

Part No. Z1-002-982, IB004857

Aug. 2010

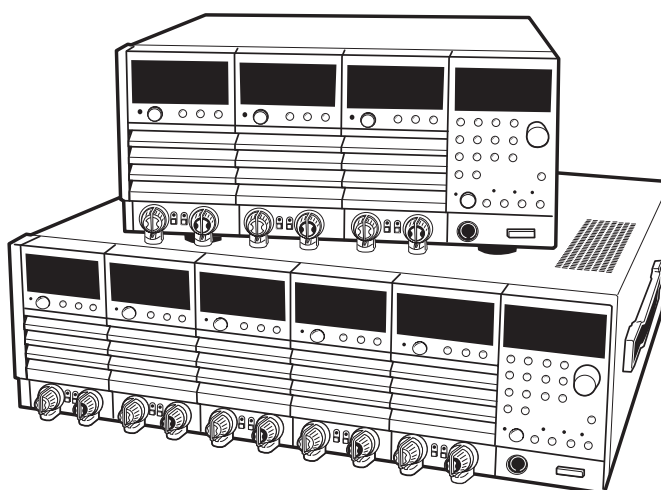
## OPERATION MANUAL

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ELECTRONIC LOAD PLZ-U Series

**PLZ 70UA**  
**PLZ 150U**

**PLZ - 30F**  
**PLZ - 50F**



## **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.

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

Both unit specifications and manual contents are subject to change without notice.

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# Safety Symbols

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



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

**DANGER**

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



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



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



Shows that the act indicated is prohibited.



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



Indicates a protective conductor terminal.



Indicates a chassis (frame) terminal.



# 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.



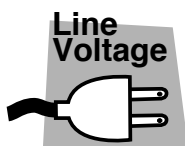
## Users

- 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.



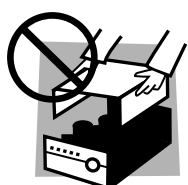
## Input power

- 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.



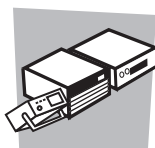
## Fuse

- 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.

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# Chapter 1 General Description

This chapter gives an overview and describes the features of the PLZ-U.

## 1.1 About This Manual

This operation manual covers the following PLZ-U Series Electronic Load Units.

Frame

- PLZ-50F
- PLZ-30F

Load unit

- PLZ150U
- PLZ70UA

### Product version covered

This operation manual covers products with frame ROM version 1.0X and load unit ROM version 2.0X.

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 on the frame and on the top panel on the load unit)

For the procedure of confirming the ROM version, see section 2.7, “Power Up.”

## 1.2 Product Overview

The PLZ-U Series Electronic Load Unit is a compact, high-performance, multi-channel electronic load unit that has three operation modes: constant current, constant resistance, and constant voltage.

The PLZ-U consists of a frame and load units. Load units are inserted into the frame (control section) for operation. The PLZ-30F and PLZ-50F Frames can accommodate up to 3 channels and 5 channels of load units, respectively.

The current capacity or power capacity can be increased through a parallel operation of load units. The load units can be combined to produce a power capacity from 75 W to 750 W (when five PLZ150Us are installed into the PLZ-50F).

In addition to high-speed response and highly precise preset resolution, various functions are provided including the soft start function, variable slew rates, switching function, ABC preset memories, four setup memories, and sequence function.

Because the PLZ-U comes standard with GPIB and RS-232C communication functions, it can easily be incorporated into various test and inspection systems. The communication functions are useful for testing batteries, DC/DC converters, switching power supplies, and multi-output power supplies.

## 1.3 Features

In addition to the advanced constant current, constant resistance, and constant voltage functions, the PLZ-U Series Electronic Load Unit offers wide variety of other features.

### ■ Compact and light

Compact and light weighing only approximately 11 kg and 17 kg for 3 channels and 5 channels, respectively.

### ■ High-speed response

In constant current mode, a current rise and fall slew rate of 2.4 A/ $\mu$ s (PLZ150U) is possible (converts to a rise and fall time of 10  $\mu$ s). Simulations that closely resemble a real load are possible by using the PLZ-U as a load for DC power transient response tests and as a dummy load

### ■ High precision and high resolution

Three ranges are built into the PLZ-U achieving both wide dynamic range and high resolution. The PLZ-U provides displays with up to 5 digits for voltage, current, and power measurement functions as well as minimum preset resolutions of 10  $\mu$ A (PLZ70UA) and 20  $\mu$ A (PLZ150U).

### ■ Variable slew rate

The current slew rate can be varied continuously in constant current mode and constant resistance mode. This feature allows the suppression of transient voltage drops due to the wiring inductance that occurs when a load is switched and transient voltages of constant voltage power supplies, etc.

### ■ Multi channels

Up to five and three channels can be installed into the PLZ-50F and PLZ-30F, respectively. Each channel is isolated and can be used independently or linked with each other. Different units (PLZ150Us and PLZ70UAs) can be installed in the frame.

### ■ Low noise

High reliability and low noise have been achieved by the adoption of a heat sensing variable speed fan and the enhanced cooling structure.

### ■ Large capacity

Parallel operation is possible on up to five adjacent load units of the same type.

Five PLZ70UAs installed in PLZ-50F operating in parallel produce 375 W.

Five PLZ150Us installed in PLZ-50F operating in parallel produce 750 W.

### ■ 0 V type

The PLZ70UA is a 0 V input operating voltage unit. 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 PLZ70UA can be used to evaluate the power supplies for these types of applications.

## ■ ABC preset memories

Three presets that are most frequently used can be stored for each operation mode and range. This allows quick switching of settings even when the load is turned on.

## ■ Load simulations

In constant current and constant resistance modes, a sequence program can be created with up to 255 steps at a minimum interval of 1 ms. Independent settings can be entered on each channel simultaneously.

## ■ Outstanding operability

Setup operations have been consolidated on the frame panel. Each channel can be configured with one hand while viewing the measured voltage and current. Rotary knobs with an analog feel and simple interface make the operation of the PLZ-U easy even for first-time users.

## ■ Load input terminal

The load input terminal is provided on both the front panel and rear panel making the load unit suitable for embedded applications.

## ■ Remote sensing terminal

Remote sensing terminals are provided on both the front panel and rear panel allowing more accurate characteristics tests.

## ■ Extensive protection functions

Equipped with overcurrent protection (OCP), overpower protection (OPP), overvoltage protection (OVP), undervoltage protection (UVP), overheat protection (OHP), and reverse connection protection (RVP) functions. Since OCP, OPP, and UVP can be varied for each channel, protection can be optimized for each equipment under test.

## ■ External control

External voltage reference can be applied and the load can be turned on/off on each channel. You can recall channel-linked ABC preset memories, recall setup memories, and turn on/off the load from the frame control connector.

## ■ Inter-frame control

By connecting the frame control signal, multiple frames can be controlled from a single frame. You can collectively turn on/off the load and recall reset values.

## ■ Setup memories

Four sets of panel settings can be stored. You can easily recall settings according to the application and perform tests.

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

GPIB and RS-232C come standard. Since panel settings, input voltage, current, and power can be read through the interface, the PLZ-U can be embedded easily into various test systems.

# 1.4 Options

## Rack mounting option

The following rack mounting options are available.  
For details, contact your Kikusui agent or distributor.

Table 1-1 Rack mounting options

Name	Model	Applicable Model	Note
Rack mount bracket (Fig. 1-1)	KRB3-PLZ-50F	PLZ-50F	Inch rack EIA standard
	KRB150-PLZ-50F		Milli rack JIS standard
Rack mount bracket (Fig. 1-2)	KRB3-PLZ-30F	PLZ-30F	Inch rack EIA standard
	KRB150-PLZ-30F		Milli rack JIS standard

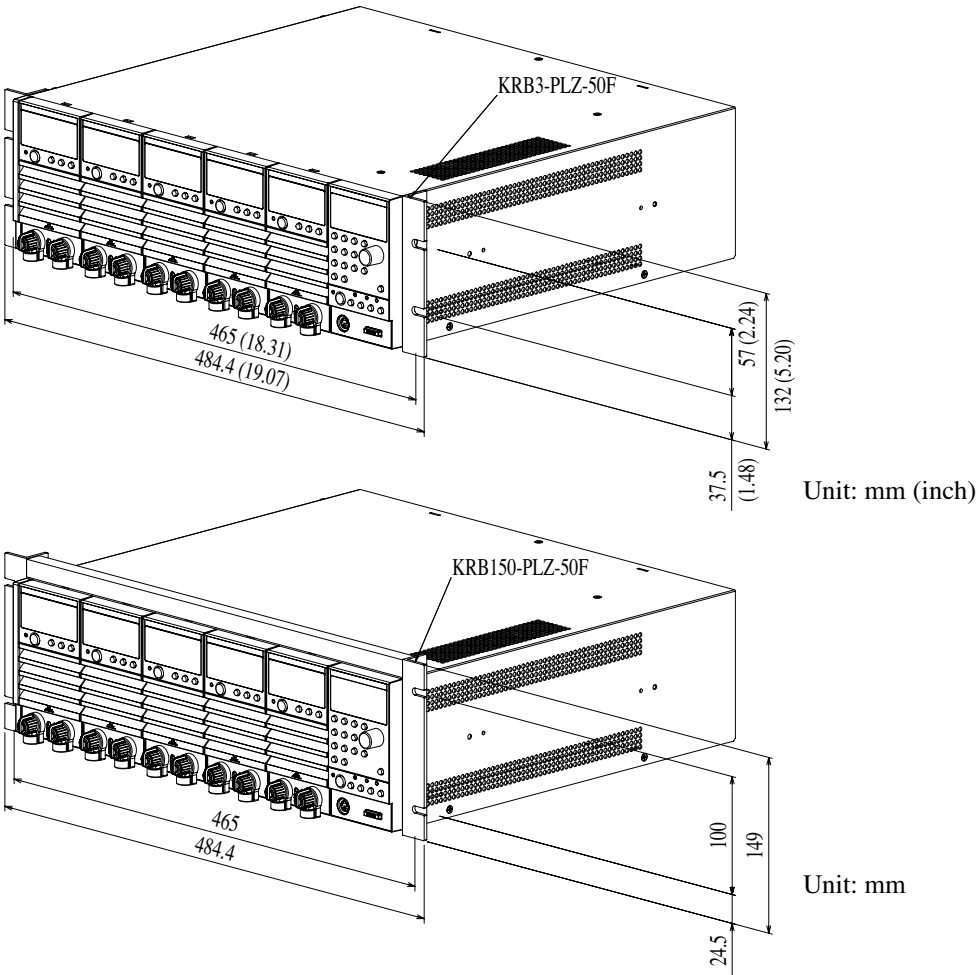


Fig.1-1 Rack mount bracket (PLZ-50F)

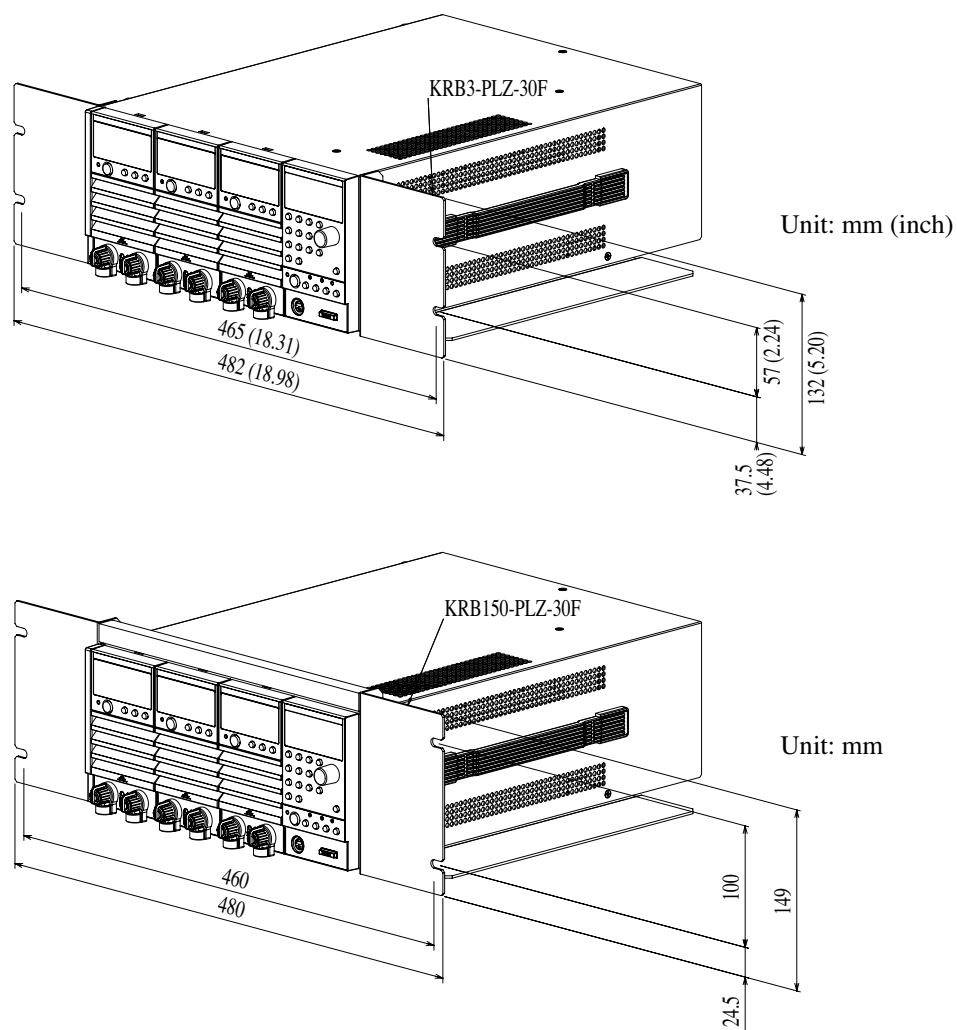


Fig. 1-2 Rack mount bracket (PLZ-30F)

## Control flat cables

Control cables that connect frames for inter-frame control. The following two types of cables are available.

Model	Cord	Length	Application
PC01-PLZ-4W	84540	300 mm	Connection between frames
PC02-PLZ-4W	84550	550 mm	

# 2

## **Chapter 2 Installation and Preparation**

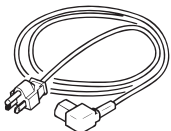
This chapter describes the procedures of unpacking and preparation before using the PLZ-U.

# 2.1 Checking the Package Contents

When you receive the product, check that all accessories indicated below are included and that the accessories have not been damaged during transportation.  
If any of the accessories are damaged or missing, contact your Kikusui agent or distributor.

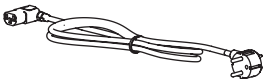
**NOTE** • It is recommended that all packing materials be saved, in case the product needs to be transported at a later date.

## 2.1.1 Frame



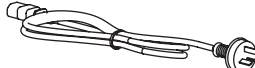
Rated voltage: 125 Vac  
PLUG: NEMA5-15  
[85-AA-0003]

or




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

or




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.



PLZ-30F (2 pcs. maximum)  
PLZ-50F (4 pcs. maximum)  
[P1-000-406]




PLZ-30F (2 pcs. maximum)  
PLZ-50F (4 pcs. maximum)  
[P1-000-405]

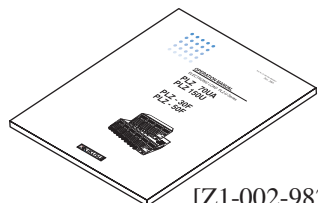
☐ Blank panel (rear)  
[Attached to the product.]\*

☐ Blank panel (front)  
[Attached to the product.]\*

\* In products that have load units installed, blank panels are installed in the empty slots.  
In products that contain the frame alone, the maximum number of blank panels are installed.



[84-49-0071]



[Z1-002-982]

☐ FRAME CONT protection dummy plug (2 pcs.)  
[Attached to the product.]

☐ Operation manual (this manual, 1 pc.)

Fig.2-1 Accessories (frame)



## 2.1.2 Load Unit

The following accessories are included with each load unit.

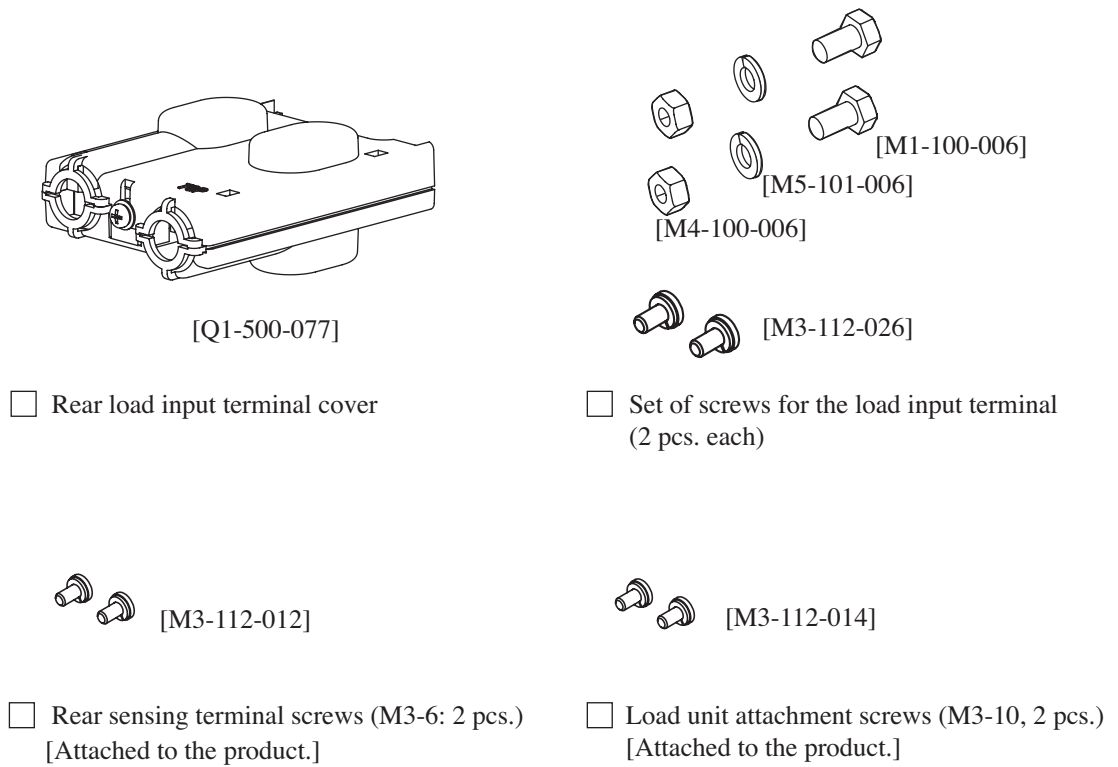


Fig. 2-2 Accessories (load unit)

## 2.2 Precautions Concerning Installation Location

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

### ■ Do not use the PLZ-U in a flammable atmosphere.

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

### ■ Avoid locations where the PLZ-U is exposed to high temperature or direct sunlight.

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

Operating temperature range: 0 °C to +40 °C (32 °F to 104 °F)

Storage temperature range: -20 °C to +70 °C (-4 °F to 158 °F)

### ■ Avoid humid environments.

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

Condensation may occur even within the operating humidity range. In such cases, do not use the PLZ-U until the condensation dries up completely.

Operating humidity range: 20 % to 85 % RH (no condensation)

Storage humidity range: 0 to 90 % RH (no condensation)

### ■ Do not place the PLZ-U in a corrosive atmosphere.

Do not install the PLZ-U 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 PLZ-U leading to malfunction and failure, or in the worst case, a fire.

### ■ Do not place the PLZ-U in a dusty location.

Accumulation of dust can lead to electric shock or fire.

### ■ Do not use the PLZ-U where ventilation is poor.

The PLZ-U employs a forced air cooling system. Air is taken in from air inlets located on panels other than the rear panel and exhausted from the air outlet on the rear panel. Secure adequate space around the PLZ-U 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.

---

- **Secure adequate space around the power switch.**

Do not place the PLZ-U in a location that would result in poor accessibility to the switch. And, do not place objects near the switch that would result in poor accessibility.

- **Do not place objects on the PLZ-U.**

Placing objects on top of the PLZ-U can cause failures (especially heavy objects).

- **Do not place the PLZ-U on an inclined surface or location subject to vibrations.**

The PLZ-U may fall or tip over causing damages and injuries.

- **Do not use the PLZ-U 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 supply waveform.**

The PLZ-U may malfunction.

- **Do not use the PLZ-U near highly sensitive measuring instruments or transceivers.**

The noise generated by the PLZ-U may affect them

## 2.3 Precautions When Moving the PLZ-U

When moving or transporting the PLZ-U to the installation site, observe the following precautions.

- **Turn off the POWER switch.**

Moving the PLZ-U while the power is turned on can cause electric shock or damage to it.

- **Remove all wiring.**

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

## 2.4 Installing Load Units

Install the load units into the empty slots of the frame. Channel numbers are automatically assigned to the load units. The left most load units is CH1.

- 
- ⚠ WARNING** • Turn off the POWER switch. Installing a load unit while the power is turned on can cause electric shock or damage to the PLZ-U.
- 

### ■ Installation procedure

1. Remove the blank panels (front and rear panels) from the slot where the load unit is to be installed.

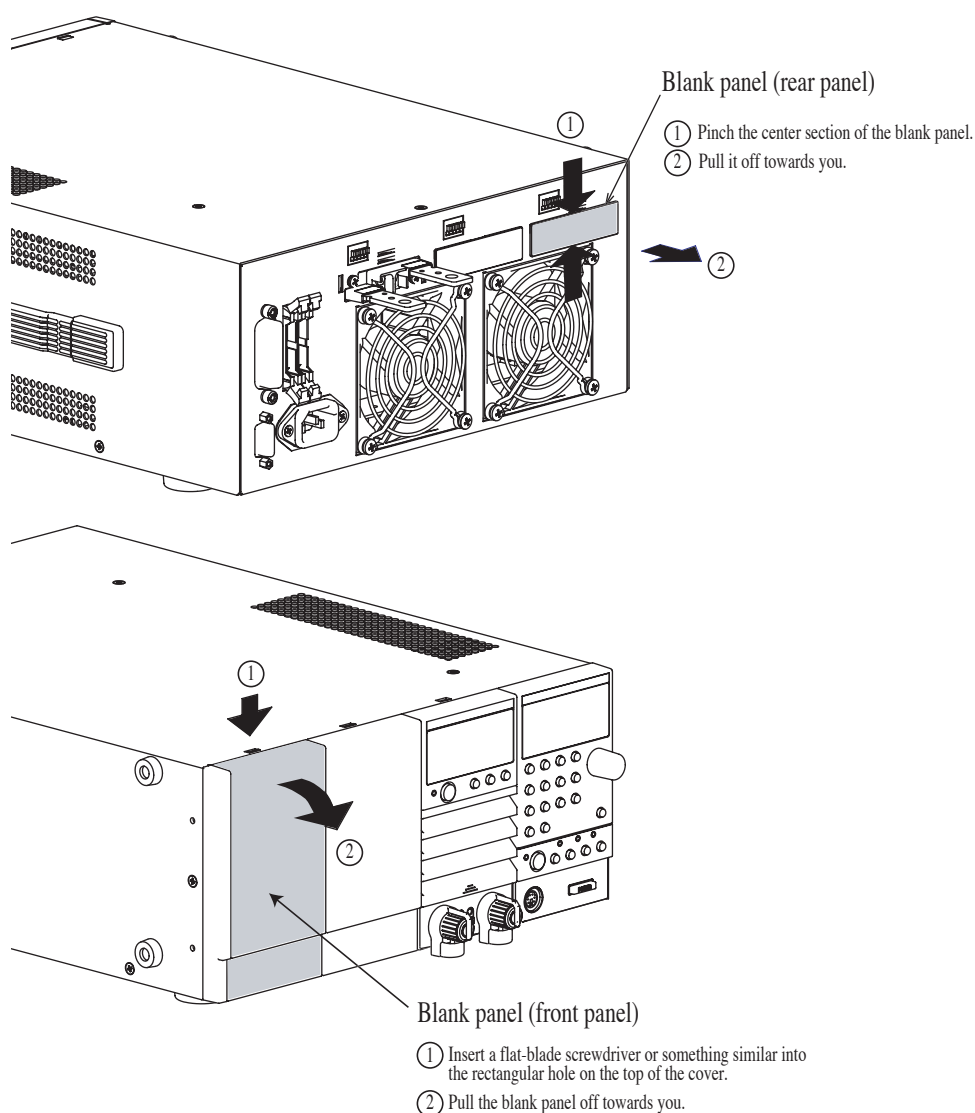


Fig. 2-3 Removing the blank panels

2. Carry the load unit with both hands and slowly insert it into the desired slot.

Check that the panel surface of the load unit is nearly flat with the frame panel surface.

3. Fix the load unit in place using the unit attachment screws (M3-10) provided.

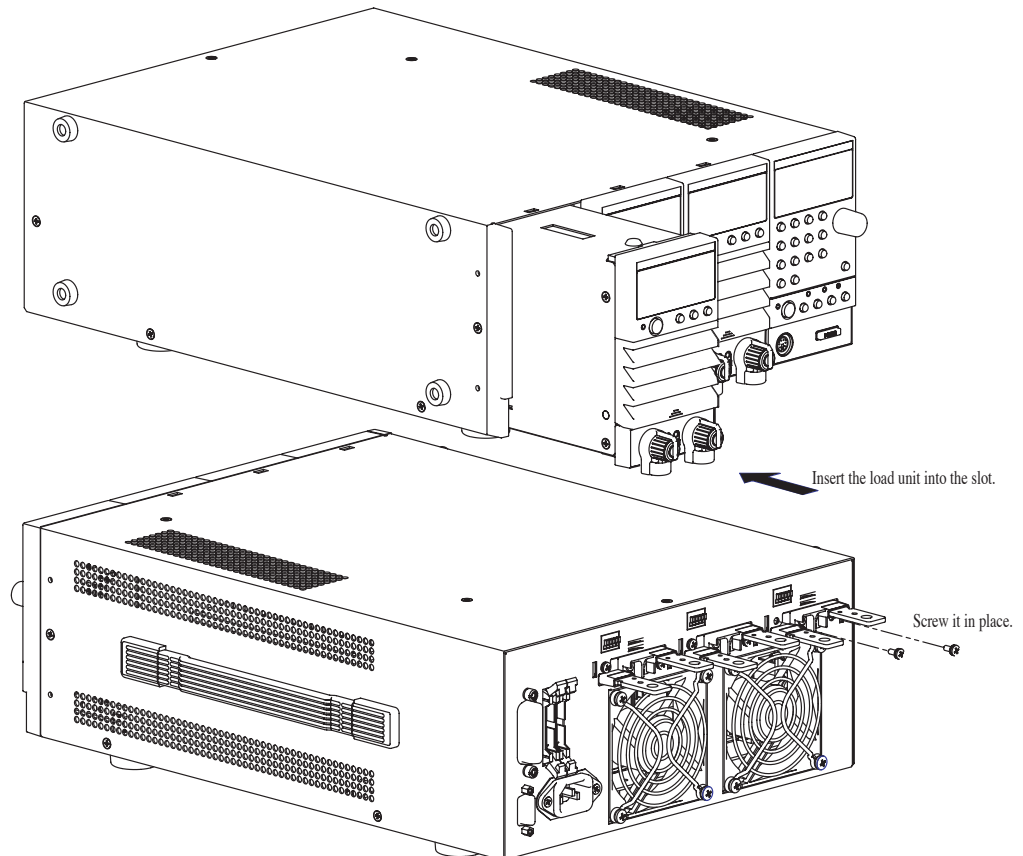


Fig. 2-4 Installing the load unit

**NOTE**

- The load unit is securely grounded when it is screwed in place. For safety reasons, be sure to fix the load unit using screws.

**■ Removal procedure**

1. Remove the unit attachment screws (M3-10) indicated in installation procedure step 3.


The screws that you removed are needed when you install the load unit again. Be sure to store them in a safe place (do not lose them).

2. Hold the load unit with both hands and slowly remove it from the slot.


**NOTE**

- Be sure to attach blank panels on both the front and rear panels in empty slots. If you do not, the cooling effect deteriorates, and the PLZ-U can malfunction.

# 2.5 Connecting the Power Cord

-  **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 rated voltage of the power cord with a three-prong plug that comes with the product (Fig. 2-5) is 125 VAC. If you are using an input power supply of a 200-V system, exchange the power cord with one that is suitable for the input voltage.

Have a qualified engineer select the appropriate power cord. If obtaining the right power cord is difficult, contact your Kikusui agent.
-  **CAUTION**

- Do not use the power cord that comes with the product for other equipment.

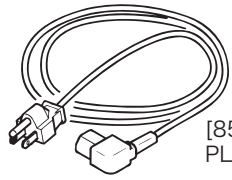

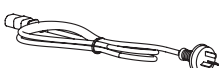
 <div>[85-AA-0003] PLUG:NEMA5-15</div>	Power cord for 100-V system Rated voltage: 125 VAC Rated current: 10 A
 <div>[85-AA-0005] PLUG:CEE7/7</div>	Power cord for 200-V system Rated voltage: 250 VAC Rated current: 10 A
 <div>[85-10-0790] PLUG:GB1002</div>	

Fig. 2-5 Power cord with a three-prong plug

- Connection procedure

1.

Check that the AC power supply is within the input power supply range of the PLZ-U.  
Input voltage range: 100 VAC to 240 VAC  
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.

## 2.6 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 PLZ-U, malfunction may occur due to external noise, or the noise generated by the PLZ-U may become large.
- 

Be sure to ground the PLZ-U for your safety.

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

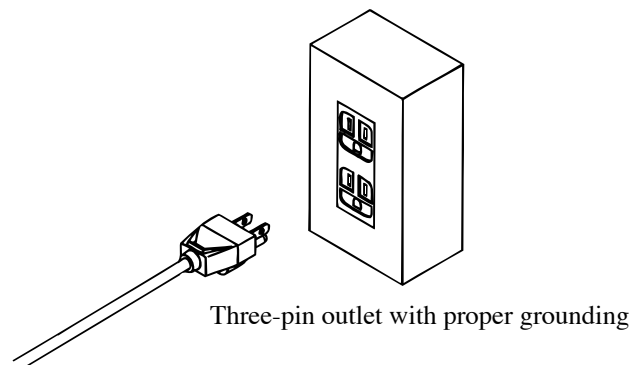


Fig. 2-6 Grounding method

## 2.7 Power Up

### Operation check

1. Turn off (  $\circ$  ) the POWER switch.
2. Check that the power cord is correctly connected.  
See sections 2.5, “Connecting the Power Cord” and 2.6, “Grounding (Earth).”
3. Check that nothing is connected to the DC INPUT (load input terminal) on the front and rear panels.

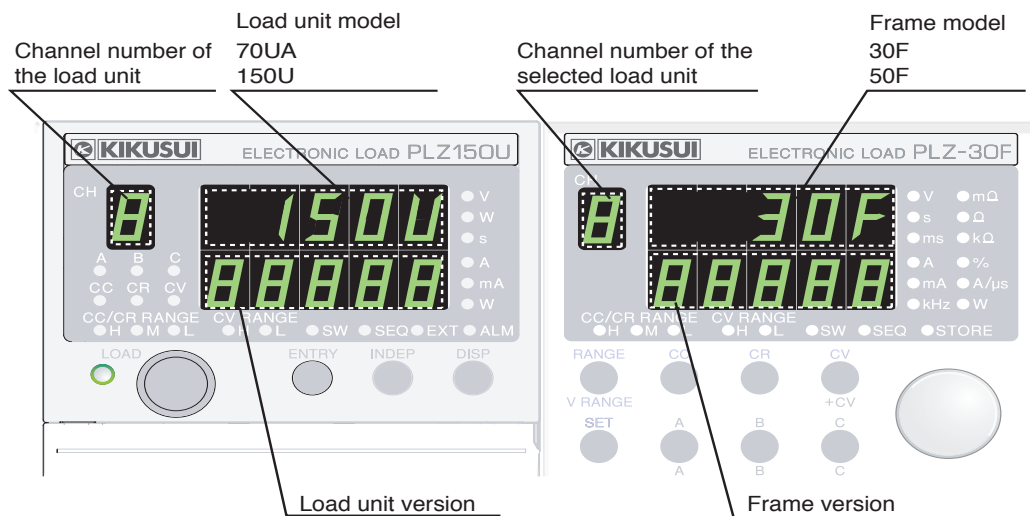


Fig. 2-7 Model and version confirmation screen (example)

4. Turn on (  $\text{I}$  ) the POWER switch.  
All the LEDs illuminate once, and the model and version are displayed.  
The model and version are displayed for approximately 1 second. Then, the load unit displays the measured value, and the frame displays the preset value.

---

**CAUTION** • The power-up operation takes up to 2 seconds per channel depending on the length of the sequence program.

---

5. Check the channel number display of the load unit.  
Channel numbers are assigned to installed slots in order from the left facing the front panel.  
The measured value displayed on the load unit indicates coarse zero.
6. Press the LOAD key of the frame and check that the LED located above and to the left of the key illuminates.
7. Press the LOAD key again and check that the LED located above and to the left of the key turns off.
8. Turn off the POWER switch to finish the operation check procedure.



## **If the PLZ-U does not operate as described in the procedure**

If the condition does not change even after taking the countermeasure indicated below, contact your Kikusui agent.

### **■ Nothing is displayed.**

Turn off the POWER switch and check the power cord connection.

### **■ The load unit freezes while displaying the model and version.**

Turn off the POWER switch and check that the load unit is installed correctly.

### **■ An alarm occurs.**

See section 4.4, “Protection Functions and Alarms”

## 2.8 Load Wiring

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

### 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 as thick wires as possible.

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

Nominal Cross-Sectional Area [mm <sup>2</sup> ]	AWG	(Reference Cross-Sectional Area) [mm <sup>2</sup> ]	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-U when the impedance of the EUT is relatively small. The voltage generated by the load wire inductance (L) and the current variation (I) is expressed using the following equation.

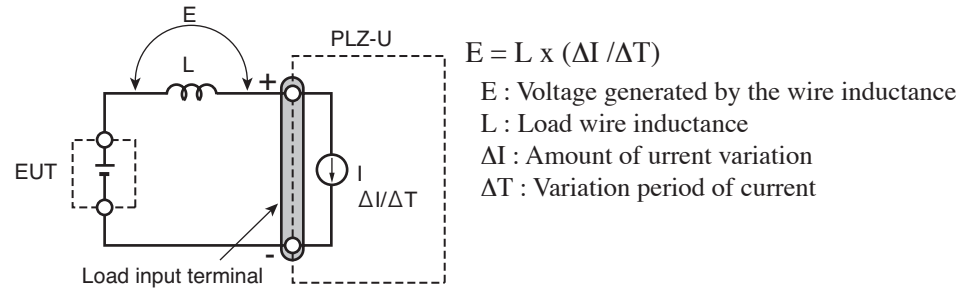


Fig. 2-8 Load wire and inductance

In general, the wire inductance can be measured approximately 1  $\mu\text{H}$  per 1 meter. If the 10 meters of load wires is connected between the EUT and the electronic load (PLZ-U) with the current variation of 2 A/ $\mu\text{s}$ , the voltage generated by the wire inductance will be 20 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, 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 that results when switching occurs 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 electronic load (PLZ-U) 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-U.

