies when the Three-phase Output Driver is used together with the Remote Controller (RC04-PCR-LA).

### Chapter 5 Using the GPIB/RS-232C Interface

Describes the functions and messages available when the Three-phase Output Driver and GPIB Interface (IB03-PCR-LA) or RS-232C Interface are used in combination for three-phase operation of the PCR-LA power supplies.

### Chapter 6 Maintenance

Describes the maintenance procedures for the Three-phase Output Driver.

### Chapter 7 Specifications

Lists the specifications.

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# Chapter 1 — General

Provides an overview of the Three-phase Output Driver and describes its features. Also denotes parts names and descriptions.

## 1.1 Outline

This device (3P03-PCR-LA) is an option for operating the PCR-LA Series AC Power supplies in a three-phase system. Connecting the outputs of PCR-LA power supplies in star connection and installing the Three-phase Output Driver in these power supplies allows them to be used as three-phase system power supplies.

## 1.2 Features

Use of this device allows the PCR-LA AC power supplies to provide the following enhanced functions, in addition to the PCR-LA power supply's standard functions.

### Three-phase Output

Use of the device allows the three PCR-LA AC power supplies to generate three-phase output, in which the U-phase unit of the three power supplies acts as a master and their V- and W-phase units acts as slaves.

### Setting of Either the Line Voltage or Phase Voltage

The three PCR-LA AC power supplies are arranged in Y-connection (star connection); output is generally set in phase voltage. However, line voltage setting is also possible.

### Independent Phase Voltage Setting

It is a common practice to set the phase voltage to the same value in all phases. However, individual phase voltage setting is also possible on a phase basis.

### Line Voltage Measurement

Connecting the SENSING terminal board at the terminal box of a PCR-LA AC power supply to a line voltage measurement point allows the line voltage to be measured.

### Measurements of the Total Power, Total Apparent Power, and Total Power Factor of Three Phases

Use of the device allows the totals of power and apparent power obtained through measurement using the three PCR-LA power supplies to be displayed. The total power factor of the three phases can also be calculated from these total values.

Measurements of the apparent power and power factor require either the RS-232C Interface, the optional Remote Controller (RC04-PCR-LA), or the optional GPIB Interface (IB03-PCR-LA).

### Variable Phase Difference

Three-phase output generates waveforms in which each phase is generally shifted by 120 degrees. Installing this device in the PCR-LA power supplies allows this phase difference to be flexibly set.

Use of this function requires either the RS-232C Interface, the optional Remote Controller (RC04-PCR-LA), or the optional GPIB Interface (IB03-PCR-LA).

# 1.3　Part Names and Descriptions



Drive-signal connector
Used to connect a drive-signal cable

Mounting holes
Used to fix this device to the PCR-LA power supply with screws
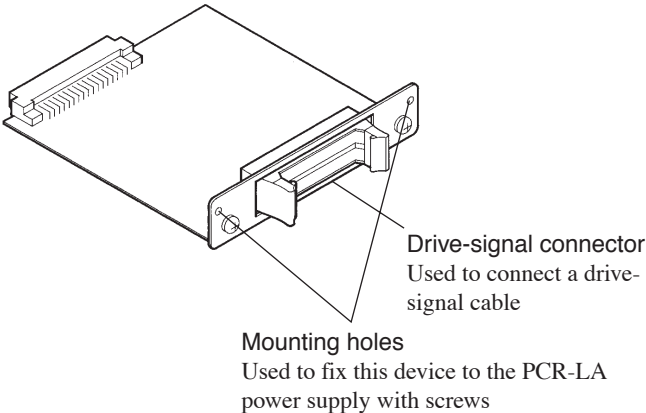
Fig.1-1　　3P03-PCR-LA

# Chapter 2 Precautions and Preparation for Use

Describes the precautions and preparation information that must be understood for use of the Three-phase Output 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.
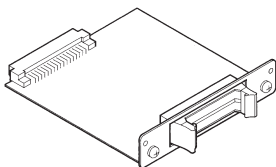


The U-, V-, and W-phase cards have the indications "U," "V," and "W" on the panel part of each card.

☐ U-, V-, and W-phase cards (one each, total of three cards)

  M3 x 6 mm

☐ Card-mounting screws (2 pcs. for each card, total of 6 pcs.)
   [M3-003-011]
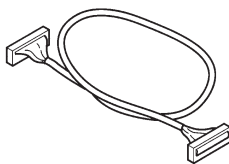


☐ Drive-signal cables (2 pcs.)      ☐ Operation Manual (1 copy)
   [91-87-5670]                         [Z1-002-782]
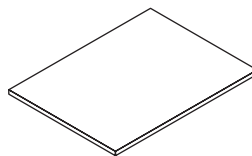
Fig.2-1      Items Contained in the Package

## 2.2 Handling Precautions

### Handling of the U-, V-, and W-phase Cards

Always observe the following precautions when handling each phase 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 Three-phase Output Driver carton, promptly install each phase card in a PCR-LA power supply.**
- **When storing the phase 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

- **Do not damage the cables.**
- **Do not pull, bend, or apply any other stress to the cables.**

## 2.3 Functional Restrictions during Three-phase Operation

Use of the Three-phase Output Driver allows the PCR-LA AC power supplies to generate three-phase outputs. However, this partially restricts the power supply functions. The following functions are not available when the device is installed in the power supplies.

- DC mode
- AC + DC mode
- Sensing
- Regulation adjustment
- Average voltage value measurement
- Average current value measurement

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NOTE • The power line abnormality simulation function can be used. However, some of the specifications differ from those achieved in single-phase operation.

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## 2.4 Combination with Other Options

The PCR-LA Series AC power supplies have various options in addition to the Three-phase Output Driver. However, the following options can be used only in the PCR-LA power supply (master) in which the U-phase card has been installed. These options do not function in a slave unit. (Note that PD03M-PCR-LA can also be installed in the V- and W-phase power supplies.)

