Technical Note for the electronic load (PLZ-4W)

When operating under parallel operation or high-speed load simulations.

It is required to arrange proper wiring of the load cables and appropriate settings of the PLZ-4W when using parallel operation or high-speed load simulations (such as swtiching function). If the load wiring and the setting of the PLZ-4W is not set up properly, it may cause to induce the oscillation and which may result in unstable operation.

This technical note describes the measures for avoiding unstable operation such as to alleviate oscillation. Please be sure to read this technical note along with the operation manual of the PLZ-4W before using the product.

1. Load wiring and Load wire inductance

The load wiring has an inductance (L). When the current (I) varies in short time period, it generates a large voltage at both ends of the wiring cable. This voltage applies to all of the load input terminals of the PLZ-4W when the impedance of the DUT (Device Under Test) is relatively small. The voltage generated by the load wire inductance (L) and the current varaiation (I) is expressed using the following equation.
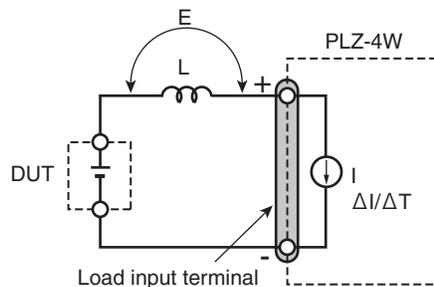
$$E = L \times (\Delta I / \Delta T)$$

E : Voltage generated by the wire inductance

L : Load wire inductance

ΔI : Current variation

ΔT : Variation period of current

In general, the wire inductance can be measured approximately 1 μH per 1 meter. If the 10 meters of load
variation of 10 A/μs, the voltage generated by the wire inductance will be 100 V.

2. Affect to the electronic load (PLZ-4W)

The voltage generated by the wire inductance and the current variation may cause following affects to the electronic load.

●When the value of instantaneous voltage drops under the minimum operating voltage depends on   the generated voltage at the load input terminal, the response of recovery will be extensively delayed. In such event, the electronic load (PLZ-4W) may generate unstable oscillation or becomes into the hunting operation.

Current ΔI

ΔT

Voltage at Load Input Terminal

Minimum operating voltage
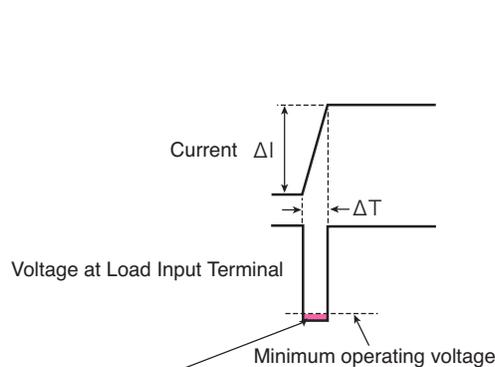
When the voltage drops under minimum operating voltage, the electronic load may generate unstable oscillation or becomes into hunting operation.
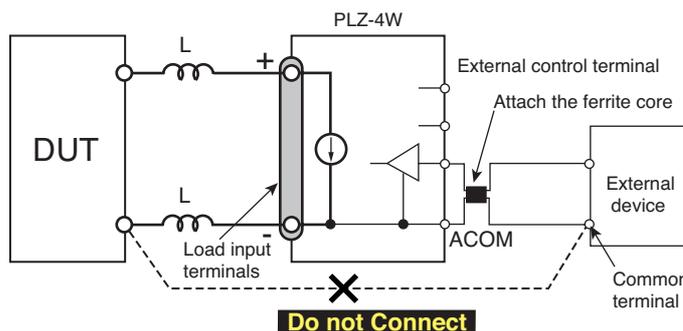
Voltage at the load input terminal
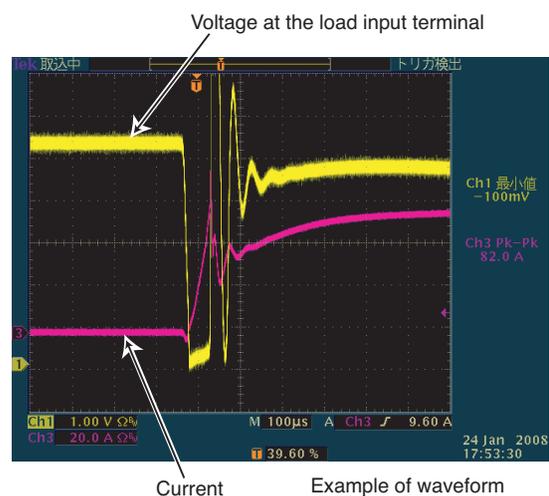
Current

Example of waveform

●The negative polarity of the load input terminal is the reference potential of the external control signal, therefore, the device connected to the external control terminal may get malfunctioned.

●When operating under the constant voltage (CV) mode or constant resistance (CR) mode or constant power (CP) mode, the load current is varied by the voltage at the load input terminal, so the operation can be affected easily by the generated voltage.

3. Measure to reducing affects of the wiring

●If the high-speed response operation is not required, set the lower response speed and decrease the slew rate setting.
In such settings, the value of $\Delta I /\Delta T$ will be decreased, accordingly the generated voltage will be reduced even the inductance of load wiring can not be reduced.
In parallel operation, when the parallel operation is selected by the menu (to set the master unit, the slave units, booster units) and the response speed is set at 1/1, the setting of response speed will change to be set at 1/2.

●In parallel operation, use the shortest cable between the load input terminal of the electronic load. It is recommended to use the bus bar instead of wiring the cable.

●The wiring to the DUT (Device Under Test) should be twisted and the shortest as possible.

●In the CV, CR, CP mode, the remote sensing should be wired at the nearest to the DUT (Device Under Test).

●If the impedance of the DUT (Device Under Test) is relatively small such as DC power supplies, attach the capacitor with capacitance of tens to thousands of μF to the load input terminals (between the positive and negative polarity).

●When using an external control, do not connect the common terminal of the external device and the terminal of the DUT (Device Under Test) which connects to the negative polarity of load input terminal of the electronic load.

●Attach the ferrite core on the connecting wire between the external device and the electronic load.

After taking the measure as described herein above, please make sure that the voltage of the load input terminal of the electronic load should not be dropped under the minimum operating voltage and not be exceeded the maximum input voltage.
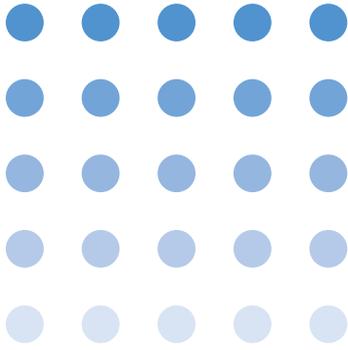
OPERATION MANUAL

ELECTRONIC LOAD PLZ-4W Series

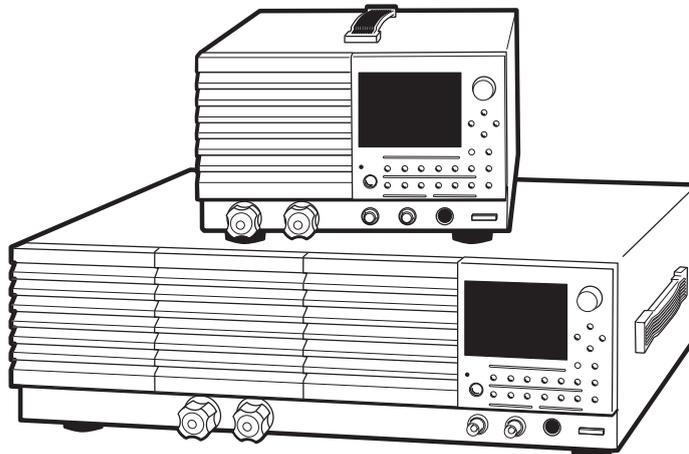# PLZ 164W
PLZ 164WA
PLZ 334W
PLZ 664WA
PLZ1004W

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 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 the 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 1000 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.

⚠ **Safety Precautions**

> **The following safety precautions must be observed to avoid fire hazard, electrical shock, accidents, and other failures. Keep them in mind and make sure that all of them are observed properly.**

Users

- This product must be used only by qualified personnel who understand the contents of this operation manual.
- If it is handled by disqualified personnel, personal injury may result. Be sure to handle it under supervision of qualified personnel (those who have electrical knowledge.)
- This product is not designed or manufactured for general home or consumer use.

Purposes of use

- Do not use the product for purposes other than those described in the operation manual.
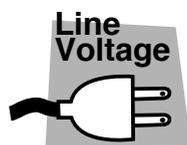
Input power

- Use the product with the specified input power voltage.
- For applying power, use the power cord provided. Note that the provided power cord is not use with some products that can switch among different input power voltages or use 100 V and 200 V without switching between them. In such a case, use an appropriate power cord.
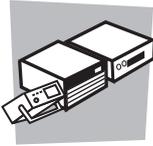
Fuse

- With products with a fuse holder on the exterior surface, the fuse can be replaced with a new one. When replacing a fuse, use the one which has appropriate shape, ratings, and specifications.

Cover

- There are parts inside the product which may cause physical hazards. Do not remove the external cover.

Installation

- When installing products be sure to observe 2.2, "Precautions Concerning Installation Location" described in this manual.
- To avoid electrical shock, connect the protective ground terminal to electrical ground (safety ground).
- When connecting the power cord to a switchboard, be sure work is performed by a qualified and licensed electrician or is conducted under the direction of such a person.
- When installing products with casters, be sure to lock the casters.

Relocation

- Turn off the power switch and then disconnect all cables when relocating the product.
- Use two or more persons when relocating the product which weights more than 20 kg. The weight of the products can be found on the rear panel of the product and/or in this operation manual.
- Use extra precautions such as using more people when relocating into or out of present locations including inclines or steps. Also handle carefully when relocating tall products as they can fall over easily.
- Be sure the operation manual be included when the product is relocated.

Operation

- Check that the AC input voltage setting and the fuse rating are satisfied and that there is no abnormality on the surface of the power cord. Be sure to unplug the power cord or stop applying power before checking.
- If any abnormality or failure is detected in the products, stop using it immediately. Unplug the power cord or disconnect the power cord from the switchboard. Be careful not to allow the product to be used before it is completely repaired.
- For output wiring or load cables, use connection cables with larger current capacity.
- Do not disassemble or modify the product. If it must be modified, contact Kikusui distributor/agent.

Maintenance and checking

- To avoid electrical shock, be absolutely sure to unplug the power cord or stop applying power before performing maintenance or checking.
- Do not remove the cover when performing maintenance or checking.
- To maintain performance and safe operation of the product, it is recommended that periodic maintenance, checking, cleaning, and calibration be performed.

Service

- Internal service is to be done by Kikusui service engineers. If the product must be adjusted or repaired, contact Kikusui distributor/agent.

Arrangement of this Manual

This Operation Manual is made up of the following sections.

Chapter 1 General Information

This chapter gives an overview and introduces the features of the PLZ-4W Series Electronic Loads.

Chapter 2 Installation and Preparation

This chapter describes the procedures of unpacking and preparation before using the PLZ-4W.

Chapter 3 For First Time Users

This chapter describes for first time users, the operation modes of the PLZ-4W and matters that users should be familiar with in operating the PLZ-4W.

Chapter 4 Names and Functions of Parts

This chapter describes the names and functions of switches, connectors, and displays on the front panel and rear panel.

Chapter 5 Basic Operation

This chapter describes the operating procedure of each operation mode and other basic functions.

Chapter 6 Applied Operation

This chapter describes functions such as ABC preset memories, switching function, and sequence function that are used in actual applications.

Chapter 7 Remote Control

This chapter describes the procedure for connecting the interface and the procedure for transmitting commands to the PLZ-4W using SCPI commands.

Chapter 8 Maintenance and Calibration

This chapter describes how to maintain, inspect, and calibrate the PLZ-4W.

Chapter 9 Specifications

This chapter lists the electrical and mechanical specifications of the PLZ-4W.

Appendix

The appendices cover the operating area of the PLZ-4W, the basic operation modes, sequence program creation table, SCPI command reference, and error messages.

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Chapter 8 Maintenance and Calibration   8-1

Chapter 9 Specifications   9-1

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1

Chapter 1   General Information

This chapter gives an overview and introduces the features of the PLZ-4W Series Electronic Loads.

1.1   About This Manual

This operation manual covers the following PLZ-4W Series Electronic Loads.

- PLZ164W
- PLZ334W
- PLZ1004W
- PLZ164WA
- PLZ664WA

Product version covered

This operation manual covers electronic loads with ROM version **1.3x**.

When contacting us about the product, please provide us the following information.

- Model
- ROM version
- Manufacturing number (indicated at the lower section on the rear panel)

For the procedure of confirming the ROM version, see section 2.7, "Checking the ROM Version."

1.2   Product Overview

The PLZ-4W Series Electronic Load is a multifunctional system designed to offer the highest levels of reliability and safety. The electonic load contains a stable and high-performance current control circuit that enables high-speed load simulations. In addition, its CPU control feature works to improve operability and multifunctional capability.

The high-precision current settings provide you with sufficient resolution.

Because the electonic load comes standard with GPIB, RS-232C, and USB communication functions, it can easily be incorporated into wide-ranging test and inspection systems.

1.3　PLZ-4W Series Lineup

The PLZ-4W Series consists of the electronic load and the load booster.

    1. Electronic load (PLZ-4W or PLZ-4WA)

    2. Load booster (PLZ-4WB)

Two types of the PLZ-4W Series are available depending on the input operating voltage.

    1. Operating range of 1.5 V to 150 V. (PLZ-4W and PLZ-4WB)

    2. Operating range of 0 V to 150 V. (PLZ-4WA)

■ Electronic load

Model	Maximum Operating Current (A)	Operating Voltage (V)	Wattage (W)
PLZ164W	33		165
PLZ334W	66	1.5 to 150	330
PLZ1004W	200		1 000
PLZ164WA	33	0 to 150	165
PLZ664WA	132		660

■ Load booster

Model	Maximum Operating Current (A)	Operating Voltage (V)	Wattage (W)
PLZ2004WB[1]	400	1.5 to 150	2 000

    *1.　PLZ2004WB is a dedicated option for PLZ1004W.

1.4 Features

In addition to the high-performance constant current, constant resistance, and constant power modes, the PLZ-4W Series Electronic Load offers wide variety of other features.

■ High-speed slew rate of 16 A/μs (PLZ1004W)

The rise and fall slew rate of the current when switching at 2 % to 100 % (20 % to 100 % in M range) of the rated current in constant current mode is 16 A/μs (PLZ1004W), which converts to rise and fall times of 10 μs (all types).

This allows you to conduct more accurate DC power transient response tests and to generate simulated waveforms for use as dummy loads.

■ Variable slew rate

Unlike the conventional electronic loads that were configured using rise and fall times, the PLZ-4W allows configuration using slew rates (A/μs) in constant current and constant resistance modes.

This allows you to optimize the voltage drop caused by the wire inductance that occurs when a load is switched or the transient control of the equipment under test (such as a constant voltage power supply).

■ Higher precision

Higher precision is offered for current settings.

Resolution at low current settings is provided using a 3-range configuration. (A 0.01 mA resolution is possible at the L range of the PLZ164W.)

■ Operability

The PLZ-4W employs a large LCD.

Measured values of voltage, current, and power at the load input terminal are indicated at all times. The values are indicated using larger characters than other sections to improve the visibility.

Coarse and fine adjustments using the rotary knob are useful for setting values over a wide range.

The easy-to-use memory function enables repetitive tests.

■ 0 V input type

A 0 V input operating voltage type is available.

This feature is a must for single cell tests of fuel cells. Moreover, the operating voltage of semiconductor devices is decreasing more and more due to the reduction of the power consumption and miniaturization of the semiconductor process. The 0 V input type can be used to evaluate the power supplies for these types of applications.

■ Sequence function

Sequence patterns set arbitrarily can be saved to built-in memory.

Up to 10 normal sequence programs or 1 fast sequence program can be saved. Up to 256 steps and 1024 steps can be saved for each normal sequence program and fast sequence program, respectively.

The sequence pattern can be edited easily using the large LCD.

■ Useful function for battery discharge tests

The PLZ-4W can measure the time from load on to load off.

When combined with the under voltage protection (UVP) function, the time from when the battery discharge is started until the battery voltage falls to the cutoff voltage can be measured (time measurement).

In voltage measurement, the voltage immediately before the load turns off is measured. If you set a timer to turn off the load after a specified time elapses, you can measure the closed circuit voltage after a specified time elapses from the start of battery discharge (voltage measurement).

■ Load booster

To achieve large capacity at low cost, the PLZ1004W comes with a load booster (PLZ2004WB).

Using a single PLZ1004W as a master unit, up to four load boosters can be connected in parallel (9 kW, 1 800 A maximum).

■ Standard GPIB, RS-232C, and USB communication functions

Because the electonic load comes standard with GPIB, RS-232C, and USB communication functions, it can easily be incorporated into wide-ranging test and inspection systems.

Wide variety of systems can be configured when combined with the sequence function.

1.5 Overview of Controls

This section describes the controls on the electronic load and combined systems.

Operation using the control panel

The PLZ-4W employs a large LCD. Measured values of voltage, current, and power at the load input terminal are indicated at all times. The values are indicated using larger characters than other sections to improve the visibility.

Coarse and fine adjustments using the rotary knob are useful for setting values over a wide range.
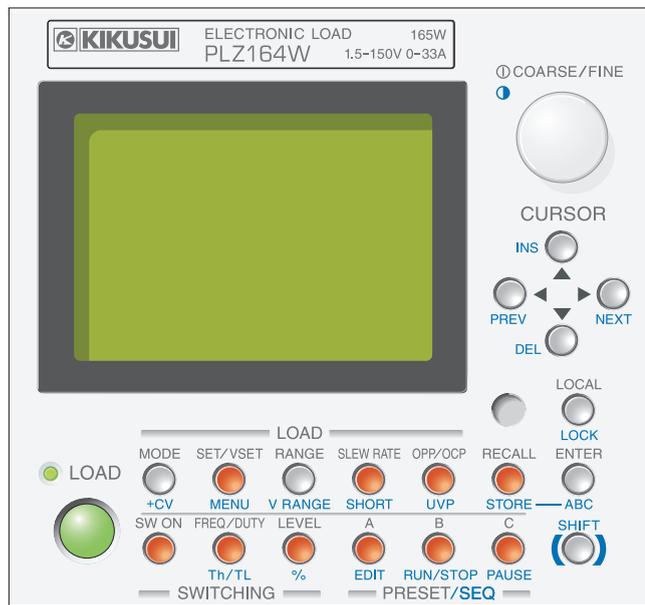
Fig.1-1   Panel control

External communication interface

The PLZ-4W can be controlled from a PC.

GPIB, RS-232C, and USB communication functions come standard.
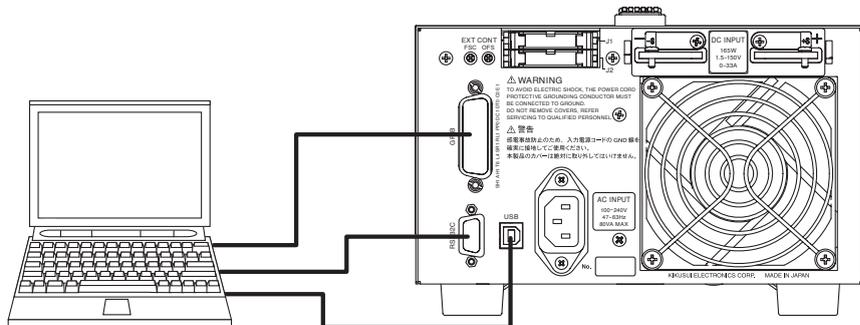
Fig. 1-2   PLZ-4W and PC connection diagram

Support for large capacity

To achieve large capacity at low cost, the PLZ1004W comes with a load booster (PLZ2004WB).

Using a single PLZ1004W as a master unit, up to four load boosters can be connected in parallel (9 kW, 1 800 A maximum).

In parallel operation without using load boosters, up to five electonic loads of the same type including the master unit can be connected in parallel (5 kW, 1 000 A maximum).

PLZ1004W

Master (PLZ1004W)   Load booster (PLZ2004WB)

Up to four PLZ2004WBs can be connected

Master (PLZ1004W)   Slave (PLZ1004W)

Up to five PLZ1004Ws can be connected
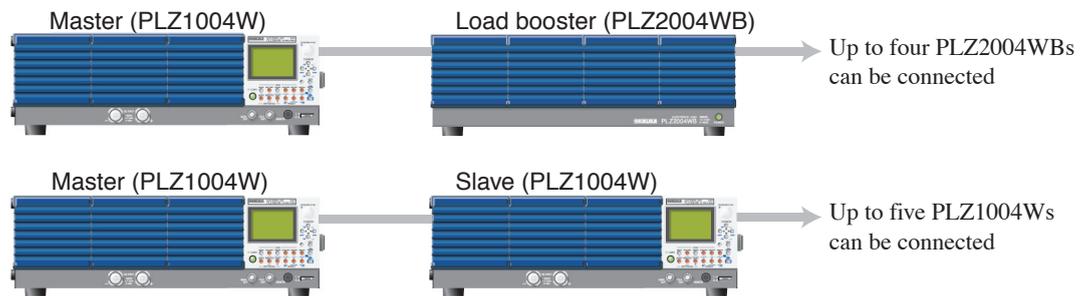
PLZ-4W other than PLZ1004W

Master   Slave

Up to five PLZ-4Ws of the same type as the master device can be connected

Fig. 1-3   Parallel connection

1.6   Options

Control flat cables

Control cable used to connect between the master unit and the slave unit (load booster) and between slave units. The following two types of cables are available.

Model	Code	Length	Application
PC01-PLZ-4W	84540	300 mm	Connect between the master unit and the slave unit (load booster) and between slave units
PC02-PLZ-4W	84550	550 mm	Connect between the master unit and load booster

The two types of cables only differ in their length. The 550-mm PC02-PLZ-4W is required to connect the master unit and the load booster.

Rack Mounting Option

The following rack mounting options are available.

Item	Model	Applicable Model	Note
Rack mount frame (Fig. 1-4)	KRA3	PLZ164W PLZ334W PLZ164WA	Inch rack EIA standard
	KRA150		Milli rack JIS standard
Rack mount bracket (Fig. 1-5)	KRB3-TOS	PLZ664WA PLZ1004W	Inch rack EIA standard
	KRB150-TOS		Milli rack JIS standard

For details, contact your Kikusui agent or distributor.
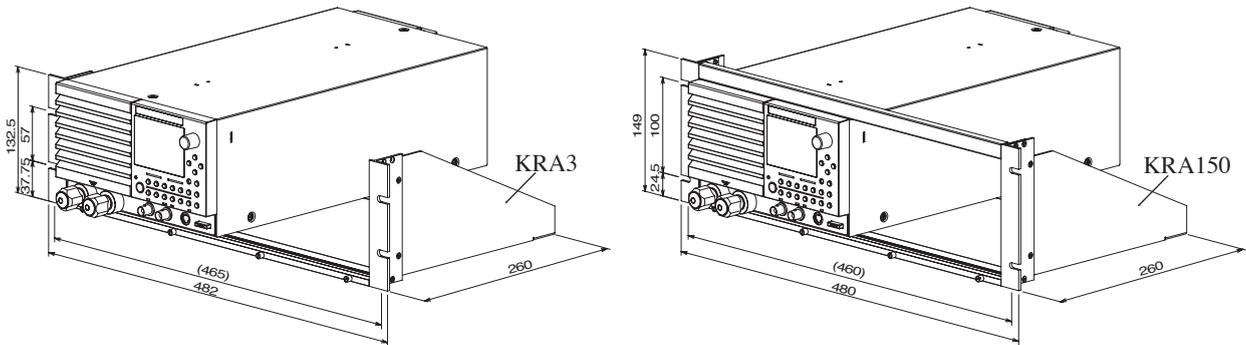
Unit: mm

Fig. 1-4   Rack mount frame

Unit: mm
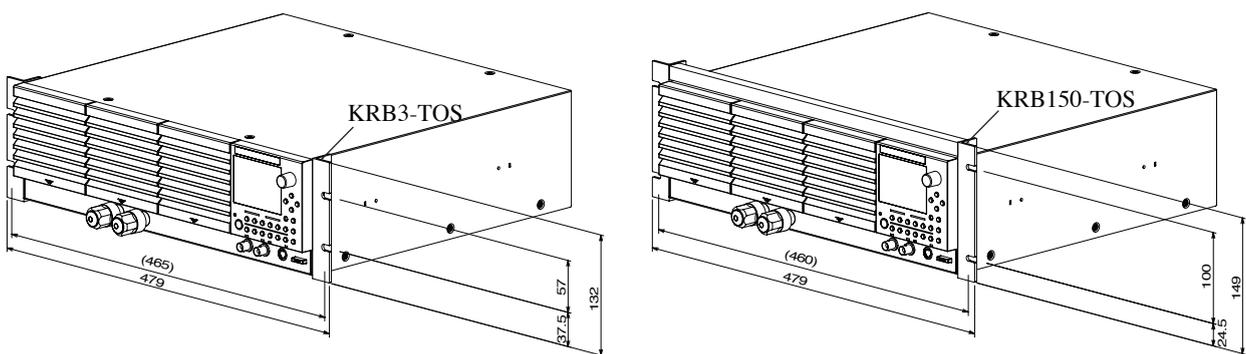
Fig. 1-5   Rack mount bracket

2

Chapter 2 Installation and Preparation

This chapter describes the procedures of unpacking and preparation before using the PLZ-4W.

2.1 Checking the Package Contents

When you receive the product, check that all accessories are included and that the product and accessories have not been damaged during transportation.

If any of the accessories are damaged or missing, contact your Kikusui agent or distributor.

NOTE
• It is recommended that all packing materials be saved, in case the product needs to be transported at a later date.

Rated voltage: 125 Vac
PLUG: NEMA5-15
[85-AA-0003]

Rated voltage: 250 Vac
PLUG: CEE7/7
[85-AA-0005]

Rated voltage: 250 Vac
PLUG: GB1002
[85-10-0790]

The power cord that is provided varies depending on the destination for the product at the factory-shipment.

☐ Power cord
(1 pc.)

[Q1-500-085]

[P2-000-228]

[M1-100-012]

[M5-101-007]

[M4-100-007]

☐ Load input terminal cover (1 pc.)
Lock plate (2 pcs.)

☐ Set of screws for the load input terminal
(2 sets)

[Z1-002-792]

[84-49-0071]

☐ Operation manual (1 copy)

☐ J1/J2 protection dummy plug (2 pcs.)
[Attached to the product.]

Fig.2-1   Accessories

2.2 Precautions Concerning Installation Location

This section describes the precautions to be taken when installing the unit. Make sure to observe them.

■ Do not use the unit in a flammable atmosphere.

To prevent the possibility of explosion or fire, do not use the unit near alcohol, thinner or other combustible materials, or in an atmosphere containing such vapors.

■ Avoid locations where the unit is exposed to high temperature or direct sunlight.

Do not place the unit near a heater or in areas subject to drastic temperature changes.

> Operating temperature range: 0 °C to +40 °C
>
> Storage temperature range: -25 °C to +70 °C

■ Avoid humid environments.

Do not place the unit in high-humidity locations--near a boiler, humidifier, or water supply.

> Operating humidity range: 20 % to 85 % RH (no condensation)
>
> Storage humidity range: 0 to 90 % RH (no condensation)

Condensation may occur even within the operating humidity range. In such case, do not use the unit until the condensation dries up completely.

■ Do not place the unit in a corrosive atmosphere.

Do not install the unit in a corrosive atmosphere or in environments containing sulfuric acid mist, etc. This may cause corrosion of various conductors and bad contacts of connectors inside the unit leading to malfunction and failure, or in the worst case, a fire.

However, operation in such environments may be possible through alteration. If you wish to use the unit in such environments, consult your Kikusui agent or distributor.

■ Do not place the unit in a dusty location.

Accumulation of dust can lead to electric shock or fire.

■ Do not use the unit where ventilation is poor.

The unit employs a forced air cooling system. Air is taken in from air inlet located on panels other than the rear panel and exhausted from the air outlet on the rear panel. Secure adequate space around the unit to prevent the possibility of fire caused by accumulation of heat.

Allow at least 20 cm of space between the air inlet/outlet and the wall (or obstacles).

Hot air (approximately 20 °C higher than the ambient temperature) is exhausted from the air outlet. Do not place objects that are affected by heat near the air outlet.

■ **Do not place objects on top of the unit.**

Placing objects on top of the unit can cause failures (especially heavy objects).

■ **Do not place the unit on an inclined surface or location subject to vibrations.**

The unit may fall or tip over causing damages and injuries.

■ **Do not use the unit in a location where strong magnetic or electric fields are nearby or a location where large amount of distortion and noise is present on the input power line waveform.**

The unit may malfunction.

■ **Do not use the unit near highly sensitive measuring instruments or transceivers.**

The noise generated by the unit may affect them

■ **Secure adequate space around the power plug.**

Do not insert the power plug to an outlet where accessibility to the plug is poor. And, do not place objects near the outlet that would result in poor accessibility to the plug.

2.3 Precautions When Moving the Unit

When moving the unit to the installation location or when transporting the unit, note the following points.

■ **Turn off the POWER switch.**

Moving the unit while the power is turned on can cause electric shock or damage to the unit.

■ **Remove all wiring.**

Moving the unit with the cables connected can cause wires to break or injuries due to the unit falling over.

■ **Hold the handle.**

When lifting the unit, hold the handle on the side or top panel.

■ **When transporting the unit, be sure to use the original packing materials.**

Otherwise, damage may result from vibrations or from the unit falling during transportation.

2.4   Connecting the Power Cord

The power cord that is provided varies depending on the destination for the product at the factory-shipment.

⚠ **WARNING**

• This product is designed to be connected to a power supply classified as Overvoltage Category II. Do not connect to a power supply classified as Overvoltage Category III or IV.

• The power cord for 100-V system shown in Fig. 2-2 has a rated voltage of 125 VAC. If this power cord is used at the line voltage of a 200-V system, replace the power cord with that satisfying that line voltage.

   Have a qualified engineer select the appropriate power cord. If obtaining the right power cord is difficult, contact Kikusui distributor/agent.

• **Do not use the power cord that comes with the product as a power cord for other equipment.**
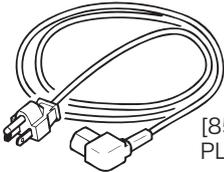
[85-AA-0003] PLUG:NEMA5-15	Power cord for 100-V system Rated voltage: 125 VAC Rated current: 10 A
[85-AA-0005] PLUG:CEE7/7 [85-10-0790] PLUG:GB1002	Power cord for 200-V system Rated voltage: 250 VAC Rated current: 10 A

Fig. 2-2   Power cord with a three-pin plug

1. Check that the AC power supply is within the input power supply range of the product.

   Input voltage range: 100 VAC to 240 VAC

   (100 V to 120 V and 200 V to 240 V for the PLZ164WA and PLZ664WA)

   Frequency range: 47 Hz to 63 Hz

2. Check that the POWER switch is turned off.

3. Connect the power cord to the AC INPUT connector on the rear panel.

   Use a power cord specified by Kikusui or one that has been selected by a qualified engineer.

4. Insert the power plug to the outlet.

2.5   Grounding (Earth)

⚠ WARNING
- Electric shock may occur, if proper grounding is not furnished.
- This product is designed as a Class I equipment (equipment furnished with electric shock protection through protective grounding in addition to the basic insulation). Be sure to connect the protective ground terminal to an appropriate earth ground.

⚠ CAUTION
- If you do not ground the product, malfunction may occur due to external noise, or the noise generated by the product may become large.

Make sure to ground the unit for your safety.

Connect the power cord to a three-pin power outlet with proper grounding.

Three-pin outlet with proper grounding
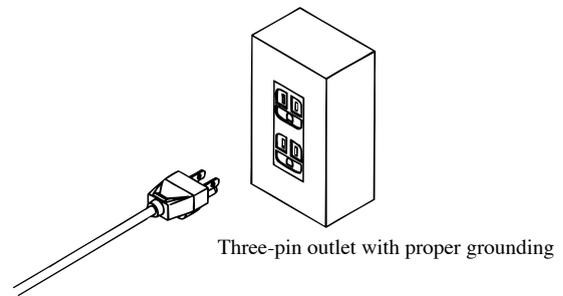
Fig. 2-3   Grounding method

2.6   Turning on The Power

<table>
<tr><td colspan="3">

Overview of the procedure

Carry out this procedure without connecting anything to the DC INPUT (load input terminal).
Turn on the POWER switch and then operate the LOAD key.
At the end, turn off the POWER switch.

If an alarm occurs during operation, see section 5.3, "Types of Protection Functions."
</td></tr>
<tr>
<td>Preparation</td>
<td>Main operation</td>
<td>Unit behavior</td>
</tr>
<tr>
<td>Do not connect anything to the load input terminal.</td>
<td>Turn on the POWER switch. Press the LOAD key.</td>
<td>The display section is activated.
LOAD indication LED illuminates.</td>
</tr>
</table>

Load on indication LED   LOAD key

POWER switch

Fig. 2-4

1. Turn off (○) the POWER switch.

2. Check that the power cord is correctly connected.

    See section 2.4, "Connecting the Power Cord" and 2.5, "Grounding (Earth)."

3. Check that nothing is connected to the DC INPUT (load input terminal) on the front and rear panels.

4. Turn on (|) the POWER switch.

    A self-test is executed. A special screen appears during the test at startup. A normal display appears when the self-test is complete.

5. Check whether the display appears as shown in Fig. 2-5.

    The measured value displayed using large numbers (section with mA, V, and W unit) indicates coarse zero.

    The characters "SET" shown under the measured value is highlighted with an underline.

This indicates that basic settings can be entered in the selected operation mode. This condition in which characters "SET" is highlighted is called the basic setting entry condition.

Constant current (CC) mode is selected on this screen. Therefore, current can be entered.
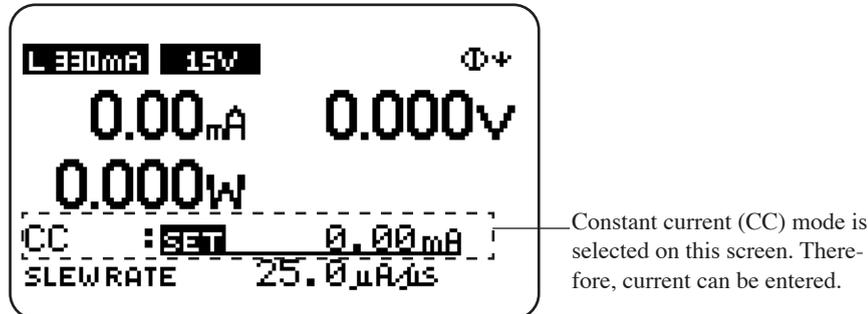
Fig. 2-5   Basic setting entry condition

6. Press the LOAD key and check that the LED above the key illuminates.

7. Press the LOAD key again and check that the LED above the key turns off.

8. Turn off the POWER switch to finish the operation check procedure.

    The PLZ-4W saves the last setup conditions through the backup function even when the power is turned off. When the power is turned on the next time, the PLZ-4W returns to the conditions that were backed up.

⚠ CAUTION • To prevent malfunction, allow at least 5 s between power cycles.

If the PLZ-4W does not operate as described in the procedure

If one of the following conditions applies to your case, carry out the corresponding procedure. If the condition does not change even after taking the countermeasure indicated below, contact Kikusui distributor/agent.

■ **Nothing is displayed.**

Check the power cord connection and power cycle the unit.

Adjust the display contrast. For the adjustment procedure, see the next page.

■ **Indicates an abnormal current or voltage.**

Power cycle the unit.

■ **An alarm occurs.**

See section 5.3, "Types of Protection Functions."

Adjusting the display contrast

1. While pressing the SHIFT key, use the rotary knob to adjust the contrast.

   The result is saved.

2.7 Checking the ROM Version
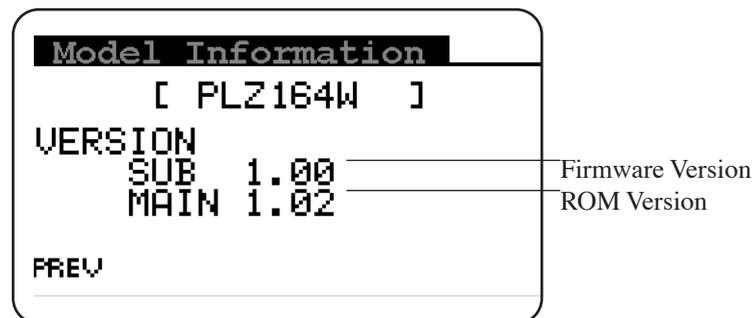
Fig. 2-6   Model Information screen (PLZ164W)

1. Press the MENU (SHIFT+SET/VSET) key.

   The menu screen is displayed.

2. Use the CURSOR ▼ key to select 4. Model Info.

   The selected section is highlighted.

3. Press the ENTER key.

   The Model Information screen of Fig. 2-6 is displayed.

4. Press the MENU (SHIFT+SET/VSET) key to close the menu.

2.8   Load Wiring

To ensure that the functions of the PLZ-4W work accurately and reliably, all wires must be connected correctly to their loads.

NOTE   • This operation manual refers to the terminal on the rear panel to which the equipment under test is connected and current is supplied as load input terminal.

2.8.1   Precautions Concerning Wiring

Electric wire used

⚠ CAUTION   • Use a load wire with sufficient diameter for the current as well as non-flammable or flame-resistant cover.

If the resistance of the load wire is large, a large voltage drop may occur when a current is supplied and the voltage at the load input terminal may fall below the minimum operating voltage. Refer to Table 2-1 and select thick wires as much as possible.

Table2-1   Nominal cross-sectional area of wires and allowable currents

Nominal Cross-Sectional Area [mm^2]	AWG	(Reference Cross-Sectional Area) [mm^2]	Allowable Current(*) [A] (Ta = 30 °C)	Kikusui-Recommended Current [A]
2	14	(2.08)	27	10
3.5	12	(3.31)	37	-
5.5	10	(5.26)	49	20
8	8	(8.37)	61	30
14	5	(13.3)	88	50
22	3	(21.15)	115	80
30	2	(33.62)	139	-
38	1	(42.41)	162	100
50	1/0	(53.49)	190	-
60	2/0	(67.43)	217	-
80	3/0	(85.01)	257	200
100	4/0	(107.2)	298	-
125	-	-	344	-
150	-	-	395	300
200	-	-	469	-
250	-	-	556	-
325	-	-	650	-

*Excerpts from Japanese laws related to electrical equipment.

Load wire inductance

The load wiring has an inductance (L). When the current (I) varies in short time period, it generates a large voltage at both ends of the wiring cable. This voltage applies to all of the load input terminals of the PLZ-4W when the impedance of the EUT is relatively small. The voltage generated by the load wire inductance (L) and the current variaiton (I) is expressed using the following equation.
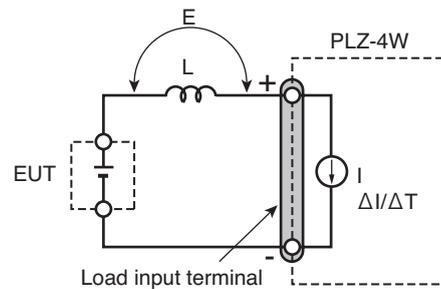
Fig. 2-7   Load wire and inductance

In general, the wire inductance can be measured approximately 1 μH per 1 meter. If the 10 meters of load cables is wired between the EUT and the PLZ-4W with the current variation of 10 A/μs, the voltage generated by the wire inductance will be 100 V.

The negative polarity of the load input terminal is the reference potential of the external control signal, therefore, the device connected to the external control terminal may get malfunctioned.

When operating under the constant voltage (CV) mode or constant resistance (CR) mode or constant power (CP) mode, the load current is varied by the voltage at the load input terminal, so the operation can be affected easily by the generated voltage.

The wiring to the EUT should be twisted and the shortest as possible.

If the load wire is long or has a large loop, the wire inductance is increased. Consequently, the current variation at the time of switching operation will cause a large voltage drop.

When the value of instantaneous voltage drops under the minimum operating voltage depends on   the generated voltage at the load input terminal, the response of recovery will be extensively delayed. In such event, the PLZ-4W may generate unstable oscillation or becomes into the hunting operation. In such condition, the input voltage may exceed the maximum input voltage and cause damage to the PLZ-4W.
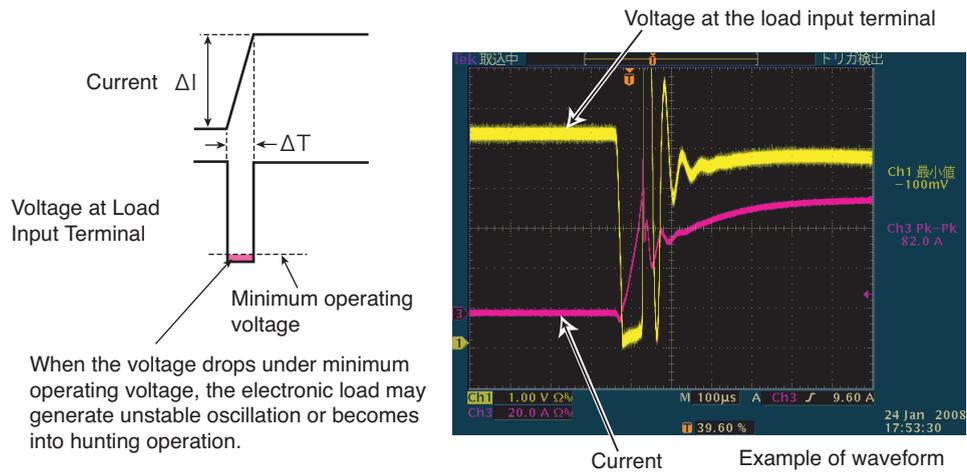
Fig. 2-8   Waveform example: Generate unstable oscillation or hunting operation

You must be careful especially when the slew rate setting is high or switching is performed using large currents through parallel operation.

To prevent problems, connect the PLZ-4W and the equipment under test using the shortest twisted wire possible to keep the voltage caused by inductance within the minimum operating voltage and maximum input voltage range or set a low slew rate.

If the high-speed response operation is not required, set the lower response speed and decrease the slew rate setting.

In the case of DC operation also, the phase lag of the current may cause instability in the PLZ-4W control inducing oscillation. In this case also, connect the PLZ-4W and the equipment under test using the shortest twisted wire possible. If only DC operation is required, a capacitor and a resistor may be connected to the load input terminal as shown in Fig. 2-9 to alleviate oscillation. In this case, use the capacitor within its allowable ripple current.

Example: R=10 Ω, C=100 μF
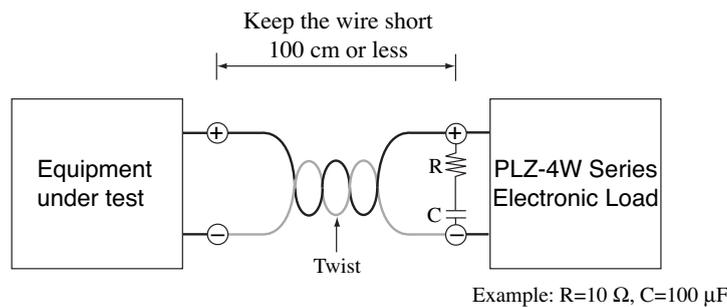
Fig. 2-9   Length of wiring

■ Operation when the response speed is changed

You can change the response speed in CC mode (CC+CV mode) and CR mode (CR+CV mode).

In some cases, the wire inductance increases and the phase lag of the current may cause instability in the PLZ-4W control inducing oscillation.

In such case, you can decrease the response speed to assure stable operation.
•   For a description of response speed, see section 5.15, "Response Speed."

Overvoltage

⚠ **CAUTION** • Do not apply voltage exceeding the maximum voltage of 150 VDC to the load input terminal, as it may cause damage.

The maximum voltage that can be applied to the load input terminal is 150 VDC. Voltage exceeding the maximum cannot be used.

If overvoltage is applied, an alarm message appears along with a beeping alarm, and the load is turned off. In this case, immediately lower the voltage of the equipment under test.
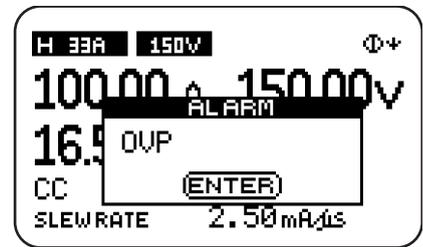
Fig. 2-10   Overvoltage alarm

Polarity

⚠ **CAUTION** • If the polarity is reversed, overcurrent may damage the EUT and PLZ-4W.

Be sure to match the polarities between the load input terminal and the equipment under test.
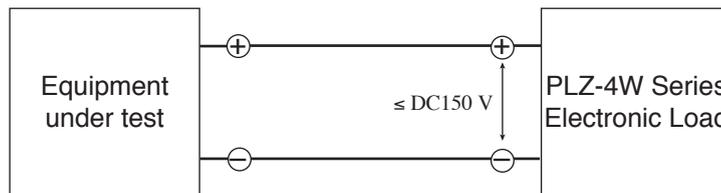
Fig. 2-11   Connection by paying attention to the polarity

If the polarity is reversed, an alarm message appears along with a beeping alarm. In this case, turn off the power of the equipment under test within 30 seconds after the alarm is activated. (the beeping alarm sounds when a reverse voltage of 0.6 V or greater is applied).

Fig. 2-12   Reverse connection alarm

2.8.2 Connection to the Load Input Terminal on the Rear Panel

Using the terminal cover

The load input terminal cover that comes with the package is used by passing through the load wire.

If the wire that you are using is thick and cannot be passed through the cover sleeve (where the wire is passed through), cut and adjust the size of the sleeve to match the thickness of the wire.

Use trial and error so that you don't cut too much of the sleeve.

φ15 line — φ10 line
φ25 line — φ20 line

Cut the sleeve to match the wire diameter by using the gauge as a reference.
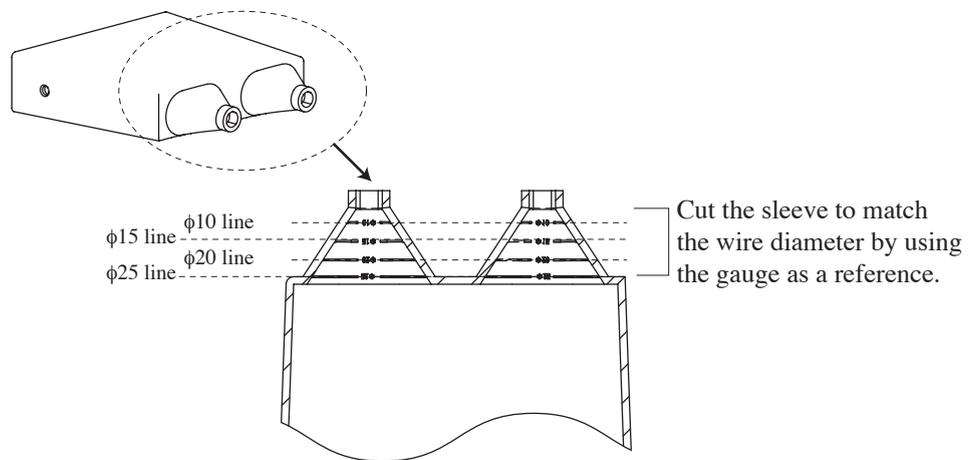
Fig. 2-13   Load input terminal cover

Attaching the lock plate

The lock plate is used to fix the load input terminal cover to the rear panel.

Once attached, you do not have to remove it. When using the load input terminal cover for the first time, attach the lock plate in advance.

Insert the lock plate to the groove on the side of the terminal.
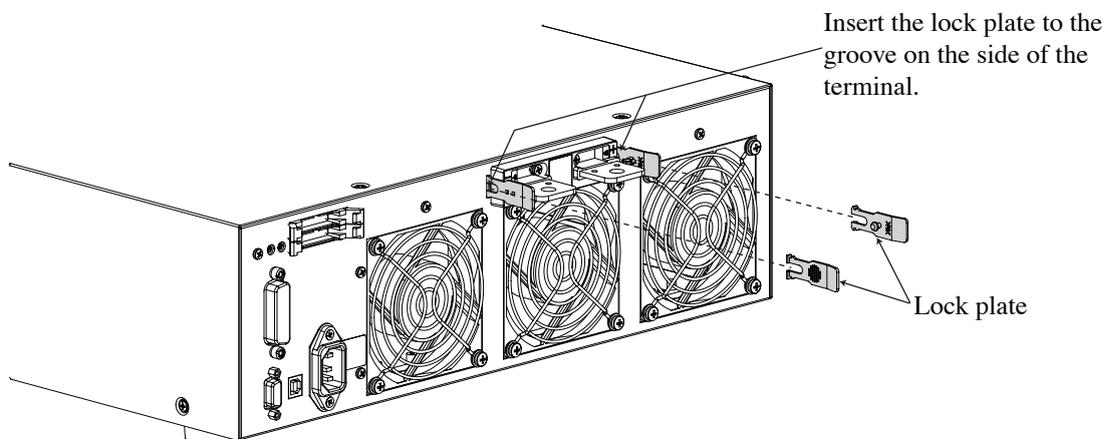
Lock plate

Fig. 2-14   Attachment of the lock plate

Connection procedure of the load input terminal on the rear panel

⚠ **WARNING**
- Do not touch the load input terminal while the PLZ-4W is turned ON, as it may lead to electric shock.
  In addition, be sure to use the load input terminal cover.
- The load input terminals on the front and rear panels are coupled inside the PLZ-4W. A voltage applied to one end will appear on the other end.

⚠ **CAUTION**
- Do not connect equipment to the load input terminals on the front and rear panels simultaneously, as it can cause damage.
- There is a danger of breakdown. Do not connect the equipment under test to the load input terminal when the load is turned on.
- There is a danger of overheat. Attach crimping terminal to the wire and use the set of screws that came with the package for connection.

1. Turn off the POWER switch.
2. Check that the output of the equipment under test is off.
3. Connect the load wire to the load input terminal on the rear panel.
   Use the load input terminal cover. See Fig. 2-13 on how to use the cover.
   For the connection procedure of the load wire, see Fig. 2-15.
4. Fix the load input terminal cover to the rear panel using the lock plate.
   Pass the inner pin of the lock plate through the hole on the side of the cover. For details, see Fig. 2-16.
5. Connect the load wire to the output terminal of the equipment under test.
6. Check the polarity of the connection.
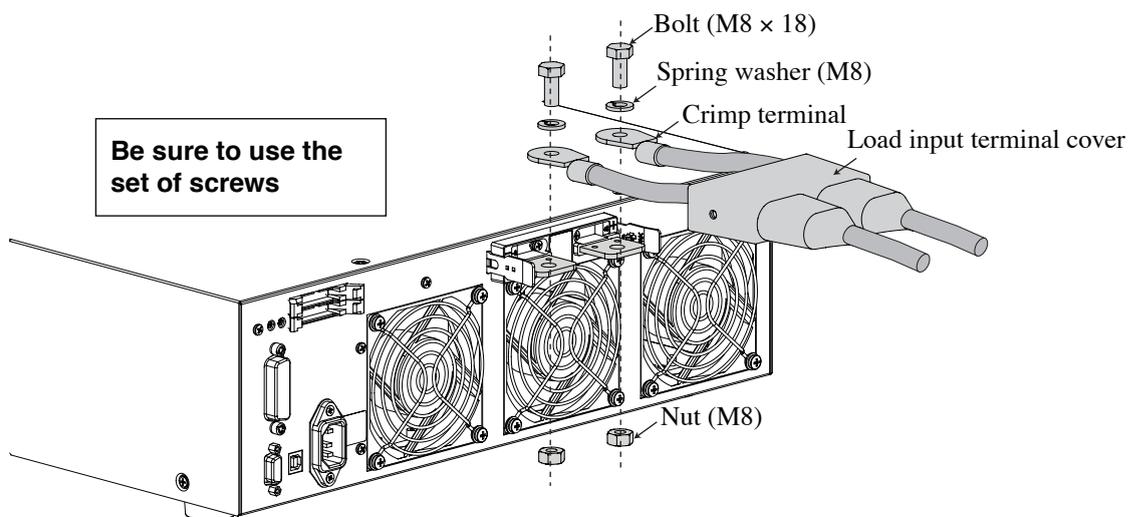
Fig. 2-15　Connection to the load input terminal on the rear panel

Move the cover until the edge touches the panel, and pinch the section indicated by the arrow to raise the side surface.

With the side surface of the cover raised, insert the lock plate pin into the hole.

Top view

Check that the left and right lock plate pins are securely inserted in the cover holes.
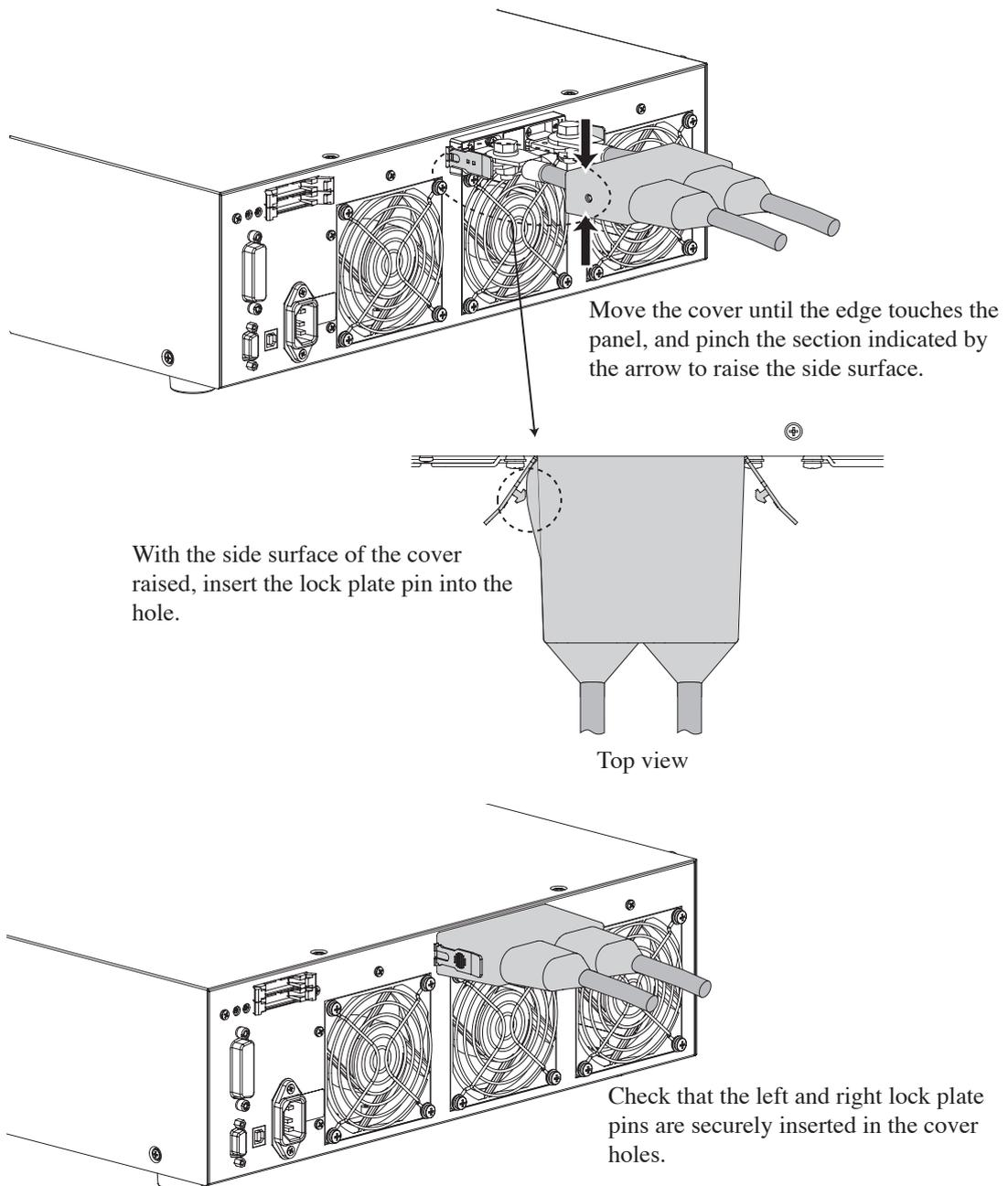
Fig. 2-16   Attachment of the load input terminal cover

Removing the load input terminal cover.

Open the lock plate left and right, and remove the pin from the hole of the cover.

2.8.3   Connection to the Load Input Terminal on the Front Panel

The load input terminal on the front panel can be used to easily connect the equipment under test and the PLZ-4W.

⚠ **WARNING**
- Do not touch the load input terminal while the PLZ-4W is turned ON, as it may lead to electric shock.
- The load input terminals on the front and rear panels are coupled inside the PLZ-4W. A voltage applied to one end will appear on the other end.

⚠ **CAUTION**
- Do not connect equipment to the load input terminals on the front and rear panels simultaneously, as it cause damage.
- There is a danger of breakdown. Do not connect the equipment under test to the load input terminal when the load is turned on.
- There is a danger of overheat. Attach crimping terminal to the wire and use the set of screws that came with the package for connection.

NOTE
- The specifications of the PLZ-4W are for the load input terminal on the rear panel.
- The maximum input current to the load input terminal on the front panel is 66 A. It is automatically limited to 66 A.

1. Turn off the POWER switch.

2. Check that the output of the equipment under test is off.

3. Connect the load wire to the load input terminal on the front panel.
   For the connection procedure of the load wire, see Fig. 2-17.

4. Connect the load wire to the output terminal of the equipment under test.

5. Check the polarity of the connection.
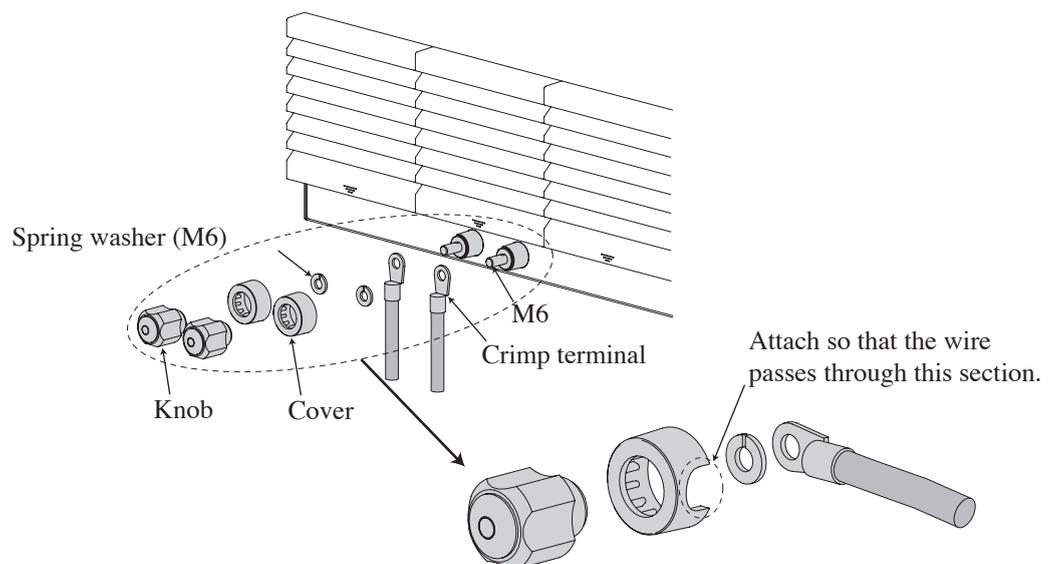
Fig. 2-17   Connection to the load input terminal on the front panel

3

Chapter 3　For First Time Users

This chapter describes for first time users, the operation modes of the PLZ-4W and matters that users should be familiar with in operating the PLZ-4W.

3.1 What Is an Electronic Load

When measuring the characteristics of the power supply in designing a power supply, a load that is applied to the power supply is required. An electronic load refers to a device that uses semiconductors (transistors) in place of a variable resistor to act as a load. Because voltage and current can be controlled freely on a semiconductor, the load can be controlled arbitrarily by embedding a control circuit.