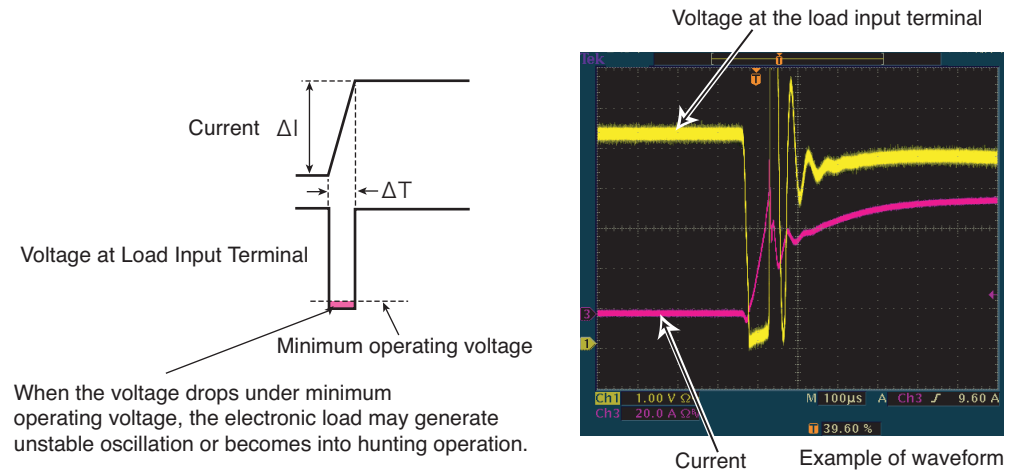


Fig. 2-9 Waveform example: Generate unstable oscillation or hunting operation

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-U and the equipment under test using the shortest twisted wire possible to keep the voltage caused by inductance between the minimum operating voltage and the maximum input voltage range or set a low slew rate.

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

In such settings, the value of  $DI/DT$  will be decreased, accordingly the generated voltage will be reduced even the inductance of load wiring can not be reduced.

In the case of DC operation also, the phase delay of the current may cause instability in the PLZ-U control inducing oscillation. In this case also, connect the PLZ-U 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. 2-10 to alleviate oscillation. In this case, use the capacitor within its allowable ripple current.

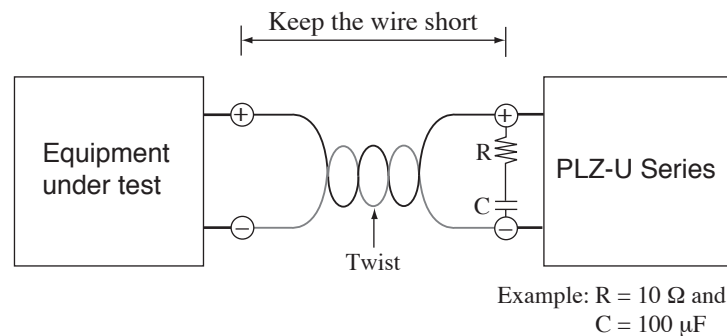


Fig. 2-10 Length of wiring

## ■ 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 an alarm buzzer, and the load is turned off. If this happens, immediately lower the voltage of the equipment under test.

## ■ Polarity

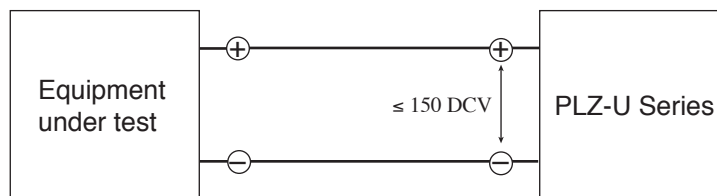
- ⚠ CAUTION** • If the polarity of the connection is reversed, overcurrent will flow and may damage the PLZ-U or the equipment under test.

Be sure to match the polarities between the load input terminal and the equipment under test.

If the polarity is reversed, an alarm message appears along with an alarm buzzer. Immediately turn off the power to the equipment under test.

- NOTE** • The buzzer sounds when a reverse voltage of approximately 0.6 V or greater is applied.

Correct connection



Incorrect connection

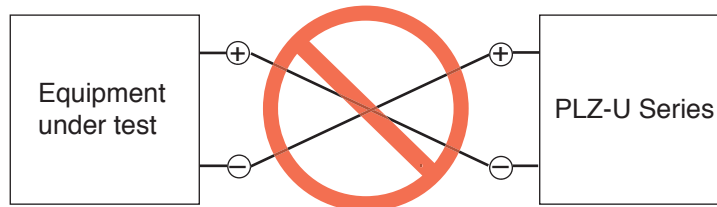


Fig. 2-11 Connect by paying attention to the polarity

## 2.8.2 Connection to the Load Input Terminal on the Rear Panel

- 
- ⚠ WARNING**
- Do not touch the load input terminal while the PLZ-U 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-U. A voltage applied to one end will appear at 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 overheating. Attach crimping terminal to the wire and use the set of screws that came with the package for connection.
- 

### ■ Connection procedure of the load input terminal on the rear panel

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 (Fig. 2-12).
4. Attach the load input terminal cover on the rear panel. For details on how to use the terminal cover, see Fig. 2-13 and Fig. 2-14.
5. Check the polarity of the connection and connect the load wire to the output terminal of the equipment under test.

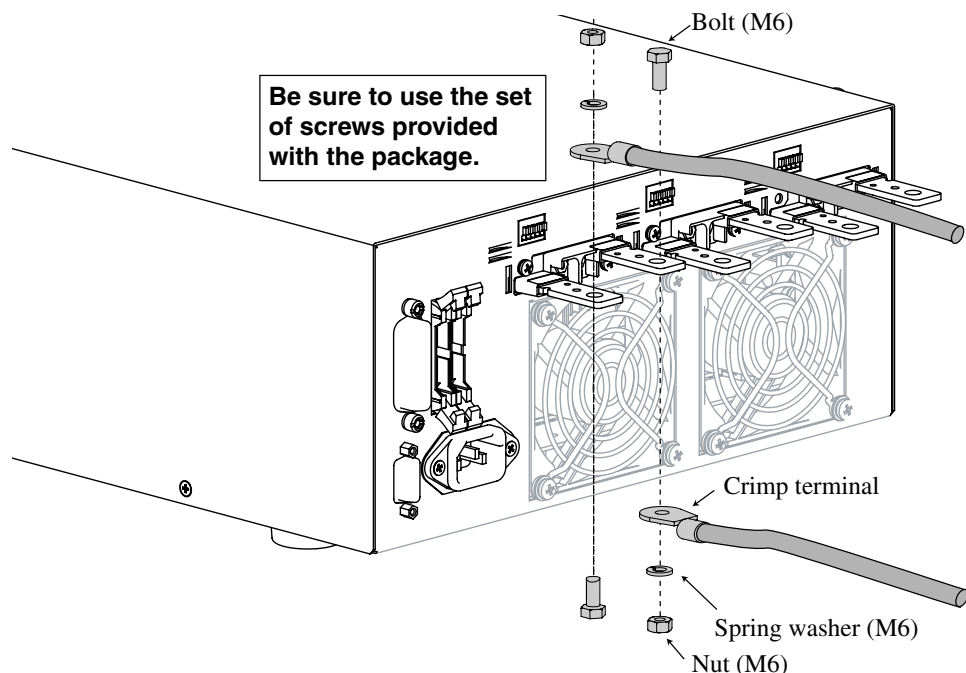


Fig. 2-12 Connection to the load input terminal on the rear panel

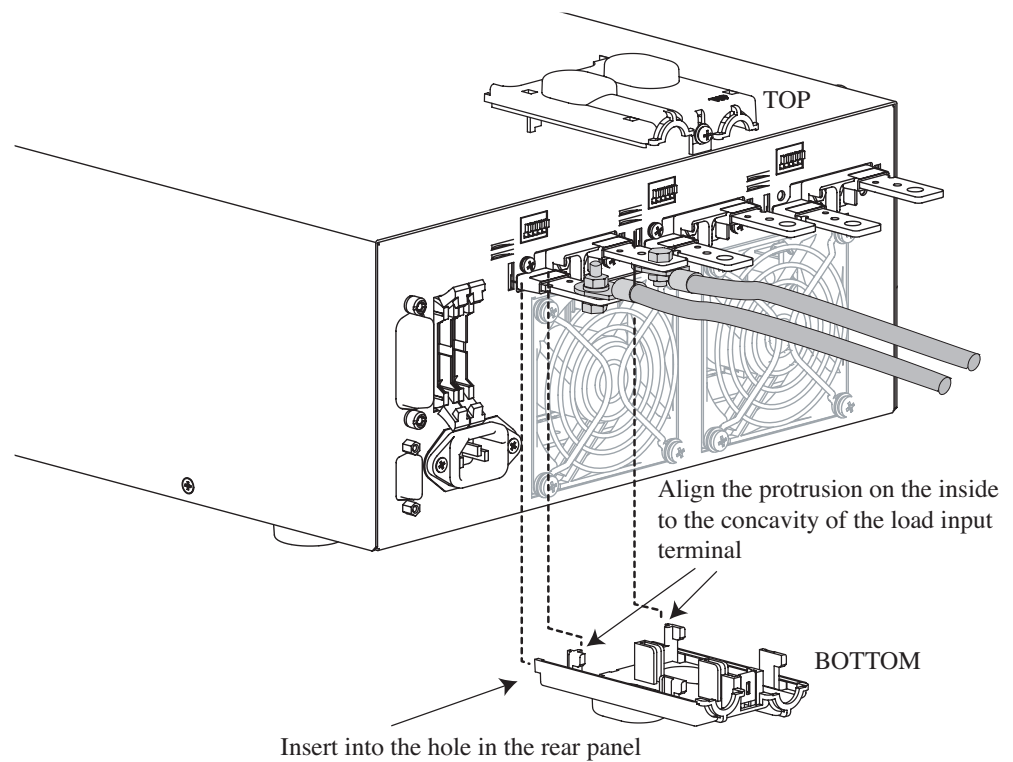


Fig. 2-13 Attachment of the load input terminal cover on the rear panel 1

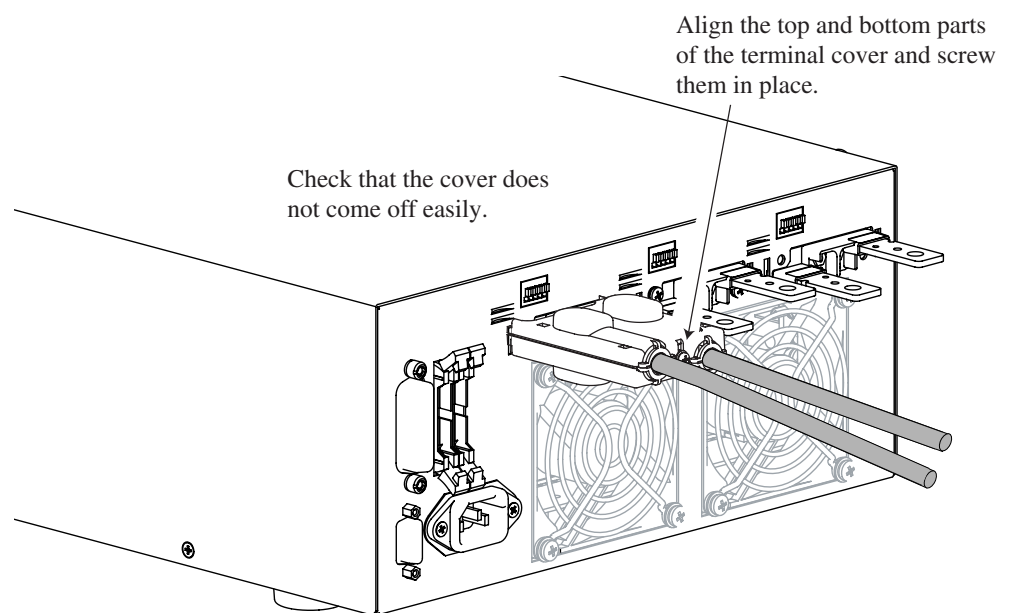


Fig. 2-14 Attachment of the load input terminal cover on the rear panel 2

## 2.8.3 Connection to the Load Input Terminal on the Front Panel

### NOTE

- The specifications of the PLZ-U 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 of the load input terminal on the front panel of each unit is 30 A.

### WARNING

- Do not touch the load input terminal while the PLZ-U is turned ON, as it may lead to electric shock. In addition, be sure to use the binding post cover.
- The load input terminals on the front and rear panels are coupled inside the PLZ-U. A voltage applied to one end will appear at 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 overheating. Attach a crimping terminal to the wire and secure it using the knob.

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. 2-15.
4. Check the polarity of the connection and connect the load wire to the output terminal of the equipment under test.

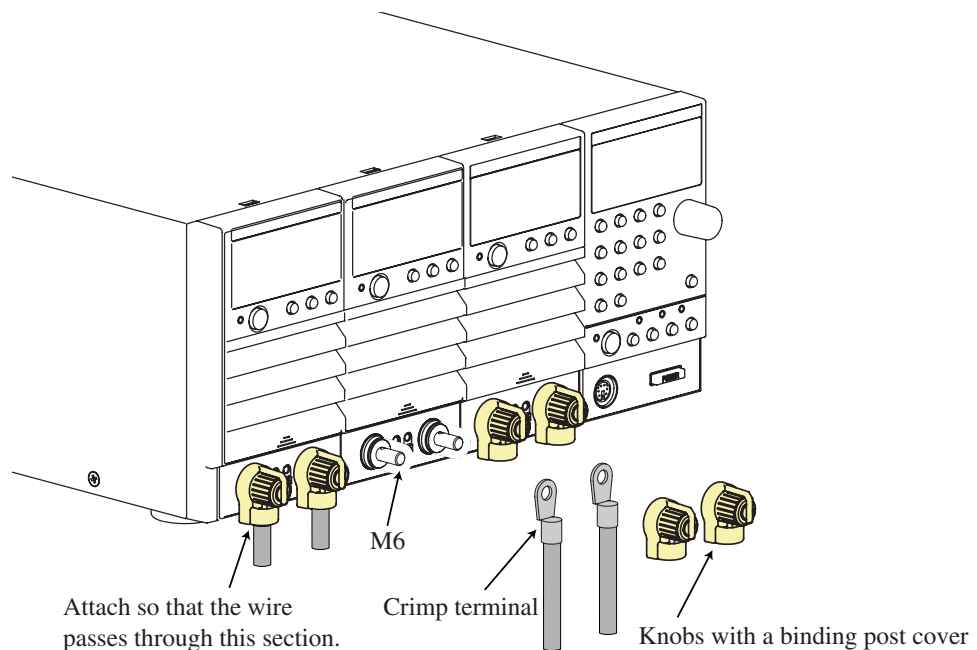


Fig. 2-15 Connection to the load input terminal on the front panel



# 3

## **Chapter 3 Names and Functions of Parts**

This chapter describes the names and functions of parts on the front and rear panels of the frame and load unit.

In the explanations, channels refer to load units that are installed in the frame.

## 3.1 Front Panel

- ⚠ WARNING**
- Do not touch the load input terminal while the PLZ-U 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-U. A voltage applied to one end will appear at 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.
  - Be sure to attach the blank panels to unused slots.
  - Avoid using the PLZ-U in a dusty environment or an environment with poor ventilation.
  - Do not obstruct the air inlet on the front panel and the air outlet on the rear panel.

### 3.1.1 Frame

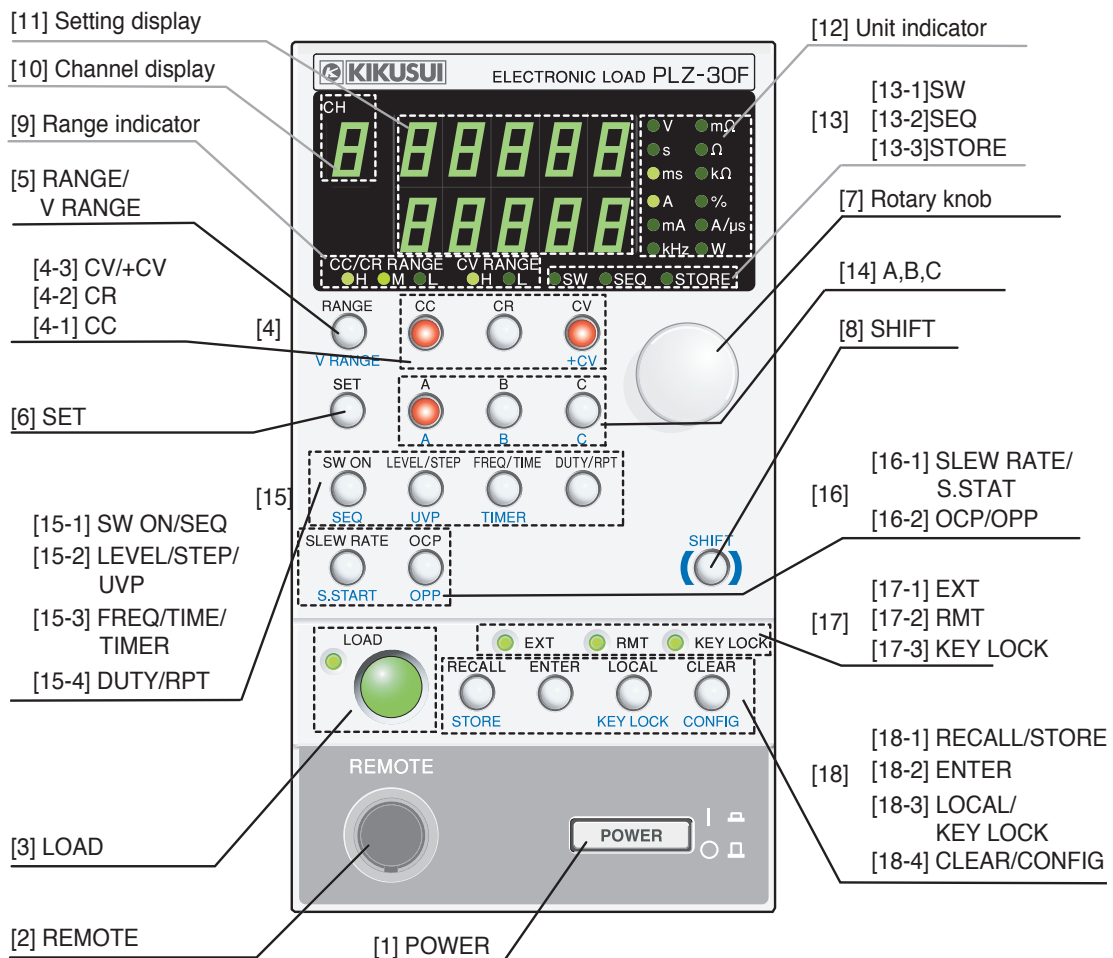


Fig.3-1 Frame front panel

---

**NOTE**

- If you press a key while holding down the SHIFT key, the function indicated below the key 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).
- 

**[1] POWER**

The POWER switch. The power toggles on and off each time the switch is pressed. Press the POWER switch while holding down the SHIFT key (SHIFT + POWER) to reset the panel settings to factory default. For details, see section 5.13, “Factory Default Settings.”

**[2] REMOTE**

A connector for functional expansion. The connector cannot be used currently.

**[3] LOAD key**

Controls the current on all channels. The current is toggled on and off each time the key is pressed. When the load is turned on, the LOAD LED on the frame and the LOAD LEDs of the channels whose load is turned on illuminate. However, channels whose independent mode is on (INDEP key is illuminated) are not affected.

**[4] CC, CR, CV/+CV keys**

Keys for selecting the operation mode of the selected channel. If you press these keys while the load is on, the load is turned off.

**[4-1] CC**

Switches the operation mode to CC. In CC mode, this key and the operation mode indicator of the load unit illuminate.

**[4-2] CR**

Switches the operation mode to CR. In CR mode, this key and the operation mode indicator of the load unit illuminate.

**[4-3] CV/+CV****CV**

Switches the operation mode to CV. In CV mode, this key and the operation mode indicator of the load unit illuminate.

**+CV**

Pressing this key while holding down the SHIFT key (SHIFT + CV) specifies a mode in which CV mode is added to CC mode or CR mode. If the PLZ-U is in CC mode, CC+CV mode is enabled. If the PLZ-U is in CR mode, CR+CV mode is enabled.

**[5] RANGE/V RANGE key**

A Key for selecting the range of the selected channel. If you press this key while the load is on, the load is turned off. After the range changes, the load automatically turns back on.

## **RANGE**

Switches the CC/CV range in the respective operation mode. Each time you press the RANGE key, the range switches in the order L, M, and H. You can check the current range with the range indicator (CC/CR RANGE) of the frame or channel.

## **V RANGE**

Each time you press this key while holding down the SHIFT key (SHIFT + RANGE) when in CV, CC+CV, or CR+CV mode, the CV range switches in the order L and H. You can check the current range with the CV RANGE LED of the frame or load unit.

### **[6] SET key**

Press this key to set the current, resistance, or voltage of CC, CR, or CV mode, respectively, on the selected channel.

In CC+CV or CR+CV mode, press the SET key to switch between current and voltage and set the values.

### **[7] Rotary knob**

The rotary knob is used to set various types of values on the PLZ-U.

### **[8] SHIFT key**

If you press a key while holding down the SHIFT key, the function indicated below the key in blue is enabled. If you press a key without holding down the SHIFT key, the function indicated above the key is enabled.

### **[9] Range indicator**

The LED indicating the range of CC, CR, or CV mode of the selected channel illuminates.

### **[10] Channel display**

Press the ENTRY key on a load unit to display the channel number on the selected load unit.

### **[11] Setup display**

Displays settings, setup memory number, configuration value, etc.

### **[12] Unit indicator**

The LED indicating the unit of the value illuminates.

### **[13] SW, SEQ, and STORE indicators**

#### **[13-1] SW indicator**

The selected channel illuminates in switching mode.

#### **[13-2] SEQ indicator**

The selected channel illuminates in sequence mode.

#### **[13-3] STORE indicator**

Illuminates when waiting for the setup memory to be stored. The indicator turns off when you press the ENTER key and the store operation completes.

## [14] A, B, and C keys

You can save and recall three preset values A, B, and C for each mode and range on the selected channel.

If you press one of these keys while holding down the SHIFT key (SHIFT + A, B, or C), the presets of all the channels can be recalled simultaneously. However, this does not apply to channels whose independent mode is on (INDEP key is illuminated).

## [15] Switching function, sequence function, etc.

### [15-1] SW ON/SEQ key

#### **SW ON**

Turns on or off switching mode on the selected channel. The SW LED illuminates in switching mode. Switching mode is valid in CC or CR mode.

#### **SEQ**

Press this key while holding down the SHIFT key (SHIFT + SW ON) to enter sequence mode on the selected channel. In sequence mode, this key and the SEQ LED of the frame and channel illuminate.

### [15-2] LEVEL/STEP/UVP key

#### **LEVEL**

Press this key to set the switching level of switching mode on the selected channel. In switching mode, the preset value (SET value) and the level value are toggled.

#### **STEP**

Press this key to set the step number of sequence mode on the selected channel.

#### **UVP**

Press this key while holding down the SHIFT key (SHIFT + LEVEL/STEP) to set the undervoltage protection (UVP) value on the selected channel.

### [15-3] FREQ/TIME/TIMER key

#### **FREQ**

Press this key to set the switching frequency of switching mode on the selected channel.

#### **TIME**

Set the step time of sequence mode on the selected channel.

#### **TIMER**

Press this key while holding down the SHIFT key (SHIFT + FREQ/TIME) to set the auto load off timer on the selected channel.

#### [15-4] DUTY/RPT key

##### **DUTY**

Press this key to set the duty cycle of switching mode on the selected channel.

##### **RPT**

Press this key to set the number of program loops on the selected channel.

#### [16] Slew rate, soft start, etc.

##### [16-1] SLEW RATE/S.START key

##### **SLEW RATE**

Press this key to set the slew rate on the selected channel.

##### **S.START**

Press this key while holding down the SHIFT key (SHIFT + SLEW RATE) to set the soft start time on the selected channel.

##### [16-2] OCP/OPP key

##### **OCP**

Press this key to set the overcurrent (OCP) value on the selected channel.

##### **OPP**

Press this key while holding down the SHIFT key (SHIFT + OCP) to set the over-power protection (OPP) value on the selected channel.

#### [17] EXT, RMT, and KEY LOCK indicators

##### **EXT**

Illuminates when the PLZ-U is being controlled using FRAM CONT on the rear panel.

##### **RMT**

Illuminates in remote control mode.

##### **KEY LOCK**

Illuminates when the keys are locked.

#### [18] RECALL/STORE function, etc.

##### [18-1] RECALL/STORE key

##### **RECALL**

Recalls the panel settings saved to the setup memory. When you press this key, the key illuminates, and the memory number is displayed in the setting display. Set the memory number using the rotary knob.

## **STORE**

Displays the setup memory number in which the current panel settings are to be saved. If you press this key while holding down the SHIFT key (SHIFT + RECALL), this key and the STORE indicator illuminate and the memory number is displayed. Set the memory number using the rotary knob.

### **[18-2] ENTER key**

This key is used to enter the memory number when saving or recalling a setup memory.

### **[18-3] LOCAL/KEY LOCK key**

## **LOCAL**

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

## **KEY LOCK**

Each time you press this key while holding down the SHIFT key (SHIFT + LOCAL), the key lock is activated or released. When releasing the lock, hold the key down until a beep is heard.

### **[18-4] CLEAR/CONFIG key**

## **CLEAR**

Clears the alarm when an alarm is activated. However, the alarm can be cleared only when the cause of the alarm has been cleared.

## **CONFIG**

Press this key while holding down the SHIFT key (SHIFT + CLEAR) to enter configuration mode.

### 3.1.2 Load Unit (Channel)

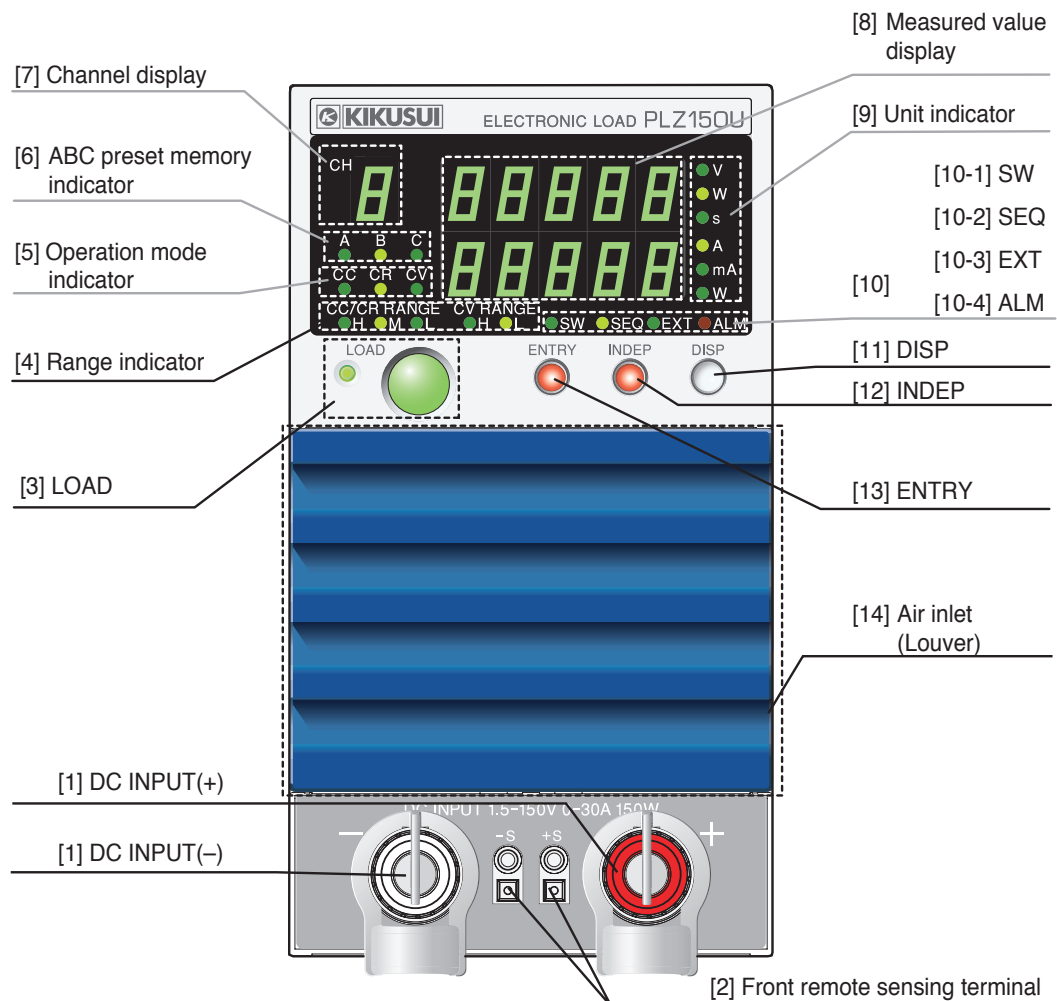


Fig. 3-2 Front panel (load unit)

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

Terminals used to connect the equipment under test to the PLZ-U. The load input terminals are located on the front and rear panels, and they are connected in parallel inside the PLZ-U.

#### [2] Front panel remote sensing terminal

Terminals used to connect the sensing wires. The remote sensing terminals are located on the front and rear panels, and they are connected in parallel inside the PLZ-U.

#### [3] LOAD key

Turns on/off the load on each channel. When the load is turned on, the LOAD LED illuminates.

#### [4] Range indicator

The LED indicating the range of CC, CR, or CV mode illuminates.



## [5] Operation mode indicator

Displays the specified operation mode in green. The actual operation status is indicated in red.

## [6] ABC preset memory indicator

When an ABC preset memory is recalled, the corresponding LED illuminates.

## [7] Channel display

Displays the channel number of the load unit. The channel numbers are assigned to the installed slots from the left facing the front panel starting with CH1.

## [8] Measured value display

Displays the measured value of the load unit in combination with the unit indicator. Displays voltage/current, voltage/power, current/power, elapsed time/alarm, or the input voltage when the load turns off. Press the DISP key to switch the display. An alarm remains displayed until it is cleared.

## [9] Unit indicator

Indicates the unit of the measured value using an LED.

## [10] SW, SEQ, EXT, and ALM indicators

### [10-1] SW

Illuminates in switching mode.

### [10-2] SEQ

Illuminates in sequence mode.

### [10-3] EXT

Illuminates in external control mode.

### [10-4] ALM

Illuminates when an alarm occurs.

## [11] DISP key

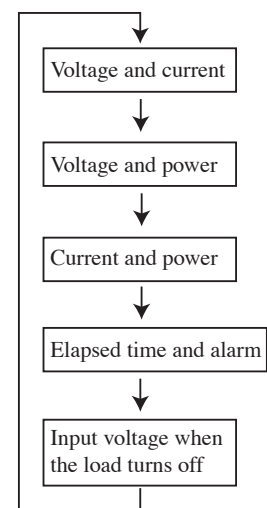
Each time you press this key the measured value display switches. The combination of voltage/current, voltage/power, current/power, elapsed time/alarm, and the input voltage when the load turns off are switched.

## [12] INDEP key

Use this key to operate the load unit independently in terms of turning on/off the load and the ABC preset memory function. This key illuminates when in independent mode.

## [13] ENTRY key

Selects the load unit you wish to operate. When you press this key, the key blinks, and the selected channel number of the selected load unit is displayed on the channel display of the frame.



---

**[14] Air inlet (louver)**

Takes in air to cool the inside of the PLZ-U.

A dust filter is furnished on the inside. Clean the dust filter periodically.

## 3.2 Rear Panel

### ⚠ WARNING

- Do not touch the load input terminal while the PLZ-U 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 connected in parallel inside the PLZ-U. A voltage applied to one end will appear at the other end.
- The remote sensing terminals on the front and rear panels are connected in parallel inside the PLZ-U. A voltage applied to one end will appear at 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.
- Be sure to attach the blank panels to unused slots.
- Avoid using the PLZ-U 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-U.

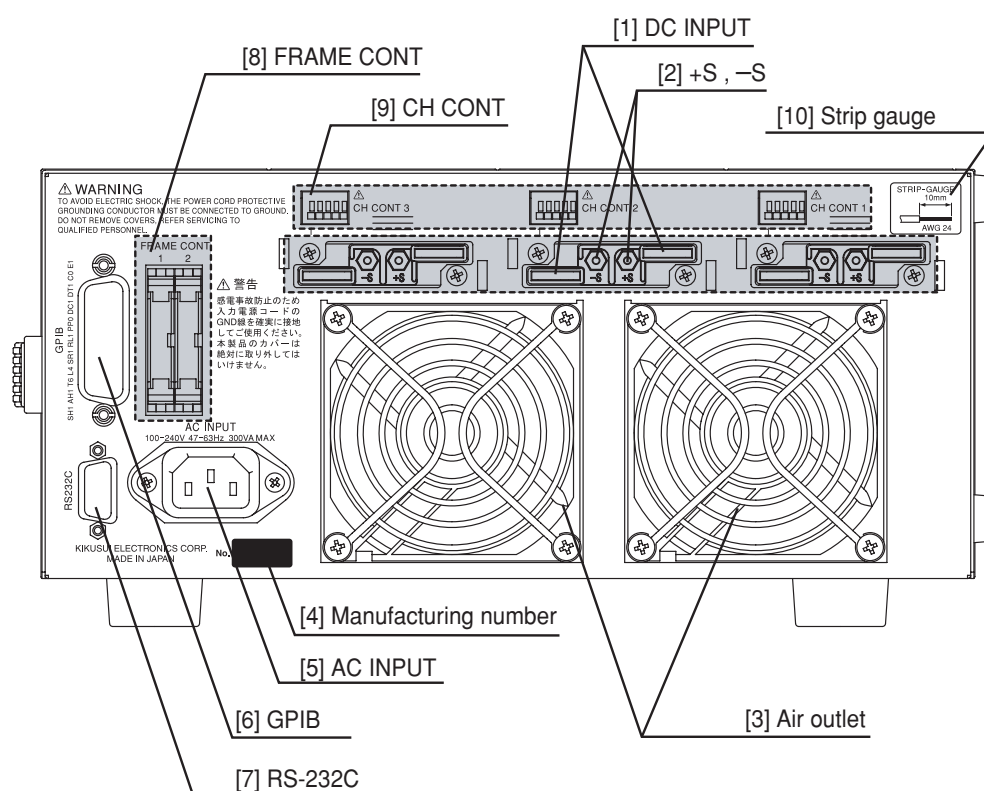


Fig. 3-3 PLZ-30F rear panel (when load units are installed)

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

Terminals used to connect the equipment under test to the PLZ-U. The terminal 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] +S and –S (remote sensing terminals on the rear panel)

Terminals used to connect the sensing wires when correcting the voltage drop caused by the resistance of the load wire. The remote sensing terminals are located on the front and rear panels, and they are connected in parallel inside the PLZ-U.

#### [3] Air outlet

Exhausts the internal air using the cooling fan to cool the inside of the PLZ-U. The speed of the cooling fan increases according to the internal temperature.

#### [4] Manufacturing number (serial No.)

Manufacturing number of the frame.

#### [5] AC INPUT

Connector used to connect the power cord.

#### [6] GPIB

A connector used to connect the GPIB cable when controlling the PLZ-U via GPIB.

#### [7] RS-232C

A connector used to connect the RS-232C cable when controlling the PLZ-U via the RS-232C.

#### [8] FRAME CONT1 and 2

Connectors used to externally control the load on/off, memory recall, and other functions simultaneously on all channels.

#### [9] CH CONT1, 2, 3 (4, 5)

Connectors used to externally control the load on/off and perform external control using external voltage reference on each channel. The connector also provides current monitor output and power supply output for the controller.

#### [10] Strip gauge

Strip gauge for the screwless terminals used on the CH CONT connectors and sensing terminals on the front panel.

# 4

## Chapter 4 Basic Operation

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

# 4.1 Panel Control Basics

## ■ Selecting and setting a channel

Use the ENTRY key on the load unit to select a channel. The selected channel is configured on the frame.