Table 2-1  Options Available in the Master Unit

| Option name | Model name |
|---|---|
| Remote Controller | RC04-PCR-LA |
| GPIB Interface | IB03-PCR-LA |
| Parallel Operation Driver (for the master) | PD03M-PCR-LA* |

\*   When this device is combined with the Parallel Operation Driver to perform parallel operation in a three-phase system, the number of power supplies to be operated in parallel is up to three for each phase.

## 2.5 Three-phase Output Driver Installation Method

The Three-phase Output Driver can be installed by inserting the U-, V-, and W-phase cards into SLOT3 or SLOT4 of the three PCR-LA power supplies, respectively.

### 2.5.1 Installing the Phase Cards in a Slot

⚠ **CAUTION** · Before installing a phase 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 phase card by the panel.

3. Orient the phase 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.
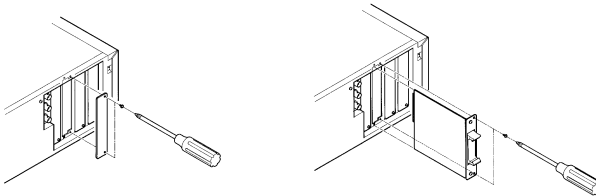


Fig.2-2     Installing a Phase Card

This completes installation of the phase card.

**NOTE** · When a Three-phase Output Driver card has been inserted into the slot of a PCR-LA power supply, that power supply

can be used only in a three-phase system. To use the power supply in a single-phase system, the phase card must be removed from the slot.

## 2.5.2  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.

   Arrange them so that no stress is applied to the drive-signal cables.

   A PCR-LA power supply with the U-phase card installed plays the role of the master unit that controls the other two power supplies. It is recommended that the PCR-LA power supply with the installed U-phase card be placed where it is easily accessible for operations.

   | U |     | V |     | W |     | V |     | U |     | W |
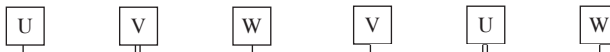
   Fig.2-3     Example of the Placement of PCR-LA Power Supplies

2. Using two drive-signal cables, connect the U-, V-, and W-phase cards.

   Open the tabs of the J1 connectors of the U-, V-, and W-phase 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.

   Connect the shields at both ends of the drive-signal cable to a card-fixing screw.

Shield
Connect the crimping terminal of
the shield to a card-fixing screw.
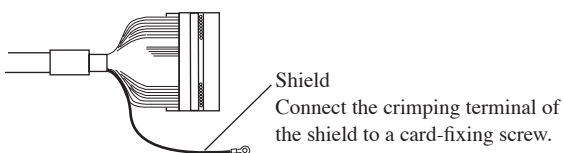
Fig.2-4    Drive-signal Cable

This completes connection of the drive-signal cables.

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⚠ CAUTION  • Moving a PCR-LA power supply with a drive-signal cable connected to the phase 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).

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## 2.6　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 "Precautions and Preparation for Use" in the PCR-LA AC Power Supply Operation Manual.

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

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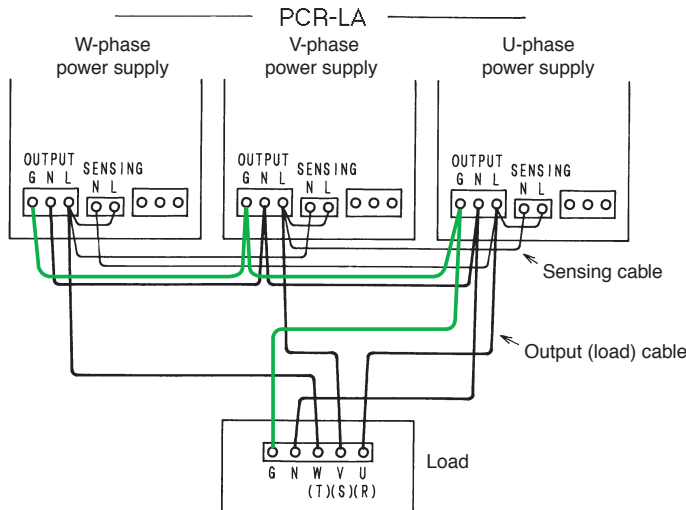


Fig.2-5　　Output Connections

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**NOTE** • Because the operation check described in the next chapter is conducted under a no-load condition, it is still not necessary to connect a load at this point.

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### 2.6.1　Connecting the OUTPUT Terminal Board

To generate three-phase outputs using three PCR-LA AC power supplies, connect the outputs of the three power supplies in three-phase four-wire Y-connection (star connection) with a neutral point. Then, always connect the neutral point to terminal N of the OUTPUT terminal boards of the PCR-LA power supplies.
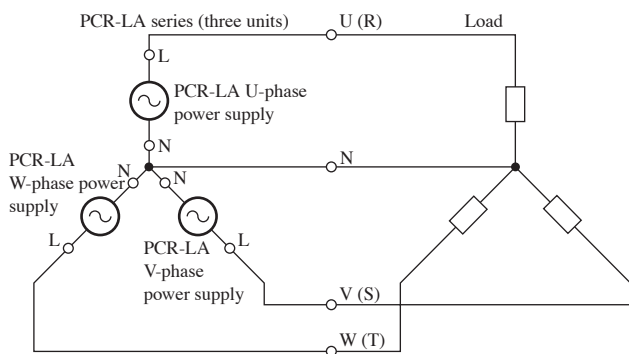
Fig.2-6    Three-phase Four-wire Connection to the Neutral Point

⚠ CAUTION  · Connection of the PCR-LA AC power supplies in delta connection may cause a malfunction or problem.