The electronic load is used as (1) a load for various electronic circuits, (2) a load for characteristics tests and life tests of various DC power supplies such as a switching power supply and primary and secondary batteries, and (3) a load for aging. The sequence function can be used to simulate the load tests of power supplies with large load fluctuation (such as a power supply for a printer) in a condition that is close to the actual load.
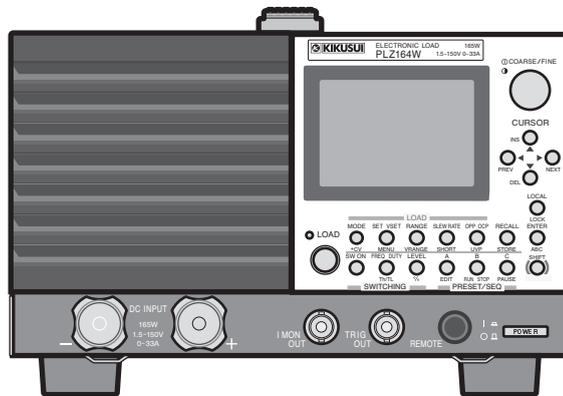
Fig.3-1   PLZ164W (1.5 V input type), PLZ164WA (0 V input type), and PLZ334W (1.5 V input type)
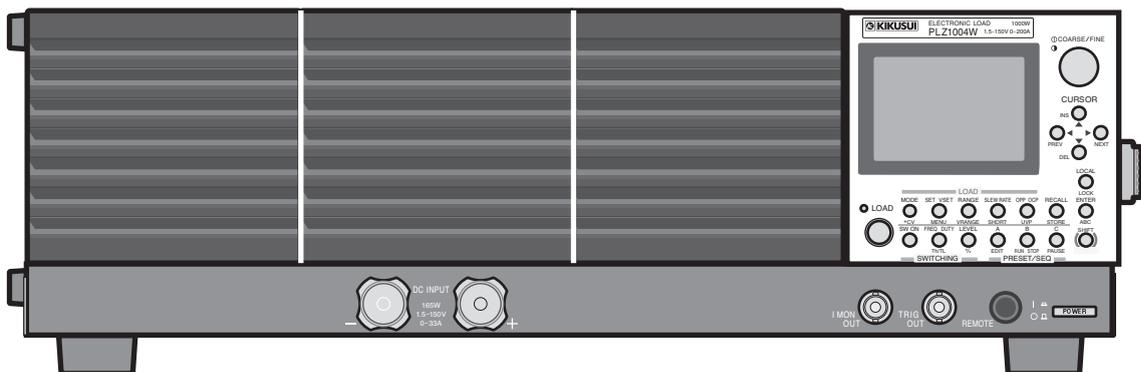
Fig. 3-2   PLZ664WA (0 V input type) and PLZ1004W (1.5 V input type)

3.2   Basic Flow of Operation

This section runs through the precautions concerning installation and preparation, the use of the operation panel, and functions that are convenient for performing experiments and tests.

- For details on the precautions concerning installation and preparation, see chapter 2, "Installation and Preparation."

Preparations before using the PLZ-4W

Precautions to be taken when installing or moving the PLZ-4W

Be sure to read section 2.2, "Precautions Concerning Installation Location" when installing the PLZ-4W.

When moving the PLZ-4W, be sure to turn off the power and remove the power cord. When lifting the PLZ-4W, hold the handle on the side or top panel.

- **Avoid using the PLZ-4W in a dusty environment, an environment with poor ventilation, on an inclined surface, a location subject to vibrations, or a location subject to strong magnetic or electric fields.**
- **Do not obstruct the air inlet on the front panel and the air outlet on the rear panel.**

Always ground the PLZ-4W

Be sure to earth ground the PLZ-4W before turning on the power to prevent electric shock.

Precautions to be taken when connecting the equipment under test

- **Be sure to turn off the power when touching the load input terminal (front and rear panels) or when connecting the load. Be especially careful of the polarity of the connection between the load input terminal and the equipment under test.**
- **Use a load wire with sufficient diameter for the current as well as non-flammable or flame-resistant cover.**
- **Do not connect equipment under test to the load input terminals on the front and rear panels simultaneously.**

On using the PLZ-4W

Precaution to be taken when turning on the power

Check that there are no irregularities in the input power supply or power cord before turning on the power. After connecting the power cord, turn on the POWER switch to turn on the PLZ-4W.

- **Allow at least 5 seconds between power cycles.**
- **If you feel something is wrong with the PLZ-4W, turn off the power switch. Then, remove the power plug from the outlet or remove the power cord from the PLZ-4W.**

Warming up the PLZ-4W

To perform stable measurements, allow the PLZ-4W to warm up for at least 30 minutes before starting tests. While the PLZ-4W is warming up, check the operation of the PLZ-4W and the connection of the equipment under test.

Voltage drop in the load wire

If the load wire is long, a voltage drop occurs due to the resistance of the cable. If the amount of voltage drop caused by the wire cannot be ignored or if you wish to set the resistance, voltage, and current accurately, execute remote sensing before making measurements. For the setup procedure of the remote sensing function, see section 6.7, "Remote Sensing Function."

How to use the operation panel

The PLZ-4W is controlled from the operation panel on the front panel. If you make an invalid selection or perform an invalid key operation, a beep is sounded to notify the error. In particular, please familiarize yourself with the use of the SHIFT key that changes the key function.

- For a description of the functions of each key, see chapter 4, "Names and Functions of Parts."
- **To prevent the possibility of electric shock, never touch the load input terminal while the equipment under test is connected and the power is turned on. When touching the load input terminal, be sure to turn off the equipment under test.**

■ Function of the LOAD key

If you press the LOAD key when the load is turned off, the LOAD LED illuminates, and the load turns on. If you press the LOAD key when the load is turned on, the LOAD LED turns off, and the load turns off.

⚠ CAUTION • There is a danger of breakdown. Turn off the load when applying the output of the equipment under test to the PLZ-4W. Then, turn the load on. If you are making the connection with the load turned on, be sure to turn off the output of the equipment under test.
If a relay or electromagnetic switch is inserted between the load input terminal and the output terminal of the equipment under test, turn on the relay or electromagnetic switch when the load is turned off. Then, turn the load on.

■ How to use the rotary knob
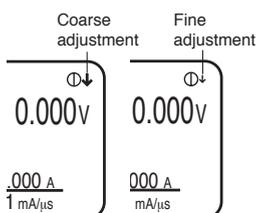
Coarse adjustment   Fine adjustment

⊕↓   ⊕↓
0.000v   0.000v

.000 A   .000 A
1 mA/μs   mA/μs

The rotary knob is used when setting values such as the current and resistance. Turning the rotary knob to the right increases the value and turning it to the left decreases the value. In addition, you can press the rotary knob to switch between coarse adjustment and fine adjustment. When the "↓" shown at the upper right corner of the screen is large, coarse adjustment is active; when it is small, fine adjustment is active. When setting a value, use coarse adjustment to set the value roughly, and then switch to fine adjustment to set value precisely.

- -

NOTE • You can traverse the full scale of values by turning the rotary knob ten and a few turns. Fine adjustment changes values at 1/10 of the rate of coarse adjustment.

- -
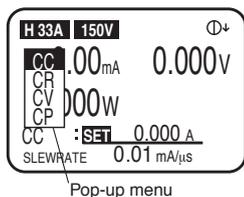
Pop-up menu

■ **Pop-up menu operation**

Some keys show a pop-up menu when you press the key. If you press the key again while the menu is shown, the selected item switches. Each time you press the key, the selected item switches one by one to the next item. When you finish the key operation, the item at that point is selected, and the pop-up menu automatically clears.

■ **How to use the SHIFT key**

The SHIFT key is used to switch the function of each key. If you press a key without holding down the SHIFT key, the function indicated above the key is enabled; if you press a key while holding down the SHIFT key, the function indicated below the key is enabled.

For example, if you press the SET/VSET key without holding down the SHIFT key, the SET/VSET (indicated in black) function is enabled. If you press the SET/VSET key while holding down the SHIFT key, the MENU (indicated in blue) is enabled.

This manual denotes the operation of holding down a key while holding down the SHIFT key as SHIFT+(notation above the key). For example, when selecting the MENU key, this manual denotes it as MENU (SHIFT+SET/VSET). In this case, press the SET/VSET key while holding down the SHIFT key.

Saving the setup conditions

You can use the memory function to save the settings that you are using. The ABC preset memories can save three separate sets of settings of each range of each operation mode. The setup memory can save 100 sets of the current setup condition and the contents of the ABC preset memories in that condition. The information saved to the memory is backed up even when the power is turned off (the information is saved until the PLZ-4W is initialized).

• For a description of the ABC preset memories, see section 6.1, "ABC preset memories." For a description of the setup memory, see section 6.2, "Setup Memory."

• For a description of initialization, see section 5.14, "Initialization."

Performing waveform simulation

The sequence function is used to perform waveform simulation. The sequence function automatically executes the time change of the waveform specified arbitrarily one operation at a time. The program information that you create is backed up even when the power is turned off.

• For a description of the sequence function, see section 6.6, "Sequence Function."

Maintenance and transportation after use

Before performing maintenance work, be sure to turn off the power and remove the power plug from the outlet or the power cord from the PLZ-4W.

• For details on maintenance, see chapter 8, "Maintenance and Calibration."

• **If the PLZ-4W requires repairs or readjustment, do not open the outer cover by yourself. Contact your Kikusui agent.**

• **When transporting the PLZ-4W, remove the power cord and cables, and use the original packing materials.**

3.3 Operating area of the PLZ-4W

As shown in Fig. 3-3, the PLZ-4W can be used within the area enclosed by the constant voltage line according to the rated voltage (L1), the constant power line according to the rated power (L2), the constant current line according to the rated current (L3), and the constant voltage line according to the minimum operating voltage (L4) (operating area where specifications are guaranteed). For PLZ-4Ws with the minimum operating voltage of 0 V, the specifications are guaranteed at input voltages at 0 V and greater. For 1.5 V input types, the specifications are guaranteed at input voltages of 1.5 V and greater. If the current is decreased, these types can be used even at voltages lower than 1.5 V. However, the specifications are not guaranteed. (Actual operating area)

Minimum voltage at which the current starts flowing to the PLZ-4W is approximately 0.3 V.

The PLZ-4W detects no signal at an input voltage less than or equal to approximately 0.3 V and an input current less than or equal to approximately 1 % of the range rating. If the input voltage is gradually increased from 0 V, no current will flow until 0.3 V is exceeded. Once a current greater than or equal to 1 % of the range rating starts flowing, the current can flow at voltages less than equal to 0.3 V.

If the minimum operating voltage (L5) in the actual operating area is reached, the operating status on the display indicates C.R using outline characters (see section 4.4, "Display").
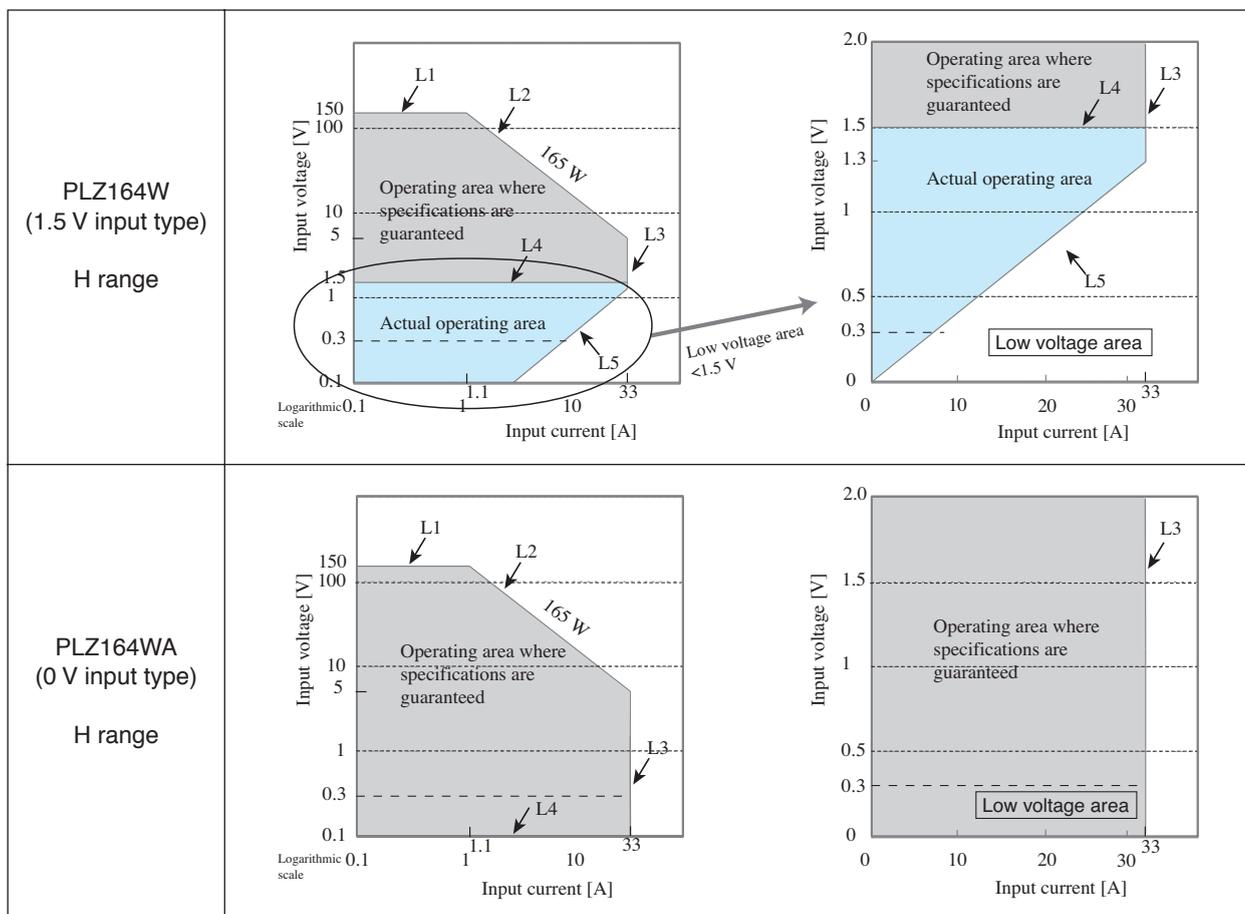
Fig. 3-3   Operating area

3.4 Basic Operation Modes

The following six operation modes are available on the PLZ-4W.

1. Constant current mode (CC mode)
2. Constant resistance mode (CR mode)
3. Constant power mode (CP mode)
4. Constant voltage mode (CV mode)
5. Constant current and constant voltage mode (CC+CV mode)
6. Constant resistance and constant voltage mode (CR+CV mode)

Below is a description of the most basic CC mode. For a detailed description, see appendix A.2, "Basic Operation Modes."

3.4.1 Operation of the CC Mode

In CC mode, the current is kept constant even when the voltage changes.

■ CC mode operation

When the PLZ-4W is used in CC mode, the PLZ-4W operates as a constant current load as shown in Fig. 3-4. The PLZ-4W sinks the specified current (I) independent of the output voltage of the constant-voltage power supply (V1).
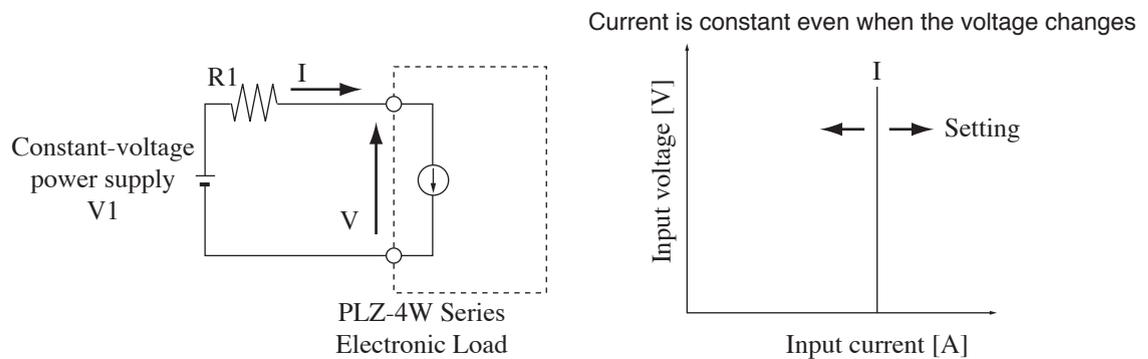
Fig. 3-4   Equivalent circuit of the constant current load and operation

■ Transition of the operating point

We will consider the case when checking the load characteristics of the constant-voltage power supply of Fig. 3-4 using CC mode.
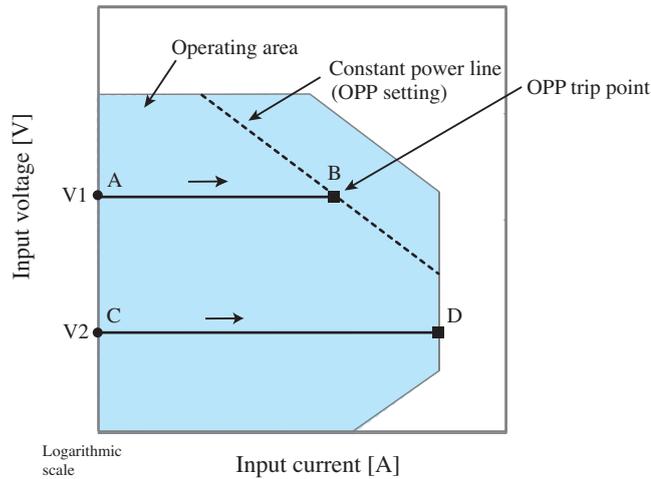
Fig. 3-5   Transition of the operating point in CC mode (OPP trip point)

Fig. 3-5: Operation on segment AB

If the voltage of the constant-voltage power supply is set to V1 and the input current (load current) of the PLZ-4W is increased, the operating point moves along segment AB.

When point B is reached, overpower protection (OPP) trips. At this point, two types of operation are available on the PLZ-4W depending on the protection action setting of the OPP.

If the protection action is set to LOAD OFF, an alarm screen indicating OPP appears, and the load turns off.

If protection action is set to LIMIT, the operating status indicates OPP, and the PLZ-4W sinks current as a constant power load at point B. Even if you attempt to increase the input current, the current is limited at point B. If you decrease the input current, the OPP is cleared, and the operating status indicates C.C. The PLZ-4W returns to CC mode, and the operating point moves along segment AB.

Table3-1   OPP action (protect action)

Point B	LOAD OFF	Turns off the load (stops the current flow). The PLZ-4W no longer operates as a load.
	LIMIT	CC mode ends. OPP continues, and the PLZ-4W sinks current as a constant power load.

Fig. 3-5: Operation on segment CD

If the voltage of the constant-voltage power supply is set to V2 and the input current (load current) of the PLZ-4W is increased, the operating point moves along segment CD. Point D is the maximum current at the range being used.

NOTE • The OPP action (protection action) and the OPP value are set in advance. For a description of the action setting, see section 5.13, "Menu Setup." For a description of the OPP value setting, see section 5.4, "Setting the Protection Function." For a description of the operating status indication, see section 4.4, "Display."

3.4.2   Let's Use CC Mode

This section describes the procedure of setting the operation mode to CC and turning on the load. Below is the flow of the operating procedure. Please familiarize yourself with the keys used in this procedure.

■ Operating procedure and operation panel

1) Turn on the power and check that the load is turned off.
2) Set the operation mode, range, current value, and the OPP value.
3) Turn on the load.
4) Change the current value.
5) Turn the load off.
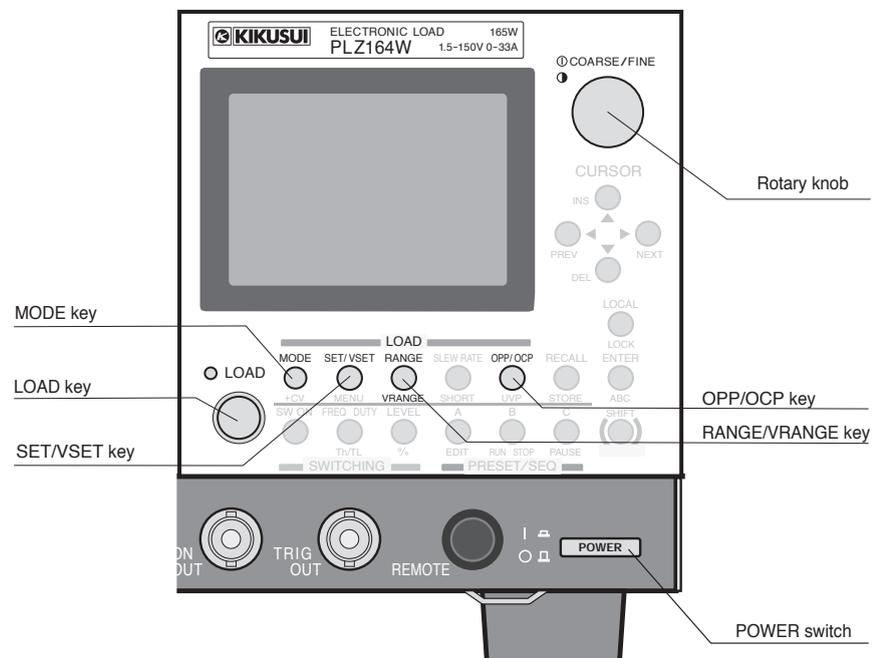
Fig. 3-6   Keys used in CC mode

■ Explanation of the operation

<u>1.</u>   Turn on the power.

Press the POWER switch to turn on the power to the PLZ-4W. Check that the LOAD LED is turned off. If the LED is illuminated, press the LOAD key to turn off the load.

NOTE   • When the load is turned ON, you cannot switch the operation mode and range.

H 33A **150V**

CC .00 mA 0.000 V
CR
CV
CP 00 W
CC :SET 0.000 A
SLEWRATE 0.01 mA/µs
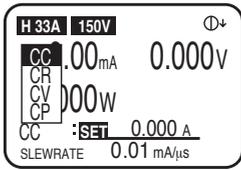
2. Select CC mode.

Press the MODE key to show the operation mode pop-up menu.

If CC is not highlighted, press the MODE key repetitively until CC is high-lighted.

When the pop-up menu closes, check that CC appears on the display.

H 33A 150V

L 0.33A
M 3.3A   0.000 V
H 33A
0.000 W
CC :SET 1.000 A
SLEWRATE 0.01 mA/µs
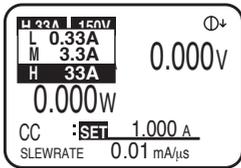
3. Select the current range.

Press the RANGE key to show the current range pop-up menu.

Each time you press the RANGE key while the menu is displayed, the current range switches in the order L (LOW), M (MIDDLE), and H (HIGH). When the desired range is highlighted, stop pressing the key.

Along with L, M, or H, the full scale value of the respective range is displayed. This value varies depending on the model.

4. Select the voltage range.

Press the VRANGE (SHIFT+RANGE) key to show the voltage range pop-up menu.

Each time you press the VRANGE key while the menu is displayed, the voltage range switches between 15 V and 150 V. When the desired range is high-lighted, stop pressing the key.

5. Set the current value.

Press the SET/VSET key to illuminate the SET/VSET key.

While viewing the display, turn the rotary knob.

You can press the rotary knob to switch between coarse adjustment and fine adjustment. First, use coarse adjustment to roughly set the value, and then switch to fine adjustment to adjust the value precisely.

H 33A **150V**

0.00 mA 0.000 V
0.000 W
CC :SET 0.000 A
OPP 181.5 W
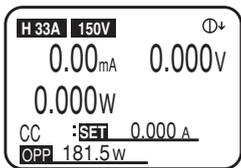
6. Set the OPP value.

Press the OPP/OCP key to illuminate the OPP/OCP key and show the OPP value on the display.

While viewing the display, turn the rotary knob.

You can press the rotary knob to switch between coarse adjustment and fine adjustment. First, use coarse adjustment to roughly set the value, and then switch to fine adjustment to adjust the value precisely.

7. Turn on the load.

Press the LOAD key to illuminate the LOAD LED and allow the current to flow.

At this point, the display shows the measured values (current, voltage, and power) at the load input terminal.

8. Change the current setting.

Turn the rotary knob while the load is turned on to change the current setting.

However, the current value cannot be set greater than the maximum value of the selected range.

9. Turn off the load.

Press the LOAD key to turn off the LOAD LED.

4
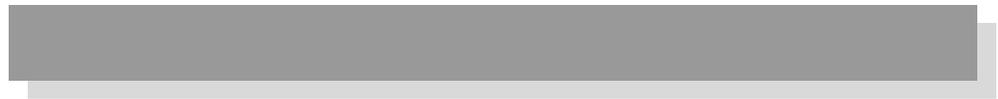
Chapter 4 Names and Functions of Parts

This chapter describes the names and functions of switches, connectors, and displays on the front panel and rear panel.

4.1 Front Panel

⚠ WARNING
- Do not touch the load input terminal while the PLZ-4W is turned ON, as it may lead to electric shock.

  In addition, be sure to use the load input terminal cover.
- The load input terminals on the front and rear panels are coupled inside the PLZ-4W. A voltage applied to one end will appear on the other end.

⚠ CAUTION
- Do not connect equipment to the load input terminals on the front and rear panels simultaneously, as it cause damage.
- Avoid using the PLZ-4W in a dusty environment or an environment with poor ventilation.
- Do not obstruct the air intake on the front panel and the air outlet on the rear panel.
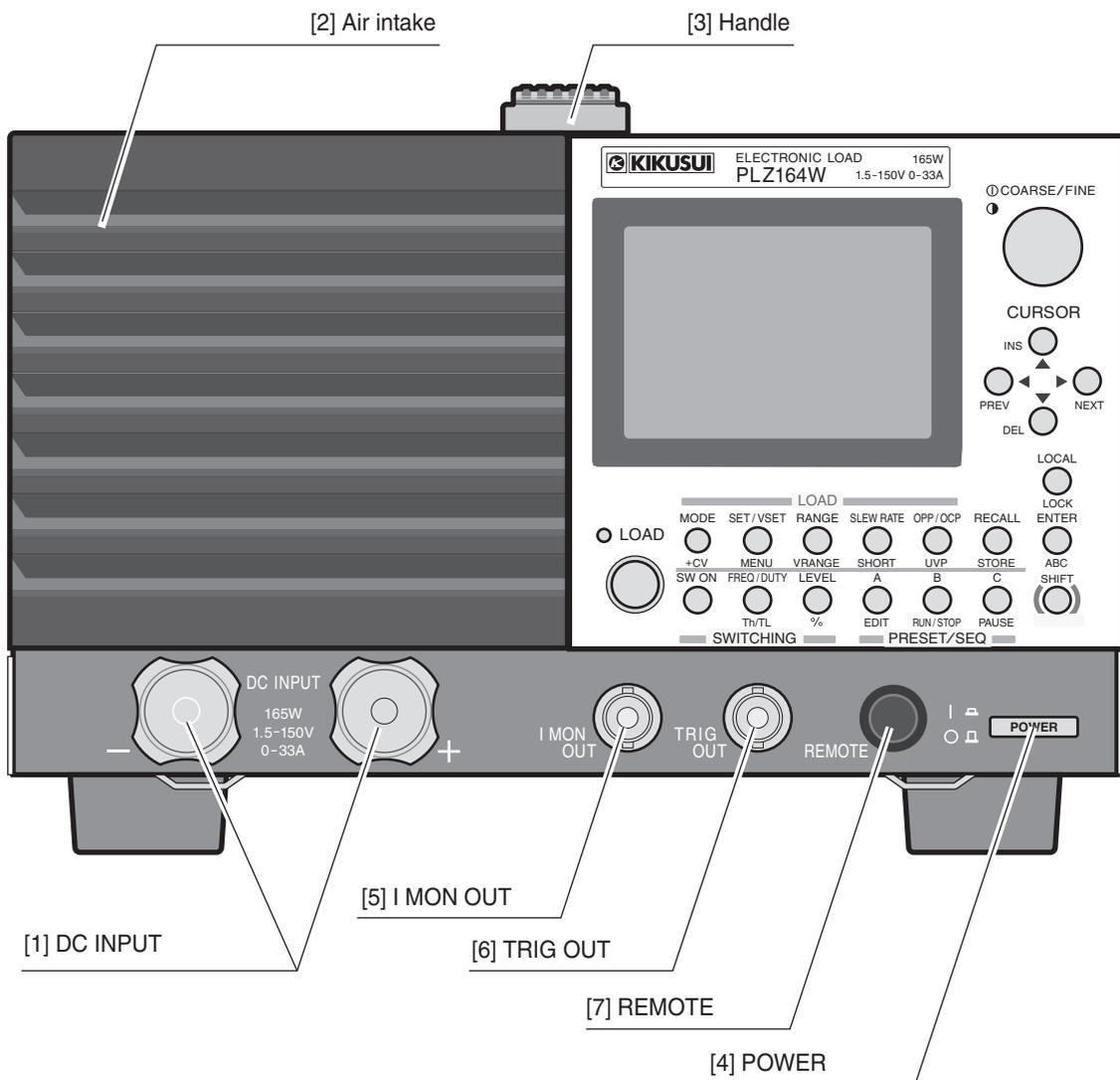
Fig.4-1   Front panel (PLZ164W)

[1] DC INPUT (load input terminal on the front panel)

The terminal on the front panel that can be used to easily connect the equipment under test and the PLZ-4W. The load input terminal is also available on the rear panel, and is connected in parallel with the load input terminal on the front panel.
- For the connection procedure, see section 2.8.3, "Connection to the Load Input Terminal on the Front Panel."

NOTE
- The specifications of the PLZ-4W are for the load input terminal on the rear panel. The load input terminal on the front panel may not satisfy the specifications.
- The maximum input current to the load input terminal on the front panel is 66 A. It is automatically limited to 66 A.

----

[2] Air intake (louver)

Takes in air to cool the inside of the PLZ-4W.

A dust filter is furnished on the inside. Clean the dust filter periodically.
- For details, see section 8.1.2, "Cleaning the Dust Filter."

[3] Handle

Used to lift the PLZ-4W. The handle is provided on the side panel on the PLZ1004W and the PLZ664WA. It is provided on the top panel on other models.

[4] POWER switch

Power switch of the PLZ-4W. The power toggles on and off each time the switch is pressed.

Pressing the POWER switch while holding down the ENTER key initializes the panel settings to factory default.
- For a description of turning on the power, see section 2.6, "Turning on The Power."
- For a description of initial settings, see section 5.14, "Initialization."

[5] I MON OUT connector

Output connector used to monitor the current. Connect a voltmeter or oscilloscope to monitor the current.
- For details, see section 6.9, "Monitor Signal Output."

[6] TRIG OUT connector

Outputs pulse signals during sequence operation or switching operation.
- For details, see section 6.9, "Monitor Signal Output."

[7] REMOTE connector

Connector for future functional expansion.

4.2 Rear Panel

WARNING • Do not touch the load input terminal while the PLZ-4W is turned ON, as it may lead to electric shock.

In addition, be sure to use the load input terminal cover.

• The load input terminals on the front and rear panels are coupled inside the PLZ-4W. A voltage applied to one end will appear on the other end.

CAUTION • Do not connect equipment to the load input terminals on the front and rear panels simultaneously, as it cause damage.

• Avoid using the PLZ-4W in a dusty environment or an environment with poor ventilation.

• Do not obstruct the air intake on the front panel and air exhaust on the rear panel with objects. In particular, allow at least 20 cm of space behind the PLZ-4W.
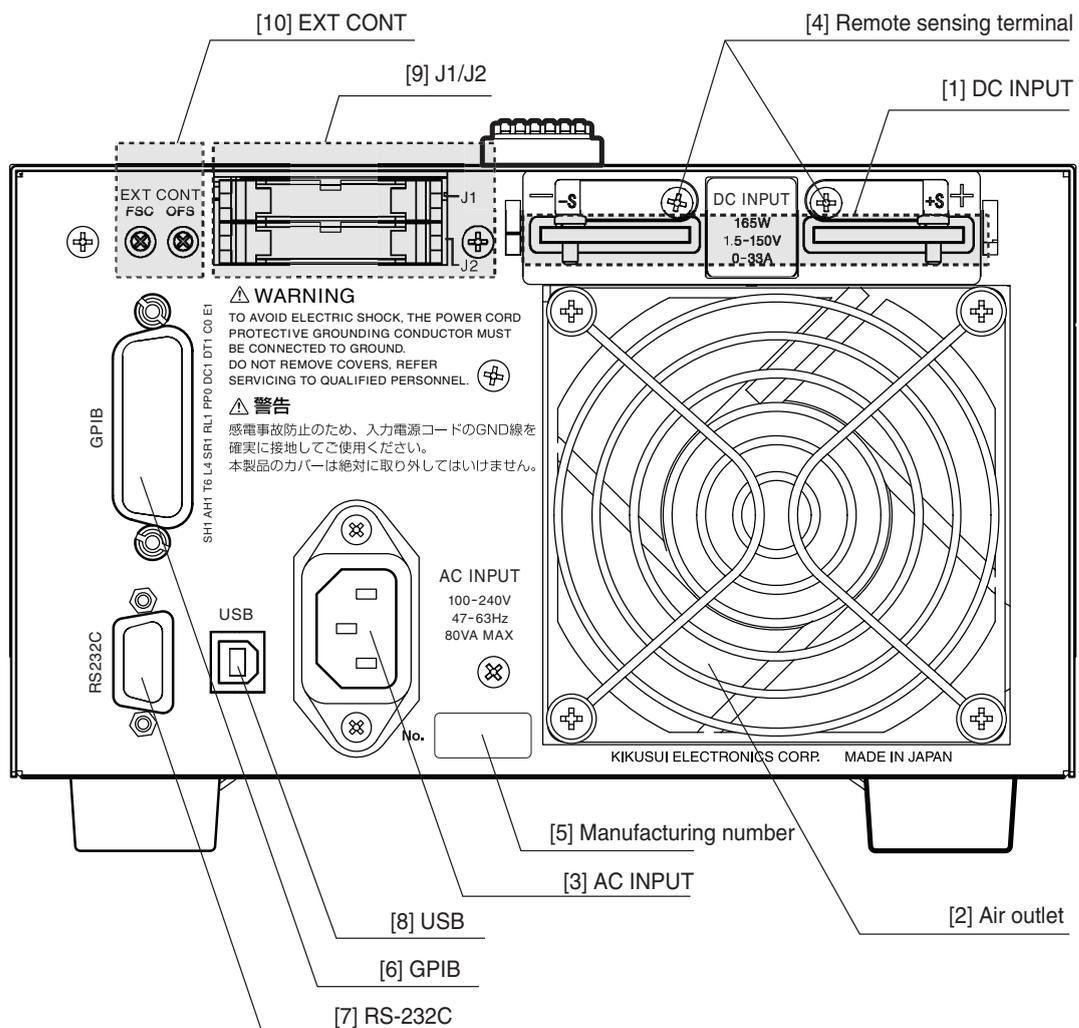
Fig. 4-2   Rear panel (PLZ164W)

[1] DC INPUT (load input terminal on the rear panel)

Terminal used to connect the equipment under test to the PLZ-4W. It is connected in parallel with the load input terminal on the front panel.
- For the connection procedure, see section 2.8.2, "Connection to the Load Input Terminal on the Rear Panel."

[2] Air outlet

Exhausts the internal air using the cooling fan to cool the inside of the PLZ-4W.

[3] AC INPUT connector

Connector used to connect the power cord.
- For a description of the connection, see section 2.4, "Connecting the Power Cord."

[4] Remote sensing terminal

Terminal used to connect the sensing wires when correcting the voltage drop caused by the resistance of the load wire.
- For details, see section 6.7, "Remote Sensing Function."

[5] Manufacturing number (serial No.)

Manufacturing number of the PLZ-4W.

[6] GPIB connector

Connector used to connect the GPIB cable when controlling the PLZ-4W externally.
- For a description of the interface setup, see section 7.4.1, "GPIB Control."

[7] RS-232C connector

Connector used to connect the RS-232C cable when controlling the PLZ-4W externally.
- For a description of the interface setup, see section 7.4.2, "RS-232C Control."

[8] USB connector

Connector used to connect the USB cable when controlling the PLZ-4W externally.
- For a description of the interface setup, see section 7.4.3, "USB Control."

[9] J1/J2 connector

Input/Output connector used to control the PLZ-4W externally using external voltage, resistance, relay contact, etc.

J1 is assigned to external control; J2 is assigned to parallel operation.
- For details on external control and the connector, see section 6.8.1, "Overview and precaution of External Control."

[10] EXT CONT

Variable resistor used to adjust the full scale and offset settings of the PLZ-4W with respect to the input value of the external control source (voltage or resistance).

4.3　Operation Panel

If you press a key while holding down the SHIFT key, the function indicated below the key is enabled.
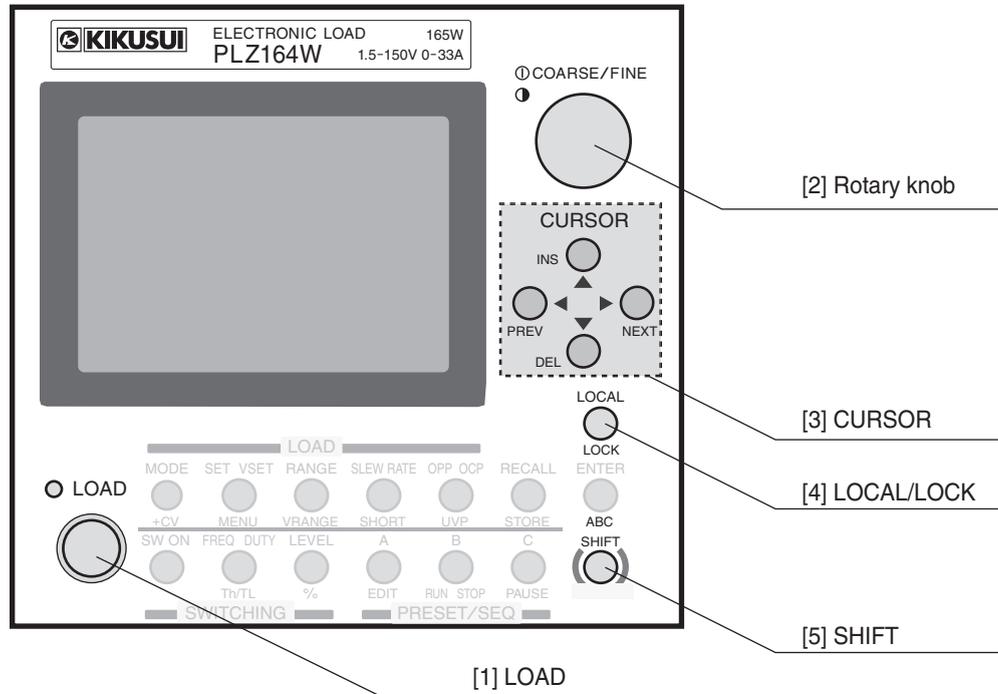
Fig. 4-3　Operation Panel

[1]　LOAD key

The current that flows through the PLZ-4W is turned on and off each time you press the key. When the load is turned on, the LED illuminates (green).

[2]　Rotary knob

The rotary knob is used to set various types of values on the PLZ-4W. By pressing the rotary knob you can switch between coarse adjustment and fine adjustment.

ⓘ COARSE/FINE

When set to coarse adjustment, " ↓ " appears on the screen. You can traverse the full scale of values by turning the rotary knob ten and a few turns When set to fine adjustment, " ↓ " appears. The value changes at 1/10 of the rate of coarse adjustment.

◑ Contrast

You can change the display contract by turning the rotary knob while holding down the SHIFT key.

[3]　CURSOR key

▲▼◄►

Moves the cursor up and down or right and left when selecting an item on the menu screen.

INS/DEL/PREV/NEXT

Operate the keys while holding down the SHIFT key to turn pages (PREV/NEXT) on the menu screen or insert (INS) or delete (DEL) steps of the sequence function.

[4] LOCAL/LOCK key

LOCAL

Switches to panel control (local control) when the PLZ-4W is being controlled remotely.

LOCK

Pressing this key while holding down the SHIFT key (SHIFT+LOCAL) locks the PLZ-4W. Pressing the LOCK (SHIFT+LOCAL) key while the PLZ-4W is locked releases the lock. When releasing the lock, keep holding the key until a beep is heard.

- For details, see section 5.11, "Lock Function."

[5] SHIFT key

Switches the function of each key. If you press a key without holding down the SHIFT key, the function indicated above the key is enabled; if you press a key while holding down the SHIFT key, the function indicated below the key is enabled.

[LOAD]
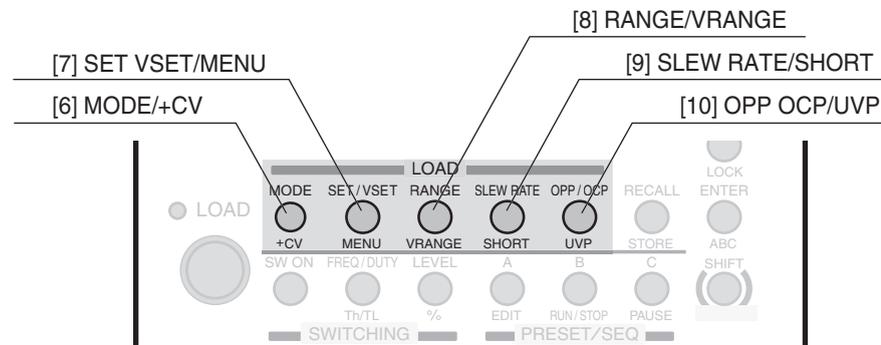
Fig. 4-4   Operation panel (LOAD)

[6] MODE/+CV key

MODE

Pressing this key when the load is turned off switches the operation mode.

Press the MODE key to show the operation mode pop-up menu. Each time you press the MODE key while the menu is displayed, the operation mode switches in the order CC, CR, CV, and CP.

When in switching mode (SW ON key is illuminated) or CC+CV or CR+CV mode, you cannot select the CV and CP operation modes on the pop-up menu. You cannot select the operation mode when the short function is enabled.

+CV

Pressing this key while holding down the SHIFT key (SHIFT+MODE) adds constant voltage mode (+CV) to CC mode or CR mode.

When in CC mode, this operation switches the mode to CC+CV; when in CR mode, this operation switches the mode to CR+CV. The current mode is indicated on the display.

[7] SET/VSET/MENU key

SET/VSET

Enters the basic setting (current, conductance, voltage, or power). This key illuminates when you can change the basic setting.

In CC+CV mode, current and voltage are selected alternately each time you press the key. In CR+CV mode, conductance and voltage are selected alternately each time you press the key.

MENU

Pressing this key while holding down the SHIFT key (SHIFT+SET VSET) shows the menu setup screen for setting the functions of the PLZ-4W and changing the settings.
- For details, see section 5.13, "Menu Setup."

[8] RANGE/VRANGE key

RANGE

Switches the current, conductance, or voltage range according to the operation mode.

Pressing the RANGE key when the load is turned off shows the range pop-up menu. Each time you press the RANGE key while the menu is displayed, the range switches in the order L, M, and H. You cannot select the range when the load is turned on or when the short function is enabled.

VRANGE

Pressing this key while holding down the SHIFT key (SHIFT+RANGE) switches the voltage range.

Pressing the VRANGE (SHIFT+RANGE) key when the load is turned off shows the range pop-up menu. Each time you press the VRANGE (SHIFT+RANGE) key while the menu is displayed, the range switches in the order 15 V and 150 V. You cannot select the range when the load is turned on or when the short function is enabled.

[9] SLEW RATE/SHORT key

SLEW RATE

Sets the slew rate value. This key illuminates when you can change the slew rate. You cannot select the slew rate in CV or CP mode.
- For details, see section 6.4, "Setting the Slew Rate."

SHORT

Pressing this key while holding down the SHIFT key (SHIFT+SLEW RATE) sets or clears the short function. A short icon is displayed while the short function is enabled. You cannot select the short function in switching, CV, or CP mode.
- For details, see section 5.12, "Short Function."

[10] OPP/OCP/UVP key

OPP/OCP

Sets the voltage for tripping the overpower protection (OPP) or the current for tripping the overcurrent protection (OCP). This key illuminates when you can set the OPP or OCP.

• For details, see section 5.4, "Setting the Protection Function."

UVP

Pressing this key while holding down the SHIFT key (SHIFT+OPP/OCP) enables you to set the voltage for tripping the undervoltage protection (UVP).

• For details, see section 5.4, "Setting the Protection Function."

[SWITCHING]
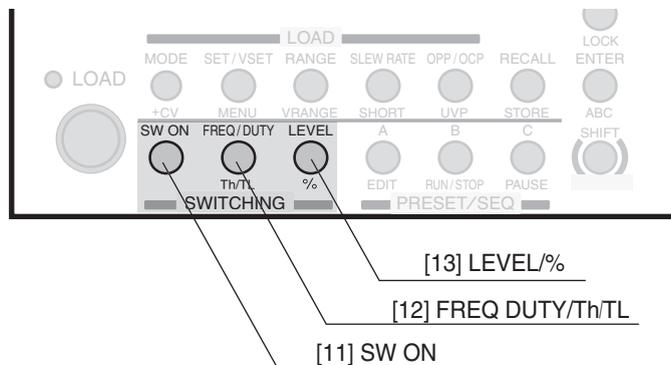
Fig. 4-5   Operation panel (SWITCHING)

[11] SW ON key

Turns on or off the switching mode. The switching mode is valid in CC mode or CR mode. The SW ON key illuminates in switching mode. You cannot select switching mode when the short function is enabled.

• For details, see section 6.3, "Switching Function."

[12] FREQ/DUTY/Th/TL key

FREQ/DUTY

Sets the switching frequency and duty cycle in switching operation. This key illuminates when you can set the switching frequency or duty cycle. FREQ and DUTY settings switch each time you press the key.

Th/TL

Pressing this key while holding down the SHIFT key (SHIFT+FREQ DUTY) enables you to set the switching time (Th: High side, TL: Low side) in switching operation. This key illuminates when you can change the switching time. Th and TL settings switch each time you press the key. You cannot select the switching time in CV or CP mode.

[13] LEVEL/% key

LEVEL

Sets the switching level in switching operation. This key illuminates when you can change the switching level.

%

Pressing this key while holding down the SHIFT key (SHIFT+LEVEL) enables you to set the switching level in terms of a percentage (0.0 % to 100.0 %) of the current setting. This key illuminates when you can change the switching level. You cannot select the switching level in CV or CP mode.

[PRESET/SEQ]
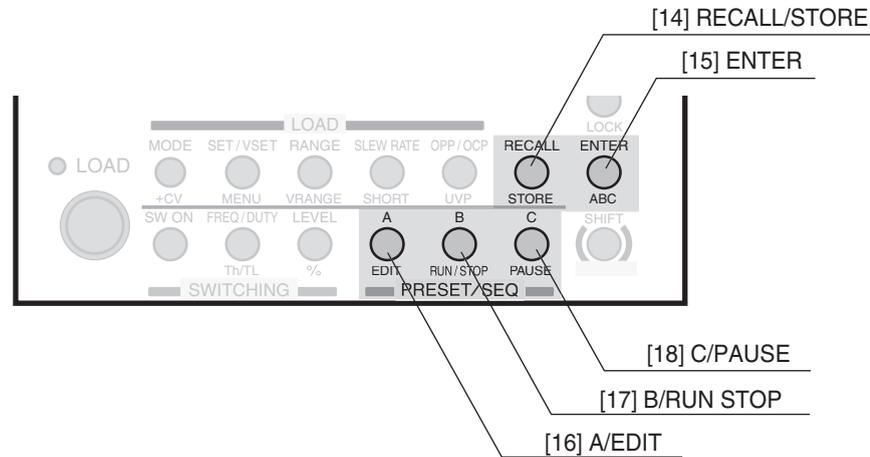
Fig. 4-6   Operation panel (PRESET/SEQ)

[14] RECALL/STORE key

RECALL

Recalls the panel settings saved to the setup memory. You cannot select this key when the load is turned on.

• For details, see section 6.2, "Setup Memory."

STORE

Pressing this key while holding down the SHIFT key (SHIFT+RECALL) saves the current panel settings to the setup memory.

[15] ENTER/ABC key

ENTER

Confirms various types of values during menu setup.
- Pressing the ENTER key when an alarm is activated resets the alarm. However, the alarm will be activated again if you do not correct the cause of the alarm.

ABC

Pressing this key while holding down the SHIFT key (SHIFT+ENTER) saves the current settings to the ABC preset memories.
- For details, see section 6.1, "ABC preset memories."

[16] A/EDIT key

A

Use this key to recall the settings stored in memory A or save the current settings to memory A.

EDIT

Pressing this key while holding down the SHIFT key (SHIFT+A) shows the sequence edit screen.
- For details, see section 6.6, "Sequence Function."

[17] B/RUN/STOP key

B

Use this key to recall the settings stored in memory B or save the current settings to memory B.

RUN/STOP

Pressing this key while holding down the SHIFT key (SHIFT+B) shows the sequence execution screen. Pressing RUN/STOP (SHIFT+B) when sequence operation is being executed aborts the operation.

[18] C/PAUSE key

C

Use this key to recall the settings stored in memory C or save the current settings to memory C.

PAUSE

Pressing this key while holding down the SHIFT key (SHIFT+C) pauses the sequence being executed. Pressing the PAUSE (SHIFT+C) key when the operation is paused resumes the sequence.

4.4 Display

You can change the display contract by turning the rotary knob while holding down the SHIFT key. The contrast setting is backed up even when the power is turned off.

[1] Range display   [2] Status display

[3] Measured value display

[4] Operation status display

[5] Elapsed time display

[6] Operation mode display

[7] Basic setting display

[8] Multi display

H 33A	150V		T⊙ R✓ ①↓

0.00mA   0.000V

0.000W   C . C

0:06:23

CC :SET 0.000 A

SLEWRATE 0.01 mA/μs
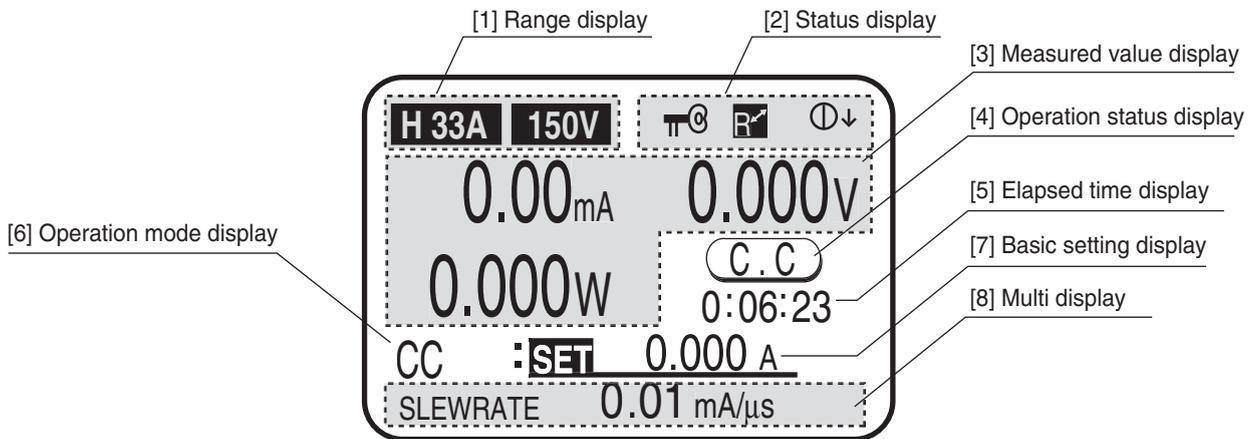
Fig. 4-7   Display

[1]   Range display

Displays the current and voltage range.

[2]   Status display

Displays (from the left) the lock, remote, and rotary knob coarse/fine adjustment status.

[3]   Measured value display

Displays the measured values of current (A), voltage (V), and wattage (W).

[4]   Operation status display

Displays the current operation mode when the load is turned on.

[5]   Elapsed time display

Displays the elapsed time since the load was turned on.

By factory default, the elapsed time display (Count Time) is turned off (not shown). To show the elapsed time, turn it on from the menu settings. You can also automatically turn off the load after a specified time elapses after the load is turned on (Cut Off).
•   For details of menu setup, see section 5.13, "Menu Setup."

[6]   Operation mode display

Displays the specified operation mode.

[7]   Setup display

Displays the basic setting in the specified operation mode.

[8]   Multi display

Displays various settings and current status according to the condition.

Chapter 5 Basic Operation

This chapter describes the operating procedure of each operation mode and other basic functions.

5.1 Panel Control Basics

The PLZ-4W is controlled from the operation panel on the front panel. If you make an invalid selection or perform an invalid key operation, a beep is sounded to notify the error. In particular, please familiarize yourself with the use of the SHIFT key that changes the key function.

- For a description of the functions of each key, see chapter 4, "Names and Functions of Parts."

■ Function of the LOAD key

If you press the LOAD key when the load is turned off, the LOAD LED illuminates, and the load turns on. If you press the LOAD key when the load is turned on, the LOAD LED turns off, and the load turns off.

■ How to use the rotary knob

Coarse adjustment   Fine adjustment

0.000v   0.000v

.000 A   000 A
1 mA/µs   mA/µs

The rotary knob is used when setting values such as the current and resistance. Turning the rotary knob to the right increases the value and turning it to the left decreases the value. In addition, you can press the rotary knob to switch between coarse adjustment and fine adjustment. When the ↓ shown at the upper right corner of the screen is large, coarse adjustment is active; when it is small, fine adjustment is active. When setting a value, use coarse adjustment to set the value roughly, and then switch to fine adjustment to set value precisely.
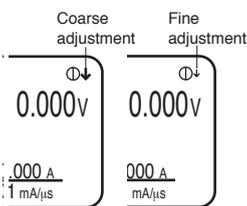
NOTE
- Fine adjustment changes values at 1/10 of the rate of coarse adjustment. When you turn the rotary knob while pressing the LOCAL key in the coarse adjustment, you can set the value more roughly.

■ Pop-up menu operation

H 33A 150V
CC .00 mA   0.000v
CR
CV 000w
CP
CC :SET 0.000 A
SLEWRATE 0.01 mA/µs
Pop-up menu

Some keys show a pop-up menu when you press the keys. If you press the key again while the menu is shown, the selected item switches. Each time you press the key, the selected item switches one by one to the next item. When you finish the key operation, the item at that point is selected, and the pop-up menu automatically clears.

■ How to use the SHIFT key

The SHIFT key is used to switch the function of each key. If you press a key without holding down the SHIFT key, the function indicated above the key is enabled; if you press a key while holding down the SHIFT key, the function indicated below the key is enabled.

For example, if you press the SET/VSET key without holding down the SHIFT key, the SET/VSET (indicated in black) function is enabled. If you press the SET/VSET key while holding down the SHIFT key, the MENU (indicated in blue) is enabled.

This manual denotes the operation of pressing a key while holding down the SHIFT key as SHIFT + (notation above the key). For example, when selecting the MENU key, this manual denotes it as MENU (SHIFT + SET/VSET). In this case, press the SET/VSET key while holding down the SHIFT key.

5.2   Turning On or Off the Load

"Turning on the load" refers to the operation of supplying current to the PLZ-4W. "Turning off the load" refers to the operation of cutting off the current to the PLZ-4W. The LOAD key is used to turn on or off the load. Please remember the expression "turning on the load" and "turning off the load", as they are used frequently in this manual.

⚠ CAUTION · There is a danger of breakdown. Turn off the load when applying the output of the equipment under test to the PLZ-4W. Then, turn the load on. If you are making the connection with the load turned on, be sure to turn off the output of the equipment under test.
If a relay or electromagnetic switch is inserted between the load input terminal and the output terminal of the equipment under test, turn on the relay or electromagnetic switch when the load is turned off. Then, turn the load on.

Functions related to turning on or off of the load

The PLZ-4W provides the following functions related to the turning on or off of the load.

■ Starting with the load turned on

By factory default, the load is not turned on unless you press the LOAD key after turning on the POWER switch.

If you select "2. Configuration" | "2. Power On" from the menu and set the Load On setting to on, the load is turned on when you turn on the POWER switch.
·   For a description of changing the menu setup, see section 5.13, "Menu Setup."

■ Displaying the elapsed time after the load is turned on

By default, the elapsed time after the load is turned on is not displayed.

If you select "1. Setup" | "1. Function" from the menu and set the Count Time setting to on, the time from load on to load off can be displayed.

This function is useful when used in conjunction with the UVP in the discharge test of batteries and capacitors.
·   For a description of changing the menu setup, see section 5.13, "Menu Setup."

■ Turning off the load after a specified time elapses

By default, the load on timer is off.

If you select "1. Setup" | "4. Cut Off" from the menu and set the time in "Time," the load automatically turns off after a specified time elapses after the load is turned on.

When the load turns off, a pop-up window appears indicating the input voltage at the time the load was turned off. This function is useful in discharge tests of batteries and capacitors.
·   For a description of changing the menu setup, see section 5.13, "Menu Setup."

■ Turning on or off the load externally

You can also turn on or off the load using an external signal through a relay or other similar methods.
- For a description of external control, see section 6.8.7, "External Control of Load On and Load Off."

5.3 Types of Protection Functions

The protection function automatically turns off or limits the load when an input that can damage the internal circuit of the PLZ-4W appears and to protect the equipment under test.

When a protection function trips, an alarm is activated. When an alarm is activated, the load is turned off (or limited), and the ALARM STATUS of the J1 connector on the rear panel (pin 16) turns on (open collector output by a photocoupler).

There are two types of protection functions: those that allow you to set the trip point and those with a fixed trip point. In addition, for the OCP and the OPP, you can specify whether to turn off or limit the load when the protection trips.
- For the operation of the protection function in each operation mode, see appendix A.2, "Basic Operation Modes."

Overcurrent protection (OCP)

The protection trips when a current that is equal to or exceeds the specified overcurrent value or 110 % of the maximum current of each range flows. At this point, the load is turned off (LOAD OFF) or the current is limited (LIMIT).

To change the protect action, select "1. Setup" | "2. Protect Action" | "OCP" and specify LIMIT or LOAD OFF.

When LIMIT is specified, the alarm is cleared when the alarm condition is corrected.
- For a description of setting the overcurrent value, see section 5.4, "Setting the Protection Function."
- For a description of changing the menu setup, see section 5.13, "Menu Setup."

Overvoltage protection (OVP)

The protection trips when a voltage that is equal to or exceeds 110 % of the maximum input voltage is applied. At this point, the load is turned off.

Overpower protection (OPP)

The protection trips when a power that is equal to or exceeds the specified overpower value or 110 % of the maximum power of each range is applied. At this point, the load is turned off (LOAD OFF) or the current is limited (LIMIT).

To change the protect action, select "1. Setup" | "2. Protect Action" | "OPP" and specify LIMIT or LOAD OFF.

When LIMIT is specified, the limit is cleared when the alarm condition is corrected.
- For a description of setting the overpower value, see section 5.4, "Setting the Protection Function."
- For a description of changing the menu setup, see section 5.13, "Menu Setup."

Undervoltage protection (UVP)

The protection trips when the voltage that is equal to or falls below the specified voltage. At this point, the load is turned off. The undervoltage protection can be disabled (OFF).

- For a description of setting the undervoltage value, see section 5.4, "Setting the Protection Function."

Reverse connection protection (REV)

The protection trips when a reverse voltage is applied to the load input terminal. At this point, the load turns off.

In this case, turn off the power of the equipment under test within 30 seconds after the protection detects a reverse voltage.

Overheat protection (OHP)

The protection trips when the temperature inside the power unit exceeds 95 °C. At this point, the load is turned off.

Check whether the air intake on the front panel and the air outlet on the rear panel are being obstructed.

Alarm input protection

The protection trips when a low level (TTL) signal is applied to the ALARM INPUT (pin 10) of the J1 connector on the rear panel.

Reset the alarm on the equipment connected to external control, and then reset the alarm on the PLZ-4W.

■ Clearing alarms

You can press the ENTER key when an alarm is activated to reset the alarm. However, note that the alarm will be activated again, if the cause of the alarm is not corrected.

5.4 Setting the Protection Function

You can set trip points for the OCP, OPP, and UVP.

■ Setting the OPP and OCP

The OPP and the OCP activate an alarm and turn off the load or limit the power or current when overpower or overcurrent occurs. When LOAD OFF is specified, a pop-up window appears when an alarm is activated.

By default, the PLZ-4W is set up to limit the power or current. The protect action is specified from the menu.

- For a description of changing the menu setup, see section 5.13, "Menu Setup."

1. **With the load turned off, check the operation mode.**

    OCP is not indicated in CC mode.

    OPP is not indicated in CP mode.

2. **Select OPP or OCP.**

    Press the OPP/OCP key.

    The OPP/OCP key illuminates.

3. **Select the one you wish to set.**

    Select OPP or OCP.

    OPP or OCP is highlighted each time you press the OPP/OCP key. Highlight the one you wish to set.

4. **Set the overpower or overcurrent value.**

    While viewing the display, turn the rotary knob to set the value.

■ Setting the UVP

When the input voltage that is equal to or falls below the specified value, an alarm is activated, the load is turned off, and a pop-up window appears. If the Count Time setting is on, the time from load on to load off is displayed in the pop-up window.

1. **Select UVP.**

    Press the UVP (SHIFT+OPP/OCP) key.

    The UVP key illuminates.

2. **Set the undervoltage value.**

    While viewing the display, turn the rotary knob to set the value.

    If you are not using the undervoltage protection, select OFF.

5.5 Operation Modes

The following four operation modes are available on the PLZ-4W. Furthermore, constant voltage mode (+CV) can be added to CC and CR modes.

- Constant current mode (CC mode and CC+CV mode)
- Constant resistance mode (CR mode and CR+CV mode)
- Constant voltage mode (CV mode)
- Constant power mode (CP mode)

■ Switching operation modes

You can switch the operation mode by pressing the MODE key when the load is turned off. Press the MODE key to show the operation mode pop-up menu. Each time you press the MODE key while the menu is displayed, the selected item switches one by one to the next item.

When you finish the key operation, the operation mode at that point is selected, and the pop-up menu automatically clears. The operation mode is indicated on the display.

By pressing +CV (SHIFT+MODE) in CC mode or CR mode, you can add CV mode.