**NOTE**

- LOAD, INDEP, or DISP keys can also be used to select a channel.

## ■ Setting

On the frame, press the function key and then turn the rotary knob to set the value. If you press an invalid key, a buzzer sounds.

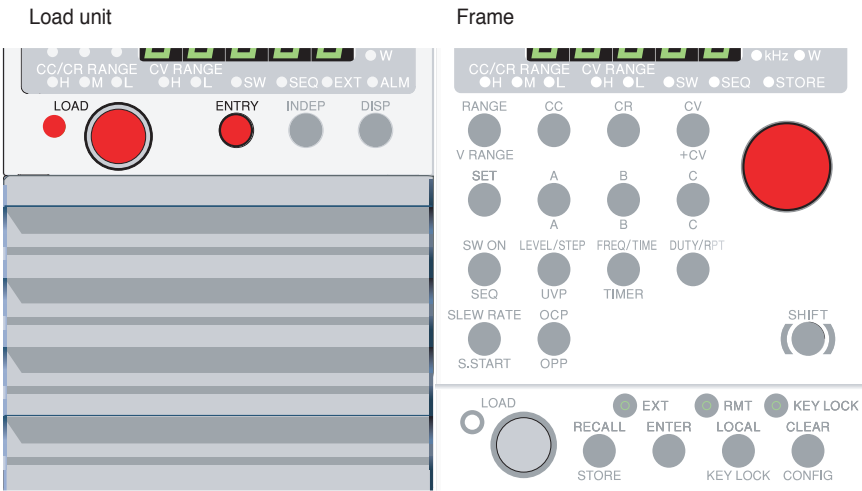


Fig.4-1 Channel selection

## 4.2 Load On/Off

There is a LOAD key on both the load unit and the frame. When the load is turned on, the LED above and to the left of the key illuminates.

If you are repeating the operation of turning on/off the output of the equipment under test when using the PLZ70UA, turn on the output only after the load input terminal voltage reaches approximately 0 V after turning off the output. If you do not, the internal bias power supply stays off, and the specified current may not be supplied.

---

**CAUTION** • When the step-by-step procedure to turning on/off the load was incorrectly performed, it may cause the damage to the PLZ-U. Be sure to follow the procedure as instructed to turning on/off the load.

---



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**NOTE** • If you set the polarity of the load-on external control to low active and open the signal input terminal, you will not be able to turn on the load from the panel. For details, see “Turning the load on/off” in section 5.10.2, “CH CONT Connector.”

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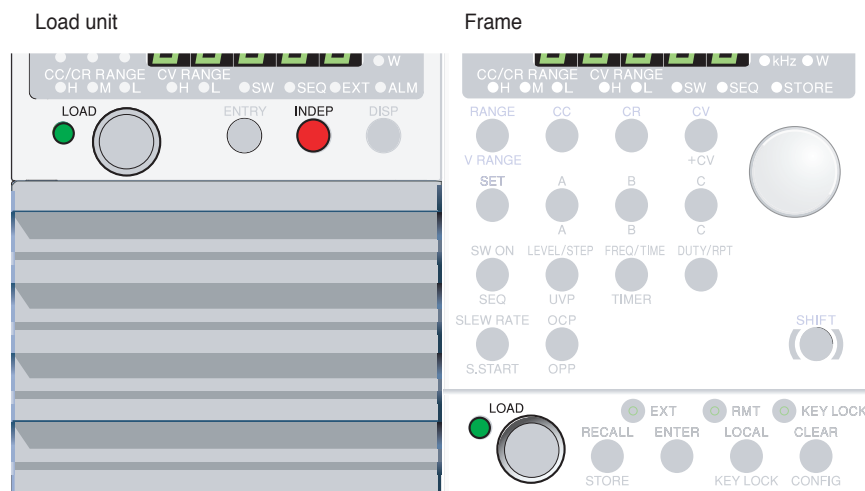


Fig. 4-2 INDEP key and LOAD key

### Load On

#### Turning on/off the load on the multiple channels simultaneously

If you press the LOAD key of the frame, the load is turned on simultaneously on all the channels which are not set to the independent mode.

1. Confirm that the load is turned off on all the channels.
2. Press the INDEP key for the channel on which you do not wish to turn on the load simultaneously, and set the channel to the independent mode.

The INDEP key illuminates.

3. Confirm whether the INDEP key lights off on the channel which you wish to turn on the load, and the INDEP key lights off on the channel which are set to the independent mode.
4. Apply the output of the DUT to the input of the PLZ-U. In case the relay or the electromagnetic switch is used for the connection between the load input terminal and the output terminal of the DUT, turn on the relay or the electromagnetic switch.
5. Press the LOAD key of the frame to turn on the load.  
Turns on the load simultaneously on channels which are not set to the independent mode.

#### **Turning on the load for the single channel.**

1. Confirm that the load is turned off.
2. Apply the output of the DUT to the input of the PLZ-U. In case the relay or the electromagnetic switch is used for the connection between the load input terminal and the output terminal of the DUT, turn on the relay or the electromagnetic switch.
3. Press the LOAD key of the channel which you wish to turn on the load.

### **Load Off**

1. If you wish to turn off the load simultaneously for the multiple channels, press the LOAD key of the frame to turn off the load. When you wish to turn off the load for the single channel, press the LOAD key of the selected channel.
2. Turn off the output of the DUT. In case the relay or the electromagnetic switch is used for the connection between the load input terminal and the output terminal of the DUT, turn on the relay or the electromagnetic switch.

### **Functions related to turning on or off of the load**

#### **■ Delayed load-on**

You can set a delay for the load to turn on. The LOAD LED illuminates when the load turns on after the specified delay time elapses.

You can also disable this function (0 ms). By factory default, the delay is set to 0 ms. For details, see section 5.9, “Configuration Settings.”

#### **■ Powering up with the load turned on**

The load turns on automatically when the power is turned on. By factory default, the load is off at power up. For details, see section 5.9, “Configuration Settings.”

#### **■ Auto load off timer**

A load off timer is built into the PLZ-U. The load turns off the specified time after the load is turned on. By factory default, the timer is turned off.



### ■ External control

An external signal can be used to control the load on/off operation.  
For details, see section 5.10, “External Control.”

### ■ Elapsed time display

Displays the time from load on to load off. You can measure the time from the start of discharge until the cutoff voltage is reached on batteries by using the undervoltage protection (UVP) function in conjunction with this display.

For the procedure of switching the display, see “DISP key” on page 3-9. For details on how to set the undervoltage protection (UVP) function, see section 4.4.3, “Setting the Trip Points.”

### ■ Load off voltage display

Holds the voltage when the load was turned off. You can evaluate batteries by setting the auto load off timer as a condition for turning off the load. The current voltage is displayed when the load is turned on.

For the procedure of switching the display, see “DISP key” on page 3-9.

### ■ Starting up the input current of the PLZ-U responds to follow the rise time of the output voltage

In the constant current (CC) mode and the constant resistance (CR) mode, you can set to start up slowly of the input current of the load (soft start).

For the soft start, see 5.1, “Soft Start.”

## 4.3 Basic Operation

The following three operation modes are available on the PLZ-U. 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)

For a description of each mode, see appendix A.2, “Basic Operation Modes.”

You set the current (A), resistance ( $\Omega$ ), and voltage (V) in CC, CR, and CV modes, respectively.

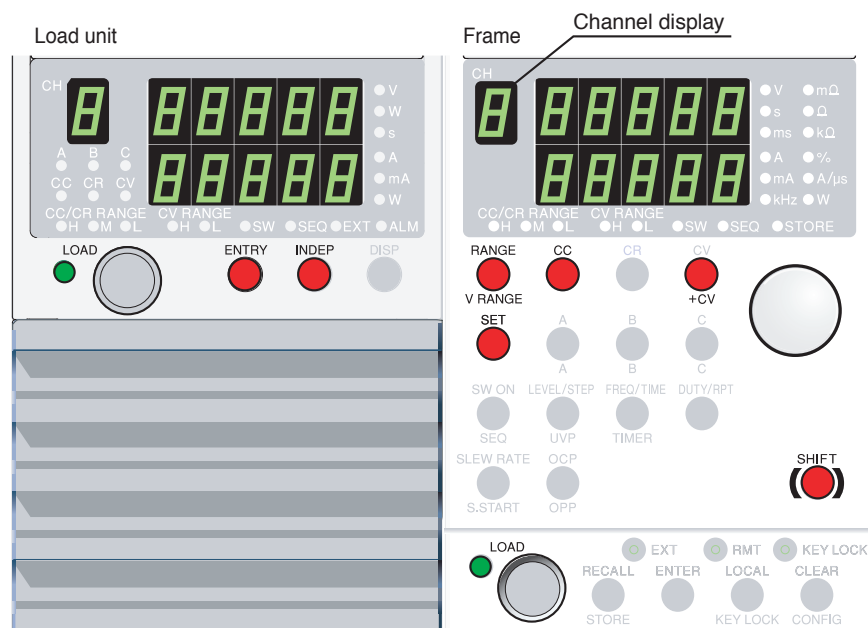


Fig. 4-3 Keys used in CC mode

### ■ Procedure

#### 1. Select the channel.

Press the ENTRY key of the desired channel.

*The ENTRY key of the channel blinks.*

*The channel display of the frame shows the selected channel number, and the settings of the channel can be changed.*

#### 2. Set the operation mode.

Press the CC, CR, or CV key.

*The selected key illuminates and the operation mode is entered.*

If you wish to add CV mode to CC or CR mode, press the +CV (SHIFT + CV) key. To clear +CV mode, press the +CV (SHIFT + CV) key again.

### 3. Sets the range.

In CC or CR mode, press the RANGE key to set the CC/CR range.

*Each time you press the RANGE key, the range LED illuminates in the order L (Low), M (Mid), and H (High), and the range is switched.*

In CV mode, press the V RANGE (SHIFT + RANGE) key to set the CV range.

*Each time you press the V.RANGE (SHIFT + RANGE) key, the range LED (V RANGE) illuminates in the order H (High) and L (Low), and the CV range is switched.]*

---

**NOTE**

- The range value varies depending on the model. For details on the range values of the PLZ-U, see chapter 8, “Specifications”
- 

### 4. Change the setting.

Press the SET key and turn the rotary knob.

If you added +CV mode, CC SET and CV SET toggles each time you press the SET key. Check the unit indicator.

*In CR mode, the resistance ( $\Omega$ ) is shown at the upper section and the conductance (S) is shown at the lower section of the setting display. The conductance unit is not indicated on the display. However, the conductance unit is S when the resistance unit is m $\Omega$  and mS when the resistance is  $\Omega$  or k $\Omega$ .*

### 5. Turn on the load.

If you press the LOAD key of the selected channel, the load is turned on only on the channel.

If you press the LOAD key of the frame, the load is turned on on all channels simultaneously. For channels on which you do not wish to turn on/off the load simultaneously, press the INDEP key to enable independent mode.

*The LOAD LED illuminates, and the current flows. The channel display shows the measured value.*

### 6. Change the setting.

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

Press the A, B, or C key while the load is turned on to recall the saved setting. (For details, see section 5.2, “ABC Preset Memories.”)

### 7. Turn off the load.

If you press the LOAD key of the channel, the load is turned off only on the channel.

If you press the LOAD key of the frame, the load is turned off on all channels simultaneously.

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

## When the DC power supply and the DUT are connected in series, and turning on/off of the DUT.

The following describes for testing the DUT (in CC mode) when the DUT (an open-close device such as a switch) is connected between the load input terminal of the PLZ-U and the output of the DC power supply.

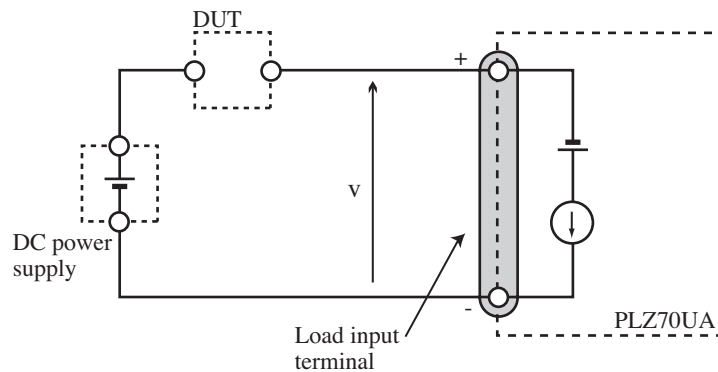


Fig. 4-4 Connecting the DC power supply and the DUT in series

As for the type of 0 V input model PLZ70UA, when the connection between the DC power supply and the PLZ70UA is opened circuit, a reverse voltage is applied to the load input terminal, and the alarm is occurred to turn off the load by the reverse connection protection (RVP). For the reverse connection protection (RVP), see section 4.4.1, "Protection Function."

### ■ To avoid the occurrence of alarm by the reverse connection protection (RVP)

To avoid the occurrence of alarm by the reverse connection protection (RVP), set the operation mode to the "CC+CV" mode, then it is necessary to set the voltage value of the CV at lower than the voltage "V" specified in the Fig. 4-4 when the current flows. The alarm can not be avoided in the CC mode. For the operation of "CC+CV" mode, see section A.2.4, "Operation of the CC+CV Mode."

1. Turn off the DUT.
2. Set the operation mode of the PLZ-U to the "CC+CV" mode.
3. Set the voltage of the CV for approximately 1 V lower than the output voltage of the DC power supply.
4. Set the current of the CC complied to the condition of the DC power supply.
5. Press the LOAD key to turn on the load.
6. Turn on the output of the DC power supply.
7. Turn on the DUT.
8. Turn off the DUT when the test is finished.

Even when you follow the procedure specified above, the alarm may occurs, in such case, it may be required to change the voltage setting of CV to prevent the alarm occurrence. For details, contact your Kikusui agent or distributor.

## 4.4 Protection Functions and Alarms

When a protection function trips and an alarm is activated, the ALM indicator of the corresponding channel illuminates. At the same time, ALARM STATUS (pin 16) of FRAME CONT connector 1 on the rear panel turns on (open collector output).

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 such conditions are detected.

- For the operation of the protection function in each operation mode, see appendix A.2, “Basic Operation Modes.”

### 4.4.1 Protection Function

#### ■ Undervoltage protection (UVP)

The protection trips when the voltage falls below the specified voltage when the load is turned on. 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 4.4.3, “Setting the Trip Points.”

#### ■ Overcurrent protection (OCP)

Overcurrent is detected on the smaller of the two values, the specified overcurrent value or 110 % of the rated current of each range. The overcurrent value can be set in the range of 0 % to 110 % of the rated current of the H range.

Through configuration, you can select whether to turn off the load or limit the current when the protection trips. When current limit is selected, the alarm is cleared when the current falls below the trip point.

- For a description of setting the overcurrent value, see section 4.4.3, “Setting the Trip Points.”
- For a description of configuration settings, see section 5.9, “Configuration Settings.”

#### ■ Overpower protection (OPP)

Overpower is detected on the smaller of the two values, the specified overpower value or 110 % of the rated power of each range. The overpower value can be set in the range of 0 % to 110 % of the rated power of the H range.

Through configuration, you can select whether to turn off the load or limit the power when the protection trips. When power limit is selected, the alarm is cleared when the voltage falls below the trip point.

- For a description of setting the overpower value, see section 4.4.3, “Setting the Trip Points.”
- For a description of configuration settings, see section 5.9, “Configuration Settings.”

### ■ Overheat protection (OHP)

When abnormal temperature is detected in the internal power unit, the load is turned off. Check whether the air inlet on the front panel and the air outlet on the rear panel are being obstructed.

### ■ Overvoltage protection (OVP)

When a voltage greater than or equal to 110 % of the rated operating voltage is detected, the load is turned off.

### ■ Reverse connection protection (RVP)

When a reverse voltage is detected on the load input terminal, the load is turned off. Immediately turn off the output of the equipment under test.

For the PLZ70UA, when the reverse connection protection (RVP) activates while the test connecting with the DC power supply and the DUT in series, see "When the DC power supply and the DUT are connected in series, and turning on/off of the DUT." in section 4.3, "Basic Operation."

## 4.4.2 Alarms

### ■ Alarm number

When an alarm is activated, the ALM indicator of the corresponding channel illuminates. Press the DISP key several times to check the alarm number.

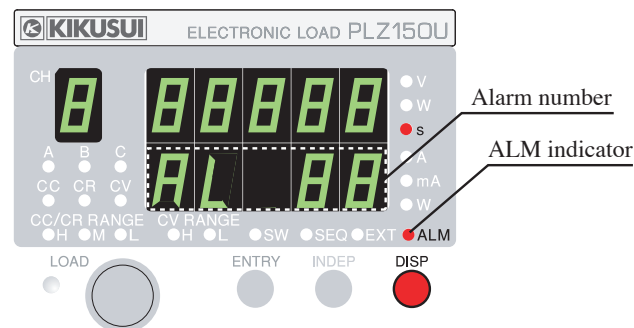


Fig. 4-5 Alarm indication example

Table 4-1 Alarm number

Alarm Number	Alarm Type
1	Undervoltage protection (UVP)
2	Overcurrent protection (OCP)
4	Overpower protection (OPP)
8	Overheat protection (OHP)
16	Overvoltage protection (OVP)
32	Reverse connection protection (RVP)

The alarm type is assigned to each bit inside the PLZ-U as shown in Fig. 4-6. The alarm number is a decimal notation of the bit. Therefore, the alarm number when multiple alarms are activated is the total of the individual alarm numbers.

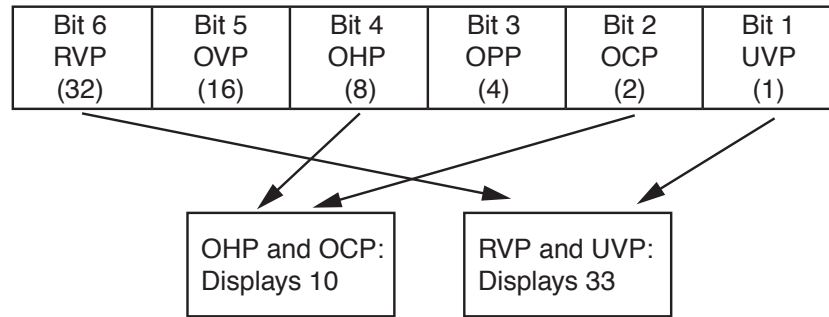


Fig. 4-6 Bit assignment of alarm numbers

### ■ Determining the alarm type from the alarm number total

The alarm numbers are determined in order from the largest value.

Here we will consider the case when the total value of alarm numbers is 10.

1. From the six alarm numbers (Table 4-1), determine the largest alarm number that does not exceed the total value of alarm numbers.

*[a] Total value of alarm numbers: 10*

*[b] The largest alarm number that does not exceed the total value of alarm numbers: 8*

*[c] Alarm number determined from [a] and [b]: 8*

2. Subtract the alarm number determined in step 1 from the total value of alarm numbers.

*[a]-[c]:  $10 - 8 = 2$*

3. Like step 1, determine the largest alarm number that does not exceed the difference value of step 2.

*[d] Difference value of step 2: 2*

*[e] The largest alarm number that does not exceed the difference value of step 2: 2*

*[f] Alarm number determined from [d] and [e]: 2*

4. Subtract the alarm number determined in step 3 from the difference value of step 2.

*[d]-[f]:  $2 - 2 = 0$*

5. Repeat the procedure until the difference value is 0.

*From [c] and [f], we conclude that alarm number 8 (OHP) and alarm number 2 (OCP) have occurred.*

### ■ Clearing alarms

After correcting the cause of the alarm, press the CLEAR key of the frame. The alarm will be cleared.

#### NOTE

- The alarm number will be displayed until the alarm is cleared using the CLEAR key. However, if current limit or power limit is selected for the action to be taken when the OCP or the OPP trips, respectively, the alarm number clears when the cause of the alarm is corrected.

### 4.4.3 Setting the Trip Points

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

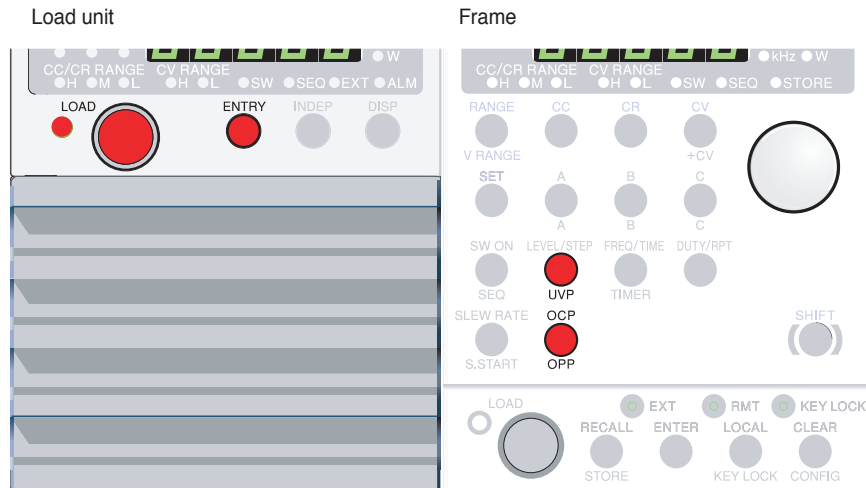


Fig. 4-7 OCP/OPP and UVP keys

#### ■ Setting the OCP and OPP

**1.** Select the channel.

Press the ENTRY key of the desired channel.

**2.** Select OCP or OPP.

To set an overcurrent trip point, press the OCP key. To set an overpower trip point, press the OPP (SHIFT + OCP) key.

*The OCP/OPP key illuminates.*

*For overcurrent, an “A” unit LED illuminates; for overpower, a “W” unit LED illuminates.*

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

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

**NOTE**

- The overcurrent value can be set in the range of 0 % to 110 % of the rated current of H range.
- The overpower value can be set in the range of 0 % to 110 % of the rated power of H range.



## ■ Setting the UVP

1. Select the channel.

2. Select UVP.

Press the UVP (SHIFT + LEVEL/STEP) key.

*The UVP key and a “V” unit LED illuminates.*

3. Set the voltage value.

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

To disable UVP, turn the rotary knob counterclockwise and select oFF.



# 5

## **Chapter 5 Application Operation**

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

## 5.1 Soft Start

The PLZ-U can be set to start up slowly of the input current of the PLZ-U (soft-start) in the constant current (CC) mode when the applying voltage and the turning on the load at the same time, or when the voltage applied with 0 V input of the load input while the load is turned on.

When the soft-start time is appropriately set, the distortion of output voltage from the DUT can be suppressed. Set the soft start in accordance with the rise time of the DUT.

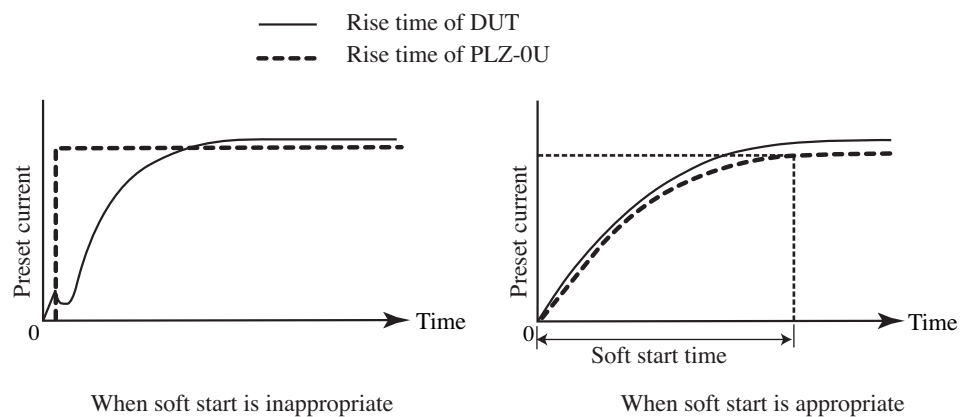


Fig.5-1 Operation of the soft start function

### ■ Procedure

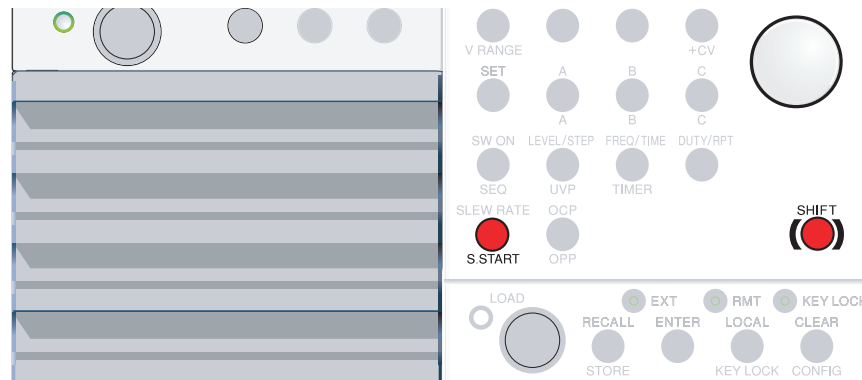


Fig. 5-2 Keys used in soft start

#### 1. Select the channel.

Press the ENTRY key of the desired channel.

*The channel display of the frame shows the selected channel number, and the settings of the channel can be changed.*

#### 2. Switch to soft start setting.

Press the S.START (SHIFT + SLEW RATE) key.

*The S.START key illuminates, and the “ms” unit LED illuminates.*

3. Select the soft start time.

Turn the rotary knob to show the desired soft start time.

You can select the soft start time from 0.1 ms, 1 ms, 3 ms, 10 ms, 30 ms, 100 ms, and 300 ms.

To change the soft start time of another channel, press the ENTRY key of the desired channel to switch the channel.

**NOTE**

- By factory default, the soft start time is set to 1 ms.

## 5.2 ABC Preset Memories

There are three preset memories, A, B, and C, for each range of CC, CR, and CV modes in which settings can be saved. The settings can be recalled or saved at any time even when the load is turned on.

In CC+CV or CR+CV mode, you can recall or save both CC and CV or CR and CV memories.

For factory default settings, see section 5.13.2, “Factory Default Settings of ABC Preset Memories.”

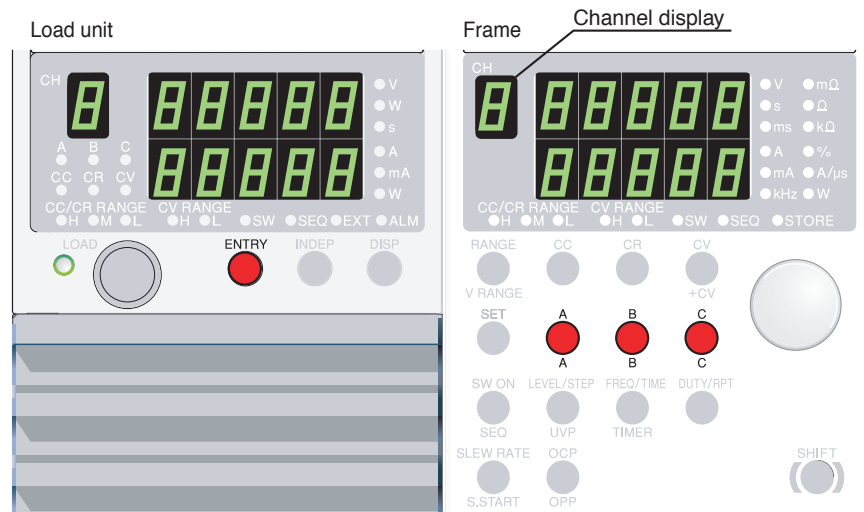


Fig. 5-3 Keys for ABC preset memories

### Saving to ABC preset memories

1. Select the channel.

Press the ENTRY key of the desired channel.

*The ENTRY key of the channel blinks.*

2. Set the operation mode, range, and setting that you wish to save.

**3. Save to the memory.**

Hold down a memory key (A, B, or C) for at least 2 seconds (you will hear a beep sound).

*The key that you held down on the frame illuminates and the preset values are saved to the selected memory. The key that is illuminated turns off when the setting is changed.*

*The ABC preset memory indicator of the channel illuminates.*

## Recalling ABC preset memories

### ■ Recalling the preset on each channel

**1. Select the channel.**

Press the ENTRY key of the desired channel.

*The ENTRY key of the channel blinks.*

**2. Set the operation mode and range.**

**3. Recall the memory.**

Press the A, B, or C key on the frame corresponding to the memory you are recalling.

*The ABC preset memory indicator of the channel illuminates.*

*The preset memory key of the frame illuminates, and the saved settings are displayed. The ABC preset memory indicator and the key that are illuminated turn off when a setting is changed.*

### ■ Recalling all channels simultaneously

You can recall the preset memories of all channels simultaneously. However, this does not apply to channels whose independent mode is on (INDEP key is illuminated).

**1. Set the operation mode and range of each channel.**

**2. Recall the memory.**

On the frame, press the A, B, or C key while holding down the SHIFT key.

*The ABC preset memory indicator of the channel illuminates.*

*The preset memory key of the frame illuminates, and the saved settings are displayed. The ABC preset memory indicator and the key that are illuminated turn off when a setting is changed.*

---

**NOTE**

- The current change rate when a preset memory is recalled with the load is turned on is equal to the specified slew rate (section 5.4, “Setting the Slew Rate”).
-

## 5.3 Switching Function

The switching function operates in CC and CR modes. The PLZ-U switches the pre-set value (SET value) and the level value at the specified switching frequency and duty cycle.

The switching settings are the switching level, switching frequency, duty cycle, and slew rate. These settings can be changed even when the load is turned on.

### NOTE

- Switching operation starts after five times the soft start time or 20 ms, whichever is longer, elapses.
- In the switching operation in CC mode, the power may be limited even if the ALM indicator does not illuminate.
- In the switching operation in CR mode, the power or current may be limited even if the ALM indicator does not illuminate.

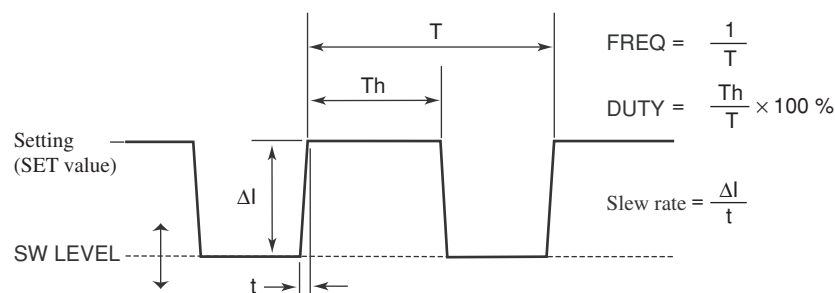


Fig. 5-4 Switching waveform

### ■ Operation

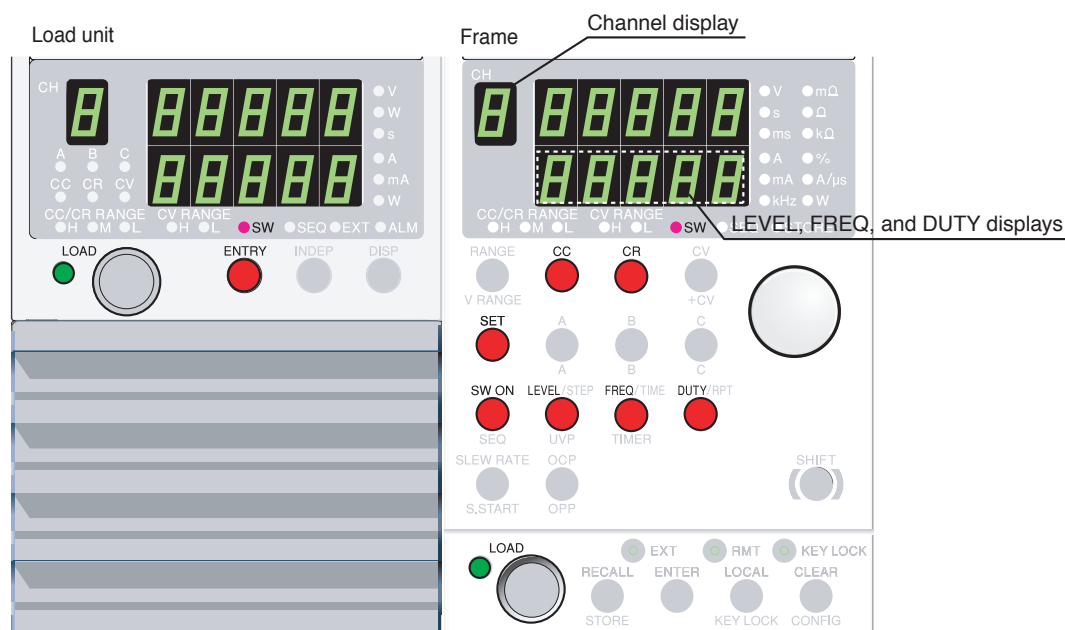


Fig. 5-5 Keys used in the switching function

**1. Select the channel.**

Press the ENTRY key of the desired channel.

*The channel display of the frame shows the selected channel number, and the settings of the channel can be changed.*

**2. Select the operation mode and range.**

Press the CC or CR key.

*The CC or CR key illuminates. The selected channel is set to CC mode or CR mode.*

**3. Set the preset value (SET value).**

Press the SET key and turn the rotary knob.

*The SET key illuminates, and the display switches to the SET display. The corresponding unit indicator LED also illuminates.*

**4. Set the switching level, switching frequency, duty cycle, and slew rate.**

Press each key and turn the rotary knob to change the value.

*The pressed key illuminates, and the corresponding unit indicator LED illuminates.*

**5. Enable switching mode.**

Press the SW ON key.

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



## 5.4 Setting the Slew Rate

The slew rate defines the slope at which the current changes when the current is drastically changed such as in a transient response test. On the PLZ-U, you set the amount of change in the current per unit time according to the CC/CR range.

### ■ Procedure

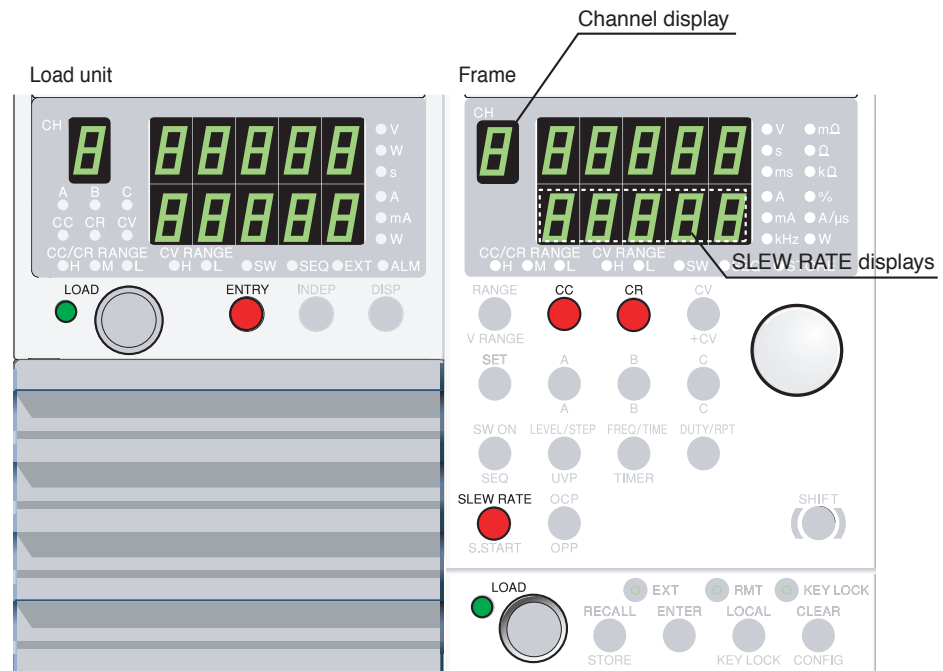


Fig. 5-6 Keys for the slew rate

**1. Select the channel.**

Press the ENTRY key of the desired channel.