NOTE  • If the neutral point is omitted, there are cases in which it will not be possible to produce the rated power.

## 2.6.2  Connecting the SENSING Terminal Board

The SENSING terminal boards are used to measure line voltage. For this measurement, connect the SENSING and OUTPUT terminal boards as specified in Table 2-2.

Table 2-2  Connections of the SENSING Terminal Boards

| SENSING terminal boards | OUTPUT terminal board to be connected |
|---|---|
| L of the U-phase power supply | L of the U-phase power supply |
| N of the U-phase power supply | L of the V-phase power supply |
| L of the V-phase power supply | L of the V-phase power supply |
| N of the V-phase power supply | L of the W-phase power supply |
| L of the W-phase power supply | L of the W-phase power supply |
| N of the W-phase power supply | L of the U-phase power supply |

# Chapter 3    Operation Method

Describes the operations and functions of the 3P03-PCR-LA Three-phase Output Driver.

This Operation Manual describes the procedures for use of the functions available in three-phase operation that differ from those available when a PCR-LA power supply is used in single-phase operation. For information not provided in this manual, see the PCR-LA AC Power Supply Operation Manual. Moreover, before reading the 3P03-PCR-LA Operation Manual, always read through the PCR-LA AC Power Supply Operation Manual.

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NOTE    • Unless otherwise specified, the operation method described in this chapter applies to the U-phase power supply.
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## 3.1    Operation Check

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

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⚠ CAUTION   • To protect a load, carry out an operation check without connecting a load. If a load has been connected to the PCR-LA power supplies, disconnect it.
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**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 three-phase operation, see "3.2 Basic Operation Required for Three-phase Operation" onward.

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NOTE    • Even if one power supply is not connected or an error occurs in one of the three power supplies, none of the PCR-LA power supplies operate.
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## 3.2 Basic Operation Required for Three-phase Operation

The basic operation for three-phase operation is as described below.

### POWER-switch operation

- When turning the POWER switches ON, turn the POWER switches of the V- and W-phase power supplies ON first, followed by the U-phase power supply POWER switch. Alternatively, turn the POWER switches of all power supplies ON simultaneously.

- When turning ON (or OFF) all three PCR-LA power supply POWER switches, complete all turn-ONs 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 OFF all POWER switches and then turn them ON again by the correct procedure.

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

### Operation and Indications of the Control Panel

- During three-phase operation, the U-phase power supply acts as the master to control the V- and W-phase power supplies. Thus, to change a setting, use the U-phase power supply control panel. Values set through the U-phase power supply control panel will be set to the V- and W-phase power supplies in the same way.

- In phase voltage setting, the voltage concerned can be set from the V- or W-phase power supply control panel. This setting changes only the voltage of the V- or W-phase power supply.

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

DESCRIPTION • **Difference in Display between Single- and Three-phase Operations**

When this device is installed in the PCR-LA power supplies to perform three-phase operation, part of the control panel display differs from that provided for single-phase operation.

(1) Indications common to each phase

- The 人 symbol and the letter "U," "V," or "W" at the left of the voltage display area indicate that a PCR-LA AC power supply has been set to the relevant phase and that the voltage reading shows the phase voltage.

- The letters "U-V," "V-W," or "W-U" at the left of the voltage display area indicate that the voltage reading shows the line voltage of the power supplies concerned.

(2) Display on the V- and W-phase power supply control panels

- These control panels display the phase (V or W) indication, voltage and current values, and LOAD level meter indication only.

(3) U-phase power supply control panel display

- During display of the power, the 人 symbol and the letters "U," "V," and "W" may all appear at the left of the current display area. This indicates the total power of the three phases.

- During a self-test, the 人 symbol and the letter "U," "V," or "W" may appear at the left of the voltage display area. This indicates the self-test result for the AC power supply of the displayed phase.

# 3.3 Switching between Phase Voltage and Line Voltage Displays

The phase voltage display and line voltage display modes for display are provided for three-phase operation. The display mode will be backed up and, when the POWER switch is turned ON, the display mode used immediately before the POWER switch was turned OFF will be selected.

1. Press the ESC key to select the Home Position.
2. Press the PHASE (SHIFT, 2) key.

    Each time the PHASE key is pressed, the display mode is switched between phase voltage display and line voltage display.

**Phase Voltage Display Mode**

- The 人 symbol and letter "U," "V," or "W" at the left of the voltage display area indicate that the phase voltage display mode is selected.

- To switch from the phase voltage display mode to the line voltage display mode, the U-to-V phase difference must be 120 degrees and the U-to-W phase difference must be 240 degrees.

Moreover, if the V- and W-phase voltages are set separately, line voltage display will not be selected. In such a case, vary it to the same value through the U-phase power supply control panel. This allows selection of the line voltage display mode.

### Line Voltage Display Mode

- The letters "U-V," "V-W," or "W-U" at the left of the voltage display area indicate that the line voltage display mode is selected.

- Setting the voltage in the line voltage display mode allows line voltage setting.

- In the line voltage display mode, the U-to-V or U-to-W phase difference cannot be modified.

- The line voltage display mode disables the measurement of output power.

- In the line voltage display mode, the V- and W-phase voltages cannot be set separately.

# 3.4 Output Voltage Setting

- Setting the voltage value to the U-phase power supply causes the voltages of all phases to be the same.

- Setting a voltage value to the V- or W-phase power supply causes only the V- or W-phase voltage to change. However, changing the U-phase voltage afterward causes both the V- and W-phase voltages to change to the same value as the U-phase voltage.

- Setting of the V- or W-phase voltage requires selection of the phase voltage display mode.
  To set the voltage using the numeric keys in the OUTPUT ON condition, select the SET mode on the U-phase power supply.