The figure below shows the transition of operation modes.
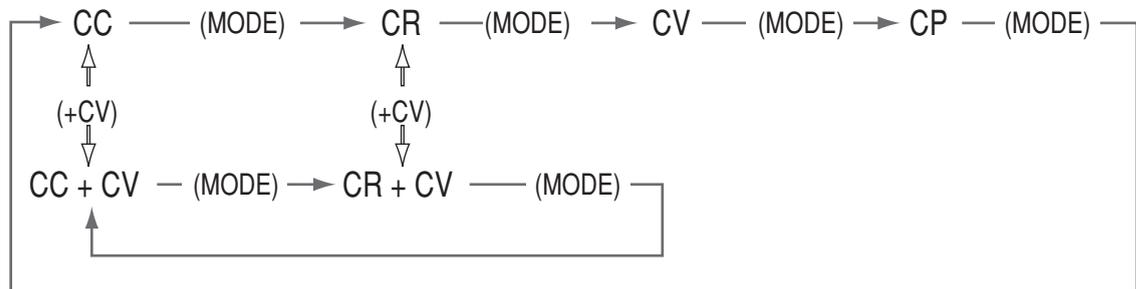
Fig.5-1   Transition of operation modes

NOTE   • You can add +CV mode even when the load is turned on.

5.6 CC Mode

In CC mode, you set the current [A]. You can also add +CV mode to CC mode.

```
Overview of the procedure

    Select the operation mode, and set the current value.
    Turn on the load and change the current value.
    Finally, turn off the load to cut off the current.

        Preparation              Main operation              Unit behavior

    Check that the load is    Turn on the load.         The display shows the
    turned off.               Change the current        voltage, current, and
    Set the operation mode.   value.                    wattage at the load input
                              Turn off the load.        terminal.
```

■ Operating procedure of CC mode

Fig. 5-2   Keys used in CC mode

1. Check that the load is turned off.

    Check that the LOAD LED is turned off. If it is on, press the LOAD key to turn it off.

2. Select the operation mode.

    Press the MODE key.

    > *An operation mode pop-up menu appears.*

    Press the MODE key repetitively until CC is highlighted on the menu.

    After selecting the operation mode, check that CC is indicated on the display.

3. Select the current range.

    Press the RANGE key.

    > *A current range pop-up menu appears.*
    >
    > *Each time you press the RANGE key while the menu is displayed, the range switches in the order L, M, and H.*

    When the desired range is highlighted, stop pressing the key.

    Along with L, M, or H, the full scale value of the respective range is displayed. This value varies depending on the model.

4. Select the voltage range.

Press the VRANGE (SHIFT+RANGE) key.

> *A voltage range pop-up menu appears.*
>
> *Each time you press the VRANGE key, the voltage range switches between 15 V and 150 V.*

When the desired range is highlighted, stop pressing the key.

5. Set the current value.

Check that the display is in the basic setting entry condition (the characters "SET" is highlighted).

While viewing the display, turn the rotary knob.

First, use coarse adjustment to roughly set the value, and then switch to fine adjustment to adjust the value precisely.

6. Turn on the load.

Press the LOAD key.

> *The LOAD LED illuminates, and the current flows.*
>
> *The display shows the measured values (voltage, current, and wattage) at the load input terminal.*

7. Change the current setting.

Turn the rotary knob to change the current setting.

The current value cannot be set greater than the maximum value of the selected range.

8. Turn off the load.

Press the LOAD key.

> *The LOAD LED turns off, and the current is cut off.*

■ Operating procedure of CC+CV mode
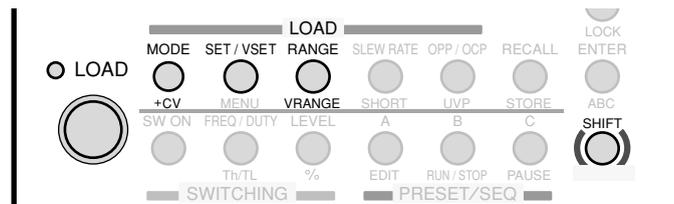
Fig. 5-3   Keys used in CC+CV mode

1. Check the operation mode.

Check that CC is indicated on the display.

2. Select the operation mode.

Press the +CV (SHIFT+MODE) key.

> *The mode switches to CC+CV.*

Check that CC+CV is indicated on the display.

3. Select the current range and voltage range.

Press the RANGE key to select the current range.

Press the VRANGE (SHIFT+RANGE) key to select the voltage range.

4. Set the current and voltage values.

Check that the display is in the basic setting entry condition (the characters "SET" is highlighted).

While viewing the display, turn the rotary knob.

To switch between current and voltage settings, press the SET/VSET key.

5. Turn on the load.

Press the LOAD key.

The LOAD LED illuminates, and the current flows.

The display shows the measured values (voltage, current, and wattage) at the load input terminal.

6. Change the current or voltage setting.

Turn the rotary knob to change the setting.

To switch between current and voltage settings, press the SET/VSET key.

7. Turn off the load.

Press the LOAD key.

The LOAD LED turns off, and the current is cut off.

5.7   CR Mode

In CR mode, you set the conductance [S], an inverse of the resistance. The resistance calculated from the conductance is also displayed.

- Conductance [S] = 1/resistance [Ω]

You can also add +CV mode to CR mode. In CR+CV mode, only the conductance is displayed.

Overview of the procedure

Select the operation mode, and set the resistance.
Turn on the load and change the conductance.
Finally, turn off the load to cut off the current.

Preparation	Main operation	Unit behavior
Check that the load is turned off. Set the operation mode.	Turn on the load. Change the conductance. Turn off the load.	The display shows the voltage, current, and wattage at the load input terminal.

■ Operating procedure of CR mode

Fig. 5-4   Keys used in CR mode

1. Check that the load is turned off.

    Check that the LOAD LED is turned off. If it is on, press the LOAD key to turn it off.

2. Select the operation mode.

    Press the MODE key.

    An operation mode pop-up menu appears.

    Press the MODE key repetitively until CR is highlighted on the menu.

    After selecting the operation mode, check that CR is indicated on the display.

3. Select the current and conductance range.

Press the RANGE key.

A current range pop-up menu appears.

Each time you press the RANGE key while the menu is displayed, the range switches in the order L, M, and H.

When the desired range is highlighted, stop pressing the key.

Along with L, M, or H, the full scale value of the respective range is displayed. This value varies depending on the model.

You cannot select separately the range for current and conductance.

4. Select the voltage range.

Press the VRANGE (SHIFT+RANGE) key.

A voltage range pop-up menu appears.

Each time you press the VRANGE key, the voltage range switches between 15 V and 150 V.

When the desired range is highlighted, stop pressing the key.

5. Set the conductance [S].

Check that the display is in the basic setting entry condition (the characters "SET" is highlighted).

While viewing the display, turn the rotary knob.

First, use coarse adjustment to roughly set the value, and then switch to fine adjustment to adjust the value precisely.

When you press the SET/VSET key, the resistance calculated from the conductance is indicated at the multi display.

6. Turn on the load.

Press the LOAD key.

The LOAD LED illuminates, and the current flows.

The display shows the measured values (voltage, current, and wattage) at the load input terminal.

7. Change the conductance setting.

Turn the rotary knob to change the conductance setting.

The conductance cannot be set greater than the maximum value of the selected range.

8. Turn off the load.

Press the LOAD key.

The LOAD LED turns off, and the current is cut off.

■ Operating procedure of CR+CV mode
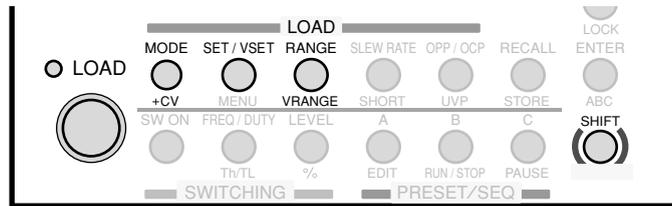
Fig. 5-5   Keys used in CR+CV mode

1. Check the operation mode.

    Check that CR is indicated on the display.

2. Select the operation mode.

    Press the +CV (SHIFT+MODE) key.

        The mode switches to CR+CV.

    Check that CR+CV is indicated on the display.

3. Select the current range and voltage range.

    Press the RANGE key to select the current range.

    Press the VRANGE (SHIFT+RANGE) key to select the voltage range.

4. Set the conductance and voltage.

    Check that the display is in the basic setting entry condition (the characters "SET" is highlighted).

    While viewing the display, turn the rotary knob.

    To switch between conductance and voltage settings, press the SET/VSET key.

5. Turn on the load.

    Press the LOAD key.

        The LOAD LED illuminates, and the current flows.

        The display shows the measured values (voltage, current, and wattage) at the load input terminal.

6. Change the conductance setting.

    Turn the rotary knob to change the conductance setting.

    The conductance cannot be set greater than the maximum value of the selected range.

7. Turn off the load.

    Press the LOAD key.

        The LOAD LED turns off, and the current is cut off.

5.8   CV Mode

In CV mode, you set the Voltage [V].

Overview of the procedure

Select the operation mode, and set the voltage value.
Turn on the load and change the voltage value.
Finally, turn off the load to cut off the current.

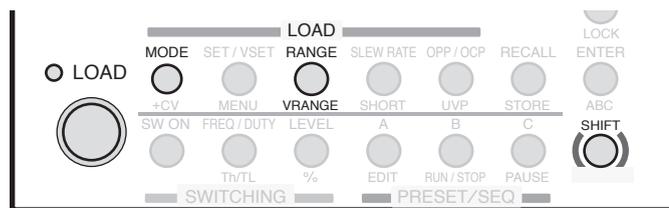| Preparation	Main operation	Unit behavior
Check that the load is turned off. Set the operation mode.	Turn on the load. Change the voltage value. Turn off the load.	The display shows the voltage, current, and wattage at the load input terminal.

■ Operating procedure of CV mode

Fig. 5-6   Keys used in CV mode

1.   **Check that the load is turned off.**

Check that the LOAD LED is turned off. If it is on, press the LOAD key to turn it off.

2.   **Select the operation mode.**

Press the MODE key.

An operation mode pop-up menu appears.

Press the MODE key repetitively until CV is highlighted on the menu.

Check that CV is indicated on the display.

3.   **Select the current range.**

Press the RANGE key.

A current range pop-up menu appears.

Each time you press the RANGE key while the menu is displayed, the range switches in the order L, M, and H.

When the desired range is highlighted, stop pressing the key.

Along with L, M, or H, the full scale value of the respective range is displayed. This value varies depending on the model.

4. Select the voltage range.

Press the VRANGE (SHIFT+RANGE) key.

A voltage range pop-up menu appears.

Each time you press the VRANGE key, the voltage range switches between 15 V and 150 V.

When the desired range is highlighted, stop pressing the key.

5. Set the voltage value.

Check that the display is in the basic setting entry condition (the characters "SET" is highlighted).

While viewing the display, turn the rotary knob.

First, use coarse adjustment to roughly set the value, and then switch to fine adjustment to adjust the value precisely.

6. Turn on the load.

Press the LOAD key.

The LOAD LED illuminates, and the current flows.

The display shows the measured values (voltage, current, and wattage) at the load input terminal.

7. Change the voltage setting.

Turn the rotary knob to change the voltage setting.

The voltage value cannot be set greater than the maximum value of the selected range.

8. Turn off the load.

Press the LOAD key.

The LOAD LED turns off, and the current is cut off.

5.9 CP Mode

In CP mode, you set the wattage (W).


Overview of the procedure

Select the operation mode, and set the wattage.
Turn on the load and change the wattage.
Finally, turn off the load to cut off the current.

Preparation	Main operation	Unit behavior
Check that the load is turned off. Set the operation mode.	Turn on the load. Change the wattage. Turn off the load.	The display shows the voltage, current, and wattage at the load input terminal.

■ Operating procedure of CP mode
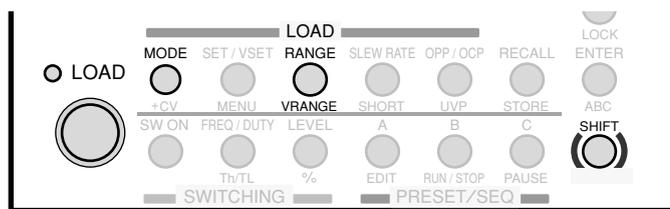
Fig. 5-7   Keys used in CP mode

<u>1.</u>   **Check that the load is turned off.**

Check that the LOAD LED is turned off. If it is on, press the LOAD key to turn it off.

<u>2.</u>   **Select the operation mode.**

Press the MODE key.

> *An operation mode pop-up menu appears.*

Press the MODE key repetitively until CP is highlighted on the menu.

After selecting the operation mode, check that CP is indicated on the display.

<u>3.</u>   **Select the current range.**

Press the RANGE key.

> *A current range pop-up menu appears.*

> *Each time you press the RANGE key while the menu is displayed, the range switches in the order L, M, and H.*

When the desired range is highlighted, stop pressing the key.

Along with L, M, or H, the full scale value of the respective range is displayed. This value varies depending on the model.

4. Select the voltage range.

Press the VRANGE (SHIFT+RANGE) key.

> *A voltage range pop-up menu appears.*

> *Each time you press the VRANGE key, the voltage range switches between 15 V and 150 V.*

When the desired range is highlighted, stop pressing the key.

5. Set the wattage value.

Check that the display is in the basic setting entry condition (the characters "SET" is highlighted).

While viewing the display, turn the rotary knob.

First, use coarse adjustment to roughly set the value, and then switch to fine adjustment to adjust the value precisely.

6. Turn on the load.

Press the LOAD key.

> *The LOAD LED illuminates, and the current flows.*

> *The display shows the measured values (voltage, current, and wattage) at the load input terminal.*

7. Change the wattage setting.

Turn the rotary knob to change the wattage setting.

The wattage value cannot be set greater than the maximum value of the selected range.

8. Turn off the load.

Press the LOAD key.

> *The LOAD LED turns off, and the current is cut off.*

5.10 Soft Start Function

The soft start function is used to gradually raise the input current at the load end by tracking the rise time of the output voltage of the equipment under test in CC and CR modes. By setting the soft start time, the distortion of the output voltage of the equipment under test is suppressed enabling the test to be carried out in a condition that is close to the actual load.

The soft start function is activated when the voltage is applied during turning the load to on.

——— Rise time of the DC power supply
······· Rise time of the electronic load

When soft start is not used   When soft start is used
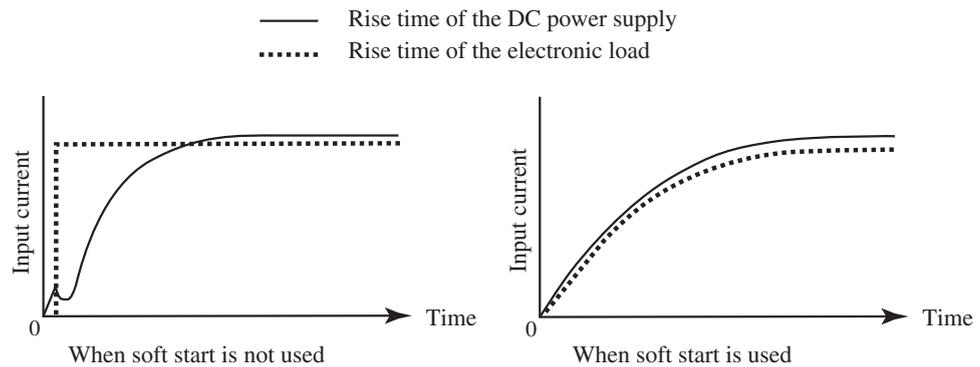
Fig. 5-8   Operation of the soft start function

■ Procedure

Fig. 5-9   Keys used in soft start

1. **Check that the load is turned off.**

   Check that the LOAD LED is turned off. If it is on, press the LOAD key to turn it off.

2. **Select the menu setup.**

   Press the MENU (SHIFT + SET/VSET) key.

   The menu appears.

3. **Select Setup.**

   Press the ▼ or ▲ CURSOR key several times until Setup is highlighted on the menu.

   When highlighted, press the ENTER key.

Menu
1. Setup
2. Configuration
3. Calibration
4. Model Info

PREV   NEXT

```
┌─────────────────────┐
│ ▉Setup▉              │
│                     │
│  1.▉Function▉       │
│  2. Protect Action  │
│  3. Memory          │
│  4. Cut Off         │
│  5. Response        │
│ PREV          NEXT  │
└─────────────────────┘

┌─────────────────────┐
│ ▉Function▉          │
│                     │
│  Soft Start  : 1ms  │
│  Count Time : OFF   │
│                     │
│                     │
│ PREV                │
└─────────────────────┘
```

<u>4.</u>   Select Function.

Press the ▼ or ▲ CURSOR key several times until Function is highlighted on the menu.

When highlighted, press the ENTER key.
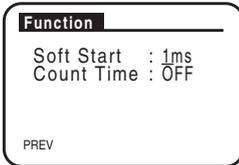
<u>5.</u>   Select soft start time.

Check that the cursor is blinking by Soft Start on the menu, and turn the rotary knob to select the soft start time.

<u>6.</u>   Exit from the menu.

Press the MENU (SHIFT + SET/VSET) key.

> *The display returns to the basic setting entry condition (the characters "SET" is highlighted).*

> *The soft start time is set.*

5.11   Lock Function

The PLZ-4W can be locked to prevent erroneous operation such as inadvertently changing the settings or overwriting the memory or sequence. The functions that can be used and those that cannot be used when the lock function is enabled are indicated below.

Table5-1   Lock function

Functions that can be used	Functions that cannot be used
Load on/off	Setting change
Sequence execution	Sequence construction
Lock set/clear	Memory store (save)
ABC preset memory recall	
Setup memory recall	
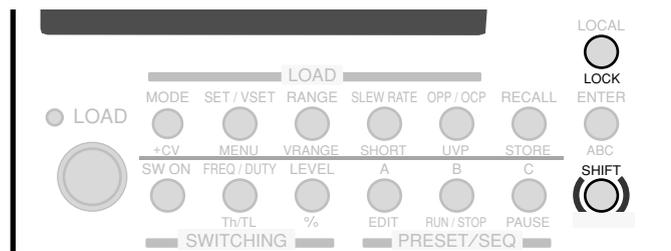
Fig. 5-10   Keys used in the lock function

■ Setting the lock

Key icon

1.   Set the lock.

Press the LOCK (SHIFT+LOCAL) key.

A key icon is indicated on the display, and the PLZ-4W is locked.

When locked, you can only carry out the following key operations: turn on or off the load, execute sequences, recall ABC preset memories, recall setup memories, and release the lock.

■ Releasing the lock

1.   Release the lock.

Hold down LOCK (SHIFT+LOCAL) for a few seconds until a beep is heard.

The key icon clears, and the lock is released.

■ Locking the PLZ-4W at power on

By default, the PLZ-4W is not locked at power on. You can change the setting from the menu so that the PLZ-4W is locked at power on.

1.   Check that the load is turned off.

Check that the LOAD LED is turned off. If the LED is illuminated, press the LOAD key to cut off the current.

Menu

1. Setup
2. Configuration
3. Calibration
4. Model Info

PREV   NEXT

Configuration

1. Master/Slave
2. Power On
3. Interface
4. External

PREV   NEXT

Power On

Load On   : OFF
Key Lock   : O̱N

PREV
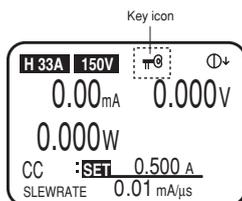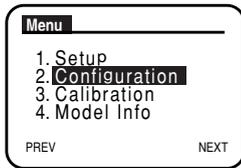
2. Select the menu setup.

   Press the MENU (SHIFT + SET/VSET) key.

   The menu appears.

3. Select Configuration

   Press the ▼ or ▲ CURSOR key several times until Configuration is highlighted on the menu. When highlighted, press the ENTER key.
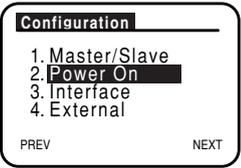
4. Select Power On.

   Press the ▼ or ▲ CURSOR key several times until Power On is highlighted on the menu. When highlighted, press the ENTER key.

5. Select key lock.

   Press the ▼ CURSOR key to move the blinking cursor by Key Lock on the menu.

   Turn the rotary knob to the right to display ON and left to display OFF. To lock the PLZ-4W at power on, select ON.
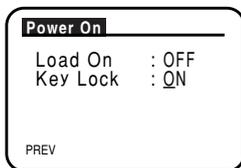
6. Exit from the menu.

   Press the MENU (SHIFT + SET/VSET) key.

   The display returns to the basic setting entry condition (the characters "SET" is highlighted).

   When you turn on the PLZ-4W the next time, it will be locked.

   To perform panel operation, hold down LOCK (SHIFT+LOCAL) for a few seconds until a beep is heard to release the lock.

5.12 Short Function

The short function is used to immediately set the maximum current (CC mode) or minimum resistance (CR mode).

When the short function is enabled, the short signal output of the J1 connector is turned on. The short signal output terminal is connected to a relay contact (30 VDC/1 A) and can be used to drive an external relay for high current to short the load input terminal.

For a description of the J1 connector, see "J1 and J2 Connectors" in section 6.8, "External Control."

⚠ **CAUTION** • Be sure to use a dedicated driver circuit to drive the relay for high current.
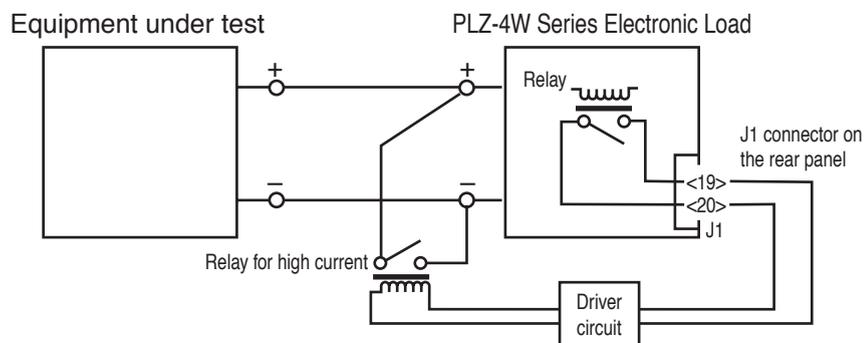
Fig. 5-11   Connection example of a relay for high current

■ **Procedure**
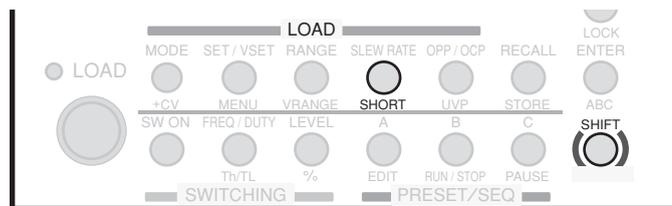
Fig. 5-12   Keys used in the short function
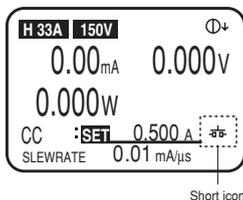
Short icon

1. Execute the short function.

    With the load turned on, press the SHORT (SHIFT+SLEW RATE) key.

    A short icon appears. When in CC mode, the value is set to the maximum current; when in CR mode, the value is set to the minimum resistance.

    • The short function setting cannot be saved to the setup memory.

2. Clear the short function.

    Press the SHORT (SHIFT+SLEW RATE) key again.

    The short icon clears, and the PLZ-4W returns to the original condition before the short function was executed.

5.13 Menu Setup

The menu is used to change the operating conditions of the PLZ-4W and the default settings of functions.

This section describes the operations on the menu and a list of menu items.

The hierarchical structure of the menu is shown below.

```
┌─────────────────────┐
│ Menu                │
│                     │
│ 1. Setup            │
│ 2. Configuration    │
│ 3. Calibration      │
│ 4. Model Info       │
│                     │
│ PREV          NEXT  │
└─────────────────────┘
```

```
┌─────────────────────┐
│ Setup               │
│                     │
│ 1. Function         │
│ 2. Protect Action   │
│ 3. Memory           │
│ 4. Cut Off          │
│ 5. Response         │
│ PREV          NEXT  │
└─────────────────────┘
```
→ To function settings

```
┌─────────────────────┐
│ Configuration       │
│                     │
│ 1. Master/Slave     │
│ 2. Power On         │
│ 3. Interface        │
│ 4. External         │
│                     │
│ PREV          NEXT  │
└─────────────────────┘
```
→ To environmental settings
Items on this screen are confirmed by power cycling the PLZ-4W.

```
┌─────────────────────┐
│ Calibration         │
│                     │
│ 1. CC(Low)          │
│ 2. CC(Mid)          │
│ 3. CC(High)         │
│ 4. CC 15V           │
│ 5. CC 150V          │
│ PREV          NEXT  │
└─────────────────────┘
```
→ To calibration items
See chapter 8, "Maintenance and Calibration.".

```
┌─────────────────────┐
│ Model Information   │
│     [ PLZ164W ]     │
│                     │
│ VERSION             │
│    SUB   1.00       │
│    MAIN 1.02        │
│ PREV                │
└─────────────────────┘
```
→ Displays specific information about the model that you are using.

Fig. 5-13   Menu hierarchy

■ Procedure
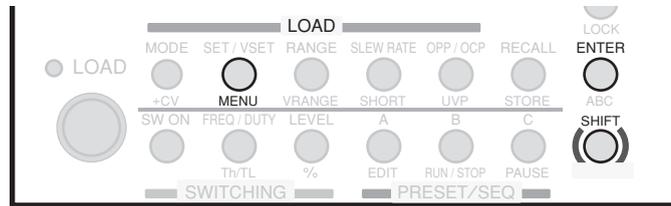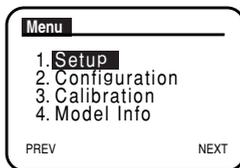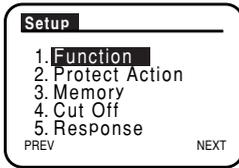
1. **Check that the load is turned off.**

    Check that the LOAD LED is turned off. If it is on, press the LOAD key to turn it off.

2. **Select the menu setup.**

    Press the MENU (SHIFT + SET/VSET) key.

    The menu appears.

```
┌─────────────────────┐
│ Menu                │
│                     │
│ 1. Setup            │
│ 2. Configuration    │
│ 3. Calibration      │
│ 4. Model Info       │
│                     │
│ PREV          NEXT  │
└─────────────────────┘
```

3. **Select the menu.**

    Press the ▼ or ▲ CURSOR key several times until the desired menu item is highlighted on the menu. When highlighted, press the ENTER key.

    • To exit from the menu, press the MENU (SHIFT + SET/VSET) key.
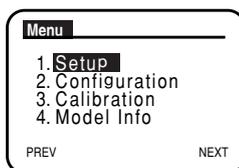
· Operation of selecting menu items

You can also select the menu item by turning the rotary knob. Turning the rotary knob to the right moves the highlight downward; turning it to the left moves the highlight upward.

```
┌──────────────────────────┐
│ ▐Setup▌                   │
│                          │
│ 1.▐Function▌             │
│ 2. Protect Action         │
│ 3. Memory                 │
│ 4. Cut Off                │
│ 5. Response               │
│ PREV              NEXT    │
└──────────────────────────┘
```
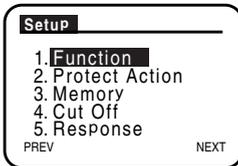
4. Then, select the next menu.

Press the ▼ or ▲ CURSOR key several times until the desired menu item is highlighted on the menu. When highlighted, press the ENTER key.

A setup item screen of the function is displayed.

· Next page and previous page

To return to the previous screen, press the PREV (SHIFT+ ◄) key. To move to the next screen (or select a menu item and move to the next screen), press the NEXT (SHIFT+ ►) key.

```
┌──────────────────────────┐
│ ▐Function▌                │
│                          │
│ Soft Start   : 1ms        │
│ Count Time : OFF          │
│                          │
│                          │
│ PREV                      │
└──────────────────────────┘
```
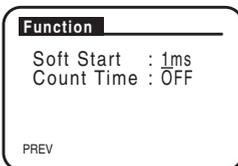
5. Select the setup item.

Press the ▼ or ▲ CURSOR key several times until the cursor moves next to the desired setup item.

6. Select the value.

Turn the rotary knob to the right or left to select the value of the item.

To move to another item, press the ▼ or ▲ CURSOR key several times to move the cursor.

7. Exit from the menu.

Press the MENU (SHIFT + SET/VSET) key.

The display returns to the basic setting entry condition (the characters "SET" is highlighted).

NOTE   • In Configuration setting, power cycle the PLZ-4W after finishing the menu setup. The new setting is confirmed by power cycling the PLZ-4W.

Table5-2   Menu items

Menu name 1	Menu name 2	Item name	Values <*1>
1. Setup	1. Function	Soft Start	<u>1 ms</u>, 2 ms, 5 ms, 10 ms, 50 ms, 100 ms, 200 ms
		Count Time (elapsed time display)	<u>OFF</u>, ON
	2. Protect Action	OCP	<u>LIMIT</u>, LOAD OFF
		OPP	<u>LIMIT</u>, LOAD OFF
	3. Memory	ABC Preset Memory Recall	<u>SAFETY</u>, DIRECT
	4. Cut Off	Time (auto load off timer)	<u>OFF</u>, 000:00:01 to 999:59:59
	5. Response	–	<u>1/1</u>, 1/2, 1/5, 1/10
2. Configuration	1. Master/Slave	Operation	<u>MASTER</u>, SLAVE
		Parallel (MASTER only)	<u>-</u>, 2, 3, 4, 5
		Load booster (MASTER: PLZ1004W only)	<u>-</u>, 1, 2, 3, 4
	2. Power On	Load On	<u>OFF</u>, ON
		Key Lock	<u>OFF</u>, ON
	3. Interface	Control	<u>GPIB</u>, RS232C, USB
	GPIB	Address	<u>1</u> to 30
	RS-232C	Baudrate	2 400, 4 800, 9 600, <u>19200</u> bps
		Data	8 (fixed)
		Stop	1, <u>2</u>
		Parity	NONE
		Ack (acknowledge)	<u>OFF</u>, ON
	USB	VID	0x0B3E (display only)
		PID	xxxx (display only)
		S/N	xxxx (display only)
	4. External	Control	<u>OFF</u>, V, R, Rinv (Inverse)
		LoadOn IN	LOW, <u>HIGH</u>
3. Calibration	1. CC (Low)	To the calibration screen (see chapter 8, "Maintenance and Calibration.")	
	2. CC (Mid)		
	3. CC (High)		
	4. CV 15V		
	5. CV 150V		
4. Model info	MODEL	(Model)	PLZxxxW
	VERSION SUB	(Firmware version)	x.xx
	VERSION MAIN	(ROM version)	x.xx

*1:Underlined values are factory default values.

5.14 Initialization

The backup function of the PLZ-4W retains the current settings, menu settings, and memory contents (ABC preset memories and setup memory) even when the POWER switch is turned off. You can initialize the PLZ-4W settings to factory default by carrying out the following operation.

- For a description of the ABC preset memories, see section 6.1, "ABC preset memories." For a description of the setup memory, see section 6.2, "Setup Memory."
- For a description of the default menu settings, see Table 5-3.

⚠ CAUTION • Use caution because the contents of ABC preset memories and the setup memory are also cleared when the PLZ-4W is initialized.

■ Initializing the PLZ-4W

1. While holding down the ENTER key, turn on the POWER switch.

   SET CLR appears when the display turns on.

   Release the ENTER key when the next information appears.

   The PLZ-4W settings are initialized.

Table 5-3   Factory default settings

Item	Panel settings	Setup memory settings (all 100 sets)
OCP value	Maximum value	Minimum value
OPP value	Maximum value	Minimum value
UVP value	OFF	OFF
Current	0 A	Full scale of H range
Conductance	0 S	Full scale of H range
Voltage	Minimum value	Full scale of H range
Wattage	0 W	Full scale of H range
Current range	H	H
Voltage range	150 V	150 V
Load on/off	Load off	Load off
Operation mode	CC	CC
Slew rate	Minimum value of H range	Maximum value of H range
ABC preset memories	Settings above in each mode	Settings above in each mode
Menu setup	See Table 5-2.	See Table 5-2.

5.15 Response Speed

The PLZ-4W operates by detecting the input current or voltage and feeding back those values. You can set the response speed of the negative feedback control. The response speed can be specified in CC mode (CC+CV mode) and CR mode (CR+CV mode). You can decrease the response speed to assure stable operation.

If the load wire is long or has a large loop, the wire inductance is increased. Consequently, the current variation at the time of switching operation will cause a large voltage drop.

In such condition, the input voltage may fall below the minimum operating voltage of the PLZ-4W causing the current waveform to be distorted. In some cases, the input voltage may exceed the maximum input voltage and cause damage to the PLZ-4W. You must be careful especially when the slew rate setting is high or switching is performed using large currents through parallel operation.

In such case, it is important that you use the shortest twisted wire possible for the connection. Then, decrease the slew rate setting or lower the response speed so that the voltage induced by the inductance is within the minimum operating voltage and the maximum input voltage range of the PLZ-4W.

In the case of DC operation also, the phase lag of the current may cause instability in the PLZ-4W control inducing oscillation. In this case also, use the shortest twisted wire possible for the connection, and achieve stable operation by lowering the response speed.

■ Response speed type and performance

The following four levels are available. Select one of the levels.

    1/1: Normal response speed
    1/2: 1/2 the normal response speed (Slows down by a factor of 2.)
    1/5: 1/5 the normal response speed (Slows down by a factor of 5.)
    1/10: 1/10 the normal response speed (Slows down by a factor of 10.)

The default setting is 1/1.

Settings other than 1/1 slow down the speed and affect the performance of soft start and slew rate as well as the rise and fall times of load on/off.

The slew rate in turn affects the switching operation.

■ Setting the response speed

You can set the response speed of the PLZ-4W using "1. Setup" | "2. Response" from the menu.

For a description of changing the menu setup, see section 5.13, "Menu Setup."

When using parallel operation or high speed load simulations (such as switching function), refer to the "Technical Note for the electronic load (PLZ-4W), When operating under parallel operation or high-speed load simulations" as provided as separate sheet and set the response speed properly.

Chapter 6   Applied Operation

This chapter describes functions such as ABC preset memories, switching function, and sequence function that are used in actual applications.

6.1 ABC preset memories

Three separate sets of settings for each range of each operation mode can be saved to memories A, B, and C. Settings are saved or recalled after determining the operation mode and range. Settings (A, B, and C) saved in the current operation mode at the current range can be recalled.

Table6-1   Memory Overview

Operation mode	Range				A	B	C
CC CR CP	Current			H	●	●	●
				M	●	●	●
				L	●	●	●
CV	Voltage			H	○	○	○
				L	○	○	○
CC+CV CR+CV	Voltage	H	Current	H	● ○	● ○	● ○
				M	● ○	● ○	● ○
				L	● ○	● ○	● ○
		L	Current	H	● ○	● ○	● ○
				M	● ○	● ○	● ○
				L	● ○	● ○	● ○

● current, resistance, and wattage   ○ voltage

In CC+CV and CR+CV modes, the settings are saved to the memories of CC, CR, and CV modes.

In CC, CR, and CP modes, the settings according to the current range are saved to the memories A, B, and C. In CV mode, the settings according to the voltage range are saved. In CC+CV and CR+CV modes, the voltage and current values are saved.

ABC preset memories can be recalled even when the load is turned on.
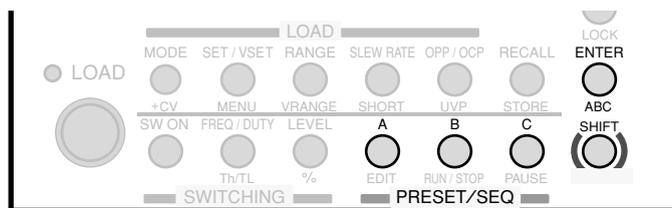
Fig.6-1   Keys for ABC preset memories

6.1.1   Saving to ABC preset memories

Three separate sets of settings for each range of each operation mode can be saved to memories A, B, and C. The settings can be saved even when the load is turned on.

1.   Select the ABC preset memories.

First, switch to the desired operation mode and set the range and value.

Next, press the ABC (SHIFT+ENTER) key.

Three keys A, B, and C illuminate.

2.   Save to the memory.

Press the A, B, or C memory key.

The pressed key illuminates.

[The settings are saved to the selected memory. The key that is illuminated turns off when the setting is changed.

6.1.2   Recalling ABC preset memories

There are two methods for recalling memories: SAFETY and DIRECT. By default, the SAFETY method is selected.

SAFETY

In this method, you check the memory contents on the display before actually recalling the settings.

DIRECT

In this method, the settings saved to memory A, B, or C are recalled directly. The recalled settings are immediately applied as current settings.

■ Changing to the DIRECT method

By default, the SAFETY method (in which the memory contents are checked on the display before actually applying them) is selected. If set to the DIRECT method, the settings of the recalled memory are applied immediately. The recall method is switched from the menu.

1.   Check that the load is turned off.

Check that the LOAD LED is turned off. If it is on, press the LOAD key to turn it off.

2.   Select the menu setup.

Press the MENU (SHIFT+SET/VSET) key.

The menu appears.

3. Select Setup.

Press the ▼ or ▲ CURSOR key several times until Setup is highlighted on the menu. When highlighted, press the ENTER key.

4. Select Memory.

Press the ▼ or ▲ CURSOR key several times until Memory is highlighted on the menu. When highlighted, press the ENTER key.

5. Select the recall method of ABC preset memories.

Turn the rotary knob to the right to display SAFETY and left to display DIRECT. To switch to the direct method, select DIRECT.

6. Exit from the menu.

Press the MENU (SHIFT+SET/VSET) key.

The recall method of ABC preset memories are set.

■ Recalling ABC preset memories (SAFETY)

1. Select the memory.

Set the operation mode and range according to the memory to be recalled. Next, press the key (A, B, or C) to be recalled.

The pressed key illuminates, and the settings stored to the memory are shown on the display.

2. Recall the memory.

To recall the memory, press the ENTER key.

To change to another memory, press the desired key (A, B, or C), check the settings, and press the ENTER key.

The settings are applied when you press the ENTER key.

■ Recalling ABC preset memories (DIRECT)

1. Recall the memory.

Set the operation mode and range according to the memory to be recalled.

2. Press the key (A, B, or C) to be recalled.

The pressed key illuminates, and the current settings are changed to the settings that were stored.

- In CC, CR, CV, or CP mode (saves one setting)

Range setting

H 33A 150V

0.00 mA   0.000 V

0.000 W   Setting

Operation mode   CC SET 8.000 A

SLEWRATE   0.01 mA

Recalls the setting (current, resistance, voltage, or power) that had been saved to preset memory A, B, or C at the curre operation mode and range setting.

For example, if you press A, the setting of 8 A at the current range of 33 A and voltage range of 150 V is saved to memory A.

Saves one setting (current, resistance, voltage, or power) at the current operation mode and range setting to preset memory A, B, or C.

[Save to ABC preset memory]

8.000 A   ○ ABC   Press ABC.
(SHIFT+ENTER)

A   B   C   Press the key of the save destination memory.

[Recall ABC preset memory]

A   B   C   Press the key of the memory to be recalled.

8.000 A

(○ ENTER)   Press ENTER.
(SAFETY only)

- In CC+CV or CR+CV mode (saves two settings)

Range setting

H 33A 150V

0.00 mA   0.000 V

0.000 W   Settings
(switch using SET/VSET)

Operation mode   CC+CV SET 8.000 A

SLEWRATE   0.01 mA

Recalls the two settings (current or resistance and voltage) that had been saved to preset memory A, B, or C at the current operation mode and range setting.

For example, if you press A, the settings of 8 A and 12 V at the current range of 33 A and voltage range of 150 V are saved to memory A.

Saves two settings (current or resistance and voltage) at the current operation mode and range setting to preset memory A, B, or C.

[Save to ABC preset memory]

8.000 A   ○ ABC
12.00 V

A   B   C   Press the key of the save destination memory.

Press ABC.
(SHIFT+ENTER)

[Recall ABC preset memory]

A   B   C   Press the key of the memory to be recalled.

8.000 A

(○ ENTER)   Press ENTER.
(SAFETY only)

Fig. 6-2   Contents stored to the ABC preset memories

6.2 Setup Memory

The setup memory can store up to 100 sets (0 to 99) of the current conditions of the items shown below. You can attach a memo using up to 15 characters to each memory set. The stored settings can be recalled as necessary.

■ Settings that are saved

- Operation mode (CC, CR, CV, or CP, and enabled/disabled condition of +CV)
- Basic settings (current, resistance, voltage, and power)
- Range setting (RANGE/VRANGE)
- Slew rate value (SLEW RATE)
- Switching frequency and duty cycle (FREQ/DUTY)
- Switching time (Th/TL)
- Switching level and ratio (LEVEL/%)
- Protection setting (OCP/OPP/UVP)
- Contents of ABC preset memories (A/B/C)

Table 6-2   Contents saved to a single memory set

Operation mode	Range				A	B	C	Other settings
CC CR CP	Current			H	●	●	●	◇
				M	●	●	●	◇
				L	●	●	●	◇
CV	Voltage			H	○	○	○	◇
				L	○	○	○	◇
CC+CV CR+CV	Voltage	H	Current	H	● ○	● ○	● ○	◇
				M	● ○	● ○	● ○	◇
				L	● ○	● ○	● ○	◇
		L	Current	H	● ○	● ○	● ○	◇
				M	● ○	● ○	● ○	◇
				L	● ○	● ○	● ○	◇

● current, resistance, wattage   ○ voltage   ◇ other values (slew rate, switching, and protection)
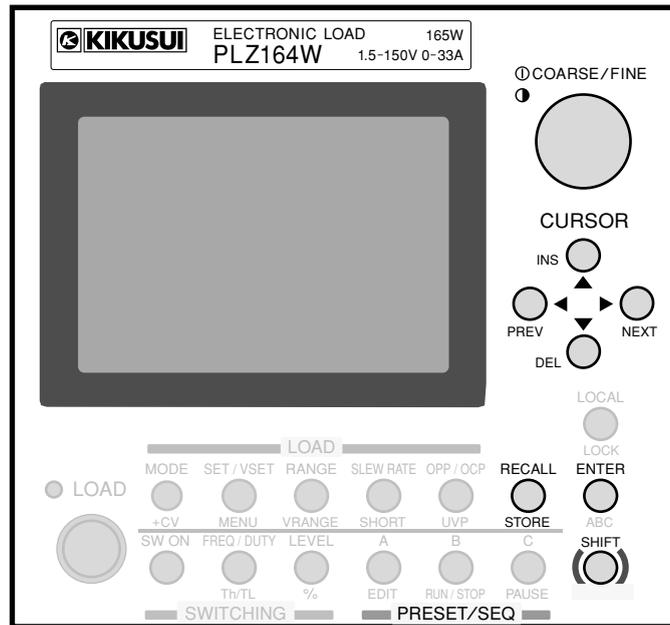
Fig. 6-3   Keys for the setup memory

6.2.1   Saving to the Setup Memory

Memo entry area
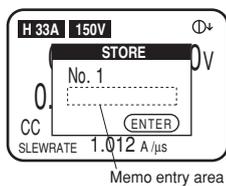
No. 1:Program1

1. Select the setup memory.

    First, set the operation mode, range, and settings as desired.

    Next, press the STORE (SHIFT+RECALL) key.

    The STORE key blinks.

    The setup memory store screen appears. The store screen shows the last number of the memory to which settings were saved previously (0 by default).

2. Select the memory number.

    Turn the rotary knob to show the number of the memory to which settings are to be saved.

3. Enter a memo.

Press the ▼ CURSOR key. The cursor blinks below the number. Turn the rotary knob in this condition to select a character.

After selecting a character, press the ▶ key to move the cursor to the right, and continue entering characters. To move to the left, press the ◀ key. You can register up to 15 characters.

- -

NOTE   • You can return to the memory number selection by pressing the ▲ CURSOR key when entering characters.

• If you press the PREV (SHIFT+◀) key or STORE (SHIFT+RECALL) key, the settings are not saved to the setup memory, and the display returns to the basic setting entry condition (the characters "SET" is highlighted).

- -

4. Save the settings to the setup memory.

Press the ENTER key.

The STORE key illuminates.

The settings described above are saved to the memory. If settings are already stored at the selected memory number, the settings are overwritten.

The STORE key remains illuminated while the saved settings are used.

6.2.2 Recalling the Setup Memory

1. Check that the load is turned off.

2. Select the setup memory.

Press the RECALL key.

The RECALL key blinks.

The setup memory recall screen appears. The recall screen shows the number of the memory to which settings were saved previously (0 by default).

3. Select the number of the memory to be recalled.

Turn the rotary knob to show the number of the memory to be recalled.
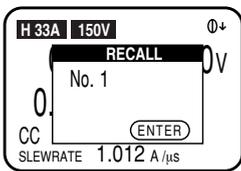
NOTE
- When a memo is attached, it is displayed under the memory number.
- If you press the PREV (SHIFT+◄) key or RECALL key, the settings are not recalled from the setup memory, and the display returns to the basic setting entry condition (the characters "SET" is highlighted).

4. Recall the setup memory.

Press the ENTER key.

The RECALL key illuminates.

The settings in the memory are recalled.

The RECALL key remains illuminated while the recalled settings are used. If you change the settings, the RECALL key turns off.

NOTE
- The setup memory cannot be recalled when the load is turned on.
- The setup memory can store most of the settings including the operation mode and range setting. Note that if the stored settings differ from the current operation mode or range setting, they will be switched.

• In CC, CR, CV, or CP mode

Range setting

H 33A 150V

0.00 mA   0.000 V

0.000 W   Setting

Operation mode

CC   SET   8.000 A

SLEWRATE   0.01 mA/µs

Recalls the operation mode, range setting, one setting (current, resistance, voltage, or power), and the contents of ABC preset memories saved at the operation mode and range setting that are saved to the specified No.

In this example, current range of 33 A, voltage range of 150 V, present setting of 8 A, and the contents of ABC preset memories saved at the current operation mode and range setting are saved.

Saves to the memory of the specified No. the operation mode, range setting, setting (current, resistance, voltage, orpower), and the contents of ABC preset memories saved at the current operation mode and range setting.

[Save to the setup memory]

STORE
↓
ENTER

STORE
No. 1
ENTER

Press STORE.
(SHIFT+RECALL)

Select No. and press ENTER.

[Recall the setup memory]

RECALL
↓
ENTER

RECALL
No. 1
ENTER

Press RECALL.

Select No. and press ENTER.

• In CC+CV or CR+CV mode

preset

Range setting

H 33A 150V

0.00 mA   0.000 V

0.000 W   Settings
(switch using SET/VSET)

Operation mode

CC+CV SET   8.000 A

SLEWRATE   0.01 mA/µs

Recalls the operation mode, range setting, two settings (current or resistance and voltage), and the contents of ABC preset memories saved at the operation mode and range setting that are saved to the specified No.

In this example, current range of 33 A, voltage range of 150 V, present settings of 8 A and 12 V, and the contents of ABC preset memories saved at the current operation mode and range setting are saved.

Saves to the memory of the specified No. the current operation mode, range setting, two settings (current or resistance and voltage), and the contents of ABC preset memories saved at the current operation mode and range setting.

[Save to the setup memory]

STORE
↓
ENTER

STORE
No. 1
ENTER

Press STORE.
(SHIFT+RECALL)

Select No. and press ENTER.

[Recall the setup memory]

RECALL
↓
ENTER

RECALL
No. 1
ENTER

Press RECALL.

Select No. and press ENTER.

Fig. 6-4   Contents stored to the setup memory

6.3 Switching Function

Switching refers to the operation of executing two load current settings repetitively. The switching function operates in CC and CR modes. The switching function is suited to transient response characteristics test of regulated DC power supplies.

You can perform various tests by setting the switching frequency, ON/OFF ratio of the switch (duty cycle), switching level, and switching time. You can also set the slew rate of the current change. (See section 6.4, "Setting the Slew Rate.")

When the switching operation is in progress, a trigger signal is output from the TRIG OUT connector on the front panel. A pulse is output at the edges indicated by the circles in Fig. 6-5.
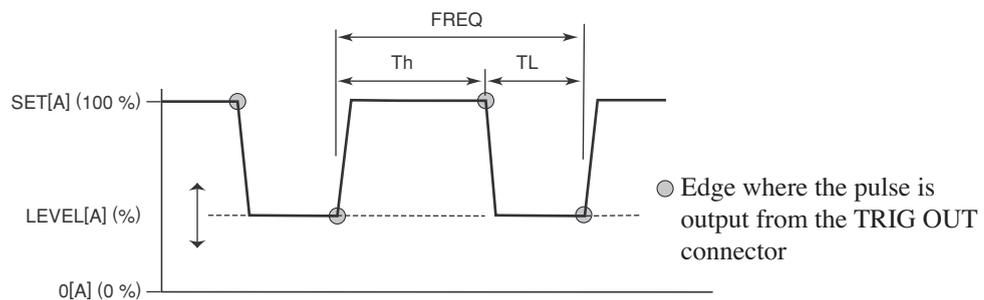
Fig. 6-5   Characteristics diagram of a switching waveform
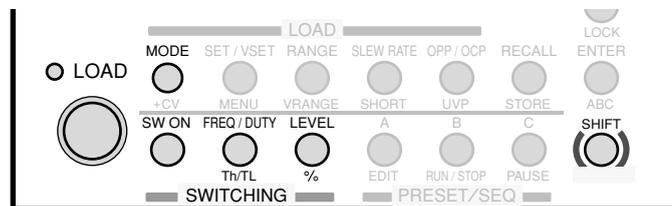
Fig. 6-6   Keys used in the switching function

■ Operating Procedure

1. Select the switching level.

   Press the LEVEL key.

   The LEVEL key illuminates.

   The maximum value that can be specified is the value specified in the current operation mode, and the minimum value is 0 A or 0 mS. If you press the % (SHIFT+LEVEL) key, you can enter the level in terms of a percentage of the current setting (0.0 % to 100.0 %).

   To reenter the level using a value, press the LEVEL key again.

2. Set the switching level.

   While viewing the display, turn the rotary knob to set the value.

   You can press the rotary knob to switch between coarse adjustment and fine adjustment.

3. Turn on the switching mode.

Press the SW ON key.

The SW ON key illuminates, and the switching mode is enabled.

・ **Setting the switching function using frequency and duty cycle**

4. Select switching frequency and duty cycle.

Press the FREQ/DUTY key.

The FREQ/DUTY key illuminates.

Switching frequency (FREQ) or duty cycle (DUTY) is highlighted alternately each time you press FREQ/DUTY.

Highlight the one you wish to set.

5. Set the switching frequency and duty cycle.

While viewing the display, turn the rotary knob to set the value.

You can press the rotary knob to switch between coarse adjustment and fine adjustment.

- -

NOTE
- You can set the switching frequency in the range of 1 Hz to 20 kHz, but if the frequency is set high, limitation is placed on the upper limit of the duty cycle. The resolution (Hz and kHz) switches automatically.

- -

・ **Setting the switching function using time**

4. Select the switching time.

Press the Th/TL (SHIFT+FREQ/DUTY) key.

The Th/TL key illuminates.

The high side (Th) and the low side (TL) of the switching time is highlighted alternately each time you press Th/TL (SHIFT+FREQ/DUTY).

Highlight the one you wish to set.

5. Set the switching time.

While viewing the display, turn the rotary knob to set the switching time on the high side and low side.

- -

NOTE
- The settings for the switching operation can be changed even when the load is turned on.

- -

■ **Operation when the response speed is changed**

You can change the response speed in CC mode (CC+CV mode) and CR mode (CR+CV mode).

In some cases, the wire inductance increases and a large voltage drop occurs due to changes in the current or the phase lag of the current may cause instability in the PLZ-4W control inducing oscillation.

In such case, you can decrease the response speed to assure stable operation.

- For details, see section 5.15, "Response Speed."

6.4 Setting the Slew Rate

The slew rate defines the slope for changing the current when the current is changed rapidly such as by using the switching function in CC and CR modes. On the PLZ-4W, you set the amount of change in the current per unit time according to the current range.

The slew rate is activated when the setting value is changed such as by switching during turning the load to on.

In CR mode, the values that can be specified (maximum slew rate at each range) are 1/10th the values of CC mode. For the detailed values, see section 9.1, "Electrical Specifications."
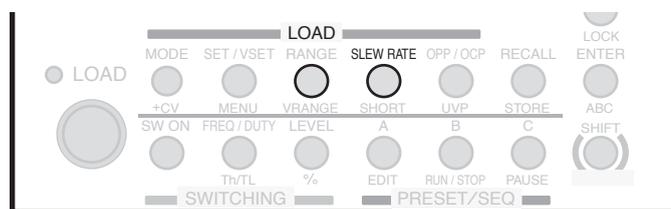

Fig. 6-7   Keys for the slew rate

■ Procedure

<u>1.</u>   Selects the slew rate.

Press the SLEW RATE key.

The SLEW RATE key illuminates.

<u>2.</u>   Sets the slew rate value.

While viewing the display, turn the rotary knob to set the slew rate value.

You can press the rotary knob to switch between coarse adjustment and fine adjustment.

6.5 Using the Elapsed Time Display and the Auto Load Off Timer

Two convenient functions are available for the discharge tests of batteries.

- Measure the time from discharge start until the cutoff voltage is reached (time measurement).
- Measure the closed circuit voltage after a specified time elapses from discharge start (voltage measurement).

V2: Voltage after the specified time elapses
V1: UVP detection voltage

Tcount: Elapsed time display (Count Time)
Tcutoff: Auto load off timer (Cut Off Time)
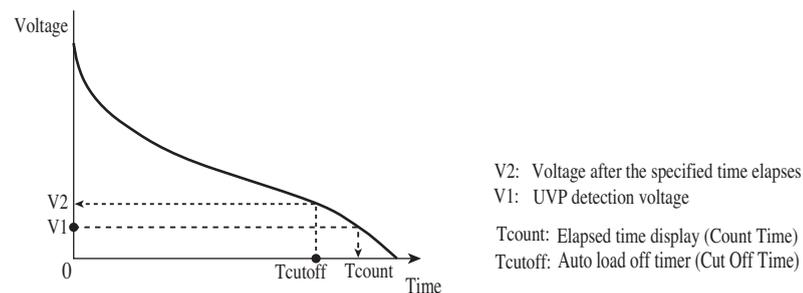
Fig. 6-8   Count Time and Cut Off Time

■ Elapsed time display (Count Time)
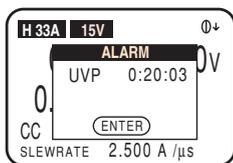
In time measurement, the PLZ-4W can measure the time from load on to load off.

As a load off condition, the cutoff voltage is set to the voltage specified for the UVP function. When the load turns off, a pop-up window appears indicating the time from load on to load off.

By default, the elapsed time after the load is turned on is not displayed. To turn on this function, select "1. Setup" | "1. Function" from the menu and set the Count Time setting to on.

- For a description of changing the menu setup, see section 5.13, "Menu Setup."
- For a description of the UVP function, see section 5.3, "Types of Protection Functions." and section 5.4, "Setting the Protection Function."

■ Auto load off timer (Cut Off Time)
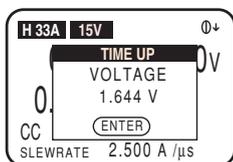
In voltage measurement, the voltage immediately before the load turns off is measured. As a load off condition, a timer is set to turn off the load after a specified time elapses. When the load turns off, a pop-up window appears indicating the input voltage immediately before the load was turned off.

By default, the load on timer is off. To turn on the timer, select "1. Setup" | "4. Cut Off" from the menu and set the time in Time.

The setting range is 000 hour 00 minute 01 second to 999 hours 59 minutes 59 seconds (000:00:01 to 999:59:59).

- For a description of changing the menu setup, see section 5.13, "Menu Setup."

6.6   Sequence Function

Sequence is a function that automatically executes instructions specified in advance one operation at a time. By specifying a sequence of operations (steps), various waveform simulations can be executed. The sequence that you create is saved by the backup function even when the power is turned off.

■ Normal sequence and fast sequence

There are two execution modes in the sequence function of the PLZ-4W: normal speed and fast speed.

• Normal sequence

A normal sequence can be set and executed from the PLZ-4W operation panel. In addition, the communication function can be used to set and execute the sequence from an external controller. The execution time can be assigned to each step. You can pause a sequence using PAUSE and resume a sequence using an external trigger input.

• Fast sequence

A fast sequence can be set and executed from the PLZ-4W operation panel. In addition, the communication function can be used to set and execute the sequence from an external controller. Each step is executed at high speeds. The high time resolution allows high-speed simulations. Each step is spaced evenly, and up to 1024 steps can be executed.
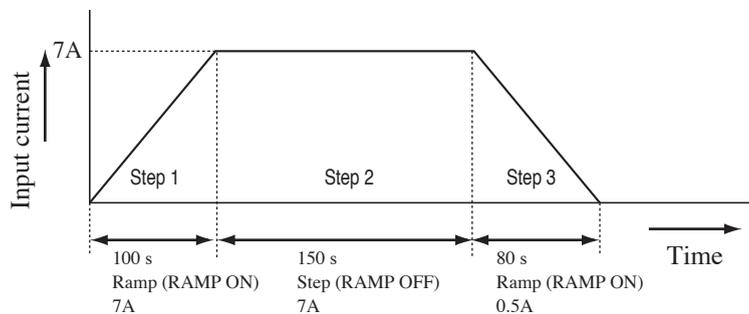
Fig. 6-9   Normal sequence execution example
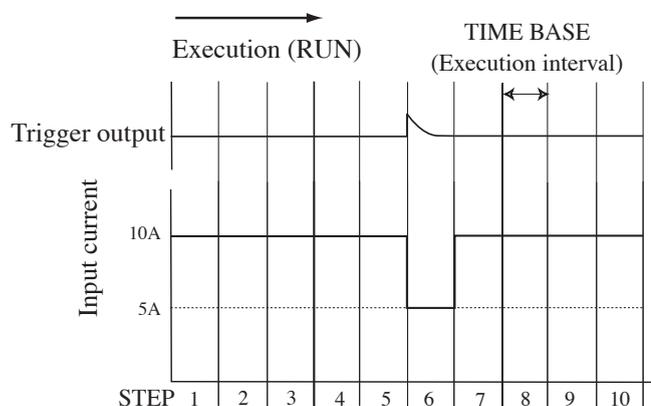
Fig. 6-10   Fast sequence execution example

6.6.1 Overview of the Normal Sequence

To create a sequence, you must understand the concept of "program" and "step."
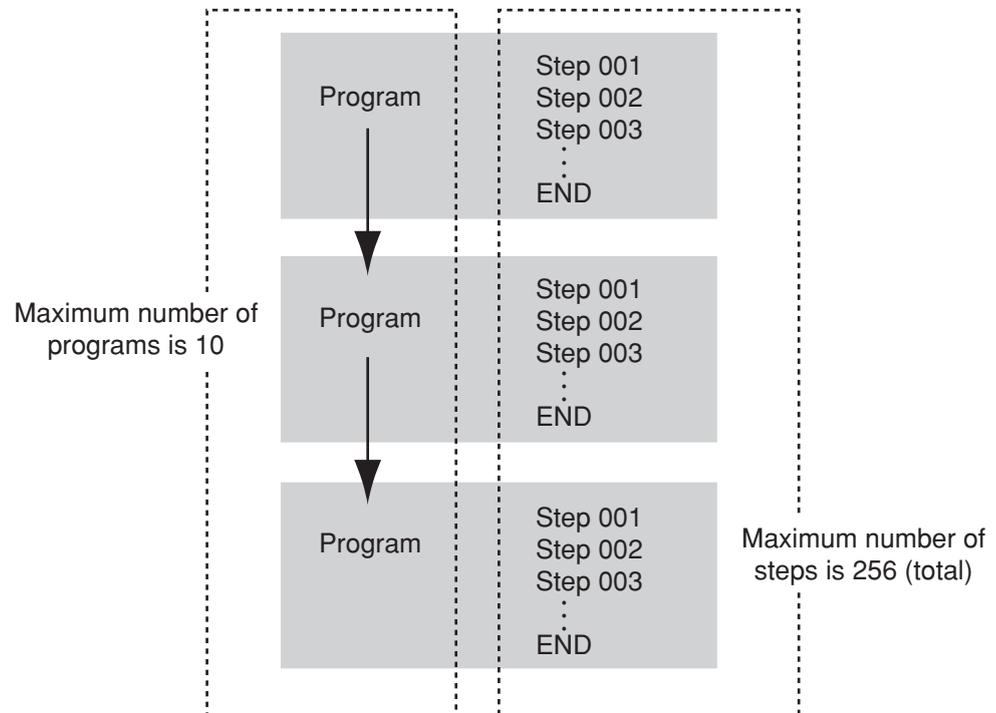
Fig. 6-11   Conceptual diagram of program and step

- **Program**

In a single program one of the four operation modes (CC, CR, CV, and CP) is selected and configured. You can also repeat the same program a specified number of times or connect another program after the program (chain). However, in a chain, the mode and range of the program to be chained must be the same.

The number of programs that can be saved is 1 for the fast sequence mode (No. 11) and 10 for the normal sequence mode (No. 1 to 10).

Below are the settings of a program.