*The channel display of the frame shows the selected channel number, and the settings of the channel can be changed.*

**2. Switch to slew rate setting.**

Press the SLEW RATE key.

*The SLEW RATE key illuminates, and the “A/us” unit LED illuminates.*

**3. Select the slew rate.**

Turn the rotary knob to show the desired slew rate.

To change the slew rate of another channel, press the ENTRY key of the desired channel to switch the channel display.

## 5.5 Elapsed Time Display and Auto Load Off Timer

You can achieve two functions that are convenient for the discharge test of batteries by combining the following four functions: elapsed time display, UVP (undervoltage protection), load-off voltage display, and auto load off timer.

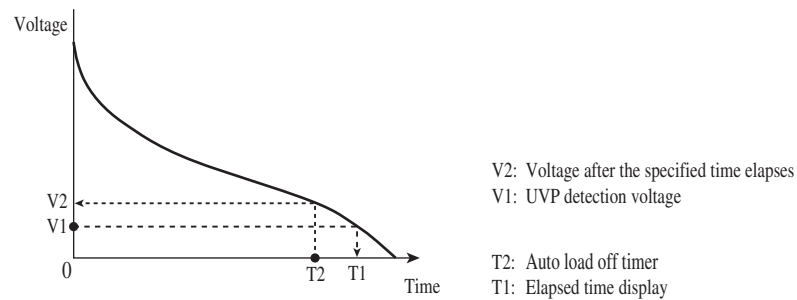


Fig. 5-7 Elapsed time display and auto load off timer

### Time measurement from the start of discharge to the cutoff voltage.

The time from when the load is turned on until the load is turned off due to the tripping of the UVP is measured.

#### ■ Procedure

1. Set the UVP voltage.
2. Switch to the elapsed time display.

For the procedure of setting the UVP voltage, see section 4.4.3, “Setting the Trip Points.” For the procedure of switching the display, see “DISP key” on page 3-9.

### Voltage measurement after a certain time elapses from the start of discharge

After the load is turned on, the load is turned off using the auto load off timer. The voltage that is present when the load is turned off is measured.

#### ■ Procedure

1. Set the auto load off timer.
2. Switch to the elapsed time display.
3. Switch to the load-off voltage display.

For a description of the auto load off timer, see section 4.2, “Load On/Off.” For the procedure of switching the display, see “DISP key” on page 3-9.

## 5.6 Sequence Function

Sequence is a function that automatically runs a stored program one step at a time in CC mode or CR mode. By specifying the setting and execution time of each step, various waveform simulations can be executed.

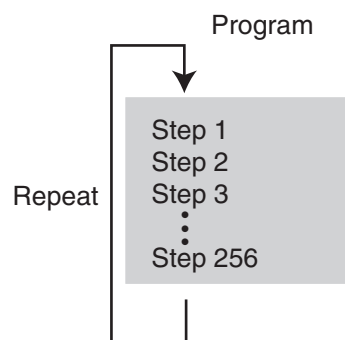
The program is independent for each channel. The program is saved even when the power is turned off through the backup function. The execution of the sequence function starts when you press the LOAD key.

In CC mode, soft start is activated when the execution of the sequence starts.

### ■ Step settings

You enter the setting and execution time for each step. You can set up to 255 steps. You can select whether to turn off the load or keep the load turned on when the sequence completes.

- Step numbers 1 to 256 (the 256<sup>th</sup> step cannot be executed)
- Step execution time 1 ms to 9999 s. 0 specifies the end of the step.
- Number of program loops 0 to 9998. 9999 specifies infinite repetitions.



### 5.6.1 Editing the Sequence

1. Turn off the load.

2. Select the channel.

Press the ENTRY key of the desired channel.

*The channel display illuminates, and the ENTRY key of the channel blinks.*

3. Set the operation mode and range.

Press the CC or CR key to select the operation mode.

*The CC or CR key illuminates and the operation mode is entered.*

Press the RANGE key to set the CC/CR range.

*Each time you press the RANGE key, the range LED illuminates in the order L (Low), M (Mid), and H (High), and the range is switched.*

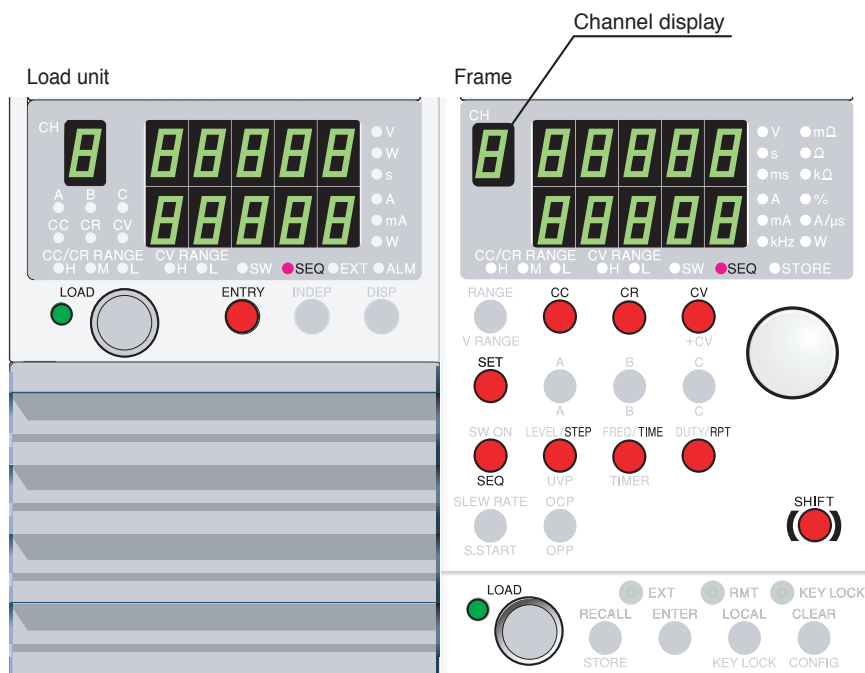


Fig. 5-8 Editing the sequence

**NOTE**

- If you change the operation mode or range while editing a sequence, the sequence settings will be cleared. If you plan to use the sequence settings again, save the sequence to the setup memory and recall it when you need it.

**4. Switch to sequence mode.**

Press the SEQ key while holding down the SHIFT key (SHIFT + SW ON).

*The SEQ key and SEQ indicator illuminate.*

*The selected channel number appears on the channel display.*

**5. Select the step number.**

Press the STEP key and turn the rotary knob to show the desired step number.

*The step number appears at the upper section of the setting display.*

**6. Enter the setting.**

Press the SET key and turn the rotary knob to enter the setting.

*The setting display of the selected operation mode appears.*

**7. Set the execution time.**

Press the TIME key and turn the rotary knob to set the execution time.

*The execution time display appears.*

**8. Repeat steps 5 to 7 as necessary.**

Up to 255 steps can be entered.

To specify the end a sequence, set the TIME (execution time) of the last step to 0.

**9. Set the number of program loops.**

Press the PRT key. Turn the rotary knob to set the number of program loops.

You can specify an infinite loop by setting RPT (the number of program loops) to 9999.

**10. Exit from sequence mode.**

Press the SEQ key while holding down the SHIFT key (SHIFT + SW ON).

*The SEQ (SHIFT + SW ON) key turns off and sequence mode is disabled.*

**11. Set whether to turn off the load or keep the load turned on at the completion of the sequence.**

Set last load in the configuration settings. For details, see section 5.9, “Configuration Settings.”

## 5.6.2 Executing the Sequence

You can execute a sequence on a specified channel or on all channels simultaneously. To start the execution of a sequence, press the LOAD key. To stop, press the LOAD key again.

---

**NOTE**

- You can select whether to keep the load turned on or turn off the load at the completion of the sequence. For details, see “Last load” in section 5.9, “Configuration Settings.”
  - In CC mode, soft start is activated at the start of the sequence execution. Therefore, the current will not reach the preset value during the soft start time. To avoid this behavior, enter a 0 A setting in step 1 for a time longer than or equal to five times the selected soft start time or 20 ms, whichever is longer.
- 

**1. Turn off the load.**

**2. Enter sequence mode.**

Press the SEQ key while holding down the SHIFT key (SHIFT + SW ON).

*The SEQ (SW ON) key and SEQ indicator illuminate. Sequence mode is enabled.*

**3. Execute the sequence (turn on the load).**

When the load turns on, the sequence is executed in order from step 1. If you press the LOAD key of a channel, the sequence is executed only on the specified channel. If you press the LOAD key of the frame, the sequence is executed on all channels simultaneously. In this case, channels whose INDEP key is turned on are excluded.

For a description of the INDEP key, see “INDEP key” on page 3-9.

#### 4. Stopping the sequence

Press the LOAD key (turn off the load).

*Turn off the load.*

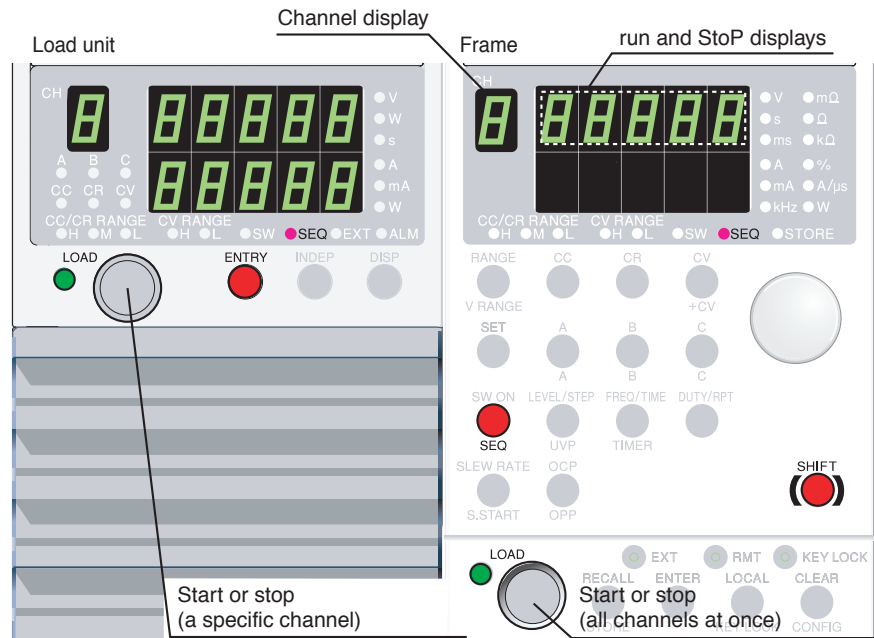


Fig. 5-9 Executing the sequence

## 5.6.3 Example Sequence

This section describes the procedure of entering the following example sequence.

- **Flow of the example sequence**

In this example, we will create a program based on Fig. 5-10.

The program repeats steps 1 to 8 three times. After repeating the sequence three times, the load is turned off and the sequence ends.

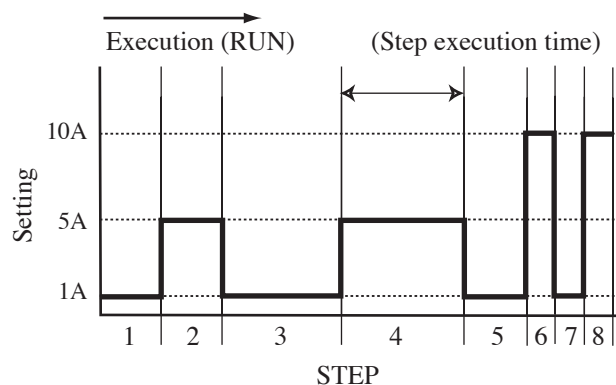


Fig. 5-10 Sequence execution example

Table 5-1 Sequence Program Creation Table

Program name: Example		Date:	By:
Channel numbers (1 to 5)	1 (PLZ150U)		
Memo	Repeat steps 1 to 8 three times. After repeating the sequence three times, turn off the load and end the sequence.		
Operation mode	CC		
Range (A)	H:30 (A)		
RPT (1 to 9999)	3		
Last load (OFF/ON)	OFF		

Step Number	Value	Execution Time	Note
1	1 A	100 s	
2	5 A	100 s	
3	1 A	200 s	
4	5 A	200 s	
5	1 A	100 s	
6	10 A	50 s	
7	1 A	50 s	
8	10 A	50 s	

## Creating the program

1. Turn off the load.
2. Select the channel.  
Press the ENTRY key of channel 1.
3. Set the operation mode.  
Press the CC key to select the operation mode.
4. Sets the range.  
Press the RANGE key to set the CC/CR range to H.
5. Enter sequence mode.  
Press the SEQ key while holding down the SHIFT key (SHIFT + SW ON).  
*The SEQ (SHIFT + SW ON) key and SEQ indicator illuminate.  
Sequence mode is enabled.*
6. Select the step number to be entered.  
Press the STEP key. Turn the rotary knob to set the step number to 1.
7. Enter the setting.  
Press the SET key. Turn the rotary knob to set the value to 1.000.
8. Set the execution time.  
Press the TIME key. Turn the rotary knob to set the value to 100.
9. Repeat steps 6 to 8 as necessary.  
Enter settings for steps 2 to 8.
10. Set the number of program loops.  
Press the PRT key. Turn the rotary knob to set the number of program loops to 3.
11. Exit from sequence mode.  
Press the SEQ key while holding down the SHIFT key (SHIFT + SW ON).
12. Set the load to turn off at the completion of the sequence.  
To enter the setting, use the configuration settings. For details, see section 5.9, “Configuration Settings.”  
The settings are saved. If no changes are made, you do not have to save the settings again.

The program in Table 5-1 has been created.



## 5.7 Remote Sensing Function

Remote sensing is a function used to compensate for the voltage drop caused by the resistance of the load wire when it cannot be neglected. Execute remote sensing to accurately set the resistance and voltage and measure the voltage and power.

Since remote sensing improves the transient characteristics in CR, CV and CP modes, operational stability can be achieved.

### ⚠ CAUTION

- If the load wire comes loose while executing remote sensing, the PLZ-U may malfunction. Check that the connection is secure. You can prevent accidents by connecting a protection fuse (see Fig. 5-9). Use a fuse with a rated current of 0.1 A and a rate voltage greater than the output voltage of the equipment under test.
- Pay attention to the polarity of remote sensing. Reversing the connection can cause damage to the PLZ-U. Insert a protection fuse in the wiring.
- If you are not using remote sensing, remove the remote sensing wires from the PLZ-U.

### ■ Remote sensing wiring

#### NOTE

- Use AWG24 wires for the remote sensing terminals on the front panel. Use AWG24 or thicker wires for the remote sensing terminals on the rear panel.
- For the remote sensing terminals on the rear panel, use crimp terminals for M3 screws.

1. Turn off the output of the equipment under test.

2. Connect the PLZ-U and the equipment under test.

Connect the +S and -S remote sensing terminals to the positive (+) and negative (-) terminals on the equipment under test, respectively.

The remote sensing should be wired at the nearest to the EUT.

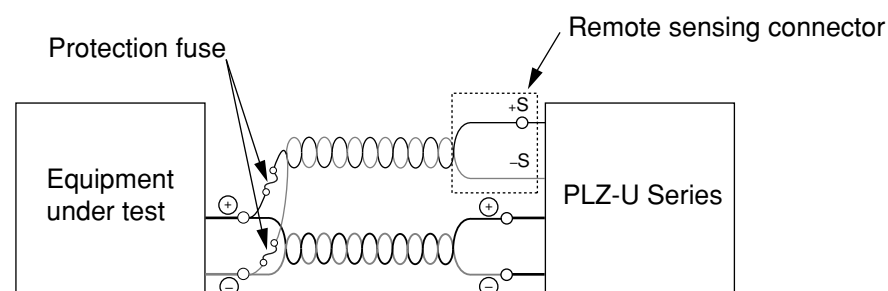


Fig. 5-11 Remote sensing wiring

# 5.8 Key Lock Function

You can lock the keys so that settings, memory, and sequence cannot be changed. The table below lists the keys that are operational even in a key locked condition.

Table5-1 Keys that are operational in a key locked condition

Channel	LOAD key (turn the load on/off)
	DISP key (switch the display)
Frame	LOAD key (turn the load on/off)
	CLEAR key (clear alarms)
	KEY LOCK (SHIFT + LOCAL) key (clear key lock)
	LOCAL key (release RMT)

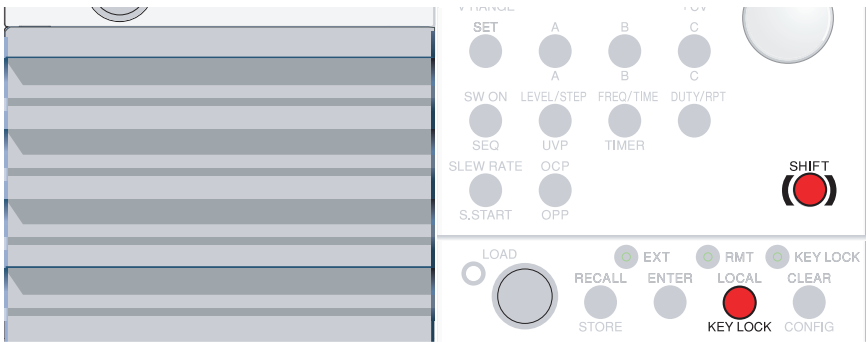


Fig. 5-12 Keys for the key lock function

## ■ Setting the key lock

Press the KEY LOCK (SHIFT + LOCAL) key.

*The KEY LOCK LED illuminates and the keys are locked.*

## ■ Clearing the key lock

Hold down the KEY LOCK (SHIFT + LOCAL) key until the KEY LOCK LED turns off. When the KEY LOCK LED turns off, the key lock is cleared.

## 5.9 Configuration Settings

Table 5-2 indicates the configuration items.

Table 5-2 Configuration settings

CONFIG Number	Item	Selectable Values *1	Relevant Function
1	Number of units operating in parallel	<u>1</u> , 2, 3, 4, or 5*2	Section 5.11, "Parallel Operation"
2	External voltage reference	<u>0</u> , 1, or 2	Section 5.10.2, "CH CONT Connector"
3	Function for turning the load off in the OCP	<u>OFF</u> or ON	Section, 4.4.3, "Setting the Trip Points"
4	Function for turning the load off in the OPP	<u>OFF</u> or ON	Section, 4.4.3, "Setting the Trip Points"
5	Delayed load-on time setting	<u>0 ms</u> to 1 s	Section 4.2, "Load On/Off"
6	Last load	<u>OFF</u> or ON	Section 5.6, "Sequence Function"
7	Polarity of the load-on external control	<u>H</u> or L	Section 5.10.2, "CH CONT Connector"
8	Powering up with the load turned on	<u>OFF</u> or ON	Section 4.2, "Load On/Off"
9	Communication function selection	<u>GPIO</u> or 232	Chapter 6, "Remote Control"
10	GPIO address	<u>1</u> to 30	Section 6.4.1, "GPIO Control"
11	RS-232C baud rate	2400, 4800, 9600, or <u>19200</u> bps	Section 6.4.2, "RS-232C Control"

\*1. Underlined values are factory defaults.

\*2. Up to 3 on the PLZ-30F

### ■ Procedure

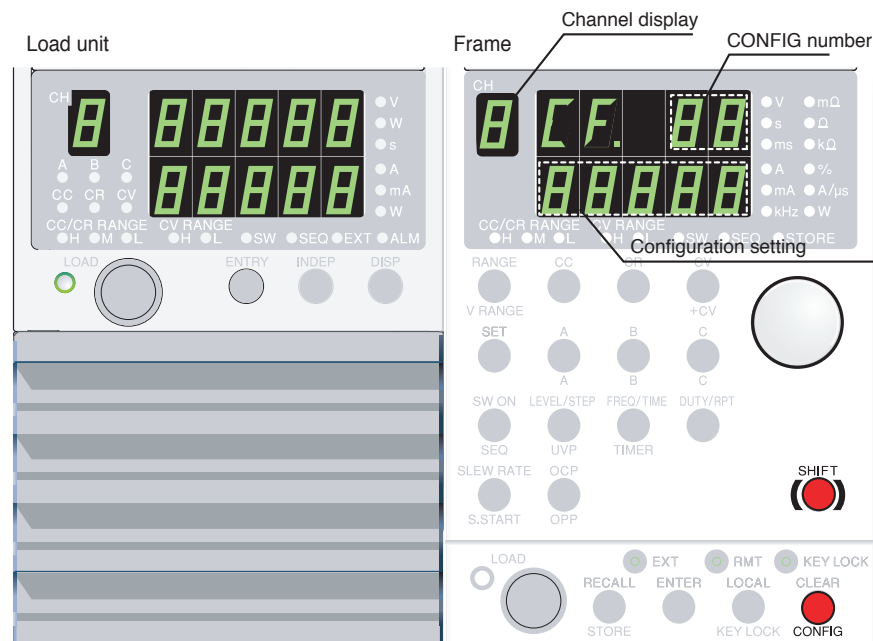


Fig. 5-13 Keys for the configuration settings and display

1. Check that the load is turned off.  
Check that the LOAD LED of each channel is turned off. If it is on, press the LOAD key to turn the load off.
2. Select the channel.  
Press the ENTRY key of the desired channel.  
*The ENTRY key of the channel blinks. The channel display of the frame shows the selected channel number.*
3. Switch to configuration settings.  
Press CONFIG (SHIFT + CLEAR).
4. Select the CONFIG number.  
Turn the rotary knob to switch the CONFIG number.  
*The upper section of the frame display shows the current configuration number.*
5. Change the configuration setting.  
While holding down the SHIFT key turn the rotary knob to change the configuration setting.
6. Terminate the configuration setting.  
Press the CLEAR key.

## Configuration settings

### ■ Number of units operating in parallel (CONFIG number 1)

Parallel operation is possible on adjacent load units of the same type in the frame when the same operation mode and range are specified.

Selectable Values	Description
1	No parallel connection
2 to 5	The number of units connected in parallel

### ■ External voltage reference (CONFIG number 2)

Select the operation mode in which the external voltage reference of the load unit will be used.

Selectable Values	Description
0	No external control
1	The external voltage reference is used for CC control in CC or CC+CV mode, CR control in CR or CR+CV mode, or CV control in CV mode
2	The external voltage reference is used for CV control in CC+CV mode or CR+CV mode.

### ■ Function for turning the load off in the OCP (CONFIG number 3)

Selects whether to turn off the load or limit the current when the OCP trips.

Selectable Values	Description
OFF	Do not turn the load off (current limit operation)
ON	Turn the load off

### ■ Function for turning the load off in the OPP (CONFIG number 4)

Selects whether to turn off the load or limit the power when the OPP trips.

Selectable Values	Description
OFF	Do not turn the load off (power limit operation)
ON	Turn the load off

### ■ Delayed load-on time setting (CONFIG number 5)

Set the delay time for turning on the load.

Selectable Values	Description
0 ms to 1 s	Delay time

### ■ Last load (CONFIG number 6)

Set whether to keep the load turned on or turn the load off at the completion of the sequence.

Selectable Values	Description
ON	Keep the load turned on at the completion of the sequence
OFF	Turn the load off at the completion of the sequence

### ■ Polarity of the load-on external control (CONFIG number 7)

Set the polarity of the LOAD ON signal from the CH CONT connector.

Selectable Values	Description
L	Low active
H	High active

## ■ Powering up with the load turned on (CONFIG number 8)

Set whether to turn on/off the load at power on.

Selectable Values	Description
ON	Automatically turn the load on at power on
OFF	Keep the load turned off at power on

## ■ Communication function selection (CONFIG number 9)

Select GPIB or RS-232C.

Selectable Values	Description
GPIB	GPIB
232	RS-232C

- After changing the setting, power cycle the PLZ-U. The new setting takes effect by power cycling.

## ■ Setting the GPIB address (CONFIG number 10)

Set the GPIB address.

Selectable Values	Description
1 to 30	GPIB address

- After changing the setting, power cycle the PLZ-U. The new setting takes effect by power cycling.

## ■ RS-232C baud rate setting (CONFIG number 11)

Set the RS-232C baud rate.

Selectable Values	Description
2400	2400 bps
4800	4800 bps
9600	9600 bps
19200	19200 bps

- After changing the setting, power cycle the PLZ-U. The new setting takes effect by power cycling.

## 5.10 External Control

There are two methods of external control. One method is by using the FRAME CONT connector of the frame. The other is by using the CH CONT connector of the channel.

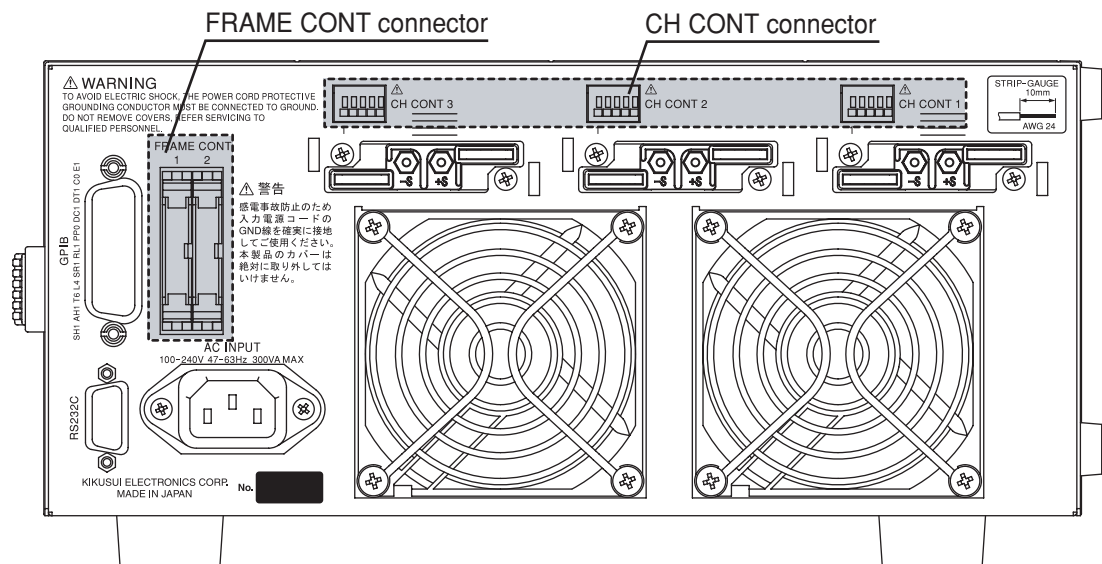


Fig. 5-14 External control

### 5.10.1 FRAME CONT Connector

The FRAME CONT connector consists of connector 1 and connector 2. Connector 1 is used for external control and inter-frame control. Connector 2 is used for inter-frame control.

You can recall ABC preset memories and setup memories and turn the load on/off. The connector also provides status outputs for load-on and alarms.

Inter-frame control is used by connecting multiple frames. From a single frame, you will be able to recall ABC preset memories and setup memories and turn the load on/off. Both connectors are standard MIL 20-pin connectors. Table 5-4 shows the pin arrangement of the connector.

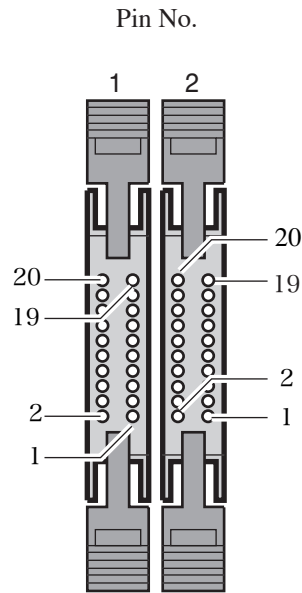
#### ⚠ CAUTION

- To disconnect the connector, release the lock levers located on either side.
- Be sure to turn off the POWER switch when attaching or removing the connector.

#### NOTE

- Be sure to use a flat cable with a strain relief. To press-fit discrete wires or flat cables, be sure to use a dedicated tool.

Table5-3 Pin numbers and compatible connectors



Manufacturer	Compatible Connector	Note
Omron	XG5M-2032 or XG5M-2035 XG5S-1001 (2 pcs.)	For discrete wires
	XG4M-2030 XG4T-2004	For flat cables
KEL	6200-020-601	

Table 5-4 Pin arrangement of connector 1

Pin No.	Signal Name	Input/Output	Function
1	A	Input <sup>*1</sup>	Recall preset memory A of all channels simultaneously
2	B		Recall preset memory B of all channels simultaneously
3	C		Recall preset memory C of all channels simultaneously
4	AUX		Reserved
5	MEM0		Recall the setup memory 0
6	MEM1		Recall the setup memory 1
7	MEM2		Recall the setup memory 2
8	MEM3		Recall the setup memory 3
9	ENABLE		Enable the turning on/off of the load, recalling of presets ABC, and recalling of setup memories 0 to 3. <sup>*2</sup>
10	LOAD ON		Turn on the load on all channels simultaneously
11	N.C.	N.C.	N.C.
12	N.C.		
13	N.C.		
14	N.C.		
15	LOAD STATUS	Output <sup>*3</sup>	Turns on when the load is on
16	ALARM STATUS		Turns on when the alarm is activated
17	+5VIF		5 V and maximum output current of 100 mA
18	N.C.	N.C.	N.C.
19	GND	GND	GND (chassis electric potential)
20	GND		

\*1. Input: Low active, pulled up to 5 V through 10 k $\Omega$  (low level input voltage: 0 V to 1 V, high level input voltage: 4 V to 5 V). The ENABLE pin is active at low level signal.

In the recalling of the ABC preset memories and setup memories, if multiple signals are set to low level, the signal that is set to low level last is valid.

\*2. When ENABLE is at low level, the following operations cannot be executed from the panel: recalling a preset memory, recalling a setup memory, and turning the load on.

\*3. Output: Open collector, output withstand voltage of 30 VDC, output saturation voltage of approximately 1.1 V, and maximum output current of 100 mA



## Turning on/off the load on all channels simultaneously

Like the LOAD key of the frame, you can turn on/off the load on all channels simultaneously. To do so, apply external signals across pins 10 and 20 (LOAD ON) and pins 9 and 20 (ENABLE) of the FRAME CONT connector.

When the load is turned on externally, the LOAD switch on the panel is active. However, when the load is turned off externally, the LOAD switch cannot be used to turn the load on.

## Recalling ABC preset memories

You can recall preset memories. Apply an external signal across pins 1 and 20 (A), pins 2 and 20 (B), or pins 3 and 20 (C) of the FRAME CONT connector for memories, A, B, or C, respectively. At the same time, apply an external signal across pins 9 and 20 (ENABLE).

## Recalling setup memories

You can recall setup memories. Apply an external signal across pins 5 and 20 (MEM 0), pins 6 and 20 (MEM 1), pins 7 and 20 (MEM 2), or pins 8 and 20 (MEM 3) of the FRAME CONT connector for memories 0, 1, 2, or 3, respectively. At the same time, apply an external signal across pins 9 and 20 (ENABLE).

## Load status

When the LOAD LED of the frame illuminates, the signal is output across pins 15 and 20 (LOAD STATUS) of the FRAME CONT connector.

When the load is turned on with the LOAD switch of the load unit or by remote control, the signal is not output.

If inter-frame control is being used, the signal is output when the LOAD LED of any frame illuminates.

## Alarm status

Notifies that an alarm is occurring on some channel. The signal is output across pins 16 and 20 (ALARM STATUS) of the FRAME CONT connector.

## Inter-frame control

By connecting multiple frames, you can turn the load on/off, recall ABC preset memories or setup memories on other frames from a single frame.

When using external frame control, FRAME CONT connector 1 (input signal of Table 5-4) of the first frame is used. When operating from the panel, use the first frame.

Up to 5 frames can be linked.

### ■ Connection procedure

1. Check that the power is turned off.  
Check that the power to all frames is turned off.  
If the power is turned on, press the POWER switch to turn off the power.
2. Connect the FRAME CONT connector of each frame.  
Refer to Fig. 5-15 and securely connect the FRAME CONT connectors.

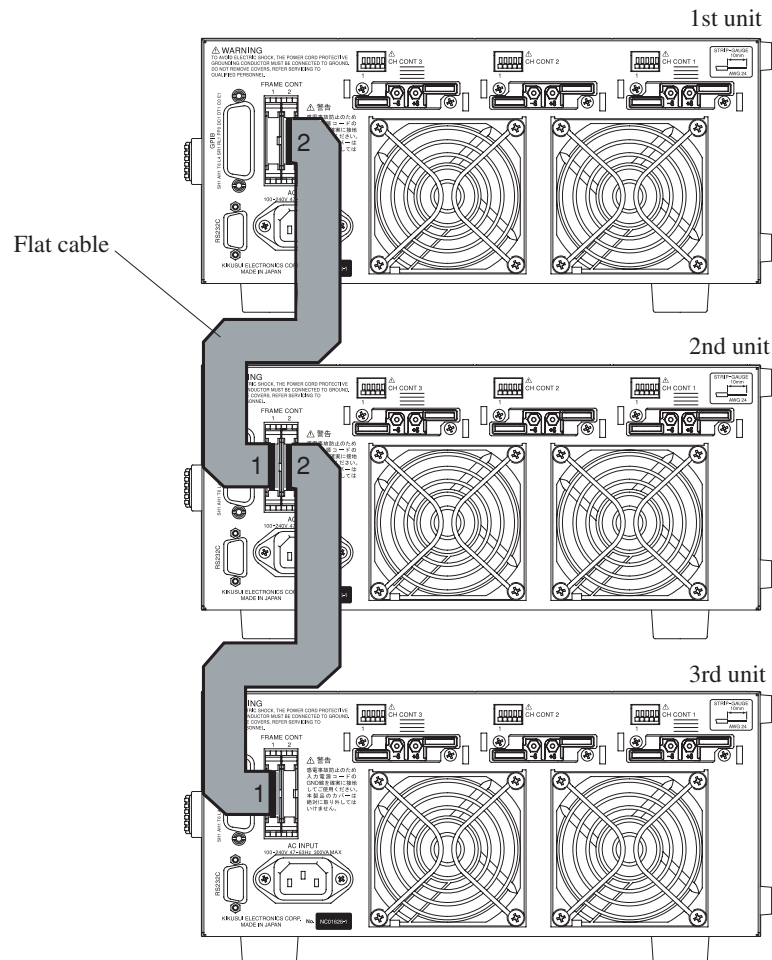


Fig. 5-15 Frame connection

## 5.10.2 CH CONT Connector

The CH CONT connector is on each slot. It can be used to turn the load on/off and receive an external voltage reference. It is also equipped with a monitor output for the load input current. The connector is a screwless connector. Table 5-5 indicates the pin arrangement.

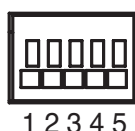


Fig. 5-16 Pin numbers

### NOTE

- Use AWG24 wires and remove 10 mm of the covering from the tip of the wires. Press the protrusion of the corresponding terminal number and insert the wire.

Table 5-5 CH CONT connector pin arrangement

Pin No.	Signal Name	Function
1	COM	Negative pin electric potential of the load input terminal
2	I MON	Load input current monitor output, 0 % to 100 % of the rated current in the range of 0 V to 10 V.
3	EXT REF	External voltage reference input. 0 % to 100 % of f.s in the range of 0 V to 10 V.
4	LOAD ON	Load-on input. Use the polarity of the load-on external control in the configuration settings to select low active or high active. Pull up to 5 V using 10 k $\Omega$ . Low level input voltage: 0 V to 1 V, high level input voltage: 4 V to 5 V
5	+12 V	12-V internal power supply output. Maximum output current of 50 mA

## Precaution when operating under high-speed load simulations

When using an external control, 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 electronic load.