- Voltage setting in the phase voltage display mode sets the phase voltage; set the voltage to 1/1.73 of the voltage required between lines. (This means that the U-to-V phase difference is 120 degrees and the U-to-W phase difference is 240 degrees.)

- Voltage setting in the line voltage display mode sets the line voltage; set the voltage required between lines and leave as is.

- For the voltage setting methods and others, see the PCR-LA AC Power Supply Operation Manual.

## 3.5　Limit Value Setting

- Voltage and frequency limit values should be set through the U-phase power supply control panel. The values set on the U-phase power supply apply to all phases.
- A voltage limit value is a limit on the phase voltage; a line voltage limit operates at a value 1.73 times the phase voltage limit.
- The current limit value should be set on a phase basis.

## 3.6　Setting the Current or Power Display Mode

- Each time the I MODE (SHIFT, I) key is pressed, the current and power display modes change as follows:

Display of the U-phase power supply

RMS → PEAK → RMS W (U-phase power) → W (total power of the three phases)
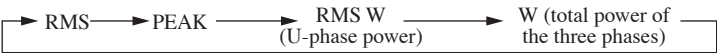
Display of the V-phase power supply

RMS → PEAK → RMS W (V-phase power) → W (V-phase power)
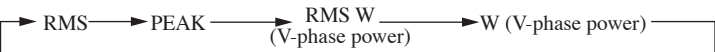
Display of the W-phase power supply

RMS → PEAK → RMS W (W-phase power) → W (W-phase power)
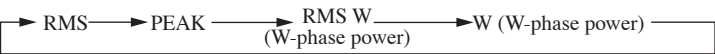
If the output power exceeds 10 kW, "E3" appears on the control panel.

Example: For output power of 12000 W, the control panel displays the following.



```
E.3
      12.0ᵂ
```
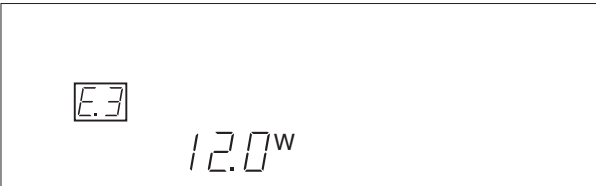
Fig.3-1　　Example of 12000-W Output Power Display

## 3.7 Memory Function

- The memory function is available only in the phase voltage display mode.
- The U-phase power supply allows the voltage and frequency to be stored in the memory.
- The V- or W-phase power supply allows only the voltage to be stored in the memory.
- The voltage read from the U-phase power supply memory is set to all phases.

## 3.8 Key-lock Function

- The key-lock function operates in all phases separately.

## 3.9 Self-test Function

For three-phase operation, the self-test is also conducted from the U-phase power supply. It will be performed on all three AC power supplies.

- The self-test operating procedure is as described in the "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.
- If an alarm occurs, the U-phase power supply always generates an intermittent buzzer tone and displays an "ALARM" indication.
- Some types of alarms also cause an intermittent buzzer tone to be generated from and an "ALARM" indication to be displayed on the relevant phase power supply in which an alarm has occurred, in addition to the U-phase power supply.
- Turning JOG causes the numbers in "Ad." and "No." to change, in addition to the letter "U," "V," or "W" at the left of the voltage display area. Each letter indicates that the relevant phase power supply is under self-testing.
- When the three power supplies are operated individually in parallel, the numbers in "Ad." for these power supplies are as shown in Table 3-1.
- The numbers in "Ad." shown in Table 3-1 are displayed on all of the U-, V-, and W-phase power supplies in the same way the letter "U,"

"V," or "W" at the left of the voltage display area determines which "Ad." number corresponds to which phase.

Table 3-1   Ad. Numbers for AC Power Supplies Operated in Three-phase Output and in Parallel

| PCR-LA power supply model name | U-, V-, or W-phase | | |
|---|---|---|---|
| | Master | Slave 1 | Slave 2 |
| PCR2000LA | 1 – 2 | 11 – 12 | 21 – 22 |
| PCR4000LA | 1 – 4 | 11 – 14 | 21 – 24 |
| PCR6000LA | 1 – 6 | 11 – 16 | 21 – 26 |

\*   The words "Master" and "Slave" in Table 3-1 represent the relationship between the master and slave units in parallel connection.
The number of power supplies to be operated in parallel is up to three per phase (when the Three-phase Output Driver is used in combination with the Parallel Operation Driver to perform parallel operations in three-phase output).

## 3.10  Functions Restricted during Three-phase Operation

During three-phase operation, the PCR-LA power supply functions will be partially restricted. The following functions are not available when the Three-phase Output Driver is installed in PCR-LA AC power supplies.
• DC mode
• AC + DC mode
• Sensing
• Regulation adjustment
• Average voltage value measurement
• Average current value measurement

NOTE   • The power line abnormality simulation function available in three-phase operation differs partially in its specifications from that available in single-phase operation. For more information on this, see "Chapter 11 Specifications" of the PCR-LA AC Power Supply Operation Manual.

# 3.11 Special Waveform Output Function

Use of the Remote Controller (RC04-PCR-LA) allows output of the peak-clipped waveform of the line voltage. However, be aware that the phase voltage waveform becomes as shown below. The setting range is 1.25 to 1.40.

If a value outside this setting range is set, no waveform will be output.