- No.   Program number (normal: 1 to 10, fast: 11)
- Memo   Memo (up to 11 characters can be specified)
- Mode   Operation mode of the program (CC, CR, CV, or CP)
- Range   Current range-voltage range of the program
                 (L-15V, M-15V, H-15V, L-150V, M-150V, or H-150V)
- Loop   Number of program loops (1 to 9999 where 9999 is infinite loop)
- Last Load   Load condition (off/on) when chain is off
- Last Set   Current value when chain is off (0 to 100 % of the range setting)
- Chain   Number of the program to be executed next (OFF, 1 to 10). Can be
                 executed only when the operation mode and range match.

A program is a collection of steps (execution unit). A program is created by setting steps in ascending order from step number 001. When a specified program is executed (RUN), steps are executed one by one in ascending order from step number 001. The completion of the last step signifies the end of one program execution.

· **Step**

In a single step, one execution condition can be specified. In other words, one operation of the executed waveform corresponds to one step. In normal sequence mode, up to 256 steps can be shared among all programs (10 programs).

Below are the settings of a step.

- Step number
- __SET   Setting at the operation mode (A, mS, V, or W)
- h:min:s.ms   Step execution time (0:00:00.001 to 999:59)
- LOAD   Load or not load (OFF/ON)
- RAMP   Current change type (ON: slope, OFF: step)
- TRIG   Output or not output the trigger signal during step execution (ON/OFF)
- PAUSE   Pause or not pause during step execution (ON/OFF)

■ Step execution pattern

Of the settings of a step, the execution pattern when RAMP (current change type), TRIG (trigger output), or PAUSE is specified are indicated below.

· **RAMP (current transition)**

RAMP sets the current transition. When turned on, the current takes on a slope form; when turned off, the current takes on a step form.

(Example) Setting: 10 A
          Step transition (RAMP OFF)
          Step execution time: 1 s

(Example) Setting: 10 A
          Ramp transition (RAMP ON)
          Step execution time: 1 s
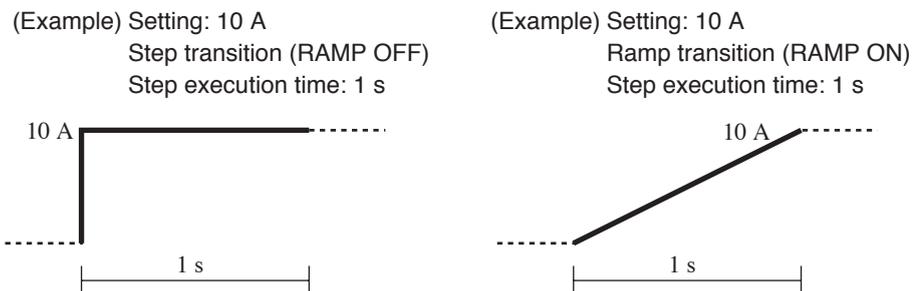
Fig. 6-12   RAMP sequence example

· TRIG (trigger output)

TRIG sets the presence or absence of trigger output. When turned on, a trigger signal is output from the TRIG OUT connector on the front panel at the same time as the step is executed.

(Example) Set trigger output at step
number n (TRIG ON)
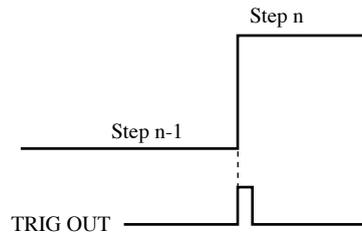
Fig. 6-13   TRIG sequence example

· PAUSE

PAUSE sets a pause in the program. When turned on, the sequence operation is paused after executing the step. To resume the operation, you press the PAUSE (SHIFT+C) key on the operation panel or apply a trigger signal to TRIG INPUT (pin 11) of the J1 connector.

For a description of the trigger signal input, see section 6.8.8, "Trigger Signal Control."

(Example) Pause and resume using the PAUSE
(SHIFT+C) key
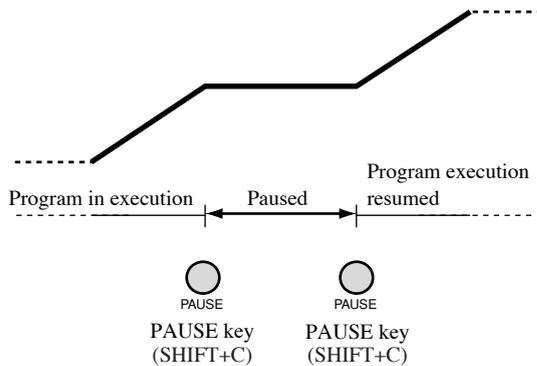
(Example) Pause by executing PAUSE
in a program and resume using
trigger input (TRIG IN)
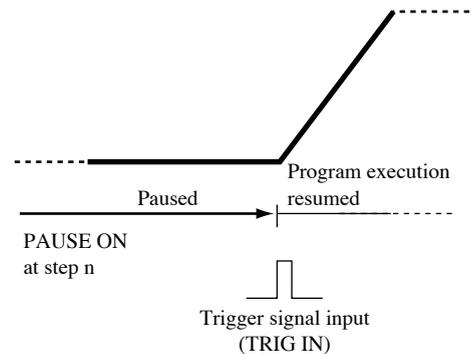
Fig. 6-14   PAUSE sequence example

6.6.2 Sequence Editing

The sequence edit screen is divided into the following four edit screens. When creating a sequence, items are set on each edit screen. This section describes the setup items on each edit screen and the setup procedure.

```
┌─────────────────────┐
│ SEQ                 │
│                     │
│ No.   : 1           │
│ Memo  : Program1    │
│ Mode  : NCC         │
│ Range : 33A, 150V   │
│ Loop  : 0001      ▼ │
│ PREV          NEXT  │
└─────────────────────┘
```

```
┌─────────────────────┐
│ SEQ                 │
│                     │
│ Last Load : ON    ▲ │
│ Last Set  : 0.000A  │
│ Chain     : 2       │
│                     │
│ PREV          NEXT  │
└─────────────────────┘
```

```
┌─────────────────────┐
│ SEQ EDIT            │
│      CC SET [A]     │
│ 001   0.005A        │
│ 002   0.010A        │
│ ---   END           │
│                     │
│ PREV TOTAL 002 NEXT │
└─────────────────────┘
```

```
┌─────────────────────┐
│ SEQ EDIT            │
│     [h:min:s.ms]    │
│ 001 100:00:--.---   │
│ 002 000:00:00.001   │
│ ---   END           │
│                     │
│ PREV TOTAL 002 NEXT │
└─────────────────────┘
```

```
┌─────────────────────┐
│ SEQ EDIT            │
│   LOAD RAMP TRIG PAUSE│
│ 001 ON  OFF OFF OFF │
│ 002 OFF OFF OFF OFF │
│ ---   END           │
│                     │
│ PREV TOTAL 002      │
└─────────────────────┘
```

(1) Program operation

Set the program number, memo, operation mode, range, and the number of loops. (Top screen of the screen divided into top and bottom halves)

(2) Operation after end of program

Set load on/off condition, basic setting, and the chain to another program after the end of the program. (Bottom screen of the screen divided into top and bottom halves)

(3) Step setting

Set the value (current, resistance, voltage, or wattage) of the step to be executed one operation at a time according to the operation mode specified in (1).

(4) Step execution time

Set the execution time of the step.

(5) Step execution pattern

■ Common operations on the edit screens

This section describes the common operations carried out on the edit screens such as moving the cursor within the edit screen, selecting items, entering values and characters, and turning pages. Please familiarize yourself with the functions of each key as they are basic operations carried out in sequence editing.

• Moving the cursor

On the edit screen, you can change the value of the item at the position of the blinking cursor. The CURSOR keys are used to move the cursor on the edit screen.

Pressing the ▼ key moves the cursor to the item below and pressing the ▲ key moves the cursor to the item above. When specifying the digit when entering values or specifying the position when entering characters, you can press the ◄ and ► keys to move the cursor left and right.

• The program operation screen is divided into top and bottom halves. Pressing the ▼ key at the bottom line (Loop) of the top half of the screen moves the cursor to the bottom half of the screen. Pressing the ▲ key at the first line (Last Load) of the bottom half of the screen moves the cursor to the top half of the screen.

· **Selecting items**

When an item is selected from several choices, turn the rotary knob to display the desired setting. For example, for ON/OFF items, turning the rotary knob to the right selects ON and turning the rotary knob to the left selects OFF.

· **Entering values**

For numerical settings, you can increase or decrease the value by turning the rotary knob. If the value consists of many digits, you can press the ◄ or ► CURSOR key to move the cursor directly to the desired digit and increase or decrease only that digit. For example, if you wish to set a value of 100 (100 times), you can simply move the cursor to the hundreds digit and enter 1 using the rotary knob.

· **Entering characters (memo)**

A memo consisting of up to 11 characters can be added to each program.

• Memos are used to identify programs. You do not have to enter a memo. However, it is recommended that a descriptive memo be added for future reference. A memo can be the date/time of measurement, test description, program name, or differences in the setup conditions.

You can select the character to be entered (alphanumeric character) by turning the rotary knob. When the desired character is displayed, press the ► key to move the cursor to the right, and continue entering the next character. To move the cursor to the left, press the ◄ key.

· **Turning pages**

Press the CURSOR key to switch edit screens. To move to the next screen, press the NEXT (SHIFT+►) key. To return to the previous screen, press the PREV (SHIFT+◄) key.

Table6-3   Setup items on each setup screen

Edit screen	Setup item	Description
Program operation	No.	Program number (1 to 10)
	Memo	Memo (11 characters)
	Mode	Operation mode (CC, CR, CV, or CP)
	Range	Range setting (L-15V, M-15V, H-15V, L-150V, M-150V, or H-150V)
	Loop	Number of program loops (1 to 9999) 9999 is infinite loop
	Last Load	Load condition after the end of the sequence (ON/OFF)
	Last Set	Current value after the end of the sequence (0.000 to 100 % of the range setting)
	Chain	The number of the next program to be executed after the end of the this program (OFF, 1 to 10)
Step setting	CC SET	Setting executed in the step (A, mS, V, or W)
	CR SET	
	CV SET	
	CP SET	
Step execution time	h:min:s.ms	Hours:minutes:seconds (0.00:00.001 to 999.59:--.---)
Step execution pattern	LOAD	Load on/off
	RAMP	Current transition (ON/OFF)
	TRIG	Trigger output (ON/OFF)
	PAUSE	Pause condition (ON/OFF)

6.6.3 Sequence Example (Normal Sequence)

Programs are created using the PLZ-4W operation panel. This section describes the procedure of entering the following example sequence from the operation panel.

· **Flow of the example sequence**

In this example, we will assume a sequence that executes 2 programs (program numbers 1 and 2) to simulate the waveform of Fig. 6-15.

As shown in Fig. 6-15, program 1 can be divided into 3 steps. After the execution of the third step of program 1, the sequence continues to program 2. Program 2 executes the 3 steps of Fig. 6-15 and ends the first loop. Here, we will set program 2 to be executed twice. When program 2 is executed 2 times, this sequence operation is finished.
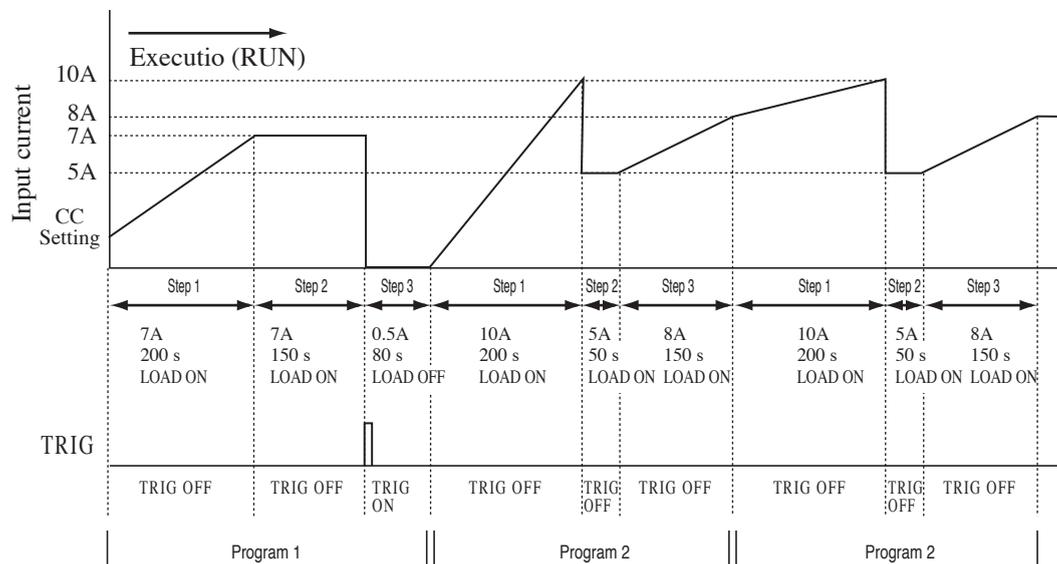
Fig. 6-15   Sequence execution example

Program 1	CC mode (executed once)		
1) 7 A	200 s	LOAD ON
2) 7 A	150 s	LOAD ON
3) 0.5 A	80 s	LOAD OFF

Program 2	CC mode (executed twice)		
1) 10 A	200 s	LOAD ON
2) 5 A	50 s	LOAD ON
3) 8 A	150 s	LOAD ON

Creating the program

Here, we will create program 1 and then program 2.

Programs can be created in any order. Therefore, you can create program 2 first and then program 1.

1. Select sequence edit.

   Press the EDIT (SHIFT+A) key to display the program edit (SEQ) screen.

■ Setting the operation of program 1

2. Set the program number. (No. :)

```
SEQ
No.    : 1
Memo   :
Mode   : NCC
Range  : 33A, 150V
Loop   : 0001        ▼
PREV            NEXT
```

   Turn the rotary knob to set the program number.

   In a normal sequence, you can select a number between 1 and 10. In sequence 1, set program number 1.

   After setting the program number, press the ▼ CURSOR key to move to the next item.
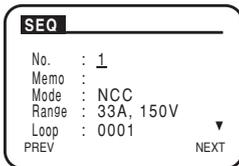
3. Enter a memo. (Memo :)

```
SEQ
No.    : 1
Memo   : Program1
Mode   : NCC
Range  : 33A, 150V
Loop   : 0001        ▼
PREV            NEXT
```

   When adding a memo, turn the rotary knob to enter the characters.

   In program 1, enter "Program1".

   After entering the memo, move the ▼ CURSOR key to move to the next item.
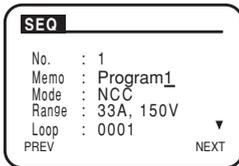
4. Select the operation mode. (Mode :)

```
SEQ
No.    : 1
Memo   : Program1
Mode   : NCC
Range  : 33A, 150V
Loop   : 0001        ▼
PREV            NEXT
```

   Turn the rotary knob to show the operation mode to be executed.

   In program 1, select NCC (CC mode).

   After setting the operation mode, move the ▼ CURSOR key to move to the next item.

5. Sets the range. (Range :)

```
SEQ
No.    : 1
Memo   : Program1
Mode   : NCC
Range  : 33A, 150V
Loop   : 0001        ▼
PREV            NEXT
```
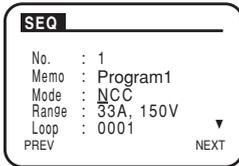
   Turn the rotary knob to select the current range and voltage range.

   In program 1, set 33 A, 150 V (PLZ164W).

   After setting the range, move the ▼ CURSOR key to move to the next item.
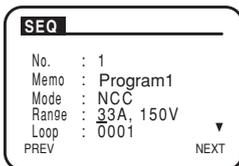
6. Set the number of program loops. (Loop :)

```
SEQ
No.    : 1
Memo   : Program1
Mode   : NCC
Range  : 33A, 150V
Loop   : 0001        ▼
PREV            NEXT
```

   Turn the rotary knob to show the number of program loops.

   Since program 1 is executed once, set 0001.

   At the last line, move the ▼ CURSOR key to move to the next item.
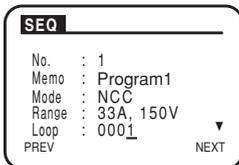
7. Set the load condition after the end of the program. (Last Load :)

```
SEQ
Last Load  : OFF      ▲
Last Set   : 0.000A
Chain      : OFF

PREV            NEXT
```

   Turn the rotary knob to select the load condition.

   Since the load is turned off at the end of program 1, select OFF. However, because the sequence continues to program 2 in this example (step 9), this setting is ignored.

   After setting the load condition, move the ▼ CURSOR key to move to the next item.

```
┌─────────────────────────┐
│ ■SEQ▬▬▬▬▬▬              │
│                         │
│ Last Load : OFF    ▲   │
│ Last Set  : 0.000A     │
│ Chain     : OFF        │
│                         │
│ PREV           NEXT    │
└─────────────────────────┘
```
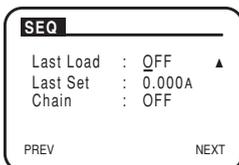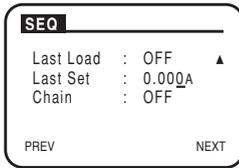
8. Set the current setting after the end of the program. (Last Set :)

   Turn the rotary knob to set the current value.

   Since the load is turned off at the end of program 1, select 0 A. However, because the sequence continues to program 2 in this example (step 9), this setting is ignored.

   After selecting the current setting, move the ▼ CURSOR key to move to the next item.

```
┌─────────────────────────┐
│ ■SEQ▬▬▬▬▬▬              │
│                         │
│ Last Load : OFF    ▲   │
│ Last Set  : 0.000A     │
│ Chain     : 2          │
│                         │
│ PREV           NEXT    │
└─────────────────────────┘
```

9. Set the number of the next program to be executed after the end of program 1. (Chain :)

   Turn the rotary knob to set the number of the program to be executed next.

   Since the sequence executes program 2 after the end of program 1, set 2.

   Press the NEXT (SHIFT+ ▶) key or ENTER key to move to the next edit screen (SEQ EDIT).

■ Setting the steps of program 1

We will set the current setting, execution time, and execution pattern of each step of program 1.

Each item is set on separate screens. Here, we will set the current setting first followed by the execution time followed by the execution pattern.
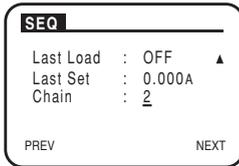
```
┌─────────────────────────┐
│ ■SEQ EDIT▬▬▬            │
│         CC SET [A]     │
│ ▬▬▬  END               │
│                         │
│                         │
│ PREV  TOTAL 000  NEXT  │
└─────────────────────────┘
```
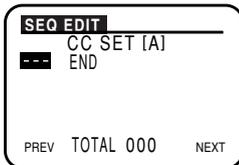
10. Insert a step line.

    On the initial screen, nothing is set for the step, and END of the last line is highlighted.

    Press the INS (SHIFT+ ▲) key with END highlighted to insert the step line 001.

```
┌─────────────────────────┐
│ ■SEQ EDIT▬▬▬            │
│         CC SET [A]     │
│ 001  7.000A            │
│ ---  END               │
│                         │
│ PREV  TOTAL 001  NEXT  │
└─────────────────────────┘
```
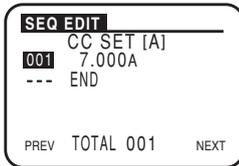
11. Set the current value of step 1.

    On the initial screen, the current is set to 0.000.

    Turn the rotary knob to set the current value of step 1 to 7 A.

```
┌─────────────────────────┐
│ ■SEQ EDIT▬▬▬            │
│         CC SET [A]     │
│ 001  7.000A            │
│ 002  7.000A            │
│ ---  END               │
│ PREV  TOTAL 002  NEXT  │
└─────────────────────────┘
```
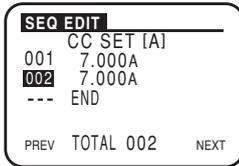
12. Set the current value of step 2.

    Move the cursor to END and press the INS (SHIFT+ ▲) key.

    Step line 002 is inserted. Like step 1, turn the rotary knob to set the current value of step 2 to 7 A.

```
┌─────────────────────────┐
│ ■SEQ EDIT▬▬▬            │
│         CC SET [A]     │
│ 001  7.000A            │
│ 002  7.000A            │
│ 003  0.500A            │
│ ▬▬▬  END               │
│ PREV  TOTAL 003  NEXT  │
└─────────────────────────┘
```
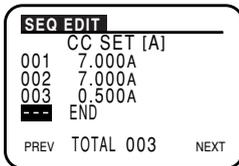
13. Set the current value of step 3.

    Move the cursor to END and press the INS (SHIFT+ ▲) key.

    Step line 003 is inserted. Like step 1, turn the rotary knob to set the current value of step 3 to 0.5 A.

    After setting the current values, press the NEXT (SHIFT+ ▶) key or the ENTER key to move to the next edit screen.

```
SEQ EDIT
          [h:min:s.ms]
001  0:00:00.001
002  0:00:00.001
003  0:00:00.001
---  END

PREV  TOTAL 003    NEXT
```

14. Set the execution time of step 1.

On the initial screen, the time is 0:00:00.001. Press the ▲ key to move the cursor to step 001. Since we are setting step 1 to 200 s (03 min:20 s), press the ◄ or ► CURSOR key to move the cursor to the digit you wish to change and turn the rotary knob.

When 60 s is exceeded, the digit is carried over to minutes (min). Therefore, keep turning the rotary knob until 03 (min):20 (s) is reached.

```
SEQ EDIT
          [h:min:s.ms]
001  0:03:20.0--
002  0:02:30.0--
003  0:00:00.001
---  END

PREV  TOTAL 003    NEXT
```

15. Set the execution time of step 2.

Press the ▼ key to move the cursor to step 002. Like step 1, turn the rotary knob to set the execution time of step 2 to 150 s (02 min:30 s).

```
SEQ EDIT
          [h:min:s.ms]
001  0:03:20.0--
002  0:02:30.0--
003  0:01:20.0--
---  END

PREV  TOTAL 003    NEXT
```

16. Set the execution time of step 3.

Press the ▼ key to move the cursor to step 003. Like step 1, turn the rotary knob to set the execution time of step 3 to 80 s (01 min:20 s).

After setting the execution times, press the NEXT (SHIFT+ ►) key or the ENTER key to move to the next edit screen.

17. Set the execution pattern of step 1.

Since we are setting step 1 to load on and slope pattern, move the cursor to each item and set LOAD and RAMP to ON.

Leave TRIG and PAUSE at OFF.

```
SEQ EDIT
     LOAD RAMP TRIG PAUSE
001   ON   ON  OFF  OFF
002   ON  OFF  OFF  OFF
003  OFF  OFF   ON  OFF
---  END

PREV  TOTAL 003
```

18. Set the execution pattern of step 2 and 3.

Like step 1, move the cursor and set the execution pattern of step 2 (LOAD ON, RAMP OFF, TRIG OFF, and PAUSE OFF), and the execution pattern of step 3 (LOAD OFF, RAMP OFF, TRIG ON, PAUSE OFF).

We are done entering all the settings of program 1.

■ Setting program 2

19. Move to the settings of program 2.

Press the PREV (SHIFT+ ◄) key three times to return to the program edit (SEQ) screen.

After returning to the program operation screen, check whether the cursor is blinking at the program number line.
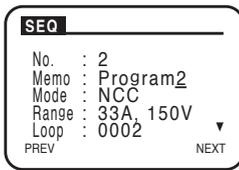
20. Set the program number.

In program 2, set the program number to 2.

Move the ▼ CURSOR key to move to the next item.

21. Enter a memo.

Enter characters in the same fashion as step 3.

In program 2, enter "Program2". After entering the memo, move the ▼ CURSOR key to move to the next item.

```
┌─────────────────────────┐
│ SEQ ▬▬▬▬▬▬          │
│                         │
│ No.   : 2               │
│ Memo  : Program2        │
│ Mode  : NCC             │
│ Range : 33A, 150V       │
│ Loop  : 0002        ▼   │
│ PREV            NEXT     │
└─────────────────────────┘
```

22. Select the operation mode, range, and the number of program loops.

Set the operation mode, range, and the number of program loops of program 2 in the same fashion as steps 4 to 6.

In program 2, set the operation mode to CC, the range to 33 A, 150 V (PLZ164W), and the number of program loops to 2.
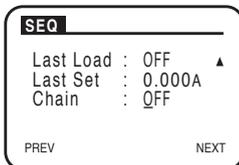
At the last line, move the ▼ CURSOR key to move to the next item.

23. Set the load condition after the end of the program and the current value.

Select the load condition and the current value after the end of program 2 (executed twice) in the same fashion as steps 7 and 8.

Since the load is turned off and the current is set to 0 A after executing program 2 twice, set OFF and 0 A, respectively.

After setting the load condition and the current value, move the ▼ CURSOR key to move to the next item.

```
┌─────────────────────────┐
│ SEQ ▬▬▬▬▬▬          │
│                         │
│ Last Load :  OFF     ▲  │
│ Last Set  :  0.000A     │
│ Chain     :  OFF        │
│                         │
│ PREV            NEXT     │
└─────────────────────────┘
```
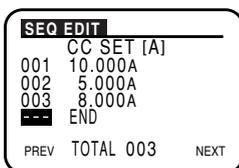
24. Set the number of the program to be executed next.

Since the sequence operation is ended after executing program 2 twice, select OFF.

Press the NEXT (SHIFT+ ▶) key or ENTER key to move to the next edit screen.
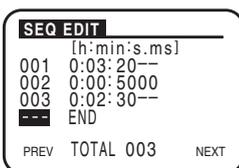
■ Setting the steps of program 2

```
┌─────────────────────────┐
│ SEQ EDIT ▬▬▬▬       │
│      CC SET [A]         │
│ 001  10.000A            │
│ 002   5.000A            │
│ 003   8.000A            │
│ ---  END                │
│ PREV  TOTAL 003  NEXT   │
└─────────────────────────┘
```

25. Set the current values of step 1 to 3.

Repeat steps 10 to 13 to set the current value of step 1 (10 A), the current value of step 2 (5 A), and the current value of step 3 (8 A).

After setting the current values, press the NEXT (SHIFT+ ▶) key or the ENTER key to move to the next edit screen.

```
┌─────────────────────────┐
│ SEQ EDIT ▬▬▬▬       │
│      [h:min:s.ms]       │
│ 001  0:03:20--          │
│ 002  0:00:5000          │
│ 003  0:02:30--          │
│ ---  END                │
│ PREV  TOTAL 003  NEXT   │
└─────────────────────────┘
```

26. Set the execution times of step 1 to 3.

Repeat steps 14 to 16 to set the execution time of step 1 (200 s (03 min:20 s)), the execution time of step 2 (50 s), and the execution time of step 3 (150 s (02 min:30 s)).

After setting the execution times, press the NEXT (SHIFT+ ▶) key or the ENTER key to move to the next edit screen.

```
┌─────────────────────────┐
│ SEQ EDIT ▬▬▬▬       │
│    LOAD RAMP TRIG PAUSE │
│ 001  ON  ON  OFF OFF    │
│ 002  ON  OFF OFF OFF    │
│ 003  ON  ON  OFF OFF    │
│ ---  END                │
│ PREV  TOTAL 003         │
└─────────────────────────┘
```
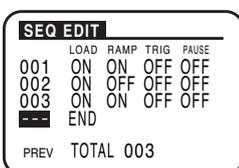
27. Set the execution patterns of step 1 to 3.

Repeat steps 17 and 18 to set the execution pattern of step 1 (LOAD ON, RAMP ON, TRIG OFF, and PAUSE OFF), the execution pattern of step 2 (LOAD ON, RAMP OFF, TRIG OFF, and PAUSE OFF), and the execution pattern of step 3 (LOAD ON, RAMP ON, TRIG OFF, and PAUSE OFF).

We are done entering all the settings of program 2.

28. Finish editing.

Pressing the PREV (SHIFT+ ◀) returns to the previous page.

Since we wish to return to the screen before entering the sequence edit screen, press the PREV (SHIFT+ ◀) key when the program edit (SEQ) screen is displayed.

■ Reediting and confirming the sequence

The program that you create is saved by the backup function even when the power is turned off. To confirm or reedit programs you have created, select sequence edit again.

```
SEQ
No.   : 2
Memo  : Program2
Mode  : NCC
Range : 33A, 150V
Loop  : 0001        ▼
PREV            NEXT
```

1. Select sequence edit.

   Press the EDIT (SHIFT+A) key.

   The program edit (SEQ) screen appears.

2. Select the number of the program you wish to confirm or edit.

   Turn the rotary knob to display the number of the program you wish to confirm or edit.

   When you select a program number, the corresponding program operation is displayed.
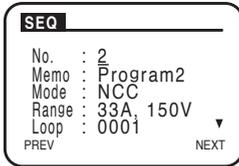
   Press the NEXT (SHIFT+ ►) key or ENTER key to move to the next edit screen.

   Press the PREV (SHIFT+ ◄) to return to the previous screen.

   Switch the screen as you like and confirm or edit the settings.

```
SEQ EDIT
      CC SET [A]
001  10.000A
002   5.000A
003   8.000A
---   END

PREV  TOTAL 003  NEXT
```
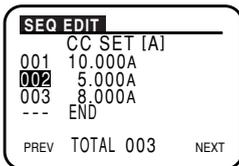
• **Inserting steps**

   Press the ▼ or ▲ CURSOR key so that the step line below the line you wish to insert is highlighted. When the step line is highlighted, press the INS (SHIFT+ ▲) key. A new step line is inserted above the line where the cursor was.

• **Deleting steps**

   Press the ▼ or ▲ CURSOR key so that the line you wish to delete is highlighted. When the step line is highlighted, press the DEL (SHIFT+ ▼) key. The step line at the cursor position is deleted.

3. Finish editing.

   Pressing the PREV (SHIFT+ ◄) returns to the previous page.

   Press the PREV (SHIFT+ ◄) key when the program edit (SEQ) screen is displayed to return to the screen before entering the sequence edit screen.

6.6.4 Overview of the Fast Sequence

To create a sequence, you must understand the concept of "program" and "step."
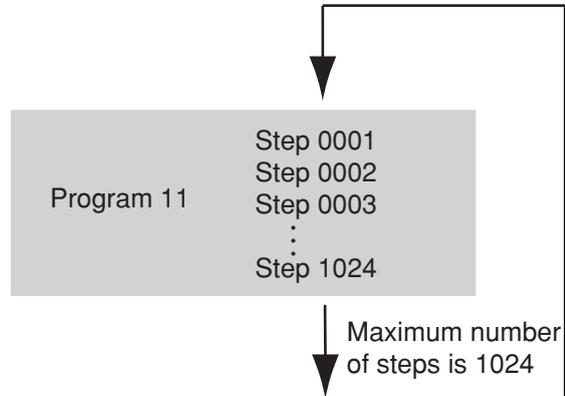
Fig. 6-16   Conceptual diagram of program and step

NOTE
- The operation modes that can be used in a fast sequence are CC and CR modes. In the explanation below, CC mode is used. When using CR mode, read the current values as resistance values.

- **Program**

The fast sequence can be saved only to program 11. Set the operation mode to CC or CR. The only method of executing the program is looping. Programs cannot be chained as in the normal sequence. The number of programs that can be saved is 1.

Below are the settings of a program.

- No.   Program number (11)
- Memo   Memo (up to 11 characters can be specified)
- Mode   Operation mode of the program (CC or CR)
- Range   Current range-voltage range of the program
                 (L-15V, M-15V, H-15V, L-150V, M-150V, or H-150V)
- Loop   Number of program loops (1 to 9999 where 9999 is infinite loop)
- Last Load   Load condition (OFF/ON) at program end
- Last Set   Current value at program end (0 to 100 % of the range setting)
- RPTSTEP   Last step number (3 to 1024) per loop
- TIME BASE   Step execution time (25 μs to 100 ms)

Resolution	25 μs to 0.1 ms	25 μs
	0.1 ms to 100 ms	100 μs

A program is a collection of steps (execution unit). When program 11 is executed (RUN), steps are executed one by one in ascending order from step number 0001. The completion of the last step signifies the end of one program execution.

- **Step**

Current	Current for the step
STEP	Step number
T	Specify the step when you wish to output a trigger signal using T.

- **TRIG (trigger output)**

TRIG sets the presence or absence of trigger output. When turned on, a trigger signal is output from the TRIG OUT connector on the front panel at the same time as the step is executed.

(Example) Set trigger output at step number n (TRIG ON)

Fig. 6-17   TRIG sequence example

- **FILL function**

This function automatically sets the current values of steps in between two separated steps for which you specify the current values.
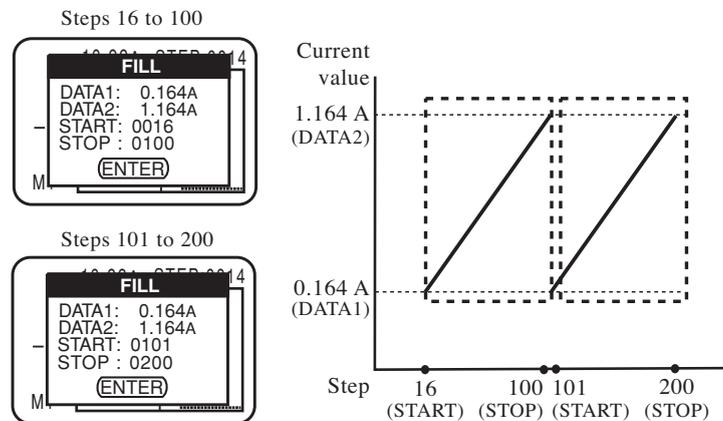
Fig. 6-18   Setup example using the FILL function

- DATA1   Current value at the start step (0.000 to 100 % of the range setting)
- DATA2   Current value at the end step (0.000 to 100 % of the range setting)
- START   Start step number
- STOP   End step number

In Fig. 6-18, the same waveform is repeated twice. DATA1 and DATA2 of the two waveforms are set to the same values, respectively, for each two-point interval. The values between two points are automatically assigned.

6.6.5 Fast Sequence Editing

The sequence edit screen is divided into the following four edit screens. When creating a sequence, items are set on each edit screen. This section describes the setup items on each edit screen and the setup procedure.

```
SEQ
No.   : 11
Memo  : Program11
Mode  : FCC
Range : 33A , 15V
Loop  : 0003        ▼
PREV           NEXT
```
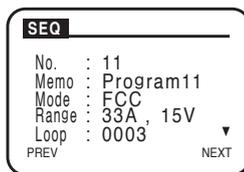
(1) Program operation

Set the program number (always set to 11), memo, operation mode, range, and the number of loops. (Top screen of the screen divided into top and bottom halves)

```
SEQ
Last Load : ON      ▲
Last Set  : 1.000A
RPTSTEP   : 15
TIME BASE : 1ms
PREV           NEXT
```

(2) Program end condition and step execution time

Set the program end condition, last step per loop, and step execution time. (Bottom screen of the screen divided into top and bottom halves)

```
     10.00A  STEP:0014

  _       ............
              ..
  M1            .............
```
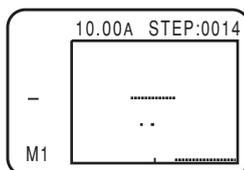
(3) Step setting and monitoring of the specified steps

Set the value (current or resistance) of the step to be executed one step at a time. You can set the presence or absence of trigger output.

To monitor the current of each step, set the magnification and move the steps.

```
         FILL
  DATA1: 0.164A
  DATA2: 1.164A
  _ START: 0016
  STOP : 1024
  M  (ENTER)
```
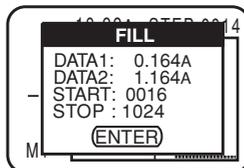
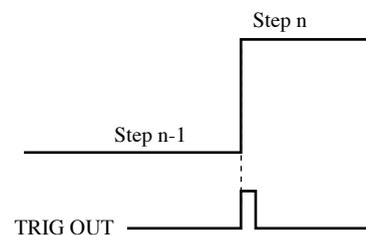(4) FILL function

This function automatically sets the current values of steps in between two separated steps for which you specify the current values.

■ Common operations on the edit screens

The common operations carried out on the edit screens such as moving the cursor within the edit screen, selecting items, entering values and characters, and turning pages are the same as those for the normal sequence. For a description of the following items, see the respective sections for normal sequence.

- **Moving the cursor**
- **Selecting items**
- **Entering values**
- **Entering characters (memo)**
- **Turning pages**

Table6-4 Setup items on each setup screen

Edit screen	Setup item	Description
Program operation	No.	Program number (11)
	Memo	Memo (11 characters)
	Mode	Operation mode (CC or CR)
	Range	Range setting (L-15V, M-15V, H-15V, L-150V, M-150V, or H-150V)
	Loop	Number of program loops (1 to 9999) 9999 is infinite loop
	Last Load	Load condition after the end of the sequence (ON/OFF)
	Last Set	Current value after the end of the sequence (0.000 to 100 % of the range setting)
	RPTSTEP	Last step number (3 to 1024) per loop
	TIME BASE	Step execution time (25 µs to 100 ms)
FILL	DATA1	Current for the start step (0.000 to 100 % of the range setting)
	DATA2	Current for the end step (0.000 to 100 % of the range setting)
	START	Start step number
	STOP	End step number
Trigger signal	TRIG	Trigger output (ON/OFF)
Magnification	M1,2,3,4,5,6,7,8	The value indicates the number of skipped steps.

6.6.6　Sequence Example (Fast Sequence)

Programs are created using the PLZ-4W operation panel. This section describes the procedure of entering the following example sequence from the operation panel.

- **Flow of the example sequence**

In this example, we will assume a sequence that executes a program to simulate the waveform of Fig. 6-19.

The program execution repeats program 11 three times (point A to point B, point B to point C, and point C to point D). After executing three times, the sequence ends with the current value of 1 A (point E).
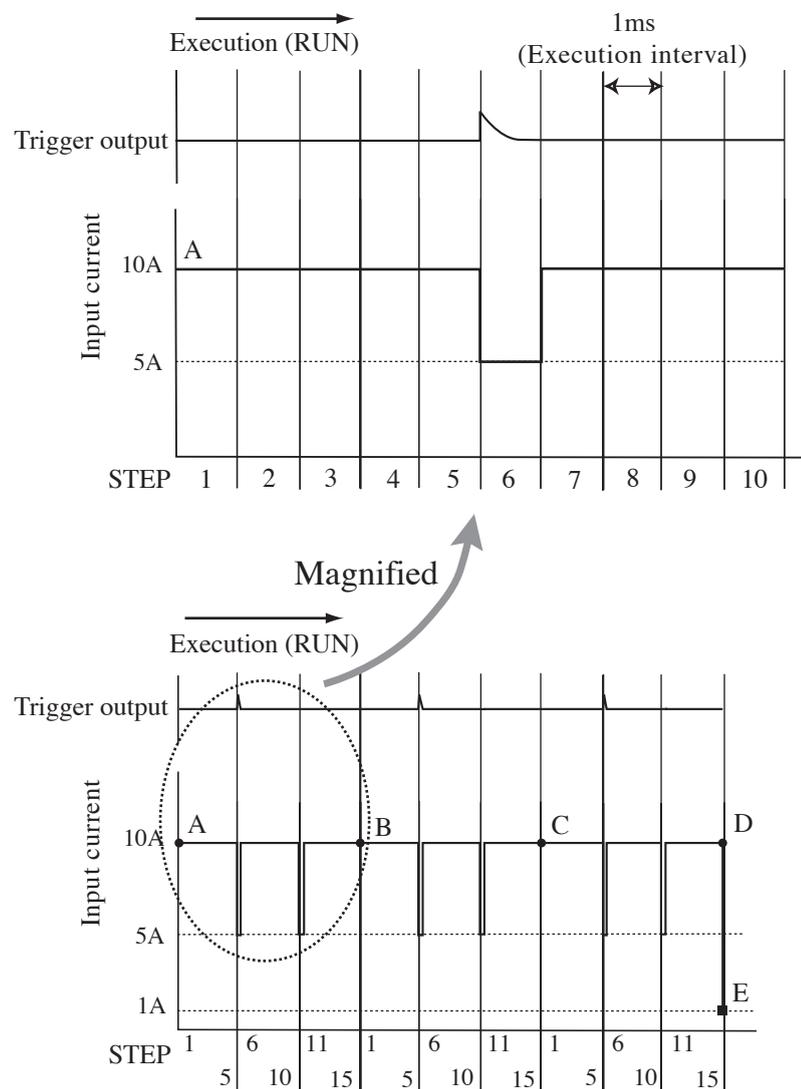
Fig. 6-19　Sequence execution example

• No.	Program number (11)
• Memo	Memo (PLZ164W)
• Range	Current range-voltage range (H-15V)
• Loop	Number of program loops (3)
• Last Load	Load condition at the end (ON)
• Last Set	Current value at the end (1 A)
• RPTSTEP	Last step per loop (15)
• TIME BASE	Step execution time (1 ms)
• Current setting	Steps 1 to 5: 10 A
	Step 5: 5 A
	Steps 7 to 10: 10 A
	Step 11: 5 A
	Steps 12 to 15: 10 A
• Trigger output	Step 6

Creating the program

```
SEQ
No.   : 11
Memo  :
Mode  : FCC
Range : 33A , 15V      ▼
Loop  : 0003
PREV              NEXT
```
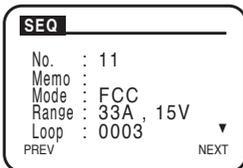
1. Select sequence edit.

   Press the EDIT (SHIFT+A) key to display the program edit screen.

■ **Setting the operation of program 11**

2. Select the program number.

   Turn the rotary knob to set the program number.

   Select 11, because you can only select 11 for a fast sequence. After setting the program number, press the ▼ CURSOR key to move to the next item.

3. Enter a memo.

   When adding a memo, turn the rotary knob to enter the characters.

   In program 11, enter "Program11". After entering the memo, move the ▼ CURSOR key to move to the next item.

4. Select the operation mode.

   Turn the rotary knob to show the operation mode to be executed.

   Select constant current mode "FCC." After setting the operation mode, move the ▼ CURSOR key to move to the next item.

5. Sets the range.

   Turn the rotary knob to select the current range and voltage range.

   Set 33 A - 15 V. After setting the range, move the ▼ CURSOR key to move to the next item.

```
SEQ
No.    : 11
Memo   :
Mode   : FCC
Range  : 33A , 15V
Loop   : 0003        ▼
PREV          NEXT
```
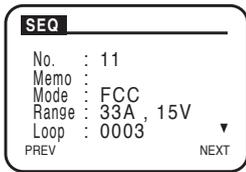
6. Set the number of program loops.

Turn the rotary knob to show the number of program loops.

Set 0003 to specify 3 loops.

At the last line, move the ▼ CURSOR key to move to the next item.

7. Set the load condition after the end of the program.

Turn the rotary knob to select the load condition.

Since the load is turned on at the end of program 11, select ON.

After setting the load condition, move the ▼ CURSOR key to move to the next item.

8. Set the current setting after the end of the program.

Turn the rotary knob to set the current value.

Since the load is turned on at the end of program 11, select 1 A.

After selecting the current setting, move the ▼ CURSOR key to move to the next item.

```
SEQ
Last Load : ON      ▲
Last Set  : 1.000A
RPTSTEP   :15
TIME BASE : 1ms
PREV          NEXT
```

9. Set the last step per loop for program 11.

Turn the rotary knob to set the step number.

Set 15.

After setting the step number, move the ▼ CURSOR key to move to the next item.

10. Set the step execution time.

Turn the rotary knob to set the step execution time.

Set 1 ms.

After setting the step execution time, press the ENTER key to move to the next edit screen.

■ Setting the current value and trigger output of each step

We will set the current value and trigger output of each step of program 11.

Here, we will set the current value first followed by the trigger output.
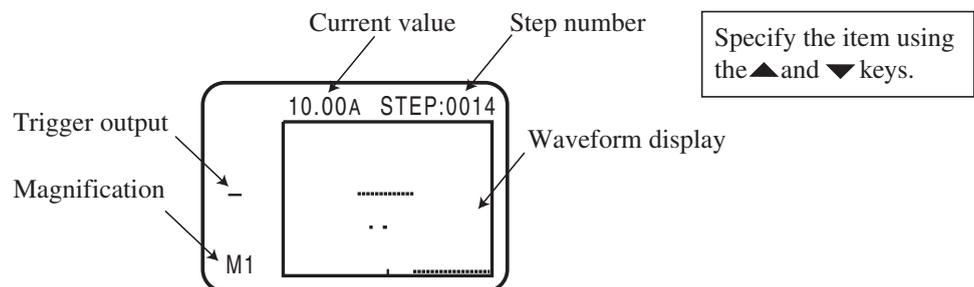
Fig. 6-20   Step setup screen

The following three items are specified.

Step number

Current value

Presence or absence of trigger output

Press the ▲ or ▼ key to select the item, and turn the rotary knob to set the value or symbol.

11. Set step 1.

Press the ▲ or ▼ key to select the step number.

Turn the rotary knob to set the step to 0001.

Press the ▼ key to move the cursor to the current value, and turn the rotary knob to set the current value of step 1 to 10 A.
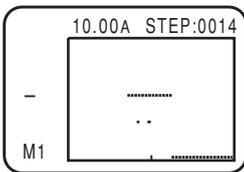
12. Set step 2.

Press the ▲ key to select the step number.

Turn the rotary knob to set the step to 0002.

Press the ▼ key to move the cursor to the current value, and turn the rotary knob to set the current value of step 2 to 10 A.

13. Set step 3 to 5.

Select the step number in the same fashion as step 12, and set the current value to 10 A.

14. Set step 6.

Select the step number in the same fashion as step 12, and set the current value to 5 A. Next, press the ▼ key to move the cursor to the trigger setting position, and turn the rotary knob to select T.

15. Set steps 7 to 10.

Select the step number in the same fashion as step 12, and set the current value to 10 A.

16. Set step 11.

Select the step number in the same fashion as step 14, and set the current value to 5 A.

But, for this step, the trigger is not set.

17. Set steps 12 to 15.

Select the step number in the same fashion as step 12, and set the current value to 10 A.

18. Finish editing.

The settings are shown within a rectangular frame on the screen. For a description of the monitor operation, see below.

Pressing the PREV (SHIFT+ ◄) returns to the previous page.

■ **Monitoring the settings**

1. Select sequence edit.

   Press the EDIT (SHIFT+A) key to display the program edit screen.

2. Press the ENTER key to move to the monitor screen.
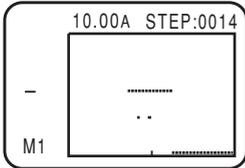
3. Set the magnification.

   Press the ▼ key to move the cursor to magnification, and turn the rotary knob to set the magnification. Eight magnification types, M1, 2, 3, ..., 8 are available. Magnification M1 is the largest.

4. Select the step number.

   Press the ▲ key to move the cursor to the step number. Turn the rotary knob to change the step. The waveform moves with the specified step centered in the rectangular frame.

   The range that can be monitored is up to the last step per loop you specified.

   At magnification M1, the waveform moves one step at a time when you turn the rotary knob. Thus, you can monitor the details. Likewise, the waveform moves 2 steps and 3 steps at a time for magnification M2 and M3, respectively. At magnification M8, the waveform moves 8 steps at a time.

5. Finish editing.

   Pressing the PREV (SHIFT+ ◄) returns to the previous page.

■ **FILL function operation**
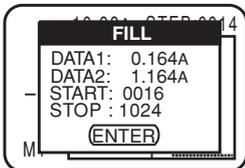
1. Select sequence edit.

   Press the EDIT (SHIFT+A) key to display the program edit screen.

2. Press the ENTER key to move to the monitor screen.

3. Press the INS (SHIFT+ ▲) key to move to the FILL screen.

4. Set the value.

   Press the ▼ or ▲ key to move the cursor to the DATA1 value. Turn the rotary knob to set the current value of the start step. Likewise, set the current value of the end step at DATA2, the start step number at START, and the end step number at STOP.

NOTE • The end step number can be set up to 1024, but the range that can be monitored is the last step per loop specified by RPTSTEP.

---

5. Finish editing.

   Press the ENTER key to move to the monitor screen.

6.6.7   Executing, Pausing, Stopping the Sequence

1. Check that the switching function and short function are turned off.

    Check that the SW ON key is turned off and that the short icon is not displayed. Even if turned on, the switching function and short function are forcibly turned off when the sequence execution screen is entered.
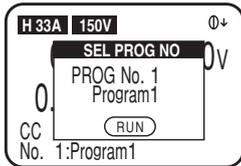
2. Enter the sequence execution screen.

    Press the RUN/STOP (SHIFT+B) or PAUSE (SHIFT+C) key.

    The sequence execution screen appears.

3. Select the program number to be executed.

    Turn the rotary knob to show the program number to be executed.

    Select 1 to 10 for normal sequence or 11 for fast sequence.

4. Execute the sequence.

    Press the RUN/STOP (SHIFT+B) key to execute the selected program.

    The measured values during execution are shown on the display.

5. Pause the sequence.

    While the sequence is executing, press the PAUSE (SHIFT+C) key.

    The PAUSE screen appears, and the sequence operation pauses.

    To resume the operation, press the PAUSE (SHIFT+C) key again. If you press the RUN/STOP (SHIFT+B) key when the sequence is paused, the sequence operation stops.
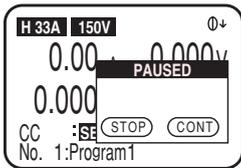
NOTE • If a pause is specified in a step (PAUSE ON), the sequence operation automatically stops after executing the step. In this case also, press the PAUSE (SHIFT+C) key to resume the operation.

---

6. Stop the sequence.

    Press the RUN/STOP (SHIFT+B) key.

    The selected program stops.

7. Exit from the sequence execution screen.

NOTE • If you press the RUN/STOP (SHIFT+B) key again after stopping the sequence, the selected program is executed from the beginning.

When sequences cannot be executed

Sequences cannot be executed across different modes and ranges.

1. You cannot execute a sequence if the mode or range of the chained program is different. Check the settings.

2. If the load is turned on and the current mode and range settings do not match the settings of the sequence that you are trying to execute, you cannot execute the sequence. Turn off the load, and set the sequence settings to match the current settings.

3. If the load is turned off and the current mode and range settings do not match the settings of the sequence that you are trying to execute, the settings of the sequence that you are trying to execute are forcibly changed to the current settings, and the sequence is executed.

Table 6-5

Before sequence execution		Sequence execution	
Load on/off condition	Mode and range settings that you are trying to execute	Execution	Mode and range settings that are executed
Load on	Matches the current settings	Possible	Same as the current settings
	Do not match the current settings	Not possible	
Load off	Matches the current settings	Possible	Same as the current settings
	Do not match the current settings	Possible	Forcibly changed to the current settings

6.7   Remote Sensing Function

Remote sensing is a function used to correct the voltage drop caused by the resistance of the load wire when it cannot be discarded. Execute remote sensing to accurately set the resistance, voltage, and power.

Remote sensing improves the transient characteristics in the CR, CV, and CP modes and thereby achieves stable operation.

⚠ CAUTION   • If the load wire is disconnected when remote sensing is being executed, the sensing wire may break.

Accidents can be prevented by connecting a protection fuse as shown in Fig. 6-21. Use a fuse with a rated current of 0.5 A and a rate voltage greater than the output voltage of the equipment under test.

■ Remote sensing wiring

Connect the remote sensing on the rear panel (+S) and the positive terminal of the equipment under test. Likewise, connect the remote sensing (-S) to the negative terminal.

The remote sensing should be wired at the nearest to the EUT.

■ Electric wire used

You do not have to take into account the allowable current as in the load wire. However, for mechanical strength, use a wire with a nominal cross-sectional area of 0.5 mm^2 or more.

Use crimp terminals for M3 screws for the connection on the PLZ-4W end.
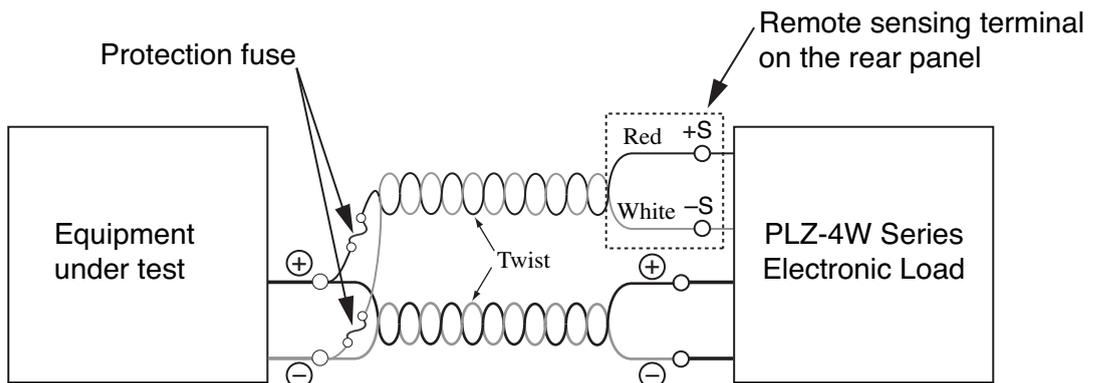
Fig. 6-21   Remote sensing wiring

6.8 External Control

6.8.1 Overview and Precaution of External Control

The settings in each operation mode normally use the internal reference signal. In external control, this reference signal is supplied externally. The external signal is either voltage (voltage control) or resistance (resistance control).

External control can control the settings from 0 % to 100 % of the selected range in the CC, CR, CP, or CV mode.

Table 6-6   External control using voltage or resistance

Control method	Operation mode	Description
Voltage	CC, CP, CV	Change of 0 V to 10 V produces a change of 0 % to 100 % of the rated value of the range
	CR	Change of 0 V to 10 V produces a change of maximum value to minimum value of the range
Resistance (proportional)	CC, CP, CV	Change of 0 Ω to 10 kΩ produces a change of 0 % to 100 % of the rated value of the range
	CR	Change of 0 Ω to 10 kΩ produces a change of maximum value to minimum value of the range
Resistance (inverse proportional)	CC, CP, CV	Change of 10 kΩ to 0 Ω produces a change of 0 % to 100 % of the rated value of the range
	CR	Change of 10 kΩ to 0 Ω produces a change of maximum value to minimum value of the range

There are other external controls as indicated below.

Table 6-7   Other external controls

Function	Description
Load on/off	Turns on/off the load and monitor the load
Current range switching	Controls the range of each operation mode or monitor the range
Trigger input	Clear the pause in sequence operation
Alarm input	Forcibly activates an alarm
Current monitor	Monitors the input current
Short signal	Relay contact output

Precaution when operating under high-speed load simulations

When operating under high-speed load simulations, do not connect the common terminal of the external device and the terminal of the EUT which connects to the negative polarity of load input terminal of the PLZ-4W. Attach the ferrite core on the connecting wire between the external device and the PLZ-4W.
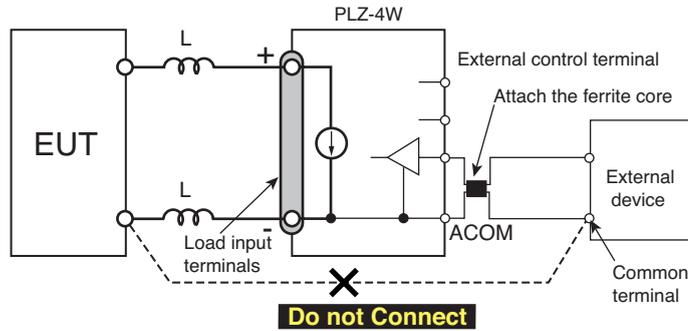
Fig. 6-22   When operation under high-speed load simulations

6.8.2   J1/J2 connector

The J1 and J2 connectors on the rear panel are of the same shape and the same number of pins. However, J1 is assigned to external control while J2 is assigned to parallel operation. For details on the pin arrangement, see Table 6-9 or Table 6-10.
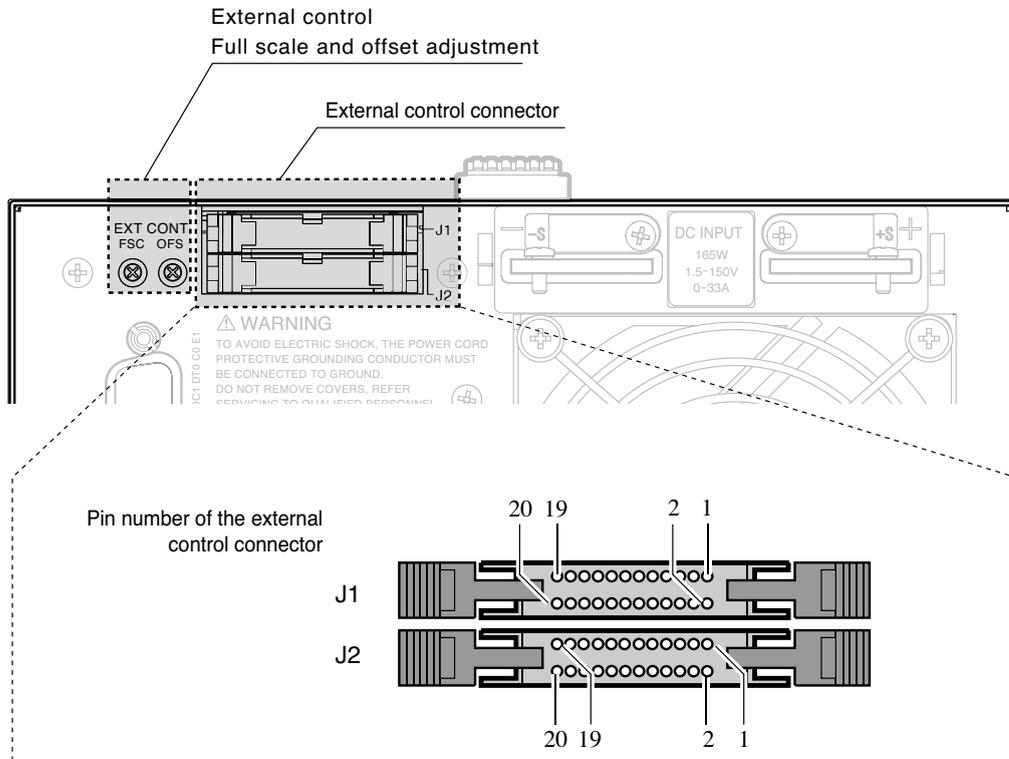
Fig. 6-23   Rear panel

⚠ WARNING • When the PLZ-4W is shipped from the factory, protection dummy plugs are attached to the J1 and J2 connectors. To prevent the possibility of electric shock, leave the dummy plug attached to the connectors when you are not using them.

⚠ CAUTION • To disconnect the connector, remove the lock levers located on either side and pull the connector itself.

• Be sure to turn off the PLZ-4W when attaching or removing the connector.

• J1 and J2 connectors are physically the same. Use caution not to use the wrong connector to prevent a malfunction.

Connecting to the connector

Use a standard MIL 20-pin connector for connecting to the J1/J2 connector. Table 6-8 shows the recommended connector.

NOTE • When using a flat cable, be sure to use a connector with a strain relief.

• To press-fit discrete wires or flat cables, be sure to use a special tool. For a description of applicable cables and tools, see the relevant catalogs of connector manufacturers.

Table 6-8   Connectors supported by manufacturers

Manufacturer	Product	Notes
Omron	XG5M-2032 or XG5M-2035 XG5S-1001 (2 pcs.)	For discrete wires
Omron	XG4M-2030 XG4T-2004	For flat cables
KEL	6200-020-601	For flat cables

Table6-9   J1 connector pin arrangement

Pin No.	Signal name	Description
1	EXT R/V CONT	Can be used in CC, CR, CV, and CP modes
		0 V to 10 V correspond to 0 % to 100 % of the rated current (CC mode), rated voltage (CV mode), or rated power (CP mode). 0 V to 10 V correspond to maximum resistance to minimum resistance (CR mode)
		0 Ω to 10 kΩ correspond to 0 % to 100 % or 100 % to 0 % of the rated current (CC mode), rated voltage (CV mode), or rated power (CP mode). 0 Ω to 10 kΩ correspond to maximum resistance to minimum resistance or minimum resistance to maximum resistance (CR mode)
2	IMON	Current monitor output 10 V f.s (H/L range) and 1 V f.s (M range)
3	A COM	Connected to the negative load input terminal on the rear panel.
4	SUM I MON	Used during master/slave operation. Connected to SUM I MON of the J2 connector.
5	PRL IN+	Used during master/slave operation. Connected to PRL OUT+ of the J2 connector.
6	PRL IN-	Used during master/slave operation. Connected to PRL OUT- of the J2 connector.
7	LOAD ON/OFF CONT	Turns on the load with low (or high) TTL level signal Pulled up the internal circuit to 5 V using 10 kΩ.
8	RANGE CONT 1	External range switch input[*1] [*2]
9	RANGE CONT 0	Pulled up the internal circuit to 5 V using 10 kΩ.
10	ALARM INPUT	Activates alarm with low TTL level signal input. Pulled up the internal circuit to 5 V using 10 kΩ.
11	TRIG INPUT	When paused, clears the pause when a low level TTL signal is applied for 10 μs or longer. Pulled down the internal circuit to A COM using 100 kΩ.
12	A COM	Connected to the negative load input terminal on the rear panel.
13	LOAD ON STATUS	Turns on when load is on. Open collector output by a photocoupler.[*4]
14	RANGE STATUS 1	Range status output. Open collector output by a photocoupler.[*4]
15	RANGE STATUS 0	
16	ALARM STATUS	Turns on when an alarm (OVP, OCP, OPP, OHP, REV, or UVP) is activated or when an external alarm is applied. Open collector output by a photocoupler.[*4]
17	STATUS COM	STATUS signal common for pins 13 to 16.
18	N.C.	
19	SHORT SIGNAL OUT	Relay contact output (30 VDC/1 A)
20	SHORT SIGNAL OUT	

*1.   Valid only when the front panel settings is H range.