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

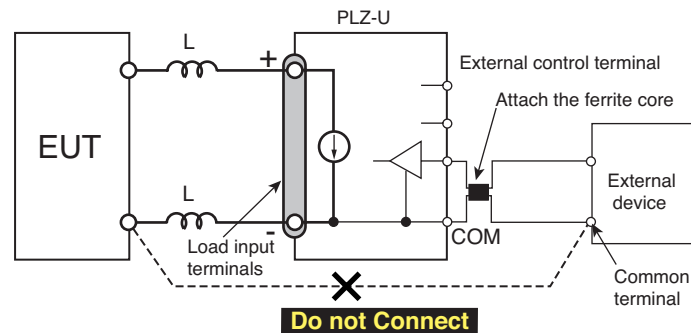


Fig. 5-17 When operation under high-speed load simulations

## External voltage reference

By applying an external voltage reference in the range of 0 to 10 V, you can vary the setting proportionally in the range of 0 % to 100 % of the rated value.

- 
- CAUTION**
- The maximum voltage that can be applied across pins 1 and 3 of the CH CONT connector is +12 V. Applying a voltage exceeding this value can damage the PLZ-U.
  - Accuracy is not guaranteed for voltages below 0 V or above 10 V.
  - Pin 1 of the CH CONT connector is connected to the negative load input terminal. Do not allow pin 1 to touch other pins.
-

**NOTE**

- Use external voltage reference of low noise and high stability.
- Use twisted or shielded wires for the signal wires. This can prevent disturbance from noise.

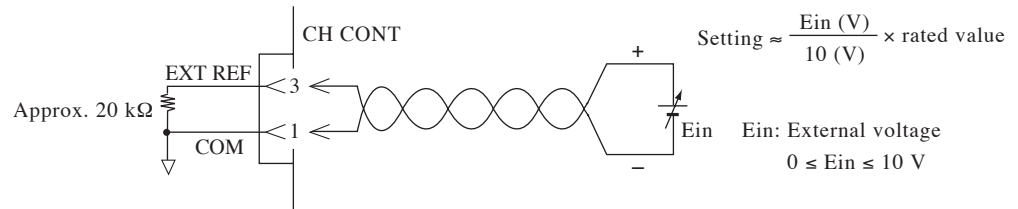


Fig. 5-18 Equivalent circuit

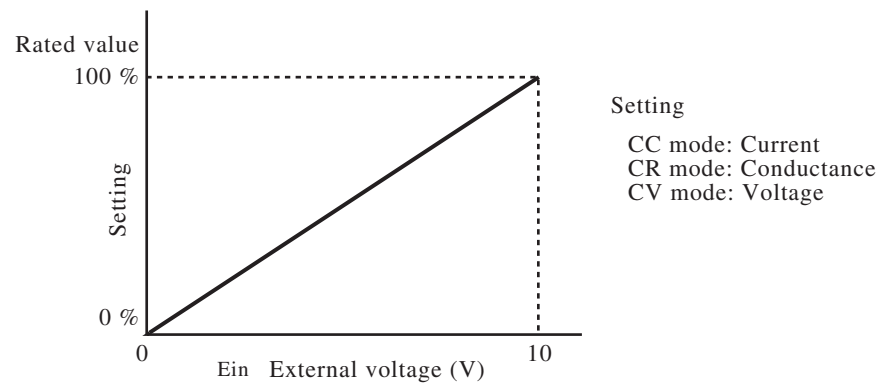


Fig. 5-19 Control using external voltage reference

**■ Procedure**

1. Connect the external voltage reference and turn on the power.  
Follow Fig. 5-18 and connect the external voltage reference across pins 1 and 3 of CH CONT.
2. Set the operation mode and range.
3. Select the external voltage reference using configuration settings.

Set CONFIG number 2 to 1	<ul style="list-style-type: none"> <li>• CC control in CC or CC+CV mode</li> <li>• CR control in CR or CR+CV mode</li> <li>• CV control in CV mode</li> </ul>
Set CONFIG number 2 to 2	<ul style="list-style-type: none"> <li>• CV control in CC+CV or CR+CV mode</li> </ul>

For the procedure of setting the configuration, see section 5.9, “Configuration Settings.”

**NOTE**

- If an external voltage reference is applied, the approximate value of the external voltage reference is shown in the setting display of the frame. In addition, the EXT LED of the channel illuminates.

## Turning the load on/off

You can turn the load on/off on each channel. Apply an external signal across pins 1 and 4 of the CH CONT connector. For turning the load on, the change in the external voltage (edge) is detected. For turning the load off, the external signal level is detected.

Use the polarity of the load-on external control in the configuration settings (section 5.9) to select low active or high active.

- See Table 5-5 for the input signal conditions.

When the load is turned on externally, the load can be turned off from the panel. However, when the load is turned off externally, the load cannot be turned on from the panel, GPIB, or RS-232C.

---

### NOTE

- If you set the polarity of the load-on external control to low active and open the signal input terminal, you will only be able to turn on the load using the CH CONT signal.
- 

---

### CAUTION

- The external signal input is TTL level. Open-circuit voltage is approximately +5 V. Be sure to return the current to CH CONT pin 1.
- 

## Current monitor output

You can monitor the input current of the PLZ-U. The monitor signal is output across pins 2 and 1 (pin 1 is common) of the CH CONT connector. Full scale of the current range corresponds to 10 V output.

---

### CAUTION

- Pin 1 of the CH CONT connector is connected to the negative load input terminal. Do not allow pin 1 to touch other pins.
- 

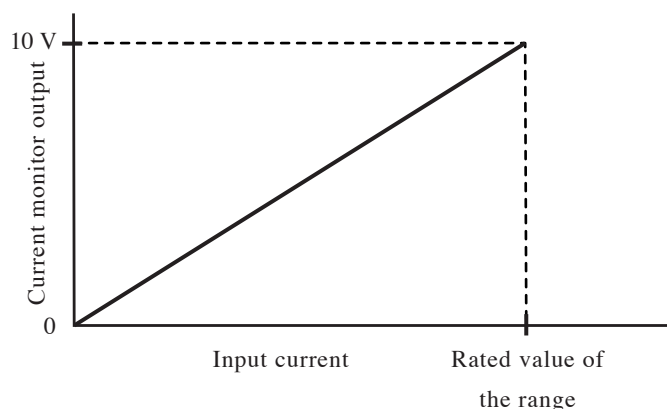


Fig. 5-20 Current monitor output

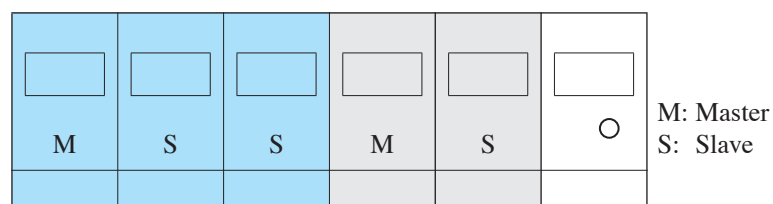
## 5.11 Parallel Operation

Parallel operation is possible on adjacent load units of the same type in the frame (up to 5 units on the PLZ-50F).

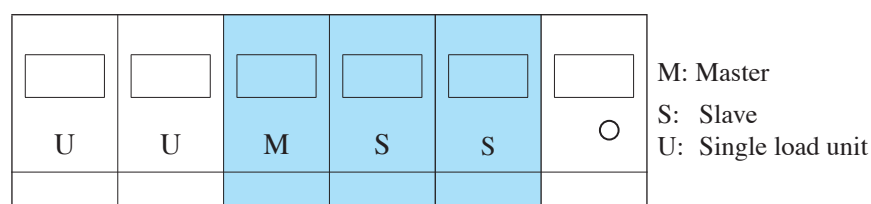
The channel at the left end facing the front of the connected channels is the master. Other channels are slaves.

Channels operating in parallel are considered a single channel. The total current and resistance (conductance) are used for displaying and setting.

Within the same frame, a combination of parallel and single-unit operation is possible.



When parallel operation of 3 units and parallel operation of 2 units are combined using the PLZ-50F



When parallel operation of 3 units and single-unit operation of 2 units are combined using the PLZ-50F

Fig. 5-21 Combination of parallel operation and single-unit operation

Table 5-6 The number of units in parallel and the capacity

Number of Units in Parallel	PLZ70UA	PLZ150U
2	30 A / 150 W	60 A / 300 W
3	45 A / 225 W	90 A / 450 W
4	60 A / 300 W	120 A / 600 W
5	75 A / 375 W	150 A / 750 W

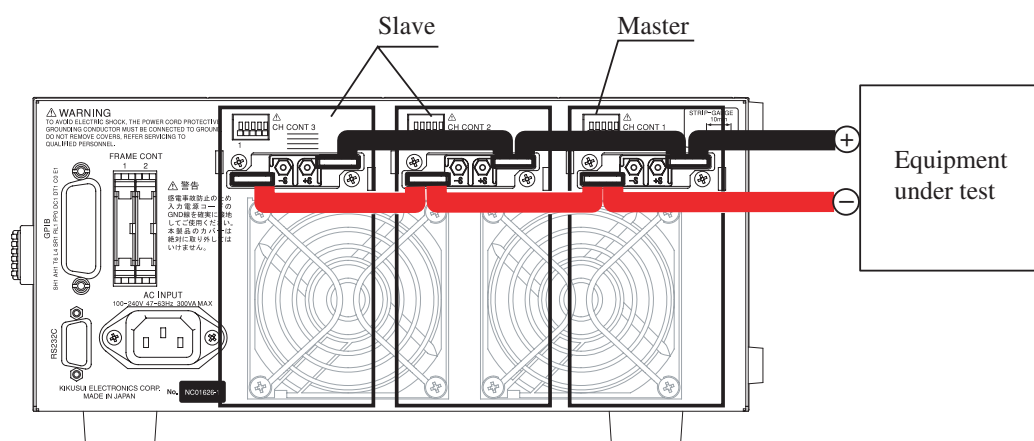


Fig. 5-22 Parallel connection (principle diagram)

**CAUTION**

- When carrying out parallel operation, be sure to use the load input terminals on the rear panel. Do not connect other equipment to the load input terminals on the front panel.
- Use a short load wire with sufficient diameter for the current for connecting the load input terminals on the rear panels of the master and slaves. It is recommended to use the bus bar instead of wiring the cable.
- Use load wires with sufficient diameter for the current as well as non-flammable or flame-resistant cover. For a description of the wire diameter, see section 2.8, “Load Wiring.”

## ■ Connection and setup procedure

1. Check that the power is turned off.  
Check that the power to all frames is turned off.  
If the power is turned on, press the POWER switch to turn off the power.
2. Connect the load input terminals on the rear panel of each channel.  
Refer to Fig. 5-22 and be sure to securely connect the load input terminals on the rear panels of multiple channels.

**NOTE**

- Check that all the channels are of the same type.
3. Press the ENTRY key of the channel you wish to make the master.
  4. Set the number of units in parallel.  
To enter the setting, use the configuration settings. For details, see section 5.9, “Configuration Settings.”  
The settings are saved. If no changes are made, you do not have to save the settings again.



## 5.12 Setup Memories

The setup memory can save up to four sets of settings indicated below. Saving and recalling are done on all channels simultaneously.

### ■ Settings that are saved

Below are the settings that are saved to the setup memory.

- Operation mode (CC, CR, CV, and enabled/disabled condition of +CV)
- Current, resistance, or voltage value present at the time of saving
- Range setting (RANGE/VRANGE)
- Slew rate value (SLEW RATE)
- Switching frequency, duty cycle, and level (FREQ, DUTY, and LEVEL)
- Soft start
- Configuration setting (CONFIG number 2 to 7)
- Contents of ABC preset memories (A/B/C)
- Auto load off timer
- Sequence

For factory default settings, see section 5.13.3, “Factory Default Settings of Setup Memories.”

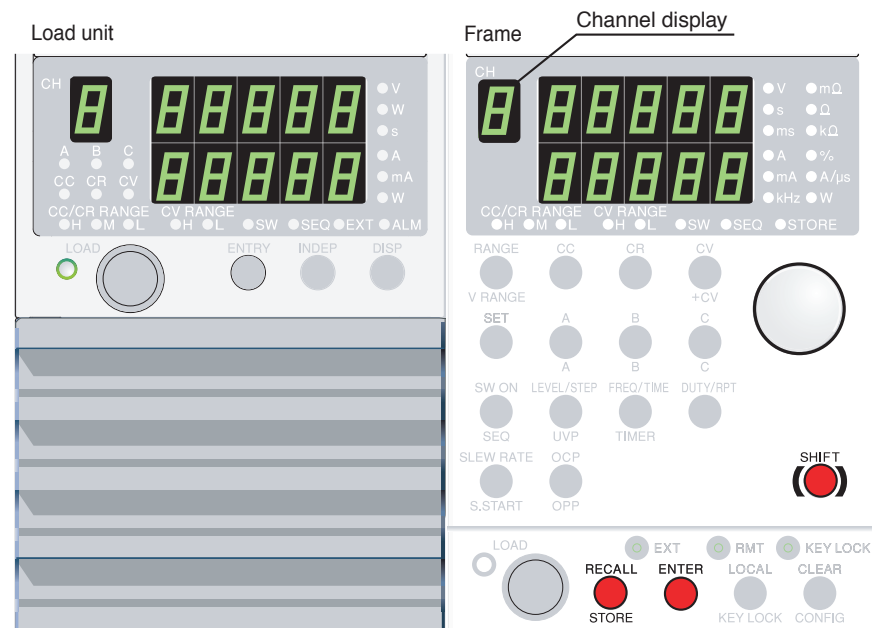


Fig. 5-23 Keys for the setup memory

### Saving to the memory

1. Press the STORE (SHIFT + RECALL) key.

The display switches to the setup memory number display. The STORE key and STORE indicator illuminate.

- 
2. Select the memory number.

Turn the rotary knob to show the number (0 to 3) of the memory to which settings are to be saved.

3. To cancel, press the STORE (SHIFT + RECALL) key again.

4. Press the ENTER key.

*The settings described above are saved to the memory.*

*The STORE key and STORE indicator turn off.*

---

**NOTE**

- If settings are already stored at the selected memory number, the settings are overwritten.
- 

## Recalling the memory

1. Press the RECALL key.

*The display switches to the setup memory number display.*

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

Turn the rotary knob to show the number (0 to 3) of the memory to be recalled.

3. To cancel, press the RECALL key again.

4. Press the ENTER key.

*The settings in the memory are recalled.*

---

**NOTE**

- If a setup memory is recalled while the load is turned on, the load automatically turns off.
  - Note that if you recall a setup memory, the current operation mode and settings will be changed.
  - The recall operation takes up to 2 seconds per channel depending on the length of the sequence program.
- 

## 5.13 Factory Default Settings

The backup function of the PLZ-U retains the current settings and memory contents (ABC preset memories and setup memories) even when the POWER switch is turned off. However, you can carry out the following procedure to reset the PLZ-U to factory default settings.

- For details on the factory default settings, see Table 5-7 and Table 5-8.

---

**NOTE**

- Use caution because the contents of ABC preset memories and the setup memories are also cleared when the PLZ-U is reset to factory default settings.
-

## ■ Resetting the PLZ-U to factory default settings

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

Keep holding down the SHIFT key until a beep is heard.

*The power up operation indicated in section 2.7, “Power Up” is executed, and the settings are reset to factory default.*

### 5.13.1 Factory Default Settings (General)

Table 5-7 Factory default settings

Item	Factory Default Settings	Relevant Function
Operation mode	CC	Section 4.3, “Basic Operation”
Current range	H range	
Voltage range	H range	
CC mode SET value	0.000 A	
CR mode SET value	0.0 S	
CV mode SET value	157.50 V	
Switching Function	Off	Section 5.3, “Switching Function”
CC switching level	0 A	
CR switching level	0 S	
Switching frequency	1.000 kHz	
Switching duty cycle	50.0 %	
Slew rate	Maximum value of H range	Section 5.4, “Setting the Slew Rate”
Soft start	1.0 ms	Section 5.1, “Soft Start”
OCP trip point	110 % of the rated current of H range	Section 4.4, “Protection Functions and Alarms”
OPP trip point	110 % of the rated power of H range	
UVP trip point	OFF	
Sequence mode	Off	Section 5.6, “Sequence Function”
Operation mode	CC	
Current range	H range	
Step setting	0.000 A	
Step execution time	0 ms	
RPT	1	
Key lock	Off	Section 5.8, “Key Lock Function”
Load	Off	Section 4.2, “Load On/Off”
Auto load off timer	Off	
ENTRY	Channel 1	Section 3.1, “Front Panel”
INDEP	Off	
DISP	Voltage and current	

- For details on the configuration settings, see section 5.9, “Configuration Settings.”

## 5.13.2 Factory Default Settings of ABC Preset Memories

The factory default settings of ABC preset memories are indicated in Table 5-8.

Table 5-8 Factory default settings of ABC preset memories

Operation mode	Range	PLZ150U			PLZ70UA		
		A	B	C	A	B	C
CC	H	0.000 A	15.000 A	30.000 A	0.000 A	7.500 A	15.000 A
	M	0.0000 A	1.5000 A	3.0000 A	0.0000 A	0.7500 A	1.5000 A
	L	0.00 mA	150.00 mA	300.00 mA	0.00 mA	75.00 mA	150.00 mA
CR	H	OPEN	100.00 mΩ	50.000 mΩ	OPEN	200.00 mΩ	100.00 mΩ
	M	OPEN	1.0000 Ω	500.00 mΩ	OPEN	2.0000 Ω	1.0000 Ω
	L	OPEN	10.000 Ω	5.0000 Ω	OPEN	20.000 Ω	10.000 Ω
CV	H	157.50 V					
	L	15.750 V					

## 5.13.3 Factory Default Settings of Setup Memories

The factory default settings of setup memories are the combination of the following three contents.

- Section 5.9, “Configuration Settings” (the underlined values)
- Section 5.13.1, “Factory Default Settings (General)”
- Section 5.13.2, “Factory Default Settings of ABC Preset Memories”

# 6

## Chapter 6 Remote Control

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

## 6.1 Overview

In addition to using the front panel, the PLZ-U can be controlled remotely using the following interfaces.

- RS-232C interface
- GPIB 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-U 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 6.3, “Using SCPI Commands” and familiarize yourself with the SCPI command syntax on the PLZ-U before actually using the SCPI commands.

## 6.2 Instrument Interface Standard

The PLZ-U 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

### IEEE 488.2 requirements

The GPIB control conforms to all IEEE 488.2 requirements.

### SCPI requirements

The GPIB and RS-232C controls all conform to the SCPI requirements. The PLZ-U conforms to the SCPI Volume 4 Power Supply instrument class.

## 6.3 Using SCPI Commands

### 6.3.1 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-U or modify the settings.

Query commands inquire settings and status of the PLZ-U.

#### Messages

The information that is exchanged between the controller and the device is called a device message.

There are two types of device messages, commands that are sent from the computer to the PLZ-U and responses that are sent from the PLZ-U to the computer.

#### Commands

A command is constructed by a single message or a combination of multiple messages using keywords, parameters, and punctuations.

Commands can be subdivided into set commands and query commands.

#### Set commands

Set commands execute a certain function of the device or modify the settings.

#### Query commands

Query commands (queries) inquire settings and status of the device.

Query messages end with a question mark.

#### Responses

Responses are messages that are sent from a device to the computer or another device.

Responses convey the status of the device or measured values to the computer or another device.

## SCPI command syntax

This operation manual denotes SCPI commands using the following format.

(Example)

```
Set command:  [SOURce:]CUREnt[:LEVel]
               [:IMMediate][:AMPLitude]
               {<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 form 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 MINi-
               mum
```