Line voltage waveform
U to V
V to W
W to U

Phase voltage waveform
U to N
V to N
W to N
"N" indicates neutral.
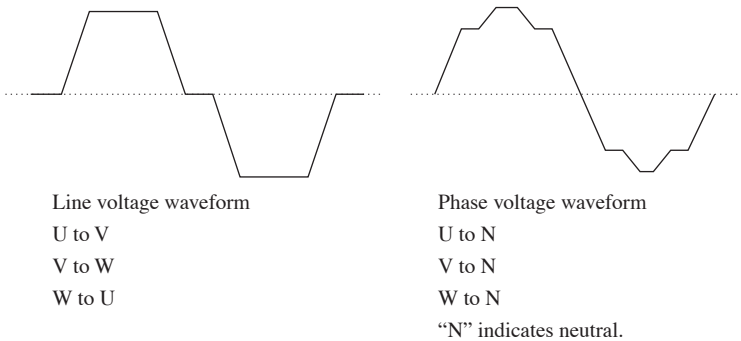
Fig.3-2    Peak-Clipped Waveform

DESCRIPTION • A general three-phase capacitor input-type rectifier circuit is as shown in Fig. 3-3. A current flows at 60-degree and 120-degree phases of the voltage waveform. Thus, the voltage waveform becomes as shown in Fig. 3-2.

Power supply    Three-phase capacitor input-type rectifier loa
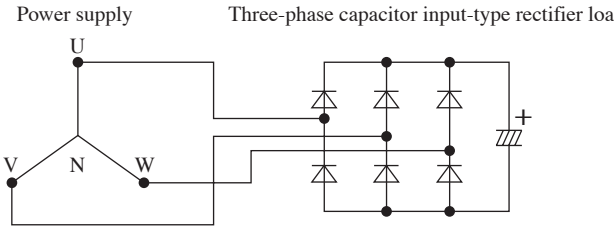
Fig.3-3    Three-phase Capacitor Input-type Rectifier Circuit

## Chapter 4    Using the Remote Controller

Describes the functions and operation methods for three-phase operation of the PCR-LA power supplies when the Three-phase Output Driver is used together with the Remote Controller (RC04-PCR-LA).

The Remote Controller is installed in the U-phase power supply.

This manual describes the procedures for the three-phase operation available functions that differ from those available when a PCR-LA AC power supply and Remote Controller are operated in a single-phase system. For information not provided in this manual, see the RC04-PCR-LA Operation Manual. Moreover, before reading the 3P03-PCR-LA Operation Manual, always read through the RC04-PCR-LA Operation Manual.

# 4.1    Switching between Phase Voltage and Line Voltage Displays

The phase voltage display and line voltage display modes are provided for three-phase operation. The display mode will be backed up, and when the POWER switch is turned ON, the display mode used immediately before the POWER switch was turned OFF will be selected.

1. Press the ESC key to select the Home Position.
2. Press the PHASE (SHIFT, 2) key.

   This procedure alternately switches between the phase voltage display and line voltage display.

**Phase Voltage Display Mode**

```
50.00Hz   0.00A人  0.2V
FRQ        Irms    Vrms
```

- The 人 symbol at the left of the voltage display area on the LCD indicates that the phase voltage display mode is selected.
- To switch from the phase voltage display mode to the line voltage display mode, the U-to-V phase difference must be 120 degrees and the U-to-W phase difference must be 240 degrees. Moreover, if the V- and W-phase voltages are set separately, line voltage display will

not be selected. In such a case, vary it to the same value through the U-phase power supply control panel. This allows selection of the line voltage display mode.

**Line Voltage Display Mode**

```
50.00Hz    0.00A△  0.2V
FRQ        Irms    Vrms
```

- The △ symbol at the left of the voltage display area on the LCD indicates that the line voltage display mode is selected.
- Setting the voltage in the line voltage display mode allows line voltage setting.
- In the line voltage display mode, the U-to-V or U-to-W phase difference cannot be modified.
- The line voltage display mode disables measurement of output power.
- In the line voltage display mode, the V- or W-phase voltage cannot be set separately.

# 4.2 Setting the U-to-V or U-to-W Phase Difference

1. Press the ESC key to select the Home Position.
2. Press the MODE key.

```
FREE        0Ω
PHASE      IMP
```

   [F1]    [F2]    [F3]    [F4]    [F5]

3. Press the F1 (PHASE) key to select the phase setting mode.

```
PHASE    FREE        FREE
         OUT_ON  OUT_OFF
```

   [F1]    [F2]    [F3]    [F4]    [F5]

4. Press the MENU key to select the U-to-V or U-to-W phase-difference setting mode.

```
PHASE   120deg  240deg
         U_V        U_W
```

   [F1]    [F2]    [F3]    [F4]    [F5]

5. Press the F3 (U-V) or F5 (U-W) key to select a phase difference of U-to-V or U-to-W.

6. Use the numeric keys or JOG/SHUTTLE to set the phase difference.

7. Press the ESC key to exit the phase-difference setting mode.

## 4.3 Displaying the V- or W-phase Current and Voltage and the V-to-W or W-to-U Line Voltage

1. Press the ESC key to select the Home Position.

2. Press the MENU key. Each time this key is pressed, the display changes as follows.

For the phase voltage display mode:

```
 ┌──────► U-phase current and voltage
 │               │
 │          V-phase current and voltage
 │               │
 │          W-phase current and voltage
 │               │
 └────────── Total power, total VA, and total power factor of the three phases
```

For the line voltage display mode:

```
 ┌──────► U-to-V phase voltage
 │               │
 │          V-to-W phase voltage
 │               │
 │          W-to-U phase voltage
 │               │
 └────────── Power, VA, and power factor (no measured value is displayed)
```
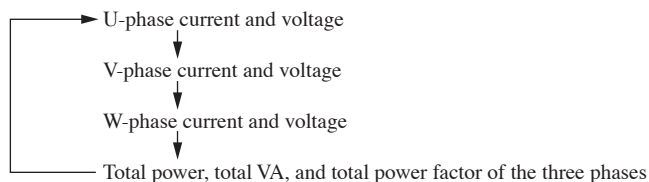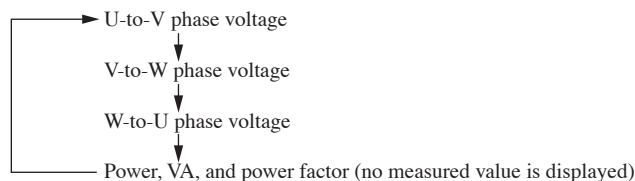
## 4.4 Switching to the Current or Power Display Mode

• Each time the SHIFT key is pressed followed by the F3 key in the Home Position, the current and power display mode changes as follows:

```
 ┌─► RMS ──────► Ip ──────► Iph ──────► UWATT (U-phase power) ─┐
 └──────────── WATT (total power of the three phases) ◄────────┘
```

## 4.5 Sequence Operation

In the sequence setting mode, items available in the DC or AC + DC mode cannot be set. In addition, AC voltage (Vac) applies phase voltage setting.