*2.

	RANGE CONT 0	RANGE CONT 1
H range	1	1
M range	1	0
L range	0	1

*3.

	RANGE STATUS 0	RANGE STATUS 1
H range	OFF	OFF
M range	OFF	ON
L range	ON	OFF

*4.   The maximum applied voltage of the photocoupler is 30 V; the maximum current is 8 mA.

Table 6-10 J2 connector pin arrangement

Pin No.	Signal name	Description
1	N.C.	
2	N.C.	
3	N.C.	
4	SUM I MON	Connect to SUM I MON of the J1 connector.
5	PRL OUT+	Used during master/slave operation. Connected to PRL IN+ of the J1 connector.
6	PRL OUT-	Used during master/slave operation. Connected to PRL IN- of the J1 connector.
7	N.C.	
8	N.C.	
9	SLAVE RANGE CONT	Used during master/slave operation. Connected to RANGE CONT 0 of the J1 connector.
10	N.C.	
11	N.C.	
12	A COM	Connected to the negative load input terminal on the rear panel.
13	N.C.	
14	N.C.	
15	N.C.	
16	ALARM INPUT	Activates an alarm with high (or low) TTL level signal input. Pulled up the internal circuit to 5 V.
17	A COM	Connected to the negative load input terminal.
18	N.C.	
19	N.C.	
20	+15V	Controls the on/off of the load booster power (cannot be used for multiple purposes).

6.8.3　External Control of CC Mode

The external control of CC mode can be carried out using external voltage or external resistance. The input current varies proportionally to the external voltage or external resistance.

(1) External voltage control

Applying an external voltage in the range of 0 V to 10 V to the PLZ-4W produces an input current that is proportional to the change.

The input current corresponding to the external voltage of 0 V is 0 A; the input current corresponding to the external voltage of 10 V is 100 % of the specified range.

Connected pins: J1-1 (signal), J1-3 (common)

⚠ **CAUTION**
- The maximum voltage that can be applied across pins 1 and 3 of the J1 connector is ±11 V. Applying a voltage exceeding this value can damage the PLZ-4W.
- Accuracy is not guaranteed for voltages below 0 V and above 10 V.
- Pin 3 of the J1 connector is connected the negative load input terminal. To prevent damaging the PLZ-4W, be sure not to let the wire of pin 3 touch any other pins.

$$Io \approx \frac{Im \times Ein}{10}$$

Io:　Input current
Im:　Rated current
Ein:　External voltage
　$0 \le Ein \le 10$ V

Fig. 6-24　Equivalent circuit

Full scale adjustment
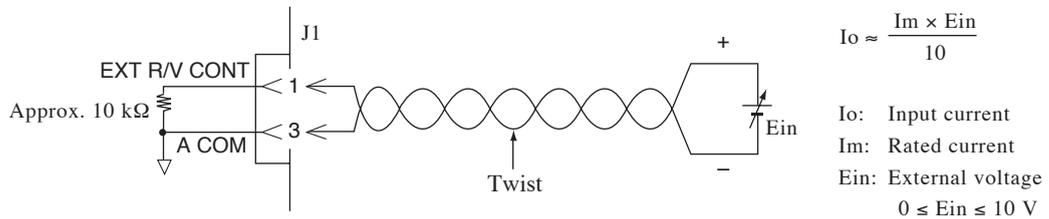
Im　: Rated current
------ : Input current (before adjustment)
——— : Input current (after adjustment)
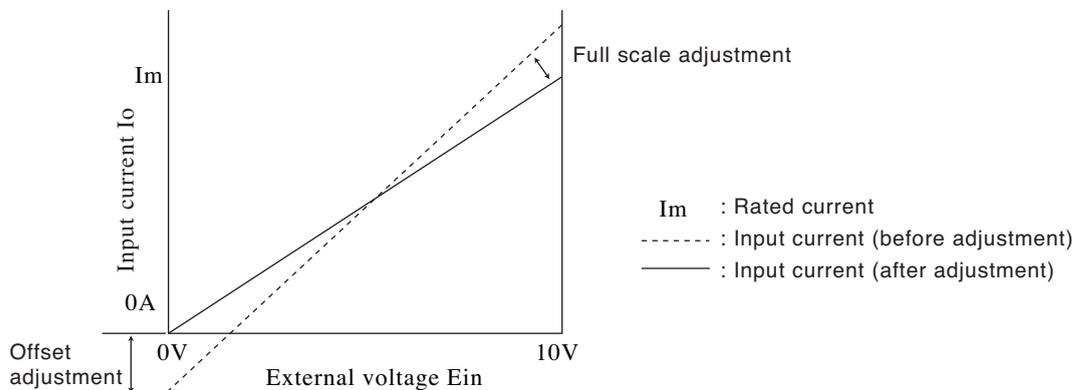
Fig. 6-25　Control the current using external voltage

■ Setup procedure for external voltage control

This procedure is common to CC, CR, CP, and CV modes. Follow this procedure for modes other than CC mode.

NOTE
- Use external voltage of low noise and high stability.
- Use twisted wires for the signal wires. This can prevent disturbance from noise.

1. **Check that the power is turned off.**

   If the power is turned on, press the POWER switch to turn off the power.

2. **Connect the external voltage.**

   Connect the external voltage across pins 1 and 3 of the J1 connector.

3. **Turn on the power.**

   Press the POWER switch to turn on the power.

4. **Check that the load is turned off.**

   Check that the LOAD LED is turned off. If the LED is illuminated, press the LOAD key to cut off the current.

5. **Set the operation mode and current range.**

   Press the MODE key to select the operation mode.

   Press the RANGE key to set the current range. When also controlling the current range externally, be sure to select H range on the panel.

6. **Select the menu setup.**

   Press the MENU (SHIFT+SET/VSET) key.

   The the menu appears.

7. **Select Configuration**

   Press the ▼ or ▲ CURSOR key several times until Configuration is highlighted on the menu. When highlighted, press the ENTER key.

8. **Select External.**

   Press the ▼ or ▲ CURSOR key several times until External is highlighted on the menu. When highlighted, press the ENTER key.

9. **Select voltage control.**

   Press the ▲ CURSOR key to move the cursor (blinking) to the Control line. Turn the rotary knob to select V.

10. **Exit from the menu.**

    Press the MENU (SHIFT+SET/VSET) key.

    The original screen displayed before entering menu setup appears.

11. Power cycle the PLZ-4W.

The menu settings are confirmed.

NOTE • You can prevent the settings from being changed inadvertently during measure-ment by pressing the LOCK (SHIFT+LOCAL) key to enable the lock.

■ Accurately proportionating the external voltage variation and input current variation

You can use the pre-set resistors OFS and FSC on the PLZ-4W rear panel to adjust the current offset value and maximum current value, respectively. The adjustment enables control that is accurately proportional to the external voltage. The adjust-ment is valid for the specified range. If you change the range, make a readjustment.

NOTE • Adjustment is made by actually supplying the load current. Prepare the power supply to be tested.

1. Turn on the load.

2. Set the external voltage to 0 V.

3. Turn OFS to set the current reading of the display measurement section to 0 A.

4. Set the external voltage to 10 V.

5. Turn FSC to set the current reading of the display measurement section to 100 % of the selected range.

6. Turn off the load to finish the adjustment.

(2) External resistance control

Connecting an external resistance in the range of 0 Ω to 10 kΩ to the PLZ-4W produces an input current that is proportional or inversely proportional to the change.

Proportional control

The input current corresponding to the external resistance of 0 Ω is 0 A; the input current corresponding to the external resistance of 10 kΩ is 100 % of the specified range.

Inverse proportional control

The input current corresponding to the external resistance of 10 kΩ is 0 A; the input current corresponding to the external resistance of 0 Ω is 100 % of the specified range.

Connected pins: J1-1 (signal), J1-3 (common)

Proportional control

$$Io \approx Im \left(\frac{Rin(k\Omega)}{10} \right)$$

Inverse proportional control

$$Io \approx Im \left(1 - \frac{Rin(k\Omega)}{10} \right)$$

Io: Input current
Im: Rated current
Rin: External variable resistor
$0 \leq Rin \leq$ Approx. 10 kΩ

Fig. 6-26   Equivalent circuit

Im   : Rated current

Proportional control
------ : Input current (before adjustment)
——— : Input current (after adjustment)

Inverse proportional control
—·—·— : Input current (after adjustment)
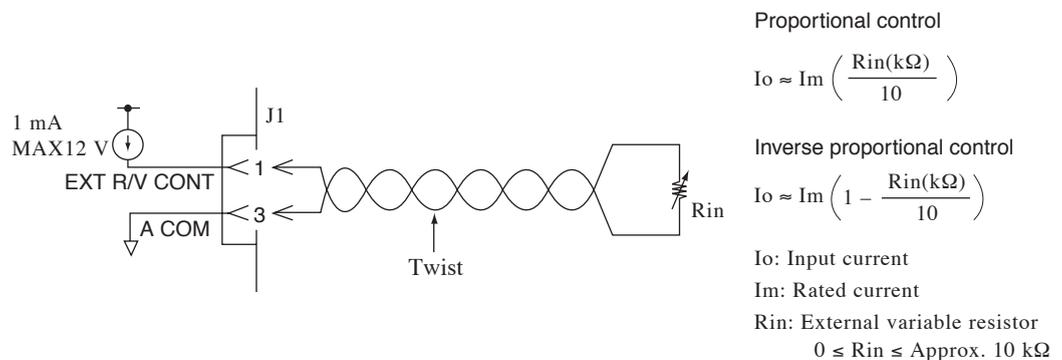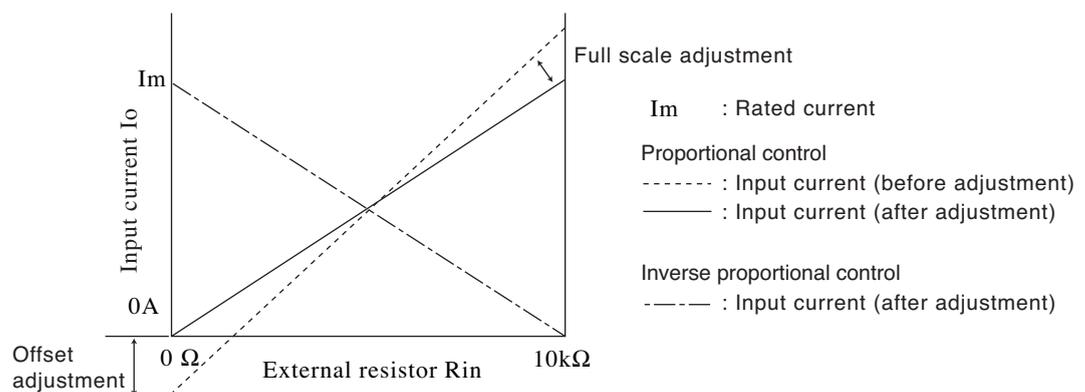
Fig. 6-27   Control the current using external resistance

■ Setup procedure for external resistance control

This procedure is common to CC, CR, CP, and CV modes. Follow this procedure for modes other than CC mode.

NOTE
- It is recommended that the external variable resistor connected to the PLZ-4W be a wire wound resistor, metal film resistor, or multirotational potentiometer that is resistant to temperature and aging. The residual resistance must be less than 50 Ω when set to the minimum resistance.
- Set the resistance to the minimum when using proportional control; set the resistance to the maximum when using inverse proportional control.
- Use twisted wires for the signal wires. This can prevent disturbance from noise.

---

1. Turn off the power.

   Press the POWER switch to turn off the power.

2. Connect the external resistance.

   Connect the external variable resistor across pins 1 and 3 of the J1 connector.

3. Turn on the power.

   Press the POWER switch to turn on the power.

4. Check that the load is turned off.

   Check that the LOAD LED is turned off. If the LED is illuminated, press the LOAD key to cut off the current.

5. Set the operation mode and current value.

   Press the MODE key to select the operation mode.

   Press the RANGE key to set the current range. When also controlling the current range externally, be sure to select H range on the panel.

6. Select the menu setup.

   Press the MENU (SHIFT+SET/VSET) key.

   The menu appears.

7. Select Configuration

   Press the ▼ or ▲ CURSOR key several times until Configuration is highlighted on the menu. When highlighted, press the ENTER key.

8. Select External.

   Press the ▼ or ▲ CURSOR key several times until External is highlighted on the menu. When highlighted, press the ENTER key.

9. Select resistance control.

   Press the ▲ CURSOR key to move the cursor (blinking) to the Control line.

   To use proportional control, turn the rotary knob to select R.

   To use inverse proportional control, turn the rotary knob to select Rinv.

10. Exit from the menu.

   Press the MENU (SHIFT+SET/VSET) key.

   The original screen displayed before entering menu setup appears.

11. Power cycle the PLZ-4W.

   The menu settings are confirmed.

- -

NOTE • You can prevent the settings from being changed inadvertently during measurement by pressing the LOCK (SHIFT+LOCAL) key to enable the lock.

- -

■ Accurately proportionating the external resistance variation and input current variation

You can use the pre-set resistors OFS and FSC on the PLZ-4W rear panel to adjust the current offset value and maximum current value, respectively. The adjustment enables control that is accurately proportional to the external resistance. The adjustment is valid for the specified range. If you change the range, make a readjustment.

- -

NOTE • Adjustment is made by actually supplying the load current. Prepare the power supply to be tested.

- -

For proportional control

1. Turn on the load.

2. Set the external resistance to 0 Ω.

3. Turn OFS to set the current reading of the display measurement section to 0 A.

4. Set the external resistance to 10 kΩ.

5. Turn FSC to set the current reading of the display measurement section to 100 % of the selected range.

6. Turn off the load to finish the adjustment.

For inverse proportional control

Set the external resistance to 10 kΩ at step 2. Set the external resistance to 0 Ω at step 4.

6.8.4 External Control of CR Mode

The external control of CR mode can be carried out using external voltage or external resistance. The resistance varies proportionally to the external voltage or external resistance.

(1) External voltage control

Applying an external voltage in the range of 0 V to 10 V to the PLZ-4W produces a resistance proportional to the change.

The external voltage of 0 V and 10 V correspond to the maximum and minimum resistances of the range, respectively.

Connected pins: J1-1 (signal), J1-3 (common)

⚠ **CAUTION**
- The maximum voltage that can be applied across pins 1 and 3 of the J1 connector is ±11 V. Applying a voltage exceeding this value can damage the PLZ-4W.
- Pin 3 of the J1 connector is connected the negative load input terminal. To prevent damaging the PLZ-4W, be sure not to let the wire of pin 3 touch any other pins.

$$\frac{1}{R_0} \approx \frac{Gm \times Ein}{10}$$

Ein: External voltage
$0 \leq Ein \leq 10$ V
R_0: Operating resistance
Gm: Rated conductance

Fig. 6-28   Equivalent circuit

Gm : Rated conductance (S)
- - - - : Conductance (before adjustment)
───── : Conductance (after adjustment)

Fig. 6-29   Control the resistance using external voltage

■ **The setup procedure is the same as with CC mode.**

See page 6-45 "Setup procedure for external voltage control".

(2) External resistance control

Connecting an external resistance in the range of 0 Ω to 10 kΩ to the PLZ-4W produces a resistance that is proportional or inversely proportional to the change.

Proportional control

The external voltage of 0 Ω and 10 kΩ correspond to the maximum and minimum resistances of the range, respectively.

Inverse proportional control

The external voltage of 10 kΩ and 0 Ω correspond to the maximum and minimum resistances of the range, respectively.

Connected pins: J1-1 (signal), J1-3 (common)

Proportional control

$$\frac{1}{R_0} \approx Gm \left(\frac{Rin(k\Omega)}{10} \right)$$

Inverse proportional control

$$\frac{1}{R_0} \approx Gm \left(1 - \frac{Rin(k\Omega)}{10} \right)$$

Gm: Rated conductance

Rin: External variable resistor

$0 \leq Rin \leq$ approx. 10 kΩ

Fig. 6-30   Equivalent circuit

Fig. 6-31   Control the resistance using external resistance

■ The setup procedure is the same as with CC mode.

See page 6-45 "Setup procedure for external voltage control".

6.8.5 External Control of CP Mode

The external control of CP mode can be carried out using external voltage or external resistance. The wattage varies in proportion to the external voltage or external resistance.

(1) External voltage control

Applying an external voltage in the range of 0 V to 10 V to the PLZ-4W produces a wattage proportional to the change.

The wattage corresponding to the external voltage of 0 V is 0 W; the wattage corresponding to the external voltage of 10 V is 100 % of the specified range.

Connected pins: J1-1 (signal), J1-3 (common)

⚠ CAUTION
- The maximum voltage that can be applied across pins 1 and 3 of the J1 connector is ±11 V. Applying a voltage exceeding this value can damage the PLZ-4W.
- Pin 3 of the J1 connector is connected the negative load input terminal. To prevent damaging the PLZ-4W, be sure not to let the wire of pin 3 touch any other pins.
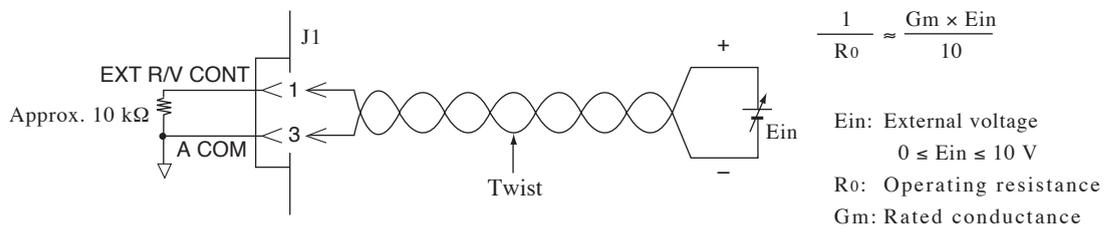

$$Po \approx \frac{Pm \times Ein}{10}$$

Po: Input power
Pm: Rated power
Ein: External voltage
$0 \leq Ein \leq 10$ V

Fig. 6-32   Equivalent circuit

Pm   : Rated power
------ : Input power (before adjustment)
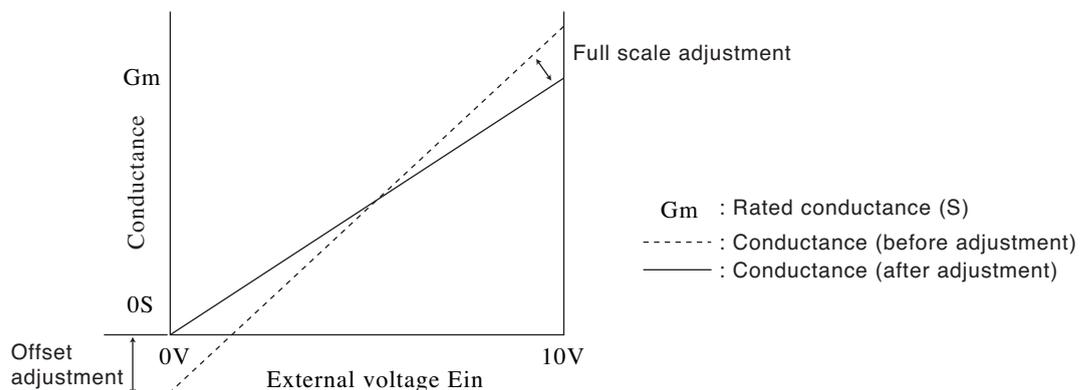——— : Input power (after adjustment)
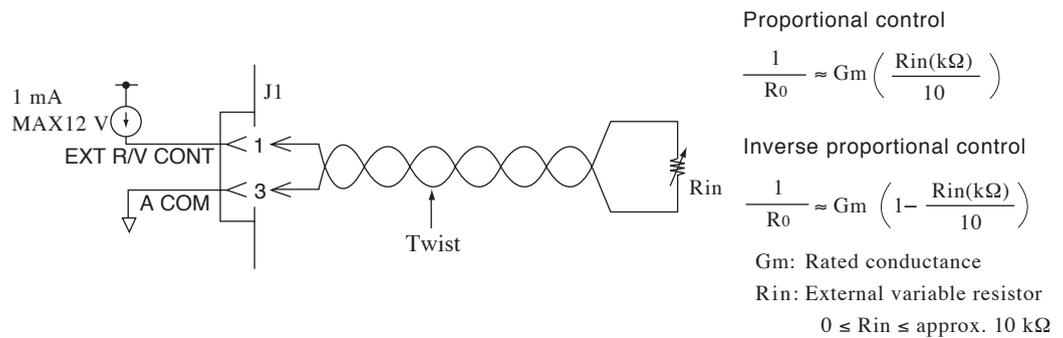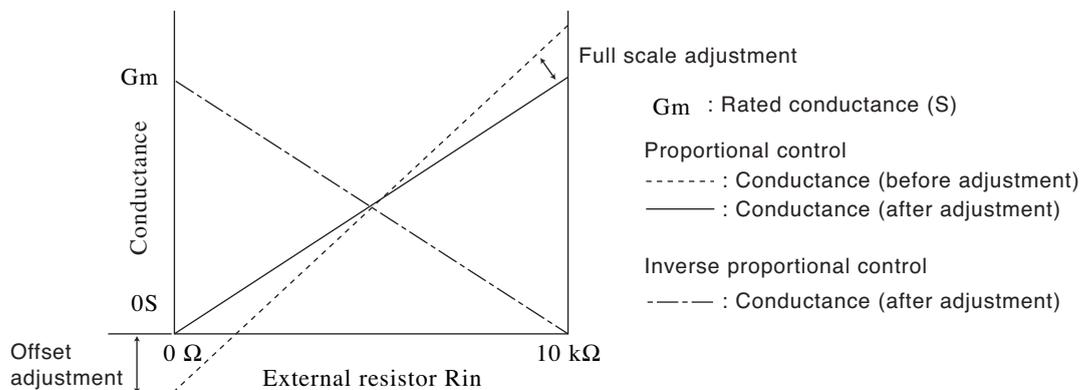
Fig. 6-33   Control the resistance using external voltage

■ The setup procedure is the same as with CC mode.

See page 6-45 "Setup procedure for external voltage control".

(2) External resistance control

Connecting an external resistance in the range of 0 Ω to 10 kΩ to the PLZ-4W produces a wattage that is proportional or inversely proportional to the change.

Proportional control

The wattage corresponding to the external resistance of 0 Ω is 0 W; the wattage corresponding to the external resistance of 10 kΩ is 100 % of the specified range.

Inverse proportional control

The wattage corresponding to the external resistance of 10 kΩ is 0 W; the wattage corresponding to the external resistance of 0 Ω is 100 % of the specified range.

Connected pins: J1-1 (signal), J1-3 (common)

Proportional control

$$Po \approx Pm \left(\frac{Rin(k\Omega)}{10} \right)$$

Inverse proportional control

$$Po \approx Pm \left(1 - \frac{Rin(k\Omega)}{10} \right)$$

Po: Input power
Pm: Rated power
Rin: External variable resistor
   $0 \leq Rin \leq$ approx. 10 kΩ

Fig. 6-34   Equivalent circuit

Full scale adjustment

Pm : Rated power

Proportional control
------- : Input power (before adjustment)
———— : Input power (after adjustment)

Inverse proportional control
—·—· : Input power (after adjustment)

Fig. 6-35   Control the wattage using external resistance

■ The setup procedure is the same as with CC mode.

See page 6-45 "Setup procedure for external voltage control".

6.8.6　External Control of CV Mode

The external control of CV mode can be carried out using external voltage or external resistance. The voltage varies in proportion to the external voltage or external resistance.

(1) External voltage control

Applying an external voltage in the range of 0 V to 10 V to the PLZ-4W produces a voltage proportional to the change.

The voltage corresponding to the external voltage of 0 V is 0 V; the voltage corresponding to the external voltage of 10 V is 100 % of the specified range.

Connected pins: J1-1 (signal), J1-3 (common)

⚠ CAUTION
- The maximum voltage that can be applied across pins 1 and 3 of the J1 connector is ±11 V. Applying a voltage exceeding this value can damage the PLZ-4W.
- Pin 3 of the J1 connector is connected the negative load input terminal. To prevent damaging the PLZ-4W, be sure not to let the wire of pin 3 touch any other pins.
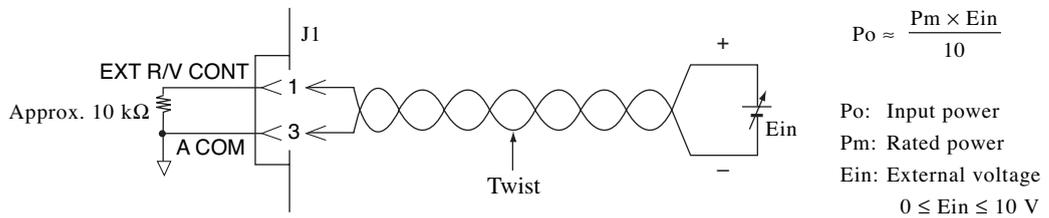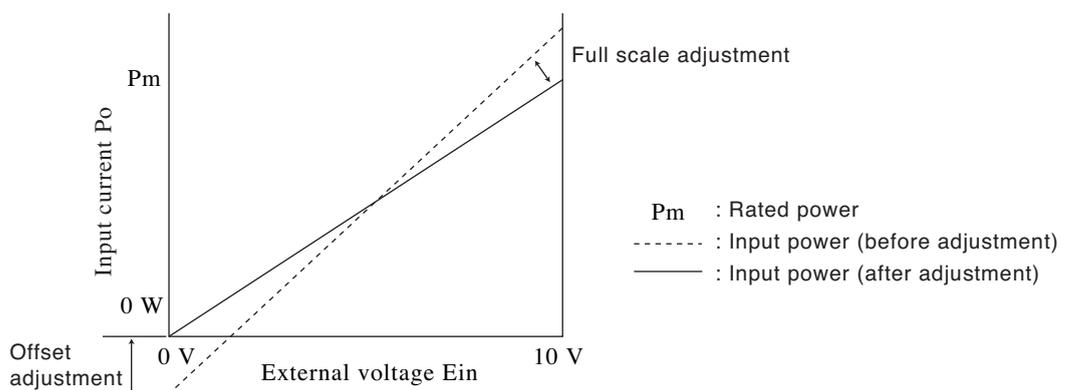

$$Vo \approx \frac{Vm \times Ein}{10}$$

Vo: Input voltage
Vm: Rated voltage
Ein: External voltage
$0 \leq Ein \leq 10$ V
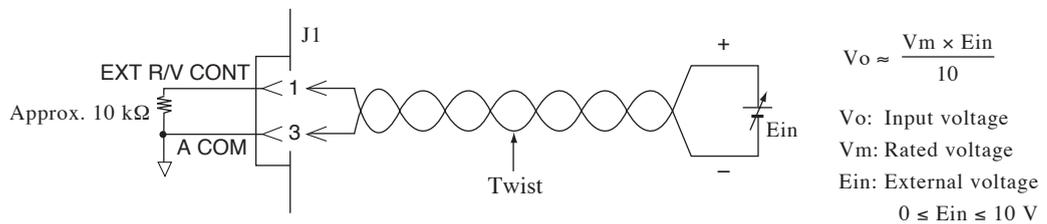
Fig. 6-36　Equivalent circuit

Vm : Rated voltage
------ : Input voltage (before adjustment)
——— : Input voltage (after adjustment)

Fig. 6-37　　Control the current using external voltage

■ The setup procedure is the same as with CC mode.

(2) External resistance control

Connecting an external resistance in the range of 0 Ω to 10 kΩ to the PLZ-4W produces a voltage that is proportional or inversely proportional to the change.

Proportional control

The voltage corresponding to the external resistance of 0 Ω is 0 V; the voltage corresponding to the external resistance of 10 kΩ is 100 % of the specified range.

Inverse proportional control

The voltage corresponding to the external resistance of 10 kΩ is 0 V; the voltage corresponding to the external resistance of 0 Ω is 100 % of the specified range.

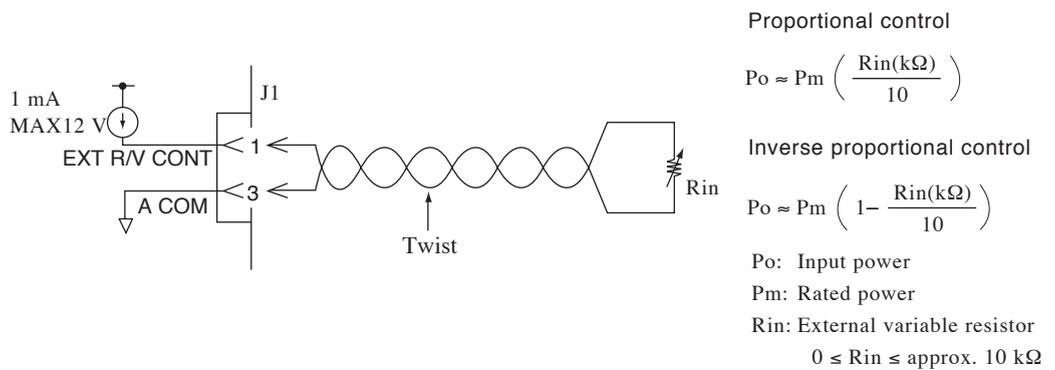Connected pins: J1-1 (signal), J1-3 (common)

Proportional control

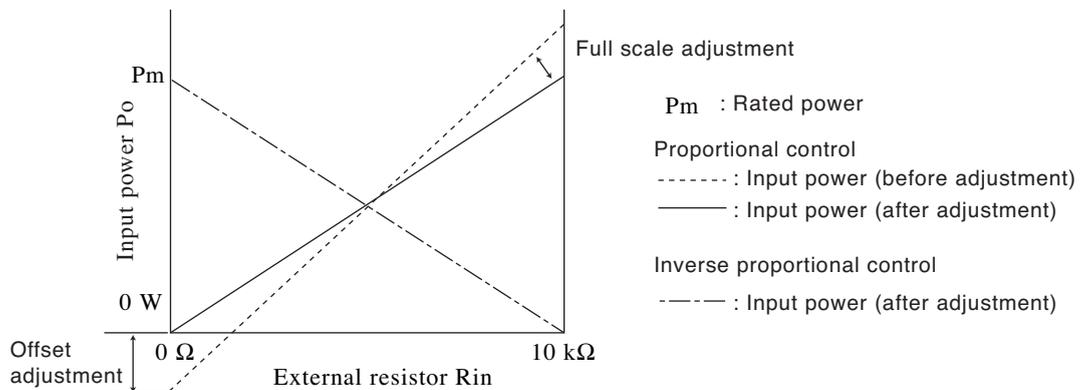$$Vo \approx Vm\left(\frac{Rin(k\Omega)}{10} \right)$$

Inverse proportional control

$$Vo \approx Vm\left(1- \frac{Rin(k\Omega)}{10} \right)$$

Vo: Input voltage
Vm: Rated voltage
Rin: External variable resistor
$0 \leq Rin \leq$ approx. 10 kΩ

Fig. 6-38   Equivalent circuit

Full scale adjustment

Vm : Rated voltage

Proportional control
------- : Input voltage (before adjustment)
———— : Input voltage (after adjustment)
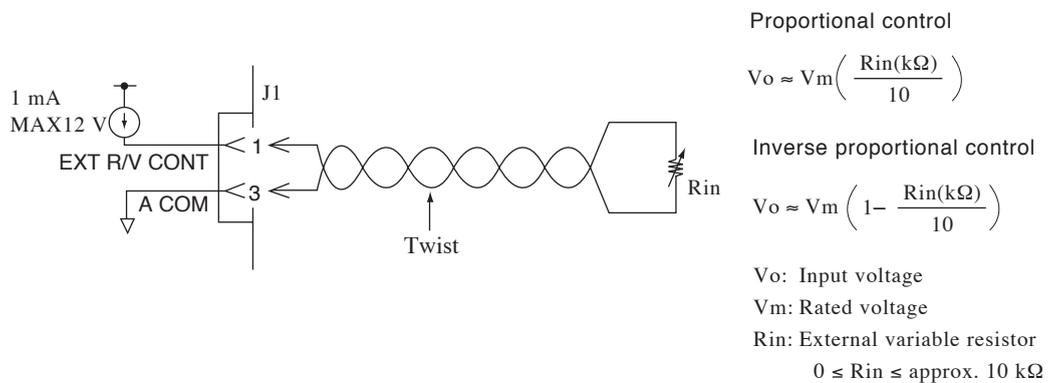
Inverse proportional control
—·—· : Input voltage (after adjustment)
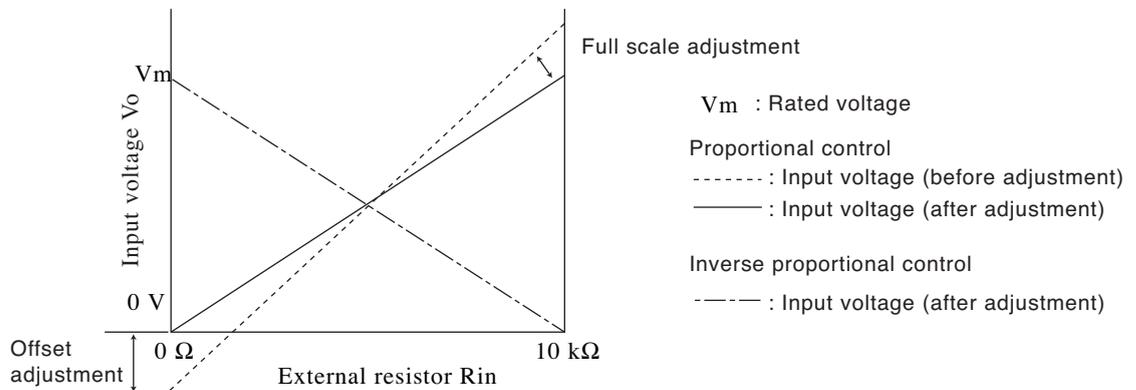
Fig. 6-39   Control the wattage using external resistance

■ The setup procedure is the same as with CC mode.

6.8.7 External Control of Load On and Load Off

The external control connector can be used to control the on/off of the load and monitor the on/off condition.

External contact control

To control the load on/off using an external contact, an external signal is applied across pins 7 and 12 of the J1 connector.

Even when the load on/off is controlled through the external contact, the LOAD switch on the panel is effective when the load is turned on externally. However, when the load is turned off externally, the LOAD switch cannot be used to turn the load on.

You can select the logic used to externally control the load on/off using the menu setup. To change the logic, select "2. Configuration" | "4. External" | "Load On IN" from the menu and specify LOW or HIGH.

* For a description of changing the menu setup, see section 5.13, "Menu Setup."

Table 6-11 Load on/off logic setting

Load On IN	External contact (SW)	
	ON (close)	OFF (open)
LOW	Load on	Load off
HIGH	Load off	Load on
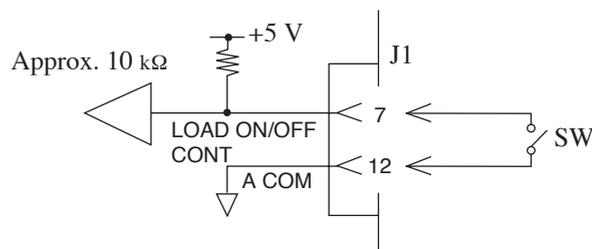
Fig. 6-40   Equivalent input circuit

NOTE
* The input terminal is connected to +5 V of the J1 connector through approximately 10 kΩ of resistance. The maximum allowable voltage is 5 V, and the operation threshold level is TTL.

Status signal output

To externally monitor the load on/off condition, the output signal across pins 13 and 17 of the J1 connector is monitored.

Maximum applied voltage   30 V
Maximum current   8 mA

	Load on	Load off
Photocoupler	ON	OFF
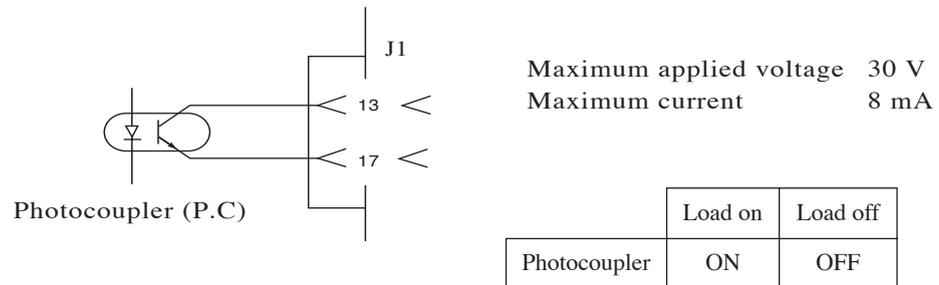
Fig. 6-41   Equivalent output circuit

6.8.8   Trigger Signal Control

The trigger signal input clears the pause during sequence execution. This is used to synchronize with external equipment.

Trigger signal input

Apply a signal across pins 11 and 12 of the J1 connector. The maximum allowable voltage is 5 V, and the minimum pulse width is 10 μs.

NOTE   • The trigger signal output is generated at the rising edge of the pulse signal applied to the trigger input connector.
   • The input terminal is connected to A COM of the J1 connector through approximately 100 kΩ of resistance. The maximum allowable voltage is 5 V, and the operation threshold level is TTL.

Fig. 6-42   Equivalent input circuit

6.8.9 External Control of the Current Range

The current range can be controlled using an external control signal. In addition, the status signal output can be used to monitor the selected range. The voltage range cannot be controlled.

Table 6-12 A list of control signals

Current range	Control input		Status output		PLZ 164W/ 164WA	PLZ 334W	PLZ 664WA	PLZ 1004W
	RANGE CONT 0 (J1-9)	RANGE CONT 1 (J1-8)	RANGE STATUS 0 (J1-15)	RANGE STATUS 1 (J1-14)				
H	HIGH	HIGH	OFF	OFF	33 A	66 A	132 A	200 A
M	HIGH	LOW	OFF	ON	3.3 A	6.6 A	13.2 A	20 A
L	LOW	HIGH	ON	OFF	0.33 A	0.66 A	1.32 A	2 A

HIGH: 5 V,   LOW: 0 V,   OFF: OPEN,   ON: SHORT

NOTE
- Set the current range on the panel to the H range.
- The current range cannot be changed when the load is turned on. The control signal input received while the load is turned on is discarded.

Range signal input

Pins 8 and 9 of the J1 connector are used (pin 12 is common). 2-bit signal.

NOTE
- The control input terminal is connected to +5 V of the J1 connector through approximately 10 kΩ of resistance. The maximum allowable voltage is 5 V, and the operation threshold level is TTL.
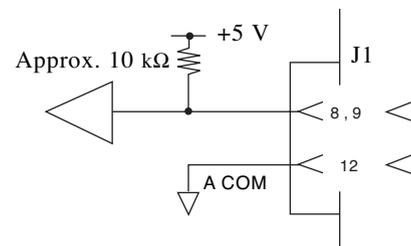
Fig. 6-43   Equivalent input circuit

Status signal output

Pins 14 and 15 of the J1 connector are used (pin 17 is common). 2-bit signal.
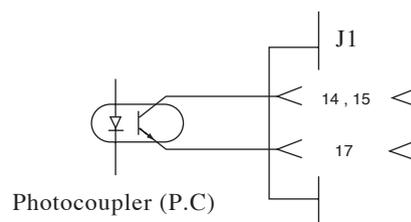
Maximum applied voltage   30 V
Maximum current   8 mA

Fig. 6-44   Equivalent output circuit

6.8.10 Alarm Signal Control

An alarm can be activated using an external control signal. In addition, the status signal output can be used to monitor the alarm condition.

Alarm signal input

Connect the external signal across pins 10 and 12 of the J1 connector. An alarm is activated on a low level signal.
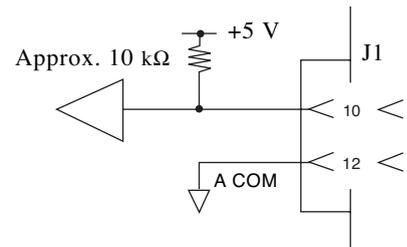
Fig. 6-45   Equivalent input circuit

NOTE   • The alarm input terminal is connected to +5 V of the J1 connector through approximately 10 kΩ of resistance. The maximum allowable voltage is 5 V, and the operation threshold level is TTL.
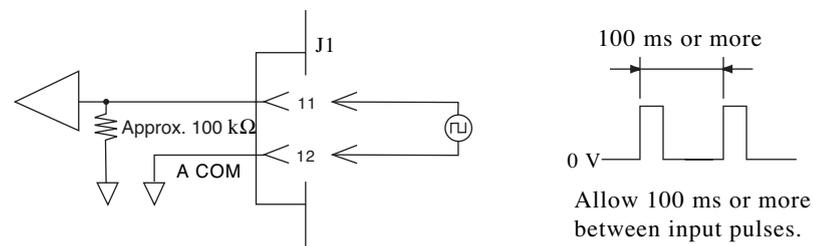
Status signal output

To externally monitor the alarm condition, the output signal across pins 16 and 17 of the J1 connector is used.

The output is turned on when OVP, OCP, OPP, OHP, REV or UVP trips or when an external alarm signal is applied.
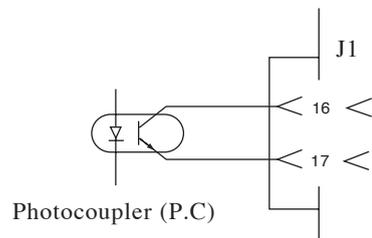
Maximum applied voltage   30 V
Maximum current   8 mA

Fig. 6-46   Equivalent output circuit

6.9 Monitor Signal Output

Trigger signal output

The trigger signal is used as a synchronization signal when monitoring the waveform of the switching operation on an oscilloscope. It is also used to synchronize with the external equipment during sequence execution.

The trigger signal is output from the TRIG OUT connector on the PLZ-4W front panel.

NOTE
- The trigger signal output voltage is 4.5 V. The pulse width is 2 μs or more, and the output impedance is approximately 500 Ω.
- The TRIG OUT connector is connected to the chassis electric potential. It is isolated from A COM.

The trigger signal output is generated under the following conditions.
- During switching operation
- When a step that has trigger output specified is executed during sequence operation.
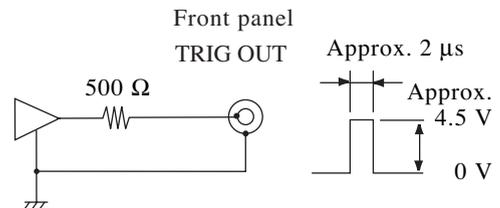
Fig. 6-47   Equivalent circuit

Current monitor output

The signal is output from the I MON OUT connector on the PLZ-4W front panel and across pins 2 and 3 (pin 3 is common) of the J1 connector.

⚠ CAUTION
- Pin 3 of the J1 connector is connected the negative load input terminal. To prevent damaging the PLZ-4W, be sure not to let the wire of pin 3 touch any other pins.

I MON OUT connector (BNC) on the PLZ-4W front panel

The common is connected to the chassis electric potential. It is isolated from A COM. For current ranges H and L, 1 V corresponds to the full scale current; for current range M, 0.1 V corresponds to the full scale current.

Across pins 2 and 3 of the J1 connector

The common is connected to A COM. For current ranges H and L, 10 V corresponds to the full scale current; for current range M, 1 V corresponds to the full scale current.

	$V_{H/L}$	V_M
I MON OUT connector (BNC)	1 V	0.1 V
Across pins 2 and 3 of the J1 connector	10 V	1 V
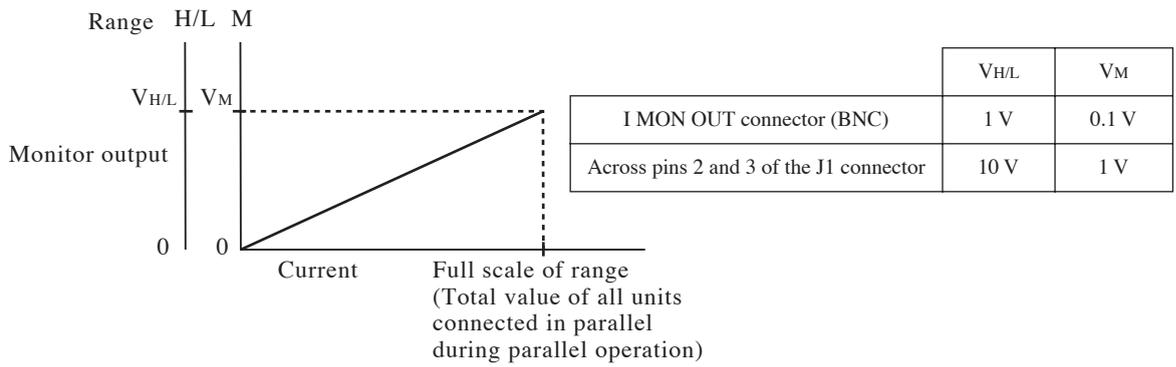
Fig. 6-48   Current monitor output

For parallel operation, the full scale of the current range is the total value of the units connected in parallel. The monitor output corresponds to this full scale current (the total of the full scale currents of each range).

6.10 Parallel operation

The PLZ-4W Series Electronic Load allows parallel operation in which multiple electronic loads can be connected in parallel to increase the current capacity or power capacity. In parallel operation, one unit becomes a master unit in charge of all controls in parallel operation. The master unit displays the total current and total wattage of the units connected in parallel.

The following two methods of parallel operation are available.

Parallel operation using the same model

In this method, multiple units configured to be slaves are connected in parallel with a unit configured to be the master. The slave units that can be connected in parallel are of the same model as the master unit. Up to four slave units can be connected (total of five units including the master unit).

Parallel operation using load boosters

In this method, load boosters (PLZ2004WB) are connected in parallel with a single master PLZ1004W. Up to four load boosters can be connected in parallel.

NOTE
- Load boosters (PLZ2004WB) can only be connected to PLZ1000W.
- During parallel operation, the specifications may not be satisfied on the individual unit.
  The accuracy of setting and measurement accuracy can be improved by carrying out calibration in parallel operation.
- The current ripple during parallel operation is approximately equal to the number of units connected in parallel times the current ripple of an individual unit.
- The resolution of setting during parallel operation varies depending on the number of units that are operating in parallel.

6.10.1 Parallel Operation Using the Same Model

To carry out parallel operation, signal wires for connecting between electonic loads and the load wire for connecting to the equipment under test are required.

Use the optional flat cable for the signal wire. For details, see "Control flat cables" in chapter 1, "General Information."

Up to four slave units can be connected, but Fig. 6-49 shows an example in which two units are connected.
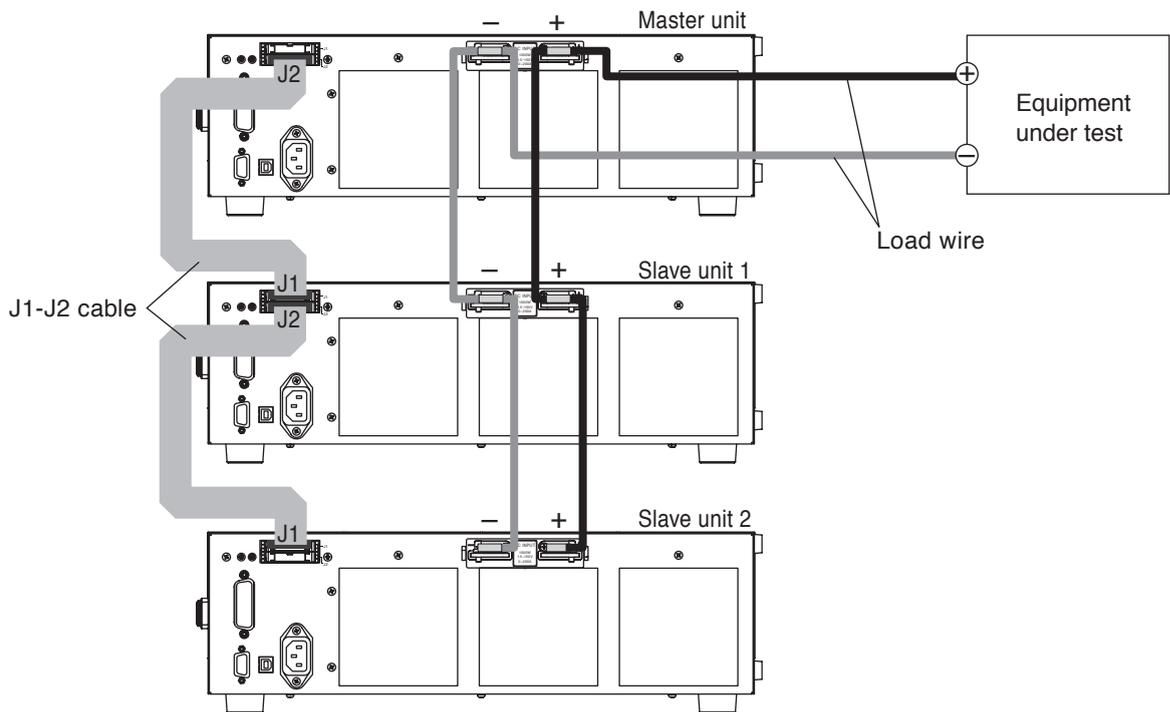
Fig. 6-49   Parallel connection of two slave units

Table 6-13 shows the relationship between the number of slave units and the capacity.

Table 6-13 The number of units connected in parallel and the capacity

Slave unit	Maximum current/Maximum power			
	PLZ164W /164WA	PLZ334W	PLZ664WA	PLZ1004W
1 unit	66 A / 330 W	132 A / 660 W	264 A / 1 320 W	400 A / 2 000 W
2 units	99 A / 495 W	198 A / 990 W	396 A / 1 980 W	600 A / 3 000 W
3 units	132 A / 660 W	264 A / 1 320 W	528 A / 2 640 W	800 A / 4 000 W
4 units	165 A / 825 W	330 A / 1 650 W	660 A / 3 300 W	1 000 A / 5 000 W

⚠ CAUTION
- When carrying out parallel operation, be sure to use the load input terminal on the rear panel. Do not connect other equipment to the load input terminal on the front panel.
- Improper connection of the J1 and J2 connectors can damage the PLZ-4W.
- Use the shortest load wire and flat cable possible for the connection. Use a load wire of sufficient thickness by taking into account the current being used. It is recommended to use the bus bar instead of wiring the cable.

NOTE
- Separate the load cable from the flat cable as much as possible to prevent unstable operation.

Parallel connection procedure

Connect the master unit and slave units using optional flat cables. Connect to the equipment under test using load wires. For a description of the wiring procedure and wire diameter, see section 2.8, "Load Wiring."

⚠ CAUTION • Use a load wire with sufficient diameter for the current as well as non-flammable or flame-resistant cover.

---

1. **Check that the power is turned off.**

   Check that the power of all units to be connected is turned off.

   If the power is turned on, press the POWER switch to turn off the power.

2. **Connect the load input terminal of each unit.**

   Refer to the connection diagram of Fig. 6-49 and securely connect the load input terminals of the units of the same model in parallel.

3. **Connect the external control connector of each unit.**

   Connect the J1 and J2 connectors of each unit in parallel using flat cables.

   Carry out the work carefully as improper connection of the J1 and J2 connectors can damage the PLZ-4W.

Setup procedure of the master/slave units

1. **Turn on the power of each unit.**

   Turn on the POWER switch of all units at once or turn on the POWER switch of slave units first to turn on the power to all units.

2. **Select the menu setup.**

   Press the MENU (SHIFT+SET/VSET) key.

   The the menu appears.

3. **Select Configuration**

   Press the ▼ or ▲ CURSOR key several times until Configuration is highlighted. When highlighted, press the ENTER key.

4. **Select Master/Slave**

   Press the ▼ or ▲ CURSOR key several times until Master/Slave is highlighted. When highlighted, press the ENTER key.

5. **Set the master and slave units.**

   Check to see that the cursor (blinking) is at the Operation item. If the cursor is at some other item, press the ▲ CURSOR key several times to move the cursor to Operation.

・ **Master unit**

```
Master/Slave

Operation  : MASTER
Parallel   : --
Booster    : --


PREV
```
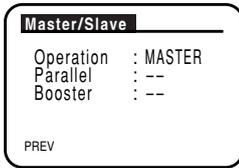
6. Set as a master unit.

First, turn the rotary knob to the right to select MASTER.

When slaves are connected, press the ▼ CURSOR key to move the cursor to the Parallel item.

Turn the rotary knob to set the total number of master and slave units.
• The Booster item appears only on the PLZ1004W.

・ **Slave units**

```
Master/Slave

Operation  : SLAVE




PREV
```
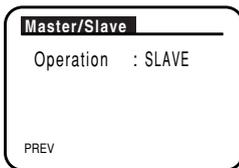
6. Set as a slave unit.

Turn the rotary knob to the left to select SLAVE.

When SLAVE is selected, the Parallel and Booster items disappear.

7. Exit from the menu.

Press the MENU (SHIFT+SET/VSET) key.

On the master unit, the original screen displayed before entering menu setup appears. On slave units, Slave Mode appears on the display.

8. Power cycle the PLZ-4W.

Turn on the POWER switch of all units at once or turn on the POWER switch of the master unit first to turn on the power to all units.

The menu settings are confirmed.

9. Set the operation mode and value, and turn on the load.

Operate the master unit to set the master mode and value. The range of the rated current and rated power on the master unit is expanded.

After entering the settings, turn off the load.

6.10.2 Parallel Operation Using Load Boosters

Load boosters are slave units dedicated to parallel operation. They operate as slave units simply by connecting them to the PLZ1004W. However, on the PLZ1004W that is to become the master unit, the master unit setting and the number of load boosters to be connected must be configured.

For the connection procedure, see section 2.6, "Parallel Connection" in the operation manual of the load booster.

For the setup procedure of the master unit, see section 2.7, "Setting the Master Unit" in the operation manual of the load booster.

NOTE • Load boosters (PLZ2004WB) can only be connected to PLZ1004W.

6.10.3 Alarms during Parallel Operation

When an alarm occurs during parallel operation, an error message is displayed, and the load of all units is turned off.

If an alarm occurs on a slave unit, "ALARM EXTERNAL" is displayed on the master unit.

Clear the alarm on the master unit.

6.10.4 Response Speed during Parallel Operation

You can change the response speed in CC mode (CC+CV mode) and CR mode (CR+CV mode).

In some cases, the wire inductance increases and a large voltage drop occurs due to changes in the current or the phase lag of the current may cause instability in the PLZ-4W control inducing oscillation.

In such case, you can decrease the response speed to assure stable operation.

During parallel operation, the response speed of the master unit is used.

When the electronic load unit is assigned as a master unit in parallel operation with response speed is set at 1/1, the setting of response speed will change to be set at 1/2 in order to secure the stable operation. It is possible to be reset to 1/1 by the menu setting, please refer to the "Technical Note for the PLZ-4W, When operating under parallel operation or high-speed load simulations" as provided as separate sheet and wire the load cable followed by the instruction.

- For a description of response speed, see section 5.15, "Response Speed."

6.10.5 Slew Rate during Parallel Operation

During parallel operation, the slew rate of the master unit is used.

6.10.6 Canceling the Parallel Operation

To switch from parallel operation back to standalone operation, turn off the power of each unit and remove the flat cables.

To set the slave units back to standalone operation, set the Operation item back to MASTER from the menu.

On the master unit to which load boosters were connected, set the number of load boosters in the menu to -, and power cycle the unit.

Chapter 7 Remote Control

This chapter describes the procedure for connecting the interface and the procedure for transmitting commands to the PLZ-4W using SCPI commands.

7.1   Overview

In addition to using the front panel controls, the PLZ-4W can be controlled remotely using the following interfaces.

- RS-232C interface
- GPIB interface
- USB interface

The interface is selected from the front panel.

The remote interface accepts two formats of commands: IEEE 488.2 common commands and SCPI commands.

Below are the IEEE 488.2 common commands that the PLZ-4W supports.

*CLS	*ESE	*ESE?	*ESR?	*IDN?
*OPC	*OPC?	*RCL	*RST	*SAV
*SRE	*SRE?	*STB?	*TRG	*TST?
*WAI				

For the detailed list of all SCPI commands, see appendix A.5, "SCPI Command Reference."

Please read section 7.3, "Using SCPI Commands" and familiarize yourself with the SCPI command syntax on the PLZ-4W before actually using the SCPI commands.

7.2   Instrument Interface Standard

The PLZ-4W conforms to the following standards.

- IEEE Std 488.2-1992 IEEE Standard Codes, Formats, Protocols, and Common Commands For Use With IEEE Std 488.1-1987
- IEEE Std 488.1-1987 IEEE Standard Digital Interface for Programmable Instrumentation
- TIA/EIA-232F
- Standard Commands for Programmable Instruments (SCPI) version 1999.0
- Universal Serial Bus Specification Rev 2.0
- Universal Serial Bus Test and Measurement Class Specification (USBTMC) Rev 1.0
- Universal Serial Bus Test and Measurement Class, Subclass USB488 Specification (USBTMC-USB488) Rev 1.0

IEEE 488.2 requirements

The GPIB control conforms to all IEEE 488.2 requirements.

SCPI requirements

The GPIB, RS-232C, and USB controls all conform to the SCPI requirements. The PLZ-4W conforms to the SCPI Volume 4 Power Supply instrument class.

7.3 Using SCPI Commands

7.3.1 Hierarchy of SCPI Commands

SCPI commands are ASCII-based commands designed for test and measurement devices. The command hierarchy is structured around the common root or node, which is the construction block of the SCPI sub system.

There are two types of SCPI commands: Set and Query.

Set commands execute a certain function of the PLZ-4W or modify the settings.

Query commands inquire settings and status of the PLZ-4W.

SCPI command syntax

This operation manual denotes SCPI commands using the following format.
(Example)

> Set command: `[SOURce:]CURRent[:LEVel][:IMMediate][:A`
>   `MPLitude]{<current>|MINimum|MAXimum}`

SCPI commands can be issued using the short form. The short form of an SCPI command is the section of the command written in uppercase.

SCPI commands can be sent in the long or short form. Since SCPI commands are not case-sensitive, CURR, Curr, and curr are all accepted as the short form of CURRent. In the long form, CURRENT, Current, and current are all acceptable.

- A space is required between the program header section and the data section.
- Multiple data values, when available, are concatenated using commas.
- Commands are concatenated using semicolons.
  > Set command: `SOURce:CURRent MINimum;VOLTage`
  >   `MINimum`
- This is equivalent to entering the following Set commands.
  > Set command: `CURRent MINimum`
  > Set command: `VOLTage MINimum`
- A colon is required between program headers.
- Colons and semicolons can be used together to link SCPI commands from different subsystems.
  > Query command: `CURRent MINimum;:MEASure:CURRent?`
- The maximum number of characters that can be transmitted in a single line is 256.

Special symbols and characters

Special symbols and characters used in this manual to describe SCPI commands are defined below.

- Characters and numbers delimited by "|" in braces indicate that one of the items is to be selected.

  Do not write braces in the actual program.

- <> indicates program data.

  Do not write <> in the actual program.

- [] indicates option data.

  When option data is not sent with the program, the default value is sent.

  Do not write [] in the actual program.

Minimum and maximum values

In the following example, MIN and MAX are used as substitutes for defining certain values.

Set command: `CURRent {<current>|MIN|MAX}`

CURR MIN sets the current value of each mode to the minimum value.

In addition, MIN and MAX can be used to inquire the minimum and maximum allowed values of most parameters as shown in the following Query commands.

Query command: `VOLTage? MIN`
Query command: `VOLTage? MAX`

- -

NOTE · When transmitting two query commands in separate lines, read the response to the first command before transmitting the second query command. Otherwise, an incomplete response may be received for the first command followed by a complete response for the second command.

- -

Unit suffix

Below are the default measurement units.

- V (voltage)
- OHM (resistance)
- W (wattage)
- MIN (minute)
- A/US (current/time)
- A (current)
- SIE (conductance)
- HR (hour)
- S (second)
- PCT (%)

The following optional prefixes are supported.

Only US is supported for the time of measurement unit A/US (current/time).

- M (milli)
- K (kilo)
- U (micro)

NOTE
- The SI standard includes lowercase characters for the above unit symbols; The IEEE standard specifies uppercase characters. SCPI commands are not case-sensitive.
- Commands are accepted even if measurement units are not specified.
- To enter "μ" in the data, use "U" instead.

Terminating command strings

All commands must be terminated using a valid terminator.

There are two types of terminators: <new line> (ASCII 0x0A) or EOI (end-or-identify). Either type can be used.

In the case of RS-232C, always use <new line> because EOI is not available.

In the case of USB, EOI is not available. Moreover, a separate terminator is automatically added to <new line>, and therefore, <new line> is not necessary.

When a command string is terminated, the SCPI command path is reset to the root level.

NOTE
- CR (ASCII 0x0D) is not a terminator.

Common commands

The IEEE-488.2 and SCPI standards contain a set of common commands for reset, self-test, and other functions. The common commands always start with an asterisk (*) and may have one or multiple parameters.