- 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}
```

For details see “Expanded numeric parameters” on page 6-7.



---

## 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.

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.

## 6.3.2 Parameter Format

The parameter format of SCPI is derived from the program parameter format defined in IEEE 488.2.

### SCPI parameter format

#### Boolean parameters

A Boolean parameter expresses a 1 or 0 condition or an ON or OFF condition.

A Boolean parameter can take on four values, 1, 0, ON, or OFF.

Below is an example of a set command using a Boolean parameter.

Set command:     [ SOURCE: ]FUNCTION:CTIME {OFF|ON}

#### Discrete parameters

A discrete parameter is used when only a limited number of values are available for the program setting.

Like the SCPI commands, discrete parameters have a long form and a short form.

Responses are returned in the short form.

Below is an example of a set command using a discrete parameter.

Set command:     [ SOURCE: ]POWER:RANGE  
                  {LOW|MEDIUM|HIGH}

#### Numeric parameters

A numeric parameter is a numeric representation consisting of a decimal point, optional sign, measurement unit, symbol, etc.

If DEFault is available as a parameter, the device automatically selects the default value.

Units such as V, A, and W can also be used with the numeric parameter.

If a value that cannot be assigned is entered, the device rounds the value to the closest possible value.

Below is an example of a command using a numeric parameter.

Set command:     CURRENT {<current>|MIN|MAX}

---

## Expanded numeric parameters

MINimum and MAXimum are available as substitutes for declaring certain values.

Set command:     [ SOURCE: ] CURRENT [ :LEVEL ]  
                  { <current> | MINimum | MAXimum }

CURR MIN sets the current value of each mode to the minimum value.

In addition, MINimum and MAXimum can be used to inquire the minimum and maximum allowed values of most parameters as shown in the following Query commands.

Query command:  CURRENT? MIN

Query command:  CURRENT? 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.
- 

## String parameters

A string parameter is used when a series of ASCII characters are requested.

A string must be enclosed in quotations or double quotations.

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 a string parameter.

Set command:     PROGrama[ :SElected ] :MEMO "My program"

## Program parameters

Below are the definitions of the parameters used in this manual for denoting SCPI commands.

### conductance

A numeric data including MAXimum and MINimum.

- Program data

Range		PLZ150U		PLZ70UA	
H	Selectable range	20 to 2	2 to 0	10 to 1	1 to 0
	Resolution	2 m	0.2 m	1 m	0.1 m
M	Selectable range	2 to 200 m	200 m to 0	1 to 100 m	100 m to 0
	Resolution	0.2 m	20 $\mu$	0.1 m	10 $\mu$
L	Selectable range	200 m to 20 m	20 m to 0	100 m to 10 m	10 m to 0
	Resolution	20 $\mu$	2 $\mu$	10 $\mu$	1 $\mu$

Unit      SIE

### current

A numeric data including MAXimum and MINimum.

- Program data

Range		PLZ150U	PLZ70UA
H	Selectable range	0 to 31.500	0 to 15.75
	Resolution	2 m	1 m
M	Selectable range	0 to 3.1500	0 to 1.575
	Resolution	0.2 m	0.1 m
L	Selectable range	0 m to 315.00 m	0 m to 157.50 m
	Resolution	0.02 m	0.01 m

Unit      A

### status-enable

A 16-bit status mask for the CONDition register that determines which bits are to be used.

Value    0 to 65535

### step

A step number of a sequence program. Up to 256 steps can be used.

### string

A string data. ASCII codes 20H to 7EH can be used.

### time

The execution time of sequence mode.

Value      0.001 to 9999 or 0 (end step)

Resolution 0.001

Unit        S

### value

A numeric data including MAXimum and MINimum. See the program data of each command.

### voltage

A numeric data including MAXimum and MINimum.

- Program data

Range		PLZ150U	PLZ70UA
H	Selectable range	1.5 to 157.5	0 to 157.5
	Resolution	10 m	10 m
M	Selectable range	1.5 to 15.75	0 to 15.75
	Resolution	1 m	1 m

Unit      V

## 6.4 Interface Setup

The factory default remote control interface setting is GPIB.

### 6.4.1 GPIB Control

#### ■ GPIB connection

Use a standard IEEE488 cable to connect the PLZ-U to the PC.

#### ■ Setting the GPIB address

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. Enter CONFIG settings.  
Press the CONFIG (SHIFT + CLEAR) key.  
“CF. 01” appears on the frame display.
3. Select the interface.  
Turn the rotary knob and set the configuration number to 9 (CF. 09).  
While holding down the SHIFT key turn the rotary knob to select GPIB.
4. Set the address.  
Turn the rotary knob and set the configuration number to 10 (CF. 10).  
While holding down the SHIFT key turn the rotary knob to select the address.
5. Power cycle the PLZ-U.  
The settings are entered.

## 6.4.2 RS-232C Control

### ■ RS-232C connection

Use a standard cross cable (null modem cable) to connect the PLZ-U to the PC.  
The RS-232C port on the PLZ-U is a standard D-sub 9-pin male connector.

Table6-1 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. Enter CONFIG settings.  
Press the CONFIG (SHIFT + CLEAR) key.  
“CF. 01” appears on the frame display.
3. Select the interface.  
Turn the rotary knob and set the configuration number to 9 (CF. 09).  
While holding down the SHIFT key turn the rotary knob to select 232.
4. Set the baud rate.  
Turn the rotary knob and set the configuration number to 11 (CF. 11).  
While holding down the SHIFT key turn the rotary knob to select the baud rate.
5. Power cycle the PLZ-U.  
The settings are entered.

## ■ Transmission/Reception via the RS-232C

Control the transmission/reception via the RS-232C using flow control. Transmission/reception may not work correctly through unilateral transmission.

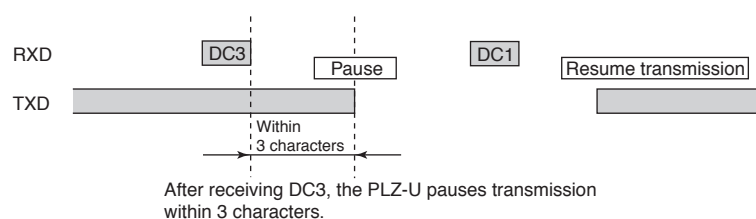
### RS-232C flow control

The transmission/reception on the PLZ-U can be controlled by using Xon/Xoff. DC (device control) codes are used to carry out control.

Table 6-2 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-U



Transmission control from the PLZ-U to the RS-232C terminal

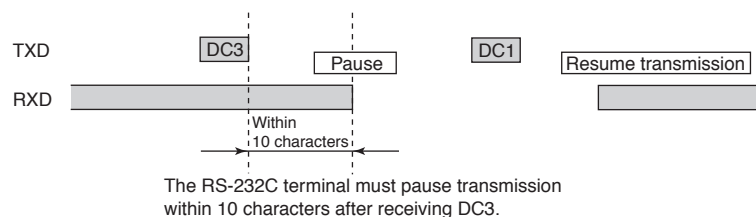


Fig.6-1 RS-232C terminal and transmission control of the PLZ-U



## 6.5 SCPI Commands

The SCPI commands below are those that are used on the GPIB or RS-232C interface.

### 6.5.1 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 6.6, “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 6.6, “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 6.6, “Status Registers.”

Query command:   **\*ESR?**

#### **\*IDN**

Queries the manufacturer name, model, and ROM version.

Query command:   **\*IDN?**

The response to \*IDN? is indicated below.

Example) For PLZ-50F with ROM version 1.00

Returns KIKUSUI, PLZ-50F, 0, 1.00.

#### **\*OPC**

The PLZ-U 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, ASCII 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 3). 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 3: Memory number

Resolution 1

## \*RST

Resets the device to factory default settings. CONFIG number 1 and 9 to 11 in the configuration settings are not changed.

The settings after initialization are as follows:

Item	PLZ150U	PLZ70UA	PLZ30F/PLZ50F
Current range	H	H	-
Voltage range	H	H	-
Operation mode	CC	CC	-
CC mode SET value	0.000 A	0.000 A	-
CR mode SET value	0.0 S	0.0 S	-
CV mode SET value	157.50 V	157.50 V	-
Switching function	Off	Off	-
CC switching level	0 A	0 A	-
CR switching level	0 S	0 S	-
Switching frequency	1.000k Hz	1.000k Hz	-
Switching duty cycle	50.0 %	50.0 %	-
Slew rate	2.4 A/μs	1.2 A/μs	-
Soft start	1.0 ms	1.0 ms	-
OCP trip point	33.00 A	16.5 A	-
OPP trip point	165.0 W	82.5 W	-
UVP trip point	Off	Off	-
LOAD OFF TIMER	Off	Off	-
Sequence mode	Off	Off	-
Operation mode	CC	CC	
Current range	H RANGE	H RANGE	
Step setting	0.000 A	0.000 A	
Step execution time	0 ms	0 ms	
RPT	1	1	
SEQ STEP 1-256	0.000 A, 0 ms	0.000 A, 0 ms	-
SEQ REPEAT	1	1	-
Load	Off	Off	OFF
ENTRY	-	-	CH1
INDEP	Off	Off	-
DISP	Voltage and current	Voltage and current	-

CONFIG No.	Item	PLZ150U	PLZ70UA	PLZ30F/PLZ50F
02	External voltage reference	0	0	-
03	Function for turning the load off in the OCP	Off	Off	-
04	Function for turning the load off in the OPP	Off	Off	-
05	Delayed load-on time setting	0	0	-
06	Last load	Off	Off	-
07	Polarity of the load on external control	High active	High active	-
08	Powering up with the load turned on	-	-	OFF

Operation Mode	Range	PLZ150U			PLZ70UA		
		A	B	C	A	B	C
CC	H	0.000 A	15.000 A	30.000 A	0.000 A	7.500 A	15.000 A
	M	0.0000 A	1.5000 A	3.0000 A	0.0000 A	0.7500 A	1.5000 A
	L	0.00 mA	150.00 mA	300.00 mA	0.00 mA	75.00 mA	150.00 mA
CR	H	0.0 S	10.000 S	20.000 S	0.0 S	5.000 S	10.000 S
	M	0.00 S	1.0000 S	2.0000 S	0.00 S	500.0 mS	1.0000 S
	L	0.000 S	100.00 mS	200.00 mS	0.000 S	50.00 mS	100.00 mS
CV	H	157.50 V					
	M	15.750 V					

Set command:     **\*RST**

### **\*SAV**

Saves the current settings of the device to the memory (0 to 3). 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 3:   Memory number  
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 obtained by serial polling except that bit 5 represents the MSS message in place of the RQS message.

For details, see section 6.6, “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-U, an ASCII character 0 is always returned in the output queue in response to this query.

Query command:  \*TST?

## **\*WAI**

Prevents the PLZ-U from executing subsequent commands or queries until the No Operation Pending flag becomes true.

Set command:     \*WAI

## 6.5.2 Channel Commands

Channel commands select the load unit channels. For the definition of channel numbers, see section 4.1, “Panel Control Basics.”

### Selecting a channel

---

**NOTE**

- This command selects the channel to which commands are applied. It does not switch the channel display LED on the frame.  
To perform the same operation as the ENTRY key on the panel, the INST:FOC command must be executed at the same time.
- 

#### INST

Selects the channel to which commands are applied using an ID. Or, queries the current setting.

Set command:     INSTrument[:SElect]  
                  {CH1|CH2|CH3|CH4|CH5}  
Query command:  INSTrument[:SElect]?

#### INST:NSEL

Selects the channel to which commands are applied using a number. Or, queries the current setting.

Set command:     INSTrument:NSElect {1|2|3|4|5}  
Query command:  INSTrument:NSElect?

### Specifying multiple channels

#### INST:COUP

Specifies the applicable channels when applying commands to multiple channels. Or, queries the current setting.

---

**NOTE**

- Be sure to execute INST:COUP at the same time as INST or INST:NSEL.  
If channels specified by INST or INST:NSEL are not included in the channels specified by INST:COUP, commands will not be applied to multiple channels.
- 

Set command:     INSTrument:COUPle {<list>|ALL|NONE}  
Query command:  INSTrument:COUPle?

- Program data  
Value   <list> CH1, CH2, CH3, CH4, CH5  
         ALL   Specifies all  
         NONE   Not specify

Example) When applying commands to CH1 and CH3  
INST CH1  
INST:COUP CH1,CH3

## Querying the channels that can be used

### INST:CAT

Queries the channel number that can be used.

Query command: `INSTrument:CATalog?`

### INST:CAT:FULL

Queries the channel number and ID that can be used.

Query command: `INSTrument:CATalog:FULL?`

Returns the current setting in response to `INST:CAT:FULL?`.

Example) When channels 1 and 3 can be used

Returns `CH1, 1, CH3, 3`.

## Selecting the channel whose settings are to be displayed

### INST:FOC

Selects the channel whose settings are to be displayed. Or, queries the current setting.

Set command: `INSTrument:[SElect]:FOCus  
{CH1 | CH2 | CH3 | CH4 | CH5}`

Query command: `command:INSTrument:[SElect]:FOCus?`

## 6.5.3 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?`

## 6.5.4 Configuration and Operation Commands

### Setting the operation mode

#### FUNC

Sets the operation mode of the PLZ-U. Or, queries the current setting.

Set command: [SOURCE:]FUNCTION[:MODE]  
{CC|CR|CV|CCCV|CRCV}

Query command: [SOURCE:]FUNCTION[:MODE]?

- Program data

Value	CC:	Constant current mode
	CR:	Constant resistance mode
	CV:	Constant voltage 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

Sets 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]?

#### VOLT

Sets 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 5.4, “Setting the Slew Rate.”

### NOTE

- The slew rate can be set to a value outside the specifications, but it is actually limited to a value within the specifications of the PLZ-U.

### CURR:SLEW

Sets the amount of current change per unit time. Or, queries the current setting.

Set command: [SOURCE:]CURRENT:SLEW <slew>

Query command: [SOURCE:]CURRENT:SLEW?

- Program data <slew>  
Value

Operation mode	Range	PLZ150U	PLZ70UA
CC	H	0.10 to 2.40	0.05 to 1.20
	M	0.10 to 0.24	0.05 to 0.12
	L (fixed)	24 m	12 m
CR	H	0.10 to 0.24	0.05 to 0.12
	M (fixed)	24 m	12 m
	L (fixed)	2.4 m	1.2 m

Resolution 0.01

Unit A/US

## Setting protection levels

### CURR:PROT

Sets 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

	PLZ150U	PLZ70UA
Selectable range	0 to 33.00	0 to 16.5
Resolution	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

Sets 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

	PLZ150U	PLZ70UA
Selectable range	0 to 165.0	0 to 82.5
Resolution	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

Sets the undervoltage protection. Or, queries the current setting.

Set command: [SOURCE:]VOLTAGE:PROTECTION[:LEVEL] UNDER {<voltage>|MINIMUM|MAXIMUM}

Query command: [SOURCE:]VOLTAGE:PROTECTION[:LEVEL] UNDER?

## VOLT:PROT:STAT

Turns ON/OFF the undervoltage protection. Or, queries the current setting.

Set command: [SOURCE:]VOLTAGE:PROTECTION:STATE {OFF|ON|0|1}

Query command: [SOURCE:]VOLTAGE:PROTECTION:STATE?

- Program data

Value ON(1): Undervoltage protection on

OFF(0): Undervoltage protection off

## Setting the range

### COND:RANG

Sets the range of CR mode. Or, queries the current setting.

Set command: [SOURCE:]CONDUCTance:RANGe  
{LOW|MEDIum|HIGH}

Query command: [SOURCE:]CONDUCTance:RANGe?

### CURR:RANG

Sets the range of CC mode. Or, queries the current setting.

Set command: [SOURCE:]CURRENT:RANGe  
{LOW|MEDIum|HIGH}

Query command: [SOURCE:]CURRENT:RANGe?

### VOLT:RANGE

Sets the range of CV mode. Or, queries the current setting.

Set command: [SOURCE:]VOLTage:RANGe {LOW|HIGH}

Query command: [SOURCE:]VOLTage:RANGe?

## ABC preset memories

### PRES:STOR

Stores the settings to memory.

Set command: [SOURCE:]PRESet:STORe  
{MEMA|MEMB|MEMC}

- Program data

Value	MEMA	Store to memory A.
	MEMB	Store to memory B.
	MEMC	Store to memory C.

### PRES:REC

Recalls settings from memory.

Set command: [SOURCE:]PRESet:RECall  
{MEMA|MEMB|MEMC}

- Program data

Value	MEMA	Recall memory A.
	MEMB	Recall memory B.
	MEMC	Recall memory C.

## Other settings

### DISP:MET

Switches the measured value display of the load unit. Or, queries the current setting.

Set command: `DISPlay:METer {0|1|2|3|4}`

Query command: `DISPlay:METer?`

- Program data

Value	0:	Voltage and current
	1:	Voltage and power
	2:	Power and current
	3:	Elapsed time and alarm (Alarm display is shown only when an alarm occurs)
	4:	Input voltage when the load turns off

### FUNC:SST

Sets the soft start time in CC mode. Or, queries the current setting.

The default value is 1 ms.

Set command: `[SOURCE:]FUNCTION:SStart  
{0.1MS|1MS|3MS|10MS|30MS|100MS  
|300MS|MINimum|MAXimum}`

Query command: `[SOURCE:]FUNCTION:SStart?`

- Program data

Value	0.0001, 0.001, 0.003, 0.01, 0.03, 0.1, 0.3, MIN, or MAX
Unit	S

### HCON:POL

Sets whether to power up with the load turned on. Or, queries the current setting.

Set command: `HCONfiguration:POLoad {OFF|ON|0|1}`

Query command: `HCONfiguration:POLoad?`

- Program data

Value	ON(1):	Automatically turn the load on at power on
	OFF(0):	Keep the load turned off at power on

## 6.5.5 Trigger Commands

Triggers are event signals that instruct the PLZ-U to change the output.

The trigger ring provides a method for controlling the output variation of the PLZ-U and programming multiple PLZ-Us to respond simultaneously.

The trigger ring is effective against processes in which the power varies depending on 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 when a trigger is activated.

Set command: `[SOURCE:]CURRENT[:LEVEL]  
:TRIGGERed[:AMPLitude]  
{<current>|MINimum|MAXimum}`

### INIT

Transitions to the trigger wait status, but automatically returns to idle when a trigger is activated. Returns an error (–213), if the PLZ-U 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. 6-2.

Set command: `INITiate:CONTinuous {OFF|ON|0|1}`

Query command: `INITiate:CONTinuous?`

- Program data

Value ON(1): Exits from idle and transitions to trigger wait status. Then, even when a trigger is activated, the PLZ-U does not automatically return to idle. The PLZ-U returns to idle when you send \*RST or device clear.

OFF(0): The function for continuing the trigger wait status is cleared, but the trigger wait status remains. Then, the PLZ-U returns to idle when a trigger is activated.

---

**NOTE**

- The query command returns 0 or 1.
-

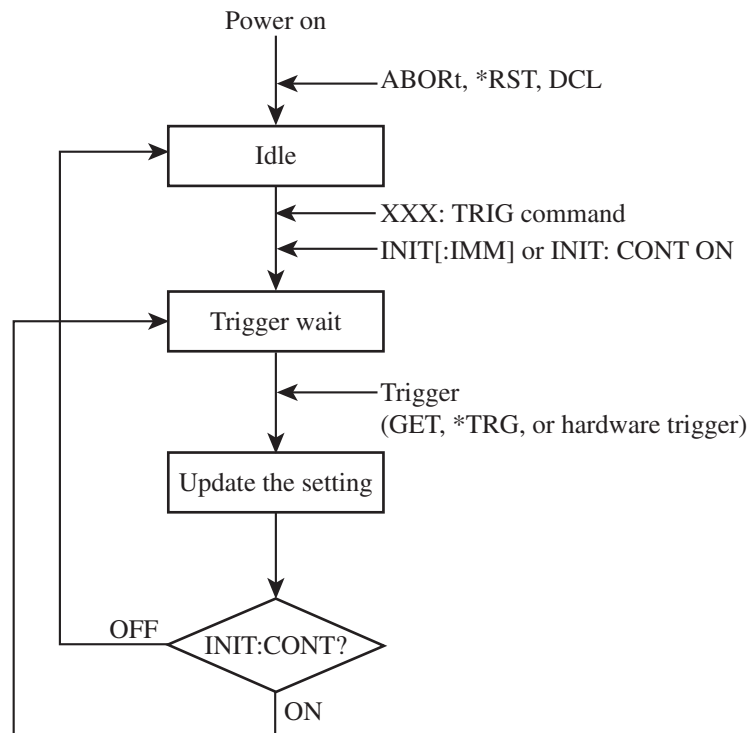


Fig. 6-2 Trigger wait status control using INIT:CONT

### INP:TRIG/OUTP:TRIG

Turns the load on/off using trigger input.

Set command:     INPUt [ :STATe ] :TRIGgered  
                   { OFF | ON | 0 | 1 }  
                   OUTPUt [ :STATe ] :TRIGgered  
                   { OFF | ON | 0 | 1 }

- Program data
 

Value	OFF(0)	Turn the load off
	ON(1)	Turn the load on

## 6.5.6 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|0|1}

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:DCYCl e <value>

Query command: [SOURCE:]PULSe:DCYCl e?

- Program data

Value 2 to 98

Resolution 0.1

Unit PCT

### PULS:FREQ

Sets the switching 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 1 to 1 K: 1

to 10 K: 10

to 20 k: 100

Unit HZ

## Sets the switching level

### PULS:LEV:COND

Sets the level for CR mode. Or, queries the current setting.

Set command: [SOURCE:]PULSe:LEVel[:VALue]  
:CONDuctance <conductance>

Query command: [SOURCE:]PULSe:LEVel[:VALue]  
:CONDuctance?

### PULS:LEV:CURR

Sets the level for CC mode. Or, queries the current setting.

Set command: [SOURCE:]PULSe:LEVel[:VALue]  
:CURRent <current>

Query command: [SOURCE:]PULSe:LEVel[:VALue]  
:CURRent?

## 6.5.7 Input State Commands

### INP/OUTP

Turn ON/OFF the load. Or, queries the current setting.

Set command:     INPut[:STATE][:IMMediate]  
                  {OFF|ON|0|1}  
                  OUTPut[:STATE][:IMMediate]  
                  {OFF|ON|0|1}

Query command: INPut[:STATE][:IMMediate]?  
                  OUTPut[:STATE][:IMMediate]?

- Program data
- |       |        |                   |
|-------|--------|-------------------|
| Value | OFF(0) | Turn the load off |
|       | ON(1)  | Turn the load on  |

### INP:EXT:LPOL/OUTP:EXT:LPOL

Sets the polarity of the channel control signal used to turn the load on. Or, queries the current setting.

Set command:     INPut:EXTErnal:LPOLarity  
                  {POSitive|NEGative}  
                  OUTPut:EXTErnal:LPOLarity  
                  {POSitive|NEGative}

Query command: INPut:EXTErnal:LPOLarity?  
                  OUTPut:EXTErnal:LPOLarity?

- Program data
- |       |          |             |
|-------|----------|-------------|
| Value | POSitive | High active |
|       | NEGative | Low active  |

### INP:EXT:REF/OUTP:EXT:REF

Sets the external voltage reference of the load unit. Or, queries the current setting.

Set command:     INPut:EXTErnal:REFerence  
                  {NONE|MAIN|SUB}  
                  OUTPut:EXTErnal:REFerence  
                  {NONE|MAIN|SUB}

Query command: INPut:EXTErnal:REFerence?  
                  OUTPut:EXTErnal:REFerence?

- Program data
- |       |      |  |
|-------|------|--|
| Value | NONE | No external control  |
|       | MAIN | External input<br>CC control for CC and CC+CV modes<br>CR control for CR and CR+CV modes<br>CV control for CV mode |
|       | SUB  | External input<br>CV control for CC+CV and CR+CV modes   |

## INP:PROT:CLE/OUTP:PROT:CLE

Clears the alarm.

Set command:     INPut:PROTection:CLEar  
                  OUTPut:PROTection:CLEar

## INP:TIM/OUTP:TIM

Sets 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       1 to 99999 or 0 (function off)  
Resolution 1  
Unit        S

## INP:DEL/OUTP:DEL

Sets the delay time until the load is turned on. Or, queries the current setting.

Set command:     INPut[:STATe]:DELaY  
                  {<value>|MINimum|MAXimum}  
                  OUTPut[:STATe]:DELaY  
                  {<value>|MINimum|MAXimum}  
Query command:   INPut[:STATe]:DELaY?  
                  OUTPut[:STATe]:DELaY?

- Program data  
Value       0.001 to 1.000 or 0 (function off)  
Resolution 0.001  
Unit        S



## Sequence commands

Programs a series of steps. For details, see section 5.6, “Sequence Function.”

### NOTE

- 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:MEMO

Sets the program memo (comment). Or, queries the current setting.

Up to 11 characters can be specified.

Set command:     PROG:MEMO "<string>"

Query command:  PROG:MEMO?

### PROG:LOOP

Sets the number of program loops. Or, queries the current setting.

Set command:     PROG:LOOP <value>

Query command:  PROG: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:     PROG:LINPut  
                  {OFF|ON|0|1}

PROG:LOUTput  
                  {OFF|ON|0|1}

Query command:  PROG:LINPut?  
                  PROG:LOUTput?

- Program data

Value   OFF(0)   Turn the load off

         ON(1)   Turn the load on

### PROG:LVAL

Sets the current value after the end of the program. Or, queries the current setting.

Set command:     PROG:LVALue  
                  {<conductance>|<current>}

Query command:  PROG:LVALue?

Returns the current value in response to PROG:LVAL?.

Example) When a current value of 9.876 A is specified

Returns 9.876.

## PROG:FSP:END

Sets the end step of the sequence mode.

Set command: PRGram[:SElected]:FSpeed[:STEP]:END  
<step>

Query command: PRGram[:SElected]:FSpeed[:STEP]:END?

- Program data <step>  
Value 1 to 255  
Resolution 1

Example) When step 1 to step 5 are looped  
PROG:FSP:END 6

## 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: PRGram[:SElected]:FSpeed[:STEP]:EDIT  
[:POINT] <step>,{<conductance>  
|<current>}},[<trig>],<time>

Query command: PRGram[:SElected]:FSpeed[:STEP]  
:EDIT[:POINT]? <step>

- Program data <trig>  
Value 0: Always enter 0 for the value, because the PLZ-U is  
not equipped with trigger output.

Returns the current value of the <step> as {<conductance>|<current>},0,<time> in  
response to PROG:FSP:EDIT? <step>.

Example) If the current value is 9.876 A in the H range of CC mode and the execu-  
tion time is 1.234 s in step 5

Returns 9.876,0,1.234 in response to PROG:FSP:EDIT? 5.

## Deletes the contents of sequence

### PROG:CLE

Deletes the contents of the sequence.

Set command:     PROG:CLEAr

## Executing the sequence

### PROG:STAT

Runs or stops the program.

Set command:     PROG:STATe {RUN|STOP}

- Program data

Value	RUN	Run the selected program
	STOP	Stop the selected program

### PROG:EXEC

Queries the execution status of the program.

Query command: PROG:EXECing?

Returns the current execution status as {RUN|STOP},<time>,<loop>,<step>,1 (1 is fixed) in response to PROG:EXEC?.

<time> returns the length of time the step is executed when the program is running and the specified execution time when the program is stopped.

Example) If step 4 of the current program is being executed (10 s), and the number of program loops is 3

Returns RUN,10.000,3,4,1.

## Other commands

### **SYST:CAP?**

Queries the SCPI instrument class and the basic functions.  
(DCPSUPPLY WITH (MEASURE&TRIGGER))  
Query command: **SYSTem:CAPability?**

### **SYST:FORM**

Queries the configuration of the units inserted into the frame.  
Slot numbers are counted from the left of the frame as slot 1, slot 2, and so on.  
Query command: **SYSTem:FORMation?**  
Returns the current setting in response to **SYST:FORM?**.  
Example) If two PLZ150Us (parallel operation) and one PLZ70UA are installed from the left end.  
Returns **SLOT1:150U MAST,SLOT2:150U SLAV,SLOT3:70UA MAST**.

### **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 (RS-232C only).  
Set command: **SYSTem:GTLocal**

### **SYST:LLO**

Sets local lockout (LLO) (RS-232C only).  
Set command: **SYSTem:LLOut**

### **SYST:REN**

REN (Remote Enable/Disable) (RS-232C only)  
Power on. The default setting is on.  
Set command: **SYSTem:REnable {OFF|ON}**

### **SYST:VERS?**

Queries the SCPI version to which the PLZ-U conforms.  
Query command: **SYSTem:VERSion?**  
Below is an example of the response to **SYST:VERS?**.  
Example) When the PLZ-U conforms to 1999.0  
Returns 1999.0.

## 6.6 Status Registers

Status registers are standard functions defined in the SCPI and IEEE 488.2.

Status registers can be classified into five groups: SCPI standard OPERation status register, QUEStionable status register, PLZ-U-dedicated CSUMmary register, IEEE488.2 standard event register, and status byte register.

### SCPI registers

OPERation (SCPI requirement)

QUEStionable (SCPI requirement)

CSUMmary (PLZ-U dedicated)

### IEEE488.2 registers

Standard event status register (\*ESR?)

Status byte register (\*STB?)

### 6.6.1 SCPI Registers

In each SCPI status register, there are sub registers, CONDition register, EVENT register, ENABLE register, PTRansition filter, and NTRansition filter.

Fig. 6-3 shows the SCPI status register structure. The character “+” represents the logic sum of the register bits. Table 6-3 to Table 6-12 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-U 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.

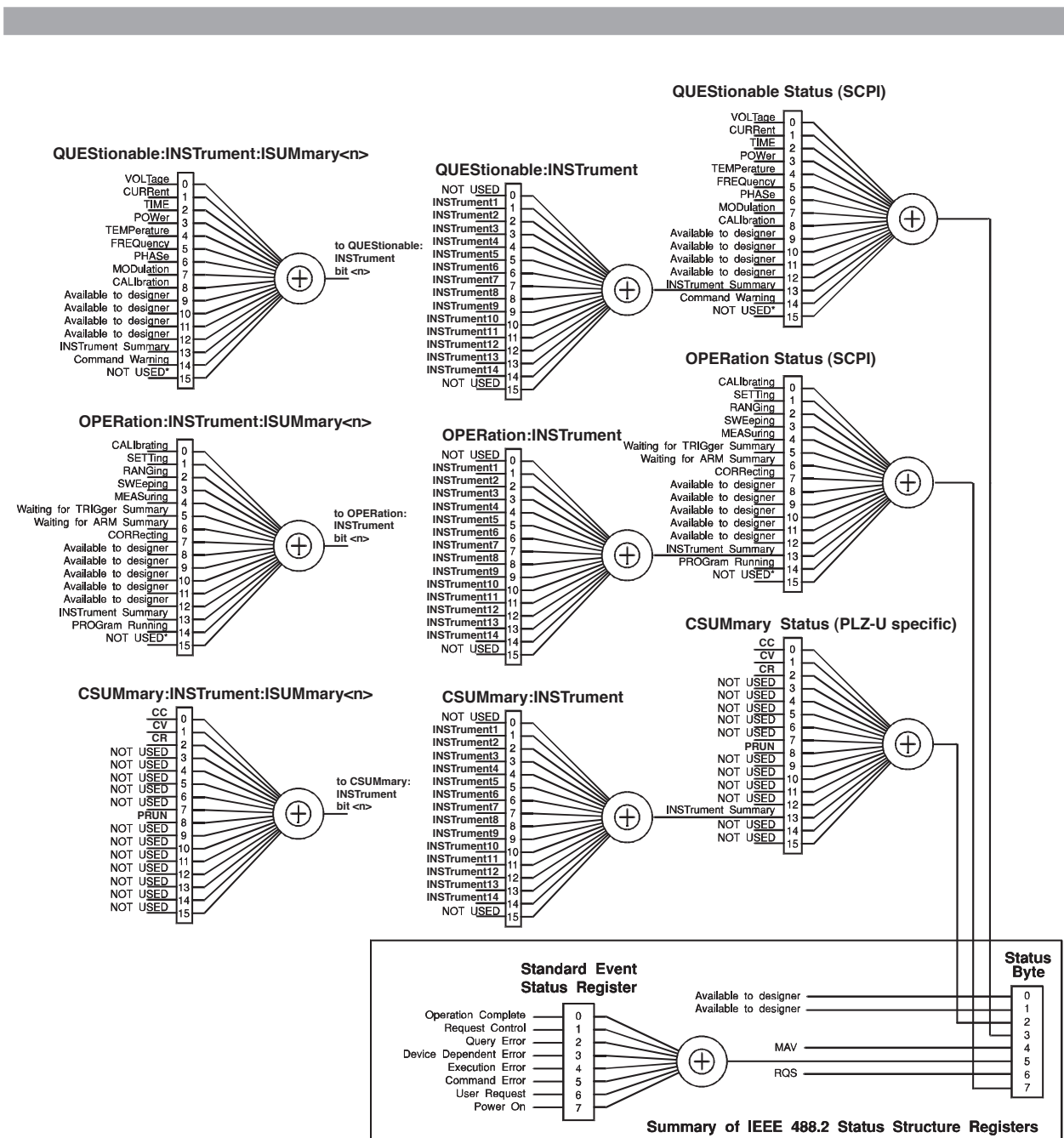
#### Transition filter

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 false to true.

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.



\* 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. 6-3 Status registers

## OPERation status register

The OPERation status register is a 16-bit register that stores information related to the operation status of the PLZ-U.

Of the bits defined by SCPI, only bits 0 and 5 are used.

Table 6-3 OPERation status register (STATus:OPERation)

Bit	Bit Weight	Bit Name	Description
0	1	CALibrating	The PLZ-U is in calibration (CAL) mode.
1	2	NOT USED	
2	4	NOT USED	
3	8	NOT USED	
4	16	NOT USED	
5	32	Waiting for TRIGger Summary	Indicates whether the PLZ-U is waiting for a trigger (TRIG).
6	64	NOT USED	
7	128	NOT USED	
8	256	NOT USED	
9	512	NOT USED	
10	1024	NOT USED	
11	2048	NOT USED	
12	4096	NOT USED	
13	8192	INSTrument Summary	
14	16384	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?

## OPERation:INSTrument subregister

Table 6-4   OPERation:INSTrument status register  
(STATus:OPERation:INSTrument)

Bit	Bit Weight	Bit Name	Description
0	1	NOT USED	
1	2	INSTrument1	
2	4	INSTrument2	
3	8	INSTrument3	
4	16	INSTrument4	
5	32	INSTrument5	
6	64	INSTrument6	
7	128	INSTrument7	
8	256	INSTrument8	
9	512	INSTrument9	
10	1024	INSTrument10	
11	2048	INSTrument11	
12	4096	INSTrument12	
13	8192	INSTrument13	
14	16384	INSTrument14	
15	32768	NOT USED	Always zero

## STAT:OPER:INST

Queries the event of the OPERATION:INSTrument subregister.

Query command: STATus:OPERation:INSTrument  
                  [ :EVENT ]?

## STAT:OPER:INST:COND

Queries the condition of the OPERATION:INSTrument subregister.

Query command: STATus:OPERation:INSTrument  
                  :CONDition?

## STAT:OPER:INST:ENAB

Sets the OPERATION:INSTrument subregister enable, or queries the current setting.

Set command:     STATus:OPERation:INSTrument:ENABle  
                  <status-enable>

Query command: STATus:OPERation:INSTrument:ENABle?



## **STAT:OPER:INST:PTR**

Sets the positive transition of the OPERATION:INSTrument subregister, or queries the current setting.

Set command:     STATus:OPERation:INSTrument  
                      :PTRansition <status-enable>  
Query command:   STATus:OPERation:INSTrument  
                      :PTRansition?

## **STAT:OPER:INST:NTR**

Sets the negative transition of the OPERATION:INSTrument subregister, or queries the current setting.

Set command:     STATus:OPERation:INSTrument  
                      :NTRansition <status-enable>  
Query command:   STATus:OPERation:INSTrument  
                      :NTRansition?

## OPERation:INSTrument:ISUMmary<n> subregister

Bit <n> subregister of the OPERation:INSTrument subregister.

For example, channel 2 (INSTrument2) is OPERation:INSTrument:ISUMmary2.

The <n> values that can be used for the PLZ-U are 1 to 5.

Table 6-5 OPERation:INSTrument:ISUMmary status register  
(STATus:OPERation:INSTrument:ISUMmary)

Bit	Bit Weight	Bit Name	Description
0	1	CALibrating	The PLZ-U is in calibration (CAL) mode.
1	2	NOT USED	
2	4	NOT USED	
3	8	NOT USED	
4	16	NOT USED	
5	32	Waiting for TRIGger Summary	Indicates whether the PLZ-U is waiting for a trigger (TRIG).
6	64	NOT USED	
7	128	NOT USED	
8	256	NOT USED	
9	512	NOT USED	
10	1024	NOT USED	
11	2048	NOT USED	
12	4096	NOT USED	
13	8192	NOT USED	
14	16384	NOT USED	
15	32768	NOT USED	Always zero

### STAT:OPER:INST:ISUM

Queries the event of the OPERation:INSTrument:ISUMmary subregister.

Query command: STATus:OPERation:INSTrument  
:ISUMmary<n>[:EVENT]?

### STAT:OPER:INST:ISUM:COND

Queries the condition of the OPERation:INSTrument:ISUMmary subregister.

Query command: STATus:OPERation:INSTrument  
:ISUMmary<n>:CONDition?

### STAT:OPER:INST:ISUM:ENAB

Sets the OPERation:INSTrument:ISUMmary subregister enable, or queries the current setting.

Set command: STATus:OPERation:INSTrument  
:ISUMmary<n>:ENABle <status-enable>

Query command: STATus:OPERation:INSTrument  
:ISUMmary<n>:ENABle?

### **STAT:OPER:INST:ISUM:PTR**

Sets the positive transition of the OPERation:INSTrument:ISUMmary subregister, or queries the current setting.

Set command:     STATus:OPERation:INSTrument  
                          :ISUMmary<n>:PTRansition  
                          <status-enable>

Query command:   STATus:OPERation:INSTrument  
                          :ISUMmary<n>:PTRansition?

### **STAT:OPER:INST:ISUM:NTR**

Sets the negative transition of the OPERation:INSTrument:ISUMmary subregister, or queries the current setting.

Set command:     STATus:OPERation:INSTrument  
                          :ISUMmary<n>:NTRansition  
                          <status-enable>

Query command:   STATus:OPERation:INSTrument  
                          :ISUMmary<n>: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-U operation.

These register bits may indicate problems with the output of the PLZ-U.

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-U.

Table 6-6 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	
3	8	OP	Over Power
4	16	OT	Over Temperature
5	32	Not Used	
6	64	Not Used	
7	128	Not Used	
8	256	Not Used	
9	512	UV	Under Voltage
10	1024	EXT	External Problem
11	2048	REV	Reverse Voltage
12	4096	Not Used	
13	8192	INSTrument Summary	
14	16384	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?`

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?`

## QUESTIONable:INSTrument subregister

Table 6-7 QUESTionable:INSTRument status register  
(STATus:QUESTionable:INSTRument)

Bit	Bit Weight	Bit Name	Description
0	1	NOT USED	
1	2	INSTRument1	
2	4	INSTRument2	
3	8	INSTRument3	
4	16	INSTRument4	
5	32	INSTRument5	
6	64	INSTRument6	
7	128	INSTRument7	
8	256	INSTRument8	
9	512	INSTRument9	
10	1024	INSTRument10	
11	2048	INSTRument11	
12	4096	INSTRument12	
13	8192	INSTRument13	
14	16384	INSTRument14	
15	32768	NOT USED	Always zero

## STAT:QUES:INST

Queries the event of the QUEStionable:INSTRument subregister.

Query command: `STATUS:QUESTIONABLE:INSTRUMENT[:EVENT]?`

## STAT:QUES:INST:COND

Queries the condition of the QUEStionable:INSTRument subregister.

Query command: **STATus:QUESTionable:INSTRument**  
**:CONDition?**

## STAT:QUES:INST:ENAB

Sets the QUEStionable:INSTrument subregister enable, or queries the current setting.

Set command:     STATus:QUESTionable  
                  :INSTRument:ENABLE <status-enable>