## 4.6 Harmonic Current Analysis Function

The Remote Controller (RC04-PCR-LA) connected to the U-phase power supply allows harmonics in a load current to be analyzed in each of the U, V, and W phases.

For this operation, add the following step between steps 2 and 3 in "4.4.3 Harmonic Current Analysis Function" in the RC04-PCR-LA Operation Manual.

<u>2a.</u> Select the phase that performs harmonic current analysis.

```
┌─────────────────────────────────┐
│ C u r r e n t    H a r m o n i c │
│     U           V           W    │
└─────────────────────────────────┘
  [F1]    [F2]    [F3]    [F4]    [F5]
```
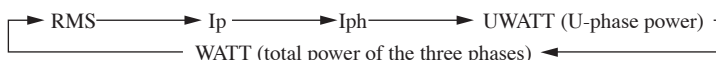
- Pressing the F1 key selects phase U, pressing the F3 key selects phase V, and pressing the F5 key selects phase W.

Thereafter, follow the procedure from step 3 onward as specified in "4.4.3 Harmonic Current Analysis Function" in the RC04-PCR-LA Operation Manual.

- The letter "U," "V," or "W," indicating the selected phase, appears at the left of the first order component of the harmonic current analysis result indicated on the display.

# Chapter 5  Using the GPIB/RS-232C Interface

Describes the functions and messages available when the Three-phase Output Driver and GPIB Interface (IB03-PCR-LA) or RS-232C Interface are used in combination for three-phase operation of the PCR-LA power supplies.

When operating the three-phase system PCR-LA AC power supplies using the GPIB or RS-232C feature, use the GPIB Interface installed in or the RS-232C Interface provided for the U-phase AC power supply.

This manual describes the functions available in three-phase operation that differ from those available when a PCR-LA AC power supply and GPIB Interface or RS-232C Interface are operated in a single-phase system. For information not provided in this manual, see the PCR-LA AC Power Supply Operation Manual. Moreover, before reading the 3P03-PCR-LA Operation Manual, be sure to read through the PCR-LA AC Power Supply Operation Manual.

## 5.1　Phase Voltage/Line Voltage Display Messages

The phase voltage and line voltage display modes for display are provided for three-phase operation. The display mode will be backed up and, when the POWER switch is turned ON, the display mode used immediately before the POWER switch was turned OFF will be selected.

### VPHASE

Switches the voltage value display method to the phase voltage display mode.

Phase voltage setting is available in the phase voltage display mode.

Measurements of the power, apparent power, and power factor can be performed in the phase voltage display mode.

#### Program message

- Syntax

    Command message: VPHASE

### VLINE

Switches the voltage value display method to the line voltage display mode.

Line voltage setting is available in the line voltage display mode.

#### Program message

- Syntax

    Command message: VLINE

# 5.2 Phase-difference Setting Messages

### PHASEV

Sets or inquires about a U-to-V phase difference.

This message is enabled in the phase voltage display mode.

If data other than the initial set values have been set to the U-to-V or U-to-W phase difference, the line voltage display mode cannot be selected.

#### Program message

- Syntax

    Command message:PHASEV <NR1>

    Query message:PHASEV?

- Program data

    Data format:Integer

    Set value:0 to 360

    Initial value:120 (setting at factory shipment)

Example: To set the U-to-V phase difference to 125 degrees

    PHASEV 125

#### Response message

Returns the U-to-V phase-difference set value in response to PHASEV?

### PHASEW

Sets or inquires about a U-to-W phase difference.

This message is enabled in the phase voltage display mode.

If data other than the initial set values have been set to the U-to-V or U-to-W phase difference, the line voltage display mode cannot be selected.

**Program message**

- Syntax

    Command message:PHASEW <NR1>

    Query message:PHASEW?

- Program data

    Data format:Integer

    Set value:0 to 360

    Initial value:240 (setting at factory shipment)

Example: To set the U-to-W phase difference to 238 degrees

    PHASEW 238

**Response message**

Returns the U-to-W phase-difference set value in response to PHASEW?

# 5.3   Output Voltage Setting Messages

## VSET/ACVSET

Sets or inquires about the phase voltage.

The VSET message and ACVSET message function in the same way.

In output voltage setting, all phase voltages are set to the same value.

These messages are enabled in the phase voltage display mode.

**Program message**

- Syntax

    Command message:VSET <NR2>

                  ACVSET <NR2>

    Query message:VSET?

                  ACVSET?

- Program data

    Same as that of single-phase operation

**Response message**

Returns a phase voltage set value in response to VSET?/ACVSET?

## LINEVSET

Sets or inquires about the line voltage.

This message is enabled in the line voltage display mode.

### Program message

- Syntax

  Command message:LINEVSET <NR2>

  Query message:LINEVSET?

- Program data

  1.73 times the voltage set by the VSET/ACVSET message can be set.

### Response message

Returns a line voltage set value in response to LINEVSET?

## UVSET

Sets or inquires about the U-phase voltage.

This message is enabled in the phase voltage display mode.