7.3.2 Program Data

Below are the definitions of the program data used in this manual for denoting SCPI commands.

conductance

Numerical data including MAXimum and MINimum.

• Program data

Range		PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
H	Setting range	0 to 23.1	0 to 46.2	0 to 139.9968	0 to 23.1	0 to 92.4
	Resolution	400 μ	800 μ	2.4 m	400 μ	1.6 m
M	Setting range	0 to 2.31	0 to 4.62	0 to 13.99968	0 to 2.31	0 to 9.24
	Resolution	40 μ	80 μ	240 μ	40 μ	160 μ
L	Setting range	0 to 231 m	0 to 462 m	0 to 139.9968 m	0 to 231 m	0 to 924 m
	Resolution	4 μ	8 μ	24 μ	4 μ	16 μ

Unit   SIE

current

Numerical data including MAXimum and MINimum.

• Program data

Range		PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
H	Setting range	0 to 34.65	0 to 69.3	0 to 210	0 to 34.65	0 to 138.6
	Resolution	1 m	2 m	10 m	1 m	10 m
M	Setting range	0 to 3.465	0 to 6.93	0 to 21	0 to 3.4652	0 to 13.86
	Resolution	0.1 m	0.2 m	1 m	0.1 m	1 m
L	Setting range	0 m to 346.5 m	0 m to 693 m	0 to 2.1	0 m to 346.5 m	0 to 1.386
	Resolution	0.01 m	0.02 m	0.1 m	0.01 m	0.1 m

Unit   A

power

Numerical data including MAXimum and MINimum.

• Program data

Range		PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
H	Setting range	0 to 173.25	0 to 346.5	0 to 1 050	0 to 173.25	0 to 693
	Resolution	10 m	10 m	100 m	10 m	20 m
M	Setting range	0 to 17.325	0 to 34.65	0 to 105	0 to 17.325	0 to 69.3
	Resolution	1 m	1 m	10 m	1 m	2 m
L	Setting range	0 to 1.732 5	0 to 3.465	0 to 10.5	0 to 1.732 5	0 to 6.93
	Resolution	0.1 m	0.1 m	1 m	0.1 m	0.2 m

Unit   W

status-enable

A 16-bit status mask for any CONDition register that determines which bits are to be used for synthesizing the summary bit of that register.

Value 0 to 65 535

slew

Numeric data representing the current change with respect to a time interval.

Value Time for the measurement current to change from 10 % to 90 %

Range	PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
H	2.5 m to 2.5	5 m to 5	16 m to 16	2.5 m to 2.5	10 m to 10
M	250 μ to 250 m	500 μ to 500 m	1.6 m to 1.6	250 μ to 250 m	1 m to 1
L	25 μ to 25 m	50 μ to 50 m	160 μ to 160 m	25 μ to 25 m	100 μ to 100 m

Resolution

PLZ164W/PLZ164WA		PLZ334W		PLZ664WA		PLZ1004W	
Value	Resolution	Value	Resolution	Value	Resolution	Value	Resolution
to 250 μ	100 n	to 500 μ	200 n	to 1 m	400 n	to 1.6 m	600 n
to 2.5 m	1 μ	to 5 m	2 μ	to 10 m	4 μ	to 16 m	6 μ
to 25 m	10 μ	to 50 m	20 μ	to 100 m	40 μ	to 160 m	60 μ
to 250 m	100 μ	to 500 m	200 μ	to 1	400 μ	to 1.6	600 μ
to 2.5	1 m	to 5	2 m	to 10	4 m	to 16	6 m

Unit A/US

step

Step number of a sequence program. In normal sequence mode, up to 256 steps can be shared among all programs (10 programs).

string

String data. ASCII codes 20H to 7EH can be used.

time

Time of the auto sequence step represented using hh:mm:ss.s format. May contain suffix units related to time such as S, MIN, and HR. By default, the value is in seconds. You cannot enter multiple units such as in 1HR30MIN.

value

Numerical data including MAXimum and MINimum. See the program data of each command.

voltage

Numerical data including MAXimum and MINimum.

• Program data

Range		PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
H	Setting range	1.5 to 157.5			0 to 157.5	
	Resolution	10 m			10 m	
M	Setting range	1.5 to 15.75			0 to 15.75	
	Resolution	1 m			1 m	

Unit V

Boolean data

Boolean data is a single binary status such as 1 and 0 or ON and OFF.

Below is an example of a command using Boolean data.

      Set command: `[SOURce:]FUNCtion:CTIMe {OFF|ON}`

Discrete data

Discrete data is used when only a limited number of values are available for the program setting.

When the response data against a query contains this format, the PLZ-4W always returns the response data in the short form.

Below is an example of a command using discrete data.

      Set command: `[SOURce:]POWer:RANGe`
                               `{LOW|MEDium|HIGH}`

Numeric data

Numeric data is numeric representation consisting of decimal point, optional sign, measurement unit, symbol, etc.

MINimum and MAXimum are accepted as substitutes for numeric values.

Units such as V, A, and W can also be used with the numeric data.

If you enter a value that cannot be specified, the PLZ-4W rounds the input data.

Below is an example of a command using numeric data.

      Set command: `CURRent {<current>|MIN|MAX}`

String data

String data is used when a series of ASCII characters are requested.

Strings must be enclosed in single or double quotation marks.

The start and end quotation marks must match. A quotation mark can be included in the string by entering two consecutive quotation marks without any characters in between.

ASCII codes 20H to 7EH can be used.

Below is an example of a command using string data.

      Set command: `PROGram[:SELected]:MEMO "My program"`

7.4 Interface Setup

The factory default remote control interface setting is GPIB.

7.4.1 GPIB Control

■ GPIB connection

Use a standard IEEE488 cable to connect the PLZ-4W to the PC.

■ GPIB configuration

1. Check that the load is turned off.

   Check that the LOAD LED is turned off. If it is on, press the LOAD key to turn it off.

2. Select the menu setup.

   Press the MENU (SHIFT+SET/VSET) key. The menu screen is displayed.

3. Select Configuration

   Press the ▼ or ▲ CURSOR key several times until Configuration is highlighted on the menu. When highlighted, press the ENTER key.

4. Select interface.

   Press the ▼ or ▲ CURSOR key several times until Interface is highlighted on the menu. When highlighted, press the ENTER key.

5. Select GPIB.

   Check that the cursor is blinking by Control on the menu, and turn the rotary knob to select GPIB.

6. Select Address.

   Press the ▼ CURSOR key and check that the cursor is blinking by Address on the menu. Then, turn the rotary knob to set the device address.

7. Exit from the menu.

   Press the MENU (SHIFT+SET/VSET) key. The original screen displayed before entering menu setup appears.

8. Power cycle the PLZ-4W.

   The settings are confirmed.

7.4.2 RS-232C Control

■ RS-232C connection

Use a standard cross cable (null modem cable) to connect the PLZ-4W to the PC.
The RS-232C port on the PLZ-4W is a standard DB9P male connector.

Table7-1   RS-232C pins

Pin No.	Function
1	Not used
2	Receive (RX)
3	Transmit (TX)
4	Not used
5	Ground (FG)
6	Not used
7	Not used
8	Not used
9	Not used

■ RS-232C configuration

1. Check that the load is turned off.

    Check that the LOAD LED is turned off. If it is on, press the LOAD key to turn it off.

2. Select the menu setup.

    Press the MENU (SHIFT+SET/VSET) key. The menu screen is displayed.

3. Select Configuration

    Press the ▼ or ▲ CURSOR key several times until Configuration is highlighted on the menu. When highlighted, press the ENTER key.

4. Select interface.

    Press the ▼ or ▲ CURSOR key several times until Interface is highlighted on the menu. When highlighted, press the ENTER key.

5. Select RS-232C.

    Check that the cursor is blinking by Control on the menu, and turn the rotary knob to select RS-232C.

6. Select Baudrate.

    Press the ▼ CURSOR key and check that the cursor is blinking by Baudrate on the menu. Then, turn the rotary knob to set the baud rate.

7. Select Stop bit.

    Press the ▼ CURSOR key and check that the cursor is blinking by Data, Stop on the menu. Then, turn the rotary knob to set the stop bit.

    The data length is fixed to 8 bits.

8. Parity is fixed to NONE.

9. Select Ack.

Press the ▼ CURSOR key and check that the cursor is blinking by Ack on the menu. Then, turn the rotary knob to set the acknowledge.

For details, see Page 7-12 "Acknowledge message".

10. Exit from the menu.

Press the MENU (SHIFT+SET/VSET) key. The original screen displayed before entering menu setup appears.

11. Power cycle the PLZ-4W.

The settings are confirmed.

■ Transmission/Reception via the RS-232C

Control the transmission/reception via the RS-232C interface using flow control or by using acknowledge messages. Transmission/reception may not work correctly through unilateral transmission.

RS-232C flow control

By using Xon/Xoff, the transmission/reception on the PLZ-4W can be controlled. DC (device control) codes are used to carry out control.

Table 7-2   DC codes

Code	Function	ASCII code
DC1	Transmission request	11H
DC3	Transmission stop request	13H

Transmission control from the RS-232C terminal to the PLZ-4W

After receiving DC3, the PLZ-4W pauses transmission within 3 characters.
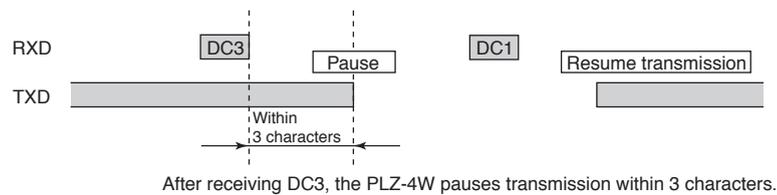
Transmission control from the PLZ-4W to the RS-232C terminal

The RS-232C terminal must pause transmission within 10 characters after receiving DC3.
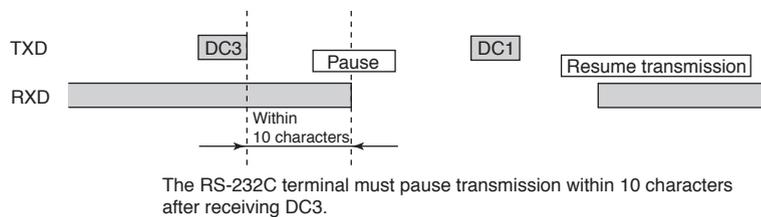
Fig.7-1   RS-232C terminal and transmission control of the PLZ-4W

Acknowledge message

An acknowledge message is information sent from the PLZ-4W to the controller. It notifies that the processing of the program message has been completed.

The acknowledge message is an ASCII code string consisting of only the header. The following two types are available.

- OK: Normal completion
- ERROR: Syntax error or other errors

To use acknowledge messages, select "1. Configuration" | "3. Interface" | "RS232C" from the menu and turn Ack ON.

On the controller, the RS-232C configuration must be set to full-duplex operation.

7.4.3 USB Control

To use the USB, download the KI-VISA software program from Kikusui website (http://www.kikusui.co.jp), and install the software in PC. The software program can only be used on a Windows environment.

■ USB connection

Use a standard USB cable to connect the PLZ-4W to the PC.

■ USB configuration

1. Check that the load is turned off.

   Check that the LOAD LED is turned off. If it is on, press the LOAD key to turn it off.

2. Select the menu setup.

   Press the MENU (SHIFT+SET/VSET) key. The menu screen is displayed.

3. Select Configuration

   Press the ▼ or ▲ CURSOR key several times until Configuration is highlighted on the menu. When highlighted, press the ENTER key.

4. Select interface.

   Press the ▼ or ▲ CURSOR key several times until Interface is highlighted on the menu. When highlighted, press the ENTER key.

5. Select USB.

   Check that the cursor is blinking by Control on the menu, and turn the rotary knob to select USB.

6. Exit from the menu.

   Press the MENU (SHIFT+SET/VSET) key. The original screen displayed before entering menu setup appears.

7. Power cycle the PLZ-4W.

   The settings are confirmed.

7.5 SCPI Commands

The SCPI commands below are those that are used on the GPIB, RS-232C, or USB interface.

7.5.1 IEEE 488.2 Common Commands

*CLS

Clears all event registers including the status byte, event status, and error queue.

For details on the registers, see section 7.6, "Status Registers."

      Set command: *CLS

*ESE

Sets the event status register that is counted by the event summary bit (ESB) of the status byte or queries the current setting.

For details on the event status registers, see section 7.6, "Status Registers."

      Set command: *ESE
      Query command: *ESE?

Example)   When *ESE 16 is transmitted, bit 4 of the event status enable register is set. Each time the execution error bit (bit 4) of the event status register is set, the event summary bit (ESB) of the status byte is set.

*ESR

Queries the event status register. This register is cleared when it is read.

For details on the event status registers, see section 7.6, "Status Registers."

      Query command: *ESR?

*IDN

Queries the manufacturer name, model, serial number, and ROM version.

      Query command: *IDN?

The response to *IDN? is indicated below.

Example)   For PLZ164W, serial number: AB123456, and ROM version 1.00

      Returns KIKUSUI,PLZ164W,AB123456,1.00.

*OPC

The PLZ-4W does not support asynchronous I/O operation.

When the *OPC command is transmitted, the Operation Complete bit (bit 0) of the standard event status register is set.

When *OPC? is transmitted, ACII character 1 is returned in the output queue.

For details, see section 12.5.3 of IEEE 488.2-1992.

      Set command: *OPC
      Query command: *OPC?

*RCL

Recalls the contents saved to the memory (0 to 99). The range of parameters that are configured are the same as the range of parameters initialized by the *RST command. For a description of the commands that are affected, see appendix A.5, "SCPI Command Reference."

Set command: `*RCL <value>`

- Program data
  Value   0 to 99
  Resolution   1

*RST

Resets the device to factory default settings. The GPIB address is not changed.

Set command: `*RST`

*SAV

Saves the current settings of the device to local memory (0 to 99). The range of parameters that are saved are the same as the range of parameters initialized by the *RST command. For a description of the commands that are affected, see appendix A.5, "SCPI Command Reference."

Set command: `*SAV <value>`

- Program data
  Value   0 to 99
  Resolution   1

*SRE

Sets the service request enable register bit or queries the current setting.

The service request enable register is used to select the summary messages in the status byte register that will be able to perform service requests.

To clear the service request enable register, send *SRE 0. If the register is cleared, service requests cannot be generated by status information.

Set command: `*SRE`
Query command: `*SRE?`

Example) Sending *SRE 8 sets bit 3 of the service request enable register. Each time the summary bit (bit 3) of the QUEStionable status register in the status byte is set, a service request message is generated.

*STB

Queries the contents of the status byte register and the MSS (master summary status) message.

The response is in a weighted decimal notation format representing the status byte register and the MSS message (bit 6). Therefore, the response to *STB? is the same as the response of serial polling except that bit 5 represents the MSS message in place of the RQS message.

For details, see section 7.6, "Status Registers."

Query command: `*STB?`

*TRG

Trigger command.

This is the same as the Group Execute Trigger command defined in IEEE 488.1.

See section 6.1.4.2.5 of IEEE 488.2.

> Set command: `*TRG`

*TST

Since there is no self-test function built into the PLZ-4W, an ASCII character 0 is always returned in the output queue in response to this query.

> Query command: `*TST?`

*WAI

Prevents the PLZ-4W from executing subsequent commands or queries until the No Operation Pending flag becomes true.

> Set command: `*WAI`

7.5.2   Measurement Commands

MEAS:CURR

Reads the measured current.

> Query command: `MEASure[:SCALar]:CURRent[:DC]?`

MEAS:POW

Reads the measured power.

> Query command: `MEASure[:SCALar]:POWer[:DC]?`

MEAS:VOLT

Reads the measured voltage.

> Query command: `MEASure[:SCALar]:VOLTage[:DC]?`

MEAS:ETIM

Reads the elapsed time of measurement.

> Query command: `MEASure:ETIMe?`

7.5.3   Configuration and Operation Commands

Setting the operation mode

FUNC

Sets the operation mode of the PLZ-4W. Or, queries the current setting.

> Set command: `[SOURce:]FUNCtion[:MODE]`
> `{CC|CV|CP|CR|CCCV|CRCV}`
> Query command: `[SOURce:]FUNCtion[:MODE]?`

• Program data

Setting   CC: Constant current mode

CV: Constant voltage mode

CP: Constant power mode

CR: Constant resistance mode

CCCV: Constant current mode + constant voltage mode

CRCV: Constant resistance mode + constant voltage mode

Entering values

COND

Sets the conductance of CR mode. Or, queries the current setting.

Set command: `[SOURce:]CONDuctance[:LEVel][:IMMediate][:AMPLitude] {<conductance>|MINimum|MAXimum}`

Query command: `[SOURce:]CONDuctance[:LEVel][:IMMediate][:AMPLitude]?`

CURR

Set the current of CC mode. Or, queries the current setting.

Set command: `[SOURce:]CURRent[:LEVel][:IMMediate][:AMPLitude] {<current>|MINimum|MAXimum}`

Query command: `[SOURce:]CURRent[:LEVel][:IMMediate][:AMPLitude]?`

POW

Set the power of CP mode. Or, queries the current setting.

Set command: `[SOURce:]POWer[:LEVel][:IMMediate][:AMPLitude] {<power>|MINimum|MAXimum}`

Query command: `[SOURce:]POWer[:LEVel][:IMMediate][:AMPLitude]?`

VOLT

Set the voltage of CV mode. Or, queries the current setting.

Set command: `[SOURce:]VOLTage[:LEVel][:IMMediate][:AMPLitude] {<voltage>|MINimum|MAXimum}`

Query command: `[SOURce:]VOLTage[:LEVel][:IMMediate][:AMPLitude]?`

Setting the slew rate

For details on the slew rate setting, see section 6.4, "Setting the Slew Rate."

- -

NOTE • The software attempts to achieve the highest slew rate, but the slew rate is limited to this value by hardware.

It is recommended that the slew rate kept lower or equal to the default value.

- -

CURR:SLEW

Sets the current change with respect to the programmed time interval. Or, queries the current setting.

Set command: `[SOURce:]CURRent:SLEW <slew>`

Query command: `SOURce:]CURRent:SLEW?`

Setting protection levels

CURR:PROT

Set the overcurrent protection. Or, queries the current setting.

Set command: `[SOURce:]CURRent:PROTection[:LEVel][:OVER]{<value>|MINimum|MAXimum}`

Query command: `[SOURce:]CURRent:PROTection[:LEVel][:OVER]?`

• Program data

	PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Setting range	0.03 to 36.3	0.06 to 72.6	0.20 to 220	0.03 to 36.3	0.13 to 145.2
Resolution	10 m	20 m	10 m	10 m	10 m

Unit   A

CURR:PROT:ACT

Sets whether to turn off the load or limit the current when the OCP trips. Or, queries the current setting.

Set command: `[SOURce:]CURRent:PROTection:ACTion {LIMit|TRIP}`

Query command: `[SOURce:]CURRent:PROTection:ACTion?`

• Program data

Value   LIMit: Limit the current when the OCP trips.

TRIP: Turn off the load when the OCP trips.

POW:PROT

Set the overpower protection. Or, queries the current setting.

Set command: `[SOURce:]POWer:PROTection[:LEVel][:OVER]{<value>|MINimum|MAXimum}`

Query command: `[SOURce:]POWer:PROTection[:LEVel][:OVER]?`

• Program data

	PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Setting range	0.1 to 181.5	0.3 to 363	1.0 to 1 100	0.1 to 181.5	0.6 to 726
Resolution	100 m	100 m	100 m	100 m	100 m

Unit   W

POW:PROT:ACT

Sets whether to turn off the load or limit the power when the OPP trips. Or, queries the current setting.

Set command: `[SOURce:]POWer:PROTection:ACTion {LIMit|TRIP}`

Query command: `[SOURce:]POWer:PROTection:ACTion?`

• Program data

Value   LIMit: Limit the current when the OPP trips.

TRIP: Turn off the load when the OPP trips.

VOLT:PROT:UND

Set the overvoltage protection. Or, queries the current setting.

Set command: `[SOURce:]VOLTage:PROTection[:LEVel]UNDe r {<voltage>|MINimum|MAXimum}`

Query command: `[SOURce:]VOLTage:PROTection[:LEVel]UN Der?`

VOLT:PROT:STAT

Turns ON/OFF the undervoltage protection. Or, queries the current setting.

Set command: `[SOURce:]VOLTage:PROTection:STATe {OFF|ON}`

Query command: `[SOURce:]VOLTage:PROTection:STATe?`

NOTE
- Use caution in the operation, because this command is linked to the VOLT:PROT:UND command.

  If a valid VOLT:PROT:UND is specified when VOLT:PROT:STAT is off, the UPP automatically turns on. In addition, if VOLT:PROT:STAT ON is executed from a off condition, the value of VOLT:PROT:UND is automatically set to a value corresponding to MINimum.

- The VOLT:PROT:STAT query command returns 0 or 1.

Setting the range

COND:RANG

Set the conductance range. Or, queries the current setting.

Set command: `[SOURce:]CONDuctance:RANGe {LOW|MEDium|HIGH}`

Query command: `[SOURce:]CONDuctance:RANGe?`

CURR:RANG

Sets the current range. Or, queries the current setting.

Set command: `[SOURce:]CURRent:RANGe {LOW|MEDium|HIGH}`

Query command: `[SOURce:]CURRent:RANGe?`

POW:RANG

Sets the power range. Or, queries the current setting.

Set command: `[SOURce:]POWer:RANGe {LOW|MEDium|HIGH}`

Query command: `[SOURce:]POWer:RANGe?`

VOLT:RANGE

Sets the voltatge range. Or, queries the current setting.

Set command: `[SOURce:]VOLTage:RANGe {LOW|HIGH}`

Query command: `[SOURce:]VOLTage:RANGe?`

Other settings

FUNC:CTIM

Sets the count time. Or, queries the current setting.

        Set command: `[SOURce:]FUNCtion:CTIMe {OFF|ON}`

        Query command: `[SOURce:]FUNCtion:CTIMe?`

- Program data

    Value   OFF(0)   Count time off

               ON(1)   Count time on

FUNC:RESP

Set the transient response speed. Or, queries the current setting. The response speed increases as the value gets larger.

Sending *RST sets 1.0. When the setting is in parallel operation, sending *RST sets 0.5.

        Set command: `[SOURce:]FUNCtion:RESPonse>`
                           `{0.1|0.2|0.5|1.0|MIN|MAX}`

        Query command: `[SOURce:]FUNCtion:RESPonse?`

- Program data

    Value   0.1, 0.2, 0.5, 1.0, MIN, or MAX

FUNC:SST

Sets the soft start time for CC mode or CR mode. Or, queries the current setting.

The default value is 1 ms.

        Set command: `[SOURce:]FUNCtion:SSTart`
                           `{1MS|2MS|5MS|10MS|20MS|50MS|100MS|20`
                           `0MS|MINimum|MAXimum}`

        Query command: `[SOURce:]FUNCtion:SSTart?`

- Program data

    Value   0.001, 0.002, 0.005, 0.01, 0.02, 0.05, 0.1, 0.2, MIN, or MAX

    Unit   S

ABC preset memories

PRES:STOR

Stores the settings to memory.

        Set command: `[SOURce:]PRESet:STORe`
                           `{MEMA|MEMB|MEMC}`

- Program data

    Value   MEMA   Store to preset memory A.

               MEMB   Store to preset memory B.

               MEMC   Store to preset memory C.

PRES:REC

Recalls settings from memory.

        Set command: `[SOURce:]PRESet:RECall`
                           `{MEMA|MEMB|MEMC}`

- Program data
  Value   MEMA   Recall preset memory A.
              MEMB   Recall preset memory B.
              MEMC   Recall preset memory C.

7.5.4   Trigger Commands

Triggers are event signals that instruct the PLZ-4W to change the output.

The trigger ring provides a method for controlling the output variation of the PLZ-4W and programming multiple PLZ-4Ws to respond simultaneously.

The trigger ring is effective against processes in which the power varies depending on the various operations of the device.

ABOR

Clears the trigger-wait status and returns to idle.

Set command: `ABORt`

COND:TRIG

Sets in advance the conductance generated when a trigger is activated.

Set command: `[SOURce:]CONDuctance[:LEVel]:TRIGgered[`
                         `:AMPLitude]`
                         `{<conductance>|MINimum|MAXimum}`

CURR:TRIG

Sets in advance the current generated when a trigger is activated.

Set command: `[SOURce:]CURRent[:LEVel]:TRIGgered[:AMP`
                         `Litude] {<current>|MINimum|MAXimum}`

INIT

Transits to the trigger wait status, but automatically returns to idle when a trigger is activated. Returns an error (-213), if the PLZ-4W is already in trigger wait status or when INIT:CONT ON is specified.

Set command: `INITiate[:IMMediate]`

INIT:CONT

Sets whether to continue the trigger wait status. Or, queries the current setting. See Fig. 7-2.

When ON is specified, the PLZ-4W transits from idle to trigger wait status. Then, even when a trigger is activated, the PLZ-4W does not automatically return to idle. The PLZ-4W returns to idle when you send *RST or device clear (GPIB and RS232 only).

When OFF is specified, the function for continuing the trigger wait status is cleared, but the trigger wait status remains. Then, the PLZ-4W returns to idle when a trigger is activated.

Set command: `INITiate:CONTinuous {OFF|ON}`
Query command: `INITiate:CONTinuous?`

NOTE   • The query command returns 0 or 1.
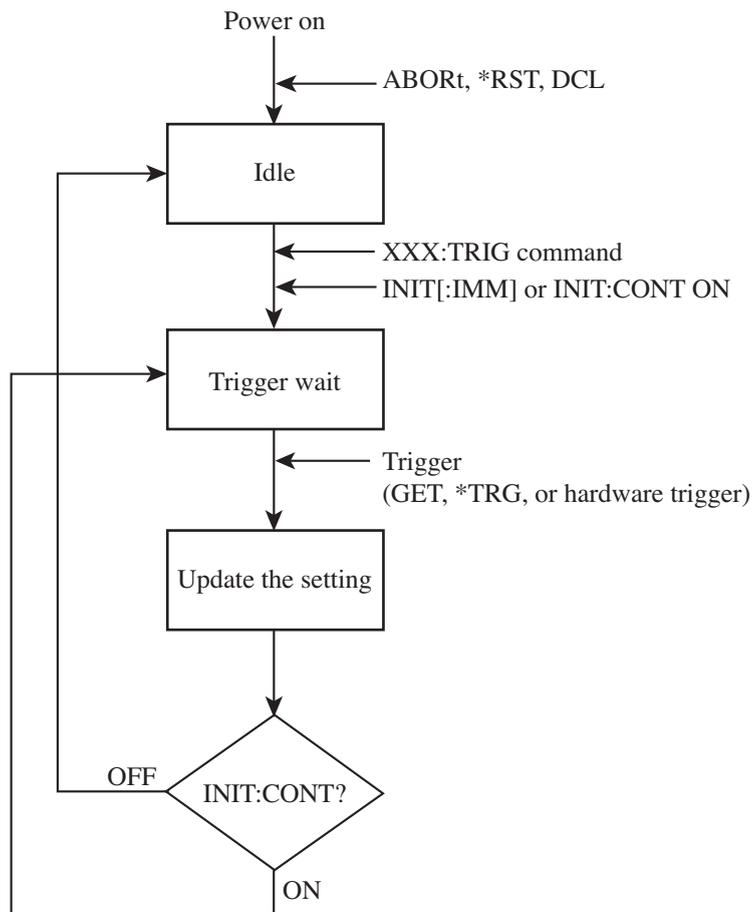

Fig. 7-2   Trigger wait status control using INIT:CONT

INP:TRIG/OUTP:TRIG

Turns ON/OFF the load depending on the trigger input.

Set command: `INPut[:STATe]:TRIGgered {OFF|ON}`
                `OUTPut[:STATe]:TRIGgered {OFF|ON}`

• Program data
Value   OFF(0)   Load off
         ON(1)   Load on

7.5.5 Switching Function Commands

Executes sequentially the multiple load currents that are specified in CC or CR mode.

PULS

Turns ON/OFF the switching mode. Or, queries the current setting.

Set command:	`[SOURce:]PULSe[:STATe] {OFF│ON}`
Query command:	`[SOURce:]PULSe[:STATe]?`

• Program data

Value	OFF(0)	Switching mode off
	ON(1)	Switching mode on

PULS:DCYC

Sets the switching duty cycle. Or, queries the current setting.

Set command:	`[SOURce:]PULSe:DCYCle <value>`
Query command:	`[SOURce:]PULSe:DCYCle?`

• Program data

Value	5 to 95
Resolution	0.1
Unit	PCT

PULS:PER

Sets the pulse period. Or, queries the current setting.

Set command:	`[SOURce:]PULSe:PERiod <value>`
Query command:	`[SOURce:]PULSe:PERiod?`

• Program data

Value	50 μ to 1
Unit	S

PULS:FREQ

Sets the pulse frequency. Or, queries the current setting.

Set command:	`[SOURce:]PULSe:FREQuency <value>`
Query command:	`[SOURce:]PULSe:FREQuency?`

• Program data

Value	1 to 20 k	
Resolution	to 10:	0.1
	to 100:	1
	to 1 k:	10
	to 20 k:	100
Unit	HZ	

Sets the switching level

PULS:LEV:COND

Sets the conductance level. Or, queries the current setting.

Set command: `[SOURce:]PULSe:LEVel[:VALue]:CONDuctance <conductance>`

Query command: `[SOURce:]PULSe:LEVel[:VALue]:CONDuctance?`

PULS:LEV:PERC:COND

Sets the conductance level in terms of a percentage of the setting. Or, queries the current setting.

Set command: `[SOURce:]PULSe:LEVel:PERCentage:CONDuctance <value>`

Query command: `[SOURce:]PULSe:LEVel:PERCentage:CONDuctance?`

• Program data

Value	0.0 to 100.0
Resolution	0.1
Unit	PCT

PULS:LEV:CURR

Sets the current level. Or, queries the current setting.

Set command: `[SOURce:]PULSe:LEVel[:VALue]:CURRent <current>`

Query command: `[SOURce:]PULSe:LEVel[:VALue]:CURRent?`

PULS:LEV:PERC:CURR

Sets the current level in terms of a percentage of the setting. Or, queries the current setting.

Set command: `[SOURce:]PULSe:LEVel:PERCentage:CURRent <value>`

Query command: `[SOURce:]PULSe:LEVel:PERCentage:CURRent?`

• Program data

Value	0.0 to 100.0
Resolution	0.1
Unit	PCT

7.5.6   Input State Commands

INP/OUTP

Turns ON/OFF the load. Or, queries the current setting.
Set command:	`INPut[:STATe][:IMMediate] {OFF│ON}`
	`OUTPut[:STATe][:IMMediate] {OFF│ON}`
Query command:	`INPut[:STATe][:IMMediate]?`
	`OUTPut[:STATe][:IMMediate]?`

• Program data
Value	OFF(0)	Load off
	ON(1)	Load on

INP:PROT:CLE/OUTP:PROT:CLE

Clears the alarm.
Set command:	`INPut:PROTection:CLEar`
	`OUTPut:PROTection:CLEar`

INP:SHOR/OUTP:SHOR

Turns ON/OFF the short function. Or, queries the current setting.
Set command:	`INPut:SHORt[:STATe] {OFF│ON}`
	`OUTPut:SHORt[:STATe] {OFF│ON}`
Query command:	`INPut:SHORt[:STATe]?`
	`OUTPut:SHORt[:STATe]?`

• Program data
Value	OFF(0)	Short function off
	ON(1)	Short function on

INP:TIM/OUTP:TIM

Set the cutoff time. Or, queries the current setting.
Set command:	`INPut[:STATe]:TIMer[:STATe]`
	`{<value>│MINimum│MAXimum}`
	`OUTPut[:STATe]:TIMer[:STATe]`
	`{<value>│MINimum│MAXimum}`
Query command:	`INPut[:STATe]:TIMer[:STATe]?`
	`OUTPut[:STATe]:TIMer[:STATe]?`

• Program data
Value	0 to 3 599 999 or 0 (function off)
Resolution	1
Unit	S

7.5.7 Sequence Commands

Programs a series of steps. For details, see section 6.5, "Sequence Function."

- -

NOTE
- Commands that include NSP are for normal sequences; commands that include FSP are for fast sequences. Commands that do not include either NSP or FSP are for normal and fast sequences.

  Normally, shared commands can be used for both normal and fast sequences. However, there are exceptions depending on the command.

- If a command includes notations such as `{<conductance>|<current>|<power>|<voltage>}`, the program data corresponding to the selected program mode is selected.

- -

Creating a sequence

PROG:NAME

Specify the program name (number). If you select a program number, all succeeding program-related commands are settings for the selected program. Selecting the program does not define the program.

Set command: `PROGram[:SELected]:NAME <value>`

- Program data
  Value   1 to 10:   Program number of normal sequence mode (NSP).
  Value   11:   Program number of fast sequence mode (FSP).

PROG:MEMO

Sets the memo of the selected program. Or, queries the current setting.

Up to 11 characters can be specified.

Set command: `PROGram[:SELected]:MEMO "<string>"`
Query command: `PROGram[:SELected]:MEMO?`

PROG:MODE

Sets the mode of the selected program. Or, queries the current setting.

Set command: `PROGram[:SELected]:MODE`
                  `{NCC|NCR|NCV|NCP|FCC|FCR}`
Query command: `PROGram[:SELected]:MODE?`

- Program data

  Value

Normal sequence		Fast sequence	
NCC	CC mode	FCC	CC mode
NCR	CR mode	FCR	CR mode
NCV	CV mode		
NCP	CP mode		

PROG:VRAN

Sets the voltage range of the selected program. Or, queries the current setting.

         Set command: `PROGram[:SELected]:VRANge {LOW|HIGH}`

         Query command: `PROGram[:SELected]:VRANge?`

• Program data

        Value   LOW   Low range

                 HIGH   High range

PROG:CRAN

Sets the current range of the selected program. Or, queries the current setting.

         Set command: `PROGram[:SELected]:CRANge`
                               `{LOW|MEDium|HIGH}`

         Query command: `PROGram[:SELected]:CRANge?`

• Program data

        Value   LOW   Low range

                 MEDium Mid range

                 HIGH   High range

PROG:LOOP

Sets the number of program loops of the selected program. Or, queries the current setting.

         Set command: `PROGram[:SELected]:LOOP <value>`

         Query command: `PROGram[:SELected]:LOOP?`

• Program data

        Value   1 to 9998 or 9999 (infinite loop)

        Resolution   1

PROG:LINP/PROG:LOUT

Sets the load on/off condition after the sequence ends. Or, queries the current setting.

         Set command: `PROGram[:SELected]:LINPut {OFF|ON}`
                               `PROGram[:SELected]:LOUTput {OFF|ON}`

         Query command: `PROGram[:SELected]:LINPut?`
                               `PROGram[:SELected]:LOUTput?`

• Program data

        Value   OFF(0) Load off

                 ON(1)   Load on

PROG:LVAL

Sets the current value after the specified program ends. Or, queries the current setting.

- For a normal sequence

  Set command: `PROGram[:SELected]:LVALue {<conductance>|<current>|<power>|<voltage>}`

  Query command: `PROGram[:SELected]:LVALue?`

  Returns the selected value in response to `PROGram[:SELected]:LVALue?`.

  Returns `{<conductance>|<current>|<power>|<voltage>}`.

- For a fast sequence

  Set command: `PROGram[:SELected]:LVALue {<conductance>|<current>}`

  Query command: `PROGram[:SELected]:LVALue?`

  Returns the selected value in response to `PROGram[:SELected]:LVALue?`.

  Returns `{<conductance>|<current>}`.

PROG:CHA (NSP only)

Set the number of the program to be executed next. Or, queries the current setting.

Set command: `PROGram[:SELected]:CHAin {<value>}`

Query command: `PROGram[:SELected]:CHAin?`

- Program data

  Value   0   End sequence operation.

            1 to 10 Number of the program executed next.

  Resolution 1

Setting a normal sequence step

PROG:NSP:INS

Inserts a normal sequence step into the selected program. Select the number previous to the step number you wish to insert.

If the parameter is omitted, the default value is applied.

Set command: `PROGram[:SELected]:NSPeed[:STEP]:INSert <step>,{<conductance>|<current>|<power>|<voltage>},<time>[,<input=1>][,<ramp=0>][,<trig=0>][,<pause=0>]`

PROG:NSP:ADD

Adds a step after the last step of the normal sequence of the selected program.

If the parameter is omitted, the default value is applied.

Set command: `PROGram[:SELected]:NSPeed[:STEP]:ADD {<conductance>|<current>|<power>|<voltage>},<time>[,<input=1>][,<ramp=0>][,<trig=0>][,<pause=0>]`

PROG:NSP:DEL

Deletes the selected program sequence step. If you do not program a new end operation and delete the last step containing an end operation, an error occurs.

Set command: `PROGram[:SELected]:NSPeed[:STEP]:DELete[:STEP]`

PROG:NSP:DEL:ALL

Deletes the all the steps of the selected program. If you do not program a new end operation and delete the last step containing an end operation, an error occurs.

Set command: `PROGram[:SELected]:NSPeed[:STEP]:DELete:ALL`

PROG:NSP:COUN

Queries the number of steps of the selected program.

Query command: `PROGram[:SELected]:NSPeed[:STEP]:COUNt?`

PROG:NSP:EDIT

Edits an existing sequence step. Or, queries the current setting.

If the parameter is omitted, the current value is retained.

Set command: `PROGram[:SELected]:NSPeed[:STEP]:EDIT <step>,{<conductance>|<current>|<power>|<voltage>},<time>[,<input>][,<ramp>][,<trig>][,<pause>]`

Query command: `PROGram[:SELected]:NSPeed[:STEP]:EDIT? <step>`

Returns the settings of the selected step in response to `PROG:NSP:EDIT? <step>`.

Returns`{<conductance>|<current>|<power>|<voltage>},<time>,<input>,<ramp>,<trig>,<pause>`.

Setting a fast sequence step

PROG:FSP:END

Sets the end step of the fast sequence mode.

Set command: `PROGram[:SELected]:FSPeed[:STEP]:END <step>`

Query command: `PROGram[:SELected]:FSPeed[:STEP]:END?`

PROG:FSP:EDIT

Edits an existing sequence step. Or, queries the current setting.

If the parameter is omitted, the current value is retained.

Set command: `PROGram[:SELected]:FSPeed[:STEP]:EDIT[:POINt] <step>,<value>[,<trig>]`

Query command: `PROGram[:SELected]:FSPeed[:STEP]:EDIT[:POINt]? <step>`

PROG:FSP:TIME

Set the step execution time of the fast sequence mode. Or, queries the current setting.

Set command: `PROGram[:SELected]:FSPeed:TIME <time>`

Query command: `PROGram[:SELected]:FSPeed:TIME?`

PROG:FSP:EDIT:LIN

Automatically calculates the values of each step using linear data between start and stop steps of the fast sequence mode

Set command: `PROGram[:SELected]:FSPeed[:STEP]:EDIT:LINear <start-step>,<start-data>,<stop-step>,<stop-data>`

PROG:FSP:EDIT:WAVE

Edits the waveform of the step of the fast sequence mode.

Set command: `PROGram[:SELected]:FSPeed[:STEP]:EDIT:WAVE <start-step>,<val1>,<val2>,<val3>,<val4>,<val5>,<val6>,<val7>,<val8>`

Deletes the contents of sequence

PROG:CLE

Deletes the contents of the sequence.

Set command: `PROGram:CLEar`

Executing a sequence

PROG:STAT

Executes the selected program or changes the operating status.

Select the program first.

Set command: `PROGram[:SELected]:STATe`
`{TRUN|RUN|STOP|PAUSe|CONTinue}`

• Program data

Value

TRUN	Set the selected program to standby (executed using triggers or CONTinue operation.)
RUN	Execute the selected program
STOP	Stop the selected program
PAUSe	Pause the sequence operation.
CONTinue	Resume the sequence operation

PROG:EXEC

Queries the number of the program currently in operation.

Query command: `PROGram[:SELected]:EXECuting?`

Returns the status of the current sequence in response to PROG:EXEC? as follows.

Returns`{RUN|STOP|PAUS}`,`<time>`,`<loop>`,`<step>`,`<program name>`.

`<program name>` is the numeric value of the program name selected by PROG:NAME.

7.5.8   Other Commands

SYST:CAP

Queries the SCPI instrument class and the basic functions.

(DCPSUPPLY WITH (MEASURE&TRIGGER))

Query command: `SYSTem:CAPability?`

SYST:ERR

Reads the error message from the error queue. The error queue can store up to 255 error messages. For a description of the messages, see appendix A.6, "Error Messages."

Query command: `SYSTem:ERRor[:NEXT]?`

Returns the current error message in response to SYST:ERR?.

Example)   When there is no error.

Returns 0, "No error".

Example)   Command error.

Returns -100, "Command error".

SYST:GTL

Switches to local mode operation (RS232 only).

Set command: `SYSTem:GTLocal`

SYST:LLO

Sets local lockout (LLO) (RS232 only).

Set command: `SYSTem:LLOut`

SYST:REN

REN (Remote Enable/Disable) (RS232 only)

Power on. The default setting is on.

Set command: `SYSTem:RENable {OFF|ON}`

SYST:VERS

Queries the SCPI version to which the PLZ-4W conforms.

Query command: `SYSTem:VERSion?`

Below is an example of the response to SYST:VERS?.

Example)   When conforming to 1999.0

Returns 1999.0.

7.6 Status Registers

Status registers are standard functions defined in the SCPI and IEEE 488.2.

Status registers can be classified into 5 groups: SCPI standard OPERation status register, QUEStionable status register, PLZ-4W-dedicated CSUMmary register, IEEE488.2 standard event register, and status byte.

SCPI registers

OPERation	(SCPI requirement)
QUEStionable	(SCPI requirement)
CSUMmary	(PLZ-4W dedicated)

IEEE488.2 registers

Standard event status register	(*ESR?)
Status byte register	(*STB?)

7.6.1 SCPI Registers

In each SCPI status register, there are sub registers, CONDition register, EVENt register, ENABle register, PTRansition filter, and NTRansition filter.

Fig. 7-3 shows the SCPI status register structure. The character "+" represents the logic sum of the register bits. Table 7-3 to Table 7-6 describe the bit number, bit weight, and the meaning of each bit.

CONDition register

The transition of the CONDition register is automatic and reflects the condition of the PLZ-4W in real-time. Reading this register does not affect the contents.

EVENt register

The EVENt register bits are automatically set according to the changes in the CONDition register. The rule varies depending on the positive and negative transition filters (PTRansition and NTRansition). The EVENt register is reset when it is read.

ENABle register

The ENABle register enables the reports to the summary bit or status bit of the event bit.

Transition filter

Use the PTRansition (positive transition) filter to report events when the condition changes from false to true.

Use the NTRansition (negative transition) filter to report events when the condition changes from true to false.

If both the positive filter and the negative filter are set to true, events can be reported each time the status changes.

If both of these filters are cleared, event reporting is disabled.

QUEStionable Status (SCPI)

VOLTage — 0
CURRent — 1
TIME — 2
POWer — 3
TEMPerature — 4
FREQuency — 5
PHASe — 6
MODulation — 7
CALibration — 8
Available to designer — 9
Available to designer — 10
Available to designer — 11
Available to designer — 12
INSTrument Summary — 13
Command Warning — 14
NOT USED* — 15

OPERation Status (SCPI)

CALibrating — 0
SETTing — 1
RANGing — 2
SWEeping — 3
MEASuring — 4
Waiting for TRIGger Summary — 5
Waiting for ARM Summary — 6
CORRecting — 7
Available to designer — 8
Available to designer — 9
Available to designer — 10
Available to designer — 11
Available to designer — 12
INSTrument Summary — 13
PROGram Running — 14
NOT USED* — 15

CSUMmary Status (PLZ-4W specific)

CC — 0
CV — 1
CR — 2
CP — 3
NOT USED — 4
NOT USED — 5
NOT USED — 6
NOT USED — 7
PEND — 8
NOT USED — 9
NOT USED — 10
NOT USED — 11
NOT USED — 12
NOT USED — 13
NOT USED — 14
NOT USED — 15

Standard Event Status Register

Operation Complete — 0
Request Control — 1
Query Error — 2
Device Dependent Error — 3
Execution Error — 4
Command Error — 5
User Request — 6
Power On — 7

Status Byte

Available to designer — 0
Available to designer — 1
— 2
— 3
MAV — 4
RQS — 5
— 6
— 7

Summary of IEEE 488.2 Status Structure Registers

* The use of Bit 15 is not allowed since some controllers may have difficulty reading a 16 bit unsigned integer. The value of this bit shall always be 0.

Partially changed SCPI Standard 1999.0 Volume1 fig.9-1.

Fig. 7-3   Status registers

OPERation status register

The OPERation status register is a 16-bit register which contains information about conditions which are part of the PLZ-4W's normal operation.

Of the bits defined by SCPI, only bits 0 and 5 are used.

Table 7-3 OPERation status register (STATus:OPERation)

Bit	Bit weight	Bit name	Description
0	1	CALibrating	The PLZ-4W is in calibration (CAL) mode.
1	2	NOT USED	Not used
2	4	NOT USED	Not used
3	8	NOT USED	Not used
4	16	NOT USED	Not used
5	32	Waiting for TRIGger Summary	Indicates whether the PLZ-4W is waiting for a trigger (TRIG).
6	64	NOT USED	Not used
7	128	NOT USED	Not used
8	256	NOT USED	Not used
9	512	NOT USED	Not used
10	1024	NOT USED	Not used
11	2048	NOT USED	Not used
12	4096	NOT USED	Not used
13	8192	NOT USED	Not used
14	16384	NOT USED	Not used
15	32768	NOT USED	Always zero

STAT:OPER

Queries the event of the OPERation status register.

Query command: `STATus:OPERation[:EVENt]?`

STAT:OPER:COND

Queries the condition of the OPERation status register.

Query command: `STATus:OPERation:CONDition?`

STAT:OPER:ENAB

Sets the OPERation status register enable, or queries the current setting.

Set command: `STATus:OPERation:ENABle <status-enable>`

Query command: `STATus:OPERation:ENABle?`

STAT:OPER:PTR

Sets the positive transition of the OPERation status register, or queries the current setting.

> Set command: STATus:OPERation:PTRansition <status-enable>
>
> Query command: STATus:OPERation:PTRansition?

STAT:OPER:NTR

Sets the negative transition of the OPERation status register, or queries the current setting.

> Set command: STATus:OPERation:NTRansition <status-enable>
>
> Query command: STATus:OPERation:NTRansition?

QUEStionable status register

The QUEStionable status register is a 16-bit register that stores information related to the questionable events and status during PLZ-4W operation.

These register bits may indicate problems with the output of the PLZ-4W.

Of the bits defined by SCPI, bits 0, 1, 3, and 4 are used.

In addition, bits 9, 10, and 11 are used as dedicated bits of the PLZ-4W.

Table 7-4 QUEStionable status register (STATus:QUEStionable)

Bit	Bit weight	Bit name	Description
0	1	OV	Over Voltage
1	2	OC	Over Current
2	4	NOT USED	Not used
3	8	OP	Over Power
4	16	OT	Over Temperature
5	32	Not Used	Not used
6	64	Not Used	Not used
7	128	Not Used	Not used
8	256	Not Used	Not used
9	512	UV	Under Voltage
10	1024	EXT	External Problem
11	2048	REV	Reverse Voltage
12	4096	Not Used	Not used
13	8192	Not Used	Not used
14	16384	Not Used	Not used
15	32768	Not Used	Always zero

STAT:QUES

Queries the event of the QUEStionable status register.

Query command: `STATus:QUEStionable[:EVENt]?`

STAT:QUES:COND

Queries the condition of the QUEStionable status register.

Query command: `STATus:QUEStionable:CONDition?`

STAT:QUES:ENAB

Sets the QUEStionable status register enable, or queries the current setting.

Set command: `STATus:QUEStionable:ENABle <status-enable>`

Query command: `STATus:QUEStionable:ENABle?`

STAT:QUES:PTR

Sets the positive transition of the QUEStionable status register, or queries the current setting.

Set command: `STATus:QUEStionable:PTRansition <status-enable>`

Query command: `STATus:QUEStionable:PTRansition?`

STAT:QUES:NTR

Sets the negative transition of the QUEStionable status register, or queries the current setting.

Set command: `STATus:QUEStionable:NTRansition <status-enable>`

Query command: `STATus:QUEStionable:NTRansition?`

CSUMmary register

Registers dedicated to the PLZ-4W.

Bits 0, 1, 2, 3, and 8 are used.

Table 7-5   CSUMmary register (STATus:CSUMmary)

Bit	Bit weight	Bit name	Description
0	1	CC	Switched to CC mode.
1	2	CV	Switched to CV mode.
2	4	CR	Switched to CR mode.
3	8	CP	Switched to CP mode.
4-7		Not Used	Not used
8	256	PRUN	PROGram is being executed.
9-15		Not Used	Not used

STAT:CSUM

Queries the event of the CSAMmary status register.

Query command: `STATus:CSUMmary[:EVENt]?`

STAT:CSUM:COND

Queries the condition of the CSAMmary status register.

Query command: `STATus:CSUMmary:CONDition?`

STAT:CSUM:ENAB

Sets the CSAMmary status register enable, or queries the current setting.

Set command: `STATus:CSUMmary:ENABle <status-enable>`

Query command: `STATus:CSUMmary:ENABle?`

STAT:CSUM:PTR

Sets the positive transition of the CSAMmary status register, or queries the current setting.

Set command: `STATus:CSUMmary:PTRansition <status-enable>`

Query command: `STATus:CSUMmary:PTRansition?`

STAT:CSUM:NTR

Sets the negative transition of the CSAMmary status register, or queries the current setting.

Set command: `STATus:CSUMmary:NTRansition <status-enable>`

Query command: `STATus:CSUMmary:NTRansition?`

Preset status

STAT:PRES

Specific events are reported at a high level by constructing status data and using the status reporting mechanism. These events are summarized in the required structures, OPERation status register, and QUEStionable register.

The STAT:PRES command only affects the ENABle register and the transition filter register of the status data structure.

The STAT:PRES command does not clear any event registers or any items from the error/event queue.

To reset all event registers and the queue within the device status reporting mechanism, use the *CLS command.

For the device-dependent status data structure, the STAT:PRES command sets the ENABle register to all 1s and sets the transition filter registers so that only positive transitions are reported.

For status data required by SCPI, the STAT:PRES command sets the transition filter registers so that only positive transitions are detected and sets the ENABle register to 0. The settings of the service request enable register, parallel poll enable register, memory registers related to the *SAV command, the PLZ-4W address, output queue, and power on status clear flag are not affected by this command.

Table 7-6   Preset values of registers that can be set by the user

Register	Filter/Enable	Preset value
Operation	Enable register	0 s
	Positive transition filter	1 s
	Negative transition filter	0 s
QUEStionable	Enable register	0 s
	Positive transition filter	1 s
	Negative transition filter	0 s
CSUMmary	Enable register	1 s
	Positive transition filter	1 s
	Negative transition filter	0 s

Set command: `STATus:PRESet`

7.6.2   IEEE488.2 Registers

Standard event status register

The standard event status register bits are set when certain events occur during PLZ-4W operation. All bits of the standard event status register are set by the error event queue.

The register is defined by the IEEE488.2 standard. IEEE488.2 common commands *ESE, *ESE?, and *ESR? are used to control the register.

Table7-7　Standard event status register

Bit	Bit weight	Bit name	Description
0	1	Operation Complete (OPC)	Set when an *OPC command is received and all operations in standby are complete. Event-800 Operation Complete message is loaded in the error/event queue.
1	2	Request Control (RQC)	Not used
2	4	Query Error (QYE)	Set when an attempt is made to read data from the output queue when there is no output or the error queue is in wait status. Indicates that there is no data in the error queue. For details on the error codes, see A.6, "Error Messages."
3	8	Device Dependent Error (DDE)	Set when there is a device-specific error. For details on the error codes, see appendix A.6, "Error Messages."
4	16	Execution Error (EXE)	Set when the PLZ-4W evaluates the program data following the header is outside the formal input range (does not match the performance of the PLZ-4W). This indicates that a valid SCPI command may not be executed correctly depending on the conditions of the PLZ-4W. For details on the error codes, see appendix A.6, "Error Messages."
5	32	Command Error (CME)	Set when an IEEE 488.2 syntax error is detected, when an unidentifiable header is received, or when a group execution trigger enters the internal IEEE 488.2 SCPI command input buffer. For details on the error codes, see appendix A.6, "Error Messages."
6	64	User Request (URQ)	Set when the bit is unmasked and the instrument wishes to respond to the 488.2 user request event. When the instrument detects the activation of the user request local control, an event is generated. Event-600 User Request message is loaded in the error/event queue.)
7	128	Power ON (PON)	Not used
8-15		Reserved	Not used

Status byte register

The status byte register stores STB and RQS (MSS) messages as defined by the IEEE488.1 standard. The status byte register can be read using IEEE488.1 serial polling or IEEE488.2 common command *STB?.

When serial polling is carried out, bit 6 responds with the request service (RSQ). The status byte value is not changed by serial polling.

The *STB? query command makes the device transmit the contents of the status byte register and the master summary status (MSS) summary message.

The *STB? query command does not change status bytes MSS and RQS.

Table 7-8   Status byte summary register

Bit	Bit weight	Bit name	Description
0	1	Reserved	Reserved for future use by the IEEE. The bit value is notified as zero.
1	2	Reserved	
2	4	CSummary (CSUM)	This bit is set to true when a bit is set in the CSUM status register.
3	8	Questionable Status Register (QUES)	This bit is set to true when a bit is set in the QUEStionable event status register and the corresponding bit in the QUEStionable status enable register is true.
4	16	Message Available (MAV)	This bit is set to true when a request is received from the digital programming interface and the PLZ-4W is ready to output the data byte.
5	32	Standard Event Status Bit Summary (ESB)	This bit is set to true when a bit is set in the event status register.
6	64	Request Service (RQS)	This bit is set to true when a bit is set in the service request enable register, and the corresponding bit exists in the status byte. The SRQ line is set on the GPIB, and SRQ illuminates.
		Master Status Summary (MSS)	Set by one of the following. Status byte bit 0 and service request enable register bit 0 Status byte bit 1 and service request enable register bit 1 Status byte bit 2 and service request enable register bit 2 Status byte bit 3 and service request enable register bit 3 Status byte bit 4 and service request enable register bit 4 Status byte bit 5 and service request enable register bit 5 Status byte bit 7 and service request enable register bit 7
7	128	Operation Status Register (OPER)	This bit is set to true when a bit is set in the OPERation event status register and the corresponding bit in the OPERation status enable register is set.
8-15		Not Used	Not Used

IEEE 488.2 status event command

See section 7.5.1, "IEEE 488.2 Common Commands."

7.7   Sample Programs

Sample programs for the PLZ-4W Electronic Load is provided at the Kikusui web-site (http://www.kikusui.co.jp). Please make use of them.

Fig. 7-4 shows the screen example of a sample program.

The contents of the sample program are subject to change without prior notice.

Fig. 7-4   Sample program screen example

8

Chapter 8 Maintenance and Calibration

This chapter describes how to maintain, inspect, and calibrate the PLZ-4W.

8.1   Maintenance

Periodic maintenance and inspection are essential to maintain the initial performance of the PLZ-4W over an extended period.

⚠ WARNING • Possible electric shock. May lead to death or injury. Be sure to turn off the POWER switch and remove the power cord plug or turn off the switchboard.

8.1.1   Cleaning the Panels

If the panel needs cleaning, gently wipe using a soft cloth with water-diluted neutral detergent.

⚠ CAUTION • Do not use volatile solvents such as thinner or benzine. They may discolor the surface, erase printed characters, or cloud the LCD.

8.1.2   Cleaning the Dust Filter

A dust filter is installed on the inside of the louver on the front panel. Periodically clean the filter to prevent clogging.

⚠ CAUTION • Clogged filters hinder the cooling of the inside of the instrument and can cause a malfunction and shortening of the service life.

Cleaning procedure

1. Remove the louver from the panel by placing a finger on the 2nd level of the louver and pulling down the 1st level while pulling it toward you.

    If the louver does not come off easily, pressing down the top level of the louver will ease the work.
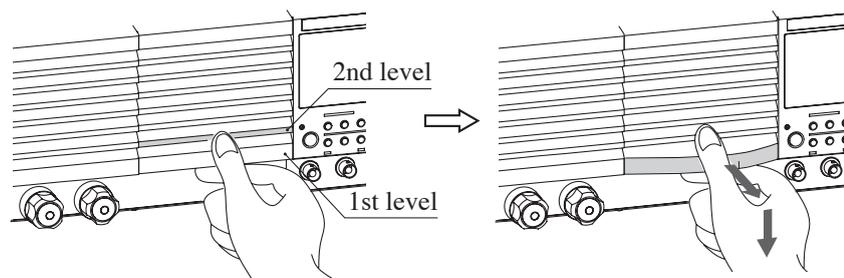
Fig.8-1   Removing the louver

2. Remove the dust filter from the inside of the louver and clean it.

Remove the dust on the dust filter such as by using a vacuum cleaner. If the filter is extremely dirty, clean it using a water-diluted neutral detergent and dry it completely.
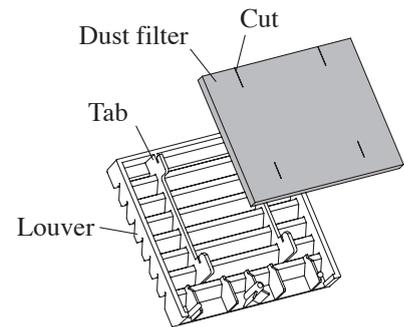
Fig. 8-2   Dust filter

⚠ CAUTION • When the PLZ-4W is in operation, air is sucked through the dust filter to cool the PLZ-4W. If moister is included in the dust filter, the temperature or humidity inside the PLZ-4W increases and may cause a malfunction.

3. Attach the dust filter to the louver.

Attach it so that the tab on the louver fits into the cut on the dust filter.

4. Attach the louver to the panel by pulling up on the louver while holding the 2nd level of the louver with your hand until the pin is fixed in place.
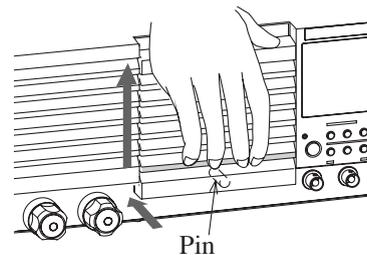
Fig. 8-3   Attaching the louver

8.1.3   Inspecting the Power Cord

Check the power cord for breaks in its protective cover, cracked plugs or rattling, and loosened screws.

8.1.4   Internal Inspection

The electrolytic capacitors, fan motor, and battery for memory backup inside the PLZ-4W are consumable parts.

It is recommended that the PLZ-4W be overhauled every 10000 operating hours along with internal inspection and cleaning. For overhauling your PLZ-4W, contact your Kikusui agent or distributor.

Backup battery

The PLZ-4W employs a lithium battery for memory backup.

The battery life depends on the operating conditions. Three years after purchase is a good estimation. If the panel settings are different at the time the power is turned off and at the time the power is turned on again, the battery is already dead.

To replace the battery, contact your Kikusui agent or distributor.

8.2   Confirming status of the fuse

To increase security of the product, the fuse are installed on each element of the load device. Those fuses protects from the effect to the connected device at minimum level causing by the failure or incorrect use of the product. If the setting current is not flowing properly, the fuse may have blown off. Please check the following procedure.

1.   Apply the current flow while the loads are connected.

2.   Remove the whole louvers on the front panel, and check if the LED lights in red.

   If the LED lights, the fuse may have blown off. In this case, contact your Kikusui distributor/agent for request of service.

Check for the input voltage and the input current within the rated value. If the measured value is out of rated range, the LED may lights on even the fuse does not blow off.

8.3   Calibration

The PLZ-4W is shipped from the factory after carrying out a strict calibration. However, to maintain the performance, periodic calibration is recommended.

8.3.1   Calibration Overview

The calibrated items are current and voltage.

The current is calibrated with respect to the current ranges (3 ranges: L, M, and H).

The voltage is calibrated with respect to the voltage ranges (2 ranges: 15 V and 150 V).

For each range, the offset and gain are calibrated.

    Offset: Value corresponding to 10 % of the range full scale

    Gain: Value corresponding to 100 % of the range full scale

The relationship between the setting and output during operation is linear. Therefore, a line is defined by calibrating the offset and gain at 2 points. During operation, the relationship between the setting and output is achieved along the calibrated line.
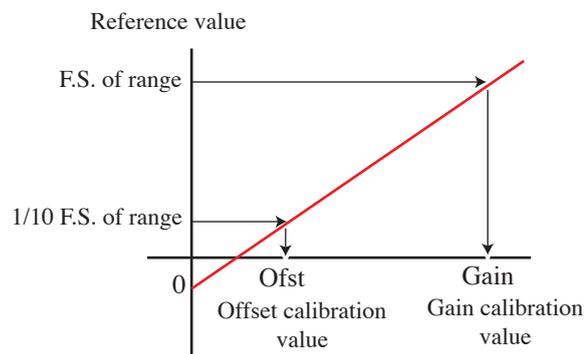
Fig. 8-4   Offset and gain calibration

■ Calibration items

The following six items are calibrated for three current ranges and two voltage ranges.