```
Query command: STATus:QUESTionable:INSTRument
               :ENABLE?
```

### **STAT:QUES:INST:PTR**

Sets the positive transition of the QUEStionable:INSTrument subregister, or queries the current setting.

Set command:     STATus:QUEStionable:INSTrument  
                              :PTRansition <status-enable>

Query command: STATus:QUEStionable:INSTrument  
                              :PTRansition?

### **STAT:QUES:INST:NTR**

Sets the negative transition of the QUEStionable:INSTrument subregister, or queries the current setting.

Set command:     STATus:QUEStionable:INSTrument  
                              :NTRansition <status-enable>

Query command: STATus:QUEStionable:INSTrument  
                              :NTRansition?

## QUESTionable:INSTrument:ISUMmary<n> subregister

Bit <n> subregister of the QUESTionable:INSTrument subregister.

For example, channel 2 (INSTrument2) is QUESTionable:INSTrument:ISUMmary2.

The <n> values that can be used for the PLZ-U are 1 to 5.

Table 6-8 QUESTionable:INSTrument:ISUMmary status register  
(STATus:QUESTionable:INSTrument:ISUMmary)

Bit	Bit Weight	Bit Name	Description
0	1	OV	Over Voltage
1	2	OC	Over Current
2	4	Not Used	
3	8	OP	Over Power
4	16	OT	Over Temperature
5	32	Not Used	
6	64	Not Used	
7	128	Not Used	
8	256	Not Used	
9	512	UV	Under Voltage
10	1024	EXT	External Problem
11	2048	REV	Reverse Voltage
12	4096	Not Used	
13	8192	Not Used	
14	16384	Not Used	
15	32768	Not Used	Always zero

### STAT:QUES:INST:ISUM

Queries the event of the QUESTionable:INSTrument:ISUMmary subregister.

Query command: **STATus:QUESTionable:INSTrument:ISUMmary<n>[:EVENT]**?

### STAT:QUES:INST:ISUM:COND

Queries the condition of the QUESTionable:INSTrument:ISUMmary subregister.

Query command: **STATus:QUESTionable:INSTrument:ISUMmary<n>:CONDition**?

### STAT:QUES:INST:ISUM:ENAB

Sets the QUESTionable:INSTrument:ISUMmary subregister enable, or queries the current setting.

Set command: **STATus:QUESTionable:INSTrument:ISUMmary<n>:ENABle<status-enable>?**

Query command: **STATus:QUESTionable:INSTrument:ISUMmary<n>:ENABle?**

### **STAT:QUES:INST:ISUM:PTR**

Sets the positive transition of the QUESTionable:INSTrument:ISUMmary subregister, or queries the current setting.

Set command:     STATus:QUESTionable:INSTrument  
                  :ISUMmary<n>:PTRansition  
                  <status-enable>

Query command:  STATus:QUESTionable:INSTrument  
                  :ISUMmary<n>:PTRansition?

### **STAT:QUES:INST:ISUM:NTR**

Sets the negative transition of the QUESTionable:INSTrument:ISUMmary subregister, or queries the current setting.

Set command:     STATus:QUESTionable:INSTrument  
                  :ISUMmary<n>:NTRansition  
                  <status-enable>

Query command:  STATus:QUESTionable:INSTrument  
                  :ISUMmary<n>:NTRansition?



## CSUMmary status register

Registers dedicated to the PLZ-U.

Bits 0, 1, 2, 3, and 8 are used.

Table 6-9 CSUMmary status 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.
3-7		Not Used	
8	256	PRUN	PROGram is being executed.
9-12		Not Used	
13		INSTrument Summary	
14-15		Not Used	

### STAT:CSUM

Queries the event of the CSUMmary status register.

Query command: STATus:CSUMmary[:EVENT]?

### STAT:CSUM:COND

Queries the condition of the CSUMmary status register.

Query command: STATus:CSUMmary:CONDition?

### STAT:CSUM:ENAB

Sets the CSUMmary 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 CSUMmary 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 CSUMmary status register, or queries the current setting.

Set command: STATus:CSUMmary:NTRansition  
<status-enable>

Query command: STATus:CSUMmary:NTRansition?

## CSUMmary:INSTrument subregister

Table 6-10 CSUMmary:INSTrument status register  
(STATus:CSUMmary:INSTrument)

Bit	Bit Weight	Bit Name	Description
0	1	NOT USED	
1	2	INSTrument1	
2	4	INSTrument2	
3	8	INSTrument3	
4	16	INSTrument4	
5	32	INSTrument5	
6	64	INSTrument6	
7	128	INSTrument7	
8	256	INSTrument8	
9	512	INSTrument9	
10	1024	INSTrument10	
11	2048	INSTrument11	
12	4096	INSTrument12	
13	8192	INSTrument13	
14	16384	INSTrument14	
15	32768	NOT USED	Always zero

### STAT:CSUM:INST

Queries the event of the CSUMmary:INSTrument subregister.

Query command: `STATus:CSUMmary:INSTrument[:EVENT]?`

### STAT:CSUM:COND

Queries the condition of the CSUMmary:INSTrument subregister.

Query command: `STATus:CSUMmary:INSTrument:CONDition?`

### STAT:CSUM:ENAB

Sets the CSUMmary:INSTrument subregister enable, or queries the current setting.

Set command: `STATus:CSUMmary:INSTrument:ENABle <status-enable>`

Query command: `STATus:CSUMmary:INSTrument:ENABle?`

### STAT:CSUM:INST:PTR

Sets the positive transition of the CSUMmary:INSTrument subregister, or queries the current setting.

Set command: `STATus:CSUMmary:INSTrument:PTRansition <status-enable>`

Query command: `STATus:CSUMmary:INSTrument:PTRansition?`

## STAT:CSUM:INST:NTR

Sets the negative transition of the CSUMmary:INSTrument subregister, or queries the current setting.

Set command:     STATus:CSUMmary:INSTrument  
                          :NTRansition <status-enable>  
Query command:   STATus:CSUMmary:INSTrument  
                          :NTRansition?

## CSUMmary:INSTrument:ISUMmary<n> subregister

Bit <n> subregister of the CSUMmary:INSTrument subregister.

For example, channel 2 (INSTrument2) is CSUMmary:INSTrument:ISUMmary2.

The <n> values that can be used for the PLZ-U are 1 to 5.

Table 6-11 CSUMmary:INSTrument:ISUMmary status register  
(STATus:CSUMmary:INSTrument:ISUMmary)

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.
3-7		Not Used	
8	256	PRUN	PROGram is being executed.
9-15		Not Used	

## STAT:CSUM:INST:ISUM

Queries the event of the CSUMmary:INSTrument:ISUMmary subregister.

Query command:   STATus:CSUMmary:INSTrument  
                          :ISUMmary<n>[:EVENT]?

## STAT:CSUM:INST:ISUM:COND

Queries the condition of the CSUMmary:INSTrument:ISUMmary subregister.

Query command:   STATus:CSUMmary:INSTrument  
                          :ISUMmary<n>:CONDition?

## STAT:CSUM:INST:ISUM:ENAB

Sets the CSUMmary:INSTrument:ISUMmary subregister enable, or queries the current setting.

Set command:     STATus:CSUMmary:INSTrument  
                          :ISUMmary<n>:ENABLE<status-enable>?  
Query command:   STATus:CSUMmary:INSTrument  
                          :ISUMmary<n>:ENABLE?

### **STAT:CSUM:INST:ISUM:PTR**

Sets the positive transition of the CSUMmary:INSTrument:ISUMmary subregister, or queries the current setting.

Set command:     STATus:CSUMmary:INSTrument  
                      :ISUMmary<n>:PTRansition  
                      <status-enable>

Query command:  STATus:CSUMmary:INSTrument  
                      :ISUMmary<n>:PTRansition?

### **STAT:CSUM:INST:ISUM:NTR**

Sets the negative transition of the CSUMmary:INSTrument:ISUMmary subregister, or queries the current setting.

Set command:     STATus:CSUMmary:INSTrument  
                      :ISUMmary<n>:NTRansition  
                      <status-enable>?

Query command:  STATus:CSUMmary:INSTrument  
                      :ISUMmary<n>:NTRansition?

## Preset status

### STAT:PRES

Specific events are reported at a higher level by constructing status data and using the status reporting system. 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 system, 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-U address, output queue, and power on status clear flag are not affected by this command.

Table 6-12 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

## 6.6.2 IEEE488.2 Registers

### Standard event status register

The standard event status register bits are set when certain events occur during PLZ-U 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.

Table 6-13 Standard event status register  
(Standard Event Status Resister)

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 appendix 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-U evaluates the program data following the header is outside the formal input range (does not match the performance of the PLZ-U). This indicates that a valid SCPI command may not be executed correctly depending on the conditions of the PLZ-U. 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 to 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 6-14 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-U 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	

## IEEE 488.2 status event commands

See section 6.5.1, “IEEE 488.2 Common Commands.”







## **Chapter 7 Maintenance**

This chapter explains the PLZ-U maintenance.

## 7.1 Maintenance

Periodic maintenance and inspection are essential to maintain the initial performance of the PLZ-U over an extended period.

- 
- ⚠ WARNING** • Be sure to turn off the POWER switch and remove the power cord plug or turn off the switchboard. If you do not, death or injury may result from electric shock.
- 

### 7.1.1 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 benzene. They may discolor the surface, erase printed characters, or cloud the LCD.
- 

### 7.1.2 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. To do so, place your finger on the bottom edge of the louver and while pressing upward pull it toward you.

If the louver does not come off easily, use your other hand and pull the bottom edge of the louver toward you. This will make the task easier.

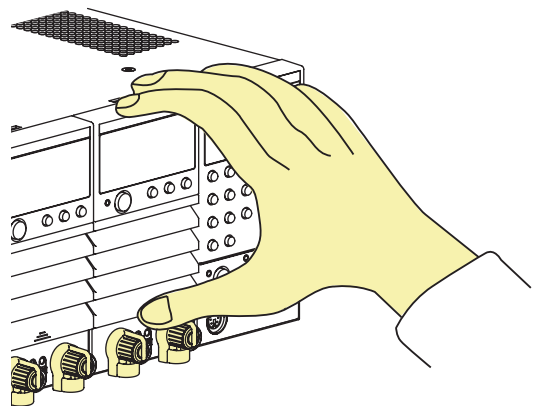


Fig.7-1 Removing the louver

2. Remove the dust filter from 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.

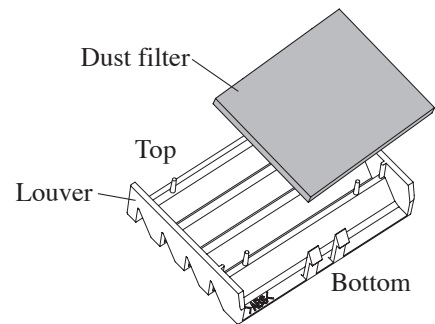


Fig. 7-2 Dust filter

- 
- CAUTION** • When the PLZ-U is in operation, air is sucked through the dust filter to cool the PLZ-U. If moisture is included in the dust filter, the temperature or humidity inside the PLZ-U increases and may cause a malfunction.
- 

3. Attach the dust filter to the louver.
4. Insert the tabs (left and right) at the top section of the louver into the panel guide and press the panel against the louver.  
Press the center of the bottom edge of the louver. When you hear a click, the louver is fixed in place.

### 7.1.3 Inspecting the Power Cord

Check the power cord for breaks in the insulation and cracks or rattling of the plug.

### 7.1.4 Internal Inspection

The electrolytic capacitors, fan motor, and rechargeable battery for memory backup inside the PLZ-U are consumable parts. It is recommended that the PLZ-U be overhauled every 10000 operating hours along with internal inspection and cleaning. To have your PLZ-U overhauled,, contact your Kikusui agent or distributor.

## 7.2 Confirming status of the fuse

To increase security of the product, the fuse are installed on the load unit. 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 louver on the front panel of the whole load units, and check if the LED lights in red.

The LED is located on the left under the variable resistors.

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.

## 7.3 Calibration

The PLZ-U is shipped after carrying out appropriate calibrations. We recommend periodic calibration to maintain the performance.

For calibration, contact your Kikusui agent or distributor.

## 7.4 Malfunctions and Causes

This section describes check items and remedies for malfunctions encountered during the use of the PLZ-U. Representative symptoms are listed. 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.

### The PLZ-U does not power up.

Symptom	Check Items	Remedy	Reference
The PLZ-U does not operate when the POWER switch is turned on.	<ul style="list-style-type: none"><li>• Is the power cord disconnected from the power outlet?</li><li>• Is the power cord inserted correctly into the AC INPUT connector on the rear panel?</li></ul>	Connect the power cord correctly.	Section 2.5, “Connecting the Power Cord”
The display freezes showing the model and version.	Are the load units installed correctly?	Turn off the POWER switch and install the load units correctly.	Section 2.4, “Installing Load Units”

### Keys do not work correctly.

Symptom	Check Items	Remedy	Reference
Panel key operations are not accepted.	Are the keys locked (KEY LOCK LED illuminated)?	Hold down the KEY LOCK (SHIFT + LOCAL) key until the KEY LOCK LED turns off.	Section 5.8, “Key Lock Function”
	Is the EXT LED of the frame illuminated?	Set FRAME CONT connector 1 ENABLE to high level (no input).	Section 5.10.1, “FRAME CONT Connector” and chapter 6, “Remote Control”
	Is the RMT LED of the frame illuminated?	Press the LOCAL key to release remote control.	
Unable to turn the load on using the LOAD key of the frame.	Is FRAME CONT connector 1 ENABLE set to enable (low level)?	Set FRAME CONT connector 1 ENABLE to high level (no input).	Section 5.10.1, “FRAME CONT Connector”
	Is FRAME CONT connector 1 LOAD ON (pin number 10) set to load off status (high level)?	Set FRAME CONT connector 1 LOAD ON to high level (no input).	
Unable to turn the load on using the LOAD key of the unit.	Does the polarity of the load-on external control in the configuration settings match the polarity of LOAD ON of the CH CONT connector?	Match the polarities.	Section 5.9, “Configuration Settings” and section 5.10.2, “CH CONT Connector”
	Is CH CONT connector LOAD ON set to load off status?	Set CH CONT connector LOAD ON to load on.	

Symptom	Check Items	Remedy	Reference
The current does not flow immediately when the load is turned on.	Is delayed load-on specified?	Shorten the delayed load-on time.	Section 5.9, “Configuration Settings”
Unable to turn on the load from the FRAME CONT connector.	Is FRAME CONT connector 1 ENABLE set to disable (high level)?	Set FRAME CONT connector 1 ENABLE to enable (low level).	Section 5.10.1, “FRAME CONT Connector”
Unable to turn on the load from the CH CONT connector.	Is the polarity of the load-on external control correct?	Match the polarities between the load-on external control in the configuration settings (CONFIG number 7) and LOAD ON of the CH CONT connector.	Section 5.9, “Configuration Settings”

### The PLZ-U does not operate according to the settings.

Symptom	Check Items	Remedy	Reference
The current is unstable.	Is there a large loop in the load wire?	Shorten and twist the load wire.	Section 2.8.1, “Precautions Concerning Wiring”
	Is an alarm occurring?	<ul style="list-style-type: none"> <li>• Check the alarm type and eliminate the cause of the alarm.</li> <li>• Eliminate the cause, and then clear the alarm.</li> </ul>	Section 4.4, “Protection Functions and Alarms”
The setting current is not flowing.	Is the LED located inside of the load unit illuminated?	Fuse blow. Immediately stop the use of the instruments and request for repair service.	Section 7.2, “Confirming status of the fuse”
The current does not change even when the rotary knob is turned.	Are the keys locked (KEY LOCK LED illuminated)?	Release the key lock. Hold down the KEY LOCK (SHIFT + LOCAL) key until the KEY LOCK LED turns off.	Section 5.8, “Key Lock Function”
	Is the EXT LED of the load unit illuminated?	Set CONFIG number 2 in the configuration settings to 0 (no external control).	Section 5.10.2, “CH CONT Connector” and section 5.9, “Configuration Settings”
	Is the RMT LED of the frame illuminated?	Press the LOCAL key to release remote control.	EXT/RMT/KEY LOCK indicator [17] in section 3.1.1, “Frame”
	Is the ENTRY key of the channel whose settings you wish to change illuminated?	Press the ENTRY key of the channel whose settings you wish to change to select the channel.	Section 4.1, “Panel Control Basics”

Symptom	Check Items	Remedy	Reference
Unable to supply the current as specified (SET value).	Is switching mode enabled?	Clear switching mode.	Section 5.3, “Switching Function”
	Is the input terminal voltage greater than or equal to the minimum voltage?	If the input terminal voltage is less than the minimum voltage, increase the voltage.	“Rating” of section 8.1, “Electrical Specifications”
	In the case of the PLZ70UA: If the power output of the equipment under test is interrupted, did you turn the power output back on before the input terminal voltage of the PLZ-U fell to 0 V?	If you need to turn the power output of the equipment under test back on, let the input terminal voltage of the PLZ-U fall to 0 V before doing so.	“CAUTION” in section 4.2, “Load On/Off”
The PLZ-U does not switch according to the settings.	Is soft start enabled?	Set the soft start time again.	Section 5.1, “Soft Start”
The sequence does not run according to the settings.	Is soft start enabled?	Enter a 0 A setting in sequence program step 1 for a time longer than or equal to five times the selected soft start time or 20 ms, whichever is longer.	Section 5.1, “Soft Start” and section 5.6.2, “Executing the Sequence”
The PLZ-U does not switch.	Is the setting (SET value) and the SW LEVEL value the same?	Set different values for the setting (SET value) and the SW LEVEL setting.	Section 5.3, “Switching Function”

## An alarm occurs.

Symptom	Check Items	Remedy	Reference
An alarm occurs.	Check the alarm number.	Check the alarm type and carry out the appropriate remedy.	Section 4.4, “Protection Functions and Alarms”
The UVP trips during switching.	Is there a large loop in the load wire?	Shorten and twist the load wire.	Section 2.8.1, “Precautions Concerning Wiring”
The RVP trips.	Is there a large loop in the load wire?	Shorten and twist the load wire.	Section 2.8.1, “Precautions Concerning Wiring”
	Is negative voltage applied to the load input terminal?	<ul style="list-style-type: none"> <li>• Immediately turn off the output of the equipment under test.</li> <li>• Be sure to match the polarities between the load input connector and the equipment under test.</li> </ul>	Section 4.4, “Protection Functions and Alarms” and section 2.8.1, “Precautions Concerning Wiring”
	When the PLZ70UA is used, do you turn on/off of the DUT?	Set to avoid the alarm occurrence.	“When the DC power supply and the DUT are connected in series, and turning on/off of the DUT.” in section 4.2, “Load On/Off”
The OHP trips.	Is the air outlet blocked?	Allow at least 20 cm between the air outlet and the wall. Do not place objects within 20 cm.	Section 2.2, “Precautions Concerning Installation Location”
	Is the dust filter clogged?	Clean the dust filter.	Section 7.1.2, “Cleaning the Dust Filter”



# 8

## Chapter 8 Specifications

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

## 8.1 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, the PLZ-U must be calibrated correctly in an environment of  $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ .
- \*\* % 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.

Model			PLZ150U	PLZ70UA
Rating				
Operating voltage (DC) <sup>*1</sup>			1.5 V to 150 V	0 V to 150 V
Current/power	Range	H	30 A / 150 W	15 A / 75 W
		M	3 A / 150 W	1.5 A / 75 W
		L	300 mA / 45 W	150 mA / 22.5 W
Isolation voltage of the load input terminal			500 VDC	
Withstand voltage between load input terminal channels			500 VDC	

### CC mode

Operating range	Range	H	0 A to 30 A	0 A to 15 A
		M	0 A to 3 A	0 A to 1.5 A
		L	0 A to 300 mA	0 A to 150 mA
Selectable range			0 % to 105 % of f.s	
Resolution	Range	H	2 mA	1 mA
		M	0.2 mA	0.1 mA
		L	0.02 mA	0.01 mA
Accuracy of setting	Range	H, M, and L	$\pm(0.2\text{ \% of set} + 0.2\text{ \% of f.s}) + V_{in}^{*2}/500\text{ k}\Omega$	
Input voltage variation <sup>*3</sup>	Range	H	2 mA	
		M	1 mA	
		L	0.1 mA	
Ripple		rms <sup>*4</sup>	3 mA	7.5 mA
		p-p <sup>*5</sup>	30 mA	50 mA

\*1. Minimum voltage at which the current starts flowing to the PLZ-U is approximately 0.3 V.  
(The PLZ-U 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. Therefore, if the input voltage is gradually increased from 0 V, no current will flow until 0.3 V is exceeded. If 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.)

\*2.  $V_{in}$ : Load input terminal voltage

\*3. At a current greater than or equal to ( $V_{in}/500 \text{ k}\Omega$ )

\*4. Measurement frequency bandwidth: 10 Hz to 1 MHz

\*5. Measurement frequency bandwidth: 10 Hz to 20 MHz

Model	PLZ150U	PLZ70UA
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#### CR mode

Operating range The value inside parentheses is the conductance.*1	Range	H	OPEN to 50 mΩ (0 S to 20 S)	OPEN to 100 mΩ (0 S to 10 S)
		M	OPEN to 500 mΩ (0 S to 2 S)	OPEN to 1 Ω (0 S to 1 S)
		L	OPEN to 5 Ω (0 S to 200 mS)	OPEN to 10 Ω (0 S to 100 mS)
Selectable range			0 % to 105 % of f.s.*2	
Resolution The value inside parentheses is the operating range.	Range	H	0.2 mS (0 S to 2 S)	0.1 mS (0 S to 1 S)
			2 mS (2 S to 20 S)	1 mS (1 S to 10 S)
		M	20 μS (0 S to 200 mS)	10 μS (0 S to 100 mS)
			0.2 mS (200 mS to 2 S)	0.1 mS (100 mS to 1 S)
		L	2 μS(0 S to 20 mS)	1 μS(0 S to 10 mS)
			20 μS(20 mS to 200 mS)	10 μS(10 mS to 100 mS)
Accuracy of setting*3	Range	H, M, and L	±(0.5 % of set*4 + 0.5 % of f.s.*5) + Vin/500 kΩ	

#### CV mode

Operating range	Range	H	1.5 V to 150 V	0 V to 150 V
		L	1.5 V to 15 V	0 V to 15 V
Selectable range			0 % to 105 % of f.s	
Resolution	Range	H	10 mV	
		L	1 mV	
Accuracy of setting	Range	H and L	±(0.1 % of set + 0.1 % of f.s)	
Input current variation *6			12 mV	

#### Voltmeter

Measurement range		0 V to 150.0 V	
Resolution	15.75 V to 150 V	0.01 V	
	0 V to 15.75 V	0.001 V	
Measurement accuracy		±(0.1 % of rdg + 15 digits)	

#### Ammeter

Measurement range	Range	H	0 A to 30 A	0 A to 15 A
		M	0 A to 3 A	0 A to 1.5 A
		L	0 mA to 300 mA	0 mA to 150 mA
Resolution	Range	H	0.001 A	
		M	0.0001 A	
		L	0.01 mA	
Measurement accuracy			±(0.2 % of rdg + 0.3 % of f.s)	

#### Wattmeter \*7

Measurement range		0 W to 150 W	0 W to 75 W
Resolution	100 W minimum	0.01 W	
	100 W or greater	0.1 W	

\*1. Conductance [S] = (Input current [A]/input voltage [V]) = (1/resistance [Ω])

\*2. Conductance f.s

\*3. Converted value in terms of the input current, during remote sensing

\*4. set = input voltage × specified conductance = (input voltage/specified resistance)

\*5. f.s = Rated current of the specified range

\*6. During remote sensing

\*7. Product of the measured voltage and measured current

Model	PLZ150U	PLZ70UA
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#### Switching mode

Operation mode		CC and CR
Selectable frequency range		1 Hz to 20 kHz
Duty cycle setting		2 % to 98 %, 0.1 % steps
Frequency resolution	1 Hz to less than 1 kHz	1 Hz
	1 kHz to less than 10 kHz	10 Hz
	10 kHz to 20 kHz	100 Hz
Accuracy of frequency setting		$\pm(0.5 \% \text{ of set } )$

#### Slew rate

Operation mode			CC and CR	
Selectable range (CC)	Range	H	0.10 A/μs to 2.40 A/μs	0.05 A/μ to 1.20 A/μs
		M	0.10 A/μs to 0.24 A/μs	0.05 A/μ to 0.12 A/μs
		L	24 mA/μs <sup>*1</sup>	12 mA/μs <sup>*1</sup>
Selectable range (CR)	Range	H	0.10 A/μs to 0.24 A/μs	0.05 A/μ to 0.12 A/μs
		M	24 mA/μs <sup>*1</sup>	12 mA/μs <sup>*1</sup>
		L	2.4 mA/μs <sup>*1</sup>	1.2 mA/μs <sup>*1</sup>
Resolution			0.01 A/μs	
Accuracy of setting <sup>*2</sup>			±(10 % of set + 5 μs)	

#### Soft start

Operation mode	CC
Selectable time range	0.1, 1, 3, 10, 30, 100, or 300 ms
Time accuracy	$\pm(30 \% \text{ of set } + 100 \mu\text{s})$

#### Sequence function

Sequence	Operation mode	CC and CR
	Maximum number of steps	255
	Step execution time	1 ms to 9 999 s
	Number of loops	1 to 9999 (9999 is infinite loop)

\*1. Fixed value

\*2. Time to reach from 10 % to 90 % when the current is changed from 2 % to 100 % of the rated current of H range.

## Protection function

Overvoltage protection (OVP)	Turns off the load at 110 % of the rated voltage
Overcurrent protection (OCP)	Set the value in the range of 0 % to 110 % of the rated current of H range. Trips at the value or 110% of the rated current of the range, whichever is less.
	The action taken when the OCP trips can be set to load off or limit.
Overpower protection (OPP)	Set the value in the range of 0 % to 110 % of the rated power of H range. Trips at the value or 110% of the rated power of the range, whichever is less.
	The action taken when the OPP trips can be set to load off or limit.
Overheat protection (OHP)	Trips when the heat sink temperature reaches 95 °C. The action taken when the OHP trips is to turn the load off.
Reverse connection protection (RVP)	Short-term protection provided by a short-circuit system using a protection diode. The action taken when the OHP trips is to turn the load off.
Undervoltage protection (UVP)	Set the value to off or in the range of 0 % to 100 % of the rated voltage.
	The action taken when the OHP trips is to turn the load off.

## Remote sensing

Sensing voltage that can be compensated	2 V for a single line
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## Miscellaneous

ABC preset memories	Saves settings (A, B, and C) for each operation mode of each range
Setup memories	Saves four sets of setup parameters
Elapsed time display	Measures the time from when the load is turned on to when the load is turned off (0.1 s to 99999 s)
Auto load off timer	Turns off the load after the specified time elapses (off or 1 s to 99999 s)
Delayed load-on	Turns on the load after the specified time elapses (0 ms to 1 s, 10 ms steps)
Parallel operation	Possible between adjacent load units (same model) in the frame.

## Inter-frame control and external control

Inter-frame control		Controls up to four slave frames from the master frame.
		Enables you to turn on/off the load, recall presets ABC on all channels simultaneously, and recall setup memories 0 to 3.
External control	Recall input of preset memories A, B, and C	Recalls preset memories A, B, and C on all channels simultaneously
	Setup memory recall input	Recalls the setup memory 0 to 3
	Enable input	Enables the turning on/off of the load, recalling of presets ABC on all channels simultaneously, and recalling of setup memories 0 to 3.
	Load-on input.	Turns on the load on all channels simultaneously.
	Load on status output	On when the load is on (open collector output)
	Alarm status output	On when the alarm is on (open collector output)
	Internal power output	5 V and maximum output current of 100 mA
Input signal		Low active, pull up to 5 V using 10 k $\Omega$ . Low level input voltage: 0 V to 1 V, high level input voltage: 4 V to 5 V

Output signal	Open collector, output withstand voltage of 30 VDC, output saturation voltage of approximately 1.1 V, and maximum output current of 100 mA.