### Program message

- Syntax

  Command message:UVSET <NR2>

  Query message:UVSET?

- Program data

  Same as that of the VSET/ACVSET message

### Response message

Returns a U-phase voltage set value in response to UVSET?

## VVSET

Sets or inquires about the V-phase voltage.

This message is enabled in the phase voltage display mode.

### Program message

- Syntax

  Command message:VVSET <NR2>

  Query message:VVSET?

- Program data

  Same as that of the VSET/ACVSET message

### Response message

Returns a V-phase voltage set value in response to VVSET?

### WVSET

Sets or inquires about the W-phase voltage.

This message is enabled in the phase voltage display mode.

**Program message**

- Syntax

    Command message:WVSET <NR2>

    Query message:WVSET?

- Program data

    Same as that of the VSET/ACVSET message

**Response message**

Returns a W-phase voltage set value in response to WVSET?

# 5.4   Output Measurement Messages

### VOUT?

Inquires about a measured voltage value.

**Program message**

- Syntax

    Query message:VOUT?

**Response message**

Returns U-, V-, and W-phase voltages, delimited by a comma (,), in the phase voltage display mode; returns U-V, V-W, and W-V voltages, delimited by a comma (,), in the line voltage display mode

Example: A response message for VOUT? in the phase voltage display mode is

        115.3, 115.4, 115.5

W-phase voltage
V-phase voltage
U-phase voltage
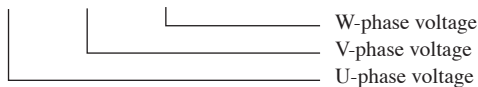
Example: A response message for VOUT? in the line voltage display mode is

        200.0, 200.1, 200.2

W-to-U line voltage
V-to-W line voltage
U-to-V line voltage
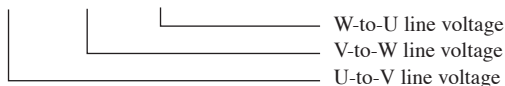
## IOUT?

Inquires about a measured current value.

### Program message

- Syntax

    Query message:IOUT?

### Response message

Returns U-, V-, and W-phase currents, delimited by a comma (,)

Example: A response message for IOUT? is

```
10.0, 10.1, 10.2
```

W-phase current
V-phase current
U-phase current

## WATT?

Inquires about a measured power value.

This message is enabled in the phase voltage display mode.

### Program message

- Syntax

    Query message:WATT?

### Response message

Returns the U-, V-, and W-phase power values and the total power,
delimited by a comma (,)

Example: A response message for WATT? is

```
200.0, 200.1, 200.2, 600.3
```

Total power
W-phase power
V-phase power
U-phase power

## PF?

Inquires about a measured power factor.

This message is enabled in the phase voltage display mode.
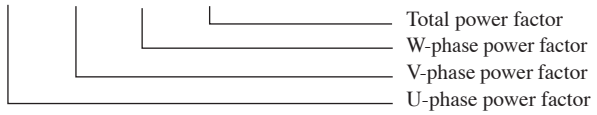
### Program message

- Syntax

    Query message:PF?

**Response message**

Returns U-, V-, and W-phase power factors and the total power factor, delimited by a comma (,)

Example: A response message for PF? is
          0.60, 0.62, 0.64, 0.62

———————————————————— Total power factor
———————————————————— W-phase power factor
———————————————————— V-phase power factor
———————————————————— U-phase power factor

The total power factor is obtained by PFtotal = Wtotal / VAtotal.

## VA?

Inquires about a measured apparent power value.

This message is enabled in the phase voltage display mode.

### Program message

- Syntax

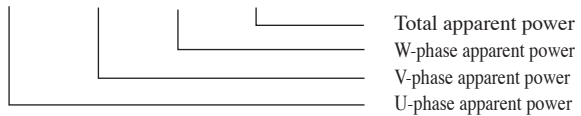    Query message:VA?

### Response message

Returns U-, V-, and W-phase apparent power values and the total apparent power, delimited by a comma (,)

Example: A response message for VA? is
          333.3, 322.7, 312.8, 968.8

———————————————————— Total apparent power
———————————————————— W-phase apparent power
———————————————————— V-phase apparent power
———————————————————— U-phase apparent power

# 5.5 Harmonic Current Analysis Messages

Harmonic current analysis can be conducted in the same way as in single-phase operation. However, it is necessary to use a message corresponding to the relevant phase to read out analyzed data in each phase.

This section briefly describes the messages for each phase, and shows the syntax only. The data format and set value of the program data on each message and its response message are the same as those applied in single-phase operation. For more information on these, see "9.4.4 Harmonic Current Analysis" of the PCR-LA AC Power Supply Operation Manual.

## UCURHARMA?

Inquires about the value representing the harmonics component (in current) of each degree in the U-phase.

### Program message

- Syntax

  Query message: `UCURHARMA {<NR1>|ODD|EVEN|LOW|HIGH}?`

## VCURHARMA?

Inquires about the value representing the harmonics component (in current) of each degree in the V-phase.

### Program message

- Syntax

  Query message: `VCURHARMA {<NR1>|ODD|EVEN|LOW|HIGH}?`

## WCURHARMA?

Inquires about the value representing the harmonics component (in current) of each degree in the W-phase.

### Program message

- Syntax

  Query message: `WCURHARMA {<NR1>|ODD|EVEN|LOW|HIGH}?`

## UCURHARMP?

Inquires about the percentage of a harmonic current value in the U-phase, obtained by regarding the current value of the basic wave component as 100 %.

**Program message**

• Syntax

Query message: UCURHARMP {<NR1>|ODD|EVEN|LOW|HIGH}?

## VCURHARMP?

Inquires about the percentage of a harmonic current value in the V-phase, obtained by regarding the current value of the basic wave component as 100 %.