    1. Offset of the internal reference voltage for output setting

    2. Gain of the internal reference voltage for output setting

    3. Offset of the measured value

    4. Gain of the measured value

    5. Offset of the internal reference voltage for protection function setting

    6. Gain of the internal reference voltage for protection function setting

The offsets of the internal reference voltage for output setting and the measured value (number 1 and 3) are calibrated simultaneously. The same also holds true for the gain (numbers 2 and 4).

Therefore, the number of calibration points is 20 (4 points × 5 ranges).

8.3.2   Preparation

Leave the PLZ-4W turned on for at least 30 minutes (warm-up) before carrying out a performance check. This is to reduce measurement errors due to initial drift. Keep the ambient temperature at $23 \pm 5°C$.

Table8-1   Test equipment used

Name	Required accuracy	Required rating
DC voltmeter	Within 0.02 %	Measurement voltage range: 0 V to 155 V
Shunt resistor	0.1 %	For 0.5 A (*1) For 1 A (*1, *2) For 2 A (*3, *4) For 5 A (*1) For 10 A (*2) For 20 A (*3, *4) For 50 A (*1) For 100 A (*2) For 200 A (*3, *4)
Regulated DC power supply (constant voltage power supply)	–	Voltage: 5 V Current: 33 A (*1) 66 A (*2) 132 A (*3) 200 A (*4)
Regulated DC power supply (constant current power supply)	–	Voltage: 155 V Current: 0.3 A

*1:PLZ164W/PLZ164WA, *2:PLZ334W, *3:PLZ664W, *4:PLZ1004W

Connect the cables as shown in Fig. 8-5. Select the shunt resistor according to the calibration item.
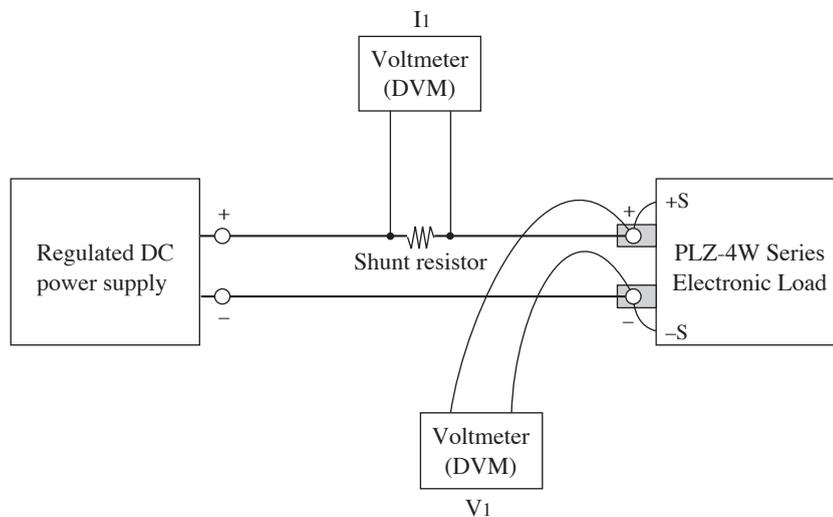
Fig. 8-5   Connection diagram

8.3.3　Calibration Procedure

Entering the calibration screen and selecting Calibration

1. Press the MENU (SHIFT+SET/VSET) key.

   The menu screen is displayed.

2. Use the ▼ CURSOR key to select 3. Calibration.

   3. Calibration is highlighted.

3. Press the ENTER key.

   The Calibration screen appears.

Calibration number ————

```
┌─────────────────────────┐
│ Calibration             │
│                         │
│   1. CC(Low)            │
│   2. CC(Mid)            │
│   3. CC(High)          │
│   4. CV 15V            │
│   5. CV 150V           │
│  PREV            NEXT   │
└─────────────────────────┘
```
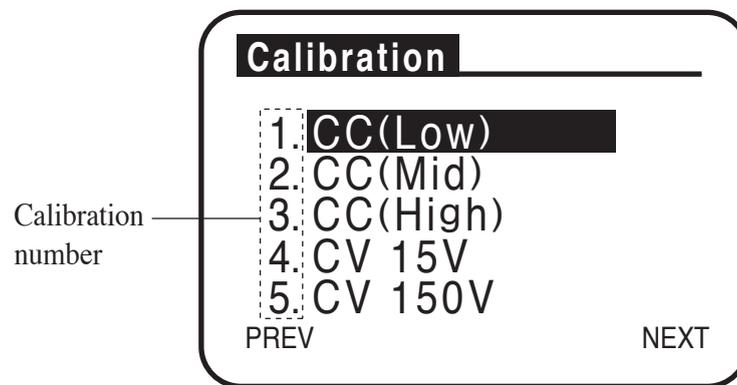
Fig. 8-6　　Calibration screen

■ Alarm

If an alarm occurs while the calibration is in progress, the load turns off along with a beeping alarm. Press the ENTER key after clearing the problem which was caused to activate an alarm, then the Calibration screen appears on the display and a beeping alarm stops. In this case, go back to the step from the beginning of the alarm occurd calibration number.

CC mode calibration (calibration number 1, 2, and 3)

Carry out calibration on the low range items first according to steps A to D. Then, carry out calibrations for Mid range and High range.

Table 8-2   Overview of the procedure

Procedure	Current range	Percentage with respect to the full scale (%)	Internal reference voltage for output setting		Measured value		Internal reference voltage for protection function setting	
			Offset	Gain	Offset	Gain	Offset	Gain
A	Low	10	●	–	●	–	–	–
B			–	–	–	–	●	–
C		100	–	●	–	●	–	–
D			–	–	–	–	–	●
A	Mid	10	●	–	●	–	–	–
B			–	–	–	–	●	–
C		100	–	●	–	●	–	–
D			–	–	–	–	–	●
A	High	10	●	–	●	–	–	–
B			–	–	–	–	●	–
C		100	–	●	–	●	–	–
D			–	–	–	–	–	●

■ Low range calibration

Step A: Calibration of the offsets of internal reference voltage for output setting and measured value

1. Connect a shunt resistor that matches the value corresponding to 10 % of the low range full scale.

2. Press the ▼ or ▲ CURSOR key to select the calibration number "1. CC (Low)".

3. Connect a CV power supply to the load input terminal and apply 5 V. Set the current of the power supply approximately in the range of 2 % to 5 % of the rated current of the load device.

4. Press the ENTER key.

   The load automatically turns on, and the offset calibration (CC (Low) Offset Adjustment) screen appears.
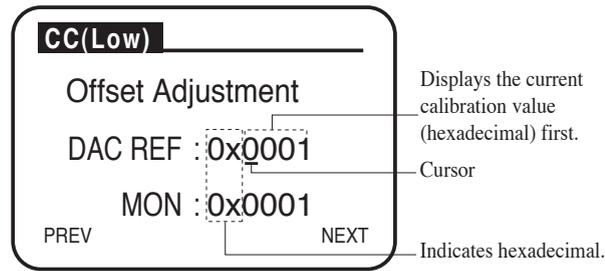
Fig. 8-7   CC (Low) Offset Adjustment screen

5. Press the ◄ or ► CURSOR key to select DAC REF, and turn the rotary knob. Set the current flowing through the shunt resistor within ±0.1 % of the value corresponding to 10 % of the range full scale.

    MON is automatically set as the offset of the measured value.

    See Fig. 8-3 for the current settings of each model.

The calibration for this item is complete. Continue to step B.

Step B: Calibration of the offset of the internal reference voltage for protection function setting

6. Press the ENTER key.

    The offset calibration (CC (Low) Limit Offs Adjust) screen appears.

7. Press the ◄ or ► CURSOR key to select DAC LIM, and turn the rotary knob. Set the current flowing through the shunt resistor within ±0.1 % of the value corresponding to 10 % of the range full scale.

    See Table 8-3 for the current settings of each model.

8. Press the ENTER key.

    The load is automatically turned off.

The calibration for this item is complete. Continue to step C.

Step C: Calibration of the gains of internal reference voltage for output setting and measured value

9. Connect a shunt resistor that matches the value corresponding to 100 % of the low range full scale.

10. Press the ENTER key.

    The load automatically turns on, and the gain calibration (CC (Low) Gain Adjustment) screen appears.

11. Press the ◄ or ► CURSOR key to select DAC REF, and turn the rotary knob. Set the current flowing through the shunt resistor within 0.1 % of the value corresponding to 100 % of the range full scale.

    MON is automatically set as the gain of the measured value.

    See Table 8-3 for the current settings of each model.

The calibration for this item is complete. Continue to step D.

Step D: Calibration of the gain of the internal reference voltage for protection function setting

12. Press the ENTER key.

    The gain calibration (CC (Low) Limit Gain Adjust) screen appears.

13. Press the ◄ or ► CURSOR key to select DAC LIM, and turn the rotary knob. Set the current flowing through the shunt resistor within ±0.1 % of the value corresponding to 100 % of the range full scale.

    See Table 8-3 for the current settings of each model.

14. Press the ENTER key.

    The load is automatically turned off.

    The calibration of the low range current is complete.

■ Mid range calibration

15. Return to number 1 of step A and calibrate the mid range (calibration number "2. CC (Mid)") by carrying out a similar procedure.

■ High range calibration

16. Return to number 1 of step A again and calibrate the High range (calibration number "3. CC (High")) by carrying out a similar procedure.

    Step 16 completes the CC mode calibration.

Table 8-3   CC mode settings

Calibration number and item			Output setting of the power supply	Current to be matched			
				PLZ164W PLZ164WA	PLZ334W	PLZ664WA	PLZ1004W
1	CC(Low)	Offset		33 mA ±0.033 mA	66 mA ±0.066 mA	132 mA ±0.13 mA	200 mA ±0.20 mA
		Gain		330 mA ±0.33 mA	660 mA ±0.66 mA	1.32 A ±0.013 A	2.00 A ±0.020A
2	CC(Mid)	Offset	Voltage: 5 V	330 mA ±0.33 mA	660 mA ±0.66 mA	1.32 A ±0.013 A	2.00 A ±0.020A
		Gain	Current: Rated current of the load device	3.3 A ±0.0033 A	6.6 A ±0.0066 A	13.2 A ±0.013 A	20.0 A ±0.020 A
3	CC(High)	Offset		3.3 A ±0.0033 A	6.6 A ±0.0066 A	13.2 A ±0.013 A	20.0 A ±0.020 A
		Gain		33.0 A ±0.033 A	66.0 A ±0.066 A	132.0 A ±0.132 A	200.0 A ±0.200 A

CV mode calibration (calibration number 4 and 5)

Carry out calibration on the 15-V range items first according to steps E to H. Then, carry out calibration on the 150-V range items.

The shunt resistor is not used, but you can leave it connected.

Table 8-4　Overview of the procedure

Procedure	Voltage range	Percentage with respect to the full scale (%)	Calibration item					
			Internal reference voltage for output setting		Measured value		Internal reference voltage for protection function setting	
			Offset	Gain	Offset	Gain	Offset	Gain
E	15V	10	●	–	●	–	–	–
F			–	–	–	–	●	–
G		100	–	●	–	●	–	–
H			–	–	–	–	–	●
E	150V	10	●	–	●	–	–	–
F			–	–	–	–	●	–
G		100	–	●	–	●	–	–
H			–	–	–	–	–	●

■ Low range calibration

Step E:　Calibration of the offsets of internal reference voltage for output setting and measured value

1. Press the ▼ or ▲ CURSOR key to select the calibration number "4. CV 15V".

2. Connect a CC power supply to the load input terminal and supply 0.3 A. Set the voltage of the power supply to 15.5 V or greater.

3. Press the ENTER key.

   The load automatically turns on, and the offset calibration (CV 15V Offset Adjustment) screen appears.
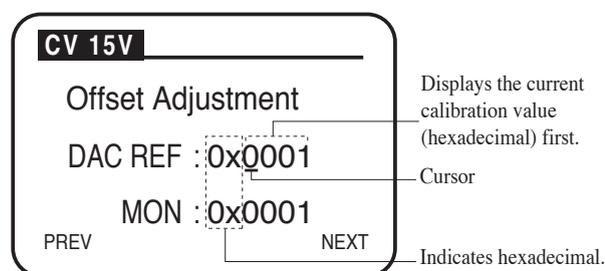
Fig. 8-8　　CV 15V Offset Adjustment screen

4. Press the ◄ or ► CURSOR key to select DAC REF, and turn the rotary knob. Monitor the input voltage on an external voltmeter, and set the input voltage within ±0.05 % of the value corresponding to 10 % of the range full scale.

   MON is automatically set as the offset of the measured value.

   See Table 8-5 and set the input voltage.

The calibration for this item is complete. Continue to step F.

Step F: Calibration of the offset of the internal reference voltage for protection function setting

5. Press the ENTER key.

   The offset calibration (CV 15V Limit Offs Adjust) screen appears.

6. Press the ◄ or ► CURSOR key to select DAC LIM, and turn the rotary knob. Monitor the input voltage on an external voltmeter, and set the input voltage within ±0.05 % of the value corresponding to 10 % of the range full scale.

   See Table 8-5 and set the input voltage.

7. Press the ENTER key.

   The load is automatically turned off.

The calibration for this item is complete. Continue to step G.

Step G: Calibration of the gains of internal reference voltage for output setting and measured value

8. Press the ENTER key.

   The load automatically turns on, and the gain calibration (CV 15V Gain Adjustment) screen appears.

9. Press the ◄ or ► CURSOR key to select DAC REF, and turn the rotary knob. Monitor the input voltage on an external voltmeter, and set the input voltage within 0.05 % of the value corresponding to 100 % of the range full scale.

   MON is automatically set as the gain of the measured value.

   See Table 8-5 and set the input voltage.

The calibration for this item is complete. Continue to step H.

Step H: Calibration of the gain of the internal reference voltage for protection function setting

10. Press the ENTER key.

    The gain calibration (CV 15V Limit Gain Adjust) screen appears.

11. Press the ◄ or ► CURSOR key to select DAC REF, and turn the rotary knob. Monitor the input voltage on an external voltmeter, and set the input voltage within 0.05 % of the value corresponding to 100 % of the range full scale.

    See Table 8-5 and set the input voltage.

12. Press the ENTER key.

    The load is automatically turned off.

The calibration of the low range voltage is complete.

■ High range calibration

13. Return to number 1 of step E and calibrate the High range (calibration number "5. CV 150V") by carrying out a similar procedure. Set the voltage of the power supply to 155 V or greater.

Step 12 completes the CV mode calibration.

Table 8-5   CV mode settings

Calibration number and item			Output setting of the power supply	Voltage to be matched
4	CV 15V	Offset	Offset Voltage: 15.5 V Current: 0.3 A	1.50 V ±0.00075 V
		Gain		15.0 V ±0.0075 V
5	CV 150V	Offset	Voltage: 155 V Current: 0.3 A	15.0 V ±0.0075 V
		Gain		150 V ±0.075 V

Exiting from the calibration screen.

1. Press the PREV (SHIFT+ ◄) key.

   The original screen displayed before entering calibration appears.

2. Press the MENU (SHIFT+SET/VSET) key.

   The original screen displayed before entering menu setup appears.

NOTE

• If you press the NEXT (SHIFT+ ►) key or ENTER key on the gain calibration screen, the calibration data is written to the internal memory.
If you only wish to check the calibration data, be sure to exit from the gain calibration screen by pressing the PREV (SHIFT+ ◄) key or MENU (SHIFT+SET/VSET) key.

8.4　Malfunctions and Causes

This section describes remedies for malfunctions encountered during the use of the PLZ-4W. Representative symptoms and their possible check items are indicated. Look for the item that corresponds to your case. In some cases, the problem can be solved quite easily.

If you find an item that corresponds to your case, follow the remedy for the item. If the remedy does not solve the problem or if your case does not match any of the items, contact your Kikusui agent.

Symptom 1: Nothing appears on the display when the POWER switch is turned on.

Check Item		Possible Cause	Remedy
Location and Status of the Object	Check Result		
Is rated voltage applied for the input power supply (AC)?	No	Broken power cord Bad connection at the AC INPUT connector on the rear panel	Check that the power cord is not broken and that the connection at the AC INPUT connector is secure.
	Yes	Malfunction	Remove the power cord plug from the outlet. Immediately stop the use of the instrument and request repairs.

Symptom 2: The display is dark.

Check Item		Possible Cause	Remedy
Location and Status of the Object	Check Result		
Is rated voltage applied for the input power supply (AC)?	No	Low supply voltage	Use the PLZ-4W in the input supply voltage range.
	Yes	Bad contrast adjustment	Adjust the contrast. See section 2.6, "Turning on The Power."

Symptom 3: Keys do not work.

Check Item		Possible Cause	Remedy
Location and Status of the Object	Check Result		
Is key lock mode enabled?	Yes	Key lock is enabled.	Release the key lock. See section 5.11, "Lock Function."
	No	Malfunction	Immediately stop the use of the instrument and request repairs.
Set to slave.	Yes	→	Set to master using menu setup. See section 5.13, "Menu Setup."

Symptom 4: Input current is unstable or oscillates.

Check Item		Possible Cause	Remedy
Location and Status of the Object	Check Result		
Is rated voltage applied for the input power supply (AC)?	No	Low supply voltage	Use the PLZ-4W in the input supply voltage range.
	Yes	Malfunction	Immediately stop the use of the instrument and request repairs.
Is the ALARM illuminated?	Yes	An internal or external error occurred on the PLZ-4W.	Check the alarm type and carry out the appropriate remedy. See section 5.3, "Types of Protection Functions."
Is there a large loop in the load wire?	Yes	→	Twist the wires. See section 2.8, "Load Wiring."
The load wire is long.	Long	→	Change the response (transient response) using menu setup.

Symptom 5: ALARM is activated.

Check Item		Possible Cause	Remedy
Location and Status of the Object	Check Result		
Is the fan stopped?	Yes	Overheat protection tripped.	Immediately stop the use of the instrument and request repairs.
Is the air intake or outlet obstructed?	Yes	Overheat protection tripped. Clogged dust filter	Allow at least 20 cm between the air outlet and the wall. In addition, do not place objects within 20 cm. Clean the dust filter.
Is OCP tripped?	Yes	The OCP setting is small.	Set an appropriate OCP value on the setup screen. See section 5.4, "Setting the Protection Function."
Is OPP tripped?	Yes	The OPP setting is small.	Set an appropriate OPP value on the setup screen. See section 5.4, "Setting the Protection Function."

Symptom 6: The load cannot be turned on.

Check Item		Possible Cause	Remedy
Location and Status of the Object	Check Result		
A sequence is in operation	Yes	→	Wait for the sequence operation to finish. Abort the sequence using the STOP key.
	No	The load on/off logic (Load ON IN) is set to low.	Set Load ON IN to high using menu setup. See section 5.13, "Menu Setup."

Symptom 7: The transmission/reception does not work when you communicate using the program previously used.

Check Item		Remedy
Location and Status of the Object	Check Result	
Is the acknowledge message used?	Yes	There is a case that your program targeted at PLZ-4W ROM version 1.17 or earlier may not work correctly with ROM version 1.18 or later. In that case, change the Ack setting to "ON + ^Q". Precedure of changing 1. Select "1. Configuration" I "3. Interface" I "RS232C" from the menu. 2. Press the ▼CURSOR key several times to select Ack. 3. Press the ENTER key. "ON + ^Q" is selected. It is impossible to select "ON + ^Q" with the rotary knob. To select ON/OFF, press the ENTER key again.

Symptom 8: The setting current is not flowing

Check Item		Possible Cause	Remedy
Location and Status of the Object	Check Result		
Is the LED located inside of the unit illuminated? See the 8.2, "Confirming status of the fuse."	Yes	Fuse blow	Immediately stop the use of the instruments and request for repair service.

9

Chapter 9   Specifications

This chapter lists the electrical and mechanical specifications of the PLZ-4W.

9.1　Electrical Specifications

Unless specified otherwise, the specifications are for the following settings and conditions.
- The warm-up time is 30 minutes (with current flowing).
- After warm-up is complete, the PLZ-4W must be calibrated correctly according to the procedures given in the operation manual in a 23 °C±5 °C environment.
- ** % of set denotes ** % of the input voltage, input current, or input power setting.
- ** % of f.s denotes ** % of the rated input voltage, rated input current, or rated input power.
- **% of rdg represents denotes ** % of the input voltage, input current, or input power reading.

Rating

Model	PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Operating voltage (DC)[*1]	1.5 V – 150 V[*2]			0 V – 150 V[*3]	
Current	33 A	66 A	200 A	33 A	132 A
Power	165 W	330 W	1 000 W	165 W	660 W

*1　Minimum voltage at which the current starts flowing to the PLZ-4W is approximately 0.3 V. For description of the minimum voltage, see "3.3 Operating area of the PLZ-4W".

*2　The minimum operating voltage (including the voltage drop due to the wire inductance component) in switching mode increases by 0.15 V per 1 A/μs at slew rate settings greater than 5 A/μs.

*3　The minimum operating voltage (including the voltage drop due to the wire inductance component) in switching mode increases by 0.3 V per 1 A/μs at slew rate settings greater than 5 A/μs.

CC mode

Model			PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Operating range	Range	H	0 A – 33 A	0 A – 66 A	0 A – 200 A	0 A – 33 A	0 A – 132 A
		M	0 A – 3.3 A	0 A – 6.6 A	0 A – 20 A	0 A – 3.3 A	0 A – 13.2 A
		L	0 A – 330 mA	0 A – 660 mA	0 A – 2 A	0 A – 330 mA	0 A – 1.32 A
Setting range	Range	H	0 A – 34.65 A	0 A – 69.3 A	0 A – 210 A	0 A – 34.65 A	0 A – 138.6 A
		M	0 A – 3.465 A	0 A – 6.93 A	0 A – 21 A	0 A – 3.465 A	0 A – 13.86 A
		L	0 A – 346.5 mA	0 A – 693 mA	0 A – 2.1 A	0 A – 346.5 mA	0 A – 1.386 A
Resolution	Range	H	1 mA	2 mA	10 mA	1 mA	10 mA
		M	0.1 mA	0.2 mA	1 mA	0.1 mA	1 mA
		L	0.01 mA	0.02 mA	0.1 mA	0.01 mA	0.1 mA
Accuracy of setting	Range	H, M	$\pm$(0.2 % of set + 0.1 % of f.s[*1]) + Vin[*2]/500 kΩ				
		L	$\pm$(0.2 % of set + 0.1 % of f.s)				
	Parallel operation		$\pm$(1.2 % of set + 1.1 % of f.s[*3])				
Input voltage variation[*4]	Range	H	2 mA	4 mA	10 mA	2 mA	8 mA
		M	2 mA	4 mA	10 mA	2 mA	8 mA
		L	0.1 mA	0.2 mA	0.6 mA	0.1 mA	0.4 mA
Ripple	rms[*5]		3 mA	5 mA	20 mA[*7]	7.5 mA	30 mA[*7]
	p-p[*6]		30 mA	50 mA	100 mA[*7]	50 mA	200 mA[*7]

*1　Full scale of H range
*2　Vin: Input terminal voltage of Electronic Load
*3　M range applies to the full scale of H range.
*4　When the input voltage is varied from 1.5 V to 150 V at a current of rated power/150 V.
*5　Measurement frequency bandwidth: 10 Hz to 1 MHz
*6　Measurement frequency bandwidth: 10 Hz to 20 MHz
*7　At measurement current of 100 A

CR mode

	Model		PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Operating range[*1]	Range	H	22 S – 400 µS (45.455 mΩ – 2.5 kΩ)	44 S – 800 µS (22.727 mΩ – 1.25 kΩ)	133.332 S – 2.4 mS (7.5 mΩ – 416.666 Ω)	22 S – 400 µS (45.455 mΩ – 2.5 kΩ)	88 S – 1.6 mS (11.363 mΩ – 625 Ω)
		M	2.2 S – 40 µS (454.55 mΩ – 25 kΩ)	4.4 S – 80 µS (227.27 mΩ – 12.5 kΩ)	13.3332 S – 2420 µS (75 mΩ – 4.1666 kΩ)	2.2 S – 40 µS (454.55 mΩ – 25 kΩ)	8.8 S – 160 µS (113.63 mΩ – 6.25 kΩ)
		L	0.22 S – 4 µS (4.545 5 Ω – 250 kΩ)	0.44 S – 8 µS (2.272 7 Ω – 125 kΩ)	1.33332 S – 24 µS (750 mΩ – 41.666 kΩ)	0.22 S – 4 µS (4.545 5 Ω – 250 kΩ)	0.88 S – 16 µS (1.136 3 mΩ – 62.5 kΩ)
Setting range	Range	H	23.1 S – 0 S (43.290 mΩ – OPEN)	46.1 S – 0 S (21.692 mΩ – OPEN)	139.9968 S – 0 S (7.1430 mΩ – OPEN)	23.1 S – 0 S (43.290 mΩ – OPEN)	92.4 S – 0 S (10.822 mΩ – OPEN)
		M	2.31 S – 0 S (432.9 mΩ – OPEN)	4.61 S – 0 S (216.92 mΩ – OPEN)	13.99968 S – 0 S (71.430 mΩ – OPEN)	2.31 S v0 S (432.9 mΩ – OPEN)	9.24 S – 0 S (108.22 mΩ – OPEN)
		L	0.231 S – 0 S (4.329 Ω – OPEN)	0.461 S – 0 S (2.1692 Ω – OPEN)	1.399968 S v0 S (714.30 mΩ – OPEN)	0.231 S – 0 S (4.329 Ω – OPEN)	0.924 S – 0 S (1.0822 Ω – OPEN)
Resolution	Range	H	400 µS	800 µS	2.424 mS	400 µS	1.6 mS
		M	40 µS	80 µS	242.4 µS	40 µS	160 µS
		L	4 µS	8 µS	24.24 µS	4 µS	16 µS
Accuracy of setting[*2]	Range	H, M	±(0.5 % of set[*3] + 0.5 % of f.s[*4]) + Vin[*5]/500 kΩ				
		L	±(0.5 % of set[*3] + 0.5 % of f.s)				

*1 Conductance [S] = Input current [A]/input voltage [V] = 1/resistance [Ω]

*2 Converted value at the input current. At the sensing point. It is not applied for the condition of the parrallel operation.

*3 set = Vin/Rset

*4 Full scale of H range

*5 Vin: Input terminal voltage of Electronic Load

CV mode

	Model		PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Operating range	Range	H	1.5 V – 150 V			0 V – 150 V	
		L	1.5 V – 15 V			0 V – 15 V	
Setting range	Range	H	0 V – 157.5 V				
		L	0 V – 15.75 V				
Resolution	Range	H	10 mV				
		L	1 mV				
Accuracy of setting[*1]	Range	H, L	±(0.1 % of set + 0.1 % of f.s)				
Input current variation[*2]			12 mV				

*1 At the sensing point during remote sensing under the operating range of the input voltage. It is also applied for the condition of the parrallel operation.

*2 With respect to a change in the current of 10 % to 100 % of the rating at an input voltage of 1.5 V (during remote sensing).

CP mode

	Model		PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Operating range	Range	H	16.5 W – 165 W	33 W – 330 W	100 W – 1 000 W	16.5 W – 165 W	66 W – 660 W
		M	1.65 W – 16.5 W	3.3 W – 33 W	10 W – 100 W	1.65 W – 16.5 W	6.6 W – 66 W
		L	0.165 W – 1.65 W	0.33 W – 3.3 W	1 W – 10 W	0.165 W – 1.65 W	0.66 W – 6.6 W
Setting range	Range	H	0 W – 173.25 W	0 W – 346.5 W	0 W – 1 050 W	0 W – 173.25 W	0 W – 693 W
		M	0 W – 17.325 W	0 W – 34.65 W	0 W – 105 W	0 W – 17.325 W	0 W – 69.3 W
		L	0 W – 1.7325 W	0 W – 3.465 W	0 W – 10.5 W	0 W – 1.732 5 W	0 W – 6.93 W
Resolution	Range	H	10 mW	10 mW	100 mW	10 mW	20 mW
		M	1 mW	1 mW	10 mW	1 mW	2 mW
		L	0.1 mW	0.1 mW	1 mW	0.1 mW	0.2 mW
Accuracy of setting[1]			±(0.6 % of set + 1.4 % of f.s[2])				

*1 It is not applied for the condition of the parrallel operation.

*2 M range applies to the full scale of H range.

Voltmeter

	Model		PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Display	Range	H, M	0.00 V – 150.00 V				
		L	0.000 V – 15.000 V				
Accuracy			±(0.1 % of rdg + 0.1 % of f.s)				

Ammeter

	Model		PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Display	Range	H, M	0.000 A – 33.000 A	0.000 A – 66.000 A	0.00 A – 200.00 A	0.000 A – 33.000 A	0.00 A – 132.00 A
		L	0.00 A – 330.00 mA	0.00 A – 660.00 mA	0.0000 A – 2.0000 A	0.00 A – 330.00 mA	0.000 A – 1.3200 A
Accuracy			±(0.2 % of rdg + 0.3 % of f.s)				
	Parallel operation		±(1.2 % of rdg + 1.1 % of f.s)				

Wattmeter

	Model		PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Display[1]	Range	H, M	0.00 W – 165.00 W	0.00 W – 330.00 W	0.0 W – 1000.0 W	0.00 W – 165.00 W	0.00 W – 660.00 W
		L[2]	0.000 W – 49.500 W	0.000 W – 99.000 W	0.00 W – 300.00 W	0.000 W – 49.500 W	0.000 W – 198.00 W
		L[3]	0.0000 W – 1.6500 W	0.0000 W – 3.3000 W	0.000 W – 10.000 W	0.0000 W – 1.6500 W	0.0000 W – 6.6000 W

*1 Displays the product of the voltmeter reading and ammeter reading.

*2 In a mode other the CP mode

*3 In CP mode

Switching mode

Model	PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Operation mode	CC and CR				
Duty cycle setting	5 % – 95 %[*1], 0.1 % step				
Selectable frequency range	1 Hz – 20 kHz				
Frequency resolution — 1 Hz – 10 Hz	0.1 Hz				
Frequency resolution — 10 Hz – 100 Hz	1 Hz				
Frequency resolution — 100 Hz – 1 kHz	10 Hz				
Frequency resolution — 1 kHz – 20 kHz	100 Hz				
Frequency accuracy of setting	±(0.5 % of set)				

*1 The minimum time width is 10 μs. Between 5 kHz and 20 kHz, the maximum duty cycle is limited by the minimum time width.

Slew rate

Model			PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Setting range[*1]	Range	H	2.5 mA/μs – 2.5 A/μs	5 mA/μs – 5 A/μs	16 mA/μs – 16 A/μs	2.5 mA/μs – 2.5 A/μs	10 mA/μs – 10 A/μs
		M	250 μA/μs – 250 mA/μs	500 μA/μs – 500 mA/μs	1.6 mA/μs – 1.6 A/μs	250 μA/μs – 250 mA/μs	1 mA/μs – 1 A/μs
		L	25 μA/μs – 25 mA/μs	50 μA/μs – 50 mA/μs	160 μA/μs – 160 mA/μs	25 μA/μs – 25 mA/μs	100 μA/μs – 100 mA/μs
Resolution			See below.				
Accuracy of setting[*2]			±(10 % of set + 5 μs)				

*1 In CC mode. The maximum slew rate of each range is 1/10th the value in CR mode.

*2 Time to reach from 10 % to 90 % when the current is varied from 2 % to 100 % (20 % to 100 % in M range) of the rated current.

Slew rate resolution

Model						
PLZ164W PLZ164WA	Setting	25 μA/μs – 250 μA/μs	250 μA/μs – 2.5 mA/μs	2.5 mA/μs – 25 mA/μs	25 mA/μs – 250 mA/μs	250 mA/μs – 2.5 A/μs
	Resolution	100 nA	1 μA	10 μA	100 μA	1 mA
PLZ334W	Setting	50 μA/μs – 500 μA/μs	500 μA/μs – 5 mA/μs	5 mA/μs – 50 mA/μs	50 mA/μs – 500 mA/μs	500 mA/μs – 5 A/μs
	Resolution	200 nA	2 μA	20 μA	200 μA	2 mA
PLZ664WA	Setting	100 μA/μs – 1 mA/μs	1 mA/μs – 10 mA/μs	10 mA/μs – 100 mA/μs	100 mA/μs – 1 A/μs	1 A/μs – 10 A/μs
	Resolution	400 nA	4 μA	40 μA	400 μA	4 mA
PLZ1004W	Setting	160 μA/μs – 1.6 mA/μs	1.6 mA/μs – 16 mA/μs	16 mA/μs – 160 mA/μs	160 mA/μs – 1.6 A/μs	1.6 A/μs – 16 A/μs
	Resolution	600 nA	6 μA	60 μA	600 μA	6 mA

Soft start

Model	PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Operation mode	CC and CR				
Selectable time range	1, 2, 5, 10, 20, 50, 100, or 200 ms				
Time accuracy	±(30 % of set +100 μs)				

Remote sensing

Model	PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Voltage that can be compensated	2 V for a single line				

Protection function

Model	PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Overvoltage protection (OVP)	Turns off the load at 110 % of the rated voltage				
Overcurrent protection (OCP)	0.03 A – 36.3 A	0.06 A – 72.6 A	0.2 A – 220 A	0.03 A – 36.3 A	0.13 A – 145.2 A
	Or 110 % of the maximum current of each range				
	Load off or limit selectable				
Overpower protection (OPP)	0.1 W – 181.5 W	0.3 W – 363 W	1 W – 1 100 W	0.1 W – 181.5 W	0.6 W – 726 W
	Or 110 % of the maximum power of each range				
	Load off or limit selectable				
Overheat protection (OHP)	Turns off the load when the heat sink temperature reaches 95 °C				
Undervoltage protection (UVP)	Turns off the load when detected.				
	Can be set in the range of 0 V to 150 V or Off.				
Reverse connection protection (REV)	By diode and fuse. Turns off the load when an alarm occurs.				

Sequence function

Model		PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Normal sequence	Operation mode	CC, CR, CV, or CP				
	Maximum number of steps	256				
	Step execution time	1 ms – 999 h 59 min				
	Time resolution	1 ms (1 ms – 1 min) 100 ms (1 min – 1 h) 1 s (1 h – 10 h) 10 s (10 h – 100 h) 1 min (100 h – 999 h 59 min)				
Fast sequence	Operation mode	CC or CR				
	Maximum number of steps	1024				
	Step execution time	25 µs – 100 ms				
	Time resolution	25 µs (25 µs – 100 µs) 100 µs (100 µs – 100 ms)				

Others

Model	PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Elapsed time display	Measures the time from load on to load off. On/Off selectable.				
	Measures from 1 s up to 999 h 59 min 59 s				
Auto load off timer	Automatically turns off the load after a specified time elapses.				
	Can be set in the range of 1 s to 999 h 59 min 59 s or off				

Common specifications

Analog external control

Load on/off control input	Turn on the load with low (or high) TTL level signal
Load on status output	On when the load is on (open collector output by a photocoupler)
Range switch input	Switch ranges L, M, and H using a 2-bit signal
Range status output	Outputs range L, M, or H using 2-bit signal (open collector output by a photocoupler)
Trigger input	Clear the sequence operation pause with a high TTL level signal for 10 μs or more.
Alarm input	Activate alarm with low TTL level signal input
Alarm status output	On when OVP, OCP, OPP, OHP, UVP, REV, or when an external alarm input is applied (open collector output by a photocoupler)
Short signal output	Relay contact output (30 VDC/1 A)
External voltage control	Operates in CC, CR, CP, or CV mode 0 V to 10 V correspond to 0 % to 100 % of the rated current (CC mode), rated voltage (CV mode), or rated power (CP mode). 0 V to 10 V correspond to maximum resistance to minimum resistance (CR mode)
External resistance control	Operates in CC, CR, CP, or CV mode 0 Ω to 10 kΩ correspond to 0 % to 100 % or 100 % to 0 % of the rated current (CC mode), rated voltage (CV mode), or rated power (CP mode). 0 Ω to 10 kΩ correspond to maximum resistance to minimum resistance or minimum resistance to maximum resistance (CR mode)
Current monitor output	10 V f.s (H or L range) and 1 V f.s (M range)
Parallel operation input	Signal input for one-control parallel operation
Parallel operation output	Signal output for one-control parallel operation
Load booster power supply control	Power on/off control signal for the load booster

Front panel BNC connector

TRIG OUT	Trigger output: Approx. 4.5 V, pulse width: Approx. 2 μs, output impedance: Approx. 500 Ω Outputs a pulse during sequence operation and switching operation.
I MON OUT	Current monitor output 1 V f.s (H or L range) and 0.1 V f.s (M range)

Communication function

GPIB	IEEE std. 488.1-1987 SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E1
	Supports the SCPI and IEEE std. 488.2-1992 command set Sets panel functions except the power switch and reads measured values
RS-232C	D-SUB 9-pin connector (conforms to EIA-232-D)
	Sets panel functions except the power switch and reads measured values Supports the SCPI and IEEE std. 488.2-1992 command set Baud rate: 2400, 4800, 9600, 19200 bps Data length: 8-bit, Stop bit: 1, 2-bit, Parity bit: None, Flow control: Xon/Xoff
USB	Conforms to USB 2.0 Specifications and USBTMC-USB488 Device Class Specifications
	Sets panel functions except the power switch and reads measured values Communication speed 12 Mbps (Full speed)

9.2　General Specifications

Model	PLZ164W	PLZ334W	PLZ1004W	PLZ164WA	PLZ664WA
Input voltage range	100 VAC – 240 VAC (90 VAC – 250 VAC) Single phase, continuous			100 VAC – 120 VAC /200 VAC – 240 VAC (90 VAC – 132 VAC /180 VAC – 250 VAC) Single phase	
Input frequency range	47 Hz – 63 Hz				
Power consumption	80 VAmax	90 VAmax	160 VAmax	450 VAmax	1 500 VAmax[*1]
Inrush current	45 A			80 A	
Operating temperature range	0 °C – 40 °C				
Operating humidity range	20 % - 85 % RH (without condensation)				
Storage temperature range	-25 °C – 70 °C				
Storage humidity range	90 % RH or less (without condensation)				
Isolation voltage	±500 V				
Insulation resistance — Primary - input terminal	500 VDC, 30 MΩ or more (ambient humidity of 70 % RH or less)				
Insulation resistance — Primary - chassis	500 VDC, 30 MΩ or more (ambient humidity of 70 % RH or less)				
Withstand voltage — Primary - input terminal	No abnormalities at 1 500 VAC for 1 minute.				
Withstand voltage — Primary - chassis	No abnormalities at 1 500 VAC for 1 minute.				
Dimensions (mm)	See outline drawing				
Weight	Approx. 7 kg	Approx. 8 kg	Approx. 15 kg	Approx. 7.5 kg	Approx. 16 kg
Battery backup	Backs up setup information				
Accessories — Power cord	1 pc. (with plug, Length: approx. 2.4 m)				
Accessories — Load input terminal cover	1 piece 2 lock plates provided				
Accessories — Set of screws for the load input terminal	2 sets (bolts, nuts, and spring washers)				
Accessories — Operation manual	1 copy				
Electromagnetic compatibility (EMC)[*2]	Complies with the requirements of the following directive and standards. EMC Directive 89/336/EEC EN 61326 EN 61000-3-2 EN 61000-3-3 Under following condition. The maximum length of all connecting cables and wires to the PLZ-4W series are less than 3 m.				
Safety[*2,*3]	Complies with the requirements of the following directive and standard. Low Voltage Directive 73/23/EEC EN 61010-1 Class I Pollution degree 2				

*1.　900 VA when input voltage is 100 VAC.
*2.　Only on models that have CE marking on the panel.
　　 Not applicable to custom order models.
*3.　This instrument is a Class I equipment. Be sure to ground the protective conductor terminal of the instrument.
　　 The safety of the instrument is not guaranteed unless the instrument is grounded properly.

9.3   Dimensions
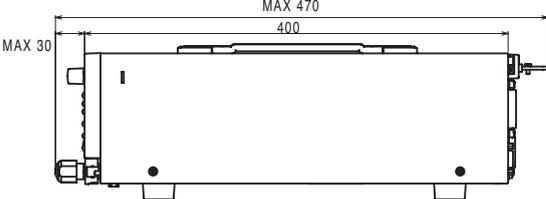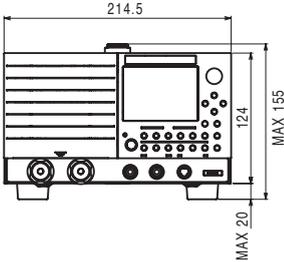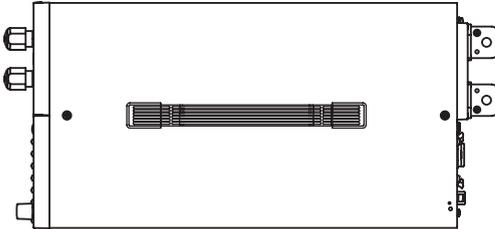
Fig.9-1   Outline drawing (PLZ164W, PLZ164WA, and PLZ334W)
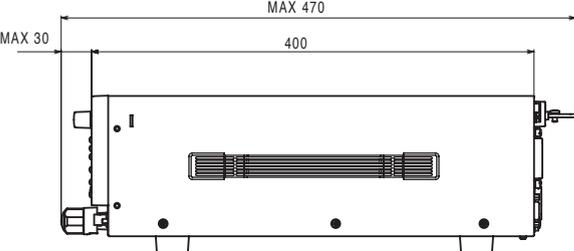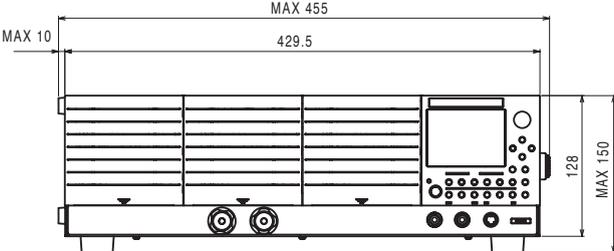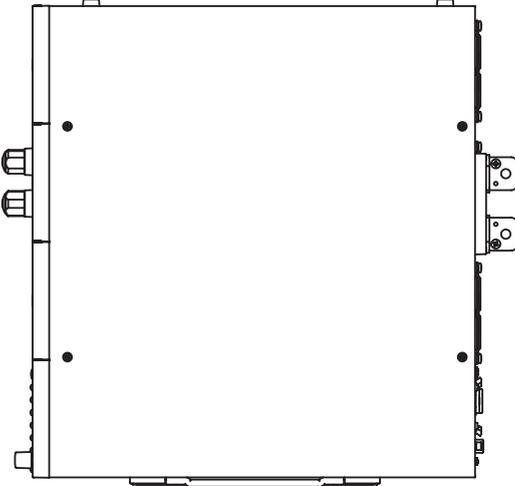
Fig. 9-2   Outline drawing (PLZ664WA and PLZ1004W)

Appendix

The appendices cover the operating area of the PLZ-4W, the basic operation modes, sequence program creation table, SCPI command reference, and error messages.

A.1   Operating Area of the PLZ-4W

As shown in Fig. A-1, the PLZ-4W can be used within the area enclosed by the constant voltage line according to the rated voltage (L1), the constant power line according to the rated power (L2), the constant current line according to the rated current (L3), and the constant voltage line according to the minimum operating voltage (L4) (operating area where specifications are guaranteed). For PLZ-4Ws with the minimum operating voltage of 0 V, the specifications are guaranteed at input voltages at 0 V and greater. For 1.5 V input types, the specifications are guaranteed at input voltages of 1.5 V and greater. If the current is decreased, these types can be used even at voltages lower than 1.5 V (actual operating area). However, the specifications are not guaranteed.

For the operating areas of each individual model, see appendix A.3, "Operating Area of Each Model."
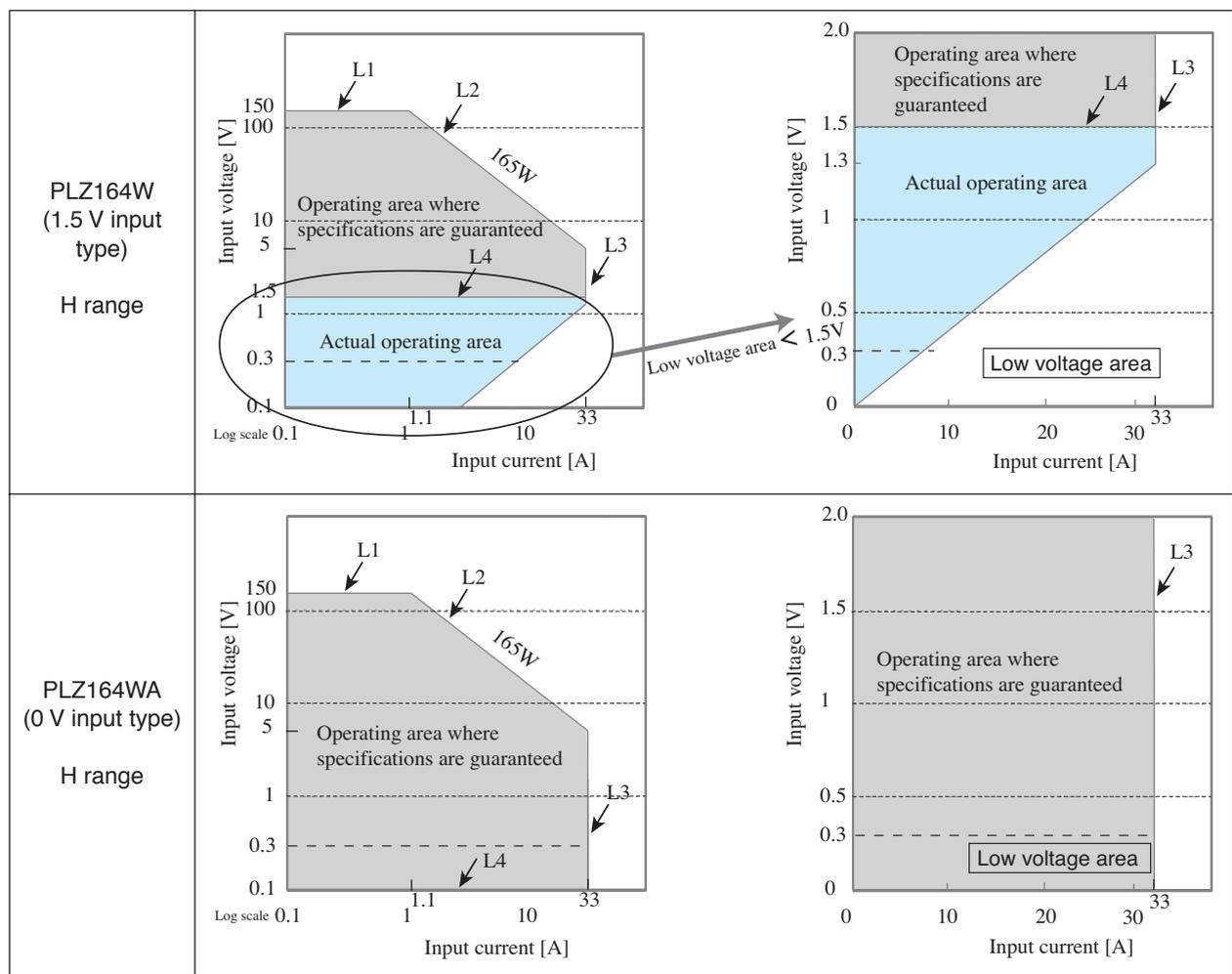
Fig.A-1   Operating area

A.2 Basic Operation Modes

The following six operation modes are available on the PLZ-4W.

1. Constant current mode (CC mode)
2. Constant resistance mode (CR mode)
3. Constant power mode (CP mode)
4. Constant voltage mode (CV mode)
5. Constant current and constant voltage mode (CC+CV mode)
6. Constant resistance and constant voltage mode (CR+CV mode)

A.2.1 Operation of the CC Mode

In CC mode, the current is kept constant even when the voltage changes.

■ CC mode operation

When the PLZ-4W is used in CC mode, the PLZ-4W operates as a constant current load as shown in Fig. A-2. The PLZ-4W sinks the specified current (I) independent of the output voltage of the constant-voltage power supply (V1).
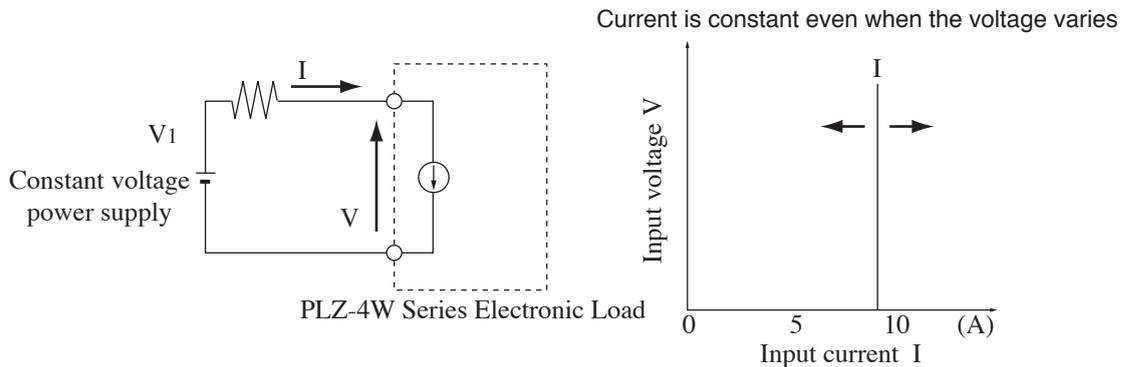
Fig. A-2   Equivalent circuit of the constant current load and operation

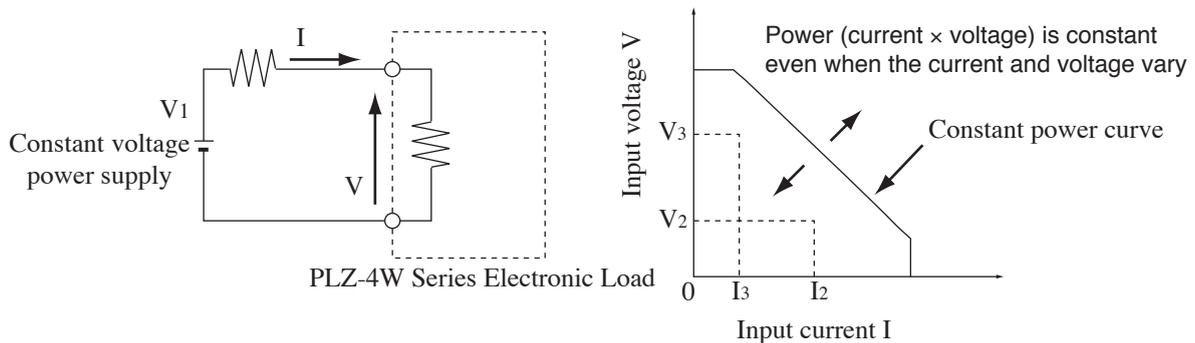### ■ Transition of the operating point: Overpower protection (OPP)

We will consider the case when checking the load characteristics of the constant-voltage power supply of Fig. A-3 using CC mode.
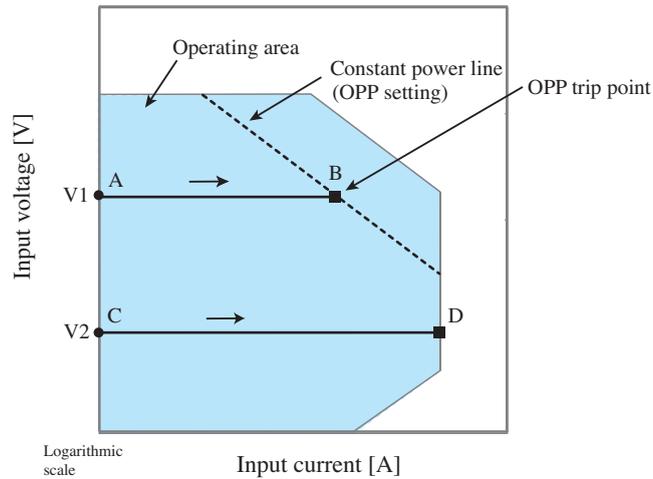
Fig. A-3   Transition of the operating point in CC mode (OPP trip point)

Fig. A-3: Operation on segment AB

If the voltage of the constant-voltage power supply is set to V1 and the input current (load current) of the PLZ-4W is increased, the operating point moves along segment AB.

When point B is reached, overpower protection (OPP) trips. At this point, two types of operation are available on the PLZ-4W depending on the protection action setting of the OPP.

If Protect Action is set to LOAD OFF, the load is turned off.

If protection action is set to LIMIT, the PLZ-4W sinks current as a constant power load at point B. Even if you attempt to increase the input current, the current is limited at point B. If you decrease the input current, the OPP is cleared. The PLZ-4W returns to CC mode, and the operating point moves along segment AB.

TableA-1   OPP action (protect action)

Point B	LOAD OFF	Turns off the load (stops the current flow). The PLZ-4W no longer operates as a load.
	LIMIT	CC mode ends. OPP continues, and the PLZ-4W sinks current as a constant power load.

Fig. A-3: Operation on segment CD

If the voltage of the constant-voltage power supply is set to V2 and the input current (load current) of the PLZ-4W is increased, the operating point moves along segment CD. Point D is the maximum current at the range being used.

A.2.2　Operation of the CR Mode

In CR mode, the PLZ-4W sinks current proportional to the voltage variation.

■ CR mode operation

When the PLZ-4W is used in CR mode, the PLZ-4W operates as a resistive load as shown in Fig. A-4. When the voltage (V1) of the constant-voltage power supply is varied, the PLZ-4W sinks current to meet I=V/R according to the specified resistance R.
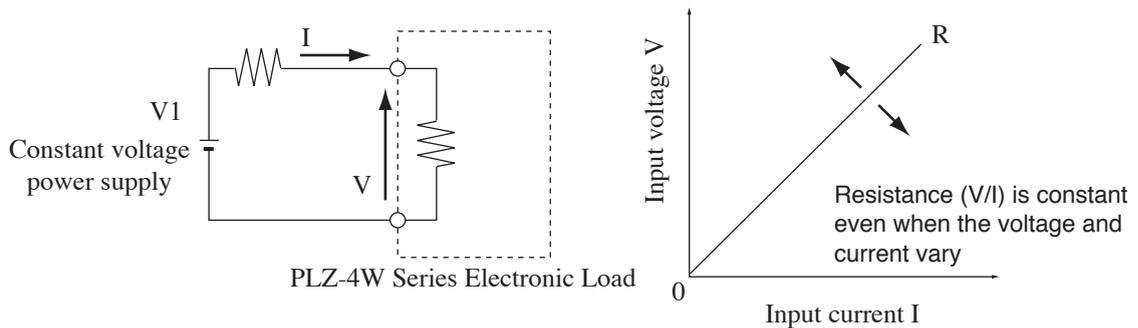
Fig. A-4　Equivalent circuit of the constant resistance load and operation

■ Transition of the operating point: Overpower protection (OPP)

We will consider the case when checking the load characteristics of the constant-voltage power supply of Fig. A-4 using CR mode.
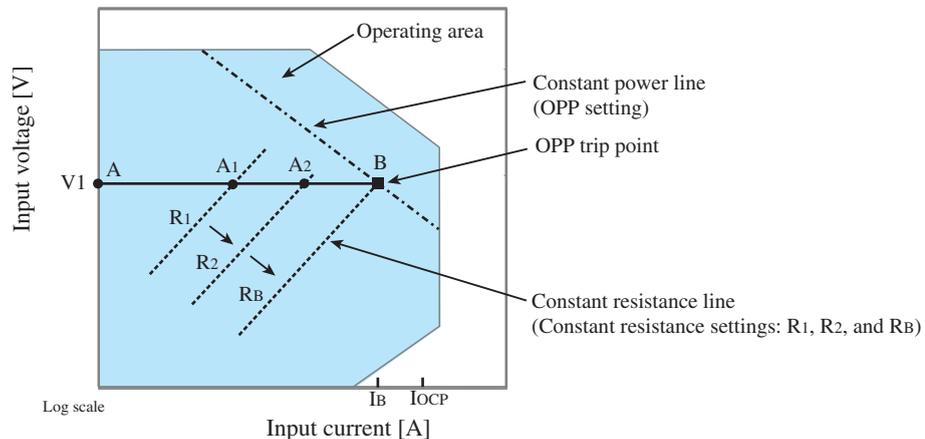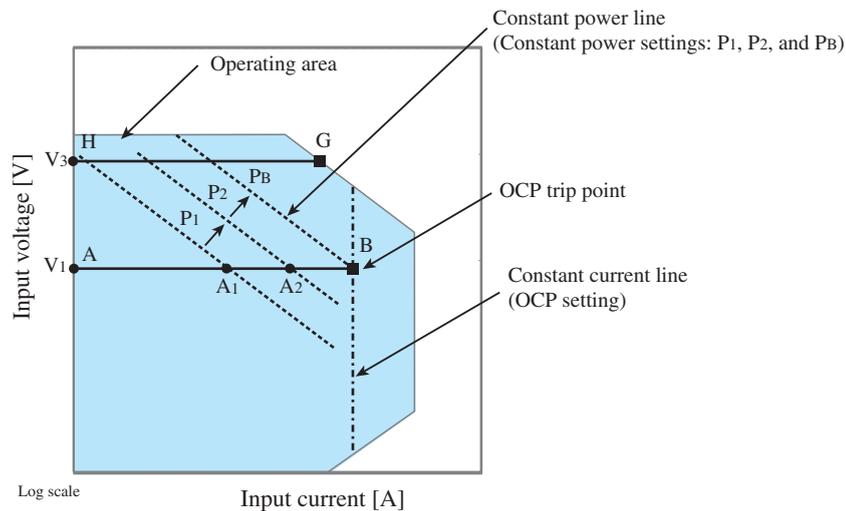
Fig. A-5　Transition of the operating point in CR mode (OPP trip point)

If the overcurrent protection (OCP) setting I_{OCP} is greater than the current value I_B at point B, when the PLZ-4W resistance is decreased ($R_1 \rightarrow R_2 \rightarrow R_B$) and the input current (load current) is increased with the voltage of the constant-voltage power supply at V1, the operating point moves along segment AB ($A_1 \rightarrow A_2 \rightarrow B$). When point B is reached, overpower protection (OPP) trips.

At this point, two types of operation are available on the PLZ-4W depending on the protection action setting of the OPP.

If Protect Action is set to LOAD OFF, the load is turned off.

If protection action is set to LIMIT, the PLZ-4W sinks current as a constant power load at point B. Even if you attempt to increase the input current by decreasing the resistance, the current is limited at point B. If you decrease the input current by increasing the resistance, the OPP is cleared. The PLZ-4W returns to CR mode, and the operating point moves along segment AB.

Table A-2   OPP action (protect action)

Point B	LOAD OFF	Turns off the load (stops the current flow). The PLZ-4W no longer operates as a load.
	LIMIT	CR mode ends. OPP continues, and the PLZ-4W sinks current as a constant power load.

■ Transition of the operating point: Overcurrent protection (OCP)
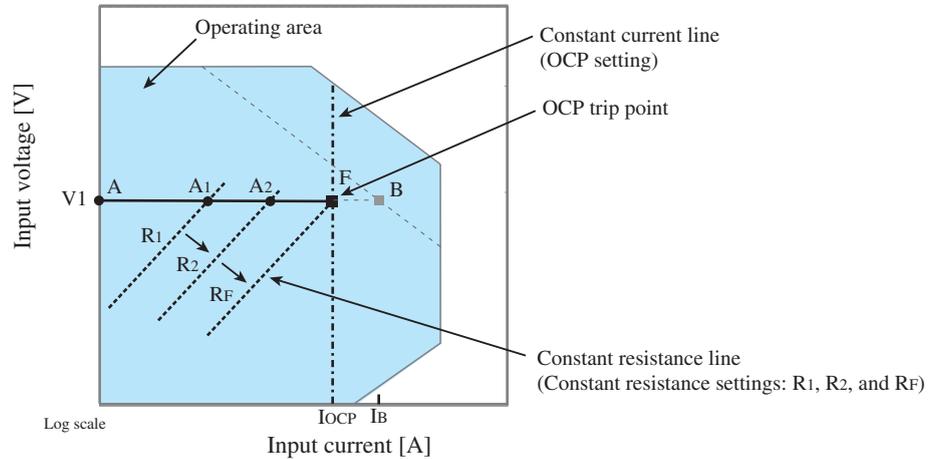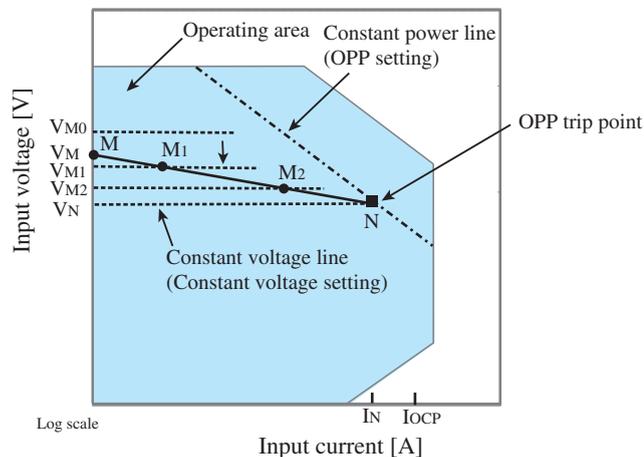

Fig. A-6   Transition of the operating point in CR mode (OCP trip point)

If the overcurrent protection (OCP) setting I_{OCP} is less than the current value I_B at point B, when the PLZ-4W resistance is decreased ($R_1 \rightarrow R_2 \rightarrow R_F$) and the input current (load current) is increased with the voltage of the constant-voltage power supply at V1, the operating point moves along segment AF ($A_1 \rightarrow A_2 \rightarrow F$). When point F is reached, overcurrent protection (OCP) trips.