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#### External analog control

Power output	12 V and maximum output current of 50 mA.
External voltage control input <sup>*1</sup>	Operates in CC, CR, and CV modes. 0 % to 100 % of f.s in the range of 0 V to 10 V.
Load-on input.	Low active (or high active), pull up to 5 V using 10 kΩ. Low level input voltage: 0 V to 1 V, high level input voltage: 4 V to 5 V
Current monitor output	0 % to 100 % of the rated current in the range of 0 V to 10 V
Common	Negative pin electric potential of the load input terminal

\*1. The time for updating the setting in CR or CV mode is approximately 100 ms.

GPIB	IEEE std. 488.2-1994 SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, and E1
	Supports the SCPI command set Sets panel functions except the POWER switch and key lock and reads measured values
RS-232C	D-SUB 9-pin connector (conforms to EIA-232-D)
	Sets panel functions except the POWER switch and key lock and reads measured values Baud rate: 2400, 4800, 9600, or 19200 bps; stop bit: 1; data length: 8 bits; parity: NONE; and flow control: XON/OFF.

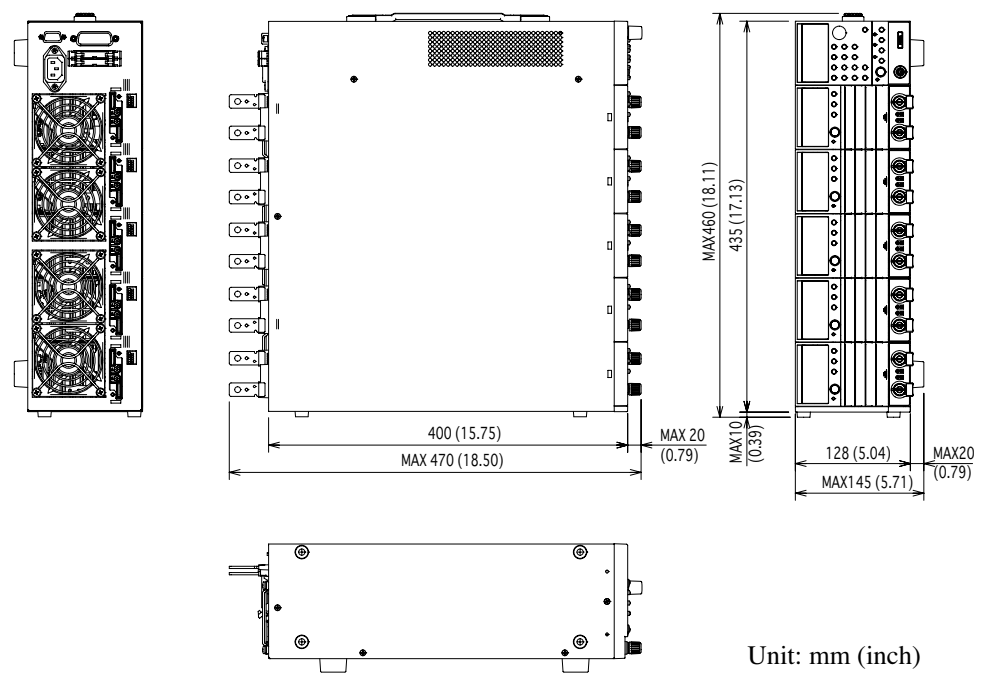
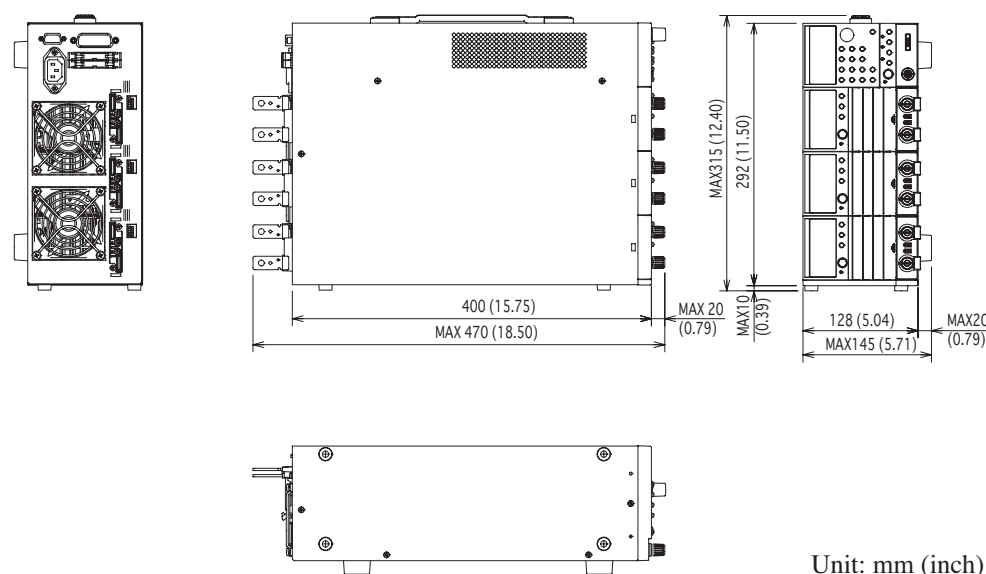
## General Specifications

Model		PLZ150U	PLZ70UA
Weight		Approx. 2 kg	
Accessories	Rear load input terminal cover	1 pc.	
	Set of screws for the load input connector	2 sets (M6 bolt, M6 nut, M6 spring washer, M4 screw)	
	Load unit attachment screws	2 pcs. (M3-10 screws, attached to the unit)	
	Sensing terminal screw on the rear panel	2 pcs. (M3-6 screws, attached to the unit)	

Model		PLZ30F	PLZ50F
Rated supply voltage		100 VAC to 240 VAC (90 VAC to 250 V) single phase	
Rated frequency		50 Hz or 60 Hz (47 Hz to 63 Hz)	
Power consumption	Frame alone	33 VA or less	40 VA or less
	When load units are installed in all channels	300 VAm <sub>ax</sub>	500 VAm <sub>ax</sub>
Cooling system		Forced air cooling using a heat sensing variable speed fan.	
Operating temperature range		0 °C to 40 °C (32 °F to 104 °F)	
Operating humidity range		20 % to 85 % RH (without condensation)	
Storage temperature range		-20 °C to 70 °C (-4 °F to 158 °F)	
Storage humidity range		90 % RH or less (without condensation)	
Insulation resistance	Primary - chassis	500 VDC, 30 MΩ or more (ambient humidity of 70% RH or less)	
Withstand voltage	Primary - chassis	No abnormalities at 1 500 VAC for 1 minute.	
Ground continuity		25 AAC, 0.1 Ω or less	
Battery backup		Backs up the setup data immediately before the power is turned off Battery life: 3 years or longer (at 25 °C)	
Number of installable load units		3	5
Dimensions (mm)		See outline drawing.	
Weight	Frame alone	Approx. 5 kg (11.02 lb)	Approx. 7 kg (15.43 lb)
Accessories	Power cord	1 pc. (with SVT3, 18AWG, 3-prong plug, cable length of 2.4 m)	
	Blank panel (front panel)	2 pcs. maximum <sup>*1</sup>	4 pcs. maximum <sup>*1</sup>
	Protection dummy plug	2 pcs. (for the FRAME CONT connector, attached to the unit)	
	Operation manual	1 pc.	
Electromagnetic compatibility <sup>*1, *2</sup>		Conforms to the requirements of the following directives and standards EMC Directive 2004/108/EC EN 61326-1 EN 61000-3-2 EN 61000-3-3	
Safety <sup>*2, *3</sup>		Conforms to the requirements of the following directives and standards Low Voltage Directive 2006/95/EC EN 61010-1 Class I Pollution degree 2	

- \*1. In products that have load units installed, blank panels are installed in the empty slots. In products that contain the frame alone, the maximum number of blank panels are installed.
- \*2. Only on models that have CE marking on the panel.
- \*3. Not applicable to custom order models.
- \*4. This unit is a Class 1 device. Be sure to ground the protective conductor terminal of the unit. The safety of the unit is not guaranteed unless the unit is grounded properly.

# 8.2 Dimensions





# Appendix

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

## A.1 Operating Area of the PLZ-U

As shown in Fig. A-1, the PLZ-U 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) (area indicated in dark gray: operating area where specifications are guaranteed). For PLZ-Us 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 (area indicated in light gray: 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.”

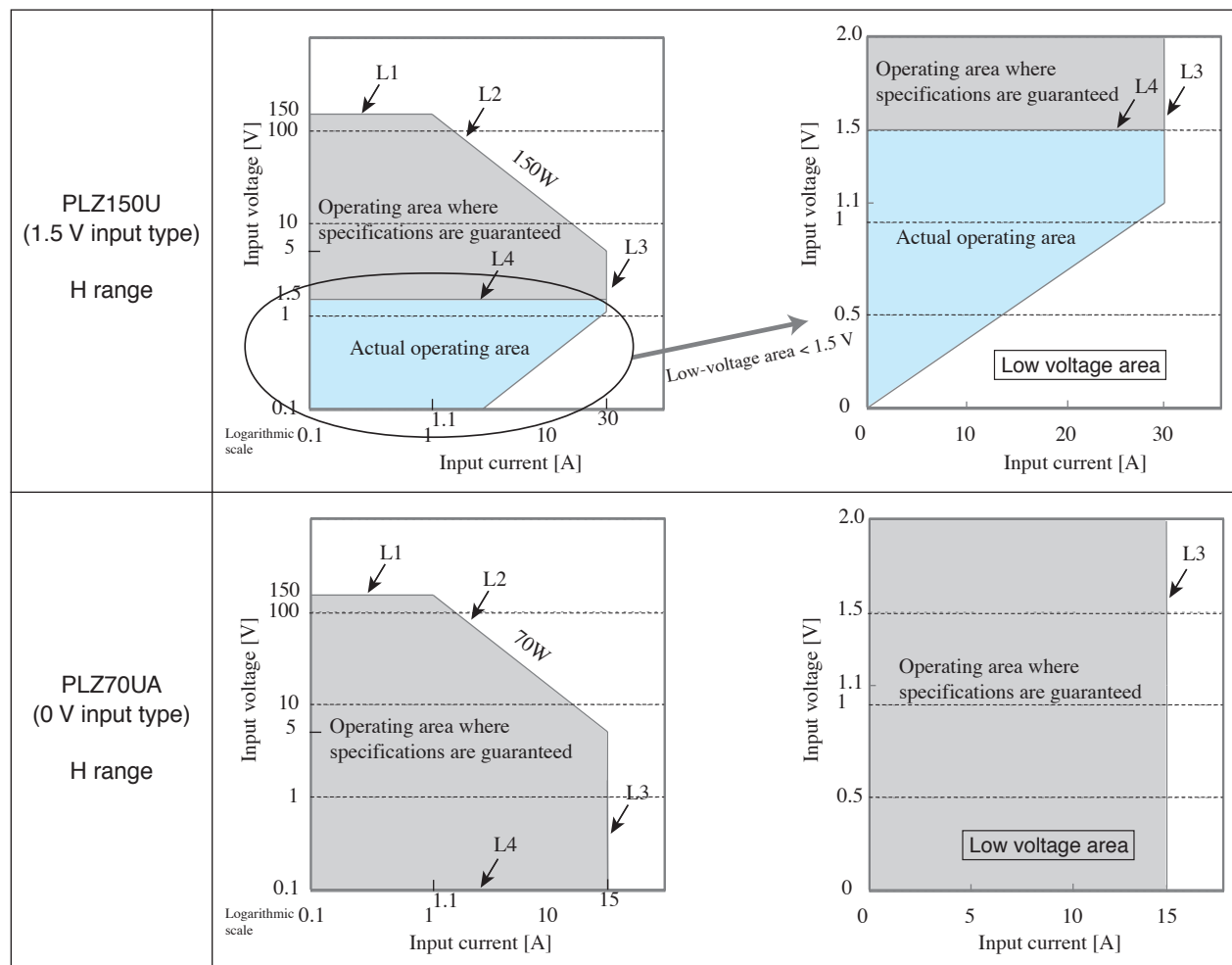


Fig.A-1 Operating area

## A.2 Basic Operation Modes

The following five operation modes are available on the PLZ-U.

1. Constant current mode (CC mode)
2. Constant resistance mode (CR mode)
3. Constant voltage mode (CV mode)
4. Constant current and constant voltage mode (CC+CV mode)
5. 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-U is used in CC mode, the PLZ-U operates as a constant current load as shown in Fig. A-2. The PLZ-U supplies the specified current ( $I$ ) independent of the output voltage of the constant-voltage power supply ( $V_1$ ).

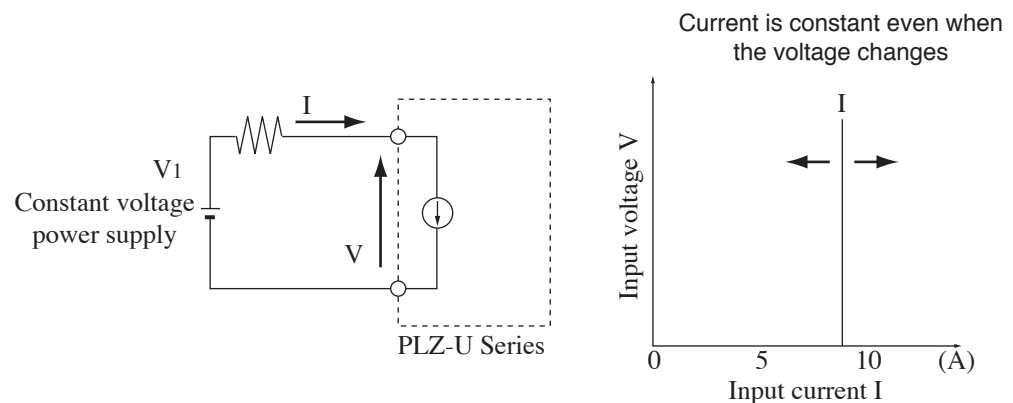


Fig. A-2 Equivalent circuit of the constant current load and operation

#### ■ 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.

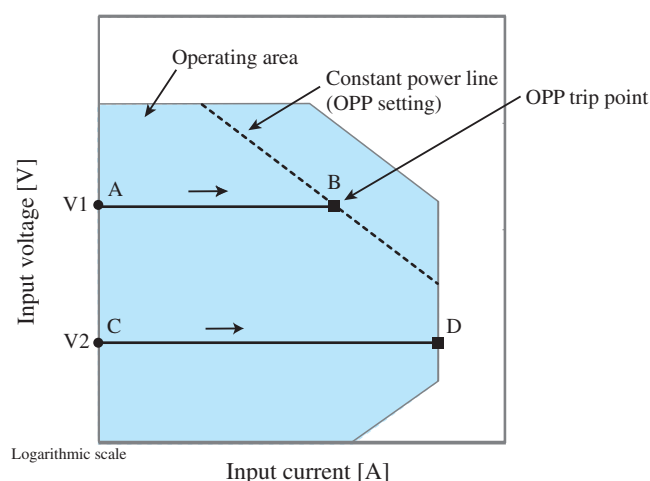


Fig. A-3 Transition of the operating point in CC mode (OPP trip point)

#### 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-U 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-U depending on the protection action setting of the OPP.

If the function for turning off the load when the OPP trips is on, the load is turned off.

If the function for turning off the load when the OPP trips is off (set to limit), the PLZ-U supplies 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-U returns to CC mode, and the operating point moves along segment AB.

TableA-1 Action taken when the OPP trips

Point B	Load-off function on	Turns off the load (stops the current supply). The PLZ-U no longer operates as a load.
	Load-off function off (limit)	CC mode ends. OPP continues, and the PLZ-U supplies 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-U 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-U supplies current proportional to the voltage variation.

### ■ CR mode operation

When the PLZ-U is used in CR mode, the PLZ-U operates as a resistive load as shown in Fig. A-4. When the voltage ( $V_1$ ) of the constant-voltage power supply is varied, the PLZ-U supplies current to meet  $I=V/R$  according to the specified resistance  $R$ .

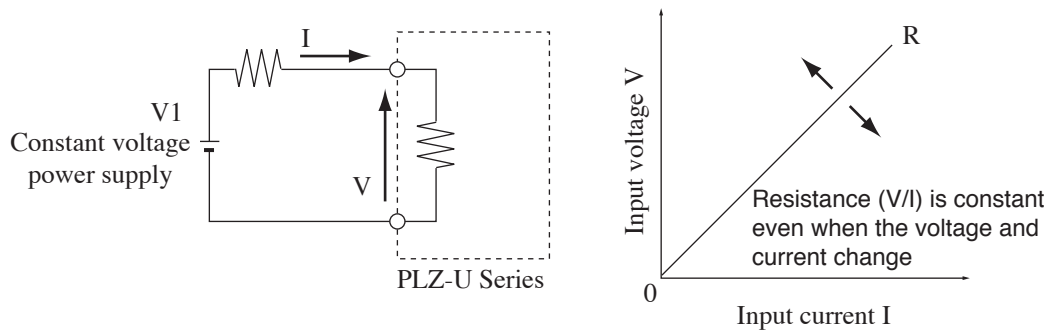


Fig. A-4 Equivalent circuit of the constant resistance load and operation

### ■ 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.

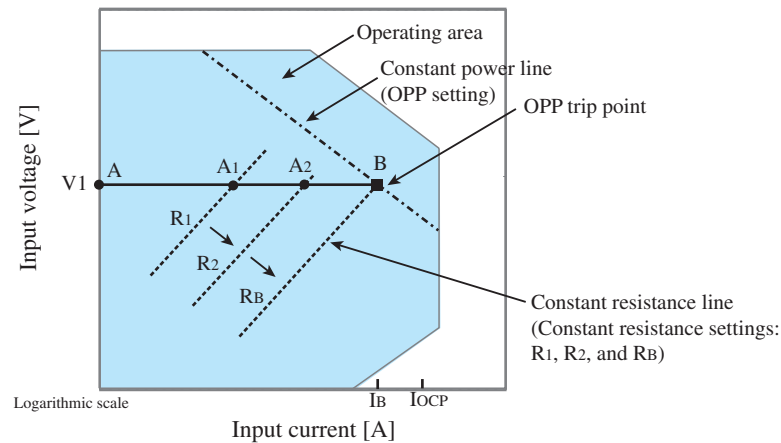


Fig. A-5 Transition of the operating point in CR mode (OPP trip point)

If the overcurrent protection (OCP) setting  $I_{OCP}$  is greater than the current value  $I_B$  at point B, when the PLZ-U 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  $V_1$ , 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-U depending on the protection action setting of the OPP.

If the function for turning off the load when the OPP trips is on, the load is turned off.

If the function for turning off the load when the OPP trips is off (set to limit), the PLZ-U supplies 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-U returns to CR mode, and the operating point moves along segment AB.

Table A-2 Action taken when the OPP trips

Point B	Load-off function on	Turns off the load (stops the current supply). The PLZ-U no longer operates as a load.
	Load-off function off (limit)	CR mode ends. OPP continues, and the PLZ-U supplies current as a constant power load.

### ■ Transition of the operating point: Overcurrent protection (OCP)

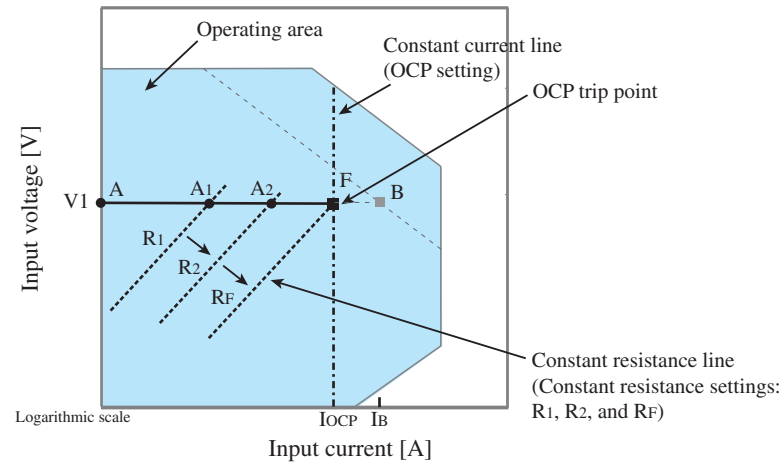


Fig. A-6 Transition of the operating point in CR mode (OCP trip point)

If the overcurrent protection (OCP) setting  $I_{OCP}$  is less than the current value  $I_B$  at point B, when the PLZ-U 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-U depending on the protection action setting of the OCP.

If the function for turning off the load when the OCP trips is on, the load is turned off.

If the function for turning off the load when the OCP trips is off (set to limit), the PLZ-U supplies current as a constant current load at point L. 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-U returns to CR mode, and the operating point moves along segment AF.

TableA-3 Action taken when the OCP trips

Point F	Load-off function on	Turns off the load (stops the current supply). The PLZ-U no longer operates as a load.
	Load-off function off (limit)	CR mode ends. OCP continues, and the PLZ-U supplies current as a constant current load.

## A.2.3 Operation of the CV Mode

In CV mode, the PLZ-U supplies current so that the voltage at the load input end of the PLZ-U is constant.

### ■ CV mode operation

When the PLZ-U is used in CV mode, the PLZ-U operates as a constant voltage load (shunt regulator) as shown in Fig. A-7. When  $V_1$  is greater than  $V$ , the input voltage  $V$  is kept constant even when the input current  $I$  varies. Current does not flow when  $V_1$  is less than or equal to  $V$ .

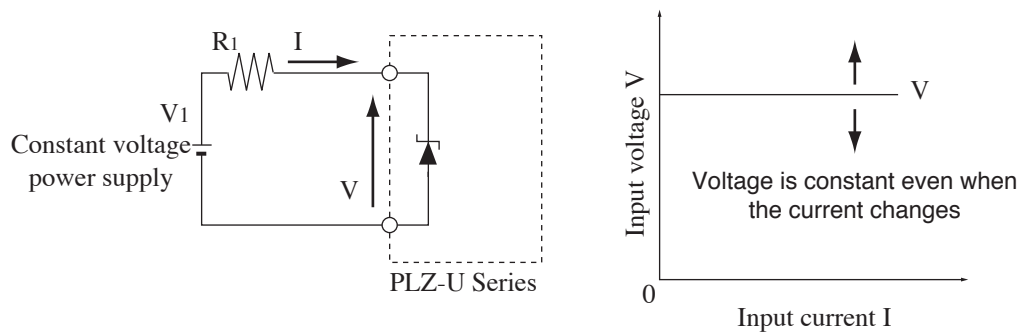


Fig. A-7 Equivalent circuit of the CV mode and operation

### ■ 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-7 using CV mode.

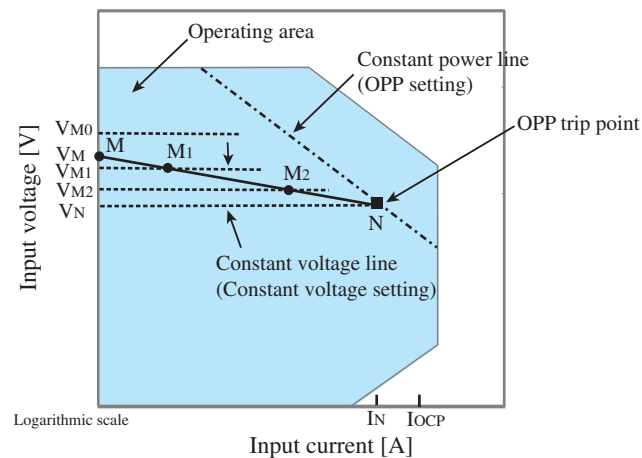


Fig. A-8 Transition of the operating point in CV mode (OPP trip point)

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-U is equal to  $V_{M0}$  ( $V_{M0} > V_M$ ), no current flows. When the voltage of the PLZ-U is decreased to a point in which  $V_{M0}$  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-U depending on the protection action setting of the OPP.

If the function for turning off the load when the OPP trips is on, the load is turned off.

If the function for turning off the load when the OPP trips is off (set to limit), the PLZ-U supplies 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-U returns to CV mode, and the operating point moves along segment MN.

Table A-4 Action taken when the OPP trips

Point N	Load-off function on	Turns off the load (stops the current supply). The PLZ-U no longer operates as a load.
	Load-off function off (limit)	CV mode ends. OPP continues, and the PLZ-U supplies current as a constant power load.

### ■ Transition of the operating point: Overcurrent protection (OCP)

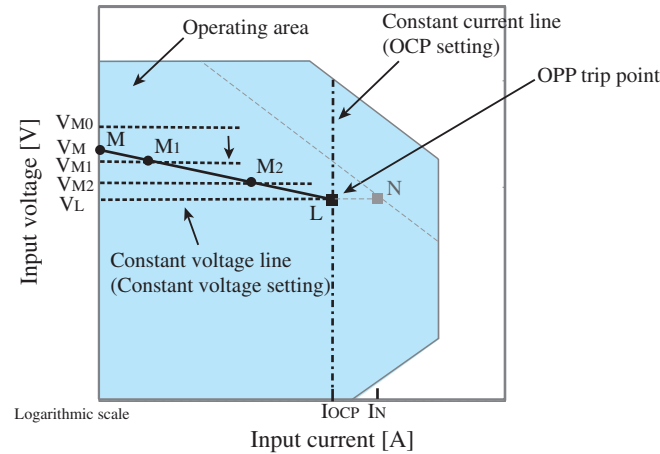


Fig. A-9 Transition of the operating point in CV mode (OCP trip point)

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-U is equal to  $V_{M0}$  ( $V_{M0} > V_M$ ), no current flows. When the voltage of the PLZ-U is decreased to a point in which  $V_{M0}$  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-U depending on the protection action setting of the OCP.

If the function for turning off the load when the OCP trips is on, the load is turned off.

If the function for turning off the load when the OCP trips is off (set to limit), the PLZ-U supplies 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-U returns to CV mode, and the operating point moves along segment ML.

Table A-5 Action taken when the OCP trips

Point L	Load-off function on	Turns off the load (stops the current supply). The PLZ-U no longer operates as a load.
	Load-off function off (limit)	CV mode ends. OCP continues, and the PLZ-U supplies current as a constant current load.

## A.2.4 Operation of the CC+CV Mode

The PLZ-U allows you to add CV mode to CC mode.

### ■ CC+CV mode operation

When the PLZ-U is used in CC+CV mode, the PLZ-U operates as a constant current load and a constant voltage load (shunt regulator) as shown in Fig. A-10. When operating as a constant current load, the PLZ-U supplies 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.

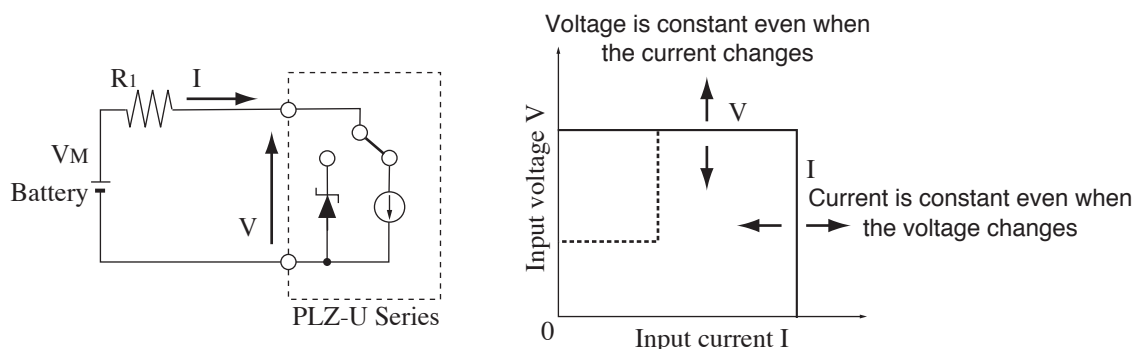


Fig. A-10 Equivalent circuit of the CC+CV mode and operation

### ■ Transition of the operating point: Overpower protection (OPP)

We will consider the case when checking the discharge characteristics of a battery of Fig. A-10.



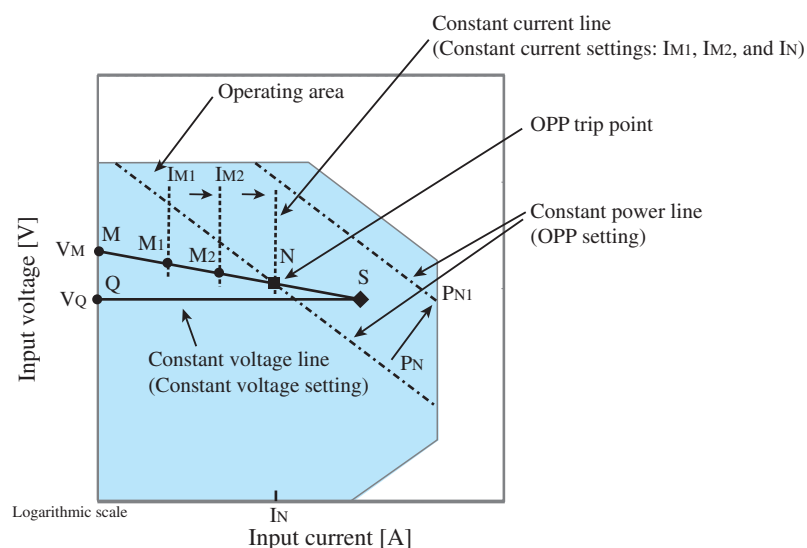


Fig. A-11 Transition of the operating point in CC+CV mode (OPP trip point)

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-U depending on the protection action setting of the OPP.

If the function for turning off the load when the OPP trips is on, the load is turned off.

If the function for turning off the load when the OPP trips is off (set to limit), the PLZ-U supplies 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-U returns to CC mode, and the operating point moves along segment MN.

Table A-6 Action taken when the OPP trips

Point N	Load-off function on	Turns off the load (stops the current supply). The PLZ-U no longer operates as a load.
	Load-off function off (limit)	CC mode ends. OPP continues, and the PLZ-U supplies 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.2.5 Operation of the CR+CV Mode

The PLZ-U allows you to add CV mode to CR mode.

### ■ CR+CV mode operation

When the PLZ-U is used in CR+CV mode, the PLZ-U operates as a constant resistance load and a constant voltage load (shunt regulator) as shown in Fig. A-12. When operating as a constant resistance load and the voltage ( $V_M$ ) of the constant-voltage power supply is varied, the PLZ-U supplies 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.

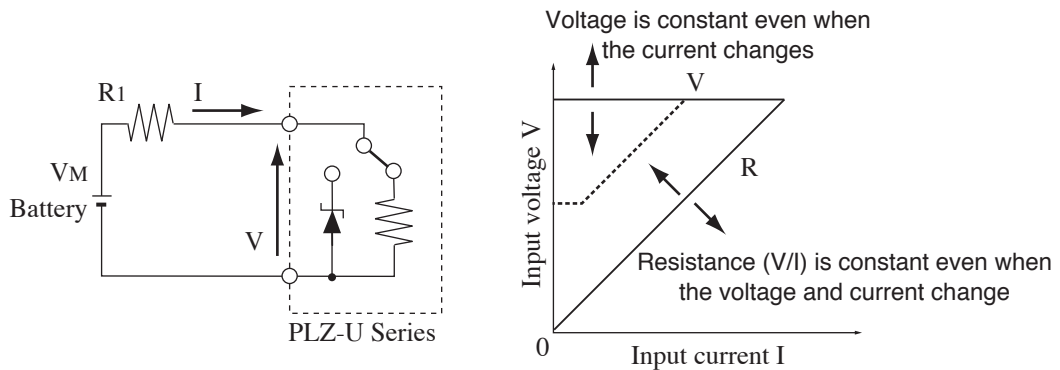


Fig. A-12 Equivalent circuit of the CR+CV mode and operation

### ■ Transition of the operating point: Overpower protection (OPP)

We will consider the case when checking the discharge characteristics of a battery of Fig. A-12.

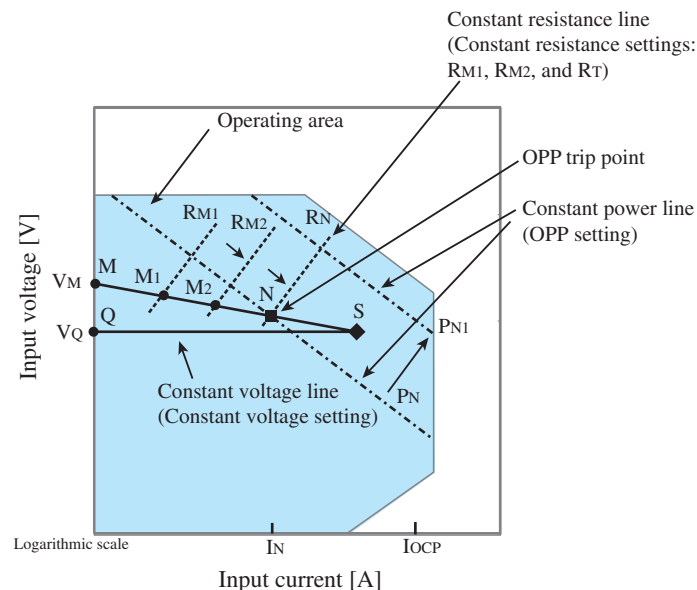


Fig. A-13 Transition of the operating point in CR+CV mode (OPP trip point)

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-U depending on the protection action setting of the OPP.

If the function for turning off the load when the OPP trips is on, the load is turned off.

If the function for turning off the load when the OPP trips is off (set to limit), the PLZ-U supplies 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-U returns to CR mode, and the operating point moves along segment MN.

Table A-7 Action taken when the OPP trips

Point N	Load-off function on	Turns off the load (stops the current supply). The PLZ-U no longer operates as a load.
	Load-off function off (limit)	CR mode ends. OPP continues, and the PLZ-U supplies 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)

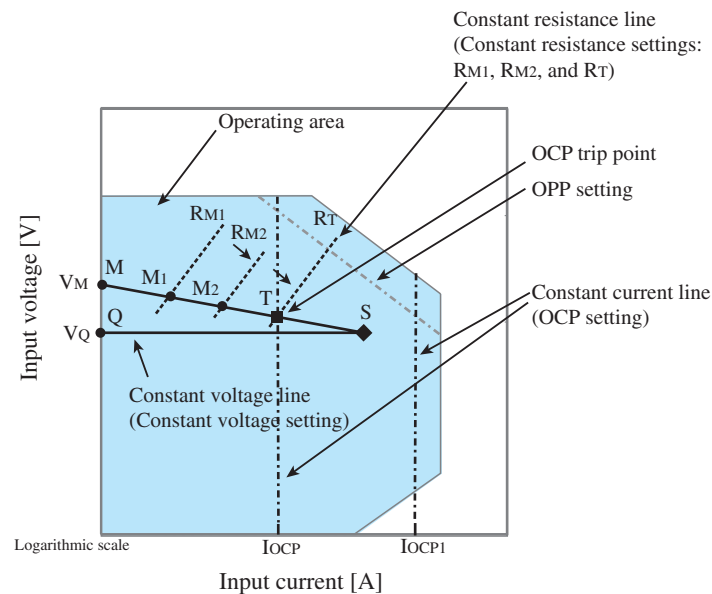


Fig. A-14 Transition of the operating point in CR+CV mode (OCP trip point)

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-U depending on the protection action setting of the OCP.

If the function for turning off the load when the OCP trips is on, the load is turned off.

If the function for turning off the load when the OCP trips is off (set to limit), the PLZ-U supplies 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-U returns to CR mode, and the operating point moves along segment MT.

Table A-8 Action taken when the OCP trips

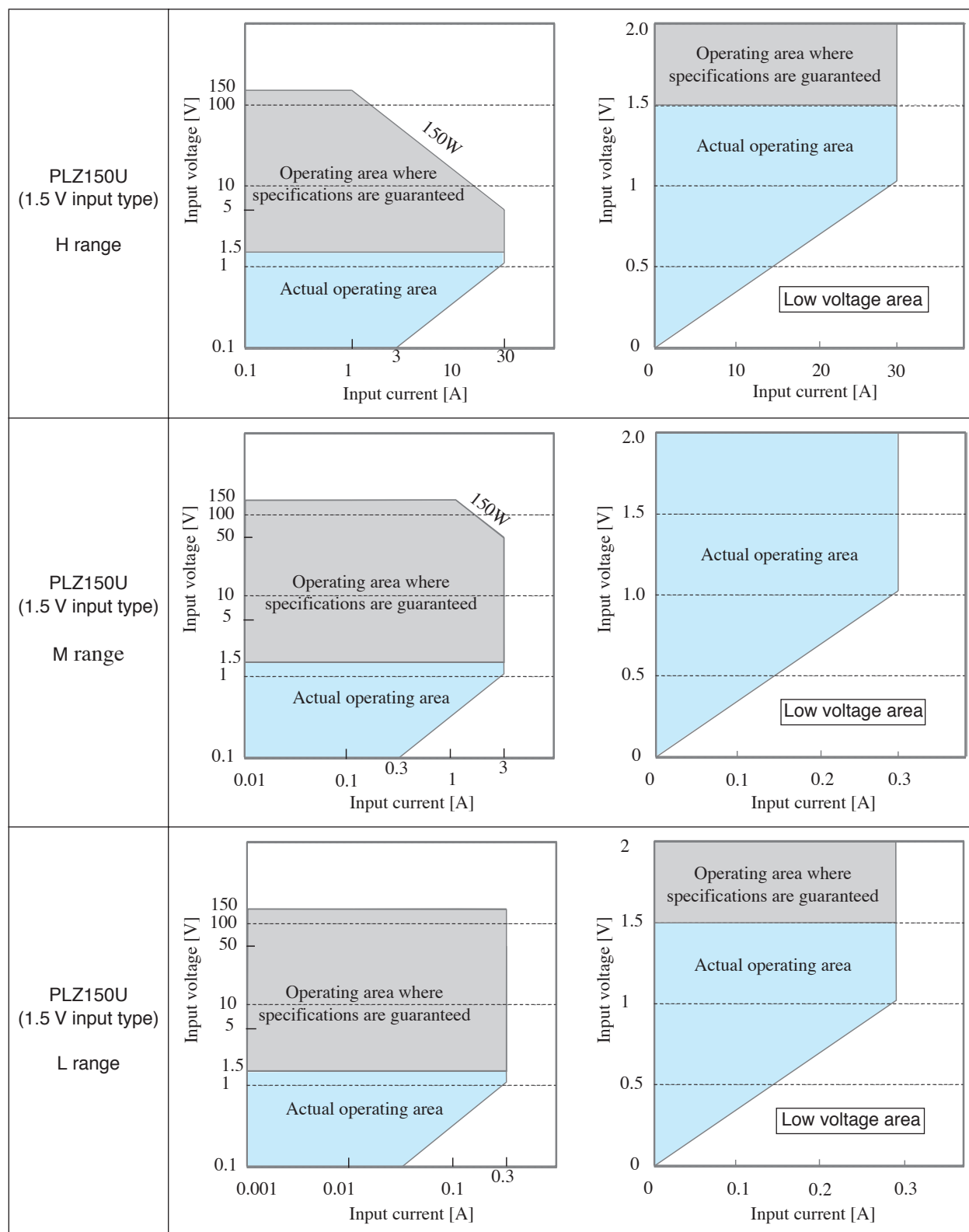
Point T	Load-off function on	Turns off the load (stops the current supply). The PLZ-U no longer operates as a load.
	Load-off function off (limit)	CR mode ends. OCP continues, and the PLZ-U supplies current as a constant current load.

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.

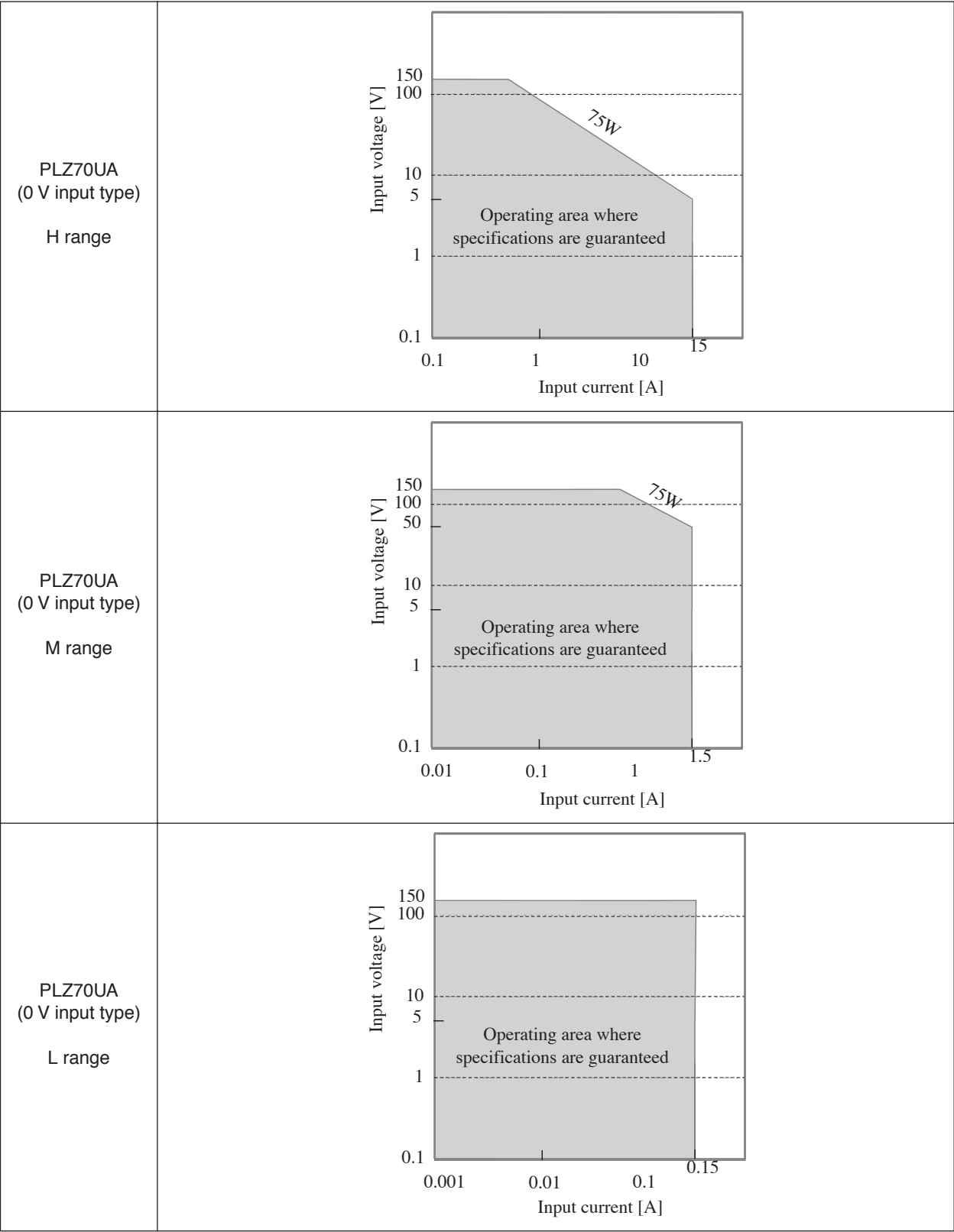
Here, the operation mode is CV. The voltage is fixed to voltage  $V_Q$  set in advance. In this case, the operating point moves along segment QS. The current is determined by the battery voltage and its internal resistance.

## A.3 Operating Area of Each Model

### A.3.1 Operating Area of the PLZ150U



### A.3.2 Operating Area of the PLZ70UA



## A.4 Sequence Program Creation Table

Program name:		Date:	By:
Channel numbers (1 to 5)			
Memo			
Operation mode	CC , CR		
Range (A)	(A)		
RPT (1 to 9999)			
Last load (OFF/ON)	OFF , ON		

Step Number	Value	Execution Time	Note
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

## A.5 SCPI Command Reference

This appendix gives an overview of the Standard Commands for Programmable Instruments (SCPI) that the PLZ-U Series Electronic Load supports.

### Summary of SCPI commands

The SCPI commands that the PLZ-U 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-U 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.)

#### Expression

Expression	Details
conductance	A value defined by SCPI. It can be MAXimum or MINimum. May include suffix units such as mS, $\mu$ S, and S.
current	A value defined by SCPI. It can be MAXimum or MINimum. May include suffix units related to current such as mA, $\mu$ A, and A.
power	A value defined by SCPI. It can be MAXimum or MINimum. May include suffix units related to wattage such as mW, $\mu$ W, 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.
step	A step number of a sequence program. Up to 255 steps can be shared.
string	A string data. ASCII codes 20H to 7EH can be used.
time	The execution time of sequence mode. May contain suffix units related to time such as S.
value	A numeric data including MAXimum and MINimum. See the program data of each command.
voltage	A value defined by SCPI. It can be MAXimum or MINimum. May include suffix units related to voltage such as mV, $\mu$ V, 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-U 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-U, an ASCII character 0 is always returned in the output queue in response to this query.	Query only
*WAI	Prevents the device from executing subsequent commands or queries until the No Operation Pending flag becomes true. (*OPC?)	N/A

## Channel commands

SCPI Command	Description	Query	Note 1	Note 2
INSTrument				
[ :SElect ] {CH1   CH2   CH3   CH4   CH5}	Selects the channel to which commands are applied using an ID.	Yes	1	○
:NSElect {1   2   3   4   5}	Selects the channel to which commands are applied using a number.	Yes	1	○
:COUPle <list>	Specifies multiple channels to which commands are to be applied.	Yes	1	
:CATalog?	Queries the channels that can be used using numbers.	Query only	1	
:CATalog:FULL?	Queries the channels that can be used using IDs.	Query only	1	
: [ SElect ] :FOCUS {CH1   CH2   CH3   CH4   CH5}	Selects the channel whose settings are to be displayed.	Yes	3	○

## 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   CR   CCCV   CRCV }	Sets the operation mode of the PLZ-U.	Yes	3	○
:SStart { 0.1MS   1MS   3MS   10MS   30MS   100MS   300MS   MINimum   MAXimum }	Sets soft start in CC mode..	Yes	3	○
[SOURCE:]CONDUCTance				
[ :LEVel ] [ :IMMediate ] [ :AMPLitude ] { <conduc- tance>   MINimum   MAXimum }	Sets the conductance of CR mode.	Yes	3	○
:RANge { LOW   MEdium   HIGH }	Sets the range of CR mode.	Yes	3	○
[SOURCE:]CURRent				
[ :LEVel ] [ :IMMediate ] [ :AMPLi- tude ] { <current>   MINimum   MAXi- mum }	Sets the current value.	Yes	1	○
:SLEW <slew>	Sets the amount of current change per unit time.	Yes	1	○
:PROTection [ :LEVel ] [ :OVER ] { <value>   MINimum   MAXimum }	Sets the overcurrent protection level.	Yes	1	○
:PROTection:ACTion { LIMit   TRIP }	Sets whether to turn off the load or limit the cur- rent when the OCP trips.	Yes	3	○
:RANge { LOW   MEdium   HIGH }	Sets the range of CC mode.	Yes	1	○
[SOURCE:]POWEr				
:PROTection [ :LEVel ] [ :OVER ] { <value>   MINimum   MAXimum }	Sets the overpower protection level.	Yes	1	○
:PROTection:ACTion { LIMit   TRIP }	Sets whether to turn off the load or limit the cur- rent when the OPP trips.	Yes	3	○
[SOURCE:]VOLTAge				
[ :LEVel ] [ :IMMediate ] [ :AMPLi- tude ] [ :AMPLitude ] { <volt- age>   MINimum   MAXimum }	Sets the voltage value.	Yes	1	○
:PROTection [ :LEVel ] UNDER { <voltage>   MINimum   MAXimum }	Sets the overvoltage protection level.	Yes	3	○
:PROTection:STATe { OFF   ON }	Turns ON/OFF the undervoltage protection.	Yes	1	○
:RANge { LOW   HIGH }	Sets the range of CV mode.	Yes	1	○
[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	
DISPlay:METER { 0   1   2   3   4 }	Turns ON/OFF the elapsed time.	Yes	3	○
HCONfiguration:POLoad { OFF   ON }	Sets whether to power up with the load turned on.	Yes	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 the load on/off using 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	○
[SOURCE:]				
CONDuctance[:LEVel]:TRIGgered[:AMPLitude] {<conductance> MINimum MAXimum}	Sets the conductance generated when a trigger is activated.	N/A	3	○
CURRent[:LEVel]:TRIGgered[:AMPLitude] {<current> MINimum MAXimum}	Sets the current when a trigger is activated.	N/A	1	○

## Switching function commands

SCPI Command	Description	Query	Note 1	Note 2
[SOURCE:]PULSe				
[:STATe] {OFF ON}	Turns on/off the switching mode.	Yes	3	○
:DCYClE <value>	Sets the switching duty cycle.	Yes	1	○
:FREQuency <value>	Sets the pulse frequency.	Yes	3	○
[SOURCE:]PULSe:LEVel				
[:VALue]:CONDuctance <conductance>	Sets the level for CR mode.	Yes	3	○
[:VALue]:CURRent <current>	Sets the level for CC mode.	Yes	3	○

## Input state commands

SCPI Command	Description	Query	Note 1	Note 2
INPut/OUTPut				
[:STATe][:IMMediate] {OFF ON}	Turn ON/OFF the load.	Yes	1	○
:EXternal:LPOLarity  POSitive NEGative}	Sets the polarity of the channel control signal.	Yes	3	○
:EXternal:REFeRence {NONE MAIN SUB}	Sets the external analog control of the load unit.	Yes	3	○
:PROTection:CLEAr	Clears the alarm.	N/A	3	
[:STATe]:TIMer[:STATe] {<value> MINimum MAXimum}	Sets the cutoff time.	Yes	3	○
[:STATe]:DELaY: {<value> MINimum MAXimum}	Sets the delay time until the load is turned on.	Yes	1	○

## Sequence commands

SCPI Command	Description	Query	Note 1	Note 2
PROG:CLEAR	Initializes the entire program.	N/A	3	
PROG[:SElected]				
:STATe {RUN STOP}	Executes the selected program or changes the operating status.	N/A	1	
:EXECuting?	Queries the state of the program currently running.	Query only	1	
:MEMO "<string>"	Sets the memo 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>}	When set to sequence, sets the current value after the specified program ends.	Yes	3	
PROG[:SElected]:FSpeed				
[ :STEP]:END <step>	Sets the end step of the sequence mode.	Yes	3	
[ :STEP]:EDIT[:POINT] <step>, {<conductance> <current>}, [<trig>], <time>	Edits an existing sequence step.	Yes	3	
:TIME <time>	Sets the step execution time of the sequence mode.	Yes	3	

## Other commands

SCPI Command	Description	Query	Note 1	Note 2
SYSTEM:CAPability?	Queries the SCPI instrument class.	Query only	1	
SYSTEM:FORMAtion?	Queries the configuration of the units inserted into the frame.	Query only	3	
SYSTEM:ERRor[:NEXT]?	Reads the error message from the error queue.	Query only	1	
SYSTEM:GTLocal	Switches to local mode operation (RS-232C only).	N/A	3	
SYSTEM:LLOut	Sets local lockout (LLO) (RS-232C only).	N/A	3	
SYSTEM:RENAble {OFF ON}	REN (Remote Enable/Disable) (RS-232C only)	N/A	3	
SYSTEM:VERsion?	Queries the SCPI version to which the PLZ-U 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 6-3, “ OPERATION status register (STATus:OPERation)” on page 35.	Query only	1	
:ENABLe <status-enable>		Yes	1	
[ :EVENT ]?		Query only	1	
:NTR		Yes	1	
:PTR		Yes	1	
STATus:OPERation:INSTrument				
:CONDition?	See Table 6-4, “ OPERATION:INSTrument status register (STATus:OPERation:INSTrument)” on page 36.	Query only	1	
:ENABLe <status-enable>		Yes	1	
[ :EVENT ]?		Query only	1	
:NTR		Yes	1	
:PTR		Yes	1	
STATus:OPERation:INSTrument:ISUMmary<n>				
:CONDition?	See Table 6-5, “ OPERATION:INSTrument:ISUMmary status register (STATus:OPERation:INSTrument:ISUMmary)” on page 38.	Query only	1	
:ENABLe <status-enable>		Yes	1	
[ :EVENT ]?		Query only	1	
:NTR		Yes	1	
:PTR		Yes	1	
STATus:QUESTionable:INSTrument				
:CONDition?	See Table 6-6, “ QUESTionable status register (STATus:QUESTionable)” on page 40.	Query only	1	
:ENABLe <status-enable>		Yes	1	
[ :EVENT ]?		Query only	1	
:NTR		Yes	1	
:PTR		Yes	1	
STATus:QUESTionable:INSTrument				
:CONDition?	See Table 6-7, “ QUESTionable:INSTrument status register (STATus:QUESTionable:INSTrument)” on page 41.	Query only	1	
:ENABLe <status-enable>		Yes	1	
[ :EVENT ]?		Query only	1	
:NTR		Yes	1	
:PTR		Yes	1	

# Status commands continued

STATus:QUESTionable:INSTRument:ISUMmary<n>				
:CONDition?	See Table 6-8, “ QUESTionable:INSTru-ment:ISUMmary status register (STATus:QUES- tionable:INSTRument:ISUMmary)” on page 43.	Query only	1	
:ENABle <status-enable>		Yes	1	
[ :EVENTt ]?		Query only	1	
:NTR		Yes	1	
:PTR		Yes	1	
STATus:CSUMmary				
:CONDition?	See Table 6-9, “ CSUMmary status register (STA- Tus:CSUMmary)” on page 45.	Query only	3	
:ENABle <status-enable>		Yes	3	
[ :EVENTt ]?		Query only	3	
:NTR		Yes	3	
:PTR		Yes	3	
STATus:CSUMmary:INSTRument				
:CONDition?	See Table 6-10, “ CSUMmary:INSTRument status register (STATus:CSUMmary:INSTRument)” on page 46.	Query only	3	
:ENABle <status-enable>		Yes	3	
[ :EVENTt ]?		Query only	3	
:NTR		Yes	3	
:PTR		Yes	3	
STATus:CSUMmary:INSTRument:ISUMmary<n>				
:CONDition?	See Table 6-11, “ CSUMmary:INSTru-ment:ISUMmary status register (STATus:CSUM- mary:INSTRument:ISUMmary)” on page 47.	Query only	3	
:ENABle <status-enable>		Yes	3	
[ :EVENTt ]?		Query only	3	
:NTR		Yes	3	
:PTR		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).

- A \*CLS command is received.
- The last item is read from the queue.

All negative values are reserved by the SCPI Standard. All errors specific to the PLZ-U 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	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 from the 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 non-decimal numeric types.
-130	Suffix error	This error is generated when parsing a suffix.
-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.

Error Code		Error Message Description
-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	The parser recognized a data element different than one allowed.

## 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 other than a command error, query error, or execution error. A part of the operation of the device did not complete correctly probably due to a hardware or firmware malfunction. 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-U

Error Code	Error Message Description
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
27	Operation denied due to incompatible FUNCTION MODE
31	Operation denied due to incompatible PROGRAM MODE



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