**Program message**

• Syntax

Query message: VCURHARMP {<NR1>|ODD|EVEN|LOW|HIGH}?

## WCURHARMP?

Inquires about the percentage of a harmonic current value in the W-phase, obtained by regarding the current value of the basic wave component as 100 %.

**Program message**

• Syntax

Query message: WCURHARMP {<NR1>|ODD|EVEN|LOW|HIGH}?

# Chapter 6      Maintenance

Describes the maintenance procedures for the Three-phase Output Driver.

## Before Requesting a Repair

If a problem occurs in the 3P02-PCR-LA, check that problem in accordance with Table 6-1. In addition, remove the Three-phase Output 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 6-1   Troubleshooting Check Sheet

| Problem | Check item | Results | Possible causes |
|---|---|---|---|
| The PCR-LA power supply display panel displays "Err2" or nothing, or retains the version-number indication. | Check whether each of the three phase cards is properly inserted into a slot. | NO | Improper phase-card installation (See 2.5.1 .) |
| | Check whether the drive-signal cables are properly connected. | NO | Improper drive-cable connection (See 2.5.2 .) |
| | Check whether all three of the PCR-LA power supply POWER switches are ON. | NO | The PCR-LA power supplies cannot be operated in a three-phase system unless all three PCR-LA power supply POWER switches are turned ON. |
| Rated output cannot be generated. | Check whether the output neutral point is connected to a load, or whether a load is connected in a three-phase three-wire system (delta connection). | NO | Outputs have been connected in delta connection. In delta connection, the presence of unbalance between three-phase currents may disable the generation of rated output. |
| Voltage different from the set voltage is generated ( $\sqrt{3}$ times or $1/\sqrt{3}$ ). | Check whether the display mode is correct. | YES | The phase voltage display mode sets the phase voltage; the line voltage display mode sets the line voltage. |
| The voltage display becomes abnormal in the line voltage display mode. | Check whether the SENSING terminal board is properly connected. | NO | The cable connection to the SENSING terminal board is improper. This disables line voltage measurement (see 2.6.2 ). |

# Chapter 7 　　 Specifications

Lists the specifications.

## 7.1　Specifications

The specifications given in this section are for comprehensive perfor-
mance with the Three-phase Output Driver installed in the PCR-LA
AC power supplies to configure three-phase system power supplies.
Other specifications comply with those of the PCR-LA Series AC
power supplies.

| Input/output power capacity (total power of three phases) | [Power capacity of one PCR-LA power supply] x 3 |
|---|---|
| Input current capacity | [Current capacity of one PCR-LA power supply] x $\sqrt{3}$ (for three-phase delta connection) <br> [Current capacity of one PCR-LA power supply] x 3 (for single-phase connection) |
| Output current capacity (phase current for each phase) | [Current capacity of one PCR-LA power supply] x 1 |
| Phase difference of the output phase voltage [1] | Within $120° \pm (0.4° + 5 \mu s)$ <br> Within $(120° \pm (0.4° + f_0 \times 1.8 \times 10^{-3}°)$ <br> "$f_0$" indicates the output frequency.) [2] |

*1 Phase difference between output voltages (phase voltages) when each
phase is checked from the neutral point in the condition in which no
phase difference is varied (120° between phases)
*2 Examples of the results in which the noted expression was converted
into an angle at a specific frequency
Within 120° ± 0.5° (for 60-Hz output)
Within 120° ± 1.2° (for 400-Hz output)

Power line Abnormality Simulation (Specifications Different from Those Achieved in Single-phase Operation)

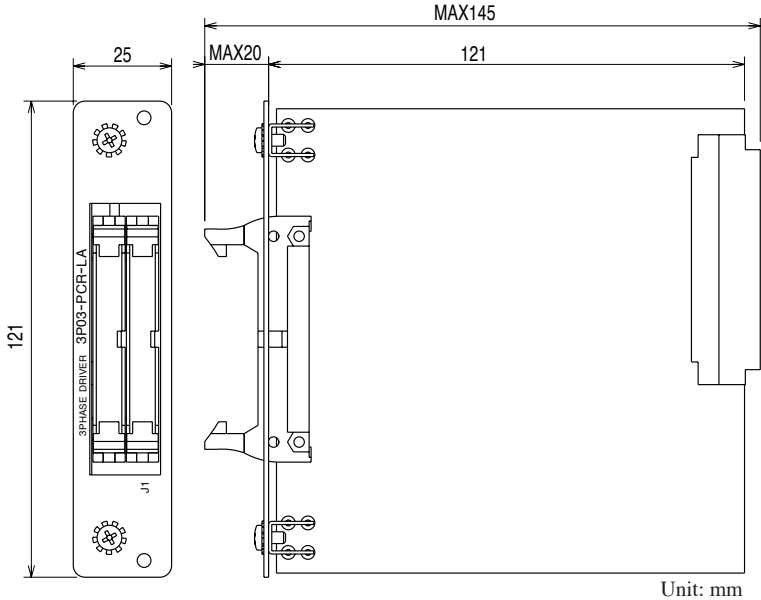| Item | | Setting range | Resolution | Setting accuracy |
|------|------|--------------|-----------|------------------|
| T1 | x 1 deg | 0 deg–360 deg | 1 deg | ±1.5 ms |
| | x 1 ms | 0 ms–999 ms | 1 ms | ±1 ms |
| T3 | x 1 | 0 ms–999 ms | 1 ms | ± (0.1 %+1 ms) |
| V (T3) | | 0 to rated voltage (phase voltage setting) | | |

# 7.2   Dimensions



Unit: mm

Fig.7-1    3P03-PCR-LA Outer Dimensions

THREE-PHASE OUTPUT DRIVER    3P03-PCR-LA

OPERATION MANUAL