At this point, two types of operation are available on the PLZ-4W depending on the protection action setting of the OCP.

If Protect Action is set to LOAD OFF, the load is turned off.

If protection action is set to LIMIT, the PLZ-4W sinks current as a constant current load at point F. Even if you attempt to increase the input current by decreasing the resistance, the current is limited at point F. If you decrease the input current by increasing the resistance, the OCP is cleared. The PLZ-4W returns to CR mode, and the operating point moves along segment AF.

Table A-3   OCP action (protect action)

Point F	LOAD OFF	Turns off the load (stops the current flow). The PLZ-4W no longer operates as a load.
	LIMIT	CR mode ends. OCP continues, and the PLZ-4W sinks current as a constant current load.

A.2.3 Operation of the CP Mode

In CP mode, the PLZ-4W sinks current so that the power consumed inside the electonic load is constant.

■ CP mode operation

When the PLZ-4W is used in CP mode, the PLZ-4W operates as a constant power load as shown in Fig. A-7. When the voltage (V1) of the constant-voltage power supply increases the input current (I) decreases so that the power consumed by the PLZ-4W $P = V \times I$ is kept constant. In Fig. A-7, $P = V2 \times I2 = V3 \times I3$.

Fig. A-7   Equivalent circuit of the CP mode and operation

■ Transition of the operating point: Overcurrent protection (OCP)

We will consider the case when checking the load characteristics of the constant-voltage power supply of Fig. A-7 using CP mode.

Fig. A-8   Transition of the operating point in CP mode (OCP trip point)

Fig. A-8: Operation on segment AB

If the voltage of the constant-voltage power supply is set to V1 and the power of the PLZ-4W is increased ($P_1 \rightarrow P_2 \rightarrow P_B$), the operating point moves along segment AB ($A_1 \rightarrow A_2 \rightarrow B$).

When point B is reached, overcurrent protection (OCP) trips. At this point, two types of operation are available on the PLZ-4W depending on the protection action setting of the OCP.

If Protect Action is set to LOAD OFF, the load is turned off.

If protection action is set to LIMIT, the PLZ-4W sinks current as a constant current load at point B. Even if you attempt to increase the input current, the current is limited at point B. If you decrease the input current, the OCP is cleared. The PLZ-4W returns to CP mode, and the operating point moves along segment AB.

Table A-4   OCP action (protect action)

Point B	LOAD OFF	Turns off the load (stops the current flow). The PLZ-4W no longer operates as a load.
	LIMIT	CP mode ends. OCP continues, and the PLZ-4W sinks current as a constant current load.

Fig. A-8: Operation on segment GH

If the voltage of the constant-voltage power supply is set to V3 and the power of the PLZ-4W is increased ($P_1 \rightarrow P_2 \rightarrow P_B$), the operating point moves along segment GH. Point G is the maximum power at the range being used.

A.2.4 Operation of the CV Mode

In CV mode, the PLZ-4W sinks current so that the voltage at the load input end of the PLZ-4W is constant.

■ CV mode operation

When the PLZ-4W is used in CV mode, the PLZ-4W operates as a constant voltage load (shunt regulator) as shown in Fig. A-9. When V1 is greater than V, the input voltage V is kept constant even when the input current I varies. Current does not flow when V1 is less than or equal to V.
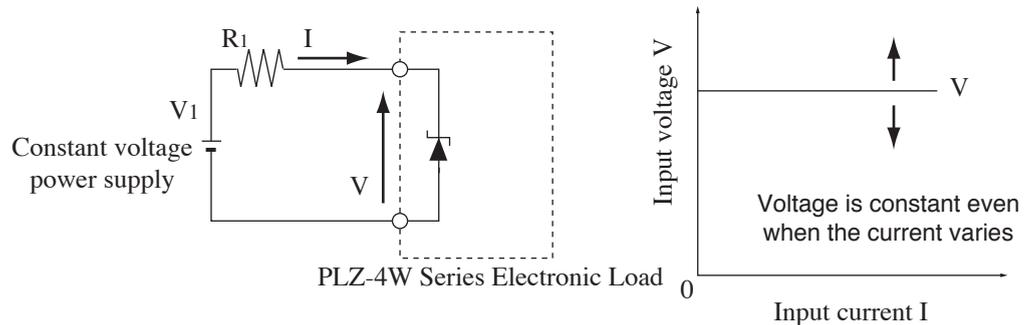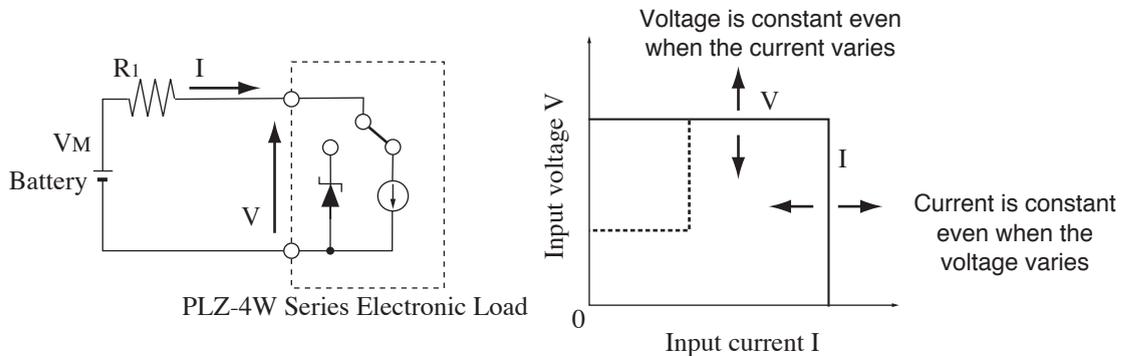
Fig. A-9　Equivalent circuit of the CV mode and operation

■ Transition of the operating point: Overpower protection (OPP)

We will consider the case when checking the load characteristics of the constant-voltage power supply of Fig. A-9 using CV mode.

Fig. A-10　Transition of the operating point in CV mode (OPP trip point)

We assume that the overcurrent protection (OCP) setting I_{OCP} is greater than current I_N at point N and denote the voltage of the constant voltage power supply as V_M. When the voltage of the PLZ-4W is equal to V_{MO} ($V_{MO} > V_M$), no current flows. When the voltage of the PLZ-4W is decreased to a point in which V_{MO} is smaller than V_M, the current starts flowing. If the voltage is decreased further ($V_{M1} \rightarrow V_{M2} \rightarrow V_N$) to increase the input current (load current), the operating point moves along segment MN ($M_1 \rightarrow M_2 \rightarrow N$).

When point N is reached, overpower protection (OPP) trips. At this point, two types of operation are available on the PLZ-4W depending on the protection action setting of the OPP.

If Protect Action is set to LOAD OFF, the load is turned off.

If protection action is set to LIMIT, the PLZ-4W sinks current as a constant power load at point N. Even if you attempt to decrease the voltage, the current is limited at point N. If you increase the voltage, the OPP is cleared. The PLZ-4W returns to CV mode, and the operating point moves along segment MN.

Table A-5   OPP action (protect action)

Point N	LOAD OFF	Turns off the load (stops the current flow). The PLZ-4W no longer operates as a load.
	LIMIT	CV mode ends. OPP continues, and the PLZ-4W sinks current as a constant power load.

■ **Transition of the operating point: Overcurrent protection (OCP)**
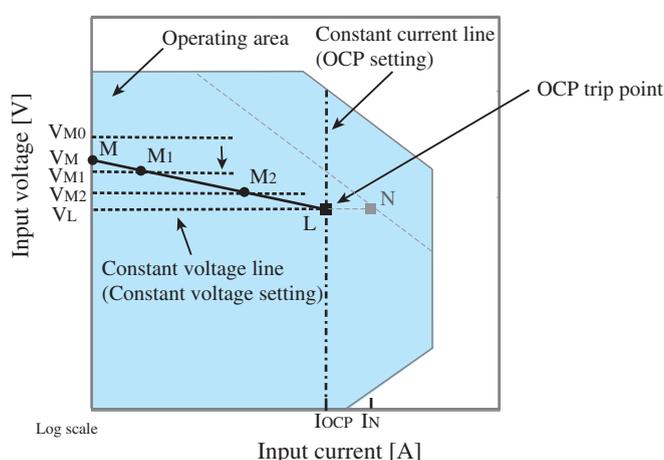
Fig. A-11   Transition of the operating point in CV mode (OCP trip point)

We assume that the overcurrent protection (OCP) setting I_{OCP} is less than current I_N at point N and denote the voltage of the constant voltage power supply as V_M. When the voltage of the PLZ-4W is equal to V_{MO} ($V_{MO} > V_M$), no current flows. When the voltage of the PLZ-4W is decreased to a point in which V_{MO} is smaller than V_M, the current starts flowing. If the voltage is decreased further ($V_{M1} \rightarrow V_{M2} \rightarrow V_L$) to increase the input current (load current), the operating point moves along segment ML ($M_1 \rightarrow M_2 \rightarrow L$).

When point L is reached, overcurrent protection (OCP) trips. At this point, two types of operation are available on the PLZ-4W depending on the protection action setting of the OCP.

If Protect Action is set to LOAD OFF, the load is turned off.

If protection action is set to LIMIT, the PLZ-4W sinks current as a constant current load at point L. Even if you attempt to decrease the voltage, the current is limited at point L. If you increase the voltage, the OCP is cleared. The PLZ-4W returns to CV mode, and the operating point moves along segment ML.

Table A-6   OCP action (protect action)

Point L	LOAD OFF	Turns off the load (stops the current flow). The PLZ-4W no longer operates as a load.
	LIMIT	CV mode ends. OCP continues, and the PLZ-4W sinks current as a constant current load.

A.2.5 Operation of the CC+CV Mode

The PLZ-4W allows you to add CV mode to CC mode.

■ CC+CV mode operation

When the PLZ-4W is used in CC+CV mode, the PLZ-4W operates as a constant current load and a constant voltage load (shunt regulator) as shown in Fig. A-12. When operating as a constant current load, the PLZ-4W sinks the specified current (I) independent of the output voltage of the constant-voltage power supply (V_M). When operating as a constant voltage load and V_M is greater than V, the input voltage V is kept constant even when the input current I varies. Current does not flow when V_M is less than or equal to V.

The switching between the modes is automatic.

Fig. A-12   Equivalent circuit of the CC+CV mode and operation

■ Transition of the operating point: Overpower protection (OPP)

We will consider the case when checking the discharge characteristics of a battery of Fig. A-12.
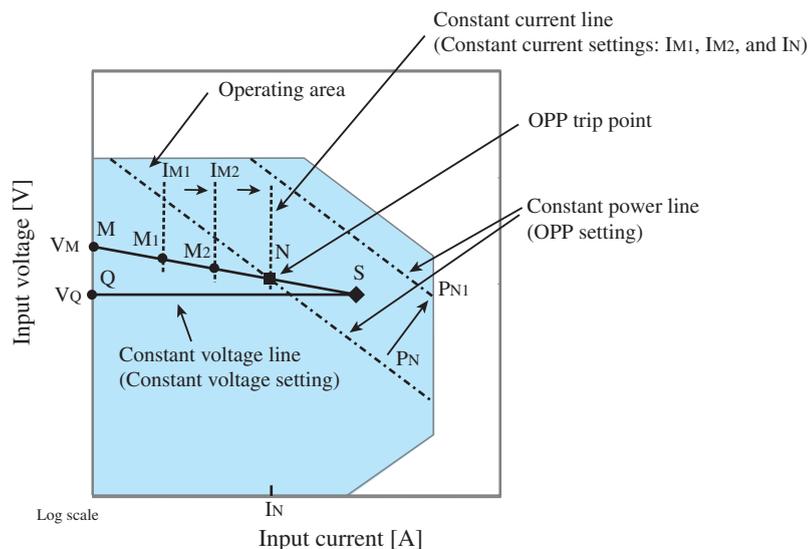
Fig. A-13   Transition of the operating point in CC+CV mode (OPP trip point)

We denote the voltage of the battery as V_M. In CC mode, if the current is increased ($I_{M1} \rightarrow I_{M2} \rightarrow I_N$) to increase the input current (load current), the operating point moves along segment MN ($M_1 \rightarrow M_2 \rightarrow N$).

When the overpower protection (OPP) setting is P_N, the OPP trips when point N is reached.

At this point, two types of operation are available on the PLZ-4W depending on the protection action setting of the OPP.

If Protect Action is set to LOAD OFF, the load is turned off.

If protection action is set to LIMIT, the PLZ-4W sinks current as a constant power load at point N. Even if you attempt to increase the current, the current is limited at point N. If you decrease the current, the OPP is cleared. The PLZ-4W returns to CC mode, and the operating point moves along segment MN.

Table A-7   OPP action (protect action)

Point N	LOAD OFF	Turns off the load (stops the current flow). The PLZ-4W no longer operates as a load.
	LIMIT	CC mode ends. OPP continues, and the PLZ-4W sinks current as a constant power load.

If the overpower protection (OPP) setting is P_{N1}, the OPP does not trip as the current is increased, and the operating point reaches point S.

Here, the operation mode is CV. The voltage is fixed to voltage V_Q set in advance.

In this case, the operating point moves along segment QS. The current is determined by the battery voltage and its internal resistance.

A.2.6 Operation of the CR+CV Mode

The PLZ-4W allows you to add CV mode to CR mode.

■ CR+CV mode operation

When the PLZ-4W is used in CR+CV mode, the PLZ-4W operates as a constant resistance load and a constant voltage load (shunt regulator) as shown in Fig. A-14. When operating as a constant resistance load and the voltage (V_M) of the constant-voltage power supply is varied, the PLZ-4W sinks current to meet I=V/R according to the specified resistance R. When operating as a constant voltage load and V_M is greater than V, the input voltage V is kept constant even when the input current I varies. Current does not flow when V_M is less than or equal to V.

The switching between the modes is automatic.
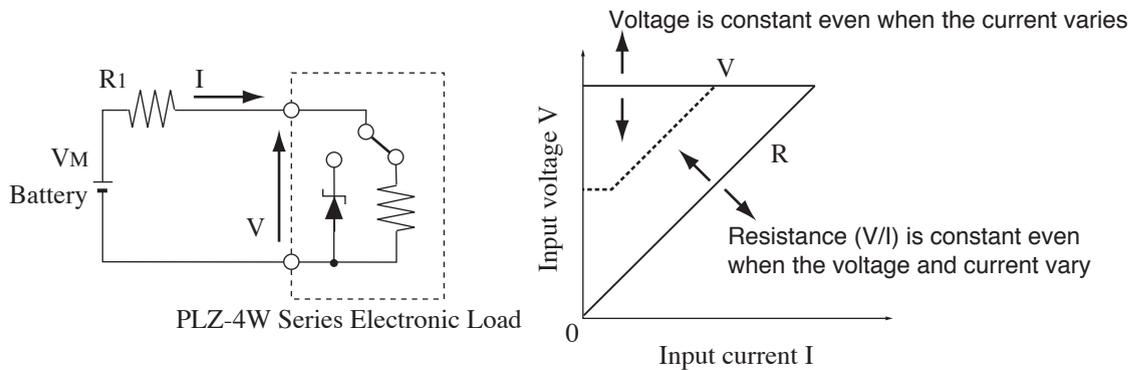
Fig. A-14   Equivalent circuit of the CR+CV mode and operation

■ Transition of the operating point: Overpower protection (OPP)

We will consider the case when checking the discharge characteristics of a battery of Fig. A-14.
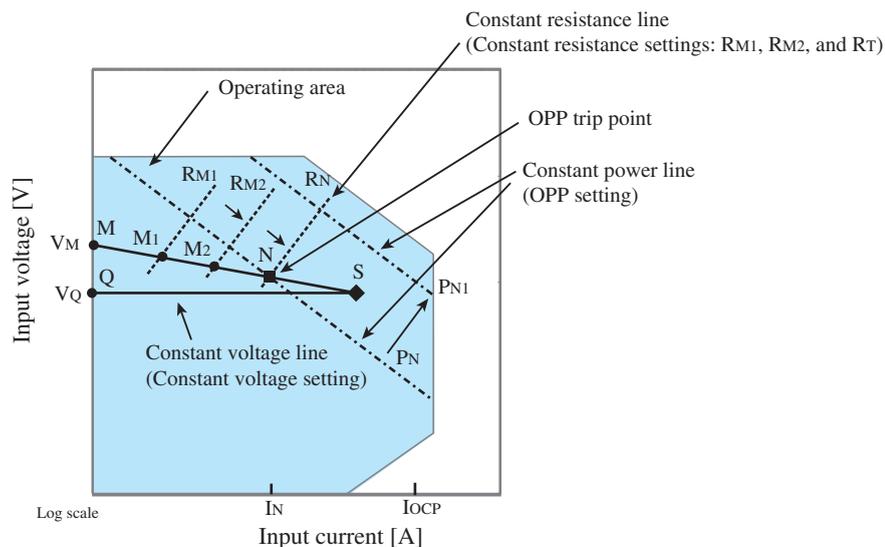
Fig. A-15   Transition of the operating point in CR+CV mode (OPP trip point)

We assume that the overcurrent protection (OCP) setting I_{OCP} is greater than current I_N at point N and denote the voltage of the battery as V_M. In CR mode, if the resistance is decreased ($R_{M1} \rightarrow R_{M2} \rightarrow R_N$) to increase the input current (load current), the operating point moves along segment MN ($M_1 \rightarrow M_2 \rightarrow N$).

When the overpower protection (OPP) setting is P_N, the OPP trips when point N is reached.

At this point, two types of operation are available on the PLZ-4W depending on the protection action setting of the OPP.

If Protect Action is set to LOAD OFF, the load is turned off.

If protection action is set to LIMIT, the PLZ-4W sinks current as a constant power load at point N. Even if you attempt to increase the current by decreasing the resistance, the current is limited at point N. If you decrease the current by increasing the resistance, the OPP is cleared. The PLZ-4W returns to CR mode, and the operating point moves along segment MN.

Table A-8   OPP action (protect action)

Point N	LOAD OFF	Turns off the load (stops the current flow). The PLZ-4W no longer operates as a load.
	LIMIT	CR mode ends. OPP continues, and the PLZ-4W sinks current as a constant power load.

If the overpower protection (OPP) setting is P_{N1}, the OPP does not trip as the resistance is decreased to increase the current. Consequently, the operating point reaches point S.
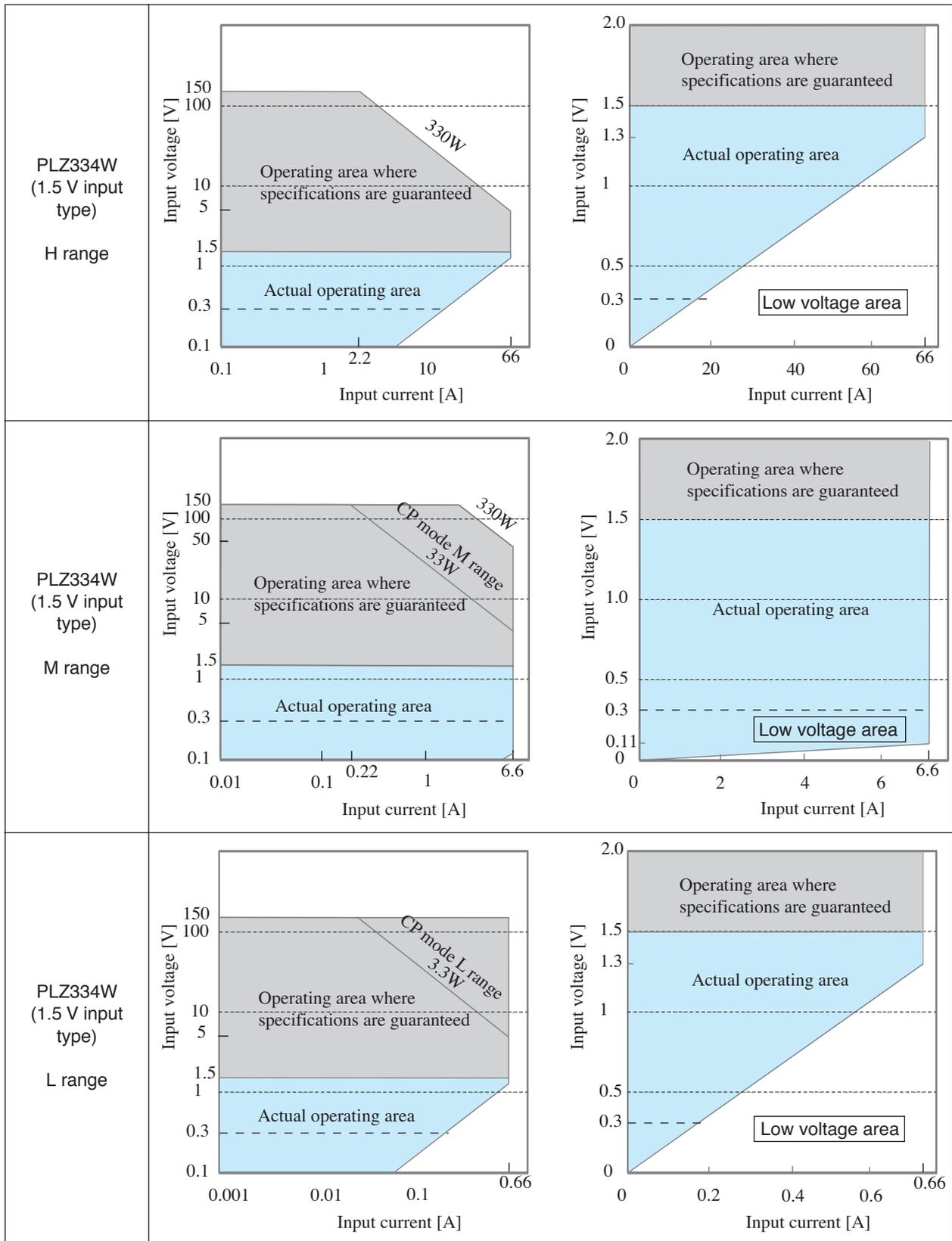
Here, the operation mode is CV. The voltage is fixed to voltage V_Q set in advance. In this case, the operating point moves along segment QS. The current is determined by the battery voltage and its internal resistance.
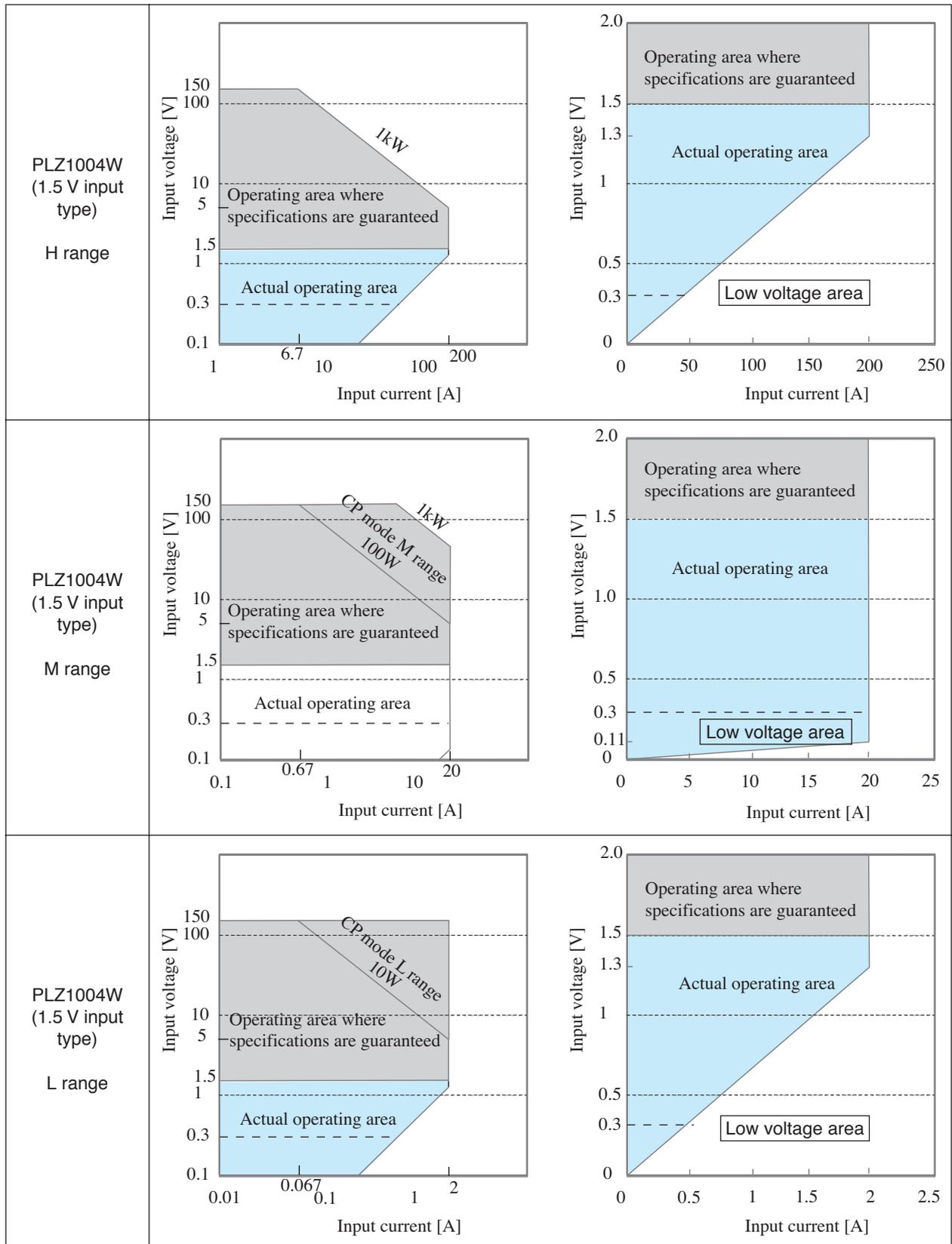
■ **Transition of the operating point: Overcurrent protection (OCP)**
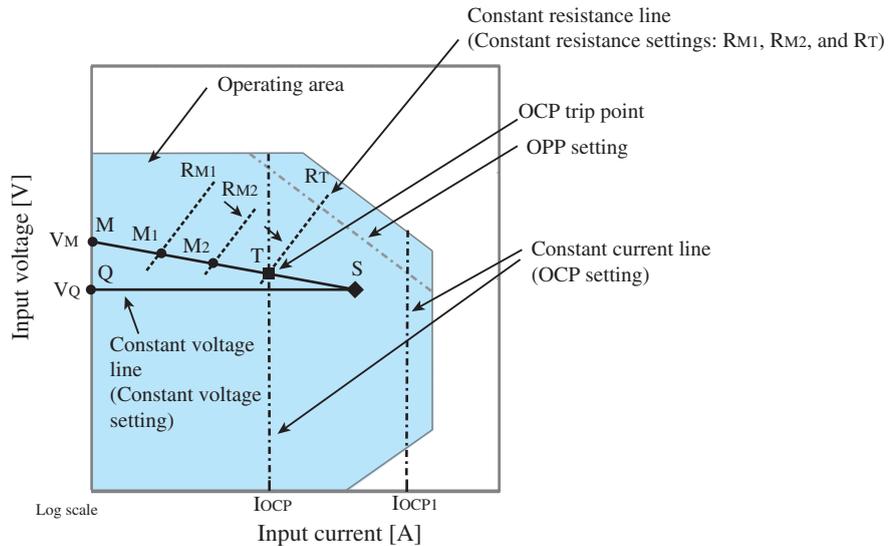
Fig. A-16   Transition of the operating point in CR+CV mode (OCP trip point)

We assume that the overcurrent protection (OCP) setting I_{OCP} is less than the current produced by the tripping of the overpower protection (OPP) and denote the voltage of the battery as V_M. In CR mode, if the resistance is decreased ($R_{M1} \rightarrow R_{M2} \rightarrow R_T$) to increase the input current (load current), the operating point moves along segment MT ($M_1 \rightarrow M_2 \rightarrow T$).

When the overcurrent protection (OCP) setting is I_{OCP}, the OCP trips when point T is reached. At this point, two types of operation are available on the PLZ-4W depending on the protection action setting of the OCP.

If Protect Action is set to LOAD OFF, the load is turned off.

If protection action is set to LIMIT, the PLZ-4W sinks current as a constant current load at point T. Even if you attempt to increase the current by decreasing the resistance, the current is limited at point T. If you decrease the current by increasing the resistance, the OCP is cleared. The PLZ-4W returns to CR mode, and the operating point moves along segment MT.

Table A-9   OCP action (protect action)

Point T	LOAD OFF	Turns off the load (stops the current flow). The PLZ-4W no longer operates as a load.
	LIMIT	CR mode ends. OCP continues, and the PLZ-4W sinks current as a constant current load.

If the overcurrent protection (OCP) setting is I_{OCP1}, the OCP does not trip as the resistance is decreased to increase the current. Consequently, the operating point reaches point S.

Here, the operation mode is CV. The voltage is fixed to voltage V_Q set in advance. In this case, the operating point moves along segment QS. The current is determined by the battery voltage and its internal resistance.

A.3　Operating Area of Each Model

A.3.1　Operating Area of the PLZ164W
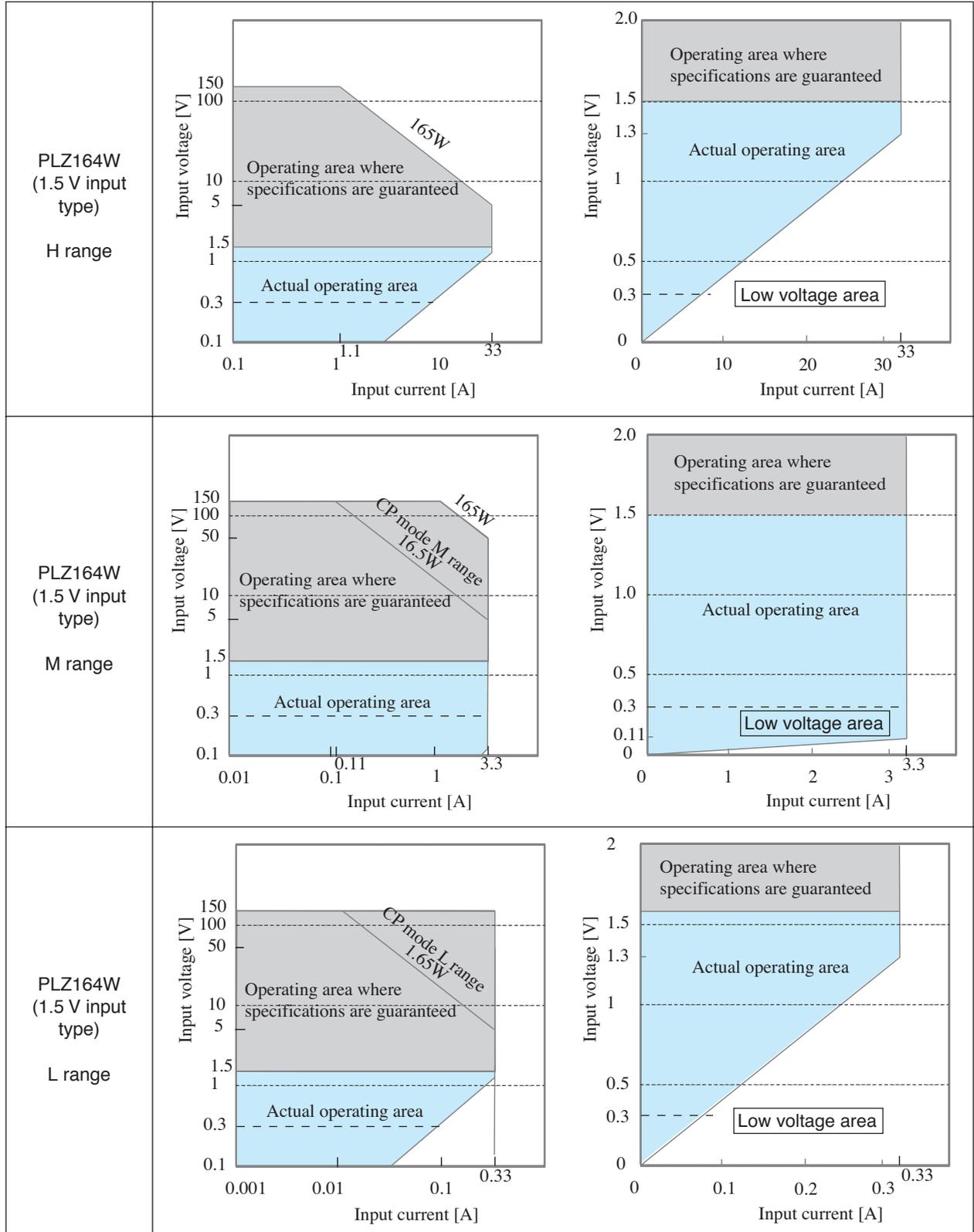
A.3.2　Operating Area of the PLZ334W

A.3.3 Operating Area of the PLZ1004W

A.3.4 Operating Area of the PLZ164WA

PLZ164WA (0 V input type) H range	
PLZ164WA (0 V input type) M range	
PLZ164WA (0 V input type) L range	
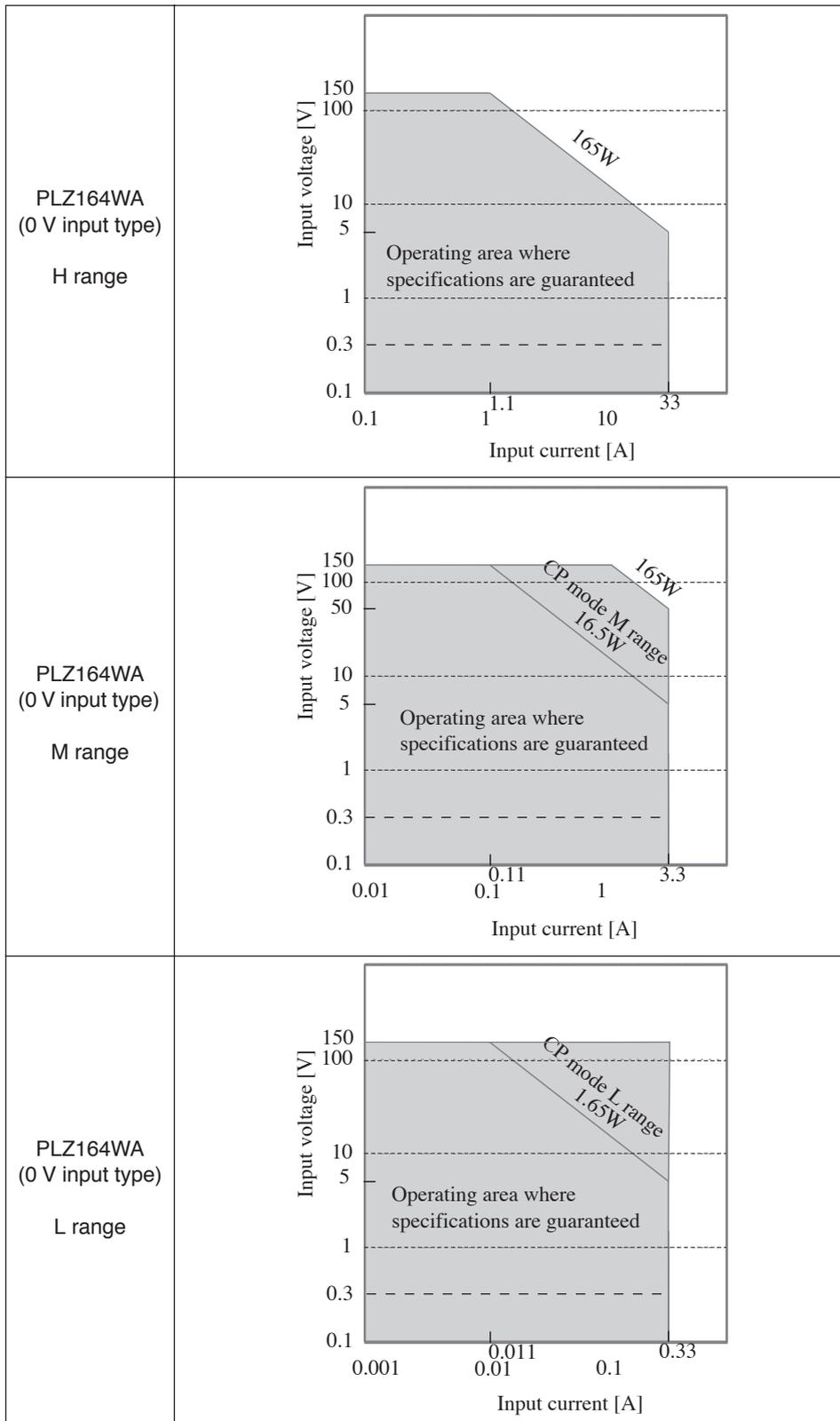
A.3.5　Operating Area of the PLZ664WA

PLZ664WA (0 V input type) H range	
PLZ664WA (0 V input type) M range	
PLZ664WA (0 V input type) L range	
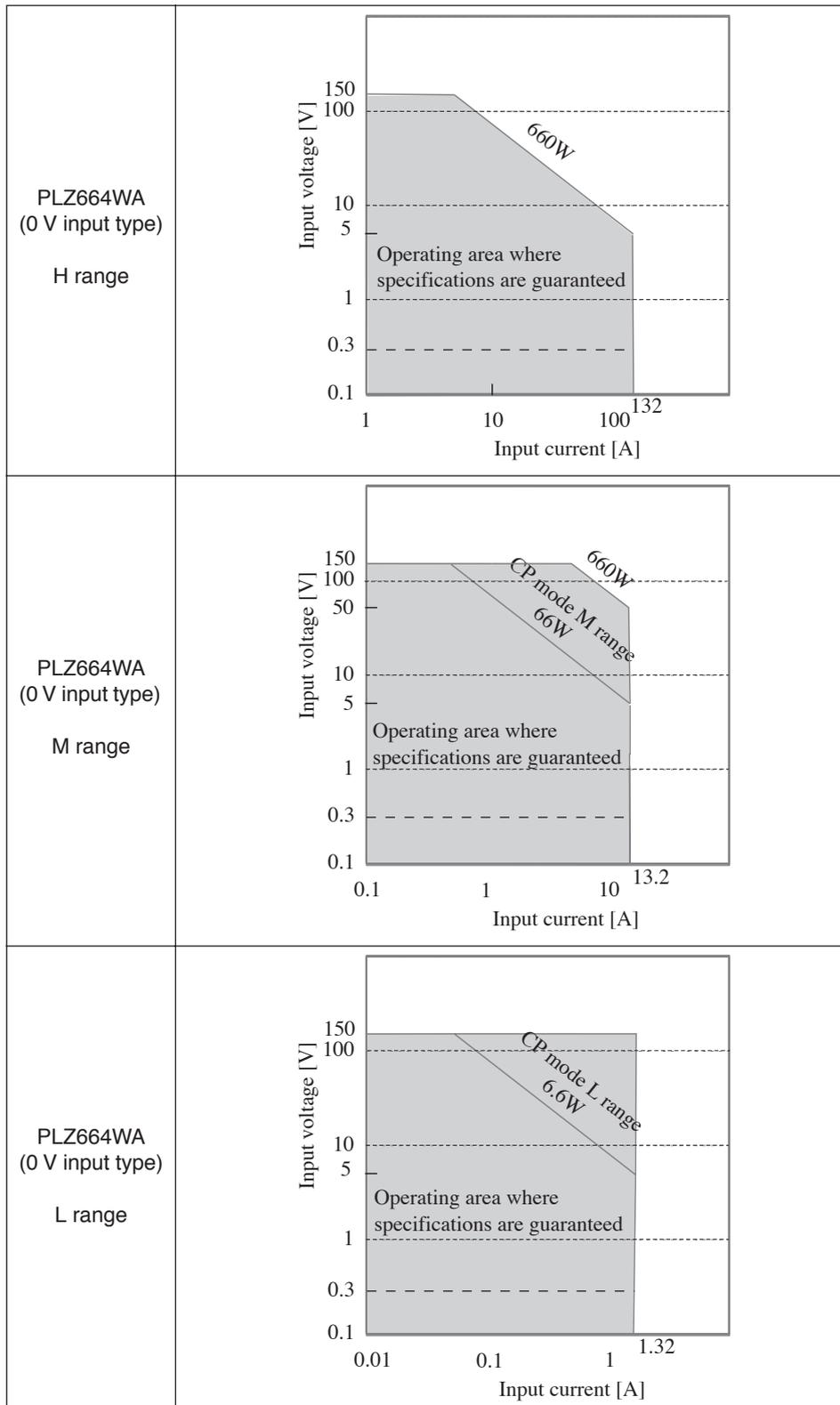
A.4　Sequence Program Creation Table

For normal sequence

Program name:				
		Date:		By:
Program number (1 to 10)				
Memo (Up to 11 characters)				
Operation mode		CC, CR, CV, CP		
Range Current (A) -- Voltage (V)		(A) -- 　　　(V)		
Loop (1 to 9999)				
Last Load (OFF/ON)		OFF, ON		
Last Set				
Chain (OFF, 1 to 10)				

Step number	Setting (mA, mS, V, W)	Execution time (h:min:s:ms)	LOAD	RAMP	TRIG	PAUSE	Note
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Entry example

Program name: Example sequence of chapter 6: PLZ164W	
	Date: By:
Program number (1 to 10)	1
Memo (Up to 11 characters)	Program1
Operation mode	CC
Range Current (A) -- Voltage (V)	33 (A) -- 150 (V)
Loop (1 to 9999)	0001
Last Load (OFF/ON)	OFF
Last Set	0
Chain (OFF, 1 to 10)	2

Step number	Setting (mA, mS, V, W)	Execution time (h:min:s:ms)	LOAD	RAMP	TRIG	PAUSE	Note
1	7 A	200 s	ON	ON	OFF	OFF	
2	7 A	150 s	ON	OFF	OFF	OFF	
3	0.5 A	80 s	OFF	OFF	OFF	OFF	

Program name: Example sequence of chapter 6: PLZ164W	
	Date: By:
Program number (1 to 10)	2
Memo (Up to 11 characters)	Program2
Operation mode	CC
Range Current (A) -- Voltage (V)	33 (A) -- 150 (V)
Loop (1 to 9999)	0002
Last Load (OFF/ON)	OFF
Last Set	0
Chain (OFF, 1 to 10)	OFF

Step number	Setting (mA, mS, V, W)	Execution time (h:min:s:ms)	LOAD	RAMP	TRIG	PAUSE	Note
1	10 A	200 s	ON	ON	OFF	OFF	
2	5 A	50 s	ON	OFF	OFF	OFF	
3	8 A	150 s	ON	ON	OFF	OFF	

A.5 SCPI Command Reference

This appendix gives an overview of the Standard Commands for Programmable Instruments (SCPI) that the PLZ-4W Series Electronic Load supports.

Summary of SCPI commands

The SCPI commands that the PLZ-4W supports are described in the tables following this section. The tables use the following headings.

- SCPI command: Full command name in long form (lowercase characters can be omitted)
- Description: Gives a description of the command function.
- Query?: Indicates whether the PLZ-4W supports the query version of the listed command.
- Note 1: 1, 2, and 3 indicate SCPI standard command, command in review, and KIKUSUI original command, respectively.
- Note 2: ○ indicates commands that are affected by *RCL, *SAV, and *RST.

Conventions used in the tables

The following conventions are used in the command list.

- N/A (not applicable) (There are no settings that relate to the command.)

Expressions

Expression	Details
conductance	Value defined by SCPI. It can be MAXimum or MINimum. May include suffix units such as mS, μS, and S.
current	Value defined by SCPI. It can be MAXimum or MINimum. May include suffix units related to current such as mA, μA, and A.
power	Value defined by SCPI. It can be MAXimum or MINimum. May include suffix units related to wattage such as mW, μW, and W.
status-enable	A 16-bit status mask for any CONDition register that determines which bits are to be used for synthesizing the summary bit of that register.
slew	Numeric data defined by SCPI, representing the current change with respect to a time interval.
step	Step number of a sequence program. In normal sequence mode, up to 256 steps can be shared among all programs (10 programs).
string	String data. ASCII codes 20H to 7EH can be used.
time	Time of the auto sequence step represented using hh:mm:ss.s format. May contain suffix units related to time such as S, MIN, and HR. By default, the value is in seconds.
value	Numerical data including MAXimum and MINimum. See the program data of each command.
voltage	Value defined by SCPI. It can be MAXimum or MINimum. May include suffix units related to voltage such as mV, μV, and V.

IEEE 488.2 commands

SCPI command	Description	Query
*CLS	Clears the status data structures.	N/A
*ESE	Sets the standard event status enable register bits.	Yes
*ESR?	Queries the standard event status register.	Query only
*IDN?	Queries the identification string. (Manufacturer information)	Query only
*OPC	Causes the device to generate the operation complete message in the standard event status register when all pending selected device operations have been finished.	Yes
*RCL <value>	Restores the current settings of the device from a copy stored in local memory.	N/A
*RST	Performs a device reset. Configures the PLZ-4W to a known condition independent from the usage history of the device.	N/A
*SAV <value>	Stores the current settings of the device to local memory.	N/A
*SRE	Sets the service request enable register bits.	Yes
*STB?	Reads the status byte and the master summary status bit.	Query only
*TRG	Trigger command. This is analogous to the Group Execute Trigger interface message defined in IEEE 488.1. See section 6.1.4.2.5 of IEEE 488.2.	N/A
*TST?	Since there is no self-test function built into the PLZ-4W, an ASCII character 0 is always returned in the output queue in response to this query.	Query only
*WAI	Prevents the device from executing any further commands or queries until the No Operation Pending flag is true. (*OPC?)	N/A

Measurement commands

SCPI command	Description	Query	Note 1	Note 2
MEASure[:SCALar]:				
:CURRent[:DC]?	Reads the measured current.	Query only	1	
:POWer[:DC]?	Reads the measured power.	Query only	1	
:VOLTage[:DC]?	Reads the measured voltage.	Query only	1	
MEASure:ETIMe?	Reads the elapsed time of measurement.	Query only	3	

Configuration and operation commands

SCPI command	Description	Query	Note 1	Note 2
`[SOURce:]FUNCtion[:MODE]` `{CC|CV|CP|CR|CCCV|CRCV}`	Sets the operation mode of the PLZ-4W.	Yes	3	○
`[SOURce:]CONDuctance`				
`[:LEVel][:IMMediate][:AMPLitude]` `{<conductance>|MINimum|MAXimum}`	Sets the conductance of CR mode.	Yes	3	○
`:RANGe {LOW|MEDium|HIGH}`	Sets the conductance range.	Yes	3	○
`[SOURce]:CURRent`				
`[:LEVel][:IMMediate][:AMPLitude]` `{<current>|MINimum|MAXimum}`	Set the current value.	Yes	1	○
`:SLEW <slew>`	Sets the current change with respect to the programmed time interval.	Yes	1	○
`:PROTection[:LEVel][:OVER]` `{<value>|MINimum|MAXimum}`	Set the overcurrent protection level.	Yes	1	○
`:PROTection:ACTion {LIMit|TRIP}`	Sets whether to turn off the load or limit the current when the OCP trips.	Yes	3	○
`:RANGe {LOW|MEDIUM|HIGH}`	Sets the current range.	Yes	1	○
`[SOURce]:POWer`				
`[:LEVel][:IMMediate][:AMPLitude]` `{<power>|MINimum|MAXimum}`	Set the wattage value.	Yes	1	○
`:PROTection[:LEVel][:OVER]` `{<value>|MINimum|MAXimum}`	Set the overpower protection level.	Yes	1	○
`:PROTection:ACTion {LIMit|TRIP}`	Sets whether to turn off the load or limit the current when the OPP trips.	Yes	3	○
`:RANGe {LOW|MEDIUM|HIGH}`	Sets the power range.	Yes	1	○
`[SOURce:]VOLTage`				
`[:LEVel][:IMMediate][:AMPLitude]` `{<voltage>|MINimum|MAXimum}`	Set the voltage value.	Yes	1	○
`:PROTection[:LEVel]UNDer` `{<voltage>|MINimum|MAXimum}`	Set the overvoltage protection level.	Yes	3	○
`:PROTection:STATe {OFF|ON}`	Turns ON/OFF the undervoltage protection.	Yes	1	○
`:RANGe {LOW|HIGH}`	Sets the voltage range.	Yes	1	○
`[SOURce:]FUNCtion`				
`:CTIMe {OFF|ON}`	Sets the count time.	Yes	3	○
`:RESPonse` `{0.1|0.2|0.5|1.0|MIN|MAX}`	Set the transient response speed.	Yes	3	○
`:SSTart` `{1MS|2MS|5MS|10MS|50MS|100MS|200MS |}`	Sets the soft start time for CC mode or CR mode.	Yes	3	○
`[SOURce:]PRESet`				
`:STORe {MEMA|MEMB|MEMC}`	Stores the settings to ABC preset memory.	N/A	3	
`:RECall {MEMA|MEMB|MEMC}`	Recalls settings from ABC preset memory.	N/A	3	

Trigger commands

SCPI command	Description	Query	Note 1	Note 2
ABORt	Clears the trigger-wait status and returns to idle.	N/A	1	
INPut[:STATe]:TRIGgered {OFF|ON}	Turns ON/OFF the trigger input.	N/A	1	
OUTPut[:STATe]:TRIGgered {OFF|ON}	Turns ON/OFF the trigger input.	N/A	1	
INITiate				
[:IMMediate]	Transitions to the trigger wait status, but automatically returns to idle when a trigger is activated.	N/A	1	
:CONTinuous {OFF|ON}	Sets whether to continue the trigger wait status.	Yes	1	O
[SOURce:]				
CONDuctance[:LEVel]:TRIGgered[:AMPLitude] {<conductance>|MINimum|MAXimum}	Sets in advance the conductance generated when a trigger is activated.	N/A	3	O
CURRent[:LEVel]:TRIGgered[:AMPLitude] {<current>|MINimum|MAXimum}	Sets in advance the current when a trigger is activated.	N/A	1	O

Switching function commands

SCPI command	Description	Query	Note 1	Note 2
[SOURce:]PULSe				
[:STATe] {OFF|ON}	Turns ON/OFF the switching mode.	Yes	3	O
:DCYCle <value>	Sets the switching duty cycle.	Yes	1	O
:PERiod <value>	Sets the pulse period.	Yes	1	O
:FREQuency <value>	Sets the pulse frequency.	Yes	3	O
[SOURce:]PULSe:LEVel				
[:VALue]:CONDuctance <conductance>	Sets the conductance level.	Yes	3	O
:PERCentage:CONDuctance <value>	Sets the conductance level in terms of a percentage of the setting.	Yes	3	O
[:VALue]:CURRent <current>	Sets the current level.	Yes	3	O
:PERCentage:CURRent <value>	Sets the current level in terms of a percentage of the setting.	Yes	3	O

Input state commands

SCPI command	Description	Query	Note 1	Note 2
INPut/OUTPut				
[:STATe][:IMMediate] {OFF|ON}	Turn ON/OFF the load.	Yes	1	O
:PROTection:CLEar	Clears the alarm.	N/A	3	
:SHORt[:STATe] {OFF|ON}	Turns ON/OFF the short function.	Yes	3	
[:STATe]:TIMer[:STATe] {<value>|MINimum|MAXimum}	Set the cutoff time.	Yes	3	O

sequence commands

SCPI command	Description	Query	Note 1	Note 2
`PROGram:CLEar`	Initializes the entire program.	N/A	3	
`PROGram[:SELected]`				
`:STATe {TRUN|RUN|STOP|PAUSe|CONTinue}`	Executes the selected program or changes the operating status.	N/A	1	
`:EXECuting?`	Queries the number of the program currently in operation.	Query only	1	
`:NAME <value>`	Specify the program name.	N/A	1	
`:MEMO "<string>"`	Sets the memo of the selected program.	Yes	3	
`:MODE {NCC|NCR|NCV|NCP|FCC|FCR}`	Sets the mode of the selected program.	Yes	3	
`:VRANge {LOW|HIGH}`	Sets the voltage range of the selected program.	Yes	3	
`:CRANge {LOW|MEDium|HIGH}`	Sets the current range of the selected program.	Yes	3	
`:LOOP <value>`	Sets the number of program loops of the selected program.	Yes	3	
`:LINPut {OFF|ON}`	Sets the load on/off condition after the sequence ends.	Yes	3	
`:LOUTput {OFF|ON}`	Sets the load on/off condition after the sequence ends.	Yes	3	
`:LVALue {<conductance>|<current>|<power>|<voltage>}`	When set to normal sequence, sets the current value after the specified program ends.	Yes	3	
`:LVALue {<conductance>|<current>}`	When set to fast sequence, sets the current value after the specified program ends.	Yes	3	
`:CHAin {OFF|<value>}`	Set the number of the program to be executed next.	Yes	3	
`PROGram[:SELected]:NSPeed[:STEP]`				
`:INSert <step>,{<conductance>|<current>|<power>|<voltage>},<time>[,<input=1>][,<ramp=0>][,<trig=0>][,<pause=0>]`	Inserts a normal sequence step into the selected program.	N/A	3	
`:ADD {<conductance>|<current>|<power>|<voltage>},<time>[,<input=1>][,<ramp=0>][,<trig=0>][,<pause=0>]`	Adds a normal sequence step to the selected program.	N/A	3	
`:DELete[STEP]`	Deletes the selected program sequence step.	N/A	3	
`:DELete:ALL`	Deletes the all the steps of the selected program.	N/A	3	
`:COUNt?`	Queries the number of steps of the selected program.	Query only	3	
`:EDIT <step>,{<conductance>|<current>|<power>|<voltage>},<time>[,<input>][,<ramp>][,<trig>][,<pause>]`	Edits an existing sequence step.	Yes	3	
`PROGram[:SELected]:FSPeed`				
`[:STEP]:END <step>`	Sets the end step of the fast sequence mode.	Yes	3	
`[:STEP]:EDIT[:POINt] <step>,<value>[,<trig>]`	Edits an existing sequence step.	Yes	3	
`:TIME <time>`	Set the step execution time of the fast sequence mode.	Yes	3	
`[:STEP]:EDIT:LINear <start-step>,<start-data>,<stop-step>,<stop-data>`	Automatically calculates the values of each step using linear data between start and stop steps of the fast sequence mode.	N/A	3	
`[:STEP]:EDIT:WAVE <start-step>,<val1>,<val2>,<val3>,<val4>,<val5>,<val6>,<val7>,<val8>`	Edits the waveform of the step of the fast sequence mode.	N/A	3	

Other commands

SCPI command	Description	Query	Note 1	Note 2
SYSTem:CAPability?	Queries the SCPI instrument class.	N/A	1	
SYSTem:ERRor[:NEXT]?	Reads the error message from the error queue.	Query only	1	
SYSTem:GTLocal	Switches to local mode operation (RS232 only).	N/A	3	
SYSTem:LLOut	Sets local lockout (LLO) (RS232 only).	N/A	3	
SYSTem:RENable {OFF|ON}	REN (Remote Enable/Disable) (RS232 only).	N/A	3	
SYSTem:VERSion?	Queries the SCPI version to which the PLZ-4W conforms.	Query only	1	

Status commands

SCPI command	Description	Query	Note 1	Note 2
STATus:PRESet	Controls the auto power-on clearing of the service request enable register, standard event status enable register, parallel poll enable register, and other event enable registers.	N/A	1	
STATus:OPERation				
:CONDition?	See Table 7-3 in section 7.6.1, "SCPI Registers."	Query only	1	
:ENABle <status-enable>	See Table 7-3 in section 7.6.1, "SCPI Registers."	Yes	1	
[:EVENt]?	See Table 7-3 in section 7.6.1, "SCPI Registers."	Query only	1	
:NTR	See Table 7-3 in section 7.6.1, "SCPI Registers."	Yes	1	
:PTR	See Table 7-3 in section 7.6.1, "SCPI Registers."	Yes	1	
STATus:QUEStionable				
:CONDition?	See Table 7-4 in section 7.6.1, "SCPI Registers."	Query only	1	
:ENABle <status-enable>	See Table 7-4 in section 7.6.1, "SCPI Registers."	Yes	1	
[:EVENt]?	See Table 7-4 in section7.6.1, "SCPI Registers."	Query only	1	
:NTR	See Table 7-4 in section 7.6.1, "SCPI Registers."	Yes	1	
:PTR	See Table 7-4 in section 7.6.1, "SCPI Registers."	Yes	1	
STATus:CSUMmary				
:CONDition?	See Table 7-5 in section 7.6.1, "SCPI Registers."	Query only	3	
:ENABle <status-enable>	See Table 7-5 in section 7.6.1, "SCPI Registers."	Yes	3	
[:EVENt]?	See Table 7-5 in section 7.6.1, "SCPI Registers."	Query only	3	
:NTR	See Table 7-5 in section 7.6.1, "SCPI Registers."	Yes	3	
:PTR	See Table 7-5 in section 7.6.1, "SCPI Registers."	Yes	3	

A.6 Error Messages

A.6.1 Overview

Errors, when detected, are placed in the queue. The queue functions as a FIFO. When the queue overflows, the last error in the queue is replaced by Error -350 (queue overflow). When all the errors are read from the queue, 0 (no error) is returned for subsequent error queries.

When one of the following occurs, the error queue is cleared (section 11.4.3.4 in IEEE 488.2).

- Reception of a *CLS command.
- When the last item is read from the queue.

All negative values are reserved by the SCPI Standard. All errors specific to the PLZ-4W are positive values.

A.6.2 A List of Errors

Command errors

An <error/event number> in the range [-199, -100] indicates that an IEEE 488.2 syntax error has been detected by the instrument's parser. The occurrence of any error in this class shall cause the command error bit (bit 5) in the event status register to be set.

Error code		Error message description
-100	Command error	This is the generic syntax error.
-101	Invalid character	A data element different from those that are allowed was encountered.
-102	Syntax error	An unrecognized syntax was encountered in the command string.
-103	Invalid separator	An invalid separator exists in the command string.
-104	Data type error	The parser recognized a data element different than one allowed.
-105	GET not allowed	A Group Execute Trigger was received within a program message.
-108	Parameter not allowed	More parameters were received than expected for the header.
-109	Missing parameter	Fewer parameters were received than required for the header.
-110	Command header error	An error was detected in the header.
-120	Numeric data error	This error is generated when parsing a data element which appears to be numeric, including the nondecimal numeric types.
-130	Suffix error	This error is generated when parsing a suffix.

Error code		Error message description
-131	Invalid suffix	The suffix does not follow the syntax, or the suffix is inappropriate for this device.
-134	Suffix too long	The suffix of the numeric element is too long.
-138	Suffix not allowed	A suffix was encountered after a numeric element which does not allow suffixes.
-140	Character data error	This error is generated when parsing a character data element.
-150	String data error	This error is generated when parsing a string data element.
-160	Block data error	This error is generated when parsing a block data element.
-170	Expression error	This error is generated when parsing an expression data element.
-180	Macro error	Macro error.

Execution errors

An <error/event number> in the range [-299, -200] indicates that an error has been detected by the instrument's execution control block. The occurrence of any error in this class shall cause the execution error bit (bit 4) in the event status register to be set.

Error code		Error message description
-200	Execution error (generic)	This is a generic syntax error for this device.

Device-specific errors

An <error/event number> in the range [-399, -300] or [1, 32767] indicates that the instrument has detected an error which is not a command error, a query error, or an execution error; some device operations did not properly complete, possibly due to an abnormal hardware or firmware condition. These codes are also used for self-test response errors. The occurrence of any error in this class should cause the device-specific error bit (bit 3) in the event status register to be set.

Error code		Error message description
-300	Device-specific error (generic)	Indicates that this device could not finish the operation due to some condition of the device.
-350	Queue overflow	A specific code entered into the queue in lieu of the code that caused the error. This code indicates that there is no room in the queue and an error occurred but was not recorded.

Query errors

An <error/event number> in the range [-499, -400] indicates that the output queue control of the instrument has detected a problem with the message exchange protocol described in IEEE 488.2, chapter 6. The occurrence of any error in this class shall cause the query error bit (bit 2) in the event status register to be set.

Error code		Error message description
-400	Query error (generic)	This is the generic query error for devices that cannot detect more specific errors.

Errors specific to the PLZ-4W

Error code	Error message
21	Operation denied due to ALARM state
22	Operation denied due to PROGRAM running
23	Operation denied due to SWITCH running
24	Operation denied due to INPUT ON
25	Operation denied due to SHORT ON
26	Operation denied due to CAL MODE
27	Operation denied due to incompatible FUNCTION MODE
31	Operation denied due to incompatible PROGRAM MODE
32	Operation denied because no more STEPs are available
41	Operation denied due to bad CHAIN combination